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Identifying the Strength Grade for Finger Jointed Timber Species According to BS 5268-2:2002

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Abstract

Off-cut wood is currently considered as waste thus is dumped by saw mills as they find no means of utilising them. Sawn timber material of furniture factories and short length of sawn timbers are also considered to be wastes in the timber industry. Finger jointing technique which interlock the end joints formed by machining a number of similar tapered symmetrical fingers are recognised in this regards as effective and sustainable means of utilisation of timber wastes. The present study was undertaken to assess the strength grade of finger jointed timber based on BS 5268-2:2002. Seven timber species which are commonly used in Sri Lanka were employed for the assessment with and without finger joints. Values of Modulus of Rupture (MOR), Modulus of Elasticity (MOE), Compression parallel to grain and Compression perpendicular to grain strength of the specimens were measured. Finger jointing was performed with constant geometry (finger length 19 mm, tip width 1 mm and finger pitch 4 mm) using polyvinyl acetate (PVA, P-SWR) adhesive at normal exposure conditions. The strength properties were evaluated by Universal Testing Machine (UTM) according to BS 373:1957. Strength classes relevant to the grade stresses were not significant for finger jointed and clear specimens of Satin, Mahogany, Jack and Grandis. Both clear and finger jointed timber specimens obtained D40 for Satin and Teak, D30 for Jack, Mahogany and Grandis. Teak shows properties similar to both D35 and D40 when used as finger jointed timber. Kumbuk was shown to change from D40 to D30 while using as finger jointed timber. Finger jointed Pine showed stress grade of C22, C24 and C27.

Keywords: Finger joint; grade stress, universal testing machine

1. Introduction

Timber is considered to be one of the oldest building materials used in Sri Lanka. It is widely used as a structural element in the construction industries thus has a steadily increased demand. In Sri Lanka there are over 400 different timber species (Muthumala and Amarasekara, 2013). During the processing, a considerable portion of timber is removed as waste dumped by sawmills. Dumping of timber as wastes and shorter sections is becoming a matter of great concern due to its scarcity. Therefore, innovative means of timber utilisation in particular, making use of waste sawn timber planks receives high recognition (Muthumala et al, 2018). A substantial portion of off-cut timbers in Sri Lanka is dumped as unused timber. No effective means has so far been found for the effective utilisation of off-cut timbers. Even though, a

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number of woodworking joints is employed for the utilisation of large timber structural elements, use of small timber sections for structural purposes is yet to be explored.

If the off-cut timber could be used for making such structural elements, timber wastage could substantially be minimised. Finger joint is considered to be a sustainable, eco-friendly and economically viable technique which ensures sustainable utilisation of small timber planks (Sandika et al, 2017).

Finger joints are described as interlocking end joints formed by machining a number of similar tapered symmetrical fingers at their ends using finger joint cutters and then binding together (BSI, BS EN 15497, 2014). Finger joints with off-cut timber may be useful in obtaining compression member with higher cross sections. As well as, production of timbers with high aesthetical value for different species is also ensured through this technique. The defects commonly found in the timbers could also be removed with this technique.

Even though the strength of finger jointed timber sections of softwoods has been evaluated extensively, little attention has so far been made on the hardwoods. However, most of the commonly used timber species in Sri Lanka are hardwoods. Therefore, the technology required for making finger joints with hardwoods has been developed and made available for local use. Finger length of 19 mm and polyvinyl acetate SWR adhesive was found to be the most suitable combination for making finger joints for local timber species (Muthumala et al., 2018). Furthermore the combination is recommended for the hardwoods and hardwood off-cuts which are used as structural components in the construction industry in Sri Lanka. In the future, finger-jointed material is certain to become more common place in both lumber and finished products as a means of upgrading defective material to clear and in creating otherwise unavailable long lengths (Hoadley, 2000).

Despite the fact that the structural performance of the finger jointed timber products such as studs, trusses, columns, beams etc., has been investigated the connections properties of finger joints have been investigated thus not included in the British Standards (BS) design code. Therefor the main objective of this study is to assess the strength grade of finger jointed timber based on BS 5268-2:2002. Which provides with necessary guidance on the structural use of timber, glued laminated timber, plywood, tempered hardboard and wood particle boards in load bearing members. It includes the recommendations on the quality, grade stresses and modification factors applicable to these materials when they are used as simple members, or as parts of built-up components, or as parts of structural components with the incorporation of other materials.

