

APPLICATION OF BAMBOO AS REINFORCEMENT IN CONCRETE SUBSTITUTE

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Abstract

The idea of the replacement of reinforced steel to bamboo in this research is to solve the problem raised from the usage of reinforced steel in construction's sector. The uneconomic reinforced steel's cost and the reducing quantity of its source are the problem that being situated in the research. The placing of bamboo in concrete structure is more economic compared to steel reinforcement as it is really helps in deducting the construction's cost. Bamboo can be replant and the source is easier to find compared to reinforced steel. Through the literature study, it is found that 'bamboo semantan' is the thickest and strongest compared to the others. Over the years, bamboo had well known as decoration materials, scaffoldings, fences, bridges, canoe, walking canes, roof, as well as furniture. This research is trying to prove that bamboo can replace the reinforced steel as the raw materials in construction industry. The significant of this final project is to benefit the plant which is high in strength such as bamboo as one of the raw materials using in construction industry. The usage of the bamboo is very effective to reduce the cost of using reinforced bar so as to invent a new environment structure.

INTRODUCTION

Bamboo is one of the oldest building materials used by mankind. For example, that we can use is bamboo culm, or stem that has been made into an extended diversity of products ranging from domestic household products to industrial applications. In addition, bamboo also used for food container, skewers, chopsticks, handicrafts, toys, furniture, flooring, pulp and paper, boats, charcoal, musical instruments, and weapons. In Asia, we can see that bamboo is quite common for bridges, scaffolding and housing. However, it is usually use for a temporary exterior structural material.

In many overly populated regions of the tropics, certain bamboo supplies the one suitable material that is sufficiently cheap and plentiful to meet the extensive need for economical housing. The most important for bamboo shoots is source of food, and a delicacy in Asia.

With the progress of science and technology has expanded and tight supply, new methods are required for bamboo processing. It as to make it more durable and easier to use in terms of building materials. Currently, we can see that many of the studies that have been done on the basic properties, and processing of bamboo into various types of composite products. in addition, a lot of research also are needed to help and encourage the application of the modern world. Some information on the basic properties of bamboo were documented. However, its properties particularly in relation to their applications as the raw material for composite products is very limited. Furthermore, bamboo is exploited in such a way that its full of potential is not being used. bamboo also as an alternative to the commonly used raw materials.

OBJECTIVE

1. To compare the strength of the bamboo and steel reinforce concrete. To identify the appropriate concrete mix for reinforce concrete.
2. To identifying the bamboo species suitable for the reinforce concrete.

PROBLEM STATEMENT

Problem statement that we review in this project is because high price of steel in the rising market. In addition, work of steel beam installation also requires more manpower than using bamboo. When by using the steel we require of 4 or 5 people in the course of the process. However, the others about if we use the bamboo instead of just need 2 or 3 people. Indirectly, we can save costs in terms of labour costs and material costs. As known, the time taken to make use steel reinforcement is also quite long compared to using the bamboo.

Among the advantages of bamboo that we can see in the bamboo is bamboos has high workability. Meanwhile, about a simple steel rust and require more perfectly care. Bamboo does not require grooming when the bamboo is already in the appropriate maturity. Furthermore, the natural resources steel decreases because a very high demand from the market.

SCOPE

1. Produce bamboo of reinforced concrete beams for low-cost housing.
2. Densify the types and methods of treatment to increase the strength of bamboo reinforcement.

LITERATURE REVIEW

The literature review is a discussion of published information through the particular subject area. However, not all information in a particular subject area in a certain time period. A summary of the literature review is also convenient source, but usually it has a pattern of organization and combines both summary and synthesis. In addition, these literature reviews is also recap the important information source or overhaul the information. Possible it was a new interpretation of old material or new combinations of a long interpretation. It was also possible to trace the intellectual development of the field, including major debates. The literature review also can evaluate the source depends on the situation.

