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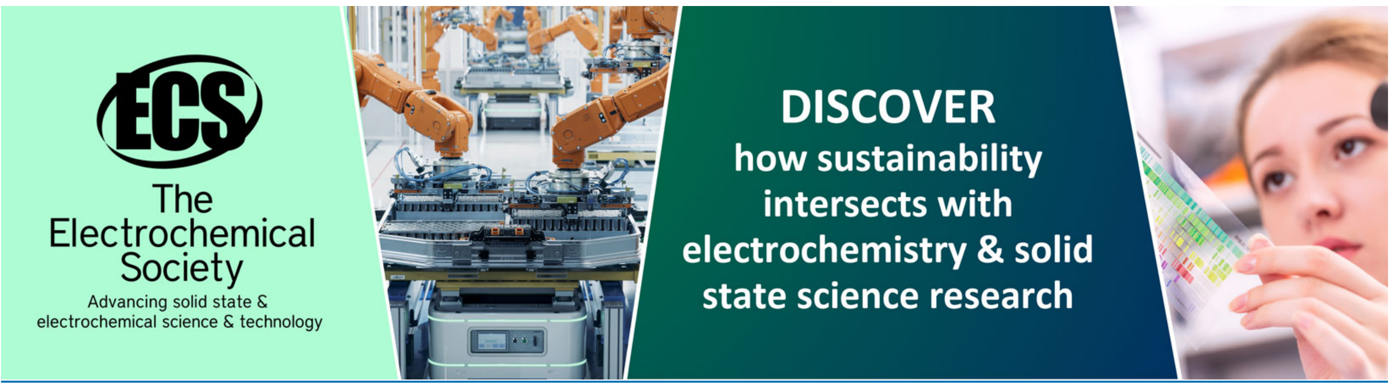
To cite this article: B S Meenakshi *et al* 2021 *IOP Conf. Ser.: Mater. Sci. Eng.* **1145** 012012



IOP Conf. Ser.: Mater. Sci. Eng. **1145** (2021) 012131 https://doi.org/10.1088/1757-899X/1145/1/012131

Retraction

Retraction: An Exploratory Examination of Concrete from Ecological Impacts Using GFRP Laminates (*IOP Conf. Ser.: Mater. Sci. Eng.* **1145** 012012)

Published 23 February 2022

This article (and all articles in the proceedings volume relating to the same conference) has been retracted by IOP Publishing following an extensive investigation in line with the COPE guidelines. This investigation has uncovered evidence of systematic manipulation of the publication process and considerable citation manipulation.

IOP Publishing respectfully requests that readers consider all work within this volume potentially unreliable, as the volume has not been through a credible peer review process.

IOP Publishing regrets that our usual quality checks did not identify these issues before publication, and have since put additional measures in place to try to prevent these issues from reoccurring. IOP Publishing wishes to credit anonymous whistleblowers and the Problematic Paper Screener [1] for bringing some of the above issues to our attention, prompting us to investigate further.

[1] Cabanac G, Labbé C and Magazinov A 2021 arXiv:2107.06751v1

Retraction published: 23 February 2022

An Exploratory Examination of Concrete from Ecological Impacts Using GFRP Laminates

B S Meenakshi[1], S Jayabharathi[2], S Kanmani[3], S Sakthivel[2], N Deepa[2], P Vinothini[2], S Elakkiya[2] and R Saravanaraja[4]
[1] Assistant Professor, KPR Institute of Engineering and Technology
[2]M. E Student, KPR Institute of Engineering and Technology
[3] Associate Professor, KPR Institute of Engineering and Technology
[4]Saravanaraja Construction, Coimbatore.
[1]meenakshi.bs@kpriet.ac.in

Abstract. Portland cement is widely used as the construction material globally because of its phenomenal durability. But concrete gets deteriorated due to material limitations, construction methods, design and severe exposure conditions. This deterioration may lead to aesthetic functional or structural issues. There are varied reasons for the deterioration of concrete and its damage is very often the result of combination of factors. Structural and non-structural reasons cause concrete to fail and hence the deterioration of building take place. There are several methods to get it refurbished we combine the results with laminates and without laminates in this paper. For this purpose, concrete prisms were casted which are strengthened outwardly with the aid of FRP laminates using epoxy resin and hardener. The consequence of this on ultimate load carrying capacity, flexural and compressive strength is tested and the laminated concrete gives more strengthen damaged concrete as a result. It can be successfully used to repair and retrofit concrete structures.

