SITUATION STUDY

OF

TIMBER SEASONING IN BHUTAN

2017

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Engineering Adaptation and Risk Reduction Division

Department of Engineering Services

Ministry of Works and Human Settlement

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Objectives

The purpose of the survey of sawmills was to ascertain the current practices of timber seasoning and to collect relevant data so as to develop necessary interventions to improve durability of timber and associated defects which arise from improper seasoning. Information on current situation of timber seasoning at sawmills were collected as a baseline for the way forward to making the use of seasoned timber in all general public constructions mandatory. Related issues and view of sawmill owners or representatives were also sought.

The purpose of making use of seasoned timber in all general public constructions, above all, is to minimize the poor performance of using unseasoned timber and the associated costs incurred in operation and maintenance.

Limitations

Collection of a very comprehensive and accurate information was limited because the figures obtainable was solely based on the approximation of sawmill owners and representatives through their regular working experience. It could not be based on accurate records as no proper record-keeping was available.

Effort was put in to collect rudimentary information on the dimensions of prefabricated doors and windows and the corresponding prices alongside. However, the limited information which could be gathered was very varied as fabrication was done based on drawings provided and the price determined likewise. Due to limited information and the absence of standard dimensions of doors and windows for public constructions, relevant analysis could not be made and no concrete conclusions could be drawn and presented.

Also, survey of all sawmills in the country could not be carried out.

Introduction

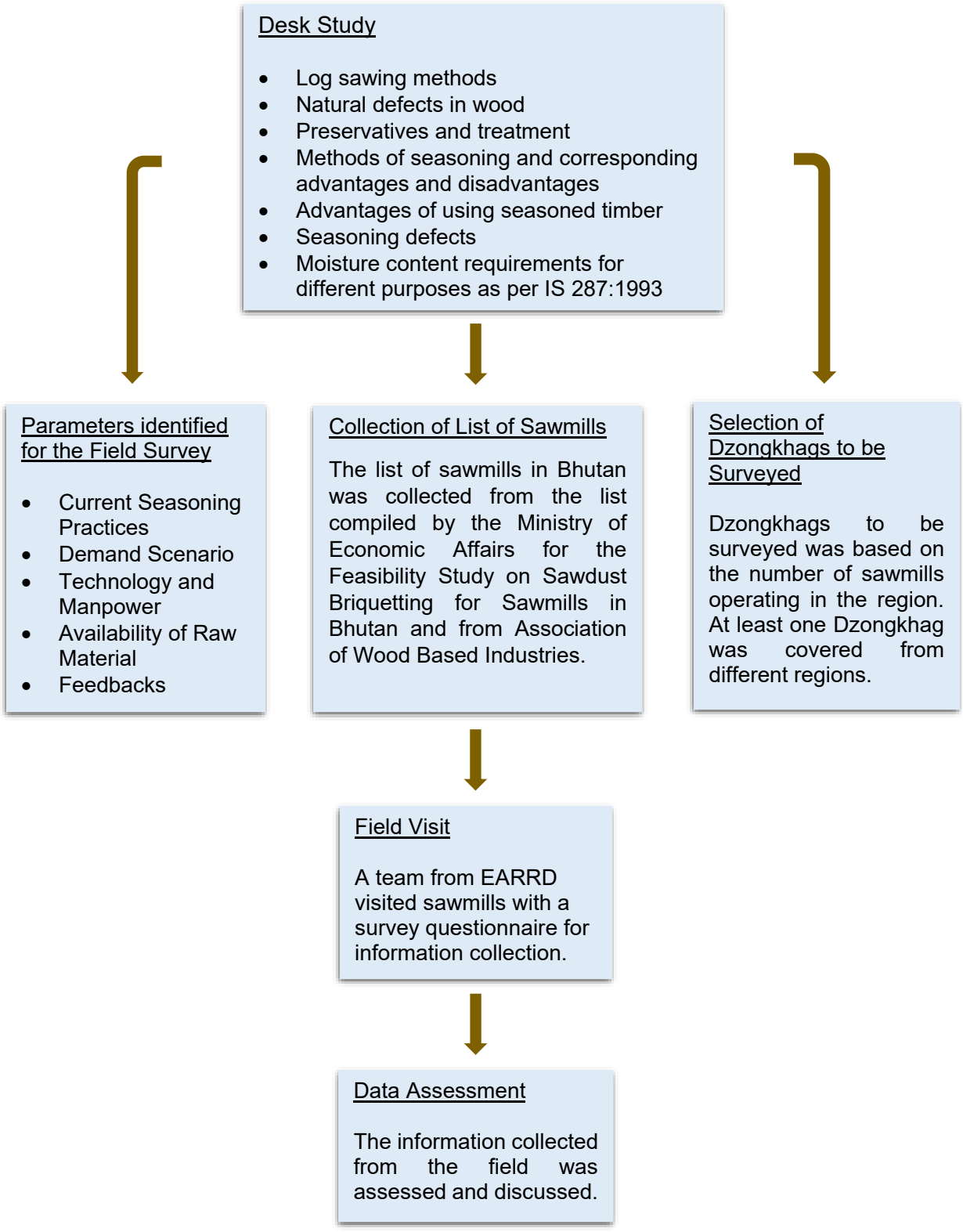
Timber seasoning is simply the controlled process of drying out water from ‘green’ timber. Seasoning induces many improvements in the properties of a timber apart from few disadvantages such as loss in volume of timber due to shrinkage and also seasoning defects. However, both shrinkage and seasoning defects can be minimized by proper monitoring while seasoning.

The purpose of seasoning is not to fully dry a timber but to bring it to an equilibrium moisture content relative to the humidity of the surrounding. Once timber attains an equilibrium moisture content, its moisture content fluctuates minimally with changes in the relative humidity of the surrounding. Seasoning can be done both naturally and artificially.

The use of unseasoned timber in construction of houses result in defects due to uncontrolled drying of timber after construction. It becomes subject to insect and fungal attacks, form cracks and create gaps at wall and timber interfaces. Consequently, it increases the energy usage of a house during cold winter days as heat is readily lost to the outside. The subsequent reduction in the serviceability increases the expenditure incurred in operation, maintenance and repair.

