Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 10, October : 2023

INVESTIGATION ON USING TILES WASTE AS REPLACEMENT OF FINE AND COARSE AGGREGATE IN CONCRETE

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Abstract

It has been shown that ceramic wastes may be used to replace both fine and coarse aggregates while making concrete. According to studies, 20–30% of the materials produced in tile production facilities are squandered. The purpose of this investigation is to ascertain if leftover tiles may replace some of the coarse and fine concrete particles. Due to these factors, recycling demolition debris from buildings, such as ceramic tile, has become an effective way to reduce solid waste and address the shortage of natural aggregates required to make concrete. There are other activities than building demolition that generate garbage made of ceramic tiles. Crushed waste ceramic tile powder and crushed waste ceramic tile crushed may be used in place of coarse and fine aggregates. 10%, 20%, 30%, 40%, and 50% of broken ceramic waste tiles were utilized to replace the coarse aggregates. Along with the ceramic coarse tile, 10% of the fine aggregate was substituted with ceramic tile powder. The M20 concrete grade was developed and tested. Crushed tiles and tile powder were used in varying amounts to replace coarse and fine aggregates in the mix design for various kinds of mixes. Workability tests, compressive strength tests, and split tensile strength tests on various concrete mixtures with varying percentages were performed after 7, 14, and 28 days of curing.

Keywords: Crushedtiles,Compressivestrength,Splittensilestrength

1. INTRODUCTION

GENERAL

Cement, fine aggregates, and coarse aggregates have long been used in the design of concrete mixes and are essential to the planning of a particular grade of concrete. But lately, the cost of materials has gone up. Fine aggregates, coarse aggregates, and cement must be replaced by a few more locally available, inexpensive resources in order to achieve the same strength as these fundamental components. The rapid depletion of natural resources raises the price of the many buildings that depend on them. This helps engineers and researchers find replacement building materials while keeping quality, strength, and stability in mind. One of the most important components of concrete is the coarse aggregate, which makes up between 70 and 80 percent of its volume and greatly influences both its physical characteristics and attributes.However, the demand for this particular construction material cannot be readily met due to rising urbanization and population expansion, especially in nations like India. As a consequence, waste products like old ceramics might be utilized to address this problem. Ceramic tile production in India is estimated to cost over 21,000 Core. Reports state that the Indian Ceramic Tiles industry grew by around 11% in 2013–14, and by 2016 it is expected to be worth Rs. 301 billion. A report released in February 2016 by the Worldwide Ceramic Tiles Material on the Market predicted that from 2016 to 2020, the global ceramic waste materials market will grow at a compound annual growth rate of 9.57 percent. Between 1000°C and 1250°C are used to create ceramic products, which produce materials that are very strong and resistant to freezing, chemical, and thermal stress. Concrete need to be utilized in lieu of conventional construction materials given the properties of ceramic waste, such as broken tiles. This helps to address problems that may arise due to improper waste disposal, such as cost, scarcity, and other environmental difficulties.

TILEAGGREGATE INCONCRETE
In this, broken tiles are used in lieu of the coarse aggregate and tile powder is used in place of the fine aggregate. Crushed tiles were used to replace fine and coarse aggregates both separately and in combination (both coarse and fine aggregates at the same time in a single mix).

The workability technique was used to examine the acceptability of these crushed waste tiles and tile powder in concrete mixes with various proportions of these components. The slump cone test is used to verify whether freshly laid concrete is usable. Testing for 3, 7, and 28 days of compressive strength on casting cubes is also performed to determine the impact of various waste component percentages on strength. Understanding the behavior and functioning of ceramic solid waste in concrete is the aim of this research. 10%, 20%, 30%, 40%, and 50% of the coarse aggregate is replaced by the remaining shattered tiles.

2. Literature Review

N.NaveenPrasad(2016)[1]: The position of coarse and fine aggregates was filled by crushed waste tiles and granite powder. While 10%, 20%, 30%, and 40% of granite powder were replaced for fine aggregate, 10%, 20%, 30%, and 40% of waste broken tiles were used in place of coarse aggregate without altering the mix design. The M20 concrete grade was created to provide the standard mix. By substituting cracked tiles and granite powder at varying percentages for coarse and fine aggregates, several kinds of mixes were created without altering the mix design. An inquiry is carried out by an experiment. It was discovered that the workability of concrete rose as the quantity of coarse aggregate substituted increased, with the compressive strength reaching its maximum at 30% coarse aggregate replacement.

