PROCEEDING OF
3rd INTERNATIONAL CONFERENCE
ON REBUILDING PLACE (ICRP) 2018
Towards Safe Cities & Resilient Communities

13 & 14 SEPTEMBER 2018
IMPIANA HOTEL, IPOH, PERAK

ORGANIZED BY:

https://icrp2018.wixsite.com/icrp18
# CONTENTS

Welcoming Address from the Rector

Foreword from the Conference Chairman

Organising Committee

Scientific Reviewer

## THEME 1: COMMUNITY STRENGTH & SPIRIT

<table>
<thead>
<tr>
<th>Paper ID</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1570449348</td>
<td>A Case Study of CPTED Principles in Relation to Bullying Behaviour in Secondary School</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Azna Abdul Wahab, Siti Rasidah Md Sakip, Halmi Zainol</td>
<td></td>
</tr>
<tr>
<td>1570452716</td>
<td>Planting Composition for Visual Quality of Green Campus Environment</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Norizan Mt Akhir, Siti Rasidah Md Sakip, Mohamed Yusoff Abbas, Noriah Othman</td>
<td></td>
</tr>
<tr>
<td>1570456374</td>
<td>Fear of Crime in Urban Parks Based on Different Levels of Concealment, Incivilities and Human Presence</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Sreetheran Maruthaveeran, Arne Arnberger, Cecil Konijnendijk van den Bosch</td>
<td></td>
</tr>
<tr>
<td>1570456375</td>
<td>Unmanned Aerial Vehicle (UAV) for Heritage Tree Detection</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Khalilah Hassan, Siti Norlizaiha Harun, Siti Rasidah Md Sakip</td>
<td></td>
</tr>
<tr>
<td>1570460007</td>
<td>Analyzing the Heritage Tree Surface Temperature for UHI Mitigation</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Using Remote Sensing and GIS Application</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nor Suhaida Yusof, Nur Huzeima Mohamed Hussain, Noradila Rusli</td>
<td></td>
</tr>
<tr>
<td>1570462058</td>
<td>Safe Place by Design: The Impact of the Physical Environment on Health</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>Aldrin Abdullah, Massoomeh Hedayati, Mohammad Javad Maghsoodi</td>
<td></td>
</tr>
<tr>
<td>1570465006</td>
<td>Comparison of Characteristics between Scale Model and CG for the Experience by Simple VR Headset with the Smartphone</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Nozomi Ishiyama, Yuji Matsumoto</td>
<td></td>
</tr>
<tr>
<td>1570466001</td>
<td>An Assessment of Spatial Comfort of Ancient Indrapuri Mosque in Aceh Besar, Indonesia</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>Laina Hilma Sari, Izziah, Erna Meutia, Zulfian</td>
<td></td>
</tr>
<tr>
<td>1570466004</td>
<td>Evaluation Study of Pedestrian Way’s Comfort, Case Study: Blang Padang Area, Banda Aceh City</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>Nanda Ulfa, Irfandi, Cut Dewi</td>
<td></td>
</tr>
<tr>
<td>1570466007</td>
<td>The Influence of Society Behaviour in Creating Slum Area (Case Study: Gampong Alue Naga, Banda Aceh)</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>Dyah Erti Idawati, Bustari</td>
<td></td>
</tr>
<tr>
<td>ID</td>
<td>Title</td>
<td>Authors</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1570466011</td>
<td>Putrajaya Lakes Management: Sensitivity and Conservation Towards</td>
<td>Wan Noor Anira Hj Wan Ali @ Yaacob, Marina Abdullah, Nor Izana Shobri</td>
</tr>
<tr>
<td></td>
<td>Sustainable Community</td>
<td></td>
</tr>
<tr>
<td>1570459229</td>
<td>Preliminary Study on Sensory Design for ASD: Autistic Classroom</td>
<td>Roslinda Ghazali, Siti Rasidah Md Sakip, Ismail Samsuddin</td>
</tr>
</tbody>
</table>

**THEME 2: CULTURE & ART**

<table>
<thead>
<tr>
<th>ID</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1570432270</td>
<td>The Architectural Openings of the Traditional Courtyard &quot;Late Straits&quot;</td>
<td>Akram Zwain, Azizi Bahauddin</td>
</tr>
<tr>
<td></td>
<td>Eclectic Style Shophouses, Penang Case Studies: Lot Nos. 3 5 and 7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lorong Ikan, George Town</td>
<td></td>
</tr>
<tr>
<td>1570451703</td>
<td>The Interior Design of Malaysian and Indonesian Traditional Mosque:</td>
<td>Azizul Azli Ahmad, Jazmin Zulkifli</td>
</tr>
<tr>
<td></td>
<td>Comparative Studies</td>
<td></td>
</tr>
<tr>
<td>1570452072</td>
<td>Biophilic Design in Heritage Indoor Workplace in George Town, Penang,</td>
<td>Josephine Ong Ming Hui, Azizi Bahauddin</td>
</tr>
<tr>
<td></td>
<td>Malaysia</td>
<td></td>
</tr>
<tr>
<td>1570456469</td>
<td>Fourth Industrial Revolution and its Impact Towards Shop Houses</td>
<td>Zalina Samadi, Nur Izati Azlan, Raja Norashekin Othman, Siti Zabeda</td>
</tr>
<tr>
<td></td>
<td>Image</td>
<td>Mohamad</td>
</tr>
<tr>
<td>1570456662</td>
<td>Place Attachment and Rural Youth's Perceptions on Rice Field Activities: The Case of Three Homestays in Kedah</td>
<td>Puteri Yuliana Samsudin, Nor Zarifah Malik, Suraiyati Rahman</td>
</tr>
<tr>
<td>1570459236</td>
<td>Malay Garden Concept through Traditional Malay Literature</td>
<td>Ismail Hafiz Salleh, Siti Rasidah Md Sakip, Mohd Sabrizaa Abd. Rashid</td>
</tr>
<tr>
<td>1570459355</td>
<td>The Historic Timber Structure Conservation of Madrasah Idrisiah</td>
<td>Afzanizam Muhammad, Siti Norlizaiha Harun, Mohd Nurfaisal Baharuddin</td>
</tr>
<tr>
<td></td>
<td>Building, Kuala Kangsar, Perak</td>
<td></td>
</tr>
<tr>
<td>1570461928</td>
<td>A Review of Assessment in Adaptive Reuse of Heritage Buildings in</td>
<td>Hasni Suryani Mat Hassan, Lilawati Ab Wahab, Dzulkarnaen Ismail</td>
</tr>
<tr>
<td></td>
<td>Malaysia</td>
<td></td>
</tr>
<tr>
<td>1570465007</td>
<td>A Study on the Influence of Workers on Intellectual Productivity</td>
<td>Sawada Hirotaka, Matsumoto Yuji Andrew I-kang Li, Naka Ryusuke</td>
</tr>
<tr>
<td></td>
<td>when Working with Clothes with Attachment</td>
<td></td>
</tr>
</tbody>
</table>
### THEME 4: URBAN WELLBEING

<table>
<thead>
<tr>
<th>ID</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1570459250</td>
<td>Interior Floor Finishes Preferences of Residents In Klang Valley: A Preliminary Survey</td>
<td>Nurrajwani Abdul Halim, Siti Norlizaiha Harun, Azizul Azli Ahmad</td>
</tr>
<tr>
<td>1570465008</td>
<td>Workplace Reform with Changing Management through the User Participation Workshop: The Case Study of Seiyo City Office</td>
<td>Ikumi Egawa, Kentaro Kawakita, Yuki Katagiri, Ami Masuda, Nozomi Ishiyama, Matsumoto Yuji, Andrew I-kang Li, Ryusuke Naka</td>
</tr>
<tr>
<td>1570466013</td>
<td>Pedestrian and Its Safety in Historical Area of Banda Aceh: An Observation</td>
<td>Irin Caisarina, Sri Anggina Harahap, Hafnidar Bahri</td>
</tr>
</tbody>
</table>

### THEME 5: SUSTAINABILITY & ENGINEERING DESIGN

<table>
<thead>
<tr>
<th>ID</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1570452286</td>
<td>Different Flying Method in Producing 3D Modeling Reconstruction for Single Tree Using Aerial Photograph of Unmanned Aerial Vehicle</td>
<td>Suzanah Abdullah, Khairul Nizam Tahar, Mohd Fadzil Abdul Rashid, Muhammad Arifin Osoman, Mohd Zulfadhli Mohd Noor</td>
</tr>
<tr>
<td>1570452308</td>
<td>Developing Library Spatial Settings Matrix through Student Learning Behaviour</td>
<td>Norhayati Kassim, Azizah Md Ajis</td>
</tr>
<tr>
<td>1570456463</td>
<td>User Perception of Energy Consumption in Two High-Performance School Buildings</td>
<td>Mohd Najib Bin Mohd Salleh, Siti Rasidah Md Sakip, Mohd Zin Kandar</td>
</tr>
<tr>
<td>1570456467</td>
<td>Initiatives Drawn for Local Skilled Construction Workers in Malaysia</td>
<td>Norazlin Mat Salleh, Edelin Hussien, Syarifah Nur Nazihah Syed Jamalullil, Nurul Huda Muhammad, Irma Hanie Ibrahim</td>
</tr>
<tr>
<td>1570459203</td>
<td>Building Information Modelling (BIM) Adoption in Contractor Organisations</td>
<td>Wan Nur Syazwani Wan Mohammad, Mohd Rofdz Ali Abdullah, Salehan Ismail</td>
</tr>
<tr>
<td>1570459224</td>
<td>The Successful Factors of Heritage Interior Scheme for Heritage Museum: Case Study 'Rumah Teh Bunga' In George Town Penang</td>
<td>Norashikin Abdul Karim, Siti Norlizaiha Harun, Salwa Ayob</td>
</tr>
<tr>
<td>1570459239</td>
<td>A Framework for Building User Oriented Maintenance Management for National Religious Secondary Schools</td>
<td>Nor Amin Radzuan, Hairul Nizam Mansor, Ashrof Zainuddin</td>
</tr>
<tr>
<td>1570459244</td>
<td>Diagnosis On Defect Caused By Humidity In A University's Accommodation: A Literature Study</td>
<td>Zaimah Zainal Abidin, Nur Azfahani binti Ahmad, Alia binti Abdullah Salleh</td>
</tr>
<tr>
<td>Page</td>
<td>Title</td>
<td>Authors</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>276</td>
<td>Accessing Energy Efficiency Potential in the Malaysian Universities: The Literature Review</td>
<td>Muhammad Hilmi Dzulkefli, Nur Azfahani Ahmad, Haryati Mohd Isa</td>
</tr>
<tr>
<td>290</td>
<td>The Enabling Factors for Green Building Development in Housing Projects</td>
<td>Nur Atifah Bahruddin, Thuraiya Mohd</td>
</tr>
<tr>
<td>299</td>
<td>Towards Automation and Robotics in Industrialised Building System (IBS): A Literature Review</td>
<td>Mohd Najib Abd Rashid</td>
</tr>
<tr>
<td>316</td>
<td>The Challenges of Implementing Machinoeki Concept in Taiping Town Yong Adilah Shamsul Harumain, Nikmatul Adha Nordin, Nur Farhana Azmi, Akinori Morimoto, Osada Teppei, Mirahida Murad</td>
<td></td>
</tr>
<tr>
<td>326</td>
<td>Energy Conservation For Malaysian Public Universities: A Literature Study</td>
<td>Nur Nadia binti Ismail, Alia binti Abdullah Salleh, Nur Azfahani binti Ahmad</td>
</tr>
<tr>
<td>332</td>
<td>Compatibility of Visibility and Harmony of Pictogram: Focus on Restroom Mark</td>
<td>Iwasaki Yuta, Matsumoto Yuji, Andrew I-kang Li, Naka Ryusuke</td>
</tr>
<tr>
<td>338</td>
<td>Evaluation of Natural Light Levels in Architectural Design Studio</td>
<td>Alfikhairina Jamil, Laina Hilma Sari, Erna Meutia</td>
</tr>
<tr>
<td>345</td>
<td>Adaptive Settlements toward Flooding in the Riverbanks of Meureudu River, Indonesia</td>
<td>Mirza Inwansyah, Cut Nursaniah, Laila Qadri</td>
</tr>
<tr>
<td>350</td>
<td>Theory of Combinatorial Design for Modular Architecture</td>
<td>Salmiah Aziz, Azizah Md Ajis, Mohd Rofdzi Abdullah</td>
</tr>
<tr>
<td>363</td>
<td>An Assesment of Outdoor Thermal Comfort of Baiturrahman Mosque in Banda Aceh</td>
<td>Kamila Bilqis, Laina Hilma Sari, Laila Qadri</td>
</tr>
<tr>
<td>370</td>
<td>Inception Space as Architectural Space Design Mechanism</td>
<td>Muhammad Heru Arie Edytiya, Zulhadi Sahputra, Mirza</td>
</tr>
<tr>
<td>377</td>
<td>Aceh Ornaments Exploration as Ideas of Contemporary Building Form through Digital Transformation</td>
<td>Zulhadi Sahputra, Muhammad Heru Arie Edytiya, Mirza</td>
</tr>
<tr>
<td>387</td>
<td>An Introduction of Landscape Visualization as a Tool to Propose the Future Design of Humane Open-Spaces for Employees among Tall Buildings</td>
<td>Era Nopera Rauzi</td>
</tr>
<tr>
<td>395</td>
<td>A Case Study of Core House Design Modification on Simple Housing:: KPR Griya Mahoni Housing, West Aceh</td>
<td>Hissa Arfira, Bustari, Laina Hilma Sari</td>
</tr>
</tbody>
</table>
A Systematic Review on Rainwater Harvesting (RWH) Installation System for Non-Potable Use
Azirah Adnan, Asmalia binti Che Ahmad, Suharto bin Teriman

How to Save it and How it Saves Us: Built Heritage and Disaster
Erna Meutia, Cut Dewi, Izziah, Muhammad Saleh
WELCOMING ADDRESS

INTERNATIONAL CONFERENCE ON REBUILDING PLACE TOWARDS SAFE CITIES AND RESILIENT COMMUNITIES

It is a great pleasure and honour to welcome all and everyone to the 3rd International Conference on Rebuilding Place (ICRP) 2018 with the theme “Towards Safe Cities & Resilient Communities”.

We gather once again under the joint auspices of the Universiti Teknologi MARA (UiTM) Perak Branch, Syiah Kuala University, Banda Aceh, Indonesia, Kyoto Institute Technology, Japan and UniversitiSains Malaysia (USM), Penang Malaysia. The theme of this event reflects growing recognition of having safe cities and the vital role of resilient communities plays in making this possible. I am very delighted that ICRP2018 has selected “Towards Safe Cities & Resilient Communities” as the theme of the conference. This is in line with the University’s mission to enhance the knowledge and expertise of Bumiputera’s in all fields of study through professional programmers, research work and community service based on moral values and professional ethics.

We will need more of this kind of platform because we need to be proactive in recognising the strategies in maintaining safe cities and its implications if such strategies were not met due to radical changes ahead. Addressing this future will call for the kind of foresight when dealing with the emergence of diversity of population in big cities and the importance of having a resilient community.

ICRP 2018 will be the perfect venue for delegates from different parts of the world to come together and deliberate issues on the safe cities and community sustainability for the purpose of transforming the socio-economic well-being and to disseminate their new research finding and exchange information to the field of environment. Therefore, with this conference as a platform to explore these ideas it is hoped a new perspective in improving and sustaining the safety of the cities as well as the ability of a community to regain functionality as resilient community can be established.

I would like to congratulate the Faculty of Architecture, Planning & Surveying (FSPU) for the excellent effort in organising this conference. To all speakers, presenters and participants, I wish you a successful and memorable conference. To the international participant, do take time out to enjoy the many attractions in Ipoh. Enjoy our hospitality.

Sincerely

Assoc. Prof. Sr. Dr. Md Yusof Hamid, AMP
Rector
Universiti Teknologi MARA
Perak Branch
FOREWORD

INTERNATIONAL CONFERENCE ON REBUILDING PLACE TOWARDS SAFE CITIES AND RESILIENT COMMUNITIES

BismillahirRahmanir Rahim
In the name of Allah, the beneficent, the merciful

‘Selamatdatang’ or Welcome

It is my pleasure and privilege to welcome all of you to this unique gathering, which brings together key representatives from multilateral organisations and national authorities on a most timely topic of common interest: that is, towards safe cities and resilient communities.

This is our third International Conference on Rebuilding Place (ICRP). The first in 2011 was conducted with the collaboration between Department of Architecture, Syiah Kuala University and Jeju University, while the second conference involved the collaboration between ICRP and Asian Vernacular Architecture Network (AVAN) and in conjunction with Aceh International Conference (AIC 2017) as well as with Syiah Kuala University, Indonesia. This conference once again sees a strengthen union between Universiti Teknologi MARA (UiTM) Perak Branch and Syiah Kuala University, Kyoto Institute Technology, Japan and Universiti Sains Malaysia (USM), Penang Malaysiaas the main organisers.

Global migration to urban areas improves the living standards, health and financial prosperity of these citizens. Nevertheless, it brings challenges to a city’s infrastructure, resources, security procedures and emergency response systems. Meeting these challenges is critical to the success of cities. The safe city concept has been developed to help government stakeholders, and police departments assuage these demands. One way to do this is having communities who are resilient. This is because resilient communities minimize any disaster’s disruption to everyday life and their local economies. Resilient communities are not only prepared to help prevent or minimize the loss or damage to life, property, and the environment, but they also have the ability to quickly return people to work, reopen businesses, and restore other essential services needed for a full and timely economic recovery. Therefore, the 2018 International Conference aims to explore the understanding of safe cities as well as investigate the strategies in enhancing safe cities. Thus, this year’s theme focusses on “Towards Safe Cities and Resilient Communities”.

It is our distinct pleasure to thank all the keynote and invited speakers, and all other speakers for attending and sharing your research findings, insights and knowledge. We hope all of you have a productive and insightful discussion throughout this two-day conference and do take this opportunity to uncover “Malaysia’s Beauty - Perak”

Sincerely

Dr. Siti Rasidah Md Sakip
Chairman of the Conference Committee
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3) Dr Cut Dewi
4) Erna Meutia
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6) M. Haiqal
7) M. Heru Arie Edytia

JAWATANKUASA PELAKSANA UNIVERSITI SAINS MALAYSIA (USM)

1) Dr Jestin Nordin
3rd International Conference on Rebuilding Place (ICRP2018)  
13-14 September 2018  
Impiana Hotel, Ipoh, Perak, Malaysia

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Dr Radzi Ismail (USM)  
Dr Muna Hanim Abdul Samad (USM)  
Dr Abdul Naser Abdul Ghani (USM)
A CASE STUDY OF CPTED PRINCIPLES IN RELATION TO BULLYING BEHAVIOUR IN SECONDARY SCHOOL

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Abstract - This paper presents a case study examining the potential influences of building design on bullying behavior and experiences, in comparison of Malaysia secondary school students. Theories of environmental psychology suggest that environmental context influences social attitudes and behaviour. The research focuses on the relationship between the physical environment of urban schools and the students’ negative behavior of two secondary schools in Selangor, Malaysia. Through discussion of the findings from previous studies, the gaps in criminology knowledge on bully-design link will be highlighted. The features of physical environment such as broken fixtures, display of student artwork and signboard and physical decay can affect the occurrence and behaviour of criminals. An observation was conducted at two secondary schools in Selangor with a random sample of 200 students from Form 1, Form 2 and Form 3 involving the observation of 17 school blocks. Three principles of Crime CPTED were analyzed in the school environment. The results indicated that there is a significant difference in territoriality and school maintenance which results in the forming of the negative environment in the schools. It was found that this, in turn, affects the frequency of bullying occurring among the students in school. The design and planning of the school’s external environment should give more consideration on creating conducive learning environment that could foster positive social behavior especially for urban schools. School environment is important to the child’s development.

Keywords - School, Bullying, CPTED, Physical Environment

1 INTRODUCTION

Bullying is a growing social issue that affects millions of students globally. For almost 30 years, bullying among students has been known as a serious problem in school (Roland & Galloway, 2002). Bullying in schools reflects a part of the bigger problem of violence in society (Atlas & Pepler, 1998). Previous longitudinal studies have found a strong and consistent relationship between bullying and later criminality (Andershed, Kerr, & Stattin, 2001; Min, F. Catalano, P. Haggerty, & D. Abbott, 2011; Dan Olweus, 2011; Renda, Vassallo, & Edwards, 2011; Sourander et al., 2011). Bullying behaviour among students is a global phenomenon and it does not only occur in Malaysia’s schools but also occurs in other countries such as Australia, Japan, England and United States. From past research, at least 5 percent of the students in both primary and secondary schools were bullied weekly or more often in North America, Australia, Japan, Scandinavian countries and several countries in Europe (Roland & Galloway, 2002). The United States Department of Justice and The National Association of School Psychologists (NASP) estimated that 160,000 children missed school each day due to the fear of the bullies (Newman-Carlson & Horne, 2004). In the year 2013, approximately 3 percent of students aged between 12 and 18 years old reported afraid of being attacked or harmed at school or on the way to and from school (Robers, Zhang, & Morgan, 2015). Bullying is linked to many negative outcomes including student achievement, physical, mental health and later life. Adolescents who are bullied suffer from terrible psychological effect and these effects can be linked to suicidal thinking.

Malaysia also is experiencing this phenomenon, and it has been a concern, especially for parents. Malaysia is a country with multi-ethnic, multicultural, and multilingual society. Usually, bullying has not been viewed as a criminal act and has either been ignored or treated as a
disciplinary matter in schools. In the meantime, there is no implementation of strong national policy that is fighting for school bullying, and the issues are left to individual schools. However, Malaysia government is in all effort to combat bullying in school. The victims apparently received helped and supported by school counseling. The perpetrator will be dealt with criminal law and if it is serious can be expelled from school. The crime in school should be noted as a serious problem as it could lead to crime in the future (Andershed, Kerr, & Stattin, 2001; Min, et al. 2011; Olweus, 2011; Renda, Vassallo, & Edwards, 2011; Sourander, et al., 2011). The built environment is believed to be one of the factors influencing crime and the level of fear of crime in society (FOC) (Sakip, Johari, & Salleh, 2012). However, there is not much of research in school crime context on how environmental approach may help in reducing school crime and increasing safety in school.

One purpose of this study is to examine the association between various aspects of the physical environment in and around schools and bullying among students. More specifically, the study aims to examine the influence of the school’s physical environment—measured in terms of both attractive and neglected material characteristics (e.g., attractive classrooms, display of artwork, graffiti on the walls, broken fixtures).

2 LITERATURE REVIEW

Criminal cases of bullying in Malaysia in the year 2014 had gained great attention by the Ministry of Education (MOE), the Social Welfare Department (SWD) and Royal Malaysian Police (RMP) when videos of bullying crimes were uploaded on to the Internet and, thus, making it viral among Malaysians. In order to reduce school violence and to create a safe school culture and environment, a blueprint for a Safe School Programme in Malaysian, also known as Safe School Concept and Manual: Implementation Guide to Create a Safe School, Community and Family for Children had been developed on 2002 by the Ministry of Education, Malaysia. Bullying can be defined as negative actions that repeatedly occur over a period of time directed against another student who has difficulty in defending himself or herself (D Olweus, n.d.; Wan Ismail et al., 2010). Negative actions referred to behaviour that was intended to inflict harm, injury, pain, or discomfort upon another individual (Atlas & Pepler, 1998). Meanwhile, Atlas and Pepler (1998) defined bullying as a form of social interaction in which there was an implied imbalance of power or strength in the interaction. The power of imbalance in bullying may not be limited to physical size and may be presented in the tone of voice, physical stance of a bully or the number of children take part as bullies and the support of peers who were involved (Atlas & Pepler, 1998). Hence, bullying can take place when there is an imbalance of power between another people with negative action and has difficulty to defend on their own.

2.1 The Relationship between Environmental Design and Bullying Behaviour

The basis of environmental design is interaction among other factors of physical, social, environmental, individual and community (Sakip et al., 2012). According to Poyner (1983), human movement and behaviour are critically affected by the design and layout of the physical environment. Architectural design and layout of buildings, street networks and so on can influence significantly how people interact, use, and move in their environments (Reynald, 2014). Crime is believed to be related to the physical environment (Liebermann & Kruger, 2004). The opportunities that exist in an environment encourage a criminal to act on a targeted victim (Liebermann & Kruger, 2004). In deciding whether or not to commit an act of crime, environmental element is one of the factors considered by criminals (Anastasia & John, 2007). Criminal behaviours are driven by their environments, whether physical or social aspect (Sakip & Abdullah, 2008). Studies by Shamsuddin, Bahauddin, and Aziz (2012) indicated a relationship between the outdoor physical environment of the school and the students’ social behaviours. However, the limitation of this research is not to evaluate the negative social behaviour related to schools environment. A study of school violence in Gangseo district, Seoul was conducted to determine the criminal spots on the way home from school for middle-school students (Lee, Ryu, & Ha, 2012). Through a cognitive map analysis, Lee, Ryu, and Ha (2012) argue that the students feel fear mostly for reasons related to human factors rather
than to space factors; among the human factors, ‘peers’ represented the most frequent reason. The most common locations for student victimization are at the playground (Fite et al., 2013; Dan Olweus, 1993; Stephenson & Smith, 1989), classroom (Atlas & Pepler, 1998; Rapp-paglicci, Dulmus, Sowers, & Theriot, 2004), and hallways (Astor, Meyer, & Behre, 1999; Stephenson & Smith, 1989; Vidourek, King, & Merianos, 2016). Certain ‘hot spots’ that indicated to be unowned spaces are where the sights of more crime event create greater fear among students (Astor et al., 1999). The presence sense of ownership of these locations has the potential to drastically decrease the prevalence of victimization in schools (Astor et al., 1999). Through these studies, victimisation occurs most likely when the adults are limited in their abilities to monitor. The school structure may play an important part in giving a chance for individual children to involve in bullying behaviours (Atlas & Pepler, 1998). Craig et al. (2000) reported that victimisation is most likely to occur in less structured environments. Studies showed that lower rates of school victimisation were associated with the school safety interventions that are focused on improving the physical environment of the school (Johnson, 2009). Johnson (2009) concluded that physical environment appears to offer intervention opportunities to reduce school victimisation.

2.2 Crime Prevention Through Environmental Design

There is a growing body of research that supports the assertion that crime prevention through environmental design is effective in reducing both crime and fear of crime in the community (Cozen, Saville, & Hillier, 2005). CPTED is focus on the relationships between people and environment. The behavior and movement of human was significantly affected by the architectural design and layout of the physical environment (Poyner, 1983). The crime patterns due to human behavior and daily routine were determined by environmental design factors (Felson, 2006). A review of 122 evaluations of crimes prevention project by Poyner (1993) indicated that over half of the area of environmental design (24 out of 45) demonstrated the reduction of crimes. The evaluation were focused on lighting, fencing, design changes to improve surveillances opportunities, the cleanup of neighborhoods, street changes, wider market gangways, electronic access control and modification. CPTED is an increasingly fashionable approach and is being implemented in a global scale (Cozen et al., 2005). Research by Rasidah, Johari, Najib, & Salleh (2012) showed high CPTED practices are able to reduce fear of crime. It is found that improved territoriality, indicated school ownership, and improved surveillance are essential factors for a better perception of safety in school (Wilcox, Augustine, & Clayton, 2006).

2.2.1 Territorial Reinforcement

Territoriality is a design concept directed at reinforcing proprietary concern and a “sense of ownership” in legitimate users of space thereby reducing opportunities for offenders by discouraging illegitimate users (Cozen et al., 2005; Perkins, Meeks, & Taylor, 1992). These strategies are not independent of one another, and they act in concert to use physical attributes to separate public, public-private and private space, to define ownership by including symbolic barriers (signage, subtle changes in road texture) and real barriers (e.g. fences, pavement treatments, landscaping and artwork) and define acceptable patterns of usage. In addition to promote opportunities for surveillance (Cozen et al., 2005; P. Cozens & Love, 2015). Eliminating any unassigned spaces and ensuring all spaces have a clearly defined and designated purpose, are routinely cared-for and monitored is also a component of territoriality (Cozen et al., 2005). Due to increase of fear, it might lead an individual to engage in target hardening activities to reduce the chances of future victimization (Melde & Esbensen, 2009). A study of five high schools was conducted to examine the relationship between school physical environment and school crime (Astor et al., 1999). The findings revealed that certain ‘hot spots’ referred to as unowned spaces such as hallways, dining areas, and parking lot where the sights of more crime event and greater fear among students (Astor et al., 1999). Astor et al. (1999) claimed the presence sense of ownership of these locations has the potential to drastically decrease the prevalence of victimization in schools. However, Astor, Meyer, and Behre (1999) suggest that by placing adult or video camera in an undefined space it did not create a sense of ownership of space among adults and students.
2.2.1 Natural Surveillance
Natural surveillance is a design strategy that uses design structures to increase the visibility of a building that gives risk perception to the potential criminal in an area and making him feel being watched (PM Cozens, Saville, & Hillier, 2005). It keeps the intruders under observation and decrease the opportunity of a crime. The lighting and natural daylight also play an important role in a good visibility, which can influence the visible distance. A good surveillance and lighting at night is able to improve visibility of the area thus reducing fear of crime (Kitchen & Schneider, 2007; Perkins et al., 1992) and to create visual clarity to the surrounding area. Surveillance can be accomplished through natural and mechanical. Natural surveillance includes the local community actions, buildings’ physical openings, and police patrol (PM Cozens et al., 2005; Perkins et al., 1992). Meanwhile, mechanical surveillance involves the use of tools such as street lighting and closed-circuit television (CCTV) (P. Cozens & Love, 2015). According to Lee and Ha (2015), visibility is an important factor that affects fear of crime in environment. Although most exterior spaces of elementary schools are high-visibility areas, the hottest spots were behind the buildings areas which were low in visibility (Lee & Ha, 2015). However, findings from Lee and Ha (2015) were contrary to the theory of CPTED that asserts the areas with good visibility as safe from criminal behavior. The result indicated that fear of crime can occur not only in places with poor visibility but also in those with very good visibility. It was found that human factors had a much greater influence.

2.2.1 Maintenance and Management
Maintenance is to promote a positive image and to routinely maintain the built environment to ensure that the physical environment continues to function effectively (PM Cozens et al., 2005). Maintenance of an area is linked to the individual behavior. The level of an area is maintained one of the factors in the quality of the activities that take place in it (Durán-Narucki, 2008) and can be a major impact on whether it will become targeted by criminals. A study of 95 schools was conducted to examine the role of school attendances in the relationship between facilities in disrepair and student’s achievement (Durán-Narucki, 2008). The condition of the school buildings were obtained through survey that were conducted through visual inspection. Durán-Narucki (2008) had indicated that student’s achievement was higher in newer building and in buildings with higher condition rating which had well maintained schedule. A good maintenance strategy directly impacts the fear of crime due to awareness of responsibility and caring of the targeted crime. It allows for the continued use of a space for its intended purpose. By including CPTED concept from the design stage of a building, it can build a safe-crime environment rather than waiting for a crime problem to happen. By reviewing and go through existing problem area and applying the CPTED principles, those problems can be avoided.

3 METHODOLOGY
For this research, two government secondary schools in Bandar Baru Bangi and Ampang, Selangor were selected as the multiple-site case studies. Thus, the limitation of the study is only in this particular secondary school in Selangor. The result of the study cannot be made generalization of bullying problems in Malaysia. Selangor is the most developed state in the country where Kuala Lumpur the capital city of Malaysia used to be located before being gazetted as a federal territory. The schools that were selected are Sekolah Menengah Kebangsaan Jalan Empat, Bandar Baru Bangi (School 1) and Sekolah Menengah Kebangsaan Taman Tasik, Ampang (School 2). The schools were selected mainly because of their different design layout. The layout of School 1 is in the form of ‘cluster and enclosed’ where the building blocks are all facing towards the center where the assembly field is located, while the design for School 2 was developed in the form of uniform buildings (army barrack like) typical of the old school buildings which were developed and designed by the JKR. (Fig. 1 and Fig. 2) Somehow, despite the differences in school layout design, the schools selection was based on the highest number of perpetration in the age range from 7 to 18 years in crime cases that was reported by police over five years ago.
3.1 Research Instruments

The research has adopted quantitative techniques of gathering data. Students from Form One, Two and Three were involved in the questionnaire. The questionnaires include open-ended questions and questions using 5 Likert scale measurement which are 1=never, 2= once a month, 3=2 to 3 times a month, 4= once a week and 5=2 to 3 times a week. Respondent’s agreement on the statement is used to measure the degree of bullying behaviour in school. The questionnaire was conducted with 81 students from School 1 and 119 students from school 2. This study used questionnaire to collect the data on the type of bullying behaviour.

Field observation was carried out at the chosen case studies to indicate environmental design factors of the school that contribute to the bully occurrences based on the absence and presence of CPTED elements. The visit includes assessing the school campus design layout, spatial quality of each space, the availability of amenities and the circulation. The result show how the characters of school spaces could strongly influence the students’ behaviour.

4 DATA ANALYSIS

From the observation of the maps, there is differences in school building arrangement which had possibility leads to different interaction between the students during the recess time. Figure 1 and Figure 2 showed school maps of SMKJE and SMKTT. The arrangement of SMKTT building that is scattered made it difficult for adults to monitor compared with the arrangement of SMKJE building which is more organized and compact. Through daily interactions with the physical and social environment, individuals learn about their places in society, their value, appropriate and inappropriate behaviour (Durán-Narucki, 2008). As part of children development, they actively look for cues on how to behave, who they are, or what they can achieve in environment in which they spend time mostly (Durán-Narucki, 2008). Rivlin and Weinstein (1984) claimed the physical characteristics of a setting can influence the behaviour of its users.

Demographics data such as school name, gender, form and race were obtained from the respondents. Table 1 shows the demographic data of the study. The sample of the study consisted of two secondary schools with 81 (40.5%) respondents from Sekolah Menengah Kebangsaan Jalan Empat (SMKJE) and 119 (59.5%) respondents from Sekolah Menengah Kebangsaan Taman Tasik (SMKTT). The gender analysis showed that the study consist of 91 (45.5%) male students and 109 (54.5%) female students. Analysis from the respondents showed that 41 (20.5%) respondents from Form One students, 46 (23%) respondents from Form Two students and 113 (56.5%) respondents from Form Three students.

![Figure 1 SMKTT school map](image-url)
Table 1 Demographic Distribution

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Total No (n=200)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sekolah Menengah Kebangsaan Jalan Empat (SMKJE)</td>
<td>81</td>
<td>40.5</td>
</tr>
<tr>
<td>Sekolah Menengah Kebangsaan Taman Tasik (SMKTT)</td>
<td>119</td>
<td>59.5</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>91</td>
<td>45.5</td>
</tr>
<tr>
<td>Female</td>
<td>109</td>
<td>54.5</td>
</tr>
<tr>
<td>Form</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Form 1</td>
<td>41</td>
<td>20.5</td>
</tr>
<tr>
<td>Form 2</td>
<td>46</td>
<td>23.0</td>
</tr>
<tr>
<td>Form 3</td>
<td>113</td>
<td>56.5</td>
</tr>
</tbody>
</table>

4.1 Bullying Behaviour

The statistical analyses by ANOVA and Tukey’s multiple comparison tests were carried out for the two different schools on the three types of bullying behaviour. Treatment effects were considered significant at P < 0.05 (Snedecor and Cochran, 1967). An analysis of variance in Table 2 showed that the effect of different school environment on physical bullying (F (1, 198) = 3.91, p = 0.05) and relational bullying was significant (F (1, 196) = 6.21, p = 0.01). The different bullying behaviour in physical bullying and relational bullying may be due to a different environment that exists in each school. Improper landscaping and building design may give the opportunity to the student to bully others. Differently, with verbal bullying, it can be done quietly and covertly where the children are able to avoid detection and punishment (Atlas & Pepler, 1998). Despite reaching statistical significance, the actual difference in mean score between the groups was quite small. The effect size, calculated using eta squared as below, was 0.02 for physical bullying and 0.03 for relational bullying.
Table 2 Bullying behaviour in two different ANOVA

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Bullying</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>12.17</td>
<td>1</td>
<td>12.17</td>
<td>3.91</td>
<td>0.05</td>
</tr>
<tr>
<td>Within Groups</td>
<td>616.79</td>
<td>198</td>
<td>3.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>628.96</td>
<td>199</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relational Bullying</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>79.27</td>
<td>1</td>
<td>79.27</td>
<td>6.21</td>
<td>0.01</td>
</tr>
<tr>
<td>Within Groups</td>
<td>2500.88</td>
<td>196</td>
<td>12.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2580.15</td>
<td>197</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Eta squared (Physical Bullying) = \( \frac{12.17}{616.79} = 0.02 \)

Eta squared (Relational Bullying) = \( \frac{79.27}{2500.88} = 0.03 \)

4.2 Territoriality

A total of 17 blocks in four schools were observed to indicate the element of territoriality that exists in each school. Table 3 shows result from the observation which indicated that there were 7 blocks in SMKJE with a total of 273 territoriality element and 10 blocks in SMKTT with 120 elements. Calculation of territoriality element per block resulted in 39 elements per block in SMKJE and 12 elements per block in SMKTT. Based on the observation of territoriality element in two schools, SMKJE had more sense of school ownership in giving of student good school environment compare with SMKTT. This was shown by the number of territoriality element per block in the school.

Table 3 Territoriality element per block in two schools

<table>
<thead>
<tr>
<th>School</th>
<th>Total Block</th>
<th>Territoriality Element</th>
<th>Total</th>
<th>Territoriality element per block</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Signage</td>
<td>Ownership</td>
<td></td>
</tr>
<tr>
<td>SMKJE</td>
<td>7</td>
<td>38</td>
<td>235</td>
<td>273</td>
</tr>
<tr>
<td>SMKTT</td>
<td>10</td>
<td>23</td>
<td>97</td>
<td>120</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>61</td>
<td>332</td>
<td>393</td>
</tr>
</tbody>
</table>

4.3 Surveillance & Maintenance

Analysis by ANOVA and Tukey’s multiple comparison tests were carried out for the two different schools once again. The objectives of this analysis are to know whether it is different in surveillance and maintenance in two different schools. An analysis of variance in Table 4 showed that the effect of different school environment on surveillance was statistically not significant (\( F(1, 13) = 0.002, p = 0.97 \)).

Table 4 One-way ANOVA Tests between two different schools with surveillance principle

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>0.03</td>
<td>1</td>
<td>0.03</td>
<td>0.002</td>
<td>0.97</td>
</tr>
<tr>
<td>Within Groups</td>
<td>203.30</td>
<td>13</td>
<td>15.639</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>203.33</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

But, Table 5 shows that there was significantly difference in school maintenance in both schools (\( F(1,11) = 8.19, p = 0.01 \)). Territoriality principle is closely related to maintenance principle.
in presence sense of ownership in school. A significant difference showed in physical and relational bullying when the students were socializing among the others. Thus, this study showed that there is a possibility of association between various aspects of the physical environment in and around schools and bullying among students.

Table 5 One-way ANOVA Tests between two different schools with maintenance principle

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>32.89</td>
<td>1</td>
<td>32.89</td>
<td>8.19</td>
<td>0.01</td>
</tr>
<tr>
<td>Within Groups</td>
<td>44.19</td>
<td>11</td>
<td>4.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>77.08</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5 DISCUSSION AND CONCLUSIONS

The purpose of this paper was to determine if there is association between various aspects of the physical environment in and around schools and bullying among students. Table 2 showed the analysis of bullying behaviour in two secondary schools. There are significantly differences in physical and relational bullying in SMKJE and SMKTT. The physical environment in school is believed to be related to developing students’ behaviour in school (Durán-Narucki, 2008; Lieberman & Kruger, 2004). This finding suggests that various aspects of the physical environment in and around schools could influence students’ interaction and relation with each other. The finding similar with Mohamad Salleh and Zainal (2014) and Rigby (2008) showed the indirect bullying was the most widely performed compared with direct bullying. Relational bullying is a group process that is difficult to see in adults.

Apart from that, the bullying is believed to be related to the physical environment (Lieberman & Kruger, 2004) as it plays an important aspect in the developing behaviours (Durán-Narucki, 2008). The opportunity that exists in an environment encourages a perpetrator to act on a targeted victim (Lieberman & Kruger, 2004). In deciding whether or not to commit an act of crime, the environmental element is one of the factors considered by criminals (Anastasia & John, 2007).

Tables 3-5 show the findings of physical features in two secondary schools based on three CPTED elements. Based on the finding on territoriality element in Table 3, the result indicated that it was significantly different in element per block between SMKJE and SMKTT. The element such as water sculpture, bench, notice board, and garden furniture play an important role in creating sense of ownership in student. Astor et al. (1999) claimed the presence sense of ownership of these locations has the potential to drastically decrease the prevalence of victimization in schools. A good conducive landscaped is believed to directly or indirectly assists in providing space for leisure and interacting with landscape components (Ali, Rostam, & Awang, 2015). This paper may have proven that the level of certain components of landscapes at the school in the region is significant that can create a sense of ownership by setting up gazebo, pergola, bench, garden tables, signboards and flower pots. Schools that include permanent student artwork in the interior spaces of school buildings also will foster student ownership (Killeen, Evans, & Danko, 2003). This can be proven by the mean (µ) value of relational bullying in SMKTT is higher (µ = 1.52) than in SMKJE (µ = 1.32).

However, even though the school layout and design were different in each school, but the monitoring in each building can be done. This finding was shown in Table 4 which indicated that there was no significant difference in the surveillance element. The visibility of the activity placemen, open space and classroom can be seen from the buildings block. The chances of bullies to bully in the hidden corner are less. Although most of the exterior spaces of the schools are a high-visibility area, there were few respondents reported that the hottest spots were behind the buildings area. This finding tends to support previous studies which indicated that there was low visibility behind the school building (Lee & Ha, 2015).

Meanwhile, Table 5 shows significant differences in maintaining element in SMKCP, SMKJE and SMKTT. The result on maintenance level in SMKJE showed that the level was 61%
to 80%. Meanwhile, the level of maintenance in SMKTT was 41% to 60%. According to Skogan and Maxfield (1981), (as cited in Melde & Esbensen (2009), the environment that lacks maintenance, poorly kept buildings and unsupervised which referred to as “sign of crime” and people tend to fear this environment which may develop a reputation for high levels of criminal behaviour. Lacks of maintenance in SMKTT may develop bullying behaviour which substantiates with previous study by Lorenc, et al. (2013) and Wilcox, et al., (2006). Dirt, decay, graffiti, litter and other sign of neglect of the environment are seen as drivers of fear (Lorenc et al., 2013; Wilcox et al., 2006). These findings tend to support previous studies on physical environment and student misconduct by Wilcox, et al. (2006). The application of colours and usage materials also may influence students’ behaviour (Shamsuddin et al., 2012) as the students enjoy being at the bench as they provide not just seating areas but also plants and water elements. It is found that more green area and seating area are better for a school environment.

As a whole, there is a possibility of association between various aspects of the physical environment in and around schools and bullying among students. By manipulation of the design and layout, physical features are believed do influence the chances of a crime to occur by affecting violent behaviour. Environmental design theories are emphasizing on physical environment as a tool to control and block any opportunities to offend. Students have a fundamental right to learn in a safe, supportive environment and to be treated with respect.

ACKNOWLEDGEMENTS

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Abstract - Campus landscape is an everyday life experience for students. But, do students perceive the landscape in every space within the campus? Proximity and access to green spaces on campus are related to how they perceive the campus environment. The aim of this study was to understand the assessment of planting composition pattern through objectivist and subjectivist paradigm which is useful for campus landscape development. Planting design as critical component contributes to the overall design concept and objectives, and this is achieved by spatial design and by the themes employed in detailed planting composition in the campus as well as shaping the outdoor campus spaces. However, planting composition is rarely issued in landscape assessment study. The landscape visual quality assessment is significant to achieve the aim in order to gain the appropriate pattern or layout of planting that is most preferable by students. The evaluation of this quality can be both objectively (physical) and subjectively (psychology). Both these paradigms can guide the researcher to identify the existing pattern and preferred planting design that is able to satisfy the students’ needs. Physical factors of plants only help in identifying the pattern and visual properties but, the psychological factors can open to different possibilities of results in landscape quality assessment. Therefore, the recognition of the relationship between planting composition and students’ preferences should be established as to bring a new model of green campus environment at the university.

Keywords - Campus landscape, planting design, planting composition, students’ preferences, visual quality

1 INTRODUCTION

In recent years, many universities around the world have attempted to transform their campuses to make them greener (Tiyarattanachai & Hollman, 2016). Green is used to define sustainability, energy saving, comfortable living, and many others. Nowadays, many developments such as commercial building and housing scheme have considered green infrastructures as environmental factor to market their product (Nazir et al., 2015), including universities (Tiyarattanachai & Hollman, 2016). The exploitation of landscape to promote the universities have long been practiced (Yahres & Knight, 1997). The promotion such as exposing students studying under the widespread canopy trees or socialising on green lawns on campus can be seen on universities websites. Indeed, these planting attributes have positively supported the image of the university (Speake et al., 2013). Furthermore, landscape has obviously become valuable resource for visual aesthetic quality in environment (Kalivoda et al., 2014). This situation substantiates that campus landscape or explicitly planting design can influence the students to enrol in the universities.

In the context of this study, the green campus is referred to the appearance of plants coverage in the outdoor campus environment which is related to landscape planting design around the campus. In planting design, one of a fundamental parts is composition. Planting composition entails devising a concept in the abstract and combining this abstraction with the environmental demands of the site to produce a beautiful, functional and appropriate space (Leszczynski, 1999). In a simple explanation, planting composition is an art of creative combinations and arrange plants according to a specific
site. Planting composition consists of shrubs, trees and groundcovers and definitely is important in reviving the condition of the surrounding environment (Othman et. al, 2015). Planting composition has elements and principles that should be followed in the landscape design (Leszczynski, 1999), which are necessary to be determined at the early stage of landscape design. According to Robinson (2004), the primary objective of planting design is to meet user’s requirements and provide visual pleasure by increasing functional and aesthetic qualities of the landscape. It also can transform the grey space before making it greener space by injecting it with intelligent planting composition (Robinson, 2004).

The character and purpose of planting design are as varied as human use of the land (Robinson, 2004). As context of this study, the campus has distinctive character and purpose that should be considered before designing the outdoor spaces with plants. Most of the previous researchers stated that plants are regard as the most critical component which influence viewer’s perception of distinct types of landscape (Kaplan, 1981; Ulrich, 1981). Plants traits can give some clues to visual preferences (Kendal et al., 2012). Therefore, planting design practices can make a real difference in landscape aesthetic when visual properties and basic design principles are well accomplished (Yilmaz et al., 2018). Concurrently, the image of campus will demonstrate differently and will motivate students more (Cheang et al., 2017) with a sense of belonging to their spaces (Rumao, 2016).

2 CAMPUS LANDSCAPE

From past history, the design of campus was predominantly about architecture and structures and less focus on landscapes (Rumao, 2016; Hanan, 2013). Nevertheless, campus designers’ perspective on campus design has changed over time and argue that nowadays students often choose an institution based on their impression and perception of a campus (Rumao, 2016). Campus landscaping is becoming the new public face of universities (Rumao, 2016). On that note, the quality of campus landscape still is an issue towards enhancing the quality of campus life.

A “green campus” has sustainability policies in promoting the construction of green buildings and greening facilities. The green design such as liveable green street networks constitute planting that is available at footpath locations such as trees, planting trees in unused spaces, replacing pavement with trees and planted landscapes, and promoting the use of green roofs on campus buildings; these are some of the ideas in developing green campus (Srivanit and Hokao, 2013). The studies by most scholars proved that landscape on campus could improve not only the outdoor environments but also improve the university community’s well-being (Matsuoka, 2008; McFarland et al., 2008; 2010; Speake et al., 2013; Liprini, 2014; Hipp et al., 2015; Cheang et al., 2017). A campus with minimal landscape is incomplete, inchoate, and incapacitated (Dober, 2000).

In conjunction with the situation, a lot of benefits of landscape provided in the campus are diversely discussed by scholars. For example, the landscape could encourage students to spend time and socialise on campus (Hajrasouliha, 2017). Psychologically, plants also could reduce students’ mental fatigue level (Hajrasouliha, 2017; Wei, 2017; Li & Sullivan, 2016), which reflect positive response (Han, 2010), and increase students’ performance (Matsuoka, 2008). Thus, the landscape indeed becomes a major influence on the visual quality (Benfield et. al, 2015), and strengthen the image and substance of higher education venues (Dober, 2000). Recently, most of the study on campus have included landscape as a significant component and should not be neglected in campus development. In fact, many universities around the world have attempted to invest in green campus initiative (Tiyarattanachai and Hollmann, 2016) by taking part in the competition and green status such as Universiti Indonesia (UI) GreenMetric World University Ranking for a better quality of life of universities’ community.

The landscape on campus is the everyday experience to students (Speake et al., 2013; Zhang, 2006). Therefore, the assessment of their surrounding is necessary towards satisfaction and well-being on campus. Landscape preference, one approach to landscape assessment, is an evaluation of how people perceive the surrounding environment and which preferred landscape is that people have
in mind (Zhang, 2006, Mirza, 2015). The specific landscape preference will influence the students’ behaviour (Wee, 2017; Mirza, 2015; Wilkins & Huisman, 2013; Shuhana et al., 2012; Zhang, 2006). Therefore, currently the preferences study on campus landscape by students is among the customary practice for university’s enhancement. Moreover, Akpinar (2016) have proposed the importance to study students’ perception and preferences for certain qualities and features of green space in campuses. He mentioned that the landscape in campuses should not only consider green or aesthetic rather it should also puts emphasis on the benefits of restoration and healthy living in campuses.

3 PLANTING COMPOSITION

Green space is a significant component of the campus design that adds value to the campus experience aesthetically, educationally, and environmentally (Karimian et al., 2017). It includes landscaped natural areas which composed of trees and vegetation (Karimian et al., 2017). Compared to other variables in landscape research, plants are regarded as a particularly powerful factor in perceived landscape aesthetic and the relationship between plants and visual quality (Ulrich, 1986). Most of the scholars stated that vegetation often serves as a method of beautification and as a visual attribute with their traits like form, texture, colour and scale of plants (Yilmaz et al., 2018, Polat & Akay, 2015). At many scales, design with plants in a landscape is intelligently determined by some criteria and by a set of objectives that define success (Yilmaz et al., 2018). Therefore, each campus must design carefully the landscape with plants because it has a strong association with function, ecology, and aesthetic qualities (Robinson, 2004).

In planting design, the primary objective is to meet user requirements and provide visual pleasure by increasing functional and aesthetic qualities of the landscape (Robinson, 2004). Robinson (2004) added plants offer enjoyable sensory experiences and create opportunities for art and design. Visual pleasure, derived from landscapes of high aesthetic quality and scenic beauty, directly affects perceptions, preferences, and uses (Daniel, 2001). Therefore, high quality of campus landscape will have a meaningful relationship with the positive responses such as happiness, excitement and energy (Han, 2010). Designing of a high-quality landscape also deals with principal disciplines with plant as a primary medium for defining space within the scene. This principle can explain how component of plants can be used in the design to create particular qualities (Leszczynski, 1999). Therefore, understanding the visual attributes of plants that are presented through colour, form, and texture is very important as to search their effects on people through aesthetic pleasure and to articulate these effects in planting design principles (Yilmaz et al., 2018). Even though there are various principles of planting design, Robinson (2004) has highlighted in his planting design handbook, there are five principles mostly employed to evaluate and determine the effects of the visual quality of certain planting composition in landscape spaces. There are harmony and contrast; balance, emphasis, sequence and scale.

These principles should be considered in conjunction with the available spaces especially in campus. The principles and objectives that landscape designers and planners have been applying for the last several hundred years did support the implication that coherence and complexity are integral in creating landscapes that people like (Kuper, 2017). According to Kaplan’s Information Processing Model (1979), the four predictors of preferences; coherence, complexity, legibility and mystery were identified as preference matrix. Kaplan’s (1987) research found that coherence and complexity were the essential preference predictors than others. However, the predictors evolve when dealing with the different setting from natural to human-made or urban to a rural environment. In this situation, campus may have different setting that possibly found different predictors.

In planting design, unity and diversity are fundamental to all design and all expression (Robinson, 2004). Unity, like the informational concept of coherence, creates aesthetic harmony, balances the composition that binds various parts into a whole; links or emphasises elements; and forms an ordered sequence of spaces and planting (Robinson, 2004), while, diversity like informational concept of complexity that can be achieved with a range of plant species and cultivars (Robinson, 2004). Additionally, legibility was found to be an ineffective predictor of the
environmental preference primarily because of its correlation with another predictor, coherence (Zhang, 2006). In the urban settings, earlier urban planner, Lynch (1960) suggested that “legibility is the ease with which a city’s parts can be recognised and can be organised into a coherent pattern” (p.2). Lynch (1960) asserted that legibility is a crucial predictor in the city setting. Meanwhile, mystery predictor often was found had a high rating in the natural environment, such as forests and wetland (Zhang, 2006).

Hence, campus environment has a complex ecosystem that gives some challenges in landscape design including the planting design setting. Through planting composition, the outdoor campus spaces will have different charm and scenery. Robinson (2004) has asserted “it is always important that the planting design contributes to the overall design concept and objectives, and this is achieved by spatial design and by the themes employed in detailed planting composition” (p.122). Unconsciously, planting composition has a power to control the visual and image of universities.

4 LANDSCAPE VISUAL ASSESSMENT

Based on the argument on the importance of planting composition in preparing quality landscape in campus, the landscape visual assessment should be comprehended. Zhang (2006) asserted that in The Macaulay Land Use Research Institute (2005), during the 1960’s to 70’s, landscape assessment focused on producing “objective” and quantitative methods with the value for the “subjective” responses to the landscape quality. These methods were developed to consider the tools to enable an evaluation by different observers which provided reliable and consistent information about observers’ responses to landscape visual quality (Zhang, 2006). According to Lothian (1999), these objective and subjective approaches have their philosophical arguments which acknowledged landscape aesthetics paradigms.

In landscape aesthetic, the objective paradigm lies in the inherent physical properties of the landscape such as landform, water bodies and colour. On the contrary, the subjective paradigm lies in people’s mind behind the eyes and their response to the landscape. The subjectivist or psychological paradigm considers landscape quality as solely a human construct based on the interpretation of what is perceived through the memories, associations, imagination and any symbolism it evokes (Lothian, 1999).

The classical philosophers all regarded aesthetics as a physical attribute (objectivist) such as Plato and Aristotle. Both philosophers argued that aesthetic qualities could be assessed objectively, and these qualities lie in the intrinsic properties of the object (Lothian, 1999). Based on this argument, the landscape can be judged from its formal quality such as line, colour and form (Lothian, 1999). However, the subjectivist places the observer in the central position, like Burke and Hume viewed aesthetically in a subjectivist or psychological term (Lothian, 1999). Burke in 18th century thought aesthetic originates with the emotions, Dewey’s in 19th century focused aesthetic with experience (Lothian, 1999).

The aesthetic quality of the landscape comes from the human mind’s perception and interpretation of the landscape (Kaplan, 1987). This approach argues that the human preference for different landscapes or perception of aesthetic qualities of the landscape is based on human knowledge and understanding of the landscape (Suhardi et al., 2006). Some of this knowledge and understanding may be innate such as something that people is born with, and some may be learned or acquired through experience and education (Suhardi et al., 2006).

5 THE RELATIONSHIP BETWEEN CAMPUS LANDSCAPE, PLANTING COMPOSITION AND LANDSCAPE VISUAL ASSESSMENT

An implicit study on people preferences for landscapes is required in the objectivist paradigm as these preferences provide the basis for human evaluation of landscape. In the subjectivist paradigm, landscapes provide a means of understanding the cognition, perception and preferences of
human observers (Lothian, 1999). As landscape researchers, it is essential to understand and identify the advantages and disadvantages of both paradigms.

We all have personal responses and views to particular plants and combinations of plants (Robinson, 2004). Tanguy and Tanguy (1985, as cited in Robinson, 2004) have described differences between what they call the ‘objective plant’ and the ‘subjective plant’. They mention that ‘objective plant’ refers to the all features or physical attributes of the plants that can be agreed and described by different people. However, ‘subjective plant’ refers to observer’s interpretation and meaning of the objective plant such as symbolic meaning and cultural meaning. Table 1 describes landscape inherent for both paradigms.

Table 1 Comparison of the objectivist and subjectivist paradigms

<table>
<thead>
<tr>
<th>Objectivist (physical) paradigm</th>
<th>Subjectivist (psychological) paradigm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beauty - an intrinsic quality of the landscape</td>
<td>Beauty - a quality in the eye of beholder</td>
</tr>
<tr>
<td>Essentially subjective</td>
<td>Essentially objective</td>
</tr>
<tr>
<td>Generally, lacks any theoretical framework</td>
<td>Often derives from a theoretical framework</td>
</tr>
<tr>
<td>Seeks understanding the landscape's physical attributes, often for management purposes</td>
<td>Seeks understanding of human preferences to understand the physical components which contribute to landscape quality</td>
</tr>
<tr>
<td>Differentiates landscape quality on the basis of implicit assumptions</td>
<td>Differentiates landscape quality on the basis of human preferences explicitly derived</td>
</tr>
<tr>
<td>Silent on causal factors</td>
<td>Seeks explanation of causal factors</td>
</tr>
<tr>
<td>Empirical, application of an approach</td>
<td>Experimental, tests hypotheses and extends approach</td>
</tr>
<tr>
<td>Site and area specific; results generally cannot be extended beyond area of study. Does not seek explanation of preferences</td>
<td>Not area or site specific; seeks results for wider application. May be applied to understand preferences in different landscapes</td>
</tr>
<tr>
<td>Assessments are often field based</td>
<td>Mainly uses surrogates (e.g. photographs) for assessments</td>
</tr>
<tr>
<td>Relatively easy, inexpensive and rapid to undertake</td>
<td>Relatively difficult, expensive and slow to undertake</td>
</tr>
<tr>
<td>Does not use respondents to evaluate landscape quality so cannot account for differences in preferences</td>
<td>Quantifies influence on preferences of respondent characteristics - age, gender, education, socio-economic, culture</td>
</tr>
<tr>
<td>Non-replicable and unique: application of approach by different individuals likely to result in different assessments of landscapes</td>
<td>Replicable: providing the sample is adequate, the preferences identified should be consistent across a range of studies</td>
</tr>
<tr>
<td>Being subjective and non-replicable, the results may be of questionable value and of short-lived application</td>
<td>Being objective and replicable the results extend knowledge and are relatively permanent for a given community</td>
</tr>
<tr>
<td>Unable to be used in a predictive sense except generally</td>
<td>Capable of predicting effect of landscape change on landscape quality</td>
</tr>
<tr>
<td>Subjectivity presented as objectivity</td>
<td>Objective evaluation of subjectivity</td>
</tr>
</tbody>
</table>

(Source: Lothian, 1999)

Table 1 displays the advantages and disadvantages of both paradigms. It depends on the research aspect but Lothian (1999) has suggested that subjectivist rather than objectivist or both paradigms should be combined. Subjectivist can offer objectivist more accuracy of the result on preferences of the community since its method is capable in predicting the effect of landscape quality of land management as well as the context of the study campus landscape management is a crucial part especially for maintenance work.

Therefore, in the context of designing campus landscape, both paradigms will help researchers to understand and assess the preferences on vegetation. Furthermore, the survey and investigation on campus landscape preferences also will assist planners and designers to carefully compose the planting design in different campus spaces with a specific composition. Both paradigms can be combined into landscape perception which provides a means for reconciling the two and
providing a role for each (Lothian, 1999). This will help a lot for landscape development in the campus community as well as an image of the university.

Figure 1 shows the conceptual framework of this research. This research begins with the understanding of landscape preferences as a study of human rating on the landscape and the reasons of preferences. They are also related to some theories in environmental psychology and landscape aesthetic, which affect perceptions. Through literature review, the researcher gathered some issues related to landscape planting that focuses on planting composition.

The physical factors or objectivist paradigm assist the researcher in identifying the existing planting composition on campus. The formal aesthetics such as the element of colours, forms, textures shadows, have briefly described the presence campus landscape. But, how people perceive their environment, which involves psychological factors or subjectivist paradigm is not highlighted. Demographic profile is the variables which have influenced most of the preferences rating. The previous studies on landscape preferences have proved gender, age, education and culture, which are the factors that have a strong relationship with a preference towards landscape (Wang & Zhao, 2017; Karimian et al., 2017; Hipp et al., 2015; Zhang 2006).

The framework aims to develop planting composition pattern that can guide campus landscape development. The framework can be used for enhancing the image of the university as well as the quality of life on campus. Students are a major concern in this study because they encounter the campus landscape daily. Subjectivist paradigm application is assisting the future development on campus landscape that is explicitly referred to in as planting design to establish student’s well-being. As mention by Robinson (2004), planting design focusses on visual sense that is produced by composition in order to bring out the best quality landscape.

7 CONCLUSIONS

Two landscape paradigms in an assessment of landscape visual quality for campus landscape have been discussed. Planting design has been identified as the primary contributor to control the
campus landscape as a whole. Planting composition objectively lies in the intrinsic qualities of formal aesthetic. However, objectivist has some disadvantages that could not assess human mind and satisfaction. Human perception and preferences towards landscape are significant for future development and landscape planning. “Objective plant’ could be viewed similarly but, “subjectively” plant may encourage specific emotion or carry specific meaning and symbolism in the different culture. Indeed, some of the plants able to grasp people’s mind having more positive thinking (Han, 2010) and release the stress (Li & Sullivan, 2016). Therefore, further analysis of the relationship between planting design on campus and students’ preferences is desired in meeting the needs and students’ well-being as well as design for a green campus.

REFERENCES


FEAR OF CRIME IN URBAN PARKS BASED ON DIFFERENT LEVELS OF CONCEALMENT, INCIVILITIES AND HUMAN PRESENCE

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Abstract - This study examined the effects of concealment, incivilities and presence or absence of people recreating (social cues) on evoking fear of crime in urban parks of Kuala Lumpur. 669 respondents from five parks rated their fear of crime to 12 manipulated photographic representations of a park trail. These results suggest that social and environmental cues may jointly affect fear experiences. From this study the photo with high concealment, with disorder and without people rated the most feared (M=5.86; SD = 1.345) and the photo with low concealment, without disorder and with the presence of people considered the least feared (M=1.85; SD= 1.327). As the level of concealment increases the mean value of fear of crime does increase. This is true either with or without the presence of people or with and without the presence of disorder. It also shows that photos under the condition without people but with the presence of disorder scored the highest mean value compared to other conditions. This shows that the presence of disorder with the absence of people evokes more fear than those photos without the presence of people and disorder. Contrarily, as the level of concealment increases, photos under the condition with people but without the presence of disorder scored the lowest level of fear.

Keywords - Urban green spaces, Prospect and Refuge Theory, Urban Forest, Manipulated photographs, Kuala Lumpur

1 INTRODUCTION

In an urbanized society today, the development of urban green spaces has become an integral entity in any urban city planning. Many are willing to pay significantly more to live near green spaces (Martin, Warren and Kinzig, 2004) because of the enormous benefits gained by the people in terms of health and well-being (Hartig, et al., 2003; Chiesura, 2004), facilitate social cohesion (Peters, Elands and Buijs, 2010; Kaźmierczak, 2013) and social contacts (Kuo et al., 1998) and enable to do certain physical activities (Arnberger, 2006; Wilhelm-Stanis, Schneider and Pereira, 2010).

Although the benefits of green spaces are usually stressed, green spaces provide some form of disservices (Lyytimäki et al., 2008). These include for example encounters with physical danger (e.g., bad weather, poisonous animals) which may evoke strong fears or other negative emotions in wild environments (Ulrich, 1993; Bixler and Floyd, 1997; van den Berg and ter Heijne, 2005), crowding perceptions (Arnberger and Haider, 2005) and conflicts between activity groups between walkers and bicyclists (Moore, Scott and Graefe, 1998; Cessford, 2003; Arnberger, 2006). Though several studies have examined the negative emotions, particularly regarding social dangers (e.g. fear of crime) occurring in urban green spaces such as parks. Many previous studies on fear of crime have been conducted in university campuses (e.g. Shaffer and Anderson, 1985; Fisher and Nasar, 1992; Fisher and May, 2009; Andrew and Gatersleben, 2010) and residential neighbourhoods (e.g. Glaser, 1994; Burgess, 1996; Coles and Bussey, 2000). Furthermore, most of these previous studies included only students’ perceptions towards safety, risk or threat. In the present article, ‘fear of crime’ is used...
in a wider sense, referring to the emotion experienced (e.g., perceived safety, perceived risk, perceived threat) rather than the actual crime, risk, safety, or security.

There are several cues which could evoke fear of crime in urban green spaces (e.g. physical and social cues). Previous studies have often focused on the physical cues or environmental attributes such as vegetation (e.g. hedges, bushes, trees) which provides concealment for perpetrators (e.g. Fisher and Nasar, 1992; Jorgensen, Hitchmough and Calvert, 2002; see for a review Sreetheran and Konijnendijk, 2014), less open view or lower prospect (Nasar and Jones, 1997; Kuo, Bacaicoa and Sullivan, 1998; Jorgensen, Hitchmough and Calvert, 2002), non-appearance of escape routes (Fisher and Nasar, 1992; Madge, 1997; Andrews and Gatersleben; 2010) or even low lighting or dark areas (Nasar, Fisher, and Grannis, 1993; Loewen, Steel, and Suedfeld, 1993; Nasar and Jones, 1997). In this sense, Grof and McCord (2011) noted that perpetrators are attracted because parks have dense foliage and poor lighting that may reduce natural surveillance.

According to Fisher and Nasar’s (1992) general typology, individuals always judge the safety of their surrounding environment based on the level of prospect and refuge. An environment which offers little prospect would foster a higher level of refuge for potential perpetrators and this would evoke a higher degree of fear amongst individuals and vice-versa. Fisher and Nasar (1992) argue that if the surrounding environment affords the individual a high degree of visibility and minimal concealment for potential perpetrators, then the individual could evaluate the surrounding environment or even avoid any potential attack. Both Hassinger (1985) and Warr (1990) also have shown that an individual’s level of fear is directly correlated to the number of hiding places within an environment. In a park setting, fear of crime could be evoked when overgrown shrubs or hedges or lower tree branches blocked the view of users particularly along the trails. The over-grown or dense, unmaintained or poorly arranged vegetation in urban green spaces also creates non-appearance of escape routes for the individuals. According to Archea’s (1985) access-exposure model, the appearance of escape routes is important in an individual’s perception of safety about their surrounding environment.

Parks are also perceived as risky when sites are more densely vegetated, particularly when the vegetation is not maintained (Schroeder, 1989; Michael and Hull, 1994) and crime is often cited as a reason to avoid densely wooded areas (Talbot and Kaplan, 1984). Densely wooded areas have consistently been associated with fear. Work by Schroeder and Anderson (1984) showed that individuals felt most vulnerable in densely forested areas and safest in open, moved areas. In another study examining fear of crime in a university campus, the results showed dense undergrowth that reduced views into areas where criminals might hide were associated with fear of crime (Nasar and Fisher, 1993). Fear of crime is higher where vegetation blocks views (Fisher and Nasar, 1992; Kuo, Bacaicoa and Sullivan, 1998; Michael and Null, 1994).

However, this does not mean that parks always invite crime. A well maintained grassy area certainly does not block views; widely spaced, high-canopy trees have minimal effect on visibility; and flowers and low growing shrubs seem unlikely to provide cover for criminal activities (Kuo and Sullivan, 2001). In other words, whenever vegetation blocks views, fear of crime is higher (Fisher and Nasar, 1992; Kuo, Bacaicoa and Sullivan, 1998; Michael and Hull, 1994). From the above studies it can be derived that dense vegetation provides potential cover for criminal activities, possibly increasing the likelihood of crime and certainly increasing the fear of crime. Large shrubs, underbrush and dense woods all substantially diminish visibility and therefore are capable of supporting criminal activity (Kuo and Sullivan, 2001). This shows that not all type of vegetation blocks view. However, in contrast, there are also studies that have shown that vegetation can deter crime. Nasar (1982), for example, found that higher levels of vegetation were associated with less fear of crime. Another study using resident drawings found that properties appeared safer when trees and shrubs were included than when they were not (Brower, Dockett and Taylor, 1983).

In green areas such as parks, light is also important where darkness leads to avoidance, and consequently empty parks (e.g. Dunnett, Swanwick and Woolley, 2002). According to a study by Loewen et al. (2003) in Canada, light was among the environmental features which was mentioned most frequently among the respondents when they were asked as to what features of the environment
contributed to making them feeling safe in relation to crime. This is because park lighting of fields and walkways can increase the ability for natural surveillance for both park users and those immediately outside the park (Groff and McCord, 2011). Indeed a systematic review study by Welsh and Farrington (2009) found that nine out of 13 studies showed a positive impact on lighting in relation to safety, whereas the remaining four studies showed no effect.

Others include the presence of physical incivilities or disorder such as vandalism, graffiti littering (e.g. broken bottles, trash) or lack of maintenance in urban green spaces. Such signs are often regarded as having a negative impact on safety in public spaces such as parks (Burgess, Harrison and Limb, 1988), as illustrated by the quote “Where there’s sand at the park, I don’t like to go there because of the needles” (girl aged 8; Castonguay and Jutras, 2009, p. 106). Other signs of incivilities such as dirty toilets in Japanese greenways were also considered a fearful sight by the users towards crime (Yokohari, Amemiya and Amati, 2006). Grass maintenance has positive effects on resident’s sense of safety; images showing well-maintained grass were given significantly higher rating than images showing grass in its existing condition (Kuo, Bacaicoa and Sullivan, 1998). Perceived disorder by an individual typically increases with observed disorder (Sampson and Raudenbush, 1999). Consequently, signs of disorder compromise the perceived livability of an area, and inspire fear of crime (Perkins, Meeks and Taylor, 1992; Perkins and Taylor, 1996; Skogan, 1990; Taylor, 1997, 1999). Constance care or maintenance in urban green spaces (e.g. urban park) may alter the environment and increase the perception of safety among the individuals through removal of signs of physical disorder.

The perceived safety in parks does not relate to the risk of being a victim of crime per se but to the presence of certain illegitimate groups of people such as loitering youths, rowdy behavior, public drunkenness, drug sales and prostitution (Groff and McCord, 2011). This presence of illegitimate people or social cues may evoke fear of crime among the people. For example, the threat (e.g. for sexual violence) of strangers loitering played a key role in deterring women from using parks in Leicester, UK (Madge, 1997). This was also noted in the small Norwegian neighbourhood forest of Buttekvernskogen, where women generally expressed fear of rape and assault by men and gang of youths loitering (Skår, 2010). Besides adult females, parents were also concerned about the personal safety of the children along the Chicago River corridor (urban greenway) which was considered as a hang-out for youth gangs engaged in criminal activity, a place for drinking and drug use and as habitat for the homeless (Gobster and Westphal, 2004).

The aim of this study was to examine the effects of environmental (concealment and disorder) and social cues (presence or absence of people recreating) on perceived fear of crime among urban parks users in the context of Kuala Lumpur, Malaysia, using manipulated photographs. Tough a similar study was conducted by Jorgensen, Ellis and Ruddell (2013) in Salt Lake City, USA, this study investigated fear of crime ratings of park scenes by women and men by only taking into account the level of concealment as environmental cues and presence or absence of people recreating as social cues with gender. However, in this study, apart from the level of concealment and presence or absence of people the authors have included disorder as an additional environmental cue.

As mentioned above, only few studies on fear of crime in urban green space have been conducted in this part of the world. Though fear of crime has gained much attention in the West, only limited number of studies investigated fear of crime in non-Western countries (Adu-Mireku, 2002; Dammert and Malone, 2006; Hwang, 2006; Johnson, 2006; Karakus, McGarrell and Basibuyuk, 2010). This is problematic, as cross-cultural understanding of fear of crime is important, and most of the research from Western countries is probably not easily transferable (Adu-Mireku, 2002; Dammert and Malone, 2006; Johnson, 2006). Consequently, the validity of existing fear of crime models (e.g., vulnerability hypotheses) and related findings is questionable, as current knowledge may be limited or even biased (Adu-Mireku, 2002). It is therefore seen as timely to study fear of crime or perceived fear of crime from an Asian perspective by looking into different demographic characteristics.

To the authors knowledge this is the first time a series of manipulated photographs have been used as stimuli to test the perceived fear of crime based on different levels of concealment (e.g. vegetation density), physical disorder (e.g. present of trash, vandalism) and present of people along a
trail in a park. Therefore, the authors hypothesised that the presence of high concealment, signs of disorder and the absence of other people along a trail in an urban park would evoke fear of crime. Moreover, the authors also hypothesised that the sign of disorder has greater impact than the absence of people in evoking fear of crime.

2 METHODOLOGY

2.1 Study Site

This study was conducted in five selected urban parks in the city of Kuala Lumpur, Malaysia. Kuala Lumpur is located about 3°08’N and 101°44’E and covers an area of 243 km2. Based on sources from Department of Statistics Malaysia (2010) the population for Kuala Lumpur in 2010 was 1.6 million people which consists of three main races; Malay, Chinese and Indians. As for the choice of urban parks selection in Kuala Lumpur it was based on the definition of urban parks given by the Planning Standards for open space and recreation. A brief description for each of these urban parks was presented in Table 1.

Table 1 Brief description of the study sites.

<table>
<thead>
<tr>
<th>No.</th>
<th>Urban park</th>
<th>Photo of the urban park</th>
<th>Park Description</th>
</tr>
</thead>
</table>
| 1   | Taman Tasik Perdana        | ![Photo](image1.png)    | Year: 1892  
Size: 92 hectares  
Character:  
The oldest public park in Kuala Lumpur. Created from former mining land. Highly maintained area. Surrounded by privately owned houses and government offices. |
| 2   | Taman Tasik Titiwangsa     | ![Photo](image2.png)    | Year:  
Size:  
Character:  
Created from former mining land. Highly used by active users. Surrounded by privately owned houses, government offices and embassies. |
| 3   | Taman Tasik Permaisuri     | ![Photo](image3.png)    | Year:  
Size:  
Character:  
Created from former mining land. Highly used by active users. Surrounded by several housing estates and also a public hospital. |
| 4   | Taman Tasik Metropolitan Batu | ![Photo](image4.png)    | Year  
Size:  
Character:  
Created from former mining land. Surrounded by several housing estates. Not frequently used by park users because of the remote location. |
2.2 Sample

A random sample consisting of urban park users was collected in the five parks in Kuala Lumpur. The sample consists of adults of both gender aged 18 and above which consists of the three main ethnic groups (e.g. Malay, Chinese and Indians). Children were excluded from the survey, as it is reasonable to assume that their perception is different and requires a different method of assessment. The respondents consisted of 669 urban park users (365 men, 304 female) aged between 18 and 73 years (M= 34.85, SD = 11.46). The first author recruited respondents composed of three main ethnic groups in Malaysia; Malays (n= 376), Chinese (n = 163) and Indians (n = 130). The respondents represented a broad range of occupations, including: 19.3% civil servant, 35.1% private sector employee, 11.5% self-employed, 0.7% pensioners, 16.6% students and 16.4% unemployed. The respondents were interviewed in five selected urban parks in Kuala Lumpur. Children were excluded from the survey, as it is reasonable to assume that their perception is different and needs different methods of assessment.

2.3 Survey Instrument

The questionnaire set of 12 manipulated photographs of an urban park setting that systematically varied in terms of concealment (low/medium/high), present of physical disorder (present/absent) and the presence of people recreating (present/absent). Each of the created photos was printed in an A4 size and was arranged in a folder file to be shown to the respondents during the survey. These questions were followed by open-ended questions to collect verbal descriptions of the photos. In addition, if the open-ended responses were used with the rating scales, these could provide valuable information that is not commonly incorporated into a quantitative method approach. The respondents were required to select one photo where they felt no fear at all/fear the least and one photo where they feared the most. Based on these two photos they were required to give reasons for their selections. For the photo which they feared the most, the respondents were also required to suggest how to improve the scene of the particular photograph in order to reduce the fear of crime. The last section of the questionnaire contained demographic information of the respondents, concerning gender, age, ethnicity, level of education and occupation were included.

2.4 Stimuli (Photo Manipulation)

A set of 12 manipulated photographs was created using Adobe® Photoshop® Elements 10. The final set of photographs was prepared using photographs of the various elements they contained (e.g. vegetation, people, trash etc.), which were then manipulated using the software and superimposed on a base photo. All the photographs were taken by the first author. Among the elements applied in developing the photographs were various types of vegetation (e.g. shrubs, trees), physical disorder (e.g. trash, broken glasses, unmaintained vegetation and vandalism) and people (e.g. people in the park). When the subsequent photographs of the original were superimposed, all these elements ensured that the elements used in the study all contained a subspace of approximately the same dimensions and that when vegetation, physical disorders and people were superimposed it was realistic in terms of perspective. A final set of 12 manipulated photographs was prepared in the following matrix 3 (concealment: high/medium/low) x 2 (presence of physical disorder: present/absent) x 2 (presence of people recreating: present/absent) (Figure 1). For the manipulation of different level of concealment, physical disorder and presence of people were described in detail in Table 2.
2.5 Survey Procedure

The survey was administered within five months from October 2012 to March 2013. In each of the selected parks, the first author selected a point or station to conduct the survey. The points or stations were strategic locations in each of the parks where most of the park visitors were concentrated. The first author was stationary at the selected points. Since a stratified random sampling was applied in this study, the first author selected randomly amongst the park user who passed. The first author was assisted by six enumerators to conduct the survey in all the five selected urban parks. These enumerators were group of final year students from the Forest Faculty, Universiti Putra Malaysia (UPM). The enumerators were given an overview of the study by the first author to have a better understanding of the study. As token of appreciation, each of the enumerators was paid a small fee per completed questionnaire by the first author.

The on-site survey was conducted as face-to-face interview. The survey was conducted in four languages, namely Malay, Mandarin, Tamil and English to cater for cultural diversity in Malaysia. Relying on the use of single language in some research settings can results in the exclusion of significant groups of respondents (Matthews & Ross, 2010). This was essential particularly in this study which involved the opinions of three ethnic groups in Malaysia. When park users agreed to take part in the survey, the first author/enumerator began by explaining in brief about the aim of the study, the procedure the interview, content of the questionnaire and the duration taken for the interview. The respondents were also assured about the confidentiality of their responses. The respondents’ involvement was voluntary and they were not offered any type of incentive or reward for participating in the study. The park users at each park were surveyed on-site on both weekdays and weekends in the morning (7:00 a.m. to 12:00 p.m.), afternoon (12:00 p.m. to 3.00 pm) and evening (3:00 p.m. to 7:00 p.m.) in order to achieve a fully representative sample of the park user.
Figure 1 The 12 final set of photographs (3 Concealment x 2 Physical disorder x 2 People present).
Table 2 Manipulation of different level of concealment, physical disorder and present of people.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Design</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concealment</td>
<td>Low concealment</td>
<td>No understory vegetation only trees</td>
</tr>
<tr>
<td></td>
<td>Medium concealment</td>
<td>Enclosure up to canopy drip-line with trees</td>
</tr>
<tr>
<td></td>
<td>High concealment</td>
<td>Enclosure above the canopy drip-line with tree</td>
</tr>
<tr>
<td>Physical disorder</td>
<td>With physical disorder</td>
<td>With trash, broken glasses, paint stain, vandalism, poor maintenance, graffiti.</td>
</tr>
<tr>
<td></td>
<td>Without physical disorder</td>
<td>Without trash, broken glasses, paint stain, vandalism, poor maintenance, graffiti.</td>
</tr>
<tr>
<td>People</td>
<td>With people recreating</td>
<td>With people recreating and passer-by.</td>
</tr>
<tr>
<td></td>
<td>Without people recreating</td>
<td>Without people recreating and passer-by.</td>
</tr>
</tbody>
</table>

3 RESULTS

The respondents rated Photo 11 (M=5.86; SD = 1.345) the most feared and Photo 2 (M=1.85; SD= 1.327) as the least feared (Figure 2). Photo 11 consists of elements such as high concealment (e.g. high, thick bushes with blocked views), presence of disorder and absence of people along the trail, while photo 2 contains low concealment, absence of disorder and presence of people along the trail. The reasons for selecting Photo 11 and 2 are summarized in Table 3.

For the attributes of concealment, the higher the concealment (e.g. low, medium and high), the higher the mean value of fear of crime. This is true either with or without the present of people or with and without the presence of disorder.

It also shows that as the level of concealment increases, photos under the condition without people but with the presence of disorder scored the highest mean value compared to other conditions (Figure 1). This mean value is high when compared to the mean values of photos without people and without disorder. This shows that the presence of disorder with the absence of people evokes more fear than those photos without the presence of people and disorder.

Contrarily, as the level of concealment increases, photos under the condition with people but without the presence of disorder scored the lowest level of fear. These mean values are lower compared to those mean values of photos with the presence of people and with the disorders. This shows photos with the presence of people without disorder creates less fear compared to those photos with people and with disorder.

4 DISCUSSION

Majority of the respondents reported dense, unmaintained vegetation as a major cue evoking fear of crime in urban green spaces. This was the most investigated attribute among the reviewed articles (see Sreetheran and van den Bosh, 2014). For example, the presence of too many trees and bushes was frequently mentioned as a specific point of concern (Talbot and Kaplan, 1984). As mentioned by a teenage girl: “It’s like there’s forest back there. Once you get past the playground, there’s like a whole lot of trees and weeds and stuff. So once you get back there, once you get behind that part of the playground, anything can happen to you!” (Brownlow, 2006, p. 234). Shrubs were considered as a potential place to hide for perpetrators or obstructions of view (Lindgren and Nilsen, 2012). In another study, a woman talked about a place where the sexual assaults were thought to have occurred. However, she mentioned: “I haven’t been there for ages so I don’t know how they are now, but no I don’t think we should have to have that part cut, it was nice beauty spot, you see. No, I wouldn’t cut a beauty spot away” (Jorgensen et al., 2007, p. 283). In contrast, some studies conducted in residential areas found that of the presence of vegetation was associated with a reduced fear of crime. For instance, a study in a Chicago housing scheme courtyard found that the presence of trees had strong positive effects on residents’ sense of safety compared to a barren courtyard (Kuo et al., 1998). Brower et a. (1983) found that respondents rated line drawings of a property including
<table>
<thead>
<tr>
<th>Photo</th>
<th>Perceived fear of crime</th>
<th>Mean</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Low concealment; without physical disorder; with people recreating.</td>
<td>1.85</td>
<td></td>
</tr>
<tr>
<td>Photo 2</td>
<td>Low concealment; without physical disorder; without people recreating.</td>
<td>2.94</td>
<td></td>
</tr>
<tr>
<td>Photo 4</td>
<td>Medium concealment; without physical disorder; with people recreating.</td>
<td>4.02</td>
<td></td>
</tr>
<tr>
<td>Photo 6</td>
<td>High concealment; without physical disorder; with people recreating.</td>
<td>4.54</td>
<td></td>
</tr>
<tr>
<td>Photo 10</td>
<td>Medium concealment; without physical disorder; without people recreating.</td>
<td>4.61</td>
<td></td>
</tr>
<tr>
<td>Photo 1</td>
<td>Low concealment; with physical disorder; with people recreating.</td>
<td>4.68</td>
<td></td>
</tr>
<tr>
<td>Photo 8</td>
<td>Low concealment; with physical disorder; without people recreating.</td>
<td>4.92</td>
<td></td>
</tr>
<tr>
<td>Photo 5</td>
<td>High concealment; without physical disorder; without people recreating.</td>
<td>5.02</td>
<td></td>
</tr>
<tr>
<td>Photo 12</td>
<td>Medium concealment; with physical disorder; with people recreating.</td>
<td>5.09</td>
<td></td>
</tr>
<tr>
<td>Photo 3</td>
<td>High concealment; with physical disorder; with people recreating.</td>
<td>5.24</td>
<td></td>
</tr>
<tr>
<td>Photo 7</td>
<td>Medium concealment; without physical disorder; without people recreating.</td>
<td>5.41</td>
<td></td>
</tr>
<tr>
<td>Photo 11</td>
<td>High concealment; with physical disorder; without people recreating.</td>
<td>5.68</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** 1 = none; 2 = low; 3 = somewhat moderate; 4 = moderate; 5 = somewhat high; 6 = high; and 7 = very high

Figure 2 The mean rating of the 12 manipulated photos.
**Table 3 Reasons for selection the most and least feared photos.**

<table>
<thead>
<tr>
<th>Photo 11 (Most feared)</th>
<th>Photo 2 (Least feared)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Absence of people</strong></td>
<td><strong>Presence of people</strong></td>
</tr>
<tr>
<td>a. Feeling so lonely…no pass by</td>
<td>a. Can see people recreating</td>
</tr>
<tr>
<td>b. No people …if anything happens very hard to get help.</td>
<td>b. You don’t feel lonely</td>
</tr>
<tr>
<td>c. Looks like a deserted place.</td>
<td>c. Easy to get help from other people</td>
</tr>
<tr>
<td><strong>Incivilities</strong></td>
<td><strong>Incivilities</strong></td>
</tr>
<tr>
<td>a. Vandalism</td>
<td>a. The trail is clean</td>
</tr>
<tr>
<td>▪ Vandalism…shows signs of irresponsible people hanging around in this area.</td>
<td>b. The place is well maintained</td>
</tr>
<tr>
<td>b. Trashes</td>
<td>c. Very neat…</td>
</tr>
<tr>
<td>▪ Garbage are not cleaned or maintained. Garbage is everywhere…this trail has been abandoned. Broken glasses…this must be the haven for drunkers. Trashes are everywhere…must be a place for perpetrators to hide.</td>
<td>d. No trash lying around</td>
</tr>
<tr>
<td><strong>Concealment</strong></td>
<td><strong>Concealment</strong></td>
</tr>
<tr>
<td>a. Tall bushes</td>
<td>a. Open view</td>
</tr>
<tr>
<td>▪ cannot see further, limited view…bushes are above eye level</td>
<td>b. More exits along the trails</td>
</tr>
<tr>
<td>▪ perpetrators might be hiding behind the bushes.</td>
<td>c. The trail looks wide</td>
</tr>
<tr>
<td>▪ both sides of the trail are closed with tall bushes…no other exits.</td>
<td>d. So spacious…you will be aware of your surroundings.</td>
</tr>
<tr>
<td>▪ bushes are messy and not well maintained.</td>
<td>e. No hiding places for perpetrators</td>
</tr>
<tr>
<td>▪ tall bushes make the surrounding area darker.</td>
<td>f. No tall bushes</td>
</tr>
<tr>
<td>▪ must be a perfect place for drug addicts.</td>
<td></td>
</tr>
<tr>
<td><strong>Others</strong></td>
<td><strong>Others</strong></td>
</tr>
<tr>
<td>a. Narrow trails.</td>
<td>a. Nice landscape</td>
</tr>
<tr>
<td>b. Presence of poisonous animals like snakes in the bushes.</td>
<td>b. Feeling so peaceful</td>
</tr>
<tr>
<td></td>
<td>c. Proper landscape management</td>
</tr>
<tr>
<td></td>
<td>d. Good planting arrangement</td>
</tr>
<tr>
<td></td>
<td>Good plant selection…not many bushes</td>
</tr>
</tbody>
</table>

Trees and shrubs to be safer than those without (Brower et al., 1983). However, in both of these studies, the vegetation was well maintained.

Open view and view distance were also found to have strong positive associations with perceived security. One woman in a Norwegian study stated: “…if it (woodland) had been more open, if people could see in, if you could see what was inside here, then perhaps I could have sent her (daughter) myself…Now, nobody can see inside here…” (Skår, 2010, p. 114). In another study (of a Swedish housing estate), the housing company manager said: “…there should be open, see-through surfaces. One should see who and what is moving a bit further away so that there are no large shrubs that make it impossible to view what is behind the shrubbery.” (Lindgren and Nilsen, 2012, p. 202). Furthermore, a wide open area will not contain any ambiguous refuges – no ‘hidey’ places, as one respondent put it (Loewen et al., 1993).

Poor landscape design was also highlighted by the respondents. They regard poor landscape design in terms of improper species selection and lack of spatial arrangement. It is important to plant according to a design (even a simple one) to enhance attractiveness and improve perceived security (Anderson and Stokes, 1989). Similarly, Shaffer and Anderson (1985) reported that security generally was rated higher when the vegetation appeared to be well integrated into the landscape design. Spatial arrangement was also considered important in creating a sense of safety. Thus, more natural vegetation could be introduced into parks and green spaces without necessarily making the parks appear unsafe. However, tree placement (either formal or “natural” arrangements) had
inconsistent effects on sense of safety in the courtyard of a housing scheme in Chicago (Kuo et al., 1998).

The overall physical appearance and signs of negligence or physical incivilities (e.g., abandoned cars, graffiti, vandalism) were noted as among the significant causal agents in evoking fear of crime in urban green spaces. As illustrated by the quote “Where there’s sand at the park, I don’t like to go there because of the needles” (girl aged 8; Catonguay and Jutras, 2009, p. 106). Other signs of incivilities, such dirty toilets in Japanese greenways, were also considered a fear-inducing sight by users due to connotations with crime (Yokohari et al., 2006). Grass maintenance impacts residents’ fear of crime; images showing well-maintained grass were given significantly higher ratings than images showing grass in its existing condition (Kuo et al., 1998). A woman in her late 40s made the following comment about maintenance in her neighbourhood park: “The grass isn’t cut. You can’t see because of all of the weeds. The weeds are out of control…That is so dangerous. Anything can happen. Kids can get stabbed, kidnapped, murdered” (Brownlow, 2006, p. 234).

The study also revealed that the presence of people can encourage safe use. In addition, William (1980) observed that well-used public spaces were populated with people engaging in what was termed “mutual acceptable use”. However, this also depends on the variety of people present, as the presence of other people might either increase or decrease fear. Most of the respondents tend to feel safe when visiting a place where many people are engaged. For example, the majority of the Turkish women from Isparta found urban parks to be safe for themselves and their children, as most of them (93%) tended to visit the parks in groups (with their family, friends, and neighbours). This is in contrast to other (Western) countries where the use of urban parks in groups is not common (Özgüner, 2011).

5 CONCLUSIONS

Fear of crime has been regarded as a significant social problem in urban areas. This has urged most scholars to devote significant attention to the causes of such fear in general or specifically in urban green spaces. Although some common attributes may apply across different cultures based on the evolutionary basis, it is essential to conduct more studies elsewhere. In addition, it is also pertinent to investigate further on the interactions of the attributes which evoke fear of crime in urban green spaces. Although it is important to investigate how natural elements may evoke fear of crime in urban green spaces (e.g. landscape design, maintenance, vegetation character and density), it should be understood that this attribute does not contribute in causing fear by itself, rather it is a complex interaction with other attributes (e.g. personal factor, physical factor, social factor, behaviour etc.). In future, more studies need to be conducted to see how other attributes contributes in evoking fear of crime in urban green spaces.

REFERENCES


UNMANNED AERIAL VEHICLE (UAV) FOR HERITAGE TREE DETECTION

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Abstract – This paper explores the potentials of Unmanned Aerial Vehicle (UAV) as a satisfying alternative tool to detect potential heritage trees by assessing the tree characteristic - the crown spread. Tree crown spread is an essential variable in tree assessment but is typically costly and time-consuming to measure in the field survey using conventional techniques. The study was carried out by a case study at Taman Perbandaran Tengku Anis, Kota Bharu. The first phase presents the procedure of capturing and processing UAV data to create and digital surface models in GIS environment. This information was used to detect the potential of heritage trees of the average crown spread estimated by the cross method. In the second phase, the researcher validated the accuracy of the methods by comparing the results with ground measurements. The results showed higher agreement between field survey and the UAV data for the crown spread, which were in the range 1.0-1.5 meters. Overall, the results accuracy was acceptable and showed that the method was feasible for tree crown measurement. Thus, as an alternative way of detecting the potential of heritage tree with indirect measures of tree characteristics. Within this study, the researchers save precious time and money that can be put in to restore before the ground survey was conducted. Reliable information is available within hours. The UAV has proven to be a useful tool for urban forestry providing a cost-effective and reliable system to obtain remotely sensed data. This information offers better method of potential heritage tree detection which is the basis for protection, care, and management of heritage tree for the future.

Keywords - UAV, GIS, Crown Spread, Heritage Tree, Detection

1 INTRODUCTION

Heritage trees are typically large and are instantly recognizable as heritage because of their massive scale. Jim (2017) has listed in his previous research related to the outstanding tree dimension (2017) namely ‘Big tree,’ ‘Great tree,’ ‘Large tree’ and ‘Giant tree.’ These heritage trees stand out because of their size and become a landmark. In defining a special status tree - heritage tree, Wadey (2012) and (Lau, Jonathan, & M.S., 2017) highlight the aspects of memorability and visibility of trees through their form, location setting and other notable characteristics, including the size of trees. A tree's size increases with its importance in memories, its uniqueness, and its distinctive meanings to the people. The more rooted values and meanings of trees are especially evident concerning big trees (Barro, Gobster, Schroeder, & Bartram, 1997). Jones et al. (2002) mention trees with their outstanding characteristic such as dimension, shape, and other physical intrinsic aspect create visual attractiveness which can easily engage people senses. Additionally, Burra Charter describes that size is part of criteria that relate to sensory perception in heritage principle. The tree dimension refers to their height, trunk diameter at breast height, and crown spread which widely used as the fundamental criteria to determine whether a tree should be officially designated as heritage trees (Jim, 2017; Polat, 2017). Additionally, an average crown spread is one of the parameters commonly measured in various champion tree programs(American Forests, 2015). The crown of any plant refers to the totality of its above-ground structures, such as the trunk/stem, leaves, branches, and reproductive parts. Tree crown spread is an essential attribute of the size of the tree that influences the benefits that a tree provides. Tree crown is the totality of branches, twigs, and leaves extending from the main trunk or stem of a tree. According to Blozan (2006), the crown spread is measured from branch tip in
two directions and then averaged. The first measure is taken where the crown is the widest. The second is made at 90 degrees to the first (Figure 1).

\[
\frac{A+B}{2} = \text{Average Crown Spread}
\]

Figure 1 The measurement of crown spread \( \frac{A+B}{2} = \text{Average Crown Spread} \)

Conventionally, the crown is measured by using a measuring tape or hypsometer from the ground survey which is typically costly and time-consuming. The UAV, a remote sensing tool, seems to be more effective than ground surveys with the small areas as a station for investigation, and their cost-effectiveness compared to aerial flights with the photogrammetric camera mounted on the board. It is also known as a drone, an aircraft designed to operate without a human on the board which can fly autonomously or semi-autonomously by remote control (Zietara, 2017; Colomina & Molina, 2014). Due to a very high spatial resolution of the photos acquired from UAV’s, aerial surveys are becoming increasingly popular. Moreover, it also influenced by the rapid increase in affordability for the average consumer. They are no longer expensive machines and can be controlled with ease, e.g., utilizing a handphone application for direct control or feedback (Clark, Meffert, Baggili, & Breitinger, 2017). In contrast to standard aerial imagery, UAV utilizes recent technological advances to provide an affordable alternative for imagery acquisition (Ritter, 2014). The conventional aerial images may be not current images updated real time, so there is a tendency to show different pictures from current status. UAV’s application is found in many different fields including in agriculture and forestry in the last decade (Birdal, Avdan, & Türk, 2017; Goodbody, Coops, Marshall, Tompalski, & Crawford, 2017; Ritter, 2014; Zietara, 2017). UAV is capable of improving the efficiency of acquisition and providing excellent spatial scale data for sustainable resource management (Goodbody et al., 2017). Their technology and data processing capabilities have made it feasible to obtain high-resolution photogrammetry data (Colomina & Molina, 2014), which can provide essential information quite quickly on demand in assessing tree characteristics. All objects captured by UAV including tree attributes are described regarding points, lines, and polygons and can be extracted merely by using GIS engine. In other words, GIS relies upon access to content, and UAV is the gamechanger bringing that content to geographic information systems (Breetzke, 2015). In this study, each tree crown was digitized, and the diameter of the speed was measured. In a geospatial database, each of these objects would be grouped into object classes, and their data would be stored in separate tables. Thus, the researchers present an alternative tool to detect potential heritage trees by assessing the tree attributes - the crown spread.
2 METHODS

2.1 Study area

This study was established at Taman Perbandaran Tengku Anis, Kota Bharu. The park was built as part of the national movement to provide large parks for urban residents. It is located at 6°15'6.17" N, 100°15'6.17" E. The effects of the park are especially interesting because it is the closest park to the city and is surrounded by dense residential areas. The park has been efficiently used by a range of different people in recent years which provides a diverse range of space, activities and a large number of mature shade trees (Figure 2).

A two-phase tree inventory was implemented in a case study. The first phase, UAV captured multiple images from the onboard camera through a mobile app – Precision flight to produce photo-realistic outputs and digital surface models. The images were processed and stitched together to create a single output image of the study area using Agisoft PhotoScan software. All these objects can be described regarding points, lines, and polygons – and tables of these objects constitute the tabular portion of geospatial data. Points, line, and polygon can be extracted merely by using GIS engine, and each tree crown was digitized, and the diameter was measured. This information then was used to detect the potential of heritage trees regarding the average crown spread identified within an arborist's tree survey in Kota Bharu (MPKB, 2010). In the second phase, the researcher validated the accuracy of the methods by comparing the results with ground measurements.

2.2 UAV Data Processing and GIS Environment

2.2.1 Image acquisition: Flight planning

This study used the low-cost drone; a Phantom 3 Advanced with the Precision flight mobile app for data capturing. The mobile app served as the controller for many of the Phantom 3’s advanced features. These free mobile apps turned a drone into an advanced remote sensing tool that empowers drone pilots to capture aerial data autonomously. It enabled operators to create flight plans and guide the drone to capture aerial imagery. After connecting drone with a remote controller, the image pixel size and camera constant will automatically be loaded to the application. The first important consideration in doing flight planning is the place where to start a mission. The possible highest point within the study area was decided as the starting point because it will influence the setting of the flight height. Another consideration was in the aspect of weather and sunlight. According to Zietara (2017), it is a crucial factor which may affect final results in the photogrammetry data. In avoiding sunlight problem that leads to the appearance of a shadow, the flight was performed during a cloudy and windless day. The flight height, side and front overlaps was determined after the study area was marked on the map. This flight mission was used that overlapped of 90% for front and 60%
side overlap respectively to ensure maximum stereoscopy and to avoid holes. The altitude of 100 meters above the ground decided to be an optimal value with standard speed setting. The whole mission lasted about 11 minutes of flight time with the use of one battery (Figure 3).

2.2.2 Image processing

The UAV produces a digital surface model which includes all objects and vegetation above the ground. The image resolution achieved by UAV surveys is exceptionally high. The visual identification of specific plant characteristics can be identified from the aerial imagery. This in turn limits the amount of ground truthing that needs to be done in the field. It resulted in 132 photos required to cover the whole study area (Figure 4).

![Figure 3 Screen capture of Precisionflight software during aerial photo mission. The screen contains flight controls, current mission parameters, communication limits, and flight path(s).](image)

![Figure 4 These are part of images are run through the UAV software, georeferenced, stitched together, and a single output image of the study area is produced.](image)

All the photos were processed using Agisoft PhotoScan software after the image acquisition was completed. This software can stitch photos together and output a single composite image- ortho-mosaic by choosing a moderate depth filtering mode. The ortho-mosaic image is a single image of the study area containing the many individual images taken during the survey (Figure 5).
2.2.3 GIS environment and crown spread measurement

In GIS environment, all object in the land surface such as points, lines, and polygons constitute the tabular portion of geospatial data. Points, line, and polygon can be extracted merely by using GIS engine, and each tree crown was digitized, and the diameter was measured. The model describes by (Blozan, 2006) was used to estimate the crown spread for each tree in the study area (Blozan, 2006). A crown spread is measured from branch tip to branch tip in two directions and then was averaged. In this study, the average crown spread was obtained by measuring the shortest and longest extent of the crown and averaging the figures.

Where: The measurement of crown spread \( \frac{A+B}{2} = \text{Average Crown Spread} \)

Then, the second phase entails measuring the tree crown spread on the ground using a measuring tape. It is essential to make a few manual measurements, using a tape measure that enables the researcher to check the accuracy of the ortho-mosaic image (Figure 8). This information then was used to detect the potential of heritage trees regarding the average crown spread. The minimum average size for crown spread identified in arborist’s heritage tree survey in Kota Bharu is 10 meters (MPKB, 2010).
3 RESULT AND DISCUSSION

The results showed higher agreement between field survey and the UAV data for the crown spread, which were in the range 1.0-1.5 meters. However, the crown spread measurement can be particularly challenging in areas with dense and multilayered trees because of the horizontal and vertical complexity (Bohlman & Pacala, 2012). This method is suitable for use in urban areas with low tree density because the crown outline identification is more pronounced. The potential heritage trees in the study area are 94 trees regardless of other physical characteristic and the health condition. The majority of the trees are from Khaya senegalensis ranging from 10 to 32.5 meters. Overall, the results accuracy was acceptable and showed that the method was feasible for tree crown measurement. Thus, as an alternative way of detecting the potential of heritage tree by indirect measures of tree characteristics.

4 CONCLUSIONS

During the past two decades, research has developed around the world on the importance, use, and value of heritage trees to support their protection and maintenance. This study offers better method of potential heritage tree detection which the basis for protection, care, and management of heritage tree for the future. Conventional heritage tree identification is typically costly and time-consuming. By using Unmanned Aerial Vehicle (UAV), this paper introduces the alternative tool and simple method with reduction of costs that are generally applicable to detect potential heritage trees by assessing the tree characteristic - the crown spread.

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ANALYZING THE HERITAGE TREE SURFACE TEMPERATURE FOR UHI MITIGATION USING REMOTE SENSING AND GIS APPLICATION

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Abstract – Urban Trees are important in reducing the heat by providing the shade and cooling effect to the urban environment. Every tree species provides different cooling effect depending on their tree characteristics. Evergreen species such as heritage tree are significant in reducing the surface temperature. In particular, heritage trees do have environmental implications which provide lots of benefits for the environment and human health. The aim of this paper is to analyse the heritage trees surface temperature in mitigating urban heat island (UHI) at Taiping Old Town. The research has conducted utilizing Landsat 8 OLI data and on-site data collection. This research integrated Geographic Information System (GIS) and remote sensing in data processing and SPSS for analysis. The result shows the low significant relationship of tree characteristics and Land Surface Temperature (LST) with (R²=0.17) indicates that external factors can reduce the cooling effect from heritage trees in reducing the surface temperature in the urban area. Moreover, there is also analysis on the LST of land cover features together with the frequency of heritage trees. The findings revealed that the higher frequency of heritage trees planted at the hard surface; the higher ability to reduce the LST (about 6°C) in urban areas.

Keywords - Heritage Trees, Urban Heat Island (UHI), Land Surface Temperature (LST), Remote Sensing, Geographic Information System (GIS).

1 INTRODUCTION

The rapid urbanisation has place substantially more pressure on natural resources, changed the urban climate, challenged the city skyline, build the concrete jungle and transformed the river into glasses (Ahmad et.al, 2010; Shaharuddin, Noorazuan & Yaakob, 2011). As the results, the heat has reflected on the urban surfaces and raises the temperature compared to the surrounding area. The direct effect on the local climate has changed the urban spaces indirectly and causes the air and surface temperature becomes warmer than those in the rural area. This effect called the ‘Urban Heat Island’ or UHI that can be observed in every town and cities (Wong & Yu, 2005). Moreover, removal and replacement of vegetation cover by various built-up structures influence the impacts to the environment which cause environmental pollution, climate changes and breakdown of ecological cycles. The impact of the climate change had been investigated by many researchers and they found that the impact such as heat stress, air pollution, and the transmission of infectious disease (Salleh, Abd.Latif, Wan Mohd, & Chan, 2013).

Therefore, strategies in mitigation UHI have become an important issue in term of energy saving and thermal comfort (Akbari, Pomerantz, & Taha, 2001; Kong et al., 2016). One of the adaptive strategies that had been addressed by many researchers is to increase the amount of vegetation cover in the urban area (Dewan & Yamaguchi, 2009; Shahidan, 2011; Kong et al., 2016). For example, the strategies of urban greening design could give the effect on providing the shade and cool to outdoor environment (Tan & Ng, 2014; Abreu-harbich, Chebel, & Matzarakis, 2015; Lin, & Tsai, 2017 ). Previous research revealed that there is a higher effect of larger temperatures in an urbanised area as compared to surrounding areas that relatively have a larger amount of vegetation (Hashim, Ahmad, & Abdullah, 2007). Thus, the
contribution of vegetation cover is important in reducing the heat in the city.

A mitigation measurement through sustainable development has to control to adverse the effect of UHIs on the environment. The planning of widespread trees and vegetation such as heritage trees for urban landscape is one of the effective methods to reduce the effects of formations of UHI (Jim, 2004; Senanayake et al., 2013; Jim & Zhang, 2013). Establishment of the urban forests for the strategic planting of trees around buildings is an excellent sustainable solutions for reducing and mitigation of UHI. Furthermore, the vegetation itself are able to enhance the air quality to the occupant (Akbari et al., 2001). Among the numerous types of vegetation cover, heritage tree has significant environmental implication which giving lots of benefits for the environment and human health (Sreetheran, Adnan, & Azuar, 2011).

Urban Heritage trees were considered at the canopy layer of vegetation which are the tree features of heritage tree are old trees (near and over 100 years), big in size (height, crowd spread and diameter breast height (DBH)), high density coverage and evergreen (Jim, 2005). The heritage trees are significant because only a few trees can excel under urban stress (Jim, 2004). Some of the matured heritage trees have the big scale of the size which contributes to a wide range of shading that gives the effect on the cooling to the outdoor environment. The finding by Abreu-harbich et al., (2015) revealed the conceptual evidence of the vegetation parameters on their thermal control strategies, the tree species which are dominant on the plagiotropic trunk and branching structure, tall, has large coverage and small leaves that are a bipinnate type and linear shape contribute to cooling effects. However, the empirical evidence of how Heritage trees mitigate UHI in urban areas are still inexplicit.

Therefore, this study intent to analyse the empirical evidence using remote sensing and Geographic Information System (GIS) method at Taiping old town. This study aims to measure the vegetation thermal comfort parameter based on tree characteristics to determine the internal and external factors of heritage trees toward mitigating UHI. The primary data were collected in May and September 2017 while the secondary data used for LST generation were obtained from Landsat 8 OLI.

2 STUDY AREA

Area of interest in this research is within the city Taiping, Perak (lat. 4°51’07”; long.100°44’29”), located about 70 km North of Ipoh and 90 km south of Penang (Yahaya, 2010). The climate in Taiping town can be categorized tropical rainforest climate in hot-humid climate (Wan Ali, Hassan, & Hassan, 2016).

Figure 1 Malaysia map (top left) and Taiping district (bottom left) with the site area for measurement heritage tree characteristics at Taiping, Perak.