It is to be regretted that, in Bhutan, mostly unseasoned timber is used in all general public constructions resulting in the associated problems and thereby increasing the government recurrent expenditure. The government has realized the need to use seasoned timber in public constructions and its inherent benefits, both direct and indirect. Therefore, as a way forward, it is seen to be necessary to make the use of seasoned timber in public constructions mandatory.

Methodology



SECTION I
DESK STUDY

1.1. Sawing Methods

1. Plain Sawing

In this method, planks are first cut from log at mutually perpendicular tangents to the circumference of the log to obtain a square cross-sectional log. The resulting square section is then sawn into parallel planks without changing the orientation or sawn into to planks by changing the orientation of the log. The planks obtained by plain sawing have annular growth rings at an angle less than 30˚ to the face of the plank. Plain sawing produces minimum waste and hence cost effective. On the other hand, plain sawn lumber has structural drawbacks due to higher chances of cupping, warping, shrinking and twisting.

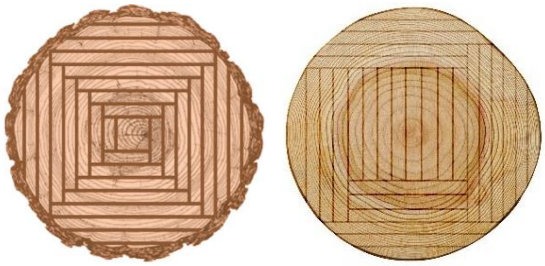


Figure 1: Plain Sawing Methods *(Hardwoods of Wisconsin, n.d.)*

2. Quarter Sawing

In quarter sawing, logs are sawn at radial angle into quarters and each quarter is sawn to produce planks. By this method, one gets planks where the annular growth rings form an angle between 30 to 60 and 60 to 90 relative to the surface of the plank. The former is termed as rift sawn and the latter as quarter sawn. The quarter sawn boards come from boards cut from the centre of the logs as shown in Figure and rift sawn boards come from the boards cut from the outside of the log as shown in Figure.

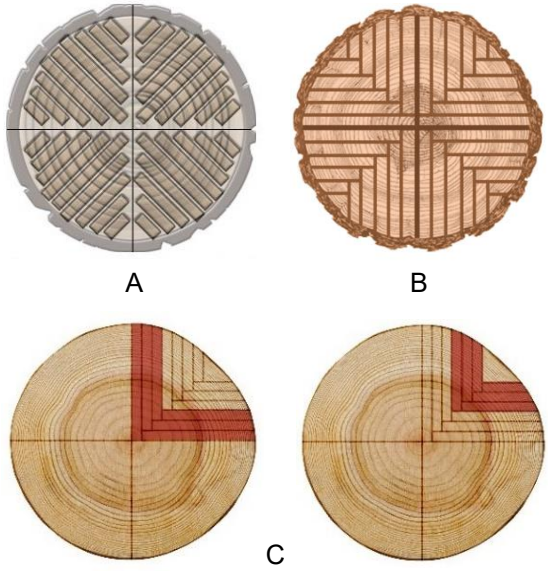


Figure 2: Quarter Sawing Methods *(Continental Hardwood Co., 2017)*

The drawback associated with quarter sawn lumber is its high cost as yield is low and is more labour intensive. The lumbers produced by this method are narrower. The advantage is that quarter sawn lumber is structurally stable as it has low propensity to warp, twist, cup and shrink.

Figure 3: Radial Sawing Method (Continental Hardwood Co., 2017)

3. Radial Sawing

Radial sawing involves sawing logs parallel to medullary rays and radially perpendicular to growth rings. Hence lumbers manufactured by this method has annular growth rings intersecting perpendicular, if not, almost perpendicular to the plank surface. Radially sawn lumber produces the most structurally stable lumber and least

Figure 4: Live Sawing Method

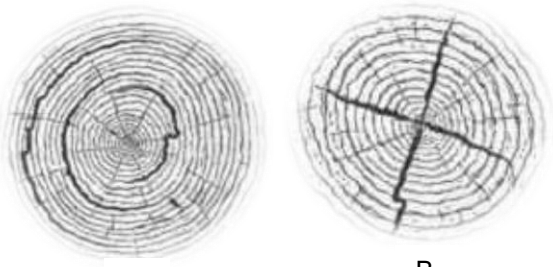
propensity to warp, shrink, cup and twist. It has a unique linear appearance.

The drawback however is that there is high wastage produced in form of wedges and hence the lumber produced by this method is the most expensive.

Figure 2: Check

4. Live Sawing

In live sawing, all the planks are cut parallel to each other with the first cut made at tangent to the annual growth rings. This produces mix of quarter sawn, rift sawn and radial sawn planks. Thus, the angle of growth rings relative to the plank surface ranges from 0 for planks curt across the exterior to almost 90 for planks cut across the log's core. This is the simplest method of sawing and is most commonly used across sawmills.



A B

A. Cup Shake
B. Heart Shake

Figure 1: Shakes *(Timber.Continued, n.d.)*

1.2. Natural Defects in Woods

1. Checks

   Check is a longitudinal crack which is usually normal to the growth rings. It is usually a result of drying stresses as the sapwood shrinks around the heartwood over time. When checks extend through the full width of the timber, it is termed as splits.

Figure 7. Rindgall

2. Shakes

   Shakes are longitudinal separation in the wood between the annual rings.

   a. Cup shake

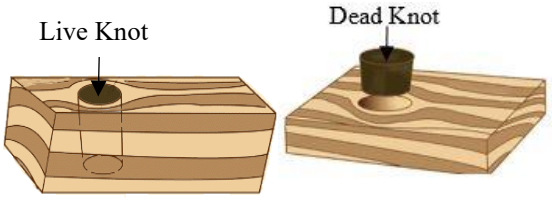
      These are curved splits which partly or wholly separates annual rings from one another. In the latter case, it is called ring shake. It is caused due to excessive frost action on the sap present in tree.

   b. Heart shake

      It occurs due to shrinkage off heartwood when tree is overmatured. Cracks propagate from pith and run towards sapwood and therefore they are wider at centre and diminish outwards.

   c. Star shake

      These are radial splits or cracks wide at circumference and diminishing towards the centre of the tree. This defect may arise from severe frost and heat of sun.



