JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Experimental Investigation on Partial Replacement of Aggregate with Ceramic Tile Waste in Concrete

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ABSTRACT

As per preservation endeavors, this examination concentrates on the waste tile aggregate as partial course aggregates replacement for concrete creation, the counter active action of ecological contamination with considering the components of reasonable and cost-sparing development ventures, particularly material utilization. Moreover, many of the construction industry in India produce construction waste that contributes largely to solid waste. Utilizing ceramic tile waste, this research will focus on ceramic wastes obtain from the construction industry in India, Presently, much of ceramic industries production goes to waste, which is not undergoing the recycle process yet. In our work, total 180 cubes, 45 beams, 45 cylinders were cast with four different proportion. Ceramic waste as partial replacement of coure aggregates with the percentage of 8%, 16%, 24% and 32% of ceramic aggregates as partial replacement of course aggregates with M-30 grade of concrete. Besides that, all other parameters are constant. The concrete cube, beams and cylinder were tested as destructive test at last which is compression test, that to find out compressive strength, tensile strength, and flexural strength of specimens of hardened concrete at 7, 14 and 28 days. From the results of the study, samples of concrete with 0 to 40% ceramic course aggregate replacement have reached optimum strength. Findings showed that concrete containing Ceramic Tile 0 to 40% showed the highest amount of compressive strength, flexural strength and split tensile strength of concrete.

Keywords- Strength, Slump, Green Concrete, Ceramic waste, recycled ceramic Tiles aggregates, and floor tile

1. Introduction

The worth of cement in present society can't be belittled. We can see solid constructions all over the place, like structures, streets, scaffolds, and dams. There is no getting away from the effect solid makes on your regular daily existence. Concrete is a composite material which is comprised of filler and a fastener. Common cement is a combination of fine aggregates total (sand), coarse aggregates (rock), concrete, and water. Concrete and lime are normally utilized as restricting materials, while the sand fastener is blended as fine aggregates and squashed stones, rock, broken blocks; clinker is utilized as coarse aggregates. The solid having concrete, sand and coarse aggregates stir up in a proper rate notwithstanding water is called concrete cement. In this sort of solid, concrete is utilized as a limiting substance, sand as fine aggregates and rock, squashed stones as coarse aggregates.

Concrete is a most adaptable development material since it is proposed to withstand the unsafe circumstances, with acceptable strength and sturdiness. Because of overutilization of the solid material breezes up evidently terrified, and

besides, the age at greater rate make various unsafe to the earth. On inverse side, the waste introduced to our condition is an impact to natural cycle, among all mechanical waste, is the huge wellspring of waste which will impact the earth.

Concrete and aggregate, which are the most essential constituents utilized in solid creation, are the fundamental materials needed for the development business. This certainly incited a constant and extending enthusiasm of natural materials used for their production. Corresponding to the need for the use of the regular assets develops a making pressure for ensuring the earth and a need to save characteristic assets, for like total, by utilizing elective materials that are either reused or disposed of as a waste.

The greater part of the development and destruction squander in our nation are not reuse yet end up in landfills possessing important land also the expense brought about in landfilling. However, many of the construction industry in India produce construction waste that contributes largely to solid waste. In general, the solid waste material is an aftereffect of the development squander material or leftover outcomes from the remodel of the structure like stone, wood, iron, concrete and other waste materials. This exploration will zero in on artistic squanders got from the business in India. As of now inthe clay industry, the creation goes to squander, which isn't going through the reuse interaction yet. Routinely, the coarse total utilized in solid creations are rock, squashed stone, stone, and limestone. Ceramics are consistently used as a piece of create of the divider and floor tiles, and squares and material tiles.

2. Literature review

The general features of a few selected experiments researches related to the properties of recycled ceramic aggregates are discussed here in after.

