STEEL FIBRE REINFORCED CONCRETE PAVEMENTS FOR ROADS

Sneha Latha Bakshetty
Department of Civil Engineering
Assistant Professor in Kshatriya Engineering College(B4), Armoor
snehalathabakshetty@gmail.com

Srikanth Ramvath
Department of Civil Engineering
Assistant Professor in Kshatriya Engineering College(B4), Armoor
srikanth4laddu@gmail.com

Naresh Kummari
Department of Civil Engineering
Assistant Professor in Kshatriya Engineering College(B4), Armoor
kummarinaresh663@gmail.com

ABSTRACT

Road transportation is undoubtedly the lifeline of the nation and its development is a essential issue. The traditional bituminous pavements and their wishes for non-stop preservation and rehabilitation operations factors towards the scope for cement concrete pavements. There are numerous blessings of FRCP over CC and bituminous pavements like low upkeep fee, availability of cement is extra in comparison to bitumen. FIBRE REINFORCED CONCRETE PAVEMENTS, which is a latest development in the area of reinforced concrete pavement layout. FRC pavements show to be more efficient than conventional RC pavements. Main function of fibres is to bridge the cracks that increase in concrete and growth the ductility of concrete factors. Improvement on Post-cracking behavior of concrete and imparts greater resistance to effect masses.

Water logging is a main cause for potholes in roads. WBM and Asphalt roads are permeable to water which damages the street and sub grade. But FRC roads are especially impermeable to water so they will not permit water logging and water being popping out on surface from sub grade. Implementation of sensors in roads might be less difficult even as using fibres for concrete. Maintenance activities associated with metal corrosion will be decreased whilst the use of FRC. Fibres reduce plastic shrinkage and substance cracking. Fibres additionally provide residual electricity after cracking occurred. The use of fibres in concrete can bring about cement saving up to ten% and inside the presence of fly ash; savings can be up to 35%.

There is a developing cognizance of the benefits of fibre reinforcement techniques of production all around the international. STEEL FIBRE REINFORCED CONCRETE has turn out to be very famous due to its tremendous mechanical overall performance compared to the conferenceal concrete. Experimental investigations and evaluation of results were conducted to observe the compressive & tensile behavior of composite concrete with various percentages of such fibres delivered to it. The concrete mix adopted has been M30 with varying percentage of fibres starting from 0.5, 1.0, 1.5 & 3%.

Keywords: *Steel Fibres, Strength, Maintenance, Fatigue Life, Ductility, Cracks control.*

INTRODUCTION

In a creating nation, for example, India, street systems shape the veins of the country. Asphalt is the layered structure on which vehicles travel. It fills two needs, to be specific, to give an agreeable and strong surface for vehicles, and to diminish weights on basic soils. In India, the conventional arrangement of bituminous asphalts is generally utilized.

Locally accessible bond concrete is a superior substitute to bitumen which is the side-effect in refining of imported oil unrefined. Petroleum and its results are damning step by step. At whatever point we think about a street development in India it is underestimated that it would be bituminous asphalt and there are extremely uncommon possibilities for thinking about an option like solid asphalts.

Inside a few decades bituminous asphalt would be a history and hence the requirement for an option is exceptionally basic. The ideal arrangement would be FIBER REINFORCED CONCRETE PAVEMENTS, as it fulfills two of the much requested prerequisites of asphalt material in India, economy and lessened contamination. It likewise has a few different preferences like longer life, low support cost, fuel proficiency, and great riding quality, expanded load conveying limit and impermeability to water over adaptable asphalts.

REVIEW OF PAPERS

W A Elsaigh, Pkearsley and J M Robberts Recently, considerable interest has been generated in the use of Steel Fibre Reinforced Concrete (SFRC). The most significant influence of the incorporation of steel fibres in concrete is to delay and control the tensile cracking of the composite material. This positively influences mechanical properties of concrete. These improved properties result in SFRC being a feasible material for concrete road pavements. The aim of this paper is to evaluate the use of SFRC for road Pavements and compare its performance to plain concrete under traffic loading. The influence of SFRC properties on performance and design aspects of concrete roads are discussed. Results from road trial sections, tested under in-service traffic, are used to validate the use of the material in roads. Performance and behaviour of a SFRC test section is compared to a plain concrete section. The performance of thinner SFRC ground slabs is found comparable to thicker plain concrete slabs. A design approach for SFRC is recommended in which an existing method for the design of plain concrete slabs is extended by incorporating the post-cracking strength of SFRC.

Alan Ross Steel fibres andconventional reinforcing mesh/bar are both used to effectively reinforce concrete dueto their ability to provide an effective restraining tensile force across any cracks that open. InAustralia and New Zealand this has typically resulted in steel fibres being substituted for mesh in themain applications of slab on grade, shot Crete for ground support and precast concrete elements, as well as a number of other more specific applications. In Western Europe it is becoming more and more common to also use combined reinforcement solutions, which consist of both steel fibres and conventional steel reinforcement. The synergies that result from combining these two types ofreinforcement make it possible to achieve commercially competitive solutions when designing toreach a desired level of ultimate load carrying capacity or serviceability. This innovation has beendriven by the incorporation of the combined reinforcement option into various technical approvals anddesign guidelines currently available in Europe.

