PARTIAL REPLACEMENT OF COARSE AGGREGATE BY WASTE CERAMIC TILES

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ABSTRACT: *Natural aggregates have risen dramatically as a result of increasing growth and innovation in the building field around us, and the production of solid waste from demolitions of structures has also expanded significantly. As a result, studies indicate that about 20-30% of material produced in tile production facilities is transformed and discarded. To cope with the restricted supply of natural aggregate and to minimize building waste, this waste material should have been repurposed. So much ceramic is seen throughout the building and development process, such as electric insulators, sanitary fittings, ceramic tiles, uneven bricks, and so on, yet these materials are readily reused in the construction field. Ceramic tiles powder may be used as a fine aggregate in the same way as ceramic tiles can be used as a partial substitute for coarse aggregate. Crushed waste ceramic tiles, as well as crushed waste ceramic tile powder, are used to substitute coarse and fine aggregates. 0 percent, 15 percent, 30 percent, 45 percent, and 50 percent of the coarse aggregates were substituted with ceramic waste broken tiles. In addition to the coarse ceramic tile. A concrete grade of M25 was developed and tested. The mix design for various kinds of mixes was created by substituting broken tiles for coarse aggregates and cement at various percentages. ' Workability, compressive strength, split tensile strength, and flexural strength tests for various concrete mixes with varying percentages of waste crushed after 7, 14, and 28 days curing time have been carried out. It has been discovered that when the proportion of shattered tiles replaced rises, the workability improves. The strength of concrete is increased by up to 30% when ceramic coarse tile aggregate is used.*

Keywords: Crushed tiles, Compressive strength, Flexural strength, Split Tensile strength

1. INTRODUCTION

One of the most important construction materials on the world is concrete. Coarse aggregate, fine aggregate, cement, water, and occasionally additives are used to make it. The necessary physical properties for the finished material may be obtained by adding additives and reinforcements to the concrete mixture. Concrete is the most extensively utilized construction material on the world due to its flexibility, durability, adaptability, and affordability. The term concrete refers to a mixture of aggregates, most often sand and gravel or crushed stone, held together by a cement paste blinder. According to the statistics, four tons of concrete are produced per person per year across the world, and 1.7 tons per person in the United States. "A solid mass that can easily be molded and sized into any shape. Cement gets firmer and binds the whole mixture when it interacts chemically with water (hydration).'' The Roman Empire made significant use of concrete technology, and the ancient Romans were among the first to utilize it on a large scale. The coliseum in Rome was mostly made of concrete, and the dome of the Pantheon is the world's largest unreinforced concrete structure. Because the usage of concrete had grown more widespread following the collapse of the Roman Empire in the mid-eighteenth century, the technology was re-pioneered. In terms of tonnage, concrete is the most widely used man-made material today.

2. MATERIAL USED

2.1 CEMENT

Ordinary Portland Cement of 53 Grade cement conforming to IS: 169-1989

2.2 COARSE AGGREGATE

Crushed aggregates with a size of less than 12.5mm were obtained from local crushing facilities IS: 2386-1963 is used to select material that only passes through a 12.5mm sieve and is kept on a 10mm sieve.

2.3 FINE AGGREGATE

The most frequent component of sand is silica (silicon dioxide, or SiO2), typically in the form of quartz, which is the most common weathering resistant mineral with IS: 2386-1963 due to its chemical inertness and significant hardness.

2.4 WATER

In most cases, drinking water was utilized. Water that is suitable for drinking must be used in the concrete, and the pH value should be between 6 and 9.

2.5 CREAMIC WASTE TILES

Broken tiles were gathered from a ceramic manufacturing unit's solid refuse and a destroyed structure. The discarded tiles were manually and with the use of a crusher broken into tiny bits. Crushed tile aggregate of the appropriate size was separated and used as a partial substitute for natural coarse aggregate. The tile waste with a dimension of less than 4.75 mm was overlooked. Crushed tile aggregate that has passed through a 16.5mm sieve but has been kept on a 12mm screen is utilized. Crushed tiles were used in lieu of coarse aggregate in percentages of 15%, 30%, 45 percent, and 50%.

