

**“EXPERIMENTAL STUDY ON STRENGTH DEVELOPMENT OF FRC  
WITH PARTIAL REPLACEMENT OF SAND BY CRUMB RUBBER  
POWDER”**

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*Conceptual—Concrete is a man-made structure material and is a standout amongst the most broadly utilized development material after water. Anyway its reliance on vitality expending material and characteristic material makes in an exorbitant material. The present work is an endeavor to improve over the general expense of the material without trading off upon the quality criteria of the material. This is to be accomplished by incomplete supplanting of sand with piece elastic just as expansion of strands to repay any misfortune in quality. The level of substitution of sand will differ from 10%, 15%, 20% with piece elastic and an expansion of metal covered steel strands from 0%,1%, 2%, 3%.and additionally utilize the steel fiber with same extent and look at job of both the fiber. The investigation will investigate the usefulness, compressive quality, flexural quality just as effect obstruction of the solid so framed.*

*keywords—Scrap Elastic, BCSF, Effect Opposition, Functionality, Compressive quality, flexural quality, Steel fiber (snared type)*

## I. INTRODUCTION

Concrete is a material made out of bond, sand and coarse total blended with water which solidifies with time. Concrete is comprised of granular materials. It would seem that coarse total which is implanted in structure bound together with bond or fastener. It fills the space between the particles and stick them together. The solid is an utilized for a development work. Cement can be threw in any shape. Since it is a plastic material in new state, diverse size and states of formwork are utilized to give distinctive shapes, for example, roundabout, rectangular. Different auxiliary individuals like shafts, pieces, balance, segment, lintel and so forth are developed with cement. Step by step the interest of cement on the globe increments, so the interest of cement later on is more, it is turning into an additionally provoking work to discover economical methods for development work. The point of reasonable development is to diminish the negative effect of condition delivered by development industry. The major testing issue on the planet that is squander the board. Squander the executives ordinarily manages the a wide range of waste whether it was made as modern, natural, family and different situations where it might be represent a danger to human wellbeing. The Waste can take any shape that is strong waste, fluid and vaporous waste and each have different strategies for transfer and the executives. Some strong waste material like papers, plastic jug, plastic pipe, steel bar and so forth. These all waste can reused without irritating the earth, anyway there is no real way to arrange the strong squanders like waste tires. Consuming of waste tires makes number of lethal exhaust and toxins into the climate will harm nature and subsequently air contamination making. The dark exhaust contain substantial metals and different unsafe toxins which are straightforwardly influencing on the human wellbeing. As it's anything but a biodegradable material, So this may influence on the dirt ripeness and vegetation. In some cases they may make uncontrolled flame. Moreover, one more test to human culture is as CO<sub>2</sub> and outflow and green house emanation, which are seen as another sort of waste, which are hurtful to the world. The outflow of CO<sub>2</sub> in the generation procedure of bond is the main natural issue, which makes bunches of ecological changes. The discharge of CO<sub>2</sub> by terminating the waste tire is the second natural issues, which are destructive to the earth. The shortage and inaccessibility at sensible rates of fine total are the serious issue in this period. Forbidding of uncovering of common total, tremendous natural issues, Defilement of water avalanches, Sound contamination because of impacting Air contamination because of Pounding. Most ideal approach to conquer this issue. Locate the other fine total for development instead of customary characteristic totals. It has been assessed that around one billion tires are pulled back from use in consistently. Squander tire elastic isn't effectively biodegradable even after a significant lot of landfill and result in a great deal of ecological and medical issues. Elastic discovers its utilization in cement in light of its property of vitality assimilation. Utilization of waste elastic tires (morsel elastic) which is somewhat supplanted with sand in the development to defeat the issue of sand.

## II. LITERATURE Audit

Jing Lv, et-al.(1) (2015) Present work fulfill the test report of compressive quality ,droop esteem , split rigidity ,flexural quality, static modulus of flexibility and unit weight for eleven different blend of elastic particles for lightweight total solid save up to 1day,7 days and 28 days. The eleven different blends ensure one essential blend and 10 diverse substitution of elastic molecule for Fine total volume from 10% to 100%.

