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Mechanical properties of concrete incorporating waste ceramic tiles and waste foundry sand

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Abstract:

From the last few years various researchers had done work in concreting and inventvarious techniques and methods to produce concrete which has the desired properties. Concrete is one of the most vital and common materials used in the construction field. The current area of research in the concrete was introducing waste foundry sand (WFS) and waste ceramic tiles in the ordinary concrete. Waste foundry sand is the byproduct of metal casting industries, which causes environmental problems because of its improper disposal. Construction industries requires huge amount of ceramic tiles and other ceramic for architectural appearance, the productions of which are drastically increased, due to this waste is also produce during handling and usage of ceramic tiles. Thus, its usage in building material, construction and in other fields is essential for reduction of environmental problems. This research was carried out to produce an eco-friendly concrete.

This paper recommends the effective use of waste foundry sand as a partial replacement for fine aggregate and waste ceramic tiles as a partial replacement for course aggregate in concrete. Ingredients for concrete are cement, course aggregate, waste ceramic tiles, fine aggregate and waste foundry sand. An experimental investigation was carried out on concrete containing waste foundry sand (WFS) in the range of 0%,20%, 22%, and 24% and waste ceramic tiles (WCT) in the range of 0%, 20%, 22%, and 24% by weight for M-25 grade concrete Concrete was produced, tested and compared with conventional concrete in plastic state as well as in harden state for workability, compressive strength & split tensile strength. These tests were carried out on standard cube, cylinder for 28 days to determine the properties of concrete. The aim of this research was to knows the behavior and mechanical properties of concrete for its eco-friendly and economical use.

Keywords— Industrial waste, Waste Foundry sand (WFS), Waste Ceramic Tiles (WCT), OPC, Eco-friendly, Compressive strength, Split tensile strength, Workability.

I. INTRODUCTION

In the present research, experimental investigations can be carried out on concrete to investigate the effect of waste foundry sand (WFS) and waste ceramic tiles (WCT) as partial replacement of fine aggregate and coarse aggregate respectively on mechanical properties of concrete such as strength, workability, durability, etc., of ordinary concrete.

The aim of this research is to evaluate the compressive strengths of concrete by waste foundry sand and waste ceramic tiles as an alternative to the use of Ordinary Portland Cement (OPC) and Sand in the production of concrete. To

improve the compressive strength, tensile strength, durability, using replacing fine aggregate and coarse aggregate by foundry sand and ceramic tile waste. To compare the strength of concrete specimen made by conventional method with that of specimens made by replacing fine aggregate partially with foundry sand to 20%,22%, 24% and coarse aggregate with ceramic tile waste to 20%, 22% and 24% by weight.

1.1 Literature Review

R. Naik, Viral M. Patel,1994.

The project to evaluate performance and leaching of CLSM in which both clean and used foundry sands were incorporated. The clean sand was obtained from a sand mining company in Wisconsin and the used foundry sand was obtained from a steel company in Milwaukee, Wisconsin. For purposes of comparison, properties of regular concrete sand (meeting ASTM C 33 requirements for use in making concrete) were also measured. Physical properties of these three foundry sands were determined using the appropriate ASTM standard .However a modified ASTM C 88 was used to measure soundness of foundry sands. The properties of used foundry sand vary due to the type of foundry processing equipment used, the type of additive for mold making, the number of times the sand is reused, and the type and amount of binder used. Han- young also investigated two types of foundry sands like silicate bonded sand as a fine aggregate and clay bonded sand also as a fine aggregate for the concrete and also performed the test for the basic and important properties of concrete like slump test, workability test, initial setting time of concrete, final setting time of concrete with the use of waste foundry sand and then, compared the results of tests with another concrete without mixed with waste foundry sand. Also measured the compressive strength, tensile strength and split tensile strength of that concrete for 7 days and 28 days.

