Experimental Investigation on Concrete Using Steel Slag as Fine Aggregate

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Abstract

Steel slag is the byproduct attained from steel manufacturing industry, is formed by the separation of molten steel from impurities. In this experiment specimen for testing were prepared, the cubes are cured for 7, 14 & 28 days and beams are cured for 7 & 28days. The fine aggregates are substituted by steel slag by 0%, 15%, 30%, 45%, 60%, and then compared with that of natural aggregates. The strength of the concrete specimen is increase when fine aggregate and coarse aggregate is replaced with steel slag. At last, there is comparison of flexure test and compressive strength test in which we see that compressive test give higher value than the flexure test.

Keywords: Industrial Waste, Compressive and Flexural Strength, Natural Aggregates, Iron Slag, Slump Change

I. INTRODUCTION

Steel slag is a byproduct attained from the industry manufacturing steel, is produced by the separating the molten steel and impurities present in it in steel making furnaces. It is formed by the reaction of calcium oxide and the inorganic non-metallic compounds available in the steel material. Steel slag contains non-metallic ceramic material and the use of it decreases the requirement of natural rocks which is used as constructional material, and hence conserving our natural rock resources. Maximum use and reutilizing of by-products and improved waste materials for profitable and environmental reasons has led to quick development of slag utilization.

II. LITERATURE REVIEW

Harsh Gupta (2017) perform the experiment on "Steel Slag as a Partial Replacement of Fine Aggregate in Terms of High Strength Concrete "in this experiment M35 grade of concrete is prepared and steel slag is partially replaced by fine aggregate up to 0%, 10%,20%,30%,40%. The concrete cube is casted and tested for 7, 14, 28 days of curing.During compressive strength test, at optimum replacement level, i.e.at 30% replacement 15.88% strength is noted for 7 days of curing while 15.14% for 14days, 12.39% for 28 days and10.67% for that of 50 days of curing on compared with the conventional concrete mix.

Rahul D. Ghode (2017) perform the experiment on "a study on strength parameters of concrete by partial replacement of cement with quarry dust and sand with iron slag" The strength and durability characteristics of concrete mixtures have been computed in the present work by replacing 10%, 20% and 30% coal dust with the cement and iron slag with sand.

Mr. Pruthviraj L. Kadam (2016) perform an experiment on "effect of partial replacement of fine aggregate by Steel Slag and its impact on compressive strength of concrete"in this experiment he casted concrete cube by partial replacement of Fine Aggregate with 0%, 10%, 20%, 30%, and 40%.

K. Thangaselvi et al (2015) carried out experiment on, the replacement was done with coarse aggregate by steel slag for different proportions of 0%, 20%, 40%, 60%, 80% and for a M40 grade of concrete is used for a water cement ratio of 0.40. Tests on compressive strength, split tensile strength, flexural strength at 7 days and 28 days are conducted on specimens.

III. MATERIALS AND METHODS

A. Cement

The Ordinary Portland cement of 43 grade confirming to IS 8112-1989 manufactured by Ultratech Company was used in this experimental work. Cement with specific gravity 3.12 was used for the preparation of test specimens. In a general sense, cement

is a adhesive and cohesive material which are capable of bonding together particle. There are different type of cement; out of that i have used 43 grade ordinary Portland cement (OPC). Initial and Final setting time of cement respectively is 90 min and 360 min.

B. Aggregates

Broken stone from the local quarry of size 20 mm and 10 mm in the ratio of 60:40 respectively confirming to IS: 383-1970 has been used as coarse aggregate. The specific gravity of 10 mm and 20 mm coarse aggregate were taken as 2.72 and 2.74 respectively. Water absorption for 10 mm and 20 mm aggregate were 0.17 and 0.15 % respectively. Fineness modulus of 10 mm and 20 mm were 4.91 and 5.12 respectively. Locally available river sand of zone II conforming to IS 383-1970 with specific gravity 2.69, water absorption 1.82 % and fineness modulus 2.86.

C. Super-Plasticizer

A commercially available super-plasticizer (SIKA 150) has been used in all mixes. The super plasticizer was added 0.6 % by weight of cement to all mixes conforming to IS 9103:1999. Super plasticizer was also used in all mixes to make concrete better in workability.

D. Steel Slag

Steel slag was collected from Grey Iron foundry (Vehicle Factory Estate, shobhapur, Jabalpur). Then mix was designed for M30 concrete. Fresh concrete properties were determined by mixing concrete. The performance of concrete in which the aggregates are replaced by steel slag by 15%, 30%, 45%,60%, 75%, are compared to that of conventional concrete and the most favorable percentage of steel slag to be found.

E. Compressive strength test

Compressive strength of concrete depends on many factors such as water-cement ratio, cement strength, quality of concrete material, quality control during production of concrete etc. Test for compressive strength is carried out either on cube or cylinder. Various standard codes recommend concrete cylinder or concrete cube as the standard specimen for the test.Out of many test applied to the concrete, this is the utmost important which gives an idea about all the characteristics of concrete. By this single test one judge that whether Concreting has been done properly or not.

F. Flexural Strength Test

The flexural strength of concrete prism was determined based on IS: 516 –1959.Beam specimens of size 100 mm x 100 mm x 500 mm were casted. The samples were de-molded after 24 h from casting and kept in a water tank for7 days and 28 days curing. The specimens were placed in UTM and tested for flexural strength.