Additionally, the study was research proposal and often chapter in theses and dissertations. Generally, the purpose of the literature review is to critically analyze the published segment of the body of knowledge through summary, classification, and comparison of previous research studies, literature reviews and theoretical articles. Revision may also form an important part of the research process as well as a research project in itself. Evaluation literature leads logically to the research question.

BAMBOO

According to the book titled *Building with Bamboo*, in this world there are about 600 species of bamboo and each of them have different attributes and criteria. In fact, for general knowledge, every single species of bamboo can be used for different purposes.

Furthermore, according to the national conferences, seminars bamboo of the 2nd drive towards strengthening the bamboo industry. Traditionally bamboo is a versatile plant that is closely related to the lives of Malaysians especially the rural folks. It is because bamboo is easily found, fast growth, high productivity and revenue collection of short round. In terms of uses and benefits we can get from this is as widespread as bamboo handicrafts, furniture to food to industrial products.

In terms of life expectancy of a reed can we learn from the book *New RHS Dictionary of Gardening*. According to A. Huxley in the book, is the scientific name of bamboo known as *Bamboos* is a plant that is abundant in ASEAN. Bamboo trees are also included in the category of plants able to survive for years.

Various types of bamboo can be found in Malaysia, in accordance the book- *India BIC Bulletin Kerala Forest Research Institute*, among which are:

- *Gigantochloa scortechini* (buluh semantan)
- *Gigantochloa levis* (buluh beting)
- *Gigantochloa ligulata* (buluh tumpat)
- *Gigantochloa wrayi* (buluh raga)
- *Bambusa heterostachya* (buluh galah)
- *Bambusa vulgaris* (buluh minyak)
- *Bambusa blumeana* (buluh duri)
- *Dendrocalamus asper* (buluh betung)
- *Dendrocalamus pendulus* (buluh akar)
- *Schizostachyum zollingeri* (buluh kasap)
- *Schizostachyum grande* (buluh semeliang)
- *Schizostachyum brachyladum* (buluh leman)

Bamboo Resources

According to the National Bamboo Seminar Conference of the 2nd entitled *Towards Enhancing Bamboo Industry*, there are 587 million in the area of bamboo forest reserve in Peninsular Malaysia. Meanwhile, a report from the national forest inventory-3 (1991-1993), estimated there were 82.2 million bamboo clump can produce 1.4 billion of bamboo measuring 6 meters in length (Figure 2.1). However, the production of bamboo forest reserves stood at 1.6, 2.1 and 2.4 million on each one for years 1991, 1992 and 1993. Bamboo resources is also commonly found in the state of Pahang, Perak, Kelantan, Kedah and Selangor. For the most widely produced bamboo is bamboo semantan (*gigantochloa scortechini*), about 70% of the output and the rest made up of *Dendrocalamus pendulus* (buluh tali), *Schizostachyum zollingeri* (buluh nipis), and *gigantochloa ligulata* (buluh tumpat)



Figure 1. Species Buluh Semantan

Bamboo Similarity

According to the National Bamboo Seminar Conference of the 2nd entitled Towards Enhancing bamboo industry, bamboo has a very extensive habitat. In fact, it is also able to survive in a variety of soils, from sandy loam soil types through to clay loam textured soils. But it will survive if the soil type is located in a well-drained. For areas that are not suitable for planting bamboo is a swampy area, soaked and watery. In addition, suitable topography is undulating surface of the area until the area is flat while the soil pH is between 4.5-6.0. The bamboo can also be planted in the open or under the auspices of a 60% sunlight.

Bamboo Semantan

The book entitled *Planting and Utilization of Bamboo in Peninsular Malaysia*, the scientific name for bamboo is *Gigantochloa scortechini* (buluh semantan). It is also one of the clumps of plants that grow close and compact. (Abd Razak Othman Abd Latif Mohmod, Walter Liese, and Norini Aaron, 1999)

In terms of height semantan bamboo will also achieve up to 15-20m, while the diameter of the stem is between 7-12cm. Long segment about is the between 40- 50cm with wall thickness ranging from 4-12mm. These bamboo shoots are orange and covered with black hairs at the top. Semantan bamboo is also available in peninsular Malaysia and is widely used in the bamboo industry in Malaysia. Here is a comparison of the strength of wood and bamboo from the collection Lama Abdul Rahman (1975) as the table below.

