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COMPARATIVE STUDY ON PARTIAL REPLACEMENT OF VARIOUS MATERIALS WITH AGGREGATES IN CONVENTIONAL CONCRETE

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Abstract -The presence of fibres in the body of the concrete or the provision of a tensile skin of fibre concrete can be expected to improve the resistance of conventionally reinforced structural members to cracking, deflection and other serviceability conditions. This project focuses on the experimental investigation on mechanical properties of steel fibre and crimped steel fibre on different strength of concrete. For this study, Bundled hooked- end steel fibres with aspect ratio of 60mm were used. The fibres were added in concrete of M25 as high strength. The effects of fibres on the different strength were studied in terms of compressive strength, splitting tensile strength, and Flexural properties. The test results shows that a significant improvement in compressive strength of concrete for a volume of fraction of 0.5% for low strength of concrete was found to be 31.6%. The test results also indicates that the splitting tensile strength of concrete was found to be 15.29%, 29.75%, 19.90% for split tensile cylinder compression, flexural strength respectively for a volume fraction of 0.5% on M25 strength of concrete. The maximum increase in strength was found to be with SS10/1 specimen while comparing the mechanical properties of the specimen with conventional concrete of M25 grade concrete. The decrease in strength was found with RP10/10 Specimen while comparing the mechanical properties with control concrete of M25 grade.

Keywords – Compressive Strength, Split Tensile Strength, Flexural Strength

I. Introduction

Concrete is the most widely used man made construction material in civil engineering practice. The concrete is cast in any desirable shape. However, plain concrete possesses very low tensile strength, limited ductility and little resistance to cracking. This deficiency has been eliminated by using fibres into the concrete. There are many ways to minimize the failure of the concrete structures made of steel reinforced concrete normally suffer from corrosion of the steel by the salt, which results in the failure of those structures. It will help of maintenance and repairing of concrete structures.

FIBRE - There is no indication as to when fibres were first to reinforce building materials. However, there is no doubt that the concept is extremely ancient and it is easy to see how textures have increased in complexity throughout the history of materials technology. According to Exodus 5:6(1), Egyptians used straw to reinforce mud bricks. There is also evidence that asbestos fibre was reinforceclay posts about 5000 years ago. Other sources state that straws ere used in sun-baked bricks; horsehair was used in plaster and asbestos fibres have been used to reinforce Portland cement. It can be also noted that a metal alloy as used as reinforcement in the fifteenth century. Researchers consider the first fibre-reinforced materials to have been produced by maxing straw or similar products into building materials or mortars. Alberto Fava, La Plata University, Argentina believes fibre-reinforcement was not originated by man but the Hornero, a tiny bird native to numerous South American countries. This clever bird has been painstakingly building straw-reinforced clay nests on treetops since before the advent of mankind.

Numerous patents have been granted regarding the various methods by which wire segments or metal chips may be incorporated within concrete mix designs. However, the real development can be ascribed to Joseph Lambot. His 1847 patent content the use of continuous fibres in the form of wires or wire meshes to create a new building material, known as ferrocement. Thirty years ago, A. Bernard from California, USA, created an artificial "stone" by adding granulated waste iron to a concrete mix.

In 1899, a composite element manufacturing process containing cement and asbestos as developed by Lhatshelc. In 1910, Porter undertook a series of experiments for strengthening concrete by the inclusion of short fibres within the mix. He concluded that the insertion of cut nails increases the tensile and compressive strength of concrete and wrote: "Indeed it is not at all improbable that, in the not very distant future, reinforcement of this nature, that is supplying resistance to particles throughout the particles, by introducing here and there short pieces of steel, on the tensile side especially, will come into use, thus making concrete a more truly homogenous structural material."

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Graham filed the first US patent for steel-fibre-reinforced concrete(SFRC) in 1911 wherein he described the use of steel silvers or shavings as a reinforcement mechanism. One year later, a second patent was taken out by Wearkley. This incorporated patent steel wire processed with to wires, by means of a ring, ensuring durable bond with the concrete.