1. Introduction

Construction activities like concrete manufacturing make a high impact on the environment and significantly it creates the greenhouse effect. In developed countries like US, Canada the commercial and residential building owe responsibility for producing electricity and the energy created by the consumers and the rate of annual production of electricity is 72%. The production of energy creates a major pollution in India [1]. The government of India claimed the average pollution during the winter season. Air pollution is responsible for deterioration of concrete and leads to rebar corrosion as also it affects the steel structures. In the urban area the deterioration of concrete is also more due to the vehicle pollution by data from the World health organization in September 2011. Delhi has exceeded the maximum PM of 198μg/m^3. In urban cities the pollution increases day by day. In metro cities the total suspended particles rate as per WHO is 97%. As per Central Pollution Control Board (CPCB) the vehicle emission is 92%. This leads to surface deterioration in concrete [2]. The main distress in concrete surface is chemical attack due to the untreated industrial disposal both in air and water which leads to immediate destruction of the concrete surfaces [3].

In this study we simply cover the concrete surface with GFRP laminates with minimum thickness to avoiding the environmental deterioration in concrete surfaces. In the past many authors studied the mechanical characteristics of concrete and there are many ways to improving the strength of the concrete and protect from the environmental disintegration of the structure. The polymer is used not only to strengthen the durability of concrete from worst environment condition [4]. Normally glass is an inert material and free from moisture and other environmental pollutions. The polymer has ensured the fibre and ties them into a very durable and strong material. There are many types of glass fibre mat according to the purpose we can choose the type of fibre [5]. In this project we use Glass - C type. This type is resistant to chemical and environmental effects from the atmosphere.

2. Materials used

2.1. Cement
Ordinary Portland cement was used for the testing for getting exact value we use without pozzolonic cement. OPC 53 grade was used for testing [12269-1987] having 100mm x 100mm x100 mm cube compressive strength is 52.68 MPa. The properties of cement are tabulated in Figure 1.

Table 1. Properties of cement used.

Sl.No	Properties	Tested values
1.	Fineness	9.8%
2.	Initial setting time	31 min
3.	Final setting time	11 hours
4.	Standard consistency	30%
5.	Specific gravity	3.11

2.2. Fine aggregate
River sand zone confining IV was used for testing. All testing was conducted as per IS:2386 (Part I) – 1963. The specific gravity of the sand is 2.58, and the sieve analysis for confining the zone of the sand comes under zone IV.

2.3. Coarse Aggregate
The coarse aggregate has a hard, dense and durable blue metal and free from alkali aggregate reaction and the aggregate must be the angular aggregate [6]. The size of the aggregate must be 20mm and the specific gravity of the aggregate is 2.79. The test procedure was followed as per IS 383-1970. The aggregates choked in water before concreting.

2.4. Glass Fiber reinforced polymer (GFRP)
Glass fibre reinforced polymer (GFRP) was used for wrapping the external surface with class-C GFRP mat with 3mm thick layers for wrapping. This C glass has high strength and high resistance to water, alkali, chemical and thermal substances. It has high tensile strength, high modulus of elasticity and stiffness. The density of C glass fibre is 2.5 g/cm^3, Tensile strength is 3300 MPa, Modulus of elasticity is 69GPa and there is zero thermal coefficient of expansion. The C type GFRP is shown in Figure 1.

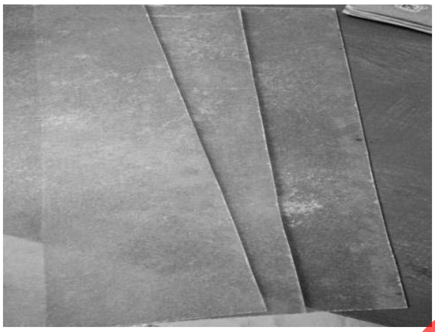


Figure 1. GFRP 3mm thick laminates

2.5. Bonding agent
Epoxy resin is used as a bonding agent. It is one of the kinds of synthetic based bonding agent. The bonding strength may vary depending upon the type of the resin, mixing ratio and placing time. The mix density of the resin is 1120 kg/m^3. The mixing and placing are followed as per the ACI code.

2.6. Water
Potable drinking water is used for concreting. The water is free from chemical and chloride content the pH of the water is 7, and there are no suspended solids and free from odour and without any color.

3. Experimental Investigation

3.1. Casting
The cube size 100 mm x 100mm x100mm were casted, the cylinder size of 150mm diameter and 300mm length were casted [7]. The prism size 100 mm x 100 mm x 300 mm were casted the mould was completely cleaned and applied with oil before placing into the mould. Pan mixture machine was used to casting the cube, cylinder and prism specimens. After 24 hours the specimens are allowed to demoulding. The casting process is shown in Figure 2.