Extensive decrease in Compressive quality, flexural quality and split elasticity was recorded at 10%, 20%, 30% substitution of elastic particles. The expanding of elastic particles can diminish the droop esteem and unit weight of lightweight total cement. The expansion of elastic molecule decreases the static modulus of flexibility.

Jian Yang, et al.(2) (2014) Explored the properties of cement arranged with waste tire elastic particles of uniform and fluctuating sizes. In this examination they isolated three gatherings of separately estimate molecule test (3mm, 0.5mm, 0.3 mm ) and one example of persistent size reviewing was utilized to supplanted 20% of all out volume of regular total. The were done to assess the usefulness, thickness ,compressive quality , flexural quality ,split elasticity, water porousness. The outcomes that the Compressive quality increments at 20% of elastic supplanting with declines the size in light of the fact that better molecule have better void filling capacity.

Flexural quality abatements at 20% of substitution altogether. The split elasticity diminishes more as contrast with flexural quality at 20% substitution. Utilization of bigger size of elastic particles will in general have higher functionality and crisp thickness than littler size molecule and persistently reviewed elastic molecule estimate demonstrated that lower water penetrability with high quality.

**P.S Songs and S.Hwang.(3) (2014) Present examination explored that the mechanical properties of high steel fiber strengthened cement. The steel fiber were included at the volume of 0.5%, 1.0% and 1.5% and 2.0%.The test were done to establish that compressive quality, split elasticity modulus of crack, sturdiness index..The compressive quality achieved most extreme at 1.5% volume, being a 15.3% improvement. The modulus of burst and split rigidity expanded with expanding the volume of steel fiber and at 2% volume part quality accomplishing 98.3% and 126.6% separately.**

**The sturdiness record increments with expanding the volume of part.**

**Camille A. Issa, and George Salem.(4) (2013) In this investigation the reused waste morsel elastic utilized as profitable substitute for fine total from 0 % to 100% in substitution of pounded sand in cement. For the examination of test that is compressive quality, conductivity, thickness and so forth. The conductivity test was conveyed for 28 days to check the elastic is great separator or not.**

**Great compressive quality was recorded at elastic substance lower than 25% in substitution of squashed sand. The expanding the elastic substance in solid builds the season of movement and therefore conductivity diminishes and making better protection properties.**

**M.A. Aiello and F.leuzzi.(5) (2010).In this exploration paper they researched the properties of new and solidified state gotten by halfway substitution of coarse and fine total with various level of waste tire elastic that is (0%,25%,50%,75% and 0%,15%,30%,50%,75%) having a similar size of supplanted total. Functionality, compressive quality, flexural quality, unit weight, post breaking conduct were resolved and thought about the outcome for the distinctive rubber treated solid blend. After that proposed to characterize the better blend in wording mechanical properties.**

**The outcomes demonstrates the compressive quality for incomplete substitution of fine total at 15% was great after that extensively diminishes and compressive quality for halfway supplanting of coarse total with elastic at 25% was great after that significantly diminishes.**

**Flexural quality showed that an impressive decrease of mechanical properties. Rubber treated cement supplanted by coarse total contrast with fine total. Post split conduct decidedly influences the fractional expansion of coarse total with waste tire elastic shred. Vitality assimilation was great.**

**Eshmaiel Ganjian, et al.(6) (2009) In this examination the disposed of tire elastic utilized as total and concrete substitutions up to 5%, 7.5% and 10% was researched. In the examination two arrangements of solid examples are readied. First arrangement of example supplanted by chipped elastic as coarse total for various rate and second arrangement of example supplanted by scrap elastic powder as concrete. The tests were done to decide the compressive quality, flexural quality, rigidity and modulus of versatility and furthermore strength test like water retention and water porousness.**

