Improved Strength of Concrete By Using Steel Slag as Coarse Aggregate

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Abstract- *Coarse aggregate is widely most used in the recent construction industry because of its easily availability and cheap in the market. The partial replacement of steel slag with natural aggregate is performed in this experiment. In this experiment specimen for testing were prepared, the cubes are cured for 7, 14 & 28 days and beams are cured for 7 & 28 days. Then properties are determined by performing different tests like compressive strength and flexural strength. The coarse aggregates are substituted by steel slag by 0%, 15%,30%,45%,60% and then compared with that of natural aggregates and the ideal percentage of steel slag is obtained.*

Keywords- steel slag, compressive strength, flexural strength, natural aggregates, workability, slump value.

I. INTRODUCTION

Concrete plays a very critical role in the design and construction of the nation's infrastructure. Concrete is prepared by mixing various constituents like cement, aggregates, water, etc. which are easily available. Concrete is unique among major construction materials because it is designed specifically for particular civil engineering projects. Concrete is combination of material which composed of granulated materials such as coarse aggregates mixed and bind together with cement or any other binder which fills the voids between the materials and glues them together. The aggregates are obtained from weathering of natural rocks, and its increased use degrading them slowly. This issue of environmental deprivation and need for aggregates, demand for an alternative source.

II. LITERATURE REVIEW

Ajay Pandurang Wanode (2018) This project was done in three phases. In first phase fine aggregate was replaced by 10% of industrial steel slag. In second phase fine aggregate was replaced by 15% of industrial steel slag and in third phase 20% fine aggregate was replaced by industrial steel slag for M30 grade of concrete. **Gaurav Desai et al (2018)** perform the experiment on “Partial Replacement of Fine Aggregate Using Steel Slag” in which, mix design is done as per the bureau of Indian standards, IS 10262- 1982 for M20 and M40 grade concrete with good degree of quality control. **I. Michael raj et al (2018)** perform the experiment on “experimental study on partial replacement of steel slag with fine aggregate in rcc elements” this work includes the determination of different properties of locally available steel slag. **R. Rajendran (2018)** perform the experiment on”An Experimental Study on M30 in which the natural coarse aggregate were partially replaced with steel slag aggregate and fine aggregate is replaced by crumb rubber” at various proportions of 10%,20%,30%,40% to find the optimum usage value of steel slag in concrete and the natural fine aggregate is partially replaced with crumb rubber at various proportions of 5%,10%,15% in the obtained optimum value of steel slag used concrete.

III. MATERIALS AND METHODS

3.1 Cement

The Ordinary Portland cement of 43 grade confirming to IS 8112-1989 manufactured by Ultra tech 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.

3.2 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.

3.3 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.

3.4 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.

3.5 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.

3.6 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 centre to centre 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 centre to centre. 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

4.1 SIEVE ANALYSIS FOR COURSE AGGREGATE

The coarse aggregate used in this investigation in 20mm downsize crushed aggregate and angular in shape as per Indian Standard specifications IS: 383 – 1970.

(a) Properties of Coarse Aggregate:

(b) Fineness modulus of coarse aggregates = cumulative percentage weight retained/100

Fineness Modulus = 512.40/100= 5.12

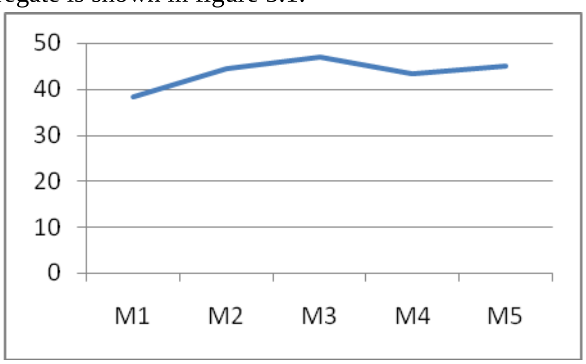
Specific gravity = 2.73

4.2 COMPRESSIVE STRENGTH OF GRADE M30 AS M1, M2, M3, M4, M5

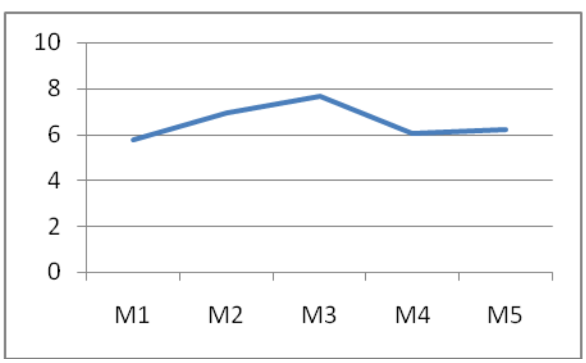
MIX	Coarse aggregate replaced by steel slag (%)	EXPERIMENTAL RESULTS	
		COMPRESSIVE STRENGTH (N/mm²)	FLEXURAL STRENGTH (N/mm²)
M1	0	38.44	5.78
M2	15	44.36	6.94
M3	30	46.94	7.66
M4	45	43.33	6.04
M5	60	44.96	6.22

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 30% 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 30% 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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