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## RESEARCH ARTICLE

# JOINT DEVELOPMENT LAMINA WOOD BEAMS OF WOOD *ACACIA* (*ACACIA* MANGIUM WILLD) AND CAMPHOR (DRYOBALANOPS SPP.,)

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**ABSTRACT**

Increasing the power of *Acacia* wood and wood beams Camphor at making lamina based on the concept of deformation. This research is compiled from *Acacia* wood board sheets and wood Camphor each test sample used as solid beams, beam lamina two layers, beams lamina three layers to gain strength *MoE* and *MoR*. Raw material for adhesive laminated beams Dovebond 30 and adhesive Synteko 1909 with Hardener 1999. The nature of physics and mechanics of wood : Testing Results *Acacia* wood moisture content < of wood Camphor and density, shear strength, *MoE*, *MoRAcacia* wood > Camphor wood. Thus, the smaller the value of test results of water content, the density value, the value of the shear strength, the strength values *MoE* and strength *MoR* result will be even greater. Beam glued lamina strength: shear adhesion strength of laminated wood beams Camphor using adhesives Dovebond 30 and Synteko 1909 Camphor wood glued have better power, better for the adhesive Dovebond 30 and adhesive Synteko 1909 amounted to 33,95% and 23,09% > beam *Acacia* wood lamina. Comparison beams lamina two layer and three layer: Camphor Wood, a second beam lamina two layers and three layers of adhesive Dovebond 30 experienced *MoE* power efficiency of 2,79% ; 16.80% and the second beam lamina two layers and three layers of adhesive Synteko 1909 experience *MoE* power efficiency of 2,31% ; 11,32% of the strength of a solid beam *MoE* . And the second beam lamina two layers and three layers of adhesive Dovebond 30 experienced *MoR* power efficiency of 4,15% ; 4,58% and the second beam lamina two layers of adhesive Synteko 1909 *MoR* have weakening strength of 4,86% and a triple beam lamina experience *MoR* power efficiency by 4,58% on the strength of a solid beam *MoR*. Strength value *MoE* and *MoR* best : Strength *MoE* and *MoR* number of layers and Camphor wood design Synteko 1909 adhesive layer number for interaction with the design is very significant, then followed by a further test. Value *MoE* further test the strength of interaction with a number of layers of design occurs in the number of layers of two layers with a design on three layer type 2 the average value of 95.899 kg/cm$^2$ ; 93.299 kg/cm$^2$ and 89.781 kg/cm$^2$. *Acacia* solid wood beams, beams solid and lamina beams Camphor wood can be used as construction materials in sheltered conditions. The selection of adhesive to provide adhesion value for the type of wood used as a beam lamina. *MoE* strength values and *MoR*, plan beam lamina of the type of wood that will be used is to get some references of previous studies. Necessary to study some other type of wood to be used as laminated beams with due regard to the age of the tree and the anatomical structure of the wood.



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## INTRODUCTION

Diversity laminated beams products as an alternative means to increase the strength of solid wood so that it can cope with a large-sized wood. Laminated beams (glulam) was originally developed in Europe, America and glulam market during this time was abroad. And in Indonesia is a product and start demanding public at large lamina beam (Glulam Beam) is a combination of a number of wooden boards into one solid unit.

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Laminated beams have advantages compared with regular sawn timber, besides the strength is good enough, we can make a larger cross-section and length. Besides, low quality wood also can be used so that more efficient use of wood utilization.

To determine the physical properties and mechanical properties and increasing strength *MoE* and *MoR Acacia* wood and Camphor on the block making lamina used based on the concept of deformation, beam bending stress. At the top shows the outer fiber experiencing maximum compressive stress due to withstand external loads on laminated beams. Instead at the bottom experienced a maximum tensile stress, whereas the middle (neutral line) did not experience compressive stress or tensile, so getting closer to the neutral line voltage is getting smaller. Therefore in this study prepared sheets of board

*Acaci*a wood and wood Camphor respectively used as the sample beam lamina two layers, the connection beam lamina two layers with 2 types, beam lamina three layers and connection beam lamina with 2 types to get alternative force. An important raw material in the manufacture of laminated beams is adhesive. Beams lamina made on an industrial scale generally use adhesive synthetic adhesive. The use of wood as a building material lamina has advantages over solid wood. According to the CWC (2000), wood lamina is an effective way in the use of wood a great power with limited dimensions of the elements into a large building materials in various shapes and sizes. While Serrano (2003) states that the advantages of using wood lamina is to increase the strength properties, provides a diverse selection , makes it possible to adjust the beam quality of the lamina with the desired voltage level. Some types of wood with different characteristics will influence the strength of the beam lamina , so further research is needed to be applied to the actual building materials.

