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Flexural Strengthening of R.C.C. Beam with Fiber-Reinforced Polymer (F.R.P) Composite

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ABTRACT: *The (F.R.P) fibre-reinforced polymer composites are generally use in Advance Concrete Technology give positive result usually in steel reinforcement structure.*

Ffibre reinforced polymer, this material have high strength capacity and resist from corrosion effect, it can be easily apply over the concrete surface with the help of adhesive epoxy for example aral dite. Strength and its workability and ductility as well is improved by using this frp, the composite behavior is completely controlled by fibre type for strenghthening.

INTRODUCTION

This fribre reinforced polymer consists of many layers which comprised different fibres together. Basically there are few types of Fibre reinforced materials like- GLASS-FIBRE, CARBON-FIBRE , ARAMID-FIBRE and BASALY-FRP. This material can be use over the concrete surface by covering or laminating with the help of adhesive such as aral dite. Figure below showing the technique of laminating the FRP sheet over the surface of cylinder from all th sides with help of adhesive. This covering is a manual work which can be easily apply over the beam or any cracked surface to prevent from any cause of damage in structure.

Methods and process:

- Measure the dry proportion of ingredients (Cement, Sand & Coarse Aggregate) as per the design requirements.
- The Ingredients should be sufficient enough to cast sample test Beams of size 75 cm length and 15 cm width.
- Thoroughly mix the dry ingredients to obtain the uniform mixture.
- Add design quantity of water to the dry proportion (water-cement ratio) and mix well to obtain uniform texture.
- Fill the concrete to the mould with the help of vibrator for thorough compaction.

Finish the top of the concrete by trowel & tapped well till the cement slurry comes to the top of the beams as shown:

CURING:

- After some time the mould should be covered with red gunny bag and put undisturbed for 24 hours at a temperature of 27 ° Celsius ± 2
- After 24 hours remove the specimen from the mould.
- Keep the specimen submerged under fresh water at 27 ° Celsius. The specimen should be kept for 7 or 28 days. Every 7 days the water should be renewed.
- The specimen should be removed from the water 30 minutes prior to the testing.
- The specimen should be in dry condition before conducting the testing.

BASIC DETAILS OF FRP

Basically this fibre reinforced polymer has already used in various country in their heavy constructions of hospitals, bridges and in the aeronotical areas, There are various types of FRP but the common used fibres are carbon fibre with the unit weight of 1.5 g per cm^3 to 1.6 g per cm^3 and other FRP such as Glass Fibre's unit weight is 1.2g per cm^3 to 2.1g per cm^3 , aramid fibre;s unitr weight is 1.2 gper cm^3 to 1.5g per cm^3 .

Generally the carvon FRP is quiet five times lighter than the steel and can be easily apply over the surface of structure because it consist of high strength capacity and increase the life of structure by protecting it from any cause of physical damage and also from any cause of chemical effects as it is corrosion resistance material. It has been tested and used in various constructions as well.

REQUIREMENT OF ADHESIVE:

For laminating or covering the layers of fibre composite we usually use a good quality of adhesive such as aral dite or fastners, to create proper bonding between FRP and concrete's surface . we can also called as a resins that create a strong bond in a very less time, it is in a liquid form with a high viscosity, as soon as we apply it over the surface area and fibre reinforced polymer it works as a glue.

According to the theory and test the unit weight of epoxy resins is 1.1 kg per m^3 1.4 kg per m^3 and also weights/unit surface area is of approx 0.5kg per m^2. This epoxies are use to apply over the surface to be treated of RC beams. It also used in reparing portions, epoxy resins generally have the tensile strength of 30MPa to 6MP and max. elongation failure at 0.9% to 4.5%, elstic modulus is 1.1 GPa to 6.00 GPa . the required time period for the curing is 3 to 14 days at the temp. of 16 degree to 23 degree.

WRAPPING OF FRP COMPOSITES WITH ADHESIVE:

Basicalliy for the lab Test we casted samples of Beams of size 30 cm length and 15 cm width as shown in the above figures. By doing the lab work we achieved the positive output as increase in strength with the help of compression testing machine.

Firstly we tested the samples Beam without wrapping fibre reinforced composite then at the same time we tested the samples of beam fully Wrapped with Fibre-reinforced composite (FRP).

