Retrofitting of RC Elements using Basalt Fibre

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Abstract- Concrete is the most widely used construction material in civil engineering industry because of its high structural and stability. In modern construction send concrete increasingly used because of the widespread availability of raw materials. However due to high specific area of the filler its strength characteristics are lower than those of conventional concrete. The most effective are super plasticizer based on polycarboxylate. The concrete used in this investigation was proportioned to target a mean strength of 30 Mpa. Specimens such as cubes, cylinders and prisms beams were used for this work. The specimens were single and doubly wrapped basalt fibre. The mechanical properties such as cube compressive strength, cylinder split tensile strength and prism flexural strength were determined on the conventional specimens. The result shows that the specimen with double wrapping of basal fiber gives better performance when compared with conventional and single wrapped specimens. The result have been analyzed and useful conclusions have been drawn. The results were compared with reference mix.

Keywords – Basalt fibres, Retrofitting, Single wrapping, Double wrapping

I. INTRODUCTION

A structure is designed for specific period and depending on the nature of the structure, its design life varies. For a domestic building, this design life could be low as twenty five years, whereas foe a public building it could be fifty years. Deterioration in concrete structures is a major challenge faced by the infrastructure and bridge industries worldwide. The replacement or reconstruction of the structures will be cost effective, strengthening or retrofitting is an effective way to strengthen the same. Sand concrete lately has been increasingly used because of the widespread availability of raw materials. The properties of sand concrete are determined the same factors as those of conventional concrete. And which is characterized by higher uniformity and fineness, high cement content, lack of hard stone lattice, increased porosity and specific surface area of the solid phase.

II. PROPOSED ALGORITHM

A. Materials Used –

Cement:

The experiment uses the qualiy – guaranteed local cement. Ordinary Portland Cement(53 grades) to IS:12269 was used in the present study. The chemical and physical properties of cement are present in table below,

Table 1. Properties of Cement

Sl.no	Property	Value
1	Specific gravity	3.15
2	Fineness	97.8
3	Initial Setting Time	45 min
4	Final Setting Time	385 min
5	Standard Consistency	30%
6	Fineness Modulus	6%

Fine Aggregate:

Fine aggregate used for SCC should is properly graded to give the minimum voids ratio and shall be free from deterious materials like clay, silt content and chloride contamination. River sand is normally preferred over crushed sand since in the former, particle size is fully water worm by attrition which helps in reduction of water content of mix and also lesser resistance to pumping. SCC contains high quality of cement and fine particles in the form of micro silica and hence use of coarser sand is preparable, Properties such as void ratio, gradation, specific surface and bulk density have to be assessed to design a dense SCC mix with optimum cement content and reduced mixing of water. Locally available river sand was used as one of the constituent in the present work. The water absorption, fineness modulus, specific gravity, bulk density have to be assesed to design a dense SCC mix with optimum cement content and reduced mixing water. Locally available river sand was used as one of the constituent in the present work. The water absorption, fineness modulus, specific gravity, bulk density of river sand was monitored as per IS: 2386-1963 (PartI and II), IS: 383-1970.

Table 2. Properties of Fine Aggregate

Si.No	Property	Value
1	Specific gravity	2.8
2	Fineness modulus	3.1
3	Water absorption	0.5%

Coarse Aggregate:

The coarse aggregate is the strongest and least porous component of concrete. Some important properties of coarse aggregate like crushing strength, durability, modulus of elasticity, gradation, shape and surface texture characteristics, percentage of deleterious materials and flakiness and elongation indices need special consideration while selecting the aggregate for SCC. The shape and size particle size distribution of the aggregate is very important as it affects the packing and voids content. The water absorption, fineness modulus, specific gravity, bulk density of all aggregates should be closely and continuously monitored as per IS:2386 -2963(Part I & II), IS: 383-1970 and must be taken into account in order to produce internal curing concrete of constant quality.