R.M. Senthamarai et al. (2005) [2]: The crushed stone aggregate was substituted with ceramic electrical insulator. The water cement ratios of 0.35, 0.40, 0.45, 0.50, 0.55, and 0.60 were used. We found the elastic modulus, split tensile strength, flexural strength, and compressive strength. The compressive, split tensile, and flexure strengths of ceramic coarse aggregate are 3.8 percent, 18.2 percent, and 6% lower, respectively, than those of ordinary concrete.

ArunaD (2015) [3]: With tile waste-based concrete, coarse aggregates were replaced with 20 mm smaller stones, and 0%, 5%, 10%, 15%, 20%, and 25% of the cement was replaced with tile wastes. Additionally, fly ash was utilized in place of portion of the cement. At a replacement rate of 25%, roof tile aggregate concrete reaches its average maximum compressive strength. A 25% substitution of roof tile aggregate leads in a 10- 15% loss in strength when compared to ordinary concrete. Concrete produced from discarded roof tiles has moderate workability. Tiles might be replaced with concrete in basic structures instead of.

Marwein, BatritiMonhun R. (2016) [4]: Broken tiles make up the ceramic trash. These tiles were used to make ceramic waste concrete (CWC) in ratios of 0%, 15%, 20%, 25%, and 30%. All concrete combinations use M20 grade concrete and a constant water to cement ratio of 0.48. The distinctive characteristics of concrete are identified at 3, 7, and 28 days, including workability for newly laid concrete as well as compressive strength and split tensile strength. According to the study, waste tile aggregate replacement should range from 5 to 30 percent, and it is appropriate for widely used mixes like M15 and M20.

D. Tavakoli (2012) [5]: Ceramic waste used in the production of concrete has no observable negative effects on the properties of the concrete. The optimal circumstance for utilizing tile waste as coarse aggregate is in proportions ranging from 10% to 20%, while the best scenario for using it as sand is in quantities ranging from 25% to 50%. These results reveal an increase in compressive strength, a decrease in unit weight, and no appreciable negative effects on water absorption.

T. Sekar (2011) [6]: Researchers tested the strength of concrete using waste materials such as shattered glass, ceramic insulator trash, and ceramic tile waste. When compared to the other two types of rubbish, ceramic tiles produced the greatest outcomes. In terms of compression, split tensile, and flexure strength, ceramic tile aggregate concrete is comparable to conventional concrete.

M.CANBAZANDB.TOPU(2010)[7]: The waste generated from the tile industry is sufficient to replace the coarse aggregate used in concrete. Recycling ceramic tile benefits both the environment and business. The cost-effectiveness of the construction is increased when tile aggregate is used since it reduces the self-weight of concrete by around 4%. The substitution of tile aggregate has a detrimental impact on the concrete's strength in terms of both compressive strength and split tensile strength. This study focused on the biggest percentages of tile waste that could be reduced into smaller percentages and used to produce concrete with acceptable qualities.

M. Ignacio Guerra-Romero, and Julia Ma Morán-del Pozo (2014) [8]: The research is focused on ceramic trash generated by Spanish businesses. The recycled ceramic aggregates complied with all technical standards set out by current Spanish law, and the concrete was constructed in line with the Spanish concrete code. 100% of coarse aggregate has been replaced with ceramic aggregate. The appropriate tests were carried out to compare the mechanical characteristics of the innovative concrete to those of traditional concrete. The qualities of the concrete created with ceramic ware aggregate are comparable to those of the concrete prepared with regular gravel.

Shakeel Ahmad and Md Daniyal (2015) [9]: Ceramic material is delicate, which results in a substantial quantity of waste during production, shipping, and installation. Crushed waste ceramic tiles were employed in concrete at replacement rates of 10%, 20%, 30%, 40%, and 50% in lieu of natural coarse aggregates. The study found that adding ceramic tile aggregate to concrete enhances its properties by increasing both compression strength and flexural strength.

Khaloo (1995) [10] Crushed tile has been investigated as a source for coarse aggregate in concrete. The crushed tile exhibited a higher water absorption value and a lower density as compared to actual crushed stones. Because the coarse aggregate is 100% crushed tile, the resulting concrete had a lower density and stronger compressive (+2%), tensile (+70%), and flexural(+29%)strengths.

Parminder Singh ,Dr. Rakesh Kumar Singla (2015) [11] a study on the use of leftover commercial ceramic tiles; and Studies have been done on a partial replacement for coarse aggregate. Three distinct concrete grades have been produced and tested. Ceramic tile aggregate should be used in concrete because of its qualities that increase strength, even if the findings go against conventional thinking. Finally, it was discovered that 20% is the appropriate amount of ceramic tile in M20 grade concrete.

