



# Structural Characteristic Laminated Timber of Indonesian Timber

Sri Handayani\*  
 Semarang State University

Fakhri Muhammad  
 Semarang State University

Woro Yuniarti  
 Semarang State University

**Abstract** — Timber is natural resource that inexhaustible if it is managed well. Timber is also called as renewable resource. And timber include a material which is easily made in to other goods. Meanwhile, structures timber are expensive and hard to obtain. But, non structures timber which is easily to obtain doesn't use optimally. There for, there should be effort of timber processing technology to solve the problem. The using of construction wood is also limited to the wood which is familiar to society, such as teak, sonokeling, meranti, and the other. Meanwhile, albasia which is easily to obtain and cheaper doesn't use optimally. The technologies used in order to support wood as is by laminated. Laminate is a combination of great variety of one or more by which the material is made into a thin layers and glued each other so that make a form of larger dimensions. Engineering experiments done by making a laminated beams of albasia and glugu. And also, laminate or Glued laminated timber (glulam, GLT), a highly important product of the wood industry and widely applied in construction engineering, is one of the first one-dimensional structures which, in comparison to single solid wood beams, has a more useable mechanical potential in strength and stiffness thanks to homogenization effects. The purpose of this research is to know how much the increases of the flexible strenght of albasia after laminated and how the influence of an adhesive variations.

**Keywords**— Timber, laminated, Glugu, Albasia, Flexible strength.

## I. INTRODUCTION

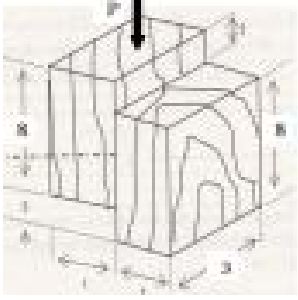
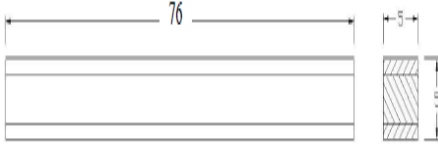
Indonesian timber is very potential for used as a building material. Timbers are having other advantage if used as building material, flexible, not easy to broke when being effected of earthquake, not get corrosion from a high humidity in tropics regions. The use of timber in construction are continues to increase, for structural and non structural. The use of timber which is redundantly would case availability of timber goes depleted. There for, , there should be effort of timber processing technology to solve the problem. The using of construction wood is also limited to the wood which is familiar to society, such as teak, sonokeling, meranti, and the other. Meanwhile, albasia which is easily to obtain and cheaper doesn't use optimally. The technologies used in order to support timber as construction material is by laminates. Laminate is a combination of great variety of one or more by which the material is made into a thin layers and glued each other so that make a form of larger dimensions. This research was applying laminated technology, using glugu and albasia as beams laminates. The purpose of this research is to find an increase flexible strenght in beam laminates, and the influence of an adhesive material variations. The other purposes from this research is to improve the quality of the wood, the improvement of the quality of albasia, so that can be used as a construction material. This research is expected to have a benefits, among others: (1) Utilizing wood that is easily obtained and achievable price, to used as glued laminated timber; (2) Giving counseling to public, about the use of glued laminated timber in construction; (3) Academically, can provide insight the development of science and technology of glued laminated timber as building materials.

## II. METHODOLOGY

Data collection techniques conducted with methods of observation, which is observing the results of testing using sheets of observation. The analysis will be used in this research is the descriptive analysis prosentase to observe the average value of the results of testing the physical properties of wood. Analysis variance be used to analyze the difference as a result of treatment variation laminates. Object of this research is wood, wood with a different kind. Wood construction and wood non construction. The variables which was set in the research, among others: (1) Functional: any laminated wood must be used as its major function for building materials or construction material; (2) Easily obtained: can be exploited easily; (3) Achievable: glued laminated timber have to be more achieved of wood construction , but with the same quality. Various type of testing are listed in table 1.

TABLE 1. TESTING SPECIFICATION

Type of Testing	Type of Glue	Type of Wood	Wood Position	Information Sample
1. Water content	-	- Albasia - Glugu	-	5 sample of both wood, and the dimension is 3x5x8 cm

2. Weight type	-	- Albasia - Glugu	-	5 sample of both wood, and the dimension is 1x1x4
3. Shear strenght	- Epoxy - Aibon	- Albasia - Glugu		5 sample of both wood, and the dimension is 3x4x8
4. Prestressed of block control	- Epoxy - Aibon	- Albasia - Glugu		5 sample of both wood, and the dimension is 5x5x76
5. Prestressed of laminated	- Epoxy	- Albasia	- position: albasia in the center of laminates - position: albasia in the side of laminates	5 sample of both glue. Center dimension: 3 cm. Side dimension: 1 cm.
	- Aibon	- Glugu	- position: albasia in the center of laminates - position: albasia in the side of laminates	5 sample of both glue. Center dimension: 3 cm. Side dimension: 1 cm.

