

Partial Replacement of Fine Aggregate by Steel Slag in M20 Grade of Concrete.

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Abstract- In construction materials, concrete is the largest production of all other materials. Aggregates are the important constituents in concrete. The increase in demand for the ingredients of concrete is met by partial replacement of materials by the waste materials that is obtained by suggests that of assorted industries. Steel scum could be a material generated throughout the assembly of steel. These wastes area unit disposed within the variety of landfills causes a vast quantity of land pollution. thus for the increasing demand to safeguard the traditional setting, particularly in build-up areas, the wants to use these wastes area unit vital. Therefore, commutation all or some portion of natural aggregates with steel scum would result in right environmental edges. the employment of waste materials from the industries has been ceaselessly stressed within the analysis work. the current work is to use steel scum as replacement for fine mixture. The M20 concrete with high volume steel scum replacement for fine mixture area unit examined within the gift study. consistent with material properties compressive strength, flexural strength and split lastingness were found by experimentation. The results were compared with conventional concrete property. The results showed that replacing about 0%, 20%, 30% and 40% of steel slag aggregates by volume for natural aggregates will not do any harm to concrete and also it will not have any adverse effects on the strength and durability.

Keyword-Strength, Durability, Workability, Economic.

I. INTRODUCTION

1.1 General

Concrete plays an important role in nation's infrastructure. Virtually three quarters of the quantity of concrete consists of aggregates. to fulfill the world demand of concrete within the future, it's a difficult task to seek out appropriate alternatives to natural aggregates for making readyconcrete. The continues use of Natural Sand ends up in the depletion of watercourse beds results into the ecological imbalance. handiness of natural aggregates is obtaining depleted and additionally it turning intoexpensive, thus the replacement of natural sand by the waste industries by-products has been unendingly emphasised throughout recent years. Natural sand is replaced by scum sand in varied share. during this study, thus an endeavor has been to review the impact of replacement of fine combination mistreatment steel scum on compressive strength, split strength, flexural strength of concrete. during this project scum from industry is employed to interchange for fine combination. Steel scum could be a byproduct obtained either from conversion of iron to steel in an exceedingly Basic chemical element chamber (BOF), or by the melting of scrap to form steel within the electric discharge chamber (EAF) like different industrial byproducts, scum trulyhas several uses, and barely goes to waste. It seems in concrete, combination road materials, as ballast, and is typically used as a part of phosphate chemical. This substance is created throughout smelting method in manyways in which. Firstly, scum represents unwanted impurities within metals, that float to the highest throughoutthe smelting method. Secondly, metals begin to oxidize as they're smelted, and scum forms a protecting crust of oxides on the highest of the metal being smelted, protective the liquid metal beneath. once the metal is smelted to satisfaction, the scum is skim from the highest and disposed of in an exceedingly scum heap to age. Aging material is a vital a part of the method, because it must be exposed to the weather and allowed to interrupt down slightly before it will be used.

1.2 Scope:

The original scope of this analysis was to analyze the properties of concrete with steel slag aggregates. The recent and hardened properties of concrete were tested with steel slag aggregates. additionally to the current analysis many tests were conjointly

enclosed like compressive strength, split enduringness and therefore the flexural strength of concrete with steel slag aggregates. For this analysis the proportion of the degree of natural aggregates usually employed in concrete was replaced by steel slag. This replacement was tired two hundredth, 30%, four-hundredth increments till all natural aggregates were replaced by the steel slag. so replacement the natural aggregates in concrete applications with steel slag would cause wide environmental edges and would be economical

1.3 Purpose:

The purpose of this research was to explore the feasibility of utilizing the steel slag as a replacement for natural aggregate in the concrete. Steel slag aggregates generally exhibit the potential to expand due to the presence of un-hydrated free lime and magnesium oxides which hydrate in humid environments. If such a product is used in the concrete, it influences both the mechanical and physical properties of concrete along with its durability. Researchers in the past have successfully incorporated this industrial byproduct as aggregates for hydraulically bound mixtures for road bases. The use of this material as a construction aggregate is being studied, and further research is on going in the United State.

II. OBJECTIVE

- The main objective is to study behavior of steel slag in concrete
- To study comparison of a compressive strength of steel slag concrete for 20%,30%and 40% replacement of fine aggregate by steel slag
- The concrete specimen cubes are cured in normal water for 7 days and 28 days
- To study the variation in compressive strength of concrete using steel slag after curing in natural water

III. METHODOLOGY

3.1 Test On Cement And Aggregates

Test on cement (Ultratech 53GRADE) and aggregates used are conducted according to IS standards. The test results obtained are described below

3.1.1 Test On Cement

No. Name of tests Method Result Limit as per IS 12269:1987

- Fineness of cement IS 4031 Part-11 2.95% Max 10%
- Standard consistency IS Part-4 29.34% -
- Initial setting time IS 4031 Part-5 57 Min 30 minutes
- Final setting time IS 4031 Part-5 190 Max 600 minutes
- Soundness test IS 4031 Part-3 1.72 10mm Max
- Compressive strength IS 4031 Part-6
- 7 days IS 516 49.86 Min 37 N/mm²
- 28 days IS 516 57 Min 53 N/mm²