DEVELOPMENTS TO 1950 **-** The first British patent was taken out by William Fickley in 1914 whereby various tortuously shaped pieces of metal reinforcement were incorporated within concrete. Fickley claimed that toughness and abrasion resistance were enhanced, but there were no improvements in tensile and compressive strength. In contrast to Fickley, a French expert, Alfesen, pointed out that the tensile strength of concrete cold be improved by adding small longitudinal bodies of iron, wood or other materials to the concrete mix.

The patents of G. Constantinesco in 1943, and those US and UK atents filed in 1954, merit particular attention. Guidance on reinforcement use, recommended at that time, are similar to those currently used for SFRC. Constantinesco recommended the use of fibres, enabling improved resistance to cracking and energy absorption by the concrete mass. He suggested the use of this new composite in several fields, particularly the construction of airport tracks, machine foundations and all similar structures.

DEVELOPMENT SINCE THE1950s **-** The Portland cement association in the USA investigated fibre-reinforced cement-based material in the late 1950s, and soon afterwards tis concrete became widely specified for roads and slabs. It has been estimated that at least 70% of all field-work undertaken in the USA during the last 25 years on fibre-reinforced concrete involved construction of overlays, bridge deck repairs, highways, streets, airfield pavements, and repair of other concrete structures, such as dams and culverts.

Types of Fibre

The fibres can be broadly classified as:

- Crimped fibres

Splitting tensile strength and flexural test of concrete with replacement of various materials in M25 grade concrete. To study the effects of concrete strength in improving the different mechanical properties of M25 concrete.

The later development of other deformed fibres had similar results of eliminating balling and improved anchorage.

- Bundles Hooked fibres.

Steel fibres for use in concrete are available in a variety of shapes, size, and metal types. Many fibres with round, rectangular and crescent shaped cross-sections, are commercially available. They range in ultimate strength from 345t.7o 2070MPa. Fibre size range from 13*025mm to 64*0.76mm. Fibres with hooked or deformed ends could be used in smaller quantities because they develop higher pollutant resistance. Fibre with large surface area, square or rectangular as compared to round, have more concrete bonding area.

Fibre contents in construction projects have typically ranged from 0.5% to 2.0% by volume higher percentages of fibres have been generally used with straight fibres. More ductile concrete with a high load bearing capacity-resulting in thinner slabs with equal or better performance than their mesh counterparts.

Durability-steel fibre slabs reinforce the structure throughout the entire matrix of the concrete, unlike mesh which is localised to one or two layers. Quick and easy application – Steel fibres can be added at the concrete plant or at the job site directly.

Efficient and cost effective-on average a dramix slab will cost between 10-15% less than an equivalent mesh slab.

II. Need for the Study

Fibre concrete used in practice is mostly with mono fibre system which provides limited enhancement of property. Addition of steel fibre improves the compressive strength of plain cement concrete. Partial replacement of GGBS with cement will increase the grade strength. The partial replacement of plastics in fine aggregates will slightly improve the durability and also reduce the self weight of concrete. The silica fume will improve the mechanical properties of concrete.

III. Objectives of the Study

The objectives of the study are to access the mechanical properties in terms of compressive,

IV. Physical Properties

A. Cement

PROPERTIES	VALUE
Compressive strength	53 Mpa
specific gravity	3.15
initial setting time	30 min
Final setting time	600 min

Table.No.1: Properties of Cement

B. Fine Aggregate

PROPERTIES	VALUE
Fineness modulus	3.24
Specific gravity	2.41
Size	4.75mm sieve
Water absorption ratio	1%

Table.No.2: Properties of Fine Aggregate

C. Coarse Aggregate

PROPERTIES	VALUE
Fineness modulus	4
Specific gravity	2.73
Size	10mm sieve
Water absorption ratio	0.50%