Paul O. Awoyera (2016) [12] examined the application of ceramic tiles in concrete in this study. On construction projects in Ota, Lagos, and Nigeria, ceramic fine and coarse aggregates are substituted for coarse and fine aggregates in various ratios. The strength properties of regular concrete are looked at when fine and coarse ceramic particles are substituted. Finally, it claims that employing ceramic waste instead of conventional concrete strengthens the concrete much more.

P.Rajalakshmi[13],Utilizing ceramic waste will be a successful first step toward increasing concrete's durability and protecting the environment. Concrete made using ceramic wastes as opposed to aggregates has significant environmental advantages. In the ceramics sector, over 30% of output is wasted. Ceramic waste aggregate is a more tenacious and resilient material than traditional coarse aggregate. It is capable of withstanding harsh temperatures. The leftover ceramic aggregate is very durable. This study looked into substituting 30%, 60%, or 100% of the coarse aggregate with ceramic tiles while utilizing M-30 grade concrete, as well as 10% or more of the fine aggregate. This study demonstrates that, regardless of the kind of concrete utilized, leftover ceramic tiles may be used in lieu of coarse and fine aggregate. Remaining ceramic tiles have a maximum strength of 10% CFA and 60% CCA and are very strong.

Prof. Shruthi H. G. (2016) [14] Ceramic tiles contaminated the environment when they were taken from industrial, construction, and demolition sites. The use of crushed tile as a coarse aggregate in concrete would also be advantageous to the economics. The research utilized M20 grade concrete and substituted 0%, 10%, 20%, and 30% of the native coarse aggregate in the concrete with ceramic tile waste. After 3, 7, and 28 days, the concrete molds' compressive and split tensile strengths were evaluated. The findings show that when natural coarse aggregate is replaced for ceramic tile aggregate by 30%, the best compressive strength is attained.

M.TawfeeqWadhah (2016)[15]: The effects of employing crushed tiles (CT) as coarse aggregate in concrete mix were investigated in this research. The technique for recycling concrete is well-established in the US. It has been shown that it is economical to create roads, streets, and highways using recycled Portland cement concrete and asphaltic concrete. It comprises the gravel-to-sand ratio in addition to the amount of water and the number of tiles. They found that the compressive strength rises when the water-to-cement ratio decreases. In the paper, only 50% and 100% of the broken tiles have been replaced. The study found that using shattered tiles as coarse aggregate in amounts less than 50% would have significant characteristics.

3. METHODOLOGY

3.1 MATERIALS:

Thefollowingmaterialswereutilisedinthisinvestigation:
OrdinaryPortlandCementof Grade53,inaccordancewithIS169-1989
CoarseandFineaggregatesthatmeetIS:2386-1963specifications.
AggregateOfCeramicTile
Water.

3.1.1 Cement:

SL.NO	Properties	Test results	IS: 169-1989
1.	Normal consistency	0.32	
2.	Initial setting time	50min	Minimum of 30min
3.	Final setting time	320min	Maximum of 600min
4.	Specific gravity	3.14	
5.	Compressive strength		
	3days strength	23.2 Mpa	Minimum of 23Mpa
	7days strength	33.6 Mpa	Minimum of 33Mpa
	28days strength	43.6 Mpa	Minimum of 43Mpa

Table-1 Properties of cement

3.1.2 Fine Aggregate:

S.No	Description Test	Result
1	Sand zone	Zone- III
2	Specific gravity	2.59
3	Free Moisture	1%
4	Bulk density of fine aggregate (poured density) Bulk density of fine aggregate (tapped density)	1385.16 kg/m3 1606.23 kg/m3

Table 2: Properties of Fine Aggregate

3.1.3 Coarse Aggregate:

S.No	Description	TestResults
1	Nominalsizeused	20mm
2	Specificgravity	2.9
3	Impactvalue	10.5
4	Waterabsorption	0.15%
5	Sieveanalysis	20mm
6	Aggregatecrushingvalue	20.19%
7	Coarseaggregate Bulkdensity(Poureddensity)	1687.31kg/m3

3.1.4 AggregateofCeramicTile:

Broken tiles were gathered from the solid refuse of a ceramic manufacturing factory and a destroyed structure. The broken tiles were taken care of and mechanically reduced to tiny fragments. Crushed tile aggregate that was separated and the right size was used to partly replace the natural coarse aggregate. The tile waste with a dimension of less than 4.75 mm was disregarded. Crushed tile aggregate that has passed through a 16.5mm sieve and been held on a 12mm screen is used. Crushed tiles were used to replace coarse aggregate in the following ratios: 10%, 20%, 30%, 40%, and 50%, in addition to replacing fine aggregate.

