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DESIGN AND STRENGTH IN RIGID PAVEMENT USING FIBRE REINFORCED CONCRETE

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ABSTRACT- ***Concrete may be a Predominant, Economical and durable material by that most of the structural elements of the world are created. The aggressive impact of concrete materials is inflicting damage to the ecological surroundings within the sense of 13 % of the world carbon dioxide emitting from cement manufacturing industries. Whereas we tend to studied about these impacts and that we come across that the substitutes of material will be utilized in place of typical concrete materials. As we discussed earlier, the materials like cement and aggregates are replaced by regionally available materials for green concrete so on control the maximum damage impacting on environment. Our project suggests that the behavior of the concrete and aggregates are totally replaced by Murum and RCA therefore provides 7.5 % lesser strength with 42.3 % economical as compared to traditional concrete. The outcome of project is replacement of pozzolana Portland cement is replaced with 200th of fly ash. Partial replacement of cement by fly ash is alternatives for aggregates as Murum and RCA (Recycled aggregates). An alternate concrete i.e., MRPPCF20 (Murum+RCA+PPC+Fly ash 20 percent) is most economical and eco- friendly concrete. So this composition will be used for concrete works corresponding to buildings, floor works and pavements.***

1. INTRODUCTION

A pavement is the stratified structure on which vehicles travel. It serves two functions, namely, to provide a comfortable and durable surface for vehicles, and to cut back stresses on underlying soils. In India, the traditional system of bituminous pavements is widely used. As a result of concrete have some deficiencies as low tensile strength, low post cracking capability, brittleness and low plasticity, restricted fatigue life, ineffectual of accommodating massive deformations, low impact strength. Cement concrete is characterized by brittle failure, the nearly complete loss of loading capability, once failure is initiated. Among two to three decades the bituminous pavement would be a history and required periodical maintenance. Now it is very essential to rethink of another material which satisfies required facilities.

More recently micro fibers, such as those utilized in ancient composite materials are introduced into the concrete mixture to increase its toughness, or ability to resist crack growth. FRC is Portland cement concrete reinforced with additional or less randomly distributed fibers. In FRC, thousands of small fibers

are dispersed and distributed randomly within the concrete throughout mix, and so improve concrete properties in all directions. The plain concrete structure cracks into two pieces once the structure is subjected to the peak tensile load and cannot withstand more load or deformation.

The fiber ferroconcrete structure cracks at constant peak tensile load, however doesn't separate and may maintain a load to terribly large deformations. Fibers facilitate to improve the post peak plasticity performance, pre-crack tensile strength, fatigue strength, impact strength and eliminate temperature and shrinkage cracks. FRC satisfies two of the abundant demanded necessities of pavement material in India, economy and reduced pollution. It also has many alternative benefits like longer life, low maintenance cost, fuel efficiency, and good riding quality, increased load carrying capability and impermeability to water over flexible pavements.

Figure 1 Polyester fiber

Figure 2 Glass fiber

1.1 Objectives of Study

1. To research the mechanical properties of concrete by adding polyester fibers in concrete mix.
2. To research the mechanical properties of concrete by adding alkali resistant glass fibers in concrete mix.
3. To find the optimum proportion of fiber content of polyester and alkali resistant glass fibers to be added in concrete in regard to their mechanical properties.
4. To see the reduction in thickness with the utilization of polyester and alkaline resistant glass fibers in concrete.

2. LITERATURE REVIEW

2.1 Effect of using fibers (glass, polyester, steel) on strength properties of concrete

Huijan wu et al. disbursed a Study on Micro-Structure and durability of Fiber Concrete. By this study author validated that glass fibers improve the strength of the concrete and impermeableness of the concrete will increase as the fiber content will increase.

S.A Kanalli et al. (2014) investigated comparative study of polymer fiber reinforced concrete with conventional concrete. He conducted a preliminary study on compressive strength, tensile strength and flexural victimization completely different proportions of polypropylene fibers resulted during a varying ratio of fiber indefinite quantity of 0.25 % by volume of M20 grade concrete. Experimental studies show that the utmost values of compressive, split tensile and flexural strength of concrete are obtained at 0.75% fiber dosage.

Pshtiwan N Shakor et al. Studied the utilization of fiber reinforced concrete in construction. During this study trail test for concrete with glass fiber and without fiber are conducted to indicate variations in compressive strength and flexural strength by using blocks of varied sizes. The experimental test results show that the GFRC could be a tremendous alternative construction material

2.2 Effect of fibers on improvement of rigid pavement

Dipan patel et al. (2013) studied the role of steel fiber in rigid pavement. During this investigation M20 grade concrete was manufactured with common ingredients corresponding to cement, fine aggregate, coarse aggregate, water, steel fiber. The water binder ratio adopted was 0.5. Concrete mix was created with crimped finish steel fibers with 25mm length and 0.5mm diameter (A/R 50).

