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Experimental Study on Flexure and Compressive Strength of the Reinforced Concrete Using Crushed Sand and Steel Fiber

Mr. Yogesh Gururaj Mane Project Guide: Prof. S. A. Gosavi
M. Tech.(structural engineering) SVERI'S Collage Of Engineering ,Pandharpur

Abstract:
The term Concrete Mix Design is the methodology of selecting suitable materials of concrete and finding out their relative amounts with an objective of generating a concrete of the required characteristics such as strength, durability, and workability in an economical manner. The required concrete proportioning of ingredient is directed by the performance of concrete in 2 stages i,e the plastic and hardened stage. The plastic concrete cannot be properly placed and compacted if it is not workable. Therefore workability as a property of concrete has a vital importance. In hardened concrete, the compressive strength is generally considered to be an basis of its other properties, depends upon many factors, e.g. quality and quantity of cement , water and aggregates; batching and mixing; placing ,compaction and curing. The aim of this study is to evaluate the mechanical performance of M30 grade concrete containing the manufacturing sand (50% replacement of natural sand) and inducing crimped steel fibers (1%) to enhance the properties of hardened concrete. The test on mechanical properties of concrete i,e. compressive , tensile, flexural and shear strength being carried out, even the study of effect of higher temperature on concrete is conducted for 7,14 and 28 days of cured specimen for both the fiber reinforced and the conventional concrete. The study gives clear picture regarding the effect caused by the addition of steel fibers and M-sand compared with that of the conventional concrete.

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I. Introduction

cement concrete is characterized by brittle failure, the nearly complete loss of loading capacity, once failure is initiated. This characteristic, which limits the application of the material, can be overcome by the inclusion of a small amount of short randomly distributed fibers (steel, glass, synthetic and natural) and can be practiced among others that remedy weaknesses of concrete, such as low growth resistance, high shrinkage cracking, low durability, etc.

The strength and durability of concrete can be changed by making appropriate changes in its ingredients like cemetitious material, aggregate and water and by adding some special ingredients . Hence concrete is very well suited for a wide range of applications. However concrete has some deficiencies as low tensile strength, low post cracking capacity, brittleness and low ductility, limited fatigue life, not capable of accommodating large deformations, low impact strength .

The presence of micro cracks at the mortar-aggregate interface is responsible for the inherent weakness of plain concrete. The weakness can be removed by inclusion of fibers in the mix. Different types of fibers, such as those used in traditional composite materials have been introduced into the concrete mixture to increase its toughness, or ability to resist crack growth. The fibers help to transfer loads at the internal micro cracks. Such a concrete is called fiber- reinforced concrete (FRC). Thus fiber-reinforced concrete is a composite material essentially consisting of conventional concrete or mortar reinforced by fine fibers .

The fibers can be imagined as an aggregate with an extreme deviation in shape from the rounded smooth aggregate .The fibers interlock and entangle around aggregate particles and considerably reduce the workability, while the mix becomes more cohesive and less prone to segregation. The fibers are dispersed and distributed randomly in the concrete during mixing and thus improve concrete properties in all directions. Fibers help to improve the post peak ductility performance, pre-crack tensile strength, fatigue strength, impact strength and eliminate temperature and shrinkage cracks.

Essentially, fibers act as crack arrester restricting the development of cracks and thus transforming an inherently brittle matrix, i.e. cement concrete with its low tensile and impact resistances, into a strong composite with superior crack resistance, improved ductility and distinctive post-cracking behavior prior to failure.

Hence, this study explores the feasibility of used of metallic and synthetic fibers; aim to do parametric study on compressive strength, tensile strength study etc. for a given grade of concrete, aspect ratio and various percentages of fibers.

In recent researches SFRC is being increasingly used fiber to improve the static and dynamic tensile strength, energy absorbing capacity and better fatigue strength. Steel fibers are add with concrete to increase the structural properties, particularly tensile and flexural strength. The extent of improvement in the mechanical properties achieved with SFRC over those of plain concrete depends on several factors, such as shape, size, volume, percentage and distribution of fibers. For a given shape of fibers, split tensile strength of SFRC was found to increase with aspect ratio (ratio of length to equivalent diameter). Even with higher ratios of fibers gave good flexural strength, workability of SFRC was found to be affected with increasing aspect ratios.

The main purpose of FRC is to increase the energy absorption capacity and toughness of the material but also increase tensile and flexural strength of concrete. concrete is relatively brittle, and its tensile strength typically only about one tenths of its compressive strength . regular concrete is therefore normally reinforced with steel reinforcing bars. For many applications, it is becoming increasingly popular to reinforce the concrete with small, randomly distributed fibers.

