INVESTIGATION ON BEHAVIOR OF RCC BEAMS WITH USED FOUNDRY SAND AS A ALETRNATIVE MATERIAL F0R NATURAL SAND

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Abstract

To produce economic concrete by mixing different ratios of fine aggregate with waste foundry sand. The fine aggregate or natural sand can be replaced by the used or waste foundry sand for different percentages such as 15%, 25%, 35% by weight respectively for M30 grade concrete. For M30 grade concrete is produced and tested for 7,14and 28days respectively. Form the results for 35% replacement of foundry sand increases the compressive strength. The bending strength has been determined at 28 day. Keeping all this view the main of this research is find out the behavior of cement concrete by adding of foundry waste in to the concrete with various percentages of used foundry sand in the cement concrete by using various tests such as compressive strength and flexural strength.

***KEYWORDS**; Waste Foundry Sand, Compressive Strength, Flexural Strength.*

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1. INTRODUCTION

From the metal casting industry foundries the by product from this industry and these are the large amount of metal-casting industry after using many times the used sand can be treated as waste this waste sand is called foundry sand or waste foundry sand.

Waste foundry sand can be used in the various engineering applications and also solve the disposal problem of foundry sand and its chemically consisting of silica sand

These foundry sand can be used in the cement concrete to increase the strength of the concrete, And this foundry sand can be used as a alternative material for the natural sand or river sand. And avoid the scarcity problem of river sand in the country.

In a developing country energy is the major role. By earning carbon credit by using industry waste foundry sand for building materials like fine aggregate, the environment problem in the country can be solved.

Concrete is the homogeneous mixture of construction material composed of cement, fine aggregate, coarse aggregate, water, admixture. The mixture quantity of each material affects the strength of harden concrete. The foundry sand consumes large amount of sand in the earth fills and avoid the various land pollution problem. By taking this point various investigation are made to the concrete or low cast concrete by replacing the fine aggregate or river sand by waste foundry sand.

2. EXPERIMENTAL MATERIALS

2.1 Foundry Sand or Waste Foundry Sand

Foundry sand uses the high amount of metal moulding processes. And these sand can recycled and reused in many times and the sand remaining after using large times for casting processes is termed as foundry sand.

This study presents the information about various uses in the civil engineering industry and also avoids the large amount of pollution in the earth. The foundry sand chemically consisting of silica sand, bentonite, sea coal, resins and dust material. And this sand used in cement concrete to increase the strength and durability properties of the cement concrete. The used foundry sand can be used as a alternative material for fine aggregate or natural sand to obtain a different properties of concrete.

Fig1. Foundry sand

Constituent	Value(%)
SiO2	87.93
Al2O3	4.70
Fe2O3	0.94
CaO	0.12
MgO	0.30
SO3	0.09
Na2O	0.19
K2O	0.21
TiO2	0.15
P2O5	0.00
Mn2O3	0.06
SrO	0.03
LOI	5.15 (0.45 to 9.47) 2.1 - 12.1
TOTAL	99.87

Fig 2. Chemical oxide composition in Foundry sand

2.2 Cement

The cement should be such that it should be clean grey and lumps free. For this work the OPC (ordinary Portland cement) is used which conforming to IS-8112 1989 and various cement tests are conducted.

2.3 Aggregate

The aggregate should be clean and it is free from dirt and dust. The aggregate should be well graded and gives enough strength to the concrete to resists the load. And also the aggregate should have higher strength, durability and lower shrinkage and it should be economical.

2.4 Coarse Aggregate

The aggregate passing through 20mm sieve and retained 4.75mm sieve is termed as coarse aggregate. The elongation index and flakiness index should be less than 15%.

2.5 Fine Aggregate

The aggregate passing though 4.75mm sieve is termed as fine aggregates. The fine aggregate should be clean and free from dirt and dust.

2.6 Water

The water is the main ingredient because it involves in the chemical reaction between the cement. The water should be potable and clean.

3. DESIGN MIX

The design mix for M_{30} is made as per IS codes. And the same mix design is used for the various test samples. Table 1 gives the design mix proportion for M_{30}grade concrete.