Rakesh kumar et al. investigated quality of concrete reinforced with synthetic fiber for the construction of pavements. Author in brief mentioned the results of addition of polypropylene discrete and fibrillated fiber on the attributes of a paving grade concrete mix of 48 Mpa, compressive strength at 28-days. Six concrete mixes were solid with fiber dosages 0.05%, 0.10% and 0.15%.

3. METHODOLOGY AND MATERIAL DESCRIPTION

Materials

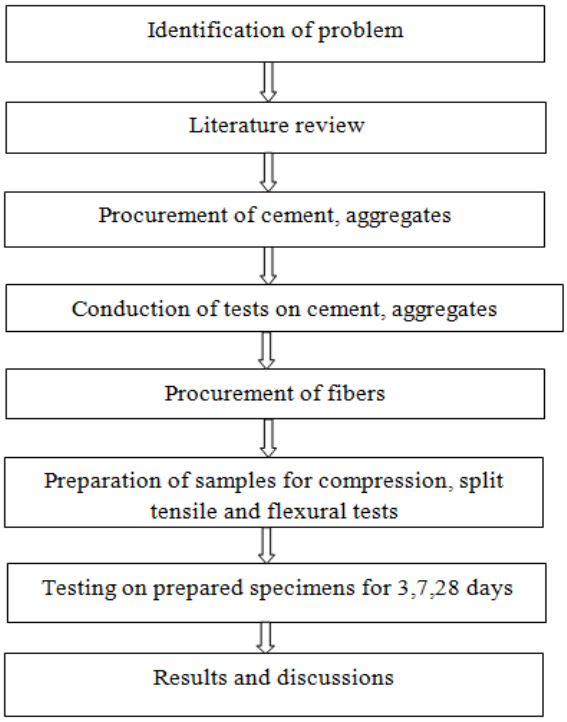
Ordinary Portland cement (OPC) of grade 53 conforming to IS: 12269 were used for the studies. Locally available stone aggregate with a maximum size of aggregate of 20mm down size and sand were used as coarse aggregate and fine aggregate respectively. The polyester fibers of 8 mm length and diameter of 0.045 mm which was produced from reliance industries Ltd., Bombay are utilized in the current study. A water reducing admixture, Rheo build 920kk is used in concrete. Its density and pH are 1.19 and & >6 respectively.

Mix Proportion

All the mixes prepared are corresponds to M-20 grade. For the design of mix IS: 10262-2009 recommendations are adopted. Design mix proportions of M-20 grade are given within the following table.1.

Ingredient	Cement	Water	Fine aggregate	Coarse aggregate	Water cement ratio
Weight	380kg/m^3	182 lit.	643 kg/m^3	1273 kg/m^3	0.48

Table: 1 Concrete Mix-proportions



4. TESTS ON CONCRETE SAMPLES AND RESULTS

S.No	Type of material	Slump value for different percentage of replacement				
		0	0.1	0.2	0.3	0.4
1	Polyester fibers	100	95	86	78	70
2	Glass fibers	100	93	81	70	

Table: 2 Slump values for different % of polyester fibers & glass fibers

Mix Proportion	Compressive strength for 28 days (Mpa)	
C.C	34.13	34.12
PFRC & GFRC (0.1%)	37.29	39.88
0.2%	38.71	40.80
0.3%	40.13	39.41
0.4%	38.03	

