EXPERIMENTAL AND ANALYTICAL INVESTIGATION ON STRENGTH CHARACTERISTICS OF RIGID PAVEMENT BY USING GLASS FIBRES AND ITS OPTIMUM DOSAGE

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Abstract - *Due to the high amount of alkali glass Fibers, GFRC gains strength. The GFRC strength under compressive loads is great due to the high content of cement and low w/c (water to cement) ratio. Additionally, these materials have excellent tensile and flexural strength. The efficiency of a Fiber's load resistance depends on its orientation. To provide the necessary tensile strength, the Fiber must be stiff. As a result, these materials perform better than regular concrete. Tensile loads are supported by the high Fiber content, while the polymers in the concrete give it flexibility. GFRC has superior physical characteristics to unreinforced concrete. The strength of steel reinforced concrete is significantly increased by properly constructed steel goods that are made with GFRC or regular concrete)*

Key Words: **GFRC, Fibre reinforced, Concrete roads, etc.**

1. INTRODUCTION

The pavement construction must be able to provide a surface with a better riding quality, better or enough skid resistance, good light reflecting properties, and less sound. The final goal is to guarantee that the transmitted stresses brought on the wheel load are adequately reduced to prevent them from exceeding the subgrade's bearing capacity. In general, rigid pavements and flexible pavements are both acknowledged as providing this function. The varieties of pavement, their layers, their purposes, and pavement failures are all described in this chapter. Pavements that are improperly designed degrade sooner and have lower riding quality.

1.1 BENEFITS OF GFRC

1) Not particularly heavy.

2) Since GFRC is internally reinforced, additional types of reinforcement that could be challenging for intricate moulds are not required[1].

3) GFRC is made of substances that are unlikely to catch fire. When exposed to fire, the concrete acts as a thermal regulator, shielding the materials from the heat of the flame.

4) Tough materials also save shipping costs, allow for design flexibility, and have a lower environmental impact[2].

5) Greater strength increases resistance to earthquake loads

6) GFRC is more resistant to freeze-thaw conditions than regular concrete and is less susceptible to the impacts of the weather.

7) Highly chemical-resistant, anti-corrosive, high flexural, impact, and tensile strength

8) Increase effect defense

9) Strengthen resistance to shrinking of plastic during curing.

1.2 GFRC DISADVANTAGES

- No ductility exists.
- The capacity of a solid material to deform under stress is known as ductility.
- More costlier than conventional concrete.
- The challenging is to self-mix GFRC. This kind of concrete is typically mixed, poured, or sprayed by a contractor.
- Although the mixture is quite adaptable, if it is not applied or poured properly, it can crumble.

1.3 METHODOLOGY

1. Collection of literature review.
2. Collection of materials.
3. Basic test conducted on materials.
4. Mix design part.
5. Casting of beams and cubes.
6. Testing.
7. Result and discussion.
8. Design of pavement thickness based on flexural strength obtained.
9. Regression analysis.
10. Conclusion.

2. REGRESSION ANALYSIS

It is collection of techniques for calculating relationship between the dependent and independent variable. Dependent variable are outcomes and independent variables are predictors[3]. The most common from is linear regression analysis finds a line that is closely fits the data according to a relevant mathematical case. This enables the researcher to calculate the outcome of expectation of dependent variable when independent variable takes on given data values. Regression analysis is used for prediction and forecasting where it overlaps with machine learning[4].

3. MATERIALS USED

3.1. CEMENT

When water is added to cement, the cement solidifies. High lime percentage typically lengthens the setting time and produces cement with a high early strength. Cement loses strength as time passes. A high silica content increases strength and extends the setting time. Iron oxide is a relatively inactive component of cement.

Table -1: Tests on Cement

Standard consistency	33%
Specific Gravity	3.072
Initial setting time	170
Final setting time	330

3.2. COARSE AGGREGATE

Natural or crushed gravel may be used as the coarse aggregate. It should be clean and devoid of dust and other contaminants, and it can range in size from a maximum of 20mm down to 4.75mm[6].

Table -2: Tests on Coarse aggregate.

Fineness modulus	6.95
Specific Gravity	2.73
Bulk specific gravity	2.72
Water absorption	0.27%

3.3. FINE AGGREGATE

Sand or fine aggregate could be crushed or natural. It might be found in a quarry or in a riverbed. Sand particles can range in size from a maximum of 4.75mm down to 150microns, or 0.150mm. All the particles in the aforementioned range must be present in good sand particles, and the sand should be graded.