Concrete containing cement, water, aggregate and discontinuous, uniformly dispersed or discrete fibers is called fiber reinforced concrete. It is composite obtained by adding a single type of blend of fibers to the conventional concrete mix. fibers can be in form of steel fibers, glass fibers, natural fibers, synthetic fibers, etc.

The characteristics of FRC depend upon many factors such as size, type, elastic properties, aspect ratio and volume fraction of fibers. For each application it needs to be determined which type of fiber is optimal in satisfying the purpose. These fibers have already been used in many large projects involving the construction of industrial floors, pavements, highways-overlays, etc. in India.

Application Of Steel Fiber Reinforce Concrete(SFRC) 1.2Slope Stabilization & Tunnel Linings Using SFRC:

Slope Stabilization using Steel Fiber Reinforced Concrete (SFRC) SHOTCRETE & GUNITE : Shotcrete is an all-inclusive term to describe the spraying of concrete or mortar that may be accomplished through either a dry- or wet-mix process. Gunite refers only to the dry-mix process in which the dry cemetitious mixture is blown through a hose to the nozzle, where the water is injected immediately prior to application. Both methods are compatible with Steel Fiber Reinforced Concrete technology. “Shotcreting” using steel fibers is being successfully employed in the construction of Domes, Ground Level Storage Tanks, Caverns, Tunnel Linings, Mines.

Roads & Pavements – Heavy Duty Tracks:

Roads & Heavy Duty Tracks Using SFRC HISTORICAL PERSPECTIVE Sher Shah Suri is generally credited with being the Father of India’s inter-city National Highway System. It was he who, in the Sixteenth Century, build the original Grand Trunk Road, starting from near modern Peshawar and going all the way up to Bengal. It is quite interesting to note that India was one of the earliest countries in the world to start building concrete roads. India’s first concrete was built in Madras (Chennai) in 1914, in front of the office of its Municipal Corporation. This road remained pot-hole free for a very long time despite the heavy rains in the region.

Hardstandings & Floorings:

Hardstandings : Floorings, Parking lots, Taxiways, Playgrounds etc. The use of Steel Fiber Reinforced Concrete (SFRC) for concrete floors has increased significantly in the last couple of decades. However, only a few engineers understand, evaluate and use them well. Engineers involved in a SFRC slab project should use the toughness value as a comparative parameter as well as a design parameter. Also the toughness value should be included in the specifications as well as the slab thickness, the dosage and the type of steel fibers that corresponds to it. The Cracking control of plain concrete slabs on soil foundation requires the execution of joints with mechanisms of load transfer between adjacent panels.

Bridges & Overlays:

Strength, durability and low cost of concrete structures can be achieved with SFRC. These structures are constructed without the use of conventional reinforcing steel bars. SFRC is ultra high-strength concrete with unique properties including high flexural and shear strength. It is also strong in compression, durable and has high impact resistance. Structures can be either precast or poured in place. A key feature of SFRC is the increased flexural strength with the use of lab- configured steel fibers that provide effective bonding.

Properties OF SFRC:

In steel fiber reinforced concrete various mechanical properties are as

1. compressive strength.
2. split tensile strength.

3. flexural strength.

Advantages of SFRC:

Fast and perfect mixable fibers and High performance and crack resistance

4. Optimize costs with lower fiber dosages
5. Steel fibers reinforced concrete against impact forces, thereby improving the toughness characteristics of hardened concrete.
6. SFRC distributes localized stress.
7. Reduction in maintenance and repair cost.
8. Provide tough and durable surfaces.
9. Reduces surface permeability ,dusting and wear.
10. Increase tensile strength.
11. They act as crack arrestor.

OBJECTIVES:

1. To analyze the effect of replacing of sand to crushed sand an steel fiber reinforced concrete.
2. To analyze the effect of addition of more volume of steel fibers on the compressive strength of steel fiber reinforced concrete beam.
3. To calculate the optimum value of percentage of steel fiber required for maximum flexure strength.
4. To study the ductility behavior of the high strength reinforced concrete using steel fibers.
5. To analyze economical feasibility.

PROBLEM STATEMENT:

- To analyze the effect on SFRC by improving toughness characteristics.
- To calculate the optimum value of percentage of steel fiber required for maximum flexural strength

Theoretical formulation:

Concrete consist of three major components, viz. water, Portland cement and aggregates. properties of the final product i.e. cement changes according to the change in the ratio of its components and hence consequentially help the engineer in deciding the proper use same according to his needs. To get certain specific properties in cement, admixtures are added and hence enhance its required characteristics.

WATER: The water in the concrete mix should be clean and free of impurities. The change in water content with respect of cement decides the properties of the cement like how easily the concrete flows, but also affects the final strength of the concrete. Excess water implies to easier flow of concrete, but decreases its strength.