As compared to the average annual rainfall between Peninsulas’s and Taiping town, the average rainfall in Taiping is about 3000mm while 2000 mm-2500 mm for Peninsula’s average. The range of temperature at Taiping is 24°C -34°C and the warmest months at Taiping in March until October with the average temperature are 31°C (Climatedata.org). The study area were divided into three zones; A, B, and C (see Figure 1) where was selected based on the temperature variation of LST distribution map which was generated from Landsat 8 OLI image. The study area also selected based on the location of heritage trees which mostly covered the streets in Taiping old town.
3 DATA COLLECTION

3.1 Satellite Images
The data used for LST generation were obtained from Landsat 8 OLI (30/3/2016) which was downloaded from USGS website. The Landsat image was chosen based on limited cloud cover and during summer in order to generate stronger warming effect of UHI (Rogan et al., 2013). The thermal band in Landsat 8 OLI at band 10 (10.60 μm - 11.19 μm) and band 11 (11.50 μm - 12.51 μm) with the spatial resolution 30m (Department of Interior U.S. Geological Survey (USGS), 2016).

3.2 In Situ Data Collection
The data were collected in May 2017 (18 May 2017-22 May 2017) and September 2017 (22 September 2017- 25 September 2017) because of the range of the warmest months in Taiping. There are three (3) species of heritage trees which are *Samanea Saman*, *Pterocarpus Indicus* and *Swietenia Macropylla* where were covered in the study area. The tree characteristics, such as crown diameter (m), tree height (m), diameter breast height (m), tree species, and coordinates of the trees were measured. The tree heights were measured using clinometer which measured the vertical angle and horizontal distance (see Figure 2a).

The crown diameter measured using tape from the north-south axis and east-west axis and calculated using arithmetical mean (Lin & Tsai, 2017) (see Figure 2b). The vertical angle measured from the base of the tree until the tip of the tree and diameter of breast height (DBH) were taken using tape from 1.4 meters from the ground (Ali et al., 2016) (see Figure 3). The coordinates of each heritage tree are also taken using GPS Garmin. All the spatial and attribute data of heritage trees characteristics were analysed in Geographic Information System (GIS) using ArcGIS software.

3.3 Land Cover Data
The land cover of the Taiping was extracted from Google Earth imagery (Rogan, Ziemer, & Ratick, 2015). The land cover features such as buildings, main road, street roads, and lake were digitized into
vector data which are in polygon for building and lake features and line for the main road and streets features. All the digitized features in WGS (World Geodetics System 84) Coordinate system were exported into shape file (.shp) data for further processed in ArcGIS software. Land cover data were used in the research to determine the external factors of LST distribution at Taiping.

4 METHOD

4.1 LST Distribution Generation

The thermal band of Landsat OLI 8 used in LST estimation were corrected for radiometric correction to reduce any atmospheric effects in images which will influence the analysis results of the research (Vlassova et al., 2014). The LST was generated by ERDAS Imaging software using the formula. The information of Landsat 8 OLI was downloaded together with the images in metadata (.txt) file. The thermal band were first converted, then calibrated the digital number to Top of Atmosphere (TOA) spectral radiance (Vlassova et al., 2014) using the radiance rescaling factors provided in the metadata file. The formula in Equation (1) (Department of Interior U.S. Geological Survey (USGS), 2016) used in converting the digital number to radiance.

\[ L_\lambda = M_1 Q_{cal} + A_1 \]  

Where: \( L_\lambda \) = TOA spectral radiance; \( M_1 \) = Radiance MULT Band; \( Q_{cal} \) = Quantized and calibrated standard product pixel values (DN); \( A_1 \) = Radiance ADD Band

Then, the spectral radiance converted into planetary reflectance using reflectance rescaling coefficients provided in the product metadata file to transform brightness temperature in Kelvin (K) that was used in generating the distribution of LST. The Equation (2) (Department of Interior U.S. Geological Survey (USGS), 2016) used to convert a digital number of imagery into TOA reflectance.

\[ p_\lambda = M_p Q_{cal} + A_p \]  

Where: \( p_\lambda \) = TOA planetary reflectance, without correction of solar angle; \( M_p \) = Reflectance MULT Band; \( Q_{cal} \) = Quantized and calibrated standard product pixel values (DN); \( A_p \) = Reflectance ADD Band

Equation (3) (Department of Interior U.S. Geological Survey (USGS), 2016) shows the formula of LST to generate the LST distribution from spectral radiance to top of atmosphere brightness temperature using the thermal constants provided in the metadata file from Landsat 8 OLI. The temperature unit also converted from degree kelvin into degree Celsius.

\[ T_s = \frac{K_2}{ln(\frac{K_2}{L_\lambda} + 1)} \]  

Where: \( T_s \) = The brightness temperature in kelvin (k); \( L_\lambda \) = TOA spectral radiance; \( K_1 \) = Constant thermal band; \( K_2 \) = Constant thermal band.

4.2 Heritage Tree Inventory

The heritage tree inventory were then been layered with the data collected from heritage tree characteristics and land cover features that were inserted into ArcGIS software. By using coordinate of heritage trees collected from in situ data collection were inserted in GIS database in point vector data. Each point of heritage tree included the attribute data showing the characteristics of the heritage tree such as crown diameter, tree height, DBH, coordinate and the ground temperature which was generated from Landsat OLI 8. The heritage tree inventory map was produced.

5 RESULTS AND FINDINGS

The result of the research in the map form showing the overlaying the LST distribution map and heritage trees inventory map as shown in Figure 4. The result included the LST distribution, heritage trees
and land cover of study areas. From the result below, the average of temperature at Taiping old town was 29°C. The map also included the heritage trees spatial data altogether with the features of building, road and water bodies. The temperature variation shows the high temperatures at the hard surface where the surface was covered with the concrete buildings. The temperature at the Lake Garden Park is cooler than around the building with the temperature around 25°C -27°C compared the heritage trees planted around the building with the temperature around 31°C-34°C.

![Urban Heat Island Map of Taiping](image)

The interpretation from the map in figure 4 shows that the species of *Samanea Saman* were planted along the streets at Lake Garden and few of them at compact building (bottom of the map). Majority of the heritage tree species at Taiping such as *Pterocarpus Indicus* which was planted along the streets near to the compact buildings altogether with the tree species *Swietenia Macropylla*.

### 5.1 Relationship between Crown Spread, Tree Height and DBH

The database of heritage trees consist of 206 trees were surveyed in the study area. According to the database, the average of crown diameter is 21.19m. Meanwhile, the average of tree height is 19.36m and the average of DBH is 1.21 m.

Figure 5 shows the relationship between crown diameters, DBH and tree height of heritage trees in the study area. From the result shows in Figure 5(a); the given the regression coefficient ($R^2=0.62$) which demonstrated a high correlation between crown diameter and DBH of heritage trees in the study area. Figure 5(b) shows the relationship between crown diameter and tree height which the regression coefficient is ($R^2=0.44$) indicated the medium relationship between crown diameter and tree height. The conclusions from the result of Figure 5 shows the positive linear relationship for both DBH and tree height with crown diameter.
5.2 Relationship between Crown Spread and LST

Figure 6 shows the relationship between crown diameter and LST in the study area. The regression coefficient ($R^2=0.17$) shows the small relationship between the crown diameter of heritage trees and LST in the study area. This result indicates the heritage trees which dominant in the vegetation parameter for thermal comfort to the environment able to slightly contribute to the reduction of temperature. This is because the modification and ground surface give the high significant in influence the temperature variation (Shahidan, 2011). Furthermore, in order to improve cooler temperature to meet the thermal comfort is not easy to control by tree characteristics (Lin & Tsai, 2017). They were influenced by various external factors in changes of temperature around the heritage trees which make it difficult in giving a cooling effect to the environment.

5.3 Relationship between land cover features and LST

Based on the result from internal factors of heritage trees in Figure 6 shows the changes of LST distribution around heritage trees were influenced by external factors. The Figure 7 below shows the land surface temperature versus the frequency of heritage trees around the land cover features (Leuzinger, Vogt, & Ko, 2010). The histogram shows the most heritage trees were planted at the main road of Taiping showing the surface temperature around 28°C-29°C. The lower temperature spectrum marks at Lake Garden of Taiping with the surface temperature around 26°C-27°C. The small frequency of heritage tree planted at compact buildings showing the highest surface temperature up to 32°C-34°C. A non-shaded surface like grass area and the bare surface has resulted in the surface temperature around 30°C-31°C at
Taiping. The result showing the loss of vegetation cover could increase the surface temperature at the city. The shaded of the mature tree like heritage tree at the hard surface can reduce the LST by 6°C by comparing the frequency of heritage trees at the main road and compact building. Thus, the loss of mature tree canopy cover over the impervious hard surface leads to increasing the surface temperature and remove the cooling effects of vegetation (Rogan et al., 2015).

Figure 7 The frequency of heritage trees at land cover surface at Taiping versus LST distribution.

6 CONCLUSION

The conclusion of the research shows the urban heritage tree temperature depends on the tree characteristics, the group number of the trees and other trails of external factors such as canopy architecture around heritage trees. Based on research finding discovered the higher group of heritage trees contribute higher reduction of LST. The result discovered the reduction of LST by 6°C at the main road were represent higher group number of heritage trees compared individual heritage trees planted at compact building. Thus, the group number heritage trees able to give the cooling effect to the environment however the external factors can contribute to the raising of temperature and remove the cooling effect at urban area.

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SAFE PLACE BY DESIGN: THE IMPACT OF THE PHYSICAL ENVIRONMENT ON HEALTH

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Abstract - Recent research examining the effect of neighbourhoods on health and well-being has often focused on neighbourhood physical environment. Good living environment is thought to improve health and fear of crime is recognised to be a mediator of the relationship between physical environment and health. Because few studies have investigated this relationship, this study aims to examine the impact of the house quality on fear of crime and health. A total of 230 households from a residential neighbourhood in Malaysia participated in the study. Using structural equation modelling, the findings indicate that housing quality and fear of crime can account for a proportion of the variance in residents’ self-rated health. However, there is no significant relationship between housing quality and fear of crime. Results also show that fear of crime does not mediate the relationship between housing quality and health in the study area. This study suggests that the environment-fear relationship should be re-examined theoretically.

Keywords - house quality, fear of crime, health, Malaysia, SEM.

1 INTRODUCTION

During the last decade, there has been an increasing interest in the impact of neighbourhood attributes on health. The World Health Organisation (WHO, 1948, p.100) defined human health as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity”. Based on this definition, health has three interrelated dimensions including physical, mental and social. Although these three dimensions are interrelated and influence each other greatly, however, one can examine the impact of other variables on each dimension, separately. Although physical health is important, mental health is one of the key dimensions of health that forms personal and social relationships.

Neighbourhood social and physical conditions have long been believed to have a direct influence on personal health (Garner & Raudenbush, 1991). Evidence suggests that living in disadvantaged neighbourhoods has negative impacts on mental and physical health (Bissonnette et al., 2012; Park et al., 2015; Wallace, 2012). Stemming largely from the previous work on fear of crime and urban environment, it is clear that the physical characteristics of the living environment could be related to perceive safety and security among residents (Armitage et al., 2011; Greenberg et al., 1982; Hedayati-Marzabi et al., 2012). The neighbourhood is one of several spaces that provide social and physical space for interactions between residents, which leads to greater sense of community. Studies using large samples have generally concluded that the built environment does affect health over and above the impact of the area composition (Kawachi et al., 1997).

The recent increase in research on the effect of neighbourhood conditions on health indicates a rediscovery of the indirect manners in which neighbourhoods may have affected an individual’s health. Moreover, certain characteristics of residents and the physical characteristics of an environment can affect neighbourhood problems, which suggest that both the social and physical conditions of the neighbourhood may affect the residents’ perceptions and attitudes (Austin et al., 2002). It is proposed that
a person’s health is influenced by a number of factors including the built environment and perceived neighbourhood safety (Lorenc et al., 2012). Dirt, decay and graffiti are signs of neglect of the environment that are seen as drivers of fear (Cozens et al., 2003; Waters et al., 2007). While neighbourhoods are regarded by policy makers as important social determinants of health (Browne-Yung et al., 2016), the mechanisms linking neighbourhoods to health outcomes remain unclear. Despite the growth in neighbourhood-health studies, the impact of neighbourhood environmental quality on health related factors has received relatively little empirical research, especially in developing countries like Malaysia. While there are many factors that can influence personal health, this study focussed on the effects associated with visual signs in the neighbourhood environment.

It is obvious that the influential factors on personal health, as a human phenomenon, can be referred not only in various economic, social, cultural and environmental factors, but also at different levels such as individual, household and community levels. The current study examines the effective factors on personal health at the household level. The relationship between the characteristics of neighbourhood environment and individual well-being has long been recognised in Western literature (Shaw & McKay, 1969). In recent years we have witnessed an increasing interest in examining the contextual impact of neighbourhood environment on individual health outcomes using sophisticated multilevel statistical methods (Maass et al., 2016). However, studies of neighbourhood effects on health outcomes are predominantly Western settings, and are rarely done in developing countries (Hedayati-Marzbali et al., 2016a).

The purpose of this study was to examine the impact of house quality, as a neighbourhood environmental attribute, on neighbourhood health. Furthermore, the current study sought to determine the mediating effect of fear of crime on the relationship between house quality and self-rated health. The study addressed the extent in which the relationship between house quality and self-rated health varies based on perceived fear of crime. It emphasises on how residents perceive neighbourhood visual quality and consequently, the positive impacts of high quality on residents’ health and well-being are triggered.

2 LITERATURE REVIEW

The modern era of environmental health was first articulated by Rachel Carson in 1962. In her classic work, she warned of human health effects (Carson, 1962). Since then, at least two paradigm shifts have revolutionised the field: first shift referred to civil rights, forming the environmental justice movement, and second, which occurred in recent years, referred to a broad range from chemical environment to the built environment (Frumkin, 2005). Architectural changes following the oil shocks of the 1970s were the most important reason to this shift. The term built environment refers to images of places including buildings, neighbourhoods and parks (Frumkin, 2005). Afterwards, there is an increasing recognition that the built environment may affect individual’s health and well-being.

There is increasing recognition that the built environment may affect individual’s health. The broken windows theory as originated by Wilson and Kelling in 1982, offers insight to public health (Frumkin, 2005). Wilson and Kelling (1982) pointed out the possibility of a specific neighbourhood having more unpleasant appearances created by signs of incivilities compared with other neighbourhoods. They suggested that the environment sends direct messages to its users that regulate individual behaviour. They further proposed that healthy places need to be well-designed, well-built and functional. Broken windows are a signal that no one cares (Wilson & Kelling, 1982). The relationships between the study variables are explained in the following subsections.

2.1 House Quality and Health

The quality of the home environment has a pervasive effect on the individual’s quality of life (Garcia, 2000). The surrounding environment of the home is also a vital indicator for people’s health and their meaningful interaction within the environment. Austin et al. (2002) found that housing quality has
positive and significant relationship with resident’s perception of safety, while there is a negative relationship between victimisation and housing quality. The underlying assumption is the existence of positive impact of housing quality on residents’ perception of safety. Research further indicated that neighbourhood disorder is negatively associated with negative health outcomes (Hill et al., 2005). Even though Hill et al. (2005) examined the effect of disorder on health, the operationalisation of disorder scale is exclusively derived from items that reference social disorder and could do a better job of indicating physical disorder. Therefore, these approaches may not always be appropriate in explaining health and well-being.

Yet despite the continued academic interest of the broken windows thesis, this theory itself has received relatively little empirical research (Abdullah et al., 2015). The results of a study in the UK context contradict the broken windows thesis, indicating that Wilson and Kelling’s hypothesis does not fully applied in the UK context (Stafford et al., 2005). Their findings highlight the influence of the residential environment on women’s health (Stafford et al., 2005).

2.2 The Built Environment, Fear of Crime and Health

Fear of crime is a significant urban stressor that has harmful psychological effects on individuals. The effects of the built environment on individual’s fear of crime is not new. Shaw and McKay (1942) were among the first to point out the deleterious effects on individuals caused by signs of disorder. Wilson (1975) proposed that people were not troubled by crime only, but they can be affected by deteriorated conditions surrounding them. Studies also suggested that there is a link between physical design features and fear of crime (Hunter, 1987; Newman, 1972).

Fear of crime is an important issue not only for individuals but also for neighbourhoods and wider societies because it affects community health (Abdullah et al., 2015). It restricts personal activities in the neighbourhood, increases dissatisfaction with the neighbourhood and reduces the overall quality of life (McCrea et al., 2005). The proponents of crime prevention by design strategies believe that physical factors diminish residents’ fear of crime. This strategy shows the impact of neighbourhood factors on individuals' behaviour in protecting their households. Likewise, theories of the determinants of mental health have focused on crime and fear as major explanatory factors (Lorenc et al., 2012; Stafford et al., 2007).

Evidence suggests the negative consequences of fear of crime to local community such as impaired health and well-being which largely explained by low levels of outdoor physical activity and high levels of psychological distress (Ross, 1993). In the UK context, Chandola (2001) also found a negative association between fear of crime and self-rated health. Although this relationship is a growing area of research, there are still many areas left unexamined. Recent studies have been inconsistent in establishing a casual pathway between fear of crime and health outcomes. For instance, Johnson et al. (2009) found no significant association between these two variables.

2.3 Research Hypotheses

The above discussions suggest that fear of crime is an important predictor of an individual’s health. The fear of crime may cause mental and physical health problems (Lorenc et al., 2012). Conversely, mental health problems may increase fear of crime (Jackson & Stafford, 2009). Meanwhile, the fear of crime may be influenced by factors in the built environment. The impact of built environment on crime and fear have been a focus of Crime Prevention Through Environmental Design (CPTED) (Abdullah et al., 2013; Lorenc et al., 2013), which emphasises natural surveillance, access control and maintenance as environmental attributes. Combining these pathways, it seems that the fear may mediate the effects of environment on individual’s health (Lorenc et al., 2013). These discussions lead to the following research hypotheses, as shown in Figure 1.

H1. There is a significant relationship between house quality and fear of crime.
H2. There is a significant relationship between house quality and health.
H3. There is a significant relationship between fear of crime and health.
H4. Fear of crime mediates the relationship between house quality and health.

Figure 1 The conceptual pathway between the study variables

3 METHODS

3.1 Study Context

This article constitutes a portion of a larger study, which examined the physical characteristics of neighbourhoods and wellbeing of residents. This study was conducted in Penang, Malaysia, specifically in the southern region of Penang which has the highest level of residential burglary compared to other areas in the island (Hedayati-Marzbali et al., 2011). As Malaysia was previously a part of the British Empire, the modern town planning system is highly influenced by the British civil administration system and originated from the UK, but it has been localised throughout decades (Siew, 2007). Penang city structure is also based on land use zoning approach as similar as the British style of zoning. Penang is now the second largest city in the country and has the second highest density of inhabitants per square kilometer.

According to the Overseas Security Advisory Council (OSAC, 2016), the overall crime rate in Malaysia is designated as ‘medium’ in 2014 to ‘high’ in 2016 as compared to the U.S. national average. Based on OSAC (2016), there continued to be a noticeable increase in crime, including reported assaults and robberies, sometimes involving weapons, in Kuala Lumpur in 2015. Although violent crime against expatriates is relatively uncommon, petty crime is fairly common and residential break-ins do occur and are becoming more frequent in landed houses (OSAC, 2016). A similar index from Numbeo, the online data collection site, ranked Malaysia fifteenth out of 118 countries for crime index (Numbeo, 2016).

This study utilises probability sampling based on a systematic sampling with random start method to select samples from the population. A team of interview staff was selected and trained to administer the field survey and walked between houses and conducted face-to-face interviews. Eligibility criteria for the study survey included: (1) residence in terraced houses, (2) length of residence at least one year, and (3) age of at least 18 years. The survey was conducted in 2014 with a response rate of 65%. The sample size for this study was 230 samples. Table 1 shows the demographic characteristics of the respondents. The survey illustrated that 45.2% of the respondents were Malay, 43.5% Chinese, 10.4% Indian and almost 1% was other races. Penang Statistics (2014) reported that the majority of Penang population are 44.7% were Malay, followed by Chinese and Indian. The proportions of all ethnic groups were highly comparable with the Penang population.

Table 1 Demographic characteristics of respondents (n = 230)

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</table>
3.2 Design and Data Collection

The data for this study were collected through a cross-sectional survey conducted in 2014. A questionnaire was distributed by a team of interview staff who were trained to administer the field survey and walked between houses and conducted face-to-face interviews. A sampling framework was developed from the list of all of the properties in the study area through on-site observation. In addition to providing details about themselves, respondents were required to indicate their level of agreement with the statements, on a 5-point and 7-point scales, for the questions that measured the key constructs.

Fear of crime is the central concept for examining neighbourhood dynamics (Hedayati-Marzbali et al., 2016b) and there is a complex relationship between neighbourhood physical conditions and perceived fear of crime. In this study, we measured fear of crime to examine its mediation role on the relationship between housing quality and health. This variable was derived from the question: in your everyday life, how worried are you about the following situations? The items were: (1) getting burglarised; (2) yourself or someone in your family getting assaulted; (3) having your car stolen; (4) having things stolen from your car in this neighbourhood; (5) being robbed or mugged on the street; and (6) having your property damaged by vandals (Foster et al., 2010; Hedayati-Marzbali et al., 2016a). The response categories ranged from 1, ‘extremely not worried’, to 7, ‘extremely worried’. A higher score indicated more fear of crime. The Cronbach’s alpha of the six items was 0.954, indicating good reliability.

In operationalising the built environment in residential areas, studies have considered house quality as one of the main dimensions, also known as image and maintenance. The items employed in the study to measure house quality were adapted and modified based on Wilson and Kelling’s (1989) Broken Windows Theory, Hedayati-Marzbali et al. (2016b), Austin et al. (2002) and the study of Cozens et al. (2005). There are six items measuring house quality based on a five-point Likert scale ranging from 1 (low quality) to 5 (high quality). The Cronbach’s alpha of the seven items was 0.897, indicating good reliability.

Health was assessed using three general health questions. Three questions based on the work of Baum et al. (2009), Hedayati-Marzbali et al. (2016a), and Wallace (2012), were used to measure the self-rated health variable. The scale was constructed based on a 5-point Likert scale (1=very poor; 5=excellent). Self-rated health was measured by asking the respondents three following questions: (1) ‘Would you say that your mental health is poor, fair, good, very good or excellent?’; (1) ‘Would you say that your physical health is poor, fair, good, very good or excellent?’; and (3) ‘How would you describe your overall quality of life?’. The Cronbach’s alpha of the three items was 0.608, indicating acceptable reliability (Nunnally & Bernstein, 1994).

3.3 Statistical Analyses

Exploratory Factor Analysis (EFA) and reliability tests were used to assess the dimensionality and internal consistency for each of the first-order reflective constructs (Hurley et al., 1997; Nunnally, 1978). The proposed model and hypothesis testing were conducted using Partial Least Squares (PLS) analysis with the Smart PLS M2 software (Ringle et al., 2005). PLS allows specifying both validating the
outer model and fitting the inner model (Diamantopoulos & Winklhofer, 2001). Nonparametric bootstrapping (Wetzels et al., 2009) with 1,000 replications was applied to test the significance of the path coefficient between latent variables as well as between the latent variables and respective manifest variables.

The result is presented in two steps: validating the measurement model and examining the structural model. The former comprises the relationships between the indicators and their respective constructs (the outer model), whereas the latter consists of the relationships between the latent constructs (the inner model). Validating the outer model was accomplished by determining the convergent and discriminant validity and reliability for the reflective constructs (Wetzels et al., 2009). Fitting the inner model was accomplished primarily through path analysis with latent variables. The structural model is assessed to test the hypotheses advanced in this study by examining path coefficients ($\beta$) and their significance levels using PLS path modelling with a non-parametric bootstrapping procedure (Chin, 1998; Henseler et al., 2009).

## 4 RESULTS AND FINDINGS

### 4.1 Outer Model Analysis

PLS makes no distributional assumptions. Thus, only non-parametric tests can be used to examine the explanatory power of the model (Chin, 1998). Construct validity consists of convergent and discriminant validity. The quality of the outer models was assessed using construct validity as well as the reliability of the latent variables. As shown in Table 2, the convergent validity of the constructs was supported because factor loadings were above the 0.7 threshold (Hair et al., 1998). As such, more than 50% of the variance in the observed variable could be explained by the underlying construct (Hulland, 1999). As shown in Table 2, the bootstrap test indicated that all loadings were significant at the bootstrap-based empirical 95% confidence interval suggesting that all indicators significantly reflect their underlying constructs.

The average variance extracted (AVE) is suggested to have a value of 0.5 and above, which indicates adequate convergence (Bagozzi & Yi, 1988). Because AVE exceeded the required 0.5 threshold, the constructs captured more than 50% of the indicators' variance. CR estimates the degree to which the respective indicators reflect the latent construct. A value of 0.7 and above is suggested for composite reliability and represents good reliability (Hair et al., 2010; Kline, 2010). With respect to discriminant validity, the root of AVE should surpass the correlation coefficient of the construct with every other construct in the model (Fornell & Larcker, 1981) and this was the case in our model (Table 3). The results further show that none of the items has multiple cross-loadings, which suggest preliminary discriminant validity. Table 3 shows that the values were above the recommended value points, thus ensuring achievement of construct validity. Therefore, each construct shares more variance with its own block of indicators than with another latent variable representing a different block of indicators (Henseler et al., 2009). In sum, these results provide support for the overall quality of the reflective constructs’ measures.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>Loadings</th>
<th>Composite reliability (CR)</th>
<th>$t$ value</th>
<th>Average variance extracted (AVE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>House Quality</td>
<td>HQ1</td>
<td>0.809</td>
<td>0.925</td>
<td>8.849***</td>
<td>0.672</td>
</tr>
<tr>
<td></td>
<td>HQ2</td>
<td>0.826</td>
<td></td>
<td>10.654***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HQ3</td>
<td>0.805</td>
<td></td>
<td>7.764***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HQ4</td>
<td>0.818</td>
<td></td>
<td>7.203***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HQ5</td>
<td>0.805</td>
<td></td>
<td>10.195***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HQ6</td>
<td>0.855</td>
<td></td>
<td>8.048***</td>
<td></td>
</tr>
</tbody>
</table>
The discriminant validity was examined using the criterion suggested by Fornell and Larcker (1981). Table 4 shows that the square root of the AVE exceeded the inter-correlations of the constructs in the model. This result suggests that the measure had adequate discriminant validity (Chin, 2010).

4.2 Path Estimates and Hypotheses Testing

In the next stage, path analysis was performed to test the four hypotheses generated for this study. Since the outer model evaluation provided evidence of reliability and validity, the inner model estimates were examined to assess the hypothesised relationships among the constructs in the conceptual model. The standardised path coefficients and significance levels provide evidence of the inner model’s quality (Hair et al., 2012) and allow researchers to test their proposed model. Table 5 presents the results of the structural model. House quality was positively related to health ($\beta = 0.232, p < 0.01$). Consistent with other studies conducted on the relationship between neighbourhood environmental conditions and health, the findings of the current study support the notion that enhancing exterior house maintenance and quality of the surrounding environment in residential areas would increase residents’ self-rated health (e.g. Jackson & Stafford, 2009; Ross et al., 2000; Wallace et al., 2012). The notion is that the individuals who perceive their physical environment in positive terms will report high self-rated health.

As shown in Figure 2, a negative relationship was found between fear of crime and self-rated health ($\beta = -0.340, p < 0.01$). However, the relationship between house quality and fear of crime ($\beta = -0.029, p > 0.05$) was insignificant in this study. The results indicate support for H2 and H3 but not for H1, as shown in Figure 3. The results also reveal that approximately 17% of the variance in health is explained by house quality and fear of crime ($R^2 = 0.174$). According to Chin (1998), based on the $R^2$ index, the explanatory power is weak.

The results further indicate that individuals who perceived high fear of crime in the residential environment, reported their personal health lower than those reported low fear of crime, consistent with the findings of other studies (Chandola, 2001; Hedayati-Marzabi et al., 2016a; Stafford et al., 2007). It was also hypothesised that when residents perceive themselves in an untended area, local control fails and fear of crime increases. However, contrary to what was expected, first hypothesis, that a negative
The relationship between house quality and fear of crime was not supported. This suggests that the relationship between house quality and fear of crime in the study area remains unclear.

In addition to direct relationships, this paper estimates the indirect relationship between house quality and self-rated health as shown in Figure 2. Although Baron and Kenny (1986) suggested the necessity of a significant direct effect of a predictor on a criterion for mediation to occur, some authors have argued that this is not necessary (Preacher & Hayes, 2008). To estimate the significance of the indirect effect, many researchers employed the Sobel test (Sobel, 1982). One limitation of the Sobel test is that it requires a normal sampling distribution of the indirect effect (Hayes, 2009), whereas the indirect effect \((ab)\) sampling distribution tends to be asymmetric with non-zero values for skewness and kurtosis (Stone & Sobel, 1990).

According to Hayes (2009), tests that assume normality of the sampling distribution should not be used to assess indirect effects and suggests the use of bootstrapping procedure as an alternative approach to test the indirect effects. The \(t\) values for both direct and indirect effects were computed through a bootstrapping procedure with 230 cases and 1000 samples. It should be noted that the \(t\) values for indirect effects are obtained by dividing the \(ab\) by the standard error (SE) of the indirect effect. The SE is the standard deviation of the repeated bootstrap estimates of the indirect effect. The result showed that the \(t\) value of indirect effect \((t=0.248)\) is less than 1.960 and insignificant at the 0.05 level. Therefore, the result does not support H4.

![Figure 2 The parameter estimates of the PLS analysis (\(\beta\) value)](image)

![Figure 3 The parameter estimates of the PLS analysis (\(t\) value)](image)
5 CONCLUSIONS

Historically, health-related concern was one of the major planning initiatives all over the world. Despite the continued interest and the influence of neighbourhood social and physical conditions on criminological literature, the indirect pathway between the neighbourhood conditions and health through fear of crime has not received empirical support, and most existing studies have been criticised for their methodological shortcomings. Until recently, this area of research was an understudied area in criminological literature. In 2001, Chandola attempted to uncover the impact of area differences in health outcomes across the UK and found the significant role of fear in health outcomes. To fill this gap, the current study examined the mediation effect of fear of crime on the relationship between house quality and self-rated health.

This empirical paper examined the relationships between house quality, fear of crime and health in a Malaysian city (that is an important strength of the study, given the predominance of the U.S. and some European contexts, but little research on the topic in the rest of the World), using SEM to test a mediation model. A field survey of a systematic random sample of Penang residents in a residential neighbourhood was used to examine the indirect relationship between house quality and health. It is obvious that interventions involving changes to the neighbourhood physical environment may be a promising way to address fear of crime in residential settings, and the broader health and well-being outcomes. The notion is that environmental changes can contribute in addressing the macro-level determinants of health behaviours, not only in deleterious areas, but also across all settings (Lorenc et al., 2013). However, this area of research has received less attention in the field of place-based crime prevention.

The current work provides a richer and more profound insight into health and well-being in residential setting. It suggests that tangible benefits to residents in the form of improved environmental conditions are possible which may lead to create safer communities and improved health and well-being. Without denying the importance of physical health, positive mental health is increasingly recognised as an important aspect of public health and may be affected by good living environment. While some researchers examine how either physical or mental health are independently related to fear of crime, most studies focus on both categories. The current study measured both physical and mental health on the basis of self-rated health. However, contrary to the expectations, fear of crime does not mediate the relationship between environmental conditions and health outcomes (e.g. Chandola, 2001; Lorenc et al., 2013). The findings of this study contradict stereotypes presented in previous studies which may refer to mixed-racial composition of the study samples. This is in agreement with the social disorganisation theory, suggesting that neighbourhood structure and social processes have great impact on crime and fear, and consequently on health outcomes.

The results of the study influence community planning and design decision makers. Disorder signs send a message to residents that things are getting out of control. Therefore, the physical upkeep and maintenance of the individual private properties may enhance the potential for physical activities within an area, which help increase social contact. Certain environmental features may set the stage for neighbourhood social interactions, thus serving as a foundation for underlying health and well-being. Altering these environmental features may have greater than expected impact on individual’s health.

5.1 Limitations and Strengths

Although the present work extends prior neighbourhood-health studies, some important limitations are worth noting. Firstly, the study focuses on the relationship among house quality, fear of crime and health and does not address the effect of environmental conditions at the neighbourhood level. The study would be useful for future work that includes testing the mediating role of fear of crime at both household and neighbourhood levels.
Many factors, such as physical and social vulnerabilities, notably influence the perceived fear of crime, and consequently health outcomes. Failure to control age and gender as physical vulnerabilities is the second limitation of this study. On the one hand, a stream of research focusing on fear of crime seeks to indicate that women and the elderly are more physically vulnerable and more likely to report higher levels of fear of crime than their counterparts (Franklin et al., 2008). On the other hand, social vulnerabilities such as the poor, less-educated people and ethnic minorities may perceive higher levels of fear than other counterparts (Taylor & Hale, 1986). These factors are important because a previous study observed the influence of the residential environment on women’s health but not for men (Stafford et al., 2005).

Moreover, as shown in Figure 2, a significant amount of variance in health is left unexplained. Based on the $R^2$ index, as the explanatory power is weak, the study suggests that there should be other variables that might have great impact on residents’ health and well-being such as demographic characteristics, social cohesion, and social control within the neighbourhood environment. Therefore, future research should have a clearer focus particularly taking account of socio demographic, ethnicity (as the study area is a multi-ethnic country) as well as gender. To advance the understanding of the link between man-made environments and health outcomes, one should consider other mediators such as social cohesion, as there is no doubt that individual health and well-being cannot be seen in isolation.

The empirical illustration of the present study of the use of PLS path modelling constitutes only a single study with limited generalisability. Causal interpretations cannot be confirmed because this study is cross-sectional in a specific context (a developing country). Moreover, we described the correlations between the variables rather than causations, so future studies should assess these associations longitudinally. The results of the study are only generalisable to high-crime contexts such as residents living in multicultural neighbourhoods. However, our larger point is that enhancing health and well-being, as one urban policy of the day, could be possible by manipulating the physical environment. Meanwhile, fear of crime may be a barrier to improve individual's health in residential settings. Therefore, policy makers and practitioners should support fear-reduction initiatives through design manipulation.

6 ACKNOWLEDGEMENTS

The authors would like to thank Universiti Sains Malaysia for financially supporting this research under FRGS Research Grant Scheme (FRGS, NO. 203/PPBGN/6711517).

REFERENCES


Abstract - The purpose of this study is to use a scale model, which has long been popular in the expression of architecture, for the simple VR headset using the smartphone (S-VR) which is popular nowadays. While investigating spatial reproducibility of the simulation using S-VR, which is one of the important tasks of utilizing VR technology in architecture field, we clarified the characteristics of the spatial impression which is felt by the difference between the scale model (Mod) and CG expressing VR space. We considered not only the merit of those, but also the characteristics. First of all, we compared S-VR and Liquid Crystal Display (LCD). We conducted an experiment by the Semantic Differential scale method (SD method), and subjects evaluated seven levels by the 13 selected adjective-pairs. S-VR gained a higher evaluation on the spatial reproducibility than LCD. Therefore, we continued the investigation focusing on S-VR. Next, we compared the impression of the space due to the difference in expression medium used in S-VR, that is, CG and Mod, and clarify their characteristics using analysis of variance. Mod tends to be evaluated as "Open", "Like", "Friendly", while CG did as "Luxury" or "Oppressed". In CG, the difference in patterns of space gave different impressions. However, in Mod, it was less likely to influence the impression, that is, whichever pattern was similar impression. As a result, when comparing impressions by Mod, it is necessary to pay attention to those characteristics. In addition to characteristics clarified in this research, considering physical conditions and the time to create Mod, for simulation comparing multiple patterns, it is best to use CG as a space expression medium. While, for instance presentation, in the case of expecting to give a better impression to the space, it is effective to use Mod.

Keywords - VR, smartphone, scale model, SD method, spatial reproducibility

1 BACKGROUND AND PURPOSE

As a background social trend, there is development of VR technology. Inexpensive handy S-VR with smartphones can greatly contribute to the spread and penetration of VR technology into the world. However, it has been often discussed the characteristics and usefulness of each tool of VR, research on spatial reproducibility of S-VR with smartphones is still in the developing stage. The purpose of this study is to use a scale model, which has long been popular in the expression of architecture, for the S-VR which is popular nowadays.

Moreover, as a new problem of the VR technology in the architecture field, it is shown that their emotional factors may be different even though the experience equivalent to the real space can be experienced in the VR experience. In addition, from the viewpoint of emotional impression, considering the need to select various spatial representation methods depending on the purpose also when expressing the VR space, there is a possibility that it is necessary to verify using S-VR.

Based on these backgrounds, the objectives of this paper are the following two: To confirm the reproducibility of spatial simulation experiences using S-VR, and to clarify the characteristics of Mod and CG as a space expression method using S-VR.
2 LITERATURE REVIEW

2.1 VR Technology in the Architecture Field

VR technology is also used in the field of architecture. Originally we are using 3D CG technology to reproduce the space, so using the created data makes space simulation experience using VR technology relatively easy. One of the important tasks in VR technology in the architecture field is said to be spatial reproducibility [Tachi 2000]. Numerous attempts have been made to show to what extent the experience equivalent to real space is possible. Many studies were done to verify spatial reproducibility. Studies to examine features and usefulness based on differences in VR presentation devices [Ono 2004] and Reproduction of “brightness feeling” [Yoshizawa 2003] and others. However, the devices used for these are high-performance, high-performance and expensive in price. There are few verifications using devices that are inexpensive, such as VR technology using smartphones, and that are easy to operate without special knowledge. By verifying the spatial reproducibility with such a simple head mount display, there is a possibility that it will become a foothold for the spread of VR technology in the architecture field. However, it cannot be said that only the spatial reproducibility is a problem of the VR technology in the architecture field. It is suggested that even if experiences equivalent to real space are possible in spatial simulated experiences, the sensibility impression felt therefrom may be different. [Okura 2006], [Yokoi 2013] also studies psychological effects in the VR space.

2.2 Evaluation of spatial impression by difference in expression method

Various methods of expressing the space are also selected by improving the technology. It is said that it is better to use various methods according to purpose in order to express real space effectively, such as model, handwritten sketch, and CG parse [Oshida 2011]. However, it is common to use CG for representation of VR space. There is a method to shoot a model with 360 ° movie as another space representation method compatible with VR technology. However, as mentioned above, CG is often used in consideration of compatibility with VR technology, the time and labor required for manufacturing multiple patterns, and physical conditions such as the location of the production. The research of the above [Okura 2006], [Yokoi 2013] also uses CG only as an expression method. Nonetheless, in evaluating spatial impressions on the emotional side, even if VR technology is used, it will be necessary to grasp the characteristics of each CG and model and to select the spatial expression method according to purpose. However, in the case of using the VR technology, there are few studies that compare the spatial expression method from the emotional aspect and are studying the features and usefulness.

Today, when spatial simulation experiences with VR are used, it is common to use CG in view of physical conditions and convenience, but it cannot be said that it is necessarily valid. Therefore, in this research, we focused on the expression method of VR space in spatial simulation experience using S-VR.

"S-VR” in this research is regarded as a medium for making VR experiences with binocular lenses using stereoscopic viewing that can be easily used with smartphones. In addition, we compare the impression in the case of using the model for the VR spatial expression method and the case using the commonly used CG, not only the goodness but also the characteristics of both of them which is regarded as an expected index.

3 COMPARISON OF S-VR AND LCD – FIRST EXPERIMENT

3.1 Outline of First Experiment

In order to confirm the difference in spatial impression and reproducibility in S-VR and LCD, by the 60th anniversary of Kyoto Institute of Technology in Japan, we conducted experiments for 30 people in their twenties. An image of a 1/10 scale model taken with a 360 degrees camera and a CG,
a total of 4 types of samples were prepared. Evaluation items were 13 emotional adjective pairs (7 levels of -3 to 3 / SD method). The outline of this experiment is shown below (Table 1).

Three patterns were prepared randomly in consideration of order effect. We did not establish a clear time limit for evaluation, and evaluated at the pace of the subject that the subject answered and asked the next question. We finished the experiment in 10 - 15 minutes. Also, the subjects were instructed to evaluate the impression of the space. The impression of the space and the impression of the device / expression method cannot be separated and mutually interfere, and the difference between the device and the expression method was read from the difference in impression for the same space.

Table 1 Outline of First Experiment

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Confirm the difference in spatial impression and reproducibility in S-VR and LCD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objects</td>
<td>Mainly for students, in their twenties (30 valid responses)</td>
</tr>
<tr>
<td>Period</td>
<td>December 20, 2017 - December 30, 2017</td>
</tr>
<tr>
<td>Contents</td>
<td>Look at the four samples and evaluate each impression with 13 adjective-pairs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Samples</th>
<th>Mod</th>
<th>CG</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-VR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LCD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Procedure</th>
<th>0. Explanation of experiment procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have the subject see 4 samples</td>
<td></td>
</tr>
<tr>
<td>I. Wear an S-VR and watch the images</td>
<td></td>
</tr>
<tr>
<td>II. Watch LCD images</td>
<td></td>
</tr>
<tr>
<td>2. Ask questions orally while watching each sample. Have them answer with numbers and the experimenter fills out the evaluation sheet</td>
<td></td>
</tr>
<tr>
<td>3. 1-2 Repeat</td>
<td></td>
</tr>
</tbody>
</table>

Several limitations exist in this study. Subjects are Japanese young people in their twenties and all have smartphones, so they are less resistant to VR technology. Therefore, you may be more interested in VR technology than true general population and may say that it is more reproducible for spatial reproducibility. This can be a selection bias. In this research we conducted verification by S-VR, which is a foothold of the spread of VR technology. However, because the mechanism is simple, it is limited to the space experience standing on the spot. The fact that the height of the line of sight is fixed and the walk-through function is not implemented, the reproducibility of the real space is limited.

3.2 Results of First Experiment

Mod and CG were summed up, and the evaluation items were simply tabulated for the device (Figure 1). Two groups of t-tests that corresponded between the devices were performed, and there was a significant difference at the 5% level in all the evaluation items. Correlation between S-VR and LCD was determined, and it was strong positive correlation with a correlation coefficient of 0.66. In addition, in all the evaluation items, the scale score difference obtained by subtracting the LCD from
the S-VR is positive, and there was a difference of two points or more in the items of "Reality / Not reality" or "Reproduced / Not reproduced". From this result, it was confirmed that S-VR was reproduced more than LCD.

Therefore, we stopped the experiment using LCD and continued the investigation focusing on S-VR. The comparison between Mod and CG will be dealt with in detail in the next section.

![Figure 1 Scale scores of devices (n = 60).](image)

### 4 COMPARISON OF MOD AND CG – SECOND EXPERIMENT

In recent years, as an effective method for decorating the overhead in a space with a high ceiling height such as an entrance, there are many cases where many ornaments of simple shape are suspended. In this study, we defined them as "hanging objects" and decided to evaluate the impression of the entire space including them. The difference in space was expressed by changing the pattern of objects hanging from the ceiling.

In the experiment, by the 60th anniversary of Kyoto Institute of Technology in Japan, we conducted experiments for 30 people in their twenties. We prepared images of 1/10 scale model taken by 360 degrees camera and CG. A total of 12 kinds of patterns of hanging objects were prepared with varying density and height -- 2 density patterns of hanging objects: 25 arranged 5 × 5 at equal and 49 arranged 7 × 7, at equal intervals in space of 1600 mm square, and 3 height patterns of hanging objects: "Frat" all the same height in the vertical direction, "Convex" the height decreases towards the center part, "Wave" the height changing in streamline form in both matrices. The height of the suspended object alone was set to be the height of 2700 mm from the ground at the highest position, and four kinds were prepared every 150 mm. The lowest position was set at a height of 2250 mm from the ground. The outline of this experiment is shown below (Table 2).

We did not establish a clear time limit for evaluation, and evaluated at the pace of the subject that the subject answered and asked the next question. We finished the experiment in 15 to 25 minutes. In consideration of the subject's burden, experiments were conducted with the mixing plan of patterns (6 types) × expression method (2 types).

In addition, from the previous experimental results, we used 16 adjective pairs selected and added with items suitable for spatial impression evaluation. Since strong positive correlation
(correlation coefficient is 0.64) was shown between items "Real / Not real" and "Reproduced / Not reproduced", only the item "Reality" was evaluated in this experiment.

In this study, we conducted an experiment using hanging group objects to construct the impression in the entrance space. We focused only on the density of the group in the horizontal direction and the change in height in the vertical direction, so it was an experiment limited to the group change on the plane. Because we did not deliberately deal with randomness, there is a possibility that the group change in different directions may be different factors of impression. In addition, since we performed experiments with limited elements such as the size, shape and color of the object itself, various studies are also required from that point of view.

### Table 2 Outline of Second Experiment

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Clarify the characteristics of Mod and CG as a space expression method using S-VR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objects</td>
<td>Mainly for students, in their twenties (30 valid responses)</td>
</tr>
<tr>
<td>Period</td>
<td>December 30, 2017 - January 20, 2018</td>
</tr>
<tr>
<td>Contents</td>
<td>Look at the 12 samples and evaluate each impression with 16 adjective-pairs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patterns of hanging objects</th>
<th>5 × 5</th>
<th>7 × 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat</td>
<td><img src="image1" alt="Flat Pattern" /></td>
<td><img src="image2" alt="Flat Pattern" /></td>
</tr>
<tr>
<td>Convex</td>
<td><img src="image3" alt="Convex Pattern" /></td>
<td><img src="image4" alt="Convex Pattern" /></td>
</tr>
<tr>
<td>Wave</td>
<td><img src="image5" alt="Wave Pattern" /></td>
<td><img src="image6" alt="Wave Pattern" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Procedure</th>
<th>0. Explanation of experiment procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Wear an S-VR and watch each samples</td>
</tr>
<tr>
<td>2.</td>
<td>Ask questions orally while watching each sample. Have them answer with numbers and the experimenter fills out the evaluation sheet</td>
</tr>
<tr>
<td>3.</td>
<td>1-2 Repeat</td>
</tr>
</tbody>
</table>

5 RESULTS OF SECOND EXPERIMENT - THE CHARACTERISTIC OF MOD AND CG

We perform two-way analysis of variance with each of adjective pair and pattern of space, and clarify characteristics of Mod and CG from multiple comparison. In addition, we compare Mod and CG by factor analysis and considered their characteristics. We considered not only the merit of those, but also the characteristics as an indicator.

5.1 The Characteristic indicated by Adjective-Pairs

First of all, we make a comparison focused on adjective-pairs. The average score per adjective-pair is shown in Fig.2. For items with significant differences, $p < 0.05$ was indicated as ** and $0.05 < p < 0.1$ as *. 
13. Organic, 5. Like, 14. Emotional, and 3. Open, a significant difference was seen in the scales score average. Mod was evaluated as "Organic", "Like" and "Emotional" than CG. The reason for this was supposed that Mod is made by hand. In addition, it was shown that the model is "Open", CG is easy to give "Oppressed" impression. Moreover, it was significant at the 10% level, in 8. Friendly, CG tends to be evaluated as "Unfriendly" from the difficulty of making it using specialized software.

Also, although significant difference was not shown, in the item of 9. Luxury, CG can be evaluated as "Luxury" to some extent from the refinement made digitally. The item 6. Interesting was highly evaluated both in model and CG. 7. Varied, 10. Elegant, 11. Coherent, 12. Relaxing, 15. Playful, and 16. Suitable items, the difference between model and CG does not significantly affect the impression of the space.

5.2 The Characteristic indicated by Patterns

Next, we focused on patterns and compared the spatial impressions. The average score per pattern is shown in Fig.3. For items with significant differences, p <0.05 was indicated as ** and 0.05 <p <0.1 as *.
5-Flat, 7-Flat, 7-Convex, and significant difference was shown between Mod and CG. "Flat" tends to be highly evaluated by Mod. In addition, by Mod, every pattern gave a good impression, alternatively, according to the simple main effect test, the method of Bonferroni which is a parametric test for multiple comparison was used, and significant difference was not shown in the evaluation scale scores between all patterns.

In CG, the difference in the impression due to the pattern of space became clear. However, in the model, the difference in the pattern of the space is less likely to influence the impression, and whichever pattern is similar impression. As a result, when comparing impressions using a model, it is necessary to pay attention to this characteristic. In CG, the difference in the impression due to the pattern of space became clear. In particular, "Wave" tended to be evaluated in CG.

5.3 The Characteristic indicated by Factor Analysis

Subsequently, we compared the model and CG by factor analysis with the spatial impression tendency obtained from the above investigation. For the extraction of factors, we adopted the least squares method without weighting, deleted 4. Dynamic, 10. Elegant, and 11. Coherent that those commonalities were less than 0.3, and pro-max rotation was performed. Thereby four factors named "Active" "Dynamic" "Nature" "Gorgeous" were extracted as latent items of space impression.

Mod tended to have a high "Natural / Dynamic factor", and it was evaluated as "friendly", "spacious" and "open". On the other hand, CG tended to have a high "Gorgeous factor", and it was evaluated as "luxurious."

6 CONCLUSIONS

In this research, while investigating the spatial simulation experience by S-VR, simple VR headset with the smartphone, we clarified the characteristics of the spatial impression which is felt by the difference between model and CG expressing VR space. In addition to characteristics clarified in this research, considering physical conditions and the time to create Mod, for simulation comparing multiple patterns, it is best to use CG as a space expression medium. While, for instance presentation, in the case of expecting to give a better impression to the space, it is effective to use Mod. The summary of those characteristics is shown below (Table 3).

<table>
<thead>
<tr>
<th>Table 3 Summary of characteristics of Mod and CG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale Model</td>
</tr>
<tr>
<td>Impression</td>
</tr>
<tr>
<td>Pattern</td>
</tr>
<tr>
<td>Factor</td>
</tr>
<tr>
<td>Summary</td>
</tr>
</tbody>
</table>

This result suggest that it is necessary to select the VR space expression medium suitable for the purpose and to give consideration to the impression in spatial simulation experiences using VR technology.

Our tasks in the future research are experiments using a small scale model of 1/50 to 1/100, relection of samples, by hanging objects in this experiment, used for impression evaluation. Moreover, it is necessary to increase the number of adjective pairs and to confirm the impression of model and CG which were not shown this time.

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AN ASSESSMENT OF SPATIAL COMFORT OF ANCIENT INDRAPURI MOSQUE IN ACEH BESAR, INDONESIA

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Abstract – This paper aims at assessing the spatial comfort of the ancient Indrapuri mosque including thermal, daylight and acoustic performance. This ancient mosque is located in Aceh Besar and built in the 12th century. The facade has been maintained and conserved. However, some conservation steps were shifted from the principle ones such as using traditional techniques and materials. The data were collected through survey and mechanical measurement. The results showed that some replacements are needed due to some spatial discomforts such as higher indoor thermal performance. It is indicated in Olgyay’s bioclimatic chart which also shows that the air movement should be increased to reach the comfort zone. The mosque acoustic performance has slightly high background noise while the sound pressure level and reverberation time still meet the standard. The daylight remains good shown by none of electrical light switched on during the day including daytime prayer i.e. Zuhr (1 pm) and ‘Ashr (4 pm).

Keywords – Old mosque, Thermal Comfort, Acoustic, Daylight

1 INTRODUCTION

Indrapuri mosque is an ancient mosque located in Great Aceh district. The mosque area was initially built in 12th century as the temple of Indrapuri Kingdom. Previously the temple was also well-known as the fortress of the Hindus people. When Islam came to Indrapuri, Sultan Iskandar Muda converted the Hindu kingdom to be Islamic (Disbudpar, 2015). The temple area with stepping terrace was also transformed to be a mosque which is called Indrapuri Mosque.

The mosque which is open layout has three tiered roofs which are supported by 36 wooden columns. The roof was initially made from rumbia leaf which provides upper apertures for circulating out the hot air. The western pulpit was built continuously connected to 1.5 m height of stone fence surrounding the layout plan (Meuko, 2015). The open terrace with steps surrounding the mosque creates a magnificent view of the mosque.

Figure 1 Indrapuri Mosque from the old to the present

This mosque is one of the ancient mosques in Aceh which is preserved yet still functioned as the daily worshipping place for Muslims. However, some replacements were applied such as the roof which was converted to be corrugated zinc sheet. The upper aperture between the tiered roofs was sealed with plastic fiber to protect the room from the rain splash. The floor has been plastered with marble which covers the umpak foundation causing the poles planted into the ground. At last, the
stone wall was partially coated with cement. This study, therefore, assesses the spatial comfort of the mosque including thermal, daylight and acoustic conditions. This performance will benefit some recommendations to approach sustainable historic building conservation.

2 SPATIAL COMFORT AND MOSQUE

The mosque is a sacred place for worshipping (Al-Hamoud, 2009; Saeed, 1996) which serves to express Muslim presence as a symbol of Islam as well as space for social gatherings, education, and community service (Kahera, et al., 2009). There are many factors contributing to the shaping of the typology, design, and role of the mosque in a multicultural atmosphere (farrag, 2017). One of the factors is spatial comfort which is required in a mosque for the presence of the solemnness to the worshippers (Al-Hamoud, 2009; Saeed, 1996). The spatial comfort in this study comprises good acoustic performance such as well sound level pressure distribution and sufficient reverberation time; thermal comfort criteria; and adequate daylight provision. Meeting the spatial comfort is also a way to conserve the energy in running the building. Therefore, it is quite essential to be carried out.

Acoustic performance inside the mosque is critical since well sound distribution would increase the solemnness of the worshippers in performing the prayer. In the mosque, the intelligibility of both speech and other sounds are extremely important, especially for holy tones that must be both spacious and effective. Several acoustical parameters govern speech audibility, intelligibility, and spaciousness of sound; the parameters usually employed in the acoustical analysis of mosques are reverberation time, sound pressure level distribution and sound transmission index (Eldien et al., 2012).

Thermal comfort criteria in tropics, i.e., Indonesia refers to the formula of neutral temperature in Indonesia developed by Karyono (2015) which indicates that the comfortable indoor temperature in Banda Aceh and its surrounding is specified in 23.4°C - 29.7°C (Sari, 2017). This condition is quite challenging to achieve due to high relative humidity (RH) and high air temperature (Ta). To get such comfortable thermal sensation, high air velocity is needed to reduce the relative humidity which is comfortable at 35% to 70% (Evan, 1980; Humphrey, 1992; ASHRAE, 1992; Karyono, 1996; Szokolay, 1990). The effect of air movement is essential to increase the efficiency of sweat evaporation and thus avoid discomfort due to moisture on the skin. In hot humid climate, the most proper air velocity for day comfort is in the range of 0.10 to 0.40 m/s and, indoor air velocities of 1.0 m/s that are delightful and are acceptable up to 1.5 m/s, above that they are unacceptable (Szokolay, 1990). This condition is accommodated in Olgyay’s bioclimatic chart which provides the comfort zone considering the air temperature, relative humidity, and air velocity. The higher air temperature, the higher airspeed should be reaching the comfort (figure 8). As commonly known that the air can be circulated naturally through optimal apertures with the cross ventilation system. Good thermal sensation in tropics can also be obtained by the use of low conductivity materials and light color which has little value of heat absorption (Emmanuel et al., 2007; Sari et al., 2018).

<table>
<thead>
<tr>
<th>Scale</th>
<th>Illuminance (lux)</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 - 19</td>
<td>Total darkness to dark</td>
</tr>
<tr>
<td>2</td>
<td>20 - 49</td>
<td>Do not demand a high visibility of the task (public areas)</td>
</tr>
<tr>
<td>3</td>
<td>50 - 99</td>
<td>Do not demand a high visibility of the task (orientation during short stop)</td>
</tr>
<tr>
<td>4</td>
<td>100 - 199</td>
<td>Do not demand a high visibility of the task (rooms not in permanent use and hallway brightness)</td>
</tr>
<tr>
<td>5</td>
<td>200 - 499</td>
<td>Details easy to see at normal brightness for reading or office area</td>
</tr>
<tr>
<td>6</td>
<td>500 - 999</td>
<td>Details difficult to see like intricate work for brightness</td>
</tr>
<tr>
<td>7</td>
<td>1000 - 1999</td>
<td>Task lighting for highly demanding work - extremely fine details like</td>
</tr>
<tr>
<td>8</td>
<td>2000 - 10000</td>
<td>Task lighting for highly demanding work - extremely fine details like special tasks in surgery (10000 lux is maximum brightness from sunlight to indoor area)</td>
</tr>
</tbody>
</table>
Building design using daylight system is considered as an excellent passive lighting design. Daylight is lighting obtained from secondary sunlight source. It provides the best source which comfortably matches with human visual response (Arab et al., 2012). To measure the indoor lighting performance illuminance level is utilized. Based on the measurable scales shown in Table 1 the illuminance of the mosque should be minimally in scale five which is ranged from 200-499 lux which means that the illuminance quantity is sufficient to easily see or read at normal brightness. In the mosque, the worshippers do not only do salat or prayer, but they also recite AlQuran which needs sufficient light.

3 RESEARCH METHOD

In order to evaluate the quantity and the quality of sound distribution inside the mosque, this study recorded sound pressure level, reverberation time and background noise. The acoustic condition was only measured for one day within the empty room. Omnidirectional speaker (NOR-223) was located in the center of the room which is 1.50m above the ground to represent the condition of standing speech. This speaker provided sound source for calculating the reverberation time (ISO3382) and sound pressure level. The measurement that was carried out on some spots (figure 2) utilized ½ inch microphone as the receiver set on 0.85m above the ground which represented the sitting condition. Before the measurement, the tools were initially calibrated in order to get the correct results. After the measurement of reverberation time and sound pressure level, the background noise was also recorded using RTA 840 and calibrated microphone condenser to identify the room criteria. The tools measured the ambient noise of sound pressure level (SPL) which was also positioned 0.85 m above the ground.

Thermal performance was evaluated by utilizing heat stress meter to record Globe temperature (Tg), Air temperature (Ta), and Relative Humidity (RH), while, the surface temperature (°C) of the building envelope was recorded using an infrared thermometer; and Air velocity (m/s) was measured using an anemometer. At last, the illuminance of daylight received inside the mosque (E) was measured using lux meter. The measurement was carried out for one day on May, 3rd 2018.
a. Sound Pressure Level

Figure 3 is the contour map of sound pressure level (SPL) which shows the even distribution of SPL in every position in the room. It means that SPL distributions are loud enough to be received by the listener against the background noise. The difference of sound pressure level in every position of the rooms meet the criteria which are less than 10dB of the sound source.

![Figure 3 Sound Pressure Level Distribution in Indrapuri Mosque](image)

b. Reverberation Time

The Reverberation Time (RT) curve (Figure 4.a) shows the uneven RT on every frequency for on octave band. It shows that the curve increases in low frequency (125 Hz - 250Hz) which is around 1.0-1.4 second, while in medium frequency the curve decreases to 1.2 second and running down below to 1 second on high frequency (4000-8000Hz). This condition shows an optimal performance of speech room criteria which also justifies an excellent performance of mosque design of Indrapuri Mosque.

![Figure 4 (a) Reverberation Time Curve of Indrapuri Mosque. (b) RC curve showing the back ground noise inside Indrapuri Mosque](image)

c. Background Noise

The mosque which is located slightly remote from the main street, surrounded by stepping walls, should have the background noise that will make it acceptable as the praying area. However, during the measurement, the zinc roof that was previously installed with rumbia leaf made some intermittence noise that is shown in Figure4b. RC curve shows that the average value stands on RC-40 and 45 which is noted as higher than recommended background noise in worshipping place.

### 4.2 Thermal Performance

The thermal performance of Indrapuri Mosque was indicated through the air temperature, globe temperature, relative humidity and the surface temperature of roof, wall, and floor. Figure 5
shows that the wall and floor temperatures are dominantly located at 27°C to 32°C which are slightly closed to air and globe temperatures. While the zinc roofs facing east, west, south and north suffer high temperature rising to 50°C-55°C at noon, then running down to 35°C at 1 pm-2 pm. In the afternoon they slightly rise toward 50°C. Meanwhile, the Relative Humidity stays at around 65% to 75% which is somewhat higher than the comfortable range of RH which is between 35% and 70%.

Figure 5 Temperatures and Relative Humidity inside Indrapuri Mosque

Figure 6 The thermal performance indicated through Olgyay’s Bioclimatic chart (Olgyay, 1992)

Figure 7 The roof aperture sealed with plastic and the fans installed and attached to the wooden beams

The air velocity was recorded in two conditions namely 80cm and 120cm above the ground illustrated with number 1 and 2 respectively next to the alphabets (A-I) that represent the measured area (Figure 8). It shows that the airspeeds are dominantly in the comfortable zone which is around 0,1-0,4m/s. However, based on Olgyay’s Bioclimatic chart, the airs speed will not give comfortable
thermal sensation due to high airspeed and relative humidity. Figure 6 shows that once the air temperature (DBT°C) and the Relative Humidity (RH%) are traced on the Olgyay’s Bioclimatic chart, it shows that the thermal performance is out of the comfort zone. The mosque with the sealed aperture of the second roof (Figure 7) and some wall apertures covered with cupboards and whiteboards (figure 10) are probably the reason for this condition. To upgrade the thermal performance to be included in the comfort zone, the air movement must be increased up to 1 m/s. The worshippers approve this condition by installing fans to overall beams in the mosque in order to get more air movement (Figure 7).

![Figure 8 Air velocity (m/s) inside Indrapuri Mosque](image)

4.3 Day Light Performance

Figure 9 shows that overall room has sufficient daylight illuminance which some areas such as A, D, G, H reach up to 2000 lux. Only area C and B suffer the minimum illuminance. Area B at the qibla position facing northwest and C facing north have been partitioned with some cupboards and whiteboards which reduce the illuminance of the daylight which is around at 100-200 lux.

![Figure 9 Daylight illuminance (lux) received inside Indrapuri Mosque](image)

5 CONCLUSION
Indrapuri Mosque shows that some replacements have caused some spatial discomforts such as high indoor thermal performance, high background noise and low illuminance of daylight in some spots. This study indicates that installing new materials should be minimized to achieve the optimal spatial comfort. Alternatively, we could conserve the mosque by installing the materials or properties close to the original one. In addition, attaching information and supporting furniture should also be wisely managed to obtain not only the facade but also the indoor comfort.

6 ACKNOWLEDGMENT

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EVALUATION STUDY OF PEDESTRIAN WAY’S COMFORT 
CASE STUDY: BLANG PADANG AREA, BANDA ACEH CITY

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Abstract - Nowadays, footways or pedestrian ways is one of important public facilities because it is not only providing a connection between place to place, but also considered as a temporary shelter (Indraswara, 2006). As a growing city which survived the 2004 Tsunami Disaster, Banda Aceh has grown rapidly, so has its public facilities. However, based on an initial observation, despite of there are several footways available across the city, only limited numbers are intensively used. In much of Banda Aceh, walking seems to be unpleasant experiences due to lack of comfort and poor facilities. In this regards, this study aims to identify individual problems of street segments by looking at the level of pedestrian's comfort and supporting elements they need in daily uses. This study selected Blang Padang area, one of the most vibrant areas of Banda Aceh and the users were interviewed using semi structured interview. In addition to interview, this study employed field observation to record existing physical conditions. The results shows that 85% of pedestrian ways around the study area are inconvenient, uncomfortable and sometimes dangerous to be used. In addition, the existing condition of pedestrian ways are in minimum condition such as its pavement, safety, vegetation, accessibility, and cleanliness; and lack of street furniture facilities. Therefore, based this, some designs are suggested to increase level of comfort in the pedestrian way around Blang Padang and Banda Aceh, so the level of pedestrian way uses can be leveled up.

Keywords - pedestrian, comfort, street furniture, perception

1 INTRODUCTION

Blang Padang square in Banda Aceh is one of the busiest pathways of the city where several vital public facilities such offices, schools and hospitals are located. The traffic on the corridor around Blang Padang square is very influential to the driving comfort that also felt by all the pedestrians that use the area. Initial observation found the condition of pedestrian way in Blang Padang field is not functional due to its physical pedestrian way condition. Article 28 Sub-Article C of Law Number 26/2007 on Spatial Planning is mandated on the need for a city spatial plan (RTRW) to include the service plan and the utilization of pedestrian way facilities and infrastructure to carry out the functions of urban areas. Therefore, the more people who use pedestrian ways will impact on the continuity of traffic around Blang Padang square. The purpose of this research is to encourage the community to use the pedestrians that has been provided often, so it can support the realization of public city space that is safe, comfortable, productive and sustainable, so that will improve the image of Banda Aceh.

2 LITERATURE REVIEW

2.1 Pedestrian Ways As City Scape

The pedestrian way includes one of the city public space support facilities provided to support traffic activity. Indraswara (2007), reveals the term pedestrian way emerged during the reign of ancient Greece, which comes from the word Pedos which means foot or walk. Pedestrian way in its function as a mode of urban connecting system that is close related to the open spaces in a city. The open space of the city serves as a transitional space in moving from one building to another building or one place to another place. Basically the pedestrian way is one form of typologies of urban public space, Carr in Muslihun (2013). In addition about being closely related to the open spaces with a city, the pedestrian way as the built environment is also closely related to the social environment in which
human behavior is part of creating an urban area. Pedestrian way can be located in the space belonging to the road, but usually followed by an increase in traffic flow. Usually the pedestrian way placement is located in residential/school, shopping centers, bus terminals, office centers, entertainment centers, social venues and industrial areas.

2.2 Pedestrian Ways Activity and Facility

User activity on an area may cause differences or equations of human behavior on the environment. Based on research conducted by Iswanto (2003), there are two elements that are strongly associated with pedestrian way activity to humans on the use of urban area elements of comfort and sense of security. Pedestrian way not only as a circulation space but also has a function as a space between human interaction with the transportation around it. Pedestrian way that has already provided needs to be checked against the capacity (width), the circumstances and its use.

A road segment needs to be equipped with pedestrian ways facilities, if along the road there are land users who have the potential for pedestrian way activity growth. According to Pushkarev and Zupan in Veronica (2014) the importance of open spaces for pedestrians in the UK are sidewalks, crossings, pedestrian way bridges, safety fences, open spaces can accommodate pedestrians so that the circulation does not interfere with vehicles that cause pedestrians to feel safe and comfortable. The availability of pedestrian ways support facilities can reduce the width of the effective pavement path provided, so that the dimensions of pedestrian ways facilities are required in accordance with prescribed standards.

Table 1: Facility and width of obstacle course of sidewalk

<table>
<thead>
<tr>
<th>Facility</th>
<th>Maximum (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Park bench</td>
<td>15 – 25</td>
</tr>
<tr>
<td>Lighting lamppost</td>
<td>7.5 – 10</td>
</tr>
<tr>
<td>Traffic light pole</td>
<td>10 – 12</td>
</tr>
<tr>
<td>Traffic sign</td>
<td>7.5 – 10</td>
</tr>
<tr>
<td>Mail box</td>
<td>10 – 12</td>
</tr>
<tr>
<td>Trash bin</td>
<td>10 – 25</td>
</tr>
<tr>
<td>Shade plants</td>
<td>6.0 – 12</td>
</tr>
<tr>
<td>Flower pot</td>
<td>1.5</td>
</tr>
<tr>
<td>Tree</td>
<td>20 - 25</td>
</tr>
</tbody>
</table>

(Source: Minister of Public Works Number 03/Prt/M/2014)

Pedestrian ways generally there are elements supporting the pedestrian ways facilities of street furniture on it. This is enabled to provide the comfort of pedestrians who perform activities on pedestrian way. According to Rubenstein 1992 in Muslihun (2013), the elements that should be on the pedestrian path include paving, lighting, sign or markers, guardrails, benches, shelters and canopies, clocks, bins, and vegetation.

2.3 Public Perceptions of Pedestrian Ways Comfort

Sugihartono in Muslihun (2013) states differences in the results of observation or perception is influenced by individuals or people who observe the object around it. Convenience can be felt through the assessment of the user observation. Therefore the assessment of perception is subjective depend on one’s understanding is needed by the pedestrian way planner in determining what is needed by the community both personally and as a group of users. However, it should be seen that the results of perception of user perception influenced by knowledge, experience, education level, age factor, profession and everyday habit of each person is different in judging about character or physical impression to pedestrian ways comfort.

2.4 Level of Pedestrian Ways Service

The criteria of pedestrian ways service level in design pedestrian way facilities need to be considered as a basic measure of space effectiveness (pedestrian space) especially related to the
comfort of the users. The capacity of the pedestrian way should also be considered in accordance with urban public space requirements. Khisty 2003 in Tejasomara (2011) there are factors that should be considered in designing pedestrian way facilities for comfort during activities such as convenience, safety that is the separation between vehicle traffic with pedestrians and security. Therefore the level of pedestrian way service is closely related to environmental factors. Especially with regard to the behavior of users walking on the comfort obtained is also based on user perceptions.

3 METHODS

The scope of this study involves the study of pedestrian way comfort evaluation as an aspect of urban architecture. This research uses qualitative method with descriptive approach that give a description to local pedestrian way comfort either individually or certain group of people. The focal point of this research is in the Blang Padang Square area of Banda Aceh City. There are steps in data collection techniques such as: 1) Determining the population and sample research used is purposive sampling; 2) The interview used is the type of semi structure interview; 3) Observation by observing directly on the object or subject of research; 4) Literature study obtained from the literature and references related to the title of the study. The data obtained from interviews and observations will be documented in a way collected and grouped by categories related to the subject of research.

4 RESULTS AND DISCUSSION

Public activities of existing roads along the pedestrian path of Blang Padang Square Banda Aceh area has various activities by utilizing the public space that has been provided. Regions around Blang Padang field can be directed from various directions intersection. The results of this study took 3 segments of the research zone that potentially lead to pedestrian way user activity.

![Figure 1 Map of Banda Aceh City. Source: Data RTRW Banda Aceh City Year 2029](image)

Regions around Blang Padang field can be directed from various directions intersection. The results of this study took 3 segments of the research zone that potentially lead to pedestrian way user activity.

The research have so far various facilities in the pedestrian way in each 1, 2, and 3 zone that have different conditions. All three zones are ineffective pedestrian way facilities conditions and uncomfortable for users of the walk that is zone 1 and 2. Zone 1 is mainly caused by pavement material made of ceramic is not feasible to use due to cracks and holes. Improper arrangement of trees destroys the surrounding footway material. In zone 2, pavement material has been cracked due to vehicle parking. Zone 3 material used from concrete is good but still looks hollow and not tidy. In each zone there are no lighting facilities for night lighting as the lighting and aesthetics of a city's public space.
Therefore, the availability of pedestrian way in Zone 1, Zone 2 and Zone 3 is very supportive as the supporting element of an urban public space, resulting in various activities around it. Similarly, as stated by Danoe Iswanto (2003) in his research that is what makes people use pedestrian path in Semarang City on the hero street, because the area is in the center of offices and trade so much of the pedestrian way activity in the area.

The survey interviewed 30 respondents. Characteristics of respondents by sex are 14 male respondents and 16 female respondents. Visitors to pedestrian paths are dominated by young people and parents aged 20-50 years old. By the 30 sample interviews at the research sites, 60% were with pedestrian path users, 27% were informants in the Blang Padang field, only 13% were interviewed with parking user in the pedestrian way area of Blang Padang, Banda Aceh. After conducting observations and direct interviews with the respondents, the researchers found various activities that took place in the pedestrian path of Blang Padang, Banda Aceh City, such as walking, sitting, vehicle parking, temporary shelter, jogging and so on.

Based on the results of interviews with a number of respondents there are 5 comfort factors that are very influential on pedestrian way users when doing activities in the pedestrianway of Blang Padang area. As shown in the graphic Figure 4.

The graphic shows the perception of interview to the pedestrian way user has several factors respectively affecting the comfort in using the pedestrian way facilities in the Blang Padang field. The five factors that greatly affect the user's convenience when passing the sidewalk from 30 respondents stated that the physical condition of the road (material pavement) is highest at 35%. Insufficient width dimensions are around 25%, 21% green path arrangement, 13% cleanliness and 6% security. The main factor that affects the comfort of walking users is pavement, because with the condition of pavement material that is not good can disrupt the free movement in the move.
Respondents' perception as much as 80% want especially the physical condition of the road is planned better than before for the convenience when on the move. Arrangement of neat trees so there are no twigs that are not irregular. As disclosed according to Rubenstein 1992 (in Muslihun 2013) can be seen that the pedestrian way supporting element one of the vegetation, in addition to having aesthetic value also to improve the quality of life in the move. An activity arrangement should take into account the amount of walking space of pavement users. Observation results show as much as 70% of the number of pedestrians per meter based on the pedestrian way dimension of 3 or 4 people walking. This indicates that the circulation volume should be the width of the pedestrian way dimension of 1.5 or 2.5 meters in accordance with the rule of the Minister of Public Works No. 03 / Prt / M / 2014.

The results of interviews conducted on 30 respondents have the same statement about the factors that affect pedestrian way comfort, as much as 85% said the pedestrian way is not comfortable to walk, because pedestrian way function is misused by other users of the activity and the physical condition of the road is not feasible to use.
The above design recommendations based on observations in the field and the results of research indicate the need for special attention to the existence of street furniture pedestrian path as the fulfillment of comfort needs for the user as a city public space. The dominance of pedestrian way user perceptions of the pedestrian way support facilities most needed for the convenience of the activity is the crossing sign of one of the most desired facilities of users as much as 37%, followed by waste bins facility around 23% because based on observations in the field seen scattered rubbish, safety of 16%, resting facilities about 14% and rest lighting facilities 10%. The results of interviews conducted on 30 respondents have the same statement about the factors that affect pedestrian way comfort, as much as 85% said the pedestrian way is not comfortable to walk, because pedestrian way function is misused by other users of the activity and the physical condition of the road is not feasible to use.

As Rustam Hakim and Hardi Utomo (2003) convenience is the most important aspect of everything that shows the pedestrian space in good shape various forms such as textures, colors, symbols, and others. The pedestrians admitted that sometimes they have a sense of laziness crossing in the crossing area due to poor conditions even the motorists do not care about pedestrians.

5 CONCLUSION

The physical condition of the pedestrian ways is a more dominant factor that supports the comfort of the user. However, to achieve the availability of good urban public space is required to establish a complementary facility of pedestrian way such as a street furniture that required by the citizens of Banda Aceh City for the convenience and safety of the pedestrian way user that has been provided. In addition, with these improvements hoping that people would prefer use the pedestrian
way as the secondary community transportation to make a city more clean, beautiful and pollution-free for urban environment in Banda Aceh City. For the government and related parties, it is advisable to revitalize the pedestrianway around Blang Padang Square in Banda Aceh City by disciplining parking lots that can disturb pedestrians on pedestrian lanes. Divide the public space in accordance with the activities and functions of their respective activities.

REFERENCES


Public Works Department (Minister of Public Works Number 03/Prt/M/2014). Law Of The Republic Of Indonesia Number 26 2007 about planning guidelines, the service plan and the utilization of pedestrian facilities and infrastructure to carry out the functions of urban areas.


THE INFLUENCE OF SOCIETY BEHAVIOUR IN CREATING SLUM AREA (CASE STUDY: GAMPONG ALUE NAGA, BANDA ACEH)

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Abstract - Banda Aceh, the municipality of Aceh Province, is currently developing in various aspects of urban areas. Many efforts have been done by the city government to improve the city condition in both physical and non-physical aspect. One program to minimize the slum area with is so-called KOTAKU or the city without slum. According to Banda Aceh city municipality, there are some areas considered as slum area and become the priority of KOTAKU program such as Alue Naga, Lampulo, Seutui, Peuniti, and Lueng Bata. Those area of slums need to be seriously managed. In addition to government programs to improve the slum area, there is a need to raise people’s awareness to take care of their settlement so that the settlement become clean area and liveable. Gampong Alue Naga, the case study is located on the seashore and with the majority of people working as traditional fisherman. It has been shown in the condition of settlement that are not liveable, unorganized houses, improper drainage system, garbage seen everywhere, which create environment problems. The situation is exaggerated by the livestock such as cows and goats that are freely occupied the settlement left dirt and unpleasant smell. This condition shows the lack of people’s awareness to take care of their environment as well as represent the low quality and poverty of society. One of contributing factors to slum is people’s behaviour which tends to neglect their environment. The characteristic of a settlement shows by the characteristic of inhabitants’ behaviour. A good behaviour toward the environment will show a better environment and vice versa. The area with high density and inhabited by people who have good attitude towards environment will create an environment far from slum. There has been a good tradition of Indonesia people called “gotong royong” or community self-help that has been exercised decades. However, the fisherman community has low mutual self-help exercise. They normally conduct mutual self-help during Maulid Nabi (Islamic event) once in a year. This study will explore how behaviour of people who live in Alue Naga contribute to the slum situation and will seek solution to minimize the creation of slum. The methods utilise by this study is mix methods, a combination between qualitative and quantitative methods.

Keywords - Slum Area, Gampong Alue Naga, environment

1 INTRODUCTION

The problem of poverty and the creation of slum areas in urban areas in developing countries has been experienced since decades ago. There have many programs developed to eliminate the slum such as KIP (Kampong Improvement Program), PNPM (National Program for Community Empowerment) and Kotaku (city without slum). Kota Banda Aceh at this moment is continuing to correct itself on many municipal aspects as to avoid creating slums.

The creation of slum area proved to be potentially the cause of many municipal problems. According to Eko Budiharjo (2011), slums condition on cities are affected a lot by physical and social characteristics that are present within the community. Physical and social characteristics that are thought to affect the slums on cities include income earned, land ownership, education level, number of family members and the community values in its neighborhood.

Alue Naga Village is located in a coast with most of the population being fishermen. The low economy of fishermen affects the quality of life and welfare as can be seen from their shabby neighbourhoods, the condition of their homes which are not fit for living in become a disorganized neighbourhood, bad system drainage, trashes that are scattered everywhere, which further impacts the environment. This condition reflects the society’s low awareness to preserve the environment and reflect a low quality of life and welfare for fishermen.
Society’s attitude to not preserve the environment also impacts uncleanliness of some area. A settlement’s behaviour towards the land they live in while accommodating activities will reflect on the character of that settlement. Because the environment of the settlement is created from many processes of human interactions with their environment, then it is imperative to raise the concern of the community to preserve the settlement area as to create a clean and liveable place.

The research method used is *mix method*, which is a research method in which two approaches are combined into one research: qualitative and quantitative, which will create a more comprehensive, valid, reliable and objective data.

2 GENERAL DISCRITION OF GAMPONG ALUE NAGA, BANDA ACEH

Alue Naga Village is one of the villages located in sub-district Syah Kuala, District municipality Banda Aceh. Alue Naga Village is divided into 4 hamlets which are Hamlet Musafir, Beunot, Kutaran, and Po Diamat. Alue Naga Village has an area of ± 329.19 Ha.

The total population of Alue Naga Village is 1730 with 562 Head of families (KK) that consist of 942 male and 788 female. The residents in Alue Naga Village in average have not completed their primary education. The detailed breakdown can be seen in table 1.

<table>
<thead>
<tr>
<th>No</th>
<th>Education Level</th>
<th>Amount</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Complete Primary School</td>
<td>290</td>
<td>16.76%</td>
</tr>
<tr>
<td>2</td>
<td>Complete Middle School</td>
<td>295</td>
<td>17.05%</td>
</tr>
<tr>
<td>3</td>
<td>Complete High School/Vocational School</td>
<td>400</td>
<td>23.12%</td>
</tr>
<tr>
<td>4</td>
<td>Complete S1/D1,2,3,4</td>
<td>59</td>
<td>3.41%</td>
</tr>
<tr>
<td>5</td>
<td>Not Complete Primary School</td>
<td>686</td>
<td>39.65%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>1730</strong></td>
<td></td>
</tr>
</tbody>
</table>

(Source: Buku Profil Desa Alue Naga, 2016)

The livelihood of Alue Naga Village are varied from security guards, merchants, students, fisherman, Civil Worker, housewife, contractor, to retiree. The detail can be seen in table 2.

<table>
<thead>
<tr>
<th>No</th>
<th>Type of Job</th>
<th>Male (Amount)</th>
<th>Female (Amount)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Security</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Carpenter</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Stonemason</td>
<td>10</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Electrician</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Tailor</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Shaman/paranormal/supranatural</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Religious Leader</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Private Teacher</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>Private Nurse</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Researcher</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Driver</td>
<td>10</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>12</td>
<td>Peddler</td>
<td>38</td>
<td>35</td>
<td>73</td>
</tr>
<tr>
<td>13</td>
<td>Entrepreneur</td>
<td>120</td>
<td>10</td>
<td>130</td>
</tr>
<tr>
<td>14</td>
<td>Mechanic</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>Welder</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>Casual Worker</td>
<td>68</td>
<td>4</td>
<td>72</td>
</tr>
</tbody>
</table>
According to the table above, the community of Alue Naga Village is still mostly students which amount to 553 people. The next highest occupation is fishermen which amount to 172 people. The main reason for that is because Alue Naga Village is located on a coast.

3 SOCIETY BEHAVIOUR AND CREATING THE SLUM

The behaviour of settlers on their settlement while accommodating activities will reflect the character of that settlement. Humans will have adjustment processes with their environment through change in behaviour, home’s condition, and the area around their home. Privacy needs also affects development through spacial consolidation (Sarwono, 1994).

Education level, Job type are among the factors that affects the behaviour of local community.

Education level will be a contributing factor for their home’s condition. So, the higher the education level of someone, the higher their understanding of meaning and function of a healthy home will be.

Table 1 illustrates the education level of the community in Alue Naga Village. In general Alue Naga Village residents have not completed primary school education (39.65%). This means that their knowledge regarding the environment as well as healthy home concept is still minimal.
3.3 Community Values In Its Neighborhood Settlement Factor

Human behaviour cannot be separated from the circumstances and environment they are in. Human behaviour is driven by certain motives that will make them behave (Ircham, 2005).

3.3.1 Instinct Theory

Instinct is an innate behaviour, that will change because of experience. In general most of the community have shown a good behaviour toward their homes. 88% of the respondent admit that they clean their homes everyday (refer to tabel 3 and diagram 1). Such behaviour will of course have a positive effect to the health of residents. This has also been expressed by informant K:

“...people around here don’t know about us because they do not socialize. But I personally always clean up...” (informant 4, interview on 6 March 2018 14.30 WIB at informant’s home).

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Respondent (Amount)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Everyday</td>
<td>42</td>
<td>88%</td>
</tr>
<tr>
<td>Every 2 days</td>
<td>5</td>
<td>10%</td>
</tr>
<tr>
<td>Every week</td>
<td>1</td>
<td>2%</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>100%</td>
</tr>
</tbody>
</table>

Sources: Questionnaire result

3.3.2 Drive Theory

This theory is developed by a principle that organisms are born with certain psychological needs and that a negative state of tension is created when these needs are not satisfied. When a need is satisfied, drive is reduced and the organism returns to a state of homeostasis and relaxation. According to the theory, drive tends to increase over time and operates on a feedback control system, much like a thermostat. Government Program are able to initiate the change within community and to drive the behavior or attitude of the local community, such as KOTAKU program (City Without Slum Program). City Without Slum program in Aceh has been implemented in 16 city/districts. The City Government engage the society to be actively participate in solving the problem of slum in their area.

3.3.3 Incentive Theory

The incentive theory is one of the major theories of motivation and suggests that behavior is motivated by a desire for reinforcement or incentives.

“Building on the base established by drive theories, incentive theories emerged in the 1940s and 1950s. Incentive theories proposed that behavior is motivated by the “pull” of external goals, such as rewards, money, or recognition. It’s easy to think of many situations in which a particular goal, such as a promotion at work, can serve as an external incentive that helps activate particular behaviors.”(Hockenbury & Hockenbury, 2003)

4. THE TRADITION OF MUTUAL COOPERATION

Gotong royong or mutual cooperation has been the key of Indonesia contemperor culture, it describe the society and all practices should be based on mutual cooperation (Bowen 1986: 545). Gotong royong can be define as a form of cooperation between people in society in their social life in order to accomplish an effort that is useful for mutual interest. In social sciences, the term of gotong royong is a principal form of collaboration, helping each other without direct payment for the work, for the benefit of the community. This respectable tradition, however, has been declining in daily practice.
The essence of dwelling is to live together, therefore the main function of a home is as a place for a man to blend in his society. A neighborhood is formed from the production of society interaction with their environment. A neighborhood is not only a place to live but a place that is formed through society patterns to organize and maintain the natural balance. In the process of maintaining the natural balance, the problem of land use occurred, such as the transformation of inhabitant behavior pattern or different facility needed personally and socially.

Good environment occurred in a situation where the community have high concern of their environment. The concern can be implemented in the way they manage their waste, such as how the rubbish organize, how discipline people toward their waste and how often a routine mutual cooperation practiced. As mention above gotong royong has traditionally rooted in Indonesia community, but unfortunately does not occurred in Alue Naga Village anymore. The following is a detail information from interview:

“....gotong royong is never been done. The cleaning will be done on a special event only, such as MaulidNabi, which is once in a year.” (Interview on 5 March 2018)

The following is how the community process of their waste. 33% of people throw their rubbish to the ocean. 31% of people who throw their rubbish to the nearby embankment, 29% burning their trash, and 6% throw their waste on nearby abandoned lots. The rubbish bin are available in the village, 3 units for every two hamlets, which is located quite far from houses.
5 CONCLUSIONS

Slum area contributes to the bad image for the city. The slum condition is affected by physical dan social characteristics of the society. Slum can be affected by some factors such as education, income and public perception for their neighborhood environment. In Alue Naga village, which most dwellers have low income and most people work as fishermen. In term of education, many of them do not complete primary school. Those two factors contribute to constructing people behaviors toward their neighborhood and environment. In addition to low education as well as income, people’s lack of concern toward their environment also contributes to the creation of slum as well. An obvious example in Alue Naga Village is there is no rule about livestock as a result dirt can be seen everywhere and the smell is bad. Above factors worsen by the situation where respectable tradition of Indonesian community of gotong royong has not been practiced anymore. In order to improve the neighborhood condition, the community needs to exercise mutual cooperation in certain period such as once in a week. Alue Naga village needs a good leader who can organized the community to improve their concern for their neighborhood.

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Muslih. (2014). The Role of the Community on Environmental Hygiene in Slum Residential Area of Labuan Bajo Subdistrict, Banawa District, Donggala District. University of Tadulako
Putrajaya Lakes Management: Sensitivity and Conservation Towards Sustainable Community

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Abstract - Lakes, natural or man-made, are important water resources for Malaysia. These inland water bodies cover an area of over 10,000 hectares and contain more than 30 billion cubic metres of water. In positive ways, lake managements are maintaining high level of effectiveness within the lake management. Putrajaya Lake is beneficial not just only to the aspect of water quality and quantity but also as a medium for education resource for the society. Putrajaya Lake is an important destination for recreation, sports and tourism in the country. Additionally, it provides a scenic and self-sustaining ecosystem. Putrajaya Lake has become an important filtering system that treats pollutants and storm water run-off before draining water into the Putrajaya Lake. The urban water body system with a total surface area of 400 hectares was designed and built so as to encircle the core island creating a complex morphometry. The design of the Putrajaya Wetland and Lake has taken into consideration of this hydrological impact. However, the rapid development and many activities surrounding Putrajaya Lake has significant effects on the quality of the water body. Therefore, the purpose of this study was to carry out the Putrajaya lake management towards sensitivity and conservation towards sustainable community. The research methodology was based on two (2) facets which is facet that included site inventory data collection, primary and secondary data. The second facet analysed the site analysis that included (i) water quality (ii) lake ecosystem and (iii) monitoring the activities at Putrajaya Lake. The findings were used in to assist Putrajaya Lake to improve its management and to have a better strategic plan and formulation of a long term lakes catchment development and management plan. This will help Putrajaya to achieve its inspiration of “City in a Garden”. Besides, development of an integrated system of lake management that will ensure sustainability of community and ecosystems.

Keywords - Sensitivity, Conservation, Man-made, Lake Management, Ecological, Sustainability.

1 INTRODUCTION

Lake is an important source of water in Malaysia and it gives many benefits to our ecosystems. It is also as a main heart for landscape development to public or civil society in creating a healthy and multipurpose space. According to Povilaitis and Querner (2008), a lake is vital for protecting biological diversity and ecosystems. Also it provides a major contribution to the economy of the situated area. It’s also as a main heart for landscape development to public or civil society in creating a healthy and multipurpose space. According to Povilaitis and Querner (2008), a lake is vital for protecting biological diversity and ecosystems. Also it provides a major contribution to the economy of the situated area. This study is to embrace the Putrajaya lake management in sensitivity and conservation towards sustainable community. The main objectives of this study are (i) to identify the Putrajaya lake management in catchment development and (ii) to monitor and assess the water quality at the Putrajaya lake for its suitability for recreational activities. In legislation, the management of lakes are subjected to various water and environment laws. At Putrajaya lakes, the laws or guidelines include the Lake Management guidelines, The Putrajaya Lake Use Master Plan, Environmental Management Guidelines, The Catchment Management Guidelines and Putrajaya Lake and Wetland Management and Operational System (PLWMOS). In Malaysia, the laws are related with lake management are Environment Quality Act 1974 and Environmental Quality (Environmental Impact Assessment) Order 1987 and also Town and Country Planning Act 1976. The act or laws is very important to lake management in measuring, promoting and also protecting the water catchment. In addition, it also control the lake pollution and conserve the biological diversity.
2 LAKES SENSITIVITY AND CONSERVATION

2.1 Water Sensitivity In Developed Community

Every planning in a community area needs to focus on several factors, especially about the environment and its contents. For example an existing leisure resource such as public park can be used as the pulse of the development of the social well being of an area. Each of these public parks is a good social system if it contains elements of water, air, land and others. This study is about the water sensitivity to be taken into account in every planning project in the City, especially in Putrajaya. Water management is one of a number of important elements that defines the sustainability, resilience and liveability of cities and towns. Based on Tony H F Wong (2007), the words ‘water sensitive’ is defined as a new paradigm in integrated urban water cycle management that combined with various fields and disciplines of engineering and environmental sciences that are associated with the provision of water services, including the protection of aquatic environments in urban areas. According to Australian Department of Industry, Innovation and Science (2018), water sensitive city interact with the urban water (hydrological) cycle in ways that:

1. Provide the water security essential for economic prosperity through efficient use of diverse available resources;
2. Enhance and protect the health of waterways and wetlands, the river basins that surround them, and the coast and bays;
3. Mitigate flood risk and damage; and
4. Create public spaces that collect, clean, and recycle water.

In Australia, Bio-retention swales, wetlands and raingardens are examples of the urban design of residential developments in the early 1990s that have been referred to as Water Sensitive Urban Design (WSUD). Furthermore, the inter-government agreement on a National Water Initiative defines (WSUD) as “the integration of urban planning with the management, protection and conservation of the urban water cycle that ensures that urban water management is sensitive to natural hydrological and ecological processes”. Andrew Speers and Grace Mitchell (2000) asserted that sustainable water management leads to WSUD and it encompasses the integration of a number of levels in many different measures that have a range of suitable applications, resulting in many different realizations of this concept, depending on the site-specific conditions of the location.

2.2 Water Quality Standard in Malaysia

Water quality is very important in determining the level of community response and wellbeing as well as health in Malaysia. Monitoring of water quality through physical observations, biological monitoring and chemical monitoring can be useful in order to better monitor the water status. In the National Water Quality Standards in Malaysia (NWQS) it shows six parameters: pH, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Ammonical Nitrogen (AN), Suspended Solid (SS) and Dissolved Oxygen). Then it will be Indexes in Water Quality Index (WQI). Water Quality Index is a tool for evaluating the water quality. All the data then would be compared with the National Water Quality Standards for Malaysia (NWQS) to determine its status. Refer Table 1.

2.3 The Roles of Lakes for Community and Cities

Water covers more than 70 per cent of the earth's surface. It covers the oceans, rivers, and lakes. If there is no water, no vegetation on land, no oxygen for animals to breathe and the planet would look entirely different than it does today. Water is necessary in keeping the human body and the environment healthy and should be valued and protected as a precious resource, which include: (i) Body Physiology: Water also helps in all major functions of the body like circulation, excretion, absorption, nerve conduction, respiration, reproduction and (ii) Plants Growth: water is important for plants nutrition, growth, and formation of food. Plants can make their food material by photosynthesis. As a result, this forms starch, that is a form of carbohydrate using water (from soil) and carbon-dioxide (from the air) in the presence of sunlight. The process of enzyme activity and energy production is initiated due to the presence of water. The seedling germinates out of the seed into a big
plant. Additionally, water also helps in loss of heat from plants by the process of transpiration through stomata.

A recent study on water quality governance in Brazil, Ecuador, and Malawi has identified four key challenges, which turned out to be critical in improving the governance in these countries (Kayser et al., 2015). The challenges identified include: insufficient data sharing and coordination between government offices, lack of monitoring and enforcement of water quality laws, unclear federal policies for surveillance of water quality, and administrative and technical management of the water services (Kayser et al., 2015). An estimated 20% of community sub-Saharan Africa was facing water systems that broke down. This highlights the importance to ensure that water systems are managed effectively and rehabilitations can be carried out quickly.

Table 1 Water Classification

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>UNIT</th>
<th>CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammoniacal Nitrogen</td>
<td>mg/l</td>
<td>I</td>
</tr>
<tr>
<td>Biochemical Oxygen Demand</td>
<td>mg/l</td>
<td>II</td>
</tr>
<tr>
<td>Chemical Oxygen Demand</td>
<td>mg/l</td>
<td>III</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>mg/l</td>
<td>IV</td>
</tr>
</tbody>
</table>

Water Classes And Uses

<table>
<thead>
<tr>
<th>CLASS</th>
<th>USES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class II A</td>
<td>Water Supply II – Conventional treatment required. Fishery II – Sensitive aquatic species.</td>
</tr>
<tr>
<td>Class II B</td>
<td>Recreational use with body contact.</td>
</tr>
<tr>
<td>Class III</td>
<td>Water Supply III – Extensive treatment required. Fishery III – Common, of economic value and tolerant species; livestock drinking.</td>
</tr>
<tr>
<td>Class IV</td>
<td>Irrigation</td>
</tr>
<tr>
<td>Class V</td>
<td>None of the above.</td>
</tr>
</tbody>
</table>

DOE Water Quality Classification Based On Water Quality Index

<table>
<thead>
<tr>
<th>SUB INDEX &amp; WATER QUALITY INDEX</th>
<th>INDEX RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biochemical Oxygen Demand (BOD)</td>
<td>91 - 100</td>
</tr>
<tr>
<td>Ammoniacal Nitrogen (NH₃-N)</td>
<td>92 - 100</td>
</tr>
<tr>
<td>Suspended Solids (SS)</td>
<td>76 - 100</td>
</tr>
<tr>
<td>Water Quality Index (WQI)</td>
<td>81 - 100</td>
</tr>
</tbody>
</table>

2.4 Water Conservation and Sustainability Community

Due to the climate change, it is suspected that in 2050, there will be an increase of water stress globally. In addition, some country had already faced water shortage problem especially in drinkable water (Corral-Verdugo & Pinheiro, 2006:IPCC,2008 :Change, 2009). As the water scarcity is increasing, the water conservation strategies need to be focussed. This effort covers the environmental engineering and environmental psychology aspect to promote the sustainability development. Sustainability development is the key component in environmental management (Barrow, 1995). For sustainable water resource management in terms of environmental engineering, several attempts have been made for water management strategies such as recycling and treatment of greywater. Greywater is the wastewater from laundry, shower and sink (not included kitchen sink) as defined by Al-Jayyousi, (2003). Survey conducted by Corral-Verdugo and Pinheiro,(2006) reported that future
orientation that refers to the tendency of people for planning strategies for long term obligation is positively related to sustainable behavior. However from the study, it is also revealed that younger generation significantly has less future orientation than older people. Therefore, a study by Al-Jayyousi, (2003) concluded that the community support towards the opportunities of recycling greywater can be maximized using the environmental policies. Malaysia has enough freshwater sources. In fact, due to climate change, mismanagement and abuse, the water problem is now faced by Malaysia (Chan & Nitivattananon, 2007). As a developing country, Malaysia also tries to accept the sustainability in water management. For instance, Malaysia is supportive with water sustainability. This can be seen with joint partnership collaboration with water expert that represents the NGO’S especially for the lake reservoir.

3 METHODS

3.1 Site Study

Putrajaya Lake within the catchment area of 51.0 km² comprises of surface area of 400 ha and an average depth of 6.6 m, while the wetlands comprise six arms with 24 cells, covering a total area of approximately 200 ha (Majizat et al. 2010 as cited by Sharip et al., 2016). Putrajaya Lake is largely located in the centre of Federal Territories of Putrajaya. Integrating the urban community development with natural element using environmental engineering approaches is the key component in designing Putrajaya Lake. The concept design of City in the Garden is to ensure for well-functioning biogenic environment and future health of the humanity (Sharip et al., 2016).

Figure 1 The main of water body at Putrajaya: Putrajaya Lake

3.2 Methodology

In this study the Lake Sensitivity and Conservation Towards Sustainable Community are discussed in two different facets. First is to study the lake catchment and management in the water sensitivity. Second is to review the maintenance activity conducted by Putrajaya Cooperation and Putrajaya Holding in providing the social activities on Putrajaya Lake (Refer Figure 2). Additional data such as land use and cultural development included. Meanwhile, the adaptation and review of landscape ecology in coastal lake were referred to the lake function and the water quality. Besides using the Lake Management guidelines, The Putrajaya Lake Use Master Plan, Environmental
Management Guidelines, The Catchment Management Guidelines and Putrajaya Lake and Wetland Management & Operational System (PLWMOS) were also used.

![Flow chart for Research Design](source: Author, 2018)

### 4 DATA ANALYSIS AND FINDING

#### 4.1 Monitoring Activities for the Putrajaya Wetland and Lake Management

To make sure that the Putrajaya Lake and Wetlands run a balanced and useful urban ecosystem, an integrated catchment and water-quality management approach has been adopted. The approach encompasses comprehensive monitoring and assessment of the ecosystem’s overall status (Majizat et al. 2010; Majizat et al.2016). The Putrajaya Lake and Wetland Management and Operational System (PLWMOS) are intended to serve as the main environmental database and spatial analytical tool for the current survey of hydrology, physic-chemical, and biotic parameters of Putrajaya Lake.

Based on the data collection and site analysis, the activities at Putrajaya Lake were permitted in only certain zone. The zones were divided into six (6) zones which are: zone 1, zone 2, zone 3, zone 4, zone 5 and zone 6. The study revealed that zone 2, 3, 5 and 6 were permissible for water activity. The activities of canoes sail boards and kayak were suitable for all zones (2, 5 & 6). According to Water Sensitive Urban Design (WSUD), the water at zone 4 are put under class IA and class IB. Water taxis and cruise boats are used to ferry residents and tourist between city destinations that are only suitable at zone 3. The factors that influence the zone 3 activities are water catchment, atmospheric and climatic fluctuations. The study found that the suitable activities for bush-walking, bird watching, jogging, cycling and relaxing were at zone 4. According to Water Sensitive Urban Design (WSUD), the water at zone 4 is under class I. The zone 4 is gazetted to preserve and conserve area for ecological. It is a land for habitat and bird mitigation. Besides, it is an area for maintainace of biodiversity of Putrajaya Lake.

The study also shows that zone 1 is not suitable and is not permitted for any recreational water activities. The zone 1 is gazetted as Wetland area which is sensitive ecological area.

The study shows that monitoring programs is part of the management activities that is undertaken to ensure a fair assessment of the Putrajaya lake functions in relation to its ecological and management requirements as well as confirming the water quality status of the lake.

The study revealed that zoning of the lake and wetlands is an important start to control the possible activities that are permissible in or around the lake. The lake zoning system has been useful, particularly in guiding the appropriate uses and activities.
### Zone 3
Canoes, kayaks, rowing skiffs, and dragon boats for sporting events.
Tour boats and Cruise boats. Vessels to comply with predetermined design and performance criteria.
Water police and Emergency response boats.
Lake maintenance vessels.

![Figure 3: The zone 3 for water taxi and cruise boat activity at Putrajaya Lake](image)

### Zone 2
- Model yachts/model power boats
- Sail boards
- Pedal powered leisure craft
- Canoes, kayaks
- Row boats
- Small electric powered boats

### Zone 5
- Model yachts/model powerboats.
- Pedal powered leisure craft.
- Small yachts and sailboards.
- Canoes, kayaks, row boats.
- Rowing skiffs, dragon boats.

### Zone 6
- Canoes, kayaks, row boats.
- Small powered boats complying with predetermined design and performance criteria.
- Powered leisure boats complying with predetermined design and performance criteria.
- Marine police and Emergency response boats.
- Lake maintenance vessels.

![Zone 2, 5, and 6 for recreational activities](image)

### Zone 1
No recreational vessels permitted.

![The wetlands of Putrajaya](image)

### 4.2 Management and Conservation of Putrajaya Lake

![The Lake Management Zoning Plan](image)

Source: PLWMOS, 2016
Based on observation and primary data, the study shows that management of Putrajaya Lake is to ensure its aesthetics viability, sustaining good water quality while providing the viz-recreational activities, including water activities. Putrajaya Holdings Sdn. Bhd., the main developer in Putrajaya, is currently monitoring the water quality in the Putrajaya Lake. The monitoring and activities analysis also revealed that PJC (Putrajaya Cooperation) and PJH (Putrajaya Holding) are to ensure the environment, biodiversity and the biological aquatic life are sustainable to Putrajaya Lake.

![Figure 7: The management and conservation of water quality at Putrajaya Lake](Source: Alam Sekitar Malaysia Sdn Bhd, 2015)

The study also shows that the Putrajaya Lake management are to (i) ensure the water quality in the lake meets certain quality standard (The Putrajaya Lake Water Quality Standards), which allow it to be used for recreational and suitable for body contact; (ii) achieve habitat enhancement and ecological functions improvement of the open space resources (biodiversity) of the lake and (iii) the urban setting surrounding it - attractive to biological, aquatic life and human. Guidelines such as Lake Management guidelines, The Putrajaya Lake Use Master Plan, Environmental Management Guidelines, The Catchment Management Guidelines and others, that are related in one way or another to the overall lake and wetland management, had been developed and introduced by management of Putrajaya Corporation to cover a wider scope of concern.

### 4.3 Conservation and Sustainability of Putrajaya Lake

Lake is an important water resource as it has multiple functions. Obviously, lake is a part of storage basins for municipal and industrial water supply, agriculture and hydropower (Sharip & Zakaria, 2008). Besides, lake has the richness of natural biodiversity and tourism potential as stated by Sharip and Zakaria, (2008). However, in urban context, mostly there are growing man made wetland and lake from storm water, groundwater and wastewater for an aesthetic, tourism and recreation function (Sharip et al., 2016) that are made for the community nearby. The findings show that activities that might adversely affect the quality and integrity of lake are the general amenity of parks and open spaces, residential neighborhoods and government institutional areas that are deemed as prohibited in the lake and wetlands area. Similarly, activities that cause damage to banks (e.g. as a result of wash of fast large craft) and the overall water quality of the lake are forbidden. One of the
case study provided this attention is Putrajaya Lake and wetland. The studied conducted by Musa, et al. (2016) regarding sustainable city related to the well being of the Putrajaya Resident confirmed the positive perceived of overall community happiness. This respectively covers the factors of well-being, social well-being and urban governance, and economic well-being within the study area.

![Figure 8: The planning and design evolution of Putrajaya Lake based on the theme of City in the Garden](source: Putrajaya Cooperation, 2001.

5 SUMMARY

The management of Putrajaya Lake is comprehensive and formulated with Catchment Development and Management Guidelines. Putrajaya Cooperation Sdn Bhd and Putrajaya Holding are comprehensive in monitoring all programs that are related with corridor and surrounding of Putrajaya Lake. It is to ensure that there is no pollution and any disturbance to Putrajaya Lake and also to the Putrajaya Community. According to Zaharah (2007), Akashah (2005), the integrated program of monitoring and regulatory control were formulated and implemented at the pertinent Master Plan of Putrajaya (land-use, drainage and water sewerage and water catchment).

Putrajaya lake is used as an education resource, research and development for public and community participation within the lake management. However, in Malaysia the lake issue is crucial in Stakeholder’s participation in strategising the lake management. Lake communities are an essential part of many lakes as they inhabit many of these natural or man-made systems. The understanding of physical, biological and characteristic of lake and its uses are important to community. Understanding the importance of community’s participation, stakeholders including NGOs in colloquium and in many of the workshops, and their role which has been incorporated as one of the national strategies to sustain lake management. These committees should be promoted to assist in the management of the lakes and their landscape.

Furthermore, Putrajaya lake also has a tranquility centre for community which provides the ecotourism destination and recreational. The ecotourism supports the water activities at Putrajaya lake. Putrajaya appealing lies in the development of a series of green areas. Besides that, the buffer zones that implement the water body which merged to form a unique ecosystem is a vibrant corridor of local wildlife and vegetation.

The contributions of this study were the participants or stakeholder which are accountability and the individual or agency that takes action in lake management laws at Malaysia lake and reservoir. The details of the strategies and planning of lake management need to be designed for a better quality of water and ecosystem. A good lake management can improve urban fabric in preserving the health of community and aquatic lifes as well as protection for flora and fauna habitat enhancement for fishes. Lake management also improve our sustainability and quality of life.

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PRELIMINARY STUDY ON SENSORY DESIGN FOR ASD: AUTISTIC CLASSROOM

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Abstract - Autism Spectrum Disorders (ASD) refers to a range of condition characterized by challenges with social skills, repetitive behaviors, speech and nonverbal communication as well as unique strengths and differences of a child. The child can survive independently, continue their routine lives and exhibit regular development in the future with the support and encouragement in order to continue their education in different learning environment. Every ASD child is unique and has his or her own combination of characteristics. Unpredictable disruptive behaviors among autistic child could occur in the classroom. Autistic people may appear to behave unusually and they can meltdown when they are in difficulties situation. The impact of sensory differences in people with Autism has been recognized recently. Therefore, designated learning environment should consider sensory issues to overcome their needs. Architects are responsible to provide a design that responds to the needs of all members of society. However, they lack awareness of sensory issues regarding the built environment in the daily life of an individual with autism prior to designing stage especially in terms of safety and security for autism. Thus, this research objective is to identify the criteria of sensory design in the classroom for autism. Developing the Design Criteria Checklist of sensory design for Autism Centre is the aim of this paper. It is hoped that this Design Criteria Checklist is part of benchmarking tool that can be used in identifying the design criteria for autism classroom. The preliminary site visit was conducted accordingly to ensure relevant variables are met in the literature. The result has highlighted the criterion factors that are related to the quality of the physical learning environment and was considered at early design phase. It is hoped that this paper could contribute to architects and designers to utilize this Design Criteria Checklist of sensory design during the design stage and create a quality environment for autistic children in Malaysian. Therefore, the paper intends to measure the conduciveness of environment for autism as well as suggestion on the benefits of creating a conducive learning environment which not only optimize the classroom environment but also fulfill the parent’s satisfaction.

