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ANALYSIS OF STRESS AND DEFLECTION OF BEAMS USING DIFFERENT TYPES OF REINFORCEMENT

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ABSTRACT: There are so many uses of fibre reinforced polymer (FRP) composites as a confinement material for concrete which has received a great deal of attention over the past two decades. Together with the retrofitting applications, the use of FRP as confinement material in the construction of new high-performance composite members in the form of concrete-filled FRP tubes has become increasingly popular. Based on the study, the failure mode, load–deflection relationship, ductility, energy absorption capacity and load-strain relationship of the beams were analysed. This study investigated the flexural behaviour of U-shape hybrid FRP-RC composite beams. The beams which are composite is consisted of U-shape hybrid G/CFRP profile and if rectangular RC beams with or without inner GFRP tube confinement at concrete compression zone of the beams.
Key Word: Fibre Reinforced Polymer, GFRP, Bamboo, Steel, Concrete, Limit State Method.

I. INTRODUCTION

Filling the FRP tube with concrete provides compressive resistance and prevents local buckling of the thin tube. The CFFT system may also include internal longitudinal steel reinforcement, as the tube will protect the steel from water infiltration and corrosion , while the steel reinforcement provide ductility and additional strength and stiffness. The flexural behaviour of U-shape hybrid profile-RC composites beams with and without inner GFRP tube confinement at concrete compression zone was experimentally investigated under four point bending test .The finding indicated that inner GFRP tube confinement in the concrete compression zone resulted in a significantly increased ductility, and the load carrying capacities of hybrid composite beams were improved significantly by the use of U-shape profile and GFRP tube confinement. The use of this information helps us to predict the behaviour of structure under different load distribution and also helps to design system to control the excessive amplitude of vibration.

II. OBJECTIVES

The aim of research is to improve the load carrying capacity, deflection and ductility. The very important use of GFRP tube at concrete compression zone had a slight increase in the ultimate load of the hybrid beams but resulted in a pronounced enhancement of their ductility.

Following are case study which is done in ANSYS software.

- To obtain vibration analysis on beam without crack by using software called computer aided ANSYS.
- To obtain vibration analysis on beam with crack by using software called computer aided ANSYS.
- We have taken the beam of given mathematical dimension and made on ANSYS software.
- Then we have applied the cross section area of meshing property on the ANSYS software.
- Then we have select the material and given its property to formulate the beam for difference behavior of its condition.
- Then we have taken the simply supported beam of same dimension to take the different materials to check the stability of beam.
- Then different types of force are applied on the body of beam.
- Then we have taken the shear force on the beam for different type of nodes in the beam.
- Then different type of result is obtained.
- And finally conclusion is being obtained.

III. METHOD OF RCC DESIGN

The aim of design is to decide the size of the member and provide appropriate reinforcement so that the structure being designed will performed satisfactorily during their intended life With an appropriate degree of safety the structure should

- Sustain all loads
- Sustain the deformation during and after construction
- Should have adequate durability
- Should have adequate resistance to misuse and fire

Various methods of RCC designs can be grouped into experimental and analytical method:-

Experimental methods of design have superseded the analytical method. However this method is time consuming and cannot be accepted for design of each and every structure.

Analytical method are based on identifying failure criteria based in material properties .Since there are limitation in estimating design loads, material behaviour and analytical methods, working condition is kept at a fraction of failure condition. The design philosophies used in R.C.C are listed below in the order of their evolution and then they are briefly explained:

i.) The working stress method (WSM)
ii.) The ultimate load method (ULM) or Load factor method (LFM) ii.) The limit state method (LSM)
CASE STUDY OF BEAM

Length of beam = 3m Depth of beam = 300mm Width of beam = 200mm M25 grade Reinforcement = 2% Assume cover = 25mm Diameter of bar = 20mm D = 300-25-20/2
(Effective depth) d = 256mm Effective cover = 25+20/2 = 35
Effective length =3+30/2+30/2 =3.3m
Clear span + Effective depth = 3.3+.265 = 3.56m

Load Calculation
Dead Load =Y + A
= 25×b×d
=25x200x300
= 1.5 KN/M
Live Load = 10 KN/M Total Load = 11.5 KN/M Ultimate Load = 11.5x1.5
= 17.5 KN/M
3.3 MATERIAL PROPERTIES USED IN ANSYS

Table.3.1 Material of concrete & structural steel

Material Used		
Assignment	**Concrete NL**	**Structural Steel**
Bounding Box		
Length X	200.mm	168. mm
Length Y	300.mm	268. mm
Length Z	3000mm	
Properties		
Young Modulus (Pa)	3E+10	2E+11
Poisson's Ratio(Pa)	0.18	0.3
Bulk Modulus(Pa)	1.5625E+10	1.667E+11
Shear Modulus(Pa)	1.2712E+10	7.6923E+11

