

THE UTILIZATION OF BAMBOO AS A REPLACEMENT OF STEEL FOR BUILDING STRUCTURES

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Abstract: Bamboo can be aligned with steel due to it has a power of pull and strength so that it can bear a flexible moment and has resistance toward the wind and earthquakes. The use of bamboo can be utilized as an alternative material for the substitutes of steel for the construction of multi-storey building structures because it has the same properties. In this study it is still limited to beam and column modeling for building structures by testing flexural strength and bamboo press. This study is laboratory experiments. The types of bamboo used in this study are *petung bamboo*, *wulung bamboo*, *gombong bamboo* and *ori bamboo*. Based on the results *the ori bamboo* has a fairly good flexural strength when used as reinforcement as it has a fairly good level of flexibility when given a load. While for *petung bamboo* and *wulung bamboo*, the strength of flexural produced is not too good when given the burden. The four types of bamboo, namely *petung bamboo*, *ori bamboo*, *wulung bamboo* and *gombong bamboo* can be utilized as reinforcement for the structures of simple building.

Keywords: *Bamboo, Test of Flexural strength*

INTRODUCTION

Bamboo has plenty of types and even hundreds of species. However, in Indonesia only four types have economic value and it can be utilized for building construction, the four types of bamboo are, *petung bamboo*, *duri bamboo*, *gombong bamboo*, and *wulung bamboo (black bamboo)*.

Bamboo has many advantages. In rural areas bamboo is often utilized as building material because there are still a lot of raw material available, in addition, in the process of building construction it can be used with simple equipment and convenient in processing. Bamboo is elastic and lightweight so that it has an earthquake-resistant structure.

The use of steel is closely related to multi-storey buildings because steel has flexible strength, very strong pull and press. Therefore, researchers are interested in researching the use of bamboo as an alternative material for substitute of steel for the construction of the multi-storey building structure because it has the same properties. This study is still limited to columns and beams.

According to Muhsin et.al (2015) Bamboo has mechanical feature and it is influenced by the type of bamboo that is used, the age of bamboo when cutting, stem, location, distance of segment and bamboo moisture. Furthermore, Frick (2004) made the determination of the mechanical features of bamboo based on types of bamboo that will be used as building materials with 12% dry water content. In tropical climates air humidity and air balance reaching 70% on average are considered as natural. Flexibility is one of the requirements for the mechanical physical feature of bamboo as a component of structures and building materials (Main, 1996).

RESEARCH METHODOLOGY

The type of study is laboratory experiments by testing the flexural strength of the concrete with boned of bamboo, the types of bamboo used are two types of bamboo, namely *Petung bamboo* and *duri bamboo*.

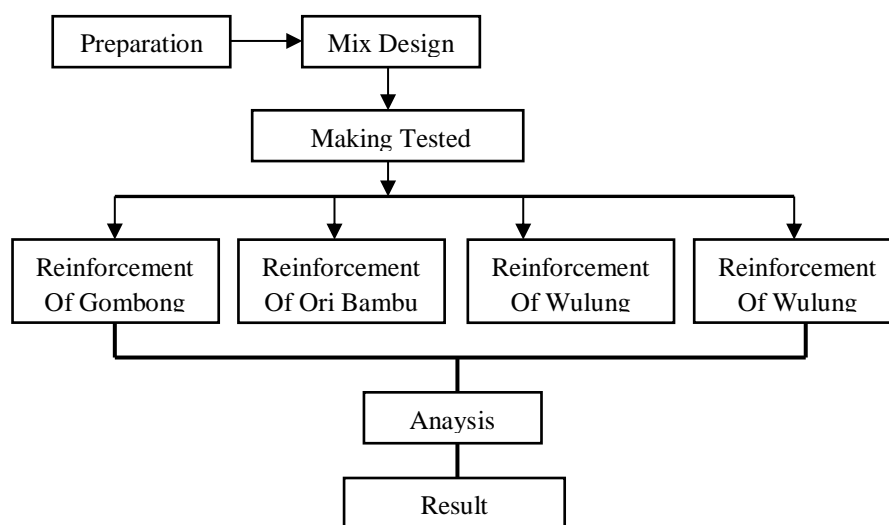


Figure 1 : Chart of Research Stages

RESULTS AND DISCUSSION

The use of bamboo reinforcement at this time for the construction of a building and other technique constructions is still very rarely found even if compared with other construction materials and easily found. Bamboo can be utilized for all types of building construction such as the use of foundations, floor, walls, columns, beams and roofs. In addition, bamboo can also be used as an substitute of reinforcement of iron. When making reinforcement, the bamboo used is in the lower base, Because it has sufficient thickness. After that the bamboo is cleaned from the thorns and the branches of the leaves. Bamboo that has been cleaned is divided into several sections with a diameter of 2-3 cm and then cleaned and preserved.