Keywords - Autism, Sensory Design, Physical Learning Environment, Safety, Security

1 INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurological disorder that affects a child’s developmental disability causing social, communication and behavioral challenges (Yates, McLaren, & Proksch, 2016). Individual with autism often affects ability to communicate, understand language, play and relate to others (Boyce, Hunter, & Howlett, 2003). In addition, ASD children can develop skill, social interaction and develop their fullest potential while in school (Shaari & Ahmad, 2016). Therefore, a quality and properly designed physical learning environment will enrich the development and education of autistic children. Hence, Shaari and Ahmad suggested that ensuring the quality of classroom contributing to improve school readiness among them and a better education system. Autistic children with disable should not be exempted from education. UNICEF (2014) stressed that disable children to Malaysia’s Person who have long term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society falls under the Disabilities (PWD) Act. UNICEF has categorized children with disable under learning difficulties. They include condition that effects the learning ability of an individual such as Autism Spectrum Disorder (ASD), Attention Deficit Hyperactivity (ADHD) and specific
learning difficulties such as (dyslexia, dyscalculia and dysgraphia). Thus, the major issue raised is when the learning environment does not constitute sensory design on autistic behavior due to sensory differences. Unpredictable disruptive behaviors among autistic child could occur in the classroom whenever the physical learning environment unconducive for them. Autistic people may appear to behave unusually and they can meltdown when they are in difficulties situation. It is important for architects to provide design that respond to the needs of all members of society. However, they are not aware of sensory issues regarding the built environment in the daily life of autism. This research objective is to identify the criteria of sensory design in the classroom for autism. Architects and designers should be aware the needs of ASD to ensure unpredictable disruptive behaviors do not happen. This paper will elaborate on sensory design which will help designers to create a physical learning environment for the educational and behavioural needs of individuals with autism.

2 DEFINE THE AUTISM BEHAVIOR

The term “spectrum” reflects the wide variation in challenges and strengths possessed by each person with autism (Autism Spectrum Australia, 2017). For instance, the functional impairment of the central part of their brain as well as other neural transmitter malfunction. This is because autistic children hardly concentrate on their activities (Noiprawat & Sahachaiseri, 2010). Yeo and Teng (2015) mentioned that ASD restricted repetitive patterns of behavior, interests and activities. Not only that ASD has poor social skill, they also experience poor eye contact, lack of joint attention, pedantic or odd speech patterns, lack of social problem-solving ability, lack of empathy, and difficulties interpreting body language. Children with ASD are having difficulties in developing their language skills, hearing and communication. Therefore, they express themselves by exhibiting unconventional behaviors such as being aggressive, bad temper or injuring themselves.

3 SENSORY DESIGN

The concept of sensory environment is still on how to create environments for people with autism in the design world (The National Autistic Society, 2015). Architects and designers should be aware how a space feels, sounds, looks, smells and functions can be incredibly influential to how autism children experience their world. Interviewed session Your Autism Magazine with Dr. Magda Mostafa highlighted that the growing population of individuals and families with autism have gained a voice and rise in autism awareness. Thus, the sensory design offered effective architecture to those with challenges and special needs. This topic will discuss briefly on sensory design and focus on safety and security towards the autistic classroom.

3.1 Acoustics

Acoustic is the most important issues in the interior design requirements for autistic children. They are afraid of noise and need a quiet and comfortable environment (Mostafa, 2014; Nazri & Ismail, 2016; Altenmüller-Lewis, 2017). A wide range of noise types were identified that caused distress for young autistic children such as sirens and whistles, bells, unexpected sudden noises, machinery noise, air hand dryers, crowd noise, classroom noise, sharp impact or explosive sounds as such hammering and others (McLaren & Page, 2015). A study showed that good acoustical quality can lead to significantly quieter teaching environments which is particularly important in enhancing the educational outcomes of autistic children. Designers are suggested to consider the level of noise and inappropriate behaviors of children with autism. This is due to their repetitive behavior usually exhibited because of their chronically high level stimulation.
3.2 Colour
The colours play an important role and may affect autistic behavior. Neutral, calming colours and the use of natural materials are best suited for autism-friendly learning environments (Altenmüller-Lewis, 2017; Nazri & Ismail, 2016). They suggested that architect or designer should carefully choose colours to ensure a good balance between the shared and private spaces and avoid disturbing and overly stimulating colours.

3.3 Smell
In addition, autistic children have difficulties and problems with strong smells and even odours. McNally et al. (2013) addressed that school kitchens, dining halls, swimming pools and bin areas are all potentially problematic sources of strong smells.

3.4 Lighting
Natural and artificial lighting need to be composed throughout educational facilities. This is because autistic children are sensitive to light. They will avoid a flickering light, once we switch on the pendaflour light (Nazri & Ismail, 2016; Altenmüller-Lewis, 2017). According to Nazri and Ismail (2016), designer should carefully control reflections, glare and shadow patterns of interior spaces. While artificial lighting should be equipped with dim control as to allow for adjustments or designed as indirect light source to create a glowing interior.

3.5 Accessibility
Children with autism having difficulties and stress when they change environment from the comfort of home to the hustle of school environment. Arriving at the school is an extremely important moment for all children. McNally et al. (2013) recommended that architect who designs the school environment should make this transition as straightforward and as stress-free as possible. This will help to make the experience less stress, more tolerable and hopefully even enjoyable for the autistic child.

3.6 Wayfinding
Complex layouts, long corridors and frequent changes of level can contribute to a feeling of disorientation and create a sense of anxiety to autistic child. According to McNally et al. (2013), designers should consider the circulation around the school is as clear and comprehensible as possible. Unclear circulation can be potentially distressing for pupils. When the autistic child becomes disoriented or lost it can cause great stress to a child with ASD.

3.7 Compartmentation
Compartmentation is to separate the spaces and to organize the spaces accordingly to its functions and sensory qualities (Mostafa, 2014). The philosophy behind this criterion by Mostafa (2014) is to define and limit the sensory environment of each activity, organize a classroom or even an entire building into compartments. Furniture, floor covering, floor level or lighting could be utilized to separate the spaces. Using transition zones helps the individual recalibrate their senses as they move from one level of stimulus to the next. This will help provide sensory cues as to what is expected of the user in each space with minimal ambiguity (Mostafa, 2014).

3.8 Building Scale
Children with ASD will be calmer in an environment that they can easily comprehend. Small-scale schools or those with simple building layouts offer the most basic surroundings for easy comprehension. The scale of a large school can be daunting for a pupil with ASD. The sheer number of buildings, doors, windows, staircases and the variety of classrooms, corridors, offices and countless other rooms to make up the landscape of any large school can present an stimulating yet sometimes disorienting universe for most children (McNally et al., 2013).
3.9 Quiet Room

Children with ASD can begin to demonstrate disruptive behavior when they become tired, distressed or over-stimulated. It needed to allow the children to calm down and in effect ‘recharge their batteries.’ A quiet room will be an area acoustically separated from but directly accessed from the classroom (Mcnally et al., 2013). It may also be treated as a flexible space, sensory room or as a small reading area that can contribute to the learning environment. A quiet room designated within the classroom itself or alternatively that may be separated but still adjacent to the classroom. Empirical research has shown a neutral sensory environment gives positive effect of such spaces with minimal stimulation, particularly in learning environments to these children with ASD. Such spaces may include a small partitioned area or crawl space in a quiet section of a room, or throughout a building in the form of quiet corners (Mcnally et al., 2013; Mostafa, 2014).

3.10 Safety and Security

An architect and designer should be aware of the need to design the so-called ‘architectural barriers’. Arnaiz, Segado, & Albaladejo (2011) mentioned that behavioral problems related to cases of ASD and they would be aggressive at any time. Autistic children have the tendency to escape and run away. Therefore, mechanisms and warning systems that make unobserved leaving of spaces or facilities which are difficult to exit need to be developed. The layout design and setting of the facilities should allow the possible freedom for all users while minimizing hazards, security risks or behavioral triggers for those with ASD (Altenmüller-Lewis, 2017). Safety and security is the most important and concern when designing learning environments. Vulnerable children may have difficulty in realizing the dangers inherent in their environment and may have an altered sense of their environment. Designers should be aware of the fittings to protect the ASD children from hot water and an avoidance of sharp edges and corners (Mcnally et al., 2013; Mostafa, 2014).

Creating a safe environment can be a challenge. Designers need to pay attention to both physical hazards (wiring, open stairways, unscreened windows, loose flooring, toxic paints, etc.) and emotional safety and security. This is because children with ASD are often prone to seizures and behaviors like tantrums or “stimming,” where injury to self and others can occur (Vogel, 2008). Behavioral problems are frequent in cases of ASD where their aggressive conduct may arise, and, therefore, elements present in the built environment must be designed and chosen bearing in mind the possibility of abuses. In particular, bathroom equipment, lighting fixtures and mechanisms, hardware, banisters, wall and floor tiles must be well anchored (Arnaiz et al., 2011).

According to Scott (2009), containment in the class base for reasons of supervision, safety or security by the use of two door handles, at high and low-level, must neither compromise escape procedures, nor violate human rights. In this situation, children must not be locked up unless they are secured or detained legally in secure provision. Scott (2009) also highlighted that robust materials should be used where there are pupils with severe disabilities. In cases like severe disabilities safety precautions for doors, windows, glass, plaster and piped or wired services will be required. He recommended designers to balance security and independence and to find the right mix between tough materials and special equipment on the one hand and ordinary, at the same time eliminating risks.

3.11 Garden

Autistic children responded positively in the garden. Exercise in a natural environment may promote directed attention and social interactions among autistic, which may positively influence exercise intentions (Hansen, Blakely, Dolata, Raulston, & Machalicek (2014); Rogerson, Gladwell, Gallagher & Barton (2016)). Research done by Hussein (2011) explored how autistic child utilized the garden. She revealed the highest number of users, use of sensory gardens by observing the zones and she discovered the pathways that link the sensory garden to the site context which continuous pathways with easy access to the features. In addition, autistic children spent a longer time in zones where sensory provided rather than aesthetic values emphasized.
3.12 Alternative

The art therapy area incorporates various activities such as painting, printing, sculpture and pottery give benefits to autistic child. Activities located outside the classroom with natural lighting creates an enjoyable and creative environment. Pre-vocational and artwork workshop can be integrated to help students create beautiful and functional objects such as simple furniture, leather goods and home accessories (Mostafa, 2014). Pet therapy is also an alternative therapy for autistic children through increased social interaction and communication as well as reduced problem behaviors, autistic severity, and stress (O’Haire, 2013).

4 RESEARCH DESIGN

The quantitative method for this study was based on Creswell (2003) suggestion where survey would facilitate the study. The data collections involved at least three methods for triangulation - questionnaires, personal on-site observations and documentation.

4.1 Experiencing Autism

Based from reviewing previous literature, the researchers have identified relevant issues and problems regarding autism, sensory issues and physical learning environment. The researcher search information on autism behaviours, characters and environment by doing intensive literature review in order to understand their needs. The identification of related issues, establishment of problem statement, identification of research objectives, research questions and research methodologies used are explained in this first phase.

4.2 Preliminary Exploration

Initial site visit were conducted during this stage accordingly to ensure relevant variables obtained as mentioned in literature search. Pusat Permata Kurnia (PKK) was selected because it is the first Autism Centre in Malaysia facilitated by the Malaysia government and located at Sentul, Kuala Lumpur, which is in non-urban area. The preliminary exploration methodology involved site visit, personal observations (photograph), documentation (Design Criteria Checklist) and interviews with the interventionists.

Before visiting the site, the researchers had prepared Design Criteria Check List that was based on a research done by McNally et al (2013). Design Criteria Checklist is part of benchmarking tool assisted in identifying the design criteria in autism centre. The identification involves a series of statements, which encompass four areas – physical building, internal environment, sensory issues and sensory space.

The physical building dealt with building entrance, building scale, safety and security. The internal environment dealt with personal space and movement, way finding, legibility, threshold, classroom, toilet, windows, playroom and quiet room. The sensory issues dealt with visual distraction, sun and glare, lighting, acoustics, smell and colour. Lastly, the sensory space dealt with calm, low stimulus spaces. Finally, yet importantly is the factor on safety and security which are elaborated in the findings.

5 FINDINGS

The results of the study highlighted factors that relate to the quality of physical learning environment. Based on the design criteria checklist it showed that the criterion has been taken into consideration at early design phase.

5.1 The Physical Building

The institution building designed the building into doublestorey. McNally et al (2013) explained that the larger schools can be disorientated and frightening places for autistic children. ASD children would be more tolerable and hopefully joy when they arrive to school. The entrance
designed as straightforward and stress-free for them. The design criteria check list for the physical building is showed in Table 1.

Table 1 The finding of physical building

<table>
<thead>
<tr>
<th>PHYSICAL BUILDING</th>
<th>YES (✓)</th>
<th>NO (X)</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Building Entrance</td>
<td>✓</td>
<td></td>
<td>Straightforward transitions, however double volume spaces provided at drop off area.</td>
</tr>
<tr>
<td>2. Scale and Organisation</td>
<td>✓</td>
<td>✓</td>
<td>2 storey height institutional building. The classroom and courtyard shared base.</td>
</tr>
<tr>
<td>- Classrooms grouped around a shared resource base.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Courtyard shared area as an identifiable grouping or cluster.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Safety and Security</td>
<td>✓</td>
<td></td>
<td>Access to and from the school is secure and the children are monitored at all times.</td>
</tr>
</tbody>
</table>

5.2 Internal Environment

The internal environment has been designed to comprehend the ASD child's impairment. The overall findings for internal environment are tabulated in Table 2.

Table 2 The finding of Internal Environment

<table>
<thead>
<tr>
<th>INTERNAL ENVIRONMENT</th>
<th>YES (✓)</th>
<th>NO (X)</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Personal space and movement</td>
<td>✓</td>
<td></td>
<td>Allowing extra space for circulation, especially at corridors and classrooms itself.</td>
</tr>
<tr>
<td>5. Wayfinding</td>
<td>✓</td>
<td>X</td>
<td>The circulation around the school is clear and comprehensible.</td>
</tr>
<tr>
<td>- Complex layouts</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Long corridors</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>- Frequent changes of level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Legibility</td>
<td>✓</td>
<td></td>
<td>Personalising rooms using individual colours or objects to facilitate association for autistic children.</td>
</tr>
<tr>
<td>7. Threshold</td>
<td>✓</td>
<td></td>
<td>A seated space within the classroom or in the form of a recess in a corridor provided.</td>
</tr>
<tr>
<td>8. The Classroom</td>
<td>✓</td>
<td>✓</td>
<td>The choice of colours, textures and materials are carefully selected physiologically, psychologically and therapeutically.</td>
</tr>
<tr>
<td>- Feel comfortable and relaxed.</td>
<td>✓</td>
<td>✓</td>
<td>The classroom was painted in light blue colour and off-white colour which consider as neutral and calming colors for the ASD.</td>
</tr>
<tr>
<td>- A place of security and familiarity.</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>- A safe place to seek refuge from the chaos.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- The classroom environment is in order and routine and the pupil should know where each activity will happen and when.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- The identification of one activity with one area (zone within the classroom).</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
Illustrated by a visual timetable and located in a prominent position in the classroom.

### 9. Toilet
- Ergonomic
- Sound
- Smell

Toilets & pantries are provided as part of a toilet training program and also the living skill program.

### 10. Windows

Provision of blinds to windows in order to minimize distraction.

### 11. Playroom / Activity Room
- A classroom has access to a secure external play area associated only with that class or age group.
- This area can then be linked to a large play area for the entire school population.

The activity room was painted in light blue colour which consider as neutral and calming colours for the ASD.

### 12. Quiet Space

Space provided at nearby the classroom to allow the child to calm down.

### 5.3 Sensory Issues.

The designer has considered sensory issues, especially on visual distraction, sun and glare, lighting, acoustic and smell. The autistic children avoid bright shiny surfaces, strong texture, bright colours, bright sunlight and fluorescent lighting. The overall findings for sensory issues are explained in Table 3.

<table>
<thead>
<tr>
<th>SENSORY ISSUES</th>
<th>YES (✓)</th>
<th>NO (X)</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. Visual Distraction</td>
<td>✓</td>
<td></td>
<td>The choice of colours, textures and materials are carefully selected</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>physiologically, psychologically and therapeutically.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The classroom was painted in light blue colour and off-white colour which</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>consider as neutral and calming colors for the ASD.</td>
</tr>
<tr>
<td>14. Sun &amp; Glare</td>
<td>✓</td>
<td></td>
<td>Provision of blinds to windows in order to minimize distraction.</td>
</tr>
<tr>
<td>15. Lighting</td>
<td>✓</td>
<td></td>
<td>Care has been taken in choosing artificial lighting.</td>
</tr>
<tr>
<td>16. Acoustics</td>
<td>✓</td>
<td></td>
<td>Care has been taken with choosing material. Acoustic panel provided at</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>music room &amp; assembly hall.</td>
</tr>
</tbody>
</table>

Table 3 The finding of Sensory Issues
5.4 Sensory Space.

ASD children having difficulty during their Meal times, PE time and break times. In PPK they allow the special space for ASD children to sit and calm down so that they can be familiar with their surrounding environment. Table 4 shows the findings of sensory space.

<table>
<thead>
<tr>
<th>SENSORY SPACE</th>
<th>YES (√)</th>
<th>NO (X)</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>18. Calm, low stimulus spaces</td>
<td></td>
<td></td>
<td>Interventionist has determined what &amp; how much to display. Care has been taken when choosing colour and materials for storage etc. The wall was painted in light blue colour. The selection of floor material – non slip vinyl in light blue colour which isa neutral and calming colour for the ASD.</td>
</tr>
<tr>
<td>19. Engaging with others</td>
<td>√</td>
<td></td>
<td>A rest space provided with a safe location from where the pupil can watch the others without being completely removed from their activity. Similarly a recess with seating along a corridor or circulation area has provided a refuge for pause or rest.</td>
</tr>
<tr>
<td>20. Safety and Security</td>
<td></td>
<td></td>
<td>Provided to ensure the safety for ASD child.</td>
</tr>
<tr>
<td>21. Garden</td>
<td>√</td>
<td></td>
<td>Sensory garden provided.</td>
</tr>
</tbody>
</table>

6 CONCLUSIONS

This paper focuses on a design criteria checklist for Pusat Permata Kurnia (PPK). The result shows that most of the criteria have been considered by an individual who is an architect and a designer. This is because the architect is a mother who has an autistic child. She explored the autistic environment and transferred an idea to PPK in order to ensure the conducive and quality of the physical learning environment that can accommodate the needs of autistic children. In future research is needed to measure the conduciveness of autism center base on the design criteria checklist. However, the measurement would be more specific using ‘Likert scale’. Creating a conducive learning environment should not only optimize the classroom environment but also upon a parent’s and teacher’s satisfaction. It is hoped that the architects and designers could create an appropriate environment to enhance and develop autistic behaviors, emotional and would accommodate autistic.
children to live their lives like normal children. Hence, this research could contribute towards the creation of a quality environment for autistic children within the Malaysian context.

REFERENCES


THE ARCHITECTURAL OPENINGS OF THE TRADITIONAL COURTYARD “LATE STRAITS” ECLECTIC STYLE SHOPHOUSES, PENANG CASE STUDIES: LOT NOS. 3, 5 AND 7 LORONG IKAN, GEORGE TOWN

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Abstract – Openings in the traditional courtyard shophouses buildings give facades a sense of scale and directional expression. For these reasons, it is important that care and sensitivity ought to be exercised in repairing existing openings as well as in designing new ones. It is to comprehend the remaining of the maintained culture in the heritage city of George Town. The Lot Nos. 3, 5 and 7 on Lorong Ikan built in 1929 are the typical shophouses along Lorong Ikan and are categorised as the Late Straits Eclectic Style in Penang. These buildings are examples of buildings and the case studies that embrace the original remaining components of the architectural heritage of George Town. This research aims to critically investigate the original openings elements preserved in these houses. The three lots were sold and were earmarked for conversion into a boutique hotel. This paper employed qualitative research approach that obtained data from the secondary sources and observation. The findings of the research point towards highlighting shop house openings, courtyard, air well centre opening, air vents, shutters and windows as well as the most important architectural openings elements preserved in this house which is an additional to its architectural character.

Keywords – Shop house Openings, Courtyard, Air Well Center opening, Air Vents, Shutters and Windows

1 INTRODUCTION

The main objective of this study is to investigate the significance of the traditional courtyard shophouses, the building architectural openings. The architectural openings in the shophouses buildings give facades a sense of scale and directional expressions. Collectively, they also determine the scale and the directional expression of the street. Hence, they are the major elements of the shophouses urban texture. Penang has a tremendous architectural history with approximately 7,000 units of traditional courtyard shop house in George Town Heritage City. This city was built 200 years ago during different periods (Tan, 2015). In George Town Heritage City and within the general Straits Eclectic Style, several building periods can be identified (Trust, 1990). This city in the northern part of the Peninsular Malaysia has been added to the UNESCO's world heritage list in 2008 as to acknowledge its rich cultural heritage constituted of unique architectural components and cultural townscape. The traditional courtyard shophouses in George Town are one of these cultural heritages that have been well studied to understand their importance in the architectural opening components in terms of heritage values context. However, in spite of all this architectural and cultural values, recent modern shophouses in Malaysia do not share similar concern and the importance of maintaining the architectural opening values. The shophouses case studies No. 3, 5, 7 have been chosen for this research because it is the most valuable and authentic artefacts and one of the most important identities of George Town heritage city. The building, a townhouse or a dwelling house, was built in the late 19th century (GTWHI). Furthermore, the building holds many tales of the past in its architecture and design. Many rooms within the building even retain some of their original furnishing. Due the reasons, it is necessary to investigate and carry out the documentation of the architectural openings.
2 PENANG’S TRADITIONAL COURTYARD SHOPHOUSES

In Penang especially in George Town Heritage City, within the general Straits Eclectic Style, several building periods could be identified by the Penang Heritage Trust (Heritage of Malaysia Trust, 1990) which is one of the non-governmental organizations (NGO). It helps to preserve the existing heritage classified as shop house buildings into six main historical styles (Figure 1). Those are, Early “Penang” Style (1790s-1850s), Southern Chinese” Eclectic Style (1840s-1900s), Early “Straits” Eclectic Style (1890s-1910s), Late “Straits” Eclectic Style (1910s-1940s), Art Deco Style (1930s-1960s), Early Modernism Style (1950s -1970s).


The unique architectural and decorative features in each style represent the history of George Town at different periods of time. However, Tan (2015) stated that the Late Straits Eclectic Style buildings seem to be far most eclectic creation, in which Traditional Chinese and Western architectural vocabularies sat side by side, a fusion of diverse ideas. Therefore, this study focused only on the traditional “Late Straits” eclectic style shophouses.

3 METHODOLOGY

This study adopted case studies type of qualitative research to obtain the findings. For the qualitative data collection technique, the study adopted a mixed method which were case studies, observation and secondary sources. Architectural documentation data and visualising materials were also used (Creswell, 2013). This was supported by the architectural detail studies on the Late Straits Eclectic Style Heritage Shop house. However, the paucity of literature in this present study made the researchers to concentrate more on the primary source via photo shoots. These photos were subsequently analysed in detail due to the minimal information on architectural openings in past literature of heritage building shop house. Since the paper focuses on heritage building shophouses, they are crucial to be investigated; hence, this study carried out the documentation of the architectural openings. Therefore, the researchers conducted this research on three combined shophouses buildings (3, 5, and 7) built in 1926 respectively. Besides, this study contributes to the cultural study that reflects the traditional architecture of George Town Heritage City, Penang.

4 RESULTS AND DISCUSSIONS

The main issue of this paper is to highlight the lack of awareness regarding the significance of the architectural openings of the traditional courtyard “Late Straits” eclectic style shophouses. The courtyard is identified as one of the main contributors for the conservation and documentation of the heritage components identity. Therefore, without any documentation as reference, it is difficult to trace its roots. This is due to the passing away of the old master-craftsmen and reluctance of the younger generations to carry on the role of the traditional craftsmanship. For that reason, any preservation and restoration works become an arduous task.
4.1 Traditional Courtyard Shophouses

A courtyard is a common architectural feature that has been applied for thousands of years in many parts of the world particularly in shophouses. Courtyards are often the primary meeting places for specific purposes including gardening, cooking, working, playing, sleeping (Edwards, Sibley, Hakmi & Land, 2006). The courtyards are located near the middle part of the shophouses. They are also the transitional space and the linkages between rooms. The circulation system gradually shifts from public spaces to semi-private spaces and through the stairs to the first floor, which leads to private spaces (Figure 2). It allows daylight to illuminate the internal space of the long narrow shophouses. The opening provides natural ventilation, it does not only increase the energy efficiency but contribute to an enjoyable private outdoor space for the residents (Ahmad & Rasdi, 2000).

![Figure 2 Location of Traditional Courtyards in Lot Nos.3, 5 and 7 Shophouses Buildings. Source: Lot Nos. 3, 5 And 7 Lorong Ikan, George Town Measured Drawings, (2016), Adapted and Surveyed by Author.](image)

As an open space within a cluster or urban fabric, the courtyard fulfils various functions, social, leisure and microclimate. The importance of such a space is due to its location. It is being located in central sites within the urban fabric or building and surrounded by arcades and colonnades, paved, landscaped with water bodies, various plants, shade and light, they all played important roles in the social and working life (Meir, 2000). Moreover, courtyard as a space can provide climatic as well as visual or acoustic protection. The courtyard geometry moreover of its material makeup should be considered in the design stage in order to provide the highest level of thermal comfort possible (Meir, 2000). In addition, the courtyard was developed to be climate responsive. Furthermore, the courtyard can be utilised as an appropriate place for promoting natural, healing environment. Almhafdy et.al (2013) stated that architects could place healing components of nature in courtyards within the building footprint of shophouses; along with windows at the end of corridors to allow natural light to filter through to the public and private areas. Shade, water, trees and flowers, wind, pavement, and colours could induce positive effects towards the five senses of the human body.

4.2 Air Well Central Opening

The air well central openings in traditional courtyard shop houses are originally to be fully open to the sky in order to function effectively as natural ventilation assisting in the natural evaporation of groundwater from the breathable walls and floor (Figure 3). Wooi (2015) asserted that at one-time people began to install sliding roofs with polycarbonate sheet covering. The effect is that air circulation and natural ventilation are reduced by at least 60 per cent which create more problems to the building. Such installations often damage timber or roof eave features. Besides, concerns for security have seen the introduction of timber and metal grilles at a higher level. Again this may cause damage to the original fabric and reduce the natural airflow. Thus, open air wells are highly recommended for the natural ventilation and the general wellbeing of the traditional shop house (Tan, 2015; Zwain & Bahauddin, 2017).
4.3 Air Vents

Vents are wall openings (Figure 4), which are independent of windows or doors that provided additional ventilation. They are placed above the ground floor openings on either side of the main door and are made secure either by vertical iron bars or by decorative carved grilles. Air vents carved to depict four bats, symbolising splendour and blessed life, and are available in a variety of shapes, ranging from small circles and squares to "lucky bat" shapes. In addition, air vents are to promote better air ventilation, they include front façade air vents and air vents on partitions.

On the front façade of traditional courtyard shophouses in Lot Nos.3, 5 and 7 buildings; there are air vents on both floors. On the ground floor, the air vents were placed above the windows, and carved to depict four bats (biān fú), which are homonymic to happiness (fú) in Chinese language pronunciation, symbolising grandeur and a blessed life (Tan, 2015). However on the first floor, there are porthole air vents which are made of precast concrete with flora decoration, can be seen from the exterior view (Figure 5).
4.3 Shutters and Windows

Shutters and windows are the architectural openings that allow illumination and natural ventilation for the inner space. They include ground floor and first floor front façade windows. The shutters and windows on ground floor front façade in the Late Straits Eclectic style always come in pairs one on either side of the main door (Figure 6). The earliest form of ground-floor architectural openings was a plain timber frame with vertical timber bars and solid timber shutters that opened inwards. Hardwood frame complete with transom, curved fanlights, vertical bars, internal bi-fold glass window and solid timber shutter could be seen in these shophouses. The materials used are Meranti timber, solid iron bar and moulded glass.

![Figure 6 Shutters and windows of of Lot Nos. 3, 5 and 7](source: Adapted and Surveyed by Author)

George Town Heritage city was under the ruling of the British and became one of the four settlements in the Straits Settlements. It was developed between the early 19th and 20th century, the shophouses that were built in the Straits Settlements began to adopt Western architectural styles with an emphasis on full-length French windows with a pair of full-length timber shutters, an arch or rectangular transom over the window opening, pilasters of classical orders and plaster renderings (Ahmed, 1994; Chen, 2005). It is to accommodate the hot and humid weather in Malaysia. Traditional shophouses built with type of architecture is called Straits Eclectic style shophouses.

Unlike the early and traditional shophouses which have a continuous row of windows (Figure 7), the Straits Eclectic style shophouses were developed with the breaking of the façade into two or three moulded openings. The tripartite arrangement of three windows on the façade reduces the actual wall space to the minimum and provides maximum ventilation. It is seen that the Western architecture style is working with the Malaysian architecture and its climate. These windows are used on the front and rear façade of the first floor of the shophouses. Such style became popular among the Peranakan China community in George Town, Penang and Melaka (Ahmed, 1994). Structurally, buildings of this style incorporate extensive use of masonry with the introduction of reinforced concrete lintels and beams, timber upper flooring and tiled roofs. On some buildings, the usage of ornaments is at a minimal but when it is applied, it is more significant towards the eye.

![Figure 7 the Early Penang and Southern Chinese Eclectic Style of Windows Façade](source: Adapted and surveyed by author)

Substantially upper-floor front façade shutters and windows could be categorised into four types. The first two reflect traditional crafts-timber and glass. The other two reflect changes to modern technologies of timber, metal and glass. The first type consists of solid timber shutters or timber
louvred shutters arranged between the party wall columns and above a waist-high parapet wall. In the Early Penang and southern Chinese Eclectic styles four to eight individual shutters were usual. The second, door-height or sill-height louvred shutters (Figure 8), together with curved fanlights with either fixed louvred or glazed panels, were introduced from the period of the Early Straits Eclectic style. The number of openings depended on the width of the shophouse, two or three were usual. Raised decorative mouldings or architraves added emphasis to the openings (Tan, 2015).

![Figure 8 The Early Straits Eclectic Style of Windows Façade](Source: Adapted and Surveyed by Author)

The shophouses on Lorong Ikan have 9 shutters and windows on the first floor front facades, 3 shutters and windows for each shophouse (Figure 9). They were made of hard-wood frames, closed timber fanlights and timber balustrades below for security purposes. They are all door-height louvred shutters (jalousies) with solid timber lower panels (Tan, 2015). The shutters from the inside usually have either timber lattice holders or wave-shaped timber pull handles that are symmetrically fixed on the frames.

![Figure 9 Three Shutters and Windows of No.3, 5 and 7 Shophouses](Source: Adapted and Surveyed by Author)

The Western influence could be seen at the facade of the shophouses (Figure 10). During Late Straits Eclectic Style, door height windows shutters were introduced, replacing the full width row of windows shutters above the low walls that were used during the Southern Chinese Eclectic Style. The Early Straits and Late Straits Eclectic Style influenced by the neoclassical windows of Europe, the shutters of the shophouses are in centralised paired arrangements. The door height of the shutters increases the openings size, thus providing maximum ventilation (Tan, 2015).
5 CONCLUSION

"Maintenance is the single most important conservation process. Whether the place is architectural, mechanical or botanical, prevention is better than cure." (Kerr, 1996).

Built heritage in George Town Heritage City, Penang has special values and significance in architecture related to history, aesthetics, building methods, design, material and culture. If this special significance of built heritage is replaced or ignored, then built heritage value is eroded. However, the features of architectural openings and styles of these traditional shophouses evolve over the years. They started from simple early shophouses with cheap attap roof and wooden structures. With the unique culture in Malaysia, the styles of the shophouses were influenced by the mix of the cultural background of all major races residing in George Town, Penang at that time. The traditional shophouses No.3, 5, 7 in Penang, which has been presented in this paper, were converted into a boutique hotel shophouses in the heritage area of George Town, Penang. One can find the original features and decorative elements of the shop house in this area. The buildings are an example of the architectural heritage of George Town city. Certainly, it is a marvellous example of Straits Settlements, were built and owned by a Peranakan family with the surname Wong since 1926. Although being old and dilapidated, many of the traditional shophouses "Late Straits" eclectic style have the potential to be restored and given a new lease of life. It would be great if the local authorities, architects, designers, conservators and the public would pay more attention to these old shophouses around George Town Heritage City, Penang and prevent people from demolishing the traditional shophouses components in order to build modern new offices. This study seeks to comprehend the remaining of the maintained culture in the city. For these reasons, it is important that care and sensitivity ought to be exercised in repairing existing openings as well as in designing new ones.

6 ACKNOWLEDGEMENT

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THE INTERIOR DESIGN OF MALAYSIAN AND
INDONESIAN TRADITIONAL MOSQUE: COMPARATIVE
STUDIES

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Abstract - Nusantara Mosque has its own classification from the perspective of building a mosque architecture in the Islamic world. The Great Mosque of Demak is the oldest mosque in Alam Nusantara and is a reference to the construction of the mosque in the 18th Century and later. The relationship between the Indonesian and Malaysian societies has sparked the equation of the construction technology of the mosque and the design of mosques in both countries. This writing is intended to analyze the design and design of mosque interior space in Indonesia and Malaysia. This comparison study examines the differences and similarities found in the Great Mosque of Demak, Java and Kampung Hulu Mosque of Malacca as the object of study. Although these two samples are within the same scope but there is a disparity between the mosque developed in Indonesia and in Malaysia. This distinction becomes wider when Indonesia and Malaysia achieve independence. Islamic architecture Mosque of Nusantara managed to break out of Arab culture and give birth to its own art and style of art. It enriches the style of Islamic architecture and demonstrates tolerance in Islam that is so clear through the language of its art.

Keyword - Interior design, Architecture, Mosque, Heritage, Islamic Architecture

1 INTRODUCTION

The main purpose of the study is to compare the architectural concepts and interior space between mosques in Malaysia and Indonesia. The research process also looks at the historical development and cultural background of pre-Islamic times, colonial times until the time of independence. This is a comparative assessment of the existence of traditional architecture that developed during the pre-Islamic period in Malaya (Malaysia) and in Java Island successfully and holistically. Design principles focus only on the concepts of interior space and the physical characteristics of traditional mosques found in both study mosques. Architectural style in the archipelago is a result of its cultural understanding, geographical position, understanding of the faith, and the level of competence to relate the form of his artwork. With regards to that, architecture has always been associated with certain time periods and becomes the visual treasures of every culture that goes on in the future.

The tradition of the Great Mosque of Demak has a great influence and is a chain of Islamic architectural journeys in the archipelago in its own unique art style. According to Drs. Oloan Situmorang, the architecture of the mosque in Indonesia has a roof or a triangular roof, and no longer uses a dome. The architecture language of the Indonesian mosque is included in the Malay-Indonesian (Indonesian) schools and is in a distinctive architectural group1. Architecture languages born in the archipelago are the result of a community's understanding of Islamic sharia, which has never set a form or style in Islamic architecture. The Malay-Indonesian community has its own distinctive features of various mosque architectural styles in the Islamic world. The difference in architectural style is the advantage and diversity of Islamic culture in the archipelago.
The Great Mosque of Demak established during the reign of Demak became the emblem of the presence and beginning of the Islamic da'wah in Java. The structure of The Great Mosque of Demak with its roofing roof was created in 1479 AD and is the oldest mosque in the archipelago, which shows the continuity of the tradition of pre-Islamic architecture. There is a similarity in terms of design principles and elements between The Great Mosque of Demak, Maqam Sunan Bonang (approximately 1570 AD) in Tuban, Kampung Laut Mosque in Kota Baru (around 1700 AD) and Kampung Hulu Mosque (1728 AD) (Wan Ramli Wan Daud, 2000).

The scope of this study is limited to the architectural and interior space concept of Kampung Hulu Mosque, Malacca and the Great Mosque of Demak, Java through a comparative study.

2 METHODOLOGY

This research uses qualitative research methodology, with presentation of facts in the form of building drawings of several components with scale-size, picture, detailed painting with measurements based on field data. Presentation of writing utilizes the descriptive method of analysis with cultural and historical approach. The historical method in this study refers to Charles Seignobos's opinion. To obtain the necessary data, this research instrument uses literature reviews, site reviews and interviews. The main source of data collection is by reviewing and collecting the information of the study site and the secondary data with the library data and visual data.

The embodiment of the construction of the mosque reflects the local cultural values found in the mosque's construction. The building of the mosque that has been analysed, is an early development of the history of mosque construction in Tanah Melayu and in Java. The study of The Great Mosque of Demak shows special features in the early days of the spread of Islam in Indonesia and the archipelago. All elements that 'come' from the outside must be stirred until the local cultural values are emphasised, (Tabrani Primadi, 1999).

Although mosques that grow in Malay and Javanese Land are conventionally without using the domed roofs and towers, it is not contrary to Islamic principles and rituals. Regarding the dome and tower, it is more to functional problem solving, as explained by Seyyed Hossein Nasr (Drs Oloan Situmorang, 1995);

In the building of the mosque, the use of domes and towers is more emphasized on the functional aspects, symbolic and beauty like the dome besides being a protector of heat and rain is a symbol of the heavenly dome and reflection of the spiritual horizon. While the outer form of the dome symbolizes aspects of divine beauty or Jamal and the 'vertical' tower symbolizes aspects of God's majesty or Jala (Seyyed Hossein Nasr, 1993).

Source of primary data collection is done by reviewing and recording informations in the field and secondary data with data of librarian and visual data. The data collection and analysis is done by doing a literature review. The study of the site encompasses the surroundings of the mosque's site, the elements of the mosque, the elements of decoration and the art of bina as a whole. Observation techniques were also conducted (participant observation) during the study of the site.

3 RESULTS

The study of Kampung Hulu Mosque, Malacca and the Great Mosque of Demak, Java in the context of history is the main focus of this study. This research is to see the existence of similarities or differences in archaeological architecture of the archipelago. From the comparison it is assumed that the process of cultural transformation is one of the most influential aspects of the concept of the architecture of Kampung Hulu Mosque, Malacca and the Great Mosque of Demak, Java.

In general, the basic form of the mosque consists of triangles and rectangles (Figure 1). The shape of the triangle is visible on the shape of the roof and the shape of the rectangular base on the
walls and the plan of the mosque as a whole. These are the basic forms of the main geometry, which are often called "abstract geometry". This rectangle is called abstract because these elements are more commonly found in intangible objects within the observed object, but only in shape (Budi A. Sukada, 1991). For example, the triangular roof that has the three dimensions, can be considered to be composed of several triangular triangular elements, as well as the square of a mosque building is a combination of several rectangular shapes (Figure 2).

In some elements of art and architecture the basic forms of triangles and rectangles are widely found in Malay society as well as the Javanese society. Joglo's architecture and the Malay house architecture (Malacca) used many basic elements such as triangles and rectangles. The Hindu-Buddhist Hindu-Buddha-Malay civilization since the first century, before the arrival of Islam to the Malay World, produced a roofed house (roof) Joglo like a pyramid house, but the roof is steeper and also produces rooflike projection whose roof meets the highest center (Wan Ramli Wan Daud, 2000).

The basic form on the roof and walls of the mosque front, side and rear view

The shape of the roof and the walls of the mosque building is the view from above.

Figure 1 Basic forms of mosque building

The transformation process creates volume (volume) on the shape of the triangular and rectangular of the Kampung Hulu Mosque, Melaka and the Great Mosque of Demak, Java.

Figure 2

Figure 3 Drawing on the general shape and nature of the architecture of Kampung Hulu Mosque, Malacca and the Great Mosque of Demak, Java.
Triangle elements, for example in Malay culture, are often present in important events such as Sirih Junjung at the wedding ceremony, Pulut Kuning, traditional dress (tengkolong), motifs on batik (bamboo shoots) and so on. So it is quintessential that many works of the Malay and Javanese are present in figures of rectangles and triangles.

In general, the architectural typology of Kampung Hulu Mosque, and the Great Mosque of Demak is rectangular and triangular cage that has centralized, radiant and symmetric properties. In Islamic culture, the shape of the rectangular architecture exists in the form of the Ka'bah that God designates to be the prayer qibla for the Muslims.

| Table 1 Ordinance Typology of Malay-Indonesian Style Mosque Architecture and Islamic Architecture |
|---|---|---|---|
| I | Basic form | Local Culture | Islamic Culture | Explanation (Seyyed Hossein Nasr, 1993) |
| 1. | Triangle | ■ | ● | There is a triangular pyramid in Arab (Egypt), but it is a pre-Islamic culture. |
| 2. | Square | ● | ■ | The square in Islamic culture is found in the form of a temple in Mecca and in the Nabawi mosque in Medina. In the cosmic Islamic architecture of the vaulted classic mosque, the four sides are the image of the earth or the material world8. |

II. Basic properties

<table>
<thead>
<tr>
<th>Local culture (pre-Islamic)</th>
<th>Meaning in Islamic culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Symmetric</td>
<td>■</td>
</tr>
<tr>
<td>2. Centralized</td>
<td>■</td>
</tr>
<tr>
<td>3. Radiant</td>
<td>■</td>
</tr>
</tbody>
</table>

Legend:

■ Present
● Absent

3.1 Similarities and Differences

In the building of the mosque there are several components such as walls, floors, ceilings, poles, door openings and windows as well as the roof. All these aspects reflect the background and mixed elements derived from the Javanese-Chinese, Malay and Islamic Hindu traditions. It is generally known that there are similarities in the mosques of Kampung Hulu Mosque, Malacca and The Great Mosque of Demak, Java. The similarities in the style of the Nusantara mosque is observed by the shape and nature of the building. The authors argue that this similarity factor is driven by the existing culture within the Malay community and the Javanese society, which is almost identical, the pre-Islamic cosmology and belief present prior to the arrival of Islam becomes an acculturation in the local culture. The "Local Genius" of existing societies makes the architecture language after the arrival of Islam still revealing the previous culture. According to Wan Ramli Wan Daud the form of
the mosque of the archipelago is related to the meeting of pre-Islamic cultural art in order to attract non-Muslims to embrace Islam."

3.2 The Influence of Foreign Culture

The roof shape of the roof over Kampung Hulu Mosque and the Great Mosque of Demak is said to be in the form of mountains derived from the culture and the previous beliefs. As disclosed by Dr Abay Subarna that:

"In symbolic terms, the shape of the roof overlap has to do with the shape of the mountains that is considered to play an important role. The form has existed since the prehistoric period in the form of punden, in the period of Hinduism associated with Mahemeru because it was considered a sacred place until it was made at that time the Mahameru replicas transferred in the form of punden (Punden berundak)."

This continuity in Islam was not only in the past, but also in the last days. So do not overdo it if it is mentioned, that the form of mountains is always present in every belief, and is expressed in various manifestations (DR. Abay Subarna, 1987)

In Malaya, the shape of the mountains is always expressed in various forms by the Malay community. The shape of the mountains is often present in various forms and meanings on motifs, ritual ceremonies and so on in Malay society.

3.3 Roof of Mosque Building

The form of roof overlap on both mosques is basically almost the same as other Nusantara mosques. The roof shape of the mosque is triangular in three stages. The largest roof area is arranged on the bottom or the first section and serves as a cover for the porch area, then the medium-sized roof is placed in the second stage and serves as the cover of the internal space (the main area of the sole) and the smallest roof area is placed in the third stage (Roof top) and serves as the cover of the middle area of the prayer space around the soko guru pillar. Kampung Hulu Mosque is supported by four (4) pole series from diamond wood (Wan Ramli Wan Daud, 2000) while The Great Mosque of Demak is supported by 16 pillars and four pillars of soko guru and soko tatal from teak wood on the middle part.

At the top of the roof there is a mustoka that is an ornament found only in the mosque of the archipelago and in China alone, the mustoka contained in the Great Mosque of Demak is embroidered with the sentence (Allah) on the top. On the part of Kampung Hulu Mosque there is only a form of flowering. This flowering has three layers and gradually becomes smaller on the top. (Figure 4) the addition of the kalimah (Allah) aims to explain the function of the building in the previous time.

Figure 4 Mustoka located at the roof of Kampung Hulu Mosque, Melaka And Great Mosque of Demak, Java. (Source: Azizul Azli 2004)
3.4 Body of the building

The Kampung Hulu Mosque Body and the Great Mosque of Demak include walls, pillars and building plans. The square plan of the mosque consists of the following space arrangements: the main prayer hall (shan), the porch room, the hall of mihrab, the pulpit, the maksura (at the Great Mosque of Demak) and the pool of ablution. The concept of designing the second room of the mosque has its similarity. Spatial planning is based on the belief that the exterior is holy and the deepest part is sacred, when compared to the basis of space planning at the mosque, the most sacred space is the mihrab.

Other structures that include the characteristics of the Kampung Hulu Mosque and the Great Mosque of Demak have a stone-built wall that also serves as a support for the roof skeleton structure. At the Great Mosque Demak (Serambi Majapahit23.) there is only the eastern part of the mosque supported by 34 units of pillars and eight (8) of them are Majapahit Poles in the middle of the porch.

The second pillar of the mosque has almost no ornamentation as well as engraving and is just left behind. The authors argue that decorative elements are reduced or abolished in the main prayer hall due to certain meanings believed to not disturb the solemnity of the pilgrims. The carvings that existed in other parts were given more attention to than the pillars of the prayer hall. This happened otherwise for the eastern port of The Great Mosque of Demak where the carving elements were so attentive and this was probably existent from Majapahit's era (Majapahit Pillar). The part of porch
pole from the circular and rectangular stones without decorations supports the verandah. Each of these pillars looks empty without any carving and decorations there. Each pole is divided into three components; Head-body-limbs. The foot of the pillar of the soko is usually made of marble stone material and without engraving. This is seen at Kampung Hulu Mosque and The Great Mosque of Demak.

If viewed from the aspect of the construction function each pillar has a similarity in the aspect of its function, as support on the roof of the mosque building. In addition to the similarity of the proportion of each pole,

3.5 Window and Source of Light

At Kampung Hulu Mosque, there is a window and a small ventilation space in each part of the mosque's body wall. On each of these windows has a grate (grille), and carved flower motifs on the top. These two aspects work in general as a place of natural light and natural ventilation in the main hall of the mosque. The Great Mosque of Demak, has larger windows and ventilated space than Kampung Hulu Mosque. The window of this wood material has a height of 1.5M and has a grille in the middle. At the top there is no ventilation hole in the Kampung Hulu Mosque.

3.6 Interior space of Mosque

The Kampung Hulu Mosque and the Great Mosque of Demak have a square-shaped plan consisting of a base and a floor. The site of the mosque has similarities with pre-Islamic times, such as the royal palace building of Majapahit. The base site of Kampung Hulu Mosque building is more rectangular with the height of the floor about 80cm from the ground.

Table 1 Comparison of Window Design and Ventilation

<table>
<thead>
<tr>
<th>No</th>
<th>Kg.Hulu Mosque</th>
<th>The Great Mosque of Demak</th>
<th>Local Culture (Pre-Islamic)</th>
<th>Local Culture (after Islam)</th>
<th>Foreign Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>![Image]</td>
<td>![Image]</td>
<td>East Window: At Kg.Hulu Mosque there is influence of the Malay house architecture. The shape and type of bulk material are almost identical. The number of grilles is four (4) The Great Mosque of Demak also has an even number of 12 units</td>
<td>East Window: The overall form of the Kg.Hulu Mosque is still influenced by Malay architecture. In The Great Mosque of Demak the immaculate and overall material is still influenced by the Javanese architecture.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>![Image]</td>
<td>![Image]</td>
<td>West Window: At the Kg.Hulu Mosque there is the same shape on the Malay house architecture. The Great Mosque of Demak. The overall shape and the immaculate material are also influenced by Javanese architecture</td>
<td>West Window: The whole form of the Kg.Hulu Mosque is still influenced by Malay architecture. At The Great Mosque of Demak the material and overall still follow the Javanese architecture. The even number of lattice is not unusual like the pre-Islamic</td>
<td></td>
</tr>
</tbody>
</table>
The base site of The Great Mosque of Demak is simpler and lower where the height of the floor is about 40cm and is arranged to form a long facet off the ground. Viewed from the aspect of the structure, the floor contained in Kampung Hulu Mosque, has similarities with the architecture of Malaccan Malay houses. Likewise applies to the Great Mosque of Demak, having similarities with the stage floor contained in traditional buildings in Java.

| 3. | Ventilation: Plant motifs as a ban on the use of animate creatures in the decoration. Plant motifs are used. | The Lotus flower in the Upper Kg Mosque is identical to Hindu-Buddhist culture. The shape of the dragon that was present at the Great Mosque of Demak was brought by Javanese culture before. |

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**Figure 6** The site is five steps high to reach the foyer at Kampung Hulu Mosque, Melaka.  
(Source: UTM Measured Painting Survey 1987/88)

**Figure 7** The site at the Great Mosque of Demak, Java elevated from ground level.  
(Source: Yulianto.S Mosque Architecture; pp. 509.)
3.7 Ablution Pool

Compelling components apart from the mosque's interior space, which has a purifying space (ablution pool). The ablution pool at Kampung Hulu Mosque, is believed to be erected along with the construction of a mosque, where it is positioned on the left side of the mosque entrance. This ablution pool is located within the building area at the end of the Eastern foyer. This ablution pool has an altitude of about 70cm off the ground and is shaped like a square plan. This ablution pool has 3 stair steps connecting with ground level.

![Figure 8: Entrance to mosque and Ablution Pool of Kampung Hulu Mosque, Malacca.](Source: UTM Measured Painting Survey 1987/88)

![Figure 9: Entrance to mosque and Ablution Pool of The Great Mosque of Demak, Java.](Source: Yulianto.S Mosque Architecture; pp. 509.)

At the Great Mosque of Demak, the ablution pool, believed to have been developed at the beginning of Islam's development (15th century) lies at the right of the mosque. These two pools of ablution are not facing the direction of the qiblah but its orientation is tilted towards the direction of the Qiblah. The Great Mosque of Demak is above the ground and is not elevated like Kampung Hulu Mosque and rectangular plan.

Something interesting in the authors' observations was the fact that traditional mosques in Indonesia often have a pool of water before entering the ablution pool area, the concept of foot cleaning ponds like this has never been found in traditional mosques in Malaysia. The surrounding ponds not only serve as a place of ablution and cleaning, but are also said to be an ocean symbol (Azizul Azli, 2004).

3.8 Mihrab

The mosque found in Kampung Hulu Mosque, Malacca is built in a narrow 85 cm wide, 166 cm high with a depth of about 150 cm, just enough to accommodate an Imam only. The Great Mosque of Demak, has a pulpit width, which only fits for one person. Has a width of 95 cm, height of 170 cm with a depth of about 165 cm. In front of the mihrab there are tortoises and two pieces of Chinese ceramics believed to be from the Ming Dynasty. This is associated with the construction period of the mosque based on other items of the same dynasty in the
mosque museum. Animals or elements of living objects, during the observation of the author, are rarely or almost never found at mosque buildings in Malaysia. More interestingly, the mosque of the Great Mosque of Demak was lowered by 2.5cm compared to the main prayer hall floor. In spite of that, this part of Kampung Hulu Mosque the elevated part.

3.9 Pulpit

The pulpit found in the Kampung Hulu Mosque, Malacca has some similarities in terms of the shape with the pulpit on The Great Mosque of Demak, Java. This resemblance is seen from the structure and ornamentation that is present. This factor is according to the opinion of Wan Hussein Azmi that Malacca at that time had many Javanese people who came to trade and served as the army of the Malacca government. This relationship is also based on the most common marriages among the rulers in the spread of Islam (Wan Hussein Azmi, 1980). If viewed on the overall construction of Kampung Hulu Mosque, it has a dome on top. At the top there is a small mustoka as it is often found on top of the roofs of mosques. The pulpit at the Great Mosque of Demak, originated from Dampar Kencana, which was occupied by the kingdom of Demak as a sultan's seat (Ali Kusnan, 1995).

If observed, its cultural form and pattern is an integration of two traditions, namely the patterns of Chinese culture and Hindu-Buddhist. This can be witnessed through the carvings in the form of dragon images depicting Chinese culture. Dragon motifs and makara temples, often found on the walls of the temple building, the basic form of the motif is applied back to the surface of the mihrab field (Sulendraningrat, P.S., 1984).

Abay Subarna explains that the elements of the dragon have been present since the previous Javanese culture. The figures of the foliage carving and the lotus flower are regarded as Hindu-Buddhist culture, which is also present in the front sight of the pulpit. The lotus flower carving found in Hindu-Buddhist culture is also found in both pulpits. In the discussion framework regarding the basic motif in terms of the lotus flower elements that are considered sacred in Hinduism, it is in accordance with the principles of Islamic teachings that the lotus is one of the signs of His entire creation (Abay Subarna, 2003).

3.10 Maksurah

The special facilities contained in the interior of the building of The Great Mosque of Demak, the Maksurah are special characteristics of mosques in Indonesia and Africa, and are never found in the mosques of Malaya. The Maksurahs are made for prayer activities for sunan, sunan family and court staff. The maksurah in the mosque consists of only one unit, at the west of the left of the mihrab space.

3.11 Pawestren.

One interesting detail during this research is the part of women's prayer called pawestren. The word pawestren is derived from the word wife (in Javanese and Sundanese), which means woman or lady: Female place (pawestren) (Masjid, 2000). There are other terms such as pawadonan or pagwadonan derived from the word wadon meaning a woman or a lady. The word is considered impolite in Javanese language and later known as pawestren ³⁶. Pawestren found in traditional mosques in Java tend to be at the left or south of the main male area (liwan) and are often welded or enclosed permanently. This is believed to be the influence of the Javanese traditional house architecture that accommodates the female room on the left.

At mosques in Malaya, special space for women is often at the back of the male main chamber. This entrance is also separated so that the boundaries of aurat can be controlled and avoided. Throughout the author’s research, the special space placing women on the left like the traditional mosques in the Land of Java had never been found.
4 CONCLUSION OF STUDY

This study is a comparison of physical designs between the traditional mosques in Malaya and in Java, which is overshadowed by the old belief system to the culture characterized by Islamic nuances. It is believed that with the inclusion of Islam in the Nusantara area, there has been a cultural acculturation process, which has led to transformation in all aspects of life including the concept of architectural design. The author finds some differences in the Kampung Hulu Mosque, Malacca and The Great Mosque of Demak, Java. In general, it can be concluded that several aspects of architecture and interior space differ in both mosques as follows:

1. **Tower:** In general, mosques in Java or Malay-Indonesian style do not have a tower in the mosque, however, most mosque traditions in Melaka have a mosque tower built at the same time as the mosque's construction.

2. **Ablution pool:** Pools on the front of the mosque often found in traditional mosques in Java are not found in mosques in Malaya (Malaysia). This is a privilege in the design of space and the meaning of philosophy in a traditional mosque in Java.

3. **Women's Prayer Room:** The prayer room for women at the traditional mosque in Java is located on the left side of the main prayer hall, this does not apply in Malaya where women are often placed at the back.

4. **Mosque Verandah:** In traditional mosques in Java often the portions of the foyer are in the East (opposite the direction of the qiblah) of the mosque, while in the traditional mosques in Malaya, the mosque verandah is usually surrounding the body of the mosque (main prayer hall).

5. **Qiblah:** Some traditional mosques in Java (except the Great Mosque of Demak and the Great Mosque of Cirebon) that are found /that the direction of the Qiblah is facing towards the West, while for the people in the archipelago the orientation of the Qiblah is somewhat inclined towards the Northwest. Traditional mosques in Malaya is hardly found in this case, almost all of its mosques face towards the Qiblah.

6. **Library:** Most traditional mosques in Indonesia have a library as a place of science and coincide with the concept of a mosque as a place of worship. It is rare in Malaya (Malaysia) where there is a library within the mosque area.

7. **Decorative items:** the plant pods dominate the shape of the pulpit; this is the evolution of the ornamental arts present in Malaya and Java earlier. This art flourished with Islamic aesthetic elements, especially with the touch of the Arabic calligraphy.

8. **Philosophically,** Kampung Hulu Mosque, Malacca and Great Mosque of Demak, Java is a national culture that is full of philosophical values and aesthetic symbols that are expressed in interior space and architecture through the symbols of tauhid, tarekat, and the faith of Islamiyah.

The mosque's flow and style of architecture is largely influenced by the ever-expanding cultural factors as well as the existing technology as it was developed. The design of mosques embraced by a long-established cultural development in local culture reveals the wisdom of the local intellectuals in cultivating Islamic art. Islam's tolerance has also been well translated in providing a magnificent and meaningful mosque design to the Muslim community. Local cultures that are acculturated into Islamic culture further enriched the Islamic culture that has flourished before.

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BIOPHILIC DESIGN IN HERITAGE INDOOR WORKPLACE
IN GEORGE TOWN, PENANG, MALAYSIA

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Abstract - Current lifestyle influences Malaysian occupants work more than 8 hours a day in order to cope with large workloads and meeting deadline. Majority of the occupants are facing overstressed, negative emotion and lead to unhealthy lifestyle. Several studies show that elements of nature are able to enhance human well-being by reconnecting human with nature elements in built environment, which is known as biophilic design. Therefore, this study aims to create a biophilic design guideline to enhance occupants’ well-being in heritage adaptive reuse indoor workplace. This study was conducted in Heritage World Site (WHS) in George Town, Penang. Mixed method research design was used to collect data from site. Both qualitative and quantitative data were analysed to validate the overall data and research by cross verifying the information from multiple methods obtained. The results proved that the existing of biophilic design patterns significantly enhance occupants’ emotional well-being and it can be used as design guideline in the future. This study also investigated the different ways of biophilic design patterns application that can affect the quality of biophilic experiences.

Keywords - Biophilic design, heritage indoor, workplace, human well-being

1 INTRODUCTION

1.1 Background

Penang was listed under the UNESCO World Heritage Site (WHS) in 2007. The heritage buildings are being protected under the National Heritage Act 2005. Any form of conservation works must obtain approval from the Penang local authority. This is to maintain the Outstanding Universal Values (OUVs) as the World Heritage Site status. The majority of the heritage buildings in Penang have been adaptively reused in order to keep it occupied and to accommodate the current lifestyle. This continuous adaptive reuse practice has evolved and conditioned the indoor space to be an unhealthy environment especially for a workplace.

Malaysian occupants work an average of 15 hours a day, exceeded their contracted hours, surpassing Singapore, Hong Kong and Australia (Fong, 2017). Studies indicated that majority of the occupants were unhappy with the current working culture where they are required to work extended hours and cope with large workloads while simultaneously meeting production targets and deadlines (Konz & Rys, 2002; Townley, 2000). A newly-released workplace survey conducted by AIA Vitality found that 53% of Malaysian employees are overworked, stressed, being emotionally negative, and lead to unhealthy lifestyles.

Physical workstation environment includes many aspects such as humidity system, lighting effect, and work area design. An occupant’s psychology is an indication of his/her environment (Piko, 2006). Occupants’ psychology in the workplace today is worse than what was experienced by the past generation (Minter, 1999). When an individual feels stress, his/her psychological, and behavioural will be detracted (Beehr & Newman, 1978; Sutton & Rafaeli, 1987).

Empirical studies proved elements of nature bring positive impacts on occupants’ well-being in term of cognition, psychology and physiology. There are growing number of research groups using experimental or quasi-experimental research designs to test the effect of nature on occupants in many factors such as productivity, stress, and discomfort symptoms, mood, emotions, job satisfaction and
attitude toward indoor workplace (Adachi, Rohde, & Kendle, 2000; Bringslimark, Hartig, & Patil, 2007; Chang & Chen, 2005; Lohr, Pearsons-Mims, & Goodwin, 1996; Shibata & Suzuki, 2004). Therefore, in order to enhance occupants’ well-being in an adaptive reuse heritage indoor workplace, the relationship between occupants and nature is an essential aspect to be re-established. Biophilic design is the term to translate an understanding of the inherent human affinity into the design of modern built environment (Kellert, 2008).

1.2 **Aim of study**

The aim of this study is to create a biophilic design guideline to enhance occupants’ well-being in an adaptive reuse heritage indoor workplace.

1.3 **Objectives of the study**

The objectives of this study are to examine and analyse biophilic design patterns in heritage indoor workplace.

2 **LITERATURE REVIEW**

2.1 **Adaptive reuse heritage building**

Heritage buildings are the legacy from the past and they also represent the cultural history. Thus, they need to be conserved for the next generation (UNESCO, 1972). As stated in Malaysia National Heritage Act 2005, buildings that are 50 years old and above are categorised as heritage buildings. Those buildings are to be preserved, protected, and enhanced.

One of the conservation methods that promotes sustainability is by applying the adaptive reuse of heritage buildings. Adaptive reuse can be defined as modifying a place to suit the existing use and be compatible, which involves no change to the culturally significant fabric, changes that are significantly reversible, or changes with minimal impact (Charter, 2013).

George Town is one of the historical port cities in Malacca Straits that is selected by United National Educational, Scientific and Cultural Organisations (UNESCO) as one of the World Heritage Site (WHS) because of its Outstanding Universal Value (OUP) in cultural diversity and living heritage.

2.2 **Biophilic Design**

Nature is basic human primary needs. Biophilia is defined as “the innate tendency to focus on life and lifelike processes” (Wilson, 1984). It was developed as a part of the evolutionary survival and, thus include certain characteristics that remained within humans until the current time. Wilson (1984) stated that loving a life is for an innate human to explore and affiliate with life. It is a deep and complicated process in mental development (Wilson, 1984). Kellert (2008) hypothesised the nourishment of this innate human connection with nature is important for modern urban human well-being. Humans are biologically responding positively to nature as per Fromm’s concept, “this affiliation can assist in humans’ intellectual, emotional, and spiritual fulfilment” (Soderlund & Newman, 2015). A conference at Rhode Island, US in 2006, Kellert, Heerwagen, and Mador (2008) established cross-disciplinary foundations for a biophilic design approach in the built environment. Biophilic design is to re-establish relationship between innate human with nature in built environment. Biophilic design can be studied by using biophilic design patterns. It has evolved from Kellert and originally was with 70 biophilic design attributes then merged into 14 biophilic design patterns (Browning, Ryan, & Clancy, 2014). The 14 biophilic design patterns are divided into 3 categories as tabulated in Table 1.

Biophilic Design can be studied by using biophilic design patterns. It has evolved from Kellert and originally was with 70 biophilic design attributes then merged into 14 biophilic design patterns (Browning, Ryan, & Clancy, 2014). The 14 biophilic design patterns are divided into 3 categories as tabulated in Table 1.

Nature in the Space defines the application of nature elements into the designed indoor space to create a biophilic environment. Natural Analogues indicate designed features that are related to nature aspects such as ornamentation, use of natural materials, and biomorphic forms. Natural imagery indicates symbolic value – for example, water element represents wealth in Chinese belief. Nature of the Space indicates exploring human response to various spatial patterns of the built environment space. Previous research studies only concentrated on one element pattern.
Table 1: 14 Biophilic Design Patterns

<table>
<thead>
<tr>
<th>Categories</th>
<th>Biophilic Design Patterns</th>
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(Source: Browning et al., 2014)

3 METHODOLOGY

3.1 Site Parameter

George Town core zone (109.38 ha.) was selected for this case study because the heritage architectures in the core zone are well-kept compared to the buffer zone. Core zone is divided into eight different zones (Figure 1). Financial zone has the most indoor workplaces such as banks, co-workers space, lawyer firms, finances firms, and government office whereas occupants have the highest level of stress and negative emotional.

![Figure 1: Heritage Zone Plan](Source: GWTHI, 2013)

3.1 Sampling Selection

The selective workplace is based on criteria: 1) It has to be a cross-disciplinary unit with different departments such as receptionist, administrative staff, and other occupants; 2) The occupants must work at least 8 hours per day and 5 working days per week; 3) The workplace is an adaptive reuse heritage commercial building.
3.2 Data Collection

This study was conducted into two phases. First was site observation and documentation. The existing architectural of the heritage building and interior layout of the workplace was observed by taking photos and was illustrated using AutoCAD. In order to observe the relationship among occupants with biophilic design patterns, the observation was conducted during working hours. The second phase was a set of questionnaire with projection technique. The questionnaire was conducted towards selected occupants who work for minimum 8 hours per day and working 5 days per week. A projection technique was used by editing a selected site photo which was taken from the existing site, using Adobe Photoshop software to add in biophilic design patterns. This questionnaire is categorised into two parts; in the first part, socio-demographic data, including age, number of children, marital status, monthly income, educational level, and years of work experience were posed. The second part of the questionnaire is ZIPERS (Zuckerman, 1977). This is to measure of emotional states. ZIPERS consists of 12 items and using 5-point scales (1 = Not at all; 2 = Slightly; 3 = Somewhat; 4 = Definitely; 5 = Very much). Questionnaire and edited site photo were given to the selected occupants to fill in.

3.3 Analysing Tools

In Phase two, Zuckerman Inventory of Personal Reactions (ZIPERS) questionnaire were analysed using Statistical Package for the Social Sciences (SPSS). In addition, triangulation method was used to analyse Phase one and Phase two data collection in order to validate the credibility of the overall data and research by cross verifying the information and data from multiple methods obtained.

4 FINDINGS

4.1 Phase 1 (Observation & Documentation)

Yeap Chor Ee heritage building was built in 1922 and was designed by Messrs Stark & McNeil and owned by Mr. Yeap Chow Ee along China Street Ghaut in World Heritage Site (WHS) core zone in George Town, Penang. The building has served in different functions – from warehouses to several banks and today it is adaptively reused as various types of commercial space which are café (Ground Floor), Penang Science Cluster Centre (Ground Floor), and co-workers space (Second Floor). The co-workers space was being selected because it fulfils the sampling selection criteria.

Although Yeap Chor Ee heritage building was built in 1922, the architecture style of the building is Art Deco Style (1930s to early 1960s). This is shown by the identical art deco style elements such as reinforced concrete structure – beams and columns, clean surfaces, geometric, linear and modern in expression. Besides, its white plain surfaces that are highlighted with parallel and bold vertical or horizontal lines have created sunburst motif to the surrounding entrance and window. There is ‘leaf’ decoration motif underneath the first floor balcony. The façade of the architectural has achieved the biophilic design pattern (P8). In addition, the existing large windows and doors provide sufficient daylighting (P6) into the main atrium staircase, corridor and indoor co-workers workplace.
Therefore, the main atrium staircase and corridor’s artificial lights are switched off during the day, to save energy and be sustainable. In the co-workers’ workplace, there is a combination of artificial light and daylighting. However, majority of the occupants preferred to work under artificial lighting rather than working beside windows with daylighting. This is due to over glaring and computer monitor screen reflection. The administration staff used whiteboard stand to block over excessive daylighting. In addition, the large windows, doors, and the openness of the workplace without any height divider in between workstation created biophilic design pattern (P11). Occupants were able to view the overall space. The large windows that surround the workplace are closed and the door access is controlled with the card system. These allowed the occupants to feel safe and secure (P12).

![Images](a) ![Images](b)

The main atrium staircase and corridor permitted natural air ventilation (P4) through the opening of windows and balcony door. At the workplace the windows are closed and the air ventilation mechanism such as ceiling fan and air cooler stand are operating all the time.

![Images](c) ![Images](d) ![Images](e)

Besides, the interior workplace used timber flooring and exposing timber roof structure and roof clay tiles (P9) without any ceiling finishes. Occupants can enjoy the existing natural materials and understand the culture and structure of the heritage building while working in the workstation. This created a sense of place in the workplace.

![Images](f) ![Images](g) ![Images](h)

The view throughout the windows had a beautiful and green scenery of sea, trees and is surrounded by other heritage buildings. However, certain windows that face other heritage building that was painted white, became very glaring towards the occupants. Most of the occupants sat further from the existing window. In addition, the window’s lowest point is higher than the occupant eye level who are sitting down. Hence, biophilic design pattern (P1) existed within the workplace, but occupants cannot enjoy the scenery except of the sky view through the window.
4.2 Phase 2 (Questionnaire and Projection Technique)
Biophilic design pattern (P1) was used to be implemented into existing site photo of workplace because; 1) projection technique by using photo for occupant to visualise before and after. Therefore, the biophilic design patterns (P2, P3, P7, P10, P13 and P14) are not suitable to be applied; 2) Biophilic design pattern (P5) is not suitable due to space limitation in the workplace.

Indoor plants include Boston Fern (*Nephrolepis exaltata*) and Areca Palm (*Chrysalidocarpus lutescens*) and were used for editing the site photo. The selection of the indoor plants was based on the highest toxic gas removal of formaldehyde (from paint, plywood, fabric, varnishes), xylene and benzene (from paint, photocopy printers, and varnishes) (C., 1996). The selection of the indoor plants was not only for visual preference but also for enhancing indoor air quality. These plants were specifically chosen based on the existing condition.

<table>
<thead>
<tr>
<th>Table 2: Descriptive Statistic for ZIPERS</th>
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<tr>
<td><strong>ZIPERS Questionnaire subscales</strong></td>
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<td>Positive Affect</td>
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<td>Sadness</td>
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<td>Attentiveness</td>
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<tr>
<td>Anger/Aggression</td>
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<td>Fear Arousal</td>
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</table>

*An item’s highest mean is given in bold type*

The result from Table 2 shows that occupants have more positive emotion and attentiveness with the appearance of indoor plants in the indoor workplace compared to the existing indoor condition which does not have indoor plant. From both results, biophilic design patterns can be achieved up to 8 patterns out of 14 patterns in Yeap Chor Ee heritage building indoor workplace which fulfills the research objective.

The eight biophilic design patterns combination promote a better indoor environment for workers to be healthier, happier, increase focus and concentration. In conjunction, the results significantly showed biophilic design pattern (P1) with indoor plants implementation into the workplace in occupants’ eye level views has a better biophilic experience compared to window view.

5 CONCLUSIONS

In a nutshell, this study that has been done in an adaptive reuse building indoor workplace has proven that the existing of biophilic design patterns significantly enhance occupants’ emotional well-being. This study also investigated that different way of application of biophilic design patterns do affects the quality of biophilic experiences. Thus, further study is required to determine the biophilic design patterns in a proper and effective way in built environment as to create better biophilic experience. In addition, the biophilic design patterns can be used as a guideline to design commercial adaptive reuse spaces, increase occupants’ performance and company socio-economics in the future.

REFERENCES


FOURTH INDUSTRIAL REVOLUTION AND ITS IMPACT TOWARDS SHOP HOUSES IMAGE

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Abstract – Conferences and conventions have been organized by the United Nations for Education, Scientific and Culture Organisation (UNESCO) since the early convention in Belgrade. The main aim of the organisation is to create heritage awareness to the participating countries’ players in their construction industry especially the multi disciplinarian’s urban builders, urban designers and city authorities. These countries have to create principles to uphold local heritage protection, conservation and revitalisation. Otherwise, new modern buildings are constructed without putting priority on the significance of the existing urban context such as heritage shop houses and heritage buildings. The heritage buildings were randomly demolished due to development pressures from various angles since the past industrial revolution until the new Industrial Revolution 4.0. Therefore, this study zoomed on issues of industrial revolution and globalisation towards outdoor ambiance in between heritage shop houses. The heritage shop houses in this study were limited to shop houses within the core zone of the historic city of the Straits of Malacca; George Town in Pulau Pinang and Melaka. The current condition of the physical and spiritual attributes of the ‘outdoor space in between the heritage street is in conditional feature that requires urgent revitalisation. The spaces have a high potential to be enhanced as ‘an urban outdoor living space’ with magnetic attraction as “a place” for promoting on-street cultural heritage ambiance. The vibrant movement of pedestrian of the observed study area has the regenerative potentials to create an attractive aura with unique, antique and authentic ambience. Thus, the outdoor space quality reflects a generative economic, environmental and social values. With this awareness, the paper discusses the scenario of urban heritage shop houses that require revitalisation. Then, the final section of the discussion presents the constructive attributes to share the setting of our local urban heritage in Malaysia.

Keywords – industrial revolution, heritage shop houses, outdoor space, core zone,

1 INTRODUCTION

This research focused on the existing phenomenon and identification of the revitalisation opportunity on the identification of constructive attributes for the heritage shop houses in the Cities of the Straits of Melaka: Melaka and George Town, Pulau Pinang. The site setting of the study are located within the Malaysian world heritage sites which was inscribed in 2008. The study evaluates an existing cultural phenomenon of selected heritage streets within the core zone of the Historic Cities of the Straits of Melaka. To enhance the valuable sites, a pro-active efforts from the local authorities especially Majlis Bandaraya Melaka Bersejarah (MBMB) and Majlis Perbandaran Pulau Pinang (MPPP) provide a significant data source. The directly-involved end users i.e. the shop owners who contributed to the life and death of the shop houses are the valuable data and are considered as significant source of information in this research.

The area of interest in heritage in Malaysia is a norm especially in the millennium age. There are the main actors in the area in which the main heritage researchers, the main heritage conservators and the main protectors are in the re-development of heritage projects. There are the role players who are involved in the built making and built revitalisation process such as heroes, rich and famous people in the ‘battle field’ in the process of managing and constructing urban built form (Bentley, I. 1985). On the other hand, there are also non-heroic people who care and observe the new image of the space in between heritage shop houses within the Historic Cities of the Straits of Malacca: George Town and
Melaka. The major players in the heritage shop houses include the builders, owners, developer and controller of the past, which still remain in the history. The most important players is the inheritance who inherited the shop houses properties from earlier generations. In dealing with the owners of shop houses properties in the recent data collection process in 2018; the researcher acts as “the andragogy-researcher” and the main actors in the heritage field as the ‘heritage expert’. The researcher learns from the most superior, knowledgeable and experienced heritage experts. The findings of this study unveils the constructive attributes with regards to the heritage shop houses valorisation in the study site.

2 THE CHALLENGE OF HERITAGE SHOP HOUSES

The tourism industry has elevated the significance of heritage shop houses and managed to sustain even during the current fourth industrial revolution, globalisation and post millennium challenges. The challenges provide both negative and positive impacts. One of the negative impacts of current challenge is it brings in pressure from global to local levels, including urban layout, image, identity, character and architecture. The worst fourth industrial revolution and globalisation impact is the influence of ‘robotic-touch’ and ‘international style’ which employs a ‘minimalism’ provocation. The industrial revolution style and international style and minimalism promote simplicity, industrialized image and functional of physical external features which would affect the natural aspect of the building.

The second impact of fourth industrial revolution and globalisation is on building physical feature, colour, opening size and composition of the façade treatment. In a new mega-city building is designed in the international style. In this international style, the low and high rise buildings in city have the image and identity of a basic cuboid form such as ‘shoe-boxed’, glazed with curtain walling system and flat reinforced concrete roofing. The external facade treatment or the envelope of the international style which is too simple look like vertical cuboid with non compliance to tropical climate.

The third negative impact of fourth industrial revolution and globalisation is the ‘minimalist principle’ in façade design (Laurence, P. L., 2006). The international style promotes architectural design feature of glazed curtain walling system which has minimum maintenance cost due to uniformity or flat surfaced façade design. This style however, has caused other problems. The reflected day light cause ‘glare effect’ to end users, higher thermal heat to local climate to surrounding grounds and the adjacent buildings causing discomfort environment. Besides the walling component challenges, the fourth negative impact of internationalisation of building design is the flat roof design. This flat roof design fails to cater all year round high degree of sunny and rainy of the tropical climate. The lacking overhangs that functions to provide shading device to the building facades. Thus, the facade treatment would actually require extra cost for providing shading device to control and reduce the day lighting effects. Besides the lack of overhang, other problems from flat roof design is on the aspect of roof maintenance and roof-top grey water collection and disposals that are storm-water system.

Thus, for the sake of responding to the latest global image and trend, the local natural factor and the richness of local cultural heritage are not considered as prioritised criteria in new urban planning and architectural style development. In terms of planning approval of plot ratio it becomes higher than it used to be (two or three storey height shop houses to high-rise buildings). As a result, the worst impact from globalisation is the creation of ‘mega-cities’ images rather than the “places of solidarity” (Charles, Landry. 2006). Building images in different locations of the globe appear to be similar to each other regardless of where their geographical positioning is, which creates ‘everywhere-ville’ and ‘anywhere ville’(Charles, Landry, 2006).

The fifth negative impact is the introduction of legacy of Modern Movement which is obvious in every city today. A similar image of international style building planning and architecture can also be found in many other cities all over the world as physical impact of globalisation at local level. The current urban development is mainly cultured by building construction’s economic force. The matter
of time and financial factors are translated into functional built form that is as modern movement projects. Non appreciative attitudes on decorative details rejected ‘simplicity’ and strictly ‘functional’ as compared to heritage buildings (Choi, A. S., Ritchie, B. W., Papandrea, F., & Bennett, J. 2010). However, with this stand in mind what will then happen to the quality of outdoor space left for end users if the environment surrounding them is left as basic form?

The impact of globalisation is further discussed in this sub-section. There are positive and negative impacts on globalisation especially towards the heritage shop houses. Within the negative impacts of globalisation, the researcher found that there are also positive impacts of globalisation. From the review analysis done on the World Heritage Committee (WHC) of the UNESCO conferences and meetings since 1972 to recent meetings, it is found that the WHC has never given up protecting and conserving heritage sites all over the world. Therefore, in handling the challenges of fourth industrial revolution, globalisation, the WHC has their methods through various approaches to safeguard the heritage sites.

3 PREINSCRIPTION 2008

The shop houses in heritage streets were considered as ‘old and ugly buildings’ by many urban modern lovers. Without any social or historical value before the UNESCO World Heritage Sites inscription in 2008 they were left as no man’s property. Those architectural heritage streets with rows of heritage shop houses which block the front of the building were left to individual efforts by the shop owners to maintain heritage properties. Based on the Conservation Management Plan (CMP) and Special Area Plan (SAP) in 2011, it was recommended to conserve the heritage shop houses in Melaka and Pulau Pinang. The façade feature was left to natural deterioration. On the other hand, the space in between heritage buildings that functioned for pedestrian and vehicular linkages were left without revitalisation efforts. The physical condition and her façade treatment were highly depended on shop owners’ creativity and affordability. They have two choices either to enhance their shop front or to bear with the natural deterioration. Generally, the physical façades were fairly repaired and maintained to keep the business operating actively. Unfortunately, not all shop owners have the affordability to maintain their property, some just remained as visual nuisance.

4 OPERATION OF WORLD HERITAGE OFFICES TO THE SURVIVAL OF HERITAGE SHOP HOUSES

Pulau Pinang and Melaka are well known as Twin Cities and are responsible in enhancing the UNESCO World Heritage Sites in 2008 to ensure they remain in the best physical condition. Both cities have set up their own World Heritage Office locally with the intention to manage and maintain the policy, and to include high focus on the Special Area Plan (SAP) within their vision and management. In the year of 2017, the World Heritage Office (WHO) in both locations are enhanced continuously under the Conservation Management Plan (CMP) in guiding the enhancement of WHS. The aim is to guide the promotion of conservation, preservation, rehabilitation and reconstruction of WHS. In Pulau Pinang, the World Heritage Office i.e. the non-statutory body office for managing WHS is known as George Town World Heritage Incorporation (GTWHI) which was established in 2010 whereas in Melaka, it is known as Melaka World Heritage Sendirian Berhad (MWHSB) which was established in 2011.

5 APPRECIATIVE VALUE ON HERITAGE OF SHOP HOUSES

Within the heritage site of Pulau Pinang there are four thousand, six hundred and sixty five (4665) number of listed buildings and the majority component are shop houses. On the other hand, there are more than three thousand (>3000) number of heritage shop houses from the Dutch era are found in Melaka (Raja Nafida Raja Shahman., 2008). Historical style and period of construction of a building is traceable based on its authentic feature of facades. Part of the process of conservation from the Jabatan Warisan Negara (Department of Heritage, Malaysia) is the documentation of existing shop
houses before and after the conservation process. The following Table 1 reflects the constructive physical attributes and spiritual attributes for revitalising heritage shop houses.

**Table 1 Physical and Spiritual Attributes of Shop houses Outdoor**

<table>
<thead>
<tr>
<th>Physical Attributes</th>
<th>Spiritual Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Façade Attractiveness</td>
<td>1. Visually Appealing</td>
</tr>
<tr>
<td>2. Cultural Heritage Components</td>
<td>2. Cultural Heritage Identity</td>
</tr>
<tr>
<td>4. Decorative Culture</td>
<td>4. Contemporary Style</td>
</tr>
<tr>
<td>5. Resilience Outlook</td>
<td>5. Resilient Materials, Pattern and Texture</td>
</tr>
<tr>
<td>6. Lively Accessibility</td>
<td>6. Robust Intensity</td>
</tr>
<tr>
<td>7. Vehicular Friendly</td>
<td>7. Traffic Calming</td>
</tr>
<tr>
<td>10. Interactive Roofing</td>
<td>10. Tropical Universal and Passive Design</td>
</tr>
<tr>
<td>11. Healthy amenity</td>
<td>11. Sense of Relief and Hygiene</td>
</tr>
<tr>
<td>13. Interactive Info</td>
<td>13. Sense of Locality</td>
</tr>
<tr>
<td>15. Surveillance and Controlled</td>
<td>15. Safe and Self-Experiential Learning</td>
</tr>
<tr>
<td>Programmed</td>
<td></td>
</tr>
</tbody>
</table>

(Sources: Author, 2018)

6 DISCUSSION OF RESULT

Based on George Town World Heritage Incorporation and Think City publication on Pulau Pinang Historic Shop Houses Style, Pulau Pinang Historic Shop Houses Style is classified into six main styles following a chronological order. The styles are: “Early Penang Style” (1790s-1850s); “South Chinese” Eclectic Style” (1840s-1900s); “Early Straits” Eclectic Style (1890s-1910s); “Late Straits” Eclectic Style (1910s-1930s); Art Deco Style (1930s-1960s) and Early Modern Style (1950-1970s). The identified style shall be conserved by the shop owners. If there are any new changes made towards the existing heritage shop house within WHS, the owner shall undergo: Cultural Impact Assessment (CIA), Dilapidation Survey (DS) and Heritage Impact Assessment (HIA) approvals. The documentations provide a quick reference for new use and function in the development. The conservation principles are applicable towards individual building rather than an application to a row of shop houses. The whole stretch which comprises at least sixteen numbers of shop houses lot shall have an appropriate approach. The current practice has selected conservation rather than any other alternative approach. This scenario happened simply because of the exposure and level of knowledge is limited to conservation only. The inscription of WHS by UNESCO in 2008 up has revitalised the real-estates property to yield in the year 2017, it has imposed a new style of heritage commercialisation for supporting tourism industry. This new heritage status requires a high expectation on high quality heritage-commercial typology. The shop houses trend is expected to reflect an appreciation beyond our normal socio-economic level but to maintain the Malaysian pride in terms of image and identity. The aim is to share shop owners’ reflection in facing a great impact due to new heritage regulations. They are now setting up a new business strategy to remain competitive with the current demand of globalised heritage tourism and marketing strategy. In order to remain relevant to the current market, a proper retail and shop front design that suit heritage theme is necessary as to create idea of heritage sustainability and revitalisation.
7 CONCLUSIONS

The awareness on current issues of urban architectural heritage is considered high among multi-disciplinarians and public. Conservation, as the most commonly practised approaches in most heritage development in many heritage cities, is no longer the most appropriate tool to manage heritage city. On the other hand, heritage revitalisation is considered as the strategic planning to handle the generalisation due to globalisation in the early decade of the millennium. Industrial revolution 4.0 and globalisation have compounded heritage awareness towards particularization of local heritage among the role players that are collectively agreed by B. Oktay, M. Faslı, N. Paşaoğulları, (2011) in attracting the tourism activities. This paper is limited to cover shop houses in the Core Zone selected streets within the Historic Cities of the Straits of Malacca: George Town in Penang and Melaka only. The environment of the space is purely composed by the heritage shop houses as the setting of the background. The revitalisation of heritage shop houses of the outdoor space depends so much on the degree of the urban controller’s awareness and knowledge on urban design. The ambience place acts as the ‘lobby’ for the public to refer to before they decide engaging into any business or activity that occupies their time, energy and money. Each of heritage shop house lot acts as the “urban-accommodation” when the shop lot offers accommodation or bed and breakfast (bnb). On the other hand, the shop lot that offers food outlet can function as “urban-kitchen”. Therefore, the construct attributes for shop houses revitalisation benefits urban public space which functions as “urban outdoor living room” provide a high level of comfort of amenity and entertainment to serve public (Lees, L., & Demeritt, D. (2010). The longer they stay within the outdoor space provides inwards investment to the heritage shop houses. Most of the heritage shop houses offer basic needs for tourists. Any of the product and service may bring in investment to leverage the heritage street. One of the objectives of urban tourism is to create a “memorable experience” to encourage future revisits to a specific place or destiny. Therefore, with the above stated advantages and opportunities of the urban heritage shop houses; the urban heritage’s outdoor space is supposedly designated for ‘urban heritage recreation. Thus, the space in between heritage building is not meant for leftover space. This critical evaluation of the space as the ‘unintended’ and ‘no man’s land’ due to individual shop owners’ greediness and limited budget for public comfort is highlighted by researchers on this aspect of urban place (Samadi, Z. and Hasbullah, M.N., 2008).

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John Punter. (2007). Developing Urban Design as Public Policy: Best Practice Principles for Design\n
Abstract - Homestay programme is one of the main subjects in maintaining the cultural activities in tourism. Homestay programme is a form of community-based tourism that offers tourists and local communities to experience the local lifestyle and heritage culture. However, rapid urbanization has resulted in replacing the traditional components with modern components. This has caused facing reduction of definition and attachment in traditional places such as rice field. Realizing that youth plays an essential part in homestay programme, this paper tends to explore rural youth’s perception of rice field activities in homestay programme. The perceptions include youth’s knowledge, experience, and values on rice field activities. This paper highlights the concept of place attachment and provides an understanding the idea of homestay programme and focuses on homestay programme which has the rice field settings and offers rice field activities. The study has chosen three homestays in Kedah as a case study. The homestay programmes are Homestay Kg. D’ Belimbing, Homestay Kg. Jeruju and Homestay Kg. Pantai Jamai, Kedah. It is hoped that this will further provide suggestions for future research.

Keyword - place attachment, homestay programme

1 INTRODUCTION

For decades, studies regarding the people’s perceptions and attitudes towards places are essential to understanding the nature of their relationships to a site. Place attachment is the central concept of environmental psychology that is associated with the person-place bonding. Place attachment is regarded as an emotional bond between people and place (Altman & Low, 1992). Past studies (e.g., Kyle, Graefe, Manning & Bacon, 2003; Gross & Brown, 2006) have shown inconsistent findings regarding the place attachment and activity involves relationship. The results have pointed to a positive or non-significant relationship. This study sets out to explore youth’s perceptions on rice field activities that focus on homestay programme.

Altman and Low (1992) described place attachment as an affective link between individuals and their environments. The research discussed that place attachment consists of interactions between affective and emotions, knowledge and beliefs and behaviours and actions regarding a setting. Shumaker and Taylor (1983) argued that place attachment is a person-place connection that grows from characteristics of people and specifiable conditions of the environment. From the previous studies, the affective, emotion, and feeling are the most commonly reported main ideas of place attachment. It can be demonstrated in the questions constructed by researchers who were studying place attachment. Cognitive and behavioural aspects are the other features of place attachment. Tuan (1977) hints to this relationship when he discusses attachment as the accumulation of memories and experience in place, and Manzo (2005) argued that our experiences and memories create place meaning. She explained that “it is not simply the places themselves that are significant, but rather what can be called ‘experience-in-place’ that creates meaning.” Besides, place attachment identified as a state of psychological well-being is resulted from accessibility to a place or a state of distress upon separation from a place (Giuliani and Feldman, 1993). In addition, long-term interactions with place and memories that occur through the place could create attachment.
Farnum et al. (2005) asserted that people-place interactions are often formed through psychological procedures rather than physical contacts. It indicates that people do not have to have physical interactions with places in making strong emotional bonds with these places. They might also integrate strong affections with mental representative places that they have never been there. In this case, they may associate strong feelings towards some environmental components and convey the same feelings to the other places with similar elements. However, this may not assure that outlook of places can always shape the emotional attachments to these places and it highly depends on the existing bonds formed through previous environmental experiences. Nevertheless, place attachment plays a positive role in people’s lives and in their care of the place. Shamai (1991) realized that people who feel an emotional attachment to a place may be more active to preserve that place. Scannell and Gifford (2010, page number?) define place attachment as: “a bond between an individual or group and a place that can vary in terms of spatial level, degree of specificity, and social or physical features of the place, and is manifested through affective, cognitive, and behavioural psychological processes”. This paper used the Tripartite Model by Scannell and Gifford (2010) to explore rural youth’s place attachment in Homestay Programmes sites and activities. This model defines three variables of place attachment. The three dimensions includes person (social norms, personal experience), psychological process (affect, cognition, behavior), and place (social properties, physical properties) dimensions. The relationship between person and place was also considered on cognitive elements. The memories, beliefs, meaning, and knowledge that individuals associated with their central settings make them personally important. Place attachment as cognition involves the bonding to place meaning as well as the cognitions that facilitate closeness to a place. Through memory, people have created place meaning and connect it to themselves. As noted earlier, one can grow attached to the settings where memorable eras or important events occurred (Hay, 1998; Hunter, 1974; Manzo, 2005; Rubenstein & Parmelee, 1992; Twigger-Ross & Uzzell, 1996).

The Community-based tourism (CBT) concept was used a long time ago to boost the rural development, both in developed countries such as Ireland (Storey, 2004) and developing countries such as Brazil (Honey, 2008). The CBT is a tourism that is closely related to nature, culture and local custom. It is designed to attract the tourist market that needs authentic experiences, enhancing community development, poverty alleviation and conservation. The demands for community-based tourism is based on the access to the rural area, better private mobility, more leisure time, fresh air and active pastimes (Ibrahim, 2004). In 1988, Homestay Programme was introduced by The Ministry of Arts, Culture, and Tourism (MOCAT). The main objective of Homestay Programme is to offer accommodation to the tourists and discover the local, cultural and natural lifestyle (Kayat, 2009; Jabil et. al, 2011). Through this programme, tourists will have the opportunity to get experience with friendly host families. Tourists will enjoy the many experiences in villages such as practice how to cook traditional cuisine, learn the Malay customs and various traditional games and activities of the Malay community (Ministry of Tourism Malaysia, 2011). Homestay Programme is situated in rural areas, where tourists will accommodate, be entertained by the cultural performances and traditional activities and have meals with their adoptive families (Aminudin and Jamal, 2006). According to Liu (2006), Homestay Programme is facing problems to attract local community to participate in the programme. There is a lack of responsibility among the local community because they do not have knowledge about the tourism activities. The key success factor in Homestay Programme is leadership and commitment (Amran & Zainab, 2009; Yahaya & Abdul Rasid, 2010). The Homestay Programme activity is one of the community based tourism that offers tourists to explore the cultural and natural landscape during their vacation.

2 METHODOLOGY

Focus group discussion using pictures was aimed to explore the perception of rural youth’s on homestay activities which was based according to the Scannel and Gifford Theory of place attachment. This part covered the dimension of process which is cognitive elements. The cognitive elements include knowledge and experience of rural youth’s on homestay activities. In this focus
group discussion, the participants were asked to explain their perceptions on activities shown in the pictures. There are twelve pictures selected before the researcher conducted the discussions. The pictures were selected according to the rice field activities in homestay programme throughout Malaysia. The pictures were label as no. 7 to no. 18. Content analysis was mainly conducted based on focus group data, as the rural youths explained about their knowledge and experience on rice field activities. Microsoft Word 2007 and Microsoft Excel 2007 were used to store, manage, and analyse (content analysis) the qualitative data from the focus group discussions. First, the data from the focus group discussions were transcribed, and the text was divided into categories. Then, codes were derived from the text, and these were grouped into sub-themes and themes (Braun & Clarke, 2008; Creswell, 2009; Creswell & Plano Clark, 2011). The sub-themes and themes consist of youths perceptions on their knowledge and experiences with rice field activities. Finally, patterns among sub-themes and themes for youth’s perceptions were identified.

3 RESULTS

This section summarizes the findings on rural youth’s perceptions on rice field activities in homestay programme. The perception of youths was categorized into two themes which is knowledge and experience. The themes were categorized into subthemes according to youth’s perceptions. The responses of youth’s perception were summarized in Table 1.1.

<table>
<thead>
<tr>
<th>Picture</th>
<th>Themes</th>
<th>Sub-themes</th>
<th>Responses</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture 7</td>
<td>Knowledge -Experience</td>
<td>-Competition</td>
<td>-“we organized kites competition to build a good relationship between village community...”</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Make kites</td>
<td>-I know how to makes kites.”</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-enjoy</td>
<td>“kites were made by adults and old villagers that have experience and knowledge on making kites...”</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-demonstrate the activities</td>
<td>-When, tourists come to my village I always demonstrate for them how to make kites and how to play kites.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-“I love to teach outsiders about my</td>
<td></td>
</tr>
</tbody>
</table>
| Picture 8 | -cycling along paddy field  
-memories with family |
| Picture 9 | -peaceful  
-calmness |
| Picture 10 | -make orang-orang |
| Picture 11 | -rice field activities  
-planting paddy  
-relax near rice field  
-no idea  
-do not know  
-play with friends |
| Picture 12 | -know the activity |
| Picture 13 | -help homestay operator  
-excited |
| Picture 14 | -enjoy  
-memories with friends  
-love environment |

-“I enjoy playing kites with my friends during my free time.”
-“I do not know how to make kites and playing kites but I have seen children and youth playing kites when tourists came to my village....”
-“I always cycling along the paddy field with my friends when i was in primary school.”
-“I also experience cycling along the paddy field.”
-“Yes, of course I have done this before. I love walking around my village. It is so peaceful and give me calmness.”
-“Yes, I love the scenery of paddy field in the morning before the sunrise.”
-“I always walk along the paddy field with my father in the morning. I enjoy the beautiful scenery of green paddy field”
-“This is orang-orang. I know how to make orang-orang. My father teach me how to make orang-orang. Normally...orang-orang can be made from bamboo”
-“Orang-orang can makes birds afraid.”
-“I have experienced planting paddy with my father. My father own a paddy field near this village.”
-“I do not have chance to plant paddy but I always see paddy farmers planting paddy in my village.”
-“I do not know how to plant paddy.”
-“I don’t know how to plant paddy but I have seen adults planting paddy.”
-“I have experienced to prepare the activity for tourist last year.”
-“My friends and I were helping the homestay operators to set up the place for catching ducks activity in paddy field.”
-“It is such a wonderful experience! The tourist were enjoying themselves so much!”
-“I enjoy the scenery of green paddy field.”
-“I remember when I was a little boy, I always playing with my friends beside the paddy field.”
| Picture 15 | -competition  
-annual event | -“I enjoy the moment and love the environment so much!”
-“There was perch (ikan puyu) fishing competition in my village. ‘Youths in this village were involved in the competition’”
-“Every year, youth in this village create an annual event.” |
| Picture 16 | -raining and harvesting season | -“Only in raining season or harvesting season there are a lot of fish.
-“For homestay activities, the organizer have to create a suitable place for tourist to experience the activities because it it not easy to catch fish in the paddy field.” |
| Picture 17 | -relax  
do not know the activity | “Every evening, youth are riding motorcycle in the village to relax and view the beautiful scenery of the village and paddy field.” |
| Picture 18 | -beautiful scenery  
calm  
relaxing  
play with friends | -“I have done this activity since primary school until now. I love the beautiful scenery of paddy field. I like the environment so much”.
-“I love relaxing near the paddy field because it gives me calmness.”
-“Children always sit near the paddy field and always play with their friends.” |

After the discussion with 13 youths in three homestays, the researcher found that youths who have knowledge and experience on rice paddy landscape activities usually do have a family background as paddy farmers and homestay operators. Besides, most of the respondents that answered and discussed on rice paddy landscape activity are males. Only four female respondents answered and explained the details of the events. The respondents seem so excited to tell the researcher about the activities, but some of them have no idea when the researcher shows the pictures. The activities that the youths were interested to know are catching ducks, playing kites, making orang-orang, catching fish using bubu and catching fish using a hand (gogoh). When the researcher asked about the activities, only a few of them can explain the activities. From their answer, the result revealed that youth with high knowledge, experience, and values on paddy field activities received support by their family. Moreover, their family owns the paddy field, and they always help their father to do the paddy field activities. Furthermore, a few of them get the knowledge from their observation in the paddy field. They are interested to know the activities, but they do not have the opportunity to try the activities.

5 CONCLUSION AND SUGGESTIONS

The study of place attachment identifies the relationship between people and place. Moreover, the place attachment concept is essential in order to know how people perceived their environment and traditional activities in their daily lives. This study would help to ensure the sustainability of culture in tourism activities, and rural youths can learn the traditional activities in their daily lives. Although the study has brought attention to the connection between landscapes and human perceptions, it should be noted that further research with different methods and larger samples are recommended to explore strengthening findings. Moreover, more topics on place attachments and activity involvements should also be covered. Therefore, future study is needed to explore the affective and behavioural elements in place attachment models to know the perception of youth as well as sustaining the rice field activities in homestay programme. In addition, future research is also needed to explore other settings of homestays including orchard plantation and fishing villages.
REFERENCES
MALAY GARDEN CONCEPT THROUGH TRADITIONAL MALAY LITERATURE

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Abstract - This study discusses the development of the Malay garden concept through traditional Malay literature and site observation of the Malay villages along Peninsular Malaysia. The hereditary of traditional Malay culture, as well as garden design concept, can offer a guideline towards safe cities and resilience communities which lead to boosting the growth of the integrity and the authenticity of the traditional Malay garden design. The strength of these characters will extensively be used in developing the concept of landscape design in Malaysia due to the increasing awareness of community spirit and environmental development as to maintain the quality and sustainability of urban life.

Keywords - Malay Garden, Malay Landscape, Cultural Landscape, Resilience Communities, Quality of Urban Life

1 INTRODUCTION

The functional ability of the establishment and the development of landscape design concept is determined by the analysis of the spatial structure (traditional Malay house compound) as well as their traditional environment due to the increasing awareness of design, inequality constraints, social disruption, environmental detriment as well as direct impact on the delinquent behaviour that affects the quality of human life.

This paper deliberates the study of the features of traditional Malay landscape with the intention on the development of the Malay garden concept and significantly to the impact and the response of the global communities on traditional Malay landscape garden design. The traditional Malay garden design and their concept is an idea for the landscape architect in the direction of enhancing multi-faceted approach that ensures the success of sustainable cities, a long-term socio-technical system as well as to integrate and highlight the social, physical, culture and communities characteristics.

2 LITERATURE REVIEW

The merging of both social culture and climate of a place together with the community characteristics that evolved and developed due to the needs of the society have resulted in vernacular architecture (Noor Hanita et al., 2012). Therefore, our priority is to know and clearly understand both as the cultures and nation as to maintain the traditions that have been held through the years. The assortment of the Malay world is too widespread and need to be explained in detail to help and lead directly to the scope of the study as a whole. The term tradition and traditional in the way of Malay life should also be described explicitly. This is because there are many traditional elements used as a continuous tradition or hereditary as well as it becomes a part of the landscape design around their house compound (Abdullah Sani et al., 2006; Nor Atiah, 2005; Lim Jee Yuan, 1987) and with the declaration of territory for the space either within the owner of the house or it is free for all inhabitants. These are the inherited characteristics of a natural and traditional landscape which traditionally was self-sufficient for daily living. Therefore, landscape architect as well as the municipal council should take action as a social responsibility to the public while fulfilling the requirements of
clients when dealing with the design concept and clearly it is not recommended to erode the natural environment.

2.1 The Scenery of Traditional Malay Landscape Design

Storytelling was the favourite pastime of the past was shared and distributed throughout the region. As such there are quite a few art forms that transcend boundaries and belonged to the whole of Malay Archipelago and beyond (Zalina, 2012). The art of storytelling in Malay world including literature, manuscripts, poetry, poems, folklore as well as live show and performance such as folk dance form, the Wayang Kulit, Mak Yong, Kuda Kepang, Barongan and Mek Mulung. Zalina(2012) also states that the oral communication delivered by the storytellers (Penglipurlara) consider anything outside the narrative as extraneous and travelled all over the Nusantara to bring news and entertain the villagers and royal courts. The information usually delivered figuratively but full with knowledge and bits of advice especially in the way of living and customs tradition. According to Zaharah Mahmud (1970) (cited in Anisa Ani et al. (2012) as well as Abdullah Sani et al. (2006)), the traditional Malay identity and their culture could be studied through traditional Malay literature such as old manuscripts, folk tales, and poetry. She also found that these sources are the most excellent method to find out the information on the background of the traditional Malay culture in the region due to the limitations of other reliable documentation. Zalina (2012) similarly mention that many of our Malay hikayat originated from a Sultan’s wished to record his royal lineage.

The Malay Annals, The Misa Melayu and The Tale of Merong Mahawangsa are clear example of this. The origin of The Malay Annals may never be uncovered but throughout the 16th and 17th centuries, many versions were zealously updated. The Tale of Hang Tuah is an example of a timeless Malay literary work which is now recognized by UNESCO as a Documentary Heritage under the Memory of the World Programed register in 2001, presently as the Mak Yong in 2005 under the Third Proclamation of Masterpieces of the Oral and Intangible Heritage of Humanity as well as Inscribed Stone of Terengganu or Batu Bersurat Terengganu in 2009 which constitutes the earliest evidence of Jawi writing in the Malay Muslim world of Southeast Asia.

Discussed by Al-Ahmadi (2003), Malays is known for their philosophy of manufacturing or construction of something as a symbol of symbolism, which means that either implicitly or explicitly based on the relationship with God, their environment as well as the human being. The strength of the Malay garden design is plants (soft landscape) and landscape furniture (hard landscape) as well as their composition and the interaction between internal and external spaces. It is unique because it clearly symbolizes the culture of the Malays in the past and shows the Malays have a substantial knowledge in term of plant functions in the garden or their environment.

Figure 1 Typical layout of traditional Malay house compound divided into three primary compounds; (1) Front compound or front yard, (2) Side compound located either on the left or right side and (3) Rear compound.
(Source: Author, 2018)
Traditional Malay house compound separated into three main areas that are front compound, side compound, and rear compound. The placements of landscape furniture as well as plant species are dependent on its role in a different compound (Mohammad Rusdi, 2012; Ahmad Zamil et al. 2014; Nur Huzeima et al.; Anisa Ani et al. 2012; Abdullah Sani, 2006; Yuan, 1997).

### 2.2 Issues in Landscape Design and Planning

The traditional Malay living environment is planned carefully through harmonious interactions between man, nature, and culture translated into the house design and the surroundings (Anisa Ani et al., 2012). Shuhana et al. (2012) defined that the landscape approach is to conserve, manage as well as to observe the value of the historic areas by considering the original setting, interrelationship of physical form, social, cultural, spatial organization and connection with natural features. The concept of the overall design of traditional Malay house includes the space division of their interior architecture is parallel with the outside areas as well as their house compound (Ahmad Zamil et al.; Noor Aimran, 2014; Zumahiran & Ismail Said, 2011; Abdullah Sani, 2006). These attributes are interconnected and considered as essential ingredients for aesthetic design, form, and function, and fashioned in harmony around traditional Malay house compound.

During the arrival of Islam in the 13th century, the Malays were still strongly animistic in their belief and culture (Ibrahim, 1991). Islam is still held but the customs and beliefs of their culture are put as priorities. Hence, any form of decision-making entirely depends on the spirit of trust and profound spiritual influence which became the foundation in their daily routines. Anisa Ani et al. and Mohammad Rusdi (2012) also state that the Malays have adapted and responded well to the environment, subtly without causing harmful effects to the traditional landscape resources. This integration has developed the cultural landscape into a modified one (Appleton, 1975). Studies by Kaplan (1975) also support this by discovering that people often choose something based on the current season or the flow from the hassles of finding something uncertain and difficult to obtain.

### 3 METHODOLOGY

The qualitative research sought to gather diverse information through multiple methods about the antiquity, characteristics, influences and current practices relating to the traditional Malay landscape design and cultural landscape as a whole. The symbolism in the Malay landscape design either in physical (tangible) or metaphysical (intangible) form can be found by referring to the Malay traditional literature along with observation to the Malay villages along Peninsular Malaysia.

#### 3.1 Traditional Malay Literature

From the traditional Malay literature, the significant characteristics emerge as the essences of Malay cultural identity, which have been identified as desperately in need of immediate acts of conservation. Mohammad Rusdi (2012) and Merriam (2009) also state that besides providing foundation or a theoretical framework for the problem to be investigated, the literature review can demonstrate how the present study advances, refines, or revises what is already known where both historical aspects and the development of the traditional landscape design and cultural landscape are appraised in order to identify key issues and recent evidence that are of significance to the research topic. Last but not least, Hasrina Baharum (2016) on her Ph.D. research illustrated the variation of traditional Malay garden from the past through Traditional Malay works of literature. All the illustration as follows:
Taman Larangan or Forbidden Garden was usually located in the compound of the palace areas and full with magnificent traditional Malay landscape elements according to their placement and function. The garden serves as a play area as well as bathing for royal princesses to enjoy their daily life. Among the ambiances that are written through traditional Malay literature; *Syair Burung Nuri* and *Hikayat Malim Deman* as follows; a hall and pavilion as a place to relax or change clothes, pool for bathing, large trees as shading, flowers and fragrant trees as decoration and aesthetic elements, fruit trees as food, fences, gates and arch as demarcation along with to protection and maintain the honor of its inhabitants.

Taman Kerohanian was usually located outside the compound of the palace. Quite secluded but it is still close to the palace ground. The garden serves as a place for worship especially for the royal family who come to perform acts of devotion and religious study. All the structure, as well as landscape elements, were developed according to traditional cosmology and religious belief with magnificent detail and finishing. *Surau, madrasah, mimbar, balai delapan segi* and *pelantar* are example of structures that were recorded along with water elements, palm species, fruit, flowering and fragrant plant species. Among the ambiances that are written through traditional Malay literature; The Garden of Kings (*Bustan Al-Salatin*) and *Hikayat Jauhar Manikam* as illustrated above.

There are some traditional Malay landscapes elements that were mentioned repeatedly in each of the literature that was reviewed. Examples of what we can see are like the word *Anggur* (*Vitis*
spp.) was written in The Tale of Hang Tuah (Hikayat Hang Tuah), The Tale of Inderaputera (Hikayat Inderaputera) and The Garden of Kings (Bustan Al-Salatin). Another example is the Bunga Tanjung (Mimusops elengi) that was mentioned in The Tale of Hang Tuah (Hikayat Hang Tuah), The Tale of Inderaputera (Hikayat Inderaputera), The Garden of Kings (Bustan Al-Salatin) as well as The Malay Annals (Sulalatus Al-Salatin).

3.2 Current Traditional Malay Living Environment

The observation to the traditional Malay villages along Peninsular Malaysia was conducted to clearly define the character and significant role in creating their landscape garden design according to the traditional Malay literature (Refer Figure 4).