**Up to 5% substitution in First set the compressive quality was great contrast with second set. The rigidity at 5% substitution the second arrangement of example was great contrast with first set. Flexural quality at 5% substitution in first set is like customary cement and correlation with second it was great. Expanding the elastic swap for total in solid will cause proportionate modulus of flexibility and after that it diminished. For the main set, when increment the elastic substitution the water penetrability profundity and water ingestion increments. Be that as it may, in second set when supplant the bond decreased the water ingestion. Further increment the substitution in both the set the impressive changes were noted.**

Ali R. khaloo et al.(7) (2008). In this examination they research the mechanical properties of cement containing a high volume of tire particles. The tire particles made out of piece elastic tire chips and blend of tire chips and scrap elastic used to supplant mineral total. The substitution of tire elastic particles at 12.5%, 25% 37.5% and half of complete volume of mineral total in cement. The tests were done to decide the compressive quality, Sturdiness, Sound retention. The outcomes demonstrate the convergence of tire elastic molecule surpasses 25% substitution a definitive compressive quality decreased methodically.

Past the 25% substitution of tire elastic particles sturdiness decline because of the efficient decrease in quality. Ultrasonic reverberation framework utilized for sound assimilation. The speed of ultrasonic wave diminished with expanding the centralization of tire elastic. with the goal that wave speed exchange through elastic is conceivably appropriate for damping of sound and shake vitality. The Ultrasonic investigation discharge extensive decrement in the ultrasonic modulus and high stable retention for tire elastic particles.

## II. EXPERIMENTAL WORK

### MATERIAL Utilized:-

Crumb rubber is reused tire delivered from vehicle tyre scrap. Amid the procedure of reused steel, tire line are evacuated, leaving waste tire rubber with granular consistency. Utilizing waste rubber related to Portland cement has numerous points of interest, including a lower unit weight, expanded pliability, better extensibility, great stun ingestion issue, improve imperviousness to fire, lower unit weight, higher commotion, heat protection coefficient.

Thus , in practical application concrete containing crumb rubber powder is proposed for use in non-essential structure, for example, parcel dividers, crash hindrances, side dividers , walk way play area and other wellbeing surfaces, and clearing in which high solid quality isn't required. A controlled of self-compacting concrete with a lower quality than customary cement. Morsel elastic is utilized as a filling in fake turf fields. In 2007, utilize this limit around 300 million pounds of elastic from dirtying landfills. By and large, it takes 2000-40000 piece tires to deliver enough filling to cover a normal football field at the city of Portland, 2008.



Crumb rubber

### FIBER.

#### A) brass coated micro steel fibre

The **brass coated micro steel fibre** used in the experiment which is obtain from Fibre zone Ahmedabad, Gujarat. Brass coated steel fibre (micro steel fibre) is a new type of additive for reinforcing concrete, which has the high tensile strength and it improve the concrete's unity.

1. Length: 13mm
2. Material: low carbon cold drawn brass coated steel fibre having tensile strength>2000Mp
3. Diameter: 0.18mm (+) 0.02 mm

#### Brass coated steel fibre having advantage compare with steel bars below:

1. Reinforcing mortar
2. Ultra high performance concrete
3. Reduced crack width and control the crack width tightly, thus improving durability of Concrete.



Brass coated steel fibre

**B) Steel fibre (Hooked type)**

Steel fiber is a cold drawn steel wire fibers with hooked ends or corrugated for optimal anchorage for reinforcing concrete to prevent cracking, provide ductility and high load bearing capacity and adding fibers is easy, effective and cost effective solutions



Steel fibre (hooked end type)

**NEED FOR CRUMB RUBBER:-**

- To reduce the quantity of sand.
- Reduce the problem associated with their disposal.
- It is cost effective and environment friendly.

