

STUDY ON FOUNDRY SAND AS A PARTIAL REPLACEMENT FOR THE FINE AGGREGATE

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ABSTRACT

*This paper demonstrates the use of waste foundry sand as a partial replacement of fine aggregate. Foundry sand is a by-product of ferrous and non-ferrous metal casting industry which contains high silica content with specific physical properties. This study presents the information about the civil engineering applications of foundry sand, which is technically sound and is environmentally safe. This research is carried out to produce an eco-friendly and low cost concrete. An experimental study has been carried out on concrete with waste foundry sand about replacing percentage of 15%. In the present study, effect of foundry sand as fine aggregate replacement on the compressive strength of concrete having mix proportions of M 20 grade was investigated. The resulted material was tested and compared with the conventional concrete in terms of its strength and workability. The tests were carried out with standard cube of dimensions 150*150*150*mm and cylinder 150*300* mm and for prism 500*100*100* mm for 3 days to determine its strength. Through the experimental result we conclude that compressive strength increases with increase in partial replacement of waste foundry sand. The aim of the experiment is to know about the mechanical properties of the concrete by addition of waste foundry sand in different proportion and also its strength.*

INTRODUCTION:

Concrete usually Portland cement is a composition of coarse aggregate, fine aggregate, cement and water. Cement acts as a binder in concrete. When aggregate mixed with dry Portland cement and water they form fluid slurry which is easily pourable and get into any shape. These ingredients lead to the formation of hard matrix which is like a durable stone like structure. Concrete plays a major role in construction as they provide strength and durability which is known as back bone in construction. We are in a situation to develop and to introduce new things to make our future generation's improvement. The ingredients in concrete are getting replaced by many products to make an innovative project. In our project foundry sand is replaced by means of river sand. Primarily foundry sand is defined as uniformly sized clean sand which has high silica quality. This sand was formerly used for preparing molds. In our project we are using the wasted sand used for molding known as foundry sand. This replacement is to improve the strength of concrete. There were many types of foundry sand. We are using non-leaded spent foundry sand which is non-hazardous. 15 to 20% of river sand is replaced by foundry sand. Total replacement of foundry sand will not provide strength to the concrete. Up to an optimum replacement foundry sand will provide good strength. When the amount of foundry sand is increased there will be a lack of binding properties, which leads to decrease in strength. By using foundry sand of 15-20%, concrete with a mix design of M₂₀ is designed. With the above designed mix proportion we have casted some number of cubes with a dimensions of 150*150*150, cylinder with a diameter of 150mm and length of 300mm, prism with a dimension of 500*100*100. Casting is followed by curing. Curing takes up to 7 days but we have cured up to 3 days. We also used accelerated curing tank to check the strength obtained within 19 hrs. Accelerated curing is a method which provides compressive strength more primarily that means the strength which gained in normal curing will be obtained within 19 hours in accelerated curing. Accelerated curing tank involves hot water within which the mold was placed and gets cured. After curing it is used to determine strength. The casted materials undergo certain test to check the strength obtained by foundry sand by curing and accelerated curing method.

METHODOLOGY



MATERIAL TESTING

The material used to construct concrete is to be tested to find their strength. The ingredients used in concrete are as follows

- Cement
- Fine aggregate – Foundry sand
- Coarse aggregate

CEMENT:

Cement plays a major role in concrete as it acts as a binder. It acts as adhesive to join with other materials. Cement is used in construction field which holds up all the materials together and hardens it. Cement has many grades we have used 43 grade cement which means it provides strength of 43N/mm² after 28 days of curing.