Table 1: Bamboo Strength Properties

species	Shear strength (MPa)	Compression strength (MPa)	definitive flexural		
			Modulus kepecahan MOR (MPa)	Modulus keanjalan MOE (MPa)	Strain
Bambusa blumeana	4.0-4.9	19.5-28.5	43.1-156.4	2.6-5.6	21.2-38.9
Bambusa vulgaris	3.3-4.8	20.5-30.0	46.1-78.4	4.1-8.1	28.7-42.6
Dendrocalamus asper	4.4-6.3	28.3-34.6	48.9-122.4	3.8-8.8	32.2-46.8
Gigantochloa scortechinii	3.6-4.9	21.6-32.3	35.9-68.9	3.7-5.9	31.1-42.2
Gigantochloa levis	3.7-5.8	37.3-42.8	37.6-119.4	3.7-6.5	35.7-48.7
Balanocarpus herri (cengal)	13.7	69	122	1.8	-
Koompasia malaccensis (kempas)	10.0	54.7	100	1.7	-

STEEL

Reinforcement steel, or better known as one of the ingredients is very important in a construction. Widespread usefulness in civil engineering also makes it one of the important stuffs. It is designed to bear the brunt of the stress and strain imposed and serves as a binder in the building structure. Therefore, the steel used to build high buildings and large.

In this study we were doing, we have changed the use of bamboo for changed reinforcement to buluh semantan. According to Tan Boon Tong in his book Building technology, designed to position steel together concrete, viable supports all the tension and stress experienced by the structure.

The Type of Steel

In the book Building Technology, states that some types of steel can be used as reinforcement to the concrete. Between steel that can be used is mild steel (keluli lembut), deformed bar (bar berbunga), BRC Steel fabric (tetulang anyaman), and high tensile wire (dawai keluli tegangan tinggi). (Tan Boon Tong) There are two grades of steel are used for mild steel reinforcement is marked as 'R' in drawing and schedule of reinforcement, and high strength steel is marked with the letter 'T'. The letter 'X' is used as a sign of other steel, stainless steel like. (GF Blackledge)

Whereas steel may also be divided into 2 groups in the book of Civil Engineering Form 4 of high tensile steel and mild steel. (Yusop bin Paal, 2011). Mild steel is typically used for construction steel works. Whereas, high tensile steel has a tensile strength of high yield. High tensile steel can be found in the work of prestressed concrete cable suspension bridges and high tensile bolts. According to information from the book Concrete Work Practice, these round bars are generally produced in the UK is hot rolled mild steel, which has the strength

characteristics of 250N/mm². Whereas, the strength characteristics of high strength steel was 460N/mm².

The Size of Reinforcement Bars

In terms of size we can learn from the book Concrete Work Practice, the nominal diameter of the bar of choice is 8, 10, 12, 16, 20, 25, 32 and 40 mm. If needed a larger diameter bar, 50mm diameter usually available through certain planning with manufacturers. For smaller cases, the size used is 8 mm diameter. (Blackledge, 1987)

In studies we have carried out, we have used high tensile steel type 12mm size as reinforcement to the concrete. Reinforcement should also be placed a little away from the mold or placed on a pedestal with a suitable space, which should be the same size as the nominal cover. These spacers are generally made of concrete, cement, fiber or plastic in several shapes and sizes to provide the right cover. These spacers are also used to prevent reinforcements from touching directly on the mold box.

The Disadvantages Of Steel

Steel has a number of disadvantages and problems in terms to get. Among them are:

- Increasing steel prices.
- Steel also easily rust if exposed to the atmosphere.
- Use a lot of steel in reinforced concrete construction will also add strength, but it also can add a lot of burden themselves as high density values.
- Poor at high temperatures.
- Lack of raw materials

Concrete

Concrete is a material made from cement, fine aggregate, coarse aggregate, and water that has been mixed according to a certain ratio. Evidence is taken from the book of Civil Engineering Form 4. (Yusop bin Deed, Werdah binti Abdul Halim and Sarifah daughter of David).

