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FLEXURAL BEHAVIOUR ON FIBER REINFORCED BUBBLE DECK BEAM WITH RECYCLED AGGREGATE

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Abstract - *At current situation, a serious problems faced by construction industry is exhaustive use of the raw materials. Recent times, the various methods are being adopted to control the use of concrete. In our method, Bubble Deck Beam is a method of virtually eliminates all concretes from the middle of a beam and which is not acting any structure function and thereby slowly reducing structural dead load. Bubble Deck Beam is a beam whose core is replace with spherical balls that can be various sizes and shapes.*

In the building constructions, the beam is very important structural member to carry a load of the slab. In this project, the in-effective concrete in the centre of the beam is to be replaced with high density polyethylene hollow spheres. Using M30 grade of concrete, number of beams with and without spherical bubbles will be casted to compare the weight and flexural strength. The use of such hollow sphere may results in a reduction of structural self-weight of about 20 to 25 percentage. The concrete above neutral axis in compression zone takes minimum stress so that we could partially replace the concrete using high density polyethylene balls of 70mm diameter. Hence the usage of concrete in beams and self-weight of beams got reduced considerably. The influence of natural coarse aggregates are replaced 100% with recycled coarse aggregate on various mechanical and durability properties of hardened concrete along with the different w/c ratio. In this study, Recron 3s polyester fiber is added to the concrete as 1%, 2%, 3%, & 4% by the weight of fine aggregate in order to improve its performance to find the optimum dosage of Recron 3s Polyester fiber. The flexural strength, compressive strength, modulus of rupture and split tensile strength of M30 grade of concrete will be tested for 7,14 and 28 days of curing and compared with the concrete made with natural coarse aggregate. Some of its major benefits are lower total cost, reduced material use, enhanced structural efficiency, decreased construction time and is green technology.

Key Words: Bubble Deck Beam, Neutral axis, HDPE Balls, Light Weight Material, Recron 3s Fiber, Flexural Behaviour, etc.,

1. INTRODUCTION

Now-a-days construction industry starts to pay a great attention to special material that is used in building construction in terms of their effects on environment. Ordinary Portland Cement (OPC) is one of the main components used in casting reinforced concrete (RC) structures. So the usage of concrete is high now-a-days, and hence there becomes a shortage of raw materials for its preparation. To reduce the usage of concrete many researches were carried out for alternate materials that can be used instead of concrete. By recycling scrap or waste plastic material turn them into useful products, and plastic is non-biodegradable material. By recycling the waste plastic material it can reduce the high rate of plastic pollution. By using this method the concrete is replaced using High Density Polyethylene(HDPE) Balls. These balls are less in weight and when we use these balls, it will not affect geometrical shape of beam. Also it greatly does not affect the strength and stress characteristics of the beam.

2. MATERIALS USED

2.1CEMENT

A cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. A cement is manufactured through a closely controlled chemical combination of calcium, silicon, aluminum, iron and other ingredients. Common materials used to manufacture cement includes limestone, shells and chalk combined with shale, clay, slate, blast furnace slag, silica sand and iron ore. The concrete proposed for this task is OPC 53 grade. The properties of bond are resolved to meet the prerequisites of IS 12269-1987 Specification for 53 grade Ordinary Portland concrete

Table -1: Properties of cement

S.NO	PROPERTY	VALUE
1.	Specific gravity	3.14
2.	Consistency	33%
3.	Initial setting time	30min
4.	Final setting time	300min

2.2FINE AGGREGATE (M - SAND)

Manufactured sand (M-Sand) is a substitute of river sand for concrete construction. Manufactured sand (M-Sand) is produced from hard granite stone by crushing. The crushed sand is of cubical shape with grounded edges, washed and graded to as a construction material. The size of Manufactured sand (M-Sand) is less than 4.75mm. since manufactured sand can be crushed from hard granite rocks, it can be readily available at the nearby places, reducing the cost of transportation from far-off river sand bed.

Table No.2 Properties of Fine aggregate

S.No.	Tests on Fine aggregate	Result
1	Specific Gravity	2.67
2	Sieve Analysis	99.87%

2.3 RECYCLED COARSE AGGREGATE

The use of waste concrete as recycled coarse aggregate conserves virgin aggregates, reduces the impact on landfills, decreases energy consumption and can provide cost savings. Recycled aggregate are comprised of crushed, graded inorganic particles processed from the materials that have been used in the constructions and demolition debris. We used 20mm size of recycled coarse aggregates to the concrete.

Table No.3 Properties of Recycled Coarse aggregate

S.No	Tests on Recycled Coarse aggregate	Result
1	Impact test	9.80%
2	Water absorption test	4.1%
3	Crushing strength test	7.81 kg
4	Flakiness index test	20.80
5	Elongation index test	17.86

2.4 STEEL REINFORCEMENT

Steel is an alloy of iron, carbon and other elements. Steel, which has high tensile strength is used with concrete in order to counteract the concrete's low tensile strength and ductility. The main purpose of inclusion of steel is resist tensile stress in particular regions of the concrete that may cause structural failure or cracking. We used 10mm diameter bars of main reinforcement and 8mm diameter bars of distribution reinforcement using HYSD bars of Fe415.

