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FLEXURAL LOAD AND DEFLECTION OF STRUCTURAL BAMBOO FILLED WITH CEMENT MORTAR

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Abstract

Bamboo has been ~~widely used as a~~ significantly and rapidly ~~renewable structural material~~ used to build ~~permanent~~ temporal and ~~temporary~~ permanent structures ~~in past decades~~since time immemorial. However, ~~the~~ this renewable natural material has a low bearing ~~capacity of bamboo is relatively low~~capacity, ~~which limits~~ limiting its ~~applications only in the~~ application to structures under light loads. ~~This paper investigated~~ Therefore, this research was carried out to determine an innovative scheme ~~to improve the load bearing capacity~~ capable of ~~bamboo~~ enhancing bamboo's load-bearing by filling ~~cement mortar in bamboo cavity~~the cavity with cement. ~~An experimental~~ Furthermore, a study ~~on~~ was carried out to experiment the deflection and flexural load ~~and deflection~~ of mortar-filled ~~structural bamboo was carried out,~~ with ~~the main parameter considered was~~ structural by considering the ~~bamboo~~ diameter and ~~bamboo node~~node parameters. ~~A total of~~ Approximately 12 specimens were ~~tested under~~

~~four~~ examined using a four-point bending protocol. ~~It was found that~~ The result showed an increase in the flexural load capacities of ~~mortar-filled~~ bamboo ~~elements are higher than the conventional bamboo~~filled with mortar. Furthermore, the ~~beneficial effect~~ advantages of the bamboo diameter and ~~bamboo node on~~ the ultimate flexural ~~capacity can be observed, indicating~~ node indicated that these ~~important~~ essential findings ~~should~~ need to be carefully ~~taken into account~~ considered in ~~the design of~~ designing structural elements for both mortar-filled and conventional ~~bamboo members and those filled with cement mortar.~~bamboos.

Keywords: bamboo, mortar-filled bamboo, node, flexural behavior

Introduction

~~Bamboo as structural material has~~ Bamboos are some of the fastest-growing plants worldwide and have been ~~extensively~~ widely used to build permanent and temporary structures ~~in past decades~~since time immemorial. ~~Bamboo~~ This plant is ~~recognized as a~~ one of the sustainable ~~material~~ materials that ~~can~~ serve as ~~a competitive and~~ an environmentally friendly and competitive alternative to nonrenewable ~~and~~ as well as polluting ~~materials such as steel and~~ materials, namely concrete ~~due to that it is a rapidly renewable structural material~~ and ~~has~~ steel with mechanical properties similar to timber (Yu et al. 2011; García et al. 2012; Sharma et al. 2015; Salcido et al. 2016). ~~In recent~~ Over the past few years, ~~a large number of~~ numerous experimental and analytical studies ~~on the mechanical properties of structural bamboo~~ have been conducted on structural bamboo's mechanical properties (Sharma et al. 2013; Lee et al. 2014; Xu et al. 2014). For instance, Gottron et al. (2014) ~~have examined the~~ carried out a research to determine bamboo's creep behaviour ~~of bamboo in particular~~

~~considering~~ by due to the ~~effect of~~ specimen ~~orientation and~~ orientation. Gottron found that ~~the bamboo loaded~~ bamboos filled with ~~the~~ OT (outer culm-wall in ~~tension (OT~~tension) ~~exhibited~~ indicated a ~~larger~~ significant modulus of rupture, ~~a lower apparent modulus of elasticity; and~~ as well as a ~~lower~~ minor residual strength ~~when compared to specimens~~ and elasticity than those with ~~their~~ OC (outer culm-wall in ~~compression (OC~~compression). ~~According to~~ A research carried out by Moran et ~~al~~ al. (2017) ~~on a research about the distribution of~~ to determine the ~~circumferential~~ elastic modulus ~~through~~ on the wall ~~and~~ found that the ~~associated~~ failure ~~strain and stress~~strain, ~~mean effective~~ moduli ~~were found to be 1358.5 MPa~~and stress of Tre Gai, Moso and Guadua bamboos were 662 MPa, 1358.5 MPa and 862 ~~MPa for bamboo Moso~~MPa, ~~Tre Gai, and Guadua,~~ respectively.

Also, several ~~researchers~~ studies have ~~investigated the behavior of~~ been conducted to investigate bamboo behavior as reinforcement in structural concrete (Ghavami 2005; Lima et al. 2008; Moroz et al. 2014; Agarwal et al. 2014; Archila et al. 2018; Muhtar 2020). One of such study was ~~performed~~ carried out by Haryanto et al. (2019~~)~~), who ~~evaluated~~ examined the ~~performance of~~ crack pattern in precast segmental bamboo reinforced concrete beams to determine the flexural failure after exposing them to flexural loads. ~~A flexural failure mechanism was indicated by the pattern of crack observed in the control beam. On the contrary~~Conversely, a shear failure mechanism was ~~indicated~~ illustrated in the precast segmental bamboo reinforced concrete ~~beams. In comparison with the precast segmental bamboo reinforced concrete~~ beams containing four bolted connections, ~~the same containing~~ although those with six bolted connections ~~demonstrated~~ had better performance. Furthermore, ~~in~~ an ~~experimental~~ experiment conducted by Haryanto et al. (2020~~),~~) with bamboo ~~was~~ used as the reinforcing material in the slab specimen for the utilization of footplate ~~foundations. It was observed~~ foundations showed that ~~compared to~~ SRC which is the acronym for (steel reinforced ~~concrete (SRC~~concrete) ~~slabs,~~ had a strength of 82% ~~can be~~

~~acquired by the~~ on bamboo reinforced concrete (BRC) slabs. ~~Ductility~~ Furthermore, ductility and stiffness demonstrated by the two types of specimens investigated ~~was~~ were almost ~~equivalent i.e. up to~~ equivalent, with percentages of 93% and 72%, respectively~~.~~.

In addition, ~~several types~~ varieties of investigation have been ~~attracted~~ carried out in recent years to improve the ~~improvement of~~ reinforced concrete structures of bamboo in ~~recent years and this has turned bamboo into a strengthening~~ order to strengthen the material (Sen & Reddy 2011; Nahar & Rahman 2015; Chin et al. 2019). ~~It has been reported previously by~~ Haryanto et al. (2017) stated that the flexural strength of ~~the~~ bamboo's beam with ~~near~~ near-surface mounted (NSM) ~~bamboo reinforcements was~~ increased by 41.7~~% and~~ %, while the deflection ductility index ~~was~~ reduced by 21.55% when compared to the control specimen. ~~In addition~~Furthermore, the ~~result of~~ research carried out on the finite ~~elemen~~ element analysis (FEA) ~~behaved similarly~~ was similar to the ~~results of the~~ experimental test. Hidayat et al. (2019) also conducted a nonlinear finite element analysis to evaluate concrete beams ~~flexurally stengthened by means of~~ flexural strength using bamboo and concluded that the load-carrying capacity ~~of the specimens was~~ improved due to the placement of bamboo plates.

~~According to~~ In accordance with the ~~studies above~~above studies, bamboo ~~can be considered~~ is defined as an attractive ~~alternative~~ and widely used material that is alternate to steel ~~in tensile loading due to its relatively~~ because of the high tensile strength, ~~falling within the~~ that range ~~of~~ between 100 ~~MPa~~ MPa to 400 MPa. ~~For~~ In addition, some ~~species of~~ bamboo, ~~the ultimate~~ have similar tensile strength ~~is same as the yield strength of~~ and mild ~~steel~~steel strength. However, ~~the~~ bamboos compressive strength ~~of bamboo~~ in the cylindrical section is ~~much~~ lower than ~~its tensile strength~~the tensile, ~~falling within the range of~~ which ranges between 12 MPa–65 MPa (Dixon et al. 2015; Lo et al. 2008; Ghavami 1995). ~~The relatively~~ According to Li et al. (2017), bamboo's low comprehensive ~~strength of bamboo~~

strength, tends to limits its applications only ~~in the structures under~~ to light ~~loads~~load structures, ~~such as short-span footbridges,~~ namely low-rise houses, ~~light roof structures~~ short footbridges, scaffolds, and ~~scaffolds (Li et al~~roof structures, etc. ~~2017). All the previous~~

Numerous studies have been ~~focused~~ conducted on ~~the~~ structural bamboo's mechanical properties ~~of structural bamboo or~~ and the ~~behavior of bamboo as~~ reinforcement ~~and~~ in strengthening materials ~~in~~ using concrete.

~~To the best knowledge of the authors~~However, ~~there are~~ little or no ~~sufficient studies have~~ research has been ~~concerned with the stiffening schemes aiming at improving the load carrying capacity of~~ carried out to improve conventional structural ~~bamboo~~bamboo's load-carrying capacity. ~~To improve~~ Therefore, this research improved the flexural capacity of ~~structural~~ bamboo, ~~a simple~~ using an effective and ~~effective stiffening scheme was proposed in the paper~~easy scheme. The flexural capacity of structural bamboo was ~~intended to be improved~~ enhanced by filling cement ~~mortar~~ in ~~bamboo~~ the material's cavity. ~~To~~ This exploratory research is used to verify the feasibility of the proposed ~~scheme, this paper presents the exploratory study on~~ scheme as well as the experimental behavior of structural ~~bamboo~~ bamboo, which is filled with cement mortar that is under axial compression. ~~A total of~~ Furthermore, approximately 12 specimens were tested ~~under~~ using four ~~point~~ bending ~~loading, aiming~~ points aimed at investigating the effects of the bamboo ~~diameter~~ node and ~~node~~ diameter on the flexural ~~behavior~~ attribute of the specimens.

Experimental Program

Test Specimens

~~A total of~~ Approximately 12 specimens, ~~including~~ comprising of 3 cement ~~mortar filled~~ comprising of bamboo elements with ~~node~~nodes, 3 cement mortar filled bamboo elements without ~~node~~ node, and 6 conventional bamboo ~~elements~~ with and without ~~node~~nodes, ~~respectively having~~ with a nominal diameter of 7, 8, and 9 cm, were tested under ~~four~~ four-point bending loading. The specimens' details ~~of the specimens~~ are ~~indicated~~ shown in Figure ~~2 and~~ 2, while the properties ~~of the specimens~~ are listed in Table 1~~.~~.