Colin D.Johnston During the past decade steel fibre-reinforced concrete has progressed from a new relatively untried and unproven material to one which has now achieved recognition in a variety of engineering applications. This paper summarizes the scope of current use in pavements, hydraulic structures, and applications amenable to the shotreting method of fabrication. It also attempts to illustrate why the material works well in these types of applications in terms of properties such as strain capacity, toughness, fatigue strength, and impact resistance. Limiting features such as problems associated with manufacture and placement, and the question of long-term durability are briefly discussed.

Unlike ordinary concrete pavement, replacement concrete slabs need to be open to traffic within 24 hours (sooner in some cases). Thus, high early-strength concrete is used; however, it frequently cracks prematurely as a result of high heat of hydration that leads the slab to develop plastic shrinkage. FRC is known to provide good resistance to plastic shrinkage and has a proven record in the building industry particularly with slab-on-grade application. However, the current specification does not address the use of FRC in civil infrastructure. The only specification under development for FRC usage is for bridge deck application which does not address the use of FRC in controlling plastic shrinkage. This research project explored the potential use of fiber reinforced concrete (FRC) in concrete pavement slab replacement particularly in controlling plastic shrinkage. Five different fiber types, including steel, glass, basalt, nylon, and polyethylene fibers were investigated. Additionally, the effect of fiber length was also investigated for the polyethylene fiber. The fibers were added at low-dosage amounts of 0.1% and 0.3% by volume. Retrained shrinkage tests were conducted to assess the cracking potential of the concrete mixtures and the ability for each fiber type to resist cracking. Results indicated that both polyethylene and nylon fibers provided the best resistance to early-age shrinkage. However, balling was a problem for nylon fiber reinforced concrete. Short fibers (< 1-in.) also had the best performance in resisting early-age shrinkage, while long fibers (> 1-in.) provided additional post-cracking capacity. For replacement slab, it is recommended that a short polyethylene fiber be used to eliminate uncontrolled cracking.

Banthia et al., 1995, The Shear behavior of fiber-reinforced concrete was studied using direct shear rests. Two 50 mm-long steel fibers, one with flattened ends and a circular cross section and the other with a crimped geometry and a crescent cross section, were investigated at fiber volume fractions varying between 0 and 2%, Direct comparison was made with flexural toughness determined as per the ASTM C1018 procedure.

It was found that both fibers provided significant improvements in shear strength as well as shear toughness and these improvements are greater at higher fiber dosage rates. Between the two fibers, the fiber with flattened ends was seen to be more effective than theone with crimped geometry, for the flattened-end fiber, an almost linear increase in the shear strength was noted with an increase in the fiber volume fraction. For the fiber with crimped geometry, on the other hand, shear strength approached a plateau volume beyond which no increases in shear strength occurred with an increase in the fiber volume fraction. While plain concrete failed at a low equivalent shear strain of 0.4%, fiber-reinforced concrete supported as high as 10% strain in shear.

When the shear toughness of steel fiber-reinforced concrete was compared with its flexural toughness, then appeared to be a direct correlation. However, given the subjectivity of this type of comparison and the limited data generated in this study, munch further research is needed to fully understand and establish this correlation.

2.3 PROPERTIES OF STEEL FIBRE REINFORCED

For the most part, because of the use of steel fiber reinforced concrete in industry, there are a ton of research are led to examine the properties of steel fiber in typical cement. Regarding to that, the committee members from concrete society are conducted the research for further application in concrete. The reasons of committee member are to create the standard and the design guide for world application. Nevertheless, because of the variety type of steel fibre in the world, the committee members are successfully done the technical report for world references and design method for steel fibre reinforced concrete.

2.3.1 Mechanical Properties

Table 2.1 Mechanical Properties of Steel Fibres

Steel Fibre (Straight End)	Density	7.85 g/cm^3
	Modulus of Elasticity	205 GPa
	Poisson Ratio	0.29
	Yield Strength	1275 MPa
	Tensile Strength	1100 MPa

According to the table above, it indicated that the mechanical properties of steel fibre for all type steel fibre. Based on literature review, this properties are based on the previous research done and it almost used in the computer program software such as Abaqus, Fortan, Lusas and also for experimental work and designing the steel fibre in the concrete. From the table, the modulus of elasticity of steel fires is higher and it will similarly to the steel rein-forcement. However the yield strength of steel fibre can assist the concrete bonding during the cracking propagation. It cause of the high value of the "yield strength for steel fibre".

2.3.2 Physical Properties

Steel fibres have a great tensile strength than traditional fabric reinforcement and it significantly greater surface area to develop bond with the concrete matrix. In addition, some of the physical characteristic of steel fibre directly effects on the concrete performance. The factors are considered to be the stronger influence on the performance.

Table 2.2 Physical Properties of Fibres

PROPERTIES	VALUE(mm)
Diameter	0.15-1.3
Length	25-60

2.4 SCOPE

The scope of the present study is to develop pavement for road construction using steel fibre, which is useful for the resistance of toughness, abrasion resistance, tension etc for rural roads.

METHODOLOGY

3.1. GENERAL

This chapter explains the experimental program, which consisted of various laboratory experiments to quantify the plastic properties, mechanical properties and cracking performance of FRC concrete consisting of ten concrete mixtures. Additionally, the mixing procedure, concrete mixture proportions, and the preparation and storage of specimens are also described in this section. The plastic properties were determined by the unit weight and the time of flow test. Visual observation was also carried out to inspect for any clumps and balls caused by the fiber clinging together. The compressive strength, modulus of rupture, flexural toughness, and residual strength tests were used to evaluate the concrete mechanical properties, while the restrained shrinkage test was used to evaluate the cracking performance in concrete.