Varinder Singh (2019) this waste material should be reused in solicitation to organize the obliged resource of trademark all out and to reduce the improvement wastes. Beat waste stoneware tiles, crushed waste creative tile powder and Granite powder are utilized as a replacement to the coarse sums and fine aggregate. The creative waste pummeled tiles were to some degree displaced rather than coarse aggregates by 10% -40 and half. Rock powder and ceramic tile powder were replaced rather than fine complete by 10% close by the stoneware coarse tile. M25 audit of concrete was organized and attempted. The mix plan for various kinds of mixes was set up by superseding the coarse sums and fine all out at unmistakable paces of broken tiles and rock powder. Test study like convenience, Compressive quality test, Split flexibility test, Flexural quality test for some, concrete mixes with various paces of waste crushed likewise, stone powder following 7, 14 and 28 days alleviating period has done. It has been seen that the usefulness increases with increase in the phase of replacement of stone powder and beat tiles increases. The nature of concrete in like manner increases with the ceramic coarse tile total up to 30% rate.

Muralidharan.T (2018) This paper manages the test concentrate on the mechanical strength properties of M25 grade concrete with the fractional substitution of sand by utilizing fired waste. To examine the mechanical properties like compressive, split rigidity, the examples were casted with 15-30%, substitution of sand utilizing fired waste and tried for various times of relieving like 7 days, 14 days and 28 days. The ideal of rate expansion of Ceramic waste is broke down thinking about the prerequisites of mechanical properties of cement.

Shaik Akhil Mastan et al. (2017) has inspected out that exploratory examination on incomplete supplanting of concrete with fly debris and fine total with foundry sand. The 3D shapes and chambers are settled at 7 years of age and 28 days. Strong shapes for compressive strength as size 15X15X15 cm and chamber for split inflexibility as size 15X30 cm were tossed by accepting weight clustering and hand mixing. The mix was relegated with various degree of waste clay tiles, for instance, 0%-40% and half to survey various properties. The result which diverts out from the assessment work exhibits that the strength made in concrete is extended, it tends to be compared to higher strength cement and it very well may be easily used as advancement material being developed work.

3. Cement

Ordinary Portland Cement of Grade 53 is utilized, which adjusting IS 12269 Cement might be recommended as a material with adhesive and cohesive properties which make it fit for bonding material sections into a minimal entirety. The most ordinarily utilized cement in development today is Portland cement and thus Ordinary Portland Cement of 53 grades has been chosen for the examination.

Figure 1: Ordinary Portland cement Sample

The aggregates which stayed on 4.75mm IS Sieve is called coarse aggregates, coarse aggregate is uncrushed rock or stone which comes about because of the characteristic breaking down of rocks, squashed rock or stone when it comes about because of smashing of rock or hard stone. A coarse aggregate which is utilized as a partof the concrete solid shape is affirmed by IS 383.oarse Aggregate

4. Coarse Aggregate

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Figure 2: Course aggregates of 20 mm size Sample

5. Fine Aggregate

Aggregate which goes from 4.75 mm sifter and contains just so substantially coarser material as allowed, fine aggregate is normal sand which is coming about because of the characteristic crumbling of shake and which has been saved by streams or chilly offices, it is additionally pounded stone sand which is created by pulverizing hard stone, it is likewise smashed rock sand which delivered by squashing regular rock.

Figure 3: Sand Sample

6. Water

Water used in the concrete cube is confirming the specification of IS 456: 2000. Water utilized for blending is liberated from the damaging measure of oils, acids, antacids, salts, sugar, natural materials or different substances that might be pernicious to concrete.

7. Ceramic Waste

Ceramic waste is available from huge ceramic modern offices, ceramic thing delivering units and from standard advancement works out. Traditional pottery, for instance, blocks, roof and floor tiles, other advancement materials, and specific ceramics, for instance, porcelain are ordinarily heterogeneous in view of the wide compositional extent of the basic muds used as rough materials.

Figure 4: Ceramic Waste Sample

8. Concrete Mix Design

Concrete mix designs can be mined complex. The choice of a concrete mix depends upon the need of the undertaking both to the extent quality and appearance and in association with close-by order and development laws. The design starts by choosing the requirements of the concrete. These necessities ponder the atmospheric conditions that the concrete will be introduced to an advantage and the required framework.

