International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 4, Issue 11, November-2018

FLEXURAL BEHAVIOUR OF UNDER REINFORCED CONCRETE BEAM WITH STEEL BAR AND GFRP BAR AS REINFORCEMENT IN TENSION ZONE WITH M20 AND M25 GRADE OF CONCRETE

Avinash Buchi[1], T. Suresh Babu[2]

1M.Tech Schlor,Civil engineering department, Visvodaya engineering college,kavali,india.
2 Professor& head of Civil engineering department, Visvodaya engineering college,kavali,india

Abstract - This paper presents the experimental study of flexural behavior of RCC beams reinforced with glass fiber reinforced polymer (GFRP) bars and steel bars. The glass fiber reinforced polymer has low elasticity and lower stiffness than the steel reinforcement. The use of GFRP bars in reinforced concrete structures has emerged as an alternative to traditional reinforced concrete beam. A total four RCC beams were tested. The size of beam is length of 1.5m, width 0.15m and depth 0.15m (1.5x0.15x0.15) m. Out of four beams, two beams were casted with GFRP bars as reinforcement in tension zone with M20 and M25 grade of concrete and remaining two beams with steel bars as reinforcement in tension zone with M20 and M25 grade of concrete. The RCC beam is tested under two point loading by using universal testing machine with simply supported condition. Experimental results indicates the load deflection curves for the beam specimen's and crack pattern of the beams.

Keywords - flexural behavouir , deflection , crack pattern , load –deflection, GFRP bar

I. INTRODUCTION

Fiberglass reinforced polymers are composed of extremely fine glass fibers. It turned out to be the solution, a major development in the technology of reinforced concrete. It has gross mechanical properties compared to the carbon fibers. However, it is stronger and more rigid or carbon fiber; it is much cheaper cost and materially less fragile. Therefore, these glass fibers are used as reinforcing agent for various polymeric products to build a very strong and adequately light material polymer composite reinforced with glass fibers known as reinforced plastic (GRP), along generally called " fiberglass ". The structural material is small scale air or gas,

Fiberglass is started when thin silica strands and another glass formulation are extruded into several small diameter fibers reduced specific to the action of the textile. The ability of heating and drawing the glass to fine fibers and fines has been known for millennia. But the work of these fibers for textile applications is recent. Before this time, all of the glass fibers have been constructed as a universal base (small length of fiber clusters).

The standard type of glass fiber used is glass fiber is E glass fiber, alumino borosilicate which is less than 1 percent of alkali oxides, primarily useful for plastic material reinforced with glass. And another type of glasses fibers used are glass (Alkali lime glass with small without boron oxide), a E-CR glass (electrical or chemical resistance and lime silica glass alumino less than 1 percent alkali metal oxides more acid resistance), C glass (alkali lime glass with more boron oxides B_2O_3, having discontinuous fibers or insulating), D glass (borosilicate glass, use constant low di-electric) , R (aluminosilicate glass and without magnesium oxide and calcium oxide with mechanical necessity as reinforcement)

Pure silica SiO_2 means silicon dioxide. It is refrigerated fused quartz glass without a true melting point, and it is also used as fiberglass. However, it has the disadvantage that only works with higher temperatures. This lower temperature required work reports and other additional substances are as fluxing agents (components means low melting point). Ordinary Glass (lime alkali) and also known as soda-lime glass name. It is crushed and ready to be hung, called cullet glass, and it was the original glass of the type used for fiberglass. E glass is free from alkali metals, and it was the initial glass formation is the application for the formation of continuous filaments. Currently, it's fiberglass production in the world. In addition, it is the largest single consumer of boron minerals worldwide. It has the ability to attack chloride ion and a low quality option for marine applications. S-glass ("S" means "strength") has high strength product strength (modulus). Accordingly, it is a main and epoxy composite aircraft. The same substance is known under the name R-glass ("R" means "reinforcement") in Europe. C-glass (“C" stands for "chemical resistance") and T-glass (“T" stands for "insulation") is a North American glass form C and are more resistant to chemical attack. C-Glass and Glass T both are often added to the insulation class of blown fiberglass.

