Demonstration of Retrofitted Concrete Cubes, Cylinders and Prisms using Basalt and Glass Wrap

K. Anitha, M. Hemapriya, R.Venkatakrishnaiah

Abstract*: Nowadays improvement in infrastructure construction is raising its place in the present scenario. But around the globe many reinforced masonry and concrete buildings are constructed annually. There are massive numbers of structures which become worse due to adjustments in use, adjustments in loading condition and modifications in design configuration, inferior construction, and material used or natural calamities. Thus, repairing and retrofitting of this structure for secure usage of has a top notch marketplace. There are several conditions wherein a civil structure might require retrofitting. In this paper an attempt has been taken to study the strength enhancement of concrete cylinders and prisms using Basalt fibre wrap, Nitro wrap and nylon wrap.. Cubes, cylinders and prisms are tested for compressive strength test, split tensile strength test, flexural strength. Then the conventional specimens and synthetic wrapped results are compared

Key Words : Retrofitting, Basalt Fiber wrap, Nito carbon fiber wrap, Nylon fiber wrap.

I. INTRODUCTION

A. General

Retrofitting refers to upgrading of existing building systems and damaged buildings to make them more resistant to loading. From the literatures it clearly indicates wrapping technique is the best method of retrofitting.[1]-[5]

B. Admixtures:

Concrete admixtures are used to improve the behaviour of concrete under a variety of type's namely chemical admixtures and mineral admixtures. Chemical admixtures are added to improve performance enhancement and mineral admixtures are added for long term strength and durability performance.

C. Types Of Synthetic Wraps

1. BASALT FIBRE WRAPS
2. GLASS FIBRE WRAPS ., ETC…

D. Uses of Basalt Fibre

- Heat protection
- Friction materials
- Windmill blades
- Ship hulls
- Car bodies
- Sports equipment
- Cavity wall ties
- Load bearing profiles
- CNG cylinders and pipes
- Absorbent for oil spills
- Chopped strand for concrete reinforcement

II. OBJECTIVE AND SCOPE

A. Objective

1. To determine the properties of synthetic wraps.
2. To determine the compressive strength of cubes, cylinders, and Prisms using synthetic wrap for M20 grade concrete
3. To compare the results of concrete cylinders, cubes and prisms using wraps with conventional concrete.

B. Scope

The scope of this research is to improve the physical properties of concrete cylinders and prisms. Even further investigation says that the columns made with these wraps it might bear the earthquake effects more comparative to normal columns. The primary emphasis of this dissertation was to compare the compressive strength of cubes and cores from the same batch of concrete, to identify if similar compressive strengths would be obtained. Further work was done to investigate how the molded cylinder wall would influence the compressive strength compared to the exposed aggregate wall of a core. The experimental investigation included several parameters that could have had an influence on the compressive strength such as aggregate size and type, specimen diameter size, strength of the concrete mix and the manner in which the sample fails.[6]-[10]

III. EXPERIMENTAL INVESTIGATION AND STUDY

Revised Manuscript Received on October 22, 2019.

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Table 1 Specific Gravity Test Of Fine Aggregate:

S.No.	Description of test	Result
A	**Cement**	
i	Consistency test	35%
ii	Initial setting time[in minutes]	35
iii	Specific gravity	3.15
B	**Aggregate**	
i	Sieve analysis of m-sand	Well Graded M-Sand
a.	Specific gravity of coarse aggregate	2.79
b	Specific gravity of m-sand	2.65
ii	Aggregate impact value	13.68%
D	**SUPER PLASTICISER 430**	
i	Specific gravity	1.18
E	**Tests on Fresh PC Mortar**	
i	Slump test	28 cm

B. CONCRETE MIX PROPORTION

Cement = **437.7kg/m³**
Water = **197kg/m³**
Fine aggregate = **726kg/m³**
Coarse aggregate = **1398kg/m**
Water cement ratio = **0.45**

A-10

Table 2:Final mix Proportion of M 20 Grade concrete as follows;

WATER	CEMENT	FA	CA
197	437	726	1398
0.40	1.00	1.66	3.2

C. WORKABILITY TEST:

SLUMP CONE TEST:

The advantages of slump cone is that it is suitable for concrete of high and medium workability. Generally the slump cone test is done to measure the consistency of fresh concrete. It is performed to check the workability of freshly made concrete.. The superplasticiers is mixed with concrete at different percentage and ml. According to arrived water content (or) mix such as 0.40.[11]-[24]

