Development of Concrete with Partial Replacement of Fine Aggregate by Waste Foundry Sand

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Abstract. This paper exhibits the utilization of waste foundry sand as an incomplete substitution of fine total. Foundry sand is a side-effect of ferrous and non-ferrous metal projecting industry which contains high silica content with explicit physical properties. This examination presents the data about the structural designing utilisations of foundry sand, which is actually solid and is earth safe. This exploration is done to create an eco-accommodating and low lost cement. A test study has been done on concrete with squander foundry sand about supplanting level of 15%. In the current examination, impact of foundry sand as fine total substitution on the compressive quality of cement having blend extents of M 20 evaluation was researched. The came about material was tried and contrasted and the traditional cement as far as its quality and usefulness. The tests were done with standard 3D shape of measurements 150*150*150*mm and chamber 150*300* mm and for crystal 500*100*100* mm for 3 days to decide its quality. Through the exploratory outcome we presume that compressive quality increments with increment in fractional substitution of waste foundry sand. The point of the examination is to think about the mechanical properties of the solid by expansion of waste foundry sand in various extent and furthermore its quality.

1. Introduction
Concrete ordinarily Portland concrete is a structure of coarse total, fine total, concrete and water. Concrete goes about as a fastener in concrete. At the point when total blended in with dry Portland concrete and water they structure liquid slurry which is effectively pourable and get into any shape. These fixings lead to the development of hard grid which resembles a tough stone like structure. Solid assumes a significant job in development as they give quality and strength which is known as spine in development [1,2]. We are in a circumstance to create and to acquaint new things with make our group of people yet to come's improvement. The fixings in concrete are getting supplanted by numerous items to make a creative undertaking. In our task foundry sand is supplanted by methods for stream sand. Essentially foundry sand is characterized as consistently measured clean sand which has high silica quality [3,4]. This sand was once in the past utilized for planning molds. In our task we are utilizing the squandered sand utilized for embellishment known as foundry sand. This substitution is to improve the quality of cement. There were numerous sorts of foundry sand. We are utilizing non-leded spent foundry sand which is non-hazardous.15 to 20% of waterway sand is supplanted by foundry sand. All out substitution of foundry sand won't give solidarity to the solid. Up to an ideal substitution foundry sand will give great quality [5,6]. At the point when the measure of foundry sand is expanded there will an absence of restricting properties, which prompts decline in quality. By utilizing foundry sand of 15-20%, concrete with a blend
plan of M20 is structured [7,8]. With the above structured blend extent we have projected some number of 3D squares, chamber and crystal. Projecting is trailed by relieving. Restoring takes as long as 7 days yet we have relieved as long as 3 days [9,10]. We likewise utilized quickened relieving tank to check the quality acquired inside 19 hrs [11]. Quickened restoring is a technique which gives compressive quality all the more fundamentally that implies the quality which picked up in ordinary relieving will got inside 19 hours in quickened relieving. Quickened restoring tank includes high temp water inside which the shape was set and gets relieved. Subsequent to restoring it is utilized to decide quality. The projected materials experience certain test to check the quality got by foundry sand by relieving and quickened restoring strategy.

2. Raw Materials for concrete

The material used to develop concrete is to be tried to discover their quality. The fixings utilized in concrete are as per the following

- Cement
- Fine aggregate
- Coarse aggregate
- Accelerator
- Water

2.1 Cement

Concrete assumes a significant job in concrete as it goes about as a fastener. It goes about as cement to get together with different materials. Concrete is utilized in development field which holds up all the materials together and solidifies it. Concrete has numerous evaluations we have utilized 43 evaluation concrete which implies it gives quality of 43N/mm² after 28 long periods of relieving.

| DESCRIPTION | TEST RESULT |
|-------------|-------------|
| Type of cement | Open Portland cement |
| Specific gravity of cement | 3.15 |

2.1.1 Chemical properties

| CONTENT | Silicon dioxide (SiO2) | Calcium oxide (CaO) | Magnesium oxide (MgO) | Iron oxide (Fe2O3) | Loss of ignition | Aluminium oxide (Al2O3) |
|---------|------------------------|---------------------|-----------------------|-------------------|-----------------|------------------------|
| CEMENT  | 21.2                   | 61.8                | 0.60                  | 3.40              | 2.80            | 5.30                   |