Table 1
Test on Cement

| No. | Name of tests | Method | Result | Limit as per IS 12269:1987 |
|-----|----------------------|-----------------|--------|----------------------------|
| 1 | Fineness of cement | IS 4031 Part-11 | 2.95% | Max 10% |
| 2 | Standard consistency | IS Part-4 | 29.34% | - |
| 3 | Initial setting time | IS 4031 Part-5 | 57 | Min 30 minutes |
| 4 | Final setting time | IS 4031 Part-5 | 190 | Max 600 minutes |
| 5 | Soundness test | IS 4031 Part-3 | 1.72 | 10mm Max |
| 6 | Compressive strength | IS 4031 Part-6 | | |
| | 7 days | IS 516 | 49.86 | Min 37 N/mm ² |
| | 28 days | IS 516 | 57 | Min 53 N/mm ² |

3.1.2 Test On Crushed Sand

No. Tests as per IS 2386 Results Limits

- Fineness module 3.2 2.6-3.6
- Silt content 0.00% - 4%
- Moisture content 3.70% -5%

Table 2
Test on Crushed Sand

| No. | Tests as per IS 2386 | Results | Limits |
|-----|----------------------|---------|---------|
| 1 | Fineness module | 3.2 | 2.6-3.6 |
| 2 | Silt content | 0.00% | 4% |
| 3 | Moisture content | 3.70% | - |

3.1.3 Test On Coarse Aggregate (10mm)

No. Tests as per IS 2386 Results Limits

- Water absorption 1.56% Max 5%
- Specific gravity 2.81 -
- Impact value 27.00% Max 45%
- Crushing strength 29% Max 45%
- Flakiness index 17% Max 35%

Table 3
Test on Coarse Aggregate (10mm)

| No. | Tests as per IS 2386 | Results | Limits |
|-----|----------------------|---------|---------|
| 1 | Water absorption | 1.56% | Max 5% |
| 2 | Specific gravity | 2.81 | - |
| 3 | Impact value | 27.00% | Max 45% |
| 4 | Crushing strength | 29% | Max 45% |
| 5 | Flakiness index | 17% | Max 35% |

3.2 Collection of Steel Slag from Steel Manufacturing Industry

The steel making industry has generated substantial solid waste. Steel slag is an industrial by product obtained from the steel manufacturing industry and hundreds of tons of it are produced every year all over the world in the process of refining metals and making alloys. We will collect our slag sample from steel manufacturing industry in Mumbai.

3.3 Preparation of the Specimen

Batching will be done by weighing the materials for the concrete specimen using a Manual Weighing Balance. Mixing was done manually on a clean concrete floor and the materials were thoroughly mixed in the dry state twice, after which water was added gradually while thoroughly mixing the concrete. Mixing of the concrete specimen continued by turning the mixture of cement, water and aggregates until the concrete was uniform in colour and consistency. This specimen is then further used for tests of fresh concrete.

3.4 Conducting test on Fresh Concrete

3.4.1 Slump cone test:

The test is carried out using a metal mould in the shape of a conical frustum known as a slump cone that is open at both ends and has attached handles

3.4.2 Initial and Final setting time of fresh concrete:

Cement once mixed with water forms paste that step by step becomes less plastic, and at last a tough mass is obtained. within the method of setting a stage is reached once the cement paste is sufficiently rigid to face up to an exact quantity of pressure. The time to achieve this stage is termed as setting time. Initial setting time is a sign regarding important stage once that if cement paste is handled then it'll begin losing its helpful properties like strength, workability. thus paste has got to be placed with its initial setting time. thus initial setting time mustn't be too less wherever a protracted time is needed in transporting, putting cement, now also can be tailored by mistreatment chemical admixture thus to best suit our demand. Final setting time of cement is that the time go on between the instant the water is added to the cement to the time at that paste has utterly lost its malleability and earned sufficient firmness to resist sure definite pressure.

3.5 Casting and Curing of Concrete Cubes:

Casting and curing of concrete cubes are done according to the IS standards.

3.6 Test On Hardened Concrete:

3.6.1 Compressive Strength Test:

When a specimen of fabric is loaded in such some way that it compresses and shortens it's same to be in compression. By definition, the final word compressive strength of a fabric is that worth of uniaxial compressive stress reached once the fabric fails utterly. The compressive strength is typically obtained through an experiment by suggests that of a compressive take a look at. The equipment used for this experiment is that the same as that utilized in a tensile take a look at. However, instead of applying a uniaxial tensile load, a uniaxial compressive load is applied.

3.6.2 Split Tensile Test:

Tensile strength is a vital property of concrete as a result of concrete structures area unit extremely prone to tensile cracking because of varied varieties of effects and applied loading itself. However, enduringness of concrete is incredibly low as compared to its compressive strength. The concrete is incredibly weak in tension because of its brittle nature and isn't expected to resist the direct tension. The concrete develops cracks once subjected to tensile forces. Thus, it's necessary to work out the enduringness of concrete to work out the load at that the concrete members might crack. The Load is applied diametrically and uniformly on the length of cylinder till the failure of the cylinder on its vertical diameter. Hence, to permit uniform distribution of the applied load and scale back the magnitude of the high compressive stress close to the purpose of application of hundreds, strips of laminate is placed between the specimen and also the loading plates of the testing machine.

IV. CONCLUSION:

It is concluded that up to 30% replacement strength increases. As the replacement goes on increasing after 30% percent the strength start decreasing gradually. As steel slag is a waste product and is cheaply available replacement of fine aggregate by steel slag is desirable and economic replacement.

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