Fig.1:CeramicTileAggregateSample

3.1.5 CERAMICTILE-FINEAGGREGATE:

After being crushed, some of the tile aggregate has a finer particle size. Since it is also a waste, this product, which is equal to sand, is used as a substitute for fine aggregate in concrete. The aggregate that passes through the 4.75mm screen replaces 10% of the fine aggregate in addition to the coarse material.

Fig.2:CeramicTilefine AggregateSample

S. No	Description	Test Results
1	Origin Rock	Feldspar
2	Impact value of crushed tiles	12.5%
3	Specific gravity of crushed tiles	2.6
4	Specific gravity of tile powder (C.F.A)	2.5
5	Water absorption of crushed tiles	0.19%

Table4: Properties of Ceramic tile aggregate

3.2 MIXING

On a non-porous surface is where mixing should take place. Distribute the prescribed quantities of

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Volume : 52, Issue 10, October : 2023
coarse and fine aggregate in alternating layers. When the mixture is evenly colored, pour the cement over it and stir it dry several times with a shovel. A coating of this uniform mixture 20 cm thick is applied. Water is added to the mixture, and it is then turned over. Until a good, consistent, homogenous concrete is produced, this procedure is repeated. Noting that the water is sprinkled rather than poured is also crucial. A little quantity of water should be added at the end of the mixing procedure to get the proper consistency. At that moment, even a little quantity would be sufficient.

3.2.1 Mix Proportion:

CEMENT	NFA	NCA	WATER
330	605	1275	185
1	1.52	3.18	0.55

For10%CCAAggregates:
MixProportions:

CEMENT	NFA	NCA	CCA	WATER
330	605	1175	100	185
1	1.52	2.85	0.33	0.55

For20%CCAAggregates:
MixProportions:

CEMENT	NFA	NCA	CCA	WATER
330	605	1030	240	185
1	1.52	2.53	0.65	0.55

For30%CCAAggregates:
MixProportions:

CEMENT	NFA	NCA	CCA	WATER
330	605	925	350	185
1	1.52	2.28	0.90	0.55

For40%CCAAggregates:
MixProportions:

CEMENT	NFA	NCA	CCA	WATER
330	605	795	480	185
1	1.52	1.93	1.25	0.55

For50%CCAAggregates:
MixProportions:

CEMENT	NFA	NCA	CCA	WATER
330	605	675	600	185
1	1.52	1.61	1.57	0.55

For10% CCA+10%CFAAggregates:
MixProportions:

CEMENT	NFA	CFA	NCA	CCA	WATER

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330	545	60	1175	100	185
1.1	1.37	0.15	2.85	0.33	0.55

For20% CCA+10%CFAAggregates:
MixProportions:

CEMENT	NFA	CFA	NCA	CCA	WATER
330	545	60	1030	240	185
1.1	1.37	0.15	2.53	0.65	0.55

For30% CCA+10%CFAAggregates:
MixProportions:

CEMENT	NFA	CFA	NCA	CCA	WATER
330	545	60	925	350	185
1.1	1.37	0.15	2.28	0.90	0.55

For40% CCA+10%CFAAggregates:
MixProportions:

CEMENT	NFA	CFA	NCA	CCA	WATER
330	545	60	795	480	185
1.1	1.37	0.15	1.93	1.25	0.55

In this project, concrete grades M20 are developed with an appropriate water cementratio to provide therequired concretestrength, as well as fordifferent fine and coarseaggregate mixreplacements.

4. RESULTS & DISCUSSIONS

4.1 WORKABILTY:

Concrete that is workable in all circumstances, that is, that can be prepared quickly, put,compacted,andmoulded,isconsideredtobeperfect.Inthischapter,two alternative methods are used to gauge the workability, and they are as follows:

4.1.1 SlumpConeTest: Thetest wascarried outonfreshlypreparedconcrete thathadbeen placed before to the moulding process. A total of 14 concrete mixes are produced atvarious periods throughout the day. Workability Table 6 displays the results of a slump conetestperformed onconcrete ofgradeM20.