### III. TESTING EQUIPMENT

#### 1. Sample Preparation

##### a. Glugu

Glugu is include the wood which is need long time to grow but multifunctional. Glugu can be used as the building material, furniture material, bridge emergency and the others. Based on The Regulation of Indonesia Construction Wood,, glugu include the second wood class. This class is a class which is can be use for structural material. In this research, glugu's dimentions which is used are, wide = 5 cm, thick = 1 cm, and length = 76 cm.

##### b. Albasia

Albasia is include the wood which fast to grow and easily to obtain. In Indonesia, the wood is very familiar and abundance. Based on The Regulation of Indonesia Construction Wood, albasia include the fourth wood class. Class which is can't use for structural material. In this research, albasia's dimentions which is used are, wide = 5 cm, thick = 3 cm, and length = 76 cm. And for beam control, the dimentions are, wide = 5 cm, thick = 5 cm, and length = 76 cm.

##### c. Adhesive

This research is using two kind of glue, epoxy and aibon.

#### 2. Tools

- a. Crab Machine
- b. Machine scales
- c. Calipers
- d. Saw
- e. Oven
- f. Clamp
- g. Desiccator
- h. Digital load detector
- i. flexible machine test



Fig. 1 Crab machine



Fig. 2 Machine scales



Fig. 3 Calipers



Fig. 4 Saw



Fig. 5 Oven



Fig. 6 Clamp



Fig. 7 Desiccator



Fig. 8 Digital Load Detector



Fig. 9 Flexible machine test

#### IV. RESULT AND DISCUSSION

The results of this research includes the achievement of the output target of the research, namely data analysis and testing objects test, as follows: Wood water content; (1.1) albasia water content: the average of albasia water content is 16.62 %, can be seen on figure 1; ( 1.2 ) glugu water content: the average of glugu water content is 19,83 %, can be seen on a figure 2; ( 2 ) Wood weight type; ( 2.1 ) albasia weight type: the average of albasia weight type is 0.39 grams/cm<sup>3</sup>, can be seen on a figure 3; ( 2.2 ) Glugu weight type: the average of glugu weight type is 0.84 grams/ cm<sup>3</sup>, can be seen on a figure 4: (3) Shear strength with adhesive variation; of the results of testing obtained shear strength glued laminated timber, the average for an adhesive aibon is 39.11 kg/cm<sup>2</sup>, and to an Adhesive epoxy is 66.717 kg/cm<sup>2</sup>. Then of these results, shear strenght greater is that uses an adhesive epoxy, can be seen on the figure 5 and 6: (4) Wood flexible strenght; (4.1) According to PKKI, albasia included in strong class IV, the average value of flexible strenght 360- 500 kg/cm<sup>2</sup>, and glugu included in strong class II, and the value of flexible strenght 725-1100 kg/cm<sup>2</sup>. Can be seen on a figure 7 to albasia flexible strenght, and figure 8 for glugu flexible strenght and table 2. (4.2) Flexible strength of glued laminated timber: with differences in variations of adhesive and the position of wood. These differences can be seen from figure 9, 10, 11, and 12. The biggest flexible strength is made by EPS, with an adhesive epoxy and the position albasia in the middle. The result showed that the product increased laminates, strong class IV into a buoyant strong III, with an increase in 254.025 kg/ cm<sup>2</sup> or 59.72 %. Of which initially was strong class IV 425.325 kg/ cm<sup>2</sup> become 679.350 kg/ cm<sup>2</sup> (class III). Can be seen on a figure 13 and table 3.