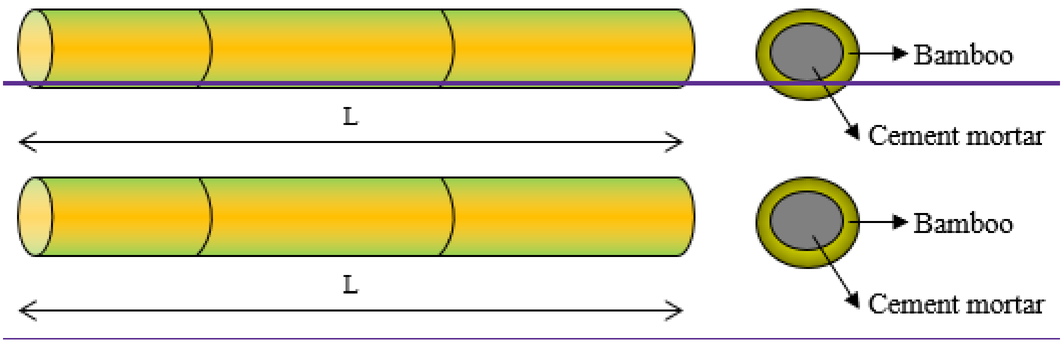


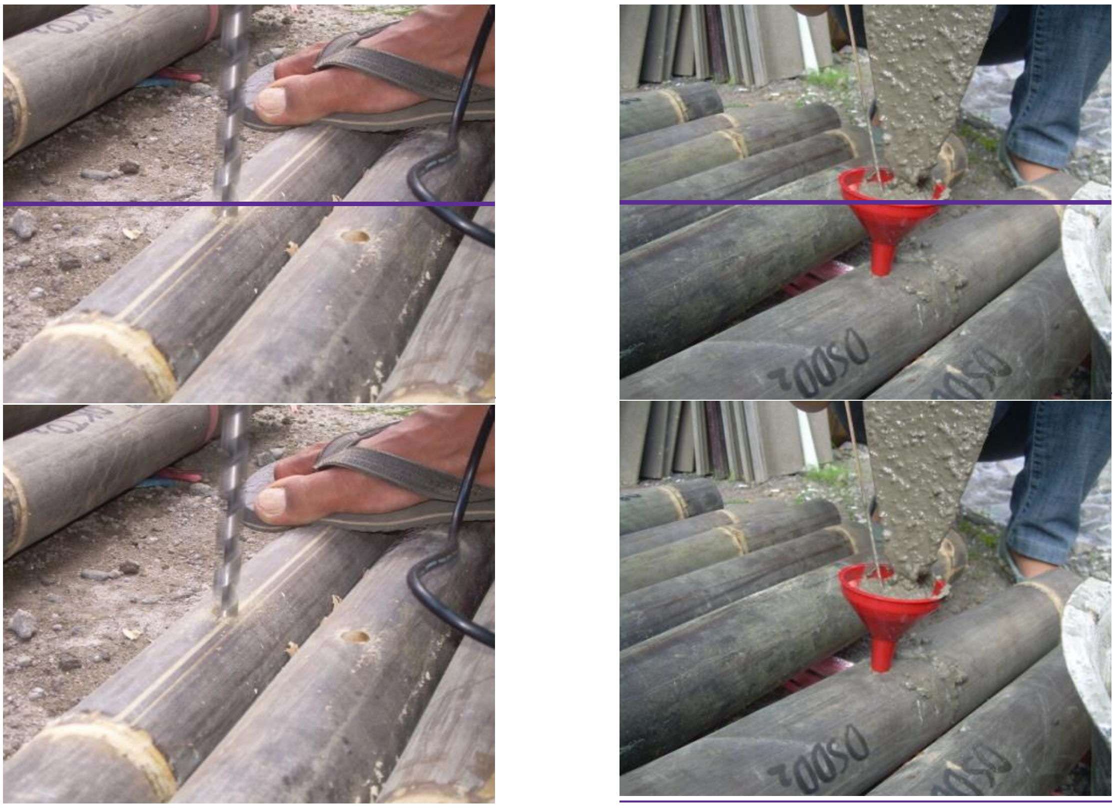
Figure 1~~.~~: Details of test specimens

Table 1~~.~~: Properties of specimens

Specimen	L (mm)	D (mm)	Material infilled	Node
SB-01	1350	70	-	without
SB-02	1350	70	-	with
SB-03	1350	70	Cement mortar	without
SB-04	1350	70	Cement mortar	with
SB-05	1350	80	-	without
SB-06	1350	80	-	with
SB-07	1350	80	Cement mortar	without
SB-08	1350	80	Cement mortar	with
SB-09	1350	90	-	without
SB-10	1350	90	-	with
SB-11	1350	90	Cement mortar	without
SB-12	1350	90	Cement mortar	with

Since Java Black bamboo ~~(Gigantochloa atroviolacea)~~ is a suitable material for furniture and interior ~~artefacts~~ artifacts The structural material used in this study is Java Black bamboo, also known as Gigantochloa atroviolacea, due to its suitability and use in furniture and interior artifacts (Khotimah & Sutiyono 2015)~~, Java Black bamboo was selected as structural bamboo in this study~~. In addition, cement mortar was selected as the infilled ~~materials in this study~~ material due to ~~that it serve~~ its ability to be used as ~~conventional~~ construction materials ~~under compression and it~~ that is compressible and compatible with bamboo. ~~As well as the bamboo diameter, the~~ The bamboo diameter and node ~~as a~~ are key ~~component of bamboo may~~ components that infl~~uence~~ uences the flexural load ~~behavior~~ of structural bamboo filled with ~~cement mortar~~cement. ~~Thus~~Therefore, this study also examined the ~~effect~~ attributes of the ~~bamboo diameter and~~ bamboo's node ~~was investigated in this study~~and diameter.

~~As listed in~~ Table ~~1,~~ 1 shows that the clear span of each test specimen (L) was 1300 mm~~.~~ ~~According to different~~ , which are classified into three groups in accordance with the external diameters (D)~~, all the~~ . These groups are as follows: specimens ~~can be classified into three groups: Specimens~~ SB-01–SB-~~04 are with the external diameter of 70 mm~~04, ~~specimens~~ SB-05–SB-~~08 are with the external diameter of 80 mm while specimens~~ 08, and SB-9–~~SB12 are~~ SB12, with ~~the~~ external ~~diameter~~ diameters of ~~90 mm~~70mm, 80mm, and 90mm. ~~The~~ Furthermore, the bamboo ~~culms~~ used ~~in~~ for the ~~test~~ analysis were ~~selected~~ carefully picked from the ~~same batch of~~ 3 year old Java Blac bamboo stems, ~~which were~~ that are 4 m in ~~length and of 3 years of age~~length, in order to ensure the ~~accuracy of the dimensions of~~ specimens have the ~~specimens~~right dimensions. ~~Furthermore, all~~ All the bamboo culms ~~used~~ utilized in this ~~study~~ research were ~~air~~ dried for 3 months to ~~ensure that the~~ obtain a moisture content ~~of bamboo~~ that is ~~less than~~ below 10%. Specimens SB-02, SB-04, SB-06, SB-08, SB-~~10~~ 10, and SB-12 were arranged at night with a bamboo ~~node at midheight~~ while ~~the other specimens~~ others were without the node. For ~~the specimens~~ those with ~~the node~~nodes, the traversal diaphragm ~~at the node~~ was ~~weakened~~ made weak by drilling a hole before casting cement ~~mortar~~ into the cavity, as shown in ~~bamboo cavity (~~Figure 2~~), which can bring convenience in casting cement mortar in bamboo cavity~~. ~~In addition~~Furthermore, the ~~mortar-filled bamboo specimens~~ mortar and cement ~~mortar~~ specimens were cured ~~for~~ and tested after 28 ~~days before they were tested.~~days.