Fig 1 SLUMP CONE TEST

D. CASTING OF SPECIMEN

All the concrete rectangular prisms with a size of 100mm depth and 500mm height were prepared. Among the nine specimens, three concrete cylinders were externally confined by BFRP composites with one, two and three layers and the remaining three concrete cylinders were reference specimens. All the cylinders were casted in single batching and they were effectively compacted by the vibrator to ensure the concrete was free from air gaps and flaws. the effective bond between the concrete and basalt fiber is solely depends upon the surface roughness of the cylinders and it was subjected to sand blasting using coarse sand in order to make the external surface rough1,2. Thereafter, the sand blasted surface was rinsed by acetone to remove the foreign material present in the surface of the cylinder. then the cylinder

Fig .2 Prisms After Casting

E. Process of wrapping:

The specimens are taken out from the water and dried before going for the tests according to the specimen. The all the sides of specimen are smoothened using salt paper and the all the dust is cleaned

thoroughly using brush, then they ready for wrapping.

By the proper mixing of glue according to its ratio(1:0.6) and by using towel and softener applying equally on corresponding sides of the cubes, as well as circumference of cylinders and sides of prisms. The synthetic wraps are being cut according to its required dimensions of cubes, cylinders and rectangular prisms. Now the wraps are being sticked from one side air tighten to avoid the voids. The following picture clearly shows the complete method of manufacture of synthetic wrapped concrete specimens. And let the glue dried by non-disturbing them upto 48 hours.The required tests are done once they are dried.High strength, non-flow, epoxy bedding and repair mortar.[25]-[30]

BASF-MasterBraceADH 2200(GLUE)

Table 3. Properties of Glue

Colour	Cement Grey
Mixed Density at 25°C	1.7g/cm3(approx.)
Flashpoint	N/A
Compression Strength to ASTM C579	60 N/mm² at 7 days
Bond To concrete	In excess of the cohesive strength of concrete
Pot life at 25°C	70 minutes
at 40°C	30-40 minutes
Tack free time	7 hours
at 40°C	2 hours 15 minutes

IV. RESULT AND DISCUSSION

A. Compressive strength test

The concrete is prepared using a baby mixture machine. The steel moulds of size 150 X 150 X 150 mm is filled with concrete and compacted. The Compaction is done by tamping and vibrating table. The mould is filled in three layers and each layer is compacted by means of tamping rod with 25 tamping. After filling the mould the top surface of the mould is finished without any undulation. The prepared specimen is subjected to curing after 24 hours of casting. They were cured in a curing tank for a nominal period of 7 days and 28 days and they were tested. Compressive strength is an important property of hardened concrete which influences other mechanical properties of concrete. [31]-[34]

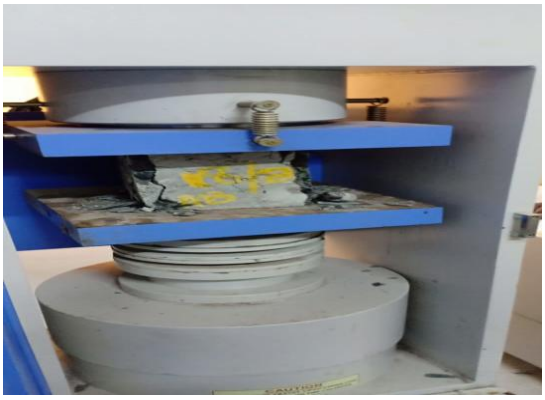


Fig 3 COMPRESSIVE STRENGTH TESTING ON CUBE.

Sample No.	Maximum load on digital indicator (KN)	Area of cubes in mm	Cube strength after 28 days N/mm²
CUBE - 1	649	22500	28.85
CUBE - 2	630	22500	28
CUBE - 3	694	22500	30.8
Average			29.21

Table 4 Compressive strength testing on conventional concrete cubes.

