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Experimental Investigation on Waste Utilization of Steel Fiber and Fly Ash in Concrete with Partially Replacement of Cement

Nitish Kumar[1], Pushpendra Kumar Kushwaha[2], Jiji M Thomas[3], Mithun Kumar Rana[4]
[1]*M. Tech. Research Scholar, Civil Department, RKDF College of Engineering, Bhopal (M. P.), India*
[2, 3, 4]*Assistant Professor, Civil Department, RKDF College of Engineering, Bhopal (M. P.), India*

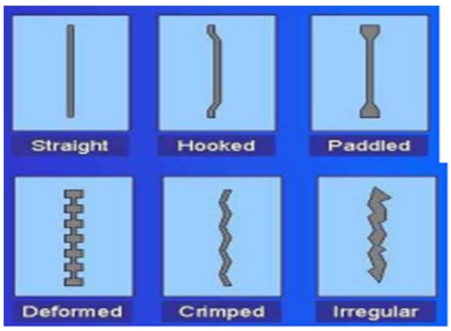
Abstract: ***In India, major part of electricity is produced from thermal power plants. These thermal power plants use different types of fuels for combustion. During combustion of coal as a fuel in these thermal power plants, a byproduct namely fly ash is produced. Indian coal has highest ash content as compared to coal found in other countries. There are nearly 85 thermal power plants in India which uses coal as source for power generation and thus produces a large amount of fly ash. This fly ash is disposed in soil, which in turn causes a lot of environmental problems. To overcome this disposal of fly ash into the soil, it can be used in concrete by partially replacing with cement. This study deals with investigation for M25 Grade of newlineconcrete to study the mechanical properties of Steel fiber reinforced concrete newline(SFRC) containing fiber of an interval of 0.5% from 0.0% to 2.0% by new line weight of cement. In this study are steel fibres are used and compare properties with conventional concrete. In this study we are casting 6 cubes and 6 cylinders out of which 2 each for 7, 14, 28 days.***

Keywords: Steel fibres, Cement and Compressive Strength, GGBS, Fly Ash, SFRC, Cement, Compressive Strength, Split Tensile Strength

I. INTRODUCTION STEEL FIBERS

Steel fiber concrete is one of the special concrete that normal concrete mix with discontinuous discrete steel fiber. There are abundant of small-scale fibers are distribute randomly during the concrete mix .The evolution of using steel fibers in the field is to replace and reduce the traditional reinforcement bar in the concrete members . Thus steel fiber tend to increase the tensile strength of the concrete by deflecting micro cracks which develop in the concrete under exterior force and load effects .The lengths of the steel fibers are usually small and short, this is because it wants to avoid inadequate workability of the concrete mixture .

A. Types of Steel Fibres



Different types of Steel fibers

II. LITERATURE REVIEW

A. Literature Review

Murthy Dakshina N R et al (2005) , in their paper entitled 'Splitting tensile strength of high volume fly ash concretes with and without steel fibres in different grades' have discussed about the effect of combination of fly ash and random steel fibres in improving tensile strength of concrete in lower, medium and higher grades. They have studied M25, M50 and M60 grades of concrete. They have used steel fibres with aspect ratio of 75 and volume fraction of 1%. At higher percentage replacement the brittleness of concrete has been increased. With steel fibres ductility can be improved upto 20% replacement. There is a drop in the split tensile strength at 30% and 40% replacements. For all grades on concrete there is overall improvement in the ductility when 1% fibres are added.

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Khadake (2013) had played out an exploratory investigation on "Steel Fiber Reinforced concrete with Flyash with M35 grade". They have examined that the workability of cement is enhanced with flyash addition rate increments. Density of concrete is high and it is increased with the rate of steel fiber increments and the value of slump is getting reduced simultaneously. "The example quality is around 80% of target quality at 28th day and 95 to 100% at 45 days, as a result of flyash and steel fibers".

Gadget (2013) has given an account of blend outline of fiber strengthened cement utilizing flyash and steel fiber. As per him, the test outcomes uncover that higher fiber content has achieved increased compressive quality, flexural quality, resistance to abrasion, and fiber split control impact. Henceforth, the percentage increment of steel fiber inside FRC is more useful for the flexural strength than the compressive strength

Muthupriya (2014) has researched about the quality of fiber strengthened self-compacting concrete with Flyash GGBFS. From this investigational work, it is analysed that, when the coarse aggregate substance is diminished, better stream in SCC can be accomplished because of the less blocking impact. The total volume of coarse aggregate was diminished to 46% rather than half to keep away from segregation. In the review it has been established that with increment in super plasticizer dose the workability can be increased.

