An Experimental Investigation on Concrete as a Partial Replacement of Ca & Fa with Crushed Tiles & Granite Powder for M-30 Grade Concrete (Normal Water & Sea Water Condition)

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Abstract— As all known concrete is a versatile engineering composite material made with cement, aggregates and admixtures. Due to the day by day innovations and development in construction field, the use of natural aggregates is very high and at the same time production of solid wastes from the demolitions of constructions is also very high. And also there is a scarcity of natural aggregates because of extensive use of concrete. Because of these reasons the reuse of demolished constructional wastes and granite powder came into the picture to reduce the solid waste and to reduce the scarcity of natural aggregates. Crushed tiles and Granite powder are used as a replacement to the coarse aggregates and fine aggregate. The combustion of waste crushed tiles were replaced in place of coarse aggregates by 0%, 5%, 10%, 15% and 20% and Granite powder were replaced in place of fine aggregate by 0%, 5%, 10%,15% and 20% without changing the mix design. M30 grade of concrete was designed to prepare the conventional mix. Without changing the mix design different types of mixes were prepared by replacing the coarse aggregates and fine aggregate at different percentages of crushed tiles and granite powder. These admixtures are used in both normal conditions and sea shore conditions. Experimental investigation like Compressive strength test & Split tensile strength tests conducted for different concrete mixes with different percentages of waste crushed tiles and granite powder after 7 and 28 days curing period(Normal water and Sea water). M30 grade of concrete was designed to prepare the conventional mix. Without changing the mix design total 5 types of mixes were prepared by replacing the fine and coarse aggregates at different percentages of granite powder and crushed tiles. Variations in the workability for these different mixes were studied and observed that, increase in the percentage of replacement of granite powder and crushed tiles.

Key words: Compressive Strength, Crushed Tiles, Granite Powder, Split Tensile Strength

I. INTRODUCTION

Portland cement concrete is made with coarse aggregate, fine aggregate, Portland cement, water and in some cases selected admixtures (mineral & chemical). In the last decade, construction industry has been conducting research on the utilization of waste products in concrete; each waste product has its own specific effect on properties of fresh and hard concrete. Conservation of natural resources and preservation of environment is the essence of any development. The problem arising from continuous technological and industrial development is the disposal of waste material. If some of the waste materials are found suitable in concrete making, not only cost of construction can be cut down, but also safe disposal of waste materials can be achieved. The use of waste products in concrete not only makes it economical but also solves some of the disposal problems.

When we are using granite powder and crushed tiles we can reduce the cracks in sea shore conditions & these are used to prevent sulphate-attack and increase the life span of the structure.

The compressive strength test results of the cube sample having plastic material and the conventional mix are as follow:

In the present construction world, the solid waste is increasing day by day from the demolitions of constructions. There are some researchers are also going on solid waste from construction to reuse them again in the construction to reduce the solid waste and to preserve the natural basic aggregates. These researches promotes to use the recycled aggregates in the concrete mix and they got good result when adding some extent percentages of recycled aggregates in place of natural coarse aggregate.

Indian tiles production is 100 million ton per year in the ceramic industry, about 5%-20% waste material generated from the total production. This waste is not recycled in any form at present, however the ceramic waste is durable, hard and highly resistant to biological, chemical and physical degradation forces so, we selected these waste tiles as a replacement material to the basic natural aggregate to reuse them and to decrease the solid waste produced from demolitions of construction. Waste tiles and granite powder were collected from the surroundings. Crushed tiles are replaced in place of coarse aggregate and granite powder in place of fine aggregate by the percentage of 5% and 10% and 15% and 20%.

II. EXPERIMENTAL PROGRAM

A. Materials Used

1) Cement

Ordinary Portland cement of grade 53 is used for this experimental work.

2) Fine Aggregate

The material which passes through BIS test sieve number 4 (4.75mm) is termed as fine aggregate usually natural sand is used as a fine aggregate at places where natural sand is not available crushed stone is used as fine aggregates. In our region fine aggregate can be found from bed of Krishna River. It conforms to IS 383 1970 comes under zone II.

3) Coarse Aggregate

The material which is retained on BIS test sieve number 4 (4.75mm) is termed as coarse aggregate. The broken stone is generally used as a stone aggregate. Coarse aggregate used is locally available crushed angular aggregate of size 20mm and 10mm are used for this experimental work.