PORTLAND CEMENT: On mixing the water, cement hardens and hence all the ingredients are bounded together. Portland cement is the most common cement used and is composed of alumina, silica, lime, iron, and gypsum. Small amounts of other ingredients are also included.

AGGREGATES: Most of the concrete mixtures consist of both coarse and fine aggregates, and help in increasing the strength of concrete with respect to what cement can provide alone. Nowadays, sand, gravel, crushed stone, recycled materials, including blast furnace slag, glass (mostly for decorative purposes), and ground-up concrete are used as aggregates.

STEEL FIBER: The amount of fibers added in the concrete mix is expressed as a percentage of total volume of the composite (concrete and fibers), termed volume fraction (Vf). Vf typically ranges from 0.1 to 3%. Aspect ratio is defines as fiber length (l) by its diameter (d). The aspect ratio of Fibers of a non circular shape can be determines by using an equivalent diameter for the calculation of aspect ratio. However, fibers which are too long tend to ballZ in the mix and create workability problems. Some recent research indicated that using fibers in concrete has limited effect on the impact resistance of the materials. The result of fiber reinforcement concrete indicates that the use of micro fibers offers better impact resistance compared with the longer fibers.

Testing of material

Fineness modulus:- Take the sieves and arrange them in this descending order with largest sive on top .If mechanical shaker is using then put the order sieves in position and pour the sample in the top sieve and then close it with sieve plate. Then switch on the machine and shaking of sieves should be done at last five minutes.

If shaking is done by the hands then pour the sample in the top sieve and close it then hold the top two sieves and shake it inverse and outwards vertically and horizontally .after some time shake the 3rd and 4th sieves finally last sieves. After sieving record the sample weight retained one each sieve. Then find the commutative weight retained. finally determine the commutative percentage retained in each sieves .add the all commutative percentage values and divide with hundred then we will get the value of fineness modulus.

Specific Gravity And Water Absorption (Is2386(part-|||)-1963):-Size of the aggregate and weather it has been artificially heated should be indicated.ISI specifies three methods of testing for the determination of the specific gravity of aggregates, according to size of aggregates .the three size ranges used are aggregates larger than 10 mm,40mm, and smaller than 10 mm. The specific gravity of aggregates normally used in road construction ranges from about 2.5 -3.0 with an average of about 2.68 .though high specific gravity is considered as and indication of high strength
.it is not possible to judge suitability of a sample road aggregate without finding the mechanical properties such as aggregate crushing, impact and abrasion value. Water absorption shall not be more than 0.6 per until by weight.

Sieve Analysis (IS383:1970):-Sieve analysis helps to determine the particular size destruction of the course and fine aggregate. This is done by sieving the aggregates as per IS2386(part l)-. 1963.In this we use different sieves as standardized by the is code and then pass aggregates through them and thus collect different sized particles left over different sieves. The apparatus used are :

1) A set of IS sieves of size - 80 mm, 63mm, 50mm, 40mm, 31.5mm ,25mm, 20mm, 16mm, 12.5mm,10mm,6.3mm,4.75mm,3.35mm,2.36mm,1.18mm,600 micron, 300 micron,150 micron, and 75 micron mm.
2) Balance or scale with an accuracy to measure 0.1 percentage of the weight of the test sample.

Workability Test On Concrete: According to Granville-"it is that property of the concrete which determines the amount of useful internal work necessary to produce full compaction". Power defined is as "that property of plastic concrete mixture which determines the ease with which it can be placed and the degree to which it resist segregation" .ACI(American concrete institute) defines is it as " that property of freshly mixed concrete or Morton which determines the ease and homogeneity with which can be placed, consolidated and finished."ASTM(American society for testing and materials) definite it as " that property determining the effort required"to manipulate a freshly mixed quantity of concrete with minimum loss of homogeneity"

Slump Test: Slump cone of bottom dia. 20cm, top dia. 10cm and height 30cm at three layers of concrete .Each layer tamped for 25 times by standard tamping rod of 16mmdiameter and 60 cm length. The subsidence of concrete under gravity in "mm is SLUMP.

Mix Design:-

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible. Variables in proportioning: With the given materials, the four variable factors to be considered in connection with specifying a concrete mix:

1. Water-Cement ratio
2. Cement content or cement-aggregate ratio
3. Gradation of the aggregates
4. Consistency

Water-cement ratio expresses the dilution of paste; cement content varies directly With the amount of paste. gradation of aggregate is controlled by varying the amount Of given coarse and fine aggregate. Consistency is established by practical requirement of placing.