In literature, strength evaluation of finger jointed sections has been mainly found to be concentrated on temperate species (Fisette and Rice 1988, Samson 1985). As far as hardwoods are concerned, there are some reports from Ghana (Ayarkwa et al. 2000). A recent report from India tries to explain the measured flexural parameters of Eucalyptus in terms of the joint areas (Kumar et al. 2013).

2. Methodology

2.1 Sample collection

Six timber species namely; Grandis (*Eucalyptus grandis*), Jack (*Aartocarpus heterphyllus*), Kumbuk (*Terminelia arjuna*), Mahogany (*Swietenia macrophylla*)**,** Satin (*Chloroxylon swietenia*) and Teak (*Tectona grandis*), were selected as hardwoods and Pine (*Pinus caribaea*)**,** was selected as softwood considering their very high usage in Sri Lanka. Timber materials labelled as wastes were collected from the State Timber Corporation (STC) saw mill at Boossa, Sri Lanka and used for the study. The timber sections were selected from visually inspected defects free portions before been further treatments.

2.2 Specimen Preparation

Specimens were prepared using seasoned (M.C. 12%) timber planks according to BS standards (BS 373:1957 and BS EN 15497:2014). Ten clear timber specimens were used as control specimens and 10 finger jointed timber specimens with same dimensions were made with constant finger geometry (finger length19 mm, tip width 1 mm and finger pitch 4 mm) as shown in Figure 1. Specimens of clear and finger jointed were prepared from two timber planks with five replicates each.

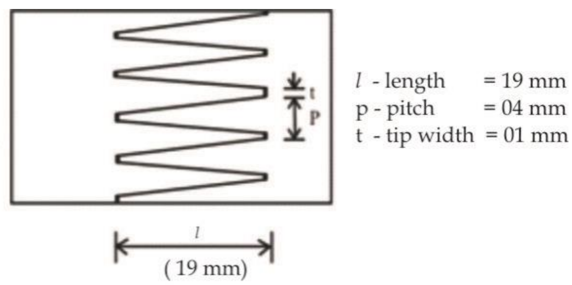

Figure 1. Finger geometry of a finger joint.

Finger jointing was performed on mid span, polyvinyl acetate- SWR adhesive was used for gluing at normal exposure conditions (Vievek et al, 2016). Specimens were prepared at the furniture factory of the State Timber Corporation, Boossa, Galle, Sri Lanka.

2.3 Specimen for three-point bending test (MOR and MOE)

The off-cut woods were dried using a kiln drier to ensure the wood moisture content is below 12%. The average moisture content of wood materials was determined using a moisture meter before the preparation of test specimens. The samples were tested based on B.S. 373:1957 standards.

2.4 Finger joint preparation

The specimens with the dimension of 300 mm×25 mm×25 mm (moisture content of 12%) were cross cut into two pieces using a circular saw and used for the static bending tests (the length of a piece was 160 mm). The specimens with the dimension of 60 mm×20 mm×20 mm were cross cut into two pieces using the same saw machine and used for the compression test-parallel to grains. Another set of specimen with the dimension of 50 mm×50 mm×50 mm were cross cut into two pieces and used for the compression test-perpendicular to grains (BS 373: 1957).

2.5 Experimental procedure

Sample testing was performed at the laboratory of STC, Battaramulla, Colombo, Sri Lanka. Three-point bending test and compression tests of the prepared specimens were conducted using Universal Testing Machine (UTM) (give the type/brand, country of produced etc) according to BS 373:1957. Before loading by UTM, the average density and natural moisture content were measured for each species.

2.6 Average density

The timber samples were placed in an oven at 105° C for 48 hours and the dry weight was measured. The density values were calculated for the seven timber species using equation 1). (BS EN 373:1957).

$$\text{Density} = \frac{\text{Weight of oven dry wood (kg)}}{\text{Volume of wood (m}^3\text{)}} \quad (1)$$

Determination of basic density was done based on the green volume and oven-dry weight using a water displacement method. Samples placed at room temperature showed good structural performance compared to those placed at hot and wet conditioned (give details) as demonstrated by Vievek et al, (2016).

2.7 Bending test

Specimens were tested by three-point bending test to obtain bending strength. The span was 280 mm for the test and load was applied on mid span of the specimen at a loading speed of 6 mm/min. Displacement was recorded with the applied load and load vs displacement graph was plotted.

Modulus of Rupture (MOR) was calculated for the ultimate state using load vs displacement graph. Maximum load represented the ultimate load and the maximum load in elastic region represented the serviceability load. When the applied load is the ultimate load, bending strength is taken as Modulus of Rupture.