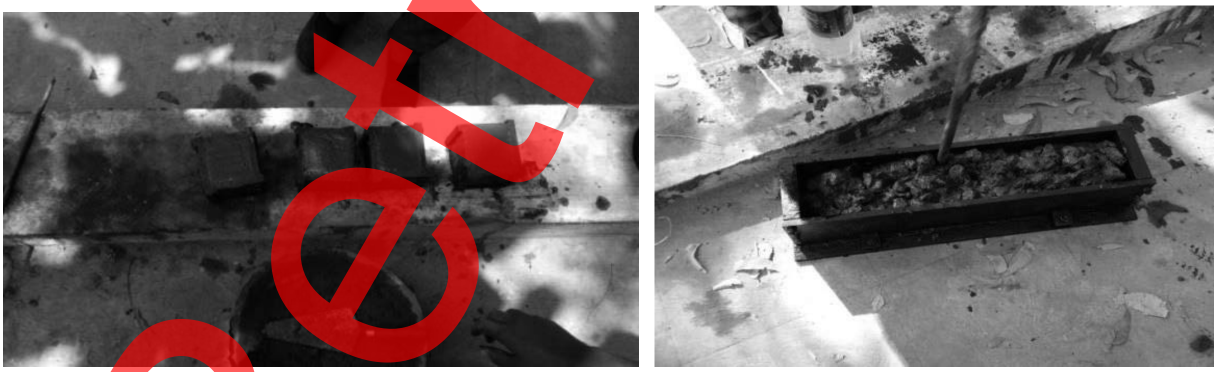


Figure 2. Casting of specimens

3.2. Curing
The specimen was allowed to cure and after 24 hours of concreting period the specimens are fully submerged into the chemical free water, preferably drinking water of pH 7 was used to curing the specimen [8]. The curing is done with the room temperature of 38 to 40° C. The specimens are in fully submerged condition of curing. Curing tank was used to cure the specimen. With continuous monitoring the cube and cylinder specimens are allowed to cure for 7 days and 28 days, and prism respectively. After curing the GFRP laminates was bonded on the soffit of the specimen [9].

4. Testing

4.1. Compressive strength
The testing of the specimen was as per IS 516 (1959). The Compression test is carried out on specimens of size 100mm x 100mm x 100mm and cubical in shape. The Compression strength of cube is determined using UTM [10]. Figure 3, shows that testing of conventional mortar cubes and testing of cube with FRP laminates.

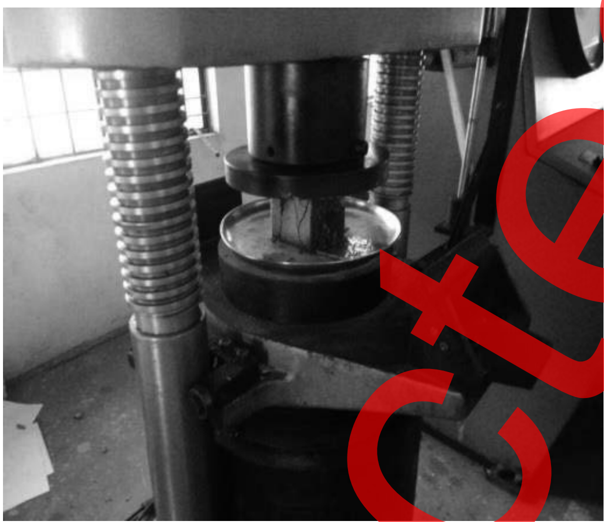


Figure 3. Testing of cube

4.2. Flexural Strength Test
The prism of size 100mm x 100mm x 300mm was placed in the flexure testing machine, the test procedure as per IS 516 (1959). The 3mm thick GFRP laminate bonded in the soffit of the beam, testing was carried out until the beam gets failed. The testing of the prism as shown in Figure 4.

5. Result and Discussion
5.1. Compression test results
We tested the mortar cubes as per IS code and the results show when compared to conventional Mortar the FRP laminated mortar is stronger by average the 7 days strength for conventional mortar has 10.81N/mm2 and for FRP laminated mortar has 15.55 N/mm2 Figure 5 and Figure 6 shows the comparison graph.

