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Experimental analysis for glass fiber reinforced polymer (GFRP) single storeyed portal frame

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ABSTRACT

The use of Glass fiber-reinforced polymers (GFRP) rebar in structural applications has been getting increasing attention due to the advantages it offers over conventional reinforcement (e.g. durability, light weight, magnetic neutrality). A possible application of GFRP rebar reinforcement is in the area of multi-storey structural frames. During late seismic tremors, numerous basic breakdown were started or brought about by bar segment joint disappointments. There are no complete seismic guidelines for the use of GFRP materials. Consequently, research is needed to gain a better understanding of the behavior of GFRP materials and their interaction with traditional materials in such application in order to implement their use on solid grounds. In this study, two full-scale quasi-static loading tests were performed on single storey portal frame specimens. The first test was performed on a Portal frame specimen reinforced with steel and its behavior was compared to that of a second similar test performed on a GFRP-reinforced Portal frame specimen.

Index terms: Glass fiber reinforced polymer (GFRP)

INTRODUCTION

Glass fiber-strengthened polymer (GFRP) fortification has developed as an expected competitor as an elective support to regular steel fortifying bars for solid structures. GFRP fortifying bars are non-destructive, have high elasticity, are lightweight, and have high solidarity to weight proportions. Considering the noteworthy recovery costs related with the decay of existing scaffolds, generally a consequence of steel erosion. The potential consumption opposition of GFRP strengthening bars could give huge incentive to structures containing fortification. The utilization of GFRP strengthening bars has expanded altogether in numerous framework applications, including span decks, asphalts, dividers, and different frameworks. Notwithstanding, there still is a hesitance to utilize GFRP strengthening bars; this hesitance generally results from the absence of long haul execution information of GFRP fortifying bars implanted in concrete.

GFRP bars are a serious choice as support in fortified solid individuals exposed to flexure and shear because of their arranging physical and mechanical properties, utilization of GFRP fortification is especially alluring for structures that work in forceful conditions, for example, in beach front districts, or for structures that have attractive reverberation imaging units are other gear delicate to electromagnetic field. The obligation of GFRP to cement can be improved by methods for mechanical ports, for example, surface distortions and sand covering, however its lower pliability stays a significant concern, particularly in structures exposed to dynamic stacking.

In the design process, two criteria that are major concern deflection and ductility. GFRP rebar usually have a significantly lower modulus of

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elasticity compared to that of steel rebars and thus, often generate higher deflections. Furthermore, the predominantly elastic behavior of GFRP rebars results in little warning before a usually sudden and brittle failure. Therefore, satisfying deflection and ductility requirements are a challenge in designing GFRP reinforced concrete structures.

AIM AND OBJECTIVES

The main aim of the project is an experimental study of behavior conventional steel and glass fiber reinforcement in concrete structures. In this project we can get a clear idea about how to perform GFRP reinforcement in concrete structures. It will be more helpful for further studies of GFRP Reinforcement in civil engineering field.

EXPERIMENTAL PROGRAM

Design consideration

The design of portal frame is done using staad pro v8i software according to the guidelines given in IS 456-2000, IS 13920.

Dimension of actual portal frame.

1. span-8mtr
2. Height-4mtr
3. Cross section of beam-400x600
4. Cross section of column-400x800

Dimensional analysis

For the purpose of experimental program the specimen scale down using Buckingham pie theorem. And taking the reduction factor of 1:4, calculations are made and following models was decided to experimental program.

1. span-2mtr
2. Height-1mtr
3. Cross section of beam-100x150
4. Cross section of column-100x200

Design properties of steel and gfrp reinforcement.

Conventional Steel Reinforcement

Bar no	Sectional Area	Tensile Stress	Modulus of elasticity
#8	50.24	500	200 Mpa
#10	78.5	500	200 Mpa

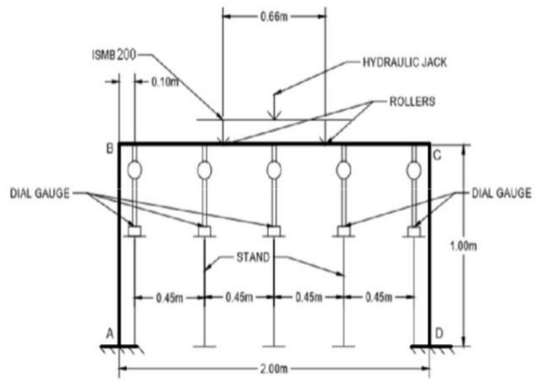
Gfrp Reinforcement.