Table 3. Properties of Coarse Aggregate

Sl.No	Property	Value
1	Specific gravity	2.75
2	Fineness modulus	7.3
3	Water absorption	0.5
4	Particle shape	Angular
5	Impact value	15.1
6	Crushing value	18.3

Water:

Water to be used for mixing and curing should be free from impurities. Mixing water quality is required accordance with the quality standards of drinking water.

Epoxy Resin And Hardene:

Epoxy is the cured end product of epoxy resin as well as colloquial name for the epoxide functional group. Epoxy is the common name for a type of strong adhesive used for sticking things. It can also be used as a solver due to its high melting and boiling points. Epoxy resin that can be used as bonding agents between CFRP and concrete surface. Thermosetting resin is used in this work. They do not melt or flow like thermoplastic when heated.

Basalt Fibre:

Basalt fibre is a relative newcomer of fibre reinforced polymers and structural composites. It has a chemical composition as glass fibre but has better strength characteristics. It is a material made from extremely fine fibres of basalt, which is composed of minerals plagioclase, pyroxene and olivine. Basalt is a type of igneous rock formed by the rapid cooling of lava at the surface of a planet. It is the most common rock in the earth's crust. The production of basalt and glass fibre are similar. Crushed basalt rock is the only raw materials required for manufacturing the fibre. In this experimental work basalt fibre used as a retrofitting material. The specimens were singly and doubly wrapped with basalt fibre.

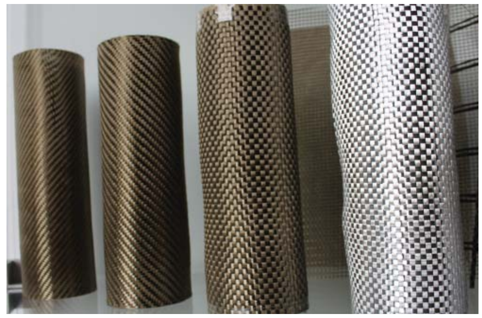

Figure 1. Basalt Fibre

Reinforcement Steel Grill Details:

The reinforcement details of the two specimens are four numbers of 8mm diameters were used for main reinforcement of 300mm spacing c/c, two numbers of 8mm diameters were used for top reinforcement and two numbers of 12mm diameters were used for the bottom reinforcement of beam. The shear reinforcement consist of 6mm diameter and 30mm c/c from the face of beam 300mmc/c.

Figure 2. Reinforcement Steel Grill Details

Casting And Curing:

The sides of mould exposed to concrete were oiled to prevent the side walls to the mould from absorbing water from the concrete and to facilitate easy removal of the specimen. The mould is arranged properly and placed over a smooth surface. The reinforcement cages were placed inside the mould with sides, top and bottom clear covers of 20mm. cement mortar block pieces were used as a cover blocks. The concrete ingredients namely cement, fine aggregate, coarse aggregate, water are weighed accurately and mixed by hand mixing. The mixing was done till a uniform mix was obtained. The concrete immediately after mixing was filled in three layers in the mould and compacting using tamping rod. The test specimens were remolded at the end of 48 hours of casting. They were marked for identifications. They are cured in water for 28 days.

Figure 3. Casting Of Beam And Surface Finishing

Figure 4. Curing Of The Specimen

III. EXPERIMENT AND RESULT

Control beam:

The beam of size 1700*225mm reinforced with two numbers of 12mm dia cast with M20 grade concrete is taken as control beam. The control beam is cured for 28 days and tested under two point loads using Loading frame. The initial crack occurred at 50kN. The failure is a compression failure. The ultimate load is 70kN. The control beam testing as shown in figure

Single Layer And Double Layer Wrapping Beam:

In this case we taken as two beams. The beam of size same as the control beam. The beams are braking at 40 kN using loadin frame. Then the beams are chipping upto neutral axis from the bottom. The epoxy resine and hardener is taken as correct proportions and paste the chipping space of the beams. Then the basalt fibre mat single layer wrapping and double layer wrapping of beams separately. After two days the beams are tested. The initial crack occurred at 50 kN for single layer wrapping and the initial crack occurred at 40 kN for double layer wrapping. The failure is a compression failure. The ultimate load 100kN and 90kN.