Figure 4 (a – c) Show the Landscape Typologies and Attributes of the Current Traditional Malay House Compound at Batu Kurau, Perak.
(Source: Author, 2014)

Table 1 List of Landscape Furniture observed by the Author from Site Survey, Traditional Malay Literatures, and Recorded in the Research Papers done by the Researchers in the Past

<table>
<thead>
<tr>
<th>No.</th>
<th>Local Name (as be called by local people)</th>
<th>English name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ampaian</td>
<td>Clothes line / washing line</td>
</tr>
<tr>
<td>2.</td>
<td>Bangsal / Sulap</td>
<td>Barn</td>
</tr>
<tr>
<td>3.</td>
<td>Bilik air / Bilik mandi</td>
<td>Shower</td>
</tr>
<tr>
<td>4.</td>
<td>Buaian</td>
<td>Tree swings</td>
</tr>
<tr>
<td>5.</td>
<td>Gerbang</td>
<td>Arch</td>
</tr>
<tr>
<td>6.</td>
<td>Guri</td>
<td>Guri (smaller than common traditional Malay water vessel)</td>
</tr>
<tr>
<td>7.</td>
<td>Jamban / Tandas</td>
<td>Latrine</td>
</tr>
<tr>
<td>8.</td>
<td>Jamung andang / Kandil</td>
<td>Torch</td>
</tr>
<tr>
<td>9.</td>
<td>Kepok padi / Jelapang</td>
<td>Paddy store</td>
</tr>
<tr>
<td>10.</td>
<td>Kolah</td>
<td>Water tank</td>
</tr>
<tr>
<td>11.</td>
<td>Kolam</td>
<td>Pond</td>
</tr>
<tr>
<td>12.</td>
<td>Pagar</td>
<td>Fence</td>
</tr>
<tr>
<td>13.</td>
<td>Pangkin</td>
<td>Resting hut (usually without shelter)</td>
</tr>
<tr>
<td>14.</td>
<td>Pasu bunga</td>
<td>Flower pot</td>
</tr>
<tr>
<td>15.</td>
<td>Pelantar</td>
<td>Open timber platform (usually for washing clothes)</td>
</tr>
<tr>
<td>16.</td>
<td>Perigi</td>
<td>Well</td>
</tr>
<tr>
<td>17.</td>
<td>Perun</td>
<td>Dump site</td>
</tr>
<tr>
<td>18.</td>
<td>Reban</td>
<td>Hen coop</td>
</tr>
<tr>
<td>19.</td>
<td>Tempayan</td>
<td>Water vessel</td>
</tr>
<tr>
<td>20.</td>
<td>Titi</td>
<td>Log bridge (usually made from Areca nut trunk / batang pinang)</td>
</tr>
<tr>
<td>21.</td>
<td>Wakaf</td>
<td>Gazebo</td>
</tr>
</tbody>
</table>

(Sources: Author, 2018)

4 RESULT AND DISCUSSIONS

The Malay community at present also follows the trend of the times. However, they can still retain some elements used by their ancestors. Through the study, it is found that 149 species have
recorded in the manuscript, and only 33 species have been used for now (only 22% of the active species). There has been an evolution of the traditional Malay landscape design nowadays even at the traditional Malay village itself.

The potential and strength of the traditional Malay landscape elements that can be used to develop the concept of the Malay garden design from the study are as follows:

- All the landscape elements that are mentioned in the traditional Malay literature composed of tropical species, and the overall material made from the Malay Archipelago is easily adapted to the local environment.
- Landscape elements are still used by the Malay community nowadays, but do not impose any design concept or properly related to the traditional Malay garden design concept.
- Malay's society has a strong belief in the use of certain landscape elements purposes, especially the group of herb and food plant as well as the placement of landscape furniture and interaction between each other in their daily life activities.

5 CONCLUSION

Due to the recent development and rapid urbanization for Malaysia, there is a need for improved understanding and appreciation towards traditional Malay cultural landscape among us. Through this study, it is clearly defined that the needs for the establishment of characterization for traditional Malay landscape design are required as a basis for informing the planning about the exact character design towards safe cities and resilient communities in future. Both of these aspects can offer the academician, scholar, contemporary planners, municipal council and landscape architect in their endeavour to preserve, conserve and create the sensitivity and the integrity towards cultural landscape as a whole.

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THE HISTORIC TIMBER STRUCTURE CONSERVATION OF MADRASAH IDRISIAH BUILDING, KUALA KANGSAR, PERAK

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Abstract - Madrasah Idrisiah is the first royal religious School in Perak. The main building is a double storey timber structure and was built in the year 1917. In 2017, through the allocation from the National Heritage Department of Malaysia, the main building of the Madrasah Idrisiah has undergone building conservation works. The building has a timber structure defect such as deterioration due to moisture problems, insect attack, fungal attack, and improper repair works. The conservation of timber structures involves the repair of beams, column, shafts and roof structures of the mosque. This paper discusses the methods and techniques for conservation work on a historic timber structure which involves the main block of Madrasah Idrisiah. The proposed conservation method is the minimal intervention and the main aims are to restore and consolidate the existing timber structure. The proposed conservation method used is based on historic building conservation guideline by Malaysia National Heritage Department.

Keywords - Conservation, Timber Properties, Timber Repair Work.

1 INTRODUCTION

Madrasah Idrisiah is the first religious school in Perak. It was built in 1917 during the reign of Sultan Iskandar Qaddasallah, son of Sultan Idris II Mursyidul 'Adzam Shah. The building is built on a land nearly 3 acres and is opposite to Ubudiah Mosque, Kuala Kangsar. The main building is a two-storey timber structure measuring 32 feet x 222 feet with an estimated floor area of 6,796 square feet. Originally, the first floor of the building was used as a student accommodation while school activities were carried out on the ground floor. This symmetrical building is built with an open corridor around it. The corridor is supported by timber pillars standing on the masonry stump on the ground floor. The center part of the building that was built strangled out to front side is the porch where the school office is located on the first floor. The main building and the school site itself are almost 100 years old and has been some further development throughout that period as shown in figure 1. Construction of additional buildings began in 1985 during the late Sultan of Perak, Sultan Azlan Shah.
2 INTRODUCTION TO TIMBER PROPERTIES

Mechanical properties or strength of timber is closely related to the density and structure of the anatomy of the wood cells (Walker, 1993). These cells are complex natural builds consists of a mixture of polymer and cellulose. The structure of the timber cells provides 16 times more natural strength than the same mass of iron (Malaysian Timber Council, 2010). The construction of this timber anatomy also affects the physical properties and strength of a timber species. Therefore, certain timber species are only applicable to certain uses. This has been proven by the history and the wisdom of traditional carpenters in a Malay traditional building which only uses certain species because of its resistance, such as chengal (Neobalanocarpus heimii), which is the most popular species for the construction of home structures. Other chengal species such as chengal mas (Hopea odorata) and chengal batu (Hopea ferrea) (Killmann et al., 1994). However, there are many other timber species that have a variety of specific strengths for construction work. Timber strength is associated with a direction of force or impact on it. A piece of timber is easy to fail or crack due to the force parallel to the grain orientation, instead the timber is stronger and will hold it if the direction of the load is perpendicular to its grain orientation. Basically, the tree anatomy is divided into two main parts that are processed into sawn timber in the sawmill where sapwood is softer and brighter in colours; and the heartwood is a harder and darker located at the core of the log. Both of it are in the same logs. The Malays have long been using heartwood for a variety of uses including handcraft making. Science has proven that the heartwood part is stronger and more durable compared to sapwood part (Walker, 1993). In the Madrasah Idrisiah conservation project, the conservator recommends not to use new timber components that include both heartwood and sapwood in the single workpiece to ensure its durability and strength. Besides that, timber components with knots are avoided because it is a critical point to fracture due to its curly grain structure.

Timber has the ability to absorb water directly and moisture from the surrounding air. When it is exposed in the dry surrounding, the timber will release the moisture through the evaporation process. Absorbing the moisture and evaporation process makes the timber swell and shrink, thus changing its size. This is called timber movement (Walker, 1993). The 'movement' of the timber cannot be seen with the naked eye, but enough to bring an affect to the quality of construction. Furthermore, timber decaying agents are a fungal attack which is also due to the moisture in the timber. Timber pests such as termites and other insects are more likely to attack the timber at certain moisture levels. In conserving the timber structures of Madrasah Idrisiah most of the timber defects are due to exposure to moisture in long derelict period. The conservators and contractors involved suggested that new timber should be kept in a dry place for two weeks to ensure the timber achieve the 'equilibrium moisture content' (EMC) level before being used for restoration. This is to avoid the timber movement occurred after the restoration works completed, which can affect the quality of workmanship.

3 THE CONSERVATION OF TIMBER STRUCTURE

Conservation of historic buildings involving timber materials, especially building structures, is essential to conserve not only in terms of heritage, but in terms of technical and mechanical that ensures the building is sturdy and sustained for the future. For conservation work involving historical or heritage timber structure, it is necessary to comply with standards and the principles of heritage conservation. For the restoration of traditional buildings, the timber to be replaced must be from the same species or at least equivalent in properties as the original timber. That is also the same goes for its construction method (ICOMOS, 1999). However, if the traditional techniques were difficult or will cause new damage on other components involved, any modern technique for conservation and construction can be used as an alternative where its effectiveness can be read by scientific data and can be proven by experience (Article 10: Venice Charter), (ICOMOS, 1964). The most important thing in the conservation project, which uses timber material is documenting every detail of the repair works, whether a new replacement, timber jointing, changes in construction techniques including the use of new materials/technologies and material sources. According to Brown (2013), the documentation
produced through the construction drawings become an important historical record for a restored building. This can be a reference for future conservation work hereafter. The conservation of the timber structure of this building refers to the National Heritage Department's Building Conservation Guidelines (JWN, 2017). The conservator has come out with proposed timber remedies techniques which accommodate the guidelines through ‘method statement’ prior the restoration. ‘Method statement’ is a standard report that explains the existing condition of the building parts, the cause of the defect, the method of recording the existing material, the proposed restoration method with diagram and the necessary precaution. Prior to the timber structure conservation work, the identification of the timber types according to the components was carried out by the Malaysian Industry Board (MTIB). There are three main types of timber used, namely Merbau (*Intsia palembanica*), Meranti Merah (*Shorea Spp.*), and Nyatoh (*Palaquium spp.*). Merbau timber is used for structure building, while Meranti Merah and Nyatoh are widely used for door components, windows and floor boards.

In the Madrasah Idrisiah conservation project, the researcher identified and categorized the timber structure repair works as below:

i. Restoration works include:
   a. Cut and Joint
   b. Duplication
   c. Modification

ii. Consolidation by steel reinforcement

iii. Consolidation by transferring the loads to additional of new structure

3.1 The Timber Structure Restoration by ‘Cut and Joint’ Technique

A total of 11 pillars was identified to have decayed on the jointing between masonry stumps. The cause of decaying is due to humidity and pest attack. The tenon of the pillars on stumps has been decayed and lost. See Figure 2. The consequence of this decaying causes the pillars to lean and become unstable to support the beams and joists of the first floor corridor.

The pillars that have been cut is replaced with the new component that is duplicated according to the original, which has the same properties in terms of strength and size. The new timber is needed to dry enough and free from defects such as cracks and knots. The new pair of timber pillars are the same
as the original timber species or at least from the species that are close in mechanical properties. The original species of timber pillars used for this building are from Merbau (*Intsia palembanica*) which is classified as a hardwood (Malaysian Timber Council, 2009) (Malaysian Timber Industry Board, 2017). The jointing between the original timber pillar and the new ones was done by using the 'half-lap' jointing and tied with screws and nuts, see Figure 3. The screw holes need to be drilled not parallel to the timber grain (diagonal) to prevent split pole along the grain line. The screw and nut connections are concealed and patched with the same timber species of the original poles. The profile pattern on the new pillar edgings is duplicated to the original pillars. The purpose is to get uniformity in design. At the last stage, after the glue has dried, the surface of the jointing is smoothen by planing and sanding the surface. The gap between the timber and the masonry stump will be inserted with waterproof glue to prevent the absorption of water in the future.

### 3.2 Duplication According the Original Timber Component

Most of the roof trusses of this building are in good condition except one of the kingposts was found deteriorating, due to roof leakage which has exposed the component with moisture. Kingpost is one of the timber members of the roof structure that stand in the middle of the truss which holds the ridge (see figure 3). All the roof truss members are tightened with its special ironmongeries. According to the ‘method statement’ that was prepared, the deteriorated kingpost should be detached from its members in order to conduct the duplication work. All the connected roof truss members are clamped accordingly before the removing deteriorated kingpost and replaced with a new one. The removed original kingpost is measured precisely to duplicate the new kingpost. The duplication work is not conducted on-site due to the custom made work. The new kingpost is made from the same grade of timber to ensure the structure authenticity is remained.

![Figure 3 Left; Deteriorated kingpost. Right Top; Kingpost position on roof truss members. Right below; Restored Roof truss with duplicated kingpost tighten with original ironmongeries.](image)

### 3.3 Modification of Jointing Technique

Any timber structure is constructed according to its special techniques. Each structural member has its sequence during the construction (Brown, 2013). Generally, in any conservation work, the minimal intervention is the priority due to the sensitive old building condition. In Madrasah Idrisiah case where the building construction is complex. Some jointing is using metal nails. This building is designed not to be dismantled or reallocate as most traditional timber houses in Malaysia (Yuan, 2002).
It can be considered as permanent structure and it is impossible to dismantle part by part to reach the defected component. One of the beams in the Madrasah building has experienced decay on both ends of the connection. The 'tenon and mortise' joints have serious decay on both of the beam ends (tenon). Whereas, the beam that are located between the two pillars is attached to the mortise on the pillars. Both pillars are still in good condition and stand firm. Technically, this beam replacement process needs to shift one of these pillars. These pillars are also attached together with roof and floor systems. In order to minimize intervention on the building as advised by ICOMOS and National Heritage Department (2017), the conservator has come out with modification on the replacing beam without changing its original appearance. Special jointing on the middle of the beam has been designed in order not to shift the existing pillars as shown in Figure 4 below:

Figure 4 Diagram shows the new beam with proposed jointing in the middle in order to minimize the intervention on both pillars during restoration work. The left-below pictures show the decay of the original beam.

Therefore, in certain cases, the problematic timber structure should be restored on-site without dismantling the other structural members that are connected. Dismantling and removing any of the existing components will bring risks to new damage. The modification of the jointing or component design itself should be necessary due to some timber restoration process that is different from the original installation process.

3.4 Reinforcement on the deteriorated Timber Beams.

A part of the timber defects that are due to moisture, pest attacks, timber aging problems and the deterioration of durability. There is a timber defect due to their natural growth such as splits and crack on timber knots (spiral grain) or wavy grain, interlocking grain, hollow timber and high dense timber. The timbers that have natural defects, should not be used in construction. There is a beam in the Madrasah building that has experienced natural defect caused fractures on knots. The timber beam
needs to be preserved to ensure that the structure does not deteriorate that will resulted in poor strength to bear the loads from the top floor.

![Figure 5 The beam number 18 has cracked due to timber knots. There are knots and crack that suspected can cause the beam to bend and will eventually break. Right: example of timber knots](https://www.woodworkingnetwork.com/best-practices-guide, 2017)

The proposed conservation method is by straightening and raising beam no. 18 to its original position with an additional steel plate. This method is intended to reinforce the first floor structure by using a custom steel plate. For security purposes and structural strengthening, the temporary steel prop is installed to transfer the beam’s loads directly to the ground. The dropped beam is slowly jacked up until it reaches its original position without damaging the other original components. The temporary steel prop will remain in use until the iron plate installation is completed. The surface of the beam is slightly cut and planed according to the shape of the steel plate. The width and length of the steel plate must have covered the cracked area. The holes are drilled through the beam matched with holes on the custom steel plate. The holes are avoided from being drilled on critical parts (cracks and knots). The steel plate shapes and thicknesses, as well as the size of the screws, are according to the engineer's recommendations. The steel plate should have located above the masonry column to help send the loads directly through it. After the installation of the steel plate, the plywood is cut according to the same shape that was originally used to cover the exposed plate screws. The direction of the woodgrain of the plywood board should be in line with the original timber beam grain direction. Plywood attached with glue and wood putty/filler are used before applying the proposed finishing.

![Figure 6 The Installation method of steel plate on beam no.18](https://www.woodworkingnetwork.com/best-practices-guide, 2017)
3.5 Transferring The Loads by Additional Structural Members

A beam in the building structure transfers its load laterally along its length to its supports which mostly are columns. Due to the nonconcurrent pattern of forces, a beam is subject to bending (Ching, 2014). One of the timber beam Madrasah Idrisiah had fractured due to 'bending stress'. This occurs due to 1 from 3 columns that support the beam which is in the middle had failed to support it loads due to natural ground movement. While in the meantime, there are 'live loads' stored above it during the roof repair work. Removing the fractured beam will give serious intervention to the structure of the building. The conservator of the project has taken an approach to ensure the fractured beam remain since the crack effect can be vanished by the putty and finishing. However, the loads which are supported by the fractured beam need to be transferred to the new structure. The new structure should not obviously change the original appearance of the building in order to remain the design authenticity. The conservator had proposed steel I-beam as the additional structure member. The proposed position of the additional I-beam is almost concealed from the outside view (see figure 7). The additional I-beam function is to support the loads from the floor joists that are supported by the existing timber beams earlier. The I-beam directly transfer the loads to both masonry columns and the middle timber pillar.

Figure 7 The new I-beam takes over the original timber beam by transferring the floor joist loads. The original exposed timber beam is preserved for aesthetic authenticity.

4 SUMMARY AND DISCUSSION

Each timber species has its own natural properties. Understanding these natural properties is a pre-requisite prior to working with this material which able to make the right decision on every proposed repair work. The completed timber works or restored can show a specific response after a certain period. From this response, it can be diagnosed to conclude the mistake of the process that has been made and the existing timber also will show an obvious effect if it is not treated properly. This is likely due to negligence during work and lack of knowledge about timber (Zwerger, 2012). To identify the timber damage is not just by looking at the physical defect and symptom, but requires an investigation on the nature of the material. Early diagnosing on timber defects and timber expert advice are the factors that priority needed before the timber building conservation work started. However, in Madrasah Idrisiah through recording procedures and documentation before timber-work begins, the conservator has first conducted an investigation into the timber properties. The method of knocking with hammer on timber components has identified the degree of damage and the distance of the timber
that is still in good density condition. Through this technique, the restoration which replace the whole pillar (such as case 3.1) has been changed to ‘cut and joint’ method. This method had saved more original timber pillars of the building and meet the principle of conservation of historic buildings by replacing just a minimal critical portion of the component rather than full replacement. Referring to international conservation practices, the timber structure of the historic building is referred to as the historical timber structure. The timber structure includes construction works or craftsmanship and constructive craftsman is part of explanation on the heritage of the building (Larsen and Marstein, 2000). Therefore, each conservation project which involves timber-work should refer to specific guidelines. The knowledge of timber helps to determine which method or technique should be used in repairing work. This is to ensure the restoration works such as old and new timber jointing is not just for cosmetic appearance, but more important are the durability and lifespan after being conserved. Additionally, thorough diagnose on the defects and causes of damage should be a part of scope in timber restoration, thereby appropriate techniques for conserving and treatments can be determined. It is hoped that in the future, the conservation work on historic timber buildings in Malaysia will have a special guideline for conservation works as well as masonry building. The modification, reinforcement of other material used in conservation are for the sake of safeguarding and prolong the building life. The conservator must try as best possible to not change the esthetic and the original appearance of the historic building. In Madrasah Idrisiah conservation, any new additional are marked and recorded to differentiate the original design for future reference.

5 ACKNOWLEDGMENT

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A REVIEW OF ASSESSMENT IN ADAPTIVE REUSE OF HERITAGE BUILDINGS IN MALAYSIA

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Abstract - Heritage buildings is one of the urban identities for the city and should be well-preserved not only because of the value and story, it also because of existing building stock. Reusing existing building stock can combat the environmental load significantly by reducing the material, transport, energy consumption and pollution in construction of new building. In recent years, adaptive reuse of heritage buildings is popping out so fast, compared to previous year whereby heritage building mainly suffers from dilapidated and poor building conditions. Adaptive reuse is converting the original function of existing buildings which services and technology are outdated to a new building purpose for a new need to meet the current development. However, the eagerness of owner and local authority in applying the adaptive reuse approach in heritage buildings, which this approach has been recently criticised for jeopardizing the authenticity of the heritage buildings. Hence, the aim of this study is to review previous studies on assessment method implement in adaptive reuse project based on the authenticity principle in conservation for heritage building. It is believed that this study can help increase the percentage of authenticity by creating an awareness between stakeholders. This study involved reviewing relevant research to embrace all information pertaining to assessment in adaptive reuse for heritage building. It is hoped that the outcome of this study will help organisation or individual who are interested in adaptive reuse for future references.

Key word - Authenticity, Adaptive reuse, Heritage buildings.

1 INTRODUCTION

Heritage buildings in Malaysia have their own value and story (Ahmad, 2006) and portray it through building styles (Sodangi, Khamidi, & Idrus, 2013). These buildings have a variety of interesting styles, influences as well as sign of the economy change (Toong & Utaberta, 2015) and become one of the urban identities for the city. Presently, heritage buildings preserved not only because of the value and story, but also because of the existing building stock. According to Rovers (2004), by using existing building stock, it contributes to combat the environmental load significantly within the next 20 years and this can contribute to sustainable development by mitigating the material, transport, energy consumption and pollution in construction of new building. Yudelson (2010) emphasized, 75% of all buildings expected to be operating in the year 2040 by reusing the existing building. This statement stressed that it is vital to conserve heritage buildings for our future development. As heritage buildings show a lot of significant as mention above, adaptive reuse approach will be used to retain the heritage buildings to extend the building’s life and avoid demolition waste, encourage reuses of the embodied energy and also provide significant social and economic benefits to the society (Douglas, 2006; Yung & Chan, 2012).

2 HERITAGE BUILDING

Building is a structure with a roof and walls that is used as a place for people to live, work, do activities, store things, etc.: the act or process of making structures by putting together materials (Fitchen, 1999). Heritage means features belonging to the culture of a society such as traditions and languages. Heritage is something transmitted by or acquired from a predecessor (Baxter, 2014;
Harvey, 2009). In short, the definitions of heritage building is a building possessing architectural, aesthetic, historic or cultural values which are declared as heritage buildings by local authority or competent authority in whose jurisdiction where such building is situated (Baxter, 2014). Heritage buildings serve as cultural and heritage symbols and thus, act as a hub of individual and community life. In addition, heritage buildings have a variety of interesting architectural styles, influences, and become one of the urban identities for the city. For example, heritage buildings situated in Ipoh, Malacca and Georgetown (Raja Nazrin Shah, 2006; Sodangi et al., 2013; Wan Ismail, 2012).

Heritage buildings portray the character of the city in various time (Elnokaly & Jun Fui, 2014) as well as symbol of the economy development (Toong & Utaberta, 2015), heritage building should be preserved because they have their own emotional, cultural, and historical values (Ahmad, 1994; Fielden, 1995; Ahmad, 2006). Thus, the function of heritage building must change to fulfil the new needs of development with integration of contemporary design that can contribute to vibrant and visually exciting spaces that people want to live, work or play in today (Aly Shehata, 2014). However, failure to maintain the property can impair the structural integrity of the fabric and accelerate the decline in investment returns (Wan Ali, Ishak, & Ibrahim, 2016). One way in keeping the heritage buildings is by adaptive reuse them to contemporary uses which fit to the new development need. This was stressed by Wan Ismail (2013) indicating that the practice of adaptive reuse the heritage buildings could save them from being replaced by new buildings which will contribute to social, economy and environment purpose. Therefore, the best way to keep the minimum loss of heritage buildings authenticity and contribute to combat the environmental load significantly is by applying adaptive reuse in the right way.

3 ADAPTIVE REUSE

Adaptive reuse converted the old buildings function which services and technology were outdated into a new building purpose for new needs of the inheritors due to development by injecting new materials and ideas while at the same time retaining the original structure and fabric (Douglas, 2006). Adaptive reuse is beginning to receive widespread attention because of the economic, social and environmental benefits that can be espoused (Bullen & Love, 2011; Melis, 2010). This is supported by Tan, Olanrewaju, and Lee (2016) where they assert currently adaptive reuse of heritage buildings is popping out so fast, compared to previous year which mainly suffers from dilapidated, neglected (Al-Obaidi, Wei, Ismail, & Kam, 2017) and turned into corpses. Adaptive reuse is one of the conservation techniques which can save heritage buildings being replaced by the new building and preserve the identity of the place (Douglas, 2006; Shen & Langston, 2010). The reuse of heritage buildings enables future generation to appreciate the identity of the building (Burke, 2007) as the heritage buildings represents unique architectural, aesthetic, political and social features of a different time (Rashid, 2016). Therefore, the best way to keep the minimum loss of heritage buildings authenticity and contribute to combat the environmental load significantly is by applying adaptive reuse in the right way.

Adaptive reuse project of heritage buildings might compromise the authenticity to satisfy the development needs (Aydin & Yaldiz, 2010). However, presently the eagerness of the owner and local authority applying the adaptive reuse has been recently criticised for compromising the authenticity (Ab Wahab, Mohd Hamdan, Lop, & Mohd Kamar, 2016; Fernando, 2001; Jasme, Othuman Mydin, & Sani, 2014b; Wan Ismail, 2012b), which continue to harm and has resulted great impact on the heritage building. They want to conserve the heritage buildings but at the same time ruin the authenticity (Tikhonova & Alho, 2015). If no tremendous effort is thrown in adaptive reuse approach, it can jeopardize the precious heritage building life, value and story. As mentioned earlier, adaptive reuse is one of the conservation techniques (Douglas, 2002), to perform adaptive reuse in the correct way, authenticity principle in conservation are used to slow down the heritage building property erosion process as well as to retain the authenticity. This paper aim to review previous studies on assessment
method implement in adaptive reuse project based on the authenticity principle in conservation for heritage buildings. The assessment of authenticity is important to make sure all the adaptive reuse projects in compliance with the guidelines to retain their authenticity.

4 AUTHENTICITY IN CONSERVATION

Authenticity in conservation principle is a process to expose the true nature of an object based on the historical evident (Harun, 2011) and help to slow down the heritage property erosion process. As a way forward to balance the need to continue development without ignoring the responsibility to care the authenticity of heritage building in adaptive reuse whilst creating economical prosperous places for generation to live and work. By referring to Table 1, there are four important principles that are emphasized in authenticity principle in conservation for heritage building to retain the authenticity of heritage building, consist of material, design, setting and workmanship (Jabatan Warisan Negara, 2012). This principle does not hinder development, but in fact acts as a catalyst to the development and well-being of a town (Burke, 2007).

The adaptive reuse is an approach of changing the building function when the original purpose of the building is no longer viable with minimum intervention and maintain as much as possible the original building fabric to harmonize with the new demand of development (Aly Shehata, 2014; Harun, 2011). This statement stressed in applying adaptive reuse, the stakeholder can change the authenticity of heritage building to parallel with the demand for development as long as the fabric is maintained. Without the ability to change, this building turned into corpses and would die (Boussaa, 2010). Heritage building function must change to fulfill the new needs of development with integration of contemporary design which can contribute to vibrant and visually exciting spaces that people want to live, work or play in today (Aly Shehata, 2014). As mentioned earlier, adaptive reuse approach has been recently criticized for compromising the authenticity. To make sure this adaptive reuse approach is done in the right way, authenticity in conservation principle are applied in adaptive reuse. Hence, the aim of this study is to review previous studies on assessment method implement in adaptive reuse project based on the authenticity principle in conservation for heritage building. Thus, it can increase the percentage of authenticity and create an awareness among stakeholders.

Table 1 Authenticity in adaptive reuse based on conservation principle

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Views toward authenticity in adaptive reuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Stressed by researcher Ahmad (2001); Harun (2011); Ahmad (2006) authenticity in material refer to the building materials, properties of materials, exterior features including color of materials, appearance, and texture of materials.</td>
</tr>
<tr>
<td>Design</td>
<td>Maintain the original design of heritage building as it was first built. It is a combination of elements that create the form, plan, space, structure, architecture style, proportion, scale, technology and the building environment (International Institute for Conservation Canadian Group, 1989; Scotland, 1998; Urban Redevelopment Authority, 1991)</td>
</tr>
<tr>
<td>Setting/layout</td>
<td>According to (Warren, Worthington, &amp; Taylor, 1998), authenticity in setting represents physical environment of a historic property situated and it relates to surrounding features and open space. Setting or layout it portrays daily activities done in the building.</td>
</tr>
<tr>
<td>Workmanship</td>
<td>Workmanship is referring to the details in making every inch of the buildings by artisan labour and skill in constructing a building to make these building have their own aesthetic values. It denotes the physical evidence of the crafts of a culture or people during any given period in history or prehistory (Warren, 1999).</td>
</tr>
</tbody>
</table>

5 PROBLEM IN ADAPTIVE REUSE OF HERITAGE BUILDINGS

People nowadays are paying greater attention about adaptive reuse, but the issue appear now is regarding the authenticity of the heritage buildings as stated in Table 2. Previous studies have
discussed on the improper conservation of the heritage building that diminishes the authenticity of heritage buildings. Owner of building reuse and adapt all sorts of buildings in spontaneous (Plevoets & Sowińska-Heim, 2018). According to Fernando (2001), 8% of the early heritage buildings in Malacca are still in the original form while 51% had been renovated and 41% had either perished or lost in originality due to renovation works in adaptive reuse. Wan Ismail (2012) reported only certain heritage building in the row to be preserved, the rest were subjected to the hideous conservation works that totally destroy the authentic value. Jasme, Othuman Mydin, and Sani, (2014) added there are still many buildings that have been adaptively reused without following the regulations. Thereby, losing the building’s authenticity and historical significance. This statement is in line with Ab Wahab, Mohd Hamdan, Lop, & Mohd Kamar, (2016), most of the walls in adaptive reuse of heritage buildings lose their authenticity of material and design. This shows that lack of authenticity in heritage building is a serious issue and need to combat due to the negative effects happened to the heritage buildings value as well as the environmental significance. From this issue, the lack of authenticity may be influenced by many interrelated factors as stated in Table 3. Most of the researchers agreed that there is no effective legal protection and control pertaining to authenticity within the local authority in adaptive reuse (Al-Obaidi et al., 2017; Omar & Ishak, 2009; Zahari, Harun, Ahmad, Zawawi, & Agus, 2016) and the stakeholders were unable to follow most of the guidelines due to incomplete information and details for each component of the building element regarding authenticity in adaptive reuse approach (Aly Shehata, 2014; Jasme et al., 2014b) that have contributed to this issue.

By viewing into the problem, improper guideline could be tricky among stakeholders which can give tremendous impact to the authenticity of the heritage building. Obviously, the local authority needs to take action to ensure that proper guidelines are sufficient among stakeholders to facilitate the authenticity assessment in adaptive reuse. The local authority contribution is necessary in attaining the authenticity in adaptive reuse of heritage building because at the end it may give the benefit to economical dynamic of society. Therefore, most of developed countries are being proactively minimizing the issues of authenticity in adaptive reuse of heritage building. It is vital to review previous studies pertaining to assessment in authenticity of adaptive reuse of heritage building as to highlight any lacking procedure in overlooking the implementation of adaptive reuse of heritage building. For that reason, it is suggested to review previous studies on assessment method implement in adaptive reuse project based on the authenticity principle in conservation for heritage building as well as it can help author to fill the loophole in applying this approach.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Issue</th>
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<tbody>
<tr>
<td>(Fernando, 2001)</td>
<td>8% of the early heritage buildings in Malacca are still in the original form while 51% had been renovated and 41% had either perished or lost in originality due to renovation works in adaptive reuse.</td>
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<td>There are still many buildings that have been adaptively reused without following the regulations, thereby, losing the building’s authenticity and historical significance</td>
</tr>
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Source: Researcher 2017

<table>
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<th>Problem</th>
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<tbody>
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<td>(Al-Obaidi et al., 2017; Omar &amp; Ishak, 2009; Zahari et al., 2016)</td>
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<tr>
<td>(Aly Shehata, 2014; Jasme et al., 2014b)</td>
<td>The stakeholders unable to follow most of the guidelines due to incomplete information and details for each component of the</td>
</tr>
</tbody>
</table>
6 RESEARCH METHOD

To obtain the aims, the essential stages of methodology were performed in several stages. This research began with the completion of literature reviews from publication and current issues. Information gathering stage of the study area was divided into two parts; the first one is a study of the background of heritage building, adaptive reuse, authenticity in conservation and the problem faced in execution of adaptive reuse project. The second part is to review the assessment method from previous researchers in assessing the adaptive reuse project for heritage building. Besides, comparative analyses were used as the approach to review previous studies on assessing the method used in implementing the adaptive reuse projects based on the authenticity principles in conservation for heritage building. A review and a series of analysis is on the four previous researchers in assessing the adaptive reuse projects for heritage buildings with different building functions and locations. A detail study on the previous research and the success research that had been conducted, the assessment method implemented in adaptive reuse projects are identified at the end of the stage.

7 REVIEW CURRENT ASSESSMENT IN ADAPTIVE OF HERITAGE BUILDING

Highlighting the above issues, the author selected four previous researchers who did the assessment in adaptive reuse of heritage building. All the selected researchers in this study have their own approach and building types to assess the adaptive reuse heritage building. Assessment is the act of judging or deciding the amount, value, quality, or importance of something, or the judgment or decision that is made (Dictionaries, 2017). In conservation, assessment of authenticity is important to make sure all the adaptive reuse projects are in compliance with the guidelines to retain their authenticity.

7.1 Jasme, Othuman Mydin, & Sani

This study was done in Core or Buffer Zones of George Town, Penang. Investigations were conducted at four heritage buildings consist of Penang State Museum, Batik Painting Museum, The Camera Museum and Sun Yat Sen Museum. All buildings in this study have changed their original use and, after the adaptation process, a visual inspection was conducted to check whether the buildings’ elements followed the Guideline for Conservation Areas and Heritage Buildings. During the site inspections and observations, pictures were taken to record and analyse the changes made to the case study buildings as per items stated in the guidelines. The interviews were also done with each building’s owner or administration staff to gain information about the background of the buildings as well as any previous restoration work that had been done. As a finding in this study, most of the buildings did not undergo major restoration projects and mostly followed the Guideline of Conservation Areas and Heritage Buildings provided by the Municipal Council of Penang under the Draft George Town Special Area Plan but not for Batik Painting Museum. Many parts of the Batik Painting Museum have been restored rather than maintaining the original materials, and all the buildings have undergone major changes by using flooring timber for plastering. The authors stressed that, the contractors and building owners were unable to follow most items stated in the guidelines. In this paper, the authors suggested that a more complete information and detailed requirements be drawn for each element of buildings as a guideline to guarantee that the authenticity of the cultural landscape and the outstanding universal value of the heritage site will be preserved.

7.2 Mydin, Keling, Sani, & Abas

This study focuses on the compliance of adaptive reuse of historic shop houses for sleep lodging with reference to the Guidelines for Conservation Areas and Heritage Buildings by Majlis Perbandaran Pulau Pinang (MPPP). In this study, a case study research methodology was used. The
case study consists of six historic shophouses around Georgetown, which adaptive reuse applied was investigated and evaluated. The buildings are Red Inn Heritage, Red Inn Penang, Rainbow Hotel at Pintal Tali Street, Ryokan Hotel at Muntri Street, Syok Hostel at Lebuh Chulia and Red Inn Court at Masjid Kapitan Keling Street. After the observation and investigation, the authors made a few conclusions. None of these six case studies have fully followed the requirements stated in the guidelines, most of the building owners were simply concerned with the exterior part of the building, but when it came to the interior, many important things were ignored. The author stressed that some of the owners wanted to make the building with traditional looks on the outside, yet modern for the interior part. However, the modern elements eventually ruined the traditional features. All this can diminish the authenticity of the heritage buildings. The authors added that for the sake of doing business, owners have endangered the guests’ lives with faulty and hazardous design. The authors also claimed that there are lack of active fire protection and overemployment of passive fire protection in these buildings. This study does not only increase awareness of heritage shophouse conversion practices but has also revealed a number of faults in the process that require serious attention in adaptive reuse heritage building project.

7.3 Aminudin
Unlike other author who chose heritage building in Penang as a case study, this author chose heritage buildings in Ipoh as a case study. Adaptive reuse of heritage buildings as a café were chosen to identify the compliance of adaptive reuse of common building elements affected in adaptive reuse approach. Three adaptive reuse cafés involved in this study consist of HOBO café, Plan B and El Negra Deli and Studio. The author also stated that building elements affected have the tendency to increase the aesthetic and authentic value of a heritage buildings. Only the structures are maintained. It also discovered that most common building elements affected in adaptive reuse project are front façade, external wall, internal wall, door, window, roof, ceiling finishes, wall finishes, floor finishes and building facilities. The author said building elements affected are potential to increase the aesthetic and authentic value of a heritage building.

7.4 Ab Wahab t. al.
In this study, the authors conducted the study to gather the true picture of applied adaptive reuse principles that has been done on heritage hotels available in Melaka and George Town World Heritage Sites. This research started with an inventory that led to the discovery of 35 hotels which applied the principle of adaptive re-use of historic buildings. Based on this finding, 4 historic hotels from adaptive re-use applications have been selected as the case studies. Results of the case studies carried out show that the level of conservation of heritage hotel is moderate and measures of control should be taken into consideration to ensure the privileges of heritage hotel. The authors stressed that most of the wall in adaptive reuse of heritage building lose their authenticity.

8 RESULTS AND DISCUSSION
After reviewing and analysing all mentioned researchers above, to date, the researchers only focus on descriptive assessments, not on numerical assessment as shown in Table 4. In this table, most researchers have discussed on the diminish authenticity in adaptive reuse in building component on heritage building using descriptive assessment with different building types without mentioning the percentage of authenticity retained. The previous researchers only mentioned whether or not the building is compliance with the guidelines. Conversely, in the context of accurateness it is vital to have numerical assessment to get the precise data pertaining to the authenticity value in adaptive reuse approach. Furthermore, with numerical assessment the results are more structured and reliable. With numerical assessment, stakeholders can determine the percentage of authenticity of adaptive reuse in heritage building project. Besides, harmonising with the new demand of development, numerical assessment in adaptive reuse can minimise intervention of building and maintain as much as possible...
the authenticity of heritage building fabric and structure which acts as a catalyst to the development and well-being of a city.

Table 4 Previous studies in assessment in adaptive reuse of heritage buildings.

<table>
<thead>
<tr>
<th>Author</th>
<th>Finding</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Ab Wahab et. al., 2016)</td>
<td>Most of the wall in adaptive reuse of heritage building lose their authenticity.</td>
<td>Assessment in adaptive reuse of heritage building to hotel in Georgetown.</td>
</tr>
<tr>
<td>(Aminudin, 2015)</td>
<td>Most of the outer layer and wall of heritage building affected in adaptive reuse. Only the structures are maintained</td>
<td>Assessment in adaptive reuse of heritage building to cafe in Ipoh</td>
</tr>
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</tr>
<tr>
<td>(Jasme et al., 2014b)</td>
<td>Many buildings that have been adaptively reused without following the regulations.</td>
<td>Assessment in adaptive reuse of heritage building to museum in Penang.</td>
</tr>
</tbody>
</table>

Source: Researcher 2017

9 ACKNOWLEDGEMENTS

The author would like to thank the main supervisor, Dr. Lilawati Ab.Wahab for her exceptional patience, encouragement, guidance, counsel, and advice throughout all the stages of this paper. Special thanks go to my second supervisor, Dr. Dzulkarnain Ismail, for his comments and suggestions given during the completion of this paper. It was a great pleasure for me to undertake this research under their supervision.

REFERENCES


A STUDY ON THE INFLUENCE OF WORKERS ON INTELLECTUAL PRODUCTIVITY WHEN WORKING WITH CLOTHES WITH ATTACHMENT

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Abstract - Increasing global competition due to globalization, diversification of people's values and so forth, has further increased the need for improvement in intellectual productivity in offices. However, various factors affect the improvement of intellectual productivity. However, a method to directly measure intellectual productivity has not been established yet. Therefore, empirical studies that quantitatively capture intellectual productivity by using proxy variables of intellectual productivity have been accumulated so far. In addition, we sometimes make a special meaning to a particular thing, as we say "attaching" to things. Watanabe (2016) pointed out that "attachment" held by people on things play a role in improving psychological value such as amplifying the sense of happiness caused by ownership and realizing identity. In this study, therefore, the researcher hypothesized that intelligent productivity will improve if you do work with attached clothes. So the subject of an experiment to evaluate “work efficiency” as a subjective evaluation and “VAS evaluation of intellectual activity degree” which are a proxy variable of intellectual productivity was carried out. As a result, it cannot be said that the work efficiency is affected by wearing attached clothes, but when a group who replied that they feel attachment less than 50% of their own clothes wear attached clothes, it was found that the results improved which was established by influencing the convergent thinking work which leads one correct answer based on already existing information. In addition, it was discovered that in this group, compared with the time of wearing clothes without attachment, immediately before the work, their global vigor, global affect, happiness, and calmness is higher and immediately after the work their global affect is high and sadness is low.

Keywords - intellectual productivity, attachment, work efficiency, intellectual activity degree

1 BACKGROUND AND PURPOSE OF STARTING RESEARCH

1.1 Background and Problems

In recent years, improvement of intellectual productivity of each office worker in the office is demanded against the backdrop of long-term economic downturn, which is said to have been lost 20 years in our country. Various problems such as a declining birth rate and an aging population do influence the trend. At the same time the software aspects such as the organisation structure and way of working are considered important to reform the hardware aspects of the physical environment in which workers work such as office space. In recent years, the number of enterprises introducing office casual is increasing as part of the trend to allow companies to work in various ways. While the selection area of clothing worn in workers offices is expanding, 66% of companies in Tokyo have dress codes, and few companies can choose their own clothes freely.

1.2 Attachment of People to Things

People sometimes have positive feelings towards specific things, like expressions that "have attachment" to things. Furthermore, it has been reported that people have attachment to the area, and various researches on regional attachment are being conducted (Suzuki, Fuji 2008).

Attachment is originally an emotional connection in humans and animals in the field of psychology, mainly is caused by mutual relations between infants and mothers (Bowlby 1969).
Today it began to be developed and used in a way that is "attached" to various things. In addition, Kino, Iwashiro, Ishihara and Dekihara (2006) pointed out that a person may personify things to the owner himself or to a familiar other person. In recent years, in the field of brand marketing and consumer behavior, the concept of affecion has also attracted attention as a factor for consumers' willingness to purchase. For example, as called emotional branding, a strategy has been developed that places emphasis on acquiring market share in people's emotions rather than mere market share (Yaeshi, Iwakura 2014). Watanabe (2016) also pointed out that "affection" that human beings hold against things plays a role in promoting psychological value such as amplifying the sense of happiness by ownership and realizing identity. We proposed a design strategy to embed attachment point of view in product and suggest that the strategy is effective in promoting the formation of attachment.

1.3 Measurement of Intellectual Productivity
As mentioned above, it is important to measure intellectual productivity in order to improve the intellectual productivity of each office worker. The Ministry of Land, Infrastructure and Transport tried to measure intellectual productivity by dividing intellectual activities into three tiers, and discussions were held (Intellectual Productivity Research Committee Report, 2011). Therefore, various empirical studies have been accumulated using proxy variables of intellectual productivity.

1.4 Purpose of the Study
Therefore, the objective of this research is to examine the impact of emotional connections between people and clothes on intellectual productivity through subjective experiment. Additionally, the influence on intellectual productivity is obtained by measuring work efficiency and intellectual activity as a proxy variable of intellectual productivity.

2 OUTLINE OF THE EXPERIMENT

2.1 Purpose and Objective of the Experiment
We performed a subject experiment to ascertain the influence of working on clothes with attachment on intellectual productivity. The subjects of this study were instructed to prepare clothes with attachment and clothes without attachment in advance. The subjects were 30 students (men:15, women:15) in Kyoto Intusitute of Technology.

2.2 Working Contents
Work content is measured as work efficiency, 100 mass calculation with simulation of simple work, Sudoku (one of the pencil puzzles that puts numbers from 1 to 9 in a 9 × 9 square frame separated into 3 × 3 blocks), which is a simulation of convergent thinking work (deriving one correct answer based on already existing information), and an associative game which simulated the divergent thinking work (to make ideas based on information and produce free thought). In this association game, the subjects were asked to write words reminiscent of "vegetables" and "sports" as much as possible within the time limit. Furthermore, VAS subjective evaluation and questionnaire were conducted to measure intellectual activity degree. The subjects were then asked to perform 100 mass calculation, Sudoku, associative games with a time limit of 4 minutes each.

2.3 Method of the Experiment
Figure 1 is the experimental procedure. For convenience, we set (a) when the subjects wear clothes with attachment, and (b) when the subjects wear clothes without attachment clothes. In consideration of the influence of accustomed by order, an experiment was conducted by separating it into group A wearing attached clothes at first and group B opposite. Furthermore, the intellectual task that the subject wears clothes with attachment is "Intellectual Work α" and the intellectual task performed by wearing clothes without attachment is "Intelligent Work β." In the questionnaire, I asked...
whether the subjects are interested in fashion, what kind of clothing subjects are attached in their own clothes and what percentage of their own clothes they have attachment.

3 RESULTS AND CONSIDERATION OF THE EXPERIMENT

3.1 Measurement result of working efficiency

3.1.1 Comparison by number of correct answers

The number of correct answers of subjects in each task in (a) when the subjects wear clothes with attachment and (b) when the subjects wear a clothes without attachment was shown in Figure 2 below.

In all the items, it was found that the number of correct answers when wearing clothes with attachment was higher than the number of correct answers when wearing clothes without attachment.Subsequently, we also made comparisons taking personal capacity differences into account.Looking at the growth rate of (a) to (b), assuming that the number of correct answers when wearing clothes without attachment is 100%, 17 out of 30 people in 100 mass calculation, 19 people in 30 in Sudoku, 19 out of 30 in associative game exceeded 100%.
3.1.2 Consideration of influence by order

In order to consider the influence of accustomed by order, regardless of the type of clothes subjects are wearing, the ratio of the results of the second work to the results of the first work of 30 subjects was examined. As a result, I found out that 20 out of 30 people in the item of 100 mass calculation, 24 people out of 30 in the item of Sudoku, and 21 out of 30 in the item of associative game improves records in the second work than in the first work.

3.2 Considering the significant difference

In order to examine whether the work efficiency is affected by the difference of clothes worn by subjects, the significant difference was examined. As a result, the significant difference of 100 mass calculation, Sudoku, associative game was \( p=0.611(>0.05) \), \( p=0.402(>0.05) \), \( p=0.343(>0.05) \) respectively.

Secondly, the significant difference of the influence of accustomed by order was examined. Regardless of the clothes worn by the subjects, the significant difference between the number of correct answers in the first task of 100 mass calculations, Sudoku and associative games and the number of correct answers in the second task were examined. As a result, the significant difference of 100 mass calculation, Sudoku, associative game was \( p=0.001(<0.05) \), \( p=0.002(<0.05) \), \( p=0.021(<0.05) \) respectively. In all work, the average score of the work of the second work is higher than the first work of 100 mass calculation, Sudoku, associative game. It turned out that it influenced the work efficiency by the order. From these results, it was found that the results of 100 mass calculations, Sudoku and associative games are not affected by the differences in the clothes worn by the subjects, but the influence of habituation by order.

3.3 Analysis by attribute difference

From the questionnaire taken at the end of the experiment, the subjects were categorized into various attributes and the work efficiency was analyzed. Among them, in a group that replied that the proportion of the number of clothes that have attachment in the owned clothes is 50% or more, (a) when the subjects wear clothes with attachment compared to (b) when the subjects wear clothes without attachment, the average point was found to be low. The average number of correct answers of subjects in each task in a group that replied that the proportion of the number of clothes that have attachment in the owned clothes is 50% or more is as shown in Figure 3.

![Figure 3 The average of the number of correct answers of subjects in each task in a group that replied that the proportion of the number of clothes that have attachment in the owned clothes is 50% or more](image-url)
To the contrary, in a group that replied that the proportion of the number of clothes that have attachment in owned clothes is 50% or less, (a) when the subjects wear a clothes with attachment compared to (b) when the subjects wear a clothes without attachment, the average point was found to be higher. The average of the number of correct answers of subjects in each task in a group that replied that the proportion of the number of clothes that have attachment in owned clothes is 50% or less is as shown in Figure 4.

![Figure 4](image)

Therefore, the significant difference between the correct answer numbers of (a) when the subjects wear clothes with attachment and (b) when the subjects wear clothes without attachment of the group who replied that the proportion of the number of clothes that have attachment in the owned clothes is 50% or less. As a result, the significant difference of 100 mass calculation, Sudoku, associative game was p=0.280 (>0.05), p=0.01 (<0.05), p=0.086 (>0.05) respectively. That is in Sudoku's correct answer number, there was a significant difference between (a) when the subjects wear clothes with attachment and (b) when the subjects wear clothes without attachment. Regarding Sudoku, it can be seen that the work efficiency is affected by the difference in the clothes worn by the subjects.

An investigation on whether there was an influence of accustomed by order in the number of correct answers of Sudoku of the group was examined. The findings showed that the proportion of clothes that have attachment in the owned clothes is 50% or less. Comparing the average points of the first correct answer number and the average points of the second correct answer number in this group, it was found that the average points of the second correct answer number is higher. But regardless of Group A and Group B, when considering the significant difference between the first and second correct answers, the result was p = 0.237 (>0.05), and no significant difference was found. In the group that replied that the proportion of clothes that have attachment in the owned clothes is 50% or less, it was not influenced by the order, and it was found that the difference in the clothes worn by the subjects do influence the performance of Sudoku.

### 3.4 Evaluation of intellectual activity degree

Measurement of intellectual activity degree was measured by adopting alert, sleepiness, effort (loss of motivation), weariness, happiness, sad, calmness, and tension called basic VAS. When using the eight items, obtain global vigor and global affect could be obtained. Measurement of the intellectual activity degree was carried out four times in total, which are the first intellectual work, after the first intellectual work, before the second intellectual work, and after the second intellectual work.
First, by looking at the measurement result of the intellectual activity degree of the subject as a whole, just before intellectual work, global vigor and happiness were higher and effort (loss of motivation) was lower when wearing clothes with attachment than when wearing clothes without attachment. Just after intellectual work, it was shown that global affect and happiness were higher and sadness was lower when wearing clothes with attachment than when wearing clothes without attachment.

Next, when the intellectual activity of the group of those that replied that the proportion of clothes that have attachment in owned clothes is 50% or less was measured, just before intellectual work, it showed that global vigor, global affect, happiness and calmness were higher when wearing clothes with attachment than when wearing clothes without attachment. Also, just after intellectual work, it was shown that global effects were higher and sadness was lower when wearing clothes with attachment than when wearing clothes without attachment.

3.5 Correlation analysis of work efficiency and intellectual activity

Here, in the group that replied that the proportion of clothes that have attachment in the owned clothes is 50% or less, the intellectual activity degree just before doing intellectual work is higher when the subjects wear clothes without attachment by wearing clothes with attachment, and that the results of Sudoku afterwards improved, the researcher examined whether there is a correlation between the items. Therefore, an analysis was done whether there is a correlation between Sudoku improvement using the test of no correlation and the increase of these intellectual activities. The results are shown in Tables 1 and 2.

As can be seen from the table above, in the group that stated the proportion of clothes that have attachment is 50% or less, the findings show that the intellectual activity degree before work is higher when wearing clothes with attachment than when wearing clothes without attachment, and the results of Sudoku later improved. This suggested that there was no correlation between them.

4 CONCLUSIONS

In this research, we aimed to clarify the influence of working with clothes that have attachment on intellectual productivity from the viewpoint of work efficiency and intellectual activity degree. As a result, the respondents reported that the proportion of clothes that have attachment in the owned clothes is 50% or less, wearing with attachment influenced convergent thinking work which leads one correct answer based on already existing information, and the result has improved. Additionally, in the group, it was shown that global vigor, global affect, happiness and calmness were higher when they are wearing clothes with attachment than when wearing clothes without attachment. Besides, after intellectual work, it shows that global effects were higher and sadness was lower when wearing clothes with attachment than when wearing clothes without attachment. However, there was no correlation between the changed intellectual activity degree and the increase in the results of convergent thinking work.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Correlation coefficient between intelligence activity and Sudoku</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sudoku</td>
<td>global Vigor</td>
</tr>
<tr>
<td>-0.356</td>
<td>0.335</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Significance probability of intellectual activity and Sudoku</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sudoku</td>
<td>global Vigor</td>
</tr>
<tr>
<td>0.233</td>
<td>0.263</td>
</tr>
</tbody>
</table>
REFERENCES
Intellectual Productivity Research Committee Report (2011). Design and evaluation of space with excellent intelligent productivity
INTERIOR FLOOR FINISHES PREFERENCES OF RESIDENTS IN KLANG VALLEY: A PRELIMINARY SURVEY

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Abstract - Residential is a place where human being built and live in and the resident is a person who lives in that place. It can be classified into three levels namely house, home and shelter. Whether it is called house or home or shelter, they play significant role for the human being who live inside them. Therefore, Malaysian construction member especially interior designers should consider the residents’ preferences on interior floor finishes. These preferences are very important to assist the residents to rebuild, recreate and reshape their living environment according to their pleasure, necessities and wishes. This paper discussed the preliminary survey that was conducted to 142 respondents who have renovated their interior spaces. The aims were to detect key features to be addressed in this research, to verify issue and research gap before the research being performed to prove that this research can be done valid and significant as well as to answer the research objectives of the research. There are two objectives of this preliminary survey which are to explore the most chosen types of interior floor finishes towards interior spaces such as living area, dining area, kitchen area, bedroom and restroom. The second objective is to discover the most popular interior floor finishes chosen by the respondents towards the selection criteria of beauty by the respondents in Klang Valley area. This study tested on selected criteria which are beauty, hygienic, durable and comfort. Nevertheless, this research only selected criteria of beauty towards interior floor finishes such as tiles, timber floor board, carpet, mosaic, marble, vinyl and others were discussed. As a conclusion, the residents do renovation with the purpose of rebuilding, recreate and reshape their living environment particularly their interior surrounding to fulfil their satisfaction, needs and desires. Therefore, all the construction members should work hand in hand to accomplish the residents’ living environment.

Keywords - residents, preferences, interior floor finishes, living environment, selection criteria.

1 INTRODUCTION

The interior elements that exist in interior spaces are floor, wall and ceiling. One of the most important elements in interior spaces is floor because the residents keep their body contact with interior floor finishes most of their time compared to wall and ceiling. Preferences as defined by Zinas Bako (2013) are lifetime phenomena and residents choose their life’s undertaking alternatives within the framework that they live in and work with. Preferences refer to certain characteristics any residents expected to get from their house to make it preferable to them. The examples of expectations could be the level of happiness, degree of satisfaction, utility from the house and so on. To minimize the wastage of natural sources, construction materials, time, energy and money due to renovation works with the purpose of rebuilding, recreate and reshape their interior surrounding to fulfil their satisfaction, needs and desires. By knowing the residents’ preferred interior floor finishes and the selection criteria then only the renovation works can be minimized to sustain residents’ living environment for future generations (Siti Norlizaiha Harun, 2005). The construction members such as interior designers, architects, town and regional planners, developers, contractors and others can also solve the construction issues especially on the residents’ interior spaces.
2 SELECTION CRITERIA OF INTERIOR FLOOR FINISHES

Selection criteria are known as to identify and define particular knowledge, attributes and experiences of residents with the purpose to carry out the task efficiently. It can be divided into two categories which are visually and physically; and psychologically. Visual and physical means in a way relate to seeing or appearance and tangible. The preferred interior floor finishes are being observed according to the beauty factors, hygienic factors and durable factors. Psychological is the study of mind and behaviour in relation to a related field of knowledge or activity which affects the residents or respondents’ feelings and emotions and intangible. The factor involved in psychology is comfort. Nevertheless, for this paper the researcher only discussed one selection criteria which is beauty.

2.1 Types of Interior Floor Finishes

There are many types of materials used for floor, wall and ceiling in Malaysia market. Materials can be divided into timber, MDF (medium density fibreboard), plasterboard, plywood, steel, aluminium, glass and acrylic (Drew Plunkett, 2010) but not all materials are suitable for interior floor finishes. For this study, the researchers only focus on the common interior floor finishes that are suitable for interior floor finishes for interior spaces of a residential for instance living area, dining area, kitchen area, bedroom and restroom. The researcher has selected common types of interior floor finishes in Malaysia which are tiles, timber floor board, carpet, mosaic, marble and vinyl.

<table>
<thead>
<tr>
<th>Interior Floor Finishes</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tiles</td>
<td>Timeless appeal, durable, cost-effective, no frequent cleaning, easy to clean and versatile in term of style.</td>
<td>Slippery with presence of dirt, grease and water; bright reflective character would be distracting; does not dampen the sound; and no insulation properties.</td>
</tr>
<tr>
<td>Timber floor board</td>
<td>Most versatile building material, easy to work with, wide range of aesthetic options and durable.</td>
<td>Tend to split and warp over time and prone to attack by insects such as termites if not treated with chemicals.</td>
</tr>
<tr>
<td>Carpet</td>
<td>Lots of colour choices and variety of textures; very comfortable; feel warms to the touch; visually warms expression of interior spaces; and flexible on styles.</td>
<td>Not stain resistance; the joints can easily be seen if not properly install; tends to show worn out pattern if install in heavy traffic; and not resistant to moisture and odour absorption.</td>
</tr>
<tr>
<td>Mosaic</td>
<td>Visually beautiful; versatile and flexible in designs; wide range of material categories, patterns and colours; can be custom-made; very durable; easy maintenance; easy to clean; resistant to chemicals; does not form mold or mild dew at all.</td>
<td>Translucent therefore, adhesives easily be seen; slippery when wet, greasy and dirty.</td>
</tr>
<tr>
<td>Marble</td>
<td>Instantly elevate the overall appearance of interior spaces; many options of colours and multicolours mixes; wide choices of decorative schemes; can be custom-made; can be cut into any shapes; every single floor is one of a kind; enable to take a very high polish, silky smooth and shimmering; sophisticated and glamour style; and great heat conductor that gives cosy and warm feeling.</td>
<td>Easily scratched, crack and chipped; reacts with acidic chemical; prone to water penetration and staining from colourful liquid agents; and slippery when getting wet, greasy and dirty.</td>
</tr>
</tbody>
</table>
3 RESEARCH APPROACH

Rossman and Wilson (1985) posit that instead of focusing on methods, researcher emphasizes on all approaches available to understand the research problem. According to Creswell (2014), research approach can be divided into three which are quantitative, qualitative and mixed methods. On the other hand, Bryman (2001) posits that traditionally, there are only two research approaches, namely, quantitative and qualitative research that provide the necessary steps and procedures to answer the research questions. For this study, the researcher applied mono method for research choice as the purist (Ayer, 1959; Maxwell & Delaney, 2004; Popper, 1959; Schrag, 1992) believed that quantitative and qualitative approaches cannot be mixed for the reason that both are based on the differences of what is important to know and how the world is observed. As suggested by Saunders et al., (2000) and Creswell (2014), the researcher executed quantitative research by using closed-ended questionnaires and have been distributed to the residential area in Klang Valley.

4 PRELIMINARY SURVEY

The aim of undergoing preliminary survey was to detect key features to be addressed in the research, to verify issue and research gap before the research was performed and to prove that this research can be done, valid and significant as well as to answer the research objectives. The total number of respondents for survey method as suggested by Isaac and Michael (1995) and Hill (1998) is between 10 to 30 participants. Nonetheless, the researcher selected 142 respondents from Klang Valley residential areas.

4.1 Research Objective

There are two objectives of this preliminary survey. The first objective was to explore the most chosen types of interior floor finishes towards interior spaces namely, living area, dining area, kitchen area, bedroom and restroom. The second objective was to discover the most popular interior floor finishes chosen by the respondents towards the selection criteria of beauty by the respondents in Klang Valley area.

The interior spaces for this study are living area, dining area, kitchen area, bedroom and restroom. The distributed survey forms are included with Likert Scale which ranging from 1 until 6. Scale 1 represents ‘very strongly disagree’, scale 2 represents ‘strongly disagree’, scale 3 represents ‘disagree’, scale 4 represents ‘agree’, scale 5 represents ‘strongly agree’ and scale 6 represents ‘very strongly agree’ to measure the satisfaction on selection criteria of beauty.

4.2 Findings of Pilot Survey

The researcher chose 142 respondents from Klang Valley residential areas to see the pattern and the reliability of this study because the pilot survey findings were very important as a guidance to be implemented in main survey and main case study.

4.2.1 Respondents’ Background

24.6% of the respondents were at the age of 41-50 and male. 116 respondents were married with 4-5 total numbers of household. 35.2% of 142 respondents with total household income RM4,001-6,000 and 36.6% lived in double storey terrace houses (refer to Table 3).
Table 2 Respondents’ Background

<table>
<thead>
<tr>
<th>Respondents’ Age</th>
<th>Total Nos (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-30</td>
<td>30</td>
<td>21.1</td>
</tr>
<tr>
<td>31-40</td>
<td>22</td>
<td>15.5</td>
</tr>
<tr>
<td>41-50</td>
<td>35</td>
<td>24.6</td>
</tr>
<tr>
<td>51-60</td>
<td>25</td>
<td>17.6</td>
</tr>
<tr>
<td>61-70</td>
<td>21</td>
<td>14.8</td>
</tr>
<tr>
<td>71-80</td>
<td>8</td>
<td>5.6</td>
</tr>
<tr>
<td>More Than 81</td>
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<td>0.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Respondents’ Gender</th>
<th>Total Nos (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>76</td>
<td>53.5</td>
</tr>
<tr>
<td>Female</td>
<td>66</td>
<td>46.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Respondents’ Marriage Status</th>
<th>Total Nos (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>26</td>
<td>18.3</td>
</tr>
<tr>
<td>Married</td>
<td>116</td>
<td>81.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Respondents’ Household No.</th>
<th>Total Nos (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
<td>4.9</td>
</tr>
<tr>
<td>2-3</td>
<td>36</td>
<td>25.4</td>
</tr>
<tr>
<td>4-5</td>
<td>64</td>
<td>45.1</td>
</tr>
<tr>
<td>More than 6</td>
<td>35</td>
<td>24.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Respondents’ Household Income</th>
<th>Total Nos (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below RM2,000</td>
<td>2</td>
<td>1.4</td>
</tr>
<tr>
<td>RM 2,001-4,000</td>
<td>32</td>
<td>22.5</td>
</tr>
<tr>
<td>RM 4,001-6000</td>
<td>50</td>
<td>35.2</td>
</tr>
<tr>
<td>RM 6,001-8,000</td>
<td>22</td>
<td>15.5</td>
</tr>
<tr>
<td>RM 8,001-10,000</td>
<td>7</td>
<td>4.9</td>
</tr>
<tr>
<td>RM 10,001-12,000</td>
<td>23</td>
<td>16.2</td>
</tr>
<tr>
<td>More Than RM 12,000</td>
<td>6</td>
<td>4.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Respondents’ Types of House</th>
<th>Total Nos (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat</td>
<td>13</td>
<td>9.2</td>
</tr>
<tr>
<td>Apartment</td>
<td>17</td>
<td>12.0</td>
</tr>
<tr>
<td>Condominium</td>
<td>2</td>
<td>1.4</td>
</tr>
<tr>
<td>Single storey Terrace</td>
<td>15</td>
<td>10.6</td>
</tr>
<tr>
<td>Double storey Terrace</td>
<td>52</td>
<td>36.6</td>
</tr>
<tr>
<td>Semi-Detached Single storey</td>
<td>6</td>
<td>4.2</td>
</tr>
<tr>
<td>Semi-Detached Double storey</td>
<td>8</td>
<td>5.6</td>
</tr>
<tr>
<td>Single storey bungalow</td>
<td>15</td>
<td>10.6</td>
</tr>
<tr>
<td>Double storey bungalow</td>
<td>10</td>
<td>7.0</td>
</tr>
<tr>
<td>Others</td>
<td>4</td>
<td>2.8</td>
</tr>
</tbody>
</table>

4.2.2 Relationship between Interior spaces and Interior Floor Finishes

Most of the respondents chose interior floor finishes before and after renovation for living area was tiles. On the other hand, for dining area most of the respondents installed marble. Tiles were the most popular interior floor finishes for kitchen area as 47 respondents selected them before and after renovation. For bedroom, 14 respondents installed tiles as well as in restroom (10 respondents). As a conclusion, the most popular interior floor finishes for all the interior spaces in respondents’ residential units were tiles.

Table 3 Crosstabulation Between Interior Spaces Towards Interior Floor Finishes After Renovation

<table>
<thead>
<tr>
<th>Interior Space: Living Area</th>
<th>Before renovation (respondents nos.)</th>
<th>After renovation (respondents nos.)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior floor finishes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tiles</td>
<td>21</td>
<td>11</td>
<td>32</td>
</tr>
<tr>
<td>Timber Floor Board</td>
<td>3</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
<td>Total</td>
</tr>
<tr>
<td>---------</td>
<td>--------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>Carpet</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Mosaic</td>
<td>10</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Marble</td>
<td>4</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>Vinyl</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Others</td>
<td>5</td>
<td>2</td>
<td>7</td>
</tr>
</tbody>
</table>

**Interior Space: Dining Area**

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tiles</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Timber Floor Board</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Carpet</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mosaic</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Marble</td>
<td>3</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Vinyl</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Others</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Interior Space: Kitchen Area**

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tiles</td>
<td>23</td>
<td>24</td>
<td>47</td>
</tr>
<tr>
<td>Timber Floor Board</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Carpet</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Mosaic</td>
<td>18</td>
<td>7</td>
<td>25</td>
</tr>
<tr>
<td>Marble</td>
<td>1</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>Vinyl</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Others</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

**Interior Space: Bedroom**

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tiles</td>
<td>8</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>Timber Floor Board</td>
<td>3</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Carpet</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Mosaic</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Marble</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Vinyl</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Others</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

**Interior Space: Restroom**

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tiles</td>
<td>6</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Timber Floor Board</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Carpet</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mosaic</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Marble</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Vinyl</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Others</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

4.2.3 Relationship between Interior Floor Finishes Before Renovation and Selection Criteria of Beauty

Beauty can be defined as the quality floor finishes as being physically attractive and the quality that gives pleasure to the senses or pleasurably exalts the mind or spirit. The factors that influence beauty are colour chroma, patterns and motives, shapes, trend, sizes and surface textures of the interior floor finishes and were considered by the residents when choosing the desired interior floor finishes for their interior spaces.

5 CONCLUSION

As a conclusion, the most popular interior floor finishes before and after renovation for living area were tiles. For dining area most of the respondents installed marble. Tiles were the most popular interior floor finishes for kitchen area as 47 respondents selected them before and after renovation. For bedroom, 14 respondents installed tiles as well as in restroom (10 respondents). Overall, the most popular interior floor finishes for all the interior spaces in respondents’ residential units were tiles. The findings of the study can assist and guide the residents to choose the suitable interior floor
finishes based on body of knowledge, help the residents to purchase interior floor finishes according to their affordability (cost), the appropriate usage of interior floor finishes with the interior spaces and the types of houses that they live in. The respondents’ preferences have no other reason than to rebuild, recreate and reshape their living environment mainly the interior surrounding to fulfil their satisfaction, needs and desires. Therefore, to achieve desired living environment all the construction members should sit together and work together to make an earth a place to live on.

Table 4 Relationship Between Interior Floor Finishes Before Renovation and Selection Criteria of Beauty

<table>
<thead>
<tr>
<th>Table: Crosstabulation on Interior Floor Finishes Towards Colour Chroma</th>
<th>Table: Crosstabulation on interior floor finishes towards patterns and motives</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 of the respondents agree on colour of tiles before doing renovation.</td>
<td>Before doing renovation, 20 of them disagree on the patterns and motives of tiles.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table: Crosstabulation on interior floor finishes towards shape.</th>
<th>Table: Crosstabulation on interior floor finishes towards size.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most of the respondents (21) disagree on the shape of tiles.</td>
<td>In term of size, 20 of the respondents mostly disagree on the size of tiles.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table: Crosstabulation on interior floor finishes towards surface texture.</th>
<th>Table: Crosstabulation on interior floor finishes towards trend.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The total number of respondents who disagree of the tiles and mosaic surface texture before renovation was 30.</td>
<td>From 142 respondents, 18 of them disagree on the tiles as trendy or stylish interior floor finishes.</td>
</tr>
</tbody>
</table>
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Francis Schrag, sage journals, American educational research association (AERA) v21 n5 p5-8 Jun-Jul 1992.
WORKPLACE REFORM WITH CHANGING MANAGEMENT THROUGH THE USER PARTICIPATION WORKSHOP: THE CASE STUDY OF SEIYO CITY OFFICE

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Abstract – In this paper, we describe about workplace reform aimed at improving productivity of General Affairs and Policy Planning department of Seiyo office, by changing management through the user participation workshop at 4th floor of Seiyo city office, and about the changes of workplace reform. The purpose of this research is to find the changes that are worker's behaviour and worker’s awareness of workplace by workplace reform. We surveyed changes, worker's behaviour and worker's awareness of workplace, by workplace reform at 4th floor of Seiyo office as one case. At workplace reform, in order to create a place where new work style can be practiced, we conducted the user’s participation workshops with workers 6 times. Through the conducted workshops, concept of work style and plan of renovation were proposed. In addition, we surveyed two methods of questionnaire survey and observation survey three times: before the workplace renovation, 3 months after the renovation, and 1 year and 3 months after the renovation. In the questionnaire survey of 3 months after the renovation, it shows that the opinions of the workers were divided between pros and cons against workplace reform. However, the survey of 1 year and 3 months after the renovation shows that almost all workers were satisfied with the new environment. In addition, we found that a positive correlation between participation rate of workshops and in satisfaction increased. The findings suggest the importance of workshops for workplace reform. In the Observation Survey, it shows that the workers selected a place freely where they can work comfortably after workplace reform. For example, they work in refresh space. In addition, the survey suggests that the floor became lively from the rise of the conversation participation rate. Also, as features of work style, after workplace renovation, it suggests that they become conscious of the work style they clearly differentiate between short intermittent works separated by conversation and phone and personal work on concentration.

Keywords - Workplace, Participatory design, Workshop, Change management, Behavioral Observation

1 INTRODUCTION

The number of workplaces by participatory design is increasing (Wang et al., 2014). However, there is limited research that investigate from comprehensive (subjective and objective) perspective. There is only one case that examined the degree of satisfaction of the office (New Office P. A., 2016, p.214-237). Therefore, in this study a case study on workplace reform with changing management of the 4th floor of Seiyo city office was used. We aimed to comprehensively survey the influence of workplace reform on worker's work style (awareness and behaviour), using a questionnaire and behavioural observation survey. In addition, "change management" means that work style changes occurring by deeply participating in the process of workplace design. The workers deepen their understanding of each goal, organizational goals, business style that keep changing the awareness about their work contents and style through participatory design (New Office P. A., 2014, p.255-256).
2 LITERATURE REVIEW

An effectiveness of participatory design is user can take ownership of own workplace (Wang et al., 2014). Furthermore, when thinking design is not made for public, but for certain identified people, participation indirectly made the process of design more effective (Kumazawa et al., 2008).

In workplace, there is correlation between conversation satisfaction and employee’s productivity (Midorikawa et al., 2010). Moreover, effectiveness of conversation and productivity by change of layout has been conducted (Okamoto et al., 1999; Numanaka et al., 2015). When evaluating productivity, communication is one of the important factors (Okamoto et al., 1999). In addition, satisfaction of conversation improves employee’s productivity. Based on these research there is correlation between conversation and employee’s productivity.

3 SUMMARY OF WORKPLACE REFORM

3.1 Background of Workplace Reform

Along with the recent declining working population, it was an urgent task to raise productivity. Even in Seiyo city, Ehime, Japan, the population and staff are expected to decrease dramatically from 2013 to 2040 (Intelligent Productivity Research Committee, 2012). It shows a possibility of financial collapse by the allocation tax being reduced. Therefore, we aimed to improve the productivity of workers by creating a workplace where they can practice better work style, through workplace reform by changing management through the user participation workshop.

3.2 Workplace Reform Policy and Flow

The goal is to make it possible for workers to practice how to improve the productivity of the whole Seiyo office by workplace reform. In this case, we aim for productivity improvement which depends on the 2 policies for the General Affairs and Policy Planning Department (hereinafter, referred to as "GAPP"). Which are 1) Reduction of cost by improving the efficiency of routine work. 2) Improving quality of output by creating innovation, realizing ideas to solve various problems, making Seiyo city attractive. As a flow of this case, first, we conducted survey and workshops (WS1, 2, 3) to grasp the current situation and the ideal. Next, based on those results, we proposed and changed the new work style and new layout. Furthermore, we held workshops (WS4, 5) to think about the way of improving productivity. Finally, in order to evaluate the effectiveness of workplace reform, we surveyed for 3 months after the renovation and it was 1 year and 3 months later the improvement of the productivity was completed.

<table>
<thead>
<tr>
<th>Schedule</th>
<th>WS1</th>
<th>WS2</th>
<th>WS3</th>
<th>WS4</th>
<th>WS5</th>
<th>WS6</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016/4/14 13:00–18:30</td>
<td>2016/5/25 9:00–12:00</td>
<td>2016/5/30 13:00–17:00</td>
<td>2016/10/19 13:00–17:00</td>
<td>2016/11/8 13:00–18:30</td>
<td>2016/11/9 9:00–12:00</td>
<td></td>
</tr>
<tr>
<td>2016/4/15 9:00–12:00</td>
<td>2016/5/30 13:00–17:00</td>
<td>2016/5/31 9:00–12:00</td>
<td>2016/10/19 13:00–17:00</td>
<td>2016/11/8 13:00–18:30</td>
<td>2016/11/9 9:00–12:00</td>
<td></td>
</tr>
<tr>
<td>Participant</td>
<td>GAPP (15) + Other 11 divisions (11) Total 26 people</td>
<td>GAPP (7) + Other 8 divisions (8) Total 15 people</td>
<td>GAPP (9) + Other 10 divisions (10) Total 19 people</td>
<td>GAPP (25) + Other 1 division (1) Total 26 people</td>
<td>GAPP (27) Total 27 people</td>
<td>GAPP (23) Total 23 people</td>
</tr>
</tbody>
</table>

Table 1 Outline of workshops
4 RESULTS OF THE WORKSHOPS

4.1 Work style Concept

Through the first half workshops (WS1-3), we created work style concept as a policy of workplace reform by making Seiyo city office and Seiyo city as ideal. As a result, the work style concept was made "ChangeSeiyo!" and the sub concept is "challenge", "connect" and "enjoy". By having the concept, the workers aim at improving the work style and aim to be a workplace where they can work challengingly as well as improving citizen service. As result, the Concept meaning changes able to make Seiyo city more attractive.

4.2 Content of Layout Suggestions

We designed workplace layout that can embody sub concepts (challenge, connect and enjoy) of the work style concept, and encourage new work style (Fig.1). The concept of the layout is "Choose a place depend on mode that is based on work style concept according to your schedule", and the layout is based on the team address system. The team address system is our original seat system. An island for each division (number of seats is smaller than the number of people) and non-territorial seats are prepared, and workers who could not sit on the division's islands will automatically sit non-territorial seats with workers of other divisions. However, the General Affairs Division only fixed the seat system. In addition, we set up six modes (team · concentration · welcome · discussion · play · share) and made space based on each mode. By having various meeting spaces are made and we aimed to promote collaboration among staff according to the number of people, mood and purpose.
5 EVALUATING THE EFFECT OF WORKPLACE REFORM

In this case, we evaluated the effect of workplace reform from the two viewpoints; questionnaire survey and behavioural observation survey. The effect evaluation was conducted 3 times before the renovation, 3 months after the renovation, and 1 year and 3 months after the renovation. In the following, it is abbreviated as BEFORE, AFTER1, AFTER2.

5.1 Questionnaire Survey

In the questionnaire survey, 30 items are related to the surrounding of seat, conference room, tools, etc. were evaluated in 6 ranks from 1 to 6 on 2 axes; satisfaction and influence, on work. (Tables 2&3).

Table 2 Summary of questionnaire survey

<table>
<thead>
<tr>
<th>Item</th>
<th>Survey on satisfaction level of workplace environment and degree of influence on work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term</td>
<td>BEFORE:2016/5/25～2016/6/1</td>
</tr>
<tr>
<td></td>
<td>AFTER1:2016/2/23～2016/03/03</td>
</tr>
<tr>
<td></td>
<td>AFTER2:2018/03/30～2018/04/11</td>
</tr>
<tr>
<td>Target</td>
<td>Seiyo city office workers (35 to 42 people)</td>
</tr>
<tr>
<td>Method</td>
<td>URL distribution mail using WEB questionnaire</td>
</tr>
</tbody>
</table>

Table 3 Questionnaire survey items (some excerpts)

1. The size of the desk              4. Ease of concentration of work at the desk
2. Desk storage capacity (withdrawal etc.) 5. Ease of conversation with people around me at my seat
3. Comfort of office chairs           6. Ease of refreshing at your desk

5.1.1 Simple Tabulation

Changes of the degree of satisfaction on each item for the workplace environment and the degree of influence of work (6 grades) are shown in Fig2. AFTER1, positive and negative reactions to the new workplace environment appeared extremely, and items were scattered at both ends of Fig.2. However, in AFTER2, these gathers together as one cluster and most items of satisfaction level raised. Especially item "meeting space" of satisfaction level is greatly raised. By setting up various kinds of meeting space, it is possible to choose a place according to the mood and situation. It seems that the cause increases the satisfaction level.
5.1.2. Relationship with workshop participation rate

A strong positive correlation is found between the degree of participation (as shown in Eq. (1)) in workshops and the degree of increase in satisfaction with the workplace (Table 4). It suggests that the higher the participation rate is in workshops, the higher the degree of satisfaction increases a trend.

The participation degree in the workshop for each division is \( x \) as follows when the number of participants in the workshop of the division is \( n \), the total number of workers in the division is \( m \) and the total number of times of workshops is \( k \).

\[
x = \frac{n}{m} \times k \tag{1}
\]

In addition, in AFTER1 the trend is particularly noticeable, and in AFTER2 the lower the participation rate is, the higher the satisfaction increases (negative correlation) as shown in Table 4. From this it can be expected that workers who joined the workshops can easily adapt to the new workplace. As It can be inferred that they experienced the element that was actually reflected in the layout.

| Table 4 Correlation between participation rate of each workshop by department and degree of satisfaction of each item |
|---|---|---|---|
| | Appropriate area is secured for the workplace | High workplace design | Ease of taking out necessary documents such as shared lockers |
| AFTER1 | Average value (change amount) | 3.13(-0.58) | 3.53(-0.04) | 1.93(-1.07) |
| | Correlation coefficient | 0.87 | 0.88 | 0.75 |
| AFTER2 | Average value (change amount) | 3.56(0.42) | 4.00(0.47) | 2.78(0.84) |
| | Correlation coefficient | -0.52 | -0.52 | -0.58 |

5.2 Effect Evaluation Using Behavioural Observation Survey

In order to grasp how to work from an objective viewpoint, we conducted behavioural observation survey of workers working at the target floor. Table 5 shows the summary of the survey.

| Table 5 Summary of behavioural observation survey |
|---|---|---|
| Item | Time and place sitting | Conversation time and opponent and place | Time on the phone |
5.2.1 Average number of people stayed

Table 6 shows the average number of people staying per day for each survey. Only BEFORE is 11.6 people, which is more less 12 than AFTER1&2. As a result, the existence of a meeting during the investigation time can be considered. In the case of a meeting during the survey time, in BEFORE, it had been held in a conference room which is not covered by the survey. However, in AFTER1&2, space was set up to allow holding conferences in the working floor by changing layouts. Therefore, in AFTER1&2 the average number of people staying seemed to increase.

Table 6 Average number of people staying per day for each survey

<table>
<thead>
<tr>
<th>Division</th>
<th>Average number of people staying per day for each survey</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BEFORE</td>
</tr>
<tr>
<td>All Divisions</td>
<td>11.6</td>
</tr>
<tr>
<td>General Affairs Division</td>
<td>5.8</td>
</tr>
<tr>
<td>Town Planning Promotion Division</td>
<td>2.8</td>
</tr>
<tr>
<td>General Policy Division</td>
<td>1.4</td>
</tr>
<tr>
<td>Finance Division</td>
<td>1.7</td>
</tr>
</tbody>
</table>

5.2.2 Usage time by location

Fig.3 shows the usage time by place per day and the rate of change from AFTER1 to AFTER2. Both AFTER1 and AFTER2, Group Seat shows the longest usage time, followed by Concentration Seat. In addition, the change rate showed an increase in the usage time in the Refresh Space, the Welcome Space, the Copier, and the Family Restaurant Seat. In the Refresh Space and the Family Restaurant Seat, scenes of personal work and light talks were observed, and it seemed that the usage time has increased since workers started to use various ways between AFTER1 and AFTER2.

5.2.3 Conversation participation rate

Figure 4 shows the average conversation participation rate per day for the entire floor and for each division. The above conversation participation rate is calculated by calculating the ratio of the number of participants in the conversation among the workers who stayed in the scope of the survey as a 15-min average. As a result, the conversation participation rate of AFTER1&2 is increasing in all cases compared to BEFORE. In all cases, increase is confirmed from BEFORE to AFTER1, and in the General Affairs Division it is only 1% increase, but in other divisions it shows a remarkable increase of 9% to 18%. Also, the change from AFTER1 to AFTER2 is divided, only 5% in the
General Affairs Division. However, in other divisions it shows a decrease of 2% to 5%. From this, the General Affairs Division only shows a different movement from other divisions. As a factor, it is conceivable that only the general affairs section adopts the fixed seat system due to the difference in working system.

![Average Conversation Participation Rate (All Division)](image)

Fig.4 Average Conversation Participation Rate (All Division)

5.2.4 Distribution of conversation time length

Fig.5 shows the histogram of the length of conversation time per 1 day by survey. The figure shows that the conversation is the most numerous for 0.5 min, followed by 1min, 2min, 3min in order, and the shorter the conversation time overall, the more the number of conversations tends to be. In addition, the number of conversations by AFTER1&2 is increasing more than BEFORE. This is presumed to happen due to the increase in conversation participation rate and the number of people staying on the floor.

![Distribution of conversation time length](image)

Fig.5 Distribution of conversation time length

5.2.5 Continuous Personal Working Time

We define Continuous Personal Working Time as the time for workers to work on individuals continuously without conversation and phone, and the histogram and increase rate are shown in Fig.6.

In AFTER1&2, 1 min of work is the most frequent, indicating frequent conversation and phone and short intermittent working. In addition, the rate of increase shows a significant increase from BEFORE to AFTER1&2, with an increase rate of 1 min and 14 min of over 300%. As one of the reasons for this, it suggests that they become conscious of the work style they clearly differentiate between short intermittent works separated by conversation and phone and personal work on concentration.
6 CONCLUSION

We carried out workplace reform through holding of 6 times user participation workshops and layout changes, and analysed worker's awareness of the workplace environment and behaviour change using questionnaire survey and behavioural observation survey.

Through the user participation workshop, we proposed concept of work style and plan of renovation. In the questionnaire survey of 3 months after the workplace renovation, it shows that the opinion of the workers was divided between pros and cons against workplace reform. However, the survey of 1 year and 3 months after the renovation shows that almost all the workers are satisfied with the new environment. In addition, we find that there is a positive correlation between participation rate of workshop and satisfaction. The finding suggests the worth of workshops for workplace reform. In the Observation Survey, it shows that worker select a place freely and work comfortably after workplace reform. For example, they work in refresh space. In addition, from the rise of the conversation participation rate, it is suggested that the whole floor became lively. As a characteristic of the work style for workers to be surveyed are the conversation time and the Continuous Personal Working Time. The longest time for Conversation time is less than 1 minute, the shorter the conversation time, the more the number of conversations tended to show. The Continuous Personal Working Time was similar to the conversation time in a short time. However, after the renovation, they become conscious of the work style. They clearly differentiate between short intermittent works separated by conversation and phone and personal work on concentration.

The research of limitation is the data accuracy of behavioural observation survey. Since we conducted an observation survey visually by investigators, we have the possibility of oversight and mistake of observation.

Finally, as a future research, it is necessary for future papers to clarify the impact of user participation workshops on workers and to study workshop methods that are suitable for workplace reform such as how to organize workshops.

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PEDESTRIAN AND ITS SAFETY IN HISTORICAL AREA
OF BANDA ACEH: AN OBSERVATION

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Abstract - As one of the heritage cities in Indonesia, Banda Aceh must pay attention to the historical area in order to maintain the region's historical values as mandated in the "Program Penataan dan Pelestarian Kota Pusaka (P3KP)". Maintaining the preservation of the area is not only done by preserving its cultural heritage, but also by maintaining the stability of its area, such as maintaining the existence of the region by creating an area for pedestrians to enjoy the historical area. The pedestrian infrastructure facilities need to be properly provided in accordance with the applicable rules, so that a vibrant environment of walking surrounding historical area can be created. This paper analysed the existing condition in Banda Aceh historical area. An observation was conducted in pedestrians sidewalk around the historical area by observing the design and safety aspects. Based on the field observations, not all pedestrian way designs have complied with the design aspects and criteria for pedestrian. Likewise with safety, some primary roads are not equipped with crossing zones, and existed crossing zones do not seem to use traffic signal. Several suggestions to impose traffic policy in this area such as using traffic calming by limiting the speed of vehicles in primary road in this area and limiting vehicle parking in public space area by allocating street parking in the nearby area.

Keywords - Heritage city, Walkable, Banda Aceh

1 INTRODUCTION

After 813 years of existence, many things have happened to the city of Banda Aceh. The length of time has created various faces for Banda Aceh along with the history of Colonialism that left behind historical and cultural designs until the 2004 Tsunami that had changed the topography of Banda Aceh. These changes have shaped an image which some still preserve today as an old town with historical values of the past.

Banda Aceh has officially been declared as one of the 10 pilot projects of the heritage city in 2012 through the "Program Penataan dan Pelestarian Kota Pusaka (P3KP)". The inauguration was conducted with consideration of historical value content in the Old Town area of Banda Aceh, starting from Peunayong, Baiturrahman Great Mosque, Taman Sari to Museum Aceh. These areas certainly have its own charm as a tourist attraction of the old town of Banda Aceh. With the condition of the areas that still has its cultural values and history, a concept of providing facilities for pedestrians takes precedence over the provision of facilities for motorized vehicles in the heritage area. The aim is to provide an opportunity to gain a better exploration experience in the area with a slower mobilization method, which is by foot.

"Pedestrians are a part of every roadway environment, and attention should be paid to their presence in rural as well as urban areas. The urban pedestrian, being far more prevalent, more often influences roadway design features than the rural pedestrian does. Because of the demands of vehicular traffic in congested areas, it is often very difficult to make adequate provisions for pedestrians. Yet provisions should be made, because pedestrians are the lifeblood of our urban areas, especially in the downtown and other retail areas” (AASHTO, 2011)

Walking is popular across ages and for all socioeconomic status; it is free and accessible to most people and can be incorporated into everyday life (McCue, 2017). In developed countries,
walking is one of the aspects that has been the focus in recent years in order to achieve sustainable mobility. Walking is the most basic and natural way to move that every human being possesses. Walking itself able to provide many benefits for the environment, the city, and the people themselves (ex: less pollution, fuel consumption and health issues). Unfortunately in developing countries, walking and pedestrian facilities rarely receive special attention. As stated by ABW (2014) that conventional planning tends to overlook many of these benefits and so it undervalues walkability improvements resulting in underinvestment in this mode: although walking typically serves 10-20% of total trips in economically developed countries, and even more in developing countries, it typically receives just 24% of total public expenditures on transportation facilities and services. This occurs because conventional transport planning is biased in various ways that favor faster modes and longer trips over slower modes and local trips (DeRobertis et al., 2014), thus making a perspective that walking is inefficient and does not require special attention.

This is also the case in Banda Aceh, in addition to trying to provide quality public transport, increasing the volume of roads is still one of the governments focus in solving transportation problems (For example congestion). Development that focuses on the improvement of motorized vehicle facilities leads to the dominance of motorized vehicle use and the lack of attention towards the improvement of facilities and infrastructure for pedestrians (including the streets in the old town of Banda Aceh), thus creating conditions that are less comfortable for people to walk. On the other hand, the new public transport scheme (Trans Koetaradja that operated since May 2016), which would be launched in July 2018 only serve for 3 corridors. They are still unable to cover the mobility demand for Banda Aceh citizens and to reduce the use of private vehicle and it is still not a choice to switch mode from private vehicle (except for captive choice). Another contributing factor to pedestrians is geometrical design that should provide comfort and safety while walking. The existing condition at several parts of historical area show there are improper design of pedestrians, lack of safety and comfort, and inadequate facilities, such as no separation between pedestrian lane and trees (pedestrians way were built in the middle of trees area), the height of pedestrian curb side, pedestrian material in damaged condition, lack of safety guidance in walking and crossing, unavailability of amenities in the pedestrian area, and poor access to vulnerable groups.

In order to present a better experience of old town exploration, the government should be able to provide a good and adequate pedestrian area for visitors, synergizing between designs that support ongoing activities and binding policies, accompanied by strict law enforcement in the process of providing pedestrian facilities and the use of motorized vehicles in the old town of Banda Aceh so that the main aspects in the provision of pedestrian areas that are safe and comfortable can be achieved.

According to Alfonzo (2005), there are five-part models of hierarchy of walking needs: Feasibility, Accessibility, Safety, Comfort and Pleasurability. Southworth (2005) suggests (six) criteria for the design of a successful walking environment: Connectivity, linkage with other modes, fine-grained land-use patterns, safety, path quality, and path context. Meanwhile, Guide to Pedestrian Best Practice (Wisconsin Department of Transportation, 2011), mentioned 2 (two) elements of safety should be concerned: traffic-related safety and personal security. Both have a significant effect in willingness to walk. Traffic security involves pedestrian security protection from traffic, the availability of sidewalks, and security to cross crowded streets. Fulfillment of traffic security needs can be achieved through the provision of accessible pedestrian areas, ensuring safe pedestrian crossings, and the addition of signs, while personal safety tends to be more difficult to be observed and predicted because of its subjective nature. However, personal safety is often associated with the number of other pedestrians in the same area. The street with higher activities intensity is usually more interesting to walk in.

So, in order to give a feeling of personal safety, the provision of lighting and mixed land use that can increase the number of activities should be considered to increase the number of pedestrians. Comfort also plays an important role in increasing the desire of walking, including aesthetic aspects and adaptation to weather conditions. This is done to ensure the availability of suitable conditions for walking. In Wisconsin, walking trip can be more appealing when interesting cultural or natural features visually enhance it (Wisconsin Department of Transportation, 2011).
The smallest detail (such as shopnings display) can have a huge effect on providing a comfortable space for walking. Factors such as the availability of benches, applying some attractive displays on the roadside, and providing a canopy of nearby buildings or utilizing trees can be used as a protection from weather conditions that reduce walking comfort.

In addition to the condition of the pedestrian area, the surrounding environmental image also influences the people's perspective on the suitability of walking in certain areas. There are several things besides providing pedestrian areas that can support the willingness to walk. The first is a motorized vehicle limitation. This limitation can increase the sense of security to pedestrians because of less threat coming from traffic.

Next is to use a mixed method that can draw a lot of activities in the area; as a result, cities were created to bring things together (Speck, 2012). When an area facilitates a lot of activities, it means that there will be an increase in the number of daily visitor, which makes the area more crowded. This may affect the perspective on walking. A walkable environment is often attractive because it is lively and sociable (Forsyth, 2015). So with the increased intensity of activity, the willingness to walk will increase.

Another thing that affects is the overall design of the area as suggested by Speck (2012). Designs involve geometric, topology, walking distance, amenities, vegetation, and more. Topology deals with accessibility and convenience. Flat topology will be easier for pedestrians as it is facilitated with good sidewalks. The distance between land use or park or place to take a break for a brief moment also needs to be considered. One of the disadvantages of walking is the small coverage of people's ability to travel. Therefore, walking activities should be supported by the provision of benches, small parks and close land use. Provision of amenities can also affect the sense of security, comfort as well as aesthetic elements. In addition, the provision benches as mentioned before can increase the distance traveled by foot. Furthermore, the provision of appropriate signs can provide a sense of security and become a medium of information for the area. Then the provision of shade vegetation can be a protector and also contribute aesthetic value for the area itself.

Thus, with the provision of appropriate designs, good policy enforcement, and government consistency, it can create a pedestrian-friendly old town in Banda Aceh and provide good exploration opportunities. The attraction to walk is also expected to attract domestic and foreign tourists to visit the old town of Banda Aceh.

2 LITERATURE REVIEW OF PEDESTRIAN FACILITIES

In general, walkable cities have similar pedestrian facilities and policy characteristics. The commonly used approaches are pedestrian protection enhancement, design adjustments to attract interest, provision of supporting amenities, and the establishment of policies that support pedestrians. The protection for pedestrians can be improved by ensuring the safety when traveling on foot. The security improvement can be done by increasing accessibility, the provision of guaranteed security when crossing, and other supporting amenities. There have been range of publications on pedestrian streets in the American and European countries, but research on pedestrian in Asia has been overlooked (Yuen and Chor, 1998).

Some cities like Cambridge, Vancouver, Boulder, Minneapolis, San Francisco, Seattle, Hong Kong, and Singapore have provided beneficial directions at the pedestrians such as the provision of a sustainable and accessible network just like the City of Minneapolis with 90 percent of its road are facilitated with sidewalk area (Muhlbach, 2012). The pedestrian way is also supported by the existence of a clear and precise master plan for pedestrians which is available in the city of San Francisco and Seattle. In addition to a connected and accessible pedestrian area, crosswalks are also one of the focuses to encourage people to walk. A safe crosswalk is required and should be accessible to every community including persons with disabilities. For instance, Minneapolis designs a crossing area with traffic lights and signposts aimed to protect a crossing pedestrian, while Seattle conducts crossing security with traffic control that is by setting speed limits for vehicles. In Asia, Singapore provides both underpass and overpass, with underpasses based on subway and overpass rests on every
commercial building. In Hong Kong, pedestrians are top priorities in the transportation system so that their direction of policies tends to benefit pedestrians.

Traffic calming is one of the strategies to increase the protection for pedestrian by physical design, provides sidewalk extension which reduces pedestrian crossing distance and increases the pedestrian space to improve the safety for pedestrians. Providing areas for street furniture and benches, transit stop, trees and landscaping may be implemented in the city. For instance, limited freeway in Vancouver has increased the safety for pedestrian due to the traffic calming strategy which makes vehicle has maximum speed limit. It has been successfully in encouraging the citizen to walk. Traffic calming approach is also applied in Hong Kong by reducing the street parking, while Singapore provides wider green belt area to strengthen the pedestrians way independency.

In some safety issues, a few steps for personal safety for citizen can be implemented, such as special staff assignments for pedestrian issues and safety in Minneapolis, Seattle and San Francisco, where they educate the staff and law enforcement related to pedestrians issues and safety.

In the aspect of design, it relates to the land use and amenities. Vancouver commercial area adopted the mixed-use form with shophouse model and residential in Hong Kong commercial area were built above the mall/shopping complex. Vancouverites were familiar with this type of housing form and felt comfortable with it and developed as an accepted form in every commercial area in Vancouver (James, 2017). Singapore also adopts this approach in small scale by compacting the provision to increase the intensity of walking within the reachable destination.

Besides that, the fulfillment of the overall needs will result in community moving rarely to a far place in order to meet their needs. With the fulfillment of easy to reach need and is also supported with good transit which make it easier to walk in the city. This can be seen in Vancouver where the pedestrian area becomes alive with various activities because people are moving between buildings to meet their needs.

Another essential element is providing amenities as to ensure safety while walking such as lighting along the pedestrian sidewalk in Minneapolis and traffic light for crossing and signage in Boulder and Seattle. The function of the pedestrian realm in Boulder and Seattle, by enhancing the sidewalk with vegetation as a buffer zone along with its maintenance, is to keep the aesthetics and comfort during walking. Providing park in public space and as a rest area in some segments of pedestrian sidewalk are also evidenced in Singapore and San Francisco.

Then for policy issues and government empowerment, all walkable cities have a clear and firm policy on pedestrian issues. Setting guidance and master plan for the provision of roads for pedestrians is an early stage of establishing pedestrian-friendly communities and empowering communities for active transport. Seattle has achieved success as a walkable city through the establishment of a master plan that has a clear purpose and size. In addition, Seattle also sets the design to prioritize pedestrians especially for vulnerable groups such as the elderly.

The provision of special programs such as the "Walk First" or "Sunday Street" event in San Francisco that prioritize pedestrians also helps in increasing the number of pedestrians significantly. Walking campaigns were also conducted in Minneapolis and Seattle, while Boulder conducts campaigns through routine education through the upholding of rights and responsibilities for pedestrians, bicycles, and motorized vehicles.

In addition to that, there is a more rigorous policy approach like in Cambridge, known as a walkable city model due to its parking policy (Riggs, 2017). Students in Cambridge are not allowed to buy parking tickets and are forced to ride bicycles or to walk. This is done to encourage communities to support active transport and help reduce the adverse effects of vehicles and improve public health. Besides that, private vehicles are also forbidden to cross the city center in order to ensure the walkability in the city of Cambridge. The city uses a policy approach called 'filtered permeability', which allows different types of vehicles to pass through certain areas where the area filters out other transport models (Riggs, 2017). Thus, transportation without a motorized vehicle is permitted to pass through in the city area. Other policies which were made are limiting speed only up to 20mil/hour in order to support the safety and pedestrians comfort.
Hong Kong can be considered as a walkable city among other countries in Asia, offering good infrastructure and facilities for pedestrians and has the highest score of walkability ratings of 70 out of 100 (Leather et al., 2011). Policies and encouragement to use the public vehicles are also evidenced in Singapore and Bangkok. Although, they were not included in the Walkable city survey, data from the Asian Development Bank per year in 1999 stated that 40% of people choose to use public transport. But there is still a 20% of people choose to walk in Bangkok. This suggests that public transport also affects the desire to walk. Singapore has shown excellent transit oriented, where an average of 300 meters there will be a bus stop that makes it is easy for people to walk (Leather, et al., 2011)

3 METHODOLOGY

This paper presents the results of an observation of pedestrian sidewalks in historical area in Banda Aceh. Observation of the pedestrians ways condition was conducted in major road in old town zone. Several data from observation was taken, documented and recorded to gain the characteristic of the design and safety aspects of pedestrian sidewalks such as material, wide, crossing, trees and determine the utilize of pedestrian ways. The findings were analysed through a review of theories and best practices that have been implemented in walkable countries. From the literature review and direct observation, this study is expected to provide a valid and reliable results.

4. PEDESTRIAN FACILITIES IN BANDA ACEH HISTORICAL AREA

Urban design plays an important role to encourage the community to walk, and it is becoming a concerned to urban designers to make better places to walk – not only as a physical activity, but also for the sensorial and experiential pleasure that may be derived from such environments (Frank et al., 2007). In the planning literature, the most common research areas that deal with aspects of the environment which affect walking behavior comprises the three ‘D’s’ of the built environment – Density, Diversity, and Design (Cervero and Kockelman, 1997).

In design aspect, some street corridors in historical area in Banda Aceh city do not imply a holistic design to achieve a “pedestrianisation”. Limited width of pedestrian sidewalk were found in Peunayong area (in front of the shoplot) (Figure 1: 5B, 5C) and area near Aceh Museum and it follows with poor pavement condition (Figure 1: 3A, 3B, 3C). The sidewalk cannot be fully utilised by pedestrians since they have to share with street food, vendors, chairs and tables, flower pots, and even motorcycle. As a result, this condition has put difficulties for pedestrians movement (Figure 1: 1A, 1B). A better condition is shown in surrounding Baiturrahman Great Mosque (Picture 1C), where only some corridors can be fully utilised by pedestrian (even in limited width). But material pavement standard should be solid, stable, coarse-grained and guiding block for disability was not implemented in all pedestrians sidewalk except only in Museum Aceh and Taman Sari area (Figure 1: 4A, 4B). In 2017, a revitalisation was conducted in “Taman Sari” as a public space in historical area by widening the sidewalk for the purpose of pleasant and attraction. As a result, it creates a vibrant environment of walking (Figure 1: 2A, 2B, 2C, 2D). Shading is used a tool of design features in pedestrians sidewalk that contributes to comfort while walking. Around the shoplot in Peunayong area, the shading comes from the shoplot itself, as there is no vegetation able to be planted as a natural and artificial shading. The various forms of shadings have degated the aesthetics apperances of the area. Meanwhile public space in “Taman Sari” and Aceh Museum which supposedly have a lot of vegetation planted, yet the natural vegetation is still not shady and lush. Thus, a reforestation is needed in order to increase people’ interest to walk around at “Taman Sari”. Bench and dust bin are amenities that are not provided along the sidewalk except in the pedestrian area of the Museum Aceh.

On the matter of safety issues of pedestrian there are only a few primary road which has crossing zone and is lacking in signage and markers for pedestrians in most of the area. The crossing zone (without traffic signal) is only available on the primary road in Peunayong area (Figure1: 5A), however it is not provided in the other historical area. This condition may cause the casualty to
pedestrians. The crossing path is not designed on the same level of street but pedestrians have to step on the curb side or median. Distress will be felt by pedestrian especially for people with disability. Nowadays, Indonesia is obliged to implement a disability-friendly design in all aspect. For instance, in all corridors of historical area, the curb side and ramp are extremely not adjusted with the road/street and crossing level. This was due to ramp not being provided by shoplot and misused by motorcycle as parking area, which resulted inconvenience to the pedestrians when crossing. Some obstacles are also found at public space entrance (such as taman sari, Figure 1: 2B, 2C) where they put poles in the pedestrians way.

![Figure 1 Existing Condition at Banda Aceh Historical Area](image)

To create Banda Aceh into a pedestrian-friendly city, some development concepts for sidewalk pedestrians must be considered, namely providing a wide pedestrian way that will increase the pedestrians volume and comfort, pedestrian security improvements (in the crossing area, providing ramps, guiding block and material), shade (natural vegetation most likely rather than artificial), amenities (lighting, bench, dust bin), design of attractive public space with affordable distance between activity support, and aesthetic enhancement.

In addition, creating attractive designs for walking will encourage people to walk by the attractive pavement design and use the attractive features around them. Basically, the old town area already has its own cultural appeal, meaning that it already has a significant value. But it is still not highlighted enough because there is an impression of not being open because of the far distance from the road and also the high fence. This can be solved by showing its flagship features around the road. The area around the Aceh museum has begun to follow this method by installing signage containing documentation of historical relics in the museum, and the need for an attractive arrangement of the regular street vendor in order to support activity around the area, like the Baiturrahman Grand
Mosque where the community begins to organize street vendors around the mosque. Furthermore, the emphasis on disable-friendly design needs to be put in place such as in the provision of pedestrian facilities in Banda Aceh.

A policy that governs the control of the old town of Banda Aceh is required. For instance the policies that prioritizes pedestrians such as traffic calming in certain primary road with high traffic can be adopted instead of limitation or banned the vehicle from entering the historical area because there is no alternative road that can divert driver to their destination. In some cases, a ban on motor vehicles – pedestrianisation– has been introduced to remove traffic from conservation or retailing areas in order to create a more pleasant environment for the pedestrian like in Cambridge (Riggs, 2017). Strict parking can be applied in some areas such as "Taman Sari" by utilizing the available parking at Baiturrahman Grand Mosque and then explore the area on foot.

The lack of law enforcement against violations at pedestrian facilities reflects an "omission" towards the offense. As a result, this illustrates a "justification of the offense"

4 CONCLUSION

As one of the 10 selected heritage cities in Indonesia, Banda Aceh has to put in special attention to support the facilities in the historical area. Creating "pedestrianisation" in the historical area is an important element in supporting the " Program Penataan dan Pelestarian Kota Pusaka (P3KP)". Besides, creating the ambience an old city would be able to provide more experience for visitors to explore various features in the old town area. With cultural and historical appeal, provision must be easier because the government only needs to improve the atmosphere to encourage people to walk in the old town area.

This can be done by providing a design that attracts people’s interest to walk while ensuring the pedestrian’s safety and security. This can be accomplished by increasing the pedestrian capacity, setting pedestrians as a priority through the procurement of secure cross-sections and the provision of connectivity between crossings with appropriate ramps and curbs that are more accessible for every community especially for people with disabilities.

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DIFFERENT FLYING METHOD IN PRODUCING 3D MODELING RECONSTRUCTION FOR SINGLE TREE USING AERIAL PHOTOGRAPH OF UNMANNED AERIAL VEHICLE

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Abstract – This paper shows the product of 3D model of single tree using different views of digital images. Typically, the users of 3D modelling become vital in certain applications that require measurement to determine the height, width, length, volume of the object. There are several technologies used to produce 3D models but require high cost. However, currently, with an advanced in technology development, an Unmanned Aerial Vehicle (UAV) is one of the emerging technologies that offers solutions to overcome the issues with a higher quality of results. UAV is widely used for aerial photographs and commonly used for collecting data in both small and larger areas or scales. More importantly, this technology is also efficient in producing three-dimensional (3D) information with a higher resolution image. Thus, the current paper attempts to demonstrate the ability of the UAV technology for 3D extraction of single tree using different flying method. This research adopts a quantitative method that implements the experimental process in data acquisition of single tree. Convergent and stereo configuration are employed during photography for data acquisition. This paper presents results of 3D modelling reconstruction of single tree taken by UAV DJI 4 Pro.

Keywords - UAV, 3D model, Aerial Photograph, Single tree

1 INTRODUCTION

Typically, the 3D structure of plant is important for many ecology studies and forestry applications (Lindberg & Holmgren, 2017), which is the point cloud data that are used to reconstruct realistic 3D tree models (Huang et al, 2015). The interpretation of a tree is more difficult than building reconstruction (Gong et al., 2002) and artificial object (Lindberg & Holmgren, 2017) due to the natural variation in appearance and characteristics such as different sizes and shapes of trees. A few years earlier, 3D mapping technology becomes available for civilian application. Currently, the technology of data acquisition for mapping has grown rapidly not only in terrestrial but also non-terrestrial measurements. The requirements of the technology mapping have increased since the usage of the UAV system (Tahar & Ahmad, 2012). This factor is influenced by the ability to save cost as well as able to collect data fast and has a higher resolution image of 3D model generation.

Recently, the use of UAV technology is almost in the line with the advance technology, particularly for aerial mapping technology. However, every technology or method in measurement always has its advantages and disadvantages. This is in accordance with the goals and targets to be achieved during measurement. There are various methods used to generate 3D mapping in line with the demand and high development of mapping in various fields. Chang et al., (2015) and Grenzdörffer et al., (2008) mentioned that UAV has been used rapidly because it is much more flexible, weather independent and efficiently produce very high resolution orthogonal-corrected image and terrain data in 3 dimensional. Furthermore, this technology has the advantages such as real-time, high spatial and temporal data solutions as required by other disciplines (Hackney & Clayton, 2015; Ruzgienne et al.,...
2014). Moreover, Uysal et al., (2015) highlights the UAV is an alternative technology that can replace the terrestrial method for image acquisition in small area coverage. Due to that, this technology is more economical to use compared to the conventional aircraft, while it can reduce the labour cost, require less maintenance and flexible during the take-off and landing area (Tuominen et al., 2015). In addition, this technology also is able to immediately collect data and thus the data can be processed faster (Ruzgienė et al., 2014).

