The Effect of Length Variation of Pegs on the Flexural Strength of Laminated Bamboo Beam (*Dendrocalamus Asper)*

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Abstract

This research studies the effect of distances variation of bamboo pegs on the flexural strength of laminatedbamboo petung beam.The beam's height and width ratio is 2:1 and longitudinal beam length 180 cm. The beam bending strength wasmeasured with lateral loading method for flextural capacity with three variations of bamboo pegs of distances 10 cm, 15 cm, 20 cm,respectively. The outer skinof the beam was glued bywhitewash adhesive glue 60#Multi Layer Double Glue Line (MDGL). The results show that pegs variations have difference strength and stifness. The 15 cm pegs has maximum strength 11.18 kN and flexural strengh 35.041 Mpa.

Keywords : Bamboo petung, laminated beam, flexural strength, variation distance pegs.

Introduction

Forest condition is apprehensive about and this has direct impact on availability of wood material. Wood is rare and to be luxurious things. Forest area in Indonesia is decreasing. Because of difficulty to get wood, people need material to substitute the wood. Bamboo is one of alternative material because of its abundant in nature. Bamboo has economic value and ease to be cultivated. It can grow on dry to wet climate, from the plain land to plateau, and open land on which it is free flooded area. The plant is known fast growing and the best quality is 3,5–5 years age. In the contrary, wood needs 30 years to be ready for felling (Morisco, 2006). In Banten Province, people usually use bamboo for making house, furniture, and another handicraft. Banten Creative Community is a non–government organization which concern on bamboo's cultivation and use for Banten community. Unfortunately, laminating method is not known yet. Nowadays, the make use of bamboo is laminating method. The advantage is any quality of bamboo can be used. It has economic benefit and also bamboo conservation (Syahrir, 2014).There is no significant difference between shear stress and stiffness of the laminated bamboo if the bamboo is laminated by glue (Zulmahdi, 2009). The uses of pegs on the laminated bamboo blades reduce the glue and making time. This research concerns on making the laminated bamboo on which the blades are united by pegs. The pegs distances have varied in order to get optimum strength and economic.

Research that will be proposed is the manufacture of laminated bamboo beams with planks together by using a variation of distance pegs, in order to get the use of distance pegs that have the power optimum and economical in manufacture. Comparison of the size or dimensions of the beam between the beam height and width is 2: 1 size (12 cm x 6 cm) with 3 pieces of distance variation peg 10 cm, 15 cm, 20 cm. Afterward, tested the strength of the beam against bending strength, which has the properties lamina beam flexural strength of the weak against flexural failure type.

Experimental/Methods

The tools used in this study can be divided into two groups, namely equipment manufacture test specimens, testing equipment and mechanical physical properties of bamboo and laminated beams. The preliminary test to determine the size of the physical properties of the specimen for testing the physical properties of bamboo follow the ISO (International Standard Organization) 22157–1– 2004. The test object laminated beams made as many as 9 beam size 6 cm x 12 cm with 3 variations within pegs 10 cm, 15 cm, 20 cm, each with 3 replications using adhesives labur resulting from previous studies and use the outer skin of bamboo. Laminated beams Tests conducted at the Laboratory Research and Development Center of Settlement MPW PUSKIM Cileunyi – Bandung on simple supported (joint–roller) with two loading points at a distance of one third of the free span. Lateral restraint is provided to prevent lateral torsional buckling contributions influence. From this setting is expected to occur under flexural failure

Material

Petung obtained Pasir Kalapa area – Kab. Pandeglang. Thermo set adhesive types of cold setting type or can be hardened at room temperature, namely Polyvinyl Acetate (PVAC) is obtained from Adhesive Specialty PT. Ligno Tangerang–Banten.

ResultsandDiscussion

A. The Nature of Physics

Checking the level of water and density is done by using the oven in the laboratory of Civil Engineering, Faculty of Engineering, University of Sultan Ageng Tirtayasa. The sample used in this trial is the end of the bamboo, middle of bamboo, and the stem bamboo (Table 1 and 2).

