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An Experimental Study on Mechanical Properties of Concrete Incorporating Foundry Sand

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Abstract **- Foundry sand is having high quality of silica and uniform physical properties. The large amounts of metal foundry is using for the metal casting process. Foundry sand is a byproduct of the ferrous and non-ferrous metal casting industry. This study presents the mechanical properties of concrete and sand partially replaced with foundry sand and the Mechanical properties of compressive, split and flexural strengths of concrete by using of M-40 grade of concrete. The partially replacement of foundry sand percentages are 10, 20, 30% and 40%.**

Keywords: Compressive Strength Split Tensile Strength And Flexural Strength Of Concrete, Foundry Sand.

INTRODUCTION

Nowadays, the world around us has became much advanced and new things are exploring everyday which makes tedious works easier for us. In construction field also, new machines are being invented using which we could able to build the structure in lesser time. Here, concrete is playing a prominent role and special concretes are getting evolved everyday by mixing different ingredients into concrete in addition to cement, sand and coarse aggregates. Nowadays a special concrete had came into scenario in which the main ingredient is foundry sand partially replaced with sand.

Foundry sand is high quality silica sand with uniform physical characteristics. It is a by- product of ferrous and nonferrous metal casting industries.

Presently, a large amount of foundry sand is produced nowadays from industries, when dumped causing various environmental problems. So, instead of wasting, if we use this foundry sand as a building material would help in reduction of stress on environment.

Concrete is a material which is composed of coarse aggregate, fine aggregate, cement, admixtures and water. Every material being used in concrete contribute strength to concrete. By using foundry sand by partial replacement into concrete, can be used to produce eco-friendly and low cost building material. In this study an experimental investigation is carried out by varying percentages of fine aggregate with foundry sand to produce low cost and eco-friendly concrete.

EXPERIMENTAL PROGRAMME

Materials Used In Present Work

Cement

The cement used was fresh and without any lumps. Testing of cement was done as per IS: 8112-1989. The physical properties of cement are listed in the Table 1.1

Table 1.1	Physical properties of cement		
	Components	*Results*	*Requirements*
1.	Fineness of cement (m2/kg)	361	Min 300
2.	Standard consistency (%)	32.5	------
3.	Initial setting time (min)	171	Min 30
4.	Final setting time (min)	272	Max 600
5.	Soundness Le-Chatlier expansion (mm)	0.4	Max 10
6.	Compressive strength at 28 days (N/mm2)	60	Min 33

Fine Aggregate

The sand used for the experimental programme was locally procured and conformed to grading zone III as per IS: 383-1970. The physical properties of fine aggregate are listed in the Table 1.2

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Table 1.2	Physical properties of fine aggregate		
	Property	Result	Remarks
1.	Bulk density (kg/m3)	1765	--------
2.	Specific gravity	2.56	---------
3.	Fineness modulus	3.35	--------
4.	Water absorbtion (%)	1.44	----------
5.	Grading zone	III	--------

Coarse Aggregate

Locally available coarse aggregates having the maximum size of 10 mm and 20mm were used in the present work. Testing of coarse aggregates was done as per IS: 383-1970. The properties of coarse aggregate are listed in the Table 1.3.

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Table 1.3	Properties of coarse aggregate		
	Property	*Value*	*Remarks*
1.	Type	Crushed	-------
2.	Maxmimum size	20mm	--------
3.	Specific gravity(20mm)	2.825	--------
4.	Total water absorbtion(20mm)	3.7%	--------
5.	Moisture content(20mm)	0.704%	--------
6.	Fineness modulus(20mm)	7.69	--------

Foundry Sand

Investigations were made on foundry sand procured from Janta Foundries, Mandi Gobindgarh, Punjab. The physical and chemical properties of the foundry sand used in this investigation are listed in Table 1.4&1.5

Table-1.4	physical properties of foundry sand	
	Property	Results
1	Specific Gravity	2.39-2.55
2	Bulk Relative Density, kg/m^3 (lb/ft^3)	2593(160)
3	Absorption, %	0.47
4	Moisture content, %	0.10-10.4
5	Clay Lumps and Friable Particles	1- 44
6	Coefficient of Permeability (cm/sec)	10^{-3}-10^{-6}
7	Plastic Limit/Plastic Index	Non plastic

Table 1.5	Chemical properties of foundry sand		
	Constituents	Value(%)	Remarks
1.	SiO_2	86.82	----
2.	Al_2O_3	5.79	--------
3.	Fe_2O_3	0.92	-----
4.	CaO	0.16	--------
5.	MgO	0.29	--------
6.	SO_3	0.10	---------
7.	Na_2O	2.2	---------
8.	K_2O	0.25	---------
9.	TiO_2	0.17	-------
10.	P_2O_5	0.00	--------
11.	Mn_2O_3	0.02	---------
12.	SrO	0.05	---------
13.	LOI	5.16	------
14.	Total	99.91	-----

Water

Potable tap water was used for the concrete preparation and for the curing of specimens.

Super Plasticizer

Conplast – SP 430, a concrete superplasticizer based on Sulphonated Napthalene Polymer was used as a water-reducing admixture and ton improve the workability of concrete containing foundry sand.