A. Live Knot B. Dead Knot

Figure 8. Knot (Defects in Timber, 2000)

Figure 9. Twisted Fibre (Ega, 2015)

Figure 10. Burls

3. Rindgall
   This defect occurs as a result of swelling caused by the growth of layers of sapwood over wounds after the branch has been cut off in an irregular manner. The newly developed layers do not unite properly with the old rot, thereby leaving cavities, from where decay starts.

4. Knot
   Knots are dark hard pieces of wood left from where the branches have been cut off. It results in discontinuity in grain direction and reduces the strength of wood. A knot which is free from decay and is firmly intact is called live or sound knot. A knot which is not firm is called dead knot or loose knot.

5. Twisted Fibre
   The defect due to the fibres of tree which get twisted when young by the force of wind is called twisted fibre.

6. Burls
   They are formed when a tree receives a shock or injury when it is young due to which the growth of tree is completely upset and irregular projections appear on the body of timber.

7. Insect Damage
   This type of defect is caused by tunneling which with some species of insect is done by larvae while with others it is the adult beetle.

8. Fungal Decay
   Usually occurs in growing mature timber or recently felled timber. As wood is an organic substance, it is susceptible to attack by wood destroying fungi causing it to rot and decay. It is characterized by abnormal mottled appearance, roughness of surface and intense discolouration. The different types of defects due to fungi are given in Figure 10.

Figure 11. Insect Damage

A. Heart Rot (New Zealand Farm Forestry Association, 2009)

B. Blue Stain (Mistretta, n.d.)

C. Wet Rot (Rehman, 2012)

D. Dry Rot

E. White Rot (Coleman, n.d.)

F. Brown Rot

Figure 12. Fungal Damage

1.3. Preservatives and Treatment

Wood preservatives and chemical compounds used to protect timber against fungi and insects. Its use is not intended to improve physical or mechanical properties of wood.

Preservatives are classified depending upon the solvent as follows:

1. Oil borne
   Few examples are creosote, carbolineum and solignum.

2. Water borne
   Pentachlorophenol, benzene-hexa-chloride, dichlorodiphenyl trichlor-ethane (D.D.T) and copper naphthenate.

3. Organic solvent borne
   Copper-chromate-arsenic composition
   Acid-cupric-chromate composition
   Chromate-zinc chloride composition
   Copper-chrome-boric composition
   Zinc-meta-arsenite composition
   Zinc-chrome-boric composition

1.4. Methods of Seasoning

Methods of timber seasoning is broadly classified into two as follows:

1. Natural Seasoning
2. Artificial Seasoning

1. Natural Seasoning

This method of seasoning commonly known as air seasoning is undeniably the oldest method of drying timbers. The suitability and the effectiveness of this process of drying timber is dependent on the surrounding climate. Accordingly, the final moisture content can vary between 15% and 20% or more. The time required to dry a timber naturally will be less if the timber was stacked in summer than in winter as drying is faster in summer. The drying duration is also dependent on the section sizes of the timber; thinner sections will require lesser drying period. The most suitable time to stack hardwoods is in winter and autumn months so that the initial drying rate will be slow.

Air drying has the following disadvantages:

i. It is a slow process
ii. There is little control over the final moisture content
iii. It requires a large site area

2. Artificial Seasoning

This method of seasoning is also known as kiln seasoning and is a technology developed to meet the commercial demand of timber which cannot be met by the age-old method of air seasoning in view of the long seasoning time it requires.

There are kilns with different builds commercially available. Nonetheless, any type of kiln requires four essential components mentioned below:

a. Controlled temperature
b. Controlled ventilation
c. Controlled humidity
d. Controlled air circulation

Improper control of the abovementioned factors causes defects in the seasoned timber. For instance, splitting and shakes are caused due to uncontrolled heat and lack of humidity during the drying process.

Kiln seasoning has the following advantages:

i. Shorter seasoning time required
ii. Allows for precise rate of drying for different timber species and sizes
iii. Have greater control over final moisture content
iv. Seasoning defects can controlled

Kiln seasoning has the following disadvantages:

i. Requires expensive equipment
ii. High energy consumption
iii. Requires timely supervision of a skilled operator
iv. Different drying schedules for various species

1.5. Seasoning Defects

The following defects occur due to seasoning:

1. Cupping
2. Bowing
3. Twisting
4. Springing
5. End Splits
6. Surface Splits
7. Case Hardening

1. Cupping
   The plank is curved along the transverse direction. It is cause by unequal amounts of shrinkage along the growth rings.

2. Bowing
   The face of the board is curved along the length. It is caused by poor stacking.

3. Twisting
   The ends of the board are twisted in opposite direction. It is caused due to shrinkage along spiral or interlocking grain.

4. Springing
   The edge of the board curve along its length while the face remains flat. It is caused by longitudinal shrinkage along irregular grain.

5. End Splits
   It occurs at the end sections of the board due to rapid drying rate compared to the interior sections. It can be prevented by painting the ends of the timber with a water proof paints.

6. Surface Checks/Splits
   It lies along the grain and is caused by rapid drying on the surface of the board.

7. Case Hardening
   It is a defect whereby the outside of the board is dry and hard but moisture is trapped in the centre cells of the wood. It is caused when the drying rate is high.