- Mix Design of concrete as per IRC 44: 2008
- Mix Design of SFRC as per IRC SP: 46-1997
- Analyze compressive strength of mixes with compression test carried out on cubes
- Analyze Flexural Strength of beams with flexural testing machine.
- Analyze Modulus of Elasticity of Cubes with modulus of elasticity testing machine
- Analyze thickness reduction of concrete slab with IRC 58: 2002 guidelines.

Steel Fibre Reinforced Concrete (SFRC) is concrete containing dispersed steel fibres. The most significant influence of the incorporation of steel fibres in concrete is to delay and control the tensile cracking of the composite material. Concrete is a brittle material that will not carry loads under pure bending when cracked. By incorporating steel fibres the mechanical properties of the concrete is changed resulting in significant load carrying capacity after the concrete has cracked. The major incentive for adding steel fibres is to improve the flexural behavior of the slab.

The increased load carrying capacity of the SFRC suggests that thinner SFRC ground slabs can be designed compared to plain concrete slabs to provide the same service. There is always a great concern that thinner ground slabs are likely to generate higher potential for curling and warping and yield higher deflections. High stresses caused by curling and warping combined with traffic loading can cause damage to edges and corners and hence failure of the slab.Excessive deflection can stimulate pumping of the support layer material resulting in failure of the slab due to formation of voids below these slabs.

3.2 MATERIAL SELECTION

3.2.1 Materials required for rigid pavements

- Cement
- Coarse Aggregates
- Fine Aggregates
- Water
- Fibres

Figure 3.2: Materials required for Rigid Pavements

3.2.2.Fibres

Fiber Reinforced concrete can be described as a composite material involving mixtures of bond, mortar or concrete with discontinuous, discrete, reliably scattered fitting fibers. Strands are generally fitful, subjectively flowed all through the solid matrices. Consistent crosssegments, woven surfaces and long wires or bars are not thought to be discrete strands.

Different types of fibres available are Textile fibres, Natural fibres and Man-made Fi-bres. Man-made fibres are categorized as Semi-synthetic and synthetic fibres. The fibre we choose in our project is Steel fibre, which comes under the synthetic fibres.

Results from road trial sections, tested under in-service traffic, are used to validate the use of the SFRC in roads pavements. Performance and behaviour of a SFRC test section is compared to a plain concrete section.

Referring to the American Concrete Institute (ACI) committee 544, in fibre Reinforced concrete there are four categories namely

1.	SFRC	-	Steel Fibre Reinforced Concrete
2.	GFRC	-	Glass Fibre Reinforced Concrete
3.	SNFRC	-	Synthetic Fibre Reinforced Concrete
4.	NFRC	-	Natural Fibre Reinforced Concrete

Steel fibres

Steel fibres are manufactured fibres composed of stainless steel. Composition may include carbon (C), silicon (Si), manganese (Mn), phosphorus (P), sulphur (S) and other elements. Fibre shapes are illustrated below.

Fiber Reinforced Concrete can be defined as a composite material consisting of mixtures of cement, mortar or concrete and discontinuous, discrete, uniformly dispersed suitable fibers. Fiber reinforced concrete are of different types and properties with many advantages. Continuous meshes, woven fabrics and long wires or rods are not considered to be discrete fibers.

Fiber is a small piece of reinforcing material possessing certain characteristics properties. They can be circular or flat. The fiber is often described by a convenient parameter called "aspect ratio". The aspect ratio of the fiber is the ratio of its length to its diameter. Typical aspect ratio ranges from 30 to 150. Fibre-reinforcement is mainly used in shotcrete, but can also be used in normal concrete. Fibre-reinforced normal concrete are mostly used for on-ground floors and pavements, but can be considered for a wide range of construction parts (beams, pliers, foundations etc) either alone or with hand-tied rebars.

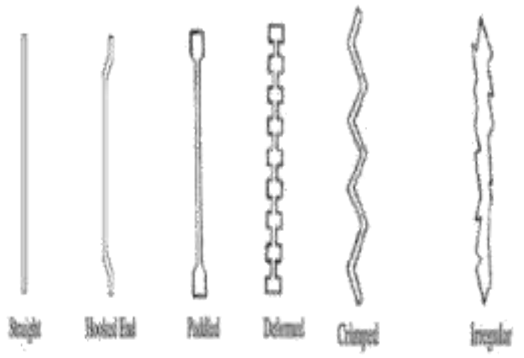

Figure 3.4: Different shapes of steel fibres (Ref: https://www.google.co.in/imghp)

3.2.3Mix Design for Concrete

3.2.3A. Introduction:

Mix design can be characterized as the way toward choosing reasonable elements of cement and deciding their relative extents with the question of delivering concrete of certain base quality and strength as financially as would be prudent. The question is to accomplish the stipulated least quality and sturdiness. The second question is to make the solid in the most efficient way. Cost shrewd all concrete depend basically on two elements; to be specific cost of material and cost of work. Work cost, by method for form works; clustering, blending, transporting, and curing is about same for good concrete and awful concrete. In this manner attention is primarily coordinated to the cost of materials. Since the cost of cement is ordinarily more than the cost of different fixings, consideration is basically coordinated to the utilization of as meager bond as conceivable predictable with strength and durability.