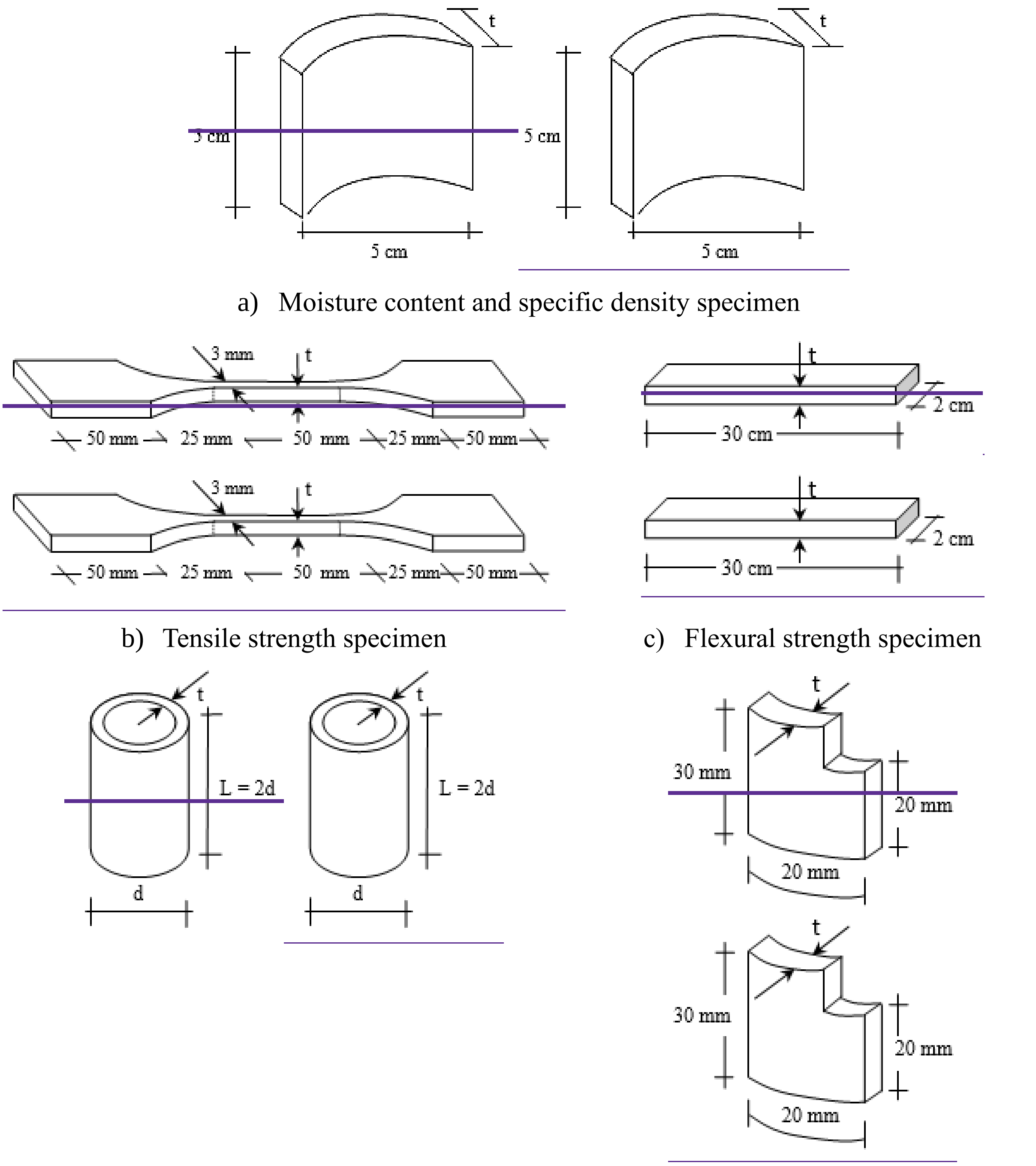


a) Drilling a hole b) Pouring cement mortar

Figure 2. Casting process

Material Properties

Six plain cement mortar cubes ~~(~~with dimensions of 50 × 50 × 50 mm~~)~~ were ~~prepared~~ analyzed and tested ~~in compression~~ to determine ~~the cement mortar~~ their properties~~. The~~, which indicated an average cube strength of ~~cement mortar~~ (f'_m) ~~was~~ 26.77 MPa. ~~Meanwhile, bamboo is an orthotropic material with high strength in the direction parallel~~ According to ~~the fibres and low strength perpendicular to the fibres respectively (Ghavami~~ Ghavami (2005~~;~~), García et al. (2012~~;~~), Sharma et al. (2013~~;~~), Lee et al. (2014~~;~~), and Moran et al. (2017), bamboo is a material with significant and low strength in the parallel and perpendicular direction to the fibres, respectively. Furthermore, ~~the~~ bamboo's compressive strength ~~of bamboo~~ in the cylindrical section is ~~much~~ lower than ~~its~~ the tensile strength (Dixon et al. 2015; Lo et al. 2008; Ghavami 1995). ~~To~~ Therefore, to obtain the material ~~properties of bamboo~~properties, specific density (SD), moisture content (MC), ~~specific density (SD),~~ tension, compression, flexural, ~~compression~~tests, ~~shear~~ and ~~tests~~ shear were ~~conducted~~ carried out with the ~~specimens used are depicted~~ specimens, as shown in Figure 3.



a) Moisture content and specific density specimen

b) Tensile strength specimen

c) Flexural strength specimen

d) Compressive strength specimen

e) Shear strength specimen

Figure 3~~.~~: Detail specimens for material properties of bamboo

~~By measuring the moisture content of chosen bamboo culms for the development of mortar-filled bamboo specimens, a~~ A preliminary estimation of the ~~required~~ needed time is required to ~~achieve~~ obtain a ~~certain~~ suitable MC percentage ~~suitable~~ for raw processing ~~of the raw bamboo~~ and fabrication of ~~the specimens became possible~~specimens. ~~It was observed that the~~ The average MC of Java Black bamboo selected for this study was 7.28%~~. This result was~~ , which is in line with the ~~previous~~ study conducted by Javadian et al. (2020~~) that conclude~~). According to Javadina, the average MC ~~of~~ used for processing the ~~raw~~ bamboo ~~culms selected for processing should fall below~~ needs to be less than 10% in order to reduce ~~the effect of~~ excessive delamination ~~or~~ as well as long-term environmental negative impacts ~~through~~ due to the degradation of the final composite product~~.~~

~~The average SD for Java Black bamboo used for this study was 0.572. Generally, bamboo culms have higher fiber density at top parts where the fibers are closely packed as has been shown by other studies on microstructure of bamboo culm of different species (~~.

According to Alvin & Murphy (1988~~;~~) and Ray et al. (2004~~)~~) bamboo has more significant fiber density at topmost parts because it is closely packed. ~~As a result~~Therefore, the average SD ~~will be lower in~~ for Java Black bamboo used for this study is 0.572 below the bottom parts and where the ~~culm~~ clum diameter and wall thickness are ~~much greater as compared to~~ more significant than the middle and top parts. ~~Moreover~~In addition, the ~~results of the~~ tensile strength and modulus of elasticity results in the tension tests of the Java Black bamboo samples along the fiber direction were 114.27 and 3682.20 MPa, respectively. ~~The~~ According to Javadian et al. (2020), bamboo's high tensile capacity ~~of bamboo~~ is ~~largely~~ significantly influenced by the ~~tensile capacity of the~~ cellulose fi~~bers within the natural hierarchical structure of bamboo, and this is also true for the modulus of elasticity of the~~

~~bamboo (Javadian et al. 2020)~~bers.

The ~~results of the~~ compression and shear tests results of the Java Black bamboo in this study were 44.65 and 8.50 MPa, respectively. ~~In addition~~Meanwhile, the ~~results of the~~ flexural and modulus of elasticity results in flexure tests of the Java Black bamboo were 93.29 and 15.339 MPa, respectively. Cellulose fibers largely contribute to ~~high~~ the increase in mechanical properties of ~~natural~~ bamboo~~. The cellulose fiber density~~ , which is ~~higher at~~ greater than the wall sections' outer layer ~~of the wall sections~~ and ~~at~~ above the ~~top portions of the~~ culms. ~~Therefore, according to~~ Javadian et al. (2020)~~,~~) stated that the ~~flexural strength or~~ Modulus of Rupture (MOR) or flexural strength increases with ~~increasing~~ a rise in fiber ~~content~~ and ~~decreasing~~ decreases the lignin content ~~at~~ in the ~~surroundings of the fibers~~surroundings. ~~Moreover,~~ Javadian et al. (2020) further stated that the ~~effect~~ effect of the culm ~~diameter~~ on the modulus ~~of elasticity in flexure~~ is similar to MOR~~. With increasing~~ , which tends to increase the culm ~~diameterthe~~ diameter with a decrease in average ~~modulus of elasticity decreases~~modulus. This observation ~~can be attributed~~ is due to the culm ~~hierarchical~~ sequential microstructure~~. With increasing culm diameter~~, ~~mainly~~ which increases at the middle and bottom ~~and middl~~ sections of the bamboo. Furthermore, the fiber density ~~decreases~~ tends to decrease due to the ~~highelignin content as compared with the fiber~~ high lignin content.

Instrumentation and Testing

~~A~~ Figure 4 shows a dial ~~gauge~~ gauge's installation process placed in the ~~mid~~ mid-span and bottom of each mortar-filled bamboo specimen ~~as shown~~ in ~~Figure 4 was installed in the bottom of the specimen~~ order to monitor the flexural deformation. ~~All~~ Furthermore, the specimens were ~~tested~~ examined under a 10,000 KN Universal Loading Machine ~~with~~ and displacement control at a constant rate of 0.1 mm/~~min, aiming at a detailed observation of~~

min to provide the ~~course of~~ reason for failure. ~~All test~~ The tested data were ~~collected~~ also gathered with a data logger~~.~~.