Table -3: Tests on Fine aggregate.

Fineness modulus	3.96
Specific Gravity	2.33
Water absorption	3%

3.4. GLASS FIBRE

In this project we have used "cem-fil Anti-crack hd Fiber".Anti-Crack hd (High Dispersion) is an engineered AR-glass chopped strand designed for mixing in concrete and all hydraulic mortars.

ADVANTAGES-

- Very poor electrical conductivity.
- Glass fiber with specific gravity of 2.68.
- Softening point: 860 - 1580 °F.
- Very good chemical resistance.
- Tensile strength ranges from 1000 to 1700 MPa.
- While the elastic modulus is 72GPas.

Fig -1: Glass fibre

4. MIX DESIGN [5]

Table -4: Shows mix design

MATERIALS	Kg/m³
CEMENT	383.16
WATER	191.6
FA	716.3
CA	1168.77

RATIO:- 1:1.869:3.05

5. RESULTS AND DISCUSSION

5.1. COMPRESSIVE STRENGTH

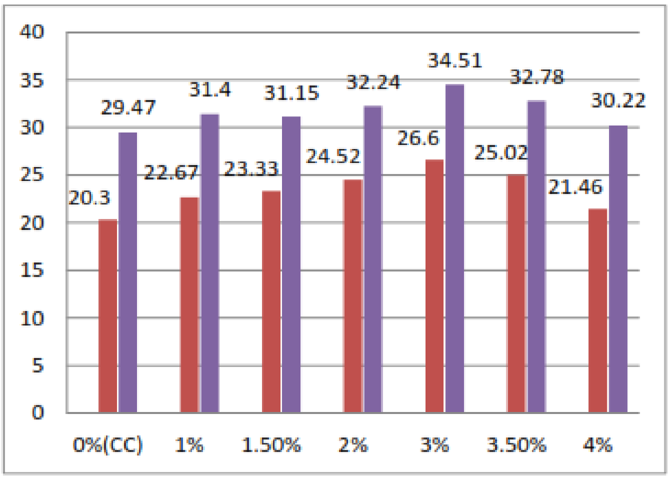


Chart -1: Compressive test results for 7&28days

The first bar in the graph represents the normal cement concrete with 20.3N/mm² as the compressive strength. The second bar is the results of concrete with 1% of glass fiber with 22.67 N/mm² as the compressive strength. The third bar represents the results of the concrete 1.5% of glass fiber with 23.33 N/mm² as the compressive strength. The fourth bar represents the results of the concrete 2% of glass fiber with 24.52N/mm² as the Compressive strength. The fifth bar represents the results of the concrete 3% of glass fiber with 26.60N/mm² as the Compressive strength. The sixth bar represents the results of the concrete 3.5% of glass fiber with 25.02N/mm² as the Compressive strength. The seventh bar represents the results of the concrete 4% of glass fiber with 21.46N/mm² as the Compressive strength.

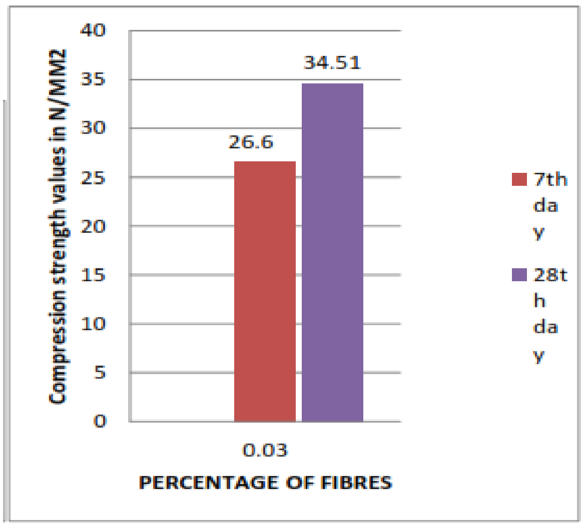
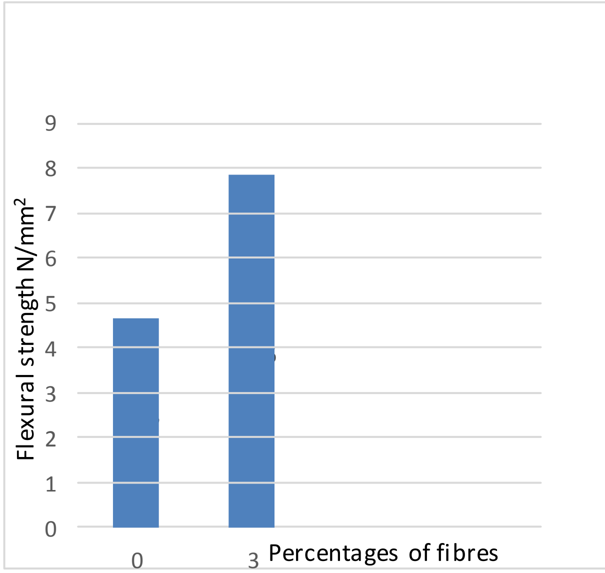