**Research purposes**

Knowing the physical and mechanical properties of *Acacia* wood and Camphor; adhesion strength of the laminated beams Acacia wood and Camphor wood adhesive Dovebond 30 and Synteko 1909 with Hardener 1999; comparison beam lamina two and three layers of *Acacia* and Camphor wood to solid wood; position of *Acacia* wood and wood connections that generate value Camphor *MoE* strength and *MoR* best .

## RESEARCH METHODS

**Research design**

The method used is an experimental method. This type of research conducted in this study is testing the water content, density shear strength, flexural strength *MoE*, *MoR*solid beams and laminated beams. The second age felled tree at the time more than >30 years.

**Object Research**

As an object of research is wood *Acacia* (*Acacia* mangium Wiild) harvested from areas Separi in Tenggarong the Kutai Kartanegara Regency with  > 25 cm and the timber Camphor (Dryobalanops aromatica) harvested from plantations that grow in the area of Muara Wahau in Sangatta the East Kutai Regency with  > 25 cm with the size of the timber based on the standard ASTM 143-05 (2005).

**Sample Test Research**

Test sample of research used in this study are as follows :

***Acacia* wood**

This study used two pieces of acacia trees which then made the test sample with a beam size solid thick 6 cm, a width of 6 cm, length 76 cm (6cm x 6cm x76cm) and laminated beams to the size of two layer ((3+3)cmx6cmx76cm), three layers ((2 + 2 + 2) cm x 6 cm x 76 cm) , the connection lamina two layers ((3 + 3) cm x 6 cm x 76 cm) 2 type and connection lamina three layers ((2 +2 + 2) cm x 6 cm x 76 cm) 2 type.

**Camphor wood**

This study used two pieces of lime trees which then made the test sample with a beam size solid thick 6 cm, a width of 6 cm, length 76 cm (6cm x 6cm x 76 cm) and laminated beams to the size of two layer ((3 + 3) cm x 6 cm x 76 cm), three layers ((2 + 2 + 2) cm x 6 cm x 76 cm), the connection lamina two layers ((3 + 3) cm x 6 cm x 76 cm) two type and connection lamina three layers ((2 + 2 + 2) cm x 6 cm x 76 cm) 2 type.

**Research Procedures**

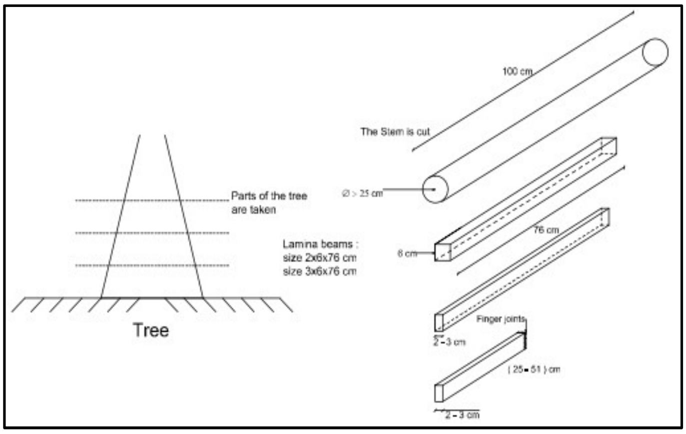
Making Beams Lamina

***Acacia* wood**

Wood logs cut into sections, then planed to remove lint and smoothed surface. Then cut to the size of the width of 6 cm , thickness 2-3 cm and a length of 76 cm . The shape and size as Picture 1 through Picture 4.

**Camphor wood**

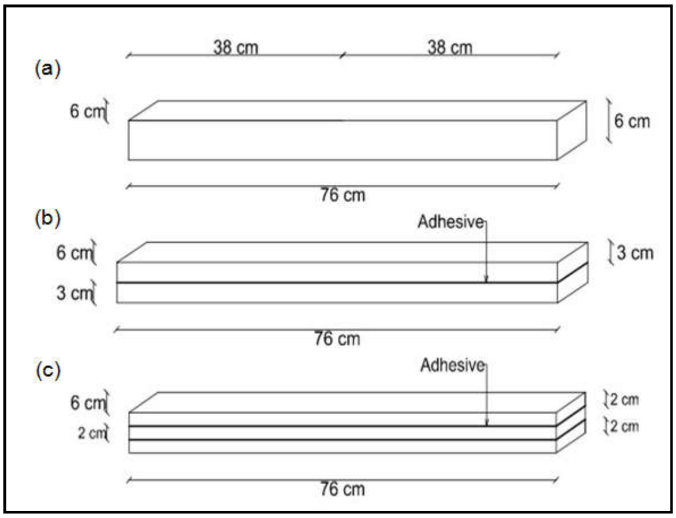
Wood logs cut into sections, then planed to remove lint and smoothed surface. Then cut to the size of the width of 6 cm , thickness 2-3 cm and a length of 76 cm . The shape and size as Picture 1 through Picture 4.



