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Partial Replacement of Steel Reinforcement by Bamboo (G+2)

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Abstract : *A Partial Replacement of Reinforcement by Bamboo project is to design and built the structure that uses bamboo as structural alternative to steel in order to replicate the shear strength and load bearing capabilities that traditional rebar provide for concrete structure while minimizing cost. The demand of steel reinforcement is high as compare to its production. Furthermore, unlike steel rebar bamboo is an abundant natural resources and it is fastest growing plant in the world. The aspect makes it cheap and easy to access on site. It is economical process. Estimated cost of bamboo reinforced concrete structure is less as compare to steel reinforcement. The present project compare to the cost of concrete structure using bamboo as a reinforcing material with the conventional method and evaluate the feasibility of using bamboo as a potential reinforcement in place of steel the project attempt to develop modular design of concrete structure for different income groups of people.*

Keywords – *physical and engineering properties, economical, cost effective, flexural strength, bamboo*

I. Introduction

Bamboo is good idea for low cost economic structure. Bamboo reinforcement is 3 times cheaper than steel reinforcement so it can easily use in rural area where people are living in temporary houses. In the history of civil engineering construction , bamboo was a vital material in construction and is one of the oldest traditional building material used by mankind. The mechanical property of bamboo and its availability in developing regions has led to its empirical use as reinforcement in concrete structures. The main purpose of this project is to ensure that a bamboo reinforced concrete structure is suitable and sustainable for light weight structure or temporary structure or rural area housing and cover-up all issues regarding structural aspect of bamboo. Effectiveness of readily available epoxy coating material in protecting bamboo strips was degradation was also studied epoxy using Varnish. With the intent to adopt bamboo reinforcement as concrete reinforcement, a series of tensile test or pull out test was also carried out to investigate the suitability of the coating to enhance the bond behaviour of bamboo composite to concrete

II. METHODOLOGY

Principle of operation

In general, techniques used in conventional reinforced concrete construction need not he changed when bamboo is to be used for reinforcement. The methods used for construction of steel reinforced concrete can be used for bamboo reinforced concrete. It is just the replacement of steel with bamboo reinforcement. All other process for

bamboo reinforced concrete construction remains same as conventional concrete construction.

Applied Methodology

Material Collection

Types of material are as follows:

[1] Steel bars having 10 mm diameter

[2] Cement (OPC 53 Grade)

[3] Coarse aggregate of 20 mm size

[4] Fine aggregate (sand)

[5] Bamboo

Material Testing

To determine the properties of materials Fineness test, Gradation of sand, Initial and final setting time, Specific gravity test, Water absorption test, Tensile strength test conducted.

Theoretical Analysis

Theoretical analysis includes different properties of materials used and their specification.

Material Specification

1. Cement

Cement is a fine, grey powder. It is mixed with water and material such aggregates. The cement and water form a paste that binds other materials together as concrete hardens. In present work 53 grade cement was used. The cement uniform colour i.e. grey with a light greenish shade and was free from lumps. Ordinary Portland cement 53 grade was used.

2. Coarse Aggregate

Crushed basalt stones from local queries were used as aggregate. The maximum size of aggregate used was 16.5mm retained to the 20mm passing. The properties of aggregate where determine by conducting tests. The aggregates were washed to removed dirt and dust and were dried to surface dry condition.

Properties of aggregate

1. Size

The largest maximum size of aggregate practicable to handle under have given condition should be used perhaps 20 mm size is the maximum size that could be conveniently used for concrete making. Using the largest possible size will result in Reduction in water requirement.

2. Shape

The shape of aggregate is an importance characteristic since it affects the workability of concrete. It is really difficult to measure aggregate as it depends on parent rock also on type of crusher use to crush it From the point of economy in cement requirement for given water cement ratio rounded aggregate preferable to angular aggregate, on the other hand, additional cement require for angular aggregate is offset to some extent by the higher strength and some time by greater durability has result of the interlocking texture of the harden concrete. Generally flaky

aggregates make poor concrete.