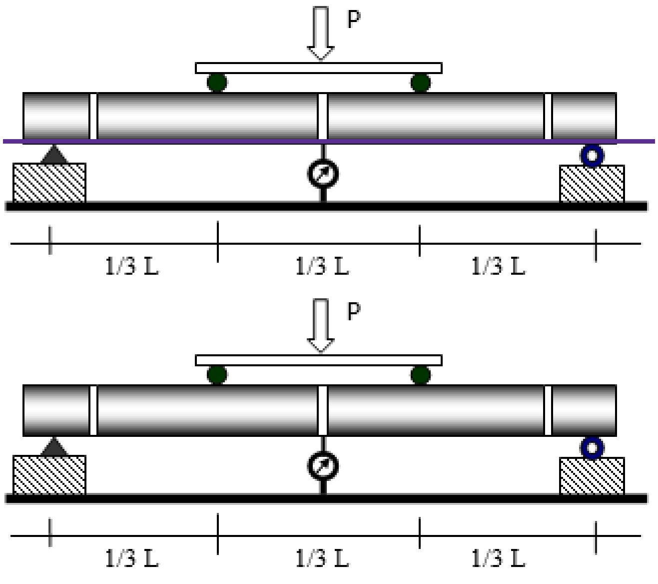


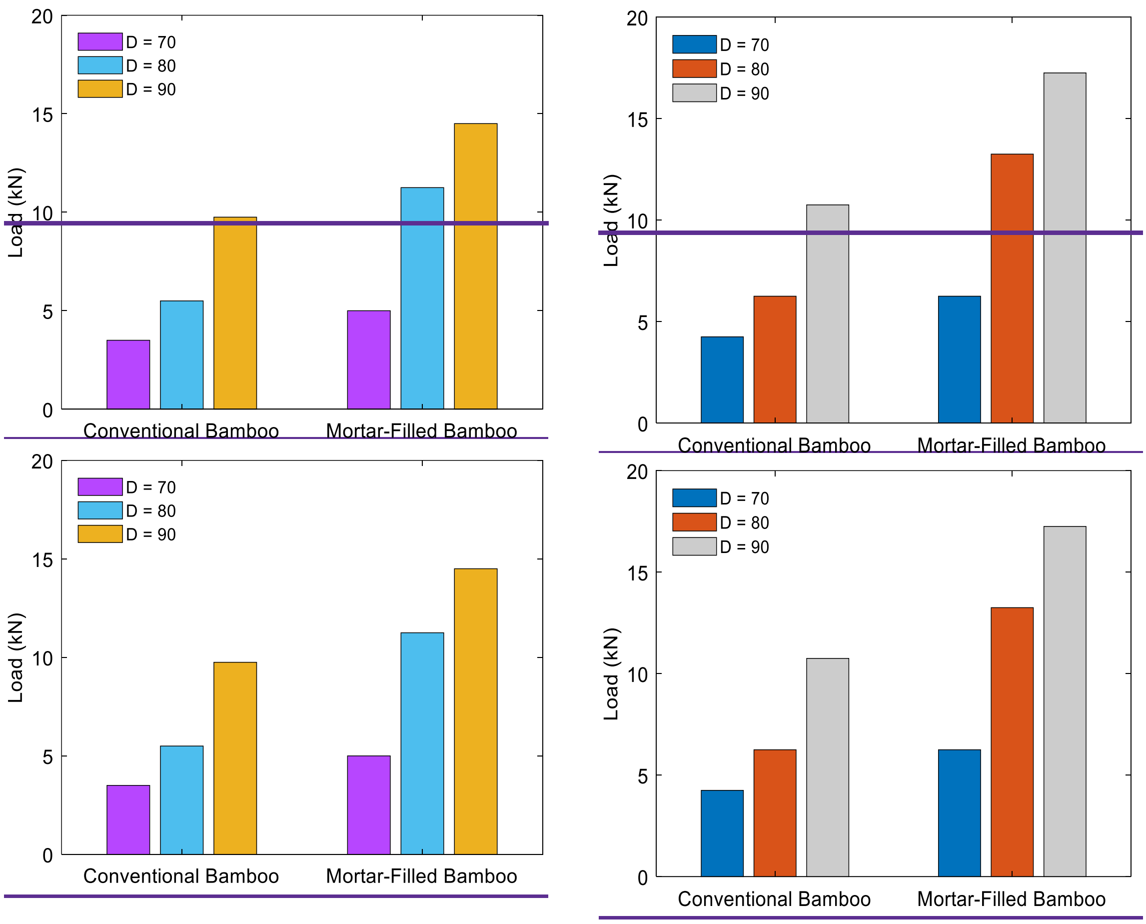
Figure 4~~.~~: Test setup and instrumentation

Results and Discussion

Effect of the Infilled Mortar

~~The effect of~~ Figure 5 shows the ~~infilled mortar~~ mortar's infilled effect on the flexural behavior of the specimens ~~is indicated in Figure 5. As shown in Figure 5,~~ with the ultimate flexural capacities of cement ~~mortar~~ filled bamboo ~~specimens are higher~~ was greater than ~~those of~~ the ~~conventional bamboo specimens~~conventional. ~~Specifically, mortar~~Mortar-infilled bamboo element with a ~~diameter of~~ 70 mm diameter was significantly ~~better,~~ better at 41.10 and 47.06%, ~~as~~ compared ~~than~~ to the conventional ~~bamboo~~ in terms of ~~its~~ flexural capacity (P_u) for specimen without and with node, respectively. ~~Increases~~ Furthermore, an increase in flexural strength were observed for the mortar-infilled bamboo element ~~having~~ with diameters of 80 and 90 mm diameter and ~~these~~ observed increases ~~were recorded as~~ of 104.~~55~~

~~and~~ 55/112.00%, and 48.~~72 and~~ 72/60.74%, ~~respectively~~ for specimen without and with node, as shown in Figure 2. This proves ~~that there is~~ a direct ~~relation~~ relationship between the mortar-infilled and the percentage increase in flexural capacity with ~~significat~~ a significant impact ~~both for~~ on a bamboo without and with node. ~~Mortar~~The mortar-infilled ~~causing enhancement in~~ enhances the flexural ~~capacity, attributed~~ capacity due to the ~~fact that the mortar-infilled results in an~~ increase in the ~~specimens'~~ specimens' moment of inertia~~, leading to higher flexural capacity of the mortar-infilled specimens.~~.



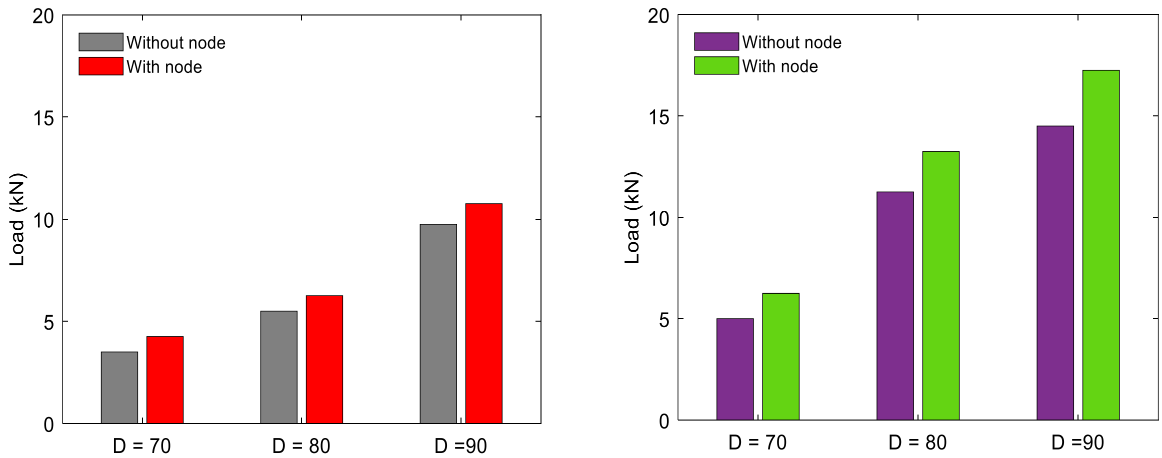
a) Specimen without node b) Specimen with node

Figure 5. Effect of the infilled mortar on the specimens' flexural capacity

Effect of Bamboo Diameter

This study also ~~explore how~~ explored the effect associated with the performance of mortar-infilled bamboo ~~elements is affected by the bamboo diameter.~~ elements, as shown in

Figure ~~6 shows the effect of bamboo diameter on the flexural load of the specimens~~6. The figure indicated that the specimen with a ~~diameter of~~ 70 mm diameter has the lowest flexural load ~~in comparation~~ compared to ~~the specimen~~ those with a diameter of 80 and 90 mm. ~~It can be indicated from~~ Figure 6 also showed that the increase in the conventional bamboo's flexural load ~~of the conventional bamboo~~ with a diameter of 80 and 90 mm ~~was~~ were 57.14 and 178.57~~% for the specimen without node~~%, respectively, ~~over the conventional bamboo~~ with a diameter of 70 mm. ~~Furhermore, for~~ Furthermore, the specimen with ~~node, the increase~~ a node increased in the conventional bamboo's flexural load ~~of the conventional bamboo~~ with a diameter of 80 and 90 mm ~~was~~ by 47.06 and 152.94% ~~over the conventional bamboo~~ with a diameter of 70 mm, respectively. ~~It also can be observed from~~ Figure 6 also showed that the increase in the ~~flexural load of the~~ mortar-infilled ~~bamboo~~ bamboo's flexural load with a diameter of 80 and 90 mm was 125 and 190% for the specimen without node~~, respectively~~, ~~over the mortar-infilled bamboo~~ with a diameter of 70 mm. In addition, for the specimen with a node, the increase in the flexural load of the mortar-infilled bamboo with a diameter of 80 and 90 mm was 112 and 176% over ~~the mortar-infilled bamboo with~~ a diameter of 70 mm~~, respectively~~. These ~~important~~ essential findings ~~above should~~ need to be ~~carefully~~ taken into account ~~in~~ to design the ~~design of~~ structural elements for ~~both~~ conventional bamboo ~~members~~ and those ~~filled~~ with cement mortar.