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

Table 1: Cement**FINE AGGREGATE:**

In this project fine aggregate refers foundry sand. Foundry sand is defined as uniformly shaped clean sand with high quantity of silica sand. They are used for ferrous and non-ferrous molds. Mostly 95 % of foundry sands are used in foundry. In our project we are using spent foundry sand. 15-20% of river sand is replaced by 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

Table 2: Sieve analysis of fine aggregate (Foundry sand)**COARSE AGGREGATE:**

Coarse aggregate is defined as the crushed pieces of rocks which were available in the size of 40,32,25,20,16,12,10 and 4.75mm. In this project we are using aggregate of about 20mm and 10mm. We are not using same size of aggregate the reason behind this is same size and shape not join as they are angular in shape. So we are using the mixture of aggregate which leads to very good binding properties.

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

Table 3: Sieve analysis of coarse aggregate

CONVENTIONAL CONCRETE

Normal concrete which is also known as conventional concrete that contains ordinary Portland cement, fine aggregate (m-sand or river sand) and coarse aggregate. This concrete does not have any special property as there is no replacement in any material. These concretes are formulated with high compressive strength and less tensile strength. The compressive strength for conventional concrete are as follows,

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

Table 4 :Compressive strength for conventional concrete

FOUNDRY SAND CONCRETE WITH A REPLACEMENT OF 15%

COMPRESSIVE STRENGTH:

Cube will undergo compressive strength that means by applying certain load the cube gets compressed and cracks will occur at certain load, which is used to calculate compressive strength of cube. The cube has a dimension of 150*150*150. The foundry sand is replaced with **15%** of the river sand. 2 cubes has cured for 3 days and the other one cube which attains a compressive strength of about **19.77 N/(mm²)** undergoes accelerated curing for about 19 hours at a temperature of about 55°celsius. The following are the compressive strength of concrete cube they are as follows:

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

Table 5: Compressive strength of cube with replacement of 15%

SPLIT TENSILE STRENGTH:

Cylinder will undergo split tensile load which means by applying some load the cylinder splits at a particular load which breaks at the center and gets spilt. That load is noted as spilt tensile load of cylinder. By using split tensile load spilt tensile strength of the cylinder was calculated. The replacement of foundry is about 15%. The cylinder has a diameter of about 150mm and length of about 300mm. The cylinder was cured for 3 days. The following are the split tensile load of cylinder and they are as follows:

S.NO	LOAD (KN)	AREA (mm)	SPLIT TENSILE STRENGTH (N/mm ²)
1	196.2 * 10 ³	17.66 * 10 ³	11.10N/mm ²
2	176.58 * 10 ³	17.66 * 10 ³	9.99N/mm ²
3	156.96 * 10 ³	17.66 * 10 ³	8.88N/mm ²

Table 6: Split tensile strength of cylinder with replacement of 15%

FLEXURAL STRENGTH OF PRISM:

Prism will undergo flexural load which means by applying some load the prism gets flexural strength and breaks at a particular load that is known as flexural load of a prism. By using flexural load of a prism flexural tensile strength of concrete was calculated. The replacement of foundry is about 15%. The prism was cured for 3 days. The following are the flexural strength of prism and they are as follows:

S.NO	LOAD (KN)	PL (N/mm)	BD ² (mm ³)	FLEXURAL STRENGTH (N/mm ²) = PL/BD ²
1	6	3 *10 ⁶	1*10 ⁶	3 (N/mm ²)
2	5.75	2.87 *10 ⁶	1*10 ⁶	2.87(N/mm ²)
3	4.5	2.25 *10 ⁶	1*10 ⁶	2.25(N/mm ²)

Table 7: Flexural strength of prism with replacement of 15%

CONCLUSION

In this experimental study spent foundry sand is used instead of fine aggregate. There are millions of waste foundry sand produced every year in India, there is also a disposal problem and environmental effects. Also in concrete, River sand is used as a fine aggregate which is very less in amount. Unfortunately, we need a way to reduce the use of River sand and increase the use of Foundry sand. So Foundry Sand is used as a replacement for the fine aggregate in concrete. Here, Spent Foundry Sand (SFS) is used as a partial replacement for the fine aggregate by 15% and 20% in M20 grade of concrete. Finally the experimental results and graph were shown in this study.

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