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EFFECT OF STEEL SLAG AS A COARSE AGGREGATE ON STRENGTH PARAMETERS OF SLAG CEMENT CONCRETE MIX

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Abstract*—The main objective of this research is to investigate the possibility of utilizing waste steel slag in concrete production. After the formation of by-product steel slag, in large amount from steel industries. This steel slag is disposed to open land area, it makes land pollution and harmful to environment. It has good physical parameters and gives enough strength to concrete and due to this it is suitable to bear heavy load. In this study workability, density before and after curing of concrete and strength parameters are evaluated by replacing the coarse aggregate by steel slag in 20%, 40%, 60%, 80%, and 100% by weight for Water–Cement ratio 0.42 in M_{20} grade concrete mix. The percentage of replacement which have been studied were, and evaluated the effect on workability. This study shows better strength of slag coarse aggregate concrete than conventional concrete mix

Keywords— Compressive Strength, Curing, Density, Split Tensile Strength, Workability

I. INTRODUCTION

Slag could be a by-product of the process of the method of smelting ore. Slag consists of metal oxides and silicon dioxides mixtures. One of the most beneficial uses for furnace slag is in concrete. Because of its chemical and physical properties, it is a very reactive aggregate. Concrete containing slag can have very high strength and can be very durable. So Slag is can be used in concrete. When it is used in concrete, it acts as filler and as a strengthening material. The by product material was alternative for replacement of coarse aggregates and for the preparation of concrete blocks. In this study the mix design is as per IS10262 2009 for M20 grade concrete.

STEEL SLAG

Slag is sometimes a mix of metal oxides and Si dioxides. Slag is named based on the furnaces from which they are generated. Slag, , has been used in civil engineering for more than 100 years. Rapidly water cooled Furnace Slag, due to its relative high amorphous silica content which has pozzolanic activities, is to be employed in the production of blended cement. Even there are some research works about the properties of concrete, in which air-cooled steel slag is used as coarse aggregate. The conclusions of these studies indicate that there is a great likelihood to use steel slag instead of natural coarse aggregate in concrete. The strength of steel slag aggregate is slightly higher than the normal aggregate, which result in more strength differences between slag aggregate concrete and natural aggregate concrete, in high strength concrete series. Slag could be a waste metallic material which could have future delayed reactions; many investigations terminated that most size of coarse combination ought to be restricted in strength of the composite. In addition to cement paste – combination magnitude relation, aggregate type has a great influence on concrete dimensional stability Slag is one of the artificial lime stone and silica, commonly used as coarse aggregate in high performance concrete

TABLE I
CHEMICAL COMPOSITION OF STEEL SLAG

Components	Percentage
Calcium Oxide	34-43%
Silicon Dioxide	27-38%
Aluminium Oxide	7-12%
Magnesium Oxide	7-15%
Iron	0.2-1.6%

NEED OF STUDY

Conventional concrete consists of sand as fine combination and gravel, limestone or granite in various sizes and shapes as coarse aggregate. There is a growing interest in mistreatment waste materials as various combination materials and vital analysis is created on the employment of the many completely different materials as combination substitutes such as coal ash, blast furnace slag, steel slag aggregate. The use of a stuff will solve issues of lack of combination in

varied construction sites and cut back environmental issues associated with combination mining and waste disposal. The use of waste steel slag coarse aggregates can also reduce the cost of the concrete production.

II. MATERIALS AND METHODOLOGY

CEMENT

Portland slag cement was used throughout the course of the investigation. The physical properties of the cement as determined from various tests conforming to Indian Standard IS:455.

STEEL SLAG COARSE AGGREGATES

Steel slag coarse aggregates was collected from the steel industries during the manufacturing process of steel. The sample was collected from JSW steel pvt. Ltd., Thoranagallu, BELLARY District..