Concrete also requires a significant proportion mixture to produce a stable concrete mix and mold malleable. For example, a should be translated 1:2:4 ratio of 1 part cement, 2 parts sand and 4 parts aggregate. Concrete ratio also consists of various other ratio of 1:1.5:3 1:2:4, 1:4:8, and 1:3:6.

Provided concrete 1:1.5:3 proportion is comparable to concrete strength grade 25, while the 1:2:4 ratio is comparable to the strength of standard concrete grade 20 CP 110: 1972. (Mahyuddin Ramli) In our research, we have chosen to provide a mix ratio 1:2:4 concrete beam sample. In the book there are examples of Building Technology and use the ratio of concrete in the table below:

Table 2. The Use Of Concrete Mix Proportion

Mix ratio	usage
1 : 1.5 : 3	Pre-stress concrete, water tanks, concrete reinforcement for beams, columns and other
1 : 2 : 4	For reinforced concrete foundations, columns, beams, floors, walls and other
1 : 3 : 6	Floor, concrete and other bodies
1 : 5 : 10	Peperit tread wall in the hard ground, concrete tread under floor hanging

Reinforced Concrete

Reinforced concrete is one of the types of concrete. Reinforced concrete has a high compressive strength and low tensile strength. Of concrete structures require high tensile reinforcement to resist the tensile stresses generated. (Yusop bin Deed, Werdah binti Abdul Halim and Sarifah daughter of David)

According to the Technology Building, when the stress of building tension, as happened in columns, beams, floor and others, ordinary concrete is not suitable for use. But, this problem can be overcome by combining reinforcement that has the ability to bear tensile stress in the concrete. (Tan Boon Tong)

In our study, we used as a model sample beam. When the beam is loaded, it will bend a little and eventually unable to resist fracture due to tensile stresses at the bottom. Therefore, the reinforcement required at the bottom of the beam to support the load imposed on it.

Nature of concrete is strong to withstand the load berth but weak in resisting stretching load. A structure that spans an opening, without the support of something like the bottom of the joists, floor beams or the like. Pressure or squeeze will occur at the top, but otherwise the tension or strain process will occur at the bottom. This means that at the same time, the structure will have either bending or accustoming process as shown in Figure 2.2:

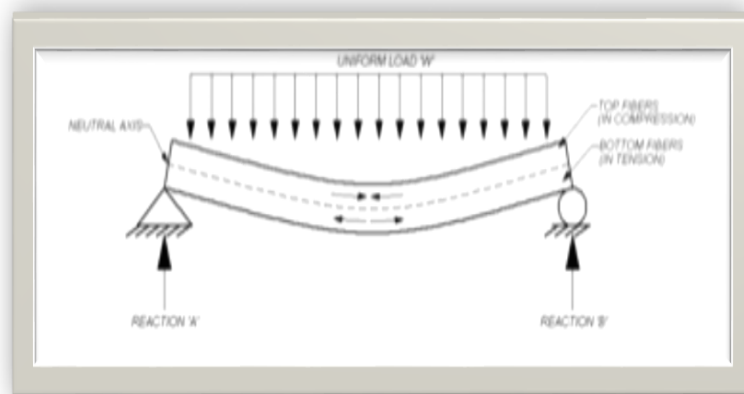


Figure 2: Beams or joists

The Relationship Between The Properties Of Building Materials

According to the book Building with Bamboo, bamboo strength is twice the compressive strength of concrete, and it also has a weight ratio of almost equal strength with the strength of steel in tension. The table below is a comparison of the nature of bamboo and other materials:

Table 3: Bamboo Strength Comparison with The Target Material

Material	Stress (N/mm ²)	Density (kg/m ³)	Ratio Of Stress : Density
Concrete	8	2400	0.003
Steel	160	7800	0.020
Bamboo	10	600	0.017
Wood	7.5	600	0.013