2 THE CURRENT APPLICATIONS OF UAV FOR 3D MODELLING

Aerial photogrammetry is defined as any images taken from the air using the specific camera mounted on the plane and is very useful in many different types of applications. In the last decade, photogrammetry has been used in community mapping and the use of aerial photogrammetry become an emergence of new trends in the geospatial industry for 3D model. The uses of 3D is an important product and demand in many applications such as building extraction (Frommholz et al., 2015; Andre Fischer et al., 1998; Xie et al., 2012), archaeology (Barsanti et al., 2012; Fabio Remondino, 2011; Gonizzi Barsanti et al., 2013), communication (Gool et al., 2002), visualisation and so on. Several methods in photogrammetry are used to generate 3D model using traditional methods such as Airborne LiDAR, telestrial laser scanning and ground survey. However, this method is considered very expensive for ground orthorectification (Rahmayudi & Rizaldy, 2016) especially for small study areas (Polat & Uysal, 2017). Currently, the development of UAV has become an alternative technology and replaced conventional method in produce 3D model. Furthermore, this technology becomes an attractive selection for aerial photogrammetry in several areas (Silva et al., 2015) and can produce a large amount of 3D georeferenced data in a short space of time.

Therefore, the use of UAV technology has grown rapidly in the world of photography, slope mapping (Tahar & Ahmad, 2012) and security application (Ma'sum et al., 2014) as well as the private sector based on certain interests. In navigation area, UAV is used for mapping the aerial photograph for certain purposes. Moreover, the advantages of using UAV in aerial photograph is very sufficient since the data acquisition requires inexpensive process with high resolution data. Besides, it is able to fly under cloud cover and easier to handle than a manned vehicle (Ajayi et al., 2017). Recently, UAV represents an application on vegetative health monitoring, precision agriculture, urban forestry, emergency management, biological and traffic monitoring (Ritter, 2014). In addition, Jannoura et al., (2014) and Xiang and Tian, (2011) have examined the abilities of UAV application in agriculture. This current paper attempts to explore the application of the DJI Phantom 4 Pro UAV technology to produce 3D model of single tree using the different methods of image captured. Specifically, this paper applies a rotor wing quadcopter with the manual flight operation for image acquisition at an altitude 50m above ground level. It is also equipped with 8.8 mm focal length and 72 dpi resolution DJI 4 pro camera operating in manual mode.

3 METHODOLOGY

In this paper, the experimental approach of quantitative method was used to collect the data in different view of camera configuration in order to achieve the structural of single tree. The experimental process consists of four phases. Phase one dealt with the planning for selection of study area and software, phase two addressed the data acquisition process using UAV DJI 4 Pro, while phase three was the most important part, that was the data processing and finally, the phase four results and data interpretations (Figure 1). This study was conducted using two types of camera configuration in the process of image acquisition: DJI 4 Pro camera in convergent and stereo configuration with altitude of UAV flying that was 50m.
4 EXPERIMENT EXECUTIONS AND RESULTS

4.1 Planning
This study was carried out at 30m x 30m areas, located at the Bandar Universiti, which includes a single tree. The image processing was performed using Agisoft Photoscan software in order to produce 3D model and camera calibration. All parameters value from camera calibration were applied in 3D processes.

Figure 1 Four experimental stages in the 3D modelling of single tree

4.2 Image Acquisition
The images were taken using UAV DJI 4 Pro an altitude 50m above the tree as shown in Figure 2. During image acquisition process, the aerial images were captured using two methods such as convergent and stereo camera configuration. UAV was flown at the height of 50m for both convergent and stereo view. The 38 images for camera configuration in convergent and 50 images for camera configuration in stereo were acquired. The selected images per camera configuration were chosen for camera calibration process. The internal parameter values of camera calibration was used for the processing in order to generate 3D model of single tree.
4.3 Data Processing

4.3.1 Camera Calibration Process

Camera calibration process was implemented in order to determine the internal parameters of the UAV camera using Agisoft software. This software identified the midpoint of four main points by using algorithm and automatically generate parameter of camera.

Figure 2: Single tree

4.3.2 Processing of 3D for Single Tree

In this phase, digital image processing was conducted for both convergent and stereo images to produce the 3D model from UAV imagery using Agisoft Photoscan software. The aerotriangulation was used to perform the production of 3D process. Moreover, all the process such as point cloud and texture creation should be executed before generating the 3D model. Figure 3 shows the process of creating 3D for both convergent and stereo camera configuration images using Agisoft software. The images were performed to align photo and continued to other processes such as build dense cloud, build mesh, build DEM and also orthomosaic. In addition, this software was used to build 3D reconstruction, visualization, survey and mapping works.

Figure 3: Process image using Agisoft Photoscan

The identification of tie point was conducted at the beginning of the process to align the digital photo automatically using invariant algorithm. This algorithm recognized the corresponding pixel point and shaped the point to become a 3D model. The position orientation between relative point was obtained with the formation of point cloud. In this situation, the same pixel values of objects were recognized. The process of creating geometric model is formed between images and tie points based on the height values. However, the geometry
model formation did not show the actual image condition until the process of 3D texture-like triangle network is produced.

4.3.3 Result and Interpretation

The process of camera calibration is automatically generated using Agisoft Photoscan software. The camera calibration process for this software was performed automatically and produce the internal parameter of the camera based on the image resolution. The internal parameter of the camera namely lens distortion \((K_1, K_2, K_3)\) as well as descentring distortion \((P_1, P_2)\) should be in good condition before performing any measurements. The result of camera calibration of both images is stated in Table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Convergence (mm)</th>
<th>Stereo (mm)</th>
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<tbody>
<tr>
<td>Focal Length</td>
<td>8.8mm</td>
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</tr>
<tr>
<td>Fx</td>
<td>2454.68</td>
<td>2454.28</td>
</tr>
<tr>
<td>Fy</td>
<td>1824.15</td>
<td>1833.37</td>
</tr>
<tr>
<td>K₁</td>
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<td>0.00843669</td>
</tr>
<tr>
<td>K₂</td>
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<td>-0.0259487</td>
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<td>K₃</td>
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<td>0.0282228</td>
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<tr>
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</table>

The image of single tree was taken using convergent and stereo camera configuration. There are different results shown between both flying method convergent and stereo during data processing. The result shows the comparison DEM resolution and ground resolution of both flying methods. The resolution image of stereo configuration recorded 5.37cm/pixel values of DEM resolution compared to a convergence which recorded 7.92cm/pixel value of DEM resolution as shown at Figure 4(a). Besides, the ground resolution of stereo flying method recorded 1.34cm/pixel compared to convergent recorded 1.98cm/pixel shown in Figure 4(b).

In the rectification process, the intensity value for each pixel was sampled using equation of space resection, camera tilt, terrain relief and image displacement. Figure 5 illustrates the 3D model of single tree for stereo and convergence view. The 3D model of convergent view shows a better image compared to 3D model of stereo view. Although, the resolution of stereo image was smaller than the convergent image, the production of 3D model by stereo image are less than satisfactory. However, the resolution depends on the parameter of the camera mainly focal length, resolution of camera and also flight altitude.
5 CONCLUSIONS

Digital rectification becomes important due to the fact that image should be combined with digital maps. In producing the 3D model of object, orthophoto is an important process to ensure that the distortion over the aerial photographs due to the method of data acquisition and the relief of the land is removed. This was formed from the stereophoto obtained from the surface with certain height and has been corrected with the point coordinates. The result shows method of convergent configuration is sufficient for the purpose of 3D modelling, while the method of stereo configuration is preferred for 2D mapping. However, the resolution image for both of the different flying method are acceptable in the GIS industry.

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DEVELOPING LIBRARY SPATIAL SETTINGS MATRIX THROUGH STUDENT LEARNING BEHAVIOUR

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Abstract – Many studies have investigated student learning behaviour (LB) in the academic library and reported that spatial setting provided sometimes could not facilitate the informal learning that took place. Does LB influence by the spatial setting or it is the other way round? This paper aims to understand these two factors that may give impact towards the design of academic library - the LB and the spatial setting. The first main objective is to identify the category of student LB by screening the activities occurred. The second is to examine how library spatial setting could facilitate the learning by investigating the activities conducted and how the space being utilized. In order to acquire the findings, content analysis method were used where keywords were identified before and during data analysis. All literature reviews were gathered from various types of journal, especially publishing in Journal Academic of Librarianship. The literature regarding the learning behaviour, learning spaces and student preference space was observed during data analysis. From the findings, two groups of learning were discovered - 1) the individual learning, and 2) the group learning. Based on these, the Matrix Model of LB and Spatial Setting was developed which influences the style of learning - i) Individual/Private, ii) Individual/Public, iii) Group/Private, and iv) Group/Public. Besides that the environment, furniture design, technology and tools also contribute to the spatial setting preference and LB. This study will benefit library scholars, designer and librarian to plan the academic library in term of arrangement of space, furniture selection as well as tools and technology to be used.

Keywords - student LB, academic library space, informal learning in library, library spatial setting, academic library.

1 INTRODUCTION

It is commonly said that present learning environment for students is going through a revolution. From the rigid educational furniture settings, it has changed to various physical settings that could cater diversity in learning behaviour. This can especially be seen in the recent library design which hasmore versatile spatial settings. It has become a challenge for spatial designers to design academic library befitting students’ needs and new types of learning in higher education. The controversy arises whether the spatial settings provided will be fully utilized, especially when the lifestyle becomes convenient due to electronic digital penetration. With the arrival of electronic access to books, journal articles, the gate counts and statistics of visitor has declined. This has also affected the use of space. Students not only can access into library content from outside the library building but they also can contact the librarian electronically. Besides, the ability to access the sources available in library, students require the good learning space that can lead to the positive outcome of their learning activities in the library. However, some problems arise on how the library spatial settings facilitate the student learning activities. Although, variety of activities occurred, the spatial settings for such function still cannot befit the condition. For example, studyroom designated for individual study that requires a silent space being used as an informal meeting area for group work. Not to mention, a significant number of working places in study rooms become underused due to inadequate table size.

In a recent trend, academic library over the world attempts to make a change in providing space, resources and services to attract students coming to the library. Many research concentrated on how to improve the systems by carrying out an evaluation to seek whether the spaces provided give a positive-negative impact to users. Some of the cases demonstrated that a single student does not necessarily choose individual table setting to work for, but instead choose a group study table, which
has a large table setting to spread own belongings such as books, papers, laptop and supplies (L. Bedwell & C. Banks, 2016).

Since there were many arguments on the space as mentioned earlier which is not accommodating LB, this paper attempts to review the student LB (henceforth stated as LB) in the library of higher institutional learning and how the academic library spatial settings should befit the condition. The research question of this study is how the appropriate spatial setting that can facilitate the learning activities in academic library by the identifying the student LB. Thus, this survey seeks to distinguish the category of LB by screening the learning activities occurs in the library. Next is to examine on how the spatial setting could facilitate the learning activities by investigating the activities conducted and how the space is being utilized.

2 THE RESEARCH METHODOLOGY

The summative content analysis was used where keywords were identified before and during data analysis. The collected literature was classified according to the topic such as LB and activities (studying, researching, completing assignments, discussing, collaborating), and spatial setting (learning environment space, furniture selection and tools was used). The study related to unobtrusive observation, pre and post evaluation of library usage, student’s perception, student’s satisfaction, space assessment, and student’s preference and student base investigation of student behaviour in the library spatial settings where most were written by librarian. The literature was gathered from the various journals, including the Journal of Academic Librarianship, Journal of Library and Information Science and Journal of Library and Information Practices and Research. The content was analysed using the coding sheet.

The paper analyzed literature that links student LB and library spatial settings from library management, psychology, business communication, facilities and architecture fields. Two objectives were formulated. First, the concept of student LB related to learning activities was developed. Second is the study of library space and features supporting learning related to spatial settings were reviewed. In regards to library spatial settings, the related literature is shown in Table 1.

<table>
<thead>
<tr>
<th>No.</th>
<th>Topics</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Student perception on the library space</td>
<td>(Gensler, 2015; S.Beatty, 2016; C.Andrews &amp; S. Wright, 2012)</td>
</tr>
<tr>
<td>3</td>
<td>Student activities in the library</td>
<td>(D.Suarez, 2007; L.Jordan &amp; T.Ziebell,)</td>
</tr>
<tr>
<td>4</td>
<td>Student satisfaction on the space provided</td>
<td>(M.Gurel, 2016)</td>
</tr>
<tr>
<td>6</td>
<td>Unobtrusive observation, post evaluation of library usage</td>
<td>(N.Abbasi, R.Tucker, K.Fisher, et.al; B.Ramsden, 2014)</td>
</tr>
<tr>
<td>7</td>
<td>Library space assessment</td>
<td>(S.Montgomery, 2014)</td>
</tr>
</tbody>
</table>

The study only involved LB in higher institution of academic library. It is also aim to investigate the learning behavior, without concerning multi tasking behavior. The focus of the study only involved the spatial settings, which covered furniture setting and tools being used, but not on digital and multi media system. Meanwhile, for student LB, the researchers analyzed the literature review investigating the activities occurred in the library including their LB. Both are important factors for spatial designers to provide better space besides the resources and services provided by the librarian. The coding method of content analysis were briefly recorded as in Table 2.
3 FINDINGS

3.1 Student LB

Previous research has interpreted student LB in an academic library in various contexts. Some researchers described the LB performed by students in an academic library in higher institutional learning as informal learning that involves a student driven course with a variety of activities with no teacher involvement (Cunningham & Walton, 2016). However, this paper defines the student LBs as “how student act upon their learning activities through individual or group study”. Though many previous researchers reveal that both ways are important behaviour in the process of learning, the situation in higher institutional learning found that the students tend to opt for individual study rather than group study (S. Bennet, 2015). This may be the most reason why it is necessary to provide a more individual spatial setting as it is for a place to accomplish serious work and to engage with intellectual material (Kathleen M. Webb et al, 2008), whereas the collaborative spatial setting for group study is for research, for study and for group work (R. Applegate, 2009).

Table 2 and Table 3 show findings from the variety of learning activities for both behaviours of individual and group learning based on a review of various literature. From individual LB, it shows that all activities require a concentration and focus towards something and some of the actions may involve writing, meditating, reading and studying, whereas, group LB require the students to collaborate with peers in a small or large group depending on their learning objectives. This may involve action like discussing, debating, presenting, meeting and brainstorming. To conclude, focusing and concentrating are associated with individual study, while collaborating and interacting are associated with group work.

Table 2 The Individual LB in Library Space

<table>
<thead>
<tr>
<th>BEHAVIOUR</th>
<th>ACTIVITIES</th>
<th>AUTHOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDIVIDUAL</td>
<td>Readings on book/article</td>
<td>(C. Imamoglu, M.O Gurel, 2016), (Sanjica et.al), (Demas.S, 2005),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(D. Suarez, 2007), (M. Melssen, 2014), (S. Beatty, 2016), (S. H. Cha,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T. W. Kim, 2015), (D. Rendina, 2016), (Powell, M. 2002), (D. A.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nitecki), (K. Simpson, 2016)</td>
</tr>
<tr>
<td></td>
<td>Doing research/course work</td>
<td>(C. Imamoglu, M.O Gurel, 2016), Powell, M. 2002),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(C. Ugwuanyi, R. Okwor, E. Ezeji, 2011), (N. Abbasi, R. Tucker,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>K. Fisher, et.al), (S. Oliveira, 2016)</td>
</tr>
<tr>
<td></td>
<td>Working on individual assignment.</td>
<td>Sanjica et.al, Neda Abbasi et.al, (Bennet, S, 2011), (Betty S, 2016),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(S. H. Cha, T. W. Kim, 2015), (DNA. Mokhtar, 2016), (SHURA, 2013),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Jordan and T. Ziebell), (David Radcliffe et.al, 2009)</td>
</tr>
<tr>
<td></td>
<td>Individual revision for examinations.</td>
<td>(Chijioke F. U, 2011, Neda Abbasi et.al, DNA. Mokhtar, 2016)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S. Beatty, 2017; SHURA, 2013; L. Jordan &amp; T. Ziebell, C. Andrews &amp; S.</td>
</tr>
</tbody>
</table>
Table 3 The GroupLB in Library Space

<table>
<thead>
<tr>
<th>BEHAVIOUR</th>
<th>ACTIVITIES</th>
<th>AUTHOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting</td>
<td>(Steelcase,1996 – 2018), (C. Andrews and S. E. Wright, 2015)</td>
<td></td>
</tr>
<tr>
<td>E-Classroom.</td>
<td>(Marry O.K. et,al,2017)</td>
<td></td>
</tr>
</tbody>
</table>

3.2 The Relationship Between LB and Spatial Setting

The library is one facility provided by the university or college for students to experience an informal learning. Library spatial settings allow students to conduct learning at their intention both at private and public area whether it is for individual or group learning. There is no specific guidelines that indicates certain spaces for certain LB, but the growing interest to understand the student’s learning needs has made spatial designers to provide a spatial settings that could satisfy the users.

In the aforementioned statement, individual LB demand focus and concentration studies, but they sought out for quietness, not silence and they prefer to stay in the community, not isolation (L. Bedwell & C. Banks, 2016). That is the reason why many individual learners chosesspatial settings with the presence of other students, and appropriating group study tables for individual work by spreading their material out to create a personal space for themselves. Whereas, group LB that involved with the collaborative studies require interaction among group members and usually they sought for optimal spatial settings that could support the process of learning. To conclude, it can be said that there are four zones of learning style found in the library spatial settings which has the same findings by Steelcase. Four categories of learning style occur in the academic library found as shown in Table 4. These 4 categories require the attributes that support the learning as shown in Figure 1.

Table 4 LB categories

<table>
<thead>
<tr>
<th>Bil</th>
<th>LB</th>
<th>LB Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Individual/Private</td>
<td>Focus and concentration</td>
</tr>
<tr>
<td>2</td>
<td>Individual/Public</td>
<td>Focus and interaction</td>
</tr>
<tr>
<td>3</td>
<td>Group/Private</td>
<td>Focus and collaboration</td>
</tr>
<tr>
<td>4</td>
<td>Group/Public</td>
<td>Collaboration and interaction</td>
</tr>
</tbody>
</table>
From the figure above, four (4) attributes of LB in academic library were determined – i) focus; ii) concentrate; iii) collaborate and, iv) interact. All these four LB will be conducted in either individual or group learning, and spatial settings that could facilitate LB and can be categorized into two (2) attributes – i) private space; ii) public space. Based on these attributes, the pattern of LB and spatial settings to achieve the learning goal may be able to be predicted. For example, if students came to the library individually and wanted to find articles and do some readings and took down some notes, he/she may need a space to focus and have more concentration. However, he/she may decide to choose a private space where it is isolated from others or any public space without the presence of other students.

Figure 2 shows the matrix that presents how all variables are interrelated with each other. It can be summarized that when an individual needs to focus and concentrate, it will require a private area to study. Whereas, individual who needs to focus but do not want to be isolated and need to interact with others will require space that is occupied by people. This can be found in studies by Applegate (2009), where the most-preferred study space, popular with both individuals and groups is a study room. It is because students may prefer the freedom to talk (Applegate, 2009). On the other hand, students in group need to focus and at the same time they need to collaborate with their peers. They will require the space slightly isolated and equipment that supports collaborative work. While for those who intend to collaborate and interact with others will find the space more open to the person's surroundings. The findings show in study by Bedwell and Banks (2016), where students like to work individually and collaboratively within a community environment rather than in solitude. The interrelationship between four groups of LB and the library spatial settings is shown in Table 5.

<table>
<thead>
<tr>
<th>No.</th>
<th>LB</th>
<th>Factor</th>
<th>Behaviour Preference</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Individual/</td>
<td>Focus and Concentration</td>
<td>- Study alone and accomplish serious work . (K.Webb, M.Schaller, S.Hunley et.al, 2008)</td>
<td>Research, reading, writing, typing</td>
</tr>
<tr>
<td></td>
<td>Private</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Individual/</td>
<td>Focus and Interaction</td>
<td>- Work alone but intentionally in the presence of others. (M.Kelly, L.Scott Webber, J.Garrison et.al, 2008)</td>
<td>Individual study, working on class assignment, individual revision,</td>
</tr>
<tr>
<td></td>
<td>Public</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Group/Private</td>
<td>Focus and Collaborate</td>
<td>- These group prefer to work in private, isolated from other activities in the building. (M.Kelly, L.Scott Webber, J.Garrison et.al, 2008)</td>
<td>Study group, group assignment, creating presentation, classroom, meeting</td>
</tr>
</tbody>
</table>
3rd International Conference on Rebuilding Place (ICRP2018)  
13-14 September 2018  
Impiana Hotel, Ipoh, Perak, Malaysia

4  

Group/Public  

Interaction and Collaboration  

Publicity visibly, interact with others. (M.Kelly, L.Scott Webber, J.Garrison et al., 2008)  

Discussing, brainstorming, collaborating, communicating

PRIVATE  

Enclosed/Quiet  

- Start away, freedom from distraction,  
- A dedicated group such as postgraduate research group and training space. (N. Abbasi, R. Tucker, K. Fisher, et al.)

ALONE (individual)  

- Table chair  
- Individual study room  
- Workstation  
- Comfort lounge setting  
- Privacy for laptop  
- Large tablet top  
- Soft furniture  
- Expressions chair  
- Lovable desk

- Reading, on front article (C. Imamoglu & M.O Gurel, 2016; C. Imamoglu & M.O Gurel, 2015)  
- Open space and flexibility (A. Masters, K. Masters, 2012)  
- Do writing group (J. Omer, 2011; V. F. J. C. 2008)  
- Do talking, consulting noting (J. Omer, 2011)  
- Working on individual assignment (C. Imamoglu & M.O Gurel, 2015)  
- Read and work at the same time (C. Imamoglu & M.O Gurel, 2015; C. Imamoglu & M.O Gurel, 2015)

GROUP (together)  

- Large work surface  
- Whiteboard smart board  
- Network connection  
- Idea furniture  
- Mobile partition  
- Computer projects  
- Points for topics  
- Soft furniture  
- Double monitor  
- Interactive space  
- Juxtaposed seating  
- Open workspace

- Discussing class materials with friends (J. Omer, 2011; V. F. J. C. 2008)  
- Study group (J. Omer, 2011; V. F. J. C. 2008)  
- Finding information/collaboration on class assignment & project. (C. Imamoglu & M.O Gurel, 2015; C. Imamoglu & M.O Gurel, 2016)  
- Creating paper. (J. Omer, 2011)  
- Group collaboration. (Study for test/ exam) (J. Omer, 2011)  
- Work and access to digital resources. (J. Omer, 2011)  
- heaven learning & teaching. (J. Omer, 2011)  
- E-Classroom. (J. Omer, 2011)

PUBLIC (open)  

- Interact with others, publicity visible, openness, self-customizable furniture, no barrier, multi-purpose space

- Individual work (J. Omer, 2011)  
- Studying, reading, working on assignments, writing  
- Work alone on class assignment (J. Omer, 2011)  
- Work on paper/project. (J. Omer, 2011)

Figure 2 The Matrix of LB and Space

3.3 The Spatial Settings in the Academic Library

In the aforementioned statement, there are four groups of learning style found - individual/private, individual/public, group/private and group/public, which require suitable spatial settings that could facilitate learning. As shown in Figure 2, even though the LB shows two similar activities for two major groups, the spatial chosen shows different settings. Spatial settings in this study referred to the space, furniture and technology and tools provided, that aid learning activities. Based on these findings, it is believed that several issues highlighted in the above statement such as underused space could be reduced.

In terms of space, though LB may fall under different category, the activities performed might be the same. In Table 5, we can see that individual LB perform some of the same learning activities. We expect that individual LB might prefer isolated space such as silence or quiet room, but the finding shows that some of them prefer to study at open area. Even though they favor to study in an open setting, they still need their own comfort zone by creating their own temporary boundary with the presence of other surroundings. Some studies suggested that the territorial markers in the form of dividers on the new tables were useful so that they felt less disturbed by others (C. Imamoglu & M.O Gurel, 2016), and another individual said that the students tend to pick out appropriate group study tables for individual work by distributing their materials out to create personal space for themselves (L. Bedwell & C. Banks, 2016). Whereas for group learning, due to the collaboration and interaction occurs among them it is expected that they may choose open space and publicity, visibility space. However, findings showed that some of them choose an isolated space for collaboration and focus activities such as a sound proof room.

219
In terms of technology and tools, K. Webster (2010) has mentioned that the necessary features of library learning spaces should support three broad activities – preparing for a group assignment; working on an individual term paper; and studying for end-of-year examinations. For group work, students sought access to book group rooms with plasma screens and data projectors, coupled with other technology to foster collaboration. They also want wireless networks, extensive access to electric sockets, presentation rehearsal facilities, and recording services. For individual work, students requested sound-proof rooms with lockable facilities so that they can store computers, notes, and other materials when they need to take a brief break. When preparing for exams, students wanted similar spaces, but enhanced by breakout areas with soft furnishings, couches, coffee, and fresh air.

To summarize all elements of space, furniture and technology and tools, the matrix as shown in Figure 3 was developed. Further explanation is displayed in Table 5. From here, it can be said that spatial setting in the library in terms of environment, furniture design and tools or equipment would be influenced by the character of student LB at that particular time when they are in the library. Any learning activities which involved focusing and concentration, probably will choose the space which is silent and free from noise (C. Imamoglu & M.O Gurel, 2016; Sanjica et al.; S. Demas, 2005; K. Webb, M. Schaller, S. Hunley et al., 2008; S. Beatty, 2016; Gensler, 2016; M. Powell, 2002; SHURA, 2013; L. Jordan & T. Ziebell), and sound proof room (C. Ugwuanyi, Okwor & E. Ezeji, 2011; M. Powell, 2002); an area which can help student to support student learning. Besides, thereview found that the most important elements in a spatial setting of library space is the installation of multiple plug point for them to plug in their own gadget or laptop (C. Imamoglu & M.O Gurel, 2016; B. Ramsden, 2011; L. Jordan & T. Ziebell; C. Andrews, S. Wright, 2012) and large worktop to spread their books and personal belongings (S. Demas, 2005; L. Bedwell & C. Banks, 2016; K. Webb, M. Schaller, S. Hunley et al., 2008; J. Gotsch & D. Holliday, 2007; L. Jordan & T. Ziebell; C. Andrews, S. Wright, 2012) which is required during learning time. In terms of furniture design, individual student behaviour should have table – chair arrangement (C. Imamoglu & M.O Gurel, 2016; Sanjica et al.; S. Demas, 2005, D. Suarez, 2007), Soft furniture (K. Webb, M. Schaller 2008; S. Hunley et al., 2008; R. Applegate, 2009; SHURA, 2013; Seating Lounge (S. Demas, 2005, D. Nitecki & K. Simpson, 2016; S. Beatty, 2017), and mobile ergonomic chair (D. Nitecki & K. Simpson, 2016).

![Figure 3 The Matrix of LB and Spatial Settings](image-url)
On the other hand, students who intended to collaborate with others when they are studying in the library probably will choose the space that is equipped with technology and tools which support the collaborative learning such as a flexible partition (S. Demas, 2005; Rendina, 2016), having whiteboards (S. Demas, 2005; M. Kelly, W. Scott et al, 2017; D. Rendina, 2016; L. Jordan & T. Ziebell), and networking accessibility (S. Demas, 2005). For environment of collaborative study, it should be either isolated space with some noise (K. Webb, M. scholars. Hunley et al, 2008), isolated (M. Kelly, W. Scott et al, 2017; D. Rendina, 2016), the space with publicity, visibility (M. Kelly, W. Scott et al, 2017; S. Oliveira, 2014) and open space (S. Beatty, 2016; Montgomery, 2014; S. Beatty, 2017).

4 CONCLUSION

In conclusion based on the findings from the literature review, it can be derived that the student LB influences the type of spatial setting in the academic library. LB in the academic library can be divided into 4 categories, there are individual/private, individual/public, group/private and group/public. LB that requires students to focus, concentrate, interact and collaborate will influence the type of environment, furniture design and tools or technology to be used. The relationship between LB and spatial setting can be seen in Figure 4.

Figure 4 Conceptual Diagram of Relationship Between and Student LB

This study is important because even though many students are strong consumers of online information resources: electronic journals, databases, and e-books, they still value the library as a place—somewhere that offers an academic ambiance for their work, a forum for engagement with others, and a flexible space that meets their shifting needs during the cycle of the semester (K. Webster, 2010). Therefore this study can help the library management in providing better facilities and space for their consumers. There are many studies have been done in investigating the student LB in the academic library but those are from overseas university. However, there are very few studies
which focuses on LB in Malaysia university library. Thus, this study intends to investigate student’s LB at the university library in Malaysia.

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USER PERCEPTION OF ENERGY CONSUMPTION IN TWO HIGH-PERFORMANCE SCHOOL BUILDINGS

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Abstract - Today, environmental pollution is a significant challenge for the world. The need to find solutions in the construction sector has been developed. However, the resulting value is strongly influenced by environmental factors, location, and climate. Expected energy demand in 2030 will reach as much as 40% compared to 2007. Malaysia recorded a 31.2% increase in energy consumption for the years 2000 to 2010. Referring by World Markets Observatory (WEMO) on 2017 report shows the increasing by 4.8% on 2030 for Malaysia’s energy usage (Yunus, 2017). To address the rising energy that directly affects the problems of urbanisation, and climate change, factor energy efficiency should be a critical action. The implementation of energy-efficiency policies can also improve the quality of life and reduce the impact of environmental pollution. One of the factors that significantly influence energy-efficiency in a building is user behaviour. According to Schipper and Meyers, a decision that made by human can affect energy consumption in a building (Lutzenhiser, 1993). Thus, the key to the energy consumption pattern in the future is to understand and identify the practical methods for managing user. However, based on Ron Widman study, there are relatively few studies that are related to user behaviour and energy toward building an institution. While Power Save School Program expects a reduction of 5% to 15%, this can only be achieved by changing in user behaviour in school (Widman, Simmons, Kaplan, & Young, 1984). This study aimed to investigate the perception of a user to use energy in building two high-performing schools in Malaysia. 140 questionnaires were distributed to the two schools with 70 polls for each school. Respondents who were involved comprised of students and teachers with 86% of students and 14% of teachers. A survey conducted referring to the three top factors influencing energy efficiency in buildings, namely: 1) Building Design, 2) Services Design and 3) User Behavior. The results from the analysis conducted by three essential user perceptions; Perception of Building Design (PBD), Perception Services Design (PSD) and Perception User Behavior (PUB) haveshown there is a relationship. The study also illustrated the monthly energy consumption data for three years until 2014. The floor area around the building has been used in deriving the energy index of the building.

Keywords - User Behaviour, Energy Efficiency Building, And School Building

1 INTRODUCTION

Environmental pollution has become a significant challenge to all countries in the world. The level of pollution has been proven to increase daily at an alarming rate. The impact of this increase in pollution directly increases the need to find solutions in the construction development sector. The issue of greenhouse gases and the depletion of ozone layer were discussed at The 21st Agenda of the Earth’s Agenda formulated from the United Nations Environment and Development Conference (UNCED) which took place in Rio de Janeiro in 1992.

Since then the green building assessment tool has begun to develop which resulted in the creation of BREEM (The UK, 1990) and LEED (The USA, 1996). This assessment tool aims to reduce the negative impact of the environment contributed to the building through greenhouse gas emissions. The resulting evaluation criteria are intended to assist designers, customers and communities to consider the impact of greenhouse gases through each of the designs produced and their solutions through energy efficiency and low carbon technology. However, this assessment tool is profoundly influenced by location and environmental factors (Mun, 2009).
Energy Efficiency is a crucial factor for a green building assessment tool. However, green buildings do not use the same method to measure energy efficiency. Green Building is a term commonly understood as Green Building or Sustainable Building (Peterson, 2010). Although it is a process for the establishment of a Sustainable Development (Salleh, 2012), Green building criteria includes focusing on improving the efficiency of energy, water and building materials and reducing the impact of buildings on human health and the environment throughout the life cycle of buildings, through placement, design, construction, operation, maintenance, addition and modification, and destruction (Sanchez, 2008).

In Malaysia, practical green building in the supervision of Greenbuildingindex Sdn Bhd (GBISB) is based on six (6) criteria; Energy efficiency (EE), environmental quality (EQ), sustainable site planning and management (SM), building material and resources (MR), water efficiency (WE), and Innovation (IN). GBISB has developed six (6) types of measurement tools for buildings and a categorised measure for urban development (Mun, 2009). Influence of green buildings in Malaysia is undoubtedly due to the growing trend of efficient green building in the world by most governments, construction industry members, academics, researchers and the general public which have also grown as a long-term business (Malangone, 2015).

2 ENERGY EFFICIENCY

The term Energy Efficiency is a generic one. In other words, it can also mean the efficient use of energy. Energy efficiency refers to low energy consumption but at the same time yields the same or better value (M.G., 1996). There is also an opinion that energy efficiency means energy conservation as it refers to the same meaning. Energy conservation refers to the user of low energy that is the same as energy consumption (Kandar, Ahmad, & Ariffin, 2009). Meanwhile, the use of the term Energy Consumption illustrates the amount of energy used. There is a close relationship between the terms whose focus is interconnected against energy consumption towards efficient use.

The issue of green building is closely related to the increasing demand of the world's energy. As evidenced in the International Energy Agency's (IEA), it estimates that the increase in energy by 2030 will reach 40% higher than demand in 2007 (González, Díaz, Caamano, & Wilby, 2011). The increasing of energy is caused by three significant sectors of world energy consumption; Industry, transportation and others (including residential buildings). Other sectors which include buildings recorded the most considerable value of 36% compared to 28% for the Industry and 27% for transportation for energy consumption in 2008. While energy consumption in buildings (residential, commercial, office) has been identified to account for 20% to 40% of total world energy consumption (R. Saidur, Saidur, Schipper, & Saidur, 2009).

However, Energy consumption in Malaysia is not the cause of this increase. It is considered an ordinary situation experienced by developing countries in meeting the needs of the state in improving their living standards. Indeed, the increased energy used will increase the amount of greenhouse gas (GHG) emissions (R. Saidur et al., 2009). Malaysia which recorded a 31.2% increase in electricity consumption for ten years from 2000 to 2010 has intensified the energy efficiency initiatives. This is a string of final energy demand forecasts which is projected to increase by almost 80% by 2030 (Unit Perancang Ekonomi, 2006).

Recently, a progressive step has been taken through the Department of Works (PWD) Malaysia, where it is given the responsibility to design and implement development projects by focusing on energy efficiency and green value in government buildings as an agenda. It is in line with Malaysia's target of reducing 40% of greenhouse gas emissions by the year from 2005 to 2020 (Rashid et al., 2011). As one of the steps towards energy efficiency, the government has enacted the temperature of the building in not less than 24 degrees Celsius (Bernama, 2011). The Tenth Malaysia Plan outlines five approaches to reduce energy subsidies under the TS2.6 New Energy Policy.

It encompasses five main points: 1. Rationalizing energy prices, 2. Diversifying energy resources, 3. Enhancing initiatives of energy efficiency, 4. Improving governance and 5. Ensuring New Energy Policy implemented. As a determinant towards green building production and
subsequent sustainable development, this is needed in emphasising the energy issues in buildings through energy efficiency design.

This is evident in the United Nations Development Program, the United Nations Environment Program, and the World Bank where the Global Environment Facility (GEF) was established in 183 countries as a partnership with international institutions, civil society organisations (CSOs) and the private sector to address the global environmental issues.

Through the grants from GEF, a Scientific and Technical Panel (STAP) has been formed and is known as the Building Sector Energy Efficiency Project (BSEEP). The goal of the department was to reduce GHG emissions from the building sector in Malaysia. The objective is to increase the energy efficiency of buildings in Malaysia, in the trade and government sectors, and to promote the design of energy conservation in new buildings and by upgrading operations in existing buildings (UNDP, 2015).

3 USER BEHAVIOR

The increase in global warming caused by climate change as a result of greenhouse gas emissions has resulted in the depletion of the ozone layer and subsequent destruction of natural habitats and loss of biodiversity. The effect of increasing energy consumption is one of the factors that affect the heat. Energy consumption in buildings has been identified contributing to 40% of the world's energy consumption, 25% of the world's water and 40% of the world's resources. The building is also recorded as a 1/3 greenhouse gas emissions of the world which resulted from its use. However, the building also has the potential to reduce its energy use by 30% and 80% (United Nations Environment Programme, 2007). Today the value of its use is continuously rising which is in line with development and modernity especially in developing countries such as Malaysia.

The impact of this increase which is a significant cause of global climate change should be addressed. To address this issue an understanding of the factors that contribute to the use of energy in the building should be identified. Three (3) factors can influence energy efficiency in buildings; a) construction design; B) Operation and maintenance; And c) User-generated behaviour (Al-Mofleh, Taib, Salah, & Azizan, 2009). The behavioural factors of the user significantly affect the energy efficiency of the building. This is due to a user who has a direct relationship with the use of space and its activities (Hoes, Hensen, Loomans, De Vries, & Bourgeois, 2009). This shows the user's behaviour does influence the pattern of power consumption in the building. Ordinarily user-building behaviour studies are based on the assumption of behaviour without observation measurement or prediction model. These assumptions resulted in limitations in simulation decisions and result in weak decisions. The difference in results for energy efficiency was based on expectations, rather than the actual ones that occurs. This is evident when the research is produced without taking into account the user factor in the simulation analysis. In most cases, the waste of energy in the building is when it is uninhabited (Masoso & Grobler, 2010).

Behavioural energy consumption behaviour has begun to get the attention of researchers as early as the 1970s, after the energy crisis (Bin, 2012). Most investigations involving user behaviour focused on energy consumption behaviour on residential buildings. However, since then, the convergence has shifted to commercial buildings. The study of user behaviour and the power of institution building is very remote as has been developed by Ron Widman (Widman et al., 1984). The importance of studying the behaviour of energy consumption in the building deserves attention as stated by the PowerSave School Program where a reduction of 5% to 15% can only be achieved based on changes in user behaviour at school. This demonstrates the user's behaviour on energy efficiency is a real issue that significantly influences energy issues in the building. This argument can be seen through the words of Lee Shipper in the cynic that says: ". . . Those of us who call ourselves energy analysts have made a mistake. . . We have analysed energy. We should have analysed human behaviour (Lutzenhiser, 1993).

There are various methods used in assessing the performance of building energy. Among them are using Post Occupancy Evaluation (POE) Assessment Methods as a guideline for building physical design checks, as well as involving users to get the real perception of energy efficiency usage.
behaviour, besides exploring knowledge on the level of greenhouse gas emissions (Wheeler, Boughlaghem, & Malekzadeh, 2011).

4 METHODOLOGY

This study involved two high-performance schools; namely Boarding School High-Performance Integration (Sekolah Menengah Berasrama Penuh Integrasi Berprestasi Tinggi (SBPI)), Gopeng, Perak, Malaysia and, High School of Science Tengku Abdullah (Sekolah Menengah SainsTengku Abdullah (SMSTA)) Pahang, Malaysia. 140 respondents participated in this study, 70 respondents from SBPI and 70 respondents in SMSTA.

The respondents involved in this study were formed by five students who form the highest level in secondary schools. The selection of students is important because 17 years old is considered matured and have a good understanding of the needs of their responsibility for the school. The questionnaire is intended to measure the attitude as well as the sense of responsibility of respondents’ towards the school area especially in electricity used and comfortable of space. A face to face interview approach was used for this study to ensure that the respondents fully understood the questions. To avoid any confusion or misunderstanding, the researchers introduced themselves as well as explained the purpose of the study undertaken.

4.1 Measuring the Construct

The questionnaire contains four parts: part A- demographic background, part B- the perception of user behaviour (PUB), part C- the perception of building design (PBD) and, part D- the perception of service design (PSD). All variables were measured using a 5 point Likert Scale of 1 – strongly disagree, 2 – not agree, 3 – agree, 4 – highly agree and 5 – strongly agree. This questionnaire was used in a pilot survey to identify any circumstances of the tricky question. The output from the pilot survey the question was restructured again for this study(Salleh, Kandar, & Sakip, 2015). The validation and confirmation of all constructs were done using Exploratory Factor Analysis (EFA). EFA was used to gather information about the interrelationship among a set of variables (Pallant, 2005). The result for the level of reliability was found by calculating the Cronbach’s Alpha. The result found the variable of PUB variable has a good reliability value as the Cronbach’s Alpha (α) value = 0.74, POD; α = 0.81 and PEE; α = 0.83. However, two items in POD were eliminated because the corrected item-total correlation value is below than 0.3. All variables have a Cronbach’s Alpha value exceeds 0.60 variables (Nunnally & Bernstein, 1994)as shown in Table 1.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Items</th>
<th>Description of Items</th>
<th>Corrected item-total correlation</th>
<th>Reliability (Cronbach’s Alpha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The perception of user behaviour (PUB)</td>
<td>Item 1</td>
<td>A Light switch is always off after a classroom/ space is not used.</td>
<td>0.68</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td>Item 2</td>
<td>A fan switch is always off after a classroom/ space is not used.</td>
<td>0.69</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Item 3</td>
<td>An air conditioner switch is always off after a classroom/ space is not used.</td>
<td>0.55</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Item 4</td>
<td>I am aware of the use of electricity with prudently is to avoid the wastage of electricity.</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Item 5</td>
<td>I am always to make sure the electric switch is always turned off when the classroom/ space in my school is not used.</td>
<td>0.45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Item 6</td>
<td>The switch of lights, fans and air conditioners that still on without anyone on the room/space will be turned off by school staff.</td>
<td>0.30</td>
<td></td>
</tr>
</tbody>
</table>
### The perception of building design (PBD)

<table>
<thead>
<tr>
<th>Item</th>
<th>The classroom/ space in this school will feel hot especially in the morning (7 am-noon)</th>
<th>0.64</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 2</td>
<td>The classroom/ space in this school will feel hot especially in the afternoon (noon – 2 pm)</td>
<td>0.57</td>
</tr>
<tr>
<td>Item 3</td>
<td>The classroom/ space in this school will feel hot especially in the evening (2 pm – 7 pm)</td>
<td>0.51</td>
</tr>
<tr>
<td>Item 4</td>
<td>The classroom/ space in this school will have a glare in the morning (7 am-noon)</td>
<td>0.52</td>
</tr>
<tr>
<td>Item 5</td>
<td>The classroom/ space in this school will have a glare in the afternoon (noon – 2 pm)</td>
<td>0.55</td>
</tr>
<tr>
<td>Item 6</td>
<td>The classroom/ space in this school will have a glare in the evening (2 pm – 7 pm)</td>
<td>0.53</td>
</tr>
<tr>
<td>Item 7</td>
<td>There is a glare of sunlight in the classroom/space in this school</td>
<td>0.59</td>
</tr>
<tr>
<td>Item 8</td>
<td>There is a glare of lighting in this classroom/space in this school</td>
<td>0.35</td>
</tr>
<tr>
<td>Item 9</td>
<td>The lights are needed for this classroom/space in this school because depending on sunlight in the classroom/space is not enough.</td>
<td>0.30</td>
</tr>
<tr>
<td>Item 10</td>
<td>The fans are needed for this classroom/space in this school because the natural ventilation in space still not provide comfortable</td>
<td>0.40</td>
</tr>
<tr>
<td>Item 11</td>
<td>The air condition is needed for this classroom/space in this school because depending on the natural ventilation still not provide comfortable</td>
<td>0.36</td>
</tr>
<tr>
<td>Item 12</td>
<td>The use of curtains or blinds is necessary to prevent heating from sunlight.</td>
<td>0.26</td>
</tr>
<tr>
<td>Item 13</td>
<td>The temperature in the classrooms in the school is cold all year round</td>
<td>-</td>
</tr>
<tr>
<td>Item 14</td>
<td>The temperature in the classrooms in the school is always comfortable all year round</td>
<td>-</td>
</tr>
<tr>
<td>Item 15</td>
<td>The temperature in the classrooms in the school is always hot all year round</td>
<td>0.31</td>
</tr>
</tbody>
</table>

### The perception of service design (PSD)

<table>
<thead>
<tr>
<th>Item</th>
<th>There is noise from outside classrooms/space that in used causing by the machine or electrical equipment such as air conditioner components</th>
<th>0.53</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 2</td>
<td>There is noise from inside classrooms/space that in used causing by the machine or electrical equipment such as air conditioner components</td>
<td>0.58</td>
</tr>
<tr>
<td>Item 3</td>
<td>Throughout the year, I am not comfortable because no natural ventilation in a room is used</td>
<td>0.65</td>
</tr>
<tr>
<td>Item 4</td>
<td>Throughout the year, I am not comfortable because there are no fans in the room that is used</td>
<td>0.66</td>
</tr>
<tr>
<td>Item 5</td>
<td>Throughout the year, I am not comfortable because there is no air-conditioning in a room that is used</td>
<td>0.48</td>
</tr>
<tr>
<td>Item 6</td>
<td>Most of the time the lighting system is not in good condition as far as I use this room in this school</td>
<td>0.74</td>
</tr>
<tr>
<td>Item 7</td>
<td>Most of the time the fans are not in good condition as far as I use this room in this school</td>
<td>0.76</td>
</tr>
<tr>
<td>Item 8</td>
<td>Most of the time the air-conditioning is not in good condition as far as I use this room in this school</td>
<td>0.73</td>
</tr>
<tr>
<td>Item 9</td>
<td>There is the use of the air conditioning system in a room/space with windows that are not airtight and open</td>
<td>0.35</td>
</tr>
<tr>
<td>Item 10</td>
<td>Lighting systems will not off automatically because of the system application that has been set in this school</td>
<td>0.44</td>
</tr>
<tr>
<td>Item 11</td>
<td>I do not feel comfortable in school for throughout the year because of there is no ventilation or breeze in a classroom/space</td>
<td>0.67</td>
</tr>
</tbody>
</table>

Note: ( - ) = Items eliminated because of corrected item-total correlation is below than 0.3.

### 4.2 Result and Discussion

The respondents who participated in this study constituted 55.1% male, and 44.9% female with a total of 140 respondents (n=140). The respondents involved in this study are students (86%), teachers (8.1%) and supporting staff (5.9%). The age range was between 16 to 20 year old(85.4%), followed with 31 to 35 year old (8%), 26 to 30 year old(3.6%), 41 to 45 year old (1.5%) and 21 to 25 year old and 36 to 40 year old respectively 0.5%. A total of 94.8% has served the schools for 1 to 5 years, 4.5% served for 11 years and above, and 0.7% served in the school for 5 to 10 years.

The perception of the user in energy use in two high-performing schools building was divided into three main constructs; PUB, PBD and PSD. The descriptive analysis using mean differences between two schools (SBPI and SMSTA), shows that there is no much meaningful difference between PUB (SBPI; M=22.04, SD=2.91, SMSTA; M=21.08, SD=3.39), PBD (SBPI ;M=42.75, SD=6.96,
SMSTA; M= 43.04, SD=7.31), and PSD (SBPI; M=29.01, SD=7.15, SMSTA; M=28.62, SD=5.16) as shown in Figure 1.

These findings can be explained that there is no difference in energy consumption in both schools. Even though the SBPI (Secondary School Boarding High-Performance Integration / Boarding High School of High-Performance Integration) is a boarding school. It was believed that there had a relationship with the management of energy use in their schools.

The correlation between perception of user behaviour (as measured by the PUB) with the perception of building design building (as measured by the PBD) and the perception of service design (as measured by the PSD) was investigated using Pearson product-moment correlation coefficient. The result was shown in Table 2. The output shows that there was a medium, positive correlation between the two variables \( r=0.358, \ n=124, p=0.00 \), with the perception of building design (PBD) and the perception of service design (PSD). The output explains that PBD helps to explain nearly 13 per cent of the variance in respondents' score the PSD. Meanwhile, there was a small, positive correlation between the two variables \( r=0.273, \ n=132, p=0.00 \), with the perception of building design (PBD) and the perception of user’s behaviour (PUB). There is 7 per cent PBD explanation on the variance of respondents' score on PUB. The result is shown in Table 2.

**Table 2 Pearson product-moment correlation between the perception of user behaviour with the perception of building design and the perception of service design**

<table>
<thead>
<tr>
<th>The perception of user behaviour (PUB)</th>
<th>The perception of building design (PBD)</th>
<th>The perception of service design (PSD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>0.273**</td>
<td>0.358**</td>
</tr>
<tr>
<td>Sig. (2-Tailed)</td>
<td>0.002</td>
<td>0.000</td>
</tr>
<tr>
<td>N</td>
<td>132</td>
<td>128</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.05 level (2-tailed).**
This finding can be explained that if the perception of user behaviour on energy efficiency is increased, user perception of the building design will also increase. It shows that the design of the building gives an influence of user behaviour in energy consumption in a building. Similarly, if the perception of the building design on energy use increases, the user’s perception of services design will also increase. This explains that the user behaviour influences building and services design.

5 CONCLUSION

This study has found that the user behaviour of the respondents to increase the user’s perception of energy efficiency in the school building design. The results recognised the relationship between the variables in proving this method can be used for benchmark energy efficiency at the design of school buildings factors. In the design process, the user behaviour factor must be taken into account, and more research needed to be done to find out the level of customer’s satisfaction and not just based on the measurement of user’s comfort based on scientific studies to neglect the study and measurement of the real comfort of users in the field. Case studies need to be made in the design of new school buildings. This is necessary for granting rights to users whose majority is a student of the child category until we deny the right of their comfort by determining the level of comfort without us checking and surely it gives the level of comfort. In addition to the energy demand pressures that are being reduced to an understanding of energy efficiency and energy saving that often fail to be well understood.

6 ACKNOWLEDGEMENT

The researchers would like to thank the Ministry of Education Malaysia (KPM), Sekolah Menengah Sains Tengku Abdullah (SMSTA), Sekolah Berasrama Penuh Integrasi Gopeng (SBPI) and Universiti Sains Malaysia for their full cooperation and support towards the successful implementation of this study. Special thanks are also accorded to all the respective teachers, students and staff as users within the study areas for their invaluable cooperation.

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INITIATIVES DRAWN FOR LOCAL SKILLED CONSTRUCTION WORKERS IN MALAYSIA

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Abstract - High skilled human resources have become increasingly demanded and important by employers in Malaysia. However, it is become challenges in terms of the availability of local skilled labour to fulfil the vacancies in construction projects. Even thought there are substantial numbers of graduates and trainees produced by the Technical, Vocational education and Training (TVET) but employers are still reliance on unskilled foreign labour to work in construction site. Therefore, the objectives of research to provides an overview of Malaysian construction industry and to identify the initiatives has been planned to encourage local skilled labour to enter construction labour market. The commitments of the government were not isolated supported with industries on this issue and the improvement and enhancement for the young generation are unlimited. Currently, construction sector is including under key contributors to the Malaysian economics with services, manufacturing, mining and quarrying and agriculture. A review from various published documents to the present has been used to provide a comprehensive summary of literature on initiatives to raise the participation of local skilled construction workers to works at the construction site. Primarily, the initiatives can be divide into three main categories such as fund, education and technology. Such result indicates that, the initiatives are injection of fund by government, transforming and rebranding Technical and Vocational Education Training (TVET) especially construction based training programmed and the usage of high technology such as Integrated Building System (IBS) to reduced dependency on unskilled foreign workers. The initiatives identified by this research will form a basis for future research on the Malaysian construction industry.

Keywords- construction, workers, initiatives, skilled labour

1 INTRODUCTION

Malaysian economy experiencing considerable progress in 2017 with year-on-year growth projected at 5.8%. Abidin (2017) stated the World Bank, based on simulations, predicted that Malaysian economy are on track to achieve the target. In fact, according to Malaysian Institute of Economic Research (MIER) analysis, Malaysia may even arrive at the high-income status as early as the first quarter of 2018. The consensus forecast for Malaysian economic growth in 2018 is within the range of 5.5 to 5.8 per cent, with the prospect of stable inflation and low unemployment. Moreover, the government is set for the future beyond 2020 with the Transformasi Nasional 2050 (TN50) vision. TN50 will prepare Malaysians, especially the youth, for future challenges such as the Fourth Industrial Revolution (Industry 4.0), an ageing society, the era of robots, climate change and the digital economy.

Indeed, with the launch of the Digital Free Trade Zone (DFTZ) in 2018, 60,000 high-income jobs are expected to be created primarily for the youth. From that scenario its look positive growth to the construction industry. The beginning of each industry is requiring the construction sectors to build the infrastructures and building. In 2017, the value of construction work done recorded were 35.1 billion Ringgit Malaysia in accordance to satisfy all the Malaysian population needs from the babies until retires. Recently, based on the official portal, Department of statistic Malaysia, in 2017 Malaysian population is 32.3 million consists of 16,620.3 thousand of male and 15,588.6
thousand of female. Each of them has their own needs to be provided. From the total population only 15.15 million includes under labour force with ages between 15 to 64 years and represent 46.9 percent out of total population. The Unemployment rate for December 2017 remained at 3.3 per cent. Meanwhile year on-year comparison, unemployment rate was 0.2 percentage points lower than December 2016. Malaysian government also always puts an effort into the employment issues and encourages creative and innovative culture to create new jobs after graduating without waiting to the existing vacancies.

Construction sector is significantly and major productive sector towards the Malaysian economics and provides a lots of jobs opportunities. The Malaysian government has several objectives, which the main objective is to distribute the country’s wealth to the population in order to raise the standards of living. This is done by improving the income of the population and also providing the employment opportunities. In conjunction of that, it is shows that the government has the right to directly control the supply and demand of the industry. Malaysian construction industry is the industry that requires a high rate of workforce (Ahmad, 2009). Most of the construction processes need intensive employment of workers.

Generally, construction site worker as labelled as foreign workers even local. It is synonym if workers on site is known as foreign, local puts as negative perceptions towards this career. More critical construction sector was labelled as a 3D sector “dirty, difficult and dangerous” (Hamid et all, 2011; Marhani et all, 2012; Mohd-Rahim et al, 2016) which are leads to discourage many locals and new graduates to stay away from entering the construction industry, thus resulting in the shortage of labours (Hamid et al., 2013). Even though, there is a lot of human capital development programmes undertaken by the government and certain private bodies, labour shortage still become the biggest concern. The used of foreign workers in the construction industry growth rapidly due to several factors. One of it is due to the inability of the local manpower to fulfil the demand. Secretary General of Master Builders Association Malaysia (MBAM) Ir. Yap Yoke Keong (2009) said that Malaysia starting to face shortage of quality people in construction especially when 9th Malaysia Plan was introduced in 2006, there are many development projects pored in the construction markets, but skilled workers are not enough to fill the vacancies in the industry. This shortage problem continued until present (Keong, 2009).

Apart from that, many researches presented factors of the unwillingness of locals to works at the construction site. Amongst the factors are uncomfortable working condition (dirty, hot, dusty, etc), exposure to unsafe and unhealthy working conditions, temporary employment status based on the project and unsecured job, insecurity of income, low wages, labelled as a dangerous, dirty and difficult work, poor image in the eyes of workforce due to employment of poor educational and unskilled foreign workers, unattractiveness of a career pathway in construction industry and work that is less prestigious, class and respectability (Shia dri, 2008; Ibrahim et al., 2010; Mat Dom et al., 2012; Hamid et al., 2013; Mohd-Rahim et al, 2016). As a result, this shortage leads to heavy reliance on unskilled foreign workers and the impact is poor workmanship at the end will affects the building performance with plenty of defects in abbreviated period building life. Hence, this research presents several initiatives taken to encourage skilled workers to work in the Malaysian construction industry. The aim of this paper is to provide better understanding on underpins issues/problems that hold the industry from moving forward. The results of this research will form a basis for designing the future research on what is needed to ensure the industry to be more productive, efficient and will be lead both locally and globally.

2 MALAYSIAN CONSTRUCTION INDUSTRY

The construction industry is a key economic engine for the overall economy. In 2017 it was contributed about 4 percent to the Malaysia’s Gross Domestic Product (GDP) and is predicted to contribute 5.5 percent to GDP by 2020. It is expected to grow at 10.3 percent per year, outpacing Malaysia’s overall economy which is projected to grow at a steady rate of 5-6 percent per year (Economic Planning Unit, 2015). Apart from that, based on Department of
Statistics shows that in 2017, the value of construction work done recorded RM35.1 billion. The expansion in value of construction work done was driven by positive growth in all sub-sectors: Civil engineering (18.4%), Special trades activities (9.5%), Non-residential buildings (1.5%) and Residential buildings (1.2%) sub-sector. The private sector continued to propelled the construction activity with 63.3 per cent share (RM22.2 billion) as compared to the public sector with 36.7 per cent share (RM12.9 billion).

Table 1: Project values by category (2013-2016)

<table>
<thead>
<tr>
<th>Sectors and Types Project</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Private Sector</td>
<td>161,363.78</td>
<td>117,127.32</td>
<td>178,143.62</td>
<td>34,311.26</td>
</tr>
<tr>
<td>Residential</td>
<td>34,781.71</td>
<td>51,097.83</td>
<td>39,075.50</td>
<td>11,265.92</td>
</tr>
<tr>
<td>Non-Residential</td>
<td>91,973.73</td>
<td>49,374.63</td>
<td>38,964.58</td>
<td>15,072.84</td>
</tr>
<tr>
<td>Social Amenities</td>
<td>4,833.53</td>
<td>2,575.03</td>
<td>3,561.94</td>
<td>1,575.82</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>29,774.82</td>
<td>14,079.83</td>
<td>96,541.66</td>
<td>6,396.68</td>
</tr>
<tr>
<td>Total Government Sectors</td>
<td>23,653.56</td>
<td>24,724.12</td>
<td>50,882.08</td>
<td>6,045.07</td>
</tr>
<tr>
<td>Residential</td>
<td>2,139.25</td>
<td>2,677.18</td>
<td>1,560.38</td>
<td>909.06</td>
</tr>
<tr>
<td>Non-Residential</td>
<td>3,925.24</td>
<td>4,049.74</td>
<td>3,546.58</td>
<td>681.61</td>
</tr>
<tr>
<td>Social Amenities</td>
<td>3,343.55</td>
<td>2,940.88</td>
<td>3,461.90</td>
<td>1,407.74</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>14,245.52</td>
<td>15,056.32</td>
<td>40,664.63</td>
<td>3,406.66</td>
</tr>
<tr>
<td>GRAND TOTAL</td>
<td>185,017.3</td>
<td>141,851.4</td>
<td>229,025.7</td>
<td>40,356.33</td>
</tr>
</tbody>
</table>

Sources: Construction Industry Development Board, Malaysia, 2017

As defined by CIDB, the construction projects can be divided into four main categories such as social amenities (education, public facilities, sports and recreation, clubs, welfare and the community), infrastructure (utility, transportation, drainage and sewerage, natural disaster resilience such as road, bridges, water supply, sewer, electrical grids and telecommunications), residential (apartments, condominiums, hostel and the likes) and non-residential (office buildings, shopping centres, industrial buildings, hotels, agriculture, manufacturing and landscaping works). Table 1 presents the value and types of projects from 2013 to 2016 by private and government sectors. Over the years construction projects based on the type and scale indicates a changing pattern. In 2014 the amount of construction projects awarded is RM141.8 billion increased by 57.5% to RM229.0 billion in 2015. Meanwhile, the construction projects awarded dominated by private sector every year at RM 178.1 billion compared to the government sector at RM50.9 billion. Construction project refers to projects awarded to the main contractor with the value of RM500,000 and above. Overall, more than half portion of construction works came from the infrastructure projects RM137.2 billion; followed by non-residential projects RM42.5 billion; residential projects at RM40.6 billion; and social amenities projects at RM8.7 billion. A total RM40.7 billion of the infrastructure projects were driven by the private sector, due to the high-value projects under the transportation and utilities segments. The major impact to Malaysian construction projects came from the implementation of 24 major projects costing more than RM1.0 billion each. These projects accounts for RM109.9 billion in 2016. The 5 largest projects were:

i. East Coast Rail Link from Port Klang, Selangor to Wakaf Bahru, Kelantan. Award: November 2016; Expected completion: 2024.
iii. Electrified Double Track (Gemas to Johor Bahru) in Johor. Award: October 2016; Expected completion: 2020
iv. 1,800MW to 2,400MW Combined Cycle Gas Turbine Power Plant in Alor Gajah, Melaka.
Award: November 2016; Expected completion: 2021

3 LABOUR IN MALAYSIA CONSTRUCTION INDUSTRY

Starting from the Sixth Malaysia Plan (1991-1995) with the government liberalising the policy on the employment of foreign labour to supplement the problem of labour shortages during that period (Chan 2001) the Malaysian construction industry relies heavily on foreign labour especially from Indonesia, Bangladesh, Myanmar and Nepal. The increasing trend of employing foreign labour was recognised during that period. As presented by Chan (2001) a total of 649,680 work permits had been issued to foreign workers, with about two-thirds of the temporary work permits being issued for work in the plantation and construction sectors at the end of the Sixth Malaysia Plan in 1995. Foreign labour has become a crucial component of the construction workforce in Malaysia, since the introduction of the policy by the government. Construction Industry Development Board, Malaysia (2014) demonstrates that approximately 25% of total construction personnel in Malaysia are foreign workers (figure 2).

The statistic from Department of Statistic, Malaysia (2013) records show the composition of labour force in Malaysia and construction sector versus non-residents and residents (figure 1) represent from top to bottom level of employees and the other hands that most of the foreign labourers in the industry are general workers and unskilled labour (figure 2). However, the data did not show the accurate statistics as there are vast numbers of illegal foreign workers in the industry with no registration or documentation. Abdul-Aziz (2001) discovered that the utilization of non-residents labour by construction companies in Malaysia because they are: (1) willing to work extra hours; (2) obedient; (3) willing to receive low wages and; (4) flexible and mobile. The statistics on construction wages and salaries in 2017 from CIDB showed that the average daily wage for local skilled labour is between RM 70.00 and RM 120.00; whereas semi-skilled workers earn between RM 60.00 and RM 100.00. The rate for foreign labour is lower, with skilled labour earning between RM 50.00 and RM 100.00 and semi-skilled foreign labour earning between RM 40.00 and RM 80.00. Average wages for unskilled labour are much lower - between RM 25.00 and RM 30.00. The willingness and wide availability of foreign labour make the employer easily hiring them and at the end it is will give significant impact on construction quality and productivity.

![Figure 1 Labour composition in Malaysia and the construction industry.](image)
Source: Department of Statistic, Malaysia

In addition, the contractors have little incentive to adopt and implement more productive, better quality and safer technologies. The situation also affects the contractors’
interest in employing highly skilled labour (CIDB 2006). The government has identified the needs for construction industry to intensify: mechanization; new construction methods and technology; prefabrication thus having the effect of reducing reliance on labour to improve the contractors’ performance and productivity. To limit the inflow of foreign labour, the government has tightened the requirements for work permits and increased the levy on foreign workers according to their job sector. The government has decided not to extend work permits for unskilled foreign labour that have been in the country for over five years and have granted amnesty to illegal foreign workers to return to their own countries without facing legal action. The CIDB has adopted two main approaches: (1) to train the existing foreign unskilled labour force; (2) to improve the industry’s image and create an awareness among local workforce of the benefits of joining the industry (Mustafa Kamal et al., 2012). However, the changes imposed by the government and the CIDB are very slow to take effect until presents and still trying hard to change the situation.

![Registered Construction Personnel by Type (Percentage)](image)

Figure 2 Composition of foreign and local construction workers by trade level.  
Source: Construction Industry Development Board, Malaysia, 2014

The statistics from the Immigration Department of Malaysia, in 2017 showed a total of 1,781,598 foreign workers in the country. Based on the Ministry of Home Affairs, Indonesia had the highest foreign workers of 728,870 people followed by Nepal (405,898), Bangladesh (221,089), Myanmar (127,705), India (114,455), Pakistan (59,281) and Vietnam (29,039). There are also workers from China (15,399), Thailand (12,603), Sri Lanka (5,964), Cambodia (5,103) and Laos (39) (Nazura Ngah et al., 2017). Based on that, a total of 767,563 construction personnel was registered in 2016 (table 2), an increase of 7.1% (2015: 716,542 personnel). This includes new and renewal of construction personnel. On the total overall statistics shows the situation is still under control mainly monopolized by Malaysian residents, nevertheless in the real world the construction site has been flooded by foreign workers working without legitimate registration. Mostly statistics presented does not reflect the actual situation at the construction site whereas dominated by the foreign workers.

<table>
<thead>
<tr>
<th>Category of Worker</th>
<th>2015 Local</th>
<th>2015 Foreign</th>
<th>2016 Local</th>
<th>2016 Foreign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skilled construction worker</td>
<td>50,855</td>
<td>1,675</td>
<td>91,637</td>
<td>2,939</td>
</tr>
<tr>
<td>Manager and site assistant manager</td>
<td>51,410</td>
<td>1,462</td>
<td>58,646</td>
<td>1,052</td>
</tr>
<tr>
<td>Construction supervisor</td>
<td>50,933</td>
<td>272</td>
<td>116,579</td>
<td>1,566</td>
</tr>
<tr>
<td>Administrative personnel</td>
<td>126,716</td>
<td>1,622</td>
<td>42,814</td>
<td>138</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>575,474</strong></td>
<td><strong>141,068</strong></td>
<td><strong>613,843</strong></td>
<td><strong>153,720</strong></td>
</tr>
</tbody>
</table>

Source: Construction Industry Development Board, Malaysia
4 INITIATIVES FOR LOCAL SKILLED CONSTRUCTION WORKERS IN MALAYSIA

The definition of initiatives based on the Cambridge dictionary is a new plan or process to achieve something or solve a problem. Malaysian governments are very committed in the issue of over reliance on foreign workers, especially in the construction sector. Unfortunately, Malaysian government unlimitedly designing and planning innovative approaches in transforming the current situation into better scenario for presents and future generation. It is not easy to change, all the efforts shaped sometimes will takes lengthy period and need various modification of other guidelines and regulations. Malaysian government regulate and consolidate the various initiatives to attract more local skilled workers entering construction industry labour market especially trade workers such as bar-bender, tiler, roofer, plumber, wiremen, plasterer, painter and others specialist needed on construction sites to avoid dependency towards foreign workers. The summary of initiatives by respective agencies as presented in Table 3. In the Eleventh Malaysia Plan 2016 – 2020, anchoring growth on people presented six strategic thrust includes 1) enhancing inclusiveness towards an equitable society, 2) improving wellbeing for all, 3) accelerating human capital development for an advanced nation, 4) pursuing green growth for sustainability and resilience, 5) strengthening infrastructure to support economic expansion and 6) re-engineering economic growth for greater prosperity (Economic Planning Unit, 2015).

<table>
<thead>
<tr>
<th>Sources</th>
<th>Initiatives</th>
</tr>
</thead>
</table>
| Economic Planning Unit, 2015, Pemandu, 2011 | • To raise the enrolment intake gradually from 164,000 in 2013 to 225,000 in 2020.  
  • To secure employment which 60% of the 1.5 million jobs that will be created will require TVET-related skills. |
| Economic Planning Unit, 2016 | • TVET education capacity will be enhanced with an allocation of RM4.6 billion to TVET institutions to optimise the Government's assets, nine unused Teachers’ Training Institutes would be transformed into four Polytechnics and balances are Vocational Colleges.  
  • Upgrading educational equipment in TVET institutions was allocated RM270 million.  
  • Double tax deductions would be given over expenses incurred by private companies to provide Structured Internship Programmes for students in TVETs. |
| Economic Planning Unit, 2017 | • TVET Masterplan was developed which consist of five thrust: -  
  i. To raise the enrolment of students and trainers  
  ii. To strengthen and intensify strategic Public-Private Partnership cooperation or between TVET and industry to create synergy in developing quality human capital.  
  iii. Career opportunities are not only limited in the industry, TVET graduates can also venture into business, especially technopreneurship or become technopreneurs in technical fields.  
  iv. matching grants, where the financial provision is given at the same value of contributions received from industry for high impact TVET programmes.  
  v. All TVET institutions under various ministries are united as a great collaboration to train Malaysians, especially young people to become a highly skilled technical workforce. |
Construction Industry Competency Forum (CICF).
- Construction Industry Competency Blueprint.
- 5000 on job apprentices produced by 2020.
- 100,000 construction personnel completed Continuous Professional Development training.
- 100,000 construction personnel graduated in construction related skills and accredited by 2020.
- Report on construction manpower supply and demand, published annually from 2017 onward.
- All qualified skilled workers and supervisory personnel accredited from 2016 onwards.
- Proportion of skilled: unskilled foreign labour improved from 5:95 to 15:85 by Q4 2020.
- All qualified skilled workers and supervisory personnel accredited from Q4 2016 onwards.
- At least 100 more new IBS component manufacturing plants established at various strategic locations by 2020.
- 5,000 professionals (engineers, architects & quantity surveyors) trained to apply IBS and modular coordination from design phase by 2020.
- components (i.e. columns, beams & slabs) for public projects to be procured separately from main contracts by 2018.

Thrust three which are most related with construction workers and covered four focus area such as firstly, is improving labour market efficiency to accelerate economic growth – government in the effort to improve labour productivity and wages through the shift to high skilled jobs. Secondly, transforming TVET to meet the industry demand – in ensuring that all graduates meet the criterion need by the industry and acquire job after completing the training, government initiatives to strengthen the governance of TVET for better management, enhancing quality and delivery of TVET programmes to improve graduate employability and rebranding TVET to increase its attractiveness. Moreover, in the National Key Economic Areas (NKEAs) also highlighted about TVET under education. NKEA is defined as a driver of economic activity that has the potential to directly and materially contribute a quantifiable amount of economic growth to the Malaysian economy. Pemandu (2011) stated that TEVT has been identified as a critical enabler for the success of the Economic Transformation Programme (ETP), with nearly one million jobs requiring vocational certificates or diplomas by 2020. Several initiatives have been introduced to raise the quality of TEVT offerings and to ensure the programmes are in line with industry needs and requirements. The ETP is an initiative by the Malaysian government to turn Malaysia into a high-income economy by the year of 2020. It is managed by the Performance Management and Delivery Unit (PEMANDU), an agency under the Prime Minister Department of Malaysia. Additional funds have been allocated to the Skills Development Fund (Perbadanan Tabung Pembangunan Kemahiran – PTPK), giving more students the opportunity to undertake TEVT programmes in private skills training institutes.

Thirdly, improving the quality of education for better student outcomes and institutional excellence – government encourages to raise the quality of graduates and programmes, and strengthening research for innovation and finally, strengthening lifelong learning for skills enhancement. The government strives to provide highly skilled human capital for better future generation and development. The government always encourages all students to be creative and innovative thinking and after completing the training try to create their own job based on their skills and expertise without relying on existing jobs for better income.

Economic Planning Unit (2016) in budget 2017 presentation by Malaysia Prime Minister always pay attention on the issues of human capital in providing high skilled workers to meet industry, demand. In budget 2017 government allocate Ringgit Malaysia 4.6 billion to TVET institutions to optimise the Government's assets. Nine unused Teachers’ Training Institutes would be transformed into four Polytechnics and balances are Vocational Colleges in order to raise the enrolment of the TVET students. Additionally, Ringgit Malaysia 270 million was allocated to
upgrade the educational equipment in TVET institutions. The industry also obtained the benefits whereas double tax deductions would be given over expenses incurred by private companies to provide Structured Internship Programmes for students in TVETs. Next in budget 2018 TVET Masterplan was developed which consist of five thrust such as i)To raise the enrolment of students and trainers; ii) To strengthen and intensify strategic Public-Private Partnership cooperation or between TVET and industry to create synergy in developing quality human capital; iii) Career opportunities are not only limited in the industry, TVET graduates can also venture into business, especially technopreneurship or become technopreneurs in technical fields; iv) matching grants, where the financial provision is given at the same value of contributions received from industry for high impact TVET programmes; v) All TVET institutions under various ministries are united as a great collaboration to train Malaysians, especially young people to become a highly skilled technical workforce (Economic Planning Unit, 2017).

In addition, Construction Industry Development Board (CIDB) had been developed as a representative of Malaysian government for construction sector governance. The government was set up CIDB in 1994 with the aim of promoting the development of the Malaysian construction industry and helps to modernize the industry. From the official web-site CIDB stated that CIDB was established under the Construction Industry Development Board Act 1994 (Act 520) to regulate, develop and facilitate the construction industry towards achieving global competitiveness. The objective establishment is to develop the capacity and capability of the construction industry through the enhancement of quality and productivity by placing great emphasis on professionalism in the endeavour to improve the quality of life. Before the establishment of the CIDB, none of the industry’s stakeholders could be considered as industry leader to promote and stimulate the overall development of the industry as all the industry’s stakeholders have their own objectives and policies. The establishment of the CIDB managed to integrate and gather the industry stakeholders under one agency. The CIDB is responsible for making recommendations to government on matters related to the construction industry and manages the important parts of the industry including registration of contractors, helping advance the knowledge base of the industry, training, safety, and education (Mustafa Kamal et. al, 2012).

Moreover, among initiatives that have been developed to enhance the construction sector performance, CIDB introduced the Construction Industry Master Plan (CIMP) 2006-2015. Mustafa Kamal et. al (2012) presented CIMP is a comprehensive plan charting the strategic position and future direction of the Malaysian construction industry over 10 years. The overall underlying thrust of CIMP emphasize on four main aspects in order to improve the Malaysian construction industry involve: 1) the importance to upgrade skills and knowledge of construction workforce; 2) modernization of the industry; 3) application of new technology; and 4) continuous innovation in the industry. The CIMP provides a long-term direction and guide for the Malaysian construction industry. However, the implementation plan sets out is general, with very little depth. It does not provide a clear insight of the problem faced by construction companies especially the small and medium size companies (SMEs). There are very little evidence indicates the successful of the CIMP.

Furthermore, issues on labour in construction sectors keep in reported by the media and researches. One of them, Hussien (2016) presented issues on shortage of skilled local and foreign workers. Majority of foreign workers employed in the construction industry are unskilled. They came to the country as general workers. CIDB was not allowed local companies to train them in their home countries before they come to Malaysia while waiting for their visa approvals. Training during that time are very inefficient and unattractive. The impact from that, are construction project are in difficulties to plan resources, resulting in project delays, work done not up to the specification/quality required, higher costs due to project delays and need to re-do as specification not met and at the end contractors must pay fines in the events of projects failures. In conjunction from that, government aspires to develop more training institutions and raised the enrolment of TVET students.

Recently for the period 2016 onward CIDB was established the Construction Industry Transformation Programme (CITP) 2016-2020 with the slogan of driving construction excellence
together. CITP is Malaysia’s national agenda to transform the construction industry to be highly productive, environmentally sustainable, with globally competitive players while focused on safety and quality standards. There are four strategic thrust under CITP has been developed to ensure the construction industry will transform are 1) quality, safety & professionalism; 2) environmental sustainability; 3) productivity; 4) internationalisation (Construction Industry Development Board, 2015). Productivity was the most related thrust to transform construction labour issues. Productivity is the primary engine of growth towards Malaysia’s high-income target. As a vital sector to the nation’s advancement, the construction industry will lead with high productivity levels through efficient adoption of up-to-date technologies and modern practices coupled with high-skilled, highly paid workforce.

CIDB in the efforts to doubled up the productivity and raised the wages of the labour has devised a planned basically can be divided into two focus namely human capital and technology. As presented in Table 3, CIDB reported in the CITP report No. 2 Q2 2017, for the strategic thrust three; productivity to date there are many progress done to ensure the successful of this thrust. Initiative one is continue investment in human capital development in construction and CIDB target to all construction related training programs and institutions streamlined and registered by CIDB quarter four, 2018. First initiatives, in 2016 Construction Industry Competency Forum (CICF) was established and conducted on 2017 to study on existing construction related training program and training providers. CICF is represented by related TVET training providers from various government and private agencies. 158 constructions related TVET programs under 4 main clusters (building, civil & structural, mechanical and electrical) and 12 major training providers have been identified. CICF agreed that in principle all construction skills training need to: 1) standardize the name for courses 2) use a common skills standard 3) standardize period of training 4) adopt a single certification. In addition, the second CICF agreed that 1) CIDB will decide on matters related to training in the construction industry as the regulator for construction industry under Act 520 2) CIDB will provide continuous supply & demand data for TVET training in the construction industry. Training quota among all TVET training institution will be based on the data 3) CIDB will be the lead agency in the construction-related training for other TVET institutions.

Secondly, CIDB targeted by 2018, training need analysis, occupational analysis and training maps has been conducted to the top ten highly demanded skilled trades. The trades are including 1) Scaffolding Erection 2) Welding 3G and 6G 3) Wireman 4) Chargeman 5) Gas Pipe Fitting (Fitting / insulation) 6) Blasting & Painting 7) Non Destructive Testing (NDT) 8) Crane Operation 9) Plant Operation 10) Plumbing. The progress is in 2016, Construction Industry Competency Blueprint developed by Saiful Training & Consultancy. Currently, the consultant completed the training map for the 10 Construction Industry Occupational Title (CIOT) and first draft of the training map was submitted on June 2017.

Next, targeted 5,000 on-the-job apprentices will produce by 2020. In 2016, 604 on-the-job apprentices produced in various skill trades such as mechanical fitters, mobile crane operators, rigging, site safety supervisor, scaffolding, architectural drafting, welding, painting & blasting, pipe fitters and wet trades via collaboration with industry stakeholders such as Petronas Chemical Group, Malaysia Mobile Crane Operators Association (MMCOA), Malaysia Offshore Contractors Association (MOCA), PUNB, Jabatan Pembangunan Kemahiran, Lendlease and ABM. In 2017, 375 more on-the-job apprentices produced in various skill trades such as hydraulic excavator, backhoe loader, scaffolding erection, welding, building wiring installation, building operation & maintenance handyman, blasting and painting via collaboration with industry such as WCE, Ceteau Malaysia Sdn Bhd, Muhibbah Engineering (M) Bhd, Vision Thermoplastic Sdn Bhd and Putra Perdana Construction SB. Additionally, projected by 2020, 100,000 construction personnel will complete Continuous Professional Development (CPD) training. In 2016 and 2017 a total 46, 319 had completed the training program in four major trades (electrical, mechanical, building & architecture and civil & structure). In addition, forecasted 100,000 construction personnel graduated in construction related skills and accredited by 2020. Until 2017, 47,138 graduates in approved construction
relate skills trainings, supervisory and management fields trained and certified.

Finally, government has been enhanced the human capital development through education and training. Then, it also encouraged the use of technology in every construction project such as Integrated Building System (IBS) to reduce the use of workers at the construction site by employing only local skilled workers and indirectly employees would earn a higher salary and improve the quality as well as performance of the buildings. The numbers of works on site will be reduce because part of the building components has been prepared in the factory. This is part of the initiatives planned under CITP thrust three, accelerate adoption of IBS, mechanisation and modern practices. In progress, CIDB by 2020 at least 100 more new IBS components manufacturing plants established at various strategic locations, all IBS components (i.e. columns, beams and slabs) for public projects to be procured separately from main contracts by 2018 and IBS’s catalogue will be produced in 2017 with cooperation CIDB and Public Work Department (PWD). Moreover, until 2017, 27 new IBS component manufacturing plants producing 4 main components (precast concrete system, metal framing, innovative product and blockwork system) established in 7 states (Johor, Selangor, Sarawak, Pahang, Melaka, Kedah & Kelantan) and 245 IBS manufacturers registered with CIDB. Next, hundred percent new Development Order in three states (Selangor, Johor and Pulau Pinang) for projects fifty million above must achieve minimum fifty IBS score by 2020. The enforcement of IBS usage in the project requires professional team to coordinate the project starting from pre and post contract stage, so that CIDB forecast at least 5,000 professionals (engineers, architects & quantity surveyors) have been trained on IBS by 2020 (Construction Industry Development Board, 2017).

5 CONCLUSION

The Malaysian government has planned enormous numbers of strategies to ensure that, Malaysia has sufficient number of competence workers for the needs of the country. The mission to reduced dependency on foreign workers to achieve development by 2020 and continuing until 2050 towards Malaysian inclusive, fair and sustainable. On top of that, initially the uniqueness of the construction products in terms of location, duration, size and cost will make the planning and management of project differ from others. This will affect the numbers of workers used and the planning of workers for such activity in the project also will be different. Based on the research shows that the construction industry predicted will increase the performance year by year. Its indicates that many projects will be implemented in future indirectly will raise the demand of skilled labour to fulfil the industry requirement. Therefore, the support from all the parties involved is compulsory for the success towards all the efforts and supplying the data in relation of labour used in each project so that the data can be used for future projects. It can be summarized that, government has been trying to resolve the construction labour issue from the grassroots starting from injection of fund, revising education syllabus and enforcing the use of technology. Despite, there is a gap between what the policy makers espouse and the viability and practical realities of what is happening in the industry. In conclusion, a staunch support from the Malaysian government is needed in providing a more effective policy in managing local skilled construction labour. Otherwise, the issues and problems facing by construction workers in Malaysian construction industry not be addressed effectively. Based on the research reveals the current situation of construction labour management and initiatives in Malaysia raised few important questions i.e. how Malaysian construction industry will enhance the situation on to raise the participation of the competence workers, how the industry will raise the quality of building performance with the availability of the local skill workers; how the industry can benefit from the new technology available to minimize the use of workers on site; and what is needed in order to realize the policy set out by the government. This will form a basis of designing a future research to improve the Malaysian construction industry. It is easy to plan but not to implement it. Not all the initiatives are implemented by the construction stakeholders. Thus, a more holistic approach is needed to ensure the economic, social, and environment aspects can be protected.
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BUILDING INFORMATION MODELLING (BIM) ADOPTION IN CONTRACTOR ORGANISATIONS

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Abstract - The construction industry has been facing various problems such as low investment rate, rising cost, additional risks, and waste in labour productivity which led to a decline in the quality of life of the construction stakeholders. To date, Building Information Modelling (BIM) has been used to improve visualization and productivity; to better coordinate construction drawings and communication; to provide faster delivery; and to lower costs. However, the adoption of BIM among Malaysian contractors organisations has been low and stagnant. Hence, this research aims to gain an overview of BIM adoption among contractors organisations as well as to investigate the reasons for the low adoption among contractor organisations. A qualitative approach in the form of semi-structured interview was used in this study to explore BIM adoption among contractors organisations. The findings were subsequently analysed using content analysis. The findings indicated that contractors organisations in Malaysia have no framework or model. Hence, developing the BIM adoption framework or model is urgently needed to encourage the development of BIM in Malaysia.

Keywords - Building Information Modelling (BIM), Adoption, Contractors organisations

1 INTRODUCTION

The construction industry is an important sector that has made great contribution to the Malaysian economic growth. However, in December 2017 Malaysia’s Gross Domestic Product from Construction had declined to 5.9% from 6.2% of the preceding three months (Department of Statistics, Malaysia, 2018). For this year, Bank Negara has forecasted Malaysia’s Gross Domestic Product to be between 5.5% and 6.0% (https://tradingeconomics.com/malaysia/gdp-growth-annual). Hence, the construction industry needs to move out from the traditional method as it had led to various problems due to reworks, time delay, rising costs, lack of communication and coordination, and wastage that have continued to plague the industry for years (Yaakob et al., 2016). In view of this problem, adopting Building Information Modelling (BIM) in the construction industry is vital.

Over the years, the global rate of adoption of BIM among commercial contractors has shown improvement (Beveridge, 2012). As reported by McGraw Hill Construction (2012), the level of adoption in North America was 28% in 2007 but had tremendously increased to 71% in 2012. From the report, the adoption rate among the contractors (74%) was also shown to be the highest compared to architects (70%) and engineers (64%). In the United Kingdom, 12% of contractors have used BIM for 6 or more years, while 19% have used BIM for more than 10 years. Meanwhile, in South Korea, the BIM adoption rate among contractors was 65% (McGraw-Hill Construction, 2014). In contrast, in Malaysia, the adoption rate of BIM among contractor organisations from 2007 to 2013 had been merely 5.2% (Jusoh, 2017). In 2016, the adoption rate among contractor organisations showed an improvement of about 13% (Construction Industry Development Board of Malaysia, 2016) yet in comparison to other countries, the adoption rate in Malaysia is still considered low.

Hence, this study seeks to gain an overview of BIM adoption among contractors organisations as well as to investigate the reasons for the low adoption among contractor organisations. The contractors organisations are the target of the study because contractors are the key players in the construction industry and they are the people responsible for transferring and interpreting models in 3-dimensional drawings to the real situation (Eadie et al., 2013).
2 LITERATURE REVIEW

In this section, the introduction of BIM, BIM adoption, and the overview of BIM among contractors organisations will be further discussed.

2.1 Definition of BIM

In the literature, various definitions of BIM were given by various researchers. Understanding the concept of BIM is vital as it helps in the application of BIM in the contractors’ organisations. Table 1 below shows the definition of BIM by previous researchers according to their different perspectives.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Definition of BIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erntrom et al.,(2006)</td>
<td>The development and use of a computer software model to simulate the construction and operation of a facility. Hence, Building Information Model produced is rich in information, object-oriented, intelligent and parametric digital representation in order to help user to make a decision.</td>
</tr>
<tr>
<td>Kymmell(2008)</td>
<td>Building information model is related to project simulation for the purpose of project components such as planning, design, construction, and operation by using a 3D model.</td>
</tr>
<tr>
<td>Young etal.,(2009)</td>
<td>A process of creating a digital model for design, construction, and operation of projects.</td>
</tr>
<tr>
<td>Taylor., (2009)</td>
<td>A parametric three-dimensional (3D) computer-aided design (CAD) technologies and processes in the architecture, engineering and construction (AEC) industry.</td>
</tr>
<tr>
<td>Smith.,(2012)</td>
<td>BIM is a process with intelligent planimetric 3D modelling through life cycle construction.</td>
</tr>
<tr>
<td>Shapiai, (2015)</td>
<td>A tool for AEC industries in parametric model in which digital information can be visualized and simulated in order to achieve a better coordination and integration among stakeholders</td>
</tr>
<tr>
<td>Autodesk (2016)</td>
<td>An intelligent 3D model-based process that equips architecture, engineering, and construction professionals with the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure.</td>
</tr>
</tbody>
</table>

From the table above, it clearly explained that BIM is not merely a model created by using a suitable software but it is also used in making decision, storing information, and describing an activity in construction projects (Shapiai, 2015)

Hence, for this study Building Information Modelling (BIM) can be described as a process of creating digital information for architecture, engineering, and construction (AEC) in the form of 3-dimensional (3D) model for a better coordination.

2.2 Definition of Adoption

According to Rogers., (1995); G. Winch., (1998); Hosseini et al., (2016)and Monko et al., (2017); adoption is the decision to make full use of any technological innovation to obtain a realistic information/result. As clarified by Rogers (1995), adoption is the process of decision making based on technological innovation of the communication channel. Furthermore, the authors also added that adoption can happen in two ways: 1) accept the innovation or, 2) reject the innovations.
2.3 Overview of BIM Adoption among Contractors Organisations

The world’s first BIM adoption among contractors organisations was initiated by Mtai (2009). The author investigated BIM adoption factors among 400 biggest contractors in the United States. Mutai (2009) addressed the challenges in adopting BIM since BIM was still new in the industry by suggesting a clear adoption strategy that should be developed. As a result, a BIM adoption model was developed. Later, Division 15 Mechanical Ltd, (2013) as one of the specialist Mechanical contractors, took the initiative to develop a strategic implementation plan which consisted of a BIM adoption model for an organisation. A BIM adoption model was conceived to reduce the adoption rate of adopting new technology among SMEs contractors in order to remain in the industry. Similar study carried out by Poirier et al., (2015) indicated that SMEs mechanical contractors in Canada were rather hesitant in adopting and implementing BIM. Meanwhile, Al Awad (2015) indicated that the use and adoption of BIM among SMEs contractors in Jordan had lagged behind. Thus, a BIM adoption framework was developed in order to assist SMEs contractors to adopt BIM in the organisations. A similar scenario was shown by Hong et al. (2016) in Australia where the BIM adoption among SMEs contractors was also limited.

In Malaysia, research on BIM adoption among contractors organisations is minimum. CIDB, (2014b) conducted a workshop regarding ‘Contractor’s Acceptance of Building Information Modelling (BIM) Towards Improvement of Project Performance and Profitability’. The study aimed to investigate the perception of individual contractors on BIM in performing their task; however, due to insufficient number of experienced contractors in the workshop, the workshop failed to achieve its goal. Similarly, Harris et al., (2014) conducted a workshop regarding ‘The way forward for Building Information Modelling (BIM) for constructions in Malaysia’. The purpose of the study, which focused on barriers and adoption factors, was to promote BIM especially among the newcomers in the industry. Meanwhile, Bidin., (2015) who investigated BIM adoption challenges among G7 contractors in Malaysia suggested in his report several success strategies in BIM adoption. A majority of previous researchers merely listed the success strategies or adoption factors without presenting the model or framework. This situation was also observed by Osman et al., (2015) in her study on BIM adoption among quantity surveying firms in Malaysia which suggests that adoption factors in a structured manner are required.

3 METHODOLOGY

In this study, the literature review used to seek information regarding BIM adoption was gathered from various sources such as journal articles, conference papers, and reports from various agencies, among them CIDB. Meanwhile, in obtaining the primary data, a qualitative approach in the
form of semi-structured interviews was conducted. According to Saunders et al., (2008) qualitative research is associated with such concepts and are characterised by their richness and fullness based on the opportunity to explore a subject as realistically as possible.

Hence, information was collected from eight (8) respondents who represented five (5) large private contractors in Malaysia. The respondents were selected based on the contractors’ experience using BIM for their entire projects in Malaysia. In addition, the Construction Industry Development Board (CIDB), an important body that enhances the development of BIM in Malaysia had provided sufficient data in connection with the organisations involved in BIM projects. Thus, in this study, the respondents were labelled accordingly as R1 to R8.

Meanwhile, the interview form was prepared to obtain the data from the respondents. The first section in the interview form filters the respondents based on their background and experience in BIM projects while section 2 explores the overview of BIM adoption among the contractors organisation. The following table presents two (2) sections of the interview form. The information gathered from the semi-structured interviews was subsequently recorded and analysed using ATLAS.ti in the form of content analysis. Content analysis was used to analyse unstructured data, such as the data from semi-structured interviews (Latiffi et al., 2016). According to Latiffi et al.,(2016), ATLAS.ti is a qualitative tool to analyse the visual and hierarchical modelling of concepts and theory. It also encompasses large number of documents and materials such as images, codes, video, audio, and geo data in order to retain the information.

<table>
<thead>
<tr>
<th>Section</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 1: Respondents’ Particular information</td>
<td>To extract the respondents’ background and experience in BIM projects</td>
</tr>
<tr>
<td>Section 2: Overview of BIM adoption among contractors organisations in Malaysia</td>
<td>To understand the definition of BIM To explore the current adoption of BIM among contractors organisations</td>
</tr>
</tbody>
</table>

4 FINDINGS AND DISCUSSION

The information gathered from the data collection was discussed in the following sections. As mentioned in 3.0, it consists of two sections.

4.1 Respondents’ Particulars

The following table shows the respondents’ particulars. From the table, four (4) respondents (R1, R2, R6 and R7) fall under Architect. Meanwhile, three (3) respondents (R3, R5 and R8) fall under Engineer. Only one (1) respondent is under Quantity Survey. In addition, this respondent had a minimum experience of 6-10 years in construction compared to other respondents.

In BIM experience, three respondents (R1, R2, and R5) had more than 5 years of experience while, four (4) respondents had 4-5 years of experience in BIM. Only one (1) respondent (R3) had minimum experience which is 2-3 years. The valuable information provided by these respondents are considered reliable as the respondents come from various background and working experience in the construction industry and BIM-based projects.

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Occupations</th>
<th>Experience in Construction</th>
<th>Experience in BIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>Architect</td>
<td>11-20 years</td>
<td>Above 5 years</td>
</tr>
<tr>
<td>R2</td>
<td>Architect</td>
<td>11-20 years</td>
<td>Above 5 years</td>
</tr>
<tr>
<td>R3</td>
<td>Engineer</td>
<td>11-20 years</td>
<td>2-3 years</td>
</tr>
<tr>
<td>R4</td>
<td>Quantity Survey</td>
<td>6-10 years</td>
<td>4-5 years</td>
</tr>
<tr>
<td>R5</td>
<td>Engineer</td>
<td>11-20 years</td>
<td>Above 5 years</td>
</tr>
</tbody>
</table>
4.2 Overview of BIM Adoption among Contractor Organisations

In this section, the findings from semi-structured interview on BIM definition and current adoption of BIM among contractor organisations in Malaysia are discussed.

4.2.1 BIM definition

The findings suggested that the definition of BIM falls into two (2) categories, process and perceived benefits. Five respondents (R1, R2, R5, R6, and R7) agreed that BIM is a process which helps contractors organisations to be seamless in their projects. These findings were echoed by various researchers, for instance Young et al.,(2009); Taylor et al. (2009); and Smith (2012), CIDB, (2014) and Autodesk (2016).

“The process of managing information is more effective, easier and faster for their user” (R1, and R6)

“BIM is a process of developing a 3D model such as architectural, structural, and mechanical drawing using BIM software” (R2)

“BIM is a collaborative tool which consists of processing, creating, and managing information for the entire lifecycle” (R5, and R7)

Furthermore, all respondents (R1, R2, R3, R4, R5, R6, R7, and R8) agreed that BIM is defined as perceived benefits or advantages. This is consistent with Erntrom et al.,(2006); Kymmell (2008) and Shapiai.,(2015) who defined BIM as a tool that gives benefits and effects to the users.

“BIM provides an advantage as it can save our time and is easier” (R1, R2, and R6)

“Detecting clashes, improving visualization, and providing better coordination are the functions of BIM” (R3, R4, R5, R7, and R8)

4.2.2 Current adoption of BIM among contractors organisations

The next results show that the adoption of BIM is low because there is no framework or models, specifically for contractors organisations, that is available in the construction industry. This resonates with the findings made by Osman et al.,(2015) in the study of BIM adoption among quantity surveyors in Malaysia. Besides, it also discovered that so far no research on BIM adoption framework/model that is relevant to contractors organisations has ever been conducted in Malaysia.

The following quotes are stated by the respondents:

“Since 2014, the adoption of BIM has become stagnant due to various challenges faced by the organisations. In addition, the lack of framework and model regarding BIM adoption is the biggest problem” (R1)

“The organisations face challenges and barriers in changing from the traditional method to BIM. Hence, the adoption of BIM only exist in the BIM department. Apart from that, there is no framework or models in the Malaysian construction industry” (R4, and R5)

“To date, there are no framework or adoption models suggested or available in the construction industry. Thus, it influences many organisations to create their own path and direction. Moreover, the adoption becomes more stagnant due to various challenges in the organisations” (R2, R3, R6, R7, and R8)
4.3 Summary of Findings

From the findings, it shows that Malaysia still lacks BIM adoption framework/models for contractors organisations. This statement is echoed by all the respondents (as per table below) which explains the limited number of BIM framework/models in the industry. Hence, the development of BIM adoption model for contractors organisation is vital in order to increase the rate of adoption. Nonetheless, various factors such as benefits, challenges or barriers in BIM adoption also need to be investigated in order to develop a comprehensive framework or models. This is because these are the factors (challenges or barriers, and benefits) mostly revealed by the respondents. The table below shows a summary of the findings.

Table 3 Summary of findings

<table>
<thead>
<tr>
<th>Items</th>
<th>Definition of BIM</th>
<th>Current adoption of BIM among contractors organisations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Process</td>
</tr>
<tr>
<td>Respondents (n=8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R1</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>R2</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>R3</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>R4</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>R5</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>R6</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>R7</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>R8</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>8</td>
</tr>
</tbody>
</table>

Noted: R is respondents. The highest score is from 5 to 8 respondents

5 CONCLUSIONS

The research confirmed the literature written by previous researchers in investigating the issues of BIM adoption. The results also revealed that no framework or models is available to facilitate BIM adoption by contractors organisations in Malaysia. As a consequence, the other variables (benefit and challenges or barriers) also must be included as part of the empirical data. The paper was presented with the aim of developing a framework of BIM adoption model for Malaysian Contractor Organisations. Thus, it is hoped that the research will encourage positive input from researchers and contractors in order to strengthen the development of BIM in Malaysia.

REFERENCES


THE SUCCESSFUL FACTORS OF HERITAGE INTERIOR SCHEME FOR HERITAGE MUSEUM: CASE STUDY ‘RUMAH TEH BUNGA’ IN GEORGE TOWN PENANG

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Abstract – There is a conflict between the conservation of museum heritage scheme and the building restoration, mainly because the idea of operating a museum in heritage building depends on restoration requirements. There is a lacking of practice to bring back the heritage interior scheme after conservation. Consequently, the history of historic building is the priority and it becomes the most expensive element of the collection. To achieve the successful interior historic scheme for exhibition inside heritage building, there are some factors that should be considered. These are: space remain intact; space heritage value; heritage space interpretation; heritage space ambience; risk of exhibition fittings; exhibition space contents; and collection adaptation. This paper is part of an ongoing research aimed at revealing these 7 successful factors of interior heritage scheme at Malay Penang Gallery also called ‘Rumah Teh Bunga’ in George Town, Penang. Assessment evaluation technique in a form of rubrics were used to test these 7 successful factors. The finding of successful factors could be served as guidelines to manage the exhibition heritage scheme to set up museum or gallery inside heritage building. Indirectly, it will contribute ultimate goal to make visitors love history and love to come to museum.

Keywords - Interior, Heritage, Scheme, Museum, Exhibition

1 INTRODUCTION

Lately, the heritage building has begun to regain its place in the hearts of visitors. Today, visitors are most interested to visit museum that originated from heritage building. The museum visitors are more excited to see the genuine object and the heritage building itself is valuable evidence as museum display. They have made a good decision in visiting museum building, not only they can see exhibition in the museum but they can enjoy the interior scheme when enter the museum building. This visiting package is worth to them. All these opportunities can be realized when the heritage building has successfully restored its history and able to deliver well through the exhibition medium. But now, what is happening is the opposite, there is lacking in bringing historic character of historic building after the change to the heritage museum. The reason is that historic buildings were damaged naturally and it was also due to the need of new function. Thus, it needs to be told in museum exhibition with the right historic interpretation to acquire appropriate historic interior scheme for heritage museum. Besides that, it is to avoid history being misinterpreted by visitors and confusion on an exhibition medium.

To achieve the success in interior scheme of heritage building, museum must play a role and give commitment as a heritage center (Beech, 1992), and the care of heritage building should be taken over (Forsyth, 2007). Occasionally, there is a conflict between the museum mission and the building restoration, mainly because the idea of housing a museum in a heritage building depends on restoration requirements. Consequently, the building is the priority and in the end it becomes the...
most expensive element of the collection. Due to that, to obtain a good historic scheme interpretation, the authenticity of interior heritage building needs to be restored well. To reach this aim, conservator should take this responsibility. The building authenticity restoration work and museum exhibition also need to be align with the heritage museum's mission (UNESCO La Habana, 2012. p. 10).

2 AUTHENTICITY CRITERIA IN CONSERVATION OF INTERIOR MUSEUM OF HERITAGE BUILDING

To accomplish the success in building authenticity restoration work, there are the authenticity criteria that should be considered for interior heritage building conservation that was based on Alho, Morais, Mendes, and Galvao (2010) studies, adopted from the USA Parks (1994). Jokilehto and Stovel (1994) found that there are five authenticity criteria in heritage building conservation that should be highlighted such as design, material, workmanship, setting and function (Alho et al., 2010). In this paper, these five authenticity criteria have been used to assess the interior of heritage museum building (Table 1).

Table 1 The Five Authenticity Criteria in Conservation of Heritage Building

<table>
<thead>
<tr>
<th>A. Design</th>
<th>The combination of elements that create the form, plan, space, structure, and style of a property. It results from conscious decisions made during the original conception and planning of a property (or its significant alteration) and applies to activities as diverse as community planning, engineering, architecture, and landscape architecture. Design includes such elements as organization of space, proportion, scale, technology, ornamentation, and materials.</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Material</td>
<td>The physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form a historic property. The choice and combination of materials reveal the preferences of those who created the property and indicate the availability of particular types of materials and technologies. Indigenous materials are often the focus of regional building traditions and thereby help define an area's sense of time and place.</td>
</tr>
<tr>
<td>C. Workmanship</td>
<td>The physical evidence of the crafts of a particular culture or people during any given period in history or prehistory. It is the evidence of artisans' labor and skill in constructing or altering a building, structure, object, or site. Workmanship can apply to the property as a whole or to its individual components. It can be expressed in vernacular methods of construction and plain finishes or in highly sophisticated configurations and ornamental detailing. It can be based on common traditions or innovative period techniques.</td>
</tr>
<tr>
<td>D. Setting</td>
<td>The physical environment of a historic property. Whereas location refers to the specific place where a property was built or event occurred, setting refers to the character of the place in which the property played its historical role. It involves how, not just where, the property is situated and its relationship to surrounding features and open space.</td>
</tr>
<tr>
<td>E. Function/Use</td>
<td>The degree of continuity of original or significant uses in a property. An historic area and its surroundings form a coherent whole including associated human activities and constructions; continuation of original or compatible uses minimizes negative impact on authenticity.</td>
</tr>
</tbody>
</table>

(Sources: USA Parks, 1994; Jokilehto & Stovel, 1994)

In this paper, all the authenticity focuses more on physical of heritage building authenticity. However, in the heritage interior scheme context, the word ‘setting’ refers to ‘interior historic setting’ as it represents the spatial setting including indoor space (Nauman, Jane, Lord, & El-sheniti, 1995). By this finding, the assessment will concentrate only on 4 criteria from the table and 1 criteria adopted from the journal of Museum International (Paris UNESCO), 1995.
THE MUSEUM EXHIBITION SCHEME FOR HERITAGE BUILDING

3.1 The Important Issues on Museum Interior Space of Heritage Building

The museums organization of New South Wales, Australia, which have contributed the comprehensive guideline, have acknowledged that the museum needs cannot be easily accommodated without compromising the heritage building interior. According to their principle in the New South Wales Heritage Act, when an entire museum building is considered a heritage site, the building and its contents turn into display. For museums exhibiting material that is not directly associated with the heritage building and its uses, the challenge is to give the visitor an understanding of the place's history while still providing space for exhibitions. There are important issues on interior space which should be observed at interior heritage building (NSW Heritage Museum and Gallery Foundation, 2004):

1. Spaces large enough to display objects and still allow people to circulate freely.
2. Doorways large enough to move exhibition furniture in and out easily.
4. Kinds of display furniture that require such as free standing showcase.
5. Need to light inside showcases, general floor items or items on walls.
6. Need a lot of wall space to hang works.

NSW Heritage Museum and Gallery Foundation (2004) also stressed the issue of cultural appropriateness in relation to the building's use need to be explored. Such as a religious/spiritual use; an association with a particular cultural group or event, appropriate representatives should be consulted about the building’s interpretation, and any other usage should be considered. Although the above space issues have been identified, it is not easy to reach the authenticity building scheme when exhibition begins.

3.2 The Successful Factors in Heritage Exhibition Scheme for Heritage Building

Towards achieving the success in heritage exhibition scheme for heritage building, there are some factors that should be looked into. There are space remain intact; space heritage value; heritage space interpretation; heritage space ambience; risk of exhibition fittings; exhibition space contents; and collection adaptation. Table 2 will elaborate further about these factors and detail on standard guidance.

Table 2 The Successful Factors in Heritage Exhibition Scheme for Heritage Building.

<table>
<thead>
<tr>
<th>No.</th>
<th>Successful Factors in HES</th>
<th>Standard Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Space remain intact</td>
<td>The original size, position, structure &amp; function of space should be extremely retained, the space highly successful to remain intact and strongly recommended for museum/gallery purpose.</td>
</tr>
<tr>
<td>2.</td>
<td>Space heritage value</td>
<td>Every element of a historic space remain intact. The space should be highly significant to the heritage value, advanced achievement in character-defining and historical elements of a space is original remained.</td>
</tr>
<tr>
<td>3.</td>
<td>Heritage space interpretation</td>
<td>Effectiveness of heritage space interpretation are achieved with the success in exhibition presentation. Tosucceed compelling of heritage space interpretation should go through an appealing presentation of placing labels, introducing interpretation panel, providing tour, installing sound spaces/video, image to invoke feeling.</td>
</tr>
<tr>
<td>4.</td>
<td>Heritage space ambience</td>
<td>These are how conservation work will change the ambience of the space. The more successful restoration work of original heritage scheme it will contribute to the more success of heritage space ambience.</td>
</tr>
<tr>
<td>5.</td>
<td>Risk of exhibition fittings</td>
<td>The exhibition fitting should respect the original physical of heritage building, and should adopt good work ethics in exhibition of heritage buildings. The</td>
</tr>
</tbody>
</table>
lower risk of exhibition fittings will contribute to a good exhibition heritage scheme.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td><strong>Exhibition space contents</strong></td>
</tr>
<tr>
<td></td>
<td>The space should be suitable to present exhibition material and should be related with exhibition content. It will be impressed space and contribute to the successful heritage space interpretation.</td>
</tr>
<tr>
<td>7.</td>
<td><strong>Collection adaptation</strong></td>
</tr>
<tr>
<td></td>
<td>The space should contain safety closed collection and a very minimal collection is good adaptation. A heritage exhibition space should be extremely dominant than object collection, whereby it will be contribute to the extremely prominent of heritage space character.</td>
</tr>
</tbody>
</table>


The successful factors are based from the three most importance guidelines on heritage restoration. First, the UNESCO charters and guideline has formulated the consideration aspects that should be taken into account on the museum planning in heritage building. Second, the National Park Service (1995), which have established the guideline in the Secretary of the Interior’s Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring and Reconstructing Historic Buildings; and third, the New South Wales Heritage Museum and Gallery Foundation (2004) which have carried out an assessment on the interpretation of exhibition space in heritage site.

3 METHODOLOGY

In this paper, a technique of assessment rubric scale was used. The rubric scale contains unit analysis. The test was developed to two parts. Part A; 5 parameters level of change of authenticity for interior museum of heritage building, and part B; 7 successful factors in heritage exhibition scheme. Level of change rubric scale and level of achievement rubric scale in heritage exhibition scheme were established and they were adopted from the three above guidelines. To measure level of change of authenticity, it rated with percentage (%); 0% - 25% (Less remain); 26% - 50% (Partly remain); 51% - 75% (Remain); and 76% - 100% (Fully remain). While, to evaluate success in heritage exhibition scheme, it rated with grading: 1 - Inadequate (Grade D); 2 - Adequate (Grade C); 3 Accomplished (Grade B); and 4 - Mastery (Grade A). Case study method (Yin, 1984; Yin, 1994; Yin, 2003) was used for this paper. ‘Rumah Teh Bunga’ has chosen as a case study to carry out this assessment rubric scale. These house was chosen based on their own identity, the only Jawi Peranakan’s richness agam house (1893) and the most important Penang Malay Gallery (2008-until now) and as a valuable legacy of heritage in George Town Penang.