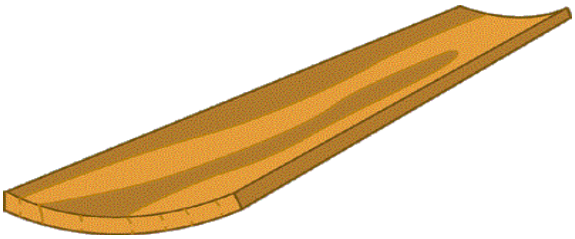


Figure 13. Cupping

Figure 14. Bowing

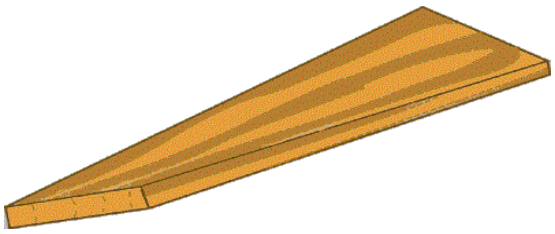


Figure 15. Twisting

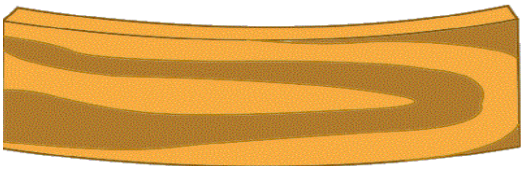


Figure 16. Springing

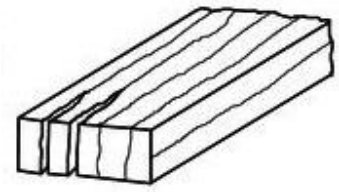


Figure 17. End

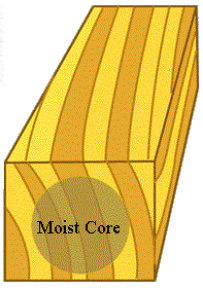


Figure 18. Case Hardening

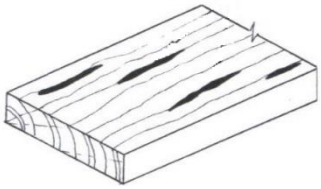


Figure 19. Surface Checks

1.6. Advantages of Seasoning

1. Increase Stability
   Wood must be dried to the equilibrium moisture content to minimize dimensional changes. The use of green timber in any construction can result in severe deformation as the timber dries.

2. Reduce propensity to fungal decay
   Drying timber to a moisture content of less than 20% or below fibre saturation point prevents the onset of decay due to fungi.

3. Reduce Weight
   Seasoning of wood reduces its weight appreciably and in effect reduces handling and transportation costs.

4. Increase Strength
   As wood dries, its strength properties are enhanced with consequent increase in the weight to strength ratio. Most species of wood increase their strength characteristics by 50% or more when seasoned to a moisture content of 15%.

5. Allow preservation treatment, gluing and finishing
   A dry timber allows for effective penetration of preservatives, proper gluing and ease finishing works.

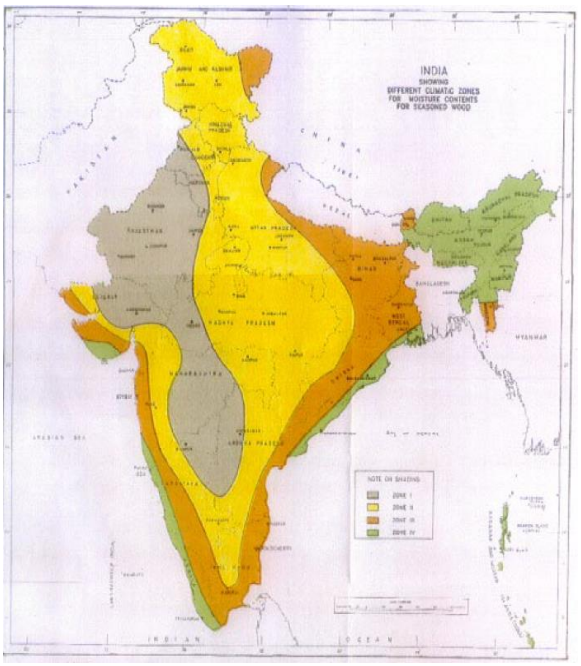


Figure 20. Zone Classification Map (IS 287:1993)

1.7. Moisture Content Requirements (As per IS 287:1993)

Scope of the Standard

This standard covers the recommendations for permissible limits of moisture content based on optimum moisture contents indicated by experimental data and the tolerances permissible in these limits for four different climatic zones into which India has been broadly divided for this purpose.

Zones

Bhutan with its proximity to the Northeast India, falls under Zone IV as in IS 287:1993. Zone IV has characteristic of average annual relative humidity more than 67 percent. As per this code, for any micro-climatic condition not covered by the meteorological data for standard stations in India on which the map is based, the zonal condition for a locality be decided on the basis of its monthly humidity data and in the light of the criterion about RH range prescribed for the four different zones.

In this regard, meteorological data from the Department of Hydrology and Meteorological Services (DHMS) under the Ministry of Economic Affairs can be used for finding out the average annual RH within different regions of the country and accordingly the permissible moisture content of timber for different uses as given in Table 1 of IS 287:1993 can be followed.

Moisture content requirement for different components of building works picked from IS 287:1993 is provided below in Table 1.

As per the code, seasoned timber (whether air or kiln-dried) shall be deemed to conform to the moisture content requirements of the standard if the averaged moisture content of all the samples from a given lot is within +2% and the moisture content of individual samples is within +3 percent of the permissible moisture content for the particular end use and zone except for few specific end uses as specified in Clause 5 of the code.

The tolerances corresponding to the different end uses given in Table 1 is provided in Table 2.

Table 1. Moisture Content Requirement for Different Building Components

Sl. No.	Use	Moisture Content (%, Max)			
		Zone I	Zone II	Zone III	Zone IV
1.	Beams and Rafters	12	14	17	20
2.	Doors and windows				
	a. 50mm and above in thickness	10	12	14	16
	b. Thinner than 50 mm	8	10	12	14
3.	Flooring strips for general purposes	8	10	10	12

Table 2. Tolerances for Moisture Content Requirement

Sl. No.	Use	Tolerances (%)	
		For a Given Lot	For an individual sample
1.	Beams and Rafters	+3	+5
2.	Doors and Windows		
	a. 50mm and above in thickness	+3	+5
	b. Thinner than 50mm	+2	+3
3.	Flooring strips for general purposes	+2	+3

SECTION II
FIELD SURVEY

2.1. Sawmills Distribution in the Country

Total number of sawmills in each Dzongkhag is presented in the table below:

Table 3: Sawmill Distribution in the Country

Sl No	Dzongkhags	Number of Sawmills
1	Sarpang	5
2	Zhemgang	2
3	Bumthang	16
4	Trongsa	1
5	Paro	21
6	Samtse	2
7	Mongar	5
8	Haa	21
9	Wangduephodrang	9
10	Tsirang	1
11	Chukha	12
12	Samdrup Jongkhar	4
13	Pema Gastshel	1
14	Lhuentse	1
15	Trashi Yangtse	1
16	Trashigang	4
17	Thimphu	16
18	Punakha	1
19	Dagana	0
20	Gasa	0
	Total =	**123**