Types of Mixes:

A. Nominal Mixes:

the past the specifications for concrete prescribed the proportions of cement, fine and Coarse aggregates. These mixes of fixed cement-aggregate ratio which ensures adequate strength are termed nominal mixes. This offer simplicity and under normal circumstances, have a margin of strength above that specified. However, due to the variability of mix ingredients the nominal concrete for a given workability varies widely in strength.

B. Standard mixes:

The nominal mixes of fixed cement-aggregate ratio (by volume) vary widely in strength and may result in under or over rich mixes . For this reason, the minimum compressive strength has been included in many specifications .These mixes are termed standard mixes.

CONRETE MIX DESIGN FOR M25 USING CRUSHED SAND

A. Design Stipulations:

a) Grade designation - M25
b) Type of cement -OPC 53 grade
c) Maximum nominal size of aggregate- 20 mm
d) Minimum cement content -300 Kg/m3
e) Maximum water cement ratio-0.45
f) Degree of workability- 0.85 compacting factor
g) Degree of quality control- Good
h) Type of exposure- Moderate
i) Characteristic compressive strength required in field at 28 days-25MPa
j) Maximum Size of aggregate-20mm

B. Test data for Materials:

a) Cement: OPC 53 Grade confirming to IS 8112
b) Specific gravity of cement -3.15
c) Specific gravity of:-
1. Coarse aggregate-2.81
2. Fine aggregate - 2.83
d) Water absorption-
1. Coarse aggregate-1.12%
2. Fine aggregate- 2.6%
e) Free surface moisture -
1. Coarse aggregate- Nil
2. Fine aggregate -Nil

Step I)

TARGET STRENGTH:

$F= F_{ck}+ k.S$ (from table 1,k=1.65 & S=4 For M25)

Ft=25+ 1.65 x 4 Ft=31.6Mpa **Step II)**

- Selection of Water/Cement ratio: Use IS 456 Table no.5
- Maximum W/C Ratio =0.45 (for M25)
- Slump-100mm

Step III) Selection of Water: Use IS10262:2009 Table no .2

- For 20mm maximum size of aggregate maximum water content =186 kg/m°
- For additional 25mm slump add 3% of water Estimated water content for 100mm slump =186 + (6/100) X 186=197 Lit

Step IV) Calculation of cement content-

- WC ratio =0.45
- Cement content-
- w/c=0.45
- 197/c=0.45
- Cement=437.78 kg/m3
- Minimum cement content for moderate condition:300Kg/m3 (FromIS456 Tableno.5)
- 437.78kg/m3> 300 kg/m3

Step V) Proportion of volume of Fine aggregate & Coarse aggregate

- From Table no.3,Volume of C.A. to 20 mm size
- For hand placing no reduced volume
- Correction:

i. For every +0.05 change in W/C ratio= -0.01
ii. For every -0.05 change in W/C ratio == +0.01
iii. For pumpable mix= -10%

for C.A.	Correcton
0.05	0.01
(0.5-0.45)	X

iv. Volume of coarse aggregate = 0.01 + 0.6 = 0.61 m3
v. Volume of Fine aggregate = 1 - 0.61 = 0.39m3

Step VI) Mix calculations:

a) Volume of concrete = $1m^3$

b) Volume of cement = {437.78/(315*1000)} =.139m^3

c) Volume of water = {197/(1*1000)}=0.197m^3

d) Volume of all aggregates = [1-(b + c)]
= [1-(0.139+0.197)
= 0.664 m'

e) Weight of coarse aggregate = 0.664 X 0.61 X 2.81 X 1000
= 1138.16 Kg/m^3

f) Weight of fine aggregate = 0.39 X 2.83 X 0.064 X 1000
= 732.86 Kg/m^3

g) Water added in batching plant by water absorption of C.A. & F.A.
= 197 + {[(1.12/100) X1138.16 + [(1.71/100)X675.88]}
= 221.30 Kg/m^3

Step VII) proportion for M25

W/C ratio	Water	Cement	Sand	Aggregate
0.45	221.30Kg/m^3	437.78Kg/m^3	675.88Kg/m^3	1138.16Kg/m^3

Mix design proportion with 221.30Kg/m^3 of water 1 : 1.54 : 2.59

CONRETE MIX DESIGN FOR M25 using Crushed Sand Design Stipulations:-

a) Grade designation - M25
b) Type of cement -OPC 53 grade
c) Maximum nominal size of aggregate- 20 mm
d) Minimum cement content -300 Kg/m3
e) Maximum water cement ratio-0.45
f) Degree of workability- 0.85 compacting factor
g) Degree of quality control- Good
h) Type of exposure- Moderate
i) Characteristic compressive strength required in field at 28 days-25MPa
j) Maximum Size of aggregate-20mm