2.8 Modulus of elasticity (MOE)

Modulus of Elasticity is considered to be an indicator for stiffness of the wood and only applies to the conditions within the elastic limit. It is the ratio of stress per unit area to the deformation per unit length. Flexural test resulted at serviceability state was used to obtain the MOE in this study.

2.9 Compression parallel to grain test

Compression parallel to grain test was carried out with loading plate moving speed of 0.5 mm min^{-1} and load vs. displacement variation was obtained. Compressive strength of clear timber at ultimate state was calculated by the maximum load acting on the timber before the failure which was obtained from the load deflection curve of compression parallel to grain test. Maximum load of the elastic limit was used to obtain the serviceability state compressive strength.

2.10 Compression perpendicular to grain test

Failure of the specimens was determined by loading them perpendicular to grain with loading plate moving speed of 0.5 mm min^{-1}. Displacement was obtained with the load applied and load vs. displacement curve was plotted. The maximum load identified with the graph was used to calculate ultimate compressive strength and the maximum load of the elastic region was used to calculate serviceability compressive strength perpendicular to grain.

2.11 Strength class identification from BS 5268-2:2002

Strength classes appeared in BS 5268-2:2002 are relevant to the grade stresses of timber at serviceability state. Therefore, the characteristic strength obtained from the bending and compression test were employed to derive grade stresses.

2.12 Grade stress-bending

Characteristic bending strength was calculated by the following factors to derive grade bending stresses. According to BS5268-2; Section depth less than 72 mm-0.856, Duration of the load very short term-0.571

$$\text{Grade stress} = \text{Strength in Serviceability Limit State (N mm}^{-2}\text{)} \times 0.856 \times 0.571 \quad (2)$$

3. Results

As shown in Table 1, the average density values varied with the species and ranged between 440-980 kg m^{-3}. The highest average density value shows in Satin timber species and the least average density value shows in Pine timber species.

Table 1: Average density and timber class of selected timber species.

Species	Average density (kg m^{-3})	Timber class according to STC classification
Teak	740	Super Luxury
Satin	980	Luxury
Mahogany	560	Luxury
Jack	640	Luxury
Kumbuk	720	Special Class
Grandis	550	Class II
Pine	440	Class III

According to BS 373:1957, the average moisture content of the specimen should approximately be 12% at normal exposure conditions for testing. As depicted in Table 2, the moisture contents varied within 9.38-13.83% thus, declared a suitable timber specimens for testing.

Table 2: Average moisture content of tested specimen.

Species	Specimen used for bending test (%)		Specimen used for compression parallel to grain test (%)		Specimen used for compression perpendicular to grain test (%)	
	Clear	FJ	Clear	FJ	Clear	FJ
Teak	10.50	10.28	10.63	10.58	9.98	10.05
Satin	12.13	12.60	11.15	11.10	10.55	10.50
Mahogany	10.85	10.88	10.35	10.33	9.68	10.03
Jack	12.33	12.50	9.38	9.58	10.70	10.65
Kumbuk	11.53	11.15	11.30	12.18	13.83	13.30
Grandis	13.50	13.35	11.35	11.65	12.45	12.10
Pine	11.35	11.38	11.15	11.60	10.43	10.40

Table 3 shows that the characteristic bending strength reduction is less for Satin and it is 9.5% compared to clear timber. Teak and Pine also have strength reduction % less than 20%. Higher strength reduction % is shows in Kumbuk timber species.

Table 3: Average serviceability bending strength of tested specimen.

Species	Clear timber section (N mm^{-2})	Finger jointed timber section (N mm^{-2})	Strength reduction percentage %
Teak	26.02	23.20	10.84
Satin	27.94	25.28	9.50
Mahogany	24.59	16.64	32.34
Jack	30.58	17.49	42.82
Kumbuk	25.77	13.26	48.54
Grandis	29.39	16.09	45.25
Pine	20.86	16.80	19.43

According to Table 4 MOE for clear timber and finger jointed timber are approximately same and Pine (soft wood) shows MOE increment and other species have MOE reduction less than 20%. The highest MOE reduction % is shows in Kumbuk timber species.

Table 4: Average MOE for tested specimens.