2.2. List of Sawmills Visited

Table 4: Sawmills Visited

Dzongkhag	Name of the Sawmills	Status	Number of Sawmills Visited
Thimphu	Highland Woodworks	Operational	4
	Menjong Woodworks	Operational	
	Sonam Sawmill	Operational	
	Ongdi Timber Industries	Operational	
Paro	Shari Sawmill	Operational	5
	Wangs Wood Industries	Operational	
	Kuenga Wood Industry	Operational	
	Rabten Sawmill	Operational	
	Sonam Sawmill	Operational	
Chukha	Bhutan Ply	Operational	10
	Phuntsho Timber Industry	Operational	
	Green Wood Manufacturing	Operational	
	Chima Wood Industry	Operational	

	Stables & Jattu	Operational		
	Bhutan Wood Panel	Operational		
	Jigme Sawmill	Operational		
	Chundu Wood Industry	Operational		
	H&K Company	Operational		
	Namgay Wood Industry	Operational		
Sarpang	Phubgyel Sawmill	Operational		5
	Khuju Sawmill	Operational		
	Gyeltshen Wood Industry	Operational		
	Samdrup Sawmill	Operational		
	Namcha Sawmill	Operational		
Haa	Yangchen Sawmill	Operational		14
	GT Sawmill	Operational		
	Tshewang Timber Industry	Operational		
	Choden Sawmill	Operational		
	Meriphuensum Sawmill	Operational		
	Gongphel Sawmill	Operational		
	Khandu Sawmill	Operational		
	Desang Sawmill	Operational		
	Rickey Sawmill	Operational		
	PG Sawmill	Operational		
	Tobjur Sawmill	Operational		
	Tshaphel Yarab Sawmill	Operational		
	Sonam and Serang Sawmill	Operational		
	Sherab Wangchuk Sawmill	Operational		
Wangdue Phodrang	Army Welfare Sawmill	Operational		4
	TP Sawmill	Operational		
	Druk Integrated Wood Complex	Operational		
	Dhendup Wood Based Industry	Operational		
Bumthang	Chithuen Gongphel Sawmill	Operational		8
	Dechen Sawmill	Operational		
	Karma Sawmill	Operational		
	Norden Pines	Operational		
	Singye Furniture	Operational		
	Tshela Sawmill	Operational		
	Chogyel Furniture	Operational		
	KTM Sawmill	Operational		
Mongar	Norbu Sawmill	Operational		2
	Richen Pelbar Sawmill	Operational		
		Total	=	52

2.3. Seasoning Practice in Sawmills in Bhutan

1. Natural Seasoning

It is commonly done in two ways:

i. Sun Drying
ii. Air Drying

The seasoning duration is dependent on the timber species and thickness. Thinner timbers up to 2 inches may take up to 90 days and the thicker ones such as floor joist may take ranging from more than 90 days to 270 days. Through natural seasoning, a moisture content of about 18-20% can be achieved in the mentioned durations.

a. Sun Drying: is the traditional way of seasoning practiced commonly in rural areas whereby the sawn timbers are erected and leaned on the edge against a post in the open without any protection from weather as shown in the figure.

Figure 21. Sun Drying

b. Air Drying: is the seasoning method where timbers are stacked in layers separated by crossers. It is normally placed under a shed with three or all the four sides open. The shed protects the stacked timber from monsoon rain. The uncontrolled and natural circulation of air between the timbers bring down the moisture content gradually. This method of seasoning is very much dependent on the weather condition and hence choice of stacking season is important.

Figure 22. Air Drying

2. Artificial Seasoning

It is the most effective and widely used commercial method of timber seasoning. This method relies on controlled environment to dry out the timber and require the following factors (Akram, 2011):

a. Forced air circulation by using large fans, blowers, etc.
b. Heat of some form provided by piped steam.
c. Humidity control provided by steam jets. The amount and duration of air, heat and humidity depends upon timber species, size and quantity.

In the field, seasoning kilns are used to achieve a moisture content of 8% – 17%. To achieve the given MC range, duration of 15 to 20 days is required for softwood and 30 to 45 days is required for hardwood.

Figure 23. Kiln Drying

2.4. Seasoning Defects in Field

If the wet timber is used, it has the tendency to bow, twist, split, cup, and check as the timber dries under uncontrolled conditions. The unseasoned timber building components and furniture are the victims of these defects which destroy their strength and aesthetics. Hence, in the long run it is inefficient and uneconomical as more cost is incurred for maintenances and energy use.

It was learned from sawmills that checks, splits and warping (cup, crook, twist & bow) are common defects occurring in kiln seasoning. These defects as we know result from improper control of kiln chamber environment such as temperature and humidity. Few sawmills refer the kiln schedule provided by kiln designers while some follow their own schedule learned from experience. While it may not be possible to eliminate these defects, proper regulation of kiln environment is vital to minimize such defects. In the field, a weight is placed on the top of the stacked timbers to prevent warping of timbers.

2.5. Moisture Content Achieved in Sawmills

Moisture content of timber is an important factor and determines the propensity of it being attacked by insects and fungi and defects due to warping and shrinking. Therefore, drying timber to the equilibrium moisture content helps to achieve quality constructions and also reduces recurring cost such as for operation and maintenance and energy consumption (energy is lost through joints of the doors and windows). All sawmills that season timber determines the moisture content using electric moisture metre.

Following tables show MC achieved by the local wood industries and the duration kept for seasoning to achieve the same.

Table 5. Seasoning duration and moisture content achieved in sawmills

Seasoning Type	Timber	Duration (days)	Moisture Content (%)
Natural Seasoning	Softwood	Up to 90	18 - 20
	Hardwood	90 - 270	
Artificial Seasoning	Softwood	15 - 20	8 - 17
	Hardwood	30 - 45	

**Note: the above values are for timber section sizes used for general construction purposes.*

2.6. Use of Preservatives

Only two woodwork industries from sawmills surveyed had used wood preservatives namely terminator for termite protection and Chromated Copper Arsenate (CCA) in the past. They discontinued its application due to associated health hazard concerns. Others felt that there is no need for applying of such preservatives for timber treatment.

2.7. Limitation of Use of Seasoned Timber in Southern Bhutan

The climate in southern regions of the country does not favour the use of wood itself in general. Whether seasoned or not, wood fabrication does not perform adequately as compared to steel fabrication and hence public prefer to use steel over wood. Using seasoned wood in these regions may delay the onset of insect and fungal attack by a little, but may not be by an amount enough to realize the life-cycle cost benefits over using unseasoned timber.