**AIM:-**

- To Experiential study on strength development of FRC with partial replacement of sand by crumb rubber powder. The strength properties being studies in our project are as below:
  1. Slump test
  2. Compressive strength test
  3. Flexural strength test

**OBECTIVE:-**

- Fine aggregate is partially replaced by crumb rubber powder.
- Brass coated steel fiber is also added with cement for increasing the strength.
- Compressive strength, Flexural strength, Workability, Impact resistance of M35 grade of concrete mix is to be find experimentally.
- Result of these concrete strength is compare with normal concrete.
- To study and compare the role of brass coated steel fibre and steel fibre.

**MIX PROPORTIONS**

**Mix Proportions for M35 Grade of concrete as per IS 10262-2009:**

Table A

<b>% Replacement of sand by CR</b>	<b>CEMENT Kg/M<sup>3</sup></b>	<b>FINE AGGREGATE Kg/M<sup>3</sup></b>	<b>COARSE AGGREGATE Kg/M<sup>3</sup></b>	<b>WATER Kg/M<sup>3</sup></b>	<b>ADMIXTURES Kg/M<sup>3</sup></b>
<b>0%</b>	<b>428</b>	<b>722.09</b>	<b>1071</b>	<b>154</b>	<b>2</b>
<b>10% CR+1%BCSF</b>	<b>428</b>	<b>649.981</b>	<b>1071</b>	<b>154</b>	<b>2</b>
<b>15% CR+1%BCSF</b>	<b>428</b>	<b>613.777</b>	<b>1071</b>	<b>154</b>	<b>2</b>
<b>20% CR+1%BCSF</b>	<b>428</b>	<b>576.672</b>	<b>1071</b>	<b>154</b>	<b>2</b>
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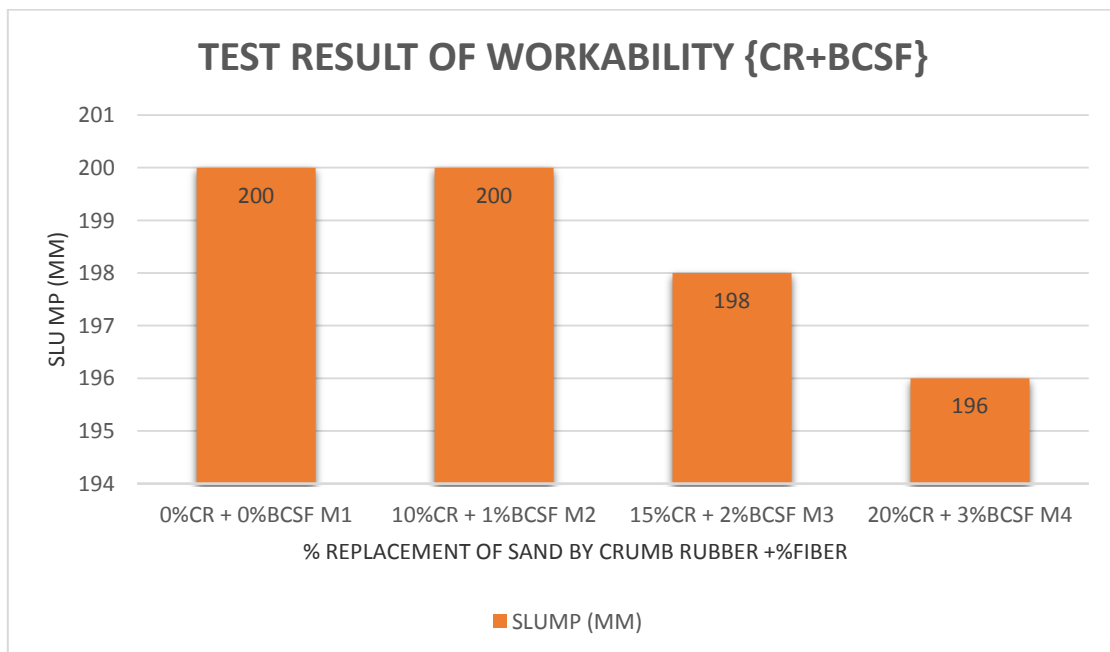
### III. EXPERIMENTAL STUDY

