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GLASS FIBER WRAPPED STRUCTURAL MEMBERS

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ABSTRACT

In recent year research is growing dramatically around the use of fiber reinforced plastic wraps, laminates strengthening of concrete members etc. From many decades the traditional techniques serving our needs within that fiber-reinforced polymer (FRP) application is effective solution to repair and strengthen structures. The glass fiber wrapping solution is mostly used for strengthening the structured member like beam, column and structural member. FRP is best alternative with respect to the money as compared to traditional repair system and material, it also provide durability and high load carrying capabilities to the weak structure.

Reinforced concrete beams with epoxy-bonded GFRP sheets were tested for failure and that is done by using symmetrical two point concentrated static loading system. Three beams are used within that one is controlled beam and other two are strengthen by applying glass fiber reinforced polymer (GFRP) sheet shear, while doing strengthening different configurations are experimented. For each beam the experiment data on load, deflection and failure modes are obtained.

Keywords—Epoxy, Glass Fiber Reinforced Polymer (GFRP), Deflection.

I. INTRODUCTION

In civil engineering industry maintenance and rehabilitation work of any structure is critical problem. It needs more money and time. But, to overcome this problem application of GFRP is key solution. GFRP material is non-corrosive, non-magnetic and resistance to various type of chemical. Externally bonded GFRP can be used to enhance the flexural, shear and tortional strength or capacity of members. Past structure are unsafe according to new design code. To increase strength and load carrying capacity of such structure application of GFRP is effective.

Additional strength may be needed to allow for higher loads to be placed on the structure. This is often required when the use of the structure changes and a higher load-carrying capacity is needed. This can also occur if additional mechanical equipment, filing systems, planters, or other items are being added to a structure. When dealing with such circumstances, each project has its own set of restrictions and demands. Whether addressing space restrictions, constructability restrictions, durability. Demands, or any number of other issues, each project requires a great deal of creativity in arriving at a strengthening solution.

Strengthening systems can improve the resistance of the existing structure to internal forces in either a passive or active manner. Passive strengthening systems are typically engaged only when additional loads, beyond those existing at the time of installation, are applied to the structure. Bonding steel plates or fiber-reinforced polymer

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(FRP) composites on the structural members are examples of passive strengthening systems. Active strengthening systems typically engage the structure instantaneously and may be accomplished by introducing external forces to the member that counteract the effects of internal forces. Examples of this include the use of external post-tensioning systems or by jacking the member to relieve or transfer existing load. Whether passive or active, the main challenge is to achieve composite behavior between the existing structure and the new strengthening elements.

In order to avoid the problems created by the corrosion of steel reinforcement in concrete structures, research has demonstrated that one could replace the steel reinforcement by fiber reinforced polymer (FRP) reinforcement. Corrosion of the steel reinforcement in reinforced concrete (RC) structures affects the strength of both the steel and the concrete. The strength of a corroding steel reinforcing bar is reduced because of a reduction in the cross-sectional area of the steel bar. While the steel reinforcing bars are corroding, the concrete integrity is impaired because of cracking of the concrete cover caused by the expansion of the corrosion products.

II. LITERATURE REVIEW

In literature many people’s done research in glass fiber mapped structural members.

History and General Overview of FRP Fiber reinforced polymer materials offer significant potential in the field of civil engineering. FRPs are not chronologically new materials, but have been used in the aerospace industry for a number of decades. Limited demand and manufacturing procedures of FRP material has traditionally resulted in high material costs. The first structures retrofits with these materials were in the late 1950's by H. Islet (Meier 1992a). The first bridges to use FRP materials in the USA were in the late 1970's. Throughout the 1990's, an increased interest in these materials has resulted from the need to efficiently retrofit deteriorating structures.Although much scientific interest in FRP has involved such uses as cables pre-stressing tendons and primary structural elements, most applications to-date involve retrofit with FRP plates or fabrics. This is primarily the result of three factors: material cost, designer unfamiliarity and insufficient behavioural understanding.

In [2] the author provided experimental study analysis on glass fiber concrete where the main aim was to study the effect of glass fibre with respect to concrete.

The Author in [2] the fly ash reinforced concrete beam wrapped with GFRP sheet is proposed in which the paper investigate about the flexural behaviour of fly ash reinforced beam wrapped with GFRP sheet.

The research in [3] the externally strengthened with FRP Composites are proposed.

In the [4] the authors provided the engineering properties of FRP as a repair and retrofit material for infrastructure.

The author in [5] paper investigated the rectangular cross section and span 700 mm were casted and tested. Three main variables which are strength, ductility and damage level of R.C.C under reinforced beam and R.C.C beam weak in flexure were investigated.

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III. PROPOSED SYSTEM

Following steps contains the procedures about fiber reinforced wrapping material.