Table 4: Comparison of The Strength Of Bamboo And Other Materials

Material	E-Modulus (N/mm ²)	Density (kg/m ³)	Ratio Of E-Modulus: Density
Concrete	25000	2400	10
Steel	210000	7800	27
Bamboo	20000	600	33
Wood	11000	600	18

Table 5: Comparison Of The Tensile Strength Bamboo And Other Materials

	Bamboo	Pine Wood	Concrete	Steel
Tension Strength (N/mm ²)	35-300	9	1/10 of compressive strength	250-350
Compressive Strength (N/mm ²)	64-110	4.3	12.6-126	250-350
The Form And Nature	1.9 times stronger than solid form because the form of a hollow cylinder. More efficient in the case of compression and bending.		Due to the cubic shape, the weight of concrete is directly proportional to the load capacity of sustained and assisted with reinforcement	More efficient in the case of tension. workability for the work of a small cross-section.

			zones tension	
Fire Resistance	During enlarges, it acts as a fire obstructions (without preservation)		Will not burn	Loss of elastic properties, at high risk for failure
Capacity Growth	80%-300% (28000)	3%-6% (16000)	no	no

METHODOLOGY

Methodology is a rigorous planning for travel in this final semester project. To facilitate the end of the project, the Methodology should be arranged as soon as possible. thus, each stage of the project will not stray from the path laid down or to be more precise, the final outcome of the study will meet the requirements of the problem to be solved. As such, it is important to know and understand in detail each of the projects that are in the structure of the Methodology of the study.

Sample Preparation

Our research has three types of experimental samples (Table 3.2) are performed for compression testing using the test as follows:

Table 6. Sample Tests Conducted

No	Type of sample	Quantity
1	Reinforcement concrete	2
2	Bamboo reinforcement concrete	3

The Preparation Bamboo

The first process that must be done when the bamboo was cut is curing. Curing is done by mixing boric acid by 20% to 30% and as much as half a bottle of insecticide (rough estimate) and dissolved in water to obtain a solution of boric acid stereobatic dyeing process, which has been cut bamboo can be dipped into a tank containing solution. This curing period takes 2 days. Curing is done so durable bamboo taken and avoid fungus. It can also help bamboo grow stronger. The methods of cutting, splitting bamboo to use proper equipment are described as below:

1. bamboo will be cut by using a split-cutter 400mm size while the width of cut bamboo using bamboo cut saws that can be inserted into the formwork before cutting must wear glove as a security measure.
2. When finished cutting the bamboo, bamboo lubricate work will be done by using the Disc Sander Machine without disturbing the Courant in bamboo region. Equipment such as

blindfolds and nose and hands are used to circumvent dust into the eyes and nose and injuries to the hand.

Reinforcement

12mm sized reinforcement cut using steel cutters, measuring 400mm of reinforced concrete samples. Reinforcement used must be removed carefully to avoid reinforcement bend or kink. Ensure free reinforcement clay, oil, paint, grease, rust and any other material that could interfere with the current run of concrete mix,

The Preparation Concrete Formwork

Types of molds used in the manufacture of construction has its own way. Here are a few steps in making a formwork :

- 1) cut plywood using wood splitting machine width for small-sized plywood
- 2) After the cutting process is completed, the board will be nailed to the plywood using a hammer.
- 3) Repeated steps 1 and 2 for a box shape so on.

Concrete Ratio

Ratio of reference we choose in this study is a reference for ordinary concrete 1:2:4 (Simen: sand: aggregate). This reference shall be provided in advance and make sure the material used is free from any improper 'bendasing'. Before entering into the box konrit reference, the reference shall be swept with a box gris oil for easy reference later opening. The steps along the supply concrete picture is as follows:

1. Provide basin, grovel and tray.
2. Cement, sand, aggregate taken in the ratio 1:2:4 and put enough water in the bucket. (Figure 3.9)
3. The method of mixing is done manually by entering the sand, cement and aggregates. Mix well all the ingredients to mix well and make a circle with the centre to include the water was measured by the ratio used (Figure 3.10). Mixing term taken to get a good concrete is for half an hour to an hour.
4. When finished mixing the concrete, the concrete will be inserted slowly into the formwork provided as soon as possible to prevent hardening of the concrete mix.
5. The next step, place bamboo reinforcement bars and concrete on the second layer and the concrete surface above the mold surface should be levelled using steel grovel (Figure 3.12).
6. Samples that have been completed will be left for a day before opening. Each sample should be labelled to avoid beam error will occur and facilitate later identification.
7. Once the concrete has hardened, the mold concrete mold is removed from the formwork slowly to avoid breaking the concrete.

Concrete Curing

Concrete curing will occur when the reaction occurs between the cement with water and freeze and cause the cement to harden. Existing specifications, the amount of water mixed in the ratio should be sufficient and proper for producing concrete mix that worked well pleased to allow the chemical reaction at the initial stage. Heat can also be generated in the process and part of the water content is lost.

Water loss that occurs is called the hydration process. It can affect the completeness of hydration while preventing the achievement of maximum strength in concrete. Therefore, this preservation must be taken to ensure that enough water. This curing method should also be done after the concrete mix freezes and hardens. Period of time is good for curing for 14 days in a row. The strength of the concrete achievements can also be known as listed in Table 3.3 Concrete strength can also be increased by the presence of water over a long time. In general, the ultimate strength of the concrete can be achieved in a period of at least one year.

Table 7: Achievement Of Concrete Strength For Ordinary Portland Cement Mould.

Long terms	Percentages
3 days	20 %
7 days	45%
28 days	60%
3 month	85%
6 month	95%
12 month	100%

Sample diagrams and step beam curing according to the proper method is as follows:

- 1) The tank will be used for preservation should be in pristine condition.
- 2) Then, add water to the tank and make sure the inserted high water samples.
- 3) Then, add all the sample beam was removed from the mold box into the water-filled tank.
- 4) Sample concrete will be left for 7,14 and 28 days.

The Test Method

Cube test is the start of testing concrete. It is conducted to find out the suitability of the concrete can be used or not. This test can be done using a specific ratio. The results can be used whether the concrete can be used or not is to see the collapse that occurred during the test run. For the study we do, we use the ratio of 1:2:4 for this cube test.

COMPRESSION TEST

In this study, one of the tests that we run is compression test. It is possible to test the workability of the concrete is broken by using structural loading. The test sample tested in the form of cubes or cylinders. Therefore, studies are performed with a cube-shaped sample as in the standard BS 1881 (1983). In addition, structural loading test also known as flexure test also applies to find the flexural strength of the material breach.

Machines used for flexural strength samples were compression machine. This machine is used to manually focus the high and should be given to avoid the error will occur. In addition, space

and during experiments conducted facilitate experimental work such as carrying samples, installation, parking and lift samples. Among the properties available in this experimental machine are:

- Can control at a high level during operation
- Safe to use
- Software used can connect machines and various forms of experimental trials.
- high data quality
- A wide range of additional tools. (Depending on user)
- System in order.

The Test Method

The purpose of load testing is conducted to ensure the integrity of the structure and this test should reflect the actual state of a structure. Ultimate load test is quite effective load and able to provide high accuracy in determining the actual strength of concrete. The procedure for testing is as follows:

1. The sample should be tested in wet conditions
2. before doing the test, make sure that the equipment may be worn and safe to use.
3. All who want to be tested samples should also be considered using a weighing scale.
4. All samples will be tested using a compression machine
5. 5) When all the tests were sample to be tested, the loading will be done by increasing the load at a certain rate by using tools that can be pumped
6. 7) The force that can be known from the assumed flexibility through manual methods. (Figure 3.16)
7. 8) Repeat steps 2 to 6 for the next test for the sample.

DATA ANALYSIS AND RESULT

SLUMP TEST

Slump test is one of fresh concrete tests. Slump test is made to measure the consistency of fresh concrete mix; it's the most commonly used all over the world according to (ASTM C143-78). The main purpose of measuring consistency by slump test is to achieve acceptable fresh concrete workability.