Test data for Materials:

a) Cement: OPC 53 Grade confirming to IS 8112
b) Specific gravity of cement -3.15
c) Specific gravity of:-
i. Coarse aggregate-2.81
ii. Fine aggregate - 2.83
d) Water absorption-
i. Coarse aggregate-1.12%
ii. Fine aggregate- 2.6%
e) Free surface moisture -
i. Coarse aggregate- Nil
ii. Fine aggregate -Nil

Step I)

TARGET STRENGTH:

F= F_{ck}+ k .S (from table 1,k=1.65 & S=4 For M25)

Ft=25+ 1.65 x 4 Ft=31.6Mpa **Step II)**

- Selection of Water/Cement ratio: Use IS 456 Table no.5
- Maximum W/C Ratio =0.45 (for M25)
- Slump-100mm

Step III) Selection of Water: Use IS10262:2009 Table no .2

- For 20mm maximum size of aggregate maximum water content =186 kg/m°
- For additional 25mm slump add 3% of water
- Estimated water content for 100mm slump

=186 + (6/100) X 186=197 Lit

Step IV) Calculation of cement content-

- WC ratio =0.45
- Cement content-
- w/c=0.45
- 197/c=0.45
- Cement=437.78 kg/m3
- Minimum cement content for moderate condition:300Kg/m3 (FromIS456 Tableno.5)
- 437.78kg/m3> 300 kg/m3

Step V) Proportion of volume of Fine aggregate & Coarse aggregate

- From Table no.3,Volume of C.A. to 20 mm size
- For hand placing no reduced volume
- Correction:

i. For every +0.05 change in W/C ratio= -0.01
ii. For every -0.05 change in W/C ratio == +0.01
iii. For pumpable mix = -10%

For C.A.	Correction
0.05	0.01
(0.5-0.45) = 0.05	X

Hence, X= (0.05 X 0.01)/0.05 = 0.01

i. Volume of coarse aggregate = 0.01 + 0.6 = 0.61 m3
ii. Volume of Fine aggregate = 1 - 0.61 = 0.39m3

Step VI) Mix calculations:

a) Volume of concrete = 1m3
b) Volume of cement=(437.78/315*1000)=.139m3
c) Volume of water=-(197/1*1000)=0.197m3
d) Volume of all aggregates=(1- (b +c))

i. =[1-(0.139+0.197) ii. .= 0.664 m3
e) Weight of coarse aggregate = 0.664X 0.61X 2.81 X 1000= 1138.16 Kg/m:3
f) Weight of fine aggregate = 0.39 X 2.83 X 0.064 X 1000-=732.86 Kg/m3
g) Water added in batching plant by water absorption of C.A. & F.A.
h) = 197+ {f(1.12/100) X1138.16 + [(1.71/100) X 732.86])=222.28 Kg/m3

W/C	Water	Cement	Sand	Aggregrate
0.45	222.28Kg/m3	437.78Kg/m3	732.86Kg/m3	1138.16Kg/m3

Mix Design proportion with 222.28Kg/m3 of water 1 : 1.67 : 2.59

Measurement of ingredients:
All cement, sand and coarse aggregate respectively are measured with Digital balance. The water is measured with measuring cylinder of capacity 1 liter and measuring jars of 5and 10 liters.

Mixing of concrete:
The ingredients were thoroughly mixed over sheet. The sand, cement and aggregate were measured accurately and were mixed in dry state for normal concrete. The dry concrete mix was then thoroughly and uniformly mixed till uniform and homogeneous. Sufficient quantity of pure water added slowly till proper mixing of cement, sand and aggregate.

Transportation of concrete:
The process of carrying the concrete mix from the place of its mixing to final position of deposition is called as transportation of concrete. The time factor is very important in case of transportation of concrete. The concrete mix should be transported as quickly as possible.

Placing of concrete:
The fresh concrete was placed in the moulds by trowel. It was ensured that the representative volume was filled evenly in all the specimens to avoid segregation, accumulation of aggregates etc. While placing concretes , the compaction in vertical position was given to avoid gaps in moulds.

Compaction of concrete:
Moulds are cleaned and oiled from inside for smooth de-molding. Concrete is mixed thoroughly and placed in the mould in three layers and compacted by electrically operated needle vibrator for beam specimens and table vibrator with suitable fixing frame for cubes and cylinders. It is vibrated till concrete woes out of mould. The vibration is continued till cement slurry just ooze out on surface of moulds. Care is taken of cement

slurry not to spill over, due to vibration and segregation. The process of consolidating concrete mix after placing it in position is called as compaction of concrete. The object of compaction is to remove air from the concrete and to give maximum density to the concrete. Presence of more air voids will reduce the strength. It also ensures an intimate contact between the concrete and the surfaces of reinforcing steel and other embedded parts of the structure. During the process of compaction it is important to note that the reinforcement should not be disturbed and the forms should not be damaged or displaced. If the compaction is not uniform, the concrete becomes porous, non-homogeneous and attains less strength. The mix to be used should have adequate workability for placing without any difficulty and in order to obtain maximum density. The mix should also not be too wet, as it would otherwise cause segregation, lower density, and excessive laitance at the top.