Classification of aggregate on the basis of shape of aggregate is as follows

[1] Rounded

[2] Irregular or partly rounded

[3] Angular

[4] Flaky

3. Strength

While considering strength of aggregate we do not imply the strength of parent rock for which the aggregate are produced, because the strength of rock it does not exactly represent the strength of aggregate in concrete. Concrete is an assemblage of pieces of aggregate bound together by cementing material, its properties are based primarily on the quantity of cement paste and the aggregate.

Experimental Analysis

General

After the collection of material some test are conducted are as follows such as test on cement, Test on aggregate, Test on TMT bar.

Test on cement

As per material details some test are conducted on cement such as fineness of cement, consistency test on cement, Initial and final setting time of cement etc.

Fineness test on cement

Fineness of cement is measured by sieving cement on standard sieve.

Objective

As per IS specification the proportion of cement of which the cement particle sizes are greater than the 90 micron is determined.

Needs

[1] Finer cement offers a greater surface area for hydration and faster the development of strength.

[2] Increase in fineness of cement is also found to increase the drying shrinkage of concrete.

[3] Fineness of cement expressed in terms of total surface area of unit weight of cement.

[4] The purpose of this test is to find out the quality of coarse material present in cement.

[5] It is quality of coarse material present in cement. It is an indirect test of fineness of

Cement.

Scope

This standard covers the procedure for determine the fineness of cement by dry sieving as represented by the mass of residue left on a standard 90 micron IS sieve.

Consistency of cement

Standard consistency of a cement paste is defined as that consistency which will permit a vicat plunger having 10 mm diameter and 50 mm length to penetrate to a depth of 33-35 mm from top of the mould.

Objective

The aims of this test is to find the basic required quantity of water to form a cement paste is specified by IS code 4031 (part 4- 1988) which the Vicat plunger will penetrate to 5-7 mm pt. to the bottom of Vicat mould.

Needs

To find the amount of water required to make the cement paste of standard consistency.

Scope

This is standard cover the procedure for determine the quantity of water required to produce cement paste of standard consistency.

Initial and final setting time

Initial setting time is that time period between the time water is added to cement and time at which 1 mm square section needle fails to penetrate the cement paste, placed in the Vicat's mould 5 mm to 7 mm from the bottom of the mould. Final setting time is that time period between the time water is added to cement and the time at which 1 mm needle makes an impression on the paste in the mould but 5 mm attachment does not make any impression.

Objective

[1] As per IS specification take the the vicat apparatus.

[2] Take the specific amount of cement and make space using water content (percent)

[3] Observed and note the setting time.

Test on coarse aggregate

As per material details some test are conducted on coarse aggregate suchas specific gravity and water absorption.

Water absorption and specific gravity on coarse aggregate

Specific gravity test of aggregate is done to measure the strength or quality of the material while water absorption test determines the water holding capacity of the coarse and fine aggregates.

Objective

[1] Take 2kg of sample and follow the procedure.

[2] Take the reading

[3] Calculate the specific gravity and water absorption.

Needs and scope

[1] The value is used to calculating air voids, voids in mineral aggregate (VMA) and voids filled by (VFA) water absorption can also be an indicator of ashphalt absorption.

[2] In OPC specific gravity of aggregate used for calculating the percentage of voids and volume of aggregate in compaction.

Calculation

Mass of Aggregate and Bucket in water = 2366gm

Mass of Bucket in water = 755gm

Mass of saturated Aggregate in water (A) = 1611gm

Mass of Saturated surface dry Aggregate in air (B) = 2500gm

Mass of oven dry Aggregate in air (C) = 2374gm

Specific Gravity = C / (B-A) = 2374 / (2500-1611) = 2.67

Water Absorption = (B-C) / C = 2500-2374 / 2374 = 5.31%

Test on fine aggregate

As per material details some test are conducted on fine aggregate such as specific gravity, moisture content and grading of sand.

Specific gravity of sand by pycnometer method

For determination of gravity of soil by Pycnometer. Volume of soil solids and water are take same. The volume of specific known weight of soil grains can be obtained by using a container of known volume and the Archimedes Principle, that a body submerged in a volume of water will displace a volume of water equal to the volume of the submerged body.