RafatSiddique et al. (2009)

Evaluated the concrete mixtures containing fine aggregate (regular sand) partially replaced with used-foundry sand (UFS). Fine aggregate was replaced with three percentages (10 %, 20 %, and 30 %) of UFS by weight. Tests were performed for the properties of fresh concrete. Compressive strength, splitting- tensile strength, flexural strength , and modulus of elasticity were determined at 28, 56, 91, and 365 days. Compressive strength, splitting-tensile strength, flexural strength, and modulus of elasticity of concrete mixtures increased with the increase in foundry sand contents. Compressive strength, splitting-tensile strength, flexural strength, and modulus of elasticity of concrete mixtures increased with age for all the foundry sand contents. Increase in compressive strength varied between 8 % and 19 %, depending upon UFS percentage and testing age, whereas it was between 6.5 % and 14.5 % for splitting-tensile strength, 7% and 12 % for flexural strength, and 5 % and 12 % for modulus of elasticity. The results of this investigation suggest that used-foundry sand could be very conveniently used in making good quality concrete and construction materials.

II. MATERIAL PROPERTIES

2.1 Cement

Cement is a binding material in concrete which binds the other material to forms a compact mass. In this project work, OPC 53 grade cement is used for experimental study.

Table 2.1 Properties of Cement

Fineness value	8.5
Consistency	29.5%
Initial setting time	32min
Specific gravity	3.17

2.2 Water

Water conforming to the requirements of IS 456-2000 is found be satisfactory for making concrete. In the present investigation, portable drinking water available in the industrial company was used for mixing and curing the paver block.

2.3 Coarse Aggregate

Locally available crushed stone aggregates of nominal size 10mm.wherever possible size of aggregate 10mm used in the project.

Table 2.2 Properties of Coarse Aggregate

Description of test	**Test result obtained**	**Permissible limits as per IS:383-1970**
Specific gravity	2.71	Minimum 2.5
Fineness modulus	7.86	
Unit weight (kg/m^3)	1603	

2.4 Fine Aggregate

A concrete with better quality can be made with sand consisting of rounded grains rather than angular grains. River or pit sand must be used but not used sea sand as it contains salt and other impurities. In this study, river sand has been used as fine aggregate.

Table 2.3 Properties of Fine Aggregate

Description of test	**Test result obtained**	**Permissible limits as per IS 383:1970**
Specific gravity	2.63	Minimum 2.5
Fineness modulus	3.06	
Unit weight of sand (kg/m^3)	1687	

2.5 Waste Foundry Sand (WFS)

Foundry sand is high quality silica sand with uniform physical characteristics. It is produced from ferrous and nonferrous metal casting industries, where sand has been used for centuries as a molding material because of its thermal conductivity.

Table 2.4 Properties of WFS

S.NO	**PROPERTIES**	**VALUES**
1	Color	Gray(blackish)
2	Bulk Density(Kg/m^3)	1598
3	Specific Gravity	2.61

Waste Ceramic Tiles

Ceramic tile aggregates are hard having considerable value of specific gravity, rough surface on one side and smooth on other side, having less thickness and are lighter in weight than normal stone aggregates.

S.NO	PROPERTIES	VALUES
1	Specific Gravity	2.39
2	Water absorption	12.5%
3	Impact value	0.19%

2.6 Slump Test

This is a test extensively used in construction site. It is very useful in detecting the variation in the uniformity of mix of given nominal proportion. It also give an idea of water cement ratio need for concrete to be used for different works.

III. MIX PROPORTION

In this study, control mix was designed as per IS 10262:2009 for M_{25} grade. Waste foundry sand and waste ceramic tiles are replace by weight of aggregateThe details of the mix proportions of concrete were given in following table 3.1.
Mix Proportion : 1:2:0.5

Table 3.1Mix Design

Title	Specification
Grade of Concrete	M25
Type and Grade of Cement	OPC 53 Grade
Size of Coarse Aggregate	10mm & 20mm
Specific Gravity of Coarse Aggregate	2.66
Specific Gravity of Fine Aggregate	2.63
W/C Ratio	0.5

Table 3.2 Mix Proportion Details

WATER	CEMENT	F.A	C.A	WCT
0.5	1	2.09	2.84	0
0.5	1	1.67	0.418	2.272

IV. EXPERIMENTAL METHODOLOGY

4.1 Compressive strength test

Fig 4.1 Compressive strength test

For cube compression tests on concrete, cube of size 150mm were employed. All the cubes were tested in saturated condition after wiping out the surface moisture from the specimen. For each trial mix, three cubes were tested at the age of 7, 14 and 28 days of carrying 400 tons capacity HELICO compression testing machine referred to BIS: 516-1959.

