Comparative study of Dendrocalamus Asper subjected to long term submergence and treated methods

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ABSTRACT: Nowadays, the enhancement of infrastructure in construction industry is crucial to reduce the construction cost. The main material such as cement and steel are significant in construction field. In order to reduce the construction cost, bamboo is applied into the concrete beam. The effectiveness of bamboo usage as reinforcement in concrete is investigated. Three different types of bamboo undergo the tensile test subjected to three different curing period. To ensure the effectiveness of bamboo usage, 2 different methods of treatment have been performed in this study. The highest strength of beam obtained from the treated sample of *Dendrocalamus asper* using Vegetable oil. The 45 days of curing period produce a high flexural strength, among others. From this finding, it is expected that bamboo can be utilized as reinforcement in concrete beam for low load bearing structures.

Keywords: *Enhancement; bamboo; highest*

1. INTRODUCTION

Bamboo is known as strong species to be used as main component for the house or light weight structures. It is significant to investigate the effect of bamboo when acting as reinforcement in concrete structures [1]. In this study 3 types of strong bamboo have been selected to be used as beam reinforcement. The characteristic of steel that is easily to rust when exposed to water would propose bamboo as reinforcement [2]. Bamboo can be treated to avoid bamboo from absorbing too much water which will cause reduction of strength. The best treatment process to solve this problem of bamboo has been investigated in this experimental study. This study emphasized the best treatment method for bamboo to be used in concrete for long term duration without affecting the strength of concrete.

2. MATERIALS AND METHOD

Three different types of bamboo has been utilized in this experimental study; *Dendrocalamus asper*, *Bambusa blumeana* and *Gigantochloa wrayi* as indicates in Figure 1.

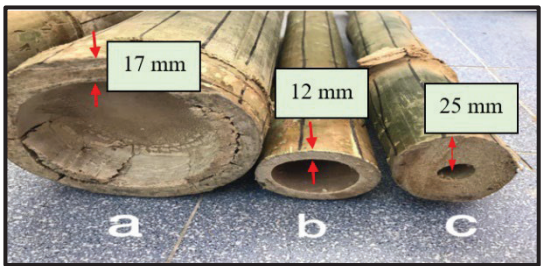


Figure 1 Different thickness for a) *Dendrocalamus asper,* b) *Gigantochloa wrayi*, and c) *Bambusa blumeana*

The bamboo samples had been dried for 30 days for the tensile test. Then, bamboo was cut into 'dogbones' shapes. The width and length of samples were 20 mm and 200 mm, respectively as indicates in Figure 2. The highest tensile strength bamboo would be selected to undergo flexural and deflection test. This type of bamboo was treated using flax and vegetable oil.

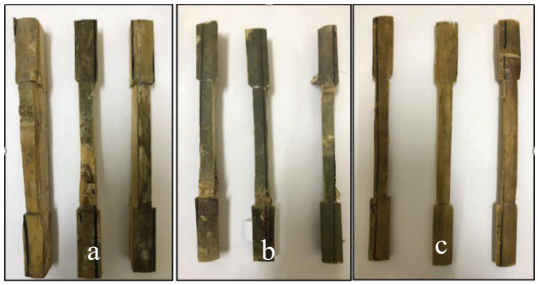


Figure 2 Dogbones shape with the 200 mm length and 20 mm width for a) Dendrocalamus asper, b) Bambusa blumeana, c) Gigantochloa wrayi

The highest tensile strength obtained from *Dendrocalamus asper* with average tensile strength 221.79 N/mm² as tabulated in Table 1. The high tensile strength of *Dendrocalamus asper* was due to the species that had the lowest number of vascular bundles, as compared with other samples. The higher number of vascular bundles could cause the lower of fibre content and it could cause the low in tensile strength [3].

Table 1 Result of tensile test.

Bamboo	Tensile strength (MPa)
Dendrocalamus asper	221.8
Bambusa blumeana	162.7
Gigantochloa wrayi	80.5

3. RESULTS AND DISCUSSION

Comparison percentage between untreated and treated samples indicate 23% higher for Treated with Vegetable Bamboo Reinforced Beam (TVOBRC) samples and 6.3% for Treated with Flax Oil Bamboo Reinforced Beam (TFOBRC) samples obtained at 75 days curing period. Meanwhile, comparison for 45 days curing period indicated the increment of 27% for TVOBRC and 13.5% for TFOBRC samples, respectively. Therefore, the best treatment oil is vegetable oil recorded at 45 days of curing period as shown in Figure 3.