Importance of compaction:
A considerable amount of air is entrapped in concrete along with the partial segregation of aggregates during the manufacture of concrete. It lowers the quality of concrete by making it porous and non-homogeneous.

Compaction methods
It is very important to decide whether to use a workable mix with hand or a stiffer mix with vibration before considering the method of compaction. It has been determined that a better surface with less blow holes is obtained for workable concrete. The compaction methods are classified as follows:

Hand compaction:
Hand compaction method is adopted for pavements, narrow and deep members. Compaction must be uniform and concrete must reach to the corners of the formwork. Excessive compaction is not good because it will try to push the aggregates at the bottom thus bringing the mortar at the Surface. Iron rods and rammers are used for the hand compaction. Mass concrete is compacted in successive layers of thickness not exceeding
30 cm by tamping with light rammers or templates. Iron rods are used for compacting reinforced concrete work in layers not exceeding 15 cm in thickness. Hand compaction is further classified as follows:

- Ramming
- Roding
- Tamping.

Finishing of concrete
After removing from vibrating table, the moulds were kept on ground for finishing and covering up for any leftover position. The concrete is worked with trowel to give uniform surface. Care is taken not to add any extra cement, water or cement mortar for achieving good surface finish. The additional concrete is chopped off from top surface of the mould for avoiding over sizes etc. Identification marks are given on the specimens by embossing over the surface after initial drying. The operations adopted for obtaining a true, uniform concrete surface are called as finishing operations .Concrete mix should be spread in such a way that no segregation takes place. Only designing the mix properly can ensure this. The results of finishing are good if the slump is about 5 cm. The choice of concrete finish depends upon the ultimate use of the completed job and the desired effect.

Importance of finishing:
Finishing is very important from engineering point of view. The importance of finishing is to keep the concrete surfaces free from undulations. Many concrete structures have an unsatisfactory appearance after exposure for some time. Some of the surfaces, which were quite pleasing when new, have weathered badly. The surface of concrete cannot be made pleasing to the eye as many unsightly features result from cracks, carelessly constructed and badly placed construction joints, patching or honey-combed or damaged areas, poor formwork and lack of sufficient cover to reinforcement.

II. Methodology:

Concrete is strong in compression and weak in tension and also it has brittle character. The concept of using fibers reinforced concrete is to improve the characteristic strength of construction material. Use of fiber reinforcement in concrete increases the strength and ductility, but requires careful placement and labor skill. Internal micro cracks, leads to the brittle failure of concrete.

It is observed that one of the important properties of Steel Fiber Reinforced Concrete (SFRC) is its superior resistance to cracking and crack propagation.

Thus the concrete is reinforced with the steel fiber in various proportions such as 0%, 0.5%, 1.0%, 1.5%, 2%, 2.5% and 3% by weight of cement. The aspect ratio is calculated by ratio of length to the diameter. All the volume proportions were tested with Aspect Ratio 60(30mm length and diameter of 0.5mm). The Compressive and Tensile Strength were analyzed as per IS standards on 7th, 14th and 28th day of curing.

Ten high strength reinforced concrete beams were cast and fifteen high strength concrete cubes were cast too. The test specimen are divided into series

- Where the first series of two beams and three cubes is of normal concrete .
- Second series of another two beams and three cubes of concrete using crushed sand replaced to sand

for remaining three series the parameters percentage of steel fiber ranges from 0.5%, 1%,1.5% respectively using crushed sand used concrete.

- The specimen used where cubes beam specimens. Dimensions of each test specimen are as under:

Cube: 150mm x 150mm x 150mm Beam: 150mm x 150mm x 700mm
Beams specimen were used to determine shear strength of SFRC beams, cubes of 150mm size were used to find the compressive strength .
Compressive strength of cubes are determined at 28 days using compression testing machine(CTM) of capacity 2000KN

Beam Failure Analysis
In this section the failure of beams during the two points loading tests are show pattern are matching with earlier experiments in the literature. Figure 1, 2, 3,4, 5 shows the failures modes of beams and their schematics