Table: 3 Compressive strengths of C.C, PFRC and GFRC at 28 days

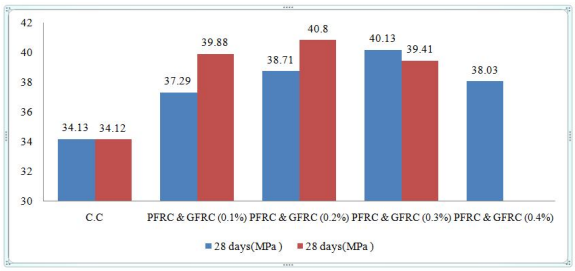


Figure: 1 Compressive strength values of C.C PFRC and GFRC 28 day

Figure: 2 Testing of Cube Specimens

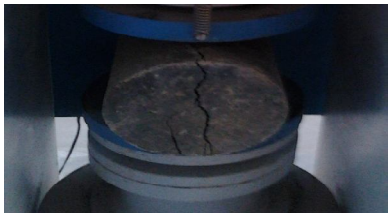


Figure: 3 Testing of Cylindrical Specimens

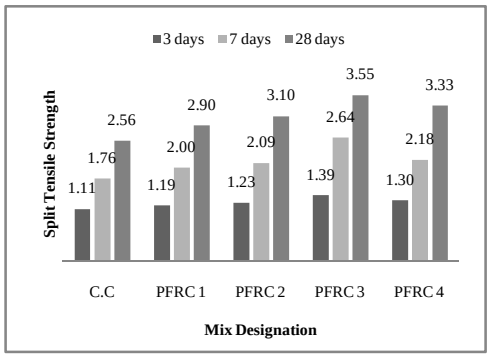


Figure: 4 Split tensile strength values of C.C and PFRC at 3, 7 and 28 Days

5. ECONOMICAL PAVEMENT DESIGN

Pavement slab is designed as per IRC 58:2002. The flexural strength is directly taken from the beam flexural test. The axial load spectrum is taken from IRC: 58-2002 and other data used in this design is given below:

A cement concrete pavement is to be designed for a two lane two-way National Highway. The total two-way traffic is 3000 commercial vehicles per day at

the end of the construction period. The design parameters are:

Design of slab thickness for conventional concrete

Flexural strength of cement concrete = 56.6 kg/cm^2

Effective modulus of sub-grade reaction of the DLC sub-base = 8 kg/cm^3

Elastic modulus of concrete = 3×10^5 kg/ cm^2

Poisson's ratio = 0.15

Coefficient of thermal expansion of concrete = $10\times10^{-6}/^0$C

Tyre pressure = 8 kg/cm^2

Rate of traffic increase = 0.075

Spacing of contraction joints = 4.5m

Width of slab = 3.5m

Design life = 20 years

Present traffic = 3000 cvpd

Type of material	Trail thickness	Sub grade modulus	Design period	Modulus of rupture	Load safety factor
Polyester fiber	25 cm	8 kg/cm^3	20 yrs	80 kg/cm^2	1.2
Glass fiber	23 cm	8 kg/cm^3	20 yrs	87 kg/cm^2	1.2
C.C	31 cm	8 kg/cm^3	20 yrs	55.6 kg/cm^2	1.2

Table: 4 Variation in the thickness in concrete mixes

Cost Comparison of C.C pavement with FRC Pavement

Type of material	Volume of concrete required (m^3)	Total cost for req. volume (Rs/-)
Polyester fiber	0.937	4660.88
Glass fiber	0.862	4161.247
C.C	1.16	5017.6

Table: 5 Cost comparisons for pavements

The construction cost of the pavement is reduced by 7.1% by using polyester fiber and cost is reduced by 17.1% by using glass fiber.

6. CONCLUSION

As given discussed in paper two forms of fibers are used for casting samples and that they are tested for compressive, split tensile and flexural strengths with varying percentages. From the tests conducted on various samples and results obtained, the subsequent conclusions are drawn:

It is observed that Slump values of the concrete are decreasing because the fiber proportion increasing. The reductions in slump with the rise within the fiber are attributed to presence of fibers that causes obstruction to the free flow of concrete.

Compressive Strength improvement ranges from 9.3% to 17.6% compared of fiber will increase from 0.1% to 0.3% for PFRC compared to the

conventional concrete at 28 days. 0.3% is observed as the optimum value.

Split tensile strength enhancement ranges from 13.3% to 38.7% compared of fiber will increase from 0.1% to 0.3% for PFRC compared to the conventional concrete at 28 days. 0.3% is observed as the optimum value

From the results it is observed that 0.2% addition of glass fiber will increase the compressive, split tensile and flexural strength by 5.12%, 16.44% and 18.03% respectively, when it's compared with polyester with similar fiber content at 28 days.

Addition of polyester fiber of 0.3% in concrete leads to decrease of pavement thickness by 19.35%. Addition of glass fiber in concrete, the pavement thickness is reduced by 25.8%.

Construction cost of the pavement is reduced by 7.11% by using polyester fiber. Construction cost of the pavement is reduced by 17.1% by using glass fiber.

7. SCOPE FOR FUTURE WORK

The present information indicates that there is significant improvement within the strength properties of concrete by victimization polyester and glass fibers. Further study is extended to understand the mechanical properties of fiber concrete by adding combination of fibers (Hybridization). We can also study totally different parameters like drying shrinkage, abrasion resistance, porosity and consistency of the concrete with and without fibers. So as to make the study a lot of economical we will replace cement with fly ash.

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