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Effect of Steel Slag and Manufactured Sand as Fine Aggregate on the Strength, Durability and Structural Properties of Self-Compacting Concrete

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Abstract: The growing demand for building materials in the modern era contributes to excessive sand quarrying from river beds, depleting sand supplies and contributing to global warming.
Thermal power plant fly ash, quarry Fines produced by crushing rocks into aggregates, as well as steel slag from steel melting furnaces, regularly cause significant environmental and disposal issues, Experimentally defined aggregate in SCC grades M40. steel slag as fine aggregate in M40 grades of SCC was developed and compared to those of traditional SCC specimens, with better performance.
Keyword: sand, fly ash, fly ash, global warming, SCC, grades

I. INTRODUCTION

SCC (Self-Compacting Concrete) is a revolutionary concrete that does not require vibration for placement in structures with congested reinforcement, restricted areas, or compaction.

It can flow under its own weight by fully filling formwork and achieving maximum flow. Also in the presence of congested reinforcement, compaction is possible. SCC is a very promising material for concrete structures because it guarantees a consistent consistency that is unaffected by placement defects or poor compaction. It has high fluidity, self–compacting capacity, and segregation in its fresh state.

A. STEELSLAG

Steel slag is a by-product of the steel-making process, created when molten steel is separated from impurities in steel-making furnaces. Steel slag has a higher crushing power and impact value than fly ash. Cementitious properties may be used as a partial substitute for natural resources in concrete.

B. Sand Manufacturing (M-SAND)

M-Sand is a by-product of the quarries' crushing and screening operations. Quarry fines are generated in large quantities during the grinding of rock into aggregates. Quarry dust is the name for quarry fines. Crushed rock sand, stone sand, crusher sand, and crushed fine aggregate are all terms for the same thing. M-Sand is collected from a stone quarry and used as a partial substitute for natural fine aggregate in this study.

II. LITERATURE SURVEY

Brito and Saikia (2013)discovered that there is an increasing interest in using waste materials as alternative aggregate materials, with extensive research being conducted on the use of a variety of materials as aggregate substitutes, including coal ash, blast furnace slag, fibre glass waste materials, waste plastics, rubber waste, sintered sludge pellets, and others. When waste materials are used as aggregate in cement mortar and concrete, their use can be greatly increased.

Khan and Shinde (2020) investigated the properties of locally accessible steel slag and the use of steel slag in concrete by partially and completely replacing it with fine aggregate while keeping the other parameters stable. The shear strength of M20 grade concrete with a constant 0.5 w/c ratio is investigated. Steel slag is replaced at a rate of 0, 20, 40, 60, 80, and 100%.

III. OBJECTIVE

1) To investigate the impact of steel slag and M-Sand replacement proportions ranging from 0% to 60% with a 10% increment of fine aggregate in the M40 grades of SCC.
2) Maximize the amount of steel slag and M-Sand replacement in M40 concrete grades to achieve SCC self-compaction and strength.

IV. MATERIALS AND METHODS

A. Material Constituents

The material constituents utilized in proportioning the SCC comprise the subsequent items

B. Material

1) Cement
2) Natural Sand
3) M-Sand
4) Steel Slag
5) Superplasticizer
6) Water

V. RESULTS AND DISCUSSIONS

A. Slump Flow by Abrams cone

Workability Test In this work the workability is tested by slump test. When the concrete is freshly mix then it is tested by filling the fresh concrete in the slump cone. The workability is measured by removing the slump cone and measured the subsidence of the concrete this value is called the slump value of the concrete.