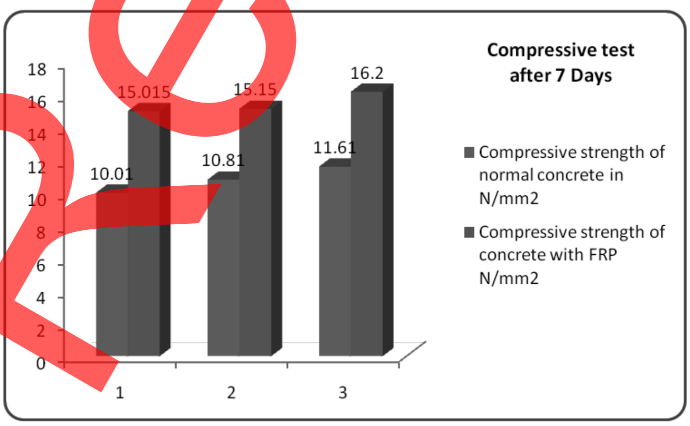


Figure 4. Compressive strength after 7 days

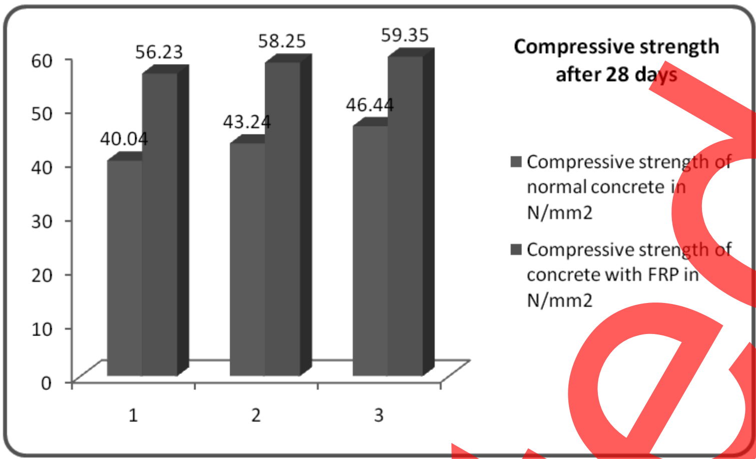


Figure 5. Compressive strength after 28 days

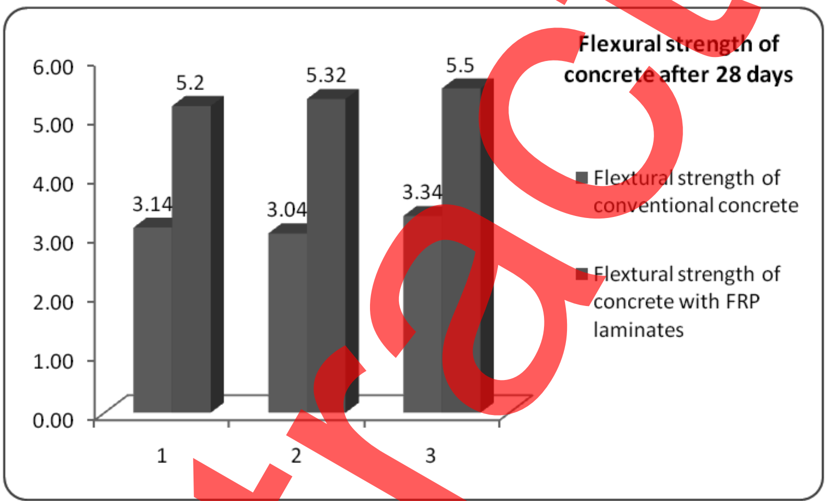


Figure 6. Flexural strength after 28 days

After 28 days curing the strength of mortar has 43.24 N/mm^2 and the FRP was pasted with mortar then the strength has 57.94 N/mm^2.

5.2. Flexural Strength Results

The flexural strength of concrete prism was tested after 28 days in the lab as per IS code as the results the conventional prism were the average strength of 3.17N/mm2 and the prism with FRP laminates have 5.34N/mm2. Load Vs deflection were noted and that values are plotted in the graph Figure 10 shows the conventional concrete prism and Figure 7 shows that the prism with FRP laminates. It shows that concrete got the ductility property.

5.3. Load deflection response

The load deflection curve was plotted in the graph this shows that the deflection is high when compared to the conventional beam and the beam fails with flexure mode with minimum crack width and the first crack was delayed when compared to the conventional concrete. The load deflection curve was shown in Figure 8 and Figure 9 is given below.

5.4. Durability studies

The concrete has better durability then only we can say that it prevents from various environmental conditions we made acid resistance, the test results show that comparing to conventional concrete the concrete have more durable by using GFRP laminate with 3mm thick the surface distressed was very slow in GFRP laminates its resist more the tests result as shown in Figure 10, acid resistance test [11].