2.2 Fine Aggregate

In this venture fine total alludes foundry sand. Foundry sand is characterized as consistently formed clean sand with high amount of silica sand. They are utilized for ferrous and non-ferrous molds. For the most part 95 % of foundry sands are utilized in foundry. In our undertaking we are utilizing spent foundry sand. 15-20% of stream sand is supplanted by foundry sand.

| Table 3: Sieve analysis of fine aggregate (Foundry sand) |
| IS SIEVE SIZE | PERCENT RETAINED | CUMULATIVE RETAINED | % PERCENT PASSING |
|--------------|-----------------|---------------------|------------------|
| 10mm         | 0.00            | 0.00                | 100.00           |
| 4.75mm       | 5.20            | 5.20                | 94.80            |
| 2.36mm       | 3.00            | 8.20                | 91.80            |
| 1.18mm       | 8.60            | 16.80               | 83.20            |
| 600 microns  | 25.80           | 42.60               | 57.40            |
| 300 microns  | 32.80           | 75.40               | 24.60            |
| 150 microns  | 20.70           | 96.10               | 3.90             |

2.3 Coarse aggregate
Coarse total is characterized as the squashed bits of rocks which were accessible in the size of 40, 32, 25, 20, 16, 12, 10 and 4.75mm. In this task we are utilizing total of about 20mm and 10mm. We are not utilizing same size of total the purpose for this is same size and shape not join as they are precise fit as a fiddle. So we are utilizing the blend of total which prompts excellent restricting properties.

Table 4: Sieve analysis of coarse aggregate

| IS SIEVE SIZE | % RETAINED | CUMULATIVE RETAINED | % PERCENT PASSING |
|--------------|------------|---------------------|------------------|
| 40mm         | 0.00       | 0.00                | 100.00           |
| 20mm         | 0.60       | 0.60                | 99.40            |
| 10mm         | 73.50      | 74.10               | 25.90            |
| 4.75mm       | 22.90      | 97.00               | 3.00             |

2.3.1 Properties of coarse aggregate and fine aggregate
Table 5: Properties of CA and FA

| PROPERTIES          | FINE AGGREGATE | COARSE AGGREGATE |
|---------------------|----------------|-----------------|
| Specific gravity    | 2.53           | 2.66            |
| Bulk density (Kg/m³)| 1510           | 1540            |
| Water absorption    | 1.04           | 1               |
| Fineness modulus    | 2.33           | 6.98            |

2.4 Accelerator
Accelerating admixture are added to increase the rate of early strength development in concrete.

2.4.1 Properties of accelerators
Table 6: Properties of accelerators

| BASE RESIN        | ETHYL CYNO ACRALYTE |
|-------------------|---------------------|

Temperature service range -65F +200F
Melting point 329F
Refractive index (ND20) 1.49
Dielectric strength 11.6

2.5 Water
Portable tap water is used for mixing of concrete and curing of the specimen as well.

2.5.1 Quality parameters of water sample

| SERIAL NO | PARAMETER | RESULTS | LIMIT AS PER IS 456 - 2000 |
|-----------|-----------|---------|-----------------------------|
| 1         | pH        | 6.8     | 6.52 – 8.5                  |
| 2         | Chlorides | 213 ppm | 2000ppm (PCC), 500ppm (RCC) |
| 3         | Alkalinity | 8       | <25                         |
| 4         | Sulphates | 118 ppm | 400ppm                      |
| 5         | Suspended solids | 93 ppm | 200ppm                      |
| 6         | Inorganic solids | 830 ppm | 3000ppm                     |

3 Conventional Concrete
Typical solid which is otherwise called customary solid that contains conventional Portland concrete, fine total (m-sand or waterway sand) and coarse total. This solid doesn't have any unique property as there is no substitution in any material. These cements are detailed with high compressive quality and less elastic strength. The compressive quality for customary cement are as per the following.

