An Experimental Study on Fibre Reinforced Concrete Using Polypropylene Fibre and Partial Replacement of Coarse Aggregate by Weld Slag Material

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***Abstract* - Normal or conventional concrete uses more of the raw material like sand, gravels, fly ash etc. its usage has been increased to an enormous amount where there are likely chances of meeting with the demand of such construction materials. It may also lead to increase the cost of the materials drastically. To overcome such situations, alternate building materials were emerging now-a-days. This study has been made as an attempt in improving the technological ailment by using recycled materials for construction. Weld Slag and Fibres, the abundantly available materials were selected for partially replacement in concrete. Weld Slag being a residual content is used in concrete with various proportions as a partial replacement of coarse aggregate in the proportion of 10%, 20% and 30% by weight. Polypropylene fibre being used for the post cracking purpose in concrete is used here for increasing the mechanical properties of the concrete along with the addition of Weld Slag. The fibre is added at the proportion of 0.2% of total volume of the concrete. This experimental investigation is carried out to evaluate the ability to increase the mechanical properties of the concrete by using Weld Slag and polypropylene fibre and to determine the optimum dosage of those ingredients.**

I. INTRODUCTION

The present day, world is facing the construction of very challenging and difficult civil engineering structures. Concrete, being the most important and widely used material, is called upon to possess very high strength and sufficient workability properties.

The advancement of concrete technology can reduce the consumption of natural resources and energy sources and less the burden of pollutants on environment. The construction materials which have been using till now may create a huge demand in the future due to lack of availability. It is effective that the waste comes from weld industries can be used in concrete as a replacement for normal construction materials such as aggregate. Presently large amount of waste weld materials are generated in the industries. Concrete is strong in compression as they aggregate efficiently carries the compression load. However, it is weak in tension as the cement holding the aggregate in place can crack, allowing the structure to fail. Reinforced concrete adds steel reinforcing bars, steel fibres, polymer fibres, glass fibres or plastic fibres to carry tensile loads. Fibre reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. While concrete brittleness to a large extent can be compensated with steel reinforcement on structural scale in fibre reinforced concrete resulting in improved structural durability, safety as well as improved performance in infrastructure sustainability. Polypropylene fibres are widely employed in the reinforcement of concrete as they present some advantages including, high durability of the fibre reinforced concrete, they have a greater effect on reducing the shrinkage of concrete and they reduce of the spalling effect in high strength concrete subjected to elevated temperature. The effect of polypropylene fibres is more pronounced in the elastic modulus due to shrinkage cracking reduction and on the fracture behavior of the fibre reinforced concrete due to the bridge effect of the crack lips.

OBJECTIVES OF THE WORK

- To study the utilization of waste materials as partial replacement of aggregates in concrete.
- To investigate the mechanical properties of the concrete using weld slag and polypropylene fibre.

SCOPE OF THE WORK

- Weld slag as a partial replacement for coarse aggregate with 10%,20% and 30%
- Polypropylene fibre as adding material with 0.2%.

II. LITERATURE REVIEW

A comparison has been made plain cement concrete and the fibre concrete containing weld slag in various proportions by weight. The workability of fresh weld fibre reinforced concrete is restricted to less weld contents. The compressive strength of weld fibre

reinforced concrete is found to be maximum for (28 days strength) weld slag fibre added concrete. The addition of weld slag in concrete has increase the performance of beam in flexural by 40% when compared with PCC. The replacement of coarse aggregate by weld slag is found to be very effective. Concrete gets early strength and hence shuttering can be removed early thereby reducing the secondary overhead cost.

III. MATERIAL USED CEMENT

Lots of factor impacts on the strength of concrete, but strength of cement is the most important and direct factor. Portland Pozzolana cement of 43 grade conforming to IS 8112-1989 is used. Specific gravity of cement is 3.09.