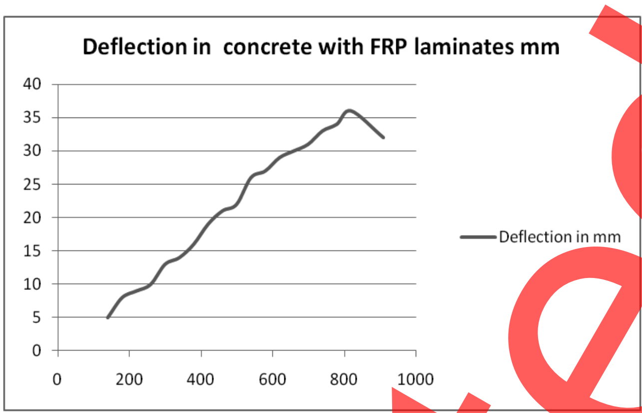


Figure 7. Load deflection curve after 28 days for conventional prism

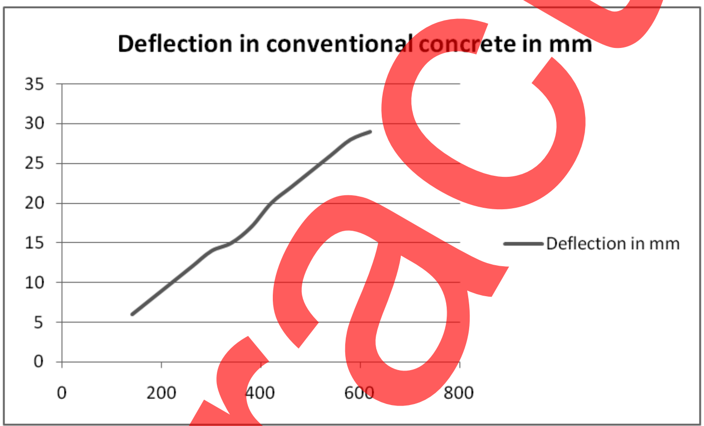


Figure 8. Load deflection curve after 28 days for prism with FRP laminates

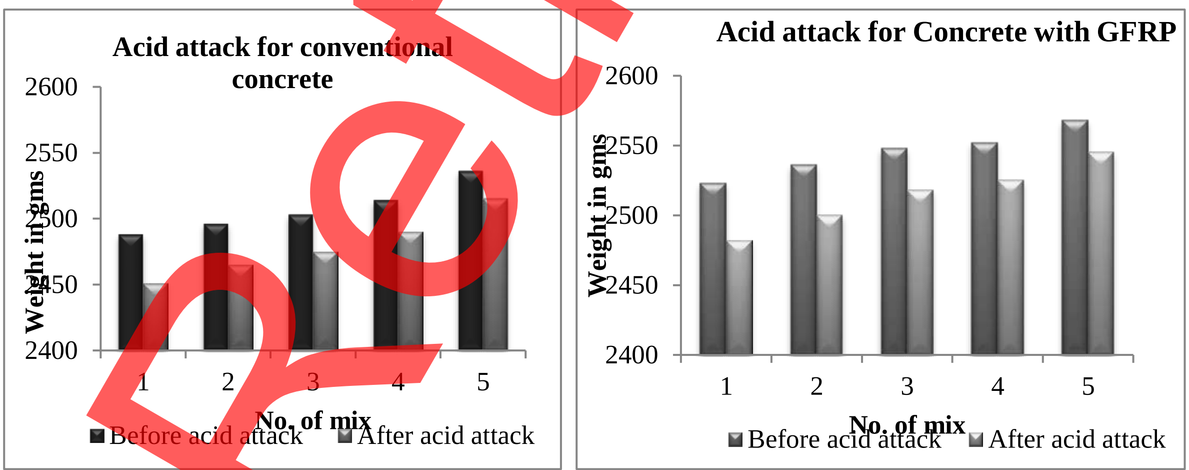


Figure 9. Acid resistance test

6. Conclusion

- The compression strength of mortar would be increased 1.67% after 7 days.
- The compression strength of mortar would be increased 25.05% after 28 days.
- The beam having ductile property when compared to FRP and conventional, FRP have much

ductile property.

- The flexural property of FRP prism was 2.05% it is more than conventional prism.
- In this paper we conclude that concrete had any defects due to environmental issues, we protect that defected concrete with 3mm thick FRP laminates, it enhances the strength of concrete and also protect the surface from further defects due to exposure condition.

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