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Experimental Investigation on Porcelain Tile as Partial Replacement for Coarse Aggregate

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ABSTRACT
In this modern world, India is one of the fast growing country in technology as well as infrastructure. Due to an intense rapid growth in infrastructure the demand of resources for construction has reached its peak. This project is based on a experimental study on the suitability of porcelain tile waste as partial replacement for coarse aggregate in concrete. The mechanical properties of the specimen like analyzing flexural and compressive strength characteristics of concrete specimens made out using porcelain tile as substitutes for conventional coarse aggregate as partial replacement using M30 grade concrete. In this project, coarse aggregate is partially replaced with 25%, 50% and 75% by porcelain tile. The water cement ratio is maintained for 0.45. It produces workable concrete with satisfactory strength at 50% replacement.
Keywords: porcelain tile waste, coarse aggregate, flexural strength, compressive strength, M30 grade concrete.

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I. INTRODUCTION

1.1 GENERAL

Now a days in concrete technology many researches are going on to increase the strength and durability of concrete. The growing concern of resource depletion and global pollution has led to the development of how material relying on renewable resources. Porcelain is mainly composed of clay bodies. Porcelain is the new generation of ceramic that is highly head resistant and offer a great resistance against pressure. However, these ceramic cannot be recycled to return to the production line in factories and we inevitably damp it in environment as waste product. To prevent the accumulation of waste product in the environment we can use them as a substitute material in concrete.

1.2 OBJECTIVES

- The main objective of the project is to determine the suitable percentage of porcelain tile waste and also to compare the values of two mixes.
- Compressive strength and flexural strength of the enhanced concrete has to be evaluated.
- To observe the water absorption of concrete containing porcelain tile waste as partial replacement for coarse aggregates.

1.3 SCOPE

- The scope of this project is to make us of porcelain tile waste as a coarse aggregate replacement material as element has coarse aggregate properties and it can be a better replacement for coarse aggregate.
- In our research work we will partially replace the coarse aggregate with porcelain tile.
- We used 25%, 50%, and 75% porcelain tile in place of coarse aggregate and compared the properties of fresh and hardened concrete properties of porcelain tile concrete of M30 grade with conventional concrete.

II. LITERATURE REVIEW

R. Senthamarai and P. D. Manoharan (2011) There is a growing interest in using waste materials such as ceramics as alternative aggregate materials for construction. While other ceramic product wastes such as sanitary wares and electrical insulators have been extensively investigated, not much findings are available on ceramic wall and floor tiles wastes. Thus, the current study focuses on the mechanical characterization of waste ceramic wall and floor tiles aggregate concrete. Ceramic wastes sourced from construction and demolition wastes were separated from other debris and crushed using a quarry metal hammer. After 24 h of casting, the concrete samples were demolded and were cured by immersion in water tank at temperature of 22 °C. The compressive and split-tensile strengths of the hardened concrete samples were determined after curing them for

3, 7, 14 and 28 days. Results showed that both the compressive strength and split tensile strength increased appreciably with the curing age than the conventional concrete.

C. Medina, M. Frías and M.S. De Rojas (2012) A pozzolanic material ordinarily contains high amounts of siliceous or aluminous components, but has no cementitious property until when it reacts with calcium hydroxide, that is available in cement, in the presence of moisture. The present study evaluates the pozzolanicity of ceramic tile powder and its effect on both hydration mechanism and strength property of recycled aggregate concrete. The tensile behavior of RAC was irregular, it initially decreased with 20% ceramic powder addition but it increased when 30% ceramic powder was added. Therefore, ceramic power derived from wall and floor tiles can be used as partial replacement for cement in recycled aggregate concrete.

Anderson et al. (2015) Cast concrete specimens using varying percentages of 20, 25, 35, 50, 65, 75, 80, and 100 of different types of ceramic including floor, wall, and recycled ceramics both with and without sticking mortar. They obtained better results in such concrete properties as compressive, tensile, and flexural strength as well as elastic modulus in specimens containing non-mortar ceramics. In this work, the effects of porcelain tile waste used in concrete mix as a coarse aggregate were investigated on the compressive, tensile, and flexural strengths of concrete and its water absorption. Additionally, the results were compared with those obtained for concrete containing red ceramic waste.

III. MATERIALS

MATERIAL USED IN CONCRETE

The material to be used in this project are

1. Coarse aggregate.
2. Porcelain tile.
3. Fine aggregate.
4. Cement.
5. Water.

3.1 COARSE AGGREGATE

Coarse Aggregate any particles greater than 0.19 inch, but generally range between 3/8 and 1.5 inches in diameter. Gravels constitute the majority of coarse aggregate used in concrete with crushed stone making up most of the remainder.

