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"INVESTIGATION ON STEEL SLAG CONCRETE MEMBERS"

Dr.Naveen G.M [1]& Dr.G.S.Suresh[2]

[1]Dept.of Civil Engineering & [2]Department .of Civil Engineering

[1]Government Engineering College & [2]National Institute of Engineering

[1]Kushalnagara ,KARANATAKA & [2]Mysore,KARANATAKA

Abstract—This Natural aggregates are becoming increasingly scarce and their production is becoming more difficult. Steel slag is an industrial by product obtained from the steel manufacturing industry. Steel slag can be used in the construction as fine aggregates in concrete by replacing natural aggregates.

Steel slag is currently used as aggregate in hot mix asphalt surface applications, but there is a need for some additional work to determine the feasibility of utilizing this industrial by-product more wisely as a replacement for both fine and coarse aggregates in a conventional concrete mixture. Most of the volume of concrete is aggregates. Replacing all or some portion of natural aggregates with steel slag would lead to considerable environmental benefits. The aim of experiment is to find the maximum content of steel slag as partial replacement of M-sand in concrete.

The percent of steel slag as partial replacement to M-sand in concrete are 0%, 10%, 20%, 30%,40%, M25 grade Concrete, the compressive strength test, Split tensile strength and flexural strength test. From the experimental studies partial replacement of M-sand with steel slag improved the harden concrete properties like Strength, Split tensile and flexural strength. The results obtained from this work is expected to be useful in determining the strength and ductility of Elements subjected to similar types of forces and thus will help toward designing elements to withstand flexural loading.

Keywords— Concrete member-sand, steel slag and Flexural load.

1. INTRODUCTION

As modern engineering practices become more demanding, there is an increasing need for a wider spectrum of construction materials with novel properties. It includes developing existing materials in to ones with modified properties in combination with other suitable materials. Cement concrete is a processed construction material of immense importance not only in the field of civil engineering but also in the history of mankind.

Concrete has attained the status of a major building material in all branches of modern constructions. Concrete is the best material of choice where strength, durability, impermeability, fire resistance and abrasion resistance are required.

The recent boom in construction has given rise for the demand of construction materials especially the River Sand. For mortar and concrete the most preferred. Fine aggregate is river sand. AsaRiver sand is mined from river beds from millions of years has greatly impact on environment. The restriction on sand mining by ministry of environment and to reduce the impact on environment many alternative materials are using as substitute to river sand, namely the M-sand. M-sand is a crushed aggregate produce from hard granite stone which is cubically shaped with grounded edges, washed and graded with consistency to be used as substitute of river sand.

M-sand are manufacture sand is also a natural material and as having quarrying and quality issues. To reduce impact and environment, alternative material to be used as substitute to fine aggregate are being extensively investigated all over the world. The rapid growth industrialization generates numerous kinds of waste products such as steel slag and iron slag. These wastes by product are consumed in construction.

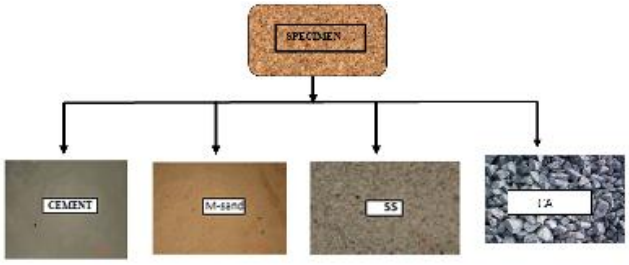
Steel Slag is a waste product generated during the production of Steel. These wastes are disposed in the form of landfills causes an enormous amount of land pollution. So for the increasing demand to protect the normal environment, especially in build-up areas, the needs to use the wastes very important.

Many researchers have investigated the use of Steel Slag (SS) in the production of cement mortar and cement concrete. The use of SS in cement mortar and concrete provides potential environmental as well as economic benefits for all related industries, particularly in areas where a considerable amount of SS is produced and also several researchers have investigated the possible use of SS as fine and coarse aggregates in concrete and its effects on the different mechanical and long-term properties of mortar and concrete. While most of the reports point to benefits of using SS as fine aggregates.

2. EXPERIMENTAL WORK

The properties of cement, M-Sand, Steel slag are tested in laboratory and are reported in section 2.1. Water cement ratio used was 0.45 by weight. The replacements of sand by BFS considered in this study are 0%, 10%, 20%,30, and 40 % which are adopted for the preparation of flexure specimens.

A.MATERIALS USED AND ITS PROPERTIES



a.Cement

Table-1 Physical Properties of Cement

Physical property	Results obtained	IS specifications
Standard consistency (%)	31	Not specification
Initial setting time	64minutes	Not less than 30 minutes
Final setting time	480 minutes	Less than 600 minutes
Fineness of cement	2.8%	Not more than 10%
Specific gravity	3.14	3.15
Compressive strength 3-days	23.6 N/mm^2	23.0 N/mm^2
Compressive strength 7-days	33.19 N/mm^2	33.0 N/mm^2
Compressive strength 28-days	44.10 N/mm^2	43.0 N/mm^2

b.M-Sand

Table-2 physical Properties of M-Sand

Fineness modulus	2.85
Density (kN/m^3)	1.78
Water content (%)	0.4
Specific gravity	2.63

c. Steel Slag (SS)

The Steel slag used to replace M-sand was obtained from Iron and Steel Plant, Tumkur. The chemical composition of this SS tested in consultancy in Mysuru and the physical properties are as shown in Table 3 & 4.