Objective

[1] Take the pycnometer of 1 litre capacity having metal conical screw top with 6 mm hole at its apex.

[2] Take measure amount of water and sand.

[3] Calculate the specific gravity of sand.

Needs and scope

The knowledge of specific gravity is needed in calculation of mix design to know the void ratio, degree of saturation etc.

Calculation

Weight of sample (A) = 750gm

Weight of Pycnometer + Sample + Water (B) = 2164gm

Weight of Pycnometer + Water (C) = 1669gm

Weight of oven dry sample (D) = 674gm

Specific Gravity = (D / (A-(B-C)) = (674 / (750-(2164-1669))) = 2.64

Surface moisture content

To determine more accurately the quantity of water to be added to the mix, the moisture content of sand has to be considered. A too high water content results in a higher water to cement ratio. As a consequence the product would be porous, with low strength and insufficient water.

Objective

[1] Take the sand which in natural form in present condition.

[2] Take standard weight of sand.

[3] Oven dries the sand and calculates the surface moisture of sand.

Need and scope

This procedure is designed to determine the total moisture and free moisture content of fine aggregate for Portland cement concrete by drying the moisture in oven. It is require knowing the absorption capacity of sand.

Calculation

Weight of sample (A) = 2000gm

Weight of oven dry sample (D) = 1939.67gm

Moisture Content = (A-D) / D*100 = (2000-1939.67) / 1939.67*100 = 3.11%

Gradation of sand

As there are different types of sand, so judge that which type of sand is best to be used. The sand is differentiated on the basis of its gradation.

Objective

[1] Select sieve as per the IS specification and perform sieving.

[2] Obtain percentage of sand retained on each sieve.

[3] Find out the zone of sand.

Need and scope

The grain size analysis is widely used to know the zone of sand which is important to fix the value for mix design calculation. And as per calculation the material in concrete are used.

Test on bar

Tensile strength test

Tensile test is one of the most common tests for steel. The test involve straining a test piece by tensile force, generally to fracture, for the purpose of determining tensile strength, yield strength event.

Objective

[1] Use 60 cm length of bar.

[2] Fix the rod in UTM machine and note down the result.

[3] Draw the graph stress vs. strain.

Need and scope

Tensile test is the one of the most common tests for steel. The test involve straining a test piece by tensile force generally to fracture for the purpose of determine tensile strength/ yield strength, ductility and reduction of area.

III. FIGURES AND TABLES

TABLE 1 Grading of coarse aggregate

IS Sieve (mm)	Wt. Retained (gm)	Wt. Retained %	Cumulative Retained %	Cumulative Passing %	Requirement
40.0	0	0.0	0.0	100.0	100
20.0	445	17.8	17.8	82.2	85-100
10.0	1065	42.6	60.4	39.6	0-20
4.75	890	35.6	96.0	4.0	0-5
Pan	100	4.0	100.0	0.0	-
Total	2500				

Sieve analysis

TABLE 2 Grading of sand

IS Sieve (mm)	Wt. Retained (gm)	Wt. Retained (%)	Cum Retained (%)	Cum Passing, (%)	Requirement
10.00	12	0.6	0.6	99.4	100
4.75	41	2.2	2.8	97.2	90-100
2.36	108	5.8	8.6	91.4	60-95
1.18	866	46.4	55.0	45.0	30-70
0.600	554	29.7	84.7	15.3	15-34
0.300	145	7.8	92.5	7.5	5-20
0.150	115	6.2	98.7	1.3	0-20
Pan	25	1.3	100.0	0.0	-
Total	1866				

TABLE 3 Zone analysis

Sieve	Zone 1	Zone 2
10	100	100
4.75	90-100	90-100
2.36	60-95	75-100
1.18	30-70	55-90
0.600	15-34	35-59
0.300	5-20	8-30
0.150	0-10	0-10

Result

To know gradation, specific gravity, consistency, yield point, fineness and surface moisture content the material was tested and the results are obtained are as follows.

