STRENGTH AND DURABILITY STUDYS ON M25 GRADE OF CONCRETE USING STEEL SLAG AS A REPLACEMENT OF FINE AGGREGATE

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ABSTRACT

Concrete is the third largest material consumed by human beings after food and water as per WHO. Concrete plays a vital role in the design and construction of the nation's infrastructure. Almost three quarters of the volume of concrete is composed of aggregates. These are obtained from natural rocks and river beds, thus degrading them slowly. This issue of environmental degradation, and need for aggregates demands for the usage of any other alternative source. Thus the concept of replacement of fine aggregate with steel slag.

The Steel slag a result of steel making is delivered amid the detachment of molten steel from polluting influences in steel making heaters. This can be utilized as sand in concrete. Steel slag sand by and large display a penchant to extend on account of the nearness of free lime and magnesium oxides that have not responded with the silicate structure and that can hydrate and grow in muggy conditions. This possibly far reaching nature (volume switches up to 10 percent or more owing to the hydration of calcium and magnesium oxides) could cause troubles with items containing steel slag, and is one motivation behind why steel slag aggregate are not utilized as a part of concrete development. The present research work deals with a view to develop efficient concrete by addition of Steel slag to evaluate the effectiveness of the use of steel slag as a partial replacement in sand To replace Sand with various percentages of steel slag waste in M25 As per the recommendation of IS: 10262:2009. Investigation have been carried out to study the effect of steel slag on variation of Compressive strength, Split Tensile Strength, Flexural Strength, Stress-Strain curve behavior and Durability studies by partially replacing the sand from 0% to 50% with Steel.

KEYWORDS – Steel –Slag, Conventional Concrete M25, Compressive, Split tensile, Stress-Strain Curve Behaviour and Durability

INTRODUCTION

Concrete is the most widely used material on earth after water. Many aspects of our daily life depend directly or indirectly on concrete. Concrete is prepared by mixing various constituents like cement, aggregates, water, etc. which are

economically available. Concrete is unique among major construction materials because it is designed specifically for particular civil engineering projects. Concrete is a composite material composed of granular materials like coarse aggregates embedded in a matrix and bound together with cement or binder which fills the space between the particles and glues them together. Concrete plays a critical role in the design and construction of the nation's infrastructure. Almost three quarters of the volume of concrete is composed of aggregates. To meet the global demand of concrete in the future, it is becoming a more challenging task to find suitable alternatives to natural aggregates for preparing concrete.

SCOPE OF THE STUDY

The scope of present investigation is to study and evaluate the effect of addition of Steel slag (0%, 10%, 20%, 30%, 40% and 50%) in M25 grade of concrete as a partial replacement of sand. Cubes of standard size 150mmx150mmx150mm 10
were cast and tested for 7 and 28 days for compressive strength and 28 and 56 days for durability studies after immersing the cubes in 50g/l of Magnesium sulphate solution (**$MgSO_4$)** and Sodium sulphate solution (**Na_2SO_4)**and HCL of 0.5% and 1% concentrations.

OBJECTIVES OF THE STUDY

The work reported in this study, Steel slag obtained from Rashtriya Ispat Nigam Ltd, Visakhapatnam, and Andhra Pradesh is used as a sand replacement of material in concrete mix. Optimal dosage range of this steel slag is chosen based on concrete mix studies. The ultimate focus of this work is to ascertain the performance of concrete mix containing steel slag and compare it with the conventional concrete mix. This is expected to provide.

a) To partially replace sand with Steel slag in concrete as it directly influences economy in construction.

b) To design and proportion the concrete mix for **M25** grade concrete, As per the recommendation of IS: 10262:2009.

c) To find the fresh and hardened properties of concrete mixes by partially replacing sand with Steel slag.

d) To check the variation of Compressive strength, Split Tensile Strength, Flexural Strength, Stress-Strain curve behavior and Durability studies by partially replacing the sand from 0% to 50% with Steel slag and comparing with conventional concrete mix and plotting the corresponding graphs separately.

Advantages

Improved workability-easier, quicker placing and compaction.

Increased strength- provides high easily strength for precast concrete with the advantage of higher water reduction ability.

Improved quality-denser, close textured concrete with reduced porosity and hence more durable

RESULTS

% of Steel Slag replacement	Average 7 Days compressive strength (N/mm^2)	Average 28 Days compressive strength (N/mm^2)
0%	20.36	32.07
10%	22.8	34.66
20%	23.16	36.10
30%	24.73	37.95
40%	26.8	40.79
50%	24.14	35.25

Table 4.2 Compressive strength with different replacement percentages of Steel slag

Fig3.3 Compression testing machine

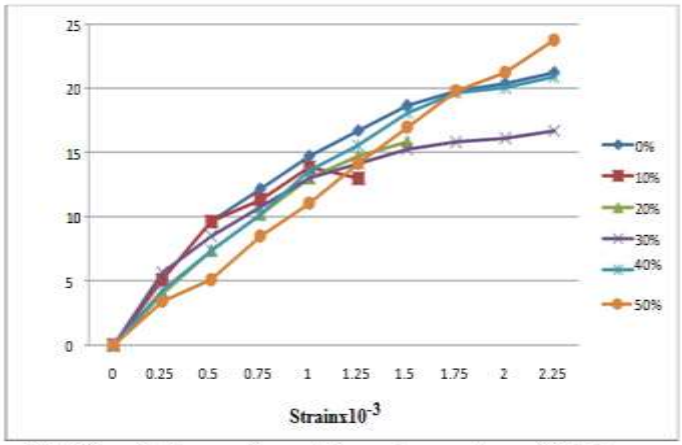

Fig 4.5 Stress-Strain curve of concrete for various percentages of Steel slag

However there is an increase in strength for the 40% replacement of Steel slag but slightly less than the strength compared to conventional concrete.

From the results of compressive strength of Na_2SO_4 (50g/l) solution for 28 and 56 days it is observed that the strength loss will be much larger if the concrete is immersed in the solution for a longer period of time. So 40% slag is optimum from the consideration of resistance to sulphate attack as observed form the experimental results.

CONCLUSIONS

The compressive strength increases with increase in percentage of steel slag up to 40% by weight of fine aggregate. The enhancement in compressive strength is about 32% for 7 days of curing and 27.2% for 28 days of curing period.

The Flexural strength increases with increase in percentage of steel slag up to 40% by weight of fine aggregate. The enhancement in Flexural strength is about 20.12% for 7 days of curing and 17% for 28 days of curing period.The benefits of Cost reduction and Utilization of waste material is possible in construction by using Steel slag as a partial replacement material for fine aggregate in concrete.

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