

Comparison of Carbon Laminated Concrete with Conventional Concrete

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Abstract:-- The shortage of conventional construction material is causing many problems in construction practices. One of the alternatives for conventional material is carbon lamination which is helpful for refurbishment as well as while for the construction of new structure. The study made is focussing on the comparison of carbon laminated concrete with conventional concrete on the parameters of compressive strength and tensile strength. The results in this aspect are encouraging.

Index Terms:— Carbon Lamination, compressive strength, split tensile strength.

I. INTRODUCTION

Everything which was created by man has an end only thing the life can be extended as in case of structures service life of structure can be extended by giving some renovation/ refurbishing treatment to a structure like concrete jacketing, steel jacketing, FRP wrapping. In case of FRP there are different types of materials like steel, glass, natural, but the material which is light weight with high strength is carbon fibre. It has high strength with low weight.

Carbon fibre, alternatively graphite fibre, carbon graphite or CF is a material consisting of fibres about 5–10 μm in diameter and composed mostly of carbon atoms. The carbon atoms are bonded together in crystals that are more or less aligned parallel to the long axis of the fibre. The properties of carbon fibres, such as high stiffness, high tensile strength, low weight, high chemical resistance, high temperature tolerance and low thermal expansion make them very popular in aerospace, civil engineering, military, and motorsports along with other competition sports. Carbon lamination is a two components composite material consisting of high strength fibers embedded in polymer matrix. Fiber Reinforced Polymers (FRP) sheets are innovative and sustainable building material being developed during last 20-30 years.

II. MATERIALS AND METHODS

The specimen of concrete is prepared for M30 Grade of concrete as per guidance of IS456:2000, set of three cube specimen of size 15cm X15cm X 15cm. one with

fibre wrapping and another without fibre wrapping. Same is prepared with concrete cylinders of size 15 cm Dia. And 30 cm height.

Lamination of carbon fibres to concrete

The execution of strengthening should be carried out according to the steps below; special care should be taken to ensure high quality work.

1. Tensile bond strength of concrete is to be measured. It is generally accepted that it should reach at least 1.5 N/mm².
2. Preparation of concrete surface: Mechanical cleaning should be carried out, grinding of surface is carried out then deep surface holes are levelled.
3. Measuring the water content of concrete surface before apply the adhesive.
4. Cleaning the concrete surface.
5. Marking the location of strengthening strips.
6. Cutting the strengthening strips as per desired length.
7. Cleaning the strengthening strips for excessive carbon and other dust for better adhesion.
8. Application of adhesive as well as carbon strips on concrete.
9. Protective layer such as sand layer can be applied for aesthetic reason.



Figure 1 Grinding of concrete surface



Figure 4 Mixing of chemicals



Figure 2 filling the holes with cement plaster



Figure 5 Application of resin layer



Figure 3 Addition of chemicals



Figure 6 Application of carbon fiber material



Figure 7 compression test



Figure 8 split tensile test

III. TESTING OF SPECIMEN

All specimens were tested on UTM1000 universal testing machine available in strength of material lab at SITCOE, Yadrav, Ichalkaranji. The cylinders were tested for split tensile strength as per IS5816:1999, and cubes were tested for compressive strength.



Figure 9 Failure pattern for split tensile test

IV. RESULTS AND DISCUSSIONS

Compression test:

Cube Type	Specimen No.	Compressive strength in N/mm ²	Average strength in N/mm ²
Without carbon lamination	CUBE 1	40.13	39.14
	CUBE 2	38.06	
	CUBE 3	39.24	
With carbon lamination	CUBE 1	41.70	41.13
	CUBE 2	40.76	
	CUBE 3	40.94	

Here it can be directly observed that after wrapping the concrete with carbon fibre sheets the compressive strength of concrete is increased by 5.08%. Which is not that significant.

Split tensile strength:

Cylinder Type	Specimen No.	Split tensile strength in N/mm ²	Average strength in N/mm ²
Without carbon lamination	CYLINDER 1	5.92	6.03
	CYLINDER 2	6.01	
	CYLINDER 3	6.18	
With carbon lamination	CYLINDER 1	13.94	13.51
	CYLINDER 2	13.09	
	CYLINDER 3	13.50	

Here it can be directly observed that after wrapping the concrete with carbon fibre sheets the split tensile strength of concrete is increased by 124.05%. This is appreciably more.

V. CONCLUSIONS

Carbon fibre wrapping or lamination to concrete increases its strength in tension rather than compression significantly. It is proving one of the best retrofitting as well as new construction material due to its high strength and low weight and easy application methods.

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