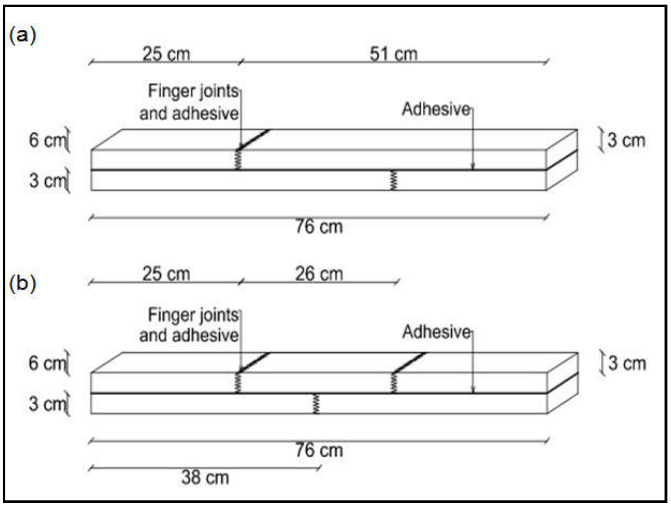

**Picture 1. Test Sampling Pattern of Acacia Wood and Camphor**

**Making Sample Test**

Samples prepared by each test 3 times of *Acacia* wood and Camphor, with a size of 6 cm x 6 cm x 76 cm. *Acacia* wood laminate test specimen and Camphor each with thick 2 cm, 3 cm and 6 cm. Laminated wood glued together with an adhesive side latches resurfacing. Whitewash adhesive with a brush evenly, and ensure that all coat with adhesion layer. Similarly, immediately next the lamina wooden structure clamped for hardening bonding occurs fairly rapidly. Clamp was carried out for one day until hardening occurs perfectly. The size and shape of the sample lamina *Acacia* wood beams and Camphor like the pictures below:

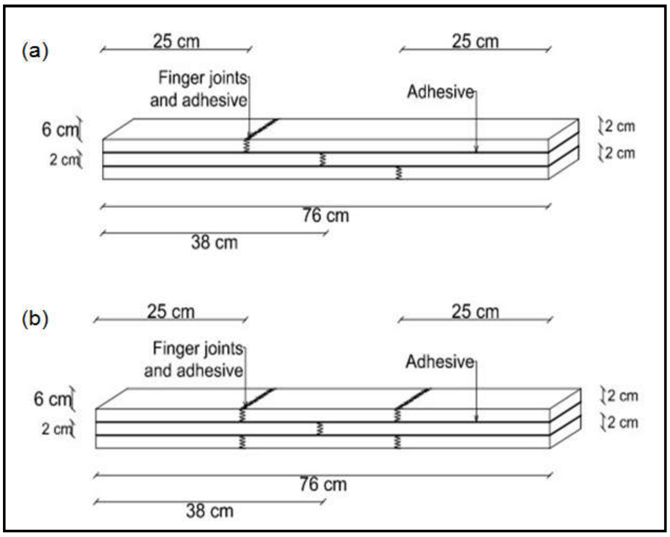



**Picture 2. Flexural strength test sample A (a) Solid beams ; (b) Lamina beams two layers (c) Lamina beams three layers**




**Picture 3. Flexural strength test sample B**

(a) Lamina beams finger joint two layers of tipe 1
(b) Lamina beams finger joint two layers of tipe 2




**Picture 4. Flexural strength test sample B**

(a) Lamina beams finger joint three layers of tipe 1
(b) Lamina beams finger joint two layers of tipe 2

### Gluing

Dovebond adhesive 30, adhesive Synteko 1909 with Hardener 1999. Before the sealing process, the board surface lamina in a state of refined, cleansed of all impurities. The whole system is done by using the resurfacing adhesive spatula/brush, and dilaburkan on both surfaces lamina with labur quantity of 200-220 g/m$^2$. Gluing wood layers lamina starts at the bottom, followed by the upper layer. wood laminates that have completed the entire process of gluing placed between two pieces of angle iron profiles are fitted with a metal plate and then performed with a distance of 30 cm is clamped each for ± 45 minutes. Prior to the alignment of the entire surface of the lamina and held flexural strength testing, laminated beams need to be conditioned in advance for a minimum of seven days to ensure the maturation process of gluing. Measurement of cross-sectional dimension which consists of width and height solid wood on the whole beam and the beam solid. Time tests are carried out at least one week after the drying process is perfect.