| S.NO | LOAD(KN) | AREA (mm²) | COMPRESSIVE STRENGTH(N/mm²) |
|------|----------|------------|------------------------------|
| 1    | 310      | 150x150    | 13.77                        |
| 2    | 345      | 150x150    | 15.33                        |
| 3    | 373      | 150x150    | 16.5                         |

4 Details of specimen

| SPECIMEN NAME | SIZE (mm)   | NOS |
|---------------|-------------|-----|
| CUBE          | 150*150*150 | 6   |
| CYLINDER      | 150*300     | 3   |
| PRISM         | 500*100*100 | 3   |

5 Foundry sand concrete with a replacement of 15%
5.1 Compressive strength
3D square will experience compressive quality that implies by applying certain heap the 3D shape gets compacted and splits will happen at certain heap, which is utilized to compute compressive quality of solid shape. The 3D square has an element of 150*150*150. The foundry sand is supplanted with 15% of the waterway sand. 2 3D shapes has relieved for 3 days and the other one 3D shape which accomplishes a compressive quality of about 19.77 N/(mm²) experiences quickened restoring for around 19 hours at a temperature of about 55°celsius. Coming up next are the compressive quality of solid block they are as per the following:

**Table 10: Compressive strength of cube with replacement of 15%**

| S.NO | LOAD (KN) | AREA (mm) | COMPRESSIVE STRENGTH (N/mm²) |
|------|-----------|-----------|------------------------------|
| 1    | 255       | 150*150   | 11.33 N/mm²                  |
| 2    | 425       | 150*150   | 18.8 N/mm²                   |
| 3    | 445       | 150*150   | 19.77 N/mm²                  |

5.2 Split tensile strength

Chamber will experience split malleable burden which implies by applying some heap the chamber parts at a specific burden which breaks at the inside and gets spilt. That heap is noted as spilt tractable heap of chamber. By utilizing split elastic burden split rigidity of the chamber was determined. The substitution of foundry is about 15%. The chamber has a width of about 150mm and length of about 300mm. The chamber was relieved for 3 days. Coming up next are the part pliable heap of chamber and they are as per the following:

**Table 11: Split tensile strength of cylinder with replacement of 15%**

| S.NO | LOAD (KN)  | AREA (mm)  | SPLIT TENSILE STRENGTH (N/mm²) |
|------|------------|------------|---------------------------------|
| 1    | 196.2*10³  | 17.66*10³  | 11.10N/mm²                     |
| 2    | 176.58*10³ | 17.66*10³  | 9.99N/mm²                      |
| 3    | 156.96*10³ | 17.66*10³  | 8.88N/mm²                      |

5.3 Flexural strength of prism

Crystal will experience flexural load which implies by applying some heap the crystal gets flexural quality and breaks at a specific burden that is known as flexural heap of a crystal. By utilizing flexural heap of a crystal flexural elasticity of cement was determined. The substitution of foundry is about 15%. The crystal was restored for 3 days. Coming up next are the flexural quality of crystal and they are as per the following:

**Table 12: Flexural strength of prism with replacement of 15%**

| S.NO | LOAD (KN) | PL (N/mm) | BD² (mm³) | FLEXURAL STRENGTH (N/mm²) = PL/BD² |
|------|-----------|-----------|-----------|-----------------------------------|
| 1    | 6         | 3 *10⁶    | 1*10⁶     | 3 (N/mm²)                         |
| 2    | 5.75      | 2.87*10⁶  | 1*10⁶     | 2.87(N/mm²)                       |
| 3    | 4.5       | 2.25*10⁶  | 1*10⁶     | 2.25(N/mm²)                       |

6. Conclusion

In this trial study spent foundry sand is utilized rather than fine total. There is a large number of waste
foundry sand created each year in India, there is additionally a removal issue and ecological impacts. Additionally in solid, River sand is utilized as a fine total which is exceptionally less in sum. Tragically, we need an approach to lessen the utilization of River sand and increment the utilization of Foundry sand. So Foundry Sand is utilized as a swap for the fine total in concrete. Here, Spent Foundry Sand (SFS) is utilized as a halfway swap for the fine total by 15% and 20% in M20 evaluation of cement. At long last the trial results and diagram were appeared in this examination.

7. Reference

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