Species	Clear timber specimen (N mm^{-2})	Finger jointed timber specimen (N mm^{-2})	MOE reduction percentage%
Teak	8865.07	8796.66	0.77
Satin	9703.65	9493.32	2.17
Mahogany	6208.59	5552.56	10.57
Jack	5537.37	5391.96	2.63
Kumbuk	5225.88	4383.83	16.11
Grandis	5375.64	5286.38	1.66
Pine	5361.99	6657.08	-24.15

Serviceability Compressive strength parallel to grain of Jack is almost similar for clear and finger jointed timber according to Table 5. Satin, Mahogany, Grandis and Pine also have strength reduction less than 20% at serviceability state. The highest Average compressive strength parallel to grain reduction % is shows in Kumbuk timber species.

Table 5: Average compressive strength parallel to grain for tested specimens at Serviceability state.

Species	Clear timber section (N mm^{-2})	Finger jointed timber section (N mm^{-2})	Strength reduction percentage %
Teak	24.45	18.20	25.54
Satin	42.21	36.62	13.24
Mahogany	15.62	13.51	13.51
Jack	14.93	14.70	1.53
Kumbuk	29.53	20.17	31.68
Grandis	15.61	13.55	13.22
Pine	15.89	15.40	3.04

Table 6 depicts that compression perpendicular to grain test significantly different from bending and compression test results because finger jointed timber strengths have been increased for all the specimens other than Jack compared to clear timber**.**

Table 6: Average compressive strength perpendicular to grain for tested specimens at serviceability state.

Species	Clear timber section (N mm^{-2})	Finger jointed timber section (N mm^{-2})	Strength reduction %
Teak	8.53	10.08	-18.13
Satin	15.51	17.16	-10.66
Mahogany	7.85	8.13	-3.66
Jack	13.43	11.03	17.90
Kumbuk	7.71	8.28	-7.31
Grandis	5.14	5.38	-4.72
Pine	6.06	7.72	-27.39

Grade Stress values of Table 7 were calculated by Bending Strength in Serviceability state×0.856×0.571.

Table 7: Grade Bending Stresses for Clear and Finger Jointed specimens.

Species	Clear Timber Section (N mm^{-2})	Finger Jointed Timber Section (N mm^{-2})
Teak	12.71	11.33
Satin	13.64	12.35
Mahogany	12.01	8.13
Jack	14.94	8.54
Kumbuk	12.59	6.48
Grandis	14.35	7.86
Pine	10.19	8.21

In Table 8, average grade stresses for compression parallel to grain values were obtained according to BS 5268-2, considering very short term for the duration of the load characteristic strength should be multiplied by 0.571.

Table 8: Average grade stresses for compression parallel to grain test.

Species	Clear Timber Specimen (N/mm^2)	Finger Jointed Timber Specimen (N/mm^2)
Teak	13.97	10.40
Satin	24.12	20.93
Mahogany	8.93	7.72
Jack	8.53	8.40
Kumbuk	16.87	11.53
Grandis	8.92	7.74
Pine	9.08	8.80

In table 9, average grade stresses for compression perpendicular to grain values were obtained according to BS 5268-2, considering very short term for the duration of the load characteristic strength should be multiplied by 0.571.

Table 9: Average grade stresses for compression perpendicular to grain test.

Species	Clear Timber Specimen (N mm^{-2})	Finger Jointed Timber Specimen (N mm^{-2})
Teak	4.88	5.76
Satin	8.86	9.80
Mahogany	4.48	4.65
Jack	7.67	6.30
Kumbuk	4.41	4.73
Grandis	2.94	3.07
Pine	3.46	4.41

Table 10 and Table 11 show that Grade Stress values are derived using lower and higher values of BS 5268-2:2002.According to the calculation in Table 10 and 11, strength classes are included in Table 12.

Table 10: Grade strength comparison for clear timber according to BS 5268-2:2002.