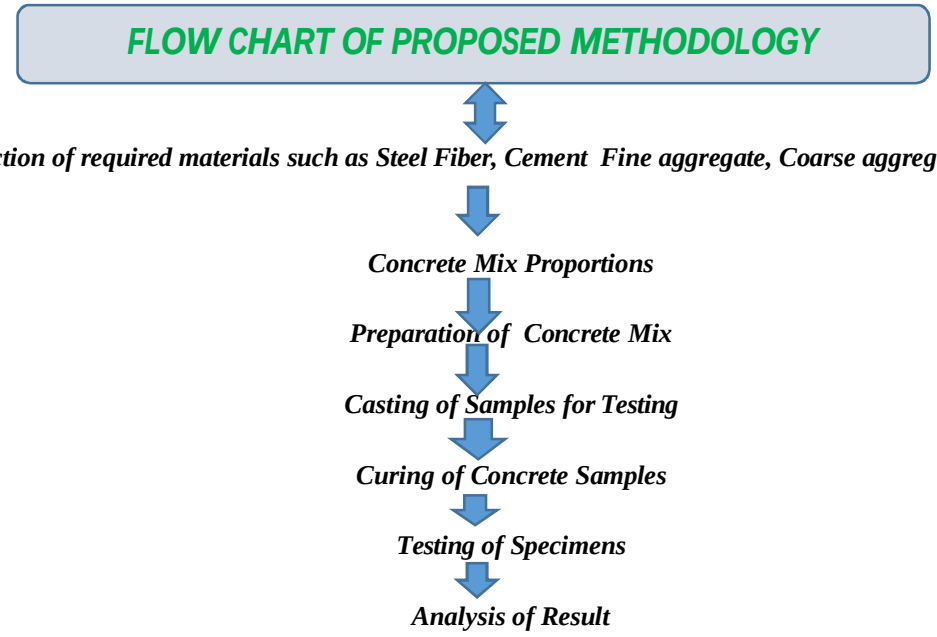
M. Mezher, et al 2019 The research aims to use waste materials in concrete to decrease cost of concrete since that waste materials in Iraq is highly available. Waste marble is very good example to use it in concrete as coarse aggregate and excellent material to produce very good quality concrete. This research study the using of waste marble as coarse aggregate and using steel pins as a low cost local steel fibers as percentages of total volume in concrete

III. OBJECTIVE

The objective of this experimental study is to:

1) Comparative study on the properties of nominal concrete and concrete containing steel fibers and fly ash.
2) Study on the workability of nominal concrete and FASFRC.
3) Determine its mechanical properties with the addition of Steel fibers and replacement of cement with Flyash.

IV. MATERIALS AND METHODOLOGY



A. *Material*

1) Cement
2) Fine aggregate
3) Coarse aggregate
4) Water
5) Admixtures
6) Steel fibres

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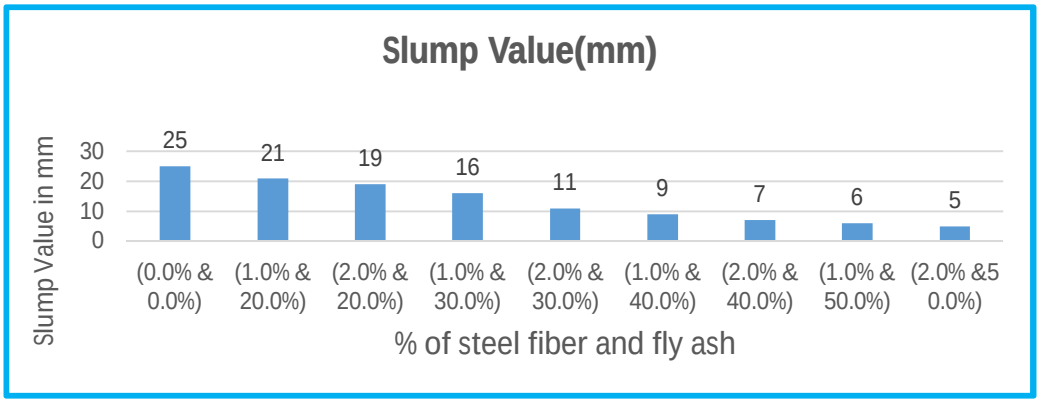
V. EXPERIMENTAL RESULT

A. *Workability*

1) *Slumps of M-25 with Metakolin and Robo sand:* In this work the workability is tested by slump test. When the concrete is freshly mix then it is tested by filling the fresh concrete in the slump cone. The workability is measured by removing the slump cone and measured the subsidence of the concrete this value is called the slump value of the concrete.