Table.No.3: Properties of Coarse Aggregate

D.Plastic

PROPERTIES	VALUE
Length	4mm
Diameter	1mm

Table.No.4: Properties of Fine Aggregate

V. Methodology

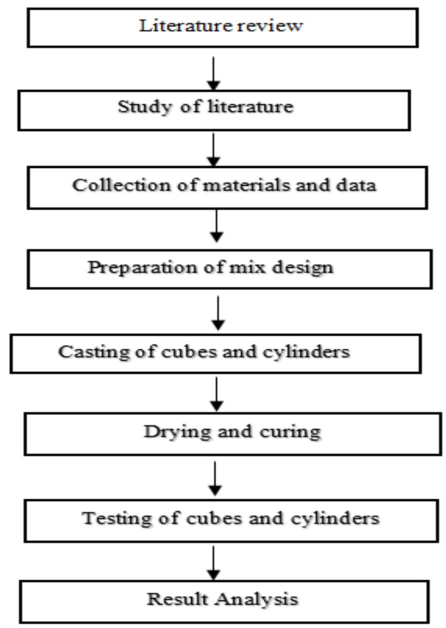

Figure.1: Methodology Flow Chart

VI. Experimental Test Results

Sieve Size	Weight Retained	% Weight Retained	Cumulative Weight Retained	%Finer
4.25	29	2.9	2.9	97.1
2.36	22	2.2	5.1	94.9
1.18	164	1.64	21.5	78.5
600mic	391	39.1	60.6	39.4
300mic	241	24.1	84.7	15.3
150mic	132	13.2	97.9	2.1
75mic	16	1.6	99.5	0.5
Pan	5	0.5	100	0

Table.No.5: Particle Size Distribution-Sand

Compaction factor (average) = 0.93

W/C Ratio	(W2)	(W3)	(W2-W1)	(W3-W1)	Compaction Factor
0.3	15.660	16.220	9.28	9.84	0.96
0.4	15.560	17.280	9.18	11.44	0.87
0.5	18.520	19.080	12.14	12.7	0.97

Table.No.6: Compaction Factor

Weight of Partially Compacted Cylinder -(W2)

Weight of Fully Compacted Cylinder -(W3)

Weight of PartiallyCompacted Concrete - (W2-W1)

Weight of Fully Compacted Concrete - (W3-W1)

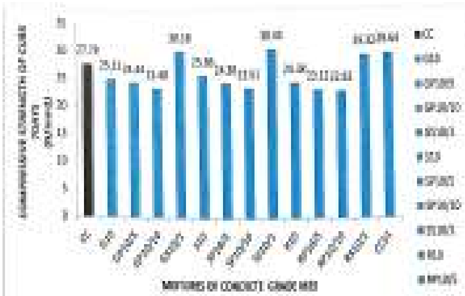

Figure.2: Compressive strength of cube for 7 days

Figure.2: Compressive strength of cube for 28 days

Figure.3: Split tensile strength of cylinder for 7 days

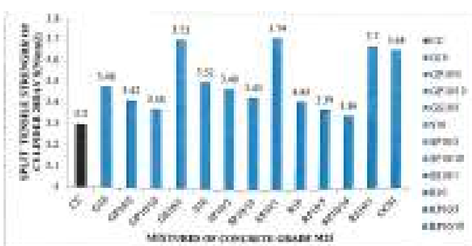

Figure.4: Split tensile strength of cylinder for 28 days

Figure.5: Compressive strength of cylinder for 7 days

Figure.6: Compressive strength of cylinder for 28 days

Figure.7: Flexural strength of cylinderfor 7 days

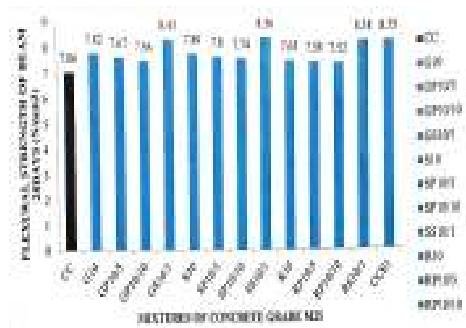

Figure.8: Split tensile strength of cylinderfor 28 days

VII. Conclusion

In this experimental study the results of Compressive strength, Tensile strength, Flexural strength of control concrete with replacement of other material was found and compared.

Above graphs indicate the values of strength for conventional concrete.

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