4. CASE STUDY : RUMAH TEH BUNGA – PENANG MALAY GALLERY

4.1 Background of ‘Rumah Teh Bunga’ - Penang Malay Gallery

Figure 1 ‘Rumah Teh Bunga’ (1893) have changed into Penang Malay Gallery (2008)

Photo by: Norashikin (2018)
‘Rumah Teh Bunga’ was located at No. 138, Hutton Road, George Town, Penang. It was built in 1893 by a prominent Malay trader, Tuan Abdul Wahab, who was one of the richest Jawi Peranakan in the late 19th century. The Jawi Peranakan are Malays whose ancestral blood were traced back outside Penang, to Jawa, Kedah and even to Arab. The house has elements that reflect the wealthy Jawi Peranakan residence, such as the crescent moon and star at the pediment. It was named Teh Bunga Mansion due to its ochre hue, and also because the owner happened to also be known by the same nickname. ‘Rumah Teh Bunga’ was bought over by one Tan Chong Keat at the turn of the 20th century, and remained a Chinese residence for several generations until it was bought over by the National Heritage Department (Jabatan Warisan Negara). Conservation work on the mansion began in 2007, over a good 18 months, and at a cost of around RM2 million. The building was then handed over to Amanah Raya Berhad as trustee. The work included replacing parts that have been damaged, and strengthening the structure. The house is 125 years old. It represented ‘Sino-Malay’ with ‘Limas’ roof architecture, decorated with Chinese and European motifs such as an age of ceramic stone floor finishes and rich cast iron window grill. The house have 2 level of floors, at ground floor level consist of an entrance porch, main guest area, main living area, 2 bedrooms, women lobby area, family dining area, kitchen, wash area, bathroom, and toilet, while, at first floor level consists of 2 bedrooms, 1 master bedroom, a special guest area and family area which consists set of sofa, television area and dressing area. Figure 2 shows the number of original space in ‘Rumah Teh Bunga’ building.

4.2 Heritage Exhibition Scheme in ‘Rumah Teh Bunga’ - Penang Malay Gallery

After the house turns into a gallery, some of the rooms have changed to exhibition purpose, and some rooms would remain as its original function. There are only 13 spaces involved in the gallery exhibition. 7 spaces at ground floor consists the exhibition of opening at Penang Island which consists information corner, trade and business area, politic, administrative and haji area, and the rest is in its original function, while, 6 spaces at first floor consist of 1 remained original area such as family area which consists set of sofa, television area and dressing room, and the rest totally change for exhibition purpose (See Figure 2).

![Figure 2 ‘Rumah Teh Bunga’ Exhibition Plan Source: Illustrated by Norashikin (2018)](image-url)
5 RESULT AND FINDING

5.1 Assessment Result at ‘Rumah Teh Bunga’ George Town, Penang

The following are the assessment rubric survey that was done at ‘Rumah Teh Bunga’ (See Table 3). This assessment involved 13 spaces of interior in this house. The assessment rubric table was divided into two parts, separated into authenticity level of change and exhibition heritage level of scheme. From the assessment result, it can been seen that correlation between these two parts was formed and it was found that the successful factors of exhibition heritage scheme in heritage building were influenced by the level of change of authenticity. Further detail on the finding will be elaborated in the next discussion in the form of diagram presentation.

5.2 Finding result at ‘Rumah Teh Bunga’ George Town, Penang

From the result in the Table 3, it can be summarized that ‘Rumah Teh Bunga’ has achieved 100% authenticity level for the criteria of ‘material’, ‘design’ and ‘workmanship’, but for the criteria of ‘function’ it has just achieved 78% and the lowest one 38% is ‘interior historic setting’ criteria. These means the original space function and the space setting havenot fully remained because the new function and new setting for the Penang Malay Gallery exhibition in ‘Rumah Teh Bunga’. Rumah Teh Bunga has successfully presented exhibition heritage scheme due to the space capability which still remains intact, high heritage value and space longlasting ambience. Briefly, the finding shows that the authenticity criteria a successful relationship factors whereby it proves that the 5 authenticity criteria would be the heritage building priority. In addition, it is to become an activator to the 7 successful factors for exhibition scheme in heritage museum building. A diagram has been formed that was inspired from the result of the ‘Rumah The Bunga’ assessment (See Diagram 1).

![Diagram 1: The successful of heritage interior scheme for heritage museum building](source: Illustrated by Norashikin (2018))

The diagram shows the transformation process for heritage museum that should be fulfilled to obtain success of heritage interior scheme.
Table 3 The assessment result to test the authenticity criteria and successful factors of heritage interior scheme for museum exhibition at ‘Rumah Teh Bunga’ George Town, Penang

<table>
<thead>
<tr>
<th>PART A</th>
<th>PART B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LEVEL OF CHANGE ON AUTHENTICITY IN CONSERVATION OF INTERIOR HISTORIC BUILDING</strong></td>
<td><strong>LEVEL OF EXHIBITION HERITAGE SCHEME</strong></td>
</tr>
<tr>
<td>Component of Changes (Please write area of space to be evaluate)</td>
<td>Authenticity Criteria / Unit of Analysis (Please mark your evaluation rate)</td>
</tr>
<tr>
<td>Name of Space (Exhibition)</td>
<td>Materials/Substance</td>
</tr>
<tr>
<td>Opening Penang Island</td>
<td>Main Guest Hall</td>
</tr>
<tr>
<td>Info Corner</td>
<td>Main Dining Hall</td>
</tr>
<tr>
<td>Trade &amp; Business</td>
<td>Bedroom 1</td>
</tr>
<tr>
<td>Politic, Administration &amp; Haji</td>
<td>Bedroom 2</td>
</tr>
<tr>
<td>Traditional Food</td>
<td>Women Lobby Area</td>
</tr>
<tr>
<td>Family Dining Lobby</td>
<td>Guest Living Lobby</td>
</tr>
<tr>
<td>Kitchen, Wash Area, Bathroom &amp; Toilet</td>
<td>Kitchen, Wash Area, Bathroom &amp; Toilet</td>
</tr>
<tr>
<td>‘Tokok’</td>
<td>Bedroom 4</td>
</tr>
<tr>
<td>Boria Performing</td>
<td>Special Guest Hall</td>
</tr>
<tr>
<td>Educational &amp; Publication</td>
<td>Bedroom 3</td>
</tr>
<tr>
<td>Penang Marriage Culture</td>
<td>Bedroom 3</td>
</tr>
<tr>
<td>Traditional Costume</td>
<td>Master bedroom</td>
</tr>
<tr>
<td>TV area with sofa set &amp; dressing area</td>
<td>Family area</td>
</tr>
<tr>
<td>TOTAL SCORE</td>
<td></td>
</tr>
</tbody>
</table>

Source: Illustrated by Norashikin (2018)
6 CONCLUSION AND PROPOSAL

From the ‘Rumah Teh Bunga’ finding, it can be concluded that the conservation work in restoring the authenticity level is very important to guarantee the achievement of successful factors in exhibiting heritage scheme for heritage museum building. As a recommendation, the successful factor for the interior heritage scheme should be proposed as a factor and should be considered when the heritage building change its function into heritage museum building. It would be a guideline to achieve successful heritage scheme after building conservation. In addition, it also can be an opportunity for the museum to attract visitors come not only to see the collections but to experience the interior heritage scheme in the museum.

REFERENCES


A FRAMEWORK FOR BUILDING USER ORIENTED MAINTENANCE MANAGEMENT FOR NATIONAL RELIGIOUS SECONDARY SCHOOLS.

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Abstract - The area of building maintenance creates an opportunity for scholar, practitioner, building owner, stakeholder, end user and others to participate in various study to establish issues and solution to the problem concerning building maintenance. Building maintenance is not only limited to restore the physical of the building and its facilities but also contribute to improve the existing environment of building user. The paper highlights the significance of building maintenance for National Religious Secondary school to take into consideration building-user as one of the main factors in maintenance management frameworks. The proposed framework is developed through unstructured interview with relevant stakeholders that involved in school maintenance with integration of building user and service quality. The objective is to investigate the nature of maintenance management for National Religious Secondary school. A pilot survey was conducted to obtain some overview on the current condition and practice of maintenance management for national religious secondary school in Perak one of the states in Malaysia. Some secondary data were provided by the national religious secondary school maintenance department. The maintenance data were analyzed with reference to the location, building elements and frequency of reported defects that were recorded in a year. The collected building maintenance data show that issues on building maintenance still occur that is equivalent with the age of the school buildings. It indicates that the proposed integration of building user in maintenance management framework will improvise the service rendered by the operator and satisfy the building user.

Keywords - Maintenance Management, Performance Measurement, Maintenance Performance, Building user

1 INTRODUCTION

Malaysia has achieved great progress in education on many areas inclusive of increasing access to pre-school education, primary and secondary education, as well as expanding opportunities to pursue at tertiary education level. The history of Malaysia national education can be seen from the early days of British occupation and it continues after Malaysia achieved its independence in year 1957. The interest of the ruling government to eliminate illiteracy after independent can be seen from the First Malaysia Plan (1966 to 1970). It is reported that:

“The Education Committee Report of 1956 laid the foundation for a system of education which would be national in character and which would give every child a place in primary school” (Economic Planning Unit, 1965 p.164-165).

The efforts to excel in education is a continuous effort that can be seen in every decades starting from 70’s, 80’s, 90’s and year 2000. Generally in 70’s, education system in Malaysia focussed to consolidate the education system to achieve its national development.

While in 80’s, the ministry was given the responsibility to lay foundation to uplift bumiputera access to tertiary education where quite a number of Majlis Amanah Rakyat (MARA) junior science college was built in the same decade. People’s Trust Council, commonly abbreviated as MARA was established in 90’s. The ministry has encouraged the private sector’s involvement and also to reduce the
gap between rural and urban schools. In year 2000, the ministry focussed to promote technical and vocational educational training (TVET) to meet industrial demand and also to give an option for students whether to pursue in academic or TVET (Economic Planning Unit, 1965-2016). Since then, Malaysia has embarked to improve human capital by way of strengthening the education system starting from preschool, primary school, secondary school and tertiary education.

The tireless effort of the government to promote access to quality education can be seen in year 2006 to 2010. For instance, the Ministry of Education spent more than RM20 billion on infrastructure development. The total sum was used for the proposed development of 400 new schools, with expansion of Information and Communications Technology (ICT) infrastructure, and also upgraded the maintenance of existing facilities (Malaysia Education Blue Print, 2013-2025 Ministry of Education, 2013).

In addition, the launching of Malaysia Education Blue Print in year 2013 has set the new paradigm of the whole education system in Malaysia. The blue print was developed with three (3) clear objectives, firstly understanding the current performance and challenges, secondly establishing a clear vision and aspiration and thirdly outlining a comprehensive transformation programme for the system, including key changes to the Ministry. The effort to uplift the standard of education, has seen the government of Malaysia allocated priority budget to Ministry of Education (MOE) amount to RM41.3 billion in 2016 budget. In Malaysia besides the provision of main stream education system, the government also has supported the religious education to meet demands from the majority of Muslim community. In Malaysia, the Islamic religious education can be classified into two categories, known as informal education and formal education. The informal education includes the pondok school and the quranic school. The formal religious education known as Madrasah (Taib, 1973). In 70’s the religious schools was not well accepted by the Muslim community due to lack of facilities and education system. The evolution of the Islamic religious education in Malaysia is further enhanced when the government is taking over 11 State Religious schools in year 1977 (Temrin & Ali, 2017).

The rising demand for religious school in Malaysia can be seen with the total number of national religious secondary schools stands at 58 numbers of schools throughout Malaysia. The same has been reported by Malaysia Education Blue Print (2013-2025 MOE, Ch3 p.23, 2013), where growing percentage of students are also registered for religious schools. It shows that the trend for religious schools has gradually increased and well accepted by the majority of Muslim community in Malaysia. In order to expand the religious education pathway the Ministry has put some plans to increase up to 77 numbers of new Sekolah Menengah Kebangsaan Agama (SMKAs’) by 2025 (Malaysia Education Blue Print 2013-2025 MOE, Ch7 p.14, 2013)

2 OVERVIEW ON SCHOOL MAINTENANCE MANAGEMENT

Building maintenance as defined by Seeley (1976) is “work undertaken in order to keep, restore or improve every part of a building, its services and surrounds, to a currently accepted standard, and to sustain the utility and value of the building. The same definition could be extended to the school maintenance in Malaysia. The school maintenance programmed constitutes three important aspects: organization, inspection and maintenance planning. Firstly is to establish a good organisation structure and – be able to identify personal in-charge complete with their responsibilities. Secondly is to conduct regular building inspection to overall of building’s elements and components. It is paramount to have good record on school building conditions. The final one is to have maintenance planning, to ensure that school building can be functioned towards intended purpose. (Elghaffar, 2007; Xaba, 2012)

The effective school maintenance will not only ensure that the physical building can be functioned to serve its intended purpose but also provides good environment for teaching and learning. In addition, efficient school maintenance will eventually secure capital investment and contribute to improve on health and safety aspects. The above will give positive impact on the educational performance of the school children (Ibrahim, Osman, Bachok, & Zin, 2016; Ropi & Tabassi, 2014; U.S. Department of Education, 2003). Generally in Malaysia the standard of maintenance management in every school is inclusive of
national religious schools. These schools do still require room for improvement. It is also concurred by C.Y.Yong (2015), Ropi and Tabassi (2014), Zainal Abidin Akasah et al. (2009), where most of the schools in Malaysia are still lacking in performing maintenance management and unable to achieve satisfactory level due to low awareness on the importance of maintenance practices. It shows that even though the same issue has been discussed by previous scholars pertaining to the school maintenance management, there are still issue to be discussed by future researcher. It is further explained by Ali, Keong, Zakaria, Zolkafli, and Akashah (2013), the growing importance of maintenance sector, poor maintenance performance and the lack of research in this area that provide impetus for this study. The issues are getting worse due to poor maintenance staffing level and also insufficient knowledge of maintenance for those who assigned to perform maintenance management practice at schools (Lavy & Bilbo, 2009; Ropi & Tabassi, 2014). The same challenges faced by schools in Malaysia.

In Malaysia, one of the main reasons why most of the building having poor maintenance is due to lack of preventive measures (Peng Au-Yong, Shah Ali, & Ahmad, 2014). In addition, improper attitude put on maintenance has led to deterioration of building fabrics and facilities. The benefits of practicing preventive maintenance is further described by Lazim, Taib, Lamsali, Saleh, and Subramaniam (2016), where it will diminish potential disruption of facilities from occurring in daily operation. The researchers and scholars are echoing the significance of preventive maintenance. However, stakeholders and masses are prone towards ad-hoc maintenance, where repairing works will take place once disruption occurred.

However in Malaysia scenario, according to Zulkarnain, Zawawi, Rahman, and Mustafa (2011), ad-hoc maintenance is still practiced by many, where in some cases the building is left unrepaired until complaints received before any repairing works. The research by Yong and Zailan Sulieman (2015) has discovered that unplanned maintenance is the preferred choice by District Education Office, since planned maintenance requires higher overhead cost. Recent evidence suggests that approach of planned maintenance is preferred by Ropi and Tabassi (2014) because reduction in repairing cost compared to unplanned maintenance. However, the practiced of school maintenance is still lacking particularly that involves the community and building user oriented maintenance services.

3 PERFORMANCE MEASUREMENT REVIEW

According to Ghalayini, Noble, and Crowe (1996), the literature pertaining to performance measurement has evolved into two phases. The first phase started in late 1880’s, where during that time performance only be measured for something tangible or financial measures. The capability to minimise cost of production and at the same time increase profit was be treated as a good performance. However in 1980’s and above, the evolution of knowledge lead by scholars and practitioners have changed the traditional financial measures and began to value the intangible or non-financial measures as a second phase of performance measurement. It could be seen by the introduction of balance score card (BSC) in year 1992 that has streamlined the criteria to be measured by every organization (Kaplan, Robert S.eNorton, 1996). Measurement of maintenance performance is an assessment that helps to identify the strengths and weaknesses of the maintenance activities. In addition, the result of performance measurement indicates the effectiveness of the existing strategy. Consequently, the management team is able to plan and make appropriate decision for future maintenance strategy.

The building user oriented maintenance services (BUOMS), can be classified as maintenance management service quality where pending evaluation by property owner or building user which covers service quality expectation versus performance (Kazemi, Ehsani, Abdi, & Bighami, 2013). Thus, this research will incorporate the flow of school maintenance management coupled with BUOMS performance measurement.
Table 1 The School Maintenance Performance Measurement Framework with integration of building user.

![Framework Diagram](image)

The above framework describes the relation between four (4) maintenance stages beginning with Planning, Implementation, Performance measurement, and Analysis and reporting.

At the planning stage, the maintenance policy is important in rendering the fundamental of any maintenance organization. It is further explained by Al-Turki (2011), where maintenance itself constitutes around 30% of the total running cost of manufacturing and construction businesses. The maintenance planning could be done at strategic and tactical level. Strategic level concerns on the existence of the business and tactical refers to the way how business is conducted.

While at the implementation stage, the efficient maintenance management must achieve sustainable interrelation between business strategy, maintenance policy, financial management and good maintenance implementation (Sodangi, Khamdi, Idrus, Hammad, & AhmedUmar, 2014). In his research Au-Yong (2013) argued that the efficient maintenance implementation can be described as producing minimal waste, expense, downtime, failure and complaint. The scholars have concluded that implementation is where the policy is interpreted and applied on the ground to achieve good maintenance cycle as well as the best maintenance implementation.

The second last stage is Performance measurement. Maintenance performance measurement can be considered as assessment that eventually be able to appraise the outcomes of the maintenance activities. The findings will be analyzed to continually improve the maintenance policies and maintenance performance as well (Maletič, Maletić, & Gomišček, 2012). The variables used inclusive of Tangible, Reliability, Assurance, Empathy and Responsiveness.

Table 2 The main variable for occupant’s satisfaction.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tangible</td>
<td>Physical facilities, equipment and appearance of personnel</td>
</tr>
<tr>
<td>Reliability</td>
<td>Ability to perform the promised service dependably and accurately</td>
</tr>
<tr>
<td>Responsiveness</td>
<td>Willingness to help customers and provide prompt service</td>
</tr>
<tr>
<td>Assurance</td>
<td>Knowledge and courtesy of employees and their ability to inspire trust and confidence.</td>
</tr>
<tr>
<td>Empathy</td>
<td>Caring, individualized attention the firm provides its customers.</td>
</tr>
</tbody>
</table>

(Sources: Parasuraman, Zeithaml, & Berry, 1988)
The final stage in the maintenance performance measurement framework is analysis and reporting. The maintenance report and analysis is imperative as a document and record to attain the real scenario of maintenance management in certain organization (Au-Yong, 2013). The maintenance report consists of complaint from the users, maintenance expenditure and technical report. The same variables will be utilized to measure maintenance performance for the school.

4 SIGNIFICANCE OF BUILDING USERS’ SATISFACTION

Building users are the people who “use/occupy the building; they are not experts in managing it but have knowledge and opinions about its performance in relation to their own objectives.” (Pemsel, S., Widen, K. and Hansson, 2010). The roles of end user in strengthening maintenance management is also mentioned by Myeda, Kamaruzzaman, and Pitt (2011). They assert that maintenance managers should value the important roles of end users in evaluating the performance of maintenance services with a great attention given on their needs and requirements. The root causes of the problem is the lack of an understanding of the maintenance management process for heritage building among school administrators as such it hinders the schools from designing a good maintenance programme for their schools (Akasah, A Z. A., 2012).

There are several studies that revealed integration between principals, representatives from parent teacher associations, students, and school community should be responsible for setting up the school maintenance program in order to prolong the life expectancy of school buildings, its furniture and equipment (Akasah, Shamsuddin, Rahman, & Alias, 2008; Elghaffar & Assistant, 2007). In year 2013, Lai and Lai pointed out that satisfaction of every stakeholders in particular the building user must be valued because they experience the maintenance contractors’ service quality and the finished works. In the final part of his thesis, Mansor (2014) informed there has been an increasing amount of literature that promote community as accountable in providing conducive learning environment on the availability of the school maintenance and facilities. Thus, promoting the concept of schools and communities in strengthening relationship for mutual benefit is considered important.

Some researchers conducted survey in the form of post-occupancy evaluation (POE) to identify real issues and also end-users’ preferences for facilities and services (Hebert & Chaney, 2012). Thus, this will measure the end-users’ perception towards facilities and services provided in the building. It is important before steps are taken to improve existing facilities and services in the building.

The efforts to provide access for end user to jointly contribute during the design stage is much appreciated. This is based on their experiences and also because they are the one who are going to use the completed building and its facilities. The idea to strengthen the involvement of end users in Building Life Cycle is reiterated by Pemsel, S., Widen, K. and Hansson (2010), where participation of end-users in the circle of design process up to occupancy offered not only benefits, but also disadvantages. Scholars have pointed out that on social and cultural barriers are the two great challenges to understand end users’ real needs. The service quality rendered to the building user is the main factor that perform satisfaction and create background of end-user’s perceived value and at the nature of quality (Lepkova, 2012).

5 METHODOLOGY

At the very outset, existing procedures have been analysed in relation to types of maintenance, time to respond to maintenance request, annual maintenance budget and level of satisfaction towards maintenance works done. The researchers discovered the issues and problems on maintenance practices for school buildings by examining secondary data from journals. In addition, the researchers derived the objectives to be used as a guide for the research. The case studies were selected for preliminary survey based on the age of the school buildings, The selected schools is in operation for more than 20 years. The boarding religious school under Ministry of Education, Malaysia. Every similar type of schools having academic buildings, hostels, surau, hall and sports facilities. This is the pilot study to identify the real
issues and problems that hovering maintenance practices for religious schools. The findings will be used as a foundation before further research to be carried out for other schools through-out Malaysia. The study employed two methods to collect the required primary and secondary data for analysis, i.e. by interview and document analysis.

This was mostly because the study needed to know the maintenance practices that were adopted in the schools. Other than that, the visual inspections of the school buildings assisted in conducting a better analysis and provided some evidence to support the results of the study. The visual inspections were carried out without any specific instrument and there were certain limitations as there were some places that were out of bounds to the researchers.

6 CONCLUSION

Insufficient budget allocation is one of the challenges that contribute for lack of maintenance for the school. As a result most of the building defects may occur continuously and unpredictable. School building of more than 30 years is prone to have defects. Even though maintenance for national religious boarding school is led by technical personnel, building user still has problem when dealing with maintenance works. Some of the maintenance works are being carried out repetitively thus, they create disturbance to the building user. As such building users face problems in dealing with their routine works due to improper maintenance management implementation at their school. One of the significance of maintenance management is it can affect occupants’ satisfaction on building performance where it can offer the occupants a positive environment which consequently will contribute to the productive and healthy life style.

The maintenance performance measurement will depend solely on occupant’s satisfaction. The variables could be grouped as follow: tangible, reliability, assurance, empathy and responsiveness. The research will reinforce the understanding and the needs to deliver services to achieve the building users’ satisfaction.

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Pemsel, S., Widen, K. and Hansson, B. (2010). “Managing the needs of end-users in the design and delivery of construction projects” (Facilities).


Abstract- In Malaysia, buildings are developed strictly according to the Malaysian Standard and the British Standard. However, due to improper maintenance performance, building issues have increased rapidly creating a concern among building users. Building issues such as defects are predominantly raised due to climatic characteristics, for instance, extreme weather, high heat and increased humidity exposure. Due to such issues, buildings are exposed to Building-Related Illness (BRI) which may affect the building users. The aim for this paper is to perform a preliminary work related to the diagnosis work for defect on humidity in university’s accommodation in order to allow a proper remedial work towards a more sustainable university. The objectives are to identify the common defect related to humidity found at university accommodation, to diagnose level of defect related to humidity found at university accommodation and to determine the suitable diagnosis for humidity’s defect at the students’ accommodation in university. University accommodations in Malaysia are chosen as the subject of research since these accommodations always have to face this issue. If humidity defects in students’ accommodation are not treated accordingly, issues may arise on the numbers of occurrence for BRI for these accommodations.

Keywords – Defects, humidity, Building Related Illness (BRI) and university’s accommodation.

1 INTRODUCTION

There are numerous challenges facing today's building, mainly due to defect which caused by the surrounding’s environment. Building issues, such as defects, are increased due to climatic characteristics, for instance extreme weather, high heat and abundant humidity exposure. Due to such issues, buildings are exposed to Building-Related Illness (BRI), which may affect the comfort of the building users. Many examples of building issues have caused by surrounding’s environment, for instance the prominent Malaysian cases of Highland Towers Apartment in Lembah Klang (Utusan Malaysia, 2013) and Sultan Mizan Stadium in Terengganu (Headlines online, 2009). Temperature variations, humidity occurrence and constant exposure on heat leads to many issues on the building structure (Othman, Jaafar, Harun, & Ibrahim, 2015) which allows defect to occur and eventually affect the buildings.

One of the major sources of defect comes from humidity. According to Othman et al., (2015), humidity is defined as the water-vapour content of the air. It is expressed in various ways. Normal atmospheric air in most of the cases is humid. Humid air is also called moist air. The capacity of air to hold moisture increases with temperature. Othman et. al., (2015) mentioned that dampness can be defined as water penetration through the walls and certain elements of the building where it is near to a water source. In addition, dampness can also be defined as extreme moisture that will lead to dampness problems, for instance rising damp (Othman, et al., 2015).

Furthermore, moisture is also known as a main source to poor indoor air quality, unhealthy buildings and the growth of mould (Norback et al., 2013). There are many ways that moisture can enter the buildings such as rainwater penetrating through leaks in walls, floors, roofs, windows and doors (Norback et al., 2013).
Record shown billions of dollars have been spent to rectified defect due to moisture problems in the United States properties (Norback et al., 2013) and study done on 420 buildings in Sweden shows that moisture can cause vivid microbial growth within 65% of the buildings in that country (Vaisala, 2013). Compared to other western countries, Malaysia is heavily exposed to moisture problems due to its climatic characteristic, which lead to adverse effect on health, deteriorate the building faster and affect its functionality.

2 THE ISSUES

One of the concerns on controlling or mitigating defect on humidity is due to the issue of Building Related Illnesses (BRI). Building related illness (BRI), as described in UK/European terminology, is a building illness related symptoms as it is referred to in the United States, and has been described as ‘a group of symptoms of unclear aetiology’ (Sundin, 2012). Humans are constantly exposed to fungi, or moulds, usually without suffering harm to health. However, in some instances inhalation of sufficient numbers of mould spores can trigger symptoms of asthma, rhinitis or bronchitis (RICS, 2017). Respiratory ill health associated with the built environment is often referred to either as building related illness (BRI) (Healthy Building Science, 2015). BRI most clearly recognized in the office environment. However, Healthy Building Science (2015), stated similar problems could occur and have been reported in academic buildings, hospitals or care homes. Figure 1 describes the symptoms of BRI that can occur due to humidity in the building.

Figure 1 Symptoms of Building Related Illness (BRI) (“Sick Building Syndrome,” 2011)

BRI also links to building leakage. Building leaks is a phenomenon of corrosion and material deterioration due to air infiltration and humidity (Kuan, 2017). It penetrates into the building and caused high dampness which links to defect. Defect on damp is generally divided into rising damp and lateral damp (RICS, 2017). Both defects involve a situation of extreme moisture that leaks into building (RICS, 2017). Defect diagnosis process involves the analysis of buildings construction to understand causes of failure or reduction in performance to enable formulation of appropriate repair measures (RICS, 2017).

This issue has occurred in many buildings, including students' accommodation of many universities. For university accommodation in Malaysia there are limited studies on identifying humidity-based defects for university accommodation. If there were diagnosis that can forecast the defect related to humidity for these buildings, building related illness issues can be prevented and building can be sustained for a long period of time.

The moisture problem that occurs at buildings usually takes place on the connection between the floor and the wall of a building. This situation can be seen in Figure 2. The occurrence of water seepage that is related to the improper waterproofing installation may lead to mould growth, flaking of paint and water stain (Luca, 2014). The affected area usually occurs on vinyl or carpet floorings.
One of the highest humidity areas in the building is the toilet. The water seepage from the toilet areas can also affected the internal wall buildings. The peeling paint and blistering of wallpaper finishes occurred due to failure of water proofing layers on the toilet wall that caused water to penetrate through the toilet wall and affect the perimeter wall outside as shown in Figure 2.

![Figure 2 The building defects occur at building due to humidity](image)

This situation can happen to all kind of buildings. For example, academic buildings vastly exposed to all sort of problems due to numerous main factors. Building defects are critical as they can physically affect the building appearance as well as damage the building structure (Hassan, Ismail, Isa, & Takim, 2011). This can subsequently affect the safety of the building users. Therefore, appropriate solutions to mitigate building defects in academic buildings should be carried out in order to ensure the buildings do not easily fall into defects (Centersetal., 2017). If the defects were not taken seriously, it may consequently lead to structural failure. In brief, all parties such as local government authorities, the academic authorities, consultants, contractors and public should be involved in the remedial works and work together in order to diminish the occurrences of defects and failures in the academic buildings. They should have a close partnership to work mutually in order to form a strong and sustainable built environment in the academic buildings (Shuib and Baharum, 2015).

The similar situation could also occur in university’s accommodation. This is why it is important to carry out this research in order to prioritize the defect diagnosis procedure in order to identify the humidity-based defect in the university’s accommodation. At the moment, all kinds of defect are treated in a general way, without prioritisation on the defect procedures (Kuan, 2017). If there were mechanisms that allow defect to be diagnosed through priority process, every defect can be treated accordingly and efficiently.

### 3 LITERATURE REVIEW

Humidity-based defect can occur in any kind of building that have leakage. To study the context of building defects in Malaysia, there are several defects can be found which are fungal attack, unwanted growth, erosion in mortar binding, paint flaking and blistering, defective plaster, wall cracking, defective rain water downpipe, wood or timer decay, insect and termites attack, defective roof structure, dampness, unstable foundation and installation of air-conditioning system that can be a source of building’s dampness in historical building (Vaisala, 2013).

According to Hassan, Ismail, Isa and Takim, (2011), building defects occur because of design deficiency, or poor quality workmanship, or because the building was not built based on the original design, or because it follows the factors that do not fit with the design requirements. For any universities’ accommodation, the common moisture problems in buildings that were identified by Othman et al., (2015) are; (1) rainwater or groundwater leaking in to the enclosure (roof, wall, windows and foundation), (2) plumbing leaks and spill, (3) water wicking from capillary suction through porous building materials (concrete or wood), (4) rainwater, condensation or plumbing water, (5) infiltration of warm or moist outside air, through cracks and holes in the enclosure during warm and humid weather, (6) exfiltration of
warm or moist indoor air through cracks and holes in the enclosure during cold weather, (7) unvented or poorly vented sources such as swimming pools, (8) insufficient dehumidification by heating, ventilating and air-conditioning systems, poor condensate drainage due to heating, ventilation and air-conditioning, system deficiency and (9) enclosure of wet materials in building during construction (Othman et al., 2014). Kuan (2017) argued that there are generalised condition of dampness associated with buildings, without considering the function of the buildings and proper prioritisation of remedies work order. Little information on the efficacy and impact of prevention strategies is available, perhaps in part because it is easier to study problems than their absence (RICS, 2017). Moreover, minimal practical knowledge acquired and applied by design, construction, and maintenance professionals has been committed to print or subject to validation; thus, this complicates the study and dissemination of best practices (HHS, NIOSH, & CDC, 2013).

3.1 Definition of Moisture and the Problems

Moisture problem can be defined as a situation of “any visible, measurable or perceived outcome caused by excess moisture indication indoor climate problems or problems of durability in building assemblies that are caused by various leaks of water” (Vaisala, 2013). However, Vaisala (2013) also had identified “moisture can be transported in both vapour and the liquid phase by diffusion, convection, capillary suction, wind pressure and gravity (water pressure).”

Moisture problem commonly happens at every building. The issues of moisture are linked with humidity that has caused building defects and are mainly recognized by many scholars such as Othman et al., (2015); United States Environmental Protection Agency (EPA) (2013). According to Halim, Harun, and Hamid (2012), moisture is known as a major cause of building defect by 76 percent and HH Setal. (2013) has identified that moisture caused 75-80 percent of building envelopes defects. The main building moisture problems are caused by leakage at building elements such as roof, wall and ceiling. For instance, a study done by Edis, Flores-colen, and Brito (2014) identified that among 14 major defects at walls and floors are water leakages through cracks, water leakages through pipe penetration, and water leakages through joints. According to Edis et al. (2014) water leakage ranks as the highest (53 per cent) of presence defect at wall and floor. The issue of waterproofing is known as the main contributor to the failure of the building that leads to the moisture problems. For example, Suffian (2013) identified that the flat roof leaky due to waterproofing that was not applied properly by the contractor (Suffian, 2013).

One of the common problems identified due to moisture is the occurrence of Building Related Illness (BRI). Building-related illness is defined as an illness in which a focus of the complaint is usually an office building or school, and not a residence or an industrial building (Healthy Building Science, 2015). Such illness, commonly encountered by family doctors, is an important societal concern, fuel led by media reports of the “sick building syndrome” (“Sick Building Syndrome,” 2011). This latter term has been widely criticized as inappropriate, since it falsely suggests that buildings can be categorized as “sick” or “healthy” and diverts attention from a proper evaluation of the patient (Sundin, 2012).

Buildings are described as “sick” when the occupants are exposed to health hazards which in some way derive from the building. This may be because of poor design, poor management and maintenance, or the use of hazardous materials. There are many health problems which are building-related, but these are divided into two classes: reasons. First, no direct, single cause-and-effect mechanism will be evident. Rather the causes are multiple and cumulative and will vary between buildings. Secondly, psychological factors play a significant role in causation” (“Sick Building Syndrome,” 2011).

According to Bahaudin et al., (2011), causes of building related illness are temperature, humidity, air movement and ventilation. In general, buildings with high BRI symptom rates, temperatures tend to be consistently higher than the recommended levels. The situation is worsened when the air temperature is
too high but there are low radiant temperatures. These situations create feelings of stuffiness and dryness. The humidification of buildings is a complex issue, since human perceptions of dryness relate to a number of environmental variables other than relative humidity levels. These include: high temperature, high levels of volatile organic chemicals (VOCs), high dust levels and air movement patterns (Bahaudin et al., 2011). Low relative humidity may be a result of outside weather conditions; alternatively, a building may, in some way, be reducing the relative humidity to levels which are causing health problems:

Building services systems may be inadvertently dehumidifying (reducing the relative humidity of) the air coming into the building. Chillers, for example, may be operating when they are not so designed because of a control problem and, in so doing, they will cool and dehumidify the air (Sundin, 2012).

The air change rate in the building may be high; whilst this has general air quality advantages, it will purge the building of the moisture derived from human occupation (perspiration and breathing); in turn, this will bring in outside air which may be of low relative humidity, thereby reducing the relative humidity within the building (Sundin, 2012).

The health problems associated with low relative humidity are predominantly dry skin, dry eyes, and sore throats. In addition, it is possible, though not yet proven, that low relative humidity can increase the likelihood of infections. This is primarily because low humidity may reduce the mucus flow which leads to less adequate rejection of micro-organisms. It is also possible that dry air produces micro-fissures in the upper respiratory tract which act as landing-sites for micro-organisms. Air movement is the third major indoor climate variable. If it is too high this can cause sensations of dryness and create draughts. Alternatively, if air movement is too low there may be stuffiness and stale air may not be dispersed and removed from the occupied areas. Ventilation problems can have many causes (Jayamurugan, Kumaravel, Palanivelraja, & Chockalingam, 2013).

3.2 Types of Dampness

Type of dampness defect is divided into four (4) types. Firstly, due to the type of construction processes. Possible characteristics of construction processes are damp patches on walls, damp smell in newly built or renovated property and the cause of dampness is plaster or concrete slabs not properly dried out (Center et al., 2017).

Secondly is rising damp. Rising damp characteristics is based on the bands of dampness and discoloration on ground floor walls up to a height of 18”–36” (Centers et al., 2017). The cause of rising damp is caused by defective or absent damp proof course (DPC). In addition, water logging of the surrounding ground due to inadequate drainage can impact on the rising damp (Centers et al., 2017).

Third dampness defect is penetrating damp. Penetrating damp characteristics is based on the patches of damp and/or mould e.g. in a corner of the ceiling, underneath the windowsill or on the walls. Windows and doors that don’t fit, holes in the roof, old or inadequate pointing to the brickwork, faulty joints in concrete slabs, blocked or leaking gutters are among the effect (Centers et al., 2017).

The fourth cause is condensation. It happens because warm moist air meets cooler wall surface or windows (Jayamurugan et al., 2013). Inadequate ventilation, insulation, heating and/or poor building design and the possible characteristics of condensation which occurs on windows, or puddles gathering on window sills. Mould and dampness, or even drops of water, all occur occurs at an outside wall. It can affect bed clothes near that wall or the contents of cupboards (Shuib & Baharum, 2015). Below are examples of dampness:

(a) Rising Damp
Figure 3 Rising damp (Property Care Association, 2013)

Figure 3 shows rising damp where water is literally drawn up by capillary action into the wall. Typically, although not exclusively, a brick wall will have rising damp to approximately a metre in height. Different types of construction, such as stone construction or where the property sits on a sloping site, may have slightly different readings, but in our experience generally rising damp rises to about a metre (Zhang, 2011).

(b) Lateral damp

Figure 4 Lateral damp (Property Care Association, 2013)

Lateral dampness, also known as penetrating dampness, is dampness that comes through the wall. Often lateral dampness can be mistaken for rising damp if it is at low level and condensation if it is at high level (Zhang, 2011).
(c) Cement pointing and dampness

One of the most common causes of this defect is repointing with a cement mortar where there was once a lime mortar. This does not only stop the walls from breathing it also causes deterioration to the face of the brick work or stone work. The suitable solution is a lime mortar, both to the pointing externally to the brickwork or stonework but also to the plaster internally together with a suitable emulsion based paint (Zhang, 2011)

4 CONCLUSION

This study will be beneficial to the parties involved such as developer, owner of building, occupants of building and maintenance department of the university. It will improve the idea to construct the building and get early prevention measures to avoid any defects and also to help better planning. For the owner of building, it will allow less maintenance on the building and get more knowledge about the defects and also alert with the defect of building. It also can help to improve the maintenance performance procedures of the maintenance department of the university by following the guideline in controlling the defect on humidity in university’s accommodation.

REFERENCES


ACCESSING ENERGY EFFICIENCY POTENTIAL IN THE MALAYSIAN UNIVERSITIES: THE LITERATURE REVIEW

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Abstract - Energy efficiency has become one of the essential elements in managing energy consumption for universities. In assessing energy efficiency, a few processes of energy audit, energy performance of the buildings and energy management need to be monitored and areas which have the potential for energy savings should be identified. The purpose of this paper is to explore the literature review that focus on the energy audit processes conducted in the Malaysian universities and to identify the best practice that can improve energy consumption of the universities. The initial energy audit framework of the Malaysian universities will be explored in the literature in order to acquire related information on energy efficiency, namely from electrical appliances and lightings systems in order to understand the relationship of these factors with the use of energy. The significant practices in energy audit can help to save electricity by comparing the energy implementation process of Malaysian universities. Through the investigation of energy consumption behavior and the number of electrical appliances, machinery and buildings activities, it will affect the energy consumption that can allow energy-efficiency in building. The Building Energy Index (BEI) will be used as an indicator and combined with the application of building energy simulation software to obtain solution and possible improvement of energy consumption during energy audit implementation. The exploration of literature will be used as a guideline for universities that consume high energy in order to control the excessive energy usage and to achieve energy efficiency for the building.

Keywords - Energy audit, energy efficiency, energy guideline, universities

1 INTRODUCTION

In order to review the energy efficiency of the universities buildings in Malaysia, a number of publications were analyzed. The purpose of the literature review is to study the available information regarding on the research problems and to explain the current development and understanding in this field. To uphold the need of this study, the gap in the previous studies were identified through the review of literature which is divided into the following categories.

a) Energy
b) Energy and its environmental, economic and social benefits
c) Energy Consumption and Performance of the Buildings
d) Energy Efficiency
e) History and Definition of Energy Audit
f) Energy Audit Guidelines and Tools
g) Phases of Energy Audit
h) Building Energy Simulation
i) Building Energy Index

2 DEFINITIONS OF ENERGY

As defined by Dictionary of Energy, energy is “the capacity or ability to do work” (Hall and Hinman, 1983). Similar to the definition by (Henry, 1980), which energy is the ability to produce an effect through the transfer of heat of work. Energy exist in various forms such as sound, heat, kinetic, chemical, mechanical, light, potential energy, electrical energy and so forth. It can be transformed from one form to another when being expended.

Confronted to the social misunderstood, “energy” is contrasted with “power”. As stated by
Coad (1982), “power” is the rate of consumption or conversion of “energy”, it is an expression of how long or how fast a given amount of energy is consumed or converted. Final energy is the energy supplied to the consumer in each end-use sector that will ultimately converted into energy services (Fauziah, 2010). In facilities management, energy is used in buildings to perform functions of heating, lighting, mechanical drives, cooling, and any other related applications to serve the end use of the various functions.

3 ENERGY AND ITS ENVIRONMENTAL, ECONOMIC AND SOCIAL BENEFITS

3.1 Energy and Environment

The process of power generation, transport and utilization will lead to significant environmental pollution. In the last decade, concern for the environmental pollution has increased considerably. The greenhouse is caused by an increase in the level of CO₂, methane and other gases are leading to global warming. CO₂ level in the atmosphere has increased from 280 ppm, in 1850 to about 360 ppm at present. According to World Meteorological Organization (WMO), the world average temperature has risen by 0.74°C since the beginning of the 20th century and the temperature has risen by 0.18°C over the last 25 years (Suruhanjaya Tenaga, 2017). Malaysian’s government also has committed to reduce carbon intensity by 40% in 2020 compared to 2005 level (Prime Minister, 2005).

To achieve this, the industry needs to change their energy culture by investing extensively in energy efficiency measures and practices. Therefore, improving industrial energy efficiency is an effective way of reducing and improving both material and water use in industries; consequently, slowing down natural resources depletion (Warrell, 2011). Improvements in energy efficiency are often suggested as a way of reducing carbon emissions.

3.2 Energy and Economic Aspect

The profit of a business is expressed as difference between sales revenues and input costs; the greater the difference the greater the profit margin. The universities input mainly includes construction costs, utility costs, labor cost and maintenance cost. Consequently, input costs can be reduced in the short-term by optimizing energy consumptions, improving awareness and use energy efficiency and in the long-term by introducing new equipment (United Nations Industrial Development Organization; UNIDO, 2011). Universities can realize large profit margins by implementing energy efficiency by reducing both material resources and energy, when energy forms a large proportion of their input cost.

3.3 Energy and Social

Firms and industries that implement energy efficiency cost-effectively increase productivity; increase in productivity is the main factor responsible for both industrial and economic growth (UNIDO, 2011). The implementation of energy efficiency may also improve the working environment of universities and the quality of life of the campus society.

4 ENERGY CONSUMPTION AND PERFORMANCE OF THE BUILDINGS

As stated in ASHRAE, energy performance is the energy consumption in certain buildings. Building can be defined and their performance assessed (Baird, 1984; Hartkopf, 1992). Although the basis for assessing the energy performance of many building components and individual systems have been fairly well established, there is a lack of understanding of the overall energy performance of building. Figure 2.3 shows the major components of building energy consumption and there are 2 main groups:

(a) HVAC related components and
(b) The components related to general building equipment.

The present study focuses on the HVAC related components since they are usually the most complicated part of building energy analysis. This is also applies for university buildings.
For Malaysian cases, the total energy consumption for buildings is recorded based on the type of electrical appliances used in the buildings. However, there are minimal research have been obtained for the energy consumption in universities in Malaysia. Figure 2.1 show the result from a study conducted by Malaysia Energy Centre (PTM) in 2003 on government building (Malaysia Energy Centre, 2003).

Figure 2.1 Total Energy Consumption in Malaysia Building

Figure 2.2 show the result U.S Energy Information Administration on a typical university energy consumption. A typical university spend an average of RM 4.70 per square foot (ft²) on electricity (National Grid, 2003).
From Figure 2.1 and 2.2, it is shown that the HVAC system consumed more energy than other electrical appliances in the building. This shows how significant is the energy efficiency processes to be obtained in the buildings, especially for managing the use of HVAC efficiently.

4 ENERGY EFFICIENCY

The term of energy efficiency is best described by the statement of “Something is more energy efficient if it delivers more services with the same output for less energy input” (International Energy Agency, 2016). This statement clearly explained that the energy efficiency is the process of eliminating wastage while using the energy. Optimizing the energy consumption pattern in the building is the key to energy efficiency. Some of the buildings in industries don’t implement energy efficiency because they are faced with the financial, cultural, technical and awareness of the consumers. Despite many efforts and benefits of energy efficiency, several technical, financial and policy barriers have constrained the implementation of energy efficiency projects. The major barriers are:

4.1 Lack of Awareness

The main barriers to energy efficiency is the lack of awareness among consumers that leads to energy wastage. Management must take into account the potential benefits of increasing efficiency.

4.2 Lack of knowledge and training

An extensive knowledge opportunity in energy audit and appropriate training are limited to certain people. This may become difficulties to give exposure to consumers since they do not know the benefit of this activities.

4.3 Lack of financing

Non-availability of adequate credit facilities and difficulties in obtaining the necessary financing for energy saving projects are strong deterrents to investments in energy efficiency.

5 HISTORY AND DEFINITION OF ENERGY AUDIT

Energy audit procedures was first used in the early of 1970s in the United States during the energy crisis (Energy Audit Institute, 2010). In order to reduce energy consumption, state funds have been used to provide incentives for energy-efficient building in the Supplement State Energy Conservation Program. Buildings that receive government funding have to follows several needs such as; (1) mandatory lighting efficiency standards; (2) mandatory thermal efficiency and insulation standards; (3) public education efforts to implement energy efficiency measures; (4) encouraging and
conduct buildings energy audit for commercial and industrial applications. In addition, energy audits have been used to provide government loan guarantees for implementing energy efficiency program (Thumann, 1998). These methods may or may not help reduce the environmental effects or global warming impacts; however, emphasize methods such as energy audit, not only reduce consumption but also save utility costs.

There are several definitions of energy audit. The simplest definition of energy audit is a process that serves to identify where a building consumes energy and points to energy conservation opportunities (Thumann, 1998). Some guidebooks define energy audit as systematic, documented verification process of objectively obtaining and evaluating energy audit evidence, in conformance with energy audit criteria and followed by communications of results to the client (Canadian Industry Program for Energy Conservation; CIPEC, 2002). Energy audit also can be defined as the analysis of energy flows in buildings, systems, processes or equipment to reduce the amount of energy input into the system without negatively affecting the energy output (Raghav, Srijaa, Rao, Bhavya, & Y.Suchitra, 1970). In the Indian Energy Conservation Act 2001 (Energy Management and Audit, Bureau of Energy Efficiency; BEE, 2008), an energy audit is defined as the verification, monitoring and analysis of the use of energy and submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption. An energy audit is an examination of energy consuming equipment/system to ensure that energy is being used efficiently which building manager examines the energy account of energy consuming equipment/system, checks the way energy is used, checks for areas of inefficiency and identifies the means of improvement (Guidelines on Energy Audit; Hong Kong, 2007).

However, in Malaysia, it was defined as a process which is very much central for conducting an energy audit program or a study conducted to identify where, when and how much energy is being used in the business and how to reduce the cost of energy for the business (Guidelines for conducting Energy Audit Commercial Buildings in Malaysia). Even though there are several definitions, the objective is the same which is to reduce the energy consumption without compromising comfort and quality of the building. This guideline is meant for registered energy managers who have basic understanding on energy audits and for them to confirm the requirement of the Efficient Management of Electrical Energy Regulation 2008 (EMEER, 2008).

Phases of Energy Audit

As refer to Oxford Thesaurus of English, “phase” is “stage, period, step, or a distinct stage of development” (Waite, 2004). In energy audit practices, it also involves some phases and each phase contains some key practices. Phases in energy audit may be referred as some stages or steps in a cycle of the energy audit process. Any program or development to be successfully implemented, it must be planned and carry out systematically according to the phases. For an example, there are four phases in an energy audit as suggested by Moncef Krarti (2011), which consists of walk-through audit, utility cost analysis, standard energy audit and detailed energy audit. However, refer to opinions from Thumann and William (2007) in their books ‘Handbook of Energy Audit’, there are three phases which are walk-through audit, standard audit and computer simulation. Despite that, there are several standard and regulation such as ASHRAE and ISO 50001: Energy Management System that are pioneer in energy audit guideline. ASHRAE stated that energy audit has four phases which are benchmarking audit, walk-through audit, energy survey analysis and detailed audit. Many countries have come out with their own guideline that referring to ASHRAE and ISO 50001. For example, Malaysia energy audit guideline stated that energy audit has two phases only which are walk-through audit and detailed audit. This shows that an energy audit may consist of a series of very definite phases that must be executed in sequence to assure maximum effectiveness. Selecting and naming of the phases is depending on the needs of the study. In that case, author ascertained two phases for an energy audit which are walk-through audit and detailed audit phases.

Basically, energy audit can be classified into two types. There are:

i. Walk-through/preliminary energy audit

ii. Detailed audits.

6.1 Walk-through Audit

According to Merriam-Webster, walkthrough is defining as an activity in which someone
walk through an area or building in order to inspect it. It also can be defined as a step by step test of all aspects of an environment, plan or process to verify it is ready for its intended purposes by Business Dictionary. In energy audit, walk-through is a process used to create an overview of potential energy savings through visual inspection of the buildings. Basically, walkthrough is looking ahead, therefore energy audit committee need to anticipating potential energy saving in the future and deciding the course of action to be taken next during this phase.

According to Moncef Krarti (2011), this phase consists of a short on-site visit of the facility to identify areas where simple and inexpensive actions can provide immediate energy use or operating cost savings. It allows the collection of basic information about the building envelope, as well as lighting systems and appliances. In energy audit, recognize the potential improvement of energy efficiency is a must. Walk-through audit are a long term planning, addresses specific timetables and measurable targets. It involves designing in the feasible way to achieve energy goals and objectives. Some engineers refer to these types of actions as Operating and Maintenance (O&M) measures. The main purposes of this phase is to provide recommendations for improving the energy efficiency by investigating operating and maintenance (O&M) measures and energy efficiency measures (EEM) with short payback periods.

According to Wayne Turner (2009), this phase must be done before auditor makes actual energy audit visit to a facility. Data collection on the facility’s use of energy through examination of utility bills and some preliminary information should be compiled on the physical description and operation of the study. This data should be analyzed so that the auditor can do the most complete job to identify Energy Conservation Measures (ECM) during actual site visit of the facility. ECM are identified and evaluated to determine their benefits and their cost effectiveness.

As mentioned by Albert Thumann and William Younger in Handbook of Energy Audit (2007), the walkthrough audit is a tour of the facility to visually inspect each of the energy using systems. An evaluation of energy consumption data to analyze energy use quantity and patterns as well as provide comparison of benchmark for similar facilities. This audit can yield a preliminary audit estimate of savings potential and provide a list of low cost saving opportunities through improvements in operational and maintenance practices.

As stated in Electrical Energy Audit Guidelines for Building (Suruhanjaya Tenaga, 2008), walk-through audit is a process used to create an overview of potential energy savings through visual inspection of the buildings including air conditioning system, lighting, metering, building automation, building maintenance and other factors affecting energy consumption of the building. References to the records of equipment ratings, technical catalogues, operation and maintenance (O&M) manuals that are readily available will be very helpful to quickly determine whether equipment or systems are operating efficiently. The walk-through/preliminary energy audit is usually carried out in a day or two by either REEM alone or with a team, depending on the size, complexity of the building and the scope of audit. Often, simple instruments such as a clamp amp meter, thermometer, hygrometer (humidity meter) and lux meter will serve the purpose. Then, identify the no-cost, low cost, medium cost and high cost improvement on energy saving. Also study on potential capital improvement of cost and energy saving.

According to Brunei National Energy Research Institute (BNERI), preliminary audit is the first step to perform any energy audit where it determines a building’s current energy and cost efficiency with the comparison of other similar buildings. Gather the utility bills and summarize them for at least one- year period. Compare the building energy index (BEI) with buildings that have similar characteristics. Perform a brief walk-through survey of the facility to become familiar with its equipment, operation and maintenance. Then, meet with owner of the buildings to learn a special problem or needs of the facility. Similar with Malaysia guidelines, Brunei guidelines also stated that to identify the no-cost, low cost, medium cost and high cost improvement on energy saving and potential capital improvement.

Walk-through audit is a simplest type of energy audit and is the most basic requirement of energy audit as stated in Guidelines on Energy Audit by Hong Kong authorities. The activities in this guideline are similar with Malaysia energy audit guidelines for preliminary audit phase. Singapore guidelines are similar with ASHRAE guidelines, such as gather utility bills, meet with owner to learn
special problems, identify the no-cost, low cost, medium cost and high cost improvement on energy saving and potential capital improvement.

From all of the opinions by researchers, guidelines and the regulation of some countries, this phase require a several vital practices. The following discussed each of them.

i. Focus on major consuming systems
Visual inspection of the facilities including HVAC, lighting, metering and building maintenance. This activity will help auditor to get a first impression of systems at the facilities.

ii. Reference to record of equipment rating, technical catalogues and Operation & Maintenance manual.
Building owner must give cooperation and provide all necessary document without hiding anything.

iii. Carry out in 1 or 2 days only
The preliminary audit activity purpose is to get the visual and idea of improvement, so the auditor do not need many days for this activity.

iv. Using simple instruments
Auditor will only use a simple instrument only such as clamp meter, thermometer, lux meter and hygrometer.

v. Identify low cost, no cost or simple action on energy cost saving
This is most vital activities because in the end of the day building owner want to reduce energy consumption and increase energy efficiency.

vi. Meet with owner
The important of this practice is auditor need to know any special failure or malfunction systems that contribute energy wastage to the systems.

vii. Identify potential capital improvement
Auditor must study any potential capital improvement.

viii. Gather utility bills
Building owner must provide auditor with monthly utility bills for auditor study the Building Energy Index and Building Utilization Index.

### Detailed Audit

According to Merriam-Webster, detail is defining as extended treatment or attention to particular items. In energy audit, detailed energy audit can be defined as a comprehensive audit and provides detailed energy project implementation plan for a facility, since it evaluates all major systems. It considers the interactive effects of all projects, the energy use of all major systems and
includes detailed energy cost saving calculations and project cost (Bureau of Energy Efficiency).

According to Moncef Krarti (2011), this audit is the most comprehensive but also time-consuming energy audit type. It includes the use of instruments to measure energy consumption of the whole building or energy systems in the building such as lighting systems, office equipment and air conditioning systems. Simplified tools are used to develop baseline energy models and to predict the energy saving measures. Moncef Krarti stated in his books, there are four general procedures can be outlined for most buildings. Step 1; building and data analysis, step 2; walkthrough survey, step 3; baseline for building energy use, and step 4; evaluation of energy conservation measures.

According to Electrical Energy Audit Guidelines for Building (Suruhanjaya Tenaga, 2008), the detailed energy audit involves in-depth investigations into how the energy is currently being consumed, current performance of existing system and identification of various potential Energy Conservation Measures (ECMs). The detailed energy audit in this guideline involves the following four (4) main processes:

i. Data collection

One of the key tasks in Energy Auditing is the collection of all energy related data required by the Energy Manager to divide the total facility energy consumption into various energy end-uses. The collected data is then used to build a reliable picture of where and how much energy is being consumed and the cost of energy being used at the building. It is recommended to use these steps, (1) desktop data collection; using all available facility data such as as-built drawing, utility bills, M&E drawings and floor area of the buildings, (2) field data collection; understanding closely with building by using measurement tools and (3) cross-checking of load demand data; use data loggers to record building energy consumption to verify the accuracy of estimated building energy consumption.

ii. End-use load apportioning

The Energy Manager can use the above suggested three steps in energy audit data collections to apportion the total building load into its major end-use loads.

iii. Identifications of ECMs

The effectiveness of an energy audit is related to the understanding in depth of the nature and operations of the audited building by the Energy Manager. Knowing the acceptable level of comfort and tolerance for lighting, temperature and humidity level by employees are essential to come up with effective and acceptable ECMs.

<table>
<thead>
<tr>
<th>Categories</th>
<th>Description</th>
<th>Potential Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>No/low cost measures</td>
<td>No cost investment and without any disruption to building operations</td>
<td>0-5%</td>
</tr>
<tr>
<td>Medium cost measures</td>
<td>Medium cost investment with some minor disruption to building operations</td>
<td>1-10%</td>
</tr>
<tr>
<td>High cost measures</td>
<td>Involve relatively high capital cost investment with much disruption to building operation</td>
<td>5-25%</td>
</tr>
</tbody>
</table>

iv. Reporting and presentation

After completing all necessary finding and recommendation, energy manager must submit full report to building owners and present the ECMs and guide building owner to start their implementation of energy improvement.
6 ENERGY AUDIT GUIDELINES AND TOOLS

There is a critical need for an effective energy audit and with the increasing interests towards energy efficiency, government has introduced energy audit authorities from government agencies such as Suruhanjaya Tenaga, Kementerian Tenaga Teknologi Hijau Dan Air (KeTTHA) and Sustainable Energy Development Authority (SEDA). There are numbers of standards, guidelines and tools provided in each country including Malaysia. Below are the standards that widely used around the world and modified by each country according to their needs:

6.1 ISO 50001

ISO 50001:2011, Energy Management Systems – Requirements with guideline for use, is a voluntary International Standard developed by ISO (International Organization for Standardization). The purpose of this International Standard is to enable organization to establish systems and processes which are necessary to improve the energy performance in terms of energy efficiency, energy wastage and energy consumption. It is applicable to all types and sizes of organization nevertheless of their geography, culture or social conditions. To achieve success in implementing this standard, all levels and functions of the organization must show high level of commitment.
7.2 ASHRAE

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) is one of the pioneers in this area where it published a series of Energy Efficiency Guides for building owners and managers. The objective of the guide is to allow building owners to implement the process for evaluating current operations and perform economic analysis to selected better improvement options. In addition, the guide shows ways to benchmark performance against comparable buildings, describe which energy consumption and cost can be reduced and explain the method, considering minimizing capital investment and maximizing return on investment.

Generally, there are four levels of analysis of energy audits (ASHRAE).

(1) Level 0 – Benchmarking/Preliminary audit:
The purpose of this preliminary audit is to get a good overview of the buildings and how it performs. Usually utility data and general building characteristics are required. Analyzing the historical data is conducted in a monthly basis for preferably three years. This analysis is used to identify different utility structures, malpractice use of facilities, and identify areas for reducing costs. Normally the main focus is to reduce the electrical load at peak demand times since this is when the utility companies charge more in order to help reduce the overall electrical demand of the grid (Thuman, 1998). Result of this analysis will be used to compare the performance of the building with similar building for benchmarking.

(2) Level I – Walkthrough audit:
This audit consists of a visual-walkthrough of the building to get familiar with the operation or maintenance problems. Several meetings with building owner were also carried out to determine any special problems or needs of the facility may have that affect energy efficiency of the buildings. Simple and no-cost improvements are suggested to provide immediate energy and operation costs savings. In addition, this report will provide a list of potential capital improvements which suggest further efforts in energy audit analysis (Krarti, 2011).

(3) Level II – Energy survey and analysis:
This level of analysis requires the use of basic calculations and measuring devices to establish a facility energy consumption baseline. Simple tools and devices are used to provide cost effective project implementation plan and more detailed analysis on building performance.

(4) Level III – Detailed energy audit analysis:
Detailed energy audit is similar to previous audit, however there is an even greater level of detail as well as higher initial costs. The detailed energy audit provides financial structure through engineering studies and computer simulation program to justify the investment on the buildings.

7.3 MS 1525
The Malaysian Standard MS1525:2014, Code of Practice on Energy Efficiency (EE) and Use of Renewable Energy for Non-Residential Building (Department of Standard Malaysia, 2014) purposes are to:

a) Encourage the design, construction, operation and maintenance of buildings in a manner that reduces the use of energy without constraining creativity in design, building function and the comfort of the occupants and cost considerations

b) Provide the criteria and minimum standards for energy efficiency in the design of buildings and methods for determining compliance with these criteria and minimum standards

c) Provide Guidance for energy efficiency designs that show good professional judgment to comply with minimum standards

d) Encourage the applicant of renewable energy in buildings to minimize reliance on non-renewable energy resources, pollution and energy consumption whilst maintaining comfort, health and safety of the occupants.

This standard only sets out the minimum requirements, so designers are encouraged to design and select equipment above those stipulated in this standard.

### 7.4 Electrical Energy Audit Guidelines for Building

This guideline is a reference for Registered Electrical Energy Manager (REEM), under Efficient Management of Electrical Energy Regulation 2008 (EMEER) by Suruhanjaya Tenaga. Any installation which a total electricity consumption equal to or exceeding 3,000,000 kWh as measured at one metering point six consecutive months must comply with requirements in the regulations. The Malaysian government has put special emphasis to ensuring adequate, reliable, secure and costs effective supplies and to utilizing energy resources efficiently while minimizing the negative impacts on the environment. An energy audit is an examination of the energy consumption of the equipment or system to ensure that energy is being used efficiently. This is a guideline for REEM during their energy audit exercise but REEM must establish their own justification in order to meet facilities requirement according to the types and purposes such as offices, hotels, hospitals and universities.

### 7 BUILDING ENERGY SIMULATION

In the 1970s, building energy simulation was developed in order to meet the demands for building construction and reduce energy consumption (Stephany, 2011). Special government agencies focus on the research and development program of various building energy model simulation (Thuman, 1998). These programs are intended for modelling of large, multizone building and their HVAC systems (ASHRAE, 1993). The interactions in buildings are by their nature very complex. While some simplified design tools and guidelines exist to help designers understand the phenomena involved, more elaborate, often computer-based tools are required for detailed analysis.

Most of the building energy analysis programs are developed in USA and Europe; directories and lists of energy analysis software have been published to show people what is available on the market, such as AEE (1991), ASHRAE (1991), Williams (1992), Degelman (1987) and Weiss and Brown (1989). There are more than 200 programs in USA and 100 programs in Europe and elsewhere (Seth, 1989), but only a handful of them are frequently used by building designers (Bloomfield, 1989; BEDTDC, 1988). Table 2.2 gives a list of the programs commonly used nowadays.

<table>
<thead>
<tr>
<th>Program</th>
<th>Reference source(s)</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>APEC ESP-II</td>
<td>(Wickham, 1985)</td>
<td>USA</td>
</tr>
<tr>
<td>ASEAM2.1</td>
<td>(Ohadi, Meyer, and Pollington, 1989)</td>
<td>USA</td>
</tr>
<tr>
<td>BESA</td>
<td>(BESA, 1993)</td>
<td>Canada</td>
</tr>
<tr>
<td>BLAST</td>
<td>(BLAST, 1991)</td>
<td>USA</td>
</tr>
</tbody>
</table>
To select the appropriate energy simulation program, it is important to be aware of its capabilities and limitations. Some of the well-known energy simulation programs are briefly presented below:

**7.1 DOE-2**
Developed at the Lawrence Berkley National Laboratory by the U.S. Department of Energy, DOE-2 is widely used because of its comprehensives. It can predict hourly, daily, monthly, or annual building energy use. DOE-2 is often used to simulate complex buildings. Typically, significant efforts are required to create DOE-2 input files using a programming language called the Building Description Language (BDL). DOE-2 has become a standard building energy simulation tool in the United States and several other countries using interfaces such as QUEST and Visual DOE (Krarti, 2011).

**7.2 EnergyPlus™**
EnergyPlus™ uses new integrated solution techniques to correct one of the deficiencies of both BLAST and DOE-2. EnergyPlus has several features that should aid engineers and architects in evaluating a number of innovative EEMs that cannot be simulated adequately with either DOE-2 or BLAST. These features include free cooling operating strategies using outdoor air, realistic HVAC system controls, effects of moisture absorption in building elements, and indoor air quality with a better modeling of contaminant and air flows within the building. A complete list of the interfaces is periodically updated on the EnergyPlus website (Krarti, 2011).

**8 BUILDING ENERGY INDEX**
The Building Energy Index (BEI) being used in this research to demonstrate the performance of electric consumption at residential colleges in the unit of kWh/m²/year (Chou, 2004). Building Energy Index (BEI) is an evaluating method from (Saidur, Masjuki, & Jamaluddin, 2007), who estimated energy intensity, BEI, in kWh/m² by using following equation:

\[
\text{BEI} = \frac{\text{Energy Consumption/Input (kWh/year)}}{\text{Gross Floor Area (m}^2}\}
\]

Basically, the energy use per unit floor area can be described as “Normalized Performance Indicators” (NPI), also known as Energy Efficiency Index (EEI) or Building Energy Index (BEI) (Kamaruzzaman and Edwards, 2006). It basically calculates the ratio of total energy used against the total built-up area to calculate building yearly consumption. The energy consumption in buildings normally in term of Energy Efficiency Index (Aziz, Zain, Baki, & Hadi, 2012). According to MS 1525 standard, recommended building energy index in Malaysia is 135kWh/m²/year. The saving targets are based on the lowest BEI.

**9 CONCLUSIONS**
As recommended by the government, public and private universities should improve their energy efficiency in order to reduce the cost of university’s operational. This research can be used as an important guidance and provide useful information for universities in Malaysia particularly on
current energy consumption and potential of energy saving improvement through the best practice of energy audit that has been identified through the research.

REFERENCES


THE ENABLING FACTORS FOR GREEN BUILDING DEVELOPMENT IN HOUSING PROJECTS

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Abstract - Transformation of the housing industry in Malaysia delivers tremendous benefits but it requires a lot of involvement and efforts from various parties to implement. Here, the transformation of green housing is able to preserve natural environment by fulfilling the quality of lifestyle of homeowners. Green housing designed sustainable resources with maximizing the resources and produces less impact on the environment. In other words, green housing is designed to reduce environmental impacts in suitable manners to meet the present without compromising the current needs of future generations as intended to enhance environmental friendly and sustainable development. Currently, green housing has received significant attention in Malaysia over the years with significant growth in environmental awareness. Furthermore, the Malaysian government had shown interest and encourages the practice of green development by introducing green building index (GBI) as green rating tool for buildings to promote sustainability and growing awareness among construction players. However, the implementation of green housing is quite low-moderate due to facing barriers to be implemented. Thus, this research put emphasis on determination of the significant enabling factors considered in developing green housing projects. The research presents data collected through questionnaire survey conducted to the developers as respondents. The data were analyzed through the quantitative method by using Confirmatory Factor Analysis (CFA) technique. The finding shows the main enabling factors for developing green housing projects are institutional, knowledge, internal action and market influence. As a result, this research is attempted to highlight the significant enabling factors being considered by developers in developing green housing projects.

Keywords- Sustainable Development, Green Building; Green Building Index (GBI); Green Housing Project

1 INTRODUCTION

The demand for housing continues to expand due to the increasing number of worldwide population due to improvement of better quality of life and rapid modernization (Fazdliel, Wira, Radzi and Ilias, 2014). In Malaysia context, Nazirah, Nor’Aini and Ayman (2013) mentioned, the demand for housing is expected to be more than 30 million in 2020 due to urbanization. However, the demand for green housing development and services are quite low due to the high cost compared to conventional products. Generally, the conventional house produces 10 to 30 tons of CO2 emission a year and it contributes to weather change disasters (Elias and Lin, 2015). Besides, urbanization leads to various problems to the environment such as destruction of flora and fauna, air pollution, water insufficiency and deterioration of ecological system due to uncontrolled development (Kai, Ta and Hui, 2013; Nazirah, Nor’Aini and Hanizam, 2012). Therefore, it is important for housing industry sectors to move and have balance environmental impacts by producing green housing (Elias and Lin, 2015)

In line of the rapid development, Malaysian government puts emphasis on housing provision needs to be developed towards sustainable manner by introducing green policy and green rating system as a guideline for green development (Fazdliel, Wira, Ilias and Radzi, 2013; Nazirah et al., 2012). However, the application of green housing concept is still at moderate level where the houses built do not comply with the requirement and principles of Malaysian green buildings rating systems (Elias and Lin, 2015; Fazdliel et al., 2014; Myeda, Kamaruzzaman, Zaid, and Fong, 2016; Nazirah et
al., 2012). In addition, the implementation of green housing is facing obstacles to implement in terms of budget constraints (Kai et al., 2013; Samari, Godrati, Esmaeili, Olfa, and Wira, 2013; Shari and Soebarto, 2012), lack of knowledge and information (Kai et al., 2013; Nadzirah and Carmen, 2015; Nazirah et al., 2012) and lack of enforcement by government (Nazirah et al., 2013; Shen, Tam, Tam and Ji, 2010). Despite facing various obstacles, Nazirah (2010) stated some developers have successfully and willing to transform towards green development by replacing these barriers.

Therefore, this research aimed to explore the enabling factors for green building development in housing projects by focusing on five (5) enabling factors: Institutional, Technology, Knowledge, Internal Action, and Market Influence. The purpose of this paper was to determine the significant enabling factors being considered by developers in developing green housing projects. The significant enabling factors are suggested based on the findings of data collection. This is in line with Nazirah et al., (2013) statement developing enablers for green housing is one of the key steps in creating encompassing perspective of the construction sector.

2 LITERATURE REVIEW

2.1 Sustainable and Green Housing

The development in past decades had used conventional methods that deliver huge environmental issues where the trend of using concrete as a structural material are commonly adopted in urban housing in Malaysia that clearly will contribute to the rapidly increasing carbon emission (Abu Hassan, Mahyuddin, Mazlina and Aulina, 2010; Nazirah et al., 2013). Therefore, the initiative by a worldwide community in mitigating environmental destruction was by introducing sustainable development. In 1987, the World Commission on Environment and Development (WCED, 1987) published ‘Brundtland Report’ where Brundtland Commission defined sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. It comprised of two key concepts (WCED, 1987):

1. The concept of “needs” is referred to the priority of world's poor
2. The idea of limitations imposed by the state of technology and social organization on the environment's ability with the goal to meet present and future needs

Sustainable development is the protection of the world which does not only specify on conserving environmental but also to fulfill the needs of future generations and other living organisms by reflecting the three (3) pillars of sustainable development: social, economy, and environment. These three (3) elements must be integrated to achieve the concept of sustainability as follow (Fazdliel et al., 2013, 2014; Mahoney and Potter, 2004; Nabila and Mariana, 2012):

![Concept of Sustainable Development](image)

Figure 1 Concept of Sustainable Development

Apart from that, when discussing the sustainability and environmental, it specifically reflects the development where implementation of green development is one of the initiatives to realize the sustainable development. Nazirah et al., (2012) mentioned, building “green” is one of best plan towards sustainability where green building is defined as a building that improves the valuable natural resources, significant operational saving and creates a healthier build environmental for users with better living (Jamilus, Ismail and Aftab, 2013; Wenxin et al., 2017).
Therefore, for a house to be ‘green’, every phase of building development process should incorporate with environmental consideration where green housing is the best concept to attract buyers where it is one of the drafts of sustainable development (Nazirah et al., 2012). Green housing is able to contribute to minimise climate change, reducing the need for physical resources, decreasing contamination, enhancing air quality and health, reducing water demand, diminishing waste and land degradation (Abu Hassan et al., 2010). Meanwhile, green housing is a building built in a superior quality that has accesses to green space, close to good public transport, using design techniques to increase energy efficiency, provide facilities that able to promote social contact and have clean and safe residential environment (Nazirah et al., 2012). Nowadays, the certification of green building can be achieved through Malaysian green building rating system which is Green Building Index (GBI) which is a certification body that able to decide if a building accomplishes the criteria of a green building or otherwise.

2.2 Enabling Factors for Green Housing Projects

In developing sustainable development countries, there are two – dimensional approaches that are required. Firstly is to create a fit and feasible neighborhood development and second is to ensure having demands for sustainable development (Plessis, 2007). Therefore, identifying of enabling factors is foremost to overall improvement. Plessis (2007) stated these enabling factors focus to enhance development at micro level which eventually affects the macro level. Each enabling factors has a role to play in order to create green housing as discussed below:

2.2.1 Institutional

Government is an institution which has major influence on the innovation of government legislation and brings a major impact to the successful Malaysian green development industry (Diyana and Nazirah, 2013; Fazdliel et al., 2013; Nazirah, 2010; Nazirah et al., 2012; Shen et al., 2010). In order to preserve environment without waiving the need for future generation, the Malaysian government had introduced green policies and regulation related to environmental preservation towards green development. Here, the government is responsible for enforcing revising legislation and introducing various incentives as to encourage involvement in green development (Nazirah et al., 2012; Tan, Shen and Yao, 2011). Therefore, Loo (2015); Pervez et al., (2017); Suhaida, Tan and Leong (2013) mentioned government had introduced National Green Technology Policy (NGTP2009) as a green policy towards green technology that aimed to enhance national economic growth, promoting sustainability, low carbon technology and preservation natural environment. Furthermore, housing industry has contributed towards sustainability by the involvement of National Housing Policy (NHP) in introducing Sustainability of the Housing Sector under thrust 5 of NHP (NHP, 2016) which are to increase the use of new technologies, innovation and provision of environmental-friendly housing, to improve research and development (R&D) efforts in the housing sector and to encourage urban renewal and redevelopment of old buildings.

Apart from the government, contribution of Malaysian Institute of Architects (PAM) and Association of Consulting Engineers Malaysia (ACEM) shown their interest on the needs of green practice by introducing Green Building Index (GBI) in2009 as Malaysian green building rating systems (Ashraf and Nurhayati, 2013; Sood, Chua and Peng, 2011; Zuhairi et al., 2014). GBI established based on 6 key criteria as guidelines to achieve green building awards which are energy efficiency, indoor environmental quality, sustainable site planning and management, material and resources, water efficiency and innovation (Aliagha, Maizon, Afeez and Kherun, 2013; Jamilus et al., 2013; Nazirah et al., 2012; Samari et al., 2013)

Other than that, government has introduced financial instrument as a financial initiative to encourage and support developers such as incentives, subsidies, tax exemption and rebates (Nazirah et al., 2012; Samari et al., 2013). Therefore, government has provided financing scheme under Green Technology Financing Scheme (GTFS) for companies that supply green technology by assuring to cover up to 2% of the loan interest rate and provides a guarantee of 60% on the financing (Env Dev Malaysia, 2010; Fazdliel et al., 2013, 2014; Nor Suzila, Asmalia and Nik, 2016; Samari et al., 2013).
Furthermore, the government also has taken action by offering incentives for tax exemption to development that adopts energy efficiency and renewable energy (KeTTHA, 2009).

2.2.2 Technology

The rapid technological development in the world has driven Malaysia to be more technology based government where Nazirah et al., (2012) asserted technology is an application of scientific knowledge where it referred to the product-based element that applied in the project like equipment, materials, process and physical solution. The technology of green housing should be more powerful in term of energy consumption, design, water saving and others. However, the acceptance of new technology in construction is slow in the beginning due to lack of confidence, high cost and limited expertise (Fazdliel et al., 2014; Nazirah et al., 2012). According to Nazirah et al., (2013), technologies are divided by two which are hard technologies (i.e: equipment and materials, physical infrastructure solutions) and soft technologies (i.e: to support the development process: adequate systems). Technology factors provided an adequate knowledge base and technical capacity for stakeholder that commonly gives impact to the implementation of green development (Plessis, 2007).

2.2.3 Knowledge

The green development can be more effectively implemented when it put emphasizes on education and training on green development (Nor Suzila, Asmalia and Nik., 2016). Indeed, the knowledge can be discovered from databases, benchmarks, guidelines, manuals and handbooks plus the knowledge of green development that can enhance the level of understanding and provide guidelines to certain activities (Nazirah et al., 2013). Furthermore, Nazirah et al., (2012) argued the knowledge from the top management itself should be developed then extend to the organization level as ways to deliver new knowledge. The knowledge and information are also gained from the involvement of universities and research institute. The lack of knowledge and expertise are obstacles in implementing green building development. However, these involvements able to promote and increase awareness among construction players as to fill the gap of knowledge in green building by introducing new rating systems, guidelines, introducing construction-related courses, sponsoring education programs, new technology and distribute them in the conferences, reports and seminars (Durmus-Pedini and Ashuri, 2010; Nazirah et al., 2012).

2.2.4 Internal Action

An internal action is an action within own organizations as to encourage green development (Nazirah et al., 2013). Internal action is separated by three (3); interest and commitment, policies and management and resources and capability. First, an internal action can be encouraged through public awareness as an initial way as explained by Nazirah et al., (2013) the growing interest and commitment among the construction players will force for policies and regulation on green development to be created. Here, the availability of this awareness towards green development, can foster the interest of construction players that commonly available as it provides information to the public, a team of building designer, stakeholders and construction team that is related to the green features of the building (Nor Suzila Asmalia and Nik, 2016). In short, the green development success in implementing is when the interest and people’s commitment, policies and management is available. When there is interest and policy, the organization of the company itself should play their roles in an effort towards green development (Nazirah et al., 2013). However, the policies formed should base on the green guidelines and principles that suit the management and priorities of the companies. Additionally, resources and capabilities are two (2) types of business assets within organization where resources is referred to the assets of company (money, materials, employee and assets) while capabilities are inclined to focus more on skills or ideas that are achievable in a business (Nazirah et al., 2013). In the nutshell, the resources of the company will reflect the capability of teams to produce profitability and viability projects.
2.2.5 Market Influence

Market influence is referring to the demand of the buyers where the commercial viability will push the developers to produce green housing projects (Nazirah et al., 2013). Nazirah et al., (2012) mentioned greater demand side which includes the clients, buyers and users will improve practice initiatives, good relationships with supply side and consequently, the delivery of green development will be improved. Furthermore, there are some factors that affect the market demand in Malaysia especially the intangible factors, where it will affect the demand of housing such as location, external and internal environment, ambience, accessibility, materials and finishes (as part of green building principles). These factors are perceived as added qualities to increase the value of housing and are to attract the client’s interest (Nazirah et al., 2013, 2012). The increasing housing demand will reflect the rapid development of the housing industry that depends on the market condition and economic flow. Here, market influence refers to the market value that is affected by the client’s demand (Diyana & Nazirah, 2013; Nazirah et al., 2013). Concisely, without the demand, the transformation of green development will be difficult to be realized.

3 METHODOLOGY

An exploratory research approach was conducted to achieve the aim of the research which was to gauge the enabling factors considered by developers in developing green housing projects. Questionnaire survey through close-ended questionnaire was implemented. This research applied purposive sampling method in obtaining data among the housing developer firms. The questionnaire was distributed to the selected developers that had been awarded green housing certificate within Kuala Lumpur and Selangor. With the total of 86 respondents, which are the total sample of research, the questionnaire was approached and sent by – hand. However, only 55 questionnaires gave practical responses which contribute to about 64% of response rate. In analyzing and evaluating the survey results, the quantitative approaches were used. Quantitative data were obtained through structural questions involving Likert’s Scale questions type which includes structured questionnaire form that was analyzed using the Statistical Package for the Social Sciences (SPSS) software through Confirmatory Factor Analysis (CFA) technique.

4 RESULTS AND ANALYSIS

4.1 Respondent’s Profile

Based on the respondent’s background, most or 43.6% of the total 55 respondent companies were established more than 15 years, while 9.1% was established for 11 to 15 years, 10.9% and 36.4% have established the company for 6 to 10 years and 1 to 5 years. In term of involvement in green building field, majority or 69.1% respondents were involved for 1 to 5 years and 30.9% involved for 6 to 10 years. It shows the majority of the respondents were moving to green development but they are still trying to sustain in the green industry with the majority has produced 1 green housing project. In short, there is the opportunity to succeed and obtaining certificate green housing development in Kuala Lumpur and Selangor area but the involvement of developers in the green industry is still low.

4.2 The Significant Enabling Factors Being Considered by Developers in Developing Green Housing Projects

The significant enabling factors were analyzed by considering the Reliability Analysis (RA) and Confirmatory Factor Analysis (CFA) where the RA used to test the reliability of instrumentation while CFA was analyzed to determine significant enabling factors. Therefore, the findings revealed, all selected item were suitable and reliable as generated via Reliability Analysis (RA). The recorded Cronbach’s Alpha values were 0.782 which is acceptable due to more than 0.70 (Sekaran, 2003).

Based on the CFA output, the value of Kaiser-Meyer-Olkin (KMO), Bartlett’s test, Measures of Sampling Adequacy (MSA) and Communalities Value (CV) were analyzed. Here, the result of Kaiser-Meyer-Olkin (KMO) value is 0.568 and p. value of Bartlett’s test is highly significant with 0.000 values where, Field (2005) recommends KMO values more than 0.5 (>0.5) are acceptable and p
value (significance) is less than 0.001 is concluded as appropriate. Hence, the CFA is considered as appropriate techniques for further analysis of data. In term of Measures of Sampling Adequacy (MSA) value and Communalities Value, it should be more than 0.500 (Dillon and Goldstein, 1984; Field, 2005) where the findings of enabling factors are. There are 16 out of 30 variables that are more than 0.5 of MSA value with all variables are more than 0.5 in Communalities Value (CV) which only 16 variables are significant and the rest should be taken out from representing as significant enabling factors being considered by developers in developing green housing projects. In regards to enabling factors, five (5) main enabling factors consisting of sub factors and attributes were tested. The results can be summarized in Table 1 below.

Overall, these 16 attributes achieved the value of MSA with more than 0.5 namely; the authority of government (0.526), Enforcement of the acts and regulations (0.552), The importance of technology (0.532), Better technology (0.519), Importance of soft skill (0.704), Support from educational sectors (0.542), Exposition to knowledge (0.697), Availability of organization (0.669), Growing of awareness (0.700), Experts’ commitment (0.766), Projection of green management (0.727), Development of companies policy (0.753), Importance of developers (0.685), Importance of resources and capabilities (0.543), Organization system (0.644) and lastly, Customers’ attraction (0.500).

Table 1 Significant Enabling Factors Being Considered By Developers in Developing Green Housing Projects

<table>
<thead>
<tr>
<th>Enabling Factors</th>
<th>MSA</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government Support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The authority of government</td>
<td>0.526</td>
<td>0.630</td>
</tr>
<tr>
<td>Regulations and guidelines</td>
<td>Taken out</td>
<td></td>
</tr>
<tr>
<td>Enforcement of the acts and regulations</td>
<td>0.552</td>
<td>0.664</td>
</tr>
<tr>
<td>Review of policies and regulation</td>
<td>Taken out</td>
<td></td>
</tr>
<tr>
<td>Professional Bodies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NGOs involvement</td>
<td>Taken out</td>
<td></td>
</tr>
<tr>
<td>Introduction of GBI benchmarking</td>
<td>Taken out</td>
<td></td>
</tr>
<tr>
<td>Introduction of master planning</td>
<td>Taken out</td>
<td></td>
</tr>
<tr>
<td>Financial support</td>
<td>Taken out</td>
<td></td>
</tr>
<tr>
<td>Introduction of financial scheme</td>
<td>Taken out</td>
<td></td>
</tr>
<tr>
<td>Affordability</td>
<td>Taken out</td>
<td></td>
</tr>
<tr>
<td>Financial Institution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The importance of technology</td>
<td>0.532</td>
<td>0.712</td>
</tr>
<tr>
<td>Better technology</td>
<td>0.519</td>
<td>0.725</td>
</tr>
<tr>
<td>Level of technology skills</td>
<td>Taken out</td>
<td></td>
</tr>
<tr>
<td>Knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge Improvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power of knowledge</td>
<td>Taken out</td>
<td></td>
</tr>
<tr>
<td>Importance of soft skill</td>
<td>0.704</td>
<td>0.750</td>
</tr>
<tr>
<td>Involvement from Universities and Research Institute</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support from educational sectors</td>
<td>0.542</td>
<td>0.667</td>
</tr>
<tr>
<td>Exposition to knowledge</td>
<td>0.697</td>
<td>0.811</td>
</tr>
<tr>
<td>Internal Action</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest and Commitment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability of organization</td>
<td>0.669</td>
<td>0.891</td>
</tr>
<tr>
<td>Growing of awareness</td>
<td>0.700</td>
<td>0.686</td>
</tr>
<tr>
<td>Experts’ commitment</td>
<td>0.766</td>
<td>0.756</td>
</tr>
<tr>
<td>Policies and Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Projection of green management</td>
<td>0.727</td>
<td>0.773</td>
</tr>
<tr>
<td>Development of companies policy</td>
<td>0.753</td>
<td>0.780</td>
</tr>
<tr>
<td>Resources and Capability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Importance of developers</td>
<td>0.685</td>
<td>0.819</td>
</tr>
<tr>
<td>Importance of resources and capabilities</td>
<td>0.543</td>
<td>0.708</td>
</tr>
<tr>
<td>Companies priorities</td>
<td>Taken out</td>
<td></td>
</tr>
<tr>
<td>Organization system</td>
<td>0.644</td>
<td>0.535</td>
</tr>
<tr>
<td>Market Influence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercialize of green housing</td>
<td>Taken out</td>
<td></td>
</tr>
<tr>
<td>Customers’ attraction</td>
<td>0.500</td>
<td>0.620</td>
</tr>
<tr>
<td>Market demand</td>
<td>Taken out</td>
<td></td>
</tr>
</tbody>
</table>

[Source: Author’s Researcher, 2018]
The finding revealed that the government and professional bodies should strictly enforce the law and policies regarding green policy and green technology policy in order to prompt and preserve natural environment. However, in term of financial incentives, the offering financial scheme for green building is not offered to green housing projects where, the financial scheme only offered to Office, Shopping Complex, Hospital and Clinic, Hotel and Resort, University and Research Institution, Exhibition Hall and School (MGTC, 2017). Moreover, the awareness among developers and design team regarding the benefit of green technology elements in their design and having strong support system from the government towards increasing greener housing development should be emphasized. In addition, in order to create awareness and understanding on the benefits of green housing, the public need to gain more knowledge and input on green development especially, technology.

5 CONCLUSION

By developing comprehensive significant enabling factors to be considered among developers in developing green housing projects, it is hoped that the performance of green housing implementation is not an issue anymore and the barriers able to mitigate. Those enabling factors could be applied to the future of green building implementation where the power of authority and organization of companies should be emphasized in realizing sustainability development. However, for future research, it is essential for research to be conducted involving developers in Malaysia to attract more industry players to go greener in their construction industry portfolio.

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Towards Automation and Robotics in Industrialised Building System (IBS): A Literature Review

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Abstract - The construction industry demands effective construction organisations, efficient construction processes and innovative construction techniques to effectively compete under increasing globalisation, market competition and technological advancements in the twenty-first century. The problems associated with construction such as decreasing quality and productivity, labour shortages, occupational safety, and inferior working conditions have opened the possibility of more revolutionary solutions within the industry. One of the prospective options is in the implementation of innovative technologies in construction such as automation and robotics is through the Industrialised Building System (IBS), which has the potential to improve the industry in terms of productivity, safety and quality. This is the review paper describe on the potential used of Automation and Robotics through Industrialised Building System as well as to adopt the concept of Industrialisation towards the better future of Malaysian Construction Industry.

Keywords - Industrialised Building System, Industrialisation, Automation and Robotics

1 INTRODUCTION

According to Thanoon et al., (2003) the IBS agenda in Malaysia begun in the early 1960’s when the Ministry of Housing and Local Government of Malaysia visited a number of European countries and evaluated their housing development programmes. Following the successful visit, the government initiated an IBS pilot project in 1964 which aimed to speed up the delivery time, and to build affordable and quality houses. The statement also supported by Kamar, Alshawi & Hamid (2009) as the introduction of Industrialized Building System (IBS) is to cope with an increasing request of affordable housing, solving issues associated with foreign labours and improving image, quality and productivity of construction industry. With the era of 4th Industrial revolution the construction industry also has to move forwards. Recently The Construction Industry Transformation Program (CITP 2016 – 2020) reported that Malaysian construction industry productivity level is one of the lowest in the economy and as compared with develop economies, with slow uptakes on technology and modern practices such as Building Information Modelling, Automation and Robotics to increase productivity (CIDB, 2015). The potential capability of Automation and Robotics is to generate higher output at a lower unit cost; with better quality products could in turn improve global competitiveness. The construction work site could, theoretically, be contained in a safer environment, with more efficient execution of the work, greater consistency of the outcome and higher level of control over the production process (Mahbub, 2008).

2 LITERATURE REVIEW

2.1 Overview of Automation and Robotics in Industrialized Building System (IBS)

In Malaysia construction industry, the best ways to implement the Automation and Robotics is through the Industrialized Building System as the system has a clear direction in adopting those technologies. Industrialized Building System was define by the Construction Industry Development Board (CIDB) as a construction technique in which components are manufactured in a controlled environment (on or off site), transported, positioned and assembled into a structure with minimal
additional site works (CIDB, 2003). Ismail and Abdul Rahim (2007) defined IBS as a set of interrelated elements that act together to enable the designated performance of a building. In a wider sense, it may also include various procedures (technological and managerial) for the production and assembling of these elements for this purpose. Abdullah & Egbu (2009) define IBS as a method of construction developed due to human investment in innovation and on rethinking the best ways of construction work deliveries based on the level of industrialization. On the macro construction perspective, IBS should be looking on to the bigger picture as it adopting the degree of industrialization. Richard (2005) stated that Industrialization is based on quantity. An important market can justify the investment in strategies and technologies capable, in return, of simplifying the production of complex goods. That is the very nature of industrialization: the production of a large quantity of units divides that investment into small (eventually infinitesimal) fractions, thereby reducing the fixed production costs of a single unit down to marginal amounts and getting the product available to a large audience. Richard (2005) also explains the degree of industrialization in Industrialized Building system. The first four are prefabrication, mechanization, automation and robotics. They do require an important investment in production facilities, but very often, they duplicate the traditional processes, merely transferring the tasks from the craftsperson to the machine. The fifth degree, which we will call reproduction, implies research and development of innovative processes truly capable of simplifying the production.

A study conducted by Mahbub (2012) to measure the implementation of automation and robotics showed that only 12% who uses the technologies on-site (majority in Earthwork)”, 12% use in the design stage, 13% in costing and tendering and 13% in project management. The study shows the implementation of automation and robotics is still low. Lundeen et al., (2017) stated that the construction industry is often considered an industry of slow change, hazardous conditions, old technology, and stagnant productivity levels. Robotics in IBS offers the potential to change that by reducing construction project cost, shortening project lead time, improving construction quality, and improving worker safety (Kapliński et al., 2002). However, the construction industry's adoption of robotics has proven slower than other industries, such as manufacturing. This is largely attributable to technological challenges arising from the unique characteristics of the construction industry (Mohd Amin et al., 2017). Yunus et al., (2017) also stated that the problem in applying modern methods of construction not only an issue in Malaysia but also plaguing contractors in developed countries such as the United Kingdom and Australia. For example, a study through interviews and questionnaires on perspective of UK house builders using offsite modern method of construction were conducted by Pan et al., (2007), found that the United Kingdom house builders are still using the conventional method to determine the cost, quality and productivity in deciding whether to use offsite technologies.
2.2 Industrialisation of Construction Industry

The concept of industrialization has put forward the construction industry to increase productivity and deliver quality construction end products. Industrialisation is the combination of a large market to divide into fractions the investment in strategies and innovation, in return, of simplifying the production and, therefore, reducing the costs. Industrialisation is defined by Musa et al., (2016); Shamsuddin et al., (2013) as modernisation process through the development of innovations, machinery, technologies and modern methods of production. Industrialisation usually requires offsite plant or factory where the work is centrally organised; production operations are mechanised and focused on mass production. (Warszawski, 2005) define Industrialization as a process of an investment in equipment, facilities, and technology with the purpose of increasing output, saving manual labour, and improving quality. Rashidi & Ibrahim, (2017) on the other hand stated that industrialization can be considered as a business strategy that transforms the traditional construction process into a manufacturing and assembly process by embracing new and advanced technologies, engaging people, and translating clients’ needs into building requirements. They also stated in one major study in 2012. Mohammad et al., (2016) conclude that the IBS players in Malaysia should start looking seriously at the possibility of moving up to the higher degree of industrialisation as mentioned by Richard (2005) in Figure 1 which incorporates prefabrication, mechanization, automation, robotics and reproduction in the process. Developers should also be encouraged to participate and involved in promoting, investing and constructing new housing schemes that adopts the Modular System that has many strong points and benefits especially in promoting sustainable, high quality and much desired end products which thereafter will lead to quality living. To gain a clear understanding on the concept of automation and robotics and its application in the construction industry, there is a need to understand the concept of industrialization which promoting automation and robotics through the IBS

2.3 Degree of Industrialisation

The Degree of Industrialisation study by Richard (2005) which is prefabricated, mechanization, automation, robotics and reproduction is in line with the Malaysian government’s vision to be a developed nation by 2020, to push forward the use of innovative technologies in most industries including the construction industry (Musa et al., 2016).

2.3.1 Prefabrication

Prefabrication is define by Azman et al., (2012) as a complete process system of construction works where almost all the component structures is manufactured onsite or offsite, and the product is transported to the site and to be installed in the high precision coordinate joint as well as achieve high quality works, and accelerate the time of completion of the projects. The massive used of prefabrication is After the World War II, prefabrication of building was the best method to fulfill the housing demand. The houses are constructed in a controlled factory environment based on the national building code specified by the US and the entire structure is transported to the site and installed onsite (Azman et al., 2012). But to ease understanding on prefabrication Richard (2005) suggested “Prefabrication starts with pre which means before and/or elsewhere. In the building industry, prefabrication generally implies building (in a factory) components or full modules very similar to the ones done on a traditional construction site, very often using the same processes and the same materials”.

2.3.2 Mechanisation

Richard, (2005) define Mechanisation comes in whenever machinery is employed to ease the work of the labour (power tools, etc.). Usually, prefabrication will be accompanied by some mechanization. For instance, the modular housing manufacturers will use pneumatic hammers, rolling bridges, etc. Mechanisation can be described as the process of applying the use of mechanical plants in carrying out a task. The level of mechanisation is defined as the number of plants and equipment employed or the number of activities carried out by mechanical plants in an operation. It can also be defined as the act of implementing the control of equipment with advanced technology, usually involving electronic hardware (Kamaruddin et al., 2016).
2.3.3 Automation

Kamaruddin et al. (2016) defined automation as “the replacement of human labour by machines; or the operation of a machine or device automatically, or remote control”. Automation can also be defined as a self-regulating process performed by using programmable machines to carry out a series of tasks. Automation goes one step further than mechanisation in that the process is not only supported by machines, but these machines can work in accordance with a programme that regulates the behavior of the machines (Mahbub, 2008). Study by Andritsos & Perez-Prat (2000) described that automation is basically accepted as the technology concerned about the application of complex mechanical, electronic or completed based systems for the operation and control of production or manufacturing.

2.3.4 Robotics

The word robot initially came from a Czech play called Rossum’s Universal Robots, published in 1920 and premiered in Prague in 1921. The author, Karel Capek (1890-1938), borrowed the word robot from the slavic robota, meaning a forced labour (Gossin, 2002). According to Mahbub (2008) robotics is a discipline overlapping artificial intelligence and mechanical engineering. Mahbub, (2015) define robotics Self-governing mechanical and electronic devices that utilize intelligent controls to carry out construction tasks and operations automatically. The construction work tasks and operations are regulated through programmable controls and sensors which are set up as a series of individual computer-controlled or robotic equipment with electro-mechanical links. According to Bock (2006) the first construction robots had been designed in the beginning seventies in order to increase the quality in prefabrication of modular homes in Japan and the late 70’s planning started for use of robots in construction sites. In the 80’s the first construction robots appeared on sites and in the 90’s, integrated automated building construction sites had been developed and implemented.

2.3.5 Reproduction

The word reproduction is borrowed from the printing technology, obviously not from biology. The analogy with printing will serve hereafter to extrapolate a methodology bringing productivity and economy in architecture. Reproduction is the introduction of an innovative technology capable of simplifying the multiplication of complex goods. The purpose of reproduction is to short cut the repetitive linear operations which are the trademarks of the craftsmanship approach, like nailing wood studs, laying bricks, etc. Instead of investing straight into machinery, reproduction is first calling upon research and development for ideas to generate a simplified process. Reproduction is not necessarily available as a down-right option; it usually accompanies some of the other degrees of industrialisation (Richard, 2005). Musa et al., (2016) stated that the real message of reproduction is to give priority to ideas rather than to machinery. A clear vision of the performance expected from the product. The ability to imagine a simplified topology and the knowledge of the processes presently available will lead to solutions capable of delivering quality architecture to the mass majority of people.

2.4 Current Development in Industrialised Building System (IBS)

Lots of previous research has focusing on the Critical Success Factors CSFs in the Industrialised Building System. Kamar (2011) for example has listed the success factors toward implementation of IBS in general and produce a framework to successful adoption of IBS which depending on four factors which is strategy, people, process and enabler. Nasrollahzadeh, Marsono & Tap (2016); Yunus et al. (2017) in their his study has establish the CSFs on the lean approach to IBS focusing to maximizing the productivity which is classifieds in seven groups namely; just-in-time factors, total quality management factors, business process reengineering factors, concurrent
engineering factors, last planner system factors, teamwork factors and value based management factors. Hadi, Muhammad, & Othman (2017) has conducted a CSFs study in Sarawak focusing on the implementation of IBS and has concluded the incentive, number of manufacturer, logistics and payment method is the CSFs of IBS in Sarawak. M. Nawi et al., (2016) have conducted a study on CSFs of IBS focusing in team integration practice. They have concluded based on the Focus Group Discussion (FGD) among construction industry stakeholders revealed the main barriers to the IBS adoption in Malaysia’s construction industry to be poor integration among project stakeholders during the planning and design phase. This was due to the domination of the fragmentation concept of the traditional method. Musa et al., (2017) in their study has provided a Framework for modular construction based on IBS approach that focusing in quality and promoting sustainability in construction. They urged that the success factor in integration of modular construction which is design, manufacturing and construction is people, technology and process. Ariffin et al., (2017) have conducted a study on the economics of scale (EOS) for IBS and come out a framework on the EOS based on the associated factors that affect Economy of Scale (EOS) and their relationships in catalyzing the IBS manufacturer especially precast concrete as the scope of study to continue their business in the construction industry. Azam Haron et al., (2015) have developed a model to enhance adoption of IBS based on the quality factor and customer satisfaction in housing project. Mahazir (2015) has conducted study on IBS and focusing on the sustainable issues. He urged that by using IBS many of the issues pertaining to sustainable will improved. Yunus et al., (2017) in their study of developing a model on the quality of IBS. He stated that the quality is one of the successes of IBS and his study will provide a fundamental in developing a guideline for construction players in integrating TQM in IBS application effectively. Yunus et al., (2015) have provided a conceptual framework based on the contractor satisfaction in IBS. The developed framework is expected to help the project team in performing IBS projects more efficiently, ensuring the quality meet the standards and encouraging effective communication between participants. There seem a limited of study has been conducted to identify the critical success factor to automation and robotics in IBS. Table 1 show the summary of studies conducted related to critical success factors in industrialised building system.

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<th>Bil</th>
<th>Previous Study</th>
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<tr>
<td>15</td>
<td>CSFs to contractor satisfaction in IBS</td>
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<td>16</td>
<td>Motivational factors of IBS</td>
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<td>17</td>
<td>Mechanisation and Automation</td>
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<td>18</td>
<td>CSFs to economic of IBS</td>
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<tr>
<td>19</td>
<td>CSFs to automation and robotics in IBS</td>
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</table>

Table 1 Current Study in Industrialised Building System IBS
3 RESEARCH METHOD

This research is still at the initial stage; therefore, the information presented in this paper is primarily based on the thorough review of the relevant literature within the scope of industrialisation and Industrialised Building System (IBS). In the course of the literature review, the definition, characteristics, benefits, and related issues of automation and robotics as well as IBS in the construction industry is examined and highlighted. All the data and information gathered directly from libraries, books, articles and other printed materials searched in the international and national journals, proceeding and bulletin.

4 CONCLUSIONS

The review in this paper describes current and potential used of automation and robotics through Industrialised Building System (IBS). As the government effort to strengthen the usage of IBS, the adoption of the Industrialisation concept as propose by the Richard (2005). It is essential as it has a very clear path on the direction of Malaysian construction industry would be.

REFERENCES


Abstract - Construction is a high-risk activity, which must be managed from procurement, throughout the design process and to the end of the construction stage. It involves professionals of different set of skills and expertise. Each party in the construction industry plays an important role in order to complete any project within the timeline, the lowest cost and the best quality product. The main cause problems occur in construction industry is due to ineffective implementation of risk management. The methods used in this research are mixed methods which were qualitative and quantitative. This research advocates the strategies that can overcome ineffective implementation of risk management among sub-contractors. Besides, this research also will provide a better understanding on the effective implementation of risk management practice in Malaysia and how the strategies can be implemented or used as guidelines by construction companies especially sub-contractors in their respective projects.

Keywords - Risk, Risk Management, Sub-Contractors

1 INTRODUCTION

Construction industries are one of the industries that will naturally involve in high risk and high uncertainty. In construction projects, the three primary targets which are the cost, time and quality are very subjective. The main cause problems occur in construction projects are due to ineffective implementation of risk specifically the ineffective risk analysis which could put any construction projects in danger. Implementation of a good risk management is very important in construction industry because it will lead to the success or failure of the project. The main principle of risk management is not about eliminating the risks but to control it properly. In construction industry there are many unpredictable risks like performance of construction players, resources availability, surrounding area and involvement of all the involved parties. Thus, the main goal of implementing effective risk management in construction projects are to complete the projects within stipulated time, cost, good quality and environmental limits. The purpose of this study is to provide a better understanding on the effective implementation of risk management practice by sub-contractors in Malaysia.

2 PROBLEM STATEMENT

The main problem to be highlighted in this paper is the lack of risk management, specifically the ineffective risk analysis, could put construction projects in danger. Risks cannot be eliminated but by applying the principles of risk management practitioners are able to improve, minimize or mitigate the ineffective implementation of risk management. Implementation of a good risk management is very important in construction industry
because it will lead to the success or failure of the construction projects are inherently complex and involve multiple feedback processes due to the rapid change in technology, environment and inflation, effective risk management implementation is a management tool that the construction industry cannot afford to ignore. According to Sawczuk (1996), no matter how small or simple the project is, it still can go wrong. Risk cannot be avoided but must be recognized, assessed and well-managed. Construction Management Practices | IRMI.com. (2018) stated a successful construction project must meet the expected level of quality, time and cost. The effective implementations of risk management has to be integrated and aligned so that the people will perform their work efficiently, effectively, and safely.

3 PURPOSE OF STUDY AND RESEARCH QUESTIONS

This conceptual paper is to provide better understanding on the effective implementation of risk management practice by sub-contractors in Malaysia. Therefore, the research questions for this paper are:

1. What critical factors causing the ineffective implementation risk management in sub-contractors organisations?
2. How ineffective implementation risk management among sub-contractors contribute to the construction projects impact?

3.1 Significance of the Research Questions

This conceptual paper is significant because it will investigate a number of critical factors that cause and impact the construction projects towards ineffective risk management by sub-contractors. This paper will determine those factors and make recommendations for future research.

3.2 Analysis and Discussion of the Literature

In order to achieve the answer to those research questions, this section describes the literature review on risk management and factors contribute to the ineffective risk management.

3.3 Risk Management

Ward and Chapman (2003) defined ‘risk’ as “hazard, chance of bad consequences, loss, exposure to chance of injury or loss”. According to Health and Safety Authority (2018), risk is defined as ‘hazard’ where a situation which could lead to harm. However, Smith et al. (2006), defined risk as an unforeseen event that occurs during the process of construction projects. Edgerton (2008) asserted that risk is quantified as the combination of the probability if the event occurred and the impact of the resulting consequence. Besides, risk can impact an organisation whether in the short, medium and long term. Risk regarding the possibility of loss can be especially problematic. If a loss is certain to occur, it may be planned in advance and treated as a definite.

According to Menard (2017), construction projects are very complex and can pose various internal and external risks. A strict set of codes, laws, and regulations must be followed during the construction process to best avoid these risks. One of the best ways to manage risks is to know the various types and how you can manage them. Sources of risks can be divided into two which are internal and external risk. Examples of internal risk are site possession delay caused by sub-contractors, problem between sub-contractor and main contractor, quality of work done and availability of labour and equipment. Examples of
external risk are earthquake and landslide. For the types of risk, they are divided into technical risk, operating risk, environmental risk, management risk, financial risk and socio-political risk. Risk management is a process that is underpinned by a set of principles. In addition, it needs to be supported by a structure that is appropriate to the organisation and its external environment or context (McCaig, 2010). A successful risk management initiative should be proportionate to the level of risk in the organisation which is related to size, nature and complexity of the organisation, aligned with other corporate activities, comprehensive in its scope, embedded into routine activities and dynamic that is by being responsive to changing circumstances (McCaig, 2010).

Then, the main purpose of project’s risk management is to identify, examine, select risk management techniques, implement the techniques and monitor the results for project success. Overall, risk management process includes the following main steps:

![Figure 1: Risk Management Process](image)

There are two basics types of approach to the management of risk in project which are informal and formal approach. The informal approach to the management of risk is one which views the risks in a subjective manner. and In addition, it is also due to the nature of this approach where many organizations implement these methods but do not realize that they are operating any kind of risk management procedure. One of the most widely used techniques in the informal approach to the management of risk is the provision of contingency fund. These are lump sum contingencies and percentage contingencies. A lump sum contingency is a sum of money put aside, in the project budget, in case any extra money is required during the project (Tadayon et al., 2012). Contingency funds can be used as a risk management technique because the amount of money allocated to a contingency fund should be representative of the cost of risks thought likely to occur in a particular project. Other informal procedures for the management of risks involve talking to experts or people with experience on similar projects and gaining their views as to the possible risk in a project, then reviewing the project in the light of these possible risks. The formal approach consists of an asset of procedures laid down by an organisation for use in the management process. These procedures are structured and give guidelines to be followed, so that they can be used by any member of the organisation.

### 3.4 Factors Contributing to Ineffective Risk Management

The most common factors for the disaster of a project must be identified. It is very important because we can find the ways to remedy them. Besides, it is very important to
know the causes from the start of the project in order to develop methods to prevent the problem.

Factors contributing to ineffective implementation of risk management are:-

(a) Ineffective Information

Although this source could interact with the other causes of failure, we are going to examine it as a separate entry. If the project team does not have effective accurate information for the project, then they are not able to deliver the project with the desired outcomes. However, there is a limit to what can be known in a project; perhaps this cause of failure is inherent in any human venture. Nevertheless, there is limit information on the full details of the project.

(b) Ineffective Resources

Lack of resources in a project is considered as one of the most significant factors for the disaster of a project. Resources for a project are divided in three which cost, people and equipment.

Every project has serious divergences in its outcome especially to the final costing. If we do not have the money to pay these extra costs, then the project will fail. There are many causes which resulted from this including inaccurate estimation, changes in the project due to external factors, changes in requirements and so forth. Sometimes, the whole project must be completed to understand that the initial financial resourcing was incorrect.