2.5 WATER

Water is the key ingredient which when mixed with cement forms a paste that binds the aggregate together. The amount of water in concrete controls many fresh and hardened properties in concrete including workability, compressive strength, permeability and water tightness, durability and weathering, drying shrinkage and potential for cracking. The role of water is important because the water to cement ratio is the most critical factor in the production of "perfect" concrete. The P^H estimation of water utilized is 6.5.

2.6 SUPER PLASTICIZER

In order to improve the workability of high performance concrete, super plasticizer in the form of poly-carboxylic either based super plasticizer (Master Glenium SKY 8233) was used as a chemical plasticizer. Master Glenium SKY 8233 is a ready-to-use liquid which is dispensed into concrete together with the mixing water. The product has specific gravity of 1.09 and solid content not less than 30% by weight of cementitous material.

2.7 RECRON 3S POLYESTER FIBER

Recron 3s Fibers are Engineered Micro Fibers with a unique "Triangular" cross-section, used in secondary reinforcement of concrete. Recron 3s Polyester fibers are manufactured in an ISO 9001:2000 facility for use in concrete as a "Secondary reinforcement" at a rate of dosage varying from 0.1% to 0.4% by volume 0.9kgs/Cu. Recron 3s is a modified polyester fiber. It is generally used as secondary reinforcing material in concrete and soil to increase their performance. Use of Recron -3s as a reinforcing material is to increase the strength in various applications like cement based precast products, filtration fabrics etc

Table No.4 -Properties of Recron 3s Polyes Fiber

S.No.	Property	Value
1	Fiber type	Polyester CT 2424
2	Cut length	12mm
3	Effective diameter	20 - 40µ
4	Specific gravity	1.34 - 1.39
5	Melting Point	250 -260□
6	Elongation	20 - 60%
7	Young's modulus	>5000 MPa
8	Alkaline stability	Very good
9	Acid resistance	Excellent
10	Dispersion	Excellent

4. MIX DESIGN

The concrete mix is the process of finding right proportions of cement, sand and aggregates for concrete to achieve target strength in structures. The concrete mix is designed as per IS 10262-1982, IS 456-2000 and SP 16 for the conventional concrete and finally river sand is replaced by M-Sand. The water cement ratio is 0.45 and the mix proportions for M30 grade of concrete.

5. EXPERIMENTAL INVESTIGATION

The results obtained by experimental test conducted on hardened concrete for conventional and Recron 3s polyester fiber reinforced concrete with fiber dosages of 0.5%, 1%, and 1.5%. The test details and results are discussed below.

5.1 FLEXURAL STRENGTH TEST

The example of standard crystal of 700 ×150 ×150 mm was utilized to decide the flexural quality of cement. The material was gauged and the materials were blended physically. The solid was filled in various layers in shape and each layer was compacted with the assistance packing pole. The example was expelled from form following 24 hours, relieved in clean water for 28 days of restoring, the examples are taken out, cleaned dry and afterward tried for flexural quality according to Indian Standard in general testing machine

$fb = (3/2) (PL/bd^2)$ N/mm²

where, P = Ultimate load (N)

L = centre to centre distance between the supports (700mm)

b = breadth of the specimen (150mm)

d = depth of the specimen (150mm)

Table -5 . Flexural strength test

No.of beams caste for test	Age of concrete (Days)	Load at peak (kN)		Flexure strength (N/mm²)		
		CB	BPB	CB	BPB	BRB
1	7	43.63	41.29	27.98	25.67	26.45
1	14	44.20	42.78	29.40	26.37	27.01
1	28	46.29	44.32	31.15	28.82	30.23

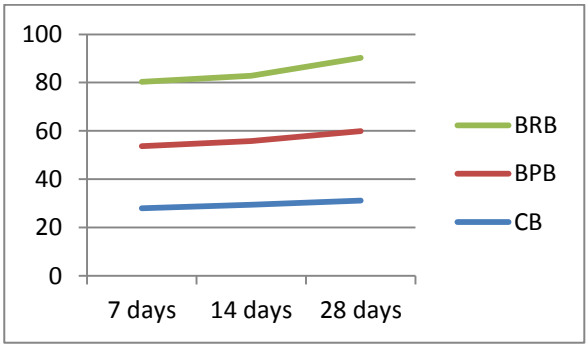

Chart -1 : Flexural strength test

5.2 COMPRESSIVE STRENGTH TEST

Compressive strength test out is completed at particular ages about cubes. Cube specimens of size 150mm × 150mm ×150mm were cast for different dosage of Recron 3s polyester fiber of 0.5%, 1%, and 1.5%. The concrete was filled in distinct layers inside the mould and layer was compacted with the aid of tamping fishing rod. The example of beauty was taken out of mould following 24 hours, treated in tidy water to get 7, 14, 28 days and nights. After 7, 14, and 28 days of solving, the individuals are applied for, wiped dry out and then analyzed for compressive strength according to Indian Common in compressive strength of the specimen calculated using the formula,