3. METHDOLOGY

- Collection of raw materials
- Check the properties of materials
- Prepared mix design M25 grade of concrete
- Tests on hardened concrete
- Check the strength of concrete
- Analysis and discussion of test

4. RESULT AND DISCUSSION

4.1 WORKABILITY

SLUMP CONE TEST

The slump cone test was conducted for fresh concrete it had prepared before the molding process. A total of 5.Concrete mixes are prepared at different times. Workability Results obtained from slump cone test for M25 grade of concrete is shown in table 1

Table 1: Test results from slump cone test for workability in mm

S.NO	Mix Designation	Aggregate Replacements % (CCA)	Workability (mm) M25
1	M0	0	62
2	M1	15	67
3	M2	30	73
4	M3	45	80
5	M4	50	81

In this research paper I found the workability of the mix proportion increases continuously in slow way so here found the result 4.6%,18.2%,28.9and 31.6%, for M1,M2,M3 And M4 mix preparation for M25 grade of concrete(M0).

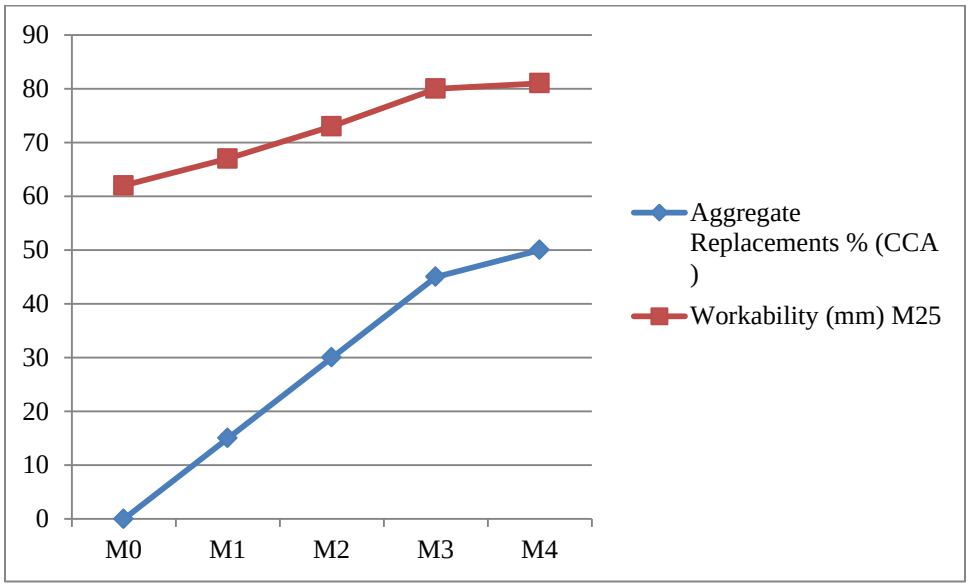

Figure 1: workability test

4.2 Compaction Factor Test:

The compaction factor test was conducted 5 concrete mix proportion. The results obtained from the compaction factor test for the workability of various mixes of replacements of M25 grade of concrete are tabulated as follow

From this result observed that the compaction factor of the mix design concrete increases slowly 2.5%, 6.7%, 9.0% and 1.7% at the M1, M2, M3 and M4 for M25 grade of concrete.

So the workability of the slump cone and compaction factor tests is same in increasing way. The workability increases with increase in waste ceramic coarse tile aggregate

Table 2: Test results of compaction factor test for workability

S.NO.	Mix Designation	Aggregate Replacements % (CCA)	Compaction Factor M25
1	M0	0	0.82
2	M1	15	0.849
3	M2	30	0.87
4	M3	45	0.903
5	M4	50	0.93

The workability of M25 grade of concrete by compaction factor test is similar to that of slump cone test. The pattern of increment for the mixes is quite same which will be discussed in detail further

4.3 Compressive strength:

Compressive strength of concrete were checked for strength of the concrete A total of 5cubes of size 150 x 150 x 150mmhad casted and tested for 7 days, 14 days and 28 days testing each of 4cubes Specimens after conducting the workability tests. The results are tabulated below

Table: 03: Compressive strength results of M25 grade of concrete for 7, 24 and 28 days

S. NO	Mix Designation	Aggregate Replacements % (CCA)	Compressive Strength of M25 grade in N/mm2		
			7days	14days	28days
1	M0	0	20.57	28.50	32.05
2	M1	15	25.06	31.05	35.2
3	M2	30	28.00	37.04	43.21
4	M3	45	22.96	30.86	35.21
5	M4	50	21.10	28.17	33.41

17.21%, 36.40%, 8.05% and 6.08% for M1, M2, M3 and M4 mix design concrete for M25 grade of concrete compressive strength for 7days.