Figure 5. control beam testing

Table 4.Deflection test on Specimen

S.No	Load in kN	Deflection in mm			Strain	
		D1	D2	D3	Compression	Tension
1	0	0	0	0	0	0.00001
2	10	0	0.97	0.87	0	0.00001
3	20	1.82	1.22	1.91	0	0. 00001
4	30	2.55	2.49	2.69	0.00001	0.00001
5	40	2.89	2.5	2.94	0.00001	0.00002
6	50	4.28	4.08	3.5	0.00001	0.00002
7	60	4.59	4.56	4.65	0.00001	0.00002
8	70	6.32	6.86	7.21	0.000005	0.000025
Initial Crack = 40 kN Ultimate Crack = 70 kN						

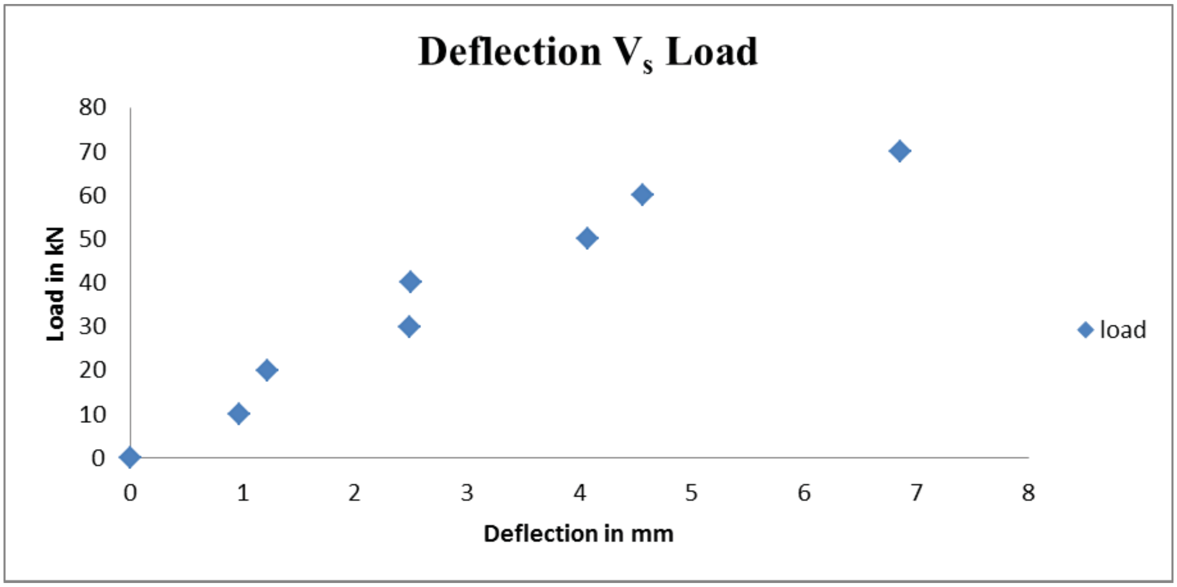

Figure 6. Graph between Deflection and load

IV.CONCLUSION

1. The ultimate load carrying capacity of beam is increased 42.9% compared to control beam
2. The deflection of the beam is decreased 8.347% compared to control beam.
3. The initial crack of the beam is decreased 25% compared to control beam.
4. Thus it can be concluded that basalt fibre can be used as a retrofitting material for concrete specimens.
5. It is proposed to study the behavior of basalt fibre in reinforced concrete piles under lateral and impact loading.
6. Basalt fibre mat used for retrofitting of beam it reduces the crack width.

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