The bed of the testing machine shall be provided with two steel rollers, 38 mm in diameter, on which the specimen is to be supported, and these rollers shall be so mounted that the distance from center to center is 60 cm for 15.0 cm specimens or 40 cm for 10.0 cm specimens. The load shall be applied through two similar rollers mounted at the third points of the supporting span that is, spaced at 20 or 13.3 cm center to center. The load shall be divided equally between the two loading rollers, and all rollers shall be mounted in such a manner that the load is applied axially and without subjecting the specimen to any torsion stresses or restraints.

IV. OBSERVATION AND CALCULATION

A. Sieve Analysis for Fine Aggregate

The Aggregate which is passing through 4.75mm sieve is known as fine aggregate. Locally available river sand which is free from organic impurities is used. Sand passing through 4.75mm sieve and retained on 150micron IS sieve is used in this investigation. The sample shall be brought to an air-dry condition before weighing and strivings this may be achieved by dryings at room temperature or by heating at a temperature of 100°C to 110°C, the air dry sample shall be weighted and sieved successively on the appropriate sieves starting with the largest. Care shall be taken to ensure that the sieves are clean before use.
Properties of Fine Aggregate:

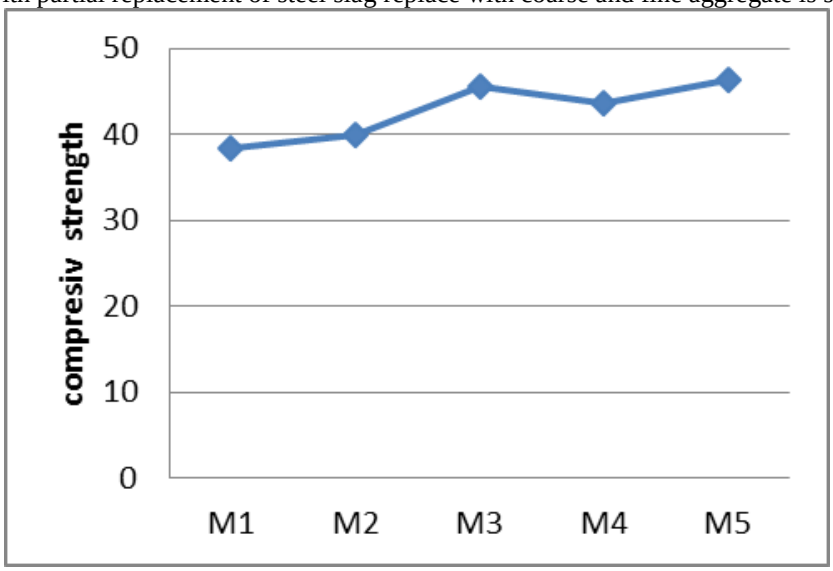
Fineness modulus of fine aggregate = cumulative percentage weight retained/100
Fineness modulus = 286.864/100= 2.86
Specific gravity = 2.69
Water absorption = 1.82%
Silt or clay content = 0.5%
Grading = well graded (zone II)

B. Compressive Strength of Grade M30 as M1, M2, M3, M4, M5

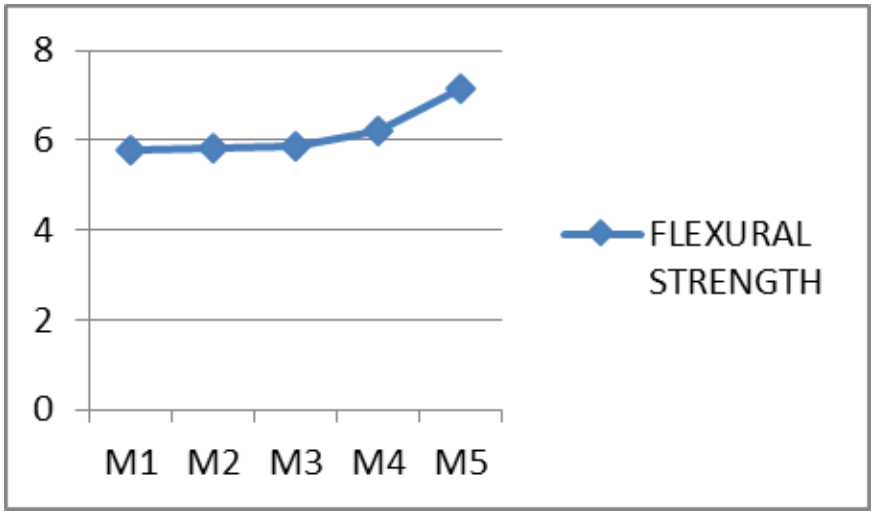
MIX	Fine Aggregate Replaced By Steel Slag (%)	EXPERIMENTAL RESULTS	
		COMPRESSIVE STRENGTH (N/mm²)	FLEXURAL STRENGTH (N/mm²)
M1	0	38.44	5.78
M2	15	39.85	5.81
M3	30	45.49	5.88
M4	45	43.55	6.20
M5	60	46.37	7.13

V. CONCLUSION

The above results indicate that the variation of compression strength of the concrete with various different mix samples. Compression strength of the concrete is maximum in 60% of steel slag replace with coarse aggregate. The variation of compressive strength of the concrete with partial replacement of steel slag replace with coarse and fine aggregate is shown in figure 5.1



The above results indicate that the flexural strength of the concrete is maximum in 60% steel slag replace with coarse aggregate. The variation of steel slag replace with coarse and fine aggregate is shown in figure 5.2.



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