COARSE AGGREGATES

Natural coarse aggregates was used throughout the course of the investigation

FINE AGGREGATES

M. Sand was used as a fine aggregate throughout the course of the investigation

TABLE III
PHYSICAL PROPERTIES OF MATERIALS

Sl. no	Test Conducted	Results	IS code
1	Specific Gravity of Slag Cement (PSC)	2.67	IS 455:1989
2	Specific Gravity of Fine Aggregates	2.53	IS 2720:1980-Part 3
3	Specific Gravity of Coarse Aggregates	2.65	IS 2386:1963-Part 4
4	Specific Gravity of Steel Slag Coarse Aggregates	2.7	IS 455:1989
5	Standard Consistency of Slag cement	29 %	IS 455:1989
6	Fineness Modulus of Slag Cement	8 %	IS 455:1989
7	Initial Setting time of Slag Cement	180 min	IS 455:1989
8	Final Setting time of Slag Cement	270 min	IS 455:1989
9	Compressive Strength of Slag Cement	23 Mpa	IS 455:1989
10	Bulk Density of Fine Aggregates a)Compacted Fine Aggregates b)Un compacted Fine Aggregates	 1350 kg/m^3 1200 kg/m^3	IS 2386:1963-Part 4
11	Bulk Density of Coarse Aggregates a)Compacted Coarse Aggregates b)Un compacted Coarse Aggregates	 1600 kg/m^3 1500 kg/m^3	IS 2386:1963-Part 4
12	Bulk Density of Steel Coarse Aggregates a)Compacted Steel Coarse Aggregates b)Un compacted Steel Coarse Aggregates	 1500 kg/m^3 1300 kg/m^3	IS 455:1989
13	Water Absorption of Fine Aggregates	0.6 %	IS 2386:1963-Part 4
14	Water Absorption of Coarse Aggregates	0.5 %	IS 2386:1963-Part 4
15	Water Absorption of Steel Slag Coarse Aggregates	4 %	IS 455:1989
16	Impact Value of Steel Slag Coarse Aggregate	31.08 %	IS 455:1989
17	Abrasion Value of Steel Slag Coarse Aggregate	25 %	IS 455:1989
18	Crushing Value of Steel Slag Coarse Aggregate	30 %	IS 455:1989

MIX PROPORTIONS: 0.42:01:1.75:2.55

TABLE III
MATERIALS PER CUBIC METER

Water kg/m^3	Cement kg/m^3	Fine aggregate kg/m^3	Coarse aggregate kg/m^3	Chemical admixture kg/m^3
205.50	440	678.47	989.83	0.66