Table 1 Design mix proportion for M_{30} mix

	Water in liters	Cement (kg/m^3)	FA (kg/m^3)	CA (kg/m^3)
By weight	158	377	772	1090

FA – fine aggregate CA- coarse aggregate

Table 2 M_{30} concrete mix proportions

Serial No	Type of Concrete	Design mix proportion for concrete				
		W/C	C	FA	CA	UFS
1	C_0	0.42	1	2.05	2.89	0
2	C_1	0.42	1	1.74	2.89	0.31
3	C_2	0.42	1	1.53	2.89	0.52
4	C_3	0.42	1	1.33	2.89	0.71

W/C- water cement ration C- cement
UFS- used foundry sand FA - fine aggregate
CA- coarse aggregate

4. EXPERIMENTAL SET UP

Table 3 Percentage of foundry sand replacement

Serial No	Type of concrete	Replacement of fine aggregates with used foundry sand
1	C_0	Normal concrete
2	C_1	15% UFS replacement
3	C_2	25% UFS replacement
4	C_3	35% UFS replacement

5. METHODOLOGY

The methodology involves evaluation of used foundry sand as a alternative material for fine aggregate at different percentages such as 15%, 25%, 35% by weight and normal controlled concrete i.e without foundry sand. And conduct various concrete tests to both controlled concrete and foundry sand concrete and the results are compared for both concretes. For cubes 150X150X150 mm size are casted total 3cubes for normal concrete and cubes for foundry sand concrete, similarly for flexural 16 number of beams were casted and the results were compared with each other.

6. COMPRESSIVE STRENGTH

The compressive strength tests were done by compression testing machine .For each mix 3-cubes were tested and average will taken. The compressive strength were made for characteristic mix ration of 1:2.05:2.89 with the replacement of foundry sand at various percentage i.e 15%, 25%and 35%.

Table 4 Compressive strength of cubes (150x150x150) for M_{30} mix at 7, 14, 28 days

SL NO	% of foundry sand	7DAYS MPa	14DAYS MPa	28DAYS MPa
1	0%	21.94	25.55	32.22
2	15%	23.55	26.49	32.98
3	25%	25.72	28.56	34.09
4	35%	26.5	29.81	34.08

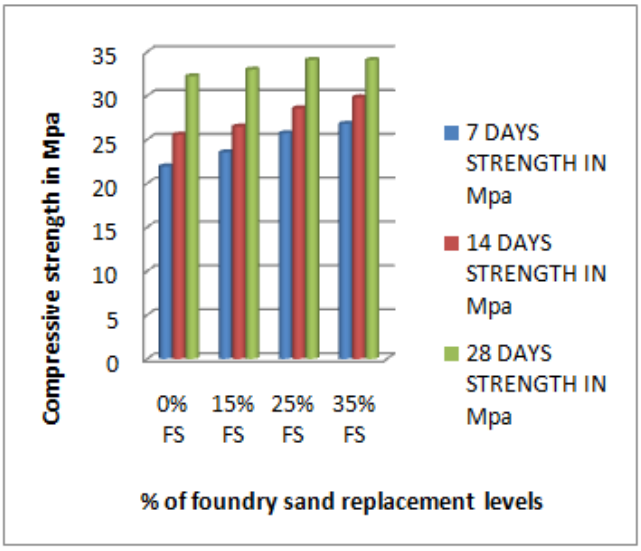

Fig2. Percentage Replacement of Foundry Sand V/S Compressive Strength (N/mm2) of Concrete for M_{30} mix at 7, 14 and 28 days.

7. FLEXURAL STRENGTH

Flexural strength of RC beams were performed on loading frame for varies mixes at 28 days curing period.

7.1 Reinforcement Details

Sixteen numbers of beams were casted with and without foundry sand. The span of the beam was 2000mm and of size 150mm x 250mm. All specimens were tested at 28th day from the date of casting. Reinforcement details of beam specimens are shown in table-6.