Table.3.2 Material of bamboo & GFRP bars

Material Used		
Assignment	**Bamboo Bars**	**GFRP Bars**
Bounding Box		
Length X	168.mm	168. mm
Length Y	268.mm	268. mm
Length Z	3000mm	
Properties		
Young Modulus (Pa)	8.6E+0.8	6000
Poisson's Ratio(Pa)	0.22	0.5
Shear Modulus(Pa)	3.52E+08	1790

ANALYSIS BY ANSYS SOFTWARE
ANSYS develops and markets engineering simulation software. ANSYS software is used to design products and semiconductors, as well as to create simulations that test a product's durability, temperature distribution, fluid movements, and electromagnetic properties. ANSYS was founded in 1970 by John Swanson. Swanson sold his interest in the company to venture capitalists in 1993. ANSYS went public on NASDAQ in 1996. In the 2000s, ANSYS made numerous acquisitions of other engineering design companies, acquiring additional technology for fluid dynamics, electronics design, and other physics analysis

BEAM STATIC SRTUCTURE
In the present case simply supported beam of length 3000mm is considered. In which both the end is fixed and is used to wear load. The material which is used in beam is structural steel, concrete, bamboo and GFRP.

Beam Specification:-

Table.4.1 Dimension of a Cantilever beam

DIMENSION REPORT	
BEAM CROSS SECTION AREA	200mmx300mm
BEAM LENGTH	3000 mm
BAR DIAMETER	20mm
MATERIAL	Grade
CONCRETE	M25
STEEL	FY 250
REINFORCEMENT	2%

.2 Static Structure Analysis with ANSYS WORKBENCH 19 Static Structure Analysis with the simply supported beam executed by ANSYS Workbench

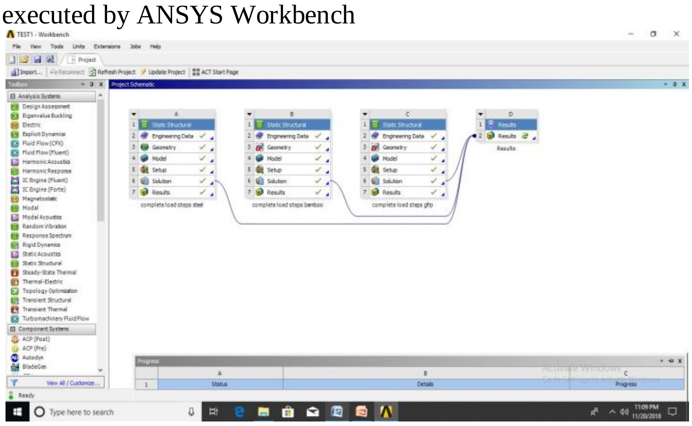

Figure.4.1 Graphical environment of ANSYS WORKBENCH

In this figure the static structure is use to design the beam of different material with different load calculation. In this we have taken the ANSYS WORKBENCH Software to create the different iteration of different compound of material for different types of uses properties. First iteration is show and taken from the static structure to make a beam with the help of material like concrete and structural steel to apply same type of force and different type of nodes. Second iteration is shown is made by static structure to identify the different type of material load to check the bearing capacity the material are Bamboo, Steel and Concrete. Third type of iteration shown is also made up by static structure to identify the load bearing capacity and its workability the material used in this beam are GFRP, Steel and Concrete. Fourth type of iteration is taken from the combination of all three type of static structure to see its result on beam and to compare it strength and workability criteria.

RESULT

Table 5.1Total deflection with respect to Steel Bamboo and GFRP

LOAD (N)	DEFLECTION (STEEL) (mm)	DEFLECTION (BAMBOO) (mm)	DEFLECTION (GFRP) (mm)
14500	0.1172	0.52278	0.55038
15000	0.11927	0.53692	0.55941
15500	0.12133	0.55105	0.56614
16000	0.1234	0.56518	0.57288
16500	0.12546	0.57931	0.57961
17000	0.12753	0.59345	0.58635
17500	0.12959	0.60758	0.59308
18000	0.13166	0.62171	0.59982
18500	0.13372	0.63585	0.60565

GRAPH ON LOAD (N) & DEFLECTION (mm)

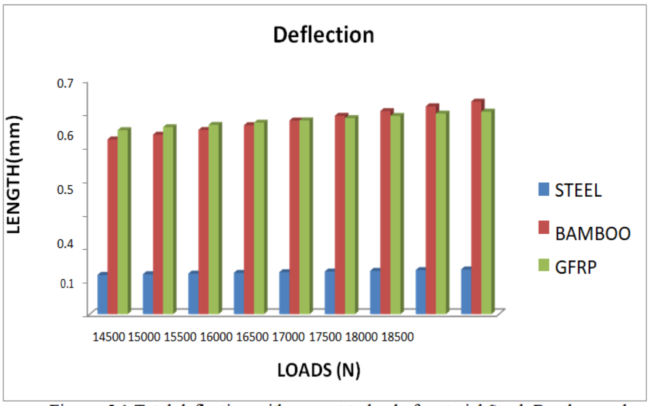

Figure. 5.1 Total deflection with respect to load of material Steel, Bamboo and GFRP