Compressive strength increases on some points as well as decreases at a level 9.95%, 32.14%, 1.15% and 7.9% for M1,M2,M23 and m4 M25 grade of concrete at 14days

Compressive strength of the M25grade of design concrete varies from up to down at some points it is increases and on some points it is decreases for 28days 10.10%,29.9%,3.2%and 7.9% for M1,M2,M3 and M4 .

On comparing the strengths of all mixes, M2 has the highest i.e., 30% replacement of coarse aggregate

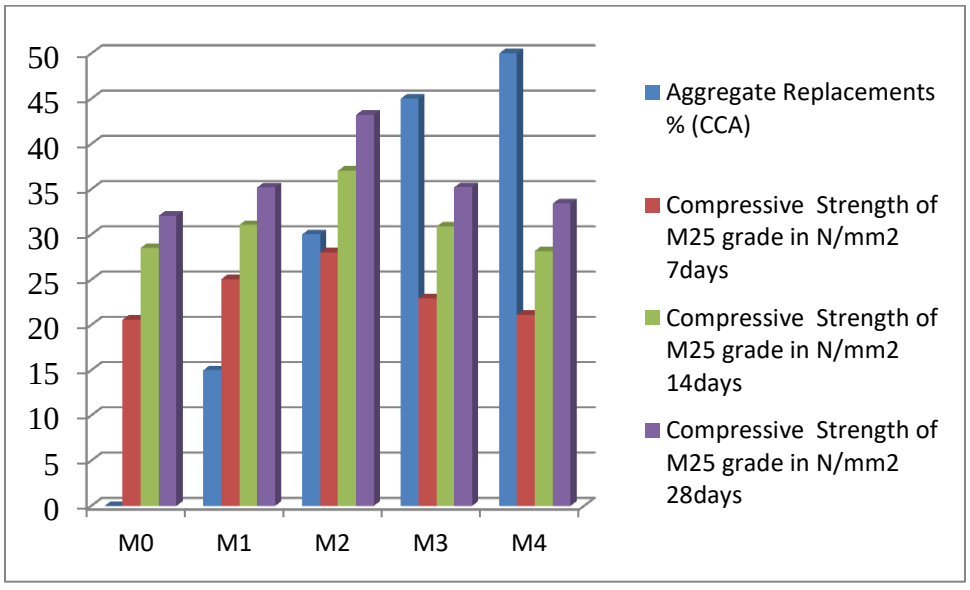

Figure 2: Comparison of Compressive strength of M25 at 7 days, 14days and 28days