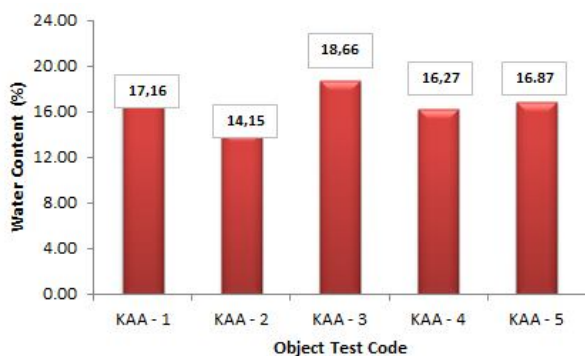


Fig. 10 Albasia water content

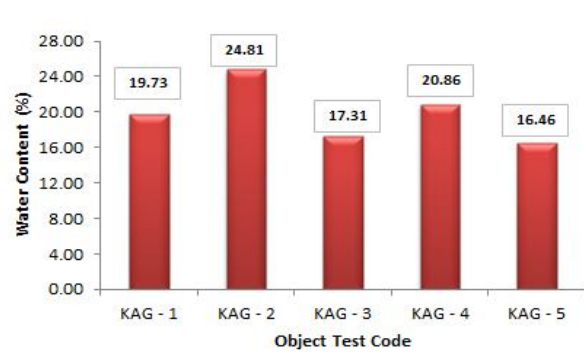


Fig. 11 Glugu water content

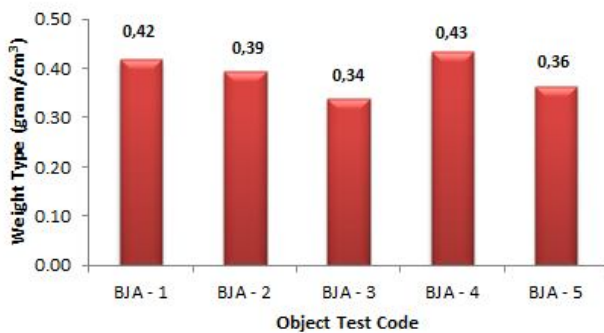


Fig. 12 Albasia weight type

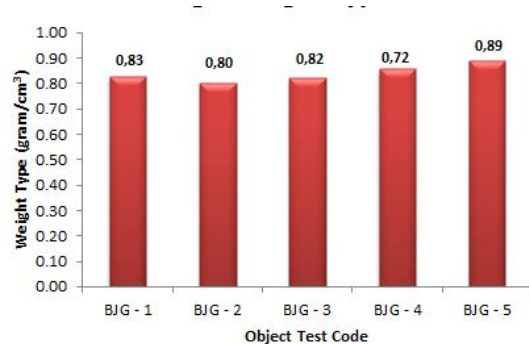


Fig. 13 Glugu weight type

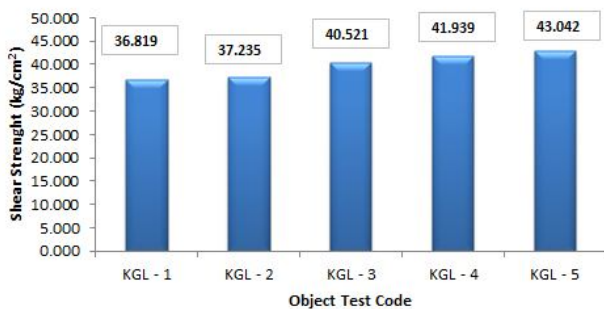


Fig. 14 Shear strength of laminated timber with aibon

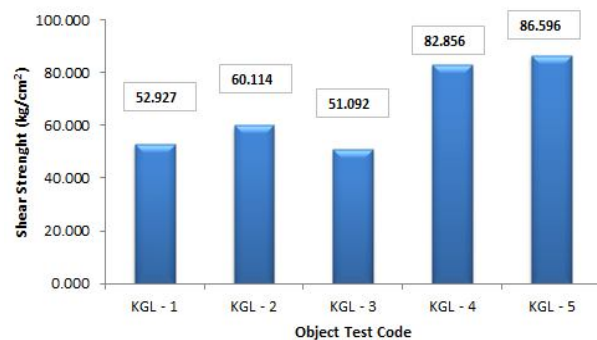


Fig. 15 Shear strength of laminated timber with epoxy

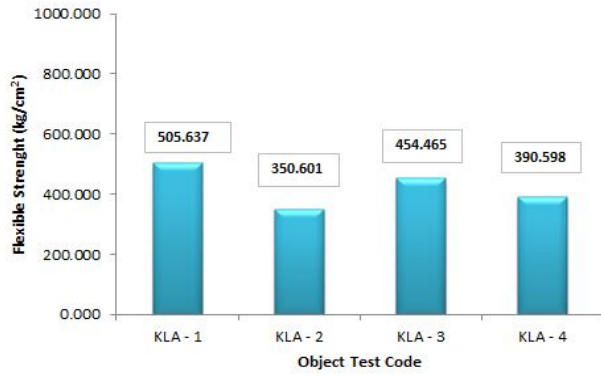


Fig. 16 Shear strength of laminated timber with aibon

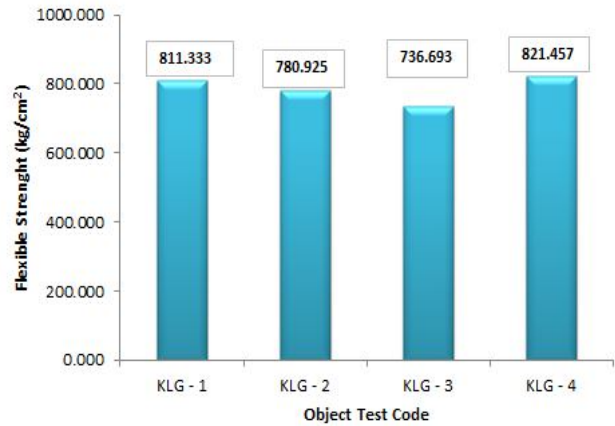


Fig. 17 Shear strength of laminated timber with epoxy

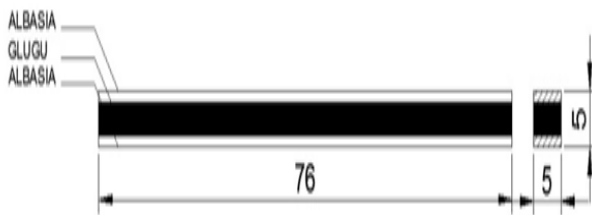


Fig. 18 EPG (An adhesive material: glue epoxy, and wood position: glugu in the middle)

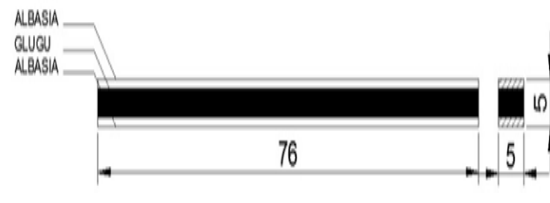


Fig. 19 AIG (An adhesive material: glue aibon, and position wood: glugu in the middle)

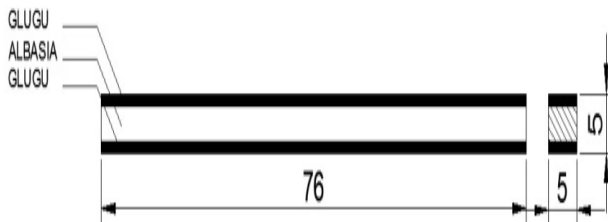


Fig. 20 EPA (An adhesive material: glue epoxy, and position wood: albasiah in the middle)

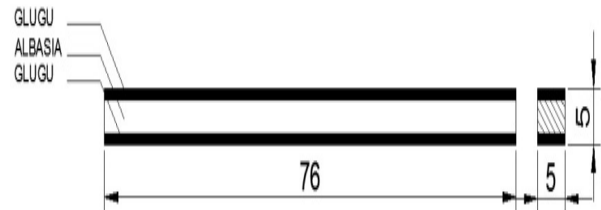


Fig. 21 AIA (An adhesive material: glue aibon, and position wood: albasiah in the middle)

Table 2. Inspection flexible strength of beam control

Inspection Flexible Strength of Beam Control			
No.	Flexible Strength of Beam Control		Explanation
	Albasia	Glugu	
1.	505.367	811.333	According to The Regulation of Indonesia Construction Timber, albasia include the fourth wood class. With the average of flexible strength 360 – 500 kg/cm <sup>2</sup> .
2.	350.601	780.925	
3.	454.465	736.693	
4.	390.598	821.457	
Average	425.325	787.602	

Table 3. Flexible strength of beam control

No.	Maximum Loading (kg)				Flexible strength of beam control				Explanation
	EPG	AIG	EPA	AIS	EPG	AIG	EPA	AIS	
1.	550	650	850	650	515.498	541.718	708.401	541.718	According to The Regulation of Indonesia Construction Timber, glued laminated timber include the third wood class. With the average of flexible strength 500 - 725 kg/cm <sup>2</sup> .
2.	690	675	750	600	614.938	564.077	626.752	572.203	
3.	600	630	800	730	530.336	586.669	702.897	603.441	
Average	613.333	651.667	800	660	554.591	564.155	679.350	572.454	