Chart -2: Shows optimum dosage of fibres

5.2. FLEXURAL STRENGTH



5.3. Chart -2: Flexural Strength

5.4. REGRESSION ANALYSIS

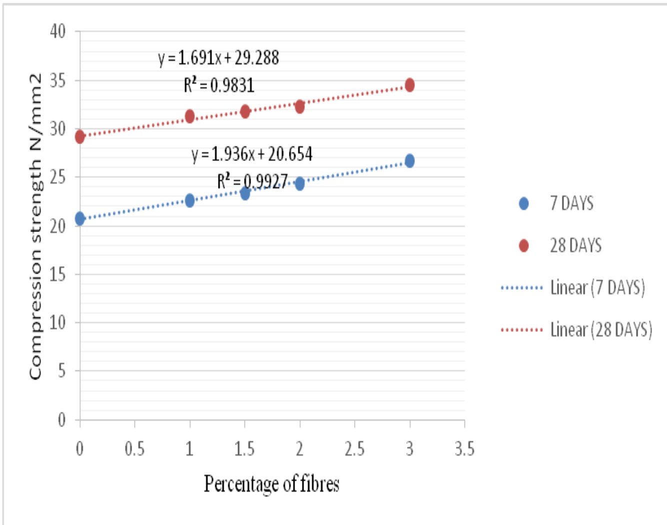


Chart -3: Regression analysis

1) The correlation greater than 0.8 is generally strong and correlation of 0.5 is said to be weak

2) If correlation is near to 0.99, predicated values become observed.

3) Higher grade of concrete we have greater coefficient of correlation.

4) Relation lies between 1 and -1.

5) When the value is 0.99 there is high chances of getting accurate compressive strength.
6) When the coefficient of correlation is less we get more deviated equation.

7) We can predict the compressive strength of no of days like 28th day of curing by deriving an equation.

Table -5: Results of pavement slab thickness.

Grade of concrete (M25)	Flexural strength (kg/cm2)	Thickness of slab(cm)
C.C	46.62	28
G.F.R.C	78.61	22

6. CONCLUSION

- It is evident that fiber reinforced concrete has 28% more compressive strength compared to normal concrete.
- There is 20.46% increase of compressive strength at 7 days and 17.1% increase at 28 days compared to normal concrete.
- The observed optimum dosage of fiber was at 3%.On addition of glass.
- Fiber in concrete, with 3% dosage the thickness of concrete pavement is decreased by 21%, which is economical when compared to normal plain concrete and is cost effective.
- In analytical study, the output and linear equation obtained displays a strong co relation after regression analysis for present study.

REFERENCES

[1] Shrikanth M. Harle, "Glass fibre reinforced concrete "-international journal of Civil engineering and research ISSN: 2278-3652 volume 5 (2014)

[2] J D chaitantya Kumar "experimental studies on glass fibre concrete"American journal of engineering research volume-5 (2016)

[3] Rahul Chaudhary(2017)(3) "experimental analysis of glass fibre reinforced concrete composites international journal of engineering research and technology volume 6.

[4] U k unamba E S Nwajagu.abutu and abutu and O J.Agbo-anike "predictive model for compression strength of concrete replacement of cement using multiple regression analysis(2020).

[5] IS:10262-2009 "Recommended Guidelines for Concrete Mix Design".

[6] IS: 383-1970 "Specification for coarse and fine aggregates".