### Bending Strength Testing

### Material

Solid beams and laminated beams made each 3 times the test sample with a size of 6 cm x 6 cm x 76 cm. Samples are prepared in accordance laminated beams the image above with the lamina thickness 2 cm to 3 cm, whereas for the lamina connection using this form of connection menjari. Solid beam in this study as a control and beam lamina performed data analysis.

### Equipment

Equipment in flexural strength testing using the following equipment :

Flexural strength testing machine (Loading Frame) and engine load (Hydraulic Jack).

### Data analysis

The data in this study using the Software. The data analysis was conducted to analyze Modulus of Elastisity (*MoE*) and the Modulus of Repture (*MoR*) of the test sample that is reviewed using factorial analysis experiments. This study consisted of two factors :

**Two Adhesive:** Dovebond 30, Synteko 1909 with Hardener 1999

Two types of wood are: Acacia wood, Camphor wood
The formula used as follows:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk}$$

Completely Randomized Design with factorial, can be planned for analisa. Setelah done completely randomized design in each group, the obtained formula result of analysis of variance MoE and MoR as Table 1 below:

**Table 1. Formula Car Fingerprint Analysis**

| Source Diversity | Degrees free | Sum of Squares | The Average Squared | F. Arithmatic | F. Table | |
|---|---|---|---|---|---|---|
| SK | db | JK | KT | $F_{arith.}$ | 5 % | 1 % |
| Treatment | (A.B) -1 | JKP | JKP/(A.B)-1 | KTP/KTG | (V1,V5) | (V1,V5) |
| Adhesive | A - 1 | JKA | JKA/(A-1) | KTA/KTG | (V2,V5) | (V2,V5) |
| Lamina | B - 1 | JKB | JKB/(B-1) | KTB/KTG | (V3,V5) | (V3,V5) |
| Interaction | (A-1)(B-1) | JKAB | JKAB/(A-1)(B-1) | KTI/KTG | (V4,V5) | (V4,V5) |
| Error | AB (n-1) | JKG | JKG/(AB(n-1) | | | |
| Total | (ABn)-1 | JKT | | | | |

### A further test

Test Least Significant Differences (LSD) is the least significant difference test, it depends on the analysis or design experiments in conjunction with analysis of variance (ANOVA) was used as a test then a further test. The formula is the least significant difference test LSD = t (DBE). Se.

## RESULTS AND DISCUSSION

### The nature of Physics and Mechanics Wood

The average value of physical properties, mechanical properties of *Acacia* wood and wood Camphor. The second age felled tree at the time more than 25 years and diameter > 25 cm, Camphor wood moisture content18,72% larger than Acacia wood moisture content of 9,72%. According Supraptono (2015), the density is an important property of wood and need to know. With the mengempaan and the adhesive penetration into the wood density value will increase. The resulting value is the average density of acacia wood for 26,23% larger than Camphor wood of 0,61 g/cm$^3$ and koefien value greater variation of 1,02% . The density value, according Setyaningsih (2006), the higher the density the more the strength and weight. Added weight of the wood by the substances contained in the wood hardly exalts the power mechanics. The shear strength of parallel fiber is a measure of the strength of wood in terms of its ability to withstand the forces that make a piece of wood gets another shift in the field of parallel fibers (Dumanauw, 2001). *Acacia* wood shear strength of 10,92% is greater than wood Camphor of 114,50 kg/cm$^2$ and the coefficient of variation for *Acacia* wood amounted to 8,23% greater than 5,62% Camphor wood . The shear strength of parallel fiber is a measure of the strength of wood in terms of its ability to withstand the forces that make the wood gets another shift in the field of parallel fibers (Dumanauw, 2001). Rigidity (stiffness) is the ability to withstand deformation or arches and wooden MoE is an indication of the stiffness. Mamlauk and Zaniewrki, 2006, states that the MoE is the slope proportional linear line and curve of stress and strain. MoR a fiber strength which occurs at maximum load that is when the object failure (failure) and said to be the maximum strength. *Acacia* wood MoE strength of 22,33% larger wood Camphor of 95.137 kg/cm$^2$ and the coefficient of variation is greater by 0,44%. Kekuatan MoR *Acacia* wood is 10,25% higher than wood Camphor of 730,70 kg/cm$^2$ and the coefficient of variation for *Acacia* wood amounted to 19,20% larger than Camphor wood by 20,26%.

