Research Journal of Agriculture and Forestry Sciences ISSN 2320 – 6063
Vol. **7(1),** 21-23, January **(2019)** *Res. J. Agriculture and Forestry Sci.*

Short Communication

Investigate the most suitable glue type for finger-joints production in Sri Lanka

Muthumala C.K.[1*], De Silva Sudhira[2], Aruna Kumara K.K.I.U.[3] and Alwis P.L.A.G.[4]
[1]Research, Development and Training Division, State Timber Corporation, Battaramulla, Sri Lanka
[2]Department of Civil and Environmental, Faculty of Engineering, University of Ruhuna, Matara, Sri Lanka
[3]Department of Crop Science, Faculty of Agriculture, University of Ruhuna, Matara, Sri Lanka
[4]Department of Agricultural Engineering, Faculty of Agriculture, University of Ruhuna, Matara, Sri Lanka
ck_muthumala@yahoo.com

Available online at: www.isca.in
Received 2nd August 2018, revised 13th December 2018, accepted 31st Decemer 2018

Abstract

Finger joint is sustainable, eco-friendly and economically valuable concept for furniture industry. It ensures the sustainable utilization of small wood cut pieces which removed as waste. Finger joints are described as interlocking end joint formed by machining a number of similar tapered symmetrical fingers in the ends of timber members using a finger joint cutter and then bonded together. Finger-jointed timber production plays a vital role in furniture industry in the world. However, issues related with the strength of the joints, fixing time, timber species and glue types etc, are still not fully investigated in Sri Lanka. This research evaluated the effects of commonly available glue types on the tensile strength of finger joint. The wood species studied were Jack, Kumbuk, Mahogany, Pine, and Teak. Mostly used polyvinyl acetate three glue types were used for this study. The response variables measured for the tension tests. Data were gathered using Universal Testing Machine. One way ANOVA was used per each timber species to analyze the data. It was found that the highest tensile strength was recorded in SWR glue type.

Keywords: Finger joint, tensile strength, polyvinyl acetate, SWR glue type.

Introduction

Off-cut wood is currently one of the wastes dumped by sawmills as they fail to fully utilize the wood supply. Waste sawn timber material of Furniture factories and short length of sawn timber are common problems in the timber industry in Sri Lanka[1]. However, some of these wasted wood are used to fuel kiln dried boiler. Joining timber is an another option in utilizing waste timber[2]. Finger joints are described as interlocking end joints formed by machining a number of similar tapered symmetrical fingers in the ends of timber members using a finger joint cutter and then bonded together[3].

Finger joint is a sustainable, eco-friendly and economically valuable concept for furniture industry. It ensures the sustainable utilization of small wood cut pieces which removed as waste[4]. It is a new concept for Sri Lankan furniture industry[5].

The finger joint timber manufacturing is considered to be a viable solution for minimizing the waste generation in furniture manufacturing activities. Type of glues applied for the joining process of finger joint is one of the key factors which determine the strength of the product. However, a study on the glue types affecting the strength of finger-jointed hardwood species has not yet been investigated in Sri Lanka. Therefore, the effect of type of glue on the strength of finger-jointed timbers was investigated using three polyvinyl acetate (PVA) adhesive types mostly used in Sri Lanka[6].

Polyvinyl resin emulsions are thermoplastic[7]. In emulsified form, the PVAs are dispersed in water and have a consistency and nonvolatile content generally comparable to thermosetting resin adhesives. PVAs are marketed as milky-white fluids for use at room temperature in the form supplied by manufacturers, normally without additives or separate hardeners[8]. SWR, SH and Speedx are mostly used three bonding materials in Sri Lanka.

Methodology

Samples were cut from seasoned planks (Ave. Moisture content 12%) of five mainly used timber species in Sri Lanka. The wood species, Jack (*Aartocarpus heterphyllus*), Kumbuk (*Terminelia arjuna*), Mahogany (*Swietenia macrophylla*), Pine (*Pinus caribaea*) and Teak (*Tectona grandis*) were obtained from defects free sawn woods. Eight finger jointed samples were made for each timber species. The size of each replicate was 6 mm x 20 mm x 300mm and they were used for tension tests.

The Vertical finger jointed samples were made using 13mm finger-joint length cutters. Polyvinyl acetate (PVA) adhesive SWR, SH and Speedx were used as bonding materials (Glue types). Samples which were placed in normal room temperature showed good structural performance compared to hot and wet conditioned[9]. According to the technical details of manufactures, bonding time range is 1-2 hours for SWR, 4-6 hours for SH and 1.5-2 hours for Speedx adhesives. In this study, the tensile strength was measured in one hour, two hours, three hours and four hours time periods.

The testing was done under both laboratory and manufactory conditions according to the regulations of the standard on BS EN 15497:2014 and BS 373:1957. Load was applied to the test piece at a constant head speed 1.25mm/min[10].