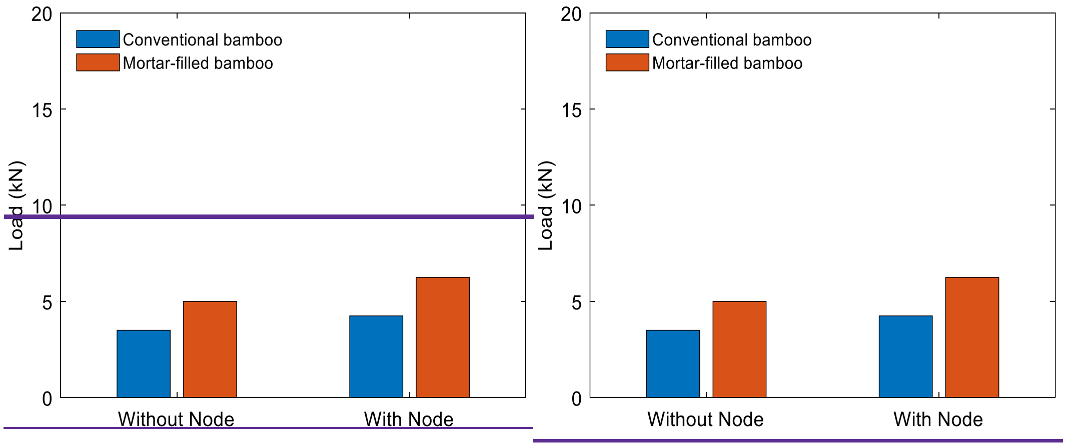


a) Specimen bamboo conventional b) Specimen mortar-infilled bamboo

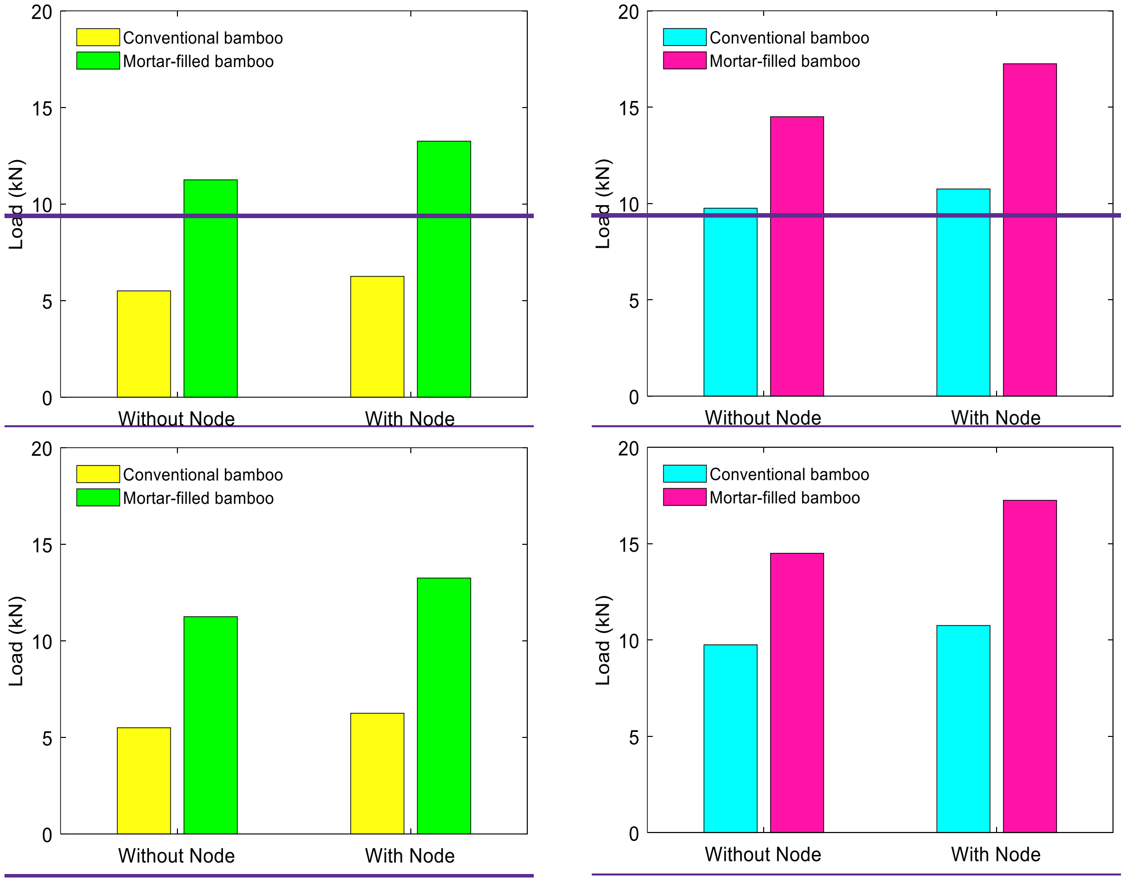
Figure 6~~.~~: Effect of the bamboo diameter on specimens' flexural load

Effect of Bamboo Node

~~The effect of~~ Figure 7 shows that the bamboo ~~node~~ node's beneficial effect on the flexural load of the specimens ~~is shown in Figure 7. As shown in Figure 7, the beneficial effect of the node on the ultimate flexural capacity~~ can be found in both conventional ~~bamboo specimens~~ and cement ~~mortar~~ filled ~~bamboo specimens~~bamboo. The ~~ultimate~~ flexural ~~capacities of~~ specimens with the bamboo node are ~~higher than those without the node~~more significant. ~~In particular,~~ This was peculiar to conventional bamboo element with ~~node was~~ nodes meaningfully ~~higher,~~ higher by 21.43, 13.~~64~~ 64, and 10.26%, ~~as~~ compared ~~than the conventional bamboo in regards of its~~ to those with flexural capacity (P_u) for specimen having a diameter of 70, ~~80~~ 80, and 90 mm, respectively. ~~Increases~~ These increases in flexural strength were ~~indicated for~~ due to the mortar-infilled bamboo with a rise in the node ~~these observed increases were noted as~~ by 25.00, 17.78 and 18.97%, ~~respectively~~ for ~~specimen having diameter~~ specimens with diameters of 70, 80 and 90 mm, as shown in Figure 7. ~~This~~ These results ~~are indicating~~ illustrate that the node's integrity ~~of the node~~ is ~~essential~~ imperative for the flexural capacities ~~both of~~ of conventional and mortar-filled bamboo elements~~.~~.



a) Specimen D = 70 mm



b) Specimen D = 80 mm

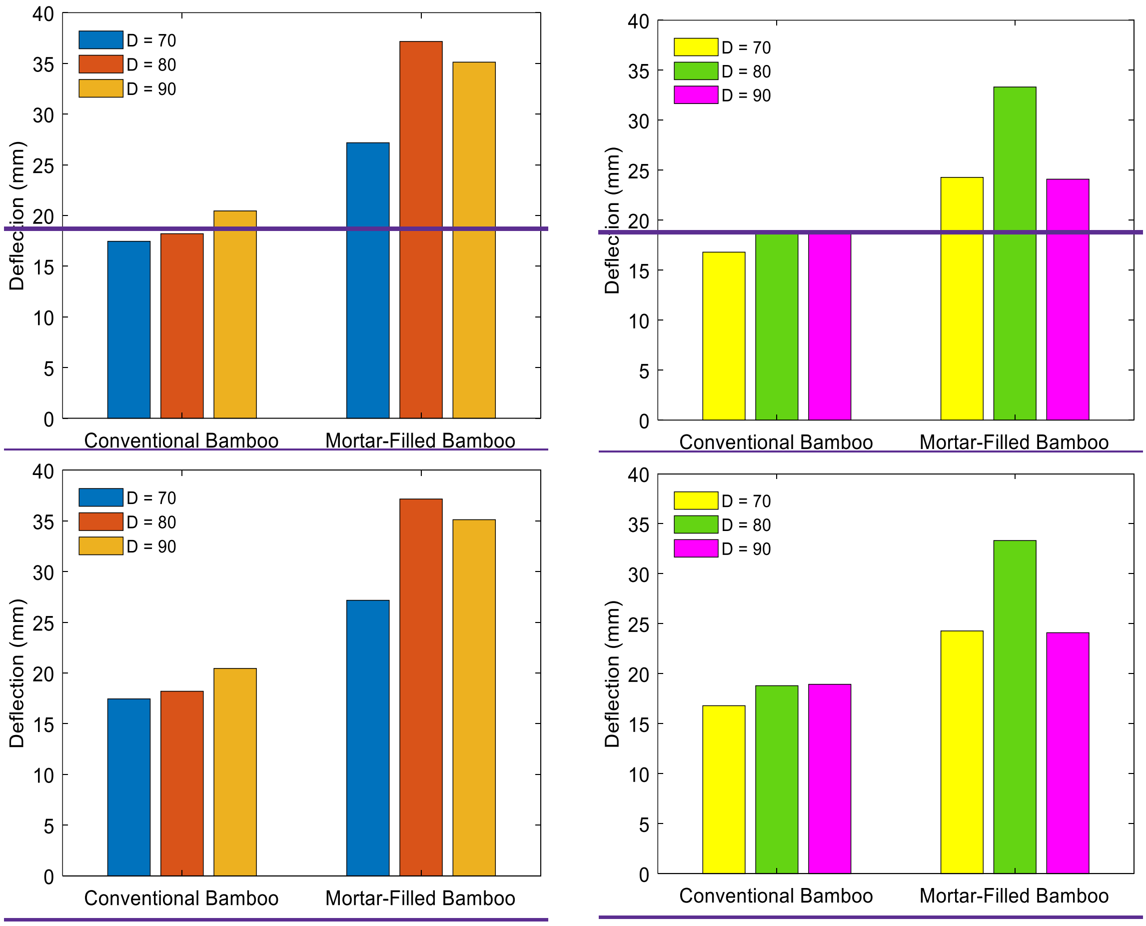
c) Specimen D = 90 mm

Figure 7~~.~~: Effect of the bamboo node on the specimens' flexural capacity

Deflection of Structural Bamboo Filled with Cement Mortar

Figure 8 shows the deflection value for all ~~types specimens~~ specimen types, including conventional ~~bamboo~~ and mortar-filled bamboo elements. ~~It can be indicated from Figure 8~~ Furthermore, the figure indicates that the deflection ~~value~~ values of cement mortar filled with bamboo specimens are ~~higher~~ more significant than ~~those of~~ the ~~conventional bamboo specimens~~conventional. ~~Particularly,~~ The mortar-infilled bamboo element with a ~~diameter of~~ 70 mm diameter was significantly greater, by 55.70 and 44.51%, ~~as~~ compared ~~than~~ to the conventional bamboo in terms of ~~its~~ specimen deflection ~~for specimen~~ without and with node, respectively. ~~Increases~~ Furthermore, an increase in the deflection value ~~were~~ was observed for the mortar-infilled bamboo element having 80 and 90 mm ~~diameter and these observed increases were recorded as~~ diameter, which increased by 104.18 and 110.86~~%,~~ % and 71.74 and 27.24.74%, respectively for specimen without and with node, as shown in Figure 8. ~~This~~

~~proves that there is~~ Therefore, this indicates a direct ~~relation~~ relationship between the mortar-infilled ~~and the~~ with a percentage increase in deflection value ~~with substantial impact both~~ for bamboo without and with node. ~~Mortar~~According to Plewes and Garden (1964), mortar-infilled causing enhancement in deflection ~~value,~~ value is attributed to the fact that the ~~mortar-infilled~~ results ~~in a~~ change ~~of~~ the specimens' physical ~~form of the specimens that has considerable influence on the total deflection to be expected (Plewes and Garden 1964).~~ form.



a) Specimen without node b) Specimen with node

Figure 5. Deflection value

Conclusions

This ~~paper has presented the experimental study on~~ research examined the flexural performance of structural bamboo filled with ~~cement mortar~~cement. ~~A~~ The study was carried out by testing a total of 12 specimens ~~were tested~~ under ~~four~~ four-point beding ~~protocol~~

protocols to ascertain the ~~effects~~ aftermath of the infilled materials, ~~the~~ bamboo ~~diameter and~~ diameter, as well as the ~~bamboo~~ node on the deflection and flexural load ~~and deflection behavior~~ of the specimens. ~~Based on the experimental results and discussions presented in this paper~~Therefore, the following conclusions ~~can be drawn~~were made.