FINE AGGREGATE

Natural river sand is used as fine aggregate. The properties of sand are determined by conducting tests as per IS: 2386(part-1). The results are shown in the table. The results obtained from sieve analysis are furnished

Table 1 Physical properties of fine aggregate

SI. No	Properties	Values
1	Specific gravity	2.66
2	Water absorption	1.15%

COARSE AGGREGATE

Properties of the coarse aggregate affect the final strength of the hardened concrete and its resistance to disintegration, weathering, and other destructive effects. 20mm size of coarse aggregate is used. The properties of coarse aggregate are shown in table.

Table 2 Physical properties of coarse aggregate

SI. No	Properties	Values
1	Specific gravity	2.67
2	Water absorption	0.85%

WELD SLAG

Replacing weld slag for coarse concrete as 10%,20% and 30% in the concrete. Specific gravity of weld slag is 2.83

Fig 1 Weld slag

POLYPROPYLENE FIBRE

Fibers are plying an increasing role as the reinforcing medium of choice for concrete construction. Specifications of polypropylene fibre are given in the table.

Fig 2 Polypropylene fibre

Table 3 Specification of PF

Type	Austenitic
Length (l)	38mm
Diameter (d)	0.4-0.6cm

IV. METHODOLOGY

Proposed Mix Design:

The aim of the experiment is to investigate the behavior of the polypropylene fibre and weld slag when partially replaced by coarse aggregate in cubes, cylinders and prisms. The Mix adopted is M30 (1: 2.13: 3.67), designed as per IS 10262:2010.

Mixes	Water	Cement	Fine Aggregate	Coarse Aggregat	Polypropylene Fibre	Weld Slag
M1	150	340	725	1249	-	-
M2	150	340	725	1124.1	0.0136	124.9
M3	150	340	725	999.2	0.0136	249.8
M4	150	340	725	874.3	0.0136	374.7

Table 4 Mix Proportions (1m3 of concrete)

V. EXPERIMENTAL WORKS

To test the concrete for compression (150mm x 150mm x150mm), split tensile strength (300 mm length with 150 mm diameter) and flexural strength (500mm x 100mm x100mm) were cast respectively. Specimen is obtained for 7 and 28 days.

Fig 3 Test of concrete

GRAPH RESULT

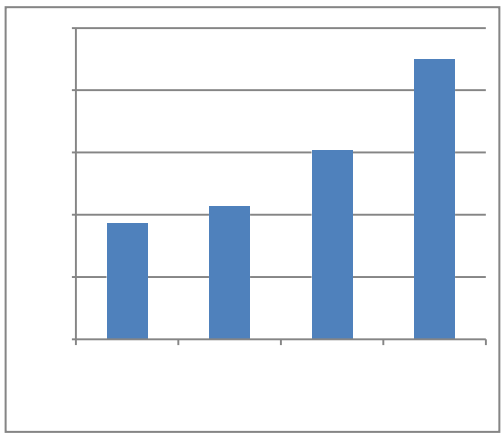

Fig 5.2 comparison of compressive strength of concrete at 7 days

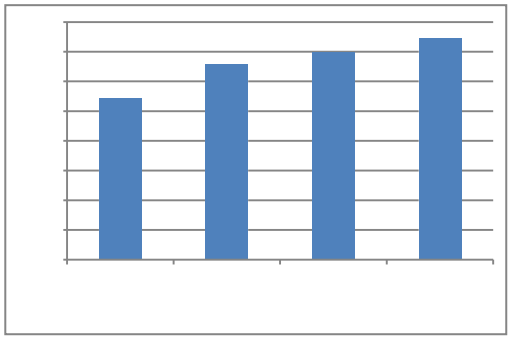

Fig 5.2 comparison of compressive strength of concrete at 28 days

V1 RESULT AND DISCUSSION

1.COMPRESSIVE STRENGTH ON CONCRETE CUBE

Table 5.1 Compressive strength of cube for 7 days

S.No	Age of test	Percentage of weld slag	Compressive strength N/mm^2
1	7 days	0	16.31
2	7 days	10	16.93
3	7 days	20	18.15
4	7 days	30	19.08