Table 1. Consistency of cement

S. No.	Depth of penetration in Different Trail	Percentage of Water added				
		25%	27%	29%	31%	33%
1	Trial-1	27	29	31.5	32	33
2	Trial-2	28.5	30	32	32.5	34
3	Trial-3	29	31.5	33	31.5	33.5

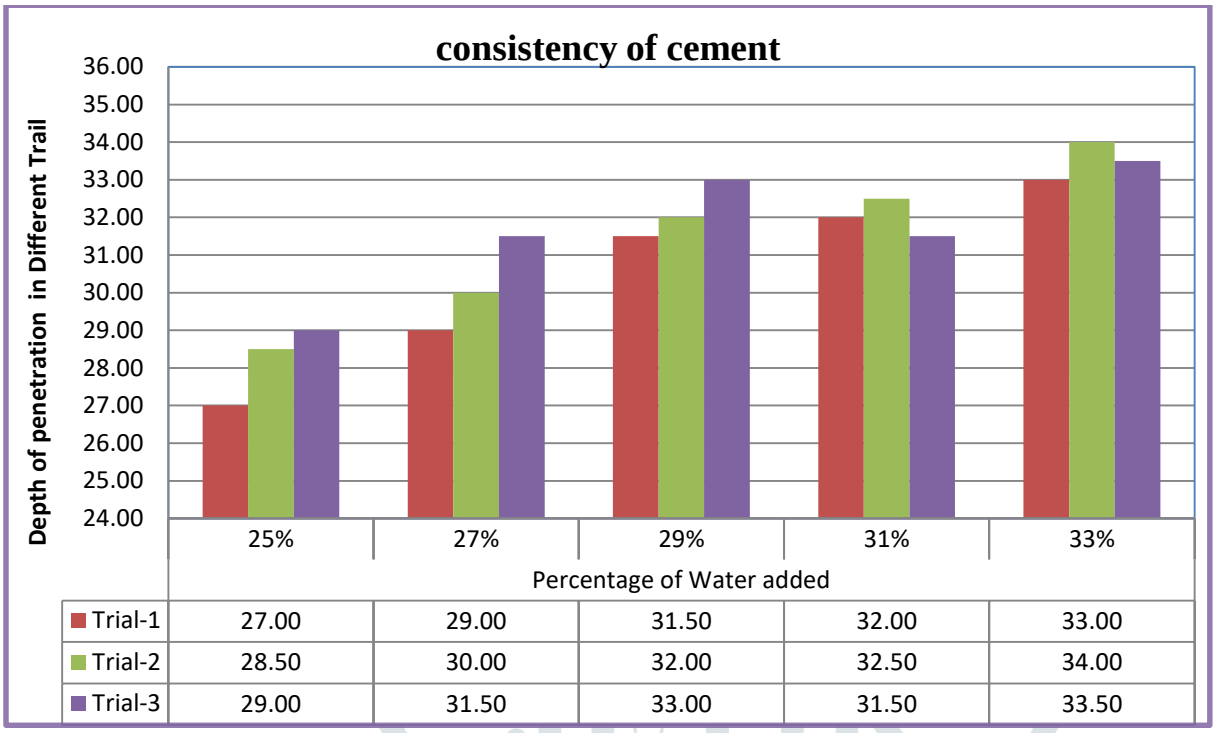


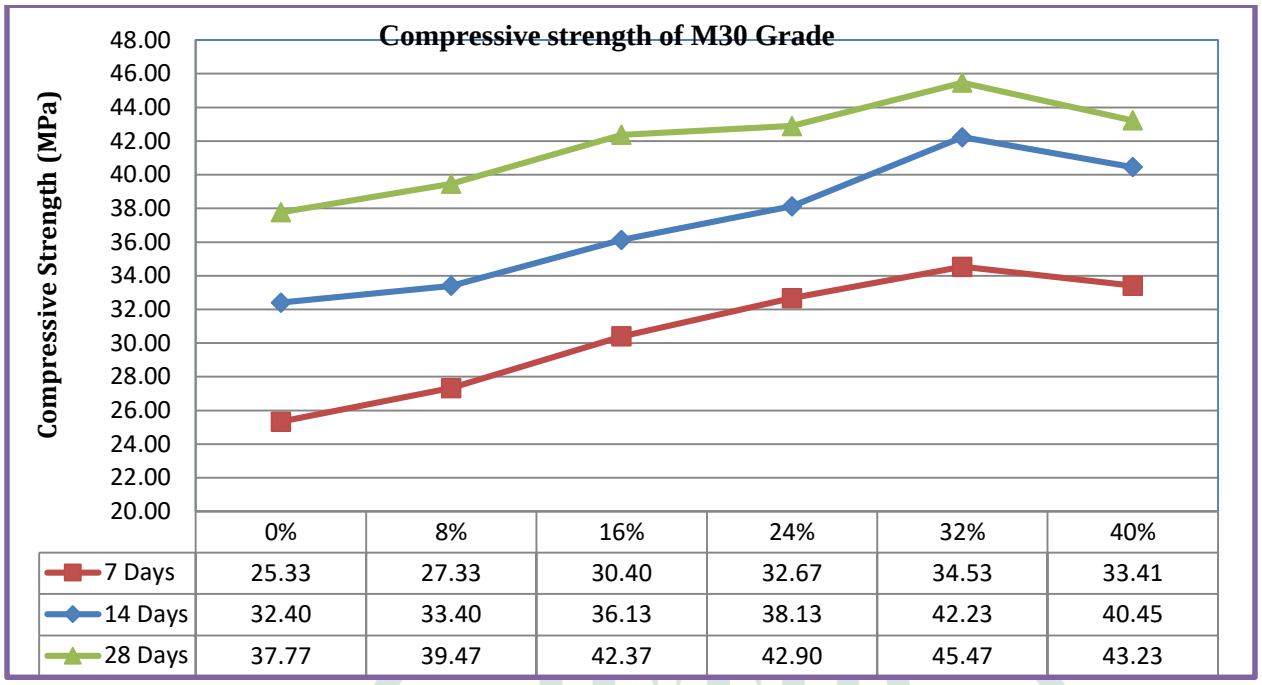
Fig. 5 consistency of cement

9. Compressive Strength of M30 Grade

The result of CTM of M30 grade of concrete cube having ceramic waste crushed tile aggregates replacement of fine aggregate with the percentage of 0%, 8%, 16%, 24%, 32% and 40% with normal aggregate, design mix is given in Table 2