Table 1. Average bamboo water level

No	The Bamboo PETUNG	Average The level of water %
1.	End of	17,37%
2.	Among	19,39%
3.	The stem	17.30–percent

Table 2. Average density of bamboo

No	The Bamboo PETUNG	Average Density (g/cm³)
1.	End of	0.66
2.	Among	0.60
3.	The stem	0.50

B. The strength of the beam Laminated

Based on the results of the test of elastic beam laminated obtained the results of the strength recapitulation of the beam laminated burden and maximum graphics can be seen in the Table 4 and picture 5,6,7, from the table and pictures drawn the conclusion to beam laminated with the influence of the use of the pivot obtained the highest maximum load is on the beam 15cm with maximum load the average 11180 N. The average maximum load on the low beam 10cm of 8340 N.

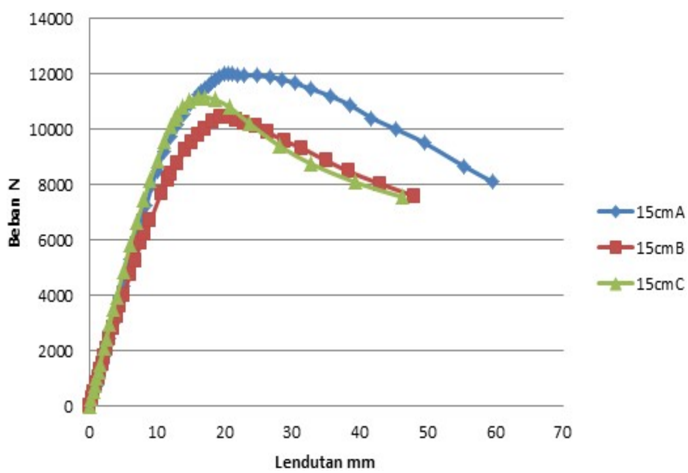


Figure 1. Graph load relations – remote Flextural Pegs 15 cm

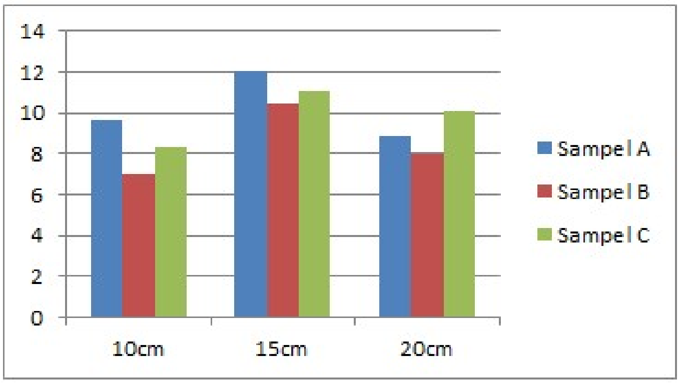


Figure 2. The beam strength column diagram

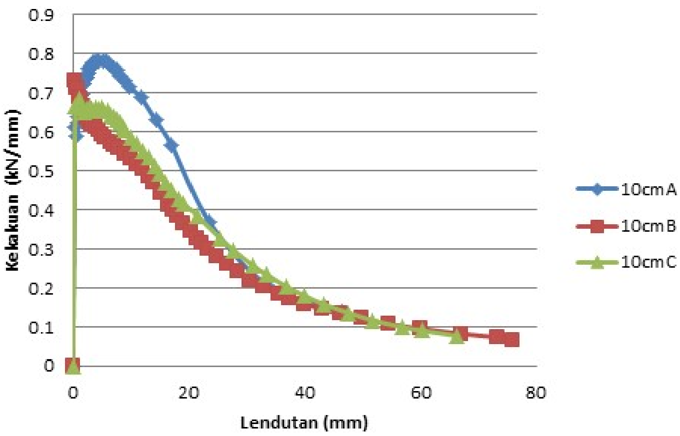
Table 3. The recapitulation of the burden and maximum moments

Name of the Test Objects	Maximum load (KN)	Average Maximum Load (KN)	Flextural mm
10cmA	9.66		17.10
10cmB	7.03	$ 8.34	28.44
10cmC	$ 8.34		25.40
15cmA	12.02		20.52
15cmB	10.44	11.18	20.48
15cmC	11.08		17.06
20cmA	8.9		13.46
20cmB	8	8.99	23.32
20cmC	10.06		22.32

C. Laminated Beams Stiffness

The value of the stiffness is a comparison between the burden with Flextural. Comparison of stiffness beam laminated with the variation of the distance Pegs on the beam laminated blades which reviewed the collapse of elastic. Thegreatness of the value of the stiffness shows the level of daktilitas from a beam. The more rigid a beam then more daktail beam. Based on the table 5 can be seen that the variation of the distance Pegs affect stiffness beam, this can be seen from the average value of the stiffness of each distance is relatively the same and not much different. The values from the table also shows that the beam with the distance of the pivot 10cm has a value of average stiffness the least 0.40 KN/mm.