### Beam glued strength Lamina

Shear adhesion strength of Acacia wood beams and wood lamina Kamper using adhesives Dovebond 30 and Synteko 1909 used in this study shear adhesion strength on beam Camphor wood lamina has better adhesiveness power, both for adhesive or adhesive Dovebond 30, Synteko 1909 amounted to 33,95 % and 23,09% compared with the shear strength adhesive lamina *Acacia* wood beams. With increasing shear adhesion strength of the beam lamina using a second adhesive Synteko 1909 showed that the adhesive can provide additional shear adhesion strength of 17,90% is greater than the adhesive Dovebond 30 for beam lamina on Camphor wood and provide additional shear adhesion strength of 28,30% *Acacia* wood for beams lamina. Beam shear strength of adhesion and adhesive laminated wood types Dovebond 30, Synteko 1909 *Acacia* wood and Camphor used in this study can be seen in Table 2.

**Table 2. Analysis of Car (ANOVA) Strength Paste Slide Beams Lamina *Acacia* wood and wood Camphor**

| Source Diversity | Degrees free | Sum of Squares | The Average Squared | F. Arithmatic | F. Table | |
|---|---|---|---|---|---|---|
| SK | db | JK | KT | $F_{arith.}$ | 5 % | 1 % |
| Treatment | 3 | 4.402 | 1.467 | 5,05 | 3,10 | 4,94 |
| Wood type | 1 | 2.625 | 2.625 | 9,03** | 4,35 | 8,10 |
| Adhesive | 1 | 1.768 | 1.768 | 6,08* | 4,35 | 8,10 |
| Interaction | 1 | 9,04 | 9,04 | 0,03$^{ns}$ | 4,35 | 8,10 |
| Error | 20 | 5.816 | 291 | | | |
| Total | 23 | 10.217 | | | | |

Information :
* = significant
** = very significant
ns = non significant

Shear adhesion strength of *Acacia* wood and wood Camphor with a confidence interval of 95% , the calculated value for the type of wood of $F_{hitung}$> $F_{tabel}$ (α, 5%), where test $F_{hitung}$= 9.03 > $F_{tabel}$ (α,5%) = 4.35 and > $F_{tabel}$(α, 1%) = 8.10, is very significant. $F_{hitung}$ adhesion value = 6.08 > $F_{tabe}$l (α ,5%) = 4,35 significant and < $F_{tabel}$ (α, 1%) = 8.10, non significant for adhesives Dovebond 30 and Synteko 1909. For the type of wood is very significant and adhesives followed by a further significant test. To see a significant difference in each treatment it is necessary to test the shear adhesion strength Advanced Acacia wood and wood types Kamper as shown in Table 3 below:

**Table 3. Advanced test LSD against the power slide paste wood types beams lamina**

| Adhesive | The average (kg/cm$^2$) | *Acacia* | Camphor | LSD | |
|---|---|---|---|---|---|
| | | | | 5% | 1% |
| *Acacia* | 74,41 | 0 | 21* | 21 | 40 |
| Camphor | 95,33 | | 0 | | |

Information :
* = significant

Further trials showed that the shear adhesion strength of the type of wood, laminated wood beams Camphor of 28,11% is greater than the shear adhesion strength of *Acacia* wood. Further test results in Table 3 above shows that the treatment beam lamina Camphor wood types have a significant effect. This is because the average value of the shear adhesion strength of each treatment has increased. And showed that wood Camphor has a shear adhesion strength of the average value is greater than the value of *Acacia* wood and wood lamina Camphor further test at greater than 0,05 LSD so that it can be interpreted that the treatment of the shear strength of a significant effect on the type of wood and amounted to 47,50% more LSD lower than 0,01 so it can be interpreted that the treatment of the shear strength of the adhesive Synteko 1909 no significant effect on the type of wood. To see a significant difference in each treatment it is necessary to test the shear adhesion strength Dovebond 30 Advanced and Synteko 1909 as shown in Table 4 as follows:

**Table 4. Test LSD Continue Slide Against Strength Adhesive Paste**

| Adhesive | The average ($kg/cm^2$) | Dovebond 30 | Synteko 1909 | LSD | |
|---|---|---|---|---|---|
| | | | | 5% | 1% |
| Dovebond 30 | 152,58 | 0 | 34,33* | 21 | 40 |
| Synteko 1909 | 186,91 | | 0 | | |