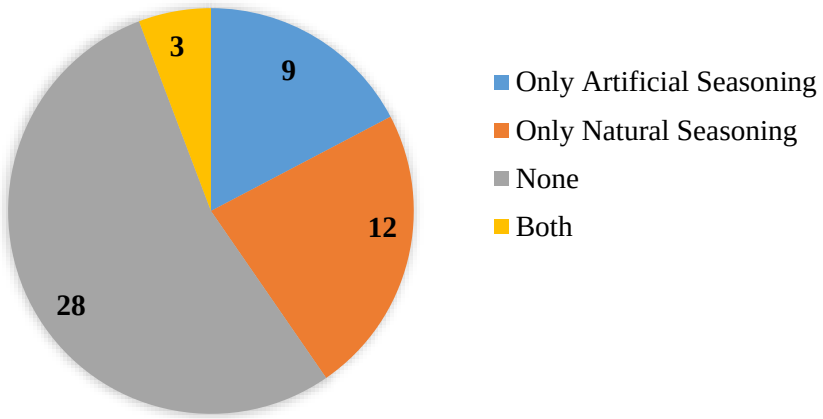
Prior to making the use of seasoned timber mandatory, there is a need to properly assess this downside in southern regions and weigh the benefits of using seasoned timber against steel. If steel is found to be a better option, special exceptions to the mandatory use of seasoned timber in public constructions may be necessary.

2.8. Data Interpretation

Information collected from the Sawmills were discussed and analyzed to meet the objectives of this report. Some of the data processed are as followed

1. Status of Timber Seasoning Practice

Among the 52 sawmills surveyed, 9 sawmills have only artificial seasoning facilities, 12 sawmills practice only natural seasoning and 3 sawmills practice both while remaining 28 sawmills do not season timber. Regrettably, the 15 sawmills air seasoning their timber do it for the sole intend of protecting the excess timbers from rotting so as not to incur loss. Given that there is uninterrupted demand, timber would be sold unseasoned. The excess air seasoned timbers are sold at the same selling rate of the wet timber or otherwise people buy unseasoned timber if the rate of the latter is increased.

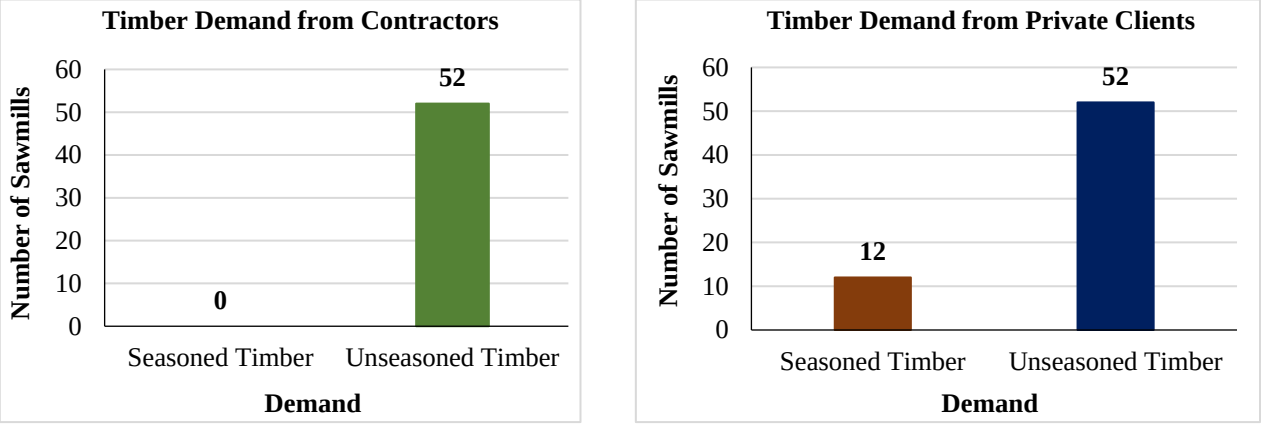


Graph 1. Number of sawmills practicing different seasoning methods

2. Timber Demand Scenario

Of the total 52 sawmills surveyed, only 12 sawmills with artificial seasoning facility (woodwork industries), which correspond to 23% of sawmills surveyed, sell seasoned timber to the private. No seasoned timber is sold to contractors doing public constructions as no contractors come with demand for seasoned timber. Nonetheless, few have supplied their seasoned timber products such as furniture and prefab doors and windows for some special constructions.

The remaining 40 sawmills with no artificial seasoning facility sell unseasoned timbers both for private works and public works. The 12 sawmills which only air season their timber do it for the sole intend of protecting it from rotting so as not to incur loss.



Graph 2. Timber Demand Secenario

3. Sawing and Seasoning Capacity

All the different sawmills surveyed use same log sawing machines, either Horizontal Trolley Saw or Mobile Saw (Wood Mizer) or both. It cuts huge logs of wood into desirable sizes and shapes at the minimum possible time period. The Wood Manufacturing Industries also use Band Saw for the flexibility it renders in terms of sawing timber into curves and irregular shapes as is demanded in furniture making. All sawmills live saw the logs which produces least wastage compared to other sawing methods.