In addition, having the wrong people in a project has a highly negative impact in the implementation of the project. Furthermore, a fully staffed project team who are unsuitable to work as a team or they need training in order to be productive, is also negative for the completion of the project.

Furthermore, lack of the proper equipment can lead to project delays, but this is not as critical as having the lack of people because it is very easy to plan from the beginning of the project, what equipment we will need. However, that does not mean that the wrong equipment or the late delivery will not cause serious problem in the project. In general, the lack of equipment is not considered a major factor of project disasters but it is a sign of poor management and planning.

(c) Ineffective Communication and Management

Strategies such as the commitment to improve communication within the team, receiving sufficient commitment from top to bottom, support from all levels of management and the consistent endorsement by top management especially communication between main contractor and sub-contractors will lead to project success (Chan et al. 2004). Baccarini and Collins (2003) found that communication is the most crucial for every level of the project management process. Nguyen and Ogunlana (2004) also found that the associated success factors in communication are related to the community’s involvement, clear information or communication channels and frequent progress meetings. According to Alauddin and London (2011), a proper communication and management among project teams members need to be monitored by the project manager. If project team members keep their relationship steady and communicate properly between each other it can effectively give impact to the success of the construction projects.

4 CONCEPTUAL FRAMEWORK

The conceptual framework for this research integrates the factors causing and giving impact to ineffective implementation of risk management. To show that this proposed
conceptual framework is appropriate to the research questions, the research questions are again stated here:

1. What critical factors causing the ineffective implementation risk management in sub-contractors organisations?
2. How ineffective implementation risk management among sub-contractors contribute to the construction projects impact?

This paper is based solely on a review of previous researches. Several methods were used to collect and reviewed the literature. First, research was conducted using Google search Engine and Google Scholar. The terms such as ‘risk management’, ‘ineffective risk management’ and ‘sub-contracting issues’ were used, and a limited amount of information was found. The most helpful literature is related to ineffective risk management toward ineffective communication and management. Second, research on selected databases pertaining to risk management was explored. The databases are Web of Science, Sciences Direct and Mendeley. The total of 22 articles were retrieved and reviewed (see Table 1).

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<th>Item</th>
<th>Articles</th>
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<td>2</td>
<td>'Exploring critical success factors for partnering in construction projects', 2004, Chan, A, Chan, D, Chiang, Y, Tang, B, Chan, E and Ho, K</td>
<td>Review of the development of the partnering concept in general and identifies critical success factors for partnering projects from various parties.</td>
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<td>5</td>
<td>Critical success factors for projects, 2003, Baccarini, D and Collins, A</td>
<td>Explanation on critical factors to project implementation and critical areas that significantly impact project success.</td>
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<td>6</td>
<td>Risk Management; Recommended Contract Practices for Underground Construction, SME, 2008, Edgerton W</td>
<td>To improve contract practices among construction practitioners</td>
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<td>7</td>
<td>Hazards and Risk, 2018, Health and Safety Authority</td>
<td>Definition of Risk Management</td>
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<td>8</td>
<td>Construction Management Practices, 2018, IRMI.com</td>
<td>Explain successful construction project must meet the expected level of quality, time and cost.</td>
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<td>9</td>
<td>'Research and Evaluation Design', 2010, McCaig, C</td>
<td>Guide for Practitioners to do Research and Evaluation</td>
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<td>10</td>
<td>The Types of Risks in Construction Projects,</td>
<td>Explanation on the types of risks in</td>
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<td>12</td>
<td>Risk Management, 2013, Ramachandran P.P.</td>
<td>Diagram of risk management process</td>
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<td>13</td>
<td>Managing Risk in Construction Projects, 2006, Smith N.J., Merna T., obling P.</td>
<td>How to manage risk in construction projects</td>
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<tr>
<td>14</td>
<td>Risk Avoidance for the Building team, 1996, Swaczuk, B</td>
<td>How to avoid risk for construction players</td>
</tr>
<tr>
<td>16</td>
<td>Transforming project risk management into project uncertainty management, 2003, Ward, S. &amp; Chapman, C.</td>
<td>Explanation on the reasons that focus on ‘uncertainty’ rather than risk could enhance project risk management, providing an important difference in perspective, including, but not limited to, an enhanced focus on opportunity management</td>
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<tr>
<td>19</td>
<td>Improvement Of Relationship Between Main Contractor And Subcontractor For Successful Construction Project Implementation, 2017, Lagiman, S.</td>
<td>Explanation on how to improve relationship between main contractor and sub-contractor to achieve end goals.</td>
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<td>20</td>
<td>Encyclopedia of Quantitative Risk Analysis and Assessment, 2008, Melnick E. and Everitt B.</td>
<td>Explanation about quantitative risk analysis</td>
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<td>22</td>
<td>Definition of Risk Management, 2011, Websters dictionary</td>
<td>Definition Risk Management</td>
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According to the literature reviews, this proposed conceptual framework is synthesised appropriately with the risk management approach. The next section will discuss the assimilation of factors and impacts in risk management (see Figure2).

The development of the conceptual framework of effective risk management for subcontractors illustrates the link between critical factors, impact and strategic to overcome
ineffective risk management among sub-contractors. Figure 2 shows the critical factors contribute to the ineffective risk management, the impact from ineffective risk management and how the implementation of strategic can provide an effective risk management by the sub-contractors. In this framework, the connection of critical factors such as human, technical and environment can give negative impact to the projects, main contractors and sub-contractors and to other resources. This highlights it is important for the main contractor to provide information on risk management to ensure the project run smoothly. However, the implication of ineffective implementation of risk management by the sub-contractors affect to the successful of the projects. To ensure the project is successfully done, the sub-contractors should have good experiences and implement good feasibility study, frequent progress meeting, clear communication, coordinate well between the parties involved, proper identification and allocation of risk and proper project planning and scheduling. This framework will be tested by the empirical data based on questionnaire survey and interviews with the sub-contractors. The future research methodology is discussed in the next section.

5 DATA COLLECTION AND DATA SOURCES FOR FUTURE RESEARCH

This paper solely based on a review of literature of risk management towards ineffective implementation by sub-contractors. For future research a quantitative and qualitative approach would be conducted to obtain data in 2018 from sub-contractors who are involved in private construction industry. According to CIDB Malaysia (2017a), nowadays private sector project is a lot more compared to public sector projects. Based on this data, this research will focus on private sector projects due to accessible and richness of data on risk management implementation. For the grades of contractor this research will focus on G3 and below which means G3, G2 and G1 due to the pattern of risk management that the contractors applied and usually these contractors become a sub-contractor. According to CIDB Malaysia (2017b), Grade G1 to G3 contractors registered under CIDB Malaysia form the largest portion of contractors at 77.3% (55,850 contractors). This study will cover ineffective implementation of risk management during construction projects. As at 30 June 2017, the number of construction projects awarded in Malaysia in 2016 to private sector are 1,645 and for the government sector is 488 which leads to grand total 2,133 (CIDB, 2017b).

6 DATA ANALYSIS STRATEGIES FOR FUTURE RESEARCH

This research will involve one category source of data which is primary. Primary data are collected through survey and interview. The main sources of input data for this research are the data gathered from the literature and through a questionnaire survey to a group of sub-contractors in the construction industry. The questionnaire was based on rank scale of 1-5. The respondents would be asked to evaluate the listed criteria based on a 5 Likert Scale with 1 = Strongly Disagree to 5 = Strongly Agree. For each criterion, the average value of the respondent's assessment will be called the index. To be more descriptive, the data will be analysed from the selected sub-contractor via the interview survey. The data are then processed by the means of content analysis for the purpose of generalizing its findings. Feedback from the survey conducted is analysed using Statistical Package of Social Science (SPSS) Version 24. Apart from that, the structured interview will be conducted with the expert panel at a related area of study on the best strategies of risk management that can be implemented. From there, suitable chart, diagram and schedule will be used to represent the data. Last but not least, conclusion and recommendation are made to conclude the research.
findings. These findings will be an input to help the subcontractors working in the construction industry preparing effective risk management processes for their new projects.

![Diagram of Critical Factors and Impacts](image)

**Critical Factors causing ineffective implementation risk management**

<table>
<thead>
<tr>
<th>Critical Factors</th>
<th>Impacts due to ineffective implementation risk management</th>
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<tbody>
<tr>
<td><strong>Human</strong></td>
<td>Project</td>
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<tr>
<td></td>
<td>• Ineffective skill levels</td>
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<td>• Ineffective reviews of architectural and engineering drawings</td>
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<td></td>
<td>• Lack of site layout</td>
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<td>• Unclear goals</td>
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<tr>
<td><strong>Technical</strong></td>
<td>Main Contractor and subcontractor</td>
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<tr>
<td></td>
<td>• Ineffective reviews of architectural and engineering drawings</td>
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<td></td>
<td>• Lack of site layout</td>
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<td>• Poor communication</td>
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<td>• Mistake and error in design</td>
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<td>• Untested technology</td>
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<td></td>
<td>• Accessibility of material</td>
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<td><strong>Environment</strong></td>
<td>Non Human Resources related factors</td>
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<tr>
<td></td>
<td>• External events</td>
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<td><strong>Strategic</strong></td>
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<td></td>
<td>• Effective site management and supervision</td>
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<td></td>
<td>• Use experienced sub-contractors and suppliers</td>
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<td></td>
<td>• Good feasibility study</td>
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<td></td>
<td>• Frequent progress meeting</td>
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<td>• Clear communication and communication channel</td>
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<td>• Frequent coordinate between parties</td>
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<td></td>
<td>• Proper identification, allocation and management risk</td>
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<td></td>
<td>• Proper project planning and scheduling</td>
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Figure 2 Conceptual Framework of Effective Risk Management for Sub-Contractors
7 CONCLUSIONS

Based on the synthesis of literature review a conclusion can be drawn about what factors that cause and provide impact due to the ineffective implementation of risk management by sub-contractors. The types of projects, grades of contractors and location were the main focused in this research. The internal risks, external risks and types of risks were reviewed in this research in order to get a better understanding on the importance of risk management. By understanding the causes and effects of ineffective construction management practices, we may reduce or avoid some of the problems that occur in construction projects. The effective implementations of risk management in construction projects leads to people performing their work efficiently, effectively, safely and making construction project becomes a success.

REFERENCES
THE CHALLENGES OF IMPLEMENTING MACHINOEKI CONCEPT IN TAIPING TOWN

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Abstract - Machinoeki is a unique community involvement concept, empower with hospitality and volunteerism that benefits the town revival. The core principal in Machinoeki concept is to inspire community through the idea of space sharing at their building premises where visitor can rest, get some information about the town, and also used the toilet service for free. The use of existing resources within the building indicates that the concept does carry the spirit of community participation as a non-direct social service from the local community to the town development. This is an interesting concept as community works voluntarily to help the local government to revitalize the town, nurture the idea of hospitality, which means cultivate and educate good services. This concept is not a medium to get local government to wash their hands but to get the community work bottom up and work hand in hand with the local government to rebuild and revive the town. Nonetheless, the implementation of this concept faced a lot of challenges from the building owners involved and received mixed responses among the local community. Are Malaysians ready to embrace such concept and how do they react to this concept? This paper explain about the challenges faced by the researcher to introduce this concept to the building owners and local community in Taiping town for the past year.

Keywords - Walkability, Rebuilding Community, Historical Town, Taiping, Machinoeki

1 INTRODUCTION

Machinoeki or also well known as Hentian Komuniti in Malaysia is a Japanese concept invented in 2002 initially in the spirit to revive Japanese cities and to solve the issue of urban sprawl in Japan. The word Machinoeki derived from the word "Machi" which means town or settlement while "Eki" means a station that provides a pit stop for a person when walking similar to the idea of Rest and Relax along the highway for the highway users. Although the original idea in Japan was mainly because of revitalization needs and urban sprawl issue (Koike, 2016), the concept has proven that it is able to cultivate a non-direct impact of community involvement in the development of town in Japan. In many cities around the globe, community participation in the town volunteering programme received mixed level of responses. In a study conducted by Jepson et.al (2012) found that participation of respondents among the local community can be enhanced through opportunity to give suggestions and the level of contributions that the community able to make in a programme. Therefore, in other words it is anticipated that cities will be able to have a stronger character and deeper sense of place with more participation from the local community including the building owners who also plays an important role in a town development. In another study conducted by Wang et.al (2010) found that the level of awareness among the community can influence the effectiveness and outcome of a programme. This shows that more education and motivation about community participation will increase in the awareness towards community participation itself. The introduction of Machinoeki concept in Malaysia, is not just because of town revival effort but also to help the local government effort to conserve heritage building, to motivate more people to walk and appreciate those buildings, the use of
Hentian Komuniti as a pit stop for rest and to alleviate the level of community participation in the town programme.

2 DEFINING THE CONCEPT

The introduction of this concept in Malaysia however is considered challenging in many ways and it is very closely related to cultural differences from Japan. The objective of this study is to implement this concept and to understand its challenges to implement such a positive concept in Malaysia. For the first time outside of Japan, the Machinoeki concept was applied in a heritage town known as Taiping, Perak in Malaysia. The significant of Taiping town to be selected as the case study is in line for its town history with the most number of “first” building in Malaysia that were developed during the British administration where modern colonial buildings were constructed as early as 1885. Inspired by the wonderful concept of hospitality and the positive outcome from Machinoeki movement in Japan, with a hope that this project able to encourage town like Taiping to revitalize through the idea of volunteerism and hospitality. This is an attempt to instills sense of place and rebuilding the town at the same time. This paper looked at the challenges face by building owners and the responses of the local community towards the concept. The understanding of these challenges and the responses from the local community towards Machinoeki concept will provide further information about the suitability of this concept outside of Japan as well as to understand the best method to implement this concept in future.

One of the main challenges faced by the researcher is the lack of previous study related to Machinoeki concept itself as this is the first time such concept was implemented other than Japan. However, such concept related to community participation, hospitality and volunteerism holds an important part in the conservation and tourism development. The motivation, opportunity and ability model or also known as MOA model was used to examine three levels of community participation. According to the recent research related to community participation using the MOA model conducted by Rasoolimanesh et. al (2017) and (2015) found that motivation has a positive effect on low level of community participation where the respondents in their study were only interested in being minimally participate in defined tourism related activities. In addition, a research supports Wang et.al (2010) study that given opportunity to participate and having a voice in the process more residents will be more interested in the decision making process. The idea of Machinoeki clearly is not a medium for local government to wash their hands but to assist in the process of creating a better outcome from any programme created by them. This is important because when the local community finally realize that town development is also part of their responsibility, more great achievements can be achieved in creating a sustainable future.

Taiping is a town located at the north part of Perak state in Malaysia with a heritage and historical background which needs to be sustained for future generations. Historically, Taiping is the earliest modern town planned in Tanah Melayu with many colonial building houses and offices, shop houses and the famous Lake Garden shows the mix culture and settlements occurred in Taiping since the beginning. Taiping retains gridiron street pattern type of the town layout. But originally it was not considered for motorized vehicles as the main users of the road. Hence local people either walk or cycle around the town. However, modern lifestyle nowadays changes their dependency on mode of transportations and as a result; it is rare to see people walking now in the town. The study started in 2017 with an inventory study on numerous elements that describe Machinoeki concept. This research project focuses on buildings and places listed in the Taiping Heritage Trail. After a careful inventory study of the trail from 40 heritage buildings in the Taiping Heritage Trail, 5 buildings were selected which are government owned building like Museum Perak, Public Library Taiping, Gallery Taiping and private owned building like Devalaya Temple and Hokkien Association. The buildings must be able to turn as information check points, to provide toilets free of service, to provide hospitality with greetings and good service. Therefore, the current building components need to have those criteria to be considered and chosen as Machinoeki or Hentian Komuniti and also need to be in the path of heritage walk as part of the needs to revive the heritage preservation in Taiping. From 40 heritage buildings, 5 buildings were selected based on their willingness to participate and basic criteria as
explained to be part of this pilot project. Subsequently after the inventory study in September 2017, a focus group discussion and interviews was conducted to allow the owner of the building to know more about the function as a Machinoeki owner and the impact of the concept to their premises in future. In strengthening the implementation of this concept; the Mayor of Taiping Municipal Council (MPT) also plays a main role to support the project. One of his main roles is to acknowledge these buildings as Hentian Komuniti of Taiping and to include the heritage buildings as the main stop within the public buses route. The basic concept of Hentian Komuniti is that these 5 buildings in Taiping need to provide free toilet services and the ability to maintain the toilet voluntarily, a rest place like a sitting area and an information counter not limited to a board but also a person in the building that is able to answer questions and the whereabouts in Taiping the includes the town history similar to the concept of Machinoeki in Japan. These concepts will not only benefit tourists but also for local people. In addition, its expected to be able to enhance more non-motorize (walking or cycling) journey within the town, hence able to revive appreciation towards historic buildings, social and economic activities, direct or indirectly – as proved by Machinoeki concept in Japan. The experimental implementation of this project started officially in December 2017 and another survey was conducted in March 2018 to understand the immediate outcome and learn about the challenges to implement this concept in Taiping town among the building owners and local community.

The fact that the town, was once an important commercial hub in the district of Larut Matang, offers a wide variety of businesses since the late 19th century. This has certainly influenced the character of the town. As reported in the Taiping Special Area Plan 2020, Taiping is largely dominated by two to three level shophouses with various styles of architecture which are unique and distinct in their own way. These features enabled the buildings to be easily distinguished from the new shophouses even though they were standing right next to each other. The sheltered passageway, commonly known as the five-foot-way also gives the shophouses their unique character and therefore assisting in creating a clear sense of place. Collectively, they form a strong and cohesive streetscape. Furthermore, one can also witness remnants of the town’s wonderful era such as the Magistrate Court, Post and Telegraph office, Railway Station, Taiping New Club, Perak Museum, and Larut Matang District Office which were built more than 100 years ago along the heritage trail. Majority of these buildings have remained relatively intact and re-used with most of them still retain the major structure of the colonial architecture. This is crucial as a place is deemed to be of historically importance to local communities if it maintains the continual pattern of human use (New South Wales Heritage Office, 2011). The presence of people throughout the day and night, particularly by those who come to work or visit during the daytime and at night, create and maintain a safe and distinctive environment in the town. Hence, it offers great potential to implement Machinoeki concept in Taiping town.

Another Hentian Komuniti project expectations is to increase in the local community motivation to walk in the town. However, safety concern becomes the main topic of concern when it comes to motivation to walk. In Malaysia, road accident is a major concern where a total of 66,296 fatalities since 2005 to 2014 has been recorded (PDRM, 2014). An accident involving pedestrian may easily result in fatal injury due to their vulnerability. Safety while walking is one of the important factors that any pedestrian will consider. An increasing number of pedestrians being involved in road accidents causing concerns regarding the risk of walking, especially for parents. Consequently, this situation could impede the struggle towards promoting the walking culture in Malaysia. In the past, many studies have investigated on the behavior of pedestrians in Malaysia particularly in urban area. Different types of people will have different types of walking behavior. There are many possible factors in measuring walking behavior. According to Daamen and Hoogendoorn (2003), walking behavior can be measured by walking speed, walking direction, walking experiences, group formation and density. Every pedestrian group has different expectation towards the pedestrian facilities. Poor maintenance of pedestrian facilities is related with the inappropriate condition of walkways and street furniture. Additionally, physical quality of linkages is important to allow people to walk or transfer comfortably within the city center.
3 FINDINGS

The findings written in this paper discussed specifically on the outcome of the focus group discussion among the building owners and findings from a programme called “Walk With Me” that has introduced Hentian Komuniti in Taiping town with the local community. The responses from the 5 building owners and 16 respondents among the local community were carefully recorded and explained in this paper as challenges in implementing the Machinoeki concept. The 5 building owners were selected based on the initial inventory study in September, 2017 and the 16 respondents were selected based on the different background, gender, age and education level in order to get different responses about the walking experience, perceptions, awareness to heritage buildings in the project. The walking programme was conducted in March, 2018, 3 months after the programme started in Taiping. All the respondents’ comments were recorded and were clarified in the discussion. The researcher has found interesting findings to study about the challenges from the programme. The discussion is based on the data collection both from the building owners and also the local community.

3.1 Local Community

Table 1 indicates background of the local community respondents who were involved in the “Walk with me” programme as one of the methods to introduce about Hentian Komuniti and also to get their responses about the concept. The programme was conducted in March, 2018. Immediately after the walking programme, the respondents were asked about their experiences in findings the three basic elements of Machinoeki in Taiping town before Machinoeki were first pilot project implemented in December, 2017. The three basic elements that are walking motivations, toilets service and information center. It is found that nearly half of the respondents refused to walk due to the factor of cost inefficient and time constraint. Consequently, a portion amounting to 81% of respondents used car as a mode of transportation in Taiping. The respondent’s experiences and perceptions on walking around the Taiping town center were identified. Almost one third of respondents have encountered difficulties while walking around the town center due to the exceedingly provision of junctions within Taiping (refer to Table 2). Yet, most respondents were willing to walk for more than 500 meters and indicated that sports do encourage walking activity. While, more than half of the respondents informed that it is very difficult to find a toilet in Taiping town and most of them use their own toilet at home. Therefore, public transportation or even walking is not suitable and efficient for them. As all respondents understand very well about Taiping, the elements of information centre is not relevant experiences for them. Therefore, this explains the percentage trend in Table 2.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Percentage (%)</th>
<th>Locality</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>18.8</td>
<td>Resident of Taiping</td>
<td>93.8</td>
</tr>
<tr>
<td>Female</td>
<td>81.3</td>
<td>Non-Resident of Taiping</td>
<td>6.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Categories of occupation</th>
<th>Health Condition</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Sector</td>
<td>Good</td>
<td>100</td>
</tr>
<tr>
<td>Private Sector</td>
<td>Transportation Mode</td>
<td>18.8</td>
</tr>
<tr>
<td>Self Employed</td>
<td>Motorcycle/Bicycle</td>
<td>18.8</td>
</tr>
<tr>
<td>Student</td>
<td>Car</td>
<td>81.3</td>
</tr>
</tbody>
</table>
3rd International Conference on Rebuilding Place (ICRP2018)
13-14 September 2018
Impiana Hotel, Ipoh, Perak, Malaysia

<table>
<thead>
<tr>
<th>Housewife</th>
<th>6.3</th>
<th>Factors of Refusal to walk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retired</td>
<td>12.5</td>
<td>Weather Condition</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Lacking facilities</th>
<th>12.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary School</td>
<td>12.5</td>
<td>Cost and time management</td>
</tr>
<tr>
<td>Secondary School</td>
<td>37.5</td>
<td>Criminal issues</td>
</tr>
<tr>
<td>University</td>
<td>37.5</td>
<td>Condition of pedestrian walkway</td>
</tr>
<tr>
<td>Others</td>
<td>12.5</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 Respondents’ experiences before Hentian Komuniti

Table 3 demonstrated respondents’ perception towards Hentian Komuniti concept introduce in Taiping town after they went through the “Walk with Me” programme. In the programme, all 16 respondents were briefed about the special three elements that related to the walking motivation, heritage building appreciation and community participation. The participants were also briefed about the walking path from one Hentian Komuniti as well as its function including the free toilet services. The respondents were asked about their walking experiences and their feedback regarding facilities provided in Hentian Komuniti. It is found that almost half of the respondents enjoyed walking and agreed that walking is an unfatigued activity. Nevertheless, they agreed that walking can enrich their knowledge about the heritage building in Taiping town after they joined the “Walk with Me” programme. The respondents reported that they are interested to learn and explore on the historical parts of Taiping town although they passed by the same building everyday using car. This is an interesting outcome from the findings. However, two third of the respondents revealed the displeasure feelings towards walking as they felt threatened by crime and accidents while walking. Consequently, the respondent suggests to provide pedestrian walkway to eliminate the safety issue among the pedestrians.

Table 3 Perception towards walking and facilities after knowing about Hentian Komuniti and its facilities

<table>
<thead>
<tr>
<th>Walking Experience</th>
<th>Extremely Agreed</th>
<th>Highly Agreed</th>
<th>Agreed</th>
<th>Disagreed</th>
<th>Highly Disagreed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking as fatigued activity</td>
<td>6.3</td>
<td>6.3</td>
<td>18.8</td>
<td>25</td>
<td>43.8</td>
</tr>
<tr>
<td>Enrich knowledge</td>
<td>62.5</td>
<td>18.8</td>
<td>18.8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Enhance interests in exploring historical area</td>
<td>68.8</td>
<td>12.5</td>
<td>12.5</td>
<td>6.3</td>
<td>0</td>
</tr>
<tr>
<td>Safe from criminal threaten</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td>56.3</td>
<td>18.8</td>
</tr>
<tr>
<td>Safe from accident</td>
<td>0</td>
<td>37.5</td>
<td>25</td>
<td>37.5</td>
<td>0</td>
</tr>
</tbody>
</table>
The perception of respondents on the facilities provided in Taiping also were evaluated. Majority agreed that toilet is the most important facilities because it is the most frequently used by visitors especially when using public transportation. However, two third of the respondents claimed that the toilet provided was insufficient and inaccessible. At the moment, only 5 Hentian Komuniti are provided with free toilet services and this does not include paid toilet services in several spots in Taiping town at a very minimal cost.

The last section of the survey was evaluating the respondents’ awareness and perceptions towards Hentian Komuniti. Based on the findings, majority of respondents acknowledged about Hentian Komuniti through media and from word of mouth. However, approximately 38% of respondents were still not familiar with Hentian Komuniti. Majority agreed that the Hentian Komuniti promotes walking activity, thus, fostering the appreciation towards the historical buildings in Taiping. Most of the respondents agreed that the Hentian Komuniti enhances the tourist attraction in Taiping for future sustainability. The respondents also suggest to provide more Hentian Komuniti in Taiping so that it can cultivate healthy lifestyle by walking. In the findings, this paper highlights that there are chain benefits from the idea of Machinoeki or Hentian Komuniti implemented in Taiping. Although, the idea is basically new, the ability of the respondents to learn more about the heritage building while walking is a good sign that the community are willing to walk more in Taiping town. With safer walking facilities like pedestrian pathway, proper crossing lane and Hentian Komuniti services like
free toilet made available will be able to assist more people to walk and appreciate the town heritage in future.

Figure 1 Chain benefit effects of the Hentian Komuniti

3.2 Building Owners

A Focus Group Discussion (FGD) were set up before the programme was initiated in December, 2017. The idea to setup the FGD session was to inform and educate the building owners on the Machinoeki concept. One of the main concerns of the building owners was the outcome of the programme. The building owners were very anxious about the water and electricity bill that they have to bare during the programme as the result of giving free toilet service. Another concern was to know who should entertain the guest when they approached at their premises. Thirdly was a question related to the profit that they get from the programme. Most of the responses recorded were related to financial status. However, there are mix responses received from the government owned building like the Public Library, the Perak Museum and also the Taiping Gallery as they are less concern about the financial status. After 3 months, an individual interview was conducted towards each building owners regarding the short outcome of the programme. The motivation of all 5 building owners who participated in the programme are moderate and it is hoped with more training and education, building owners will be able to see the positive outcome from the programme. Some building owners were very skeptical about the programme outcome and were very silent. It is still very challenging to define the level of acceptance among the building owners in this programme as it is still new but the researcher able to anticipate that with enough education and awareness, they will accept this idea better in future. This is important as the maturity of the community including the building owners in implementing a new concept especially voluntarily for a free cost are still low if compared to other developed countries like Japan. The researcher could not put any high expectations towards the building owners as the concept is still new in Taiping and the outcome of the programme depends much on the feedback from the community first. Figure 2 shows a picture of all building owners participated in the programme during an appreciation ceremony by the local government. While figure 3 shows one of the programme participated by the researcher to educate the local community and building owners about Machinoeki concept that promotes hospitality and volunteerism.
The challenges to implement Machinoeki concept can be derived into four immediate outcomes of the project from the responses of the building owners and local community:

a. Motivation to do something for free without expectations among the building owners
b. Lack of safety, infrastructure and facilities for pedestrian were the main concern of the community.
c. Walking is not a culture among the local community
d. Awareness about the town history and heritage appreciation alleviates during walking.

The level of challenges in the implementation of Machinoeki concept among two different group participants are varied. The challenges faced by in the implementation among local community was mainly to attract more people to walk. The lack of walking gives direct impact to the rate of success in the project. Without people walking, nobody will use Hentian Komuniti services therefore the researcher was unable to access the level of success of the project. Different responses between building owners were received as each of the building owners provided different kind of services. Government owned building like the library and the museum received consistent number of visitors everyday due to the nature of its service. Therefore, more local community knows about Hentian Komuniti existence in Taiping or at least aware about it. Both building owners also able to give responses towards the use of toilet and information services as the number of visitors are acceptable. Instead, building owners of private building are still skeptical about the programme not only because there was no frequent visitors at their premises but the facilities to facilitate walking to the building is
very poor. As a result, people either drive to their building or did not use Hentian Komuniti functions such as pit stop either to rest or use the toilet services. According to the initial literature review, community involvement can be improved through awareness and more education about it. Therefore, with enough training and constant motivation about community involvement in town development the programme will be able to improve future situation. In addition to that, more participation also allows more people to voice out their opinion to improve town programme. For example, the lack of safety while walking was raised by the participants of the programme. Since, the number of vehicles on the road are high, many participants felt unsafe to cross the road and walk along the road. Proper infrastructure and facilities to accommodate pedestrian are needed to encourage more people to walk and to give more confidence. In addition to the added facilities, the existing building design can also act as pedestrian pathway. The five footway which is also part of the building act as perfect natural pedestrian pathway. However, the local authority needs to educate and inform the building’s owners not to extend their building or allow motorcycles to park at the footway. In cultivating walking as part of Malaysian culture, the people should be exposed through education on the benefits of walking rather than seeing this as a process to reduce traffic congestion. Cultivating walking as a culture is a worldwide problem but it is not impossible to conduct as many other countries has made evidence on the benefits of walking to the town. Other than health benefits, walking also increase the awareness of the town condition, appreciation towards the building history and its heritage values especially for town like Taiping. In addition to that, community will become more attach and will improve social communication among each other. This will create a better sense of place and improve the sense of belonging among the local community.

5 CONCLUSIONS

In conclusion, there are a few strategies that can be implemented in future to rebuild the historical town. Firstly, is to educate the community to care about the town starting as early as kindergarten age up until adulthood. The community needs to learn to do something without any expectations from the local authority and to do things voluntarily as part of their duties as a citizen. The changes in their action and mentality will improve other challenges such as walking motivation. Community will realize that more walking will improve better social communication, health and of course to reduce traffic congestion in the town. The promotion of walking culture is also part to improve the health of the community wellbeing. The education and continuous awareness about the town history from the local community must be initiated by family first and then to their neighborhood and the whole community. The concept of rebuilding the town will be realized if everyone work hand in hand to care for the town.

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REFERENCES


ENERGY CONSERVATION FOR MALAYSIAN PUBLIC UNIVERSITIES: A LITERATURE STUDY

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Abstract - Energy is commonly used widely around the world. This has led to a worrying scenario where more energy resources are extracted than found. Energy has become one of the essential inputs for social and economic development and a basic need in our modern life and contributes to a nation's growth and development. The wastage of energy is a great concern for universities and other industry. Universities are a place of knowledge and it is justifiable to propose or apply this method. The objectives for this research was to propose the best method of energy conservation, in the field of non-structural energy conservation method, by using literature study. The variables that are established are awareness, stakeholder involvement, top management support and energy management team. This literature review was based on the five universities that were selected. This research will contribute towards knowledge in scope of energy conservation, as well to inspire universities to participate in energy conservation.

Keywords - Best Practices, Energy Conservation, Public Universities

1 INTRODUCTION

Energy is widely used in human daily life, neither at home, shopping mall nor during working hours. According to Noranai and Kamalludun (2012), approximately 48% of all available electrical energy is used in commercial and office building in Malaysia. According to Sheau Ting, Hakim Bin Mohammed, and Wai Choong (2012), global warming is not the only reason for energy conservation, other related issues such as unstable energy price, uncertain future energy supply, as well as increasing world population will lead to higher energy demand and serve as reasonable motivation for the world to conserve energy.

The energy-economy threat is about the sky-high energy trading price. The continual rise in energy cost will impact developing countries adversely causing higher production price. Energy-security threat refers to the continual availability energy resources. The current scenario is worrying because more energy resources were extracted than found. Furthermore, the energy-environment threat concerns the degradation of the environment due to the production and use of energy, while the energy-social threat refers to global overpopulation. The steadily increasing human population is a burden to world resources and contributes to higher energy demand.

Energy conservation refers to attempts made to cut down energy consumption and is one of today’s most outstanding events in the energy market (Azlina, Siti, Abdullah, Kamaludin, & Radam, 2015). University is a place of knowledge, where ideas are generated, transferred, and creative solution is offered. It is a place of targeting local and worldwide communities. University campus has been identified as a place for that need to achieve sustainable energy conservation (Yen, Syarafina, Shakur, & Wai, 2010).

2 THE ISSUES

At present, renewed interest in energy conservation is motivated by concerns about environmental problems such as climate change, greenhouse gases, global warming and threats to biodiversity (Abrahams et al., 2009). Several sectors such as residential, commercial, industrial, and transport are influenced by the increasing energy consumption, especially in developing countries due to major developments (Hunt, V. D., 1982). According to Tang, F. E. (2012), “A better understanding of the
energy use pattern will lead to easier identification of more viable and cost-effective energy measures. Therefore, cutting operating costs in the long run”

In the future, total energy consumption in Malaysia is expected to increase and this corresponds with the estimation of the International Energy Agency (IEA), where energy consumption in Asia is forecasted to increase by 2.2 times in 2008-2035 (EIA, 2011). Energy wastage in a Malaysian university is mainly caused by inefficient energy use and lack of awareness among the users (Yen et al., 2010). Malaysian utility company, Tenaga Nasional Berhad (TNB) has raised electric rate in 2015, which directly will affect the university energy expenditure (Muhammad, H., 2017). The majority of the energy systems implanted in these facilities such as air-conditioning system and lighting are still manually operated.

Facilities manager from UTM and IIUM have agreed that local university nowadays are facing serious energy wastage problem, have cost them more than ten million Ringgit annually (Ng et al., 2010). TNB has raised electricity tariffs in 2015, the biggest concerns for many universities energy expenditure (Sukri, Yusri, Abdullah, Abdul, & Majid, 2012). The Malaysian Ministry Education (MOE) and The Malaysian Ministry of Higher Education (MOHE) has urged all education centers to play their role to save energy (Sukri et al., 2012). According to Yen et al. (2010), energy costs them more than ten million Ringgit annually and this burden the universities which has led to new thinking and search for new methods of economizing energy. According to Tang (2012), energy consumption increases when more air-conditioners are turned on and more electrical devices are in function.

Malaysia’s energy consumption increases every year, which involves universities as a major user in the classification of commercial building due to activities and populations, (Muhammad, 2017). According to Finlinson (2005), addressing energy conservation in large organizations that incur multi-level energy expenditures are particularly important. According to Tang (2012), one of the major environmental issues resulting from energy consumption is the emission of carbon dioxide (CO2) which contributes to global warming.

A previous study has investigated by Zhou et al., (2013), on energy consumption and conservation measures for universities and colleges in Guangdong. In Malaysia, a survey of energy conservation opportunities was conducted by Yen et al. (2010), a research by Tang (2012) on the implementation strategies for energy sustainability on a Malaysian university campus. Therefore, more studies need to be conducted to save cost of energy expenditure. Until now there is a limited study in ranking best strategies for energy conservation in Malaysian public universities. The study will lead to a better understanding of energy conservation pattern. As a result, it will lead to easier identification of cost-effective energy consumption

3 LITERATURE REVIEW

3.1 Definition of Energy Conservation

There is numerous definition offered in the literature of energy conservation, but the accurate definition of energy conservation is inconclusive. According to IEA (2007), energy conservation can be described as “Using less energy service and therefore saving the energy that would be needed to provide it”.

Cutler and Christopher (2006) define energy conservation as “A collective term for activities that reduce end-use demand for energy by reducing the service demanded”. Energy conservation refers to efforts made to reduce energy consumption and is one of today’s most prominent issues in the energy market (Azlina et al., 2015).

3.2 Energy Conservation Method

According to Yen et al. (2010), the use of efficient electrical equipment and application of passive technology in the building is categorized as structural energy management where public awareness, energy management, energy codes, regulation and other supporting elements are termed as non-structural energy conservation measures.

According to Choong et al. (2017), universities have a larger number of building users compared to industries and, therefore, the human factor is critical to energy saving. According to Yen et al. (2010), non-structural energy conservation includes integrating energy conservation concept in the management and co-curriculum of universities and improving energy awareness and energy use behaviour among
3.2.1 Awareness

Simpson (1994) has mentioned that energy awareness is an essential component of the energy conservation program on campus. Furthermore, energy saving among student will help them to be more aware about energy saving at home, work and in their life. According to Al-Mofleh et al. (2009), energy conservation in Malaysia can be achieved through integration of three tools one of it is supportive tools such as public awareness. “Behaviour” is defined as “the totality of infra and extra organism's actions and interactions of an organism with its physical and social environment” (Wolman, 1973). According to Vesma (2002), in terms of behavioural approach, attitudes, knowledge, consciousness, cognizance, and skills can tremendously aid in energy preservation. According to Yen et al.(2010), without energy awareness, effort in energy conservation can be unmanageable, which may contribute to energy wastage. Without the top-down initiatives or shared awareness combined with motivation, possibility of academicians being impartial to the project will arise (Elmuradov et al., 2015). For users, the university may set regulation, such as to forbid students from using rice cooker, televisions, refrigerator and other high current electronic appliances in a hostel. In addition, penalties can be imposed to enforce such a policy (Yen et al., 2010).

3.2.2 Top Management Support

According to Sheau Ting et al.(2012), commitment from top management has been identified as the key determinant of the success or failure of a program. Furthermore, without the commitment of money, time, personnel and other relevant resources, the program will not achieve the desired results. UniMAP’s Sustainable Group members believe, much has to be done, since there is a commitment by the Malaysian Government to reduce carbon footprint up to 40% by 2020 (Elmuradov et al., 2015).

3.2.3 Stakeholder Involvement

Abdullah Saleh (2016) assert good relationship between stakeholder is vital to meet the objective towards sustainability besides delivery of service to the society and country. Besides that, good communication within an organization can help to reduce much inefficiency.

To ensure energy on campus is utilized efficiently, sufficiently and adequately, a residential area that possesses relevant energy conservation knowledge plays a critically important part. The community must be educated about energy in order to practice conservation on campus. Without this knowledge, the community will not practice energy conservation and subsequently, this will contribute to energy wastage.

According to Yen et al.(2010), many conferences, seminars, and workshop on energy should also be conducted from time to time. Proving energy education is projected as the third implementation strategy to accomplish energy conservation objectives on campus (Sheau Ting et al., 2012). If the proof of concept is presented to convince management that new implementations will result in more benefit than current ones (Elmuradov et al., 2015).

3.2.4 Energy Management Team

Amber, Aslam, Mahmood, and Kousar (2017) are of the opinion that energy management team of universities are responsible for monitoring, analysing and maintaining energy consumption data of their buildings. They are responsible for preparing reliable energy consumption forecasts to prepare their energy budget.

According to Abdullah Saleh (2016), the efficiency of building and their equipment degrades over their service life, and even faster when they are not maintained properly. The Energy Management Group of Sustainable Campus Team at UniMAP were highly motivated to improve operation methods of chillers at the Campus, where results in change of practice reduced electricity usage (Elmuradov et al., 2015).

Yen et al.(2010) opine the simplest and most efficient method of maintaining energy is to operate equipment whenever it is required. Energy savings can be accomplished without affecting occupant comfort by turning the equipment off (Thumann, 1985). The motion sensor can be used for many purposes in university; the sensor will turn off if no movement is detected. This would reduce
unnecessary energy cost.

4 RESEARCH METHODOLOGY

This study was conducted using analysis of literature review on the energy conservation towards public universities. The sources of the study were mostly from the secondary data which is journal and articles. They were mainly drawn between 2005 until 2017 to assure the data obtained were updated based on the review on the current scenario of energy conservation for public universities.

5 FINDING AND DISCUSSION

Based on the review, the results had a few of similarities on the energy conservation. Table 1 summarized the appropriate energy conservation that was obtained from several authors.

Table 1 Energy Conservation

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Author and Year of Publication</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Xuan Zhou, Junwei Yan, Junwen Zhu, Panpan Cai (2013)</td>
<td>Survey of energy consumption and energy conservation measures for colleges and universities in Guangdong province</td>
</tr>
<tr>
<td>c</td>
<td>Ng Sock Yen, Elia Syarafina AbdulShakur, Choong Weng Wai, Ph.D. (2010)</td>
<td>Energy conservation opportunities in Malaysian universities</td>
</tr>
<tr>
<td>d</td>
<td>Low Sheau Ting, Abdul Hakim BinMohammed and Weng Wai Choong (2012)</td>
<td>Proposed implementation strategies for energy sustainability on a Malaysian university campus</td>
</tr>
<tr>
<td>g</td>
<td>Alia Abdullah Saleh (2016)</td>
<td>Critical success factors structural model for energy management of Malaysian public universities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-Structural Energy Conservation</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top management support</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1) Participate in energy saving activities</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Establishment of organizational</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Committed to resource allocation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4) Improve completed energy saving project</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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</tr>
<tr>
<td>Awareness</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>1) Motivation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2) Conduct Programme</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>3) Occupant Behavior</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>4) Implementing policies</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Stake holder involvement</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>1) Providing Education</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2) Promotion and Integration</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
3) Application new technologies and R&D

<table>
<thead>
<tr>
<th>Energy Management Team</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Operation and Building Maintenance</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>2) Monitoring energy usage</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>

6 RESEARCH FOCUS

The research will be focusing on the energy conservation in Malaysian public universities. Universities have a large number of buildings and facilities ranging from classrooms, halls, offices, restaurants, sports centres, libraries, labs, shops, clinics, hostels and other similar facilities. Mostly the percentage of energy utilization in universities is higher. For this scope of field only five (5) research universities shall be selected for this study, which is Universiti Putra Malaysia (UPM), University of Malaya (UM), Universiti Teknologi Malaysia (UTM), Universiti Kebangsaan Malaysia (UKM) and Universiti Sains Malaysia (USM).

The selection of these universities was due to their participate on in research, public universities and have their own strength in different aspects which have undergone changes to enhance their sustainability. UTM has launched several energy saving initiatives in 2010 such as “Sustainability Campus Campaign” and “Go Green Campus” within the campus to reduce the utility bills, (Sukri et al., 2012), and also receiving the Energy Management Gold Standard Certification under the ASEAN Energy Management Schemes (AEMAS) in 2011. For example, UKM has Institut Alam Sekitar Dan Pembangunan (LESTARI), UM has a Spatial Environmental Governance for Sustainability Research; UPM has a Sustainable Consumption Research Centre, USM has Centre for Global Sustainability Studies and UTM have Sustainability Unit.

7 CONCLUSIONS

This work will assist in improving the sustainability in building with best practice of energy conservation. This may further improve the energy conservation in the building and can avoid wastage of energy in public university buildings. Furthermore, it follows the government order to participate in energy conservation among universities.

This study will provide the opportunity to help the building management to control energy usage and avoid energy wastage. In condition to achieve energy saving construction, this also may aid them in solving the trouble of high energy consumption today. On the other hand, the Ministry of Education Malaysia has urged all education centers to conserve energy.

Other than that, it can improve the knowledge and act as a good reference for academicians in improving the best practices for energy conservation for universities. Thus, this may increase the amount of specialization and expertise related to the areas and professions.

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COMPATIBILITY OF VISIBILITY AND HARMONY OF PICTOGRAM: FOCUS ON RESTROOM MARK

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2Assistant Prof., Faculty of Prof. Design and Architecture, Kyoto Institute of Technology., Ph.D., Japan
3Associate Prof. Faculty of Design and Architecture, Kyoto Institute of Technology., Ph.D., Japan
4Prof., Faculty of Design and Architecture, Kyoto Institute of Technology, Ph.D., Japan

Abstract - In recent years, there are many various design signs to guide people. In the signature "pictogram" which enables guidance without using words is often used. However, when looking into a building, a signature using the pictogram is given its own design to match with the indoor space, and signs which are difficult for the user to understand are distributed. It can be thought that these pictograms are being redesigned to adapt to architecture. Therefore, this study aimed for a sign plan which is easy for users to understand, and the necessity in having one standard pictograms harmonizing with various buildings. Visibility is important for pictograms, and in this research, the objective is to study the conditions of pictograms that are compatible in visibility and harmony. For reference to the research conducted for each generation, an experiment using the pictogram of the Japanese Industrial Standard toilet mark, which had high recognition of all generations was conducted. The pictograms were divided based on gender that is pictograms for men and for women. The existing designs filled with colour and new designs with only contour lines are more harmonious using textures of concrete, brick, white wall, wood pictograms were synthesized. The researchers analysed and compared with all of these textures with the pictograms. As a result, the design of the outline of the pictogram for men and the pictogram for women is more harmonious in all scenes. The findings displayed that both male pictograms and female pictograms showed significant differences in the two scenes, and a significant trend was observed in the remaining two scenes. Experiments on the width of the contour line using 4 scenes images were conducted. The same experiment was conducted as comparison on the pictograms of the line widths with the greatest thickness. As a result, there was not much difference in the width of the width of the contour line of the pictogram in all scenes of male pictograms and female pictograms. The study also will highlight the effect on visibility and harmony by shape and color as future prospect.

Keywords - pictograms, compatibility, harmony

1 INTRODUCTION

1.1 Background and Purpose of Research

In recent years sign has been positively designed in Japan. For example, the 2020 Tokyo Olympic Games, Paralympic Games, signages were designed to make it easier for foreigners and tourists as well as Japanese to find objects, concepts, location. One of them was changing 7 kinds of pictograms so as to match the pictogram of the Japanese Industrial Standard (hereinafter referred to as JIS) and the pictogram of the International Organization for Standardization (hereinafter referred to as ISO), and 15 new pictograms and help marks were added. From this change, it could be seen that pictogram, which is a figure that provides information on objects, concepts or states regardless of letters and languages (Traffic Ecology · Mobility Foundation, 2017). Signage plays an important role in communication. Although the number of foreign tourists visiting Japan has declined after the Great East Japan Earthquake due to the visit Japan project, which is a visit to Japan promotion business (Japan Tourism Agency), it aims to increase the number of foreign tourists visiting Japan. Since foreign tourists visiting Japan are expected to increase in the future, the necessity of graphic symbols for guidance using pictograms will also increase. In Japan, there is a standard symbol to follow such as JIS Z 8210 "Public Information Symbols" for the pictograms guide. Public Information Symbols is "Everyone can understand even without professional or occupational training.
"JIS Z 8210" and is "a figure symbolised for guiding for unspecified large number of people [JIS Z 8210]." However, since JIS is an arbitrary standard, various other redesigned pictograms are often used. For example, you may see only contour line pictograms, angular designs, designs like illustration etc. From these facts, the pictogram of the signature has been redesigned to harmonize with the architecture. Although it is easier for users to unify figure symbols, it is possible to recognise quickly if the pictogram in any place is the same because everyone can understand common signs if signs were unified even if race and age are different. Therefore, I thought that a harmonized and unified pictogram is necessary in modern times where globalization advances. In this paper, the aim of the study was the design of pictogram is in harmony with various architectures. So many people can understand easily the Public Information Symbols.

2 COMPARATIVE EXPERIMENT OF PICTOGRAM

2.1 Outline of Experiment

Comparative experiments for 10 male students and 10 female students with the indoor space was conducted from December 28, 2017 to January 10, 2018. The researchers used the filled with color pictograms and only contour line pictograms (FIG. 1) and asked which pictograms are in harmony. In this research, I used the pictogram of JIS which was widely used in Japan, and I let test subject answer “which is more assimilated to the background texture filled with color pictograms or only contour line pictograms”.

![Figure 1: Filled with color pictogram (left) only contour line pictogram (right)](image)

2.2 Comparative Experiment Method

Indoor space Computer Graphics, which only the wall texture was different and the other elements are all the same, was created. I synthesized two kinds of pictograms for men's design and women's design which filled with color pictograms and only contour line pictograms for Computer Graphics of four scenes "concrete", "brick", "white wall" and "wood" (Fig. 2). We arranged these images on one display and experimented with the two pictograms harmonized with the texture of the wall of the indoor space.

![Figure 2: A comparative image (Filled with color pictogram and only contour line pictogram)](image)
2.3 Comparative Experimental Results

The experimental results are shown in Table 1 and Table 2. The numbers in the table are the number of people who answered that they are more harmonious compared the two pictograms. There were more responses. The only contour line pictograms are more harmonious than filled with colour pictograms except for the female pictogram on which wall texture is "brick".

<table>
<thead>
<tr>
<th>Table 1 Experimental result of male pictogram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Filled with color (people)</td>
</tr>
<tr>
<td>Only contour lines (people)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2 Experimental result of male pictogram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Filled with color (people)</td>
</tr>
<tr>
<td>Only contour lines (people)</td>
</tr>
</tbody>
</table>

2.4 Analysis of Experimental Results

The researchers conducted Chi-squared test with the statistically significant result obtained in the experiment or with a significance level of 5%. As a result, there was a significant difference in "concrete" and "wood" in the pictogram for men, and a significant tendency was seen in "bricks". Then, in order to correspond to all scenes, I conducted chi-square test on data of experiments of pictograms for all men, and a significant difference was observed. In female pictograms, there was a significant difference in "concrete" and "wood", and a significant difference was seen in "white wall". Significant differences were also seen in all pictograms for women when all the scenes were integrated. From these results it can be said that the only contour line pictograms are more harmonically than the pictograms filled with color. Therefore, as a next step, we conducted experiments on the width of the optimal contour line for only contour line pictograms.

3 EXPERIMENT ON LINE WIDTH OF ONLY CONTOUR LINE PICTOGRAMS

3.1 Outline of Experiment

In order to investigate the influence on visibility and harmony by changing the width of the line width of the only contour line pictogram, experiments using the magnitude estimation method (hereinafter referred to as ME method) were conducted. The researchers made test subjects answer about how easy it is to recognize compared to the standard image and how harmonized it is when compared to the standard image.

3.2 Experiment Method

5 kinds contour lines male pictograms and female pictograms, whose line width are all different, were used. The researchers synthesis them into 4 scene images of "concrete", "brick", "white wall", "wood (Fig. 3). These images are all the same without pictograms. In this experiment I covered 20 people in total, 10 men and 10 women. The participants were shown each image randomly every 5 seconds and white image between each image was inserted to avoid the influence of the previous image. The researchers had tested subjects see an image of the standard stimulus, and asked how much visibility and harmony when compared to the standard image.
3.3 Experimental Results

Function of $R = kSn$ (R: psychological quantity, S: physical quantity, k: constant, n: exponential exponent) was found for the physical quantity and the psychological quantity using the ME method. The results of the function in each scene regarding line width and visibility, line width and harmony of male and female pictograms were obtained. In this experiment, the line width is a physical quantity, and visibility and harmony are psychological quantities. Experimental results on visibility and harmony are shown in Tables 3 and 4.

Table 3 Experimental results on visibility of pictogram

<table>
<thead>
<tr>
<th>Surface</th>
<th>Male pictogram</th>
<th>Female pictogram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>$R = 159.7350S^{0.7312}$</td>
<td>$R = 160.8052S^{0.735}$</td>
</tr>
<tr>
<td>Brick</td>
<td>$R = 166.1116S^{0.9063}$</td>
<td>$R = 163.0797S^{0.8706}$</td>
</tr>
<tr>
<td>White Wall</td>
<td>$R = 164.3993S^{0.7365}$</td>
<td>$R = 164.7404S^{0.7201}$</td>
</tr>
<tr>
<td>Wood</td>
<td>$R = 172.3058S^{0.8551}$</td>
<td>$R = 157.7611S^{0.8742}$</td>
</tr>
</tbody>
</table>

Table 4 Experimental results on harmony of pictogram

<table>
<thead>
<tr>
<th>Surface</th>
<th>Male pictogram</th>
<th>Female pictogram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>$R = 55.0174S^{-0.6966}$</td>
<td>$R = 64.5952S^{-0.5893}$</td>
</tr>
<tr>
<td>Brick</td>
<td>$R = 64.1800S^{-0.6259}$</td>
<td>$R = 64.4614S^{-0.5717}$</td>
</tr>
<tr>
<td>White Wall</td>
<td>$R = 60.7016S^{-0.6238}$</td>
<td>$R = 62.7191S^{-0.6752}$</td>
</tr>
<tr>
<td>Wood</td>
<td>$R = 60.9256S^{-0.6517}$</td>
<td>$R = 64.4614S^{-0.5717}$</td>
</tr>
</tbody>
</table>

3.4 Analysis of Results

The purpose of this research was to clarify the design which visibility and harmony are compatible. Therefore, cases which only visibility or harmony of the values strongly works were excluded. Specifically, the difference between visibility and harmony on the function was found, and numerical values smaller than the average numerical value were adopted. The numerical value that takes the maximum numerical value in the function of the sum of visibility and harmony within the range below the average numerical value is the numerical value of this research. The results are shown in Table 5.

Table 5 Result of line width of pictogram with integrated scene

<table>
<thead>
<tr>
<th>Surface</th>
<th>Male pictogram(mm)</th>
<th>Female pictogram(mm)</th>
<th>Male pictogram(%)</th>
<th>Female pictogram(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>0.75</td>
<td>0.8</td>
<td>2.14</td>
<td>2.29</td>
</tr>
<tr>
<td>Brick</td>
<td>0.8</td>
<td>0.75</td>
<td>2.29</td>
<td>2.14</td>
</tr>
<tr>
<td>White Wall</td>
<td>0.8</td>
<td>0.8</td>
<td>2.29</td>
<td>2.29</td>
</tr>
<tr>
<td>Wood</td>
<td>0.8</td>
<td>0.85</td>
<td>2.29</td>
<td>2.43</td>
</tr>
</tbody>
</table>
In order to obtain the general-purpose numerical value of the line width, a percentage with respect to the length of the reference frame line of the pictogram (Fig. 4) was calculated. As a result, the pictogram for men has a line width of 2.14% in "concrete", the line width of 2.29% in the other three scenes with respect to the length of the reference frame line of the pictogram. In the pictogram for women, the line width of 2.29% in "concrete", "white wall", the line width of 2.14% in "brick", the line width of 2.43% in "wood". Figure 4 shows the pictogram of line width that is easier to see and match with architecture obtained in this research.

Figure 4 Pictogram with line width of 2.29% obtained from research

4 CONCLUSION

In conclusion, the pictograms were compared and analyzed filled with colour. The only contour lines pictograms we found in this study are more harmonic with the texture of the architecture than the pictograms filled with colour. Pictograms that were compatible with visibility and harmony was 2.29% of the line width compared to the reference frame of the pictogram in Figure 4. Furthermore, analysis of the experimental results suggest that there is little possibility that colours and shapes have influence on visibility and harmony because the results show little difference in the results between male pictograms and female pictograms. Likewise, because the results for each scene were similar in this experiment, the possibility that the visibility and harmony may not be influenced by the architectural texture may be considered.

5 FUTURE PERSPECTIVE

The researchers used four scenes in this experiment, but it did not correspond to the texture of various other architectures. Therefore, it is necessary to conduct experiments with various textures and standardize pictograms. In addition, the researchers used the toilet mark which is the male pictogram or the female pictogram in this experiment, they are relatively similar. Thus, it is necessary to confirm to what extent, shape and colour of the pictogram influences visibility and harmony strongly, conducting experiments with a pictogram showing an airport representing an airport, a pictogram showing a railroad representing a train station, a pictogram "P" representing a parking lot and a pictogram "i" representing an information corner which is completely different from a pictogram of a human type. Finally, there are color hue, saturation, and brightness as elements that improve the compatibility of visibility and harmony more. I think that by changing these color elements, we can obtain a pictogram suitable for further research purpose. According to the research of [Kishimoto et al. (2013)], since it is indicated that saturation has the most influence on attractiveness among hue, lightness, and saturation, I would like to clarify in future research for saturation.
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EVALUATION OF NATURAL LIGHT LEVELS IN
ARCHITECTURAL DESIGN STUDIO

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Email of corresponding author*: alfikhairina@gmail.com

Abstract - Indonesia as a country with tropical climate has an abundant sun exposure. This high level of sun intensity should be able to be utilized as the main light during the day. One of the places that can take advantage of this sun exposure is classroom, where teaching and learning activities never stop, and the demand for visual comfort is very high. One example is the Faculty of Engineering in Universitas Syiah Kuala. In this building there are four architectural studios which is Studio A, B, C, and D. These four studios are mainly used by architecture students as a place to design and draw. This drawing activity requires a good level of lighting. However, during the day where sunlight exposure is highly optimized, the use of lights as a lighting medium is still needed. If the lighting requirements cannot be met due to power shortage, drawing activities in this studio will be affected. Therefore, an evaluation of lighting designs for each studio is required. This study aims to evaluate the level of natural lighting in each studio by doing observation, surveys by questioners, and light measurement using Lux Meter. It is hoped this study will provide design recommendations to improve the natural lighting of the architectural studio.

Keywords - Natural Light Levels, Architecture Studios, Sunlight Exposure

1 BACKGROUND

Building is one of the largest energy users as stated by World Green Building Council. The construction sector absorbs as much as 30-40% of the world's total energy [1]. Therefore, the application of the concept of energy saving in buildings will be able to provide a significant effect on the sustainability of energy availability. One of the energy saving measures that can be applied to buildings is to optimize the design to accommodate the use of natural potential like lighting. Lighting that can be a major point in this energy saving process is natural lighting.

Natural lighting is a source of illumination that comes from sunlight. To obtain natural lighting a room, large openings or glass walls are required to be at least 1/6 of the floor area. Each room with different functions has different levels of indoor lighting requirements [2]. Fulfilling the standard requirements of indoor lighting levels is important. This is because when humans do any activity in the room, one of the most needed factors is the availability of lights, both natural lighting and artificial lighting. Without any lighting, the room will tend to be dark and can hamper any activities to be performed. Thus, if the lighting standard is met well, the activity can also be done optimally.

In addition, standard lighting levels must also be met in a studio because the main activity undertaken in the studio is drawing. If the room had a poor level of light illumination this will interfere with the activities of drawing. Furthermore, this will lower the quality of the design.

2 LITERATURE REFERENCES

Natural lighting is a source of illumination that comes from sunlight. Natural rays have many advantages. In addition to saving electrical energy, natural lights can also kill germs. To obtain natural lighting in a space, large windows or glass walls at least 1/6 of the floor area is required. Natural lighting is obtained by the entry of sunlight into the room through windows, cracks and open sections of the building. Thus, this ray should not be blocked by buildings, trees or high fence walls.
Soegijanto (1998) explains in his theory that natural lighting is meant to get the indoors lighting from natural light. In order to design natural lighting, the availability of natural light received at the site has to be known first. The availability of natural light is mainly influenced by two things, the first one is Geographical location, especially is the distance to the equator or degree of latitude, and the second one is Climate, which is the condition of the sky and type of clouds.

In optimizing the entry of natural light into a room, it takes some lighting designing strategy. These strategies will be helpful if appropriately applied to the design of the building. Below are the explanations of the strategy according to Lechner (2007):

1. Orientation, the best orientation is towards the south and north, and the worst orientation is towards the west and east.
2. The shape, shape of the building does not only determined by the combination of horizontal and vertical openings, but also by how many floor areas have access to natural light. Generally in many multi-storey buildings, the 15-foot perimeter zone will fully gets natural light, and 15 feet above it will only get natural light partially.
3. Use a separate opening for natural scenery and lighting. Use high windows, clerestory, or skylights for good natural lighting, and use low windows for scenery.
4. Color, interior with bright colors can reduce glare, dark shadows and the ratio of excess light levels, and also can reflect more light into space. The ceiling should have as much reflective factor as possible. The order of importance levels of the reflected surface is the ceiling, back wall, sidewall, floor, and small furniture.
5. Lighting through the roof, there are two advantages when using horizontal openings which are: first, they allow illumination that is not uniformly fair on a very wide interior area, while the natural light from the window is limited to a depth of 15 feet; secondly, horizontal openings also receive more light rather than vertical openings.
6. Space planning. It is very advantageous to bring light into the interior.

Even after all the factors mentioned above have already been identified and used as the initial reference in the study, the main thing that has to be considered in the measurement of natural light is that each room has varied illumination needs that depend on the complexity of visual work. The more complicated and detailed the works, then the room will require a greater level of illumination.

<table>
<thead>
<tr>
<th>Number</th>
<th>Visual Works</th>
<th>Illuminance (lux)</th>
<th>Glare Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regular vision</td>
<td>100</td>
<td>28</td>
</tr>
<tr>
<td>2</td>
<td>Rough work with great detail</td>
<td>200</td>
<td>25-28</td>
</tr>
<tr>
<td>3</td>
<td>Public works with reasonable details</td>
<td>400</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>Fairly hard work with small details (drawing studio, sewing)</td>
<td>600</td>
<td>19-22</td>
</tr>
<tr>
<td>5</td>
<td>Hard work, long duration of works, small details (hand sewing)</td>
<td>900</td>
<td>16-22</td>
</tr>
<tr>
<td>6</td>
<td>Very rough work, very long duration of works, consistant, very detailed</td>
<td>1300-2000</td>
<td>13-22</td>
</tr>
<tr>
<td>7</td>
<td>Extraordinary hard work, very detailed, need constant duration of works (ex: instrument making)</td>
<td>2000-3000</td>
<td>10</td>
</tr>
</tbody>
</table>

(Source: Satwiko, 2009)

From the table above, it can be concluded that the drawing studio has activities that are difficult and require a high level of detail. Thus, the minimum standard of illuminance level is at 600 lux.
3 METHODS

This research was conducted in Architectural Design Studio, Faculty of Engineering, Syiah Kuala University, located at Jl. Tgk. Syech Abdur Rauf No.7, Banda Aceh, Aceh, Indonesia.

![Figure 1: Engineering Faculty of Universitas Syiah Kuala](image)
(a) Exterior design, (b) Inside Studio A, (c) Inside Studio B

This research was conducted using three methods, which were observation, natural lighting level calculation and questionnaire. The results of the three research methods would be a reference in the creation of lighting design solutions that hopefully will help improve the natural lighting levels in each studio. In the process of making this design solution simulation using Autodesk Ecotect 2011 software was also used.

During observation method, a comparative study about the location of the object that had been selected was conducted. The result of this observation method is mainly about basic data about each studio, such as room size, number and type of openings, furniture used inside each studios, and solar orientation of the studios itself. Questionnaire method was conducted during the Architecture Design course. The researchers asked 20 potential respondents in each studio to fill out the questionnaire. When potential respondents were willing to participate, the researcher provided a questionnaire containing questions that have been prepared previously. The questions in these questionnaire are related to the level of visual comfort felt by the respondent being the user of the room. Using this method, the researchers also measured the level of illumination on the research object by using lux meter.

![Figure 2 Flowchart of the research methodology](image)
4 RESULTS

In the early observation, there were some problems that might be the cause on why sunlight could not enter the room optimally. The first problem identified during the observation was that there were many windows in this room not being exposed towards open area where sunlight can enter the room freely. There were only two sides of the walls that has openings, and there is one side of the wall where the openings are exposed towards the building's corridors. This prevents sunlight to get into the room. Second problem that was identified is that three out of four studios observed are located right between two other two-storey buildings. This shows that even if all of the windows are facing towards open area, these studios will always be exposed to the shadow of the building next to it., Thus, this also prevent the studios to be able to get as much natural lights as possible.

Besides, some problems that were identified made it easier to identify resolution during the process of making natural lighting design solutions. All of these studios are located on the second floor of the building, and there are different from other rooms located in Engineering Faculty building. There is no other room right above all of these studios, meaning that the alteration of ceilings or roof is possible during the process of designing the new solution for each studios.

The second method used in this study was a set of questionnaire, where in each studio, 20 participants were given two questions and they had to choose among the available answers. The first question asked participants’ opinion about the natural light condition inside the studio they were in. During this question, lamps inside the studio were switched off, so that the participants can feel directly the condition of the room only with natural light without the help of other kind of lighting. Majority of respondents stated that the studio they were using the lighting is dim. The exact number of answers are shown in Figure 4.

![Figure 3 Lux Meter used during natural light measurement](image)

![Figure 4 Respondents’ assessments towards natural light level inside each studio](image)
The second question was on the respondents’ preference about the natural light level inside the studio. The respondents were asked if they want to have the studio brighter or want the studio to be dimmer. Majority of the respondents want the studio to be brighter. The exact number of answers are shown in Figure 5.

![Figure 5 Respondents’ preference towards studio’s natural light level](image)

The third method used in this study was the natural light measurement using Lux Meter. This method was done simultaneously with the questionnaire. The amount of lux meter used in this method is six pieces, where one lux meter is placed outside the room, which to not obstruct any object. This was done so that lux meter can measure the bright light of the sky more accurately. The other five lux meters will be placed on five specified measurement points within each studio. In the measurement process, lux meter will be placed on the drawing table. This was done to know the value of illumination of light that exists on student workstation or student work area that is a table.

![Figure 6 Zone divisions and measurement points in each studio](image)

Based on the measurement of the natural lights, it can be concluded that no studio in each zone can achieve the lighting standard in a studio image that is 600 lux. Although it can not reach a minimum standard of 600 lux, it can be seen that among the four studios, studio C has the best lighting levels, while studio B has the worst lighting levels. Below is a graph of the average natural light in each studio measured previously.

![Figure 7 Graph of average lighting in each studio](image)
5  SOLUTION

Based on the respondents’ answers to the questionnaire, the majority of the respondents stated that a solution that makes it possible for more natural light to get into the studio is needed. The method used for the solution is by creating a simulation with Autodesk Ecotect Analysis software.

Figure 8 Result of current lighting level simulation

Figure 8 above shows the illumination calculation results in each of the drawing studios. In the simulation, the selected time is at 11.00, this hour is chosen because of the time consideration where the intensity level of sunlight is very optimal. The simulation result from Autodesk Ecotect Analysis and the calculation result using lux meter is similar, where the average illumination level in each studio is able to reach 250-300 lux, and the zone that has the highest illumination level is the zone near the openings of the room.

One of the many things that can be done in using simulation method is improving the natural lighting level in the drawing studio that is by enlarging the opening. Referring back to the results of calculations and simulations, the openings that should be enlarged and improved are openings that face the hallway. The problem with this opening is that its position is too high and is overshadowed by the shading above the hall, so natural lights cannot enter the room optimally.

Figure 9 The simulation results after the size change of openings

Once the openings facing the hall in each studio are enlarged, the A and B zones which are originally the darkest zones, the illumination level changes and the A and B zones level of brightness will nearly match the C and D zones.

6  CONCLUSIONS

The results of evaluation with several methods of data retrieval is that the four studios do not have the minimum requirement of light intensity. The results of the questionnaires from the respondents also concluded that each image studio requires a design change to make the natural lighting level more effective. One of the easiest steps to take is to clean the opening glass of the studio. In addition, another important step is to change the size of the openings on the windows that lead to the hall of the building.
REFERENCES
ADAPTIVE SETTLEMENTS TOWARD FLOODING IN THE RIVERBANKS OF MEUREUĐU RIVER, INDONESIA

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Abstract - Meureudu Riverbanks, was a pioneer place of a collective settlements, that was developed than eventually became a City of Meureudu in Aceh Province, Indonesia. Initially it formed as traditional fishermen settlements but has now shifted into modern settlements. However, the settlements have developed sporadically to form an unplanned pattern of settlements. This condition has resulted in low maintaining river, and has not adapted to the existence of the dwelling with the environment. Floods occur repeatedly in the river that affects the community. This study aimed to find the residential pattern design and adaptive settlements with Meureudu River watersheds. Easy and close access roads to markets created economy of the people in motion. This has also caused large number of unbridled migrants to enter and build the settlements. The method used is a combination of quantitative methods based on interview data and questionnaires and qualitative exploratory methods based on field observation. The data were collected through observation, field measurement and secondary data sources. The results show that the condition of settlements along the river basin do not reflect the culture of the river. In order not to further aggravate the condition of the settlement and its impact on the occupants, two types of houses, namely in the form of stage and non-stage are recommended. The stage house is located on the riverfront with an orientation overlooking the river. Undersea area can be used as security from the puddle of river water runoff during the flood and as a garden area and public while dry, while at a distance of 100 meters from the river non-stage house form might be built because the runoff of flood water can no longer affect on occupancy.

Keywords - adaptive settlements, riverbanks, floods, Meureudu River, Indonesia

1 INTRODUCTION

The majority of settlements have grown in areas around the water including rivers, lakes as well as seas (Mahatmanto, 2008). Meureudu River was initially started off as the beginning of collective settlements and eventually developed into the City of Meureudu. Currently, the city of Meureudu acts as the capital of Pidie Jaya Regency in Aceh Province, Indonesia, with the function as a center of district government, tourism activities, trade and service center and city of transit. However, the settlements growhave grown sporadically along the Meureudu River basin and have formed an unplanned pattern of settlements. Such conditions have resulted in not ideally circulating environments of settlements and resulted in poorly maintained river, bad infrastructure in the neighborhoods (swales) for drainage flow, unavailability of adequate green open spaces along the watersheds, and non-adaptive existence of the dwelling (both construction and distance) as a form of flood mitigation (Irwansyah et al, 2015). This condition has caused City of Meureudu to experience repeated floods that may harm the community.

Residential and human is an inseparable unity, involving mutually beneficial relationships and is strongly influenced by the quality of the environment and the quality of the individual. Human relationships with the environment reside are formed by various factors, among others: culture, environmental conditions, influence from outside, and behavior (Hirsan, 2011). Settlement is a collection of dwelling where initially each occupant mutually agreed formally and informally to form a community based on socio-cultural proximity. The socio-cultural relationship and the ability of each individual to adapt have greatly influenced the development of controlled settlements and provide a feeling of security for the residents. Many settlements have not developed but are uncontrolled and inconvenience to their inhabitants.
Adaptation is a strategy that humans use to respond to environmental and social changes (Allan, in Marfai, 2012). Maryono (2005) explains, rain factor is a natural condition that can cause floods depending on the intensity. Flood is a natural phenomenon that is part of the climate cycle. Floods cause disastrous for humans is the result of human intervention to nature (Kusumaatmadja, 2004, as cited in Suhandini, 2011). Flood is an ordinary natural event, then developed into a disaster problem if the water overflows disrupt the life, livelihood, and human safety (Setyowati, 2010). In order for settlements in Meureudu river watershed area to be sustainable, it is necessary to make adjustments to respond to repeated floods in Meureudu City. Marfai (2012) stressed that the adaptation process is very dynamic because the environment and human population are changing constantly. Human adaptation to the environment indicates the interrelation between humans and the environment (Desmawan, 2012). Flood adaptive housing model is one form of mitigation that can be recommended for the development of Meureudu City.

In Aceh Middle Term Development Planning Year 2012-2017 (RPJM) mentioned that the quality of the environment and disaster is one of the priorities of development to handle. If it was not handled properly it may impact the development of regional economy. The reason the research was conducted in the Meureudu riverbanks because it is a new district capital, and it includes an important development barometer in Aceh. Thus, planning in preparation for anticipated development and inadequate development and minimal disasters is a necessity that could not be postponed.

2 RESEARCH METHODOLOGY

The study was located in Meureudu City, 152 km from Banda Aceh City, precisely in Meureudu river watershed area. This area is used as trading area, fisherman's housing and its facilities with medium density level, and pond land.

![Map of Research Locations](source)

Figure 1 Map of Research Locations

Source: Detailed Spatial Planning (RDTR) Capital of Meureudu Sub-district, Pidie Jaya District

2.1 Study Approach

The method used for this study was mixed method. The method, which is a combination of quantitative methods based on interview data and questionnaires and qualitative exploratory methods that was based on field data (field observation) in the exploration of potential settlement Meureudu River.

Sources of data in this study include primary data derived from field research (e.g. observation, questionnaires, interviews, and documentation) and secondary data derived from literature review and documents from agencies related to this research. Data were collected through observation, field measurement and secondary data sources. Field observation is the most dominant portion in obtaining data and information.
Data processing uses analysis of survey results that have been done in the field related to the pattern of adaptation of the dwelling and the environment. The analysis process aims to understand certain phenomena in order to have a deeper knowledge through space. The complexity of phenomena reviewed was based on the process of formation and expression of spatial. In this case the symptoms were examined on how the process of flooding, adapted by the society to face the flood, form spatial pattern.

3 RESULTS AND DISCUSSIONS

3.1 Description of the City of Meureudu

The settlements in Meureudu River watershed include the oldest settlements. This settlement has a swampy type of land, with topography in the form of a gentle plain with an altitude between 2-5 m above sea level, having a slope classification of <8%. This is measured from the height of the river i.e. about -0.5-1 meter. This means that there are some residential locations below the level of river water.

In macro this settlement lies in the trading zone. Therefore, many residents work as merchants and shopkeepers. Other professions are civil servants. There are those who work as fishermen and fish farming and pond shrimp. In this area there is harbor Fish Landing Place (TPi). As a result many residents work as transporters. Based on data on the study site, 60% are of indigenous population and 40% of migrants. Factors such as easy and close access to markets influence the economy of the people. These have also caused a large number of unbridled migrants to enter and build.

Residents get land as a residence that is derived from inheritance, buy, or rent it. Non-stage house (land) dominates the shape of the house by 70% and in addition to the stage-shaped house. The orientation of the building is toward the river, sideways from the river, and back to the river. This is influenced by the changes in the environmental conditions where there are roads. The condition of the settlement paid less attention to the environmental hygiene problem, it is seen that people are still throwing garbage into the river and making the communal toilets (MCK) on the river.

Transportation routes are dominated by land access. There is an asphalt road that the frontal car can pass from downtown to the beach, while the road environment is made of concrete and land that can only be used by motorcycle. Besides land access there are still people who use river transportation normally by boat.

3.2 Land Use of Meureudu River Watershed and the Problems

The form of the settlement extends along the stream with the development in the border of the river to the mainland. The settlement of Meureudu City originally shaped the structure of a traditional fishing town settlement; it was characterized by the existence of open spaces and proximity to water access. From the analysis it was found that fisherman settlements in Meureudu City experienced a shift in function from traditional to modern. This condition is caused by the large number of migrant residents who have strong capital, have trade skills, and have good management skills, which can affect indigenous people.

The land use designation leads to the Meureudu River watershed leading to an optimal land use system that can support all regional functions. Newly grown homes on vacant land in the basin have resulted in irregular conditions. The composition of houses is very close together and there are unclear environmental roads. The settlement pattern of Meureudu River watershed area and settlement problems are as Figure 2.

The phenomenon of the width of the river 20-30 meters with a depth of 5-8 meters is given dykes as high as 1 meter from concrete rebates and boulders. Based on the RDTRK of Meureudu City 2014-2034, Meureudu River must have a minimum border of 5 meters along the outer leg of the embankment. In addition, the width of the river border 0-2 meters, almost along the river body directly adjacent to the wall of the building. Population growth is not followed by the availability of settlement land, resulting in the large number of residents who build buildings on the river border/buffer area. River buffers and water bodies are the determination of some distance from rivers or bodies of water that are allowed for flooding.
3.3 **Design of Adaptive Settlement Models**

This study resulted in the formulation of an adaptive settlement model with the Meureudu River watershed environment as one of the solutions to tackle floods. Planned two types of houses namely in the form of stage and non-stage. The stage house is located on the riverfront with an orientation overlooking the river. In addition, undersea area can be used as security from the puddle of river water runoff during the flood and as a garden area and public while dry, while at a distance of 100 meters from the river non-stage house form may be built because the runoff of flood water has no affect anymore.

Based on the settlement model recommended by the Ministry of Housing and Regional Infrastructure, the settlement model for the Meureudu River watershed area is an integrated design model that is planned by design. The choice of this model is due to several factors such as the people in this region has historically settled for a long time, so relocation is not an easy problem because people are reluctant to move to other places. Besides, the threat of flooding can come at any time. Thus, being friendly with floods is the right solution for the settlements in the City of Meureudu.
CONCLUSIONS

It can be concluded that besides being influenced by topographical factors of sloping areas and river boundaries that do not meet the standards, the floods in Meureudu City are worsened by the conditions of occupancy and infrastructure that do not respond to flooding. The easy and close access road to the market keeps the people's economy moving, but that aspect also has caused the large number of unbridled immigrants to enter and grow in the Meureudu River watershed. The concept of the above handling is proposed based on the study of settlement conditions and adapted to the needs and desires of citizens (interviews) because the concept has minimized the eviction house residents.

REFERENCES


THEORY OF COMBINATORIAL DESIGN FOR MODULAR ARCHITECTURE

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Abstract - Combinatorial is another sub-topic and sub ordinate of Golden Mean theory. This natural law of design has been experimented by various scientists and researchers in the past decades such as an architect Christopher Alexander, Nikos A. Salingeras (architectural theorist) and well known computer scientist, Stephen Wolfram. This paper is part of on-going research of modular construction system (MCS) in Malaysia. Objectives of the research were to propose an appropriate scheme and concept for sustainable design for modular home based on research findings (scope of on-going research by the researcher). The researcher conducted questionnaires survey (pilot study) and case study (Structured Expert Interviews) to collect data of MCS in Malaysia. Combinatorial in modular architecture is the theory of conceptual design for future building design process of MCS. The researcher discuss in details and to clarify the proportion combinatorial for MCS in aspect of building forms and arrangements through proposed combinatorial formula. In Malaysia, design technique should relate to local culture, weather, and available materials sources as mentioned by the experts. Combinatorial design of modular architecture is an alternative design for compact affordable home. This combinatorial geometry (shipping container size) repeated, duplicate and can be oriented in a few ways to forming combinatorial models of building design. Proposed concept possibly can improve user decision making (generating digital way of design process) e.g. building players to plan their building lifecycle projects in term of economical design, green shape, reduced construction time and cost. Thus, it may be able to promote user friendly design, fast track construction, and quality based product, less wastage and varied of design selection can be chosen of the user.

Keywords - Combinatorial Geometry, Modular Architecture, Spatial Planning, Sustainability

1 INTRODUCTION

The basic aspects of architectural design were the buildings must conveniently and functional to use, durable and delight (Morgan, 1960). Nikos A. Salingeras criticized architects nowadays were more on popularity rather than to fulfill the main purpose of basic, function and needs of architecture itself. As the function of architecture were to protect the environment and fulfill human need of habitat. The true architecture not just for visual eye and sculpture but it is for functional structure. The structure that built by several series of spaces with considering the needs of people and the relation of structure to the ecology. Sustainable design is essential for the development of architecture that can meet the needs of future. Alexander stated pattern was important part of architectural design. Pattern defined as ordered and logical structure (Salingaros, 2004). Pattern can be found in natural environment, human, art, space, time, and music. The definition of Mathematics itself is a science of patterns. Successful buildings obey the same system law as a complex organism and an efficient computer program. The user used the building to suite their own needs of common and daily life while the contractor tried to minimize cost and to standardize the building parts. This happened because of to make their activities easier and convenient to their own needs (Salingaros, 2004). Naturally, architects and engineers are not exactly expert in construction means and method (Siang, 2006). In Malaysia, the construction industry is highly aware of the need to improve the integration, planning and control of its design and production process (Nawi et al, 2009). Consequently, the reality of construction is that most of the problems encountered in the field such as reworks, delay, low in quality or productivity and even legal entanglement and claims often compounded by inherent design flaws that generated in
the design phase (Nawi et al, 2009). As quoted by Horikoshi et al, to realize sustainable building design, improving energy efficiency by architectural passive design is essential at the conceptual design stage. With the raise of complex social structure and culture, humans began to modify their natural environment to better fit their needs (Werner & Long). Architecture is designed to satisfy the different representational, functional, aesthetic, and emotional needs of organisations and people who live or work in structures (Werner & Long). Affordable home price normally in between RM 250,000 to RM400,000 (N.R, 2011). The type of affordable home can come in different range of types and sizes such as for singles, couples, families and flat shares as well as for seniors.

2 MODULAR ARCHITECTURE IN MALAYSIA

In Malaysia, MCS or Offsite Manufacturing included in Industrialised Building System (IBS). The definition of offsite is the manufacture and pre-assembly of components, elements or modules, before installation into their final location (Goodier & Gibb). To relate MCS and Malays culture, Traditional Malay Architecture was successful and be at its best of its time for prefab and modular design in the country. With a direct dependence of a nature for its resources and embodying a deep knowledge of ecological balances, the house is efficiently designed to suit the local climatic requirements using various ventilation and solar-control devices and low-thermal-capacity building materials. The house also evolved a prefabricated building system which is flexible and varied to suit the needs of the users (Yuan). It was known for the first prefab in the world. It has also developed a very sophisticated addition system which allow the house to be extended in line with the growing needs of the users. How to gain this kind of achievement still leave question marks to the building players such as architects, building designers and researchers itself. As modern design of building more focus on reduced cost and to gain more profit then to think to give the comfort to the user. The current available and major materials for building construction were steel and concrete. As mentioned by Z, 2015 the problems of modular construction in Malaysia were about limited durable materials and higher cost. The improvement of constructability rarely been mention as the benefit of offsite but in theory offsite can improve constructability by providing designers with the fresh perspective and outlook on the concept of repetition, preassembly and standardization (Nawi et al, 2009). Form and energy efficiency is related between each other. Cities are main leak of the country. Nowadays, people look at the idea to find alternative urban model in the city itself (Chiri et al. 2012). The configuration of urban spatial structure, together with the different land use patterns, is dependents on the availability of renewable and energy resources in the area. Nevertheless the complexity found in the changeover to new sustainable models cannot be attributed only the moment of transition in which we live, rather than the confusion hidden behind the concept of "sustainability".

3 COMBINATORIAL FOR MODULAR ARCHITECTURE

Modularity in general is part or series module of something whether it became appliances, furniture, machinery, automotive, aerospace, or buildings. Constructed a modules or unit packaging schemes. Standard parts of modular approaches offer gains in time, cost and quality (Bertram, 2005). For building design, modular refer to parts of a building define by 3D compartments such as LEGO. As combinatorial is arrangements and combination of geometric objects and with discrete properties of these objects. Mentioned by Christopher Alexander houses were generated by patterns. Spatial configuration is concerned with finding feasible locations and dimensions for a set of interrelated objects that meet all design requirements and maximize design quality in term of design preferences (J.J Michalek et al, 2002). Spatial configuration is relevant to all physical design problems, so it is an important area inquiry (J.J Michalek et at, 2002). Reported attempts to automate the process of layout design started over 35 years ago (Levin, 1964).

Geometry decomposition was one of the ideas on ways to relate modular construction and combinatorial things. Combinatorial geometry is the study of combinations and arrangements of geometric objects and with discrete properties of these objects. Historically, modularity has played an
important role in the study of combinatorial geometries (Brylawski, 1975). The questions might concern, for example, the complexity of arrangements of objects of the above type or the occurrence of certain substructures in such arrangements. Besides that, the term combinatorial geometry related to the field of combinatorics. The divaricate of math dealing with combinations of objects belonging to a finite set in following certain limitations, like those graph theory called as combinatoric. Theory development of combinatorial design has brought incredible success; in the application is not expected, in connection with basic math, and the desire to produce order out of chaos, obviously (Colbourn, 2003). Moreover, he questioned about the future of application of combinatorial geometry. He explained that new mathematical truths will be found and that unanticipated application will arise. The challenge is to seek both and to know that each profit from the other (Colbourn, 2003). Christopher Alexander in his book, Pattern Language, defines patterns in a solution of space. In an aspect of design, combinatoric as mathematical approach can be found in the research by Alexander Christopher. The building blocks can be combined in an infinite number of ways (Alexander, 1977). The question is for a given fixed area which shape will create the greatest feeling of spaciousness (Alexander et al, 1977). There is mathematical answer for this question. In this research proposed square as building blocks. The general objective of combinatorial concept for Modular Architecture are; To reduced design and construction cost, To reduced design and construction time, Greater flexibility in term of shape to maximize building function in aspect of space and usability, Shorter and cheaper maintenance periods, To reduced maintenance cost, and To optimize building function and design.

3.1 The Methods of Combinatorial Concept for Modular Architecture such as following diagram:

The objective was to develop of necessary strategies, standards, designs, specifications and procedures for cost reduction through equipment modularization, equipment standardization and process simplification. The products of combinatorial providing a repetition of identical units, both in the dimensioning building spaces as well as in the layout of the building. This theory may give option and maximize option focusing on affordability home project in Malaysia for the users. Its response on the issue of individual housing needs. Neither the demand of affordable home in Malaysia is increasing nor the demand to own the house itself. With this theory, it might provide more idea in producing affordable home in the near future. Figure 3.1 shows best shape for MCS of public housing design has been choosing by the experts through structured interviews questionnaires in Malaysia. The experts chose Pattern B as the most practical shape of affordable home design. It was 75% from the total rating by the experts. Concurrently, 25% chose pattern A as the best shape design for MCS in Malaysia. This is the second best shape for modular design by using combinatorial concept. Pattern A and B were considered to be the best as it was economical and practical. Other patterns were not favorable due to issues such as less economical, used a lot of footprint and poor ventilation in terms of arrangement and orientation.

As suggested by experts, Pattern A and B were the best shape for house pattern arrangement. Therefore, the researcher proposed five (5) combinatorial ways of most practical pattern for affordable homes as agreed by architectural and design experts on the most practical pattern arrangement. The pattern proposed is based on a single unit of high-rise home. The method proposed by the researcher entitled as Combinatorial Concept of design. The combinatorial tiling is defined as a process or technique to figure out the floor plan and pattern composition by repeating the modules in the given square area. The figures (3.3, 3.4, 3.5, 3.6, 3.7, 3.8, and 3.9) in the next discussion were house pattern suggested by the researcher for affordable homes (Type A, B, C, D and E) in Malaysia. Methods and calculation of combinatorial design stated and described in next discussion as below:

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<td>a) Home Type A (600-800 sqft)</td>
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<td>Home Type A (Figure 3.3) consists of approximately 600 to 800 square feet (sqft) of floor plan area. The selection of five (5) methods of combinatorial designs has been carried out from the geometric probability formulation. Proposed methods as logic modules combination and serve only as a guideline where in practice outcome of pattern proposal will depend on land topology. The pattern formulated is simplified in a diagram as shown in Figure 3.4.</td>
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There are five methods of combination using geometric probability idea. In the Method 1 combination, the module combination is the combination of two B modules, two C modules and one D module. Method 2 incorporated the combination of five C modules. The combinatorial pattern of Method 3 consists of one D module and three C modules. Meanwhile, method 4 consists of two D modules and one C module. The fifth method embraces of two D modules. The pattern was formulated using combinatorial probability and geometrical probability equation as further explained in the points below. Figure 3.5 shows geometrical probability, $P$ approach of Home Type A. The shaded area indicates the expected total area of Home Type A. Below is formulation example of combinatorial design for Home Type A:
Given equation for Combinatorial Probability as \( C \),

\[
C = nr = (xr)!
\]

**Combinatorial Design**

**Method 1**

Modules (\( x_2, x_3, x_4 \))

To Simplify \( n_1 = [1(x_2), 1(x_3), 1(x_4)] \)

\[
\begin{align*}
\text{Given two (2) modules of } &B, \text{ three (3) modules of } C \text{ and one (1) module of } D \text{ to make a home with 800 sqft floor area. The stated combinatorial design of Method 2 can be simplified in equation such as shown below:}
\end{align*}
\]

\[
2B + 3C + 1D + k_1 = 800\text{ft}^2 + k_1
\]

Where,

- \( C = \) Combinatorial probability
- \( n = \) total area/object
- \( r = \) Object counting of 1
- \( x = \) Object counting of 1 x square area
- \( 0! = 1, \) Factorial

\[
B = \text{Module with 80 sqft floor area}
\]

\[
C = \text{Module with 160 sqft floor area}
\]

\[
D = \text{Module with 320 sqft floor area}
\]

\[
k_1 = \text{Balcony with 30 sqft floor area}
\]

\[
k_2 = \text{Balcony with 60 sqft floor area}
\]

\[
\begin{align*}
P(X) &= \frac{\text{area of desired outcomes}}{\text{area of total outcomes}} \\
&= \frac{nr}{(nr)}
\end{align*}
\]

Where,

- \( P = \) geometric probability
- \( X = \% \) of geometric probability
- \( n = \) total area/object
- \( r = \) Object counting of 1
- \( x = \) Object counting of 1 x square area

\[
P = 100\%
\]

\[
C = \text{nr} = (xr)!
\]

Note:

To consider \( C = nr \) as earlier formulation for combinatorial probability

\[
P(\%) = \frac{[2(x_2)+2(x_3)+1(x_4)]}{n_1}
\]

\[
C = \frac{800\text{ft}^2}{800\text{ft}^2} = 1
\]

\[
P = \frac{[1(100)]}{1} = 100\%
\]
b) Home Type B (801-1000 sqft)

Home Type B (Figure 3.6) covers approximately 801 to 1000 square feet (sqft) of floor plan area. The selection of five (5) methods of combinatorial designs has been derived from the geometric probability formulation. The proposed method as rational modules combination and it is for recommendation only whereby in practice the proposed pattern will be determined by land topology. The pattern formulated is streamlined in diagram as shown in Figure 3.7. Figure 3.8 shows the geometrical probability approach of Home Type B and it shows the expected total area of Home Type B.

![Figure 3.6 Type B Affordable Home Pattern](image)

![Figure 3.7 Morphology of Home Pattern Type B](image)

![Figure 3.8 Geometrical Probability Approach for Home Pattern Type B](image)

c) Home Type C (1001-1200 sqft)

Home Type C (Figure 3.9) comprises of around 1001 to 1200 square feet (sqft) of floor plan area. The selection of five (5) methods of combinatorial design has been carried out from the geometric probability formula. Suggested methods as practicality modules combination and only for parameter where in practice the proposed pattern will be subject to land topology. The pattern formulated in simplify home morphology diagram as Figure 3.10.

![Figure 3.9 Home Type C Affordable Home Pattern](image)

![Figure 3.10 Geometrical Probability Approach for Home Pattern Type C](image)
Figure 3.9 Type C Affordable Home Pattern

Figure 3.10 Morphology of Home Pattern Type C

Figure 3.11 Geometrical Probability Approach for Home Pattern Type C

Figure 3.11 shows geometrical probability approach of Home Type C. The shaded area indicated expected total area of Home Type B.

d) Home Type D (1201-1400 sqft)

Figure 3.12 Type D Affordable Home Pattern

Figure 3.12 Type D Affordable Home Pattern
Home Type D (Figure 3.12 and 3.13) covers of approximately 1201 to 1400 square feet (sqft) of floor plan area. Range five (5) methods of combinatorial designs have been carried out from the geometric probability formulation. Anticipated methods as logic modules combination and only for guideline where in practice the outcome proposal pattern will depend of land topology. The pattern formulated in simplify diagram as Figure 3.14. Figure 3.15 shows geometrical probability approach of Home Type D. The shaded area indicated expected total area of Home Type D.

![Figure 3.13 Morphology Home Pattern Type D](image)

![Figure 3.14 Geometrical Probability Approach for Home Pattern Type D](image)

e) Home Type E (1401-1600 sqft)

Home Type E (Figure 3.16 and 3.17) covers of approximately 1401 to 1600 square feet (sqft) of floor plan area. Selection five (5) methods of combinatorial designs have been carried out from the geometric probability formulation. Proposed methods as logic modules combination and only for guideline where in practice the outcome proposal pattern will depend of land topology. The pattern formulated in simplify diagram as Figure 3.18.

![Figure 3.15 Type E Affordable Home Pattern](image)

![Figure 3.16: Type E Affordable Home Pattern](image)
Figure 3.19 shows geometrical probability approach of Home Type E. Shaded area indicated expected total area of Home Type E.

![Figure 3.18 Geometrical Probability Approach for Home Pattern Type E](image)

Table 3.1 shows formulated floor area with combinatorial design proposal for affordable home scheme.

Table 3.1 Formulated Floor Area using Combinatorial Probability Approach; Types of Floor Pattern of Affordable Home and Conceptual Formula

<table>
<thead>
<tr>
<th>Methods</th>
<th>Types/Floor Area (sq ft.)</th>
<th>Types/Area (sq ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/ft²</td>
<td>A = 600-800</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B = 801-1000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C = 1001-1200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D = 1201-1400</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E = 1401-1600</td>
<td></td>
</tr>
<tr>
<td>1/ft²</td>
<td>2B + 3C + 1D = 1000 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A + B +</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3C + 1D + k₁ = 1200 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3B + 4C + 1D + k₁ = 1400 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1B + 4C + k₂ = 1600 + k₂</td>
<td></td>
</tr>
<tr>
<td>2/ft²</td>
<td>5C + k₁ = 800 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6C + k₁ = 960 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1B + 3C + 2D + k₁ = 1200 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1B + 2C + 3D + k₂ = 1360 + k₂</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4C + 3D + k₂ = 1600 + k₂</td>
<td></td>
</tr>
<tr>
<td>3/ft²</td>
<td>3C + 1D + k₁ = 800 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3C + 1D + k₁ = 800 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1B + 1C + 4D + k₁ = 1200 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1B + 8C + k₂ = 1360 + k₂</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2C + 4D + k₂ = 1600 + k₂</td>
<td></td>
</tr>
<tr>
<td>4/ft²</td>
<td>1C + 2D + k₁ = 800 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2C + 2D + k₁ = 960 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1B + 7C + k₁ = 1200 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6C + 1D + k₂ = 1280 + k₂</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2C + 4D + k₂ = 1600 + k₂</td>
<td></td>
</tr>
<tr>
<td>5/ft²</td>
<td>2D + k₁ = 640 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3D + k₁ = 960 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1C + 3D + 1k = 1120 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4D + k₂ = 1280 + k₂</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5D + k₂ = 1600 + k₂</td>
<td></td>
</tr>
<tr>
<td>6/ft³</td>
<td>(5C)8 + k₁ = 6400 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3D)8 + k₁ = 7680 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1C + 3D)8 + k₁ = 8960 + k₁</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(4D)8 + k₂ = 10240 + k₂</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(5D)8 + k₂ = 12800 + k₂</td>
<td></td>
</tr>
</tbody>
</table>

(Source: Salmiah, 2018)

3.2 Findings: Probability in Modular Architecture

Combinatorial concept proposed by researcher for MCS is correlation with data science process. In combinatorics, probability of things leads to data science. The researcher simplifies the data collected and presented as a scope of data science in term of architectural design especially. In brief, the formulated solution of raw data collected simplified in Combinatorial concept of Modular Architecture Framework as shown as Figure 3.20 below.
Therefore, from the findings the researcher suggested combinatorial concept is design alternative technique to improved current MCS issues in Malaysia. To give an example of combinatorial aspect; the formulation of Affordable Home Type A consist of 600 to 800 sq ft floor area introduced as equation $2D + k1 = 640 + k1$ meaning that the combinatorial code for Home Type A is $A(2D)$. To explain: $2D + k1 = 640 + k1$

Where,

- $D =$ Module with 320 sq ft floor area
- $k1 =$ Balcony with 30 sq ft floor area (giving 0 finite of home square area)

Combinatory code produced for Home Type A is $A(2D, k1)$.

To summarise the home combinatory code for example:

a) Home Type A
   $A(2B, 3C, 1D, k1), A(5C, k1), A(3C, 1D, k1), A(1C, 2D, k1), A(2D, k1), A[[(5C)]8, k1}$

b) Home Type B
   $B(2A, 1B, 3C, 1D, k1), B(6C, k1), B(3C, 1D, k1), B(2C, 2D, k1), B(3D, k1), B[[(3D)]8, k1}$

c) Home Type C
   $C(3D, 4C, 2D, 1D, k1), C(1B, 1C, 4D, k1), C(1B, 7C, k1), C(1C, 3D, k1), C[[(1C, 3D)]8, k1}$

d) Home Type D
   $D(1B, 4C, k2), D(1B, 2C, 3D, k2), D(1B, 8C, k2), D(6C, 1D, k2), D(4D, k2), D[[(4D)]8, k2}$

e) Home Type E
   $E(10C, k2), E(4C, 3D, k2), E(2C, 4D, k2), E(2C, 4D, k2), E(5D, k2), E[[(5D)]8, k2}$

This code may be presented for user satisfaction assessment e.g. building player or home buyers to give selection of products before proceed for prototype (testing) or construction of the product (home unit). This might be able to reduce product waste with using this statistical satisfactory from user. To clarify, there are needs further exploration of the concept proposed in order to understand and realized what combinatorial concept may help and improve building life cycle. Computer software or apps is linked with code is suitable to develop the concept further.
4 RESEARCH METHODOLOGY

A collection of data analyzed in this paper is obtained through literature review from other authors in the aspect of IBS and MCS development towards meeting green construction and innovation in Malaysia and combinatorial geometry topic. The data has been collected through questionnaires survey (pilot study) and case studies (structure interviews with the experts) in Malaysia. Feedback for the questionnaires was very slow by using online questionnaires survey with total 500 online respondents and 20 questionnaires by postal. 6% of respondents were given feedbacks for the questioners of the total respondents. Based on the feedback of this pilot study, the researcher decided not to continue using this method as a major research method due to the inaccuracy of data. The result of the questionnaires survey might be bias and differs due to the high percentage of non-response. In addition, case studies method were conducted to get reliable data. The researcher contacted Mr. Nazrol from CIDB centre to obtain information on MCS companies which are registered under CIDB in Malaysia. Only four MCS companies were registered in 2015. The researcher also collected relevant documents of MCS from personnel experts throughout the case studies. Besides that, the researcher also collected data relevant to the study such as photos, size and dimensions, specifications, cost, materials using of the construction, location and any other relevant information. The analysis attempts to review the definitions, characteristics, issues, trends and sustainable design of modular construction and scientific way of architectural design (in aspect modular architecture).

5 RECOMMENDATIONS AND CONCLUSIONS

Suggested of the combinatorial concept for MCS might be able to cover issue product modularity in sustainable shape design especially. This concept will improve user decision making e.g. building players in order to look for appropriate methods before to proceed with any decision of prototype, testing and hands-on construction at site. Thus, with the concept proposed by the researcher it may be able to promote user friendly design, fast track construction, and quality based product, less wastage and varied of design selection can be chosen of the user. The combinatorial concept was developed based of economization of product and risk management approach (based on Literature Review) with direct engagement from practitioner in construction industry to choose best shape of design to look for in MCS. Despite this combinatorial concept not been testing yet unto real world consideration, should future research to look into account this method for further research and assessment. Area to be considered in order to sustain of the concept development in future such as computational software based. Due to the formulation of affordable home based on combinatorial probability and combinatoric code. As combinatoric code has been used in field of Artificial Intelligence (AI) and Internet of Things (IOT) The objective was to develop to necessary strategies, standards, designs, specifications, and procedures for cost reduction through equipment modularization, equipment standardization and process simplification. The products of combinatorial providing a repetition of identical units, both in the dimensioning building spaces, as well as in the layout of the building. With this theory, it might be provided more idea in producing affordable home in the near future. Through the reuse of formwork, sustainable and inexpensive designs can be attained. The system allows for the customzation of designs, while maintaining the benefits of a regular prefabrication product, so their cost and performance can be improved over time (Jonas et al. 2014). Challenge of MCS in Malaysia is vastly complex but to apply this alternative construction system in near future is inevitable action. So, the right track and steps of conceptual and construction technique certainly can help narrow down suitable solution of current problem faced by building players to apply MCS in construction industry. In short, the combinatorial design was an experimental design to find out the sustainable shape and economic way of design.

REFERENCES


AN ASSESSMENT OF OUTDOOR THERMAL COMFORT OF BAITURRAHMAN MOSQUE IN BANDA ACEH

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Abstract - The thermal comfort of the outer space is an important thing to study. This would be the same as well as with the inner space of the mosque, especially if the outer space has a function that is tied to the inner space. Baiturrahman Great Mosque is a building of worship that has an outer space with enough important functions in the form of haram to perform prayers. The thermal comfort evaluation of the outer space of the Baiturrahman Grand Mosque of Banda Aceh is conducted to determine the thermal condition in order to optimize the function of the outer space in relation to thermal comfort. This research uses done by doing literature review, field observation, interview and filling questionnaire as well as make direct measurements about environmental influences such as air temperature, wind speed, solar radiation, humidity and review the influence of the outer space parts such as floor surface and use of imagery associated with external thermal conditions. Based on the design characteristics of the Grand Mosque of Baiturrahman Great Mosque some things that affect thermal comfort such as the use of floor materials, imagery and vegetation elements. Of the various indicators, which most affect the sensation of heat in the outer space of the Baiturrahman Great Mosque is the availability of imagination elements. In areas where perception is perceived to have the highest value +1.4 is a rather warm sensation and in areas without imagery has the highest value of +1.5 is a warm sensation. While the material element affects the sensation of heat in the skin stimulus due to its conductivity. In this case the natural ceramic floor material provides the highest heat stimulus on the skin with an average temperature of 47.3 °C and the lowest temperature is found on the shaded grass material of 28.2 °C.

Keywords - Thermal Comfort, Outer Space, Thermal Condition

1 INTRODUCTION

Banda Aceh, that is in the humid specify climate, has a thermal condition with high radiation and climate temperatures, with high humidity levels as well as fluctuating wind velocity. Therefore, it needs an architectural design that create comfortable micro climate. In architectural design, comfort is essential for both inner and outer space.

Baiturrahman Great Mosque Banda Aceh is one of 132 mosques that is located in Banda Aceh. It has a land area of 31000 m² with a building area of 4000 m² (Simas Kemenag, 2017). The mosque that was built since 1875 has been renovated with a large scale, especially on the outside space. Before being renovated, the Baiturrahman Grand Mosque was surrounded by a lawn with green grass and several types of trees. The grass is known to reduce the heat coming to it because of its good ability to absorb heat. This allows the creation of a cooler thermal environment compared to the condition of the soil without grass. Prior to renovation, trees can provide imagery and also reduce the heat intensity directly from the sun. Vegetation elements such as grass and trees make the thermal conditions of the outer space becomes cool.

However, the condition of the outer space of the Baiturrahman Grand Mosque has now changed. After the renovation in the outer space, the pasture has been replaced with marble ceramic material. 12 units of large electric umbrella are also installed to provide coolness (Reza Munawir, 2017). This will certainly change the thermal conditions of the area that are affected by the impact of sunlight reflections from the marble floor material. Around the building 35 palm trees has been planted. But palm trees are less effective in reducing heat from the sun. The existence of 12 umbrellas is expected to reduce heat, however, the umbrella does not cover the entire floor area.

The design of outer space of Baiturrahman Grand Mosque Banda Aceh which was renovated must have different heat conditions. From the above descriptions, this study was carried out to...
evaluate the influence of outer space design on Baiturrahman Great Mosque for thermal comfort around its area.

2 THEORITICAL REVIEW

2.1 Thermal Comfort in Outer Space

According to ISO 7730, thermal comfort is a state of mind that expresses human satisfaction with the thermal environment. Another opinion expressed by Karyono (2001: 24) which means thermal comfort as a hot or cold sensation as a response form of skin sensors to the temperature around him. Thus, based on the above understanding, thermal comfort is a sense of satisfaction that is derived from stimuli or skin receptors which link to the thermal environment.

In general, based on ASHRAE 55-2004: 3 there are several factors that affect human reactions to thermal comfort i.e air temperature, radiation temperature, wind speed, humidity, clothing and activity. But the thermal comfort of the inner chamber will be different from the thermal comfort of the outer space. The thermal comfort of the inner chamber is affected by the choice of building material type, shape and / or orientation of the building itself, openings, building area and others (Sastra et al, 2006), while the thermal comfort of the outer space is affected by the configuration of the building mass against the temperature in an area, which will affect the environmental thermal comfort (Wonorahadjo et al. 2008).

Spagnolo et al. (2003) has another opinion about thermal comfort in the outer space environment. According to the comfort of space, its sometimes hasthe same effect as the environment outside space. After he reviewed several studies of thermal comfort in the space of various references, the result is a growing theory that the theory of thermal comfort inner space can be applied to the thermal comfort of outer space without modification. Nastaran, Zaky, Elias and Andreas (2002) states that the thermal comfort of outdoor space is influenced by the energy balance of the human body that is affected by meteorological variables such as air temperature, humidity, radiation and velocity wind and human personal influences such as body metabolism and clothing.

Maidinita, Hardiman and Prianto (2009) stated in his article, 'Spatial Pattern of Housing and Thermal Leisure in Semarang' that elements such as floor surfaces and imagery do affect thermal comfort in an outer space. There is a temperature difference that is affected by the surface of paving, grass, water elements and the use of vegetation in an outer space.

2.2 Standards and Scale

According to Fanger (1970), there is a thermal comfort scale which is divided into three sensation scale as in Table 1 as follows:

<table>
<thead>
<tr>
<th>Large Scale</th>
<th>Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>+3</td>
<td>Hot</td>
</tr>
<tr>
<td>+2</td>
<td>Warm</td>
</tr>
<tr>
<td>+1</td>
<td>Slightly Warm</td>
</tr>
<tr>
<td>0</td>
<td>Neutral</td>
</tr>
<tr>
<td>-1</td>
<td>Slightly Cool</td>
</tr>
<tr>
<td>-2</td>
<td>Cool</td>
</tr>
<tr>
<td>-3</td>
<td>Cold</td>
</tr>
</tbody>
</table>

(Source: Fanger, 1970)

This scale was used to compare the sensation of heat felt by respondents due to heat sensation based on measurement. thermal sensation that can be sought in two ways by asking a questionnaire and making accumulations with the formula. During the submission of questionnaires, the respondents were asked about the sensation of heat they felt by declaring it in the range of numbers as on the Fanger scale. The results obtained were large percentages at each level of the scale, while the final result with the accumulation of the formula showed the numbers with Fanger scale ranges such as in Table 1.

364
2.4 Thermal Comfort Relation

There are many similarities to finding thermal comfort in various studies. Indonesia experiences a humid tropical climate. Therefore, the equations used should be based on the humid tropical conditions. Here are some equations formulated by some Sangkartadi et al:

Sangkertadi et. al (2012) conducted field studies in humid tropical climates (locations in Manado City) and managed to have two equations of thermal comfort for humans outdoor activities in normal walking (walking) and sitting moderate activities, as follows:

\[ Y_{JS} = -3.4 - 0.36 v + 0.04 T_a + 0.08 T_g - 0.01 RH + 0.96A_{DU} \]  

\[ Y_{DS} = -7.9122 - 0.5215 v + 0.0468 T_a + 0.1673 T_g - 0.0007 RH + 1.4329A_{DU} \]  

Note: \( Y_{JS} \) when walking normally; \( Y_{DS} \) while sitting moderate; \( T_a \) air temperature; \( T_g \) global radiation temperature (black ball temperature); \( RH \) relative humidity and; \( ADU \) The area of human body skin (m²)

3 RESEARCH METHODOLOGY

3.1 Research sites

This research was conducted in the outer space of Masjid Raya Baiturrahman Banda Aceh. Map of research location can be seen in Figure 1, as follows:

![Map of research location](image)

Figure 1 Map of research location. (a) Baiturrahman Great Mosque Banda Aceh and surrounding areas; (b) Outdoor Zone of Masjid Raya Maiturrahman Banda Aceh

3.3 Research methods

The research method used was quantitative and descriptive method. The evaluation made referred to the aspect of thermal comfort in the outer space of Baiturrahman Grand Mosque Banda Aceh. Here are some data collection methods that were done:

1. Literature review
   This method was done by collecting data and information relating to thermal comfort of outer space Baiturrahman Grand Mosque Banda Aceh.