II. METHODOLOGY FOR EXPERIMENTAION

A.Materials and its testing

The various materials used in the mix design cement (OPC), fine aggregates, coarse aggregates and potable water. The experiment results for cement, fine aggregates and coarse aggregates

A.1 Cement

the cement used in the experimental investigation is ordinary Portland cement (OPC) of Ultra-tech brand. The physical properties procured as per IS:4031-1968. The test results as shown below table 1.

Table 1: Test results of cement

PROPERTIES	RESULT
FINENESS	5%
Specific gravity	3.15
Standard consistency	30.5%
Setting time	INITAL-82min FINAL - 6hr 25min

A.2 Fine aggregate

The sand is free from clay matter, organic impurities, and silt and sand is sieved on 4.75mm sieve. The physical properties like fineness modulus, specific gravity, moisture content, bulk density are tested as procedure in IS:2386. The test results as shown below table 2.

Table 2: Results of tests on fine aggregates

PROPERTY	RESULTS
Fineness modulus	2.35
Specific gravity	2.224
Bulk density, % voids	Compact state - 32.2% Loose state - 36.482%
Moisture content	0.604%

A.3 Coarse aggregate

The maximum size of coarse aggregate used is 20mm which is local available. The physical properties of test results as shown in table 3.

Table 3: Test results on coarse aggregates

PROPERTIES	VALUE
Fineness modulus	7.25
Specific gravity	2.627
Bulk density	COMPACT STATE - 1.55kg/1 LOOSE STATE-1.404kg/1
Crushing value	26.63%
Impact value	20.4%
Water absorption	0.31%

B. Mix design

The mixing of materials are weighed exactly with their proportions and thoroughly mixed in their dry condition before water is added. The prepared mix was then immediately used for casting RCC beams as per **IS 10262-2009** code, has been used for the design of M20 grade concrete mix

B.1 Selection of water cement ratio for M20 grade of concrete;

From IS 456 maximum water cement ratio = 0.55

From IS 10262; 1982 adopt water cement ratio = 0.5
0.5 < 0.55, hence ok

B.2 Selection of water content:

From IS 10262; 2009 maximum water content
for 20 mm aggregates = 186 kg

B.3 Calculations for cement content:

Water Cement Ratio (W/C) = 0.5
Estimated water content (50 -75 slump) = 180 lit
Cement content = 360 kg/ m3
360 kg/m3 > 310 kg/m3, hence it is satisfied

B.4 Mix Design Calculations

The mix calculations per unit volume of concrete shall be follows
(a)Volume of concrete = 1 m^3
(b)Volume of cement = 0.114 m^3
(c) Volume of water = 0.180 m^3
(d) Volume of all in aggregate = 0.706 m^3

Table 4: Mix Proportion of M20 Grade concrete

Water	Cement	Fine aggregate	Coarse aggregate
180	360	533.84	1224.07
0.5	1	1.48	3.40

Table 5: Mix Proportion of M25 Grade concrete

Water	Cement	Fine aggregate	Coarse aggregate
180	382	460.5	1211.9
0.5	1	1.20	3.17

III. EXPERIMENTAL PROGRAM

A. General:

The present investigation is aimed to study the flexural behaviour of RCC beam made with different reinforcement bars (steel bar and GFRP bar) with M20 and M25 grade of concrete.

A.1 Preparation of test specimens:

The size of the test specimens is 1500x150x150 mm. Total four beams were casted. One beam with steel reinforcing bar in tension zone with M20 grade of concrete. One beam with GFRP bars as reinforcement in tension zone with M20 grade of concrete. One beam with steel reinforcing bar in tension zone with M25 grade of concrete. One beam with GFRP bars as reinforcement in tension zone with M25 grade of concrete. The beams are cured for 28 days and tested under standard condition on 28th day

A.2 Beam details:

Table 6 details of beam specimen

S.NO	Grade of concrete	Testing of beam for days	Reinforcement bar	Longitudinal reinforcement		Stirrups diameter(mm)
				Top(mm)	Bottom(mm)	
1	M20	28	Steel	8	12	6
2	M20	28	GFRP	8	12	6
3	M25	28	Steel	8	12	6
4	M25	28	GFRP	8	12	6

Fig 1 Test specimen

B. Test procedure and test set up:

The schematic arrangement of the test set up is shown in fig.2 the beam is subjected to a two point loading with a clear span of 1350mm. The beam loaded under simply supported condition. The load is gradually applied on the beam by using universal testing machine (UTM). The deflection of the tested beam is measured with the help of dial gauge; it is placed at the mid span of the beam. The results are observed on the dial gauge.