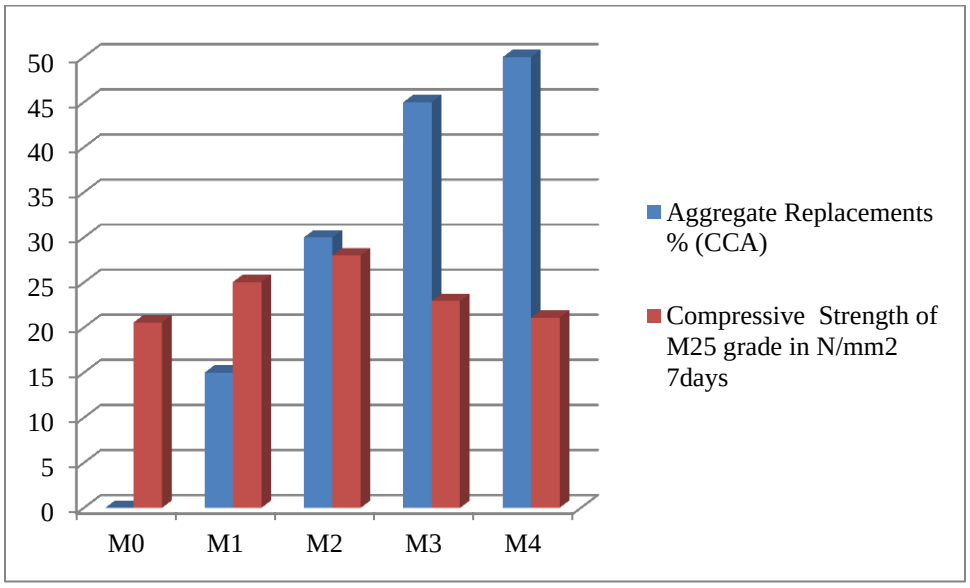

Figure 3: Comparison of Compressive strength of M25 at 7 days

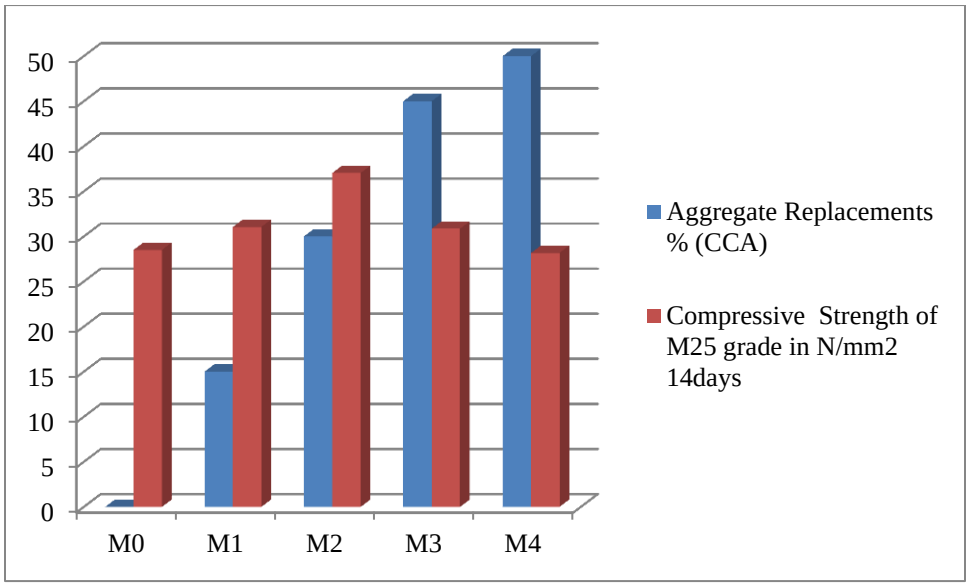

Figure: 4 Comparison of Compressive strength of M25 at 14 days

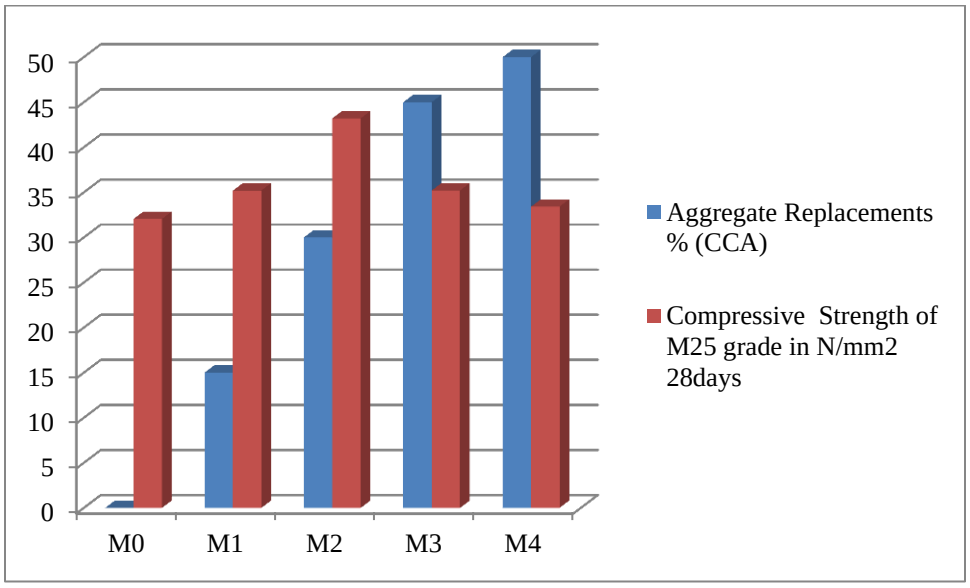

Figure:5 Comparison of Compressive strength of M25 at 28 days

The results obtained from compression testing gives comprehensive outcome of the project as the replacement the replacement of tile aggregates produces a concrete with suitable properties as conventional