Table 5.2 Compressive strength of cube for 28 days

SI.no	Age of test	Percentage of Weld slag	Flexural strength N/mm^2
1	28 days	0	3.33
2	28 days	10	4.01
3	28 days	20	4.31
4	28 days	30	4.7

VII CONCLUSION

Experimental tests are conducted and Mechanical properties of concrete such as compressive strength, splitting tensile strength and flexural strength are determined for conventional concrete and weld slag replaced concrete cast at various mix proportions. The strength parameters of conventional concrete and weld slag fibre reinforced concrete are compared. The test results of hardened concrete were shown that there is a considerable increase in Compressive strength, Flexural strength and Tensile strength. The weld slag fibre reinforced concrete test was conducted for 10%, 20% and 30%. By increasing the percentage of weld slag, all the strengths also increased. Hence 0.2% will be an optimum percentage of the fibre reinforced concrete for high strength concrete and hence weld slag fibre reinforced concrete is used in construction

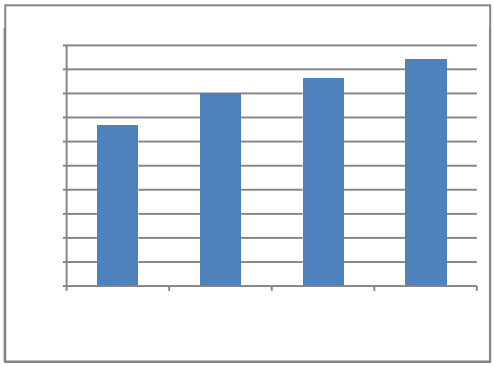

Fig5.3 comparison of compressive strength of concrete for 28 days

2. SPLIT TENSILE STRENGTH ON CONCRETE CYLINDER

Table 5.3 Splitting tensile strength of cylinder

GRAPH RESULT

3. FLEXURAL STRENGTH ON CONCRETE PRISM

Table 5.4 Flexural strength of prism

s.no	Age of test	Percentage of wed slag	Compressive strength N/mm2
1	28 days	0	37.43
2	28 days	10	37.57
3	28 days	20	38.02
4	28 days	30	38.75

GRAPH RESULT

s.no	Age of test	Percentage of weld slag	Split tensile strength N/mm ^{2}
1	28 days	0	2.72
2	28 days	10	3.29
3	28 days	20	3.50
4	28 days	30	3.73

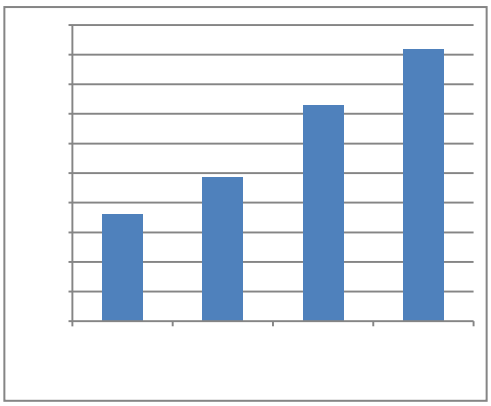

Fig 5.6 Comparison of flexural strength of concrete at 28 days

VII CONCLUSION

Experimental tests are conducted and Mechanical properties of concrete such as compressive strength, splitting tensile strength and flexural strength are determined for conventional concrete and weld slag replaced concrete cast at various mix proportions. The strength parameters of conventional concrete and weld slag fibre reinforced concrete are compared. The test results of hardened concrete were shown that there is a considerable increase in Compressive strength, Flexural strength and Tensile strength. The weld slag fibre reinforced concrete test was conducted for 10%, 20% and 30%. By increasing the percentage of weld slag, all the strengths also increased. Hence 0.2% will be an optimum percentage of the fibre reinforced concrete for high strength concrete and hence weld slag fibre reinforced concrete is used in construction

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