#### SLUMP TEST

The slump test of the concrete is done to assess the workability and consistency of fresh concrete. Consistency refers to the ease with which concrete flows. It is used to indicate degree of wetness. Slump test is done to check the correct amount of water to be added to the mixture. In this study, the test is conducted as per IS specification. The slump test was done after two hour and the result of the slump test so conducted is as follows:

Table B

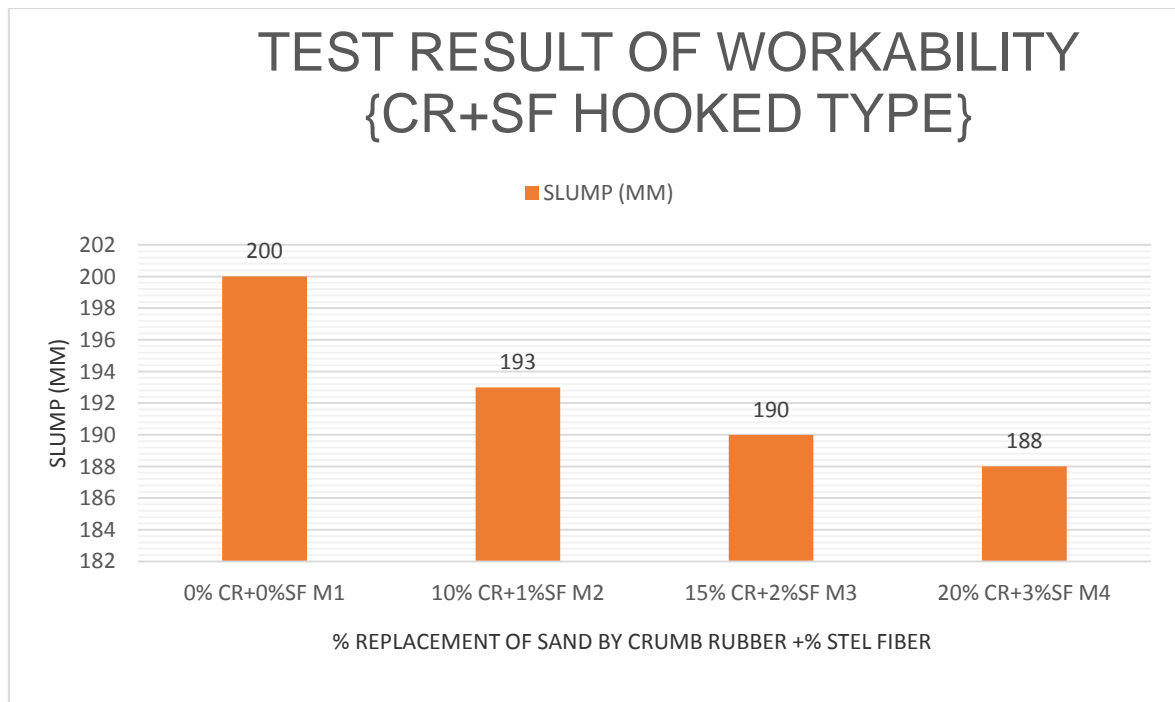
Test result of workability for (Crumb rubber+ BCSF)		
Mix	Proportion	Slump(mm)
M1	0%	200
M2	10% CR + 1%BCSF	200
M3	15% CR + 2%BCSF	198
M4	20% CR + 3%BCSF	196



