International Journal of Advanced Research in Engineering Technology & Sciences ISSN: 2394-2819
July-2016 Volume 3, Issue-7
Email:editor@ijarets.org www.ijarets.org

EXPERIMENTAL INVESTIGATION ON STRENGTH CHARACTERISTICS OF CONCRETE WITH PARTIAL REPLACEMENT OF FINE AGGREGATE WITH FOUNDRY SAND

Sandeep Singh Charak
M.Tech Student
Department of Civil Engineering
SDDIET, Barwala, Haryana

Er Ravi Rana
Assistant Professor
Department of Civil Engineering
SDDIET, Barwala, Haryana

ABSTRACT*: Generation of waste foundry sand as by product of metal casting industries and its improper disposal causes environmental problems. Thus, the usage of such waste as building material, construction and in other fields is essential for reduction of environmental problems**. Due to ever increasing quantities of waste materials and industrial by-products, solid waste management is the prime concern in the world. Now a day, we need to look at a way to reduce the cost of building materials, and particularly cement is currently so high that only rich people and governments can afford meaningful construction. Studies have been carried out to investigate the possibility of utilizing a broad range of materials as partial replacement materials for cement in the production of concrete. This study investigated the strength properties of foundry sand in concrete*

*The aim of this research is to know the behavior and mechanical properties of concrete after addition of foundry waste in different proportion by tests like Compressive strength and split tensile**.***

KEYWORDS: *Waste foundry sand, concrete, compressive strength, split tensile strength, utilization.*

INTRODUCTION

The Waste generated from metal casting industries creates many environmental problems and its use in concrete can resolves this problem to some extent. As it contain high quality silica that is a byproduct of nonferrous and ferrous metal casting Industries. Pathariya Saraswati C et al [1] has studied the application of Waste Foundry Sand for Evolution of Low-Cost Concrete. J.M. Khatib et al [2] has studied Capillarity of concrete incorporating waste foundry sand. Yogesh Aggarwal et al [3] has studied the Microstructure and properties of concrete using bottom ash and waste foundry sand as partial replacement of fine aggregates.G. Ganesh Prabhu et al [4] Effects of foundry sand as a fine aggregate in concrete production. Foundry sand (FS) is a by-product from the metal alloys casting industry with high silica content.

In another study, Singh and Siddique [5] studied the abrasion resistance and strength properties of concrete containing waste foundry sand (WFS).

OBJECTIVE

The main objective of this paper is to study the strength parameters of concrete in which fine aggregate in conventional concrete is replaced with foundry sand at room temperature. The main parameters studied are compressive strength, split tensile strength flexural strength and their results are studied and compared with conventional concrete.

EXPERIMENTAL PROGRAM

A Materials

A.1 Cement

Cement is a binding material and is used in concrete with the addition of aggregate and get harden after the addition of water. Portland pozzolana Cement (PPC) of 53 grades taken from Ultra-Tech Ltd. Conforming to IS: 8112-1989 was used in the research study. Certain test were conducted on cement according to IS 1489-1991(Part-I) like consistency test, soundness test, initial and final setting time.

Chemical properties of ultra tech cement (PPC) 53 grade	Result (%)	Physical properties of ultra tech cement (PPC) 53 grade	Result
SiO_2	23.5	Specific gravity	2.90
Al_2O_3	12.5	Standard consistency	31.5
CaO	47	Initial setting time	210 min
MgO	1.75	Final setting time	250 min
Fe_2O_3	2.02	Compressive strength N/mm^2 after 28 days	50 N/mm^2

Table-1 chemical and physical properties of cement

A.2 Aggregate

It is a natural deposit of gravel and sand and it also give structure to the concrete. Aggregate in the concrete occupies 75 to 80% of the total volume of concrete so it influence the following properties of concrete like workability, compressive strength, durability and ultimately the economy of concrete

A.2.1 Coarse Aggregate

The aggregate having size more than 4.75 mm are coarse aggregate. Locally coarse aggregate having the maximum size of 10 mm and 20 mm were used. A different type of test was done as per IS: 383-1970. The aggregates were washed by water to remove dirt and dust and allowed to dry at room temperature. Elongation and flakiness were also maintained to less than 15

A.2.2 Fine Aggregate

The aggregate that passes through 4.75mm IS sieve and should not have coarse aggregate
More than 5 percent Fine aggregate fills the voids between coarse particles which help the concrete to flow in proper manner i.e workability and it also maintain the uniformity in mixture. Fine aggregates are taken from crusher near baddi university, Baddi [H.P].Different test were also performed on fine aggregate as per IS: 383-1970[13]

A3 Foundry Sand

Foundry sand from mandi Gobindgarh steel plant of specific gravity 2.65 and fine modulus of 3.0 was used. As it is used as partial replacement of fine aggregate, the maximum size of sand was taken as 4.75mm and minimum size was 150 micron.