Information :
* = significant

Further trials showed that the shear adhesion strength of the beam using an adhesive lamina Synteko 1909 amounted to 22, 50% greater than the shear adhesion strength of the beam using an adhesive lamina Dovebond 30. From the results of a further test in Table 4 above shows that the treatment beam adhesive lamina 1909 Synteko significant effect. This is because the average value of the shear adhesion strength of each treatment has increased. And showed that the adhesive Synteko 1909 has the average value of adhesion shear strength greater than the adhesive Dovebond 30 and further test the value of the difference in the average value of adhesive Synteko 1909 amounted to 63,48% larger than 0,05 LSD so that it can be interpreted that the treatment of the shear strength of adhesive Synteko 1909 a significant effect on adhesion and amounted to 14,18% lower than the 0,01 LSD so that it can be interpreted that the treatment of the shear strength of the adhesive Synteko 1909 no significant effect on adhesion.

### Comparison Beams Lamina Layer 2 and Layer 3

Strength *MoE*, *MoR* for solid beam, the beam lamina 2 ply, 3 ply laminated beams *Acacia* wood adhesive Dovebond 30 and Synteko 1909 in this study can be seen in Figure 5 and Figure 6 as follows:

Solid beam bending strength testing and *Acacia* wood laminated beams with concentrated loads amid the landscape in Figure 5, shows the strength of the maximum *MoE* occurred in 2 layers laminated beams, laminated beams and beam 3 ply solid adhesive Dovebond 30 and Synteko 1909. Judging from the two beams lamina, lamina beam two layers with a thickness of 3 cm using adhesive Dovebond 30, a laminated beams that hold the greatest MoE strength of 16,81% greater than the three-layer laminated beams, followed by a three-layer laminated beams by using an adhesive that secures the power Synteko 1909 *MoE* 15,50% greater than the three-layered laminated beams.

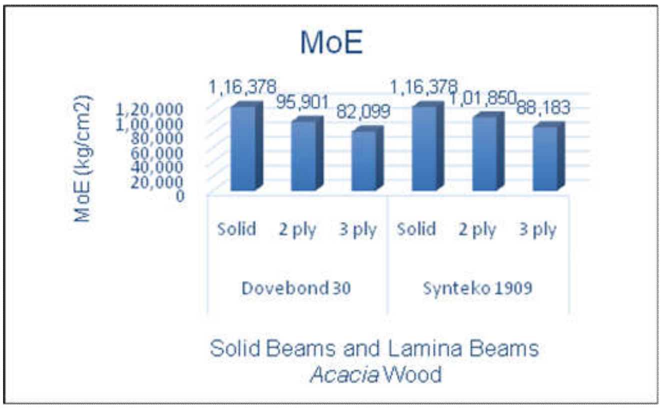



**Figure 5. The Average Value *MoE*Solid Beams, Lamina Beams 2 Ply, Lamina Beams 3 ply *Acacia* Wood Adhesive Dovebond 30 and Synteko 1909**

*MoE* solid beams withstand the force of 116.378 $kg/cm^2$. Thus both the lamina beam two layers and three layers of adhesive Dovebond 30 have weakening the power of the *MoE* of 17,60%, 29,45% and the second beam lamina two layers and three layers of adhesive Synteko 1909 have weakening *MoE* of 12,48%, 24,23% of the strength of a solid beam *MoE*.

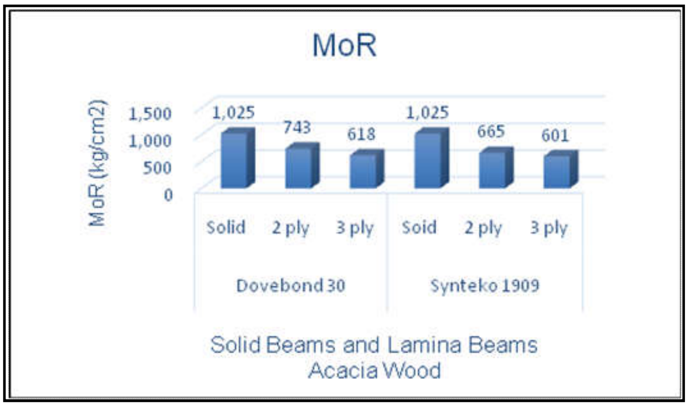



**Figure 6. The Average Value*MoR*Solid Beams, Lamina Beams 2 Ply, Lamina Beams 3 ply *Acacia* Wood Adhesive Dovebond 30 and Synteko 1909**