Table 2. Compressive strength of M30

Compressive strength of M30 (N/mm^2)						
Days	**0**	**8**	**16**	**24**	**32**	**40**
7	25.33	27.33	30.40	32.67	34.53	33.41
14	32.40	33.40	36.13	38.13	42.23	40.45
28	37.77	39.47	42.37	42.90	45.47	43.23



	0%	8%	16%	24%	32%	40%
7 Days	25.33	27.33	30.40	32.67	34.53	33.41
14 Days	32.40	33.40	36.13	38.13	42.23	40.45
28 Days	37.77	39.47	42.37	42.90	45.47	43.23

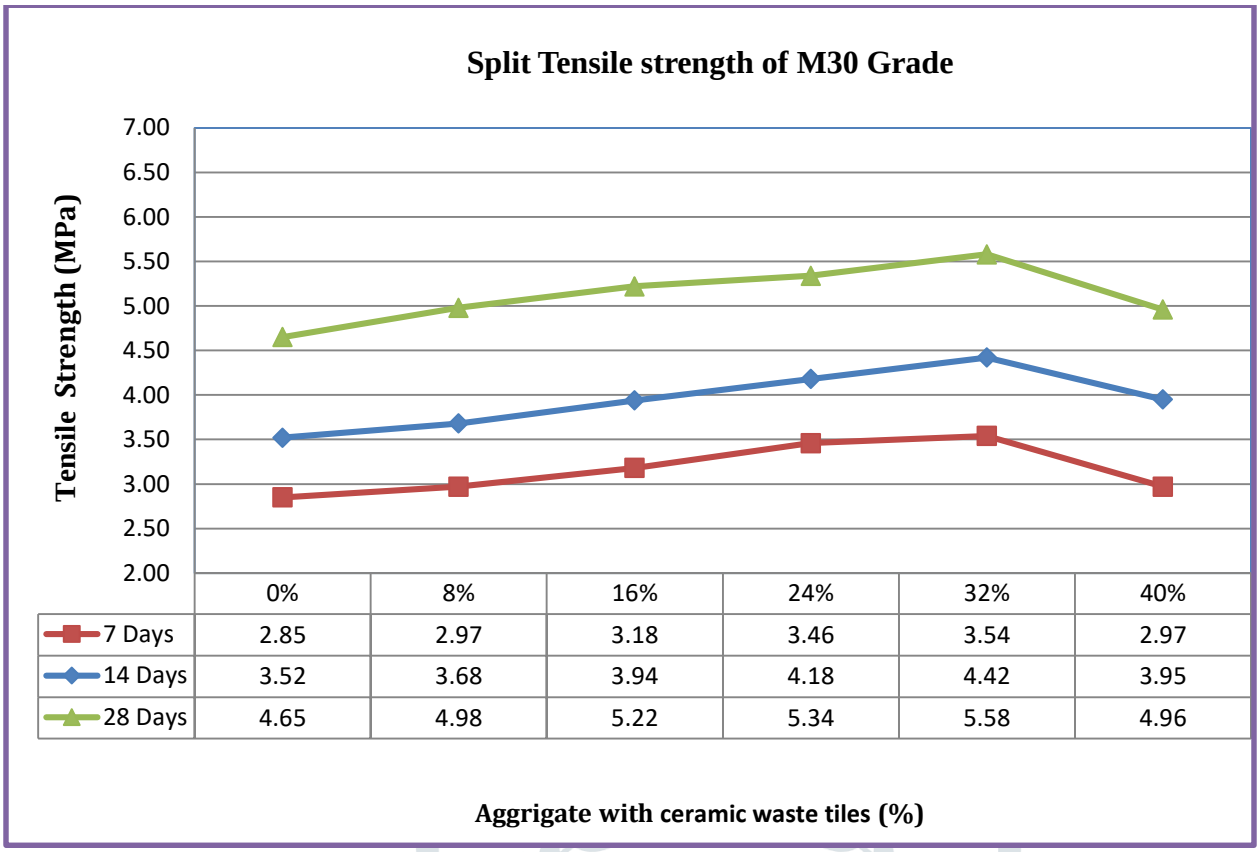
Fig. 6. Compressive strength of M30 grade