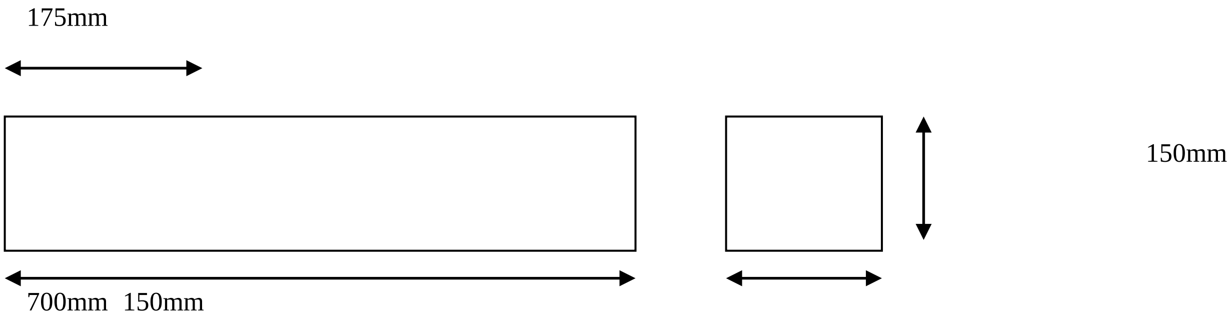


Fig.1 failure pattern of beam 1

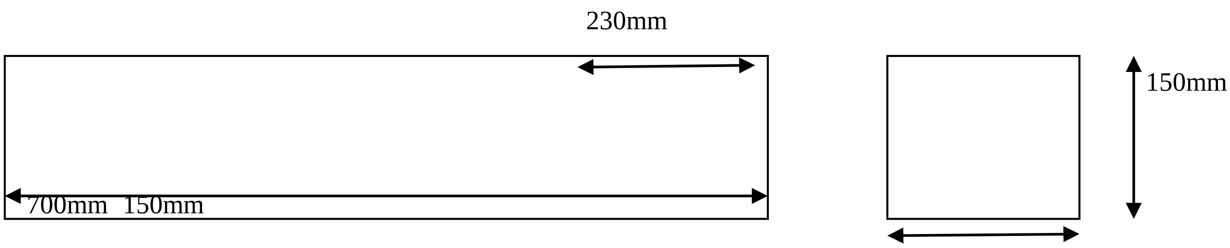


Fig.2 failure pattern of beam

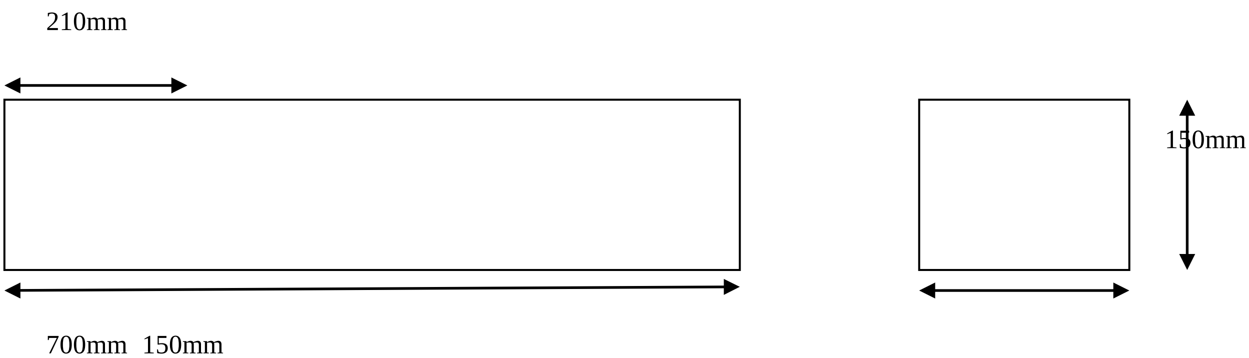
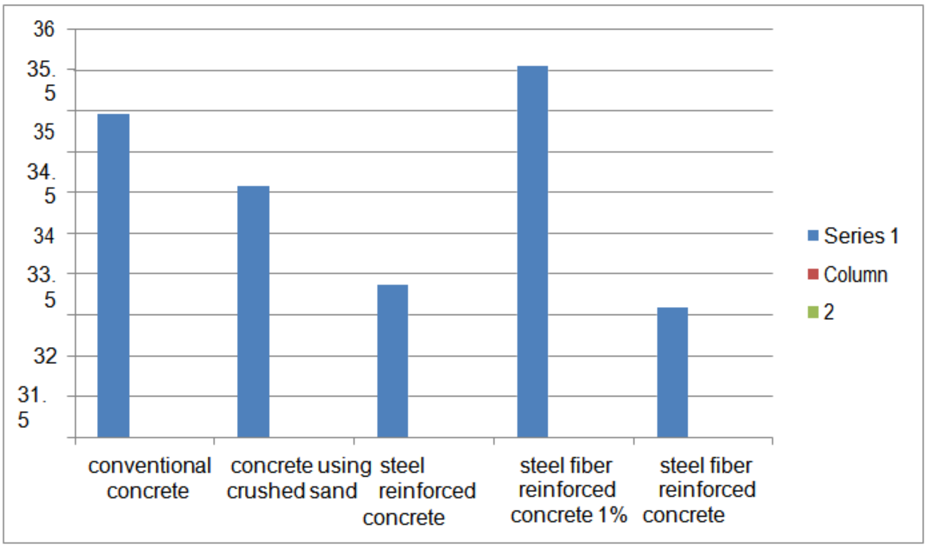