Graph A

Table C

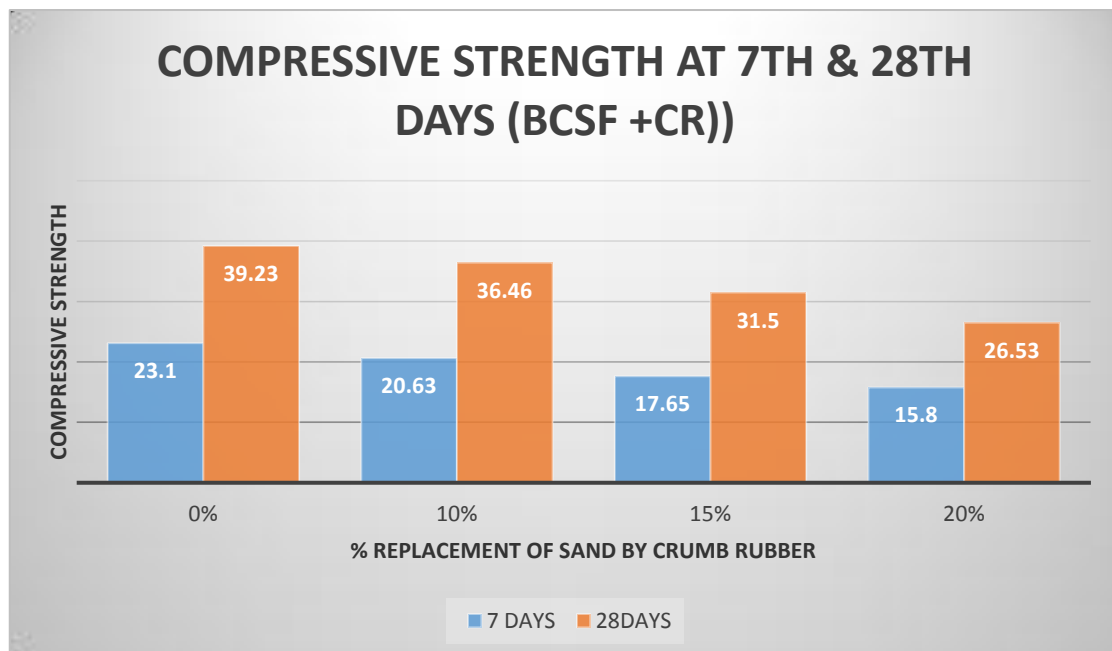
Test result of workability for (Crumb rubber+ SF (Hooked type))		
Mix	Proportion	M 35 slump(mm)
M1	0%	200
M2	10% CR + 1%BCSF	193
M3	15% CR + 2%BCSF	190
M4	20% CR + 3%BCSF	188