S.No	MixDesignation	AggregateReplacements %(CCA+CFA)	Workability(mm)
			M20
1	Mix1	0+0	65
2	Mix2	10+0	68
3	Mix3	20+0	71
4	Mix4	30+0	76
5	Mix5	40+0	81
6	Mix6	50+0	83
7	Mix7	10+10	65
8	Mix8	20+10	69

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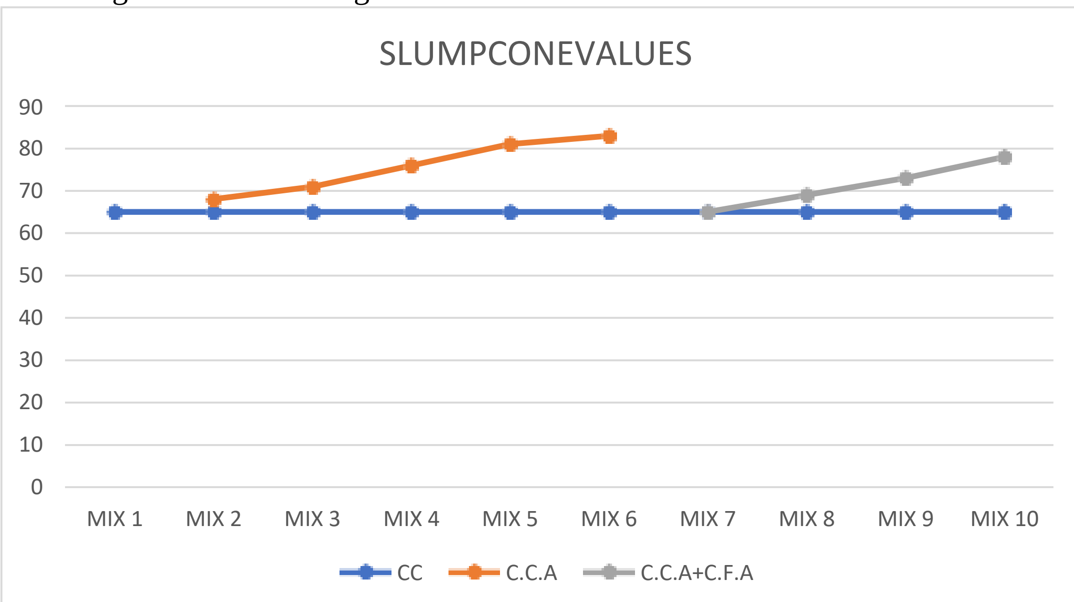
9	Mix9	30+10	73
10	Mix10	40+10	78

Table6: Thefindingsoftheslumpconetestfor workabilityweremeasuredinmillimetres.

Theworkabilitydetermined bytheslumpconetestincreases in aproportional wayto theincrease in mix percentage replacement. As previously stated, the workability range of concreteisexpandingwhile remainingin themedium rangeoverall.



Graph1:Comparisonofworkability forvariousmixeswithconventionalconcrete

Inaccordancewiththeresults,itisobservedthattheworkabilityoftheMix1,Mix2,Mix3,Mix4,Mix5,Mix6,Mix 7,Mix8,Mix9,andMix10mixesisincreasedby4.8percent,9.6percent,17.7percent,25.8percent,30.6percent,1.6percent,8percent,14.5percent,22.5percent,and16.1percentwhencomparedtotheconventionalM20concrete grade.

4.1.2 CompactionFactorTest:

The compaction factor test was performed using the same mix that had been used for the slump cone workability evaluation. The results of the compaction factor test for the workability of various combinations of concrete alternatives for M20 grade are summarized in the following table:

S.No	MixDesignation	AggregateReplacements %(CCA+CFA)	CompactionFactor
			M20
1	Mix1	0+0	0.82
2	Mix2	10+0	0.84
3	Mix3	20+0	0.85
4	Mix4	30+0	0.87
5	Mix5	40+0	0.89
6	Mix6	50+0	0.93