Sample No.	Maximum load on digital indicator (KN)	Area of cubes in mm	Cube strength after 28 days N/mm²
CUBE - 1	780	22500	34.66
CUBE - 2	760	22500	33.78
CUBE - 3	810	22500	36
Average			34.81

Table 5 Compressive strength testing on basalt fibre wrapped concrete cubes

Sample No.	Maximum load on digital indicator (KN)	Area of cubes in mm	Cube strength after 28 days N/mm²
CUBE - 1	747	22500	33.2
CUBE - 2	720	22500	32
CUBE - 3	760	22500	33.7
Average			32.97

Table 6 Compressive strength testing on glass fibre wrapped concrete cubes

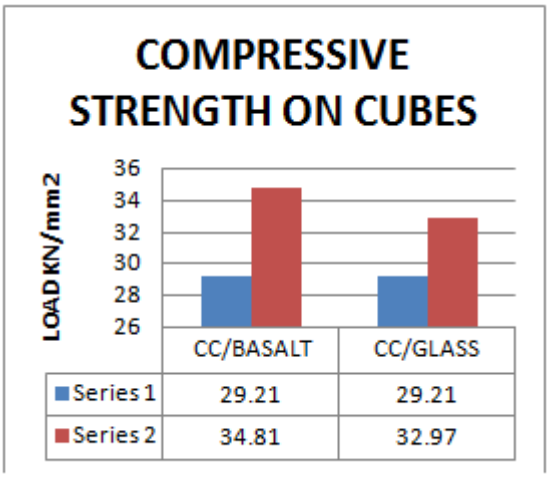


Fig 4 Graph showing comparision of synthetic wrapped cubes with conventional concrete cubes(M20);

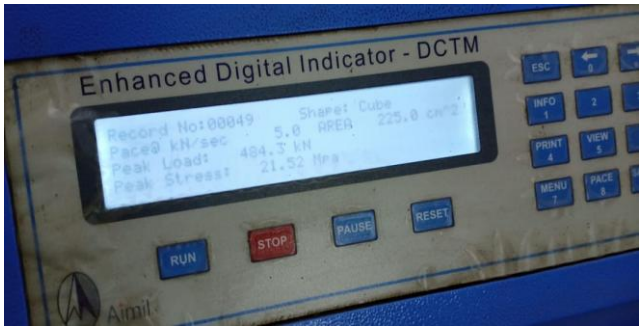


Fig 5 Digital Indicator Of Maxload of Final Reading.

B. Split tensile strength test

The specimen is prepared with designed concrete mix of size 150mm diameter and 300mm height. The concrete is filled in three layers and compacted well and it is vibrate using table vibrator. The specimen is subjected to curing for 28 days, aftercuring the specimen is subjected to testing according to the procedure as per IS: 5816 –1976. The specimen is placed horizontally between the loading surface of the compression testing machine and the load is applied till the specimen fails. The split tensile test apparatus is shown in Figure 3.9 The load is noted for ultimate failure. Split tensile strength of the cylinder was found by using the equation (3.2)

Split tensile strength = $2P/\pi L D$

Where,

P is the compressive load on the cylinder

L is the length of the cylinder

D is the diameter of the cylinder

Sample No.	Maximum load on digital indicator (KN)	Area of cylinder in mm	cylinder strength after 28 days N/mm²
CYLINDER 1	176	94200	3.7
CYLINDER 2	160	94200	3.39
CYLINDER 3	185	94200	3.92
Average			3.67

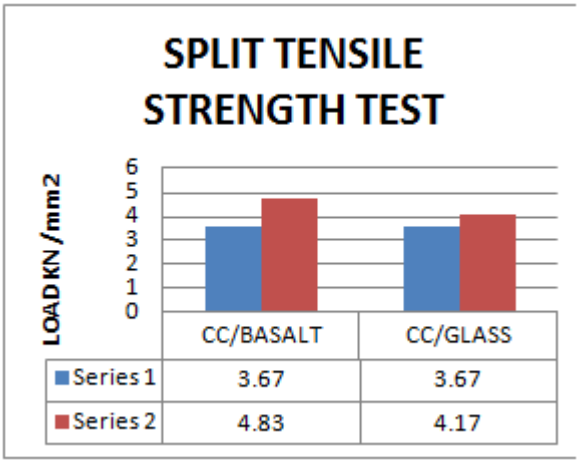
Table 7 Split tensile strength testing on conventional concrete cylinders

Sample No.	Maximum load on digital indicator (KN)	Area of cylinder in mm	Cylinder strength after 28 days N/mm²
CYLINDER 1	228.8	94200	4.85
CYLINDER 2	210	94200	4.55
CYLINDER 3	240	94200	5.09
Average			4.83

Table 8 Split tensile strength testing on basalt fibre wrapped concrete cylinders.