3.2.3B. Variables in proportioning:

With the given materials, the four variable factors to be considered in connection with specifying a concrete mix are:

- Water-Cement ratio
- Cement content or cement-aggregate ratio
- Gradation of the aggregates
- Consistency

The exertion in proportioning is to utilize a base measure of glue that will grease up the mass while crisp and in the wake of solidifying will tie the total particles together and fill the space between them. Any overabundance of glue includes more prominent cost, more noteworthy drying shrinkage, more noteworthy helplessness to permeation of water and accordingly assault by forceful waters and weathering activity. This is accomplished by limiting the voids by great degree.

3.2.3C. Various Methods of Proportioning:

3.2.3D. DOE Method:

The DOE approach became first published in 1975 and then revised in 1988.While Road Note No. Four or Grading Curve Method changed into especially evolved for concrete pavements.

The following steps are involved in DOE Method:

Step 1: Finding the target mean strength
Target mean strength= (specified characteristic strength)+((Standard deviation) x (risk factor))
Note: - risk factor is on the assumption that 5% of results are allowed to fall less than the specified characteristic strength.

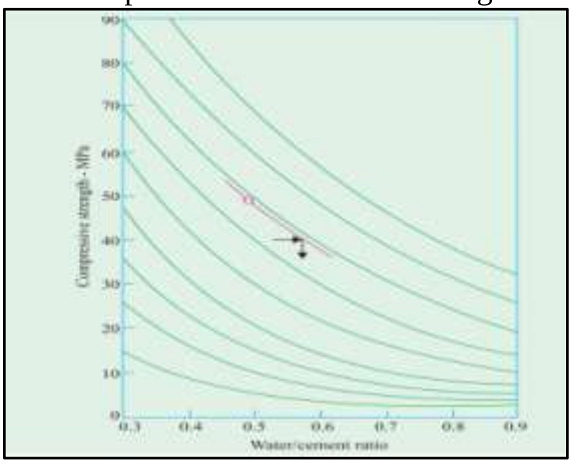

Figure 3.5: w/c ratio v/s Compressive strength curves

Step 2: Calculate the Water/Cement ratio with the help of table 3.1 and parent 3.1 Using the table findout the 28 days compressive strength of the approximate kind of cement and styles of C.A. Mark a point on the "Y" axis inside the above discern 3.1 same to the compressive power read from the desk beneath, that is at a w/c of 0.5.

Table 3.1: Approximate Compressive Strength of Concrete made with a free w/c ration of 0.50. According to the 1988 British Method

Type of Cement	Type of C.A	Compressive Strength at the age (cube) of days MPa			
		3	7	28	91
Ordinary Portland Cement (Type I)	Uncrushed	22	30	42	49
Sulphate Resisting Cement (Type V)	Crushed	27	36	49	56
Rapid-Hardening Portland Cement(Type III)	Uncrushed	29	37	48	54
	Crushed	34	43	55	61

Step 3: Next decide water content for the required workability, expressed in terms of slump of Vee-Bee time,taking into consideration the size of aggregates and its type from table 3.2.

Table 3.2: approximate free water contents required to give various levels of workability according to 1988 British method.

Aggregate		Water Content Kg/m^3 for:			
Max Size Mm	Type	Slump 0 – 10	10 - 30	30 - 60	60 – 180
		Vebe> 12 seconds	6 – 12	3 – 6	0 – 3
10	Uncrushed	150	180	205	225
	Crushed	180	205	230	250
20	Uncrushed	135	160	180	195
	Crushed	170	190	210	225
40	Uncrushed	115	140	160	175
	Crushed	155	175	190	205

Aggregates form the major portion of the pavement structure. Bear stresses occurring on the roads and have to resist wear due to abrasive action of traffic. Aggregates are also used in flexible as well as in rigid pavements. Therefore, the properties of aggregates are of considerable importance to highway.

Aggregate is one of the important constituents in concrete, which has effect in strength development. Was to determine the relative performance of uncrushed aggregates to crushed (crushed aggregates) is two types of coarse aggregates. Using larger coarse aggregate typically lowers the cost of a concrete mix by . Both gravel and crushed stone are generally acceptable for making quality. Grading refers to the determination of the particle-size distribution for aggregate.Grading refers to the determination of the particle-size distribution for aggregate.For crushed aggregate, the particle shape and surface texture depend on these numerical determination; the physical requirements of coarse aggregates.

Desirable Properties of Road Aggregates:

- Strength
- Hardness
- Toughness
- Durability
- Shape of aggregates
- Adhesion with bitumen

Step 4: Find the cement content material understanding the water/cement ratio and water content material. Cementcontent material is calculated truly dividing the water content material by means of w/c ratio the cement content so calculated ought to be in comparison with the minimum cement content certain from the sturdiness consideration as given in table 3.3 and 3.4 better of the two must be followed. Sometime maximum cement content is likewise certain. The calculated cement content has to be less than the required most cement content.

Table 3.3: Requirements of BS 8110: Part I: 1985 Ensure Durability Under Specified Exposure Conditions of Reinforced and Pre-stressed Concrete Made with Normal Weight Aggregate.

Condition of Exposure	**Nominal Cover of Concrete in mm**				
Mid Moderate Severe Very Severe Extreme	25 - - - -	0 5 - - -	20 30 40 50 -	20 25 30 40 60	0 0 5 0 0
Maximum Water/ Cementitious material ratio	.65	60	0.55	.50	45
Minimum content of cementitious Material in kg/m^3	275	00	325	350	00
Minimum grade MPa	30	5	40	45	0

Step 5: Find out the whole mixture content. This requires an estimate of the wet density of the completely compacted concrete. This may be found out from determine 3.1.3.4.2 for approximate water content material and unique gravity of mixture.