Step1 Grinding Work

In columns apart from the grinding at plain surface areas it is also necessary to remove all the sharp corners with grinder and form at least a minimum of 20 - 25mm radius for proper application of fiber wrap system

Step2 Forming Radius at Corners (using R&M radius gauge)

Before applying primer coat the grinding work throughout the surface should be completed and in case of sharp edges in columns and beams the radius of corners must be maintained for better performance of the wrapping system.

Step3 Grooving in columns

Parallel to the surface grinding work, also prepare the grooves as per the laminate width & require depth for end anchoring on both sides to the laminate for better strength with Epoxy adhesive.

Step4 Drilling for Anchors

Before, the primer work drilling of anchors is done, for which marking has to be done at the center of the overlapping distance as specified (or) given in the drawing. The depth of the drilling is as per the size of Fiber Anchors, which is almost 50mm to 60mm long.

Step5 Primer Coating (R&M Resin Primer-11).

In order to promote adhesion and prevent the surface from drawing resin from the FRP, a low viscosity epoxy primer compatible to the substrate is applied with a roller until the substrate is locally saturated.

Fig.1.Migration from relational database to NoSQL

Fig.1: Primer Coating on column

Step6 Application of Epoxy Putty

The adhesive, high viscosity putty is applied on the surface wherever it is necessary to fill the porosities to make it smooth & uniform in nature.

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Fig.2:Application of epoxy putty

Step7 Cutting Fiber to required length

In a clean area away from the resins, the fabric (Carbon) is carefully measured and cut in accordance with the specifications.

Step 8 Apply Fiber Wrapping: (Just after Epoxy Coating)

Immediately after applying the epoxy layer we must start doing fiber wrapping around the surface as per the guidelines of the manufacturer. While wrapping roller application with pressure is must so that the fiber should get properly embedded in the epoxy for superior bonding with concrete which results in developing a better strength.

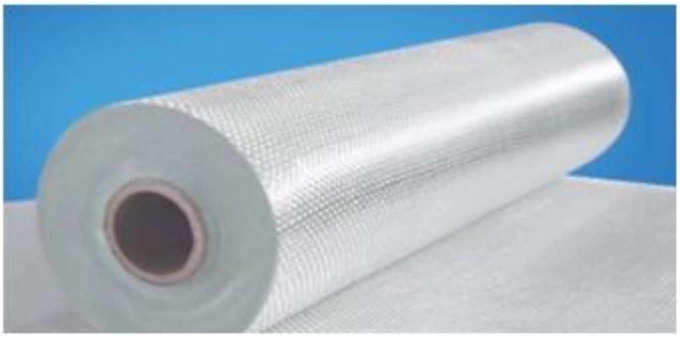

Fig.3: Cutting Fiber to required length

Step 9 Fixing Of Fiber Anchors

After completing the wrapping work fiber anchors are normally applied at the ends of the wraps on columns & beams as well as where overlapping joints occur. The anchor is inserted in the drilled hole as shown in the figure and then protruding fibers are manually spread in circular shape so that it should give a locking effect from all 360°.

The purpose of placing fiber anchor is to hold the ends & joints of the wrap so that it should not peel off from the ends in any circumstances and it provides a long lasting life to the fiber wrapping system.

Step10 Application of Epoxy

Second coat of Saturate (Just after fixing of fiber anchor) after completing the wrapping, second coat of Epoxy Saturate is applied.

Step11 Sand sprinkling on Column after Strengthening

Sand sprinkling is done to make the surface rough for plastering purpose as well for the safety of strengthened member.

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IV RESULTS AND ANALYSIS

Table 1 Results of cylinder testing

Sr. No	Sizes(mm)	Load(KN)	Compressive strength(Mpa)	Lab ID
1.	150*301	464.9	26.30	Bare
2.	150*302	653	36.99	Bare
3.	154*304	728.7	41.23	1 layer CFRP 400 gsm
4	154*304	795.3	45.00	1 layer CFRP 400gsm
5	154*303	976.3	55.25	2 layer CFRP 300gsm
6	155*301	1052.6	59.55	2 layer CFRP 300gsm

The table 1 shows the results of cylinder testing which shows sizes in mm of column, and load in KN and compressive strength of cylinder in Mpa with different lab IDs.

V CONCLUSION

GFRP wrapping is one of the non-destructive ways for strengthening the given concrete member.

The Fiber-reinforced plastic is a composite material made of polymer matrix reinforced with fibres. The ultimate strength is increased defiantly but how much it is unpredictable. By use of the GFRP wrapping in the beams, the initial cracks are formed at higher loads than their control beams.

The increase in strength of beam defiantly depends upon the increasing number of laminates provided to the beam.

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