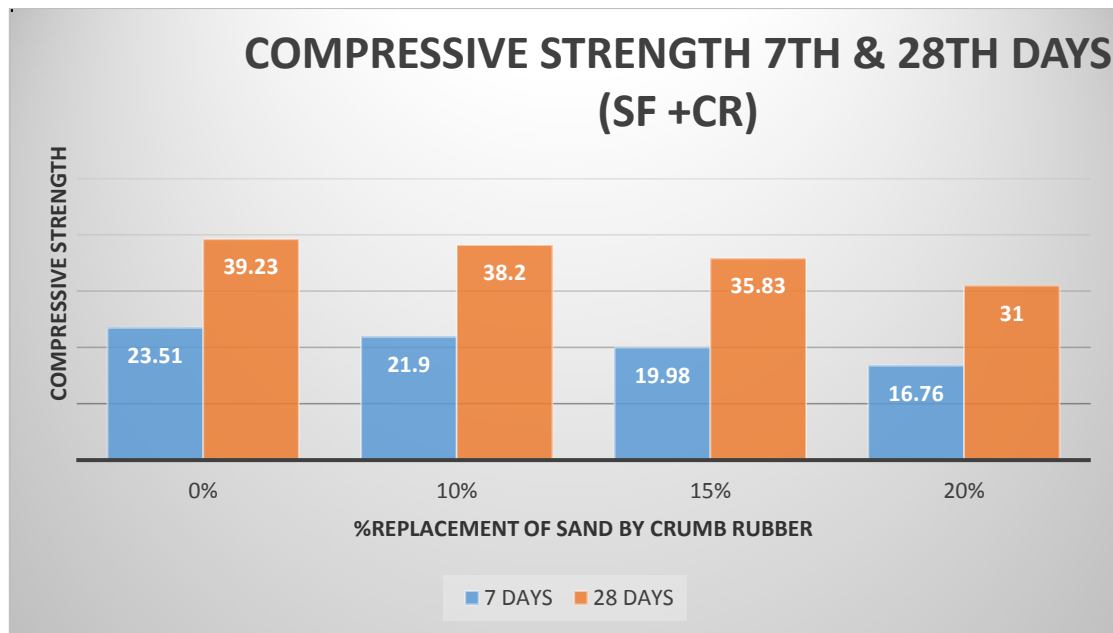
Graph B

#### Compressive strength

The compressive strength of the hardened concrete was determined by subjecting three specimens from every mixture to compressive stress until the maximum bearing load was reached.. The data show a decrease in the compressive strength in concretes with the increasing of percentage of crumb rubber. Here the strengths of concretes with 10% and 15% replacement of Crumb rubber was very good with the addition of 1% steel fibre.(hooked type) as compare to the addition of 1% brass coated steel fibre with crumb rubber which is given in graph C and Graph D.