Sample No.	Maximum load on digital indicator (KN)	Area of cylinder in mm	Cylinder strength after 28 days N/mm²
CYLINDER 1	202	94200	4.28
CYLINDER 2	198	94200	4.20
CYLINDER 3	190	94200	4.03
Average			4.17

Table 9 Split tensile strength testing on glass fibre wrapped concrete cylinders.



B. Flexural strength test

The beams are casted of size 500 x 100 x 100 mm and subjected to 28 days of strength. They are tested according to IS 516 – 1959. Two point loading. The tamping bar should be a steel bar weighing 2 kg, 40 cm long and should have a ramming face 25mm square. The bed of testing machine should be provided with two rollers of 38mm diameter on which the specimens are placed and the rollers are spaced such that the distance between two rollers should be 40 cm. Flexural strength of the beam was found by using the equation below. The flexural strength test apparatus is shown in Figure 3.10.Flexural strength of the beam was found by using the equation below in Equation (3.3)

Flexural strength of the specimen is expressed as,

Modulus of rupture (f b) = $\frac{PL}{bd^2}$

Where,

P is the load applied

L is the length of the specimen

b is the breadth of the beam

d is the depth of the beam

Sample No.	Maximum load on load indicator (KN)	Area of rectangular prisms in mm	Flexural strength after 28 days N/mm²
PRISM -1	470x9.81	500x100x100	4.49
PRISM -2	450x9.81	500x100x100	4.30
PRISM -3	470x9.81	500x100x100	4.49
Average			4.42

Table 10 Flexuralstrength testing on conventional concrete rectangular prisms

Sample No.	Maximum load on load indicator (KN)	Area of rectangular prisms in mm	Flexural strength after 28 days N/mm²
PRISM -1	650x9.81	500x100x100	6.20
PRISM -2	630x9.81	500x100x100	6.02
PRISM -3	660x9.81	500x100x100	6.31
Average			6.17

Sample No.	Maximum load on load indicator (KN)	Area of rectangular prisms in mm	Flexural strength after 28 days N/mm^2
PRISM -1	530x9.81	500x100x100	5.06
PRISM- 2	540x9.81	500x100x100	5.16
PRISM -3	525x9.81	500x100x100	5.02
Average			5.08

TABLE 11 FLEXURALSTRENGTH TESTING ON GLASS FIBRE WRAPPED CONCRETE RECTANGULAR PRISMS.

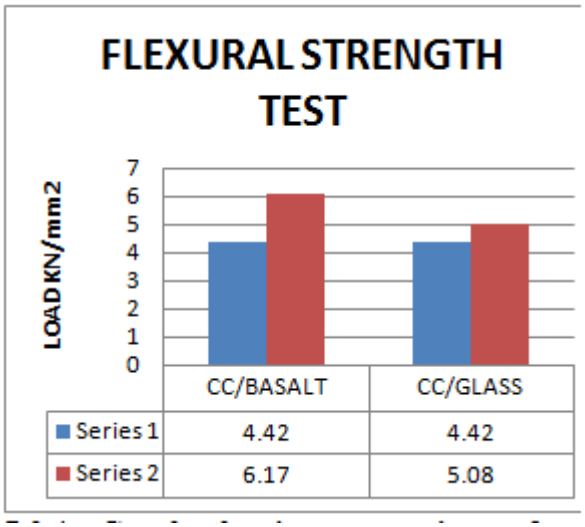


FIG 7 SHOWING COMPARISON OF SYNTHETIC WRAPPED RECTANGULAR PRISMS

with conventional concrete prisms(M20);

fig 8 images showing the bending moment while doing flexural test

Fig 9specimens After Completion Of Test

V. CONCLUSION

1. The synthetic fiber wrapped specimens proves to be capable of withstanding greater loads.
2. The compressive strength of the cylindrical specimens wrapped with basalt fiber wrap increases by 18%, basalt and glass carbon fiber wrap increase by 14.6% and nylon fiber wrap increases by 15.8% than controlled specimens.
3. The Split Tensile strength of the cylinder specimens wrapped with basalt fiber wrap increases by 7 times, basalt and glass carbon fiber wrap increases by 7 times and nylon fiber wrap increases by 8 times.
4. The Flexural strength of the prism specimens wrapped with basalt fiber wrap increases by 2.5 times, basalt and glass carbon fiber wrap increases by 2 times than controlled specimens.
5. The Use of the basalt fiber wrap, basalt and glass carbon fiber wrap and nylon fiber wrap enhances the strength behavior of the concrete specimen.
6. Among these three fibers wrap basalt fiber wrap shows more strength enhancement.

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