10. Split Tensile strength of M30

The split tensile strength of the concrete material is attempted by making chamber of size 150mm x 300mm and is reliably cured for 7,14 and 28 days testing. Completely 45 chambers were casted for standard M30, grade and for 0%, 8%, 16%, 24%, 32% and 40% by weight fractional replacement of ceramic waste crushed tile aggregate for coarse aggregate.

Table 3. Split Tensile strength of M30

Tensile Strength in N/mm^2 contain ceramic waste tiles aggregate						
Day's	0	8	16	24	32	40
7	2.85	2.97	3.18	3.46	3.54	2.97
14	3.52	3.68	3.94	4.18	4.42	3.95
28	4.65	4.98	5.22	5.34	5.58	4.96



	0%	8%	16%	24%	32%	40%
7 Days	2.85	2.97	3.18	3.46	3.54	2.97
14 Days	3.52	3.68	3.94	4.18	4.42	3.95
28 Days	4.65	4.98	5.22	5.34	5.58	4.96

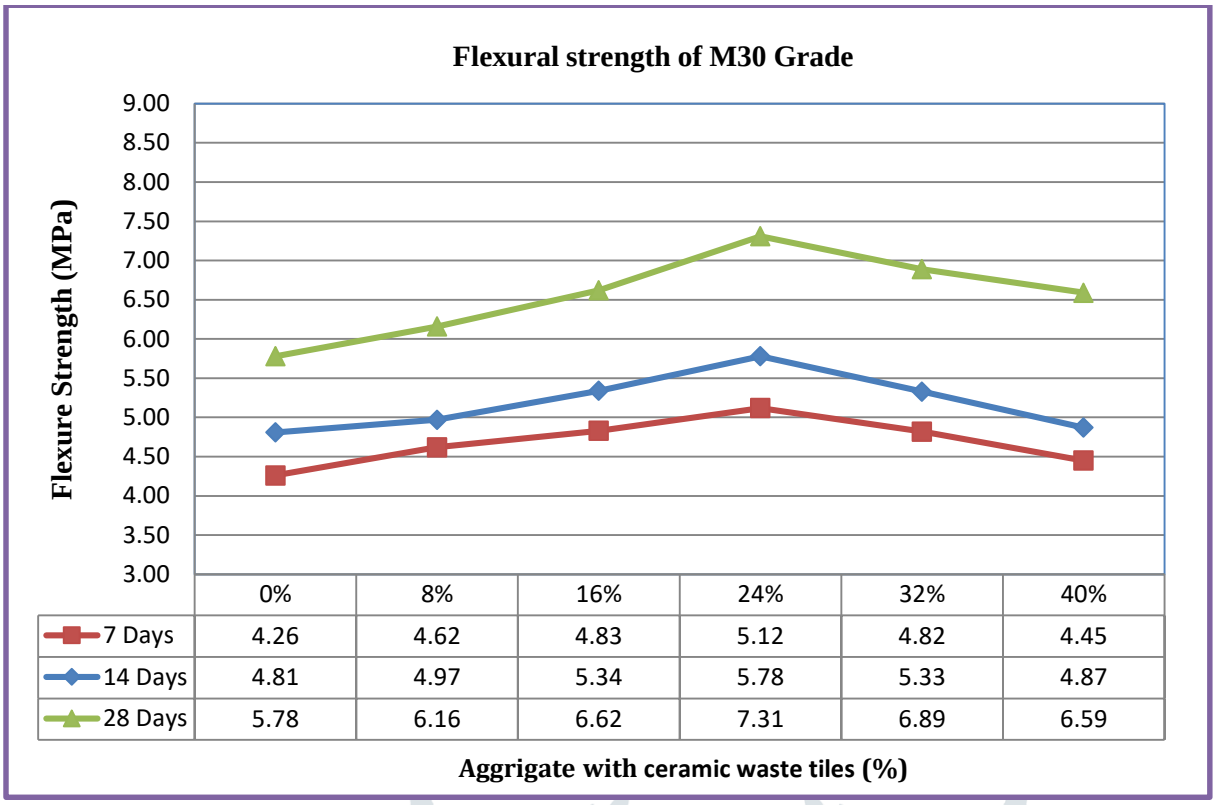
Fig. 7. Split Tensile strength of M30

11. Flexural strength of M30

The results are determined by the universal testing machine. M30 grade of concrete contains ceramic waste tiles aggregate with the replacement of coarse aggregate.

Table 4. Flexural strength of M30

Flexure Strength in Div. contain ceramic waste tiles aggregate						
Day's	**0**	**8**	**16**	**24**	**32**	**40**
7	4.26	4.62	4.83	5.12	4.82	4.45
14	4.81	4.97	5.34	5.78	5.33	4.87
28	5.78	6.16	6.62	7.31	6.89	6.59



	0%	8%	16%	24%	32%	40%
7 Days	4.26	4.62	4.83	5.12	4.82	4.45
14 Days	4.81	4.97	5.34	5.78	5.33	4.87
28 Days	5.78	6.16	6.62	7.31	6.89	6.59

Fig. 8. Flexural strength of M30 grade of ceramic waste tiles aggregate

5. Conclusions

Following are the salient conclusions of the study:-