Data were analyzed by using one way ANOVA per each timber species at 0.05 significant level to find the effects of glue type and time period on glue tensile strength.

Results and discussion

Analized data were shown in Table-1 and Table-2.

As shown in Figure-1, the highest mean tensile strength was recorded in SWR glue and the least was SH glue. Out of five timber species, the highest mean tensile strength was recorded in Jack followed by Mahogany and Pine and the least strength was recorded in Teak. Moderate mean tensile strength level was recorded in Kumbuk.

Figure-2, clearly shows that mean glue tensile strength of SWR was increased considerably against the time compared to the other two glue types. When considering three glue types, the highest mean tensile strength was recorded in SWR glue and the least was SH glue.

Table-1: Analyzed results by ANOVA Procedure.

After 4 hours	Sum of Squares	df	Mean Square	F	Significance
Between Groups (SWR, SH, Speedx)	463.093	2	231.547	65.937	0.000
Within Groups	94.815	27	3.512		

Table-2: Descriptive details in tensile strength of three glue types (N/mm^2).

Adhesive type	No. of pieces	Mean	Std. Deviation	Minimum	Maximum
SH	08	6.1000	1.52490	3.33	8.25
Speedx	08	9.5667	1.16852	7.50	10.83
SWR	08	15.6083	2.61614	10.83	19.33

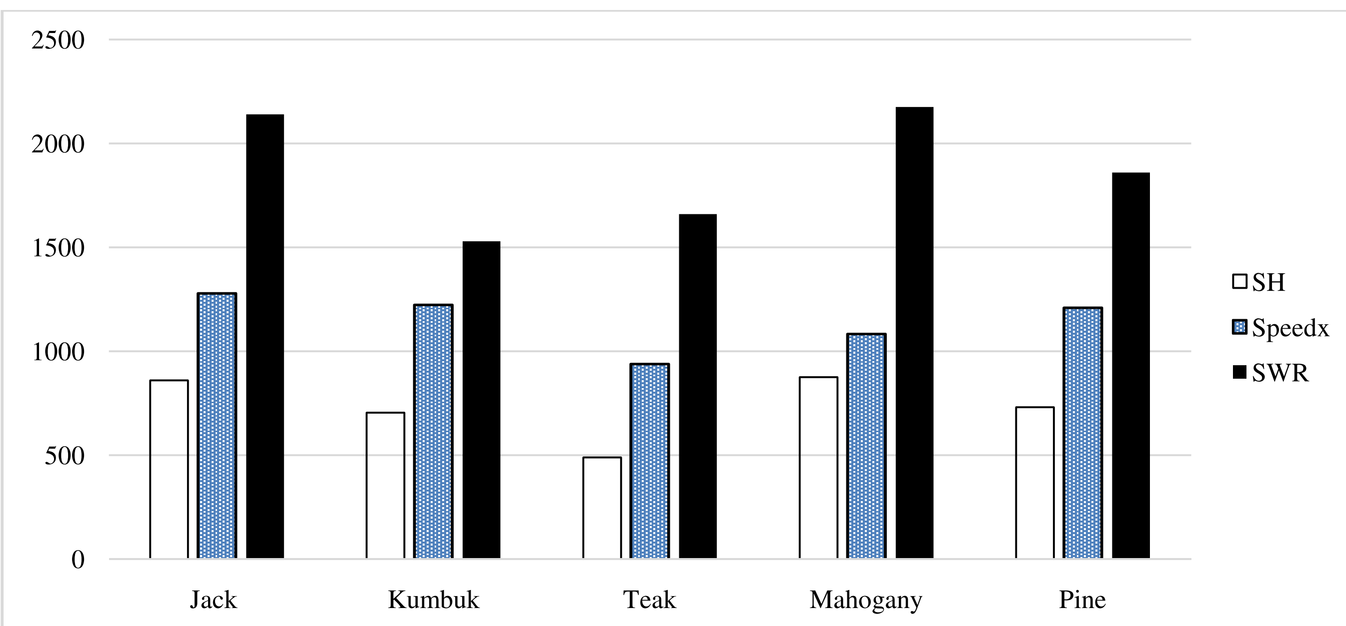

Figure-1: Mean Tensile Strength of Three Glue Type against Five Timber Types for After 4 Hours.