A4 Water

Water plays a very important role in making workable concrete and it also contributes in chemical reaction when it reacts with cement. Water is used for curing purpose and also for mixing, so it should be clean and free from salts, acid, alkalis and other unwanted material. Generally we can use ordinary water which is fit for drinking.

MIXING AND TEST PROCEDURES

A procedure was adopted in the batching; mixing and casting operation was carefully done. The coarse and fine aggregate were weighed first with an accuracy of 0.5grams.Fresh concrete properties like slump value, compaction factor were determined according to an Indian standard specification. The 150mmx 150mm concrete cubes were cast for compressive strength beams of size 100 x 100 x 500mm for flexural strength and cylinder of size 150 x 300mm for split tensile strength. The concrete was filled in the mould in three layers, each layers is being tamped with tamping rod and were allowed to remain in the mould for 24 hours. The samples were remolded and subjected to compressive strength and tensile split test for 7, 14 and 28 days.

(a) Compressive Strength Test

It is performed on compression testing machine of 2000KN capacity. Three cubes of 150x150x150mm from each batch were tested in room temperature. The comparison was made on properties of concrete after partial replacement of fine aggregate by WFS with various percentages as 0%, 5%, 10%, 15%, 20%.

M20 Grade of concrete	
M-1	0% WFS
M-2	5% WFS
M-3	10% WFS
M-4	15% WFS
M-5	20% WFS

Table 2: Detailed Description of Concrete Mixes

Mixture No.	M-1	M-2	M-3	M-4	M-5
Cement(Kg/m^3)	390	390	390	390	390
Natural sand (Kg/m^3)	569	541	513	484	456
WFS (%)	0	5	10	15	20
WFS (Kg/m^3)	0	28	56	85	113
Coarse aggregate (12.5mm) (Kg/m^3)	1165	1165	1165	1165	1165
W/C ratio	0.5	0.5	0.5	0.5	0.5
Water (Kg/m^3)	195	195	195	195	195
Super plasticizer(L/m^3)	0.59	0.59	0.59	0.59	0.59
Slump (mm)	90	85	85	80	80
Air temperature (°c)	27	27	28	27	27
Concrete temperature (°c)	26	27	27	26	26

Table 3: M20 Grade Mixes

Type of concrete	Avg. ultimate compressive strength at 7 days (N/mm^2)	Avg. ultimate compressive strength at 14 days (N/mm^2)	Avg. ultimate compressive strength at 28 days (N/mm^2)
M1	27.5	30.60	37.80
M2	25.6	32.30	39.40
M3	25.90	32.45	39.70
M4	28.66	32.60	38.60
M5	30.20	33.50	40.70

Table 4: COMPRESSIVE STRENGTH OF CUBES FOR M20 grade at 7, 14, 28 DAYS.

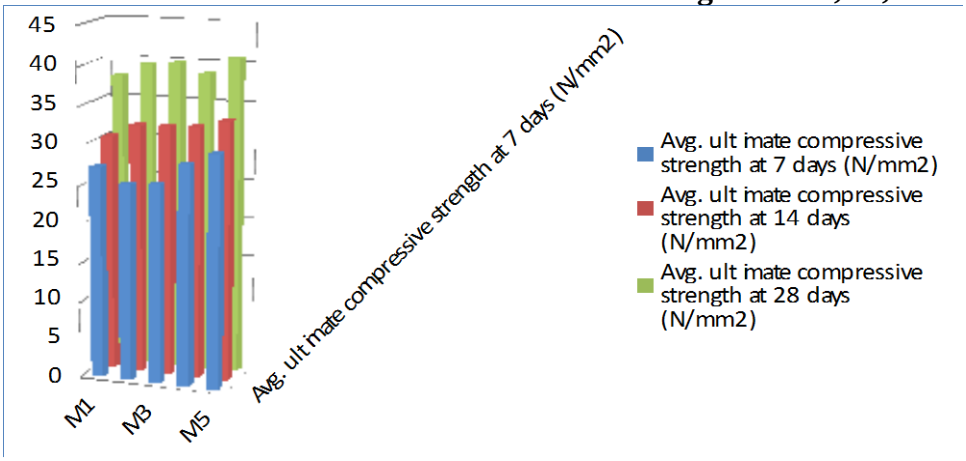

FIGURE: - 1: Graph of % replacement of waste foundry sand v/s compressive strength (N/mm2) for 7, 14, 28 days.