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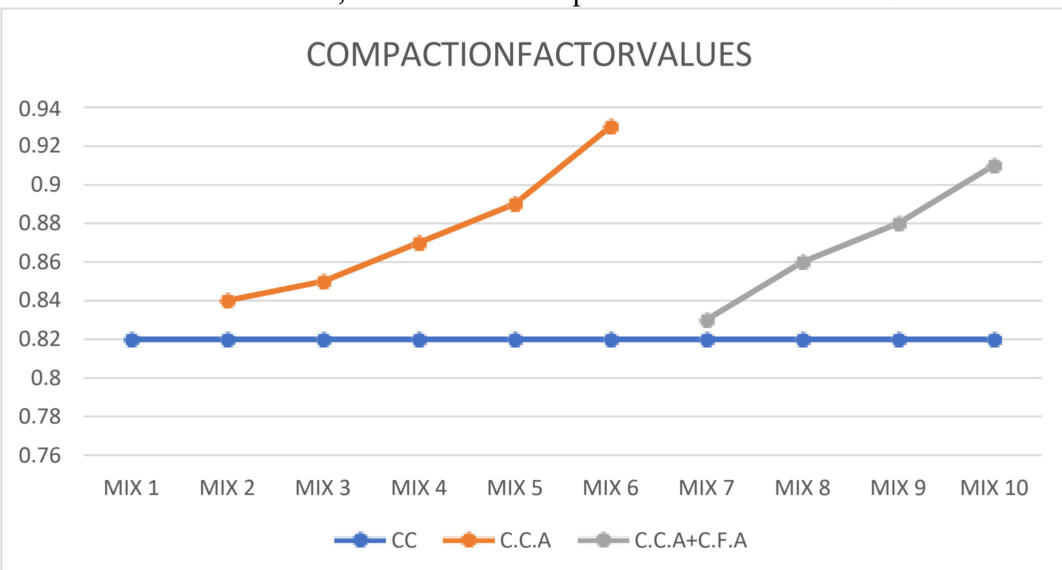
7	Mix7	10+10	0.83
8	Mix8	20+10	0.86
9	Mix9	30+10	0.88
10	Mix10	40+10	0.91

Table7:Compactionfactortestresultsforworkability

The compaction factor test, which measures the workability of M20 grade concrete, issimilartotheslumpconetestin thatit measuresthe consistencyof theconcrete. Thepatternofincrementfor themixtures is almostsame, andthis will beexplored inmoredetail later.



Graph2:Compactionfactorfordifferentmixturescomparedtotraditionalconcrete

Accordingtotheresults,theworkabilityofMix1,Mix2,Mix3,Mix4,Mix5,Mix6,Mix7,Mix8,Mix9,andMix10 mixesisincreasedbyanamountof2.4percent, 4.3percent,6.1percent,
8.5 percent,13.4 percent,1.2percent, 4.9percent,7.3percent, 10.9percent,3.6percent, and9.7percentwhen compared to conventional M20concretegrade.The workability obtained from both the slump cone and the compaction factor testsincreases in a comparable way. The workability improves as the amount of ceramic coarse tileaggregate rises, but there is a little divergence when the amount of ceramic fine tile aggregate isincreased.

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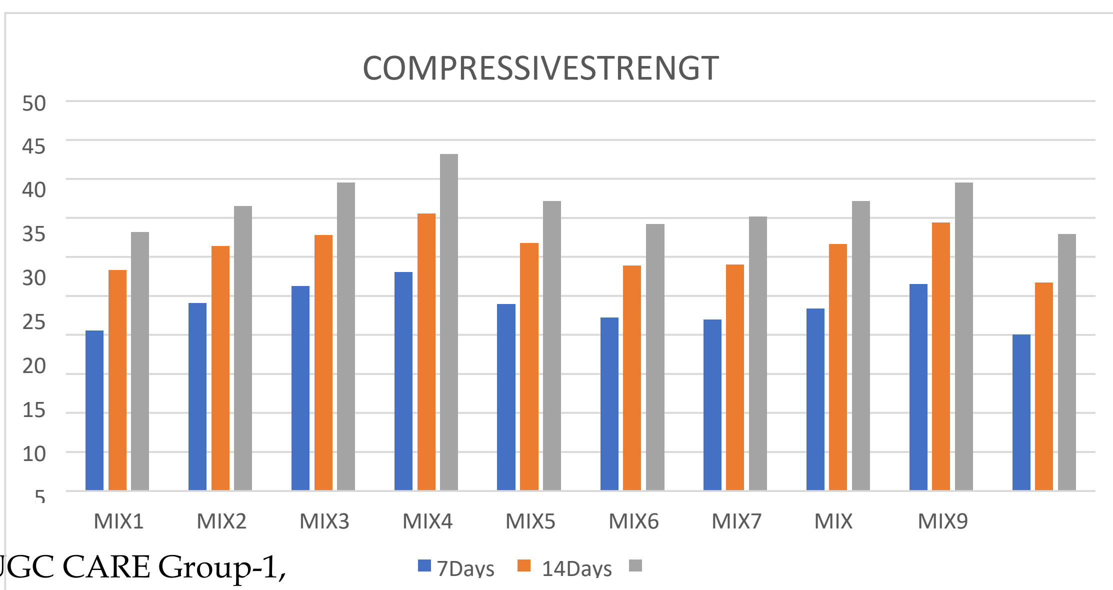
4.2 Compressivestrength:

After performing the workability tests, a total of 30 cubes with dimensions of 150 x 150x 150mm were cast and tested for 7 days, 14 days, and 28 days on each of 13 specimens afterbeingcasted and tested.Theoutcomes aresummarized in thetablebelow:

Table 8 Compressive Strength Test Results

S.No	MixDesignation	AggregateReplacements %(CCA+CFA)	CompressivestrengthofM20grade N/mm^2		
			7days	14days	28days
1	Mix1	0+0	20.67	28.56	33.45
2	Mix2	10+0	24.19	31.26	36.7
3	Mix3	20+0	26.23	32.96	39.4
4	Mix4	30+0	28.15	37.45	43.14
5	Mix5	40+0	23.53	31.75	37.15
6	Mix6	50+0	22.23	28.87	33.4
7	Mix7	10+10	21.95	29.8	34.18
8	Mix8	20+10	23.54	31.4	36.14
9	Mix9	30+10	26.85	34.4	38.55
10	Mix10	40+10	20.52	26.65	32.5

Graph6:CompressiveStrengthcomparisonat7,14and28days



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ISSN: 0970-2555
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Comparing the compressive strengths of various mixes to standard concrete after 7 days of curing, the following values are obtained: 20.67, 24.19, 26.23, 28.15, 23.53, 22.23, 21.95, 23.54, 26.85, and 20.52. The compressive strength of concrete changes as follows after 7 days of curing: 20.67, 24.
The compressive strength of mixes 1, 2, 3, 4, 5, 6, 7, 8, and 10 varies from conventional concrete in the following ways: After 14 days of curing, the prices were 28.56, 31.26, 32.99, 37.45, 31.75, 29.8, 31.4, 34.4, and 26.65 for mixes 1, 2, 3, 5, 6, 7, 8, 9, and 10.After 28 days of curing, the compressive strengths of Mix 1, Mix 2, Mix 3, Mix 4, Mix 5, Mix 6, Mix 7, Mix 8, Mix 9, and Mix 10 were compared to standard concrete. After 28 days of curing, the results were 33.45, 36.7, 39.4, 43.14, 37.15, 33.4, 34.18, 36.14, 38.55, and 32.5 compared to standard concrete.

4.3 SplitTensilestrength:

In the following table, the split tensile strength achieved by testing the cylindricalspecimenforM20grade ofconcretetoallofthemixesintendedfordifferentreplacementsis

S.No	MixDesignation	AggregateReplacements %(CCA+CFA)	Split Tensile Strength of M20 grade N/mm^2		
			7days	14days	28days
1	Mix1	0+0	1.66	2.15	2.58
2	Mix2	10+0	1.66	2.21	2.68
3	Mix3	20+0	1.67	2.26	2.61
4	Mix4	30+0	1.70	2.25	2.67
5	Mix5	40+0	1.68	2.21	2.57
6	Mix6	50+0	1.66	2.15	2.56
7	Mix7	10+10	1.68	2.16	2.58
8	Mix8	20+10	1.68	2.2	2.62
9	Mix9	30+10	1.69	2.21	2.67
10	Mix10	40+10	1.65	2.19	2.50