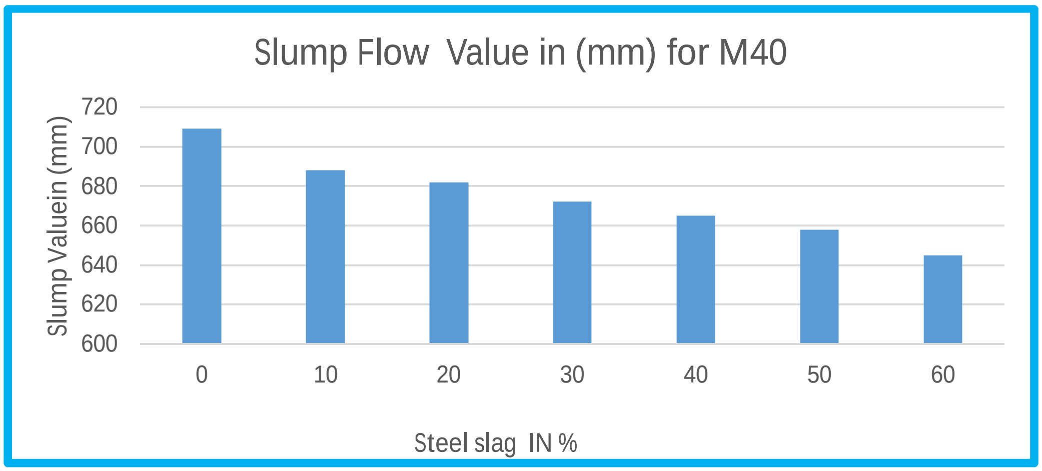

Figure 1. slump flow for M40 grade

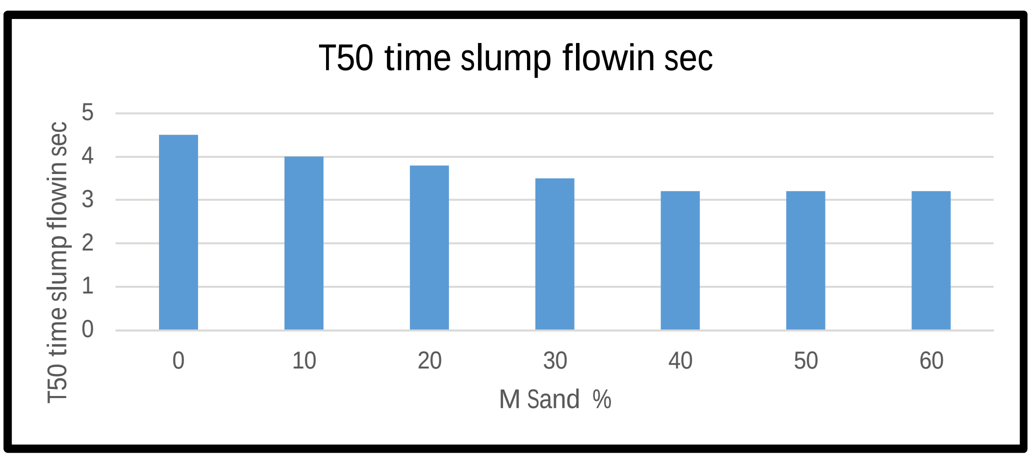

Figure 2 T50 time slump flow in sec for M40 grade

B. *Compressive Strength*

Compressive Strength in N/mm^2 for M40 at different percentage of steel slag

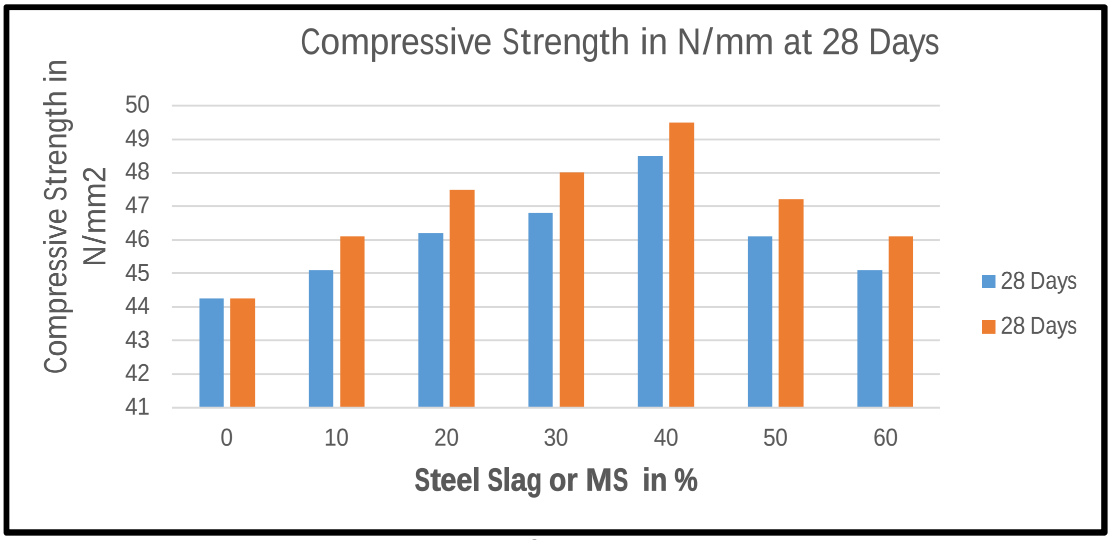

Figure 3 Compressive Strength in N/mm^2 for M40 at different percentage of steel slag

According to the values obtained from the aforementioned figures, the best replacement percentage for fine aggregate with steel slag in terms of compressive strength is discovered to be 40%, and the best replacement percentage for fine aggregate with M-sand in terms of compressive strength is found to be 30%.