(B) Split Tensile Test

The tensile strength of concrete is approximately 10% of its compressive strength. Tensile splitting strength tests of concrete block specimens were determined as per IS: 5816-1999.

After curing of 28 days the specimens were tested for tensile strength using a calibrated compression testing machine of 2000 KN capacity.

Type of concrete	Average ultimate split tensile strength at 28 days (N/mm2)
M1	4.2
M2	3.7
M3	3.5
M4	3.4
M5	3.89

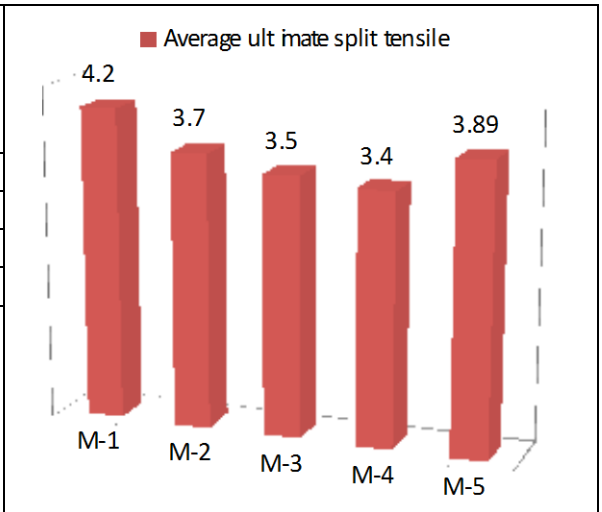

FIGURE: - 2

CONCLUSION

Based on above study the following observations are made regarding the properties and behavior of concrete on partial replacement of fine aggregate by waste foundry sand

(1) Compressive strength increases on increase in percentage of waste foundry sand as compare to traditional concrete.
(2) In this study, maximum compressive strength is obtained at 60% replacement of fine aggregate by waste foundry sand
(3) Split tensile strength decrease on increase in percentage of waste foundry sand.
(4) Use of waste foundry sand in concrete reduces the production of waste through metal In dustries i.e. it's an eco-friendly building material.
(5) The problems of disposal and maintenance cost of land filling is reduced.
(6) Application of this study leads to develop in construction sector and innovative building material.
(7) The result of percentage cost change reduces up to 3.5 for 20 to 40 % replacement of waste foundry sand.
(8) This shows that the concrete produced is economical.

REFERENCE

1. Pathariya Saraswati C et al has studied the application of Waste Foundry Sand for Evolution of Low-Cost Concrete. International Journal of Engineering Trends and Technology (IJETT) – Volume 4 Issue 10 - Oct 2013
2. J.M. Khatib,B.A. Herki, S. Kenai "Capillarity of concrete incorporating waste foundry sand" Construction and Building Materials 47 (2013) pp 867–871
3. Yogesh Aggarwal et al has studied the Microstructure and properties of concrete using bottom ash and waste foundry sand as partial replacement of fine aggregates. Construction and Building Materials 54 (2014) 210–223
4. G. Ganesh Prabhu et al Effects of foundry sand as a fine aggregate in concrete production. Foundry sand (FS) is a by-product from the metal alloys casting industry with high silica content. Construction and Building Materials 70 (2014) 514–521
5. Singh Gurpreet, Siddique Rafat. Abrasion resistance and strength properties of Concrete containing waste foundry sand (WFS)
6. IS: 383-1970, Specifications for coarse and fine aggregates from natural sources for concrete, Bureau of Indian Standards, New Delhi, India
7. [7] IS: 10262-1982, recommended guidelines for concrete mix design, Bureau of Indian Standards, New Delhi, India.
8. IS: 1489-1991, Specifications for 53-Grade Portland Pozzolana cement, Bureau of Indian Standards, New Delhi, India
9. IS: 516-1959, Indian standard code of practice methods of test for strength of concrete, Bureau of Indian Standards, New Delhi, India.
10. IS: 5816-1999, Indian standard code for splitting tensile strength of concrete – method of test, Bureau of Indian Standards, New Delhi, India.