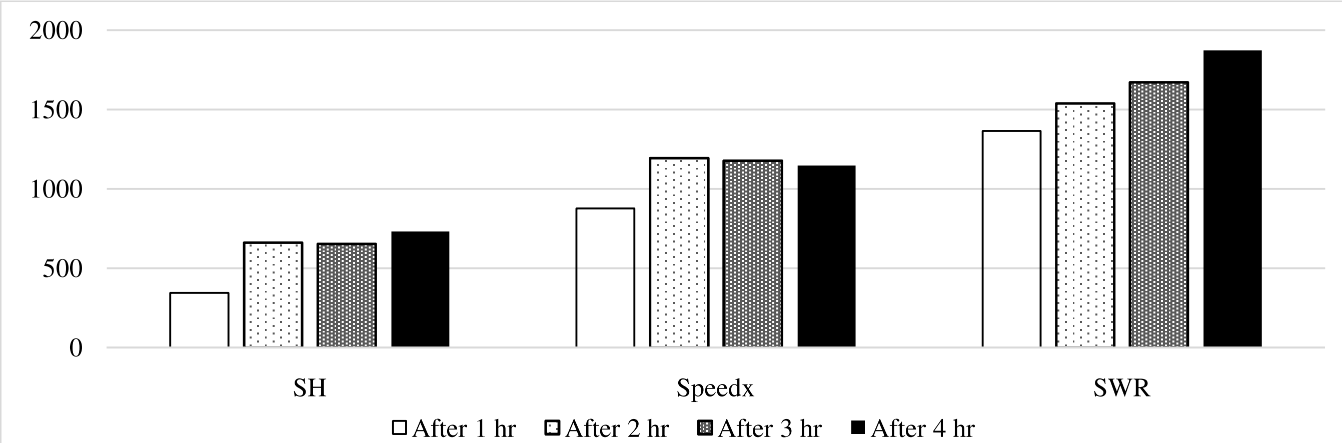

Figure-2: Mean tensile strength against the glue types in different time period.

Considering the overall values the tensile Strength of SWR varied from 1170N/mm^2 up to 2320N/mm^2 and 800N/mm^2 up to 1370N/mm^2 in Speedx. Tensile Strength values of SH varied from 160N/mm^2 up to 990N/mm^2.

According to Figure-1 and 2, the highest mean tensile strength can be obtained from Jack and Mahogany with SWR glue and allocating time period (fixing time) of 4 hours.

Conclusion

Based on the investigation, the following conclusions were drawn. Timber type, glue type and fixing time period were found to have direct and considerable effect on tensile strength of finger jointed timber solids. The highest mean tensile strength can be obtained from SWR glue as a bonding material, compared to SH and Speedx. The highest mean tensile strength was recorded in allocating time period of 4 hours, compared to allocating time period of 1hour, 2 hours and 3 hours. It was found that the glue type directly affect the glue tensile strength. However further researches should be conducted to determine the glue strength of other timber species.

References

1. Muthumala C.K., De Silva Sudhira, Alwis P.L.A.G. and Arunakumara K.K.I.U. (2017). Properties of Finger jointed hardwood and Softwood timber species in Sri Lanka. *International Conference on Structural Engineering and Construction Management,* Kandy, Sri Lanka, 106-111.

2. Muthumala C.K., De Silva Sudhira Alwis P.L.A.G. and Arunakumara K.K.I.U. (2018). Assessment of Quality Parameters of Finger jointed timber solids with different joint configurations (Unpublished doctoral dissertation). Faculty of Agriculture, University of Ruhuna, Sri Lanka.

3. BS EN 15497:2014 (2014). Structural finger jointed solid timber-Performance requirements and minimum production requirements. British Standards Institution, London, 7.

4. Sandika A.L., Pathirana G.D.P.S. and Muthumala C.K. (2017). Finger joint timber products for effective utilization of natural resources: An analysis of physical properties, Economic factors and Consumers’ perception. *International Symposium on Agriculture and Environment*, University of Ruhuna, Sri Lanka. 19th Jan. 109-111.

5. Abeysinghe L.S., Pathirana S. and Kumara M. (2016). Economic factors and physical properties of Finger joint timber product to promote effective utilization of natural resources. Proceedings of the International Forestry and Environment Symposium. Department of Forestry and Environmental Science. University of Sri Jayewardenepura, Sri Lanka, 60.

6. Sathesrajkumar S., De Silva S., De Silva S. and Muthumala C.K. (2016). Performance of Finger jointed timber boards with different joint configurations. 7th International Conference on Sustainable Build Environment, Kandy, Sri Lanka. 16-18 Dec 2016.

7. Jokerst R.W. (1981). Finger jointed wood products. USDA Product Service, Research paper FPL 382. Madison, WI: Forest Product laboratory. US Department of Agriculture. USA.

8. British Standards Institution (2001). Classification of Thermoplastic Wood Ashesives for Non-structural Applications. *British Standards Institution*.

9. Vivek S., De Silva S., De Silva S. and Muthumala C.K. (2016). Finger joint and their structural performance in different exposure conditions. 7thInternational Conference on Sustainable Build Environment, Kandy, Sri Lanka, 16-18 Dec 2016 www.civil.mrt.ac.lk/conference/ ICSBE_ 2016/ICSBE2016-225.pdfAccessed 28 Feb 2018

10. British Standards Institution (1999). Methods of testing small clear specimens of timber. British Standards Institution. London, 1.