4.4 Split Tensile strength:

The split tensile strength obtained by testing the specimen for M25 grade of concrete to all the mixes designed for various replacements are given below

Table 04: Split tensile strength results for M25 grade of concrete

S.no	Mix Designation	Aggregate Replacements % (CCA)	Split Tensile Strength of M25 grade in N/mm2		
			7days	14days	28days
1	M0	0	1.60	2.05	2.50
2	M1	15	1.63	2.17	2.60
3	M2	30	1.72	2.20	2.66
4	M3	45	1.62	2.10	2.54
5	M4	50	1.60	2.00	2.51

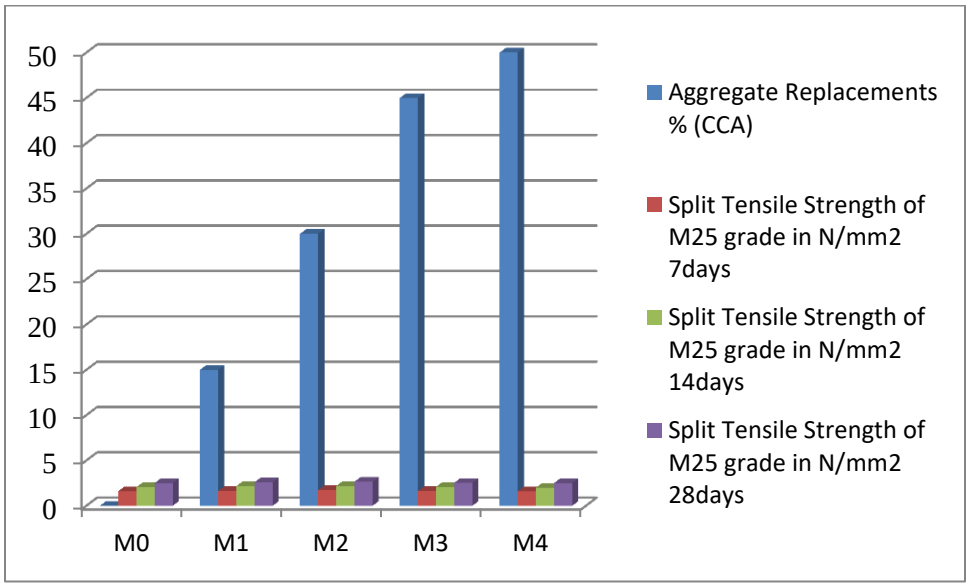

Figure 6: Split tensile strength for M25 at 7days,14days and 28days

The split tensile strength of concrete varies as 0%, 1.1%, 2.7%, and 0%, M1, M2, M3, and M4, compared with the conventional concrete after 7days of curing.

The split tensile strength of concrete varies as 0.41%, 3%, and 4.2%, and-1.2% for M1, M2, M3, and M4, compared with the conventional concrete after 14days of curing.

The split tensile strength of concrete varies as 1.90%, 7.1%, -1.5%, 0.30%for M1, M2, M3, and M4, compared with the conventional concrete after 28days of curing

Flexural strength

The flexural test is prepared for the mix, which has maximum compressive strength and split tensile strength i.e., M3 (30% of CCA) and the results are plotted below

Table 05: flexural strength results for M25 grade of concrete

S.no	Grade of concrete	Mix code	Flexural Strength in N/mm2		
			7Days	14Days	28Days
1	M25	M0	7.90	8.05	9.91
1	M25	M3	8.80	9.15	10.13

The strength of a beam increases in a linear fashion. The strength variation between the three classes is growing. The flexural strength of conventional varies by 7 days, 14 days, and 28 days for M2 mix, respectively. The strength observed after 7 days is almost same for all three grades, however after 14 days, M25 shows a fast increase in strength. Even though we are not comparing it to traditional concrete, the strength achieved is acceptable.