Table 4.1 Compressive Strength Test

Mix	At 28 Days (N/mm²)
0% WFC and WCT	28.06
20% WFC and WCT	35.55
22% WFC and WCT	35.11
24% WFS and WCT	34.66

Fig 4.2 compressive test result

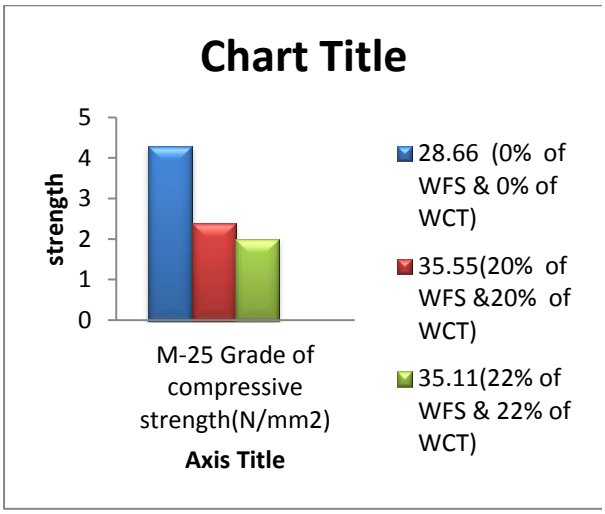


Fig 4.2 Compressive Strength Test

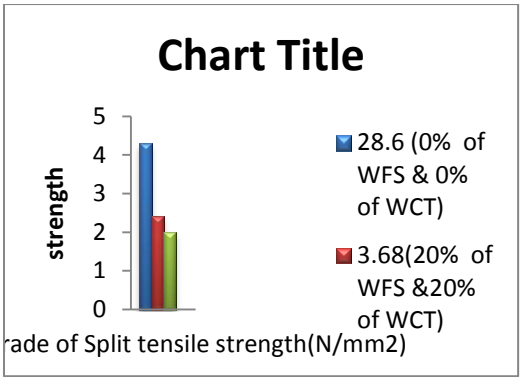
4.2 Split tensile test

Tensile strength is one of the basic and important properties of concrete. The results are required for the design of concrete subject to transverse shear, torsion, shrinkage and temperature effects. Its value is also used in the design of pre-stressed concrete structures, liquid retaining structures, roadways and runway slabs.

Table : 4.2 split tensile strength

Mix	At 28 Days (N/mm^2)
0% WFC and WCT	3.06
20% WFC and WCT	3.68
22% WFC and WCT	3.54
24% WFS and WCT	3.11

Fig 4.2 Split tensile Test



V. RESULTS & DISCUSSION

- Workability of concrete mix increases with increase in percentage of waste foundry sand and waste ceramic tiles as compare to regular concrete.
- As waste foundry sand is waste from metal industries and waste ceramic tiles is waste from construction industries therefore both waste can be effectively use in concrete mix hence an eco-friendly construction material.
- It is found that compressive strength of concrete mix is increases with increase in percentage of waste foundry sand and waste ceramic tiles as compare to regular concrete. It was maximum for 20 % replacement after that it increase.

By using this waste in concrete, problems regarding to safely disposal is reduced.

REFERENCE

- A FERHAT BINGOL, Compressive Strength Of Light Weight Aggregate Concrete Exposed To High Temperatures
- D BEHESHTI ZADEH, H AZAMIRAD, Structural Lightweight Concrete Production Using Eskandan Region Pumice
- DHAWAL DESAI (IIT BOMBAY), Development Of Special Concrete
- G. AMATO ,The Use Of Pumice Light Weight Concrete For Masonry Applications
- J.SAHAYA RUBEN & DR.G.BASKAR, Experimental Study Of Concrete Reinforcement Material Increment Based Composites
- K.KRISHNA BHAVANI SIRAM, Cellular Concrete Blocks As A Replacement Of Burnt Clay Bricks.
- M.S SHETTY , Concrete Technology

N. SIVA LINGA RAO, Properties Of Aggregate Concrete With Cinder And Silica Fume Admixture