Table 5 Reinforcement details

SL. NO.	Beams	Reinforcement		No of beams
		Bottom	Top	
1	NCC	2#16mm	2#8mm	2
2	FSR	2#16mm	2#8mm	2
3	FSR	2#16mm	2#8mm	2
4	FSR	2#16mm	2#8mm	2
5	NCC	2#8mm	2#8mm	2
6	FSR	2#8mm	2#8mm	2
7	FSR	2#8mm	2#8mm	2
8	FSR	2#8mm	2#8mm	2

NCC-Normal cement concrete FSR-Foundry sand replacement

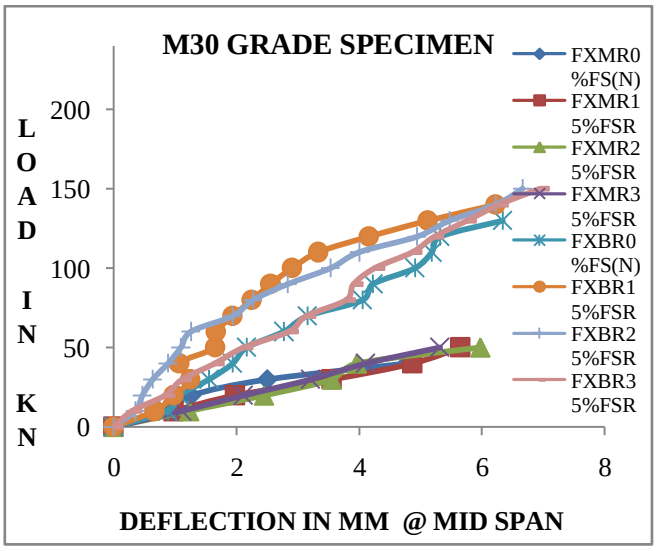

Fig3. P-delta curve for mid span

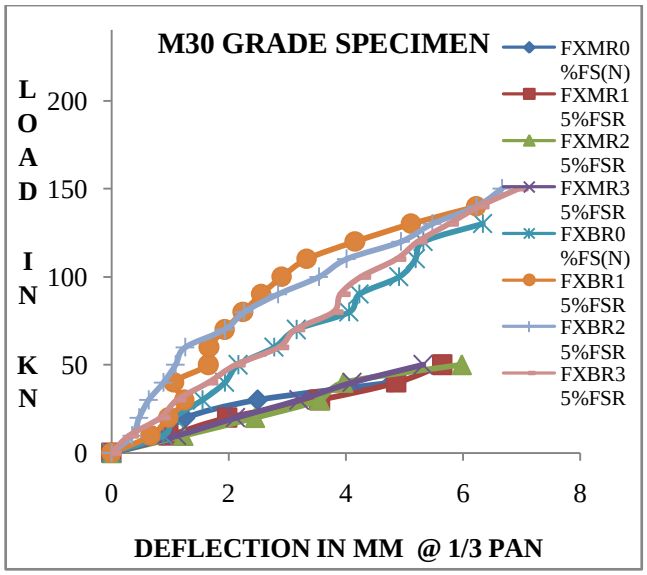

Fig4. P-delta curve for 1/3 span

Table 6 Detailed Description of beams after Testing

Beams	**Values obtained**		
	1st Crack in (KN)	**2nd Crack (KN)**	**Failure Load (KN)**
NCC	40	45	48
FSR	35	45	51
FSR	35	45	53
FSR	40	50	56
NCC	110	130	139
FSR	110	130	140
FSR	130	150	152
FSR	120	140	154

8. CONCLUSION

Based on the experimental results on compressive strength and flexural strength the following conclusions are made:

1. As the percentage of foundry sand increases the compressive strength also increases.
2. For 35% of foundry sand replacement the compressive strength is optimum.
3. The various environmental problem can be avoid by using this research.
4. From flexural behavior test results of load at first crack, second crack and failure load it may be observed that the behavior of USF replaced concrete beams were slightly larger than that of NCC RC beams.
5. Failure load of USF replaced concrete beams were slightly higher than that of NCC.

ACKNOWLEDGEMENTS

I am thankful to Mr. Shashi kumar A and Dr.G Narayana for their guidance. I also thank department of civil engineering S J C institute of technology, chickallapura. And last but not the least my dear friends who have supported me to complete this project work.

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