A. Horizontal Trolley Saw

B. Mobile Saw

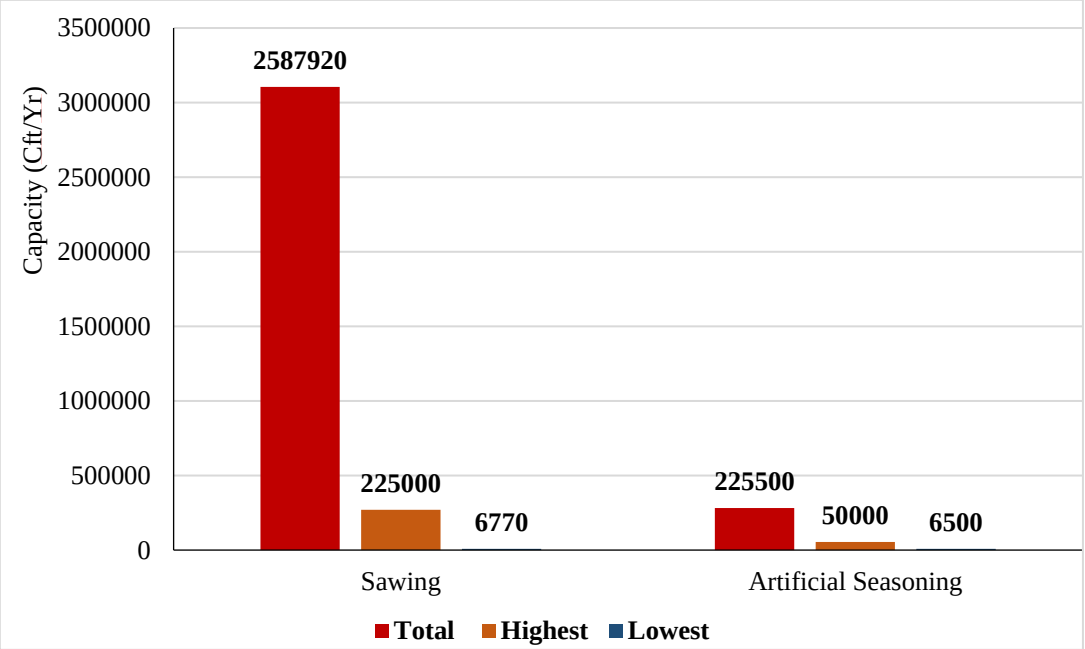
C. Band Saw

Figure 24. Sawing Machines

Of the 52 sawmills surveyed, 40 sawmills sell only sawn timbers. The remaining 12 Woodwork Industries sell sawn timber only when there is excess of timber from that required for their industrial use. Sawmills surveyed have the total sawing capacity of approximately 2587920 Cft/Yr. The lowest

sawing capacity is 6670 Cft/Yr while few sawmills have sawing capacity as high as about 225000 Cft/Yr. However, due to labour and timber supply shortages, sawmills are not functioning to its full capacity.

Artificial seasoning technology is adopted only by Woodwork Industries since they manufacture timber products such as furniture, plywood and other timber products. Out of the 52 sawmills, only 12 were wood manufacturing industries and had installed seasoning kilns for drying timbers. The combined seasoning capacity is about 225500 Cft/Yr. Bhutan Wood Panel has the highest seasoning capacity of 5400 Cft per month.



Graph 3. Sawing capacity and seasoning capacity

Note:

i. Sawing Capacity
- *Calculated for 52 sawmills surveyed*
- *8 working hours/day for effective duration of months*

ii. Seasoning Capacity
- *Calculated for 12 woodwork industries with artificial seasoning capacity*
- *Average seasoning duration of 30 days for effective duration of 10 months.*

The persons consulted during the survey of sawmills expressed the following to be the reasons for appreciably high demand for unseasoned timber compared to seasoned timber.

i. Time period for the completion of project
All public works are awarded to a contractor with a time frame for completion. Since not all sawmills have artificial seasoning facility and air seasoning takes a long duration of about few months to bring down the timber to a moisture content of about 18-20%, contractors prefer to purchase unseasoned timber to save time.

ii. Cost
Timber can be seasoned artificially in seasoning kilns to reduce the seasoning duration. From the sawmills surveyed, it was found that depending upon the timber species and size of the timber, a maximum duration of about a month or a month and a half is required to bring the moisture content of timber to about 8-17%. However, installing seasoning technology requires moderate investment cost which small sawmills can not afford. Also, the additional

energy cost, skilled labour cost, other overhead costs and the investment in technology increases the unit cost of timber.

The rates of artificially seasoned timber differ for different wood species and from sawmills to sawmills on different factors the sawmill proprieters include for determining the cost per unit of seasoned timber. However, approximately Nu. 50 to Nu. 60 per Cft is charged for seasoning timber to the required moisture content for building works and for making furniture. While this additional upfront cost might be worth the gain in perspective from life-cycle cost, many contractors aren't willing to pay this extra cost as they aren't liable for the operation and maintenance of the structure after it's completion.

iii. Self logging
Self logging from community forest and other sources is practised in many dzongkhags. As a result, there is decrease in demand of timber from sawmills whether seasoned or unseasoned.

2.9. Use of Timber Waste

The waste material such as sawdust and wood splinters are supplied to Bhutan Ply and Bhutan Board Products Limited in Phuentsholing and also to briquette manufacturing companies. Woodwork Industries however burn the waste for heating up boilers to produce steam which is circulated in seasoning kilns.

2.10. Shortage of Log Supply

Few sawmills expressed that the quantity of log that each sawmill is entitled to get from source depot per month is less and not enough. Nevertheless, this is the case only for sawmills with high sawing capacity per month. Currently, each sawmill can avail about 1000-1200 Cft of log from depot per month.

Also, when the quantity of logs at depot is not enough, log allotment is done through lucky-dip whereby some sawmills do not get timber.

SECTION III
ISSUES AND FEEDBACKS

3.1. Inability to Comply with Government Timber Price

Sawmills have difficulty complying with the timber price fixed by NRDCL. The following are the reasons expressed:

i. Supply of Defective Logs

Almost all sawmills expressed that about 5-10% of logs are defective in a lot they receive from the auction depot. As of now, there is no procedure to refund for the defective logs. The loss due to unusable portion of logs are recovered from the price added to the government price which is charged to the customers.

While they agreed to our view that there is no way to know if there are interior defects in a log beforehand, they suggested the need for a refund procedure if they come across such defects when sawing the logs. This would encourage and make it possible for them to comply with the government timber price.

It was learned that the seasoning kilns installed in few sawmills are underutilized when there is shortage of timber supply. Consequently, the cost per unit of seasoned timber is increased which further discourages contractors undertaking public works to procure seasoned timber. In their view, if there is consistent and enough supply of timbers, sawmills could operate optimally and hence the price of timbers both unseasoned and seasoned could be kept low. Also, if the supplied logs are 100% usable (excluding the wastage from sawing) or sawmills are refunded for the defective logs, certain amount of decrease in the price of timber could be realized.

Note:
Defective logs here refer specifically to logs attacked by insects and fungi.

ii. Over-measurement of Log Quantity

It was learned from consultation with sawmills that there is some disparity in the measurement of log sizes at source depot. The log sizes are over-measured at source and is in excess of the value when they re-measure at sawmill. Consequently, sawmills incur extra cost in procurement of logs due to this gap in measurement which consequently gets added to the price of timbers.

iii. Delay in Log Deployment

The vehicles the sawmills send to get the timber lot that they are given in auction depot are send back empty due to some delay. This increases the transportation cost for sawmills which consequently gets added to the final price of the timber.