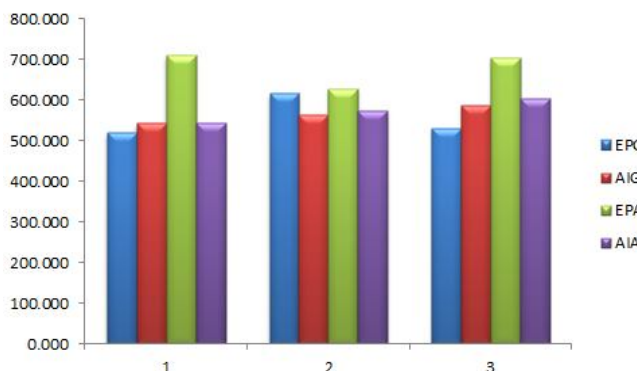


Fig. 21 Flexible strenght of glued laminated timber beam

### V. CONCLUSION

After conducting the research, can be concluded that: (1) Prestressed of glued laminated timber with EPG code is 554.591 kg/cm<sup>2</sup>, and maximum load is 690 kg; (2) Prestressed of glued laminated timber with EIG code is 564.155 kg/cm<sup>2</sup>, and maximum load is 675 kg; (3) Prestressed of glued laminated timber with EPS code is 679.350 kg/cm<sup>2</sup>, and maximum load is 850 kg; (4) Prestressed of glued laminated timber with EIS code is 572.454 kg/cm<sup>2</sup>, and maximum load is 730 kg.

The biggest prestressed is made by glued laminated timber with EPS code, with an adhesive epoxy and the position albasia is in the middle. The result showed that the product increased laminates, strong class IV into a buoyant strong III, with an increase in 254.025 kg/ cm<sup>2</sup> or 59.72 %. Of which initially was strong class IV 425.325 kg/ cm<sup>2</sup> become 679.350 kg/ cm<sup>2</sup> (class III).

### VI. SUGGESTION

From the research that has been done, there are some suggestions that can be concluded to the reader and further research, among others: (1) Gluing on the side of the wood, possible there are not sticking perfect because the surface of wood is not uniform, then need more carefulness, because perfection of gluing is make affect of glued laminated timber strenght. (2) To prevent damage occurs on the surface of glue, need attention in the process of the emphasis of test objects.

### ACKNOWLEDGMENT

The author would to say thank you to Directorate Gendral of Higher Educat (DIKTI) through PKM funding to support this research.

### REFERENCES

- [1] Brandner R. & Schickhofer G. (2008). *Glued laminated timber in bending: new aspects concerning modeling*. Competence Centre holz.bau forschungs gmbh, 8010 Graz, Austria.
- [2] ASTM.1995. *American Standart For Testing and Method.Standart for testing of evaluaty wood preservation by field test with stakes*. Philadelpia. 1995.
- [3] Fakhri. 2001. *Pengaruh Jumlah Kayu Pengisi Balok Komposit Kayu Keruing-Sengon terhadap Kekuatan dan Kekakuan Balok Kayu Laminasi (Glulam Beams)*. Universitas Pascasarjana UGM.
- [4] Handayani, S. 2003. *Pengujian Sifat – sifat Mekanik lentur dan Geser Kayu Sengon dan Kayu Suren dari Daerah Bagian Utara Jawa Tengah*, [Jurnal]. Semarang. Teknik Sipil FT UNNES.
- [5] Handayani, S. 2009. *Metode Perekatan Dengan Lem Pada Sambungan Pelebaran Kayu*. [Jurnal]. Semarang. Teknik Sipil FT UNNES.



- [6] Iskandar, 2006. *Pemanfaatan Kayu Hutan Rakyat Sengon (Paraserianthes falcataria (l) nielsen) untuk Kayu Rakitan*. Prosiding Seminar Litbang Hasil Hutan.
- [7] Lezian Arsina. 2009. *Pengaruh Rasio Bambu Petung Dan Kayu Sengon Terhadap Kapasitas Tekan Kolom Laminasi*. Teknologi Dan Kejuruan, Vol. 32, No. 1, Pebruari 2009.
- [8] SNI 03-6850-2002. *Metode Pengujian Pengukuran Kadar Air Kayu dan Bahan Berkayu*. PUSLITBANG-Badan Standarisasi Nasional.
- [9] Mulyo Wicaksono, Teguh. 2009. *Analisis Kekuatan Lentur Kayu Laminasi dalam Perkuatan Kayu Sengon Sebagai Pengganti Balok*. [skripsi]. Semarang. Jurusan Teknik Sipil FT UNNE