MAXIMUM BENDING SRESS WITH RESPECT TO ITS DEPTH

Table 5.2 Maximum Bending Stress with respect to its Depth

DEPTH	STEEL BARS (MPa)	BAMBOO (MPa)	GRPF REBAR (MPa)
0	-2.0353	-1.459	-1.0629
25	-1.6853	-1.1969	-0.90281
50	-1.3497	-0.96303	-0.76888
75	-1.0116	-0.72212	-0.6284
100	-0.6737	-0.4816	-0.48832
125	-0.33683	-0.24095	-0.34841
150	-8.05E-03	-8.47E-03	-0.20835
175	0.34282	0.24734	6.77E-02
200	0.67768	0.48658	7.71E-02
225	1.0154	0.72857	0.21759
250	1.3511	0.96567	0.35585
275	1.6857	1.1987	0.49279
300	2.0536	1.4953	0.66266

COMPARSION BETWEEN BENDING STRESS AND DEPTH

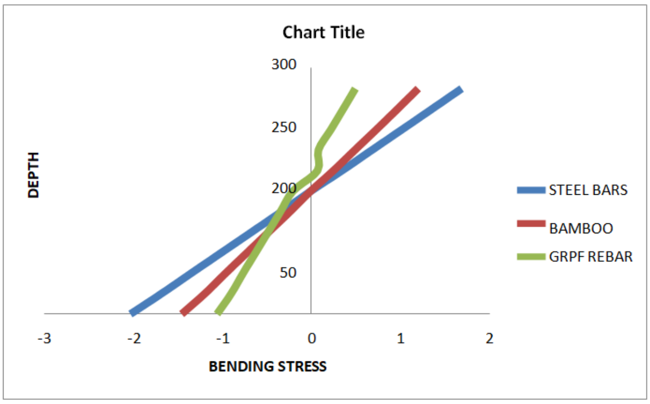

Figure.5.2 Comparison between bending stress with respect to depth

DEFORMATION GRAPH WITH RESPECT TO ITS DEPTH

Table 5.3 Deformation table with respect to its Depth

DEPTH	STEEL (mm)	BAMBOO (mm)	GRPF (mm)
0	0.13138	0.63409	0.30914
25	0.13151	0.63445	0.3094
50	0.13162	0.63475	0.30962
75	0.13171	0.63498	0.30981
100	0.13177	0.63514	0.30996
125	0.1318	0.63523	0.31007
150	0.13181	0.63525	0.31013
175	0.1318	0.6352	0.31016
200	0.13176	0.63509	0.31015
225	0.13169	0.6349	0.31011
250	0.1316	0.63465	0.31002
275	0.13149	0.63433	0.30989
300	0.13135	0.63393	0.30972

COMPARISON BETWEEN DEFORMATION AND DEPTH

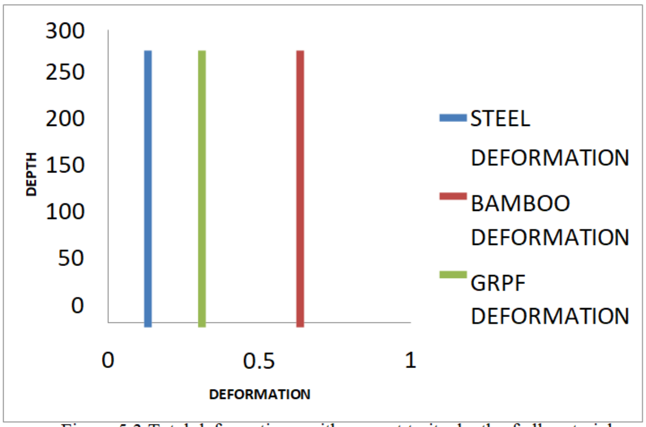

Figure.5.3 Total deformations with respect to its depth of all material

IV. CONCLUSION

Steel is better to get less defection and shear stress in beam. So using composite rebar is better than GFRP and Bamboo.

- First we have checked the deflection due to its load in that Steel bear less deflection than Bamboo and GFRP.
- Second graph we have check the Maximum Bending moment with respect to its Depth.
- Third graph we have check the Maximum deflection with respect to its Depth.

In all the case we have seen that the Steel is more better then the Bamboo and GFRP material. So hence we have concluded that the Steel is best of the other material.

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