Fig 2 loading diagram

IV.RESULTS AND DISCUSSION

A. Load deflections:

The mid span deflection of the beam specimen is observed by using dial gauge is placed at the mid span of the beam. load to mid span deflection values are calculated for different loads. The load-deflection curves are for different beam is given below

B. Results

B.1 ***Load vs deflection graph for RCC beam with M20 grade of concrete***

The maximum load carrying capacity of the RCC beam with M20 grade of concrete is 92.7 KN and corresponding maximum deflection is 9.1mm as shown in figure 3.

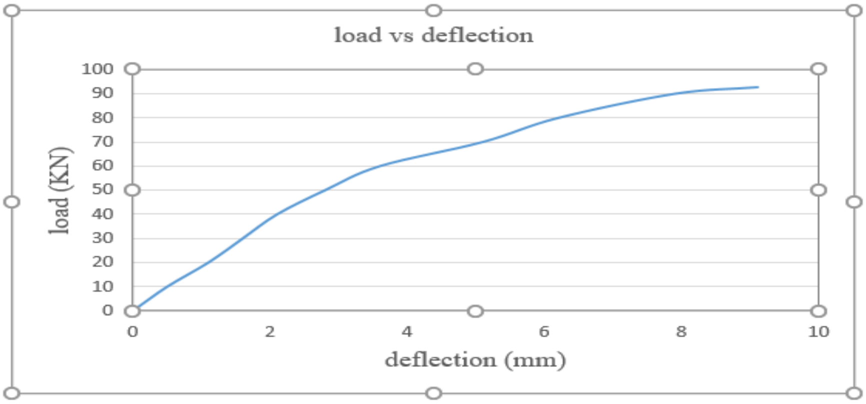

Fig 3 Load vs deflection curve for RCC beam with M20 grade of concrete

B.2 ***Load vs deflection graph for GFRP beam with M20 grade of concrete***

The maximum load carrying capacity of the GFRP beam with M20 grade of concrete is 88.1 KN and corresponding maximum deflection is 10.4 mm as shown in figure 4.

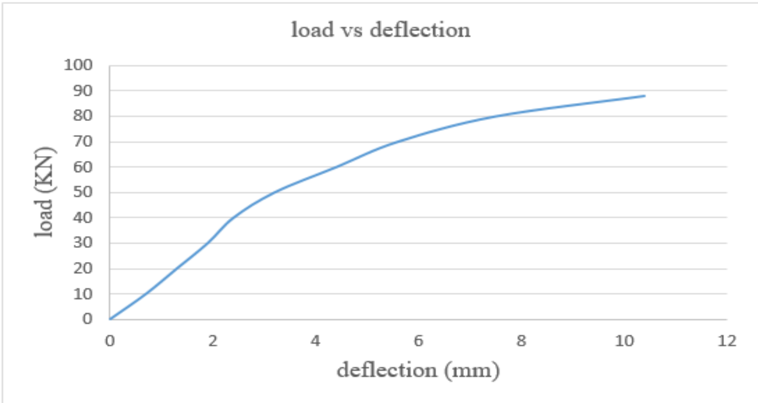

fig 4 Load vs deflection curve for GFRP beam with M20 grade of concrete

B.3 ***Load vs deflection graph for RCC beam with M25 grade of concrete***

The maximum load carrying capacity of the RCC beam with M20 grade of concrete is 97.7 KN and corresponding maximum deflection is 8.3 mm as shown in figure 5.