(1) The flexural load capacities of cement ~~mortar~~ filled bamboo ~~elements~~ are ~~much higher~~ greater than ~~those of~~ their conventional ~~bamboo~~counterpart, which verified the feasibility of the proposed stiffening scheme for conventional structural bamboo. ~~Furthermore~~In addition, it is ~~reasonably~~ efficient to increase the flexural load by filling cement mortar.

(2) The experimental ~~ultimate~~ flexural capacities of conventional ~~bamboo elements~~ and cement ~~mortar~~ filled bamboo elements ~~are generally increase~~ tend to rise with an increase in ~~bamboo~~ diameter. ~~Hence~~Therefore, the bamboo diameter is significant and cannot be ignored.

(3) The ~~beneficial~~ effect of the node on the ultimate flexural capacity ~~can be found~~ is present in both conventional bamboo elements and cement ~~mortar filled bamboo elements~~filled, thereby indicating that the bamboo node's integrity ~~of the bamboo node~~ is essential for ~~the~~ their flexural ~~capacities of mortar filled bamboo elements and conventional bamboo elements~~capacities.

(4) The deflection of cement mortar filled bamboo elements ~~are substantially~~ is significantly greater than those of ~~conventional bamboo~~conventional. This is attributed to the fact that the mortar-infilled ~~results in a~~ bamboos change ~~of~~ the physical form of the specimens that ~~has considerable~~ influence ~~on~~ the total ~~deflection to be expected~~deflection.

Acknowledgment

The authors are grateful to the Jenderal Soedirman University, ~~Indonesia~~ Indonesia, for funding this research. ~~Assistance~~ The authors are also grateful for the assistance provided by Fidia Rahmawati ~~for~~ in performing different ~~tests is also acknowledged.~~tests.

2. Submitted to the journal “Jurnal Teknologi” (22 November 2020)

- Submission Acknowledgement from the Editor in Chief

[Jurnal Teknologi] Submission Acknowledgement "Flexural Load and Deflection Behavior of Structural Bamboo Filled with Cement Mortar"

Yahoo/Inbox

Editor-in-Chief <journal_utm@utm.my>
To: Yanuar Haryanto

Sun, Nov 22, 2020 at 1:37 AM

Dear Yanuar Haryanto:

2. Thank you for submitting the manuscript, "**Flexural Load and Deflection Behavior of Structural Bamboo Filled with Cement Mortar**" to Jurnal Teknologi. With the online journal management system that we are using, you will be able to track its progress through the editorial process by logging in to the journal web site:

Â Â Manuscript URL: https://journals.utm.my/jurnalteknologi/authorDashboard/submission/16319
Â Â Username: **yanuar1701**

3. As stated in the Author Guidelines; all articles that have been chosen to be published in Jurnal Teknologi will be charged Malaysian Ringgit 530.00 per article. All payments should be madeÂ **after receiving our official invoice**. We will not be responsible for payments made prior to that.

4. Your submitted article will undergo several repetitive reviewing processes. If you have any questions, please contact **me** or email to **journal_utm@utm.my**.

Thank you for considering this journal as a venue for your work.

Warm regards;
Editor-in-Chief

[Jurnal Teknologi] Submission ORCID

Yahoo/Inbox

Editor-in-Chief <journal_utm@utm.my>
To: Gathot Heri Sudibyo

Tue, Apr 20, 2021 at 4:28 PM

Dear Gathot Heri Sudibyo,

You have been listed as an author on a manuscript submission to Jurnal Teknologi.
To confirm your authorship, please add your ORCID id to this submission by visiting the link provided below.

Register or connect your ORCID iD

More information about ORCID at Jurnal Teknologi

If you have any questions, please contact me.

Editor-in-Chief

Jurnal Teknologi, Penerbit UTM Press
Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia
https://journals.utm.my/jurnalteknologi
Email: journal_utm@utm.my

3. First decision: Revised required (23 Februari 2021)

- Reviewers’ comments

Prof. Dr. Norhazilan Md Noor <journal_utm@utm.my> Tue, Feb 23, 2021 at 1:28 PM
To: Yanuar Haryanto, Gathot Heri Sudibyo, Nor Intang Setyo Hermanto, Hsuan-Teh Hu, Laurencius Nugroho and 1 more...

Dear Yanuar Haryanto, Gathot Heri Sudibyo, Nor Intang Setyo Hermanto, Hsuan-Teh Hu, Laurencius Nugroho, Bagyo Mulyono:

We have reached a decision regarding your submission to Jurnal Teknologi, "**Flexural Load and Deflection Behavior of Structural Bamboo Filled with Cement Mortar**".

Our decision is: REVISION REQUIRED
----

2. Reviewers have now commented on your paper. You will see that they are advising you to revise your manuscript. If you are prepared to undertake the work required, I would be pleased to consider your article for publication.

3. For your guidance, reviewers' comments are attached.

4. Please be advised all articles that have been chosen to be published in Jurnal Teknologi will be charged MYR 530.00. Should you agree to this term, please submit the following items within three (3) weeks through the system and through email journal_utm@utm.my and qpenerbit@utm.my:

a) **Revised Manuscript**.
b) **List of CORRECTIONS DONE**.
and
c) Filled document "**JT Invoice Request and Payment Instructions REGULAR ISSUE**" to enable us prepare a formal invoice for payment purpose.

We look forward for your favourable reply. Thank you.

Yours sincerely;

**Prof. Dr. Norhazilan Md Noor
Universiti Teknologi Malaysia, Malaysia
norhazilan@utm.my**

https://journals.utm.my/index.php/jurnalteknologi/

Reviewer A:
Recommendation: Revisions Required

Referee's comments

1. Abstract does not summarize the result briefly.
2. Please explain in detail about the required physical and mechanical properties on the material used. as conoh, percentage of moisture content, accpectable bamboo defect and etc.
3. Provide standards used for sample perparation and lab test.
4. Do provide detailed tabulate test results on both mechanical and physical properties.
5. Simplified the provided table into one or two specific graph.

A. EvaluationsPlease evaluate the paper according to the following criteria. Check the item if you agree to the statement:

- The work presented in the manuscript is original
- The manuscript uses appropriate language and styles
- The title of the manuscript is appropriate
- The problem described in the manuscript is clearly stated
- The manuscript is free from obvious errors
- The manuscript does not dwell on any sensitive issues

B. Suggestions to the author(s)What can the author(s) do to improve the quality of this paper?

Refer to referee's comment section.

Reviewer B:
Recommendation: Revisions Required

Referee's comments

Experimental Program:
- How many nodes in each specimen?
- What is the distance between the bamboo node's?
- What is the range of wall thickness (t)?

Results and Discussion
- Please explain more about Figure 8. How can the increase of bamboo diameter reduce deflection?

A. EvaluationsPlease evaluate the paper according to the following criteria. Check the item if you agree to the statement:

- The topic is important and relevant for publication
- The work presented in the manuscript is original
- The manuscript uses sufficient references
- The manuscript uses appropriate language and styles
- The title of the manuscript is appropriate
- The order of the presentation is satisfactory
- The introduction is adequately developed
- The adopted methodology described in the manuscript is sound
- The manuscript does not dwell on any sensitive issues

B. Suggestions to the author(s)What can the author(s) do to improve the quality of this paper?

- For abstract and conclusion, please add the results (How many percent is the increase for each variable?)
- Put a summary table for test result in the Result and Discussion
- Add a figure of specimen state at the end/failure state (for every specimen)
- Add load-displacement responses of all test specimens

Reviewer C:
Recommendation: Revisions Required

Referee's commentsA. EvaluationsPlease evaluate the paper according to the following criteria. Check the item if you agree to the statement:

- The topic is important and relevant for publication
- The work presented in the manuscript is original
- The manuscript uses sufficient references
- The manuscript uses appropriate language and styles
- The title of the manuscript is appropriate
- The abstract adequately summarizes the content of the manuscript
- The quality of figures and illustrations is acceptable for publications

B. Suggestions to the author(s)What can the author(s) do to improve the quality of this paper?

1. The Authors should consider the corrections written on the Manuscript.
2. The methods should be better expatiated.
3. The Authors can consider reporting the effect on the compressive strength of the timber since it was considered as another area of weakness (though this is debatable).

----

4. Manuscript resubmission (31 Maret 2021)

- Response to reviewers

LR **Yanuar Haryanto** <yanuar_haryanto@yahoo.com> Wed, Mar 31, 2021 at 12:52 PM
To: Prof. Dr. Norhazilan Md Noor
Cc: Gathot Sudibyo, Laurencius Nugroho

Dear Prof. Dr. Norhazilan Md Noor,

The revision of this paper has been completed. The valuable suggestions from the reviewers are greatly appreciated. We have made the necessary amendments to incorporate the comments raised by the reviewers to the revised paper.

Since we don't currently have access to the stage of the revision workflow in the submission system (please kindly find the screenshot in the attachment), the revised paper together with "authors' response to reviewer" outlining each change made (point by point) as raised in the reviewer comments are only attached in this email. Moreover, the revised paper has also been checked and corrected by professional native speaker proofreader to improve its readability.

We are looking to hearing from you in the near future.

Yanuar Haryanto
Ph.D Student
Computer Aided Structural Analysis Laboratory
Department of Civil Engineering
National Cheng Kung University
Taiwan (R.O.C)
https://www.scopus.com/authid/detail.uri?authorId=57170836900

Manuscript 16319
Response to Reviewers

Dear Professor Dr. Norhazilan Md Noor,

Thank you for giving us the opportunity to submit a revised draft of the manuscript "Flexural Load and Deflection Behavior of Structural Bamboo Filled with Cement Mortar" for publication in the *Jurnal Teknologi (Sciences & Engineering)*. We appreciate the time and effort that you and the reviewers dedicated to providing feedback on our manuscript and are grateful for the insightful comments on and valuable improvements to our paper. We have incorporated most of the suggestions made by the reviewers. Those changes are highlighted within the manuscript in red colored texts. Please see below for a point-by-point response to the reviewers' comments and concerns.