$fck = P/A$

Where, fck = Compressive strength (N/mm²)

P = Ultimate load (N)

A = Loaded area (150mm ×150mm)

Table -6. Compressive strength test

No.of cubes casted for test	Age of concrete (Days)	Average compressive strength (N/mm²)		
		CC	BPC	BRC
3	7	14.45	14.08	14.40
3	14	21.86	20.45	21.80
3	28	35.30	33.91	34.38

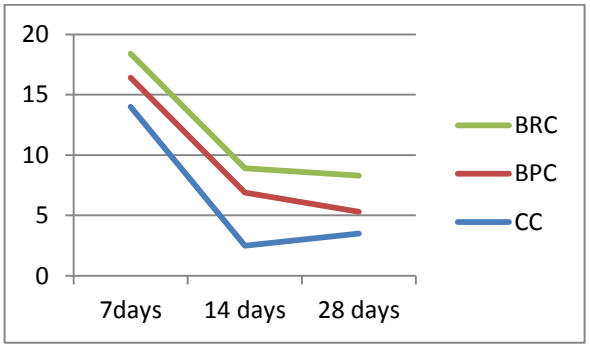

Chart-2: Compressive strength

Where,

CC= Conventional Cube

CB= Conventional Beam

BPC/B = Bubbled Plastic Cube/ Beam

BRC/B= Bubbled Rubber Cube/Beam

5.3 SPLIT TENSILE STRENGTH TEST

The tensile strength of concrete is one of the basic and important properties which greatly affect the extent and size of cracking in structures.

The concrete is very weak in tension due to its brittle nature. Hence it is not expected to resist the direct tension. So, concrete develops cracks when tensile forces exceed its tensile strength.

Splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. The procedure based on the ASTN C496 (Standard Test Method of Cylindrical Concrete Specimen) which similar to other codes like IS 5816 1999.

Table No-7. Average Tensile strength test

S.No	% of super plasticizer	Average Tensile strength (N/mm^2)	
		7 days	28 days
1	10%	3.2	2.7
2	20%	3.0	2.74

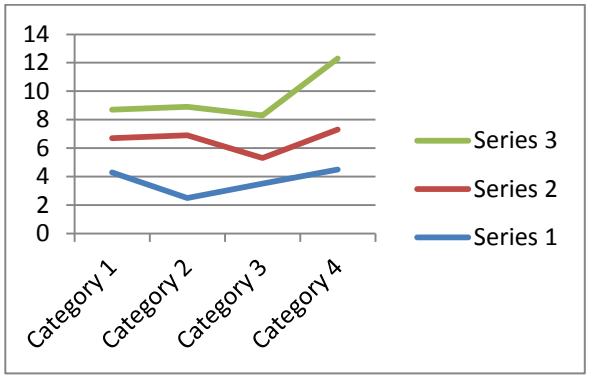

Chart-3: Tensile strength

6. CONCLUSIONS

The flexural behavior of the beam with replaced balls are tested and compared with conventional beam in this study. The theoretical explanation of the test beams were carried out. From this present study the following conclusion are listed.

Flexural behavior of conventional beam and beam with balls are marginally similar. Replacing the concrete by balls in compression zone does not exhibit significant change in the load carrying capacity of the beams.

In this study compared to other ball beams had more load carrying capacity, and deflection of the beam is controlled.

Deflection of the ball beam is considerably lower than the conventional beam.

By replacing concrete with these balls in reinforced concrete beams had no need of additional labors and time. Economically this method is effective and percentage of concrete replaced from beam is based upon count of balls. In this method huge amount of concrete reduction can be done without affecting

REFERENCES

1. Rami A Hawileh, Jamal A Abdalla, Fakherdine Fardmanesh, Poya Shahsana and Abdolreza Khalili 2017 Performance of Reinforced Concrete Beams cast with different percentages of GGBS replacement to cement. Arc. of Civil and Mech. Eng. 17 3511-9

2. Aswathy S Kumar, Anup Joy 2013 Experimental Investigation on partial replacement of concrete below neutral axis of beam. IJSR 8 1670-4

3. Adam M Mnaack and Yahya C Kurama 2012 Behaviour of Reinforced Concrete Beams with Recycled Concrete Coarse Aggregates. J. Str. Eng. ASCE 3 1-12

4. Arati Shetkar and Nagesh Hanche 2015 An Experimental Study On Bubble Deck Beam System With Elliptical Balls pro. NCRIET & Indian J S R 12 21 -7

5. Amer M Ibrahim, Nazar K Ali and Wissam D. Salman 2013 Flexural capacities of reinforced concrete two-way bubble deck beam of plastic spherical voids. D. J. Eng. S. 6 9-20

6. Ade S. Wahyuni, Hamid Nikraz,and Vanissorn Vimonsatit 2012 Reinforced Concrete Beams With Lightweight Concrete Infill. S.R.Eng. 27 2370-9.

7. Paul Makesh A, Moses Aranganathan S and Seileysh Sivaraja S 2011 Cost Effective to Residential