The values from the table also shows that the beam 10cm more daktail compared the beam 15cm and 20cm, this is indicated by the average value of rata stiffness which is smaller than the beam 15cm and 20cm.



Picture 3. Graph load relations – intimacy – Remote Flextural Pegs 10 cm

The value of the capacity of the flexible beam wood or commonly called *modulus of rupture* (MOR) *and modulus of elastic* (MOE) (Gere and Timoshenko, 1985).Flexible voltage (MOR) maximum at the beam a distance of 15 cm with an average of 35,041 Mpa, compared with the distance 10 cm and 20 cm in a row elector value of average 25,739 Mpa, and 28,027 Mpa. To the value of the elasticity modulus (MOE) maximum are also available on the beam a distance of 15 cm with an average of 11761,03 Mpa, compared with the distance 10 cm and 20 cm in a row elector value of average 8537,87 Mpa, and 9421,37 Mpa from these results it can be concluded that the influence of the variation of the distance Pegs value that acquired an average of different.

Table 4. The recapitulation of the stiffness beam bamboo strong elastic

The name of the Test Objects	Maximum load (KN)	Average Maximum Load (KN)	Maximum moment (KN–mm)	Average Maximum Moment (KN–mm)	Stiffness (KN/m²)	The average Stiffness
10cmA	9.66		3864.00		0.56	
10cmB	7.03	$ 8.34	2812.00	3337.33	0.32	0.40
10cmC	$ 8.34		3336.00		0.33	
15cmA	12.02		4808.00		0.59	
15cmB	10.44	11.18	4176.00	4485.33	0.51	0.58
15cmC	11.08		4472.00		0.66	
20cmA	8.9		3560.00		0.66	
20cmB	8	8.99	3200.00	3594.67	0.34	0.48
20cmC	10.06		4024.00		0.45	

Table 5. The recapitulation of the value of MOR and MOE Beam Bamboo Laminated

No	The name of the Test Objects	Pprop (N)	Flextural (mm)	MOR (MPA)	Average	MOE (MPA)	Average
1	10cmA	5830	7.7	30.1875	25.739	10647.32	8537.87
	10cmB	5670	11.02	21.968		7235.424	
	10cmC	6630	12.06	25.06		7730.876	
2	15cmA	7980	9.26	37.56	35.041	12118.65	11761.03
	15cmB	6210	8.12	32.63		10754.695	
	15cmC	8860	10.04	34.94		12409.736	
3	20cmA	5530	7.12	27.81	28.027	10922.14	9421.37
	20cmB	6050	12.08	25.00		7042.89	
	20cmC	6650	9.08	31.27		10299.07	

Conclusions

Based on the discussion and purpose of the research that has been done can be drawn some conclusions among others as follows:Testing the beam flexible with distance latch 10 cm, 15 cm, and 20 cm produce flexible strength by an average of USD 25,739 berututan Mpa, 35,041 Mpa, and 28,027 Mpa. The results of the test is there is a significant difference is the existence of the influence of the use of remote variations latch toward the strong elastic beam laminated bamboo.The average for damages the beam laminated there on the continued latch beam laminated where some latch apart from the beam bar bar laminated bamboo.The beam with the distance of the pivot 15 cm have the value of the average stiffness is greater compared with the beam distance latch 10 cm, and 20 cm that has a value of average sequentially 0.40 kN/mm, 0.58 kN/mm, and 0.48 kN/mm. The value shows that the beam 10cm more daktail compared the beam 15cm and 20cm, this is indicated by the value of the average stiffness which is smaller than the beam 15cm and 20cm.

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