Reviewers' Comments to the Authors

A. Reviewer A

1. **Comment from Reviewer A:** Abstract does not summarize the result briefly.

   Author(s) response: We would like to thank the reviewer's suggestions. We have modified the abstract to address the comment raised by the reviewer. The revised text reads as follow:

   Bamboo has been significantly and rapidly used to build temporal and permanent structures since time immemorial. However, this renewable natural material has a low bearing capacity, limiting its application to structures under light loads. Therefore, this research was carried out to determine an innovative scheme capable of enhancing bamboo's load-bearing by filling the cavity with cement mortar. Furthermore, a study was carried out to experiment flexural load carrying capacity and the deflection of mortar-filled structural bamboo by considering the diameter and node parameters. A total of 12 specimens were examined using a four-point bending protocol. The result showed the ultimate flexural load carrying capacity of mortar-filled bamboo specimens are higher than those of the conventional bamboo specimens. Specifically, mortar filled bamboo specimen with a diameter of 70 mm was significantly better, 41.10 and 47.06%, as compared than the conventional bamboo in terms of its flexural load carrying capacity for specimen without and with nodes, respectively. Increases in flexural load carrying capacity were also observed for the mortar-filled bamboo specimens having 80 and 90 mm diameter and these observed increases were recorded as 104.55 and 112.00%, and 48.72 and 60.74%, respectively for specimen without and with nodes. Furthermore, the deflection of mortar-filled bamboo elements are substantially greater than those of conventional. Finally, the advantages of the bamboo diameter and bamboo nodes on the flexural load carrying capacity indicated that these essential findings need to be carefully considered in designing structural elements for both mortar-filled and conventional bamboos.

2. **Comment from Reviewer A:** Please explain in detail about the required physical and mechanical properties on the material used. as conoh, percentage of moisture content, accpectable bamboo defect and etc.

   Author(s) response: Thank you for pointing this out. We have modified the explanation preliminary requirement of specimens of bamboo to address the comment raised by the reviewer. The revised text reads as follow:

Therefore, the preliminary tests of bamboo material in this research were conducted to determine the physical proprieties such as the moisture content (MC) and specific density (SD), and the mechanical properties such as compressive strength, tensile strength, shear strength, and flexural strength. Since there is a lack of standardization of culm bamboo material as a construction material due to large number of bamboo species and geometry, this study refer to ISO 3129-1974 [28], the wood international standard for sampling method requirement of physical and mechanical testing by used small specimens. The specimens used are depicted in Figure 3.

3. **Comment from Reviewer A:** Provide standards used for sample preparation and lab test.

   Author(s) response: Thank you for the reviewer's concern. We have added the explanation about the standard or procedure to conduct the preliminary test of bamboo material. The revised text reads as follow:

   Finally, Table 2 summarizes the physical and mechanical properties of Java Black bamboo used in this study in accordance with ASTM D143-94 [29].

4. **Comment from Reviewer A:** Do provide detailed tabulate test results on both mechanical and physical properties.

   Author(s) response: We appreciate the positive feedback from the reviewer. Accordingly, throughout the manuscript, we have provided the list of physical and mechanical properties into one table. Please kindly check Table 2 as follow:

***Table 2** Physical and mechanical properties material properties of bamboo*

Bamboo Properties	***Average Value***
Physical Properties	
Moisture content (%)	*7.28*
Specific Density (gr/cm^3)	*0.572*
Mechanical Properties	
Compressive strength parallel to grain $f_{c,0}$ (MPa)	*44.65*
Tensile strength parallel to grain $f_{t,0}$ (MPa)	*114.27*
Shear stress parallel to grain $f_{s,0}$ (MPa)	*8.50*
Flexural strength (MPa)	*93.29*
Modulus of Elasticity E_T (MPa)	*3682.20*
Modulus of Elasticity E_F (MPa)	*4733.82*

5. **Comment from Reviewer A:** Simplified the provided table into one or two specific graph.

   Author(s) response: We agree with the reviewer's assessment and thank you for the reviewer's concern. We have simplified the results into two graphs, which are the load and deflection value of the specimens. Hence, we have replaced Figure 5-7 into one Figure 5 and Figure 8 (a-c) to Figure 6. Please kindly check the revised figures as follow:

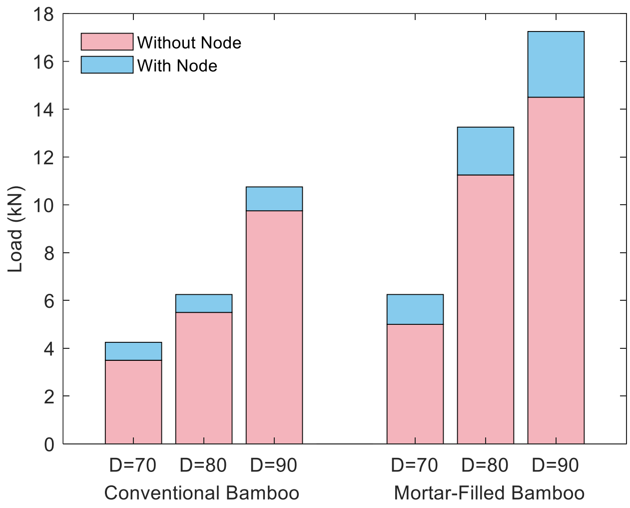


Figure 5 *Effect of the infilled mortar on the specimens' flexural capacity*

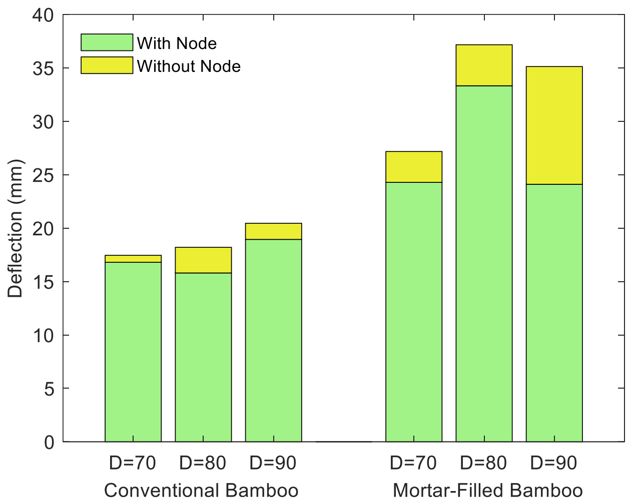


Figure 6 *Deflection value*

B. Reviewer B

1. **Comment from Reviewer B:** How many nodes in each specimen?

   Author(s) response: Thank you for pointing this out. We have modified the sentences to address the comment raised by the reviewer. The revised text reads as follow:

   Specimens SB-02, SB-04, SB-06, SB-08, SB-10, and SB-12 were arranged with five bamboo nodes while others were without the nodes. For those with nodes, the traversal diaphragm was drilled to make a hole before casting cement mortar into the cavity, as shown in Figure 2. Furthermore, the cement mortar specimens were cured by covering their surfaces with wet gunny bags, and tested after 28 days.

2. **Comment from Reviewer B:** What is the distance between the bamboo node's?

   Author(s) response: We appreciate the reviewer for helping us in improving this manuscript. Although we agree that this is an important consideration, the distance between the bamboo nodes cannot be informed in this manuscript because we were not measured in the experimental. However, we believe this study makes a valuable contribution to the field because it presents useful information for understanding an innovative scheme capable of enhancing bamboo's load-bearing by filling the cavity with cement mortar. As a potential limitation of the study, we have suggested that the distance between the bamboo nodes need to be further studied in the the future work. The sentences read as follows in point 3 of the conclusions:

The beneficial effect of the nodes on the flexural load carrying capacity is present in both conventional bamboo and mortar-filled bamboo elements, thereby indicating that the bamboo nodes' integrity is essential for their load carrying capacity. The distance between nodes need to be further considered in the future work.

3. **Comment from Reviewer B:** What is the range of wall thickness (t)?

   Author(s) response:

   Furthermore, the bamboo used for the test were carefully picked from the 3 year old Java Blac bamboo stems, that are 4 m in length and about 50-100 mm in wall thickness, in order to ensure the specimens have the right dimensions.

4. **Comment from Reviewer B:** Please explain more about Figure 8. How can the increase of bamboo diameter reduce deflection?

   Figure 6 shows the deflection value for all specimen types, including conventional and mortar-filled bamboo elements. Furthermore, the figure indicates that the deflection values of cement mortar-infilled bamboo specimens are more significant than the conventional. The mortar-infilled bamboo element with a 70 mm diameter was significantly greater, by 55.70 and 44.51%, compared to the conventional bamboo in terms of specimen deflection without and with nodes, respectively. An increase in the deflection value was aslo observed for the mortar-infilled bamboo element having 80 and 90 mm diameter, which increased by 104.18 and 110.86% and 71.74 and 27.24%, respectively for specimen without and with nodes. Therefore, this indicates a direct relationship between the mortar-infilled with a percentage increase in deflection value for bamboo without and with nodes. Mortar-infilled causing enhancement in deflection value, attributed to the fact that the mortar-infilled results in a change of the physical form of the specimens that has considerable influence on the total deflection to be expected [31]. Finally, the increase of bamboo diameter that provide additional stiffening enhances the resistance of the specimens to loading, leading to greater deflection in the specimens. Unfortunately, in some cases the benefit of this stiffening is unpredictable [31].

   Author(s) response:

5. **Comment from Reviewer B:** For abstract and conclusion, please add the results (How many percent is the increase for each variable?)