1. In this exploratory examination, we have used waste tiles aggregate as incomplete substitution of coarse aggregate an option material of concrete for M30 review of concrete and from different tests on fresh and solidified concrete we have closed after outcomes.

2. The fundamental point is to find the water content required to make a concrete paste of standard consistency as dictated by the IS Code. The rule is that standard consistency of concrete is that consistency at which the Vicat plunger enters to a point 5-7mm from the base of Vicat shape. The consistency of the bond in this examination was seen to be 34%.

3. Slump exhibits that the workability decrements with the extension in the rates of containing ceramic waste tiles aggregate with the percentage of 0% to 40%. All investigated containing ceramic waste tiles aggregate mixes had stature slump regards and commendable workability a M30 grade of concrete.

4. Compressive quality outcomes speak to that concrete threw within M30 review of concrete at 7, 14 and 28 days have increments with the level of the ceramic waste crushed tiles aggregate increment from 0 to 32% and reduces after 32% to 40% at 7,14 and 28 days.

5. We can see that the split tensile strength of concrete is extended when the level of the ceramic waste

tiles aggregate have increments from 0 to 32% and reduces after 32% to 40% at 7, 14 and 28 days with M30 review.

6. We can see that the flexure quality in M30 audit of concrete at 7, 14 and 28 days, flexural quality are higher than when level of usage of 0%, 8%, 16% and 32% of the level of the ceramic waste tiles aggregate with the replacement of coarse aggregate increments and reduce after 24% to 40% with the age of 7, 14 and 28 days

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