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Increase in Flexural Strength of Beams by using FRP Composites

SubhasChSahoo
M.RATH

Abstract

During its whole life span, nearly all engineering structures ranging from residential building to power stations and bridges faces degradation or deteriorations. The main causes for those deteriorations are environmental effects including corrosion of steel, gradual loss of strength with ageing, variation in temperature, freeze-thaw cycles, repeated high intensity loading, contact with chemicals and saline water and exposer to Ultra-violet radiations. Addition to these environmental effects earthquakes is also a major cause of deterioration of any structure. This problem needs development of successful structural retrofit technologies. So it is very important to have a check upon the continuing performance of the civil engineering infrastructures. The structural retrofit problem has two options; repair/retrofit or demolition/reconstruction means complete replacement of an existing structure may not be a cost-effective

Keywords:

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two point test
frp

Author correspondence:

M.K.RATH
Profesor Department of Civil Engineering
Centurion University of Technology, Bhubaneswar

1. Introduction

To overcome some of the shortcomings that are associated with steel plate bonding, it was proposed in the mid-1980s that fiber reinforced polymer (FRP) plates could prove advantageous over steel plates in strengthening applications Consequently, corrosion-resistant systems are not required, making preparation prior to bonding and maintenance after installation less arduous than for steel. The reinforcing fibers can be introduced in a certain position, volume fraction and direction in the matrix to obtain maximum efficiency, allowing the composites to be tailor made to suit the required shape and specification. The resulting materials are non-magnetic, non-conductive and have high specific strength and stiffness in the fiber direction at a fraction of the weight of steel. They are consequently easier to transport and handle, require less false work, can be used in areas of limited access and do not add significant loads to the

[1] Shahawy et.al 1996 by experiment found that strengthened of CFRP laminates over a reinforced concrete rectangular beams [2] Victor et.al 1996 studied the how the externally bonded woven composite fabrics reinforced concrete beams will increase in strength [3] Takeda 1996 observed experimentally the flexural behaviour of reinforced concrete beamsstrengthened with carbon fibre sheets [4] Spadea1998 observed the structural behavior of composite RC Beams with externally bonded CFRP [5] Khalifa 1998 experimentally observed the externally bonded FRP how to increase the shear capacity of RC flexural members [6] Grace 1999observe the Strengthening behavior of Reinforced Concrete Beams by using fiber reinforced polymer laminates

2. Research Method

Concrete is a composite construction material composed of aggregate, cement and water. There are many formulations that have varied properties. The aggregate is generally coarse gravel or crushed rocks such as limestone, or granite, along with a fine aggregate such as sand. The cement and water form a paste which hardens by chemical reaction into a strong, stone-like mass. The inert materials are called aggregates, and for economy no more cement paste is used than is necessary to coat all the aggregate surfaces and fill all the voids. The concrete paste is plastic and easily molded into any form or troweled to produce a smooth surface. Hardening begins immediately, but precautions are taken, usually by covering, to avoid rapid loss of moisture since the presence of water is necessary to continue the chemical reaction and increase the strength. Too much water, however, produces a concrete that is more porous and weaker. The quality of the paste formed by the cement and water largely determines the character of the concrete. Proportioning of the ingredients of concrete is referred to as designing the mixture, and for most structural work the concrete is designed to give compressive strengths of 15 to 35 MPa.

Mix Design of M25 Grade Concrete

Design Stipulations

(a) Characteristics strength (fck) =25N/mm^2

(b) Maximum water cement ratio (w/c) =0.5

Materials supplied

(a)Cement: KonarkPortland Slag cement (PSC)

(b)Course aggregate: 20mm & 10mm down

(c)Fine aggregate: Sand conforming to grading zone IV

SET-1:

The cross sectional dimensions of the set of beams is 100 mm by 100 mm and length is 500mm. 4, 12 mm φ bars are provided as the Main longitudinal reinforcement and 8 mm φ bars as stirrups at a spacing of 150mm.

SET-1 (28 days testing conducted with one point load)

2.1 EXPERIMENTAL SETUP

All the specimens were tested in the loading frame of the “Structural Engineering” Laboratory of Centurion University of Technology, Bhubaneswar. The testing procedure for the entire Specimen was not same. Two type of testing procedures are adopted .After the curing period of 28 days & 7 days was over, the beam as washed and its surface was cleaned for clear visibility of cracks. The most commonly used load arrangement for testing of beams will consist of one point loading & two-point loading. This has the advantage of a substantial region of nearly uniform moment coupled with very small shears, enabling the bending capacity of the central portion to be assessed. If the shear capacity of the member is to be assessed, the load will normally be concentrated at a suitable shorter distance from a support.

One-point loading can be conveniently provided by the arrangement of UTM machine .Two point loading can be provided by the arrangement of flexural testing machine. The loading frame must be capable of carrying the expected test loads without significant distortion. Ease of access the middle third for crack observation.

The specimen was placed over two steel rollers bearing leaving 50mm from the end of the beam. The remaining was divided into three equal parts. Two point loading and one point loading arrangement was done as shown in the figure. Loading was done by the machine of capacity 100 KN.