Following table shows the result for specific gravity and water absorption

TABLE 4 Results of coarse aggregate after testing

Sr no.	Test on coarse aggregate	Observe value %	Standard value
1	Specific gravity	2.67	-
2	Water absorption	5.31	-

Coarse aggregate testing

Following table shows the result for Specific gravity and surface moisture content

TABLE 5 Result of fine aggregate after testing

Sr no.	Test on fine aggregate	Observe value %
1	Specific gravity	2.64
2	Surface moisture content	3.11
3	Water absorption	11.28

Following table shows result for fineness of cement, consistency of cement, initial and final setting time.

TABLE 6 Result of cement after testing

Sr no.	Materials	Test on material	Observe value	Standard value
1	Cement	Fineness of cement	2.48	
		Consistency of cement	31	
		Initial setting time	154	Min. 30
		Final setting time	262	Min. 600

Following table shows results of TMT bar.

TABLE 7 Result of TMT bar tensile strength

Sr no.	Description	Load (KN)
1	Yield load	62.4
2	Ultimate Load	74.9

Tensile strength test of steel bar

IV. Conclusion

The tensile strength of bamboo is good and can be used as reinforcement in R.C.C. structure for low cost housing project. According to study by researchers in world, in next 60 years steel production will be reduced hence a utilization of natural and eco- friendly options like bamboo should be used. Bamboo should be treated by epoxy coating like varnish, tar coating etc. In this project the test are conducted on materials which are used in project. The further work and the test has carried out in next semester.

References

[1] Sri Murni Dewi and Devi Nuralinah (2017) MATEC web of conference 103, 02001 (2017). The Recent Research on Bamboo Reinforced Concrete.

[2] Anurag Nayak, Arehant Bajaj, Abhishek Jain, Apoorva Khandelwal, Hirdesh Tiwari (2013) IOSR Journal of Civil Engineering, Replacement of Steel Reinforcement by Bamboo Reinforcement. [PP 50-61].

[3] Atul Agarwal, Bharadwaj Nanda, Damodar Maitry. Experimental Investigation on Chemically Treated Bamboo Reinforced Concrete Beams and Columns (2014)

[4] Khosrow Ghavami. Department of Civil Engineering, Pontificia Universidadde Catolica, PUC-Rio, Rua Marques de Sao Vicente 225, 22453-900 Rio de Janeiro, Brazil. Bamboo as Reinforcement in Structural Concrete Elements (2004).

[5] Ajinkya Kaware, Prof. U.R. Awari, Prof. M.R. Wakchaure. International Journal of Innovative Research in Science, Engineering and Technology Vol. 2, Issue 6, June 2013. Review of Bamboo as Reinforcement Material in Concrete Structure.

[6] M.M. Rahman, M.H. Rashid, M.A. Hossain, M.T. Hasan and M.K. Hasan. International Journal of Engineering and Technology IJET-IJENS Vol: 11 No: 04. Performance Evaluation of Bamboo Reinforced Concrete Beam (2011).

[7] Omkar Gaikwad, Dipak Patil, Mayuri Rathod, Suraj Saw, Vijay Wairagade. International Advanced Research Journal in Science, Engineering and Technology. Literature Review on Bamboo Reinforced Concrete (2019).

[8] T. Gutu. International Journal of innovative Technology and Exploring Engineering (IJITEE). A Study on the Mechanical Strength Properties of Bamboo to Enhance its Diversification on its Utilization (2013).

[9] Rohit Deshmukh, Aditya Raj, Avinish Kumar, Amit Mahto, Bhimsingh Ratthaur. International Journal for Research in Applied Science & Engineering Technology (IJRASET). Behaviour of Bamboo Reinforced Slab Panel (2018).

[10] Heisel Felix, Hebel Dirk, Schlesier Karsten, Griebel Dragan. Chair of Architecture and Construction, Future Cities Laboratory, Singapore ETH-Centre. Bamboo Reinforcement A sustainable Alternative to steel (2014).

[11] IS 2386 (Part-01): 1963 for Fine Aggregate Physical test.

[12] IS 2386 (Part-01): 1963 for Coarse Aggregate Physical test.

[13] IS 1786: 2008 for Rebar Steel Physical test.

[14] IS 1489 (Part-01): 2015 for Cement Physical test.

[15] Concrete Technology theory and practice- M.S Shetty.