Solid beam bending strength testing and *Acacia* wood laminated beams with concentrated loads amid the landscape in Figure 6, shows the strength of *MoR* maximum occurs in two layers laminated beams, laminated beams and beam 3 ply solid adhesive Dovebond 30 and Synteko 1909. Judging from the two beams lamina, lamina beam three layers with a thickness of 2 cm using adhesives Dovebond 30, a laminated beams that hold the greatest power of *MoR* by 20, 23% greater than the beam lamina two layers, followed by a three-layer laminated beams by using an adhesive that secures the power Synteko 1909 *MoR* amounted to 10,65% larger than two layers laminated beams. *MoR* solid beam resist forces of 1.025 $kg/cm^2$. Thus both the lamina beam two layers and three layers of adhesive Dovebond 30 have weakening the power of *MoR* by 27,51% ; 39,71% and the second beam lamina two layers and three layers of adhesive laminated beams Synteko 1909 have weakening *MoR* amounted to 35,12% ; 41,37% of the strength of a solid beam *MoR*. Strength *MoE*, *MoR* for solid beam, the beam lamina 2 ply, 3 ply laminated wood beams Camphor using adhesive Dovebond 30 in this study can be seen in Figure 7 and Figure 8 as follows:

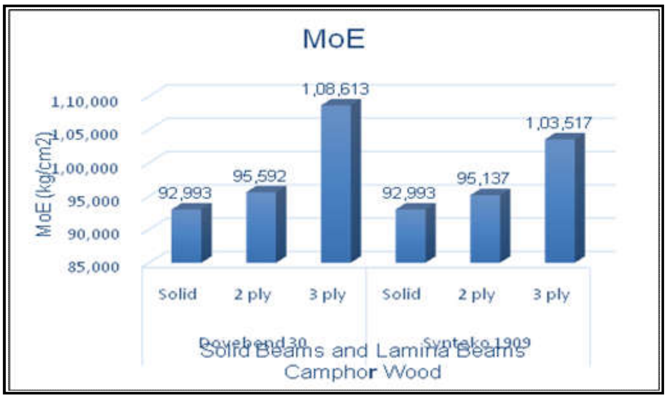



**Figure 7. The average Value*Mo E* Solid Beams, Lamina Beams 2 ply, Lamina Beams 3 ply Camphor Wood Adhesive Dovebond 30 and Synteko 1909**

Solid beam bending strength testing and Camphor wood laminated beams with concentrated loads amid the landscape in Figure 7, showing the strength of the maximum *MoE* occurred in 2 layers laminated beams, laminated beams and beam 3 ply solid adhesive Dovebond 30 and Synteko 1909. Judging from the two beams lamina, lamina beam three layers with a thickness of 2 cm using adhesives Dovebond 30, a laminated beams that hold the greatest *MoE* strength of 13,62% is greater than the beam lamina two layers, followed by a three-layer laminated beams by using an adhesive that secures the power Synteko 1909 *MoE* amounted to 8,81% greater than the beam lamina two layers. *MoE* solid beam resist forces of 92.993 kg/ $cm^2$. Thus both the lamina beam two layers and three layers of adhesive Dovebond 30 experienced *MoE* power efficiency of 2,79%, 16,80% and the second beam lamina two layers and three layers of adhesive Synteko 1909 experienced the efficiency of the modulus of elasticity of 2,31% ; 11,32% of the strength of a solid beam *MoE*.

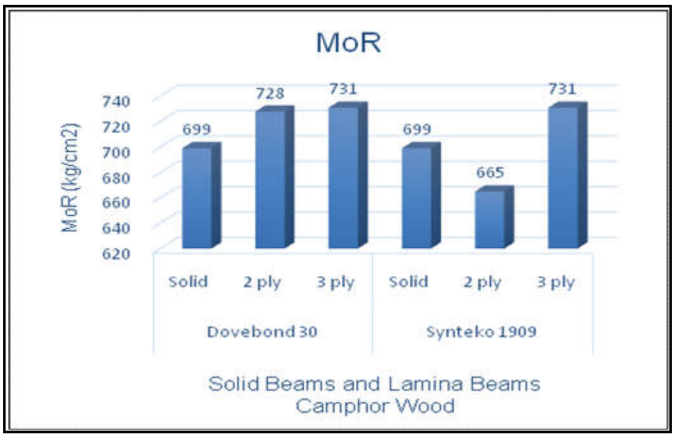



**Figure 8. The Average Value*MoR* Solid Beams, Lamina Beams 2 ply, Lamina Beams 3 ply Camphor Wood Adhesive Dovebond 30 and Synteko 1909**