Table9:SplittensilestrengthresultsforM20gradeofconcrete

Graph9:Splittensilestrengthofconcreteat7,14,28days

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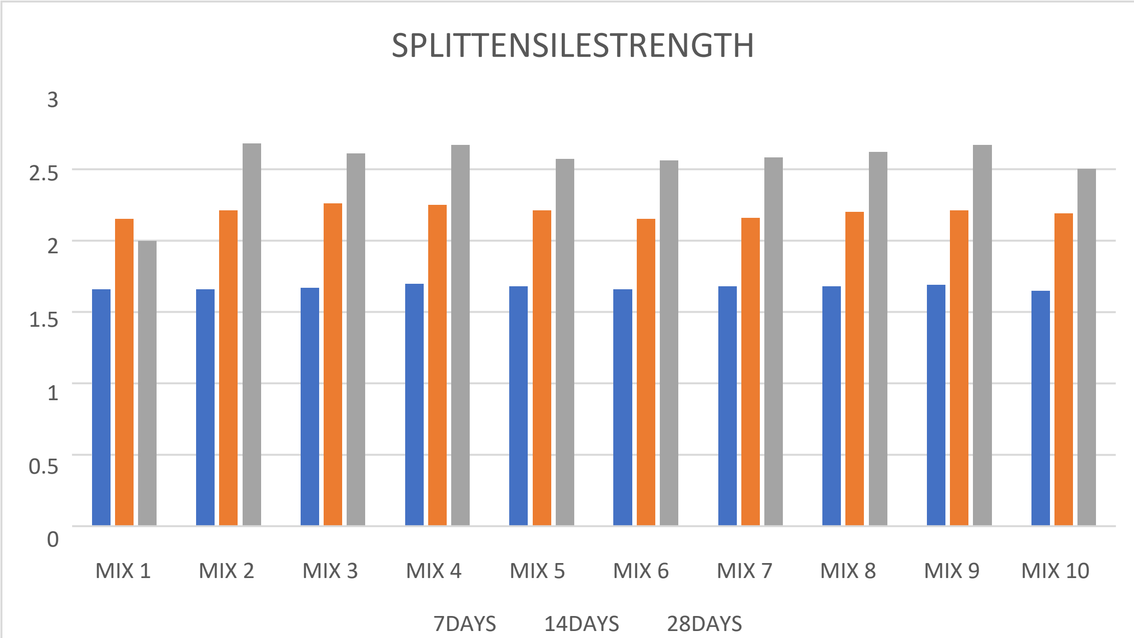

The findings show that the strength, or tensile strength, of the hybrid concrete is muchhigherthanthatof conventionalconcreteatallcuringagestested(7days,14days,and28days),compared to conventional concrete. When different amounts of aggregates are substituted forcement,the strength of theconcrete increases.

The split tensile strength of concrete changes in the following ways after 7 days of curing: When compared to normal concrete, Mix 1, Mix 2, Mix 3, Mix 4, Mix 5, Mix 6, Mix 7, Mix 8, Mix 9 and Mix 10 each have a ratio of 1.66, 1.66, 1.67, 1.70, 1.68, 1.66, 1.69 and 1.65: For Mix1, Mix2, Mix3, Mix4, Mix5, Mix6, Mix7, Mix8, Mix9, and Mix: 1.66, 1.66, 1.67, 1.70, 1.68, and 1.65

The split tensile strength of Mix 1, Mix 2, Mix 3, Mix 4, Mix 5, Mix 6, Mix 7, Mix 8, Mix 9, and Mix 10 differs from normal concrete in the following ways: After 14 days of curing, Mix10 has 2.15 2.21 2.26 2.25 2.21 2.15 2.16 2.2 2.21 2.19 2.19 2.19 2.19 2.19 2.19 2.19 as compared to normal concrete.

The split tensile strength of concrete changes in the following ways after 28 days of curing: Compared to normal concrete, Mix 1, Mix 2, Mix 3, Mix 4, Mix 5, Mix 6, Mix 7, Mix 8, Mix 9 and Mix 10 have 2.58, 2.68, 2.61, 2.67, 2.57, 2.56, 2.58, 2.62, 2.67 and 2.50: 2.50 for Mix1 and 2.58 2.68 2.61 2.67 2.57 2.56 2.58 2.62 2.67.

5. CONCLUSION

- The primary goal of the study is to create a concrete that is much more stable anddurable than ordinary concrete by substituting coarse and fine particles with finer aggregates.Designing mix designs for all of the material replacements has been completed, and a total of 90specimens (42 cubes, 42 cylinders, and 6 beams) have been produced and tested in the areas ofstrengthcalculation as fitas comparisons havebeencompleted.
- The findings that follow may be reached from experimental research on compressive strength, split tensile strength, and flexural strength, as well as taking environmental considerations into account:
- As the ratio of tile aggregate replacement increases in the mix, the workability of concrete becomes better. Utilizing tile powder, which acts as an admixture because to its chemical

properties, enhances the workability even further. Up to a threshold of 30% replacement, the properties of concrete improved linearly with the addition of ceramic aggregate before starting to degrade linearly once again.

- When compared to the other concrete mixes evaluated in this research, the M3 concrete mix produced concrete that was stronger in terms of compressive strength, split tensile strength, and flexural strength. But it is possible to use combinations of ceramic coarse aggregate having up to 50% ceramic coarse aggregate.
- In certain circumstances, the use of ceramic fine aggregate gradually alters the properties of concrete.
- A little increase in the mechanical properties of concrete is shown when tile powder and ceramic coarse aggregate are used. The split tensile strength of ceramic tile aggregate follows a substantially straighter path as compared to the common grades of concrete.

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