2. Observation
   This method was conducted by having direct observation of the field that is located outside of Masjid Raya Baiturrahman Banda Aceh.

3. Questionnaire
   This method was done by distributing questionnaires to the community and asked them about their thoughts of the thermal sensation particularly the Thermal Sensation Vote (TSV) specified in Table 1. (Questionnaire attached)

4. Measurement
   This method was done by measuring the outer thermal condition of the Baiturrahman Grand Mosque using thermal measurement tools such as:
   a. Measure wind speed by using anemometer. By paying attention to the direction of the coming wind, the anemometer is placed facing the direction of the wind.
b. The air temperature, the temperature of the black ball radiation and air humidity are measured using the Heat Stress Thermometer.

c. The temperature material is measured using Infrared Thermometer.

In this study, there are twenty points of measurement. The measurement points of this study can be seen in Figure 2. The measurement points were divided into seven parts of the study based on the condition of imagery that is under the umbrella of an electric umbrella; above the open courtyard; under the auspices of the building; on grass areas without shade; on grass areas with shade trees; on areas near the pool without shade; on the pedestrian way without shade. The division of the measurement points can be seen in Figure 2 and Table 2.

![Figure 2 Thermal Measurement Point](image)

<table>
<thead>
<tr>
<th>Measurement Points</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B, C, E, F, G, I, K, M, N, O, Q</td>
<td>Under the shade of the electric Umbrella</td>
</tr>
<tr>
<td>J</td>
<td>Above the open courtyard</td>
</tr>
<tr>
<td>T, S, H</td>
<td>Under the shade of the building</td>
</tr>
<tr>
<td>R</td>
<td>In the grass area without shade</td>
</tr>
<tr>
<td>L</td>
<td>In the grass area with shade trees</td>
</tr>
<tr>
<td>P</td>
<td>In the area near the pond without shade</td>
</tr>
<tr>
<td>D</td>
<td>In the pedestrian area without shade</td>
</tr>
</tbody>
</table>

In this study, every 20 points were measured in a certain time span in one round, carried out sequentially from point A to point T. The range of time is between 10:00-10:30, 11:00-11:30, 12:00-12:30, 14:00-14:30, 15:00-15:30 and 16:00-16:30. After the measurement, it will take the results of a calculated average with the same condition.

4 RESULTS AND DISCUSSION

4.1 Imaging Condition

Shadows in the outer space of the Baiturrahman Grand Mosque of Banda Aceh are obtained from several shades, including the shade of electric umbrellas, shade path and a few trees. The study was conducted on February 28, 2018 - March 2, 2018, when the sun is closer to the equator.

The different shade of Masjid Raya Baiturrahman Banda Aceh running from morning to afternoon show the less possibilities of the people to get shaded (Figure 3).
Measurement Data Results

After the process of measurement, the numbers are converted into formula using Sangkartadi calculation formula 1 and 2 which can be seen in Table 3. Based on Table 3 it can be seen that the thermal state based on the influence of the imagery shows the highest number in condition 2, 4, 5 and 7, that is respectively the marble floor area in the open courtyard, the open grass area, the grass area near the date palm and the pedestrian way area. This is influenced by the absence of imagery in the area that had resulted in the heat recovery from the rising solar radiation.

Table 3 Simulation results on circumstances based on viewing conditions

<table>
<thead>
<tr>
<th>POINT</th>
<th>TA(°C)</th>
<th>TG(°C)</th>
<th>RH(%)</th>
<th>V (m/s)</th>
<th>YJS</th>
<th>YDS</th>
<th>Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31,2</td>
<td>36,1</td>
<td>64,0</td>
<td>1,52</td>
<td>1,3</td>
<td>1,4</td>
<td>Slightly Warm</td>
</tr>
<tr>
<td>2</td>
<td>31,5</td>
<td>37,1</td>
<td>63,7</td>
<td>1,56</td>
<td>1,4</td>
<td>1,5</td>
<td>Warm</td>
</tr>
<tr>
<td>3</td>
<td>31,5</td>
<td>37,7</td>
<td>65,1</td>
<td>1,92</td>
<td>1,3</td>
<td>1,4</td>
<td>Slightly Warm</td>
</tr>
<tr>
<td>4</td>
<td>31,4</td>
<td>37,3</td>
<td>64,4</td>
<td>1,68</td>
<td>1,4</td>
<td>1,5</td>
<td>Warm</td>
</tr>
<tr>
<td>5</td>
<td>31,5</td>
<td>37,2</td>
<td>64,4</td>
<td>1,55</td>
<td>1,4</td>
<td>1,5</td>
<td>Warm</td>
</tr>
<tr>
<td>6</td>
<td>31,4</td>
<td>37,0</td>
<td>64,4</td>
<td>1,54</td>
<td>1,3</td>
<td>1,4</td>
<td>Slightly Warm</td>
</tr>
<tr>
<td>7</td>
<td>31,6</td>
<td>36,5</td>
<td>63,6</td>
<td>1,25</td>
<td>1,4</td>
<td>1,5</td>
<td>Warm</td>
</tr>
</tbody>
</table>

Note: (1) Under Umbrella; (2) Above the Open Court; (3) Open courts near the pond; (4) Open Grass Area; (5) Grass Area Near Dates Tree; (6) Grass Area under Building Shade and; (7) On the pedestrian path (natural ceramic stone area).

Another thing to consider is the temperature of the material. Based on Table 4 it can be seen that the highest material temperature was found in natural stone ceramic with no shade condition that is 47.3°C. But the natural stone ceramic area is an area that is not directly affected by the skin, where the visitors are still allowed to use footwear. Thus, high temperatures are not a problem. In the marble floor area without shade temperature acquisition is also quite high that is 37.6°C. This area is an area that is prohibited from using footwear. Therefore, the skin can feel its heat temperature directly. The lowest temperature obtained was on the Grass with 28.2°C.

Table 4 Results of Material Temperature Measurements on the Outer Space of Masjid Raya Baiturrahman Banda Aceh.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Average Material Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marble floors shaded by umbrella</td>
<td>32,3</td>
</tr>
<tr>
<td>Marble floors without shade</td>
<td>37,6</td>
</tr>
<tr>
<td>The exposed grass</td>
<td>33,5</td>
</tr>
<tr>
<td>The shaded grass</td>
<td>28,2</td>
</tr>
<tr>
<td>Natural Stone Ceramics without shade</td>
<td>47,3</td>
</tr>
</tbody>
</table>

In addition to measured data, there are also questionnaire data to see firsthand the responses felt by visitors. Unlike the results of the measurement, most visitors feel that the thermal state is quite comfortable, this can be seen in Diagram 1 which shows that the majority of the respondents (75%) felt a relatively neutral thermal condition, then there were 28 respondents who felt that the thermal conditions of the outer space feel warm, 22 respondents felt slightly cool, 15 respondents felt slightly warm.
warm, 6 respondents felt cool and 3 respondents felt hot. The above situation occurs because of the adaptive nature of humans at the surrounding temperature by looking at the highest percentage of respondents coming from Banda Aceh.

Diagram 1 Thermal Comfort Expectations

In Diagram 2, when respondents answered questionnaires about their expectations of thermal conditions most of them hoped that the thermal state could be cooler which constituted 75% of the respondents.

Diagram 2 Thermal Comfort Expectations
Note: (A) Warmer; (B) The temperature is quite comfortable and; (C) Cooler

In Diagram 3, the respondents gave some recommendations for mosque design recommendations to make it better. 123 respondents said that in order for the design to be given more trees, 26 respondents said that there should be more umbrellas and 23 said to add other aesthetic elements such as flowers.

Diagram 3: Hope for Improved Design
Note: (A) Made more umbrellas; (B) Planted more trees and; (C) Include other aesthetic elements such as flowers
5 CONCLUSIONS AND RECOMMENDATIONS

Based on some descriptions above a conclusion can be drawn. Outer Space of Design of Baiturrahman Great Mosque used material of white marble floor. It has a major shield element of 6 electric umbrellas. The surface of the grass is planted on a heap of soil above the basement. The thermal situation in the outer space of the mosque on average is in the range of warm. Floor materials that are not covered by shade has higher heat levels than those not, especially on skin sensations when touching the surface of the material. The respondents felt quite satisfied with the thermal circumstances of the Baiturrahman Grand Mosque of Banda Aceh. However, they also expect that the thermal conditions will be cooler.

Recommendations to improve the thermal situation is to provide a cooler thermal conditions such as by adding shade elements to the outer parts of the unoccupied mosque. Like planting trees in some sections of an open grass lawn that is useful in reducing heat. In addition, an electric umbrella to cover the entire surface of the floor can also be added. Electric umbrellas are installed continuously so that no hot gaps can enter the floor. The other recommendation is adding some shade vegetation that can lower the ambient temperature and reduce heat.

REFERENCES
INCEPTION SPACE AS ARCHITECTURAL SPACE DESIGN MECHANISM

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Abstract - This paper explains the idea of inception space from Inception (2010), a movie directed by Christopher Nolan, to explore the inception space potential in designing architectural space. Inception space is an architectural space design mechanism that translates the essential experience of space users as an effort to implant idea in the form of positive emotions. In other words, the architectural space is a medium of inception to a space user or a target (mark). The main purpose of inception space design is to affect the target (mark) by planting the idea ‘secretly’. The target is unaware of the intervention and considers the idea presented itself. This process becomes the beginning of an idea to grow in one's mind the beginning of mindset and would resulted in behavior change. In other words, architects or planners can apply this mechanism to design and influence users so that the design success rate can be improved. The main design keywords as part of the inception process are perception, memory, scenario, layer, and labyrinth. The development of design methods of inception space can be explored and applied to different targets and contexts by applying these design keywords. For example, this design mechanism can be applied to dementia with memory and visuospatial deficit through wayfinding programming.

Keywords - perception, memory, scenario, layer, labyrinth

1 INTRODUCTION

The fascinating thing about the science fiction movie released in the summer of 2010 by director Christopher Nolan is the process by which an architect is able to create an architectural space in the layers of dreams only through the mind. In addition, through the design, the architect assisted by the \textit{inceptor} is able to implant a new idea to someone through his subconscious spaces or dream space called Inception. The planted idea is expected to change the mindset and behaviour of target audience in the real world.

There is a slightly different meaning between actual meaning and science fiction meaning. However, both have one thing in common that is a beginning process of something. Nolan reveals the same thing in the Inception movie by interpreting inception as the process of implant an idea to someone through his subconscious or subconscious mind. This process becomes the beginning of an idea to grow in one's mind which would resulted in behavior change.

Starting from the idea exploration on Inception movie, whether inception, the process of planting ideas to a person called a target (mark), can be applied in the architectural space design method. It is the research question of this study. This study negates the process of dreaming as it does on the Inception movie. This is because dreaming requires deeper research and is very subjective. Subliminal stimulus is also not strong enough to influence one's thinking and behaviour.

This paper aims to produce design mechanisms that can improve the success of programming in design. This success relates to how architects or planners influence space users in positive ways to follow the programming.

This research is limited only in design mechanism keywords that is searching from the Inception film without continuing on how this design mechanism is used on specific targets. These key words are associated with literature studies to support the statement that it can influence users.
2 INCEPTION SPACE

2.1 Extraction and Inception Process in Inception Movie

The Inception movie describes the extraction of classified stored information and the inception process that involves unconscious mind of the target (mark). Both of these processes begin with an initiation process that consists of research on the target background. The results of the initiation process are then translated into layers, which are used to obtain the most basic information (extraction) and implant an idea that is capable to affect the target’s behaviour in real world (inception). Designing of these layers, the extractor or inceptor translates the memory as the target background into scenarios and settings with the labyrinth and or maze rules. The diagrams below describe the process of inception based on the exploration of the Inception movie.

As illustrated in diagram 1 that the Inception process was carried out by Cobb (the main character) to his wife, Mal. The process of finding the most essential objects of his wife and instilling the idea that the world currently being lived is not real. Therefore, Mal must immediately wake up and live life in the real world. The keywords involved at this layer are perception, memory, and setting. The perception that occurs in the user (Mal) is safe as the most important place to keep secrets. The concept of memory used is a doll house as a childhood memory in the middle of the city as a labyrinth setting.

In the first layer (diagram 2), the idea that will be instilled in the target is a statement "I will not follow my father's footsteps". The inception process in this layer applied keywords that are perception, memory about father and son relationships, settings, and scenarios. The designed setting is a warehouse space. The scenario used is the kidnapping process. In this process, the targeted person
was kidnapped and forced to remember a number combination of a safe. The target person was convinced that there are other parties who want confidential information stored in the safe.

Diagram 3 Second Inception in second layer.

In the second layer, as explained in diagram 3, the idea that will be instilled in the target is a statement “I will create something for myself”. The inception process at this layer implements keywords that are perception, memory, settings, and scenarios. The designed setting was a bar room and bedroom in a hotel. The scenario used is a process involving Mr. Charles. The receptor was convinced that the targeted person was in a dream world and someone was trying to extract confidential information from him. Indirectly, the targeted person acted against his subconscious. The receptor helps the targeted person to suspect someone in planning the previous kidnapping so that the projection will indirectly act according to what the target person’s expected.

Diagram 4 Second Inception in third layer.

In diagram 4, the idea that will be instilled in the target is a sentence statement “My father does not want me to be him”. The inception process at this layer applied keywords that are perception, memory, settings, and scenarios. The setting that was designed is a patient treatment room in the fortress of military defense. The scenario used a conversation between the target and his critical father's projections. The conversation continues by checking the contents of the safe that has been grabbed from the start, namely a paper windmill. The targeted person’s experience was translated positively in the form of the windmill.

Based on this exploration, there are five keywords involved in the process of inception space design. These keywords are perception, memory, scenario, layer, and labyrinth. Perception is part of the process of absorbing the quality of architectural space through sensation stimuli. These stimuli are transformed into neural representations to be compared with information already stored in the target information center. This information data was derived from experience or target memory. Perception,
memory, and imagination are in constant interaction; The domain of presence fuses into images of memory and fantasy (Pallasmaa, 2012, p.71). This memory can be revived through the scenario (program) and the setting of the architectural space. Finally, the setting follows the principles of the labyrinth or maze in layers consisting of different scenarios.

The next section explains the design keywords as findings from the result of exploration of Inception film. These keywords become important and as method in designing an Inception space, a space that can influence users to follow architect or planner programming. These design keywords were further studied with some supporting literature.

2.2 Inception as Perception

Our immediate awareness of the phenomenal world is given through perception (Norberg-Schulz, 1974, p.27). Perception is an initial process of a user to experience consciously the quality of architectural space. The way a user responds to the stimulus that comes from surrounding environment which will affect how a user behaves towards the architectural space (Mlodinow, 2012). Human behavior is the product of an endless stream of perceptions, feelings, and thoughts, at both the conscious and the unconscious levels (Mlodinow, 2012, p.16). The comparing process between neural representations with information stored in the brain in the perception process has the potential to be incepted (Figure 1). As explained by Passer and Smith (2009) that the so-called top-down process is highly dependent on information previously stored in the brain. In top-down processing, sensory information is interpreted in light of existing knowledge, concepts, ideas, and expectations (Passer & Smith, 2009, p. 150).

In other words, knowing what information is stored in one's information center (brain) makes it easy to do inception. Knowledge or information stored in the brain is the result of experience involving all senses in the human body.

Figure 1 The process of perception.

Culture in which the subject grows does affect perceptual experience (Passer & Smith, 2009, p. 164). Therefore, the experience of the target (mark) needs to be explored according to the culture where the target does spatial activities through everyday concepts. The everyday world is sensual. It does not only provoke sight but also touch, hearing, smell. The architecture of the everyday encompasses places that are known by their aroma, surfaces recognizable by their tactile qualities as well as positions that are established by echo and reverberation. (Berke, 1997, p. 223).

2.3 Inception as Memory

The inception process involves a process of translating the target experience. This is closely related to the memory of the target. Hugo Munsterberge, a German psychologist, designed the theory of memory. According to him, we cannot record all the details we experienced so we will fill in the blank details with our other minds. There are three concepts about memory: (1) we only remember
the essence of an event, (2) we fill in the missing details with the things that are made up, and (3) we will believe the memory. The idea that we can remember events that never happened is a key element of Philip K. Dick’s story “We Can Remember It for You Wholesale,” about implanting memory. The memory of long-standing events is particularly easy to implant (Mlodinow, 2012, p.75).

Not only visual, the smell can also act as a trigger for memory of architectural space elements. A particular smell makes us unknowingly re-entering a space completely forgotten by the retinal memory; The nostrils awaken a forgotten image, and we are enticed to enter a vivid daydream (Pallasmaa, 2008, p.32).

Finally, architectural elements that are able to generate memory are needed in the process of inception. This memory helps scenario and setting to ‘look’ and ‘feel’ familiar. This situation makes inceptor to instill an idea into the target easily.

2.4 Inception as Scenario

Scenario is a description of what could possibly happen (merriam-webster.com). In other words, the scenario contains the action described. This understanding is closely related to the program in architecture. No architecture without action, no events, no programs (Tschumi, 1998, p.121). The inception process depends on the scenario or action that has been described by the inceptor. One of the scenarios was how the target (mark) interacts with the projections and elements of the architectural space. So the real task of inception is not just to deliver ideas, but to deliver them surreptitiously to an unwilling recipient. Further, he must adopt these ideas as his own, as a basis for action, and as if he had arrived there himself without intervention (Andersen, 2011). Therefore, the scenario or program is described without making the target (mark) aware that he was being directed.

2.5 Inception as Layer

In Inception movie, setting and scenarios are used by an inseptor on each layer of dream space as inception process. There are various translations of target (mark) experience on each layer. On each layer, inception involves both scenarios and settings, where both are translations of the target experience. The basic setting used is the labyrinth as one of the architectural paradox.

The film concludes that the process of inception sounds impossible because everyone is equipped with a mind that will look for traces where an idea existed. Therefore, this pure creation process involves high imagination, the ability to translate ideas that you want to plant into emotional concepts and does not require specific ideas. The process of translating ideas into positive emotions starts from uncovering the experience of the target.

2.6 Inception as Labyrinth

The architect in the Inception movie, Ariadne, designed the subconscious layout using the labyrinth or maze principles. The movie calls these two terms but the dream layout space follows maze rules that have many paths and intersections so it requires challenges for visitors to choose the right path and make decision. What Ariadne provides is a place for people to interact in a narrative context, interior and the city. In other words, Ariadne builds a stage where the show will take place (Kapper, 2011).

Metaphorically, the labyrinth is referred to as difficult, unclear, and confusing situation (Kern, 2000, p.23). There are several interpretations that Kern has brought to the labyrinth definition. However, this paper describes the interpretation associated with Inception movie that is as a process of self-transformation.

This definition is not much different to the maze that Tschumi invented such as to create a different space or experience of space. Labyrinth is referred to as a sensual experience of space. The labyrinth is a place where all sensations, all feelings are enhanced, but where there is no presence of an overview to provide a clue as to how to exit (Tschumi, 1998, p.42).
3 DESIGN METHOD

3.1 Inception as Architectural Concept

“Inception thinks through images. An image is not simply a representation of reality but also shows, through its movement, a complexity, a difficulty, and a truth” (Husson, 2011). The next discussion is the development of the inception space concept. Broadly speaking, the inception space consists of layers where each layer has specific scenarios and settings. These scenarios and settings involve the translation of experience from perception and memory.

Cobb in Inception film (2010) explained that “Dreams, they feel real while we are in them, right? It is only when we wake up that we realize something was actually strange.” Cobb’s statement, an extractor and inceptor, suggests a setting from the inception space. An ‘unusual’ architectural space that feels strange will more easily affect the target. Therefore, the setting uncovers the potential elements of an architectural space that is ‘unusual’ or out of the box and probably it can be ‘ugly’. A simple analogy is that the target is more ‘remembering’ a setting in which the pedestrian pathway as roof is compared to similar paths as path by pedestrians. Another example is a cross sensation where light produces regular sound wave stimuli and music rhythms produce heat stimuli. Furthermore, the development of settings follows the concept maze and or maze.

The initial stage of the development of inception space is the initial approach of a target (mark). Targets are identified by the target's daily approach in carrying out activities and creating space. This observation is to find the most essential experience of the target. Essential experience is the most core experience that is able to be remembered by the target. If a transformation is made, it will affect the target mindset so that the inception process occurs indirectly in carrying out its daily activities. This initiation stage also includes exploration of the quality or memory images stored by the target. This exploration can be done by analyzing elements of the architectural space as part of the activities carried out by the target.

Before the experience translation phase becomes a scenario and setting, keywords are needed as trigger. This trigger can be a theme or purpose of the idea that will be instilled in the target in the form of positive emotions. These positive emotions have a deeper effect on the target than negative emotions. The experience and memory are then translated into scenarios and settings on inception space design.

The design of architectural space consists of labyrinth and or mazes layers to try to speed up the inception but gain time. Each layer will offer a different time if the inception is carried out at the same speed. This layer as a setting keeps the target in the scenario process by following the principle of choosing the right path and decide it correctly. Each layer will apply special programming based on the trigger that has to be achieved as one of the inception processes. This programming will be studied further from previous research. For instance, healing space to people with dementia.

These layers are synchronized by involving all potential senses of the target. Senses help the target to recognize settings better and store information about settings in the form of memory. This memory will help the target to strengthen the ideas that have been planted.

If the target was to plant an idea to a person with dementia with memory and visuospatial deficit, the next step is to study the symptom. The study of previous research on dementia will produce several requirements that have to be fulfilled by inception space design later. This process is part of the initiation process of the target.

4 CONCLUSIONS

Through the exploration of Inception movie by the director Christopher Nolan (Inception, 2010) and literary approaches, there are five key concepts involved in the process of inception to target as space users. Perception, memory, scenario, layer, and labyrinth are the main concepts of inception that can guide targets quietly.

Inception space is an architectural space that translates the essential experience of space users as an effort to implant ideas in the form of positive emotions. In other words, the architectural space is a medium of inception to a space user or a target (mark). It is possible that the development of design
methods of inception space can be explored and applied to different targets and contexts. Finally, as the main purpose of the inception process, the target (mark) is unaware of the intervention of the designed space and assumes the main idea used in the concept comes by itself.

This research can be continued further by providing a case study of specific targets and contexts. For example through this programming on how to influence dementia people with memory and visuospatial deficit can find their way to and back (wayfinding) between their house (as base) to the mosque (as center of labyrinth). The context that can be continued further is the old East sector lecture housing complex of Syiah Kuala University, at Banda Aceh, where most of the houses have almost the same facade. This same facade will further confuse the sufferers. It is hoped that through further research, Inception space design mechanism can contribute to the increasing success rate of architects or planners in influencing space users positively in architectural design spaces.

REFERENCES
ACEH ORNAMENTS EXPLORATION
AS IDEAS OF CONTEMPORARY BUILDING FORM
THROUGH DIGITAL TRANSFORMATION

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Abstract - Aceh is one of the Provinces that is rich in motives and ornaments. The richness of Aceh motives and ornaments can be observed in Aceh craft works such as perforative art crafts at Rumoh Aceh, hand-weaving crafts, embroidery crafts, and plaiting crafts found around different parts of Aceh. These ornaments can inspire creative ideas of the developing contemporary building oriented in locality. One approach to develop creative and innovative exploration of ornaments is by utilizing fractal methods. The use of jBatik software as one of the innovations in digital technologies can be used as tools in the process of exploration and transformation of Aceh ornaments with fractal method approach. The use of jBatik software is considered suitable to create similar pattern or motives observed between Aceh ornaments and batik. The chosen study case in this study was the development of the terminal building of Sultan Iskandar Muda Airport in Aceh. The steps of transformation process are: analysis and improvement of ornament geometry, interpretation of fractal principles on ornaments, interpretation of ornament variants with jBatik and exploration of interpretation results of ornament with fractal application. The application of ornament transformation into architectural design is done in 3 ways, i.e. development of alternative design of study case building, application of ornament exploration in designs, and finalization of the designs. Aceh ornament exploration through this digital transformation process is expected to re-actualize the traditional architectural heritages into a contemporary context and to contribute in the enrichment and preservation of local ornaments using technologies.

Keywords - exploration, Aceh ornaments, digital transformation, jBatik, design method.

1 INTRODUCTION

Aceh is one of the Provinces that is rich in motives and ornaments. The province is located at the tip of the Sumatera island with 23 Regencies/Cities in which every Regency/City has a distinctive motives and ornaments respectively.

The richness of Aceh motives and ornaments can be observed in Aceh craft works such as perforative art crafts at Rumoh Aceh (figure 2a), hand-weaving crafts (figure 2b), embroidery crafts (figure 2c), and plaiting crafts (figure 2d) found different Regency/City in Aceh.
In this study, the focus is perforative art crafts (ornament in Rumoh Aceh). These ornaments can inspire creative ideas of the developing contemporary building oriented in locality. The use and application of Aceh ornaments in the current architectural designs generally still look stereotypical, i.e. form tracing without further elaboration process. Nevertheless, it should be appreciated as one of the efforts in maintaining and preserving the existence of Aceh ornaments which gradually became rare as lesser Acehnness build this kind of traditional house.

Here are some examples of the use and application of Aceh ornaments in building design, among others: The Regent of Aceh Jaya Office, that is located on the roof and wall elements (figure 3a), Bank Mandiri Office Banda Aceh, located on the roof and wall elements (figure 3b), Governor’s Office of Aceh, is located on the roof, wall and column elements (figure 3c), and Sultan Iskandar Muda Aceh Airport, which is located in the interior (figure 3d, 3e, 3f).

One approach to develop creative and innovative exploration of ornaments is by utilizing fractal methods. Utilization of the method is performed by using jBatik software to transform Aceh ornaments applied into building design elements. The transformation can regenerate the new and more dynamic, aesthetic formations and patterns of modern Aceh ornaments. The study case in this study was the development of the terminal building of Sultan Iskandar Muda Airport in Aceh. This explorative study was conducted to develop a new approach in codifying local ornaments with the...
advancement of computational processes. Aceh ornament exploration through this digital transformation process is expected to re-actualize the traditional architectural heritages into a contemporary context and to contribute in the enrichment and preservation of local ornaments using technologies.

![Figure 4 Sultan Iskandar Muda Airport](Sources: Firman Hidayat, 2011)

As architects, we must have a frame of mind adapted to the times and conditions of today's ideal, rather than being forced to think with outdated structures from the past. Local culture should be able to synergize with modernization as a collaboration to complement each other. In its development, the local culture must utilize sustainable technologies in building a new path of knowledge.

## 2 ACEH ORNAMENT

In the context of architecture, ornaments are elements of decorations used to beautify parts of a building or an object. Acehnese cultures are strongly influenced by Islamic culture. Therefore, most motives, ornaments, and Aceh craft designs are derivated from Islamic cultures. According to Barbara Leigh, (1989) the motives used in Aceh are divided into 5 categories: (1) geometric patterns, (2) floral patterns, (3) bird patterns, (4) other animals patterns, and (5) islamic calligraphy patterns.

If investigated further, they contained mathematical logic in created patterns based on Aceh ornaments geometry. Basically Aceh ornaments is simple geometry that contains not only repetition (iteration), recursion, movement, rotation, scale, but also the reflection which combined with each other in a variety of scales and positions. Aceh ornaments can be created both generatively and iteratively. Generatively means it can be reconstructed using the same technique, and iteratively refers to its construction that is done in a similar repeated pseudo-algorithmic pattern.
In this study, the ornaments to be transformed is Bungong Seulanga ornaments. This ornament was chosen after going through the transformation process in trial and error to three ornaments selected earlier, among others: 1) Pucok Reubong ornaments, 2) Bungong Seulanga ornaments, and 3) Bungong Jeumpa Keumang ornaments.

Tabel 1  List of chosen Aceh ornaments

<table>
<thead>
<tr>
<th>Name of Ornament</th>
<th>Origin of Ornament</th>
<th>Basic shape</th>
<th>Geometrical Tracing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bungong Seulanga</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3  FORM TRANSFORMATIONS IN ARCHITECTURE

In simpler word, transformation is a process of change from an initial form into a new form. Transformation is strongly tied to the creativity of changing the shape of "origin" into a "new" form tailored to the corresponding context. The creativity inherent in architectural transformation is the process of how to explore the essence of the original form and how to reconstruct the original form into a new form.

The highest level of creativity in architectural transformation occurs when the designer successfully explores the essence of the original form and transforms it into new forms as a result of more innovative design exploration. Actualizing Aceh ornaments richness as a legacy of the past into the current context can be tailored to the goals to be achieved such as representing the Acehnese identity, the value to be displayed, the functional aspects, and the use of technology.

According to Slamet Wirasonjaya "The world is transformed from one form to another and from one adventure to another. While the design should be able to transform themselves remarkably from original to futuristic".

In design theory, Antoniades (1992) said that the transformation is the channel of creativity. Antoniades (1992) explains that there are three forms of transformation strategies in design: traditional, borrowing, and decomposition/deconstruction. The traditional strategy is to emphasize the step-by-step form of transformation through adjustment to external factors, internal and aesthetic elements. Borrowing strategy refers to elements or components of objects around which were studied and interpreted as metaphorical or analogical references. Decomposition/deconstruction strategy suggests a process to interpret objects apart and then find a new way to recombine the parts to find a new order in a different composition.

4  JBATIK AS TRANSFORMATION TOOLS

The rapid architecture growth has caused the appearance of new methods, trends, and paradigms. Those changes are influenced by the development of engineering technology intensively. The architecture world has undergone a progressive development in the use of digital technology to assist in the creative process of architectural design.

The use of jBatik software as one of digital technology innovations can be used as tools in the process of exploration and transformation of Aceh ornaments with fractal method approach. Mathematical logics is in the form of Aceh ornaments patterns that can be translated into the software to create new combinations of patterns that are more innovative.

jBatik is a software that can produce patterns by using mathematical formula (fractal). From one fractal formula, the software can generate various patterns simply by changing the parameters. A pattern can be modified and combined with other patterns or create different new patterns.

The use of jBatik software is perceived suitable because of the similarity between pattern or motives of Aceh ornaments with batik. Blending technology with the locality gives the understanding
that the locality, in this case, the Aceh ornaments, are able to be adapted to the technological advancements that represents the dynamic basic of Aceh ornaments.

5 FRACTAL APPLICATIONS ON JBATIK SOFTWARE

jBatik is a software to make batik pattern by using fractal formula. jBatik uses one type of fractal that is an L-system language to create forms of batik motifs. L-systems are part of the mathematical sciences that deal with iteration, recursion, movement, rotation, scale, and reflection.

<table>
<thead>
<tr>
<th>Initiator</th>
<th>Rules</th>
<th>Remark</th>
<th>Visual</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>F</td>
<td>Draw cylinder</td>
<td>a</td>
</tr>
<tr>
<td>-</td>
<td>F-F</td>
<td>Rotate to the left</td>
<td></td>
</tr>
<tr>
<td>+</td>
<td>F+F</td>
<td>Rotate to the right</td>
<td></td>
</tr>
<tr>
<td>&amp;</td>
<td>F&amp;F</td>
<td>Rotate along Z- , toward user</td>
<td></td>
</tr>
<tr>
<td>^</td>
<td>F^F</td>
<td>Rotate along Z+ , toward computer screen</td>
<td></td>
</tr>
</tbody>
</table>

Figure 6 Example of variables and rules in jbatik
(Sources: Preserving local ornament through algorithm)

In L-system language, the structure of the language consists only of the main formula (axiom) and the detail formula. The main formula is the initial symbol used. While the detail formula is the symbols used to replace the initial symbol of the main.

For example:
Main Formula: A
Detail Formula: A = AB
The meaning of iteration is to replace A with A = BA repeatedly. For example, if Iterate Axiom: A as many as n times the following sequence will be generated:
n = 0 → iteration 0: A
n = 1 → iteration 1: AB
n = 2 → iteration 2: ABB
n = 3 → iteration 3: ABBB
n = 4 → iteration 4: ABBBB
n = 5 → iteration 5: ABBBBB
n = 6 → iteration 6: ABBBBBB
n = 7 → iteration 7: ABBBBBBB
6 ALGORITHM OF ORNAMENT TRANSFORMATION

Simply put, the notion of algorithm is the process of trace instruction in the description of ornament transformation by using jBatik software. The process of transformation digitally using a computer cannot codify something that is abstract like the value and meaning of the socio-cultural elements which exist in the ornaments of Aceh. The process of transforming Aceh ornaments using fractal-based digital technology such as:

6.1 Analysis and Improvement of Geometry of Bungong Seulanga Ornament
This refinement step is done by using AutoCAD based on the original geometry of structure and shape of Bungong Seulanga ornament. The analysis is on how the basic form and the transformation rules take place on the geometry form of Bungong Seulanga ornament as reference for further transformation process using fractal methods.

![Figure 7 Analysis of Bungong Seulanga ornaments geometry](image)

6.2 Interpretation of Fractal Principles on Ornaments
This stage is done to acquire the principles and parameters of fractal and geometry on Seunga bungong ornament. The fractal principles present in the Bungong Seulanga ornament is self-similarity (fractal made from different parts of one another) and self affinity (fractal as in series of interconnected parts of one another). Fractal parameters that affect the formation process are the number of iterations (repetition), the angle and the length of the initiator (preliminary) and the generator (ornament).

![Figure 8 Interpretation of the principle of fractal ornament](image)
6.3 Interpretation of Variant Ornaments with jBatik

This stage was tackled by interpreting Bungong Seulanga ornament variants as much as 3 (three) pieces to get the results close to the ornament form of reference in the database. This stage was done by interpreting the smallest elements of the ornamental structure formers and the iteration structure of the ornamental structure-forming elements. Afterwards, the iteration structures of the ornamental structure-forming elements are combined into a whole ornament based on the results of the analysis and improvement of its geometry. Ornament interpretation process was done by using the rules of depiction with jBatik software, i.e. by using the L-system language.

![Figure 9 Ornament interpretation variant with jBatik](image)

6.4 Exploration of Ornament Interpretation Results with Fractal Application

This stage begins by sorting the structures and substructure of the ornaments, and the ornament-forming elements along with the algorithm process. One element of the ornament structures was chosen as the basic concept for exploration in the development of various architectural forms with jBatik. A consideration in determining the elements of ornaments used, among others, is the suitability of the shape with the figure of the building to be designed, the complexity of the results of transformation associated with the application process on the design, and the aesthetic value resulting from the transformation process.

![Figure 10 Transformation of ornaments interpretation results into fractal interpretation](image)
7 EXPLORATION OF SHAPE IN BUILDING DESIGNS

The process of exploring the shape of the building with a study case of Sultan Iskandar Muda Airport in Aceh is accomplished in 3 ways:

7.1 Developing Alternative Designs for the Building in this Case Study
This stage was done by studying the conditions of existing design of the airport terminal Sultan Iskandar Muda Aceh. From the interpretation of the basic geometry of the existing design, geometry development of new building figures was adapted to the concept of exploration result and interpretation of ornament with fractal application.

Figure 11 Development of building figure design
7.2 Application of Ornament Exploration Results on Design
This stage was the stage of application / application of exploration which resulted from the ornament interpretation with jbatik after the simplification and the completion of the designs.

Figure 12 Application of ornaments exploration results on design case study

7.3 Finalisation of the Designs
This stage was the final stage of the Aceh transformation process using fractal-based digital technologies (jBatik software) and its application to the designs.

Figure 13 Finalization of the designs

8 CONCLUSIONS

Exploration of ornaments with fractal method is novelty in architectural design. With the help of digital technology, Aceh ornaments can be re-explored in variants of new, unimaginable forms to be developed into contemporary building designs.

Transformation with jBatik tends to lead to the decomposition method and will eliminate the "spirit" of the original form of the ornament, therefore it is necessary to combine borrowing method to keep the original shape visible. The use of fractal methods with jBatik software should be used
under the supervision of local cultural experts to preserve the identity and meaning of local ornaments.

This explorative study was undertaken to develop new approaches in the execution and codification of local ornaments with the advancement of computing processes that contribute to the enrichment and preservation of local ornaments using digital technology.

REFERENCES
AN INTRODUCTION OF LANDSCAPE VISUALISATION AS A TOOL TO PROPOSE THE FUTURE DESIGN OF HUMANE OPEN-SPACES FOR EMPLOYEES AMONG TALL BUILDINGS

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Abstract - Tall buildings is one solution for urban areas where limited available land and high prices become a problem for investors. This causes the optimization of land less attention to the social impact of increasing the number of high buildings in city. The fact happens nowaday is the unavailability of public open space for micro economic activities such as street vendors who are currently crowded around the edge of the highway surrounding tall buildings. Therefore, this study aims to make the planning of future design of humane open space for workers and office workers. One of the methods used is landscape visualisation to see the existing conditions. the example of selected area is karet pasar baru timur 5 street located between Sahid Sudirman complex and Apartment Pavilion. According to study of one photo captured on road condition, future design planning can be made by reducing the road sections of the road and expanding the sidewalk located in the middle that separates the traffic lane. Thus, the open space is more humane with the arrangement of parking areas and planning good sanitation and feasible course. This result is a draft proposal as the introduction of further research to be conducted with more interdisciplinary knowledge sectors review.

Keywords - Landscape visualisation, Tall buildings, Open spaces, Future design.

1 INTRODUCTION

Tall building as a building type is a technological innovation of the nineteenth century in a response to the economic, industrial, and social changes. The tall building can accommodate many people on a smaller land than would be the case with low-rise building on the same land. Quality of life is improved by tall building that offers the opportunity to create open spaces such as plazas, parks and other community spaces by freeing up space at the ground level (Ali, et al., 2008). A review of high-rise literature will reveal that tall buildings generally grew as a building type out of necessity-that is not based on arbitrary willfulness (Beedle et al., 2007). The rapid economic development in Asian countries as followed by Indonesia has caused this building type become widely employed in big cities such as Jakarta, Yogyakarta, Surabaya, Medan etc. Currently, Jakarta is investing in urban developments and utilizing tall building for urban growth.

The outgrowth of business is increasing in demands compared to office attendants, employees and office complex. Thus, it requests public facilities for example supermarkets, restaurants, food court, coffee shops, place for worship, public open space and so on. The rising number of tall buildings make those amenities larger following the number of people as well. However, most developed tall building do not provide enough open space. As a result, the people use the existing open space around the building complex. Another problem arised is the need for affordable food for employees. Subsequently, it creates social impacts that generate appearence of street vendor on roadside. Thus, it decreases value and function of the previously open space to be not decent and comfortable.

If there is an additional one high-rise building put into an existing high-rise complex, it will have at least the same amount of employees as one existing tall building. It may cause street vendors staying by roadside around the tall buildings. Street vendors are often regarded as an 'element out of
place’ against their location, activity, physical appearance, even structure and pattern of urban design (Widjajanti, 2016). Meanwhile street vendors’ activities grow and develop in the urban space due to the influence of the main region activities where they are located (McGee and Yeung, 1977). However, if the activities and apace arrangement are not regulated, they will always lead to conflict. Besides that street vendors’ existence as activities in the urban space is regarded as a nuisance element or unplanned element or element out of place, and it often causes a lack of harmony in physical order and environmental visual aesthetics (Hough, 1990; Creswell, 1996; Yatmo, 2008). Their presence in the public space is one of the activities that can be categorized as “activity support”, street vendors’ activities together with other activities strengthen the function of urban public space (Shirvani, 1985).

Thus, this research aimed to find a method to do future design planning a humane open-space where both vendors street can provide hygienic food and employees can share public space while they surround the tall buildings. These street vendors can be seen as "in place element" by understanding the context of their presence in a location, and to consider the potential vendors as local identity, so it is important to recognize the context of their presence in urban planning, which can be a consideration in the determination of planning policies, demolition and eviction of street vendors (Yatmo, 2008). The future design is not only open space for employees and street vendors but also turning it into green open space as to reduce pollution and water absorption area. Furthermore, the space utilization is reviewed based on location, activities, accesbility and comfort.

2 QUALITY OF SPACE AS FUTURE DESIGN

The quality of life in an urban environment has physical, economic, and social aspects. The public open space is the part of the urban environment; therefore, when the public space is satisfactory, it has a direct impact on the quality of life. The perception of the community of public open space is related to the quality of life such as health, recreation, and environment (Nasution et al, 2014). Consequently the quality of space is defined as area where people are satisfied to spend time there and where the place is worthy to be a place to do activities and socializing.

As mentioned before, the Citizenship behaviors may also result from work engagement (e.g., Alfes et al., 2013; Babcock-Roberson and Strickland, 2010; Rich et al., 2010). As posited earlier, work engagement implies that employees are physically, cognitively and affectively connected with their workplace. The quality of the physical features of the open space has been seen as an important aspect that improves people’s satisfaction and quality of life (Beck, 2009), promotes better use of public spaces (Gehl, 1987) and enhances the social, environmental and economic values of cities (Beck, 2009).

The future design is a creation that provides look of the future. It is an oppurtunity to enhance the quality of space available such as open space or as a way to provide a new one as green open space as solution for informal economic and vendors street around tall building complex. A basic need of a cities is open spaces that have economic value, social value, and environment value. Those value should be included in future design planning.

2.1 Area of study

In this research, the future design is narrowed to the space that is used by vendors street at Sahid Sudirman complex in Jakarta, Indonesia. This site was chosen randomly based on tall buildings density at Karet Pasar Baru Timur 5 street because the new tall building which was newly launched a couple of months earlier and it is located next to Apartemen Istana Sahid (see Figure 1). It only has traffic lanes inside for drop off and parking area for motorcycle.

Based on site condition, the issue of informal economic dominates traffic lanes between Sahid Sudirman complex and Apartement Pavilion. The phenomena shows most vendors street put their carts in the middle of traffic lanes where there is small sidewalk for trees. It provides seats for consumers to eat behind the carts under the shaded trees and plastic tent to avoid the sun and rainfall. Most of these consumers are office boy and employees of tall buildings. It changes the image of
roadside which functions as traffic lanes to public open space. The vendors' street, drivers and riders of online transportation, employees and office boy frequent the street vendor. As a result, the lane along the edge of road is crowded. Its lane is connected among tall buildings for instance Sahid Sudirman Complex, citywalk mall and pavilion apartment. The consumer increases because the Sahid center that operates and it is the fourth highest building in Jakarta, where more than hundred employees work there.

The government through the Regulation of the Minister of Public Works No. 05 / PRT / M / 2008 in the Guidance Book and the Use of open green spaces stated for office grounds, shops and business places the open green spaces are generally in the form of sidewalks and open parking areas. As for urban areas, green open space is a city park that can be used by residents to perform various social activities in one city or part of the city. Based on the regulation, there is no specific provision that regulates public open space around high buildings. However, the unavailability of this public open space causes pedestrian paths, highway edges and secondary roads to be shoveled by pedestrian which, on the other hand, provides affordable food sales services for employees and office workers working on high-rise buildings. In addition, indirect impacts on traffic are congested on the main traffic lane at K.H. Mas Mansur road.

2.2 Landscape Visualisation

The potential of landscape visualisations and their role of conveying information for planning decisions is concisely described by Sheppard (2001, p. 194) as “specifically to provide the means for both an emotional (affective) response to proposed future environments and an analytical assessment of expected aesthetic changes”. Landscape visualisation techniques take a variety of forms. Traditionally they included models, drawings and paintings. Since the 1960s photographs and photomontages have been widely used (e.g. Sheppard, 1989; Al-Kodmany, 1999) and from the 1990s the improved capabilities to link CAD, GIS and landscape visualisation software have substantially enhanced the possibilities for digital representation (Lovetta et al., 2015).

Three-dimensional digital visualisation of landscapes offers many advantages over conventional methods of representation, particularly when communicating complex spatial arrangements to non-designers (Bishop, 2005; Kwartler, 2005). At the present time a common approach is to compile information for a study area in a CAD or GIS database and then generate three main types of 3D outputs. These can be summarized as rendered still images (or scrolling panoramas) from defined viewpoints, animated sequences (showing fly-throughs along specified paths or changes over time) and real-time models (or virtual worlds) where the user has the ability to freely navigate a landscape (Appleton et al., 2002).
3 METHOD

Generally, methods for the assessment of existing landscapes and proposed futures using landscape visualisations (see e.g. Daniel, 2001; Lange & Legwaila, 2012; Ribe, Armstrong, & Gobster, 2002; Zube, Sell, & Taylor, 1982) can be grouped into quantitative perceptual (asking people about ‘judgments’), qualitative perceptual (asking people to describe differences between the presented stimuli), quantitative analytical (developing metrics to estimate the degree of differences e.g. in before/after images) and qualitative analytical (describing objective differences between images) approaches (Downes et al., 2015). In this research, qualitative analytical method applied as introduction for landscape visualisation for designing future plan of roadside around Sahid Sudirman complex where the traffic lanes also serve as open public space because of vendors street.

In this case, the image analysis based on basic needs of city which are economic, social and environmental (ecology). The economic aspect is visible to the existance of vendors street on sidewalk. On the other hand, social part reflects on activities and trades along sidewalk among riders, drivers, employee and vendors street. Furthermore, there are trees with medium size lined up on roadside that may be included as environment even though it is not included in ecology principle. Therefore, this area literally should be identified as open space.

Figure 2 Analysis of Photograph 1
Image analysis made from one photograph captured by camera on July 2018. Two other images are street view image on September 2017 that used as data to complete the perceptual of current condition. The picture was analyzed to extract the key content elements:

- Structural elements: key existing and built structures which are dominant in the scene and/or do not match in scale or position.
- Street furniture: vendors street, taxis, motorcycles.
- Street: road connects buildings located between Citywalk Sudirman and Apartment Pavilion
- Sideway: existing sidewalk
- Vegetation: Street trees, herbaceous planting and mown grass.

As illustrated in Figure 2, the planned condition supposed to be vehicle traffic with two different lanes that have sidewalks in the center. However, currently on the left and right sides of the sidewalk has been filled with street vendors and used as a parking lot for two-wheeled vehicles and four wheels that no other space allotted for taxis and rental transportations online. According to this finding, the vehicle traffic lanes has been changed its function to public open spaces due to social impact of employee who works in highrise buildings. The needs for affordable food and the increase demand of online transportation riders and drivers has caused vendors street to be high in demand than before. Thus, the space is crowded by traders and irregular vehicle parking.

Consequently, this open space is not feasible to be used as a place to eat, rest and traffic. The need for sustainable planning is one way to anticipate the current inhumanity. In using this simple method, it is expected to make simple planning in maintaining the current functions. The image analysis shows tangible key contents namely trees, traffics, parkings, people, trading activities at present. The result shows that those elements should be maintained for future planning design. Through this landscape visualisation, we could sort out main elements for further open space planning in this area.

4 RESULT

From the results of image analysis made on photograph 1, changes in space function due to social impact can be seen. Not only that, this unhumanity space also affects employee’s performance indirectly both from the psychological and productivity because the environment is not healthy even for activity to eat and drink. Therefore, future design planning which can be used as a proposal for that place in the future is an open space that has three main basic values based on the needs of city such as economic, social and environmental (ecology). So with this there is a decent and humane place for the workers to sit leisurely while their income is unable to afford food in the tall buildings.

From the results of image analysis and measurement conducted on the area of research reviews, the authors use the help of digital applications such as google maps, google earth, sketch up and autocad in making illustrations of proposals for humane open-spaces future design. From the illustration, the size of the existed sidewalk around 1 meter is enlarged by reducing the size of the vehicle path in both sides. In addition, given sufficient space for two-wheeled vehicles and four-wheeled parking temporary, especially for online vehicles and taxis to wait for passengers out of the building. Furthermore, sanitary pathways are made under sidewalk to facilitate vendors street dispose of wastewater and facilitate rainwater flowing.

In Figure 3 it is one of the possible suggestions to make the sidewalk that becomes an informal open space because it is filled with street vendors to be more humane. However, the result from this study cannot be generalised because it uses only one simple research method. Besides, future design planning for humane open spaces requires an integrated study and multidisciplinary review.
5 CONCLUSIONS

There are more methods similar to technology and software. However, this research is an introduction to planning the future design that may enhance the quality of the city and humanity in business center. We understand, one method is never enough to propose new solution for complicated problems in a city especially for central business district. Moreover, it is an initial step to influence government policy related to the holding of obligations for open spaces inside high-rise buildings complex. After all, this research is a preliminary research to investigate an open space to be planned for future design in city space which may provide solution to the problem. Further research will be done by integrating more aspects, regulations and software as mentioned in the method section.

We may be proud of having great city which has high-rise building skyline at night, but we still need to remember how's the life of ordinary people who work for well-to-do inside. The city should serve the community equally and not only based on economic level and business interests. Further research on this will be conducted so that a more detailed and relevant information can be made as suggestions or proposal for municipal government in Jakarta to organize green open space among high buildings. So that both have an equally beautiful portrait of a city between tall buildings adjacent to a public open space.

Figure 3 Proposal future design for humane open-space among tall buildings
REFERENCES


A CASE STUDY OF CORE HOUSE DESIGN MODIFICATION ON SIMPLE HOUSING: KPR GRIYA MAHONI HOUSING, WEST ACEH

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Abstract - KPR Griya Mahoni Housing of West Aceh is a housing loan provided by banks to individual customers who will buy a house. Currently, the housing is in great demand, especially for those who have limited monthly incomes to build their own house as well as to buy it in cash. There are two types of houses offered by developers such as 36 type and 36 plus type which are designed with different space. Customers are able to choose the plan provided by the developer as desired. However, after the houses are occupied, many changes were done to fulfill residents’ individual needs. The condition leads to some problems such as the formation of space with poor openings, less air ventilation and windows, and unorganized building mass. Based on these problems the study was conducted to determine what factors influence the residents to change the house and to examine how the core housing changes in the KPR Griya Mahoni housing of West Aceh. This research used quantitative descriptive research method with data collection obtained through observation, interview, questionnaire, and documentation. Based on the results of the study 56.70% of the residents in KPR Griya Mahoni did expansion to the house. Some the factors that affect the changes in the KPR Griya Mahoni housing are increased income, land status, land area and completeness of facilities and basic infrastructure.

Keywords - Home Design Modification, Griya Mahoni Modification, West Aceh.

1 INTRODUCTION

One of the main needs for the people is having a proper house to live. Moreover, the house also serves as a shelter where the family spends a lot of time to interact and communicate between the whole family members. This kind of housing is in great demand in the public, especially for those who have limited monthly income to build their own house as well as to buy it in cash. There are several causes of the situation mentioned earlier such as easy to have a house by paying DP (Down Payment) and easy installments payment within a certain period.

Figure 1 Site research
KPR Griya Mahoni housing is located on Jl. Imam Bonjol, Seuneubok, Johan Pahlawan, West Aceh Regency. The types of house offered by the developer are 36 type and 36 plus type with different space of interior. For instance, there is a house that only has a toilet without a kitchen and so on. Thus, residents can choose the plan that has been provided by the developer as desired. However, after the post-habitation of various forms of change in the core house, residents make changes in accordance with the needs of each occupant. This has caused some problems such as the formation of space with poor openings, lacks air vents and windows, unorganized building mass.

2 HOUSING AND MODIFICATION

KPR is an abbreviation of Kredit Perumahan Rakyat which means a house loan product of banks in terms of financing as well as the purchase of a home either for ready stock or indent. The ready stock house is a house that has been built and installed with all basic facilities in terms of electricity and water. Indent house is a new house built by the contractor through the government of the housing development (developer) after being ordered by the buyer. Not only houses that can be financed by the bank but also include home stores (shop), apartments, office homes, renovations, apartments, and also the construction of residential houses (Indonesian Banking Architecture).

The modification of core house is a change made to the main home design in order to have the minimum room space for the central activities but also to have the completeness of space for other activities. The changes are also meant that a home will not only meet the minimum requirement but also meet the standard requirement of the standard house (Nurasrizal, 2010). It can be concluded that the development and change of houses are aimed to meet the need for space effectively without having to move (Mai et al, 2007; Tipple, 1992).

There are several factors that may affect residents in making changes to the core house in terms of the number of family members, improvement of income, family business factors, proximity to the workplace, land status, the size of the housing area and the completeness of basic facilities and infrastructure. In addition, the types of core home changes include improvement. It involves not to change the type, number and shape of the house but only to make quality improvements to the material of house. Partial improvement involves change is only done by enhancing the quality of material and it is only done for few numbers of houses. Reshuffle involves changes made for the whole house. Expansion includes a change made to the home by extending outwardly. In addition, maintenance includes a change that does not make any kind of modification and the quality improvement of materials of the house.

Changes made to the core house should be done using the concept of growing house. According to Agusniansyah et al, (2016) growing house is a house developed from small size to larger size. In the development of the house, it can be done horizontally and vertically. However, if the house was changed after purchasing it, it would be more difficult than directly building it with the concept of growing house. Houses that grow horizontally are done when there is availability of vacant land, so the house grows towards the side, front and rear, while the house grows vertically if the occupants have limited land. The absolute requirement for a vertically growing house is that it must have a solid foundation that aims to prepare the building to grow vertically in the future.

According to Agusniansyah et al, (2016), the stage of implementation of construction and development of houses is carried out in stages as it is to accommodate the addition of space needed by the occupants and adjusted to the amount of budget of the occupants and the amount of land that is available. For the design of the vertical-grown house, the types can be done in the following way: construction of the initial design was built by preparing the structure for the top design. So, the building for 1st-floor is prepared for 2nd floor. The direct home design is made thoroughly to compliment the design development.
3 RESEARCH METHODOLOGY

The housing is located in a potential and strategic location which means a place away from the crowd and it only takes 5 minutes from the highway and trade and education center. It is very close access to Teuku Umar University, Education Science College of Bina Bangsa Meulaboh, Economics and Management College of Meulaboh. The housing is also equipped by public facilities such as mosque, kindergarten, green open spaces, wide asphalt road 6 meters, and drainage. This research was located at Jalan Imam Bonjol, Seuneubok, Johan Pahlawan, Ranto Panyang Timur Village, Meureubo Sub-district, Aceh Barat Regency, Aceh – Indonesia, 23617. This research focused only on 36 type houses (31 units) and 36 plus types (39 units) of KPR Griya Mahoni Housing. This is because only these types of houses are facilitated by a home loan from the banks. The method used for this research is descriptive quantitative. In principle, this quantitative research aims to answer the problem of core house design modification of KPR Griya Mahoni housing in West Aceh. Moreover, quantitative research is also often referred to as the traditional research in terms of concrete, rational, measurable, and systematic.

Furthermore, to obtain the necessary information in the research, researchers use some data collection techniques. This refers to the opinion of Gulo (2002) that data collection in a study aims to collect information related to the object of research in order to achieve research objectives. In this study data collection techniques conducted were observation, questionnaires, and documentation. The technique of determining the number of samples was done by simple random sampling technique. It was selected because of limited time and financial matter. The number of samples can be determined by using the following formula:

Slovin Formula (Ridwan, 2005:65)

\[ n = \frac{N}{N (d^2 + 1) + 1} \]

whereby:

- \( n \) = Sample
- \( N \) = Population
- \( d \) = Precision Value 95% or 0.05

Therefore:

Population in KPR Griya Mahoni housing West Aceh can be calculated:

\[ \text{Population (N)} = 70 \text{ HoH (Head of Household)} \]

\[ n = \frac{N}{N (d^2 + 1)} \]

\[ n = \frac{70}{70 (0.05)^2 + 1} = 59.57 \approx 60 \text{ HoH} \]

Meanwhile, data analysis selected by the researcher in the study was Rank Spearman Bivariate Correlation Analysis and quantitative descriptive data analysis. Non-Parametric Bivariate Correlation Analysis Rank Spearman is an analysis used to find correlations of factors that influence changes in core houses with changes in core houses. While the analysis of quantitative descriptive data is data collection carried out by researchers by explaining what factors are the cause of house changes, what elements/types of space arise due to changes in houses that occur and what changes occur in housing KPR Griya Mahoni Aceh West, and then the factors found were analyzed to draw conclusions (Nazir, 1998).
4 RESULTS AND DISCUSSION

Table 1 Correlation of Core House Change Factors

<table>
<thead>
<tr>
<th>No</th>
<th>Factors Observed</th>
<th>correlation coefficient</th>
<th>Significance Terms &lt;0.10</th>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Number of family members vs core house design changes</td>
<td>0.168</td>
<td>0.200</td>
<td>Not determined</td>
</tr>
<tr>
<td>b</td>
<td>Increased Income vs core house design changes</td>
<td>0.522</td>
<td>0.000</td>
<td>determined</td>
</tr>
<tr>
<td>c</td>
<td>Family business factor vs. core house design changes</td>
<td>0.120</td>
<td>0.361</td>
<td>Not determined</td>
</tr>
<tr>
<td>d</td>
<td>proximity to the workplace vs. core house design changes</td>
<td>-0.041</td>
<td>0.755</td>
<td>Not determined</td>
</tr>
<tr>
<td>e</td>
<td>Land Status Vs core house design changes</td>
<td>0.459</td>
<td>0.000</td>
<td>Determined</td>
</tr>
<tr>
<td>f</td>
<td>Size of the housing area Vs core house design changes</td>
<td>0.249</td>
<td>0.055</td>
<td>Determined</td>
</tr>
<tr>
<td>g</td>
<td>Completeness of basic facilities and infrastructure Vs core house design changes</td>
<td>0.382</td>
<td>0.003</td>
<td>determined</td>
</tr>
</tbody>
</table>

(Source: SPSS Analysis Calculation Result, 2018)

From the calculation of SPSS in Table 1, the researcher concluded that the significant factors that affect the core home changes are increased income, land status, size of the housing area and completeness of basic facilities and infrastructure.

Besides, the limitations on the amount of space available trigger residents to make changes by adding necessary spaces. This change affects the originally tidy house design and the previously well-structured building masses that become irregular due to the addition of space that is done either permanently or temporarily. The samples taken in this study were 60 families (25 units for house type 36 and 35 units for house type 36 plus). This sample division is in accordance with the technique of determining the number of samples using simple random sampling technique. Figure 2 shows the house type 36 and the layout of the 36 plus sightings.

After 2 years post-habitation, many residents have made house changes. The type of change made by most residents is the expansion and addition of space that reaches 56.70%. Many of the residents did add a permanent kitchen space to 26.98% with the average extension area (7.92 m²), and the temporary kitchen reached 7.90%, with the average area of expansion (4.91 m²). Table 2 is a condition of room expansion that has been done by the residents.

Table 2 explains the reasons the residents did extensions and additions to the permanent bedroom (23.02%). 5 space-forming elements: floors, walls, and ceilings are already in good condition with an average area of 11.12 m². The residents also extend and add permanent washroom (17.78%) with average additions (2.68 m²) and for temporary washroom (1.97%) with average expansion and average extension (1.65 m²). Extension and addition were also done for dining room at 14.47% with the average addition being (7.7 m²), while for temporary only reaches 1.31% with wide expansion and average addition (7 m²).
**Figure 2. The house type 36 and type 36 plus**

**Table 2 Room condition of expansion that has been done by the residents**

<table>
<thead>
<tr>
<th>Addition of permanent rooms</th>
<th>Addition of non-permanent rooms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addition of permanent kitchen</td>
<td>Addition of non-permanent kitchen</td>
</tr>
<tr>
<td>Addition of permanent bedroom</td>
<td></td>
</tr>
<tr>
<td>Addition permanent washroom</td>
<td>Addition non-permanent washroom</td>
</tr>
</tbody>
</table>
Changes made by the residents varied. There is a change towards the back and towards the side. Changes were made according to the needs of each occupant. Changes in spaces by residents can be seen in the Table 3.

Table 3 Rooms modification of house type 36 and 36 plus

<table>
<thead>
<tr>
<th>Sample</th>
<th>Original Plan</th>
<th>Original Room</th>
<th>Modified Plan</th>
<th>Modified Rooms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample 1</td>
<td><img src="image1" alt="Image" /></td>
<td>1 living room 2 bedrooms 1 family room</td>
<td><img src="image2" alt="Image" /></td>
<td>1 kitchen 1 bedroom 1 washroom 1 clothesline</td>
</tr>
<tr>
<td>G/40</td>
<td><img src="image3" alt="Image" /></td>
<td>1 living room 2 bedrooms 1 family room</td>
<td><img src="image4" alt="Image" /></td>
<td>1 bedroom 1 dining room 1 kitchen 1 washroom</td>
</tr>
<tr>
<td>Sample 2</td>
<td><img src="image5" alt="Image" /></td>
<td>1 living room 2 bedrooms 1 family room</td>
<td><img src="image6" alt="Image" /></td>
<td>1 kitchen 1 washroom</td>
</tr>
<tr>
<td>J/01</td>
<td><img src="image7" alt="Image" /></td>
<td>1 living room 2 bedrooms 1 family room</td>
<td><img src="image8" alt="Image" /></td>
<td>1 kitchen</td>
</tr>
<tr>
<td>Sample 3</td>
<td><img src="image9" alt="Image" /></td>
<td>1 living room 2 bedrooms 1 family room</td>
<td><img src="image10" alt="Image" /></td>
<td>1 kitchen 1 washroom</td>
</tr>
<tr>
<td>Sample 4 G40</td>
<td><img src="image11" alt="Image" /></td>
<td>1 living room 2 bedrooms 1 family room</td>
<td><img src="image12" alt="Image" /></td>
<td>1 kitchen</td>
</tr>
</tbody>
</table>

(Sources: Author analysis, 2018)
Home changes made by the residents do not only affect the changes in the spaces in the house but also affect the air and light circulation. Good air circulation and light are when light and air can easily enter the room. Air and day light will easily enter the house when there is availability of a medium that it can pass through. One of the most important media is the presence of windows because through the air window and day light enable the light from outside to enter the house. To find the optimal openings in the space is from 1/6 x the total floor area (Esa D et al, 2011). The following is the percentage of optimal openings in the core house and the house that has made changes.

### Table 4 Recapitulation of Percentage of Air and Light Circulation Rating at home type 36 plus and type 36

<table>
<thead>
<tr>
<th>Name of Room</th>
<th>Assessment Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core House</td>
<td></td>
</tr>
<tr>
<td>Living Room</td>
<td>100%</td>
</tr>
<tr>
<td>Bedroom 1</td>
<td>100%</td>
</tr>
<tr>
<td>Bedroom 2</td>
<td>100%</td>
</tr>
<tr>
<td>Family Room</td>
<td>100%</td>
</tr>
<tr>
<td>Washroom</td>
<td>-</td>
</tr>
<tr>
<td>Modified House</td>
<td></td>
</tr>
<tr>
<td>Bedroom 3</td>
<td>-</td>
</tr>
<tr>
<td>Kitchen</td>
<td>41.66%</td>
</tr>
<tr>
<td>Dining Room</td>
<td>-</td>
</tr>
<tr>
<td>Clothesline</td>
<td>-</td>
</tr>
<tr>
<td>Washroom</td>
<td>-</td>
</tr>
</tbody>
</table>

(Sources: Author analysis, 2018)

Information:
- (√): Sufficiently wide-open aperture

In Table 3, it is found that the spaces in the core house such as the living room and bedroom are 100% sufficient and do not require expansion. When compared to home changes, the spaces that normally experience extension is only the kitchen space (41.66%) that meets the optimum open space. Based on the findings, other spaces have not met the exposure area optimal set.

### 5 CONCLUSION

After conducting the research on Core House Design Modification on Simple Housing (Case Study: KPR Griya Mahoni Housing, West Aceh), it is found that the type of change that most residents do is expanding such as adding space as to meet the needs of daily life. This according to Maslow (as cited in Nurasrizal, 2010) that residents will make changes to the house only to meet the needs as in the stage of Survival Needs. This means that the changes made by residents at home only aim to meet the most basic needs in a single dwelling. Most of the residents do the expansion either permanently or temporarily. Thus indicating that income generation factor is the main factor of change in Housing KPR Griya Mahoni. Other main change factors are land status, land area and completeness of basic facilities and infrastructure. While other factors that affect the core home changes in accordance with the literature review is the number of family members, family business factors, and proximity to the workplace. Therefore, the researchers recommend that the concept of growing house in order to answer this housing problem. There are several steps in expanding the growing house. For instance, construction of the initial design is done by preparing the structure for the top design. Therefore, the 1st floor building is prepared for 2nd building. The direct home design is made thoroughly by completing the design development. The initial house is devoted to the core of the overall design, and the next design wraps the old design. The first stage of development begins with a core house and after that followed by its modification in the concept of growing house.
REFERENCES


Abstract - Rainwater that falls upon a roof surfaces which are collected and transferred to the storage facility for later use is a method known as Rainwater Harvesting (RWH). This method is a step towards conserving the public drinking water where the demand continues to grow worldwide. In Malaysia, there is a huge potential of rainwater harvesting based on the available rainfall amount. Even so, the existing RWH design guideline in Malaysia is lacking on the technical specification regarding congruousness of RWH installation method with the building physical characteristic. Therefore, systematic literature review is one of the ways to identify and understand the suitability between the type of RWH installation system with the building physical characteristic. The main objective of this study is to review the existing articles from year 2000 to the present on the installation systems used in RWH for non-potable purposes. The RWH installation system, types of building and building characteristics used in the previous studies will be evaluated in order to understand the suitability or regularity of the combinations. This review uses the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) as reviewing method. The systematic review process involved four stages which are identification, screening, eligibility and included. The sources of this review are Science Direct and Google Scholar. The result shows there are three types of RWH installation system were identified namely Gravity Fed System (GFS), Indirect Pumping System (IPS) and Direct Pumping System (DPS). DPS is commonly applied for non-potable purposes in residential, commercial and educational buildings. Small yard area, sloping site condition and types of soft landscape will affect the type of RWH installation system to be used. The result can be used to determine the suitability of the RWH installation system for different types and characteristics of a building.

Keyword – Systematic review, Rainwater Harvesting (RWH), installation systems, building characteristic, non-potable use.

1 INTRODUCTION

Water conservation is an important issue in sustainable buildings and a basic strategy in facing current water shortages (Taleb et al., 2011). The main factor that hinders the development of society and has a negative impact on urban development and the basic life of the population is the lack of water resources (Hashim et al., 2013). Among several options for water conservation in buildings, rainwater harvesting (RWH) are very attractive (Özdemir et al., 2011; Domènech et al., 2013). The RWH system is a simple method that uses scientific techniques to store rainwater that falls on the roof surfaces into the storage for daily use such as bath, laundry, toilets and garden watering. This method is also called roof water harvesting which involves the collection, storage and distribution process of collected rainwater. Collected rainwater harvesting system could reduce the dependency on main water supply (Che-Ani et al., 2009).

RWH systems are becoming increasingly common in several locations around the world (Jones and Hunt, 2010). The rediscovery of these systems was driven by the high water tariffs, the scarcity of this resource and the effort of national and international associations that helped to disseminate RWH system implementation (Gouvello et al., 2014). Many countries such as Germany,
Australia, United States, Japan, China, India, Sri Lanka, Japan and Singapore have implemented the RWH system.

Malaysia receives a lot of rainfall throughout the year. The average rainfall is estimated to be around 3000 mm a year calculated based on the average rainfall of 2420 mm in Peninsular Malaysia, 2630 mm in Sabah and 3830 mm in Sarawak (Z. Salmah, and K. Rafidah, 1999). Obviously, there is a huge potential in rainwater harvesting in Malaysia based on the available rainfall. In fact, rainwater harvesting is not new in Malaysia especially in the rural areas such as in Sandakan, Sabah. RWHS was implemented since 1984 to supply the rural community there for all their non-portable uses due to the limited treated water supply from the State Water Board (Sandakan Municipal Council, 2008).

From this study, several guidelines on RWH system which are normally used in Malaysia were identified. The guidelines are Urban Stormwater Management Manual for Malaysia (MSMA 2nd Edition) that was developed by Department of Irrigation and Drainage Malaysia in 2012, Garis Panduan Sistem Pengumpulan dan Penggunaan Semula Air Hujan was developed by Ministry of Urban Wellbeing, Housing and Local Government in 2013, Manual Rekabentuk Sistem Pengumpulan dan Penggunaan Semula Air Hujan (SPAH) was developed by Ministry of Works Malaysia and NAHRIM Technical Report No. 2 was developed by National Hydraulic Research Institute of Malaysia (NAHRIM) in 2014. However, these developed design guidelines are lacking on the technical specification regarding congruousness of RWH installation method with the building physical characteristic which is important to understand before RWH is planned and implemented. Thus, the objective of this systematic review is to evaluate the RWH installation system with the types and characteristics of buildings used based on previous studies in order to understand the suitability or trend of the system.

2 METHODOLOGY

This systematic literature review was performed to analyse the installation systems used in RWH for toilet flushing and was used together with the characteristics of building selected. Systematic literature review was a method used to identify and evaluate the available research information on given research question. This method can provide an overview of the particular field of knowledge and can also confirm the existence of research on the topic. It also used to detect gaps in knowledge and areas that can be studied for future studies (Petticrew & Roberts 2008; Kitchenham 2011).

Systematic review increases the methodological rigour, as its process of implementation must be replicable and transparent (Transfield et al., 2003). The procedure adopted to perform this review was based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). This procedure consists of the stages shown in Figure 1.

In the first stage of PRISMA that is identification, two sources of electronic databases were used that were Science Direct and Google Scholar. Science Direct is a full-text scientific database which is provided by the medical and scientific publishing company Elsevier (Tober, 2011). The web portal allows users to browse the world of scientific publications. The displayed search results in Science Direct database show the date of research published, the authors, the articles sources, the research title, the abstract of the research in systematic site design and quality writing style (Colepicolo, 2015). According to Tober (2011), the credible criteria for an electronic database must display the authors, published date, sources and high quality writing style and language. Science Direct follows the progress of science and technology with the immediate publication of diverse documents (Colepicolo, 2015). University libraries and institutions offer Science Direct access to their communities of researchers. In addition, professionals such as researchers, educators and students to use the Science Direct also find the required information as well as sharing their scientific research (Tober, 2011).
Google Scholar is the academic version of Google launched on 20th November 2004. Users can search scientific information such as books, journals and patents from multiple sources because the Google Scholar index includes various online academic books, journals, theses, conference papers, technical reports and other scientific information. Google Scholar also resembles subscription-based tools such as Elsevier's Scopus and the Web of Science (Falagas, 2008). In the advanced search the results are displayed by title words, authors, source, date of publication, and subject areas. Each retrieved article is represented by title, date, authors, sources and abstract which are considered as a credible online database highlighted by Tober (2011). The number of cited articles is shown under each retrieved articles and it also can be accessed by clicking on the relevant link usually on the journal's site. According to Falagas (2008), even though Google Scholar can help in the retrieval of even the most obscure information, its use is marred by inadequate and less often updated. Thus, only reliable articles retrieved from trusted sources were used in this review.

Additional record that is Project Report and Case Study of Rainwater and Greywater in Buildings by Department of the Environment, Transport and the Regions (DETR) of United Kingdom was included in this review. The report consists of information on the system used for RWH, installation guidelines and several related case studies. Common issues regarding design, installation, maintenance and management of RWH were also included in the report. The report can be referred by those who are responsible for the installation or monitoring of rainwater systems and those who wish to get the underlying data and information captured from the rainwater systems monitored.

It is noteworthy that the classification of RWH system in this review was adapted from National Hydraulic Research Institute of Malaysia (NAHRIM) Technical Guide No. 2. The National Hydraulic Research Institute of Malaysia (NAHRIM) has been aggressive in promoting rainwater harvesting in Malaysia. Refer to the NAHRIM official website NAHRIM which was established in September 1995 under the Ministry of Natural Resources and Environment (NRE). Through this study, among all the guidelines that have been mentioned, only this guideline has classified the types of RWH installation system clearly and in an orderly manner. Besides, this guideline is also the most recent of all the guidelines. The RWH system category, stated in the NAHRIM Technical Guide No. 2, includes Gravity Fed System (GFS), Indirect Pumping System (IPS) and Direct Pumping System (DPS).

The keyword search strategy or terms used in this review were like ‘rainwater harvest installation system for toilet flushing’, ‘rainwater harvest system for non-potable uses’ ‘harvested rainwater system’, ‘roof-collected water system’ to mention a few. Only English published articles range from year 2000 until April 2018 are considered in this review. All the identified articles were screened by their titles to remove the duplicate or similar articles found in the different database used. By reading the titles and abstracts, the irrelevant items for the defined issue such as RWH for irrigation purpose, RWH quality, RWH pollutants, RWH for potable uses, RWH potential for a city, RWH environmental impact, RWH life cycle cost, RWH material, RWH ancient technology, RWH energy intensity, RWH policy, RWH storage sizing, etc. are excluded from this review.

The next stage is eligibility screening where all articles that have been filtered will be evaluated in full text eligibility screening. After full-text assessment, 58 articles were excluded for some reasons and only 18 articles were included for this review after considering few aspects. The exclusion and inclusion criteria are stated in Figure 1.

After selecting the eligible articles, the following data: authors, years of publication, countries where the studies were implemented, research strategy, research main objective, types of RWH systems used, harvested rainwater usage purpose, implementation status and their study results were extracted in each study. The building characteristic such as number of storey, yard area, site condition and landscape will affect the used of RWH installation system. Numbers of storey will affect the RWH system used (Zhang, 2009; Domènech, 2011). The criteria used for choosing the tank locations were based on the optimum ground area availability, its conditions and surrounding vegetation.
(Angrill, 2012). The roots from surrounding trees can damage the underground structure (Biddle, 2012). Hence, those characteristics also were extracted. The extracted data were analysed by using Microsoft Excel 2010 and presented in graphical techniques.

Figure 1 Data collection and screening flow diagram adapted from PRISMA, 2009.
3 RESULTS

3.1 Data Collection Countries and Types of Building Involved

A total of 18 publications and report were screened using PRISMA guideline and has been filtered according to the desired objectives to analyse suitable RWH installation system for toilet flushing use. The results of extracted data from previous studies were summarized in the tabulated form as shown in Table 1.

After the screening process, 18 publications and report have been reviewed from 10 countries from 6 continents around the world and 3 types of building have been identified. As illustrated in Figure 2, European (44%) and Asia (33%) stand out as continents with the largest number of researcher in this subject that contributed to this review. North and South America, Australasia and Africa showed the same amount of researcher (6%) regarding RWH system. The breakdown according to the countries is shown in Figure 3.

Through this review, three types of buildings used as case study for the RWH research were identified as shown in Figure 4, where residential and commercial buildings show the same number of buildings that is 6 numbers that represent 32% of the total numbers of building. Educational building is the most widely used building as case study for RWH study that is a total of 7 numbers of buildings (36%).

![Figure 2 Percentage of continents involved in reviewed studies.](image)

![Figure 3 Percentage of countries involved in reviewed studies.](image)

![Figure 4 Percentage of types of building involved in reviewed studies.](image)
3.2 RWH Installation System

The types of RWH installation system as specified by NAHRIM are Gravity Fed System (GFS), Indirect Pumping System (IPS) and Direct Pumping System (DPS) and were analysed along with the types of buildings mentioned above to (Figure 5). The purpose of this analysis is to understand the selection of RWH installation system with the type of building used in the previous studies. Result shows that for educational building GFS and DPS are mostly used (43%), while IPS is seldom used (14%). For commercial building, IPS is the most widely used (50%), while GFS was

Table 1 Summary of systematic review on RWH installation system extracted from previous studies

<table>
<thead>
<tr>
<th>References</th>
<th>Countries</th>
<th>Research Strategy</th>
<th>Research Main Objectives</th>
<th>Building Types &amp; Characteristics</th>
<th>RWH System Applied</th>
<th>RWH Usage Purpose</th>
<th>Implementation Status</th>
<th>Study Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mubarak et al. (2018)</td>
<td>Indonesia</td>
<td>Case study</td>
<td>Reliability of RWH to cover potable water demand.</td>
<td>Commercial building (Transportation logistics company)</td>
<td>IPS</td>
<td>Non-potable use</td>
<td>Feasibility Study</td>
<td>Current water demand can be totally covered (100%) by using rainwater.</td>
</tr>
<tr>
<td>Ward et al. (2011)</td>
<td>United Kingdom</td>
<td>Case study</td>
<td>Evaluate financial two different RWH.</td>
<td>Commercial building (Office)</td>
<td>IPS</td>
<td>Toilet flushing</td>
<td>Implemented</td>
<td>RWH can fulfill 44% of WC water demand.</td>
</tr>
<tr>
<td>Li et al. (2016)</td>
<td>China</td>
<td>Desktop Study</td>
<td>Utilise Potential of RWH</td>
<td>Residential</td>
<td>IPS</td>
<td>Toilet flushing</td>
<td>Implemented</td>
<td>RWH can fulfill 34% of WC water demand.</td>
</tr>
<tr>
<td>Challen et al. (2000)</td>
<td>United Kingdom</td>
<td>Case Study</td>
<td>Potential of RWH in large roof building</td>
<td>Commercial Building (Supermarket)</td>
<td>GFS</td>
<td>Toilet flushing</td>
<td>Feasibility Study</td>
<td>Excellent reasons for installation. 70.7% possibility water saving.</td>
</tr>
<tr>
<td>Combatt et al. (2000)</td>
<td>United Kingdom</td>
<td>Case Study</td>
<td>Monitoring RWH efficiency</td>
<td>Residential (27 units)</td>
<td>IPS</td>
<td>Toilet flushing</td>
<td>Implemented</td>
<td>Total water saving around 60%.</td>
</tr>
<tr>
<td>Pinzon et al. (2012)</td>
<td>Spain</td>
<td>Case Study</td>
<td>Economic and environmental feasibility of RWH.</td>
<td>Residential (Apartment)</td>
<td>IPS</td>
<td>Non-potable use</td>
<td>Feasibility Study</td>
<td>Optimal scale for RWH can be achieved in large scale and high-density developments.</td>
</tr>
<tr>
<td>Ward et al. (2013)</td>
<td>United Kingdom</td>
<td>Case Study</td>
<td>Performance of RWH in large building</td>
<td>Commercial building (Office)</td>
<td>GFS</td>
<td>Toilet flushing</td>
<td>Feasibility Study</td>
<td>Office-scale RWH system potentially offer significant water and cost savings.</td>
</tr>
<tr>
<td>Gerhard and Farrah (2017)</td>
<td>Brazil</td>
<td>Case Study</td>
<td>Evaluate the potential for potable water savings by using rainwater.</td>
<td>Residential (Apartment)</td>
<td>IPS</td>
<td>Non-potable use</td>
<td>Feasibility Study</td>
<td>Potable water savings from 35.7% to 42.0%.</td>
</tr>
<tr>
<td>Islam et al. (2015)</td>
<td>Bangladesh</td>
<td>Case Study</td>
<td>Evaluate the potential of RWH</td>
<td>Educational building (University of Information and Science)</td>
<td>IPS</td>
<td>Non-potable use</td>
<td>Feasibility Study</td>
<td>Potential of RWH will exceed the non-potable water demand.</td>
</tr>
<tr>
<td>Saber et al. (2015)</td>
<td>Singapore</td>
<td>Case Study</td>
<td>Evaluate the feasibility of RWH</td>
<td>Educational building (Nanyang Technological University)</td>
<td>GFS</td>
<td>Non-potable use</td>
<td>Feasibility Study</td>
<td>Potential 66% water saving.</td>
</tr>
<tr>
<td>Appan (2000)</td>
<td>Malaysia</td>
<td>Case Study</td>
<td>Evaluate the reliability of RWH system.</td>
<td>Educational building (UTM Residential College)</td>
<td>IPS</td>
<td>Toilet flushing</td>
<td>Feasibility Study</td>
<td>Potential of RWH will exceed the non-potable water demand.</td>
</tr>
<tr>
<td>Hameed and Morden (2011)</td>
<td>Malaysia</td>
<td>Case Study</td>
<td>Evaluate the efficiency of RWH system</td>
<td>Educational building (Universiti Farta Malaysia)</td>
<td>IPS</td>
<td>Non-potable use</td>
<td>Implemented</td>
<td>RWH reduced 37% of potable water consumption.</td>
</tr>
<tr>
<td>Alkutat et al. (2009)</td>
<td>Malaysia</td>
<td>Case Study</td>
<td>Evaluate the potential of RWH system</td>
<td>Educational building (Universiti Farta Malaysia)</td>
<td>IPS</td>
<td>Toilet flushing</td>
<td>Feasibility Study</td>
<td>High potential, can meet the demand for toilet flushing uses.</td>
</tr>
<tr>
<td>Project Report by DHERA (2001)</td>
<td>NA</td>
<td>NA</td>
<td>Commercial building (The new Lincon College Faculty)</td>
<td>IPS</td>
<td>Toilet flushing</td>
<td>Implemented</td>
<td>Water saving 260,000 litres per annum, 100% cover toilet flushing uses.</td>
<td></td>
</tr>
<tr>
<td>Project Report by DHERA (2001)</td>
<td>NA</td>
<td>NA</td>
<td>Educational building (Bedfordshire East Schools Trust)</td>
<td>IPS</td>
<td>Toilet flushing</td>
<td>Implemented</td>
<td>Saving the cost of 200,000 litres of mains water usage per annum.</td>
<td></td>
</tr>
<tr>
<td>Project Report by DHERA (2001)</td>
<td>NA</td>
<td>NA</td>
<td>Commercial building (Broad District Council)</td>
<td>IPS</td>
<td>Toilet flushing</td>
<td>Implemented</td>
<td>Saving the cost of 48,000 litres of mains water usage per annum.</td>
<td></td>
</tr>
</tbody>
</table>

References:
- Mubarak et al. (2018) in Indonesia
- Ward et al. (2011) in United Kingdom
- Li et al. (2016) in China
- Challen et al. (2000) in United Kingdom
- Combatt et al. (2000) in United Kingdom
- Pinzon et al. (2012) in Spain
- Ward et al. (2013) in United Kingdom
- Gerhard and Farrah (2017) in Brazil
- Temessen et al. (2013) in Ethiopia
- Islam et al. (2015) in Bangladesh
- Saber et al. (2015) in Singapore
- Appan (2000) in Malaysia
- Hameed and Morden (2011) in Malaysia
- Alkutat et al. (2009) in Malaysia
- Project Report by DHERA (2001) in NA
- Project Report by DHERA (2001) in NA
- Project Report by DHERA (2001) in United Kingdom

Notes:
- IPS: Indirect Pumping System
- GFS: Gravity Fed System
- DPS: Direct Pumping System
- NA: Not Applicable
- SL: Soft Landscape
- LS: Large Scale Plant
- SL: Small Landscape
- NA: Not Applicable
moderately used (33%) and the less popular system used was DPS (17%), while, for residential building the most widely system used was DPS (50%), followed by IPS (33%) and GFS (17%).

3.3 Building Characteristics

The building characteristics that have been determined in the methodology stage were analysed along with the types of RWH installation systems (Figure 6). This analysis is to understand the trend or pattern between the characteristic of the building with the installation system of RWH. The result shows that type of building storey does not affect the selection of RWH installation system where all the systems (100%) are multi-storey building. Large yard area does not really affect the IPS (83%) and DPS (86%) selection but it does affect the GFS selection (17%). However, with the small yard area factor where GFS was affected (83%) by this characteristic, it does not affect the IPS (17%) and DPS (14%). Flattest site condition does not really affect the RHS installation system because it can be applied (100%) to IPS and DPS, and (67%) for GFS. In this review, sloping site condition is only applied for GFS (33%) but none (0%) for IPS and DPS. The types of soft landscape at the building affect the RWH installation where large tree such as palms exist, where only GFS is applied (17%) and none (0%) for IPS and DPS. In the shrub landscape existence, IPS shows the highest application (83%), where DPS (57%) and GFS (50%) are moderately applied. In no landscape condition, GFS (33%) and DPS (43%) were moderately used but only a few (17%) on IPS.
3.4 Implementation Status

The implementation status of the RWH installation system in the previous studies also was analysed in this review. This analysis was done to strengthen the previous research results in term of credibility factor of each installation system in RWH. Systems that have been implemented are practically proven, while implementation status at feasibility study stage has not been practically proven yet. As shown in Figure 7, IPS shows the highest percentage (83%) on implemented status and followed by DPS (57%). Meanwhile, all (100%) previous studies that applied GFS are still in feasibility study stage followed by DPS (43%) and IPS (17%). However, the findings from all the previous studies shows positive results (100%) on the benefits of harvested rainwater (Figure 8).

![Figure 7: RWH installation system implementation stages of previous studies](image)

![Figure 8: RWH installation system finding result of previous studies](image)

4 DISCUSSION

This review has revealed several RWS installation systems used in various features and types of building together with the countries involved and the usage purpose of harvested rainwater cached. The results of this review have also discovered the attractive potential of RWH in saving the potable water consumption as a step towards the sustainable environment. This review has several strengths. In the literature search, there were restrictions by year of publications which will ensure that only the latest installation systems of RWH are included in the review. This study also includes the report from government regarding installed RWH in several locations which are the technical data taken from the actual situation of the building that has been installed by the expert and the system effectiveness was proven. However, there are also limitations. English language restriction was imposed and it is possible that studies of RWH installation system from non-English-speaking countries may have been missed. This review also encountered some difficulties where only a few studies regarding RWH have explained the installation system applied. There were a lot of studies that focus on the economic feasibility of RWH, the quality of rainwater, the efficiency of RWH and the potential of RWH but none focus on the RWH installation system itself.

Firstly, this review revealed that United Kingdom is the most involved country that has conducted research regarding RWH installation system. There are three types of building that commonly used to study the feasibility, potential and the efficiency of RWH. They are residential building, commercial building and educational building. The types of building classification are based on Ekholm, (2000). Educational building was the most widely used type of building found in this review that can be used as RWH case study site. As it is known, education campus is a large community that contains many buildings and many occupants and in such situation the use of water will be high. According to Anand and Apul (2011), the percentage or potable water used just for toilet
flushing used in educational and office buildings is likely higher since toilets and sinks are the primary uses of water in these buildings. Second, this review found that the GFS and DPS were the most types of installation system used at educational building. This situation may be caused by the cost involved since GFS does not require pumps to distribute water to the distribution pipes because the header tank will distribute the water using the force of gravity. A water pump is typically required to provide adequate pressure if the tank supplies water for indoor use (Tam, 2010). This will reduce the operation cost and electricity consumption from using water pump (Cheng, 2002). Besides, the selection factors of DPS are possibly caused by limited ceiling space and inadequate building structure strength since DPS is only used as underground rainwater tank. The size and location of water tank will affect the building structure and design (Zhang, 2009).

Contrast with the commercial buildings, IPS is the most widely RWH installation system used for this kind of building. IPS requires a rainwater tank installed underground and also placed on the ceiling as header tank. The underground water tank installation requires high cost. Sub-surface or underground tanks which are usually associated with purpose-built ground catchment systems that will increase the construction cost (Tam, 2010). According to Melbourne Water (2007), underground tanks will require additional protection against surface run-off or groundwater entry, animal or human faecal material and soils which will result in increased installation costs. Underground tank presented the largest impacts of installation cost due to its higher energy consumption (Angrill, 2012). However, this is not a problem since commercial buildings often have a lot of capital. Besides, this system is also suitable to be used in high water demand building. In densely populated areas where more water is consumed, an important consideration would be whether a part of the urban water requirement can be covered by rainwater harvesting (Nolde, 2007). Residential building commonly used DPS and it is possible because the ceiling space and the structure strength are not suitable to use for other types of RWH installation system like IPS and GFS.

Third, this review has identified the trend or relationship between the characteristic of the building with the installation system of RWH. Based on the characteristic analysed earlier, the most obvious features that can affect the types of RWH installation system are the size of yard area, site condition and soft landscape.

Large yard area is suitable for all types of system while small yard area is only suitable for GFS where the rainwater tank is installed on the ceiling space. Flattest site condition is suitable for all types of RWH installation system while sloping site condition is not suitable for system that need rainwater tank to be installed on-the-ground or underground such as IPS and DPS. Thus, only GFS can be used in the condition. Last but not least, underground rainwater tank is not suitable to be used when the site has large tree such as trees and palms. The reason is the root from the plant can affect or damage the tank.

Finally, this review analysed the implementation status of the studies in order to support or strengthen the credibility of the previous studies. From all the published articles, only two implementation stages found, feasibility studies and implementation. Research at the feasibility study are conducted mostly to evaluate the possibility and feasibility of potable water saving while at the implementation stage, the efficiency of the installed RWH system is studied. However, from all the studies reviewed, all results show that RWH can successfully reduce the potable water consumption especially for non-potable purpose.

5 CONCLUSION

This systematic review has demonstrated considerable heterogeneity of RWH installation system used for toilet flushing purpose. The pattern of RWH installation system applied in the different types of building also has been identified together with the relation between the characteristics of the building with the suitability types of the RWH installation system used. As for the conclusion, Direct Pumping System (DPS) is the most common installation system chosen in Rainwater Harvesting (RWH) implementation. The result can be used to determine the suitability of the RWH installation system in different types of building and different site or building characteristics.
REFERENCES


Abstract - Banda Aceh is the capital of Aceh province that is located on the north end of Sumatra, Indonesia. As one of the cities lies above the Indo-Australia tectonic plate, on December 26, 2004, a tectonic earthquake with magnitude of 9.2 scales Richter caused tsunami waves, which caused destruction of the whole town. The connection between cultural heritage and disaster has always being linked with cultural heritage, which is seen as a burden and something that has to be protected. Protecting the cultural heritage from destruction such as from disaster has always been associated with the continuity of the society’s identity. However, the cultural heritage is not always a passive victim in a disaster, cultural heritage can also play an active role in giving power and helping people to rise from difficult times after a disaster. This study is part of the whole project of mapping and zoning built-heritage in Banda Aceh by using a digital humanities approach combining several methods such as mapping, GIS, interview, and participant observation. In this paper we present a partial finding of interview with 252 respondents in Banda Aceh about their perception of heritage and their stories of heritage and disaster. The goal of this study is to understand how cultural and disaster protection are linked in the perspective of cultural heritage as active agents.

Keywords - Tsunami, Cultural Heritage, Active Agent

1 BACKGROUND

Indonesia is one of the countries that often experience disaster that is caused by natural and non-natural factors. Indonesia lies geographically at the confluence of four tectonic plates of the Eurasian plate, the Indo-Australian plate, and the pacific plate. These tectonic plates are known as the ring of fire; the meeting of each plate can cause an earthquake. This plate encounters lanes which are under the sea, thus, a large earthquake with shallow depths can potentially become the main cause of tsunami.

Banda Aceh is the capital of Aceh province, located on the north end of Sumatra, Indonesia. As one of the cities lies above the Indo-Australia tectonic plate, on December 26, 2004, a tectonic earthquake with magnitude of 9.2 scales Richter caused tsunami waves that had destruction to the whole town.

Based on the massive earthquake and tsunami of Aceh in 2004, some researchers suspected the massive ancient earthquake and tsunami that occurred in Aceh has some effects to 2004 earthquake. Pale seismologist research has successfully revealed that the earthquake-tsunami disaster that occurred in Aceh in the past, around the year 1390 AD and 1450 AD (Hilman, 2015) has some effects to 2004 earthquake. The events of tsunami during the 1450s indicate the occurrence of a massive earthquake and tsunami marked by the disappearance of the Pasai Ocean Kingdom (Hilman, 2015). This has also been explained by Lombard, on his way to Aceh, describing a city that is geographically unfavorable, locating below the surface of the sea, often experiencing flood and has swampy areas. In addition to the unfavorable natural conditions and floods, Aceh also often experienced earthquakes (Lombard, 1991). Some of the travelers who took a trip to Aceh, namely Beaulieu who visited Aceh around 1620-1630 stated there has been a big earthquake that occurs three to four times a year. In addition to the earthquake, flooding also occurred repeatedly. Beaulieu recorded a major earthquake that occurred on March 7, 1621 and had caused panic (Lombard, 1991).
The long-term history of disaster has led to a change in the center of Kota Banda Aceh (Lombard, 1991; Kamal, 2008). Based on the history of Banda Aceh, which was divided into 4 most prominent periods that has caused changes in the history of the architecture of Banda Aceh, the Islamic period, the period of Tamaddun Islam, the Colonial period and the Postcolonial period (Kamal, 2008). This can be seen from the traces of the cultural heritage in Banda Aceh. However, the physical evidence of history cannot be found in urban spaces. This may be due to damaged or lost due to disasters, wars, conflicts, new developments and other natural processes of destruction (Kamal, 2008). In addition to these historical buildings, Banda Aceh is also known for other historic sites that are important, interesting and have unique backgrounds.

All along, the relation between cultural heritage and disaster is constantly linked with cultural heritage as a burden and something that must be saved. Of course, saving the cultural heritage is very important for the continuity of the society identity itself. But the cultural heritage is not always a passive victim in a disaster, cultural heritage can play an active role in giving power and helping people to rise from difficult times after a disaster. According to Rico (2014), the cultural heritage is a witness of the history of a great occurrence. After the 2004 Tsunami, Banda Aceh's presence as a disaster-prone area was the concern of many parties. This was reflected by the increasing research on tsunami disaster and the possibility of occurrence.

Based on the explanation above, this study aims to examine on how people's perceptions of the relationships between cultural heritage building and disasters. This study discussed how a cultural heritage building can become an active agent in disaster, especially the 2004 Tsunami Disaster in Banda Aceh.

2 LITERATURE REVIEW

2.2 Post-disaster Cultural Heritage in the city of Banda Aceh

As mentioned above, geographically, Banda Aceh is one of the main cities in disaster prone areas such as earthquakes, tsunamis, floods, and others. As the historical record of a traveler who came there was at least some disasters that were recorded (Lombard, 1991). Disaster history whose traces can be seen from the heritage of the Banda Aceh City heritage has led to a physical changes in the city center of Banda Aceh (Lombard, 1991 and Arif, 2008).

As an old city, which has been standing for more than 800 years, Banda Aceh has a long history. Banda Aceh is known as the center of the largest Islamic empire in Southeast Asia, so it has an important role in the history of spreading Islam. However, there is not much historical physical evidence that are found in urban spaces which are thought to be damaged or lost due to disasters, wars, conflicts, and new developments, and other natural damage processes (Arif, 2008). The 2004 Tsunami disaster has caused more severe damage to the cultural heritage; it is also believed that an ancient tsunami has caused the change and displacement of kingdom (Hilman, 2015).

So far, the inventory of Cultural Heritage Buildings in Banda Aceh has been carried out by the Culture and Tourism Office who issued "List of Sub-District Sites in Banda Aceh City in 2013", Badan Pelestarian Cagar Budaya issued "List of Historical and Ancient Relics that have been Defined as Protected Cultural Heritage Law No. 5 of 1992 concerns Cultural Heritage Objects, while Law No. 11 of 2010 concerns Cultural Heritage. As of December 31, 2012", Aceh Heritage Community has also published their list and Unsyiah Architecture Department has also conducted research and inventory of cultural heritage buildings in Banda Aceh in year 2012 in collaboration with the Culture and Tourism Office. The process involved the identification of cultural heritage in Banda Aceh into three basic periods, the pre-colonial, post-colonial, and post-tsunami periods and recommends that protection is needed for this cultural heritage. Below are the location of built-heritage in Banda Aceh.

Among the relics of the historical sites of the kingdom of Aceh Darussalam are historic buildings that have high architectural values like the Baiturrahman Grand Mosque which is a religious symbol, courage and the nationalism of the Acehnese as well as center for religious education in archipelago during Sultan Iskandar Muda's reign. Other buildings inherited from the kingdom of Aceh Darussalam which also has historical values are Gunongan and Pinto Khop which were
innitially located near the Aceh Keraton and was built by Sultan Iskandar Muda around the 16th century. During the Dutch colonialism between the end of 19th Century to early 20th Century, this keraton was destroyed and the Dutch rebuilt a new building called pendopo Governour (the Dutch Governor's residence). These sites along with the family and the kings of the Aceh Darussalam Sultanate's graveyard complex, the graves of Acehnese clerics, the tombs of the Gampong Pande kings, the ancient tombs, Kerkhoff burial complex, which is the burial site of 2200 Dutch soldiers, and the Dutch Governor's residence have survived several catastrophic events of war, conflict, new development, and other natural damage processes that occurred in the city of Banda Aceh.

In addition to these historic buildings, the city of Banda Aceh also have many other historical sites with important, interesting and unique to disaster. The occurrence of the 2004 tsunami have left a number of historical traces that have emerged naturally and artificially. A study conducted by Rico (2014), a larger vessel, the Floating PLTD in Punge Blang Cut, and a smaller fishing boat in Lampulo, standing permanently on the second floor of a house, are among real traces of tsunami. There was hope that the remaining tsunami boats in 2006 could be nominated to achieve World Heritage List status. The PLTD Apung was brought from Kalimantan and used as an electricity generator to supply Aceh from the port of Ulee Lheue, the trip ended unexpectedly about 4 km to the mainland from the place it was moored. In 2007, there was a discussion about returning it to the sea, but in mid-2008, a decision to build a Tsunami Education Park on the land adjacent to the ship was made. Additionally, tours are offered on the deck of the ship, from where the entire city can be observed. The smaller of the famous boats have landed at the second level of a house in Lampulo. The current position of the ship is a real symbol of the great strength of the tsunami wave. The boat saved 59 people in this incident. These sites were changed to the destination of tourists and tsunami visitors. In 2009, both ships showed the effects of an authentic and unforgiving weather that is the characteristics of Sumatra.
Aceh Tsunami Museum Competition held by the Aceh Rehabilitation and Reconstruction Agency (BRR) in cooperation with the Aceh government and IAI Aceh in 2007.

Each of cultural heritage has its own characteristics that have the potential to be superior, but has not been managed in an integrated manner so that it can be a source of reference for disaster (Rahardjo, 2013). Therefore a special approach is needed for the rebuilding of areas and buildings of cultural heritage in disaster-prone areas (Dewi, 2017). This shows that the management of cultural heritage is important for people living in disaster-prone areas.

To save Banda Aceh’s cultural assets that are still lagging behind in the form of cultural heritage buildings as well as to protect and revivethe public memory of areas that have played an important role in the history of the city of Banda Aceh is important during the process of disaster mitigation.

2.3 Role of Cultural Heritage as an Active Agent in Disaster

From several studies on the role of cultural heritage buildings after the 2004 Tsunami disaster, it was found that cultural heritage objects have an important and active role in the emergency, reconstruction, and following periods. Cultural heritage buildings are not only passive victims who are waiting to be saved, but are one of the active agents that help the community to survive (Dewi, 2017; Rico, 2014; and Dewi and Rauzi, 2018).

The community considers Masjid Raya Baiturrahman to have an important role for survivors to survive because it has served as a refuge and decision-making places during the reconstruction period (Dewi, 2017). In addition, Masjid Raya Baiturrahman has helped create resilience in the community. The community interpretresreligious buildings as shelters for rescuers in times of disaster, and as a sense of security during critical times. Mosques are significant in the post-tsunami Acehnese context. For example Mc Coughney (2017) quoted one of Banda Aceh’s residents’ expression, “Take a look at Ulee Lheue Mosque … as we can see it still stood up [in the tsunami] while the surrounding buildings were smashed to pieces.” Many residents expressed both practical and spiritual reasons that the mosques are attractive for evacuation; in the words of one resident: “I am not sure that the building is strong enough. It might collapse, if it is God’s will. So, I will go to the mosque first, go together with others. We can read the Quran there.” In the words of another resident, ‘God knows everything, the people inside of [the mosque], maybe will be saved as well, because there were many mosques that survived the disaster’. This expression clearly expresses the role of cultural heritage, especially mosque, as place of refuge during disaster.

Therefore, according to Rico (2014), the study of post-disaster heritage has dimmed the association of heritage as an endangered species and more emphasis on factors of heritage management which covers a much more productive line of inquiry. Furthermore, heritage at risk management has to pay attention to formalization of local ideas and networks.

It then remains to be further discussed whether heritage can ever be constructed separately from its state of ongoing and inevitable decay, considering the mobility of heritage value as it is able to migrate in and out of a state of tangibility.

3 METHODS

This study is part of the whole research project using a digital humanities approach by combining several methods mapping, GIS, interview, and participant observation. The combination of the method provides social and cultural context as well as spatial understanding of the relationship between cultural heritage and society. In this paper we present partial data of the real study and the focus was to understand how cultural and disaster protection are linkeded in the perspective of cultural heritage as active agents. It is necessary to explore the perceptions of communities about cultural heritage and their relationship to disasters. The number of interviews has been conducted with 252 respondents. Besides gaining basic information such as age, occupation, ethnic group, and education, we asked several main questions such as: What is a cultural heritage in Banda Aceh?, and Why do they to them as heritage? What is the meaning (function) of the cultural heritage related to disaster? Data analysis is done by coding or grouping the results of interviews conducted into several
categories. The results of this analysis showed how the community's own understanding of cultural heritage in the context of tangible objects and how cultural heritage can play an active role as an instrument that is able to withstand the tsunami.

4 RESULTS AND DISCUSSION

The distribution of the samples is illustrated in Table 1. The majority of the respondents were dominated by women and students between 18 to 24 years old. Most of them have lived in the city more than five years. The detail of data is shown below:

Table 1 Summary of Data

<table>
<thead>
<tr>
<th>Item</th>
<th>Evacuation Building</th>
<th>Memory</th>
<th>Disaster Mitigation</th>
<th>Ruin Old Cultural Heritage</th>
<th>Emerging New Cultural Heritage</th>
<th>Local Wisdom</th>
<th>Do Not Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
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<td></td>
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<tr>
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<td>22</td>
<td>6</td>
<td>1</td>
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<td>47</td>
<td>9</td>
<td>3</td>
<td>2</td>
<td>126</td>
</tr>
<tr>
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</tr>
<tr>
<td>&lt;17</td>
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<td></td>
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<td></td>
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<td>28</td>
<td>5</td>
<td>3</td>
<td>2</td>
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<td>5</td>
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<td>12</td>
<td>1</td>
<td>1</td>
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<td>23</td>
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<td>10</td>
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<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>&gt;65</td>
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<td>6</td>
<td>9</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>16</td>
</tr>
</tbody>
</table>

From the results of data processing Table 1 shows that people's understanding of cultural heritage objects are: Rumah Aceh, Masjid Raya Baiturrrahman, Pendopo, Pintu Khop, natural cultural heritage: Blangpadang, Gampoeng Pande, fortresses, tombs, and also tsunami cultural heritage: floating PLTD ships and Aceh Tsunami Museum.
24% respondents stated that Rumoh Aceh is a cultural heritage object that contains historical value and needs to be protected. Aceh Traditional House is a wooden house in the form of a stage, erected on a number of round poles that are placed on a stone foundation, and the connection between the pillars and not rigid beams is the main factor that the building is able to anticipate earthquake loads (Meutia, 2016).

Based on the cultural heritage and disaster relations, 49.0% out of the 252 respondents did not see any relation between cultural heritage and disaster. This perception has two possibilities. Firstly, not all interviewees were in Banda Aceh when the tsunami strikes because in the set of questionnaire there is no statement which informs the duration of stay in Banda Aceh as criteria. Secondly, the lack of public knowledge on the role of cultural heritage on disaster. Cultural heritage is referred to as an object that is old and vulnerable and does not have the ability to withstand a disaster. This object will be damaged and lost due to disaster. People still see cultural heritage buildings as victims of great natural events that can kill and eliminate not only these objects but even human lives. However, 21.7% and 17.4% of the total number of people were interviewed, they reported that they view cultural heritage and disaster relations as rescue building as well as disaster mitigation. The ability to understand cultural heritage as an agent of change to disaster, will be able to save the building from disaster. The community believe that building provide them security during the post-disaster period. Here are some examples from the interviews expressed by the respondents in relation to cultural heritage and disasters.

(Male_Bachelor_Student_Acehnese)

Rumoh Aceh tends to be made high and the design of the building is made of wood because we know that in Banda Aceh there were frequent earthquakes or catastrophic disasters, actually the Aceh house was made resistant to disasters such as floods

(Male_Bachelor_Student_Javanese)

Cultural heritage has a role in disaster because in the cultural heritage can also tell about past disasters, if we look at ourselves, Aceh has a distinctive house shape that characterizes the house that was built to avoid earthquakes, floods and animals so the point is that cultural heritage is one of the ways humans protect themselves from nature.

Cultural heritage as an object has memories of past events such as the great power of a leader of the region and also memories of grief in the 2004 tsunami event. There are very few respondents who viewed cultural heritage and disaster as related. However, the emergence of new heritage, such as a floating PLTD ship weighing 5000 tons which function as a power plant ship in the city of Banda Aceh crossing up to 4 km from its moorings in ilheu-lheu and stopping in the middle of community housing during the 2004 Aceh earthquake and tsunami and other tsunami heritage, has created new awareness on the relation between heritage and disaster. These tsunami debris have more intangible and important values for community to remind them of the tragic event.

In addition, this phenomenal ship had saved tsunami victims from disaster malignancy (Kamal, 2008). Not only the floating ships as witnesses of a major event, the tsunami memorial as a building built after the tsunami by the Reconstruction and Rehabilitation Agency (BRR), an official government institution formed to handle the post-disaster recovery process were also named as new cultural heritage. The community claimed the Tsunami memorial represented in the form of a building that kept memories of tsunami events as objects. These objects are silent witnesses to the tsunami, such as post-tsunami photos, documentary videos which were recorded by the community at the time of the incident. Theoretically, a museum is a building where objects of historical, scientific, or artistic interest are kept; museum can also mean a building where people can go to view works of art or objects of interest to science or history. Below are example from the interviews expressed by the respondents in relation to cultural heritage and disasters as the emergence of new cultural heritage.
If it is linked to the disaster, it is loss for our cultural heritage, for example, yesterday's tsunami, many monuments have been lost or it could have caused a new cultural preservation like for example, the PLTD has become a cultural reserve for us, so is the house with a boat, from that disaster another cultural heritage can emerge.

Like the Tsunami Museum, there was a disaster in the past and became a tourist object in Banda Aceh.

The rebuilding of the cultural heritage building after the tsunami must also fulfill the needs of the community. Therefore, immediate action to restore the function of architectural inheritance, especially those related to daily activities (communal) such as mosques, meunasah, and others is necessary. This is the center for the people of Aceh after the tsunami. Thus, reconstructing or restoring architectural heritage buildings traditionally damaged is deemed important. Unlike the case with the experts in heritage studies determining the construction of architectural heritage after an extraordinary disaster is the potential to reduce resilience. For example, the idea of returning architectural inheritance in its original form, so that it is possibly delay reconstruction and gains a lot of resources different based on what people want. People, especially in Banda Aceh, really value the authenticity of use or function; not material (Dewi, 2017).

5 CONCLUSION

The city of Banda Aceh holds many historical sites, which are important, interesting and have unique background. Currently, the connection between cultural heritage and disaster have always been associated with cultural heritage and is referred to burden and must be saved. But the cultural heritage is not always a passive victim in disaster, cultural heritage can play an active role in giving strength and helping people to rise from adversity after a disaster. The understanding of the community through the respondents has revealed that the Aceh Rumoh and the Grand Mosque as a cultural heritage building are able to become a shelter for victims in the disaster.

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