Clear Timber	HARDWOOD																		SOFT WOOD		
	Teak			Satin			Mahogany			Jak			Kumbuk			Grandis			Pine		
	Lower	Test	Higher	Lower	Test	Higher	Lower	Test	Higher	Lower	Test	Higher	Lower	Test	Higher	Lower	Test	Higher	Lower	Test	Higher
Bending	12.5	12.71	16	12.5	13.64	16	11	12.01	12.5	12.5	14.94	16	12.5	12.59	16	12.5	14.35	16	10	10.19	11
	1.652%		-25.885%	8.358%		-17.302%	8.410%		-4.080%	16.332%		-7.095%	0.715%		-27.085%	12.892%		-11.498%	1.865%		-7.949%
	D40	D40	D50	D40	D40	D50	D35	D40	D40	D40	D50	D50	D40	D40	D50	D40	D50	D50	C27	C27	C30
MOE(Mean)		8865.1	9500	9500	9703.65	10000		6208.6	9500		5537.37	9500		5225.9	9500		5375.64	9500		5361.99	6800
			-7.162%	2.099%		-3.054%			-53.014%			-71.562%			-81.788%			-76.723%			-26.819%
		D30	D30	D30	D30	D35		D30	D30		D30	D30		D30	D30		D30	D30		C14	C14
MOE(Minimum)	7500	8865.1	12600	7500	9703.65	12600	6000	6208.6	6500		5537.37	6000		5225.9	6000		5375.64	6000	4600	5361.99	5800
	15.398%		-42.131%	22.709%		-29.848%	3.360%		-4.694%			-8.355%			-14.813%			-11.615%	14.211%		-8.169%
	D40	D40	D50	D40	D40	D50	D30	D30	D35		D30	D30		D30	D30		D30	D30	C14	C16	C16
Compression //	12.6	13.97	15.2	23	24.12		8.6	8.93	12.6	8.1	8.53	8.6	15.2	16.87	18	8.6	8.92	12.6	8.7	9.08	
	9.807%		-8.805%	4.643%			3.695%		-41.097%	5.041%		-0.821%	9.899%		-6.698%	3.587%		-41.256%	4.185%		
	D40	D50	D50	D70	D70		D35	D35	D40	D30	D35	D35	D50	D60	D60	D35	D35	D40	C40	C40	
Compression ⊥	4.6	4.88		4.6	8.86		4	4.48	4.6	4.6	7.67		4	4.41	4.6	2.6	2.94	3	2.6	3.46	
	5.738%			48.081%			10.714%		-2.679%	40.026%			9.297%		-4.308%	11.565%		-2.041%	24.855%		
	D70	D70		D70	D70		D60	D70	D70	D70	D70		D60	D70	D70	D35	D40	D40	C40	C40	
Average Density	700	740	780	840	980	1080		560	640		640		700	720	780		550	640	420	440	450
	5.405%		-5.405%	14.286%		-10.204%			-14.286%				2.778%		-8.333%			-16.364%	4.545%		-2.273%
	D40	D40	D50	D60	D70	D70		D30	D30		D30		D40	D40	D50		D30	D30	C24	C27	C27
Overall strength class	**D40**				**D70/D40**			D30			D30			D40			D30			C27	

Table 11: Grade strength comparison for finger jointed timber according to BS 5268-2:2002.

FJ Timber	HARDWOOD																		SOFT WOOD		
	Teak			Satin			Mahogany			Jak			Kumbuk			Grandis			Pine		
	Lower	Test	Higher	Lower	Test	Higher	Lower	Test	Higher	Lower	Test	Higher	Lower	Test	Higher	Lower	Test	Higher	Lower	Test	Higher
Bending	11	11.33	12.5	12.5	12.35	16		8.13	9		8.54	9		6.48	9		7.86	9	7.5	8.21	10
	2.913%		-10.327%	-1.215%		-29.555%			-10.701%			-5.386%			-38.889%			-14.504%	8.648%		-21.803%
	D35	D35	D40	D40	D40	D50		D30	D30		D30	D30		D30	D30		D30	D30	C24	C24	C27
MOE(Mean)		8796.7	9500		9493.32	9500		5552.6	9500		5391.96	9500		4383.8	9500		5286.38	9500		6657.08	6800
			-7.996%			-0.070%			-71.092%			-76.188%			-116.705%			-79.707%			-2.147%
		D30	D30		D30	D30		D30	D30		D30	D30		D30	D30		D30	D30		C14	C14
MOE(Minimum)	7500	8796.7	12600	7500	9493.32	12600		5552.6	6000		5391.96	6000		4383.8	6000		5286.38	6000	6500	6657.08	7200
	14.740%		-43.236%	20.997%		-32.725%			-8.058%			-11.277%			-36.867%			-13.499%	2.360%		-8.156%
	D40	D40	D50	D40	D40	D50		D30	D30		D30	D30		D30	D30		D30	D30	C22	C22	C24
Compression //	8.6	10.4	12.6	18	20.93	23		7.72	8.1	8.1	8.4	8.6	8.6	11.53	12.6		7.74	8.1	8.7	8.8	
	17.308%		-21.154%	13.999%		-9.890%			-4.922%	3.571%		-2.381%	25.412%		-9.280%			-4.651%	1.136%		
	D35	D35	D40	D60	D70	D70		D30	D30	D30	D35	D35	D35	D40	D40		D35	D30	C40	C40	
Compression ⊥	4.6	5.76		4.6	9.8		4.6	4.65		4.6	6.3		4.6	4.73		3.5	3.07	4	2.6	4.41	
	20.139%			53.061%			1.075%			26.984%			2.748%			-14.007%		-30.293%	41.043%		
	D70	D70		D70	D70		D70	D70		D70	D70		D70	D70		D50	D50	D60	C40	C40	
										0											
Average Density	700	740	780	840	980	1080		560	640		640		700	720	780		550	640	420	440	450
	5.405%		-5.405%	14.286%		-10.204%			-14.286%				2.778%		-8.333%			-16.364%	4.545%		-2.273%
	D40	D40	D50	D60	D70	D70		D30	D30		D30		D40	D40	D50		D30	D30	C24	C27	C27
Overall strength class	**D40/35**				**D70/D40**			**D30**			**D30**			**D30**			**D30**			**C27/C24/C22**	