Fig.3 Failure pattern of beam 3

Test results:

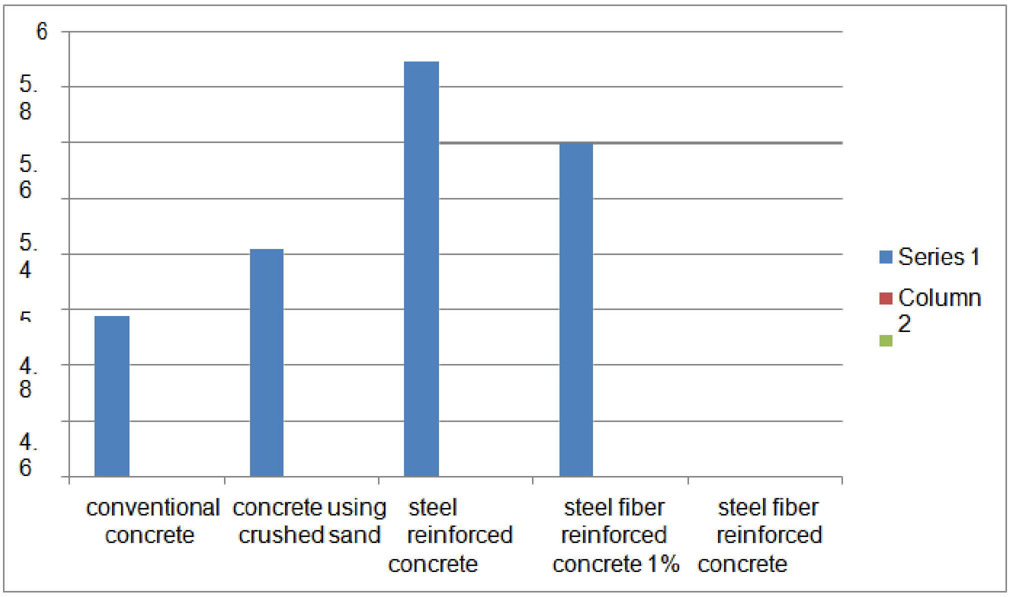
For cubes - compressive strength after 28 days

Case	Reading (N/mm²)
1. Conventional concrete	34.96
2. Concrete using crushed sand	34.07
3. Steel fiber reinforced fiber 0.5%	32.8
4. Steel fiber reinforced concrete 1%	35.55
5. Steel fiber reinforced concrete 1.5%	32.59



For beams-

Case	reading(N/mm²)
1. Conventional concrete	4.98
2. Concrete using crushed sand	5.22
3. Steel fiber reinforced concrete 0.5%	5.89
4. Steel fiber reinforced concrete 1%	5.6
5. Steel fiber reinforce concrete 1.5%	4.62



III. Conclusion

1. It is observe that the workability of steel fiber reinforced concrete gets reduced as the percentage of steel fiber increases.

2. Compressive strength goes on increasing by increase in steel fiber percentage to the optimum value. The optimum value of fiber content of steel fiber reinforced concrete was found to be between 0.5% to 1%.

3. While testing the speciman,the plain cement concrete specimens have shown typical crack propagation pattern which loaded in to splitting of beam in two piece geometry. But due to addition of steel fibers in concrete cracks gets ceased which results in to the ductile behavior of SFRC.

4. The effective utilization of quarry dust in concrete can save the waste of quarry works ; and also produces a greener concrete.

5. The effect of steel fibers can be still promising as steel fibber reinforced concrete is used for sustainable and long- lasting concrete structure.

6. Non availability of sand at reasonable cost as fine aggregate in cement concrete for various reasons, search for alternative material stone crusher (quarry) dust qualifies itself as a suitable substitute for sand at very low cost.

7. Crushed stone dust is free from chemical impurities such as sulphates and chlorides which improves the properties of concrete like strength and durability.

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