VI. CONCLUSION

Blending of M-sand with fine aggregate reduces the amount of microfines, which improves the workability, strength, durability and structural properties of the concrete. The fresh concrete properties analyzed by replacing 40% ofsteel slag as fine aggregate and 30% of M-Sand as fine aggregate satisfies all the self compactability tests such as slumpflow test,

From the above results, it is concluded that the steel slag and M- sand can be used as fine aggregates as partial replacement in SCC. Utilization of steel slag and M-Sand as fine aggregate in SCC reduces the environmental impact, depletion of natural resource and cost of construction. The findings ofthe present research would be helpful to the construction industries to focuson the use of steel slag and M-Sand as a partial replacement of fine aggregate and to produce comparable, even better quality of SCC. It would reduce cost of construction and enlarge the scope of sustainable concrete using industrial by-products.

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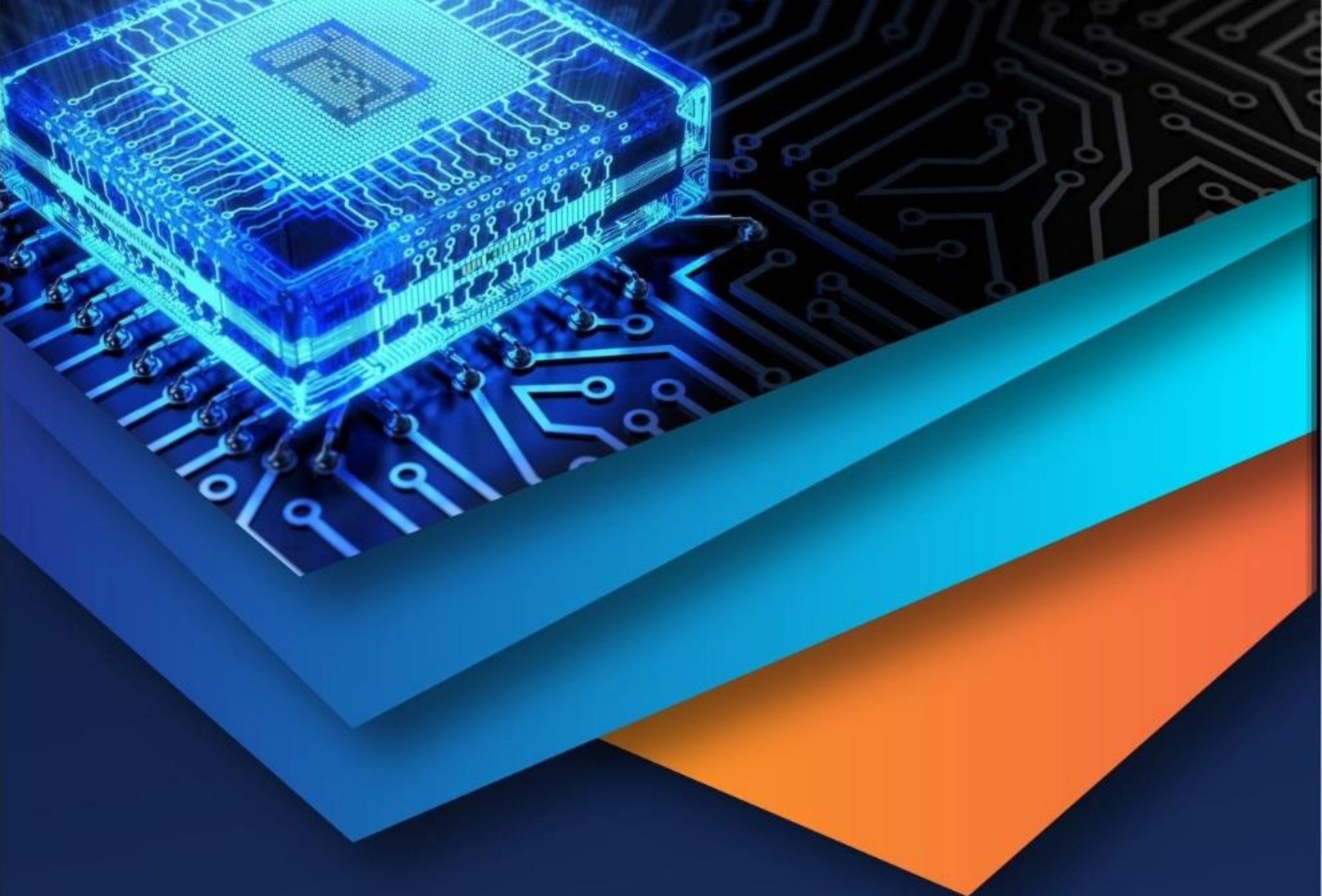

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