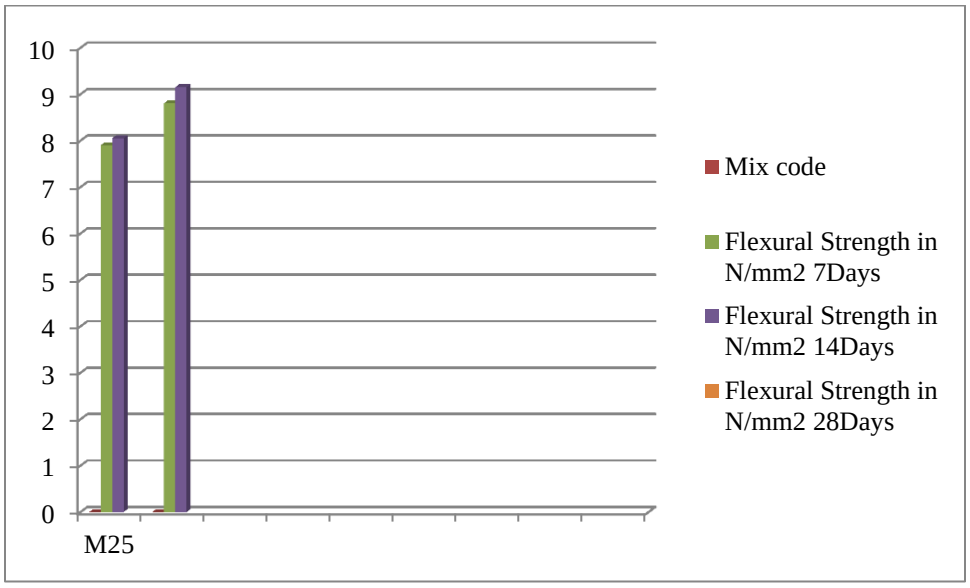

Figure7: Comparison of flexural strength for different mixes of M25 Grade

5. SUMMARY AND CONCLUSION

The basic objective of the study is to prepare a concrete much more stable and durable than the conventional by replacing aggregates coarse. Mix designs for all the replacements of materials has done are prepared and tested in the aspect of strength calculation and also comparisons has done

The following conclusions are made based on the experimental investigations on compressive strength, split tensile strength and flexural strength considering the—environmental aspects also:

- The workability of concrete increases with the increase in tile aggregate replacement. The workability.
- The compressive strength of concrete initially increases with replacement of coarse aggregate with the ceramic tiles aggregate up to 30% and after that there is decrease in compressive strength of concrete with further replacement of coarse aggregate as the mix became less cohesive and less workable.
- The properties of concrete increased linearly with the increase in ceramic aggregate up to 30% replacement later it is decreased linearly.
- M2 mix of concrete produced a perfect concrete in terms of compressive strength, split tensile strength and flexural strength than the other mixes. But the mixes up to 30% of ceramic coarse aggregate can be used.
- The split tensile strength of ceramic tile aggregate is very much in a straighter path compared to the conventional grades of concrete.

6. FUTURE SCOPE OF WORK

There is a huge scope of research in the recycled aggregate usage in concrete mainly ceramic tile wastes in the future. The possible research investigations that can be done are mentioned below:

- Ceramic tiles waste is useful for floor work in construction filed
- Ceramic waste easily recycled and economic aggregate for construction which is totally waste when it is not recycled

- A study on properties of concrete made with combination of recycled aggregate and tile aggregate in different proportions can be investigated to enhance the concrete properties and also to reduce the pollution or waste generation from construction industry

- Ceramic tiles have high strength compressive strength so it is useful for construction.

- By the use of ceramic tile aggregate in concrete, the physical properties like durability, permeability etc., can be analyzed to prepare a concrete with more advantageous than conventional concrete.

- The mechanical properties of concrete with marble aggregate ''waste" either from manufacturing units or from construction demolition can be investigated to improve the properties like permeability; resistance to sound can also be studied.

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