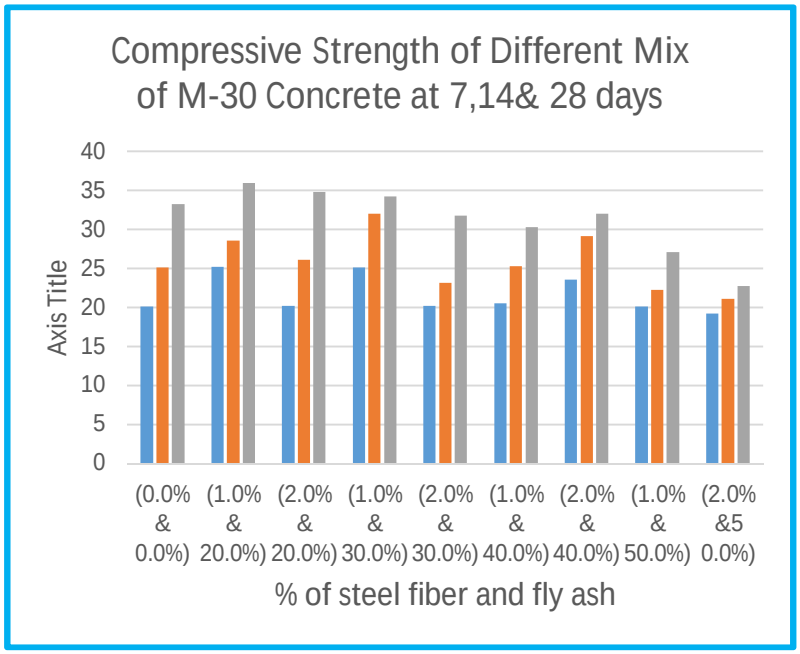


Slumps of M-25 at different percentage of SF and FA

2) *Discussion:* In the slump test, it has been Find that, there is gradual decline in the slump value of the concrete with the percentage increase of fly ash and steel fibers in the nominal concrete as compared to control. The slump value of cement is 25 for H0 whereas, for S8 (50 % & 2.0%) it is coming up to 5mm.

B. *Compressive Strength Test*

The effect of Steel fiber and Fly ash used in the present study on compressive strength of concrete for M25 grade of concrete with varying dosages as 0%, 20%, 30%,40% and 50%Fly ash replacing cement by v/eight and at 7 days, 14 days and 28 days has been shown in table



Compressive Strength of Different Mix of M-25 Concrete at 7,14and 28 days at different Percentage of SF and FA

1) *Discussion:* From the Experimental test results, it is observed that the optimum compressive strength is obtained with the mix proportion H1 (1.0% & 20%) at the end of 28 days. The compressive strength of S2 is 35.92 N/mm2 at the end of 28 days. Thus, it can be anticipated that, there is an increase of 7.97 % in the compressive strength of with the 1.0 % addition of steel fiber and 20% replacement of flyash in the nominal concrete.

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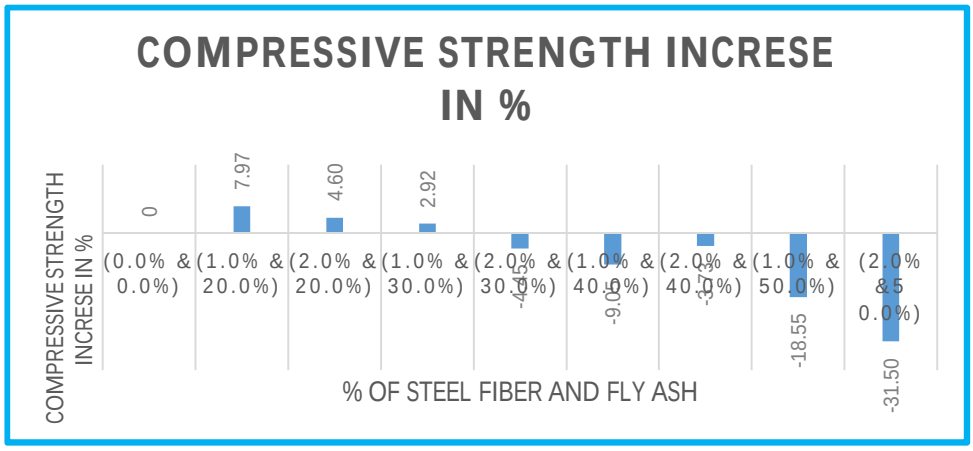
C. Variation of Compressive Strength of Flyash Steel Fibre Reinforced Concrete at 28 days



Varying of compressive strength at 7,14and 28 days by using steel fiber and fly ash

Discussion - Thus, it can be anticipated that, there is an increase of 7.97 % in the compressive strength of with the 1.0 % addition of steel fiber and 20% replacement of flyash in the nominal concrete.