Solid beam bending strength testing and Camphor wood laminated beams with concentrated loads amid the landscape in Figure 8, shows the strength of *MoR* maximum occurs in two layers laminated beams, laminated beams and beam 3 ply solid adhesive Dovebond 30 and Synteko 1909. Judging from the two beams lamina, lamina beam three layers with a thickness of 2 cm using adhesives Dovebond 30, a laminated beams that hold the greatest power of *MoR* 0,41% larger than the beam lamina two layers, followed by a three-layer laminated beams by using an adhesive that secures the power Synteko 1909 amounted to *MoR*9,92% greater than the beam lamina two layers. *MoR* solid beam resist the forces of 699 kg/$cm^2$. Thus both the lamina beam two layers and three layers of adhesive Dovebond 30 experienced MoR power efficiency of 4,15% ; 4,58%, and the second beam lamina two layers of adhesive Synteko 1909 have weakening strength of*MoR* 4,86% and a three-layer laminated beams *MoR* experiencing power efficiency by 4,58% on the strength of a solid beam *MoR*.

**Strength value *MoE* and the best *MoR***

Strength *MoE* and the *MoR* , the number of layers to the design of *Acacia* wood adhesive Dovebond 30 with a confidence interval of 95%, the calculated value for the number of layers, where $F_{arithmatic} < F_{table}(\alpha , 5 \%)$ and $< F_{table} (\alpha , 1 \%)$ values calculated number of layers, the calculated value and the calculated value interaraksi design is non- significant. So in this case , the power of *MoE*, *MoR* number of layers with a design using adhesive Dovebond 30 no relationship and influence on the type of wood, adhesives and interaction lamina Acacia wood beams. Strength *MoE* and *MoR* number of layers and design of acacia wood with a confidence interval of 95%, the calculated value for the number of layers of $F_{arithmatic} < F_{table} (\alpha, 5\%)$ and $< F_{table} (\alpha, 1\%)$ value in counting the number of layers and the design value is non- significant. The value of the interaction of $F_{arithmatic} = 57{,}64 > F_{table} (\alpha, 5\%) = 3{,}88$ and $> F_{table} (\alpha, 1\%) = 6{,}93$ is very significant for the adhesive Synteko 1909. In this case, the power of the *MoE* and count the value *MoR* layer and the calculated value Acacia wood design is non significant. *MoE* strength for interaction with the number of layers is very significant design, then followed by a further test. Values further test the interaction design with a number of layers of laminated beams three layers is significant. Strength *MoE* and *MoR* number of layers and wood design Camphor adhesive Dovebond 30 with a confidence interval of 95%, the calculated value for the number of layers, the design value and the value of the interaction of $F_{arithmatic} < F_{table} (\alpha, 5\%)$ and $< F_{table}(\alpha, 1\%)$ non significant. In this case, the power of *MoR* value in counting the number of layers, the calculated value of design and value interaction *Acacia* wood is non significant. *MoE* strength and *MoR* number of layers and design Camphor wood adhesive Synteko 1909 with a confidence interval of 95%, the calculated value of $F_{arithmatic} < F_{table} (\alpha, 5\%)$ and $< F_{table}(\alpha, 1\%)$ non significant. Values interaction $F_{arithmatic} = 3{,}02 < F_{table} (\alpha, 5\%) = 3{,}88$ and $< F_{table} (\alpha, 1\%)$ non significant 6,93%. In this case, the power *MoE* value in counting the number of layers and the calculated value Camphor wood design is non-significant. As for the number of layers of interaction with the design is very significant, then followed by a further test. Value *MoE* further test the strength of interaction with a number of layers of design occurs in the number of layers of two layers with a design on three layer type 2 the average value of 95.899 $kg/cm^2$; 93.299 $kg/cm^2$ and 89.781 $kg/cm^2$. Based on the physical and mechanical properties of wood test results, then the solid *Acacia* wood beams, solid beams and laminated wood beams Camphor wood strength was classified as strong class II and can be used as an ingredient on the condition of protected buildings. Gluing strength, then for the purposes of making laminated beams as construction materials needed memilihan fairly dry wood and adhesives in order to provide additional shear adhesion strength. Comparison beam lamina, the determination of the number of layers and the connection finger joints to support the increased strength of the adhesive material selection is the most appropriate to use. The selection of adhesive to provide adhesion value for the type of wood used as a beam lamina. *MoE* strength values and *MoR*, plan lamina and lamina finger joints of the type of wood that will be used is to get some references of previous studies. Necessary to study some other type of wood to be used as laminated beams and laminated beams finger joints with due regard to the age of the tree and the anatomical structure of the wood.

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