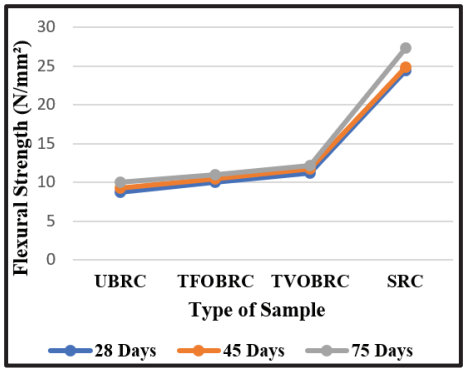
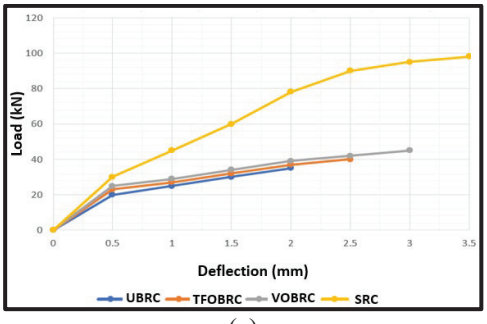
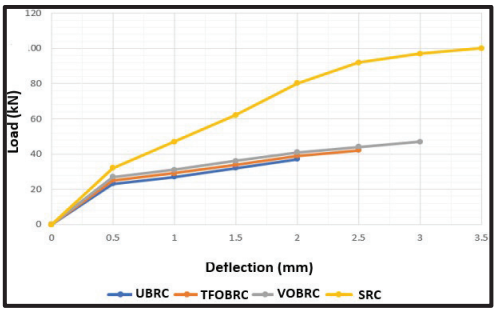


Figure 3 Flexural Strength for 28, 45 and 75 days

At the 40 kN of load applied, the deflection of Untreated Bamboo Reinforced Beam (UBRC) 166.67% higher than Steel Reinforcement Concrete Beam (SRC), while 11.11% and 17.65% are higher than TVOBRC and TFOBRC, respectively. The lowest deflection of TVOBRC and TFOBRC than UBRC because the surface already treated to prevent bamboo from absorbing water in concrete and reduce the swelling of bamboos until it reaches it fiber saturation point.



(a)



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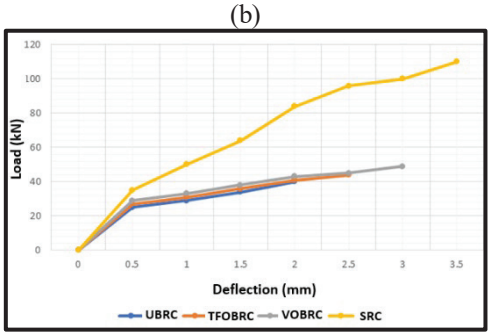

(c)

Figure 4 Comparison of deflections for a) 28 days, b) 45 days and d) 75 days curing period.

4. CONCLUSION

Based on the finding, the tensile strength for *Dendrocalamus asper* is higher than *Bambusa blumeana* and *Gigantochloa wrayi.* So, *dendrocalamus asper* is suitable to be adopted as reinforcement since it can counter the weakness of concrete that low in tensile strength. The bamboo is heated in 100° C and then soaked in vegetable oil is better than treated with flax oil. Overall, the behaviour of *dendrocalamus asper* soaked with vegetable oil at 75 days curing developed high flexural strength and deflection compared to untreated and treated with flax oil samples.

ACKNOWLEDGEMENT

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REFERENCES

[1] A. Agarwal, B. Nanda, & D. Maity, (2014). "Experimental investigation on chemically treated bamboo reinforced concrete beams and columns", *Computers and Chemical Engineering*, vol. *71*, pp. 610–617, 2014.

[2] Z. Xu, J. Li, M. Liao, Y. Yang & H. Hamada, (2013). "Tensile Properties of Bamboo jute and Kenaf mat-reinforced composites". ICCM *International Conference on Composite Materials*, 2013, pp. 8980-8987.

[3] B. D. Awalluddin, M. A. Mohd Ariffin, M. H. Osman, M. W. Hussin, M. A. Ismail, H. S. Lee, & N. H. Abdul Shukor Lim, "Mechanical properties of different bamboo species", *MATEC Web of Conferences*, *138*, 2017.