VI. CONCLUSION

1) The workability of different concrete mixes decreases as compared to the control mix. From the test results it has been observed that the compressive strength of different concrete mixes, increases at all ages in comparison of the control mix, From the Result is seen that the compressive strength in M25 grade of concrete at 7, 14, and 28 days increases when the percentage of the steel fiber and fly ash (1%SF& 20%FA) . (1%SF& 20%FA) At steel fiber and fly ash replacement of Cement strength observed to be maximum and after strength is decreasing. The strength increase at 28 days is up to 7.9 %,for M25 grade of concrete

2) At 28 day Maximum compressive strength of M25 grade of concrete is 35.922 N/mm2 at 1%SF& 20%FA . Compressive strength of concrete increases gradually by addition of Steel fiber from 0 % to 7.92 %. There is extensive increment in the compressive strength as compared with plain concrete (without fibers).

3) Use of waste and by-products as cement replacement, not only makes the concrete economically viale but also solve the problem of dumping the waste product which is a major problem in india,

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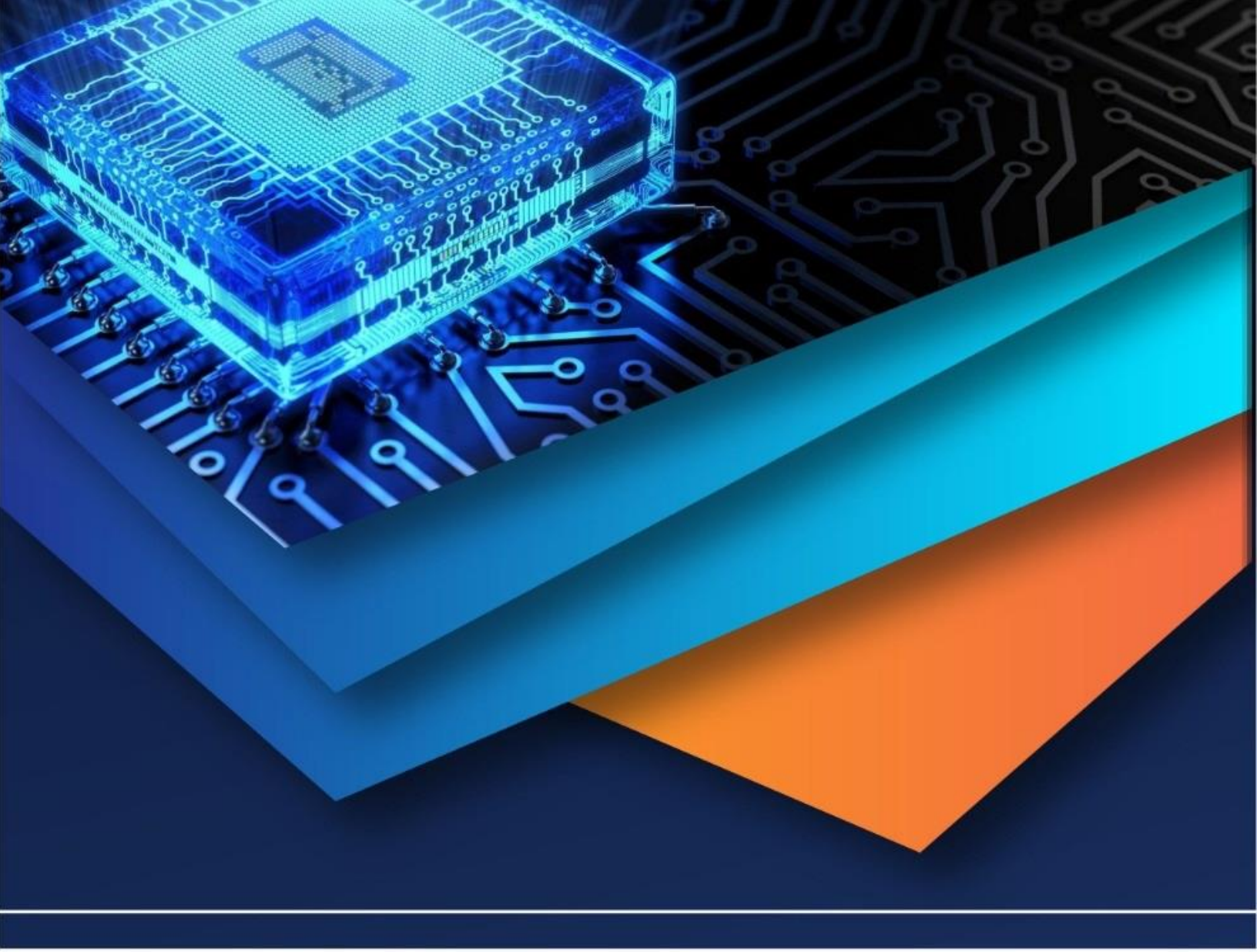

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