RESULTS AND DISCUSSION

Compressive Strength

The compressive strength for different replacement levels of foundry sand contents (0%, 10%, 20%, 30% and 40%) at the end of different curing periods (28 days, 56 days) are given in Table 1.6

Table-1.6	Compressive Strength (MPa) of Concrete with Foundry Sand		
	Foundry Sand Content, %	Compressive Strength, MPa	
		7 days	28 days
1	0	35.24	50.89
2	10	36.73	51.59
3	20	37.46	52.51
4	30	36.85	51.38
5	40	34.37	49.73

Split tensile strength

It was found that split tensile strength of concrete incorporating foundry sand (using 10 %, 20 %, 30 % and 40%) replacement levels with fine aggregate and a w/c of 0.5) depended on the percentage of foundry sand used. The variation of split tensile strength was shown in Table 1.7.

Table-1.7	Split Tensile Strength (MPa) of Concrete with Foundry Sand		
	Foundry Sand Content, %	Split Tensile Strength, MPa	
		7 days	28 days
1	0	3.39	4.06
2	10	3.45	4.09
3	20	3.49	4.13
4	30	3.46	4.08
5	40	3.34	4.02

Flexural strength

The flexural strength was found increasing gradually with different replacements of foundry sand contents (0%, 10%, 20%, 30% and 40%) at the end of different curing periods (28 days, 56 days) are given in Table 1.8

Table-1.8	Flexural Strength (MPa) of Concrete with Foundry Sand		
	Foundry Sand Content, %	Flexural strength in Mpa	
		7 days	28 days
1	0	4.16	4.99
2	10	4.24	5.02
3	20	4.28	5.07
4	30	4.25	5.02
5	40	4.10	4.94

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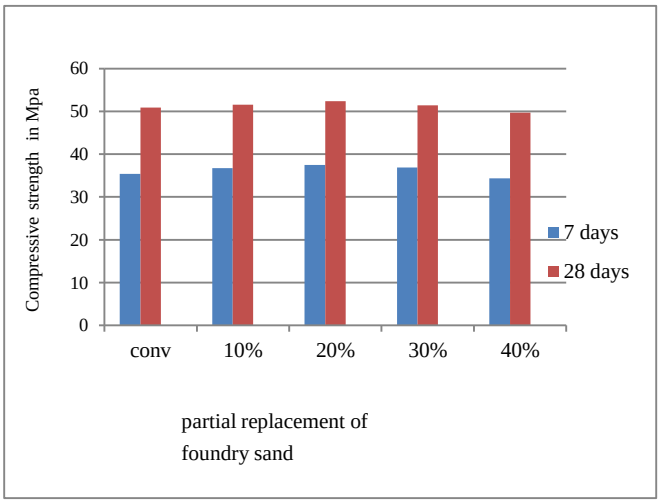
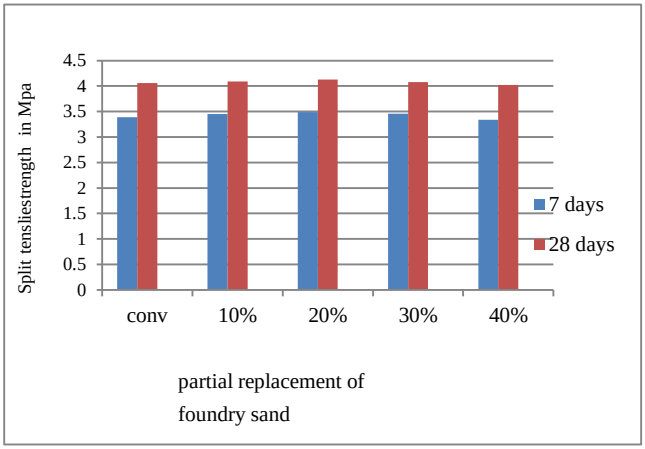
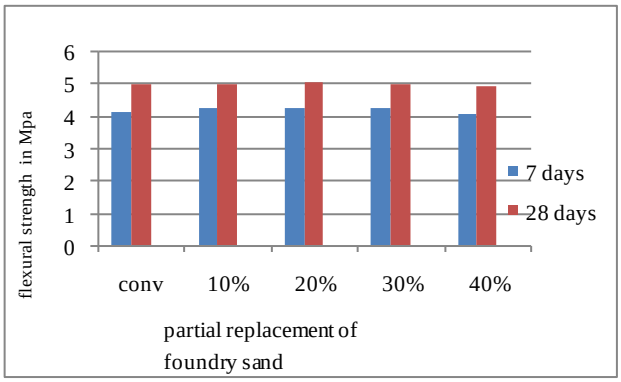


Graph 1: compressive strength testing for partial replacement of foundry sand



Graph 2: Split tensile strength testing for partial replacement of foundry sand



Graph 3: Flexural strength testing for partial replacement of foundry sand

CONCLUSIONS

The following conclusions are drawn from this study:

Compressive strength of concrete showed a gradual increase and later decreased with the increase in sand replacement with different replacement levels of foundry sand. The compressive strength increased upto replacement levels 0%, 10% & 20% whereas decreased at replacement levels 30% and 40% at 28-days and 56 days as shown in Table 1.6. The optimum value of compressive strength is obtained at replacement level 30%.

Split tensile strength also increased at replacement levels of foundry sand upto 0%, 10%, 20% & 30% but decreased at replacement level 40% as shown in Table 1.7. The optimum value of split tensile strength is obtained at replacement level 40%.

Flexural strength also showed a gradual increase with partial replacements levels upto 0%, 10%, & 20% and later decreased at 30% and 40% as shown in Table 1.8. The optimum value of flexural strength is obtained at replacement level 30%.

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