Table 12: Strength class identified.

Species	Category	Clear timber	Finger jointed timber
Teak	Hardwood	D40	D35/D40
Satin	Hard wood	D40/D70	D40/D70
Mahogany	Hard wood	D30	D30
Jack	Hard wood	D30	D30
Kumbuk	Hard wood	D40	D30
Grandis	Hard wood	D30	D30
Pine	Soft wood	C27	C22/24/27

3.1 Strength class for clear and finger jointed timber

Strength class for selected timber species were obtained considering the average density, MOE and grade stresses included in Table 7, Table 8 and Table 9 which were obtained as experiment results. In this case, BS 5268-2:2002 was used and strength class for clear and finger jointed timber were obtained separately. Nearest higher and lower value for the test resulted value were obtained from BS 5268-2:2002 and considering the minimum deviation for grade stress which were obtained from test strength class were selected. Deviation was calculated as a percentage by using equation 3.

$$\text{Deviation} = \frac{\text{Grade stress obtain as experiment results} - \text{Nearest grade stress}}{\text{Grade stress obtain as experiment results}} \times 100\% \qquad (3)$$

4. Discussion

According to the BSI standard- BS 5268:2002, "Grade stresses for tropical hardwoods graded in accordance with BS 5756 rules for service classes 1 and 2", teak clear timber shows grade stresses for Bending-13.7 (N/mm^2), Compression parallel to grain-13.4 ($N\ mm^{-2}$), Compression perpendicular to grain-3.1($N\ mm^{-2}$)and MOE- 7400 ($N\ mm^{-2}$). In experimental results values are also closely similar to the standard values as Bending- 12.71 ($N\ mm^{-2}$), Compression parallel to grain-13.97 ($N\ mm^{-2}$), Compression perpendicular to grain-4.88 ($N\ mm^{-2}$) and MOE- 8865 ($N\ mm^{-2}$). So, accuracy of the Experimental values are acceptable.

According to Table 12, considering finger jointed timber, Teak shows similar to both D35 and D40. Finger jointed Satin, Mahogany, Jack and Grandis timber are almost similar to clear timber in this case. Kumbuk has been changed from D40 to D30 while use as finger jointed timber. (D represent-Hard wood and C represent-Soft wood). Pine clear timber shows C27 and Finger jointed Pine shows C22, C24 or C27. All the clear specimens and finger jointed specimens except Kumbuk, show nearly similar Grade stress classes. Thus, this finger joint technology can be used for producing elements.

5. Conclusion

Finger joint technique is used locally for manufacturing process in Sri Lanka considering the mechanical properties. Therefore, the reliability of finger joint as an alternative method of connecting timber structural elements needed to be evaluated. The performance of finger jointed standard specimens and the strength grade of them were studied based on BS 5268-2:2002.

No significant differences in strength classes relevant to the grade stresses were observed for finger jointed and clear specimens for Satin, Mahogany, Jack and Grandis. Both clear and finger jointed timber specimens obtained D40 for Satin and Teak, D30 for Jack, Mahogany and Grandis. Teak showed similar properties to both D35 and D40 when it was used as finger jointed timber.

Grade stress class was changed in Kumbuk species from D40 to D30 while it was used as finger jointed timber. Finger jointed Pine showed properties of C22, C24 and C27. The present findings proved that finger joint technique is useful in effective utilization of off-cut timbers to manufacture finger jointed structural and non-structural elements.

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