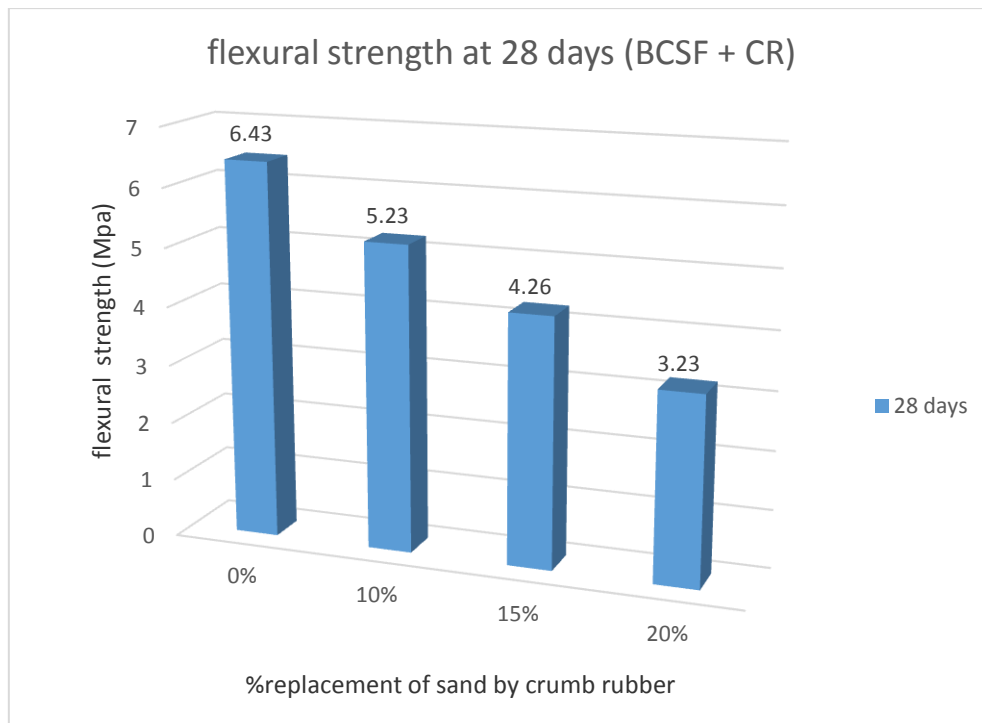
Graph C



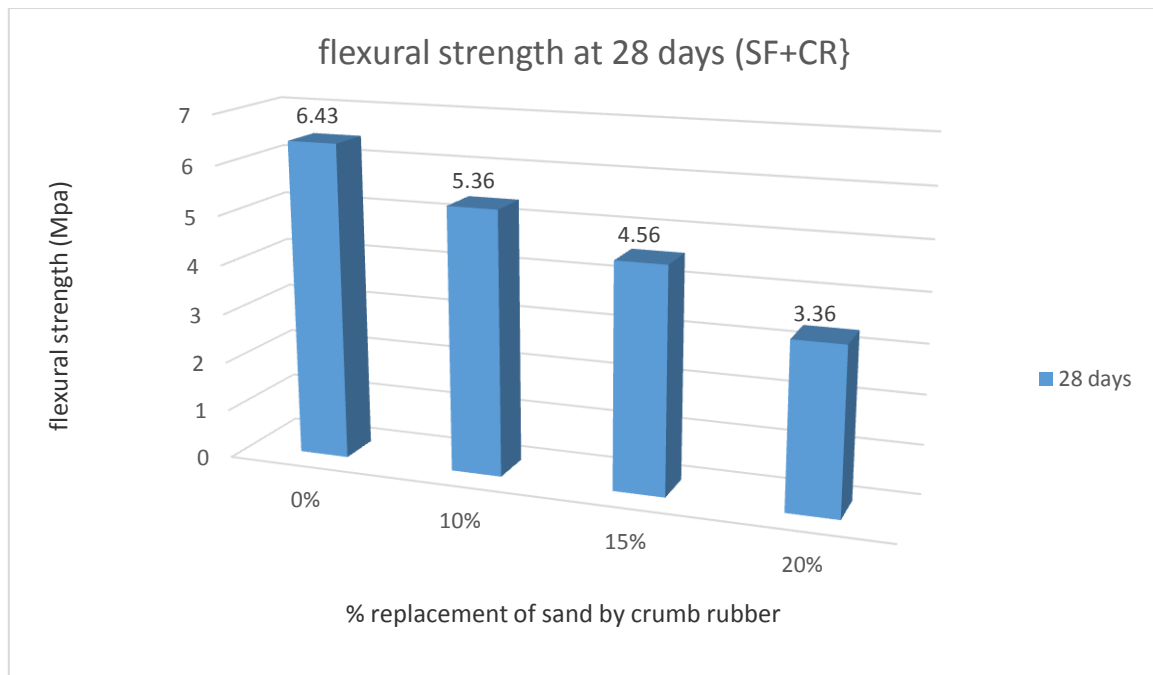
Graph D

### Flexural strength

The flexural strength of the normal and crumb rubber concrete for the different proportions of crumb rubber in fine aggregate at 28th day results were given in the Graph E and F. The flexural strength test was used to determine the flexural strength of concrete. The test was performed on prisms of dimensions 100 x 100 x 500 mm (Cured for 28 days by immersing under water. After 28 days the flexural strength was determined by the two point loading technique, computed by using the expression  $F_b = PL/bd^2$ , where  $F_b$  is the flexural strength in MPa, P is the maximum load applied in N, L is the span length in m, b is the width of specimen in mm and d is the depth of the specimen in m. The test is carried out with beam specimen to find out the flexural strength of conventional and rubber replaced concrete using flexural testing machine and the results are shown in graph E and graph F.



Graph E



Graph F

## CONCLUSIONS

The conclusion from the experimental study are as below:-

1. The workability is good at **10%** that is **200mm**, when using the combination of crumb rubber and brass coated steel fibre compare to the combination of crumb rubber and steel fibre (hooked type).
2. The compressive strength is good at **10% (38.20MPa)** and **15% (35.83 MPa)** when using the combination of crumb rubber and steel fibre (hooked type), which is more than the target strength.
3. The compressive strength is good at **10%**, when using the combination of crumb rubber and brass coated steel fibre, which is more than the target strength.
4. The Compressive strength at 10% is more, when using the combination of crumb rubber and steel fibre (hooked type). As compare to the combination of crumb rubber and brass coated steel fibre.
5. The flexure strength is decreases when increasing both the combination (CR+BCSF) and CR+SF).

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