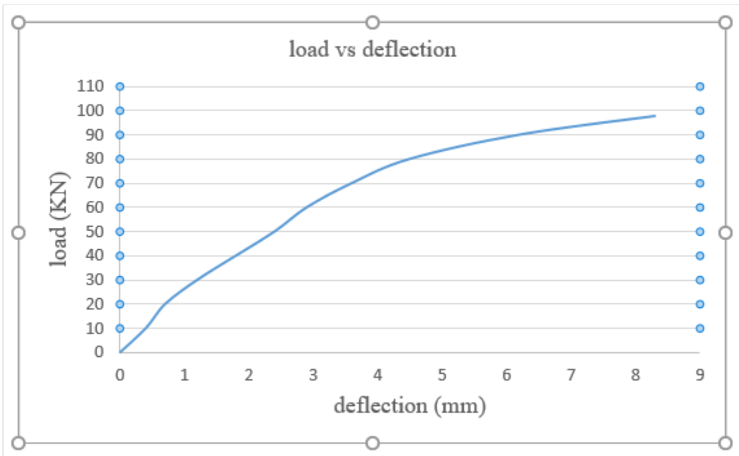

Fig 5 Load vs deflection curve for RCC beam with M25 grade of concrete

B.4 ***Load vs deflection graph for GFRP beam with M25 grade of concrete***

The maximum load carrying capacity of the RCC beam with M20 grade of concrete is 91.5 KN and corresponding maximum deflection is 9.2 mm as shown in figure 6

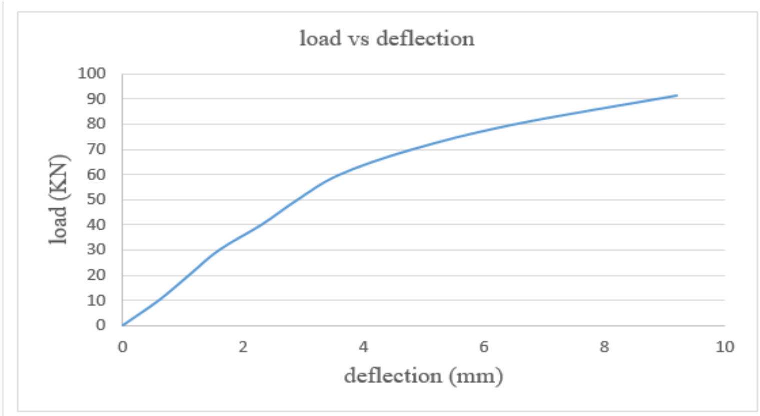

Fig 6 Load vs deflection curve for GFRP beam with M25 grade of concrete

V. CONCLUSION

1. The ultimate deflections for RC beam is 15 percent less than the GFRP beam with M20 grade of concrete.
2. For M25 grade concrete with GFRP bar the deflections are 10 percent more than the RCC beam.
3. The RCC beam with M20 grade of concrete has ultimate load carrying capacity is 4 percent more than the GFRP beam.
4. The comparison between GFRP beam and RCC beam with M25 grade of concrete the ultimate load carrying capacity of GFRP beam is 6 times less than RCC beam
5. crack initiation is early in GFRP beam due to low modulus of elasticity of GFRP bar when compared to RC beam.

REFERENCES

Abid Alam.Md, Imran Ahmad, Fazlur Rehman (2013) "Experimental Study On Properties Of Glass Fiber Reinforced Concrete" International Journal Of Engineering Trends And Technology, (Ijett) – Volume 24 Number 6- pp- 297-301. (2013)

Deshmukh S.H, Bhusari J. P Zende A. M (2012) "Effect of Glass Fibres on Ordinary Portland Cement Concrete", IOSR Journal of Engineering, Vol. 2, PP:1308-1312

Patil, S. S., Shaikh, A. N., Niranjan, B. R., (2013), Experimental and Analytical Study on Reinforced Concrete Deep Beam", International Journal of Modern Engineering Research, 3 (1), 45-52.

Ritchie, P.A., Thomas, D.A., Le-Wu, L., Connelly, G.M (1990), External Reinforcement of Concrete Beams using Fiber Reinforced Plastics, ACI Structural Journal, 88(4), 490-50

Srinivas.T, N.V Ramana Rao (2015) "study on flexural behavior of RCC Beam containing high volume fly ash". ISOR journal of mechanical and civil engineering, e-ISSN:2278-1684, volume 12 (July-aug 2015**).**

Shirsath, P M Yeole (2015) "Effect Of Glass Fiber On The Strength Of Rcc Beam". International Journal of Modern Trends In Engineering And Research, Volume 2, pp-757-762.

Viradiya, S. R., Vora, T. P. (2014), Comparative Study of Experimental and Analytical Results of FRP Strengthened beams in Flexure, International Journal of Research in Engineering and Technology, 3(4), 555-561.