III. RESULTS AND DISCUSSIONS

Slump Values

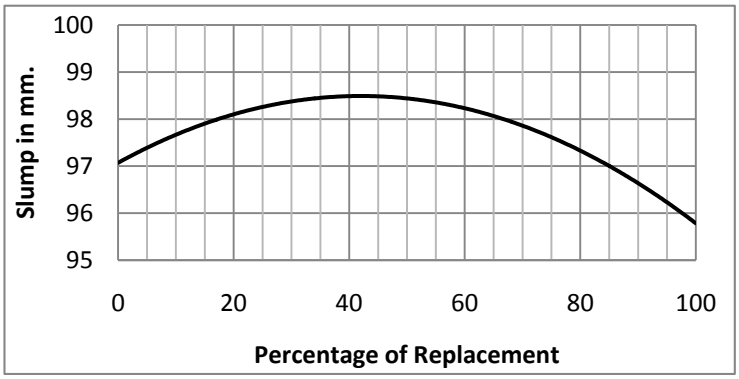

Fig. 1 slump values for different percentage of replacement of slag aggregate

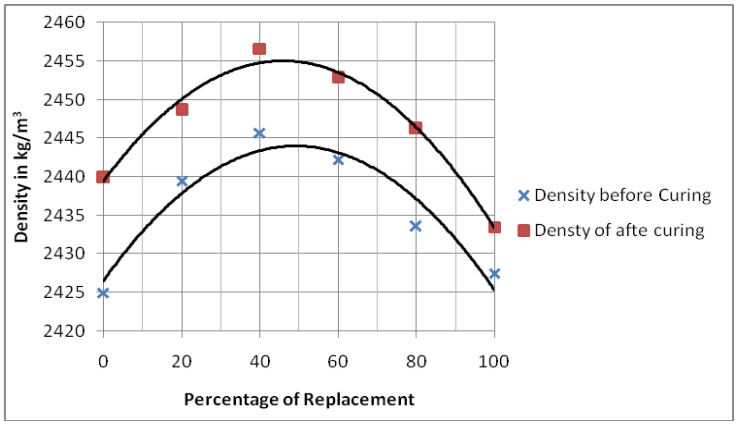

Fig. 2 Variations in densities for different percentage of replacement of slag aggregate

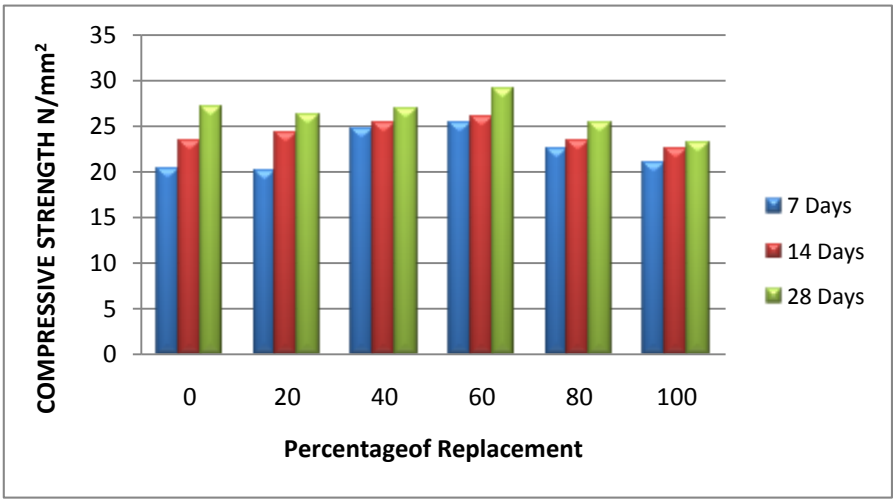

Fig. 3 Compressive strength for different percentage of replacement of slag aggregate

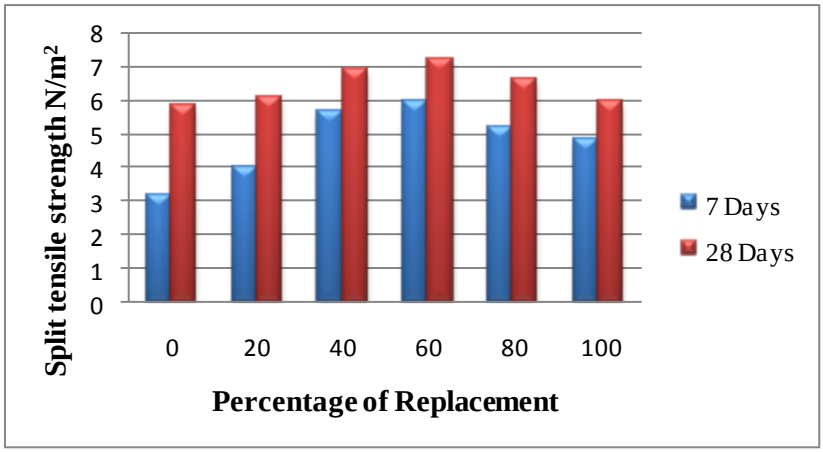

Fig. 4 Split tensile strength for different percentage of replacement of slag aggregate

IV. **CONCLUSION**

I. The workability of the concrete is decreasing at 50% of replacement of slag coarse aggregate.
II. The density of the concrete is decreasing at 50% of replacement of slag coarse aggregate.
III. The compressive strength of concrete mix is increased at 60% of replacement of slag coarse aggregate
IV. The split strength of concrete mix is increased at 60% of replacement of slag coarse aggregate
V. This study concludes 50% to 60% of replacement of slag coarse aggregate is optimum.

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