Figure 2.a Bamboo Cleansing



Figure 2.b Bamboo preservation

The making of bamboo reinforcement is made with bamboo which has been cleaned and given a preservation by means of bamboo being painted and sown with sand after which it is made assembly of the tested object. Bamboo assembly is used as a core reinforcement but the role of iron is still used as a ring or bracelet to assemble the reinforcement. The size of iron for reinforcement that used is the iron number 8. Image of ring to control reinforcement.



Figure 3: Tulangan Bambu

After all reinforcements are assembled, then making formwork from plywood for the casting process. The distance of formwork with reinforcement is 5 cm. the process of making formwork is done.



Figure 4: Making formwork

The casting process uses concrete mixer machine while the concrete quality used is concrete quality of K250. For the waiting period of concrete before testing are 28 days.



Figure 5a Casting process



Figure 5b. Handling

Before reaching 28 days. The concrete or the tested object is treated, by means of the concrete is given the wet gunny sack which is closed from the top. The treatment method is done by wetting when the concrete is in the room / or in the laboratory. The purpose of the maintenance is in order the concrete does not lose water so that the moisture can achieve an expected quality. In addition, it can prevent the cracks in the concrete or tested objects that can cause instability in the concrete structure.

The Test of flexural Strength of Reinforced Concrete of Bamboo

Test the flexural strength of the fracture in the center ($\frac{1}{3}$ from the distance of the middle placement point), then the flexural strength of the concrete is calculated according to the formulation

$$f_c = \frac{P.L}{b.h^2}$$

f_c : flexural strength of Tested object

P. : The readable highest load on the tested machine (read in tons to three digits behind the comma)

L. : The distance between the two lines of placement (mm)

b. :The width of the cross vertically (mm)

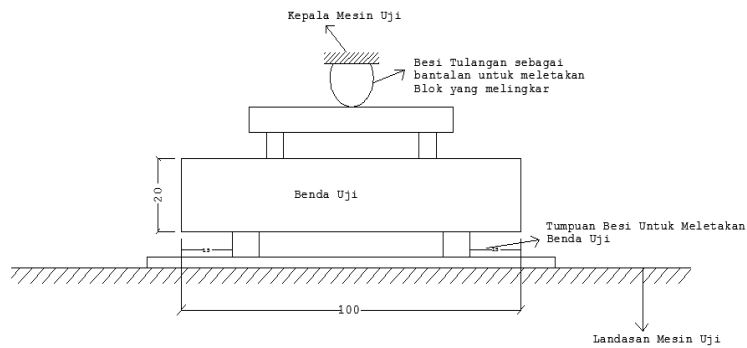
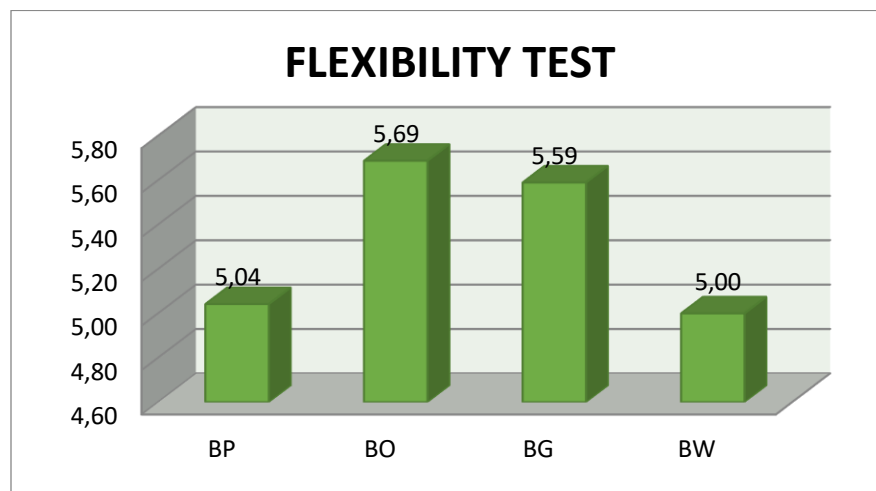


Figure 6a :Testing Illustration



Figure 6b: Testing process



The calculated flexural strength is the last crack when the specimen is given a load with maximum load. Based on the graph of the calculation of the flexural strength of petung bamboo only the mosquito holds a load of 5.05 Mpa. Ori Bamboo can hold a load of 5.69 MPa. Gombong Bamboo flexural strength can withstand loads of 5.59 MPa. Whereas wulung bamboo has flexural strength of 5.00 Mpa

Looking at the test graph above, it can be said that *Ori bamboo* has a fairly good flexural strength when used as reinforcement because it has a fairly good level of flexibility when given a load. While for *petung bamboo* and *wulung bamboo*, the resulting flexural strength are not too good when given a load.

CONCLUSION

Ori bamboo has sufficient flexural strength to be used as a reinforcement to replace steel or iron reinforcement while petung bamboo and wulung bamboo are not too good to be used as iron reinforcement because they have poor flexural strength. Therefore it can be concluded that bamboo

species that can be used as reinforcement are bamboo ori. But the use is still limited to the types of simple building construction

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