One point load test

2.2 TEST PROCEDURE

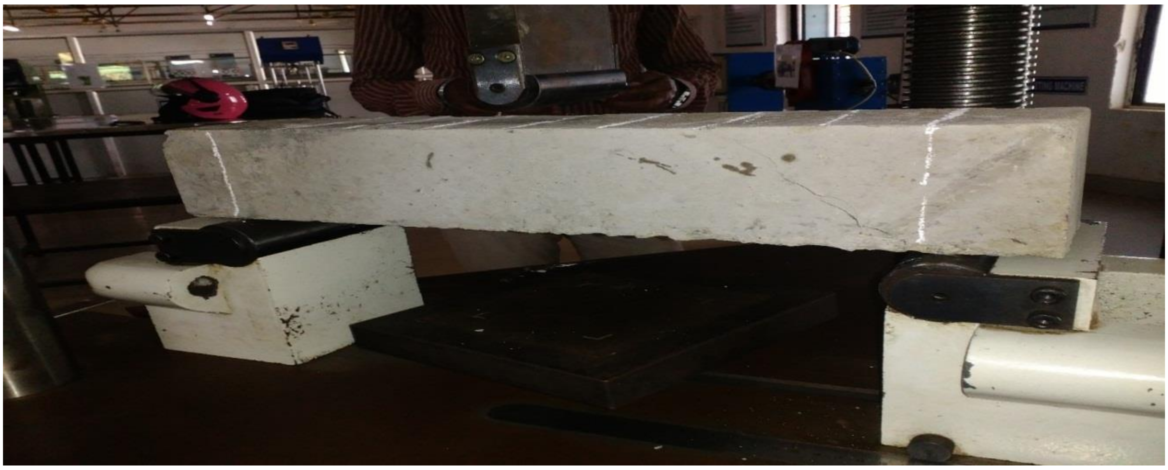
Before testing the member was checked dimensionally, and a detailed visual inspection made with all information carefully recorded. After setting and reading all gauges, the load was increased incrementally up to the calculated working load, with loads and deflections recorded at each stage. Loads will then normally be increased again in similar increments up to failure, with deflection gauges replaced by a suitably mounted scale as failure approaches. This is necessary to avoid damage to gauges, and although accuracy is reduced, the deflections at this stage will usually be large and easily measured from a distance. Similarly, cracking and manual strain observations must be suspended as failure approaches unless special safety precautions are taken. If it is essential that precise deflection readings are taken up to collapse. Cracking and failure mode was checked visually, and a load/deflection plot was prepared. This chapter describes the experimental results of SET I beams (weak in flexure), SET 2 beams (weak in flexure) and SET 3 beams (weak in flexure). Their behavior throughout the static test to failure is described using recorded data on deflection behavior and the ultimate load carrying capacity are tested SET-1: Test conducted using one point load

Beam-1

Control beam

Experimental set up for control beam

Control beam

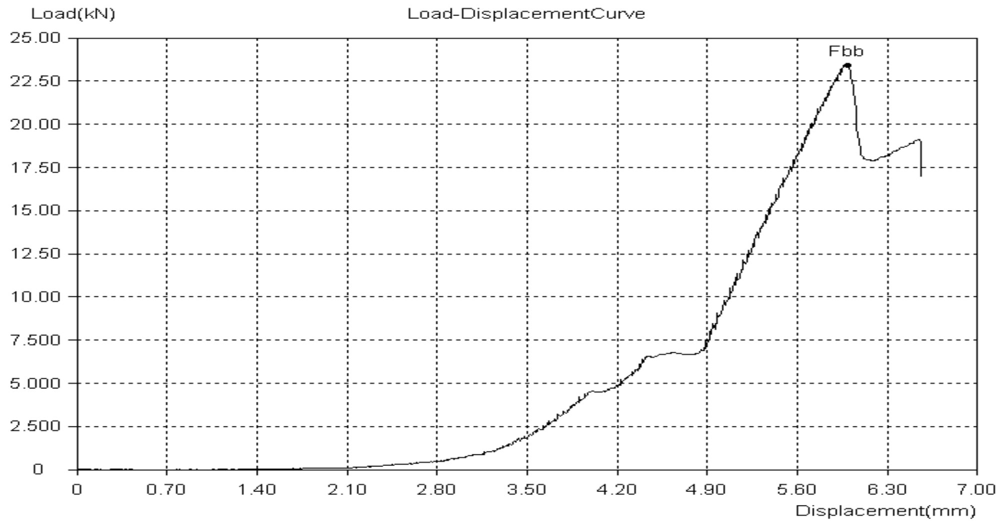


The test result conducted by one point load using UTM Visible Crack

3. Results and Analysis

flexural strength of rcc beam at 28 days

SampleID	flexural strength of rcc b	TestDate	2/18/2016
Operator	Preeti Rekha	Type	Flat
Size(mm)	100*100	So(mm2)	10000.00
Ls(mm)	500	Fbb(kN)	23.40
Rbb(MPa)	18		



COMPARISION OF RESULTS

Sl. no	Sample reference	Age in days	Size of Beam	Load in kg	Flexural strength in kg/cm²
01	Control beam	28	150	87.0	221.5
02	Control beam	7	150	48.0	163.2

4. Conclusion

- The general cracks developed at higher loads and there will be further protection to developing the cracks by external wrapping through fiber
- Initial flexural cracks appear at the load of 87kn. There was no cracks developed in other 3 no's of beam up to 100kn load applied.

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