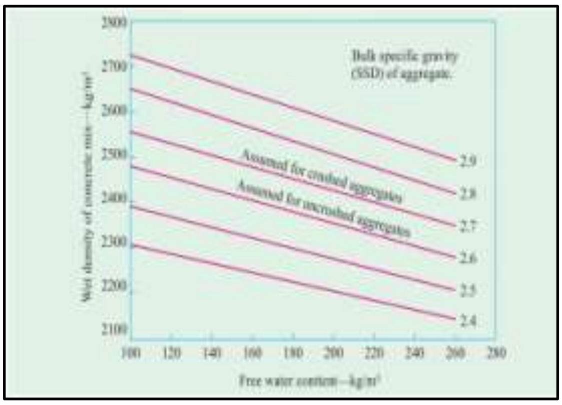

Figure 3.6: Appropriate water content v/s specific gravity of aggregates.

If specific gravity is unknown, the cost of two.6 for uncrushed aggregate and a couple of.7 for beaten aggregate may be assumed. The mixture content is acquired by way of subtracting the weight of cement and water content from weight of fresh concrete.

Step 6: Then, share of great aggregate is decide in the general mixture the usage of parent under. Figure3.3(a) is for 10mm, 3.3(b) is for 20mm size and figure 3.3(c) is for 40 mm size of coarse aggregates. The parameters worried in Fig 11.5 are most size of coarse combination, stage of workability, the w/c ratio, and the percentage of great aggregates passing 600 μ sieve. Once the proportion of F.A.

Is obtained, multiplying by means of the load of overall combination offers the weight of F.A. Then the burden of the C.A. May be discovered out. C.A. May be in addition divided into unique fractions depending at the form of aggregate. As well-known steerage the figures given inside the table 3.5 may be used.

Table 3.5: Proportion of coarse aggregates fractions according to the 1988 British method

Total C.A	**5 – 10 mm**	**10 – 20 mm**	**20 – 40 mm**
100	33	67	-
100	18	27	55

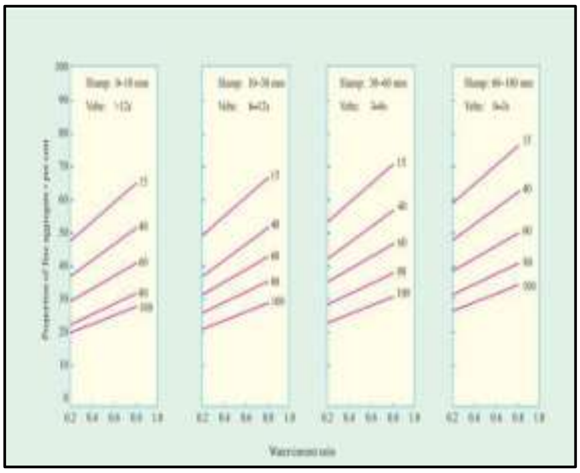

Figure 3.7 Recommended percentage of fine aggregate in total aggregate as a function of free w/c ratio for various values of workability and maximum size of aggregates 10mm.Numbers on each graph are thepercentage of fines passing 600 µm sieve.**(Building Research Establishment, Crown copyright).**

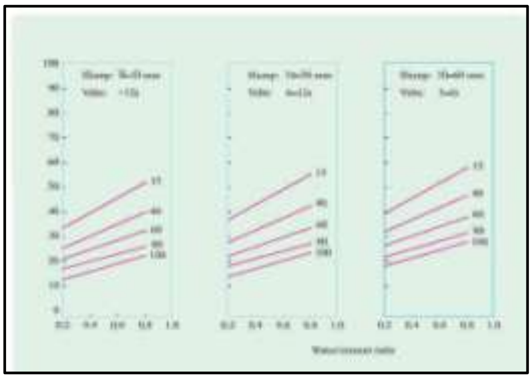

Figure 3.8: Recommended percent of pleasant aggregate in general combination as a function of unfastened w/c ratio for numerous values of workability and maximum length of aggregates 20 mm. Numbers on each graphare the percentage of fines passing 600 µm sieve.**(Building Research Establishment, Crown copyright).**

The proportion so worked out should be tried in a trial mix and confirmed about its suitability for the given concrete structure.

Table 3.6: Concrete mix design

CONCRETE MIX DESIGN		
I	STRIPULATION FOR PROPORTIONING	
01	Grade Designation	M30
02	Type of Cement	OPC 53 grade
03	Maximum Nominal size of Aggregate	20 mm
04	Maximum w/c ratio	0.65
05	Workability	0.85(CFV)
06	Exposure Condition	Severe
07	Degree of Supervision	Good
08	Type of aggregate	Uncrushed aggregate
II	TARET STRENGTH FOR MIX PROPORTIONING	
01	Target mean strength	38.25 MPa
02	Characteristic strength @ 7 days	30 MPa
III	SELECTION OF WATER CEMENT RATIO	
01	Maximum w/c ratio	0.65
02	Adopted w/c ratio	0.45
IV	SELECTION OF WATER CONTENT	
01	Maximum Water Content	168 lt/m^3
02	Estimated water content for 50-75 mm slump	162 lt/m^3
V	CALCULATION OF CEMENT CONTENT	
01	w/c ratio	0.45
02	Water content	180 kg/m^3
03	Cement content(180/0.45)	400 kg/m^3
VI	MIX PROPORTION FOR 1 m^3 of CONCRETE	
01	Mass of cement in kg/m^3	400
02	Mass of water in kg/m^3	180
03	Aggregate content= wt. of fresh concrete-{wt. of cement+wt of water content} =2400-{400+180}	1820 kg/m^3
04	Mass of F.A. in kg/m^3 = (aggregate content) X (proportion of F.A.) = (1820) X (35%)	637 kg/m^3
05	Mass of C.A.= (aggregate content)-(mass of F.A.) = 1820-637	1183 kg/m^3