The present timber price as fixed by NRDCL in collaboration with Department of Forestry is given below for reference.

Table 6. 2015 Revised Price of Timber under Different Dzongkhags (Nu./Cft)

Sl. No.	Dzongkhag	Logs				Sawn			
		Conifer		Broadleaf		Conifer		Broadleaf	
		A Class	B Class	A Class	B Class	A Class	B Class	A Class	B Class
1.	Thimphu	159.89	154.69	139.89	134.69	301.83	294.20	299.44	291.02
2.	Paro	161.03	155.83	141.03	135.93	306.88	299.26	305.01	296.61
3.	Haa	161.03	155.83	141.03	135.93	309.82	302.19	308.25	299.84
4.	Wangdue	159.70	154.50	139.70	134.50	301.54	293.91	299.12	290.71
5.	Gasa	159.70	154.50	139.70	134.50	301.54	293.91	299.12	290.71
6.	Punakha	159.70	154.50	139.70	134.50	301.54	293.91	299.12	290.71
7.	Tsirang	159.70	154.50	139.70	134.50	301.54	293.91	299.12	290.71
8.	Dagana	159.70	154.50	139.70	134.50	301.54	293.91	299.12	290.71
9.	Bumthang	156.07	150.87	136.07	130.87	296.21	288.59	293.24	284.84
10.	Trongsa	162.34	157.14	142.34	137.14	305.41	297.78	303.39	294.98
11.	Zhemgang	162.34	157.14	142.34	137.14	305.41	297.78	303.39	294.98
12.	Sarpang	162.34	157.14	142.34	137.14	331.11	323.49	331.74	323.33
13.	Chukha	171.60	166.40	151.60	146.40	345.34	337.71	347.42	339.02
14.	Samtse	171.60	166.40	151.60	146.40	310.37	302.74	308.86	300.45
15.	Monggar	159.04	153.84	139.04	133.84	310.37	292.94	298.05	289.64
16.	Lhuentse	159.04	153.84	139.04	133.84	310.37	292.94	298.05	289.64
17.	T/Yangtse	159.04	153.84	139.04	133.84	310.37	292.94	298.05	289.64
18.	T/Gang	159.04	153.84	139.04	133.84	309.19	301.56	307.56	299.15
19.	S/Jongkhar	157.86	152.66	137.86	132.66	306.43	298.80	304.51	296.10
20.	P Gatshel	157.86	152.66	137.86	132.66	298.84	291.21	296.14	287.73

Rural Rates	Conifer (Nu./Cft)	Broadleaf (Nu./Cft)
Special Class	131.84	131.84
A Class	126.69	126.69
B Class	111.41	105.21

3.2. Need for Standard Dimensions

Sawmills expressed a need to develop standard door and window dimensions categorized based on the functional use of the public infrastructure. The advantages of such standardization they expressed are as follows:

i. Stock Keeping

Currently, sawmills are not able to keep door and window products in stock because of no existing standard door and window dimensions for general public constructions. So, when some contractors who come to place order for fabrication of doors and windows, sawmills don't get enough time to meet the supply deadline and do not take the order. Therefore, if there exists standard door and window dimensions for general public works, sawmills could maintain stock and would have to produce only the additional quantity required. The quality of work would be improved if sawmills supply doors and windows as they have adequate machines required for such works which would not be possible at site due inadequacy of machines available.

ii. Wastage Reduction

Having standard dimensions in place would enable lengthwise pre-sizing of logs at supply depots. This would help reduce wastage due to unusable log lengths left while sawing at sawmills. In the present scenario, logs of different lengths are supplied whereby lots of unusable log lengths are left while sawing. This wastage again adds to the price of timber.

iii. Cost Comparison

Standard dimensions of doors and windows would enable easy price comparison of these products from different sawmills. While we expressed the drawback in just comparing the products based on price, a sawmill owner in response said that sawmills could be held liable if the product is found to be substandard. Also, an agency concerned could monitor and certify their products.

3.3. Assignment of Timber Works to Sawmills

Some sawmills considered possible objections from Architects on the standardization of door and window dimensions for general public works and suggested an alternative whereby all timber works be given to the sawmills since the commencement of a project. Current practice is that contractors come in the last minute with order for fabrication works which sawmills are not able to take given the limited time.

If the timber works are assigned to sawmill since the commencement of a project, they would get enough lead time for fabricating the timber items while the civil works are undergoing in parallel.

On the contrary, sawmill owner shared his experience in undertaking timber works for a project where he faced tough time fitting the prefabricated doors and windows into the openings due to poor civil works; he had to resize the products. Therefore, he feels that there is a need to look into to this drawback and strategize to address it for this alternative to function.

3.4. Establishment of Regional Seasoning Chambers

It was expressed by some sawmills, who may not be in position to invest in kiln seasoning technology individually, the possibility of setting up state-run regional seasoning chambers. However, setting up regional seasoning chambers would require further transportation of sawn timbers to the chamber site for seasoning and then transported to work site which would incur additional transportation cost and hence shoot up the price of seasoned timber.

3.5. Self-Logging

Some logs are purchased from community forests at cheaper and negotiable price while others are obtained from different sources and hence demand does not come to sawmills. There is a need to properly monitor the sourcing of timbers for public works. Even if use of seasoned timber is made mandatory, there is no guarantee that a properly seasoned timber will be used.

3.6. Proper Grouping of Timbers at Source

Some sawmill owners felt that there is a need for proper grouping of timbers at source. For instance, some A Class quality logs are mixed with B Class and vice versa. As a result, they end

up paying A Class timber price for some B Class quality logs while they pay B Class timber price for some A Class quality logs (the latter however is an advantage to them). They feel that there is a need for a wider classification system.

3.7. Labour Issue

Sawmills face shortage of labour as they are allowed to have only limited number of Indian labours whereas recruiting Bhutanese labours is difficult as they are unable to pay the high salary they demand. Moreover, it was opinioned that the local labours lack the willingness to learn and develop their skills and are only interested to get paid. Few local labours work for a month or two and leave as a result of which sawmills have to recruit new local labours from time to time.

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