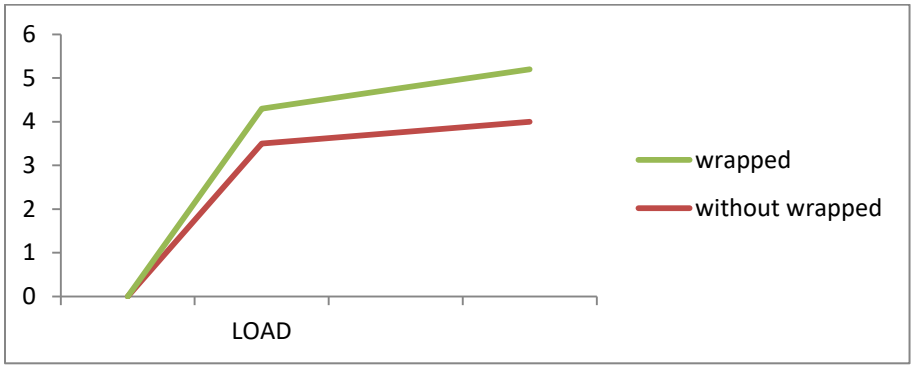
Testing

- Now place the concrete Beams into the testing machine individually. (centrally)
- The Beam should be placed correctly on the machine plate (check the circle marks on the machine). Carefully align the specimen with the rectangular size seated plate of 75 cm length and 15 cm width.
- The load will be applied to the specimen axially.
- Now slowly apply the load at the rate of 140kg/cm2 per minute till the Beam collapse.
- The maximum load at which the specimen breaks is taken as a compressive load.

By following all the procedures, we got the results separately for beams without wrapped FRP(fibre-reinforced polymer) and beams wrapped with FRP, so practically we observe that after the collapse of beams without FRP the beams collapse and breakdown into two parts as shown below but the beams which are wrapped with FRP composite not only increased in strength but also wrapped after collapse and did not break the bond with FRP (fibre-reinforced polymer) composite. That simply means that after any cause of damage or collapse of beam it will remain stable and bonded with FRP and will not leave the bond or fall down easily.

Above Casted Beam of grade M20, mix grade 1:1.5:3 with water-cement ratio 0.5 tested until it collapse in compression Testing machine and obtained the average strength of 3 samples of beam without wrapping FRP (fibre-reinforced polymer) of 35.10 N/mm^2.

Table showing the readings of beam:



CONCLUSIONS

1) By using fibre reinforced polymer FRP we obtain the positive result, increase strenthn of RCC member.
2) The FRP has high Tensile strength and also give the strength of almost double as of original because of low elastic modulus of Fibre reinforced polymer.
3) Apart from this it also protect the RCC beam or any concrete surface covered with FRP from Corrosion.
4) There various advantages of using this moder material in RCC beams or any other concrete surface such as it is quiet light in weight so that it can be easily transport from one place to another, it can be easily apply manually no machine is required for this work. It can be also use in repairing work.
5) The most important thing to be understand of using this FRP sheet is that it resist the displacement of any RCC beam after the breakdown or cracked formed, it holds the cracks together and breaked beam to prevent from any accident that can cause damage to labours or anyone.
6) It is completely favourable in all weathers as it has high resistance capacity, higher stiffness, durable as well.

REFERENCES

i. E.GUDONIS, E TIMINSKAS, V GRIBNIAK, G KAKLAUSKAS, A K ARNAUTOV, V TAMULENAS, fibre – Reinforcement for the concrete structures,
State of the art review of application and design, eng. Structural technology,
2014 (147-158) doi – 10.3846/2029882X.2014.889274.
ii. A.GHOBARAH, M.N GHORBEL, S.E CHIDIAC, Upgrading the torsional resistance of reinforced concrete beams using polymer, J.COMPOS construction 06 -2002 (257-263) doi-10.1061/asce1090-0268 (2002) 6:4-257.
iii. T.ROUSAKIS, retrofitting & strengthening of contemprorary structures, material used in M.Beer, I.A KOUGIOUMTZOGLOU, E. PATELLI, I.K AU-EDs, ENCYCL. EARTHQUAKE ENGINNERING BERLIN HEIDELBERG, BERLIN, HEIDELBERG, and – pp1-15 doi- 10.1007/978-3-642-36195-5_303-1.
iv. L. KOUTAS, T.C TRIANTAFILLOU, USE OF ANCHORS IN SHEAR STRENGTHENING OF REINFORCED CONCRETE T-BEAMS WITH FRP, J COMPOS CONSTRUCTION 17 (2013) 101-107.doi-1061/(ASCE) CC.1943-5614.0000316.