Therefore, estimated quantities in kg/m^3 are,

- Cement = 400
- F.A.= 637
- C.A = 1183

MIX PROPORTION FOR M30 GRADE OF CONCRETE:

(400/400) : (637/400) : (1183/400) = 1 : 1.593 : 2.958

3.3 SAMPLE PREPARATION

Concrete containing hydraulic cement, water, best mixture, coarse combination and discontinuous discrete Steel fibres is called Steel Fibre Reinforced Concrete. It may also con-tainpozzolans and different admixtures generally used with conventional concrete. For maximum structural and non-structural functions, steel fibre is generally used of all the fibres. Steel fibres are added in conjunction with dry blend of all components on the way to put together the SFRC.

Factors affecting the properties of FRC

Properties of concrete are suffering from many elements like residences of cement, excellent aggregate, coarse aggregate. Other than this, the fibre bolstered concrete is suffering from comply with-ing factors:

- Type of fibre
- Aspect ratio
- Quantity of fibre
- Orientation of fibre

So, if you want to decrease these consequences we want to discover surest fibre content to be blended inside the concrete blend. Different proportions of fibres are blended with concrete blend and cubes are organized on which compressive energy was performed after 7 days and 28 days. The fibre content material at which the most compressive energy changed into acquired may be the optimum fibre content material.

ANALYSIS & RESULTS

5.1 GENERAL

When heavy vehicle passes over a SFRC slab, cracks propagate when the flexural strength is exceeded. This crack will require additional energy widen. The additional energy to widen this crack is either supplied by environmental load or by traffic load. The energy absorption provided by SFRC concrete is higher than of plain concrete and all these has been shown in below figures 5.1, 5.2 etc.For the same stress/strength level, SFRC slabs yields greater number of load cycles compared to plain concrete slabs.