   Author(s) response: Thank you for the reviewer's concern. We have modified the abstract to address the comment raised by the reviewer. The revised text reads as follow:

   Bamboo has been significantly and rapidly used to build temporal and permanent structures since time immemorial. However, this renewable natural material has a low bearing capacity, limiting its application to structures under light loads. Therefore, this research was carried out to determine an innovative scheme capable of enhancing bamboo's load-

bearing by filling the cavity with cement mortar. Furthermore, a study was carried out to experiment flexural load carrying capacity and the deflection of mortar-filled structural bamboo by considering the diameter and node parameters. A total of 12 specimens were examined using a four-point bending protocol. The result showed the ultimate flexural load carrying capacity of mortar-filled bamboo specimens are higher than those of the conventional bamboo specimens. Specifically, mortar filled bamboo specimen with a diameter of 70 mm was significantly better, 41.10 and 47.06%, as compared than the conventional bamboo in terms of its flexural load carrying capacity for specimen without and with nodes, respectively. Increases in flexural load carrying capacity were also observed for the mortar-filled bamboo specimens having 80 and 90 mm diameter and these observed increases were recorded as 104.55 and 112.00%, and 48.72 and 60.74%, respectively for specimen without and with nodes. Furthermore, the deflection of mortar-filled bamboo elements are substantially greater than those of conventional. Finally, the advantages of the bamboo diameter and bamboo nodes on the flexural load carrying capacity indicated that these essential findings need to be carefully considered in designing structural elements for both mortar-filled and conventional bamboos.

We also have modified the conclusions to address the comment raised by the reviewer. The revised text reads as follow:

This research examined the flexural performance of structural bamboo filled with cement mortar. The study was carried out by testing a total of 12 specimens under four-point bending protocols to ascertain the aftermath of the infilled materials, bamboo diameter, as well as the nodes on the flexural load carrying capacity and deflection behavior of the specimens. Therefore, the following conclusions were made:

- *Mortar-infilled bamboo element with a diameter of 70 mm was significantly better, 41.10 and 47.06%, as compared than the conventional bamboo in terms of its flexural load carrying capacity for specimen without and with nodes, respectively. Increases in flexural load carrying capacity were also observed for mortar-infilled bamboo element having 80 and 90 mm diameter by 104.55 and 112.00%, and 48.72 and 60.74%, respectively for specimen without and with nodes. This finding verified the feasibility of the proposed stiffening scheme for conventional structural bamboo. In addition, it is efficient to increase the flexural load carrying capacity by filling cement mortar.*
- *The experimental flexural load carrying capacities of conventional and mortar-filled bamboo elements tend to rise with an increase in diameter. Therefore, the bamboo diameter is significant and cannot be ignored.*
- *The beneficial effect of the nodes on the flexural load carrying capacity is present in both conventional bamboo and mortar-filled bamboo elements, thereby indicating that the bamboo nodes' integrity is essential for their load carrying capacity. The distance between nodes need to be further considered in the future work.*
- *The deflection of mortar-filled bamboo elements is significantly greater than those of conventional bamboo. This is attributed to the fact that the mortar-infilled bamboos change the physical form of the specimens that influence the total deflection to be expected. Furtehermore, the increase of bamboo diameter that provide additional stiffening enhances the resistance of the specimens to loading, leading to greater deflection in the specimens. The load-displacement responses need to be further analyzed in the future study.*
- *After removing the covering bamboo, it was observed that infilled mortar were crushed, showing that the strength of infilled material was fully utilized.*

6. **Comment from Reviewer B:** Put a summary table for test result in the Result and Discussion.

Author(s) response: : We agree with the reviewer's assessment and thank you for the reviewer's concern. Accordingly, throughout the manuscript, we have added a summary table as suggested. Please kindly check Table 3 as follow:

This section thoroughly presents the observed and measured results for the flexural load carrying capacity and deflection behavior of the specimens due to the effect of infilled cement mortar, bamboo diameter, and bamboo nodes as listed in Table 3.

Table 3 Result of the maximum of flexural load and deflection

Specimen	Load (kN)	Deflection (mm)
SB-01	3.50	17.45
SB-02	4.25	16.80
SB-03	5.00	27.17
SB-04	6.25	15.48
SB-05	5.50	18.20
SB-06	6.25	15.80
SB-07	11.25	37.16
SB-08	13.25	33.32
SB-09	9.75	20.45
SB-10	10.75	18.94
SB-11	14.50	35.12
SB-12	17.25	24.10

7. **Comment from Reviewer B:** Add a figure of specimen state at the end/failure state (for every specimen).

Author(s) response: Thank you for the reviewer's concern. Although we agree that this is an important consideration, we have only added Section 3.5 (General Failure Modes) in this manuscript. The revised text reads as follow:

Failure modes in flexural elements are classified into two major types: flexural failure and shear failure. The former occurs when the imposed load exceeds the flexural capacity of the materials of the beam, while the latter occurs due to deficiency in shear resistance between different materials of the beam. In this study, the general failure trend in specimens with nodes present consistently originated from the node scar located at the tension side where the diaphragms were once present. Upon further loading, it initiated a lateral shearing failure while reaching its ultimate flrxufral load carrying capacity. Comparatively, for the specimens without nodes, the failure mode also showed a transverse failure no the tension side with some lateral shear. Furthermore, after removing the covering bamboo, it was observed that infilled mortar were crushed, showing that the strength of infilled material was fully utilized. The general failure modes of the specimens are illustrated in Figure 7.

(a)Failure due to flexural load

(b)In-illed mortar

Figure 7 General failure modes of the specimens

8. **Comment from Reviewer B:** Add load-displacement responses of all test specimens

   Author(s) response: We appreciate the positive feedback from the reviewer. Although we agree that this is an important consideration, the load-displacement responses cannot be added in this manuscript because we were only recorded the ultimate displacement in the experimental. Again, we believe this study will make a valuable contribution to the field because it presents useful information for understanding an innovative scheme capable of enhancing bamboo's load-bearing by filling the cavity with cement mortar. As a potential limitation of the study, we have suggested that the load-displacement responses need to be further studied in the the future work. The sentences read as follows in point 4 of the conclusions:

   The deflection of mortar-filled bamboo elements is significantly greater than those of conventional bamboo. This is attributed to the fact that the mortar-infilled bamboos change the physical form of the specimens that influence the total deflection to be expected. Furtehermore, the increase of bamboo diameter that provide additional stiffening enhances the resistance of the specimens to loading, leading to greater deflection in the specimens. The load-displacement responses need to be further analyzed in the future study.

C. Reviewer C

1. **Comment from Reviewer C:** The Authors should consider the corrections written on the Manuscript.

2. **Author(s) response:** We appreciate the reviewer for helping us in improving this manuscript. We have considered the corrections written on the manuscript. Furthermore, the revised paper has been checked and corrected by professional native speaker proofreader to improve its readability.

3. **Comment from Reviewer C:** The methods should be better expatiated.

   Author(s) response: We appreciate the positive feedback from the reviewer. Accordingly, throughout the manuscript, we have provided the methods, particularly regarding the focus of the study that was carried out to experiment flexural load carrying capacity and the deflection of mortar-filled structural bamboo by considering the diameter and node parameters. The text reads as follow:

   Figure 4 shows a dial gauge's installation process placed in the mid-span and bottom of each mortar-filled bamboo specimen in order to monitor the flexural deformation. Furthermore, the specimens were examined under a 10,000 KN Universal Loading Machine and displacement control at a constant rate of 0.1 mm/min to provide the deflection behavior. The tested data were also gathered with a data logger.

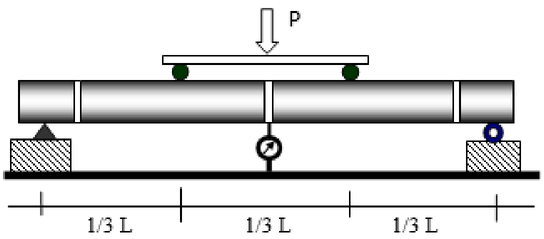


Figure 4 Test setup and instrumentation

4. **Comment from Reviewer C:** The Authors can consider reporting the effect on the compressive strength of the timber since it was considered as another area of weakness (though this is debatable).

   Author(s) response: Thank you for the reviewer's concern. Accordingly, throughout the manuscript, we have provided the list of physical and mechanical properties into one table, including compressive strength parallel to grain. Please kindly check Table 2 as follow:

***Table 2** Physical and mechanical properties material properties of bamboo*

Bamboo Properties	***Average Value***
Physical Properties	
Moisture content (%)	*7.28*
Specific Density (gr/cm^3)	*0.572*
Mechanical Properties	
Compressive strength parallel to grain $f_{c,0}$ (MPa)	*44.65*
Tensile strength parallel to grain $f_{t,0}$ (MPa)	*114.27*
Shear stress parallel to grain $f_{s,0}$ (MPa)	*8.50*
Flexural strength (MPa)	*93.29*
Modulus of Elasticity E_T (MPa)	*3682.20*
Modulus of Elasticity E_F (MPa)	*4733.82*

5. Paper accepted for publication (20 April 2021) - Editor Decision

Prof. Dr. Norhazilan Md Noor <journal_utm@utm.my> Tue, Apr 20, 2021 at 4:29 PM

To: Yanuar Haryanto, Gathot Heri Sudibyo, Nor Intang Setyo Hermanto, Hsuan-Teh Hu, Laurencius Nugroho and 1 more...

Dear Yanuar Haryanto, Gathot Heri Sudibyo, Nor Intang Setyo Hermanto, Hsuan-Teh Hu, Laurencius Nugroho, Bagyo Mulyono:

We have reached a decision regarding your submission to Jurnal Teknologi, "Flexural Load and Deflection Behavior of Structural Bamboo Filled with Cement Mortar".

CONGRATULATIONS!!

Your article has been queued for future publication of Jurnal Teknologi (Sciences and Engineering) **V**

Thank you.

Best regards;

**Prof. Dr. Norhazilan Md Noor
Universiti Teknologi Malaysia, Malaysia
norhazilan@utm.my**

Jurnal Teknologi Editorial Team
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6. Proof Correction (10 Juni 2021)

- Email to Editor in Chief

Yanuar Haryanto <yanuar_haryanto@yahoo.com>
To: UTM eJournals

Thu, Jun 10, 2021 at 1:30 PM

Dear Professor Dr. Rosli Md Illias,

Please find in the attachments the file of proof corrections as well as the separated word file provide the conclusions section that has been corrected as suggested. Thank you.

Sincerely yours,

Yanuar Haryanto
Ph.D Student
Computer Aided Structural Analysis Laboratory
Department of Civil Engineering
National Cheng Kung University
Taiwan (R.O.C)
https://www.scopus.com/authid/detail.uri?authorId=57170836900

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