Aggregates are also used as base material under foundations, roads, and railroads. In other words, aggregates are used as a stable foundation or road/rail base with predictable, uniforms properties (e.g. to help prevent differential setting under the road or building), or as a low-cost extender that binds with more expensive cement or asphalt to form concrete. Coarse aggregate consists of natural disintegration of rock or uncrushed gravel, as per IS:383. Coarse aggregate used in this project is of the size 20mm. The physical properties of coarse aggregates like specific gravity, fineness modulus and water absorption are tested in accordance with IS:2386-3. The Specific gravity, Water absorption (%), Crushing strength (%), and Impact values were obtained such as 2.645, 1.4, 20.19, 10.5.

3.2 PORCELAIN TILE

Porcelain tiles or ceramic tiles are porcelain or ceramic tiles common used to cover floors and walls, with a water absorption rate of less than 0.5 percent. The clay used to build porcelain tiles is generally denser. They can either be glazed or unglazed. The Specific gravity, Water absorption (%), and Impact value (%) were obtained such as 2.36, 0.94, 12.5.

3.3 FINE AGGREGATE

Sand, mineral, rock or soil particles that range in diameter from 0.02 to 2mm (0.0008-0.08 inch). Most of the rock-forming minerals that occur on the Earth's surface are found in sand, but only a limited number are common in this form. Although in some localities feldspar, calcareous material, iron ores, and volcanic glass are dominant constituent of sand, quartz is by far the commonest,for several reasons; it is abundant in rocks, is comparatively hard, has practically no cleavage so that it is not readily worn down, is nearly insoluble in water, and does not decompose. Specific gravity and water absorption values were obtained such as 2.68 and 2.14.

3.4 CEMENT

A cement is a binder, a substance used for construction that sets, hardens and adheres to other material to bind them together. Cement mixed with fine aggregate produces mortar for masonry, or with sand and gravel, produces concrete. Setting and hardening results from hydration, which is a chemical combination of the cement compounds with water that yields submicroscopic crystals or a gel-like material with a high surface area. Because of their hydrating properties, constructional cements, which will even set and harden under water, are

often called hydraulic cements. The most important of these is Portland Cement. The Ordinary Portland Cement (53grade) conforming to IS:8+2-1989 is used. Specific gravity Consistency (%), Initial setting time (minutes), Final setting time (minutes), were obtained such as 3.14, 31, 32, 320.

3.5 WATER

Water, a substance composed of the chemical elements hydrogen and oxygen and existing in gaseous, liquid and solid states. It is one of the most plentiful and essential of compounds. A tasteless and odorless liquid at room temperature, it has the important ability to dissolve many other substances.

IV. MIX DESIGN

4.1 MIX PROPORTION

Table 4.1 Mix Proportion

CEMENT	FINE AGGREGATE	COARSE AGGREGATE
437.78 kg/m3	664.3 kg/m3	1173 kg/m3
1	1.52	2.6

V. RESULTS DISCUSSION

5.1 Comprehensive Strength

Mix	Compressive strength N/mm2		
	7days	14days	28days
0%	19.22	26.13	29.12
25%	21.00	27.85	32.14
50%	25.14	32.53	37.59
75%	23.10	29.78	34.33

5.2 Split Tensile Strength

Mix	Split Tensile strength N/mm2		
	7days	14days	28days
0%	2.40	2.52	3.13
25%	2.58	2.64	3.40
50%	3.33	3.70	4.05
75%	3.29	3.50	4.32

5.3 Flexural Strength

Mix	Flexural strength N/mm2		
	7days	14days	28days
0%	2.33	3.1	3.51
25%	2.61	3.35	3.82
50%	3.29	4.56	5.16
75%	3.14	4.05	4.58

5.4 Load Frame Test

S. No	Load	Deflection
1	0	0
2	5	0.010
3	10	0.020
4	15	0.030
5	20	0.040
6	25	0.080
7	30	0.140
8	35	0.150
9	40	0.200
10	45	0.260
11	50	0.330
12	55	0.360
13	60	0.420
14	65	0.590

VI. CONCLUSION

In this experimental study to use porcelain tile waste material as replacement for concrete aggregate not only to improve concrete properties but also to prevent the accumulation of waste product in the environment. Ceramics generally harder than the coarse aggregates. For this reason, porcelain tile waste can be abused to increase concrete compressive strength. The results of this study may be encapsulated as follows: Replacement

of porcelain waste by 50% for coarse aggregate was capable of increasing compressive strength by up to 29.09%.Porcelain tile waste was found to improve concrete modulus of rupture by up to 23.05% for a 50% replacement of coarse aggregates. It can be concluded that, within the scope of experimental carried the porcelain tile waste concrete can be a suitable alternate for conventional concrete. It could be a economical as compared to the conventional concrete.

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