Bar no	Sectional Area	Tensile Stress	Modulus of elasticity
G8	50.24	600	30 Mpa
G10	78.5	600	30 Mpa

EXPERIMENTAL SET UP

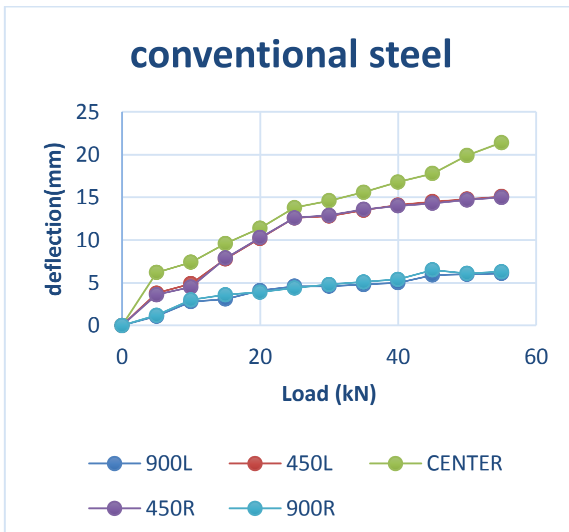
In the experimental set up consist of loading frame on which four ISMB 150 were rigidly fixed by the means of metal nuts, bolts and wires. In this portal frame having base plate 8mm thick is connected to the ISMB 150 by the help of clamps. Furthermore the testing unit consist of 5 dial gauges placed at 100mm, 450mm, 1000mm, and 1450mm.1900mm from the left-hand side respectively.

For the application of load a 250kN hydraulic jack is mounted at the top of the loading facing downward side below which an ISMB 200 section was placed over two roller support 330 mm from the middle of support on either side.

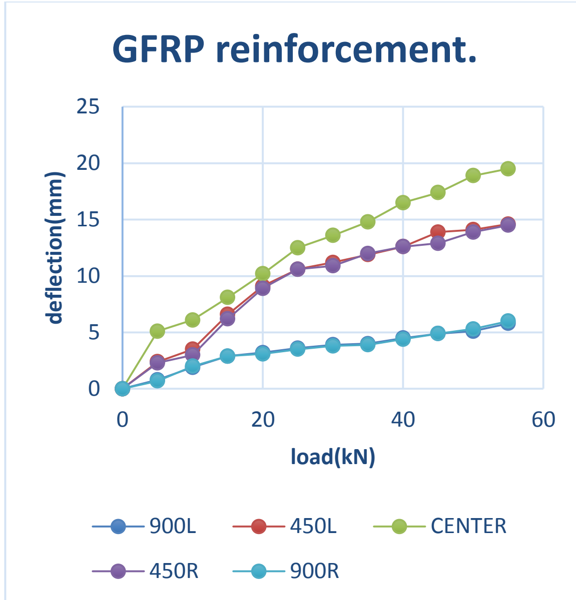


RESULT AND DISCLUSSIONS

In the experimental program load vs deflection chart plotted on static loading in the two specimen one of conventional concrete portal frame and other one is GFRP reinforced portal frame.



1.Conventional steel portal frame load test result.



2. GFRP-Rienforcement portal frame load test result.

CONCLUSIONS

The experimental investigation was performed to study the behavior of portal frame using GFRP reinforcement and conventional steel under two point static loading. Based on the experimental observation and analysis of test result, the following conclusions drawn from this study are as follows.

1. The GFRP reinforcement showed a predominantly elastic behavior with very low plasticity features, when tested under static loading.
2. The GFRP reinforcement take more time to collapse than conventional steel. It will be gave more time to escape when any seismic condition occurs.
3. Research is needed to gain a better understanding of the behavior of GFRP reinforcement model and their interaction with concrete. The long term data not available because the GFRP material is modern one.

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