Also slump test is one of the simple and important tests which helps us to get a homogenous fresh concrete mix before casting. Slump test has a direct effect on compressive strength of the hardened concrete as slump test shows the water/cementing material ratio. In other words, when slump is big then water/cement ratio is big and the compressive strength of concrete is low.

Result of slump test

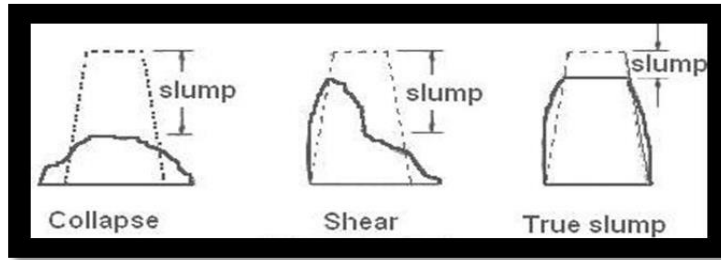


Figure 3: Types of Slump

After the slump test is done, the results of the slump test we found that, true slump of the fall was 0.7 cm. Relevant Standards: BS 1881: Part 125: 1983. Testing concrete- Methods for mixing and sampling fresh concrete in the laboratory.

Cube Test

Cube test is another important test in concrete work. The purpose of this test is to determine concrete strength of concrete. Results from these tests will give the impression that it is the right mix and permanent. It will also give a clear picture to be made of concrete. In all projects, test cubes will be made on each concrete mix changed. This is to test the breakdown strength at day 7 until 28 days

Table 8: shown cube compression test analysis results

Days	7	14	28
Weight (kg)	7.6	7.9	7.8
Concrete strength (kN)	246.8	259.66	395.86

During the concrete work conducted, workability test shall be carried out two times a day and additional testing is required when substances or mixture ratios changed. Tests carried out either deposition or trial testing opiate factor as the British Standards B.S. 1881

COMPACTION TEST

Compressive strength is the capacity of a material or structure to withstand axially directed pushing forces. It provides data (or a plot) of force versus deformation for the conditions of the test method. When the limit of compressive strength is reached, brittle materials are crushed. Concrete can be made to have high compressive strength, e.g. many concrete structures have compressive strengths in excess of 50 MPa, whereas a material such as soft sandstone may have a compressive strength as low as 5 or 10 MPa By contrast, a small plastic container might have a compressive strength of less than 250 MPa.

Data Of Reinforced Bamboo Concrete

Table 9: Data Compression Test for Reinforced Bamboo

Day	7	14	28
Weight (kg)	55.45	59.30	65.40
Compression strength (kN/mm ²)	31.392	33.845	38.259

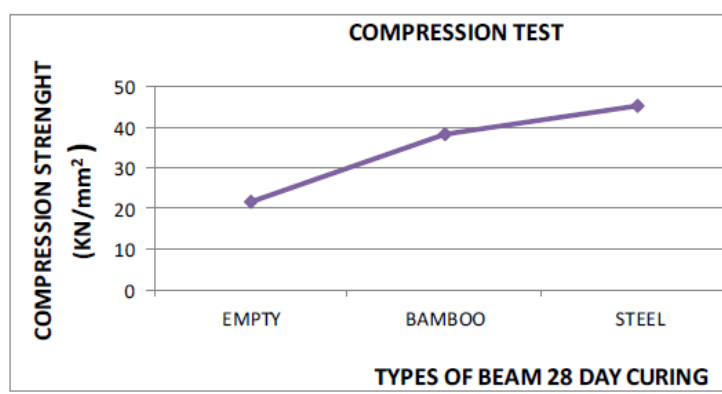


Figure 4: compression test flow

Data of Reinforcement Concrete

Table 10: Data of Compaction Reinforced Steel Concrete

Day	7	14	28
Weight (kg)	78.60	-	82.50
Compression strength (kN/mm ²)	42.674	-	45.126