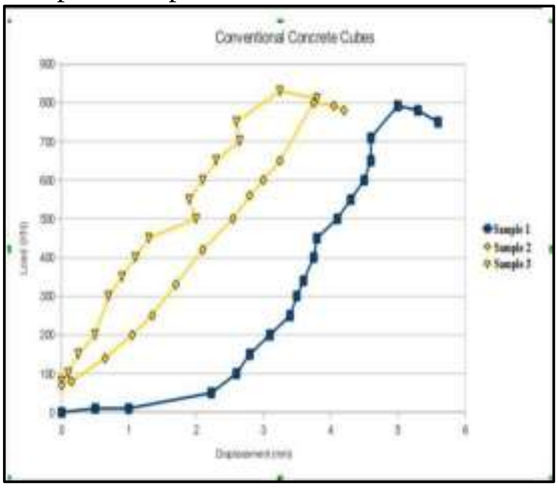

Figure 5.1: Graph between load v/s Displacement for Conventional Concrete cubes

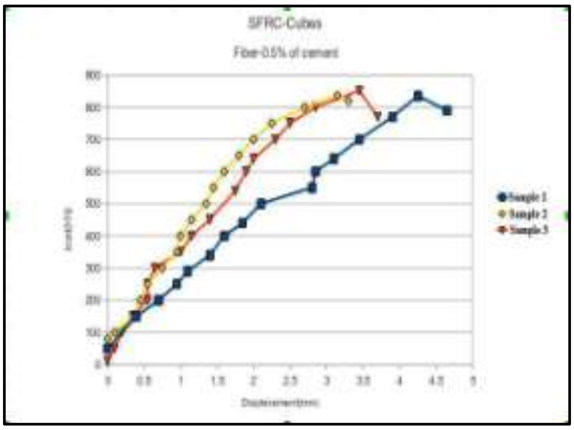

Figure 5.2: Graph between load v/s Displacement for Fibre 0.5% wt. of Cement

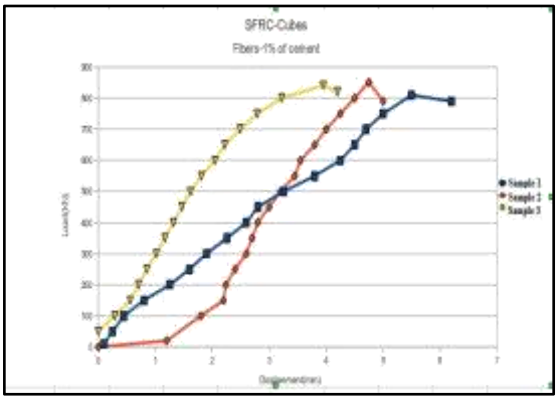

Figure 5.3: Graph between load v/s Displacement for Fibre 1.0% wt. of Cement

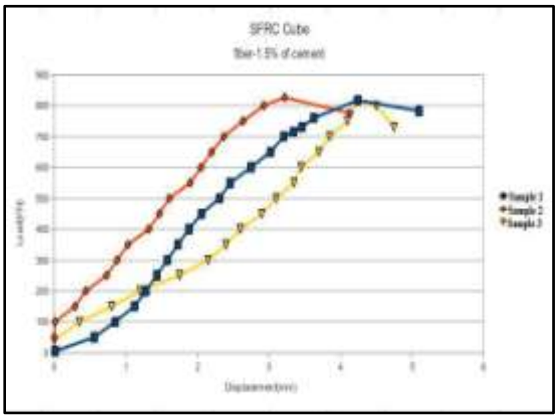

Figure 5.4: Graph between load v/s Displacement for Fibre 1.5% wt. of Cement

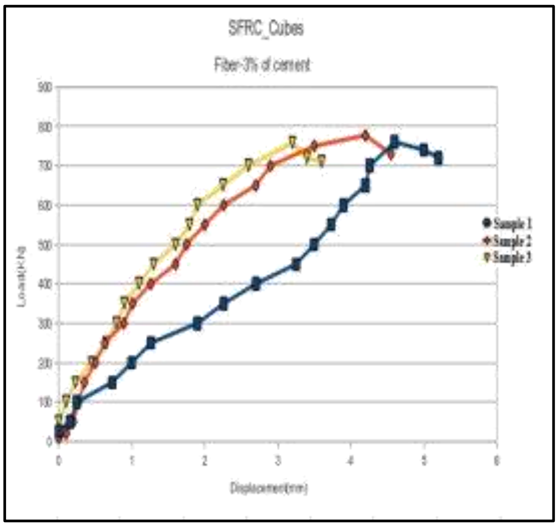

Figure 5.5: Graph between load v/s Displacement for Fibre 3.0% wt. of Cement

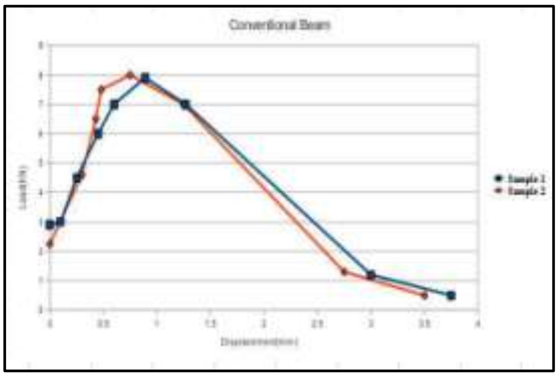

Figure 5.6: Graph between load v/s Displacement for Conventional Concrete Beams

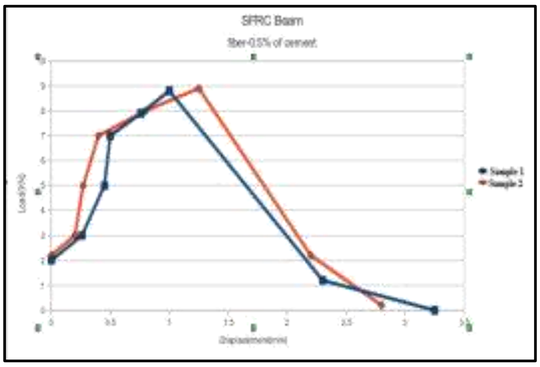

Figure 5.7: Graph between load v/s Displacement for Beams of fibre-0.5% wt. Cement

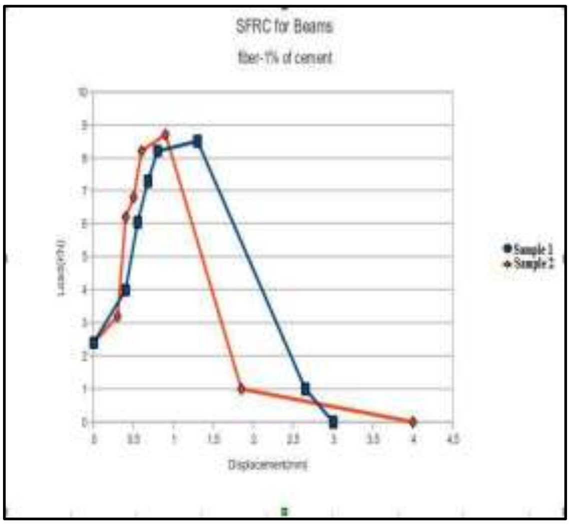

Figure 5.8: Graph between load v/s Displacement for Beams of fibre-1.0% wt. Cement

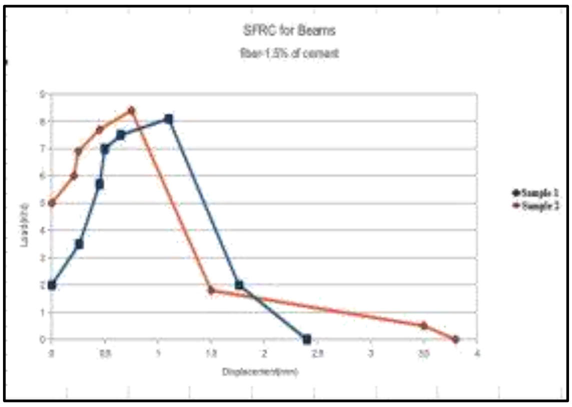

Figure 5.9: Graph between load v/s Displacement for Beams of fibre-1.5% wt. Cement

