EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF AGGREGATES WITH GRANITE POWDER AND CERAMIC TILES IN CONCRETE

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Abstract: **According to studies, 20–30% of the material created in tile manufacturing factories ends up as trash. To deal with the finite supply of natural aggregate and to lessen construction waste, this waste material should be required for reuse. In place of the coarse aggregates and fine aggregate, crushed waste ceramic tiles, crushed waste ceramic tile powder, and granite powder are employed. 10 percent, 20 percent, 30 percent, 40 percent, and 50 percent of the coarse aggregates were replaced with the crushed ceramic waste tiles. Along with the ceramic coarse tile, 10% of the fine aggregate was swapped out for granite powder and ceramic tile powder. A concrete grade called M30 was developed and tested. Different types of mixes' mix designs were created. A concrete grade called M30 was developed and tested. By substituting crushed tiles and granite powder at varying ratios for the coarse aggregate and fine aggregate, many types of mixtures were created. After a 28,56,90 days curing period, experimental tests for workability, compressive strength, and split tensile strength were conducted on various concrete mixes including various amounts of crushed trash and granite powder. It has been found that when the replacement rate of smashed tiles and granite powder increases, so does the workability. With the addition of ceramic coarse tile aggregate, the strength of concrete additionally rises by up to 30%.**

***Keywords*: ceramic tiles, granite powder, compressive strength, split tensile strength.**

I. INTRODUCTION

The concrete strength above 5000 psi was often used for specific building elements. For example, the high-rise concrete buildings composed of the lower floor columns may use 12,000 psi or more strength concrete, to keep the columns sizes small. Bridges may use concrete of strength 10,000 psi in long beams to minimize the number of spans required. The other structural needs may occasionally require high strength concrete. The concrete of very high strength may be specified if the structure must be very rigid, even much stronger than required to bear the service loads. For these commercial reasons the concrete of strength as high as 19000-psi has been used.

II. OBJECTIVES

The objectives of this study are as follows

- To optimize the usage of aggregates with granite powder
- To optimize the usage of aggregates with ceramic tiles.
- To evaluate the compressive and spilt tensile strength of concrete.

III. MATERIALS

The properties of cement are presented in Table 1.

Table 1 Physical properties of cement

S. No.	Property	Cement(53 grade)
1	Specific gravity	3.15
2	Fineness	7.11%

3.1 Ceramic Tile Aggregate: -Broken tiles were collected from the solid waste of ceramic manufacturing unit and from demolished building. The waste tiles were crushed into small pieces by manually and by using crusher. The required size of crushed tile aggregate was separated to use them as partial replacement to the natural coarse aggregate. The tile waste which is lesser than 4.75 mm size was neglected. The crushed tile aggregate passing through 16.5mm sieve and retained on 12mm sieve are used. Crushed

tiles were partially replaced in place of coarse aggregate by the percentages of 10%, 20% and 30%, 40% and 50% individually and along with replacement of fine aggregate with granite powder also.

3.2 Granite Powder: Since granite powder is obtained from crushing of granite rocks, the chemical and mineral composition of granite is similar to that in cement and natural aggregates. It is chosen to test the behavior of concrete along with the ceramic tile waste.

IV. EXPERIMENTAL INVESTIGATIONS

4.1 Compressive strength results

The compressive strength conducted in compression testing machine for the cast and cured specimens and the results are furnished in table 2.

Table2: Compressive strength of concrete with granite powder and ceramic tiles as partial replacement of cement in concrete.

Sl.no	MIX DESIGNATION	Aggregate Replacement % (CCA+GP)	28 days (N/mm²)	56days (N/mm²)	90 days (N/mm²)
1	M0	0	40.12	43.55	46.89
2	M1	10+10	42.70	46.27	49.53
3	M2	20+10	45.88	49.77	53.49
4	M3	30+10	52.51	57.09	60.99
5	M4	40+10	48.05	52.12	56.01
6	M5	50+10	45.05	48.96	52.66

4.2Split Tensile strength results

At the age of 7 and 28days, the cylindrical specimens (150mm diameter x 300mm height) were tested for evaluating the split tensile strength. The experiment is performed by putting a cylindrical sample horizontally between a compression testing machine loading surface and the load is applied until the cylinder fails along the vertical diameter.

Table3:Split Tensile strength of concrete with granite powder and ceramic tiles as partial replacement of cement in concrete

Sl.no	MIX DESIGNATION	Aggregate Replacement % (CCA+GP)	28 days (N/mm²)	56days (N/mm²)	90 days (N/mm²)
1	M0	0	3.93	4.24	4.58
2	M1	10+10	4.22	4.56	4.92
3	M2	20+10	4.48	4.85	5.23
4	M3	30+10	5.19	5.63	6.06
5	M4	40+10	4.90	5.30	5.73
6	M5	50+10	4.36	4.72	5.06

V. CONCLUSION

In this study the concrete ingredients like fine and coarse aggregates are replaced by granite powder and ceramic tiles. Granite powder replaced with constant percentage of 10% in fine aggregate and ceramic tiles are replaced with different percentages of 10%, 20%, 30%, 40% and 50% in coarse aggregate.

1. The compressive strength of normal concrete at the age of 28 days,56 days&90 days are 40.12 N/mm^2,43.55 N/mm^2&46.89 N/mm^2.
2. The compressive strength of 10% ceramic tiles and 10 % of granite powder at the age of 28 days,56 days & 90 days are 42.70 N/mm^2, 46.27 N/mm^2& 49.53 N/mm^2 .
3. The compressive strength of 20% ceramic tiles and 10 % of granite powder at the age of 28 days,56 days & 90 days are 45.88 N/mm^2, 49.77 N/mm^2&53.49 N/mm^2 .
4. The compressive strength of 30% ceramic tiles and 10 % of granite powder at the age of 28 days,56 days & 90 days are 52.51N/mm^2, 57.09 N/mm^2&60.99 N/mm^2 .
5. The compressive strength of 40% ceramic tiles and 10 % of granite powder at the age of 28 days,56 days & 90 days are 48.05 N/mm^2, 52.12 N/mm^2&56.01 N/mm^2 .
6. The compressive strength of 50% ceramic tiles and 10 % of granite powder at the age of 28 days,56 days & 90 days are 45.05 N/mm^2, 48.96 N/mm^2&52.66 N/mm^2 .
7. The Split tensile strength of normal concrete at the age of 28 days,56 days&90 days are 3.93N/mm^2,4.24 N/mm^2&4.58 N/mm^2.

8. The Split Tensile strength of 10% ceramic tiles and 10 % of granite powder at the age of 28 days,56 days & 90 days are 4.22 N/mm^2, 4.52 N/mm^2&4.92 N/mm^2 .
9. The Split tensile strength of 20% ceramic tiles and 10 % of granite powder at the age of 28 days,56 days & 90 days are 4.48 N/mm^2, 4.85 N/mm^2&5.23 N/mm^2 .
10. The Split tensile strength of 30% ceramic tiles and 10 % of granite powder at the age of 28 days,56 days & 90 days are 5.19 N/mm^2, 5.63 N/mm^2&6.06 N/mm^2 .
11. The Split Tensile strength of 40% ceramic tiles and 10 % of granite powder at the age of 28 days,56 days & 90 days are 4.90 N/mm^2, 5.30 N/mm^2&5.73 N/mm^2 .
12. The Split Tensile strength of 50% ceramic tiles and 10 % of granite powder at the age of 28 days,56 days & 90 days are 4.36 N/mm^2, 4.72 N/mm^2& 5.06 N/mm^2 .

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