Table-3 Physical Properties of SS

SI .No	Test	Results
1.	Specific gravity	2.5
2.	Grading zone	II

Table-4 Chemical Properties of SS

Constituents	Compositions (%)
SiO_2	33.8
Al_2O_3	13.4
CaO	41.7
MgO	7.4
S	Traces
Others	3.7

d.Coarse Aggregate (CA)

Table 5: Properties of coarse aggregate

SI. No	Test	Results
1.	Specific Gravity	2.67
2.	Water absorption, %	0.5
3.	Aggregate crushing value, %	27.98
4.	Aggregate impact value, %	28.44

e.Water

Ordinary potable water was used for mixing. The mixing water should be fresh, clean, and potable

B.CASTING &TESTING OFSPECIMEN

Casting of specimens

Parameters considered in this study are, the percentage of M-sand replacement by 0%, 10%, 20%,30% and 40% by weight were considered in this study. A total of 15 Beam specimens have been cast on edge in 5 groups. 3 specimens were cast at a time. The dimension of specimens100x100x500mm and using of Iron moulds for casting the specimens. Fresh concrete is tested for workability like slump test and the results as shown in fig.1. In each casting 3 cubes 150x150x150mm of side was also cast as control specimens. A plate vibrator was used for compacting the specimens. Moulds were dismantled 24 hours after casting and cured under water up to age of 28 days. After curing the specimens were removed from water and kept in a cool and dry place till they were tested. All the specimens were white washed before testing to ensure visibility of cracks clearly. Three cubes were tested for strength after testing each set of specimens in each group. Thebeams are then tested for 28 days for the flexural strength as shown in fig.2.

Designation of specimens

SS-1: Normal concrete
SS-2: Concrete with 10% replacement of steel slag
SS-3: Concrete with 20% replacement of steel slag
SS-4: Concrete with 30% replacement of steel slag
SS-5: Concrete with 40% replacement of steel slag

Table6: Slump Test results

Mix proportion	Slump in mm
SS-1	55
SS-2	70
SS-3	90
SS-4	100
SS-5	120

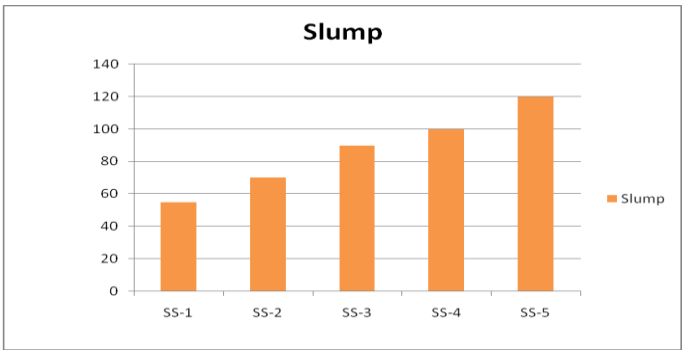


Fig.1 Slump variation in mm

Fig.2 Specimens testing Arrangement

3.RESULT & DISCUSSION

Behavior of average of three Specimens for each percentage of slag replacement under Compression loading and flexural loading, represented by the curves show in fig 3 and 4.

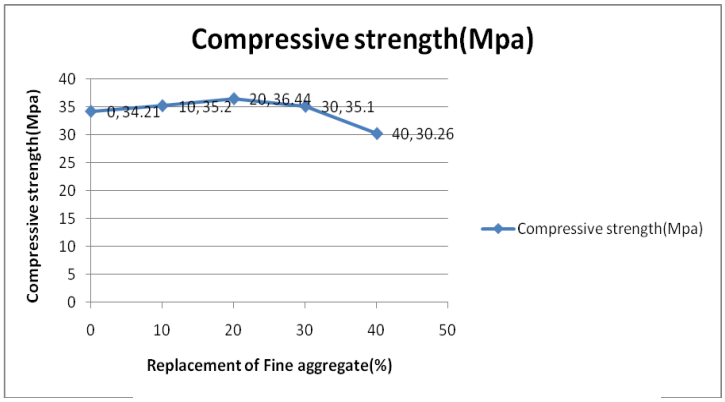


Fig.3 Compressive strength test results for 28 days

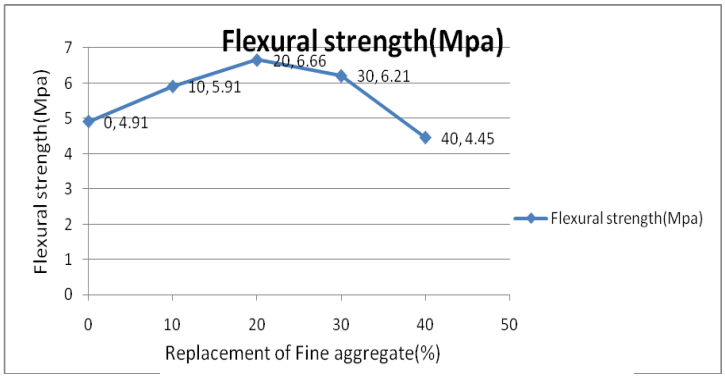


Fig.4 flexural strength test results for 28 days

From the above figure 3 and figure 4 shows that optimum value of 20% replacement of M-sand by steel slag, results was found to be optimum and 40% of steel slag replacement with M-sand will slightly decrease in strength as compare to normal concrete.

4. CONCLUSION

From the above experimental investigation, the following conclusions can be drawn,

- Steel slag is a variable replacement for M-sand in industrial areas or areas where there is scarcity of fine aggregate.
- From the result of fresh concrete, the increase in slump value is absorbed up to 40% of M-sand replaced with steel slag.
- Replacement of 20% of Steel slag has shown increase in ultimate strength under flexural loading.
- Thus we can conclude that 20% of steel slag as substitute for M-sand to produce structural concrete which can be used for practical structural application.
- Steel slag beams have good moment of resistance compare to normal concrete.

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