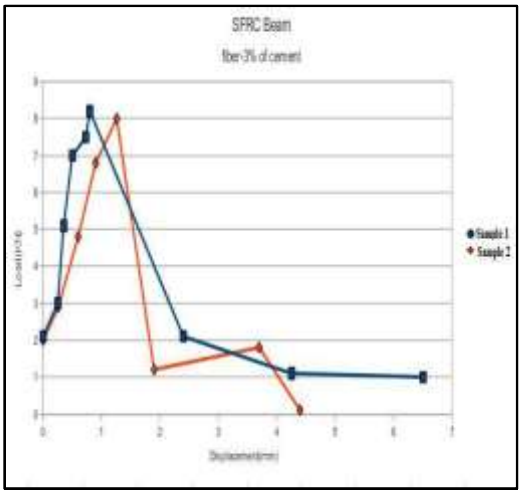

Figure 5.10: Graph between load v/s Displacement for Beams of fibre-3.0% wt. Cement

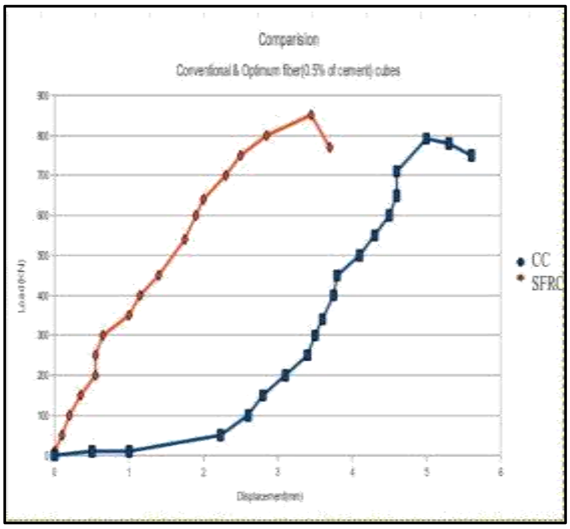

Figure 5.11: Graph between load v/s Displacement, Comparison Conventional & Optimum fibre (0.5% of cement) cubes.

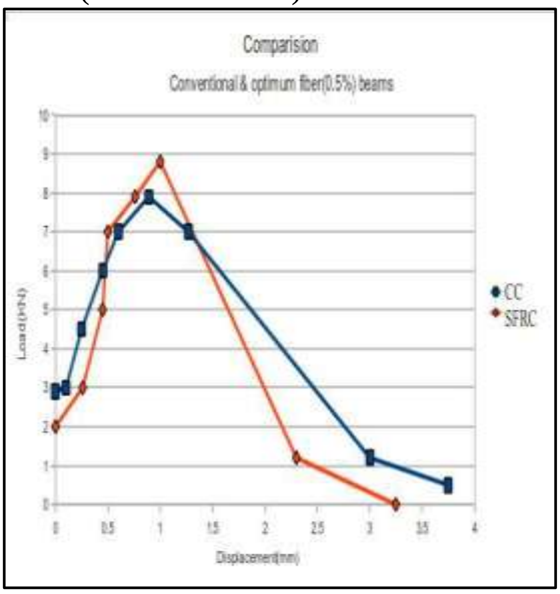

Figure 5.12: Graph between load v/s Displacement, Comparison Conventional & Optimum fibre (0.5% of cement) beams.

Table 5.1: Comparison of design parameters of normal concrete pavement and SFRC pavement.

S.NO.	% of fibre in various Mix	Slump in (mm)	Vee-Bee value in Sec	Compressive strength in N/mm²	Flexural Strength (KN/m²)
1	0	18	18.200	35.880	3.578
2	0.5	15	26.020	37.379	3.983
3	1.0	20	26.090	37.073	3.870
4	1.5	14	38.690	34.511	3.713
5	3	20	47	34	3.

			.060	.000	645

5.2 ECONOMIC ANALYSIS

1. Cost of construction for 0% Fibres Mix i.e. Normal mix

- Length of road = 75 m
- Width of road = 7.5 m
- Pavement thickness = 37 cm
- Total = 208.13

As per the SOR rates cost of construction of 1 m^3 of Cement Concrete road is Rs. 845

2. Cost of construction of 0.5% Fibres Mix i.e. Steel Fibres mix

- Length of road = 75 m
- Width of road = 7.5 m
- Pavement thickness = 33.5 cm**SUMMARY ANDCONCLUSION**

CONCLUSION

- Therefore, by going through different journals and studies papers we are able to finish that FRC might be economically and correctly solving the existing problems with RC pavements.
- FRC is a sustainable improvement inside the present technology.
- We did no longer carry out the bonding take a look at but by means of going thru journals and the checks which we did, we've got observed that because of randomly distribution of discontinuous fibres they're used to bridge throughout the cracks that expand and provides a few publish cracking ductility.
- The research emphasizes that fibre reinforcement in a cement certain avenue base has the potential to enhance performance by using improving fatigue lifestyles of the base and improved resistance to reflective cracking of the asphalt.
- The studies additionally establish that the residences of hardened SFRC, consisting of flexural electricity, are remarkably higher than those of conventional RCC. Thus, the use of metal fibre for powerful pavement construction can be cautioned undoubtedly.
- Addition of metallic fibres reduces the workability of concrete; hence it becomes important to utilize top notch plasticizers. And those SFRC is used for foremost, high budget tasks only because Steel fibres are value effective.
- The use of fibres in concrete can bring about cement saving up to 10% and inside the presence of fly ash; savings may be as much as 35%.
- " TURN POLLUTION INTO SOLUTION "

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