DISCUSSION AND RECOMMENTDATION

Sample For Normal Concrete

This sample has a width, height and length of each is 200mm, 300mm, and 400 mm. weights for the first sample and the second sample before curing process was 52.30kg and 58.90kg, the weight of the first and second samples after curing process when each registered a weight of 53.60kg and 59.85kg. Obtained from the table, the compressive strength tests were conducted on each sample, the first sample has reached the maximum strength is 18.149kN/mm², while the second sample reached a value of 21.582kN/mm

Samples For Reinforced Concrete

Width, height, and length of the samples is of 200mm, 300mm, and 400mm. weight for each sample prior to the curing process of the first sample of the second sample of 74.60kg and 82.50kg. Weight for the first sample and the second sample after the curing process each

recorded weight of 76.20kg and 83.90kg. Results of compressive strength tests were conducted it was found that the value for maximum strength, compressive strength of samples of the first recorded 42.674kN/mm² whereas, the second sample recorded the maximum strength of 45.126kN/mm².

Samples Of Semantan Bamboo Reinforced Concrete

All these samples have a width, height, and length is 200mm respectively, 300mm, and 400 mm. weights for the first sample, the second sample and third sample before curing process was 55.45kg, 59.30kg and 65.40kg. After the curing process conducted the first sample, the second sample and third sample each registered a weight of 53.40kg, 61.15kg and 68.20kg.

Obtained from the table, after the compressive strength tests were conducted on each sample, the maximum strength of each respective sample recorded a value of 31.392kN/mm², 33.845kN/mm², and 38.259kN/mm².

Comparisons Between Steel Reinforced Concrete with Reinforced Concrete Bamboo

To achieve the second objective of comparing the strength of steel reinforcement in concrete with bamboo reinforcement to be applied in the beam, the discussions have been conducted to compare the strength values obtained from the test. The average value of each compressive strength of reinforced concrete and steel- reinforced concrete bamboo respectively recorded the strength of 45.126kN/mm² and 38.259kN/mm². From the results of the discussions we've done, here it is seen that the strength and capacity of bamboo reinforced concrete cannot reach the strength of steel reinforced concrete. Even so, it still able to bear the load of the concrete beams in construction work. The bamboo reinforced concrete suitable for structures that do not accommodate oversize loads such as residential home one or two floors.

CONCLUSION AND RECOMMENDATION

Conclusion

The conclusion that can be made of our projects is it suitable and safe to use. This is because the reference to the structural loading tests were carried out in the laboratory of Engineering University Selangor (UNISEL), reinforced concrete, steel reinforced concrete and bamboo common concrete compressive strength value.

The average value of each compressive strength of reinforced concrete and steel- reinforced concrete bamboo respectively recorded the strength of, 45.126kN/mm² and 38.259kN/mm². Here can be seen that the strength and ability of bamboo reinforced concrete cannot access the value of strength of steel reinforced concrete. Even so, it is still able to bear the burden as concrete in construction works.

Recommendation

In reality, not everyone knows that's bamboo cans be Used as a Substitute of steel reinforcement in concrete reinforcement as shrouding. Generally, more Vulnerable to the use of bamboo as a basketball court, walking sticks, chopsticks, Rafts and more. With details on advantages of bamboo as a building material has not been clearly King maker General. In Addition, we try to highlight the use of bamboo in the construction industry as one of the alternatives uses of steel reinforcement in reinforced concrete reinforcement as shrouding.

However, there are missing flaws in our projects and it is possible to make repairs in time to increase the strength of the bamboo dating to bear the burden. Some of the recommendations are:

1. Finding the initiative to test all types of bamboo available in Malaysia and make comparison to the strength values obtained by appropriate tests.
2. Using bamboo that has been cured and uncured and then compare its ability to carry the load.
3. Using bamboo that is consistent in terms of age when the bamboo is cut from clumps.
4. Choosing the more matured bamboo.
5. Bamboo strands more adequately.
6. Bamboo strands with a diameter of greater consistency.

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