4) Granite Powder

Granite powder will be collect; 4.75 mm passed materials was separated to use it as a partial replacement to the fine aggregate. Granite powder was partially replaced in place of fine aggregate by the percentages of 5%, 10%, 15% and 20%

5) Crushed Tiles

Crushed them into small pieces by manually and by using crusher. And separated the coarse material to use them as partial replacement to the natural course aggregate. Separated the tile waste which is lesser than 4.75 mm. Crushed tiles were partially replaced in place of coarse aggregate by the percentages of 5%, 10%, 15% and 20%

Physical Properties	Granite Powder	Crushed Tiles
Appearance	Black & Brown	Grey
Specific gravity	2.9	2.39
Water absorption %	0.10%	0.19%

Table 1: Physical Properties of Granite powder and Crushed Tiles

B. Mix Design

This chapter deals with preparation of Mix design to cast the samples and experimental methodology for carrying out compressive and split tensile strength of concrete samples. Different types of concrete mixes were prepared and casted for different dosages of admixtures, with water cement ratio 0.45.

Water	Cement	Fine Aggregate	Coarse Aggregate (60% + 40%)
186	413.33kg	629.77kg	1169.577kg
0.475	1	1.66	2.23

Table 2: Mix proportion (Kg/m^3) and mix ratio

III. TESTS & RESULTS

Mix design was prepared for M30 grade. 20 mm nominal size of coarse aggregate and Zone – III sand is used for preparing conventional mix. Crushed waste tiles were collected from demolished construction waste and crushed them by manually and by using crusher. From industry we will collect waste granite powder and crushed tile by using passing them on 4.75 mm sieve to use them as partial replacement for coarse and fine aggregates respectively.

Different types of mixes were prepared by changing the percentage of replacement of coarse and fine aggregates with crushed tiles and granite powder. Total 11 types of mixes are prepared along with conventional mix. 5%, 10%, 15% and 20% f both coarse and fine aggregates are replaced by using crushed waste tile and granite powder individually. And also replacement of both coarse and fine aggregates is done at a time by changing the percentages of 5%, 10%, 15% and 20%. The details of mix designations are as follows:

S.No	Mix Code	Cement (%)	Fine aggregate (%)		Coarse aggregate (%)	
			Sand	Granite Powder	Coarse Aggregate	Crushed tiles
1	A0	100	100	0	100	0
2	A1	100	95	5	95	5
3	A2	100	90	10	90	10
4	A3	100	85	15	85	15
5	A4	100	80	20	80	20

A. Compressive Strength Values of Partial Replacement of CA & FA with Different Mixes at 7 & 28 Days (Normal Water)

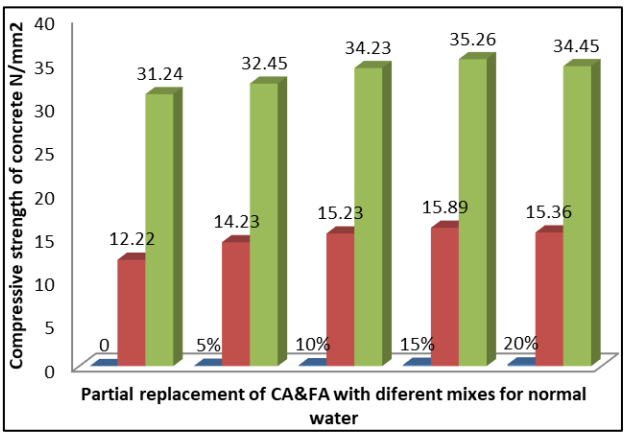

Fig. 3.1:

B. Compressive Strength Values of Partial Replacement of CA & FA with Different Mixes at 7 & 28 Days (Sea Water)

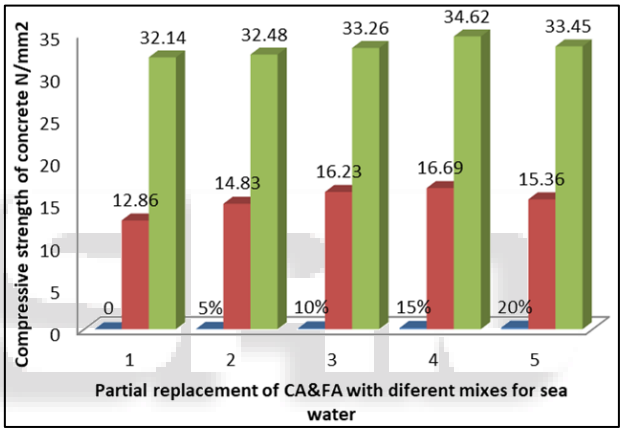

Fig. 3.2:

From Fig:3.1 It is observed that the compressive strength of the concrete increases to 16.44%,24.63%,30.03%,25.69% and 3.87%,9.57%,12.86%,10.27% when Course and fine aggregates mixes increases from 0%,5%,10%,15% and 20% for CTM when it is compared with conventional concrete at 7 days and 28days with normal water.

From Fig: 3.2 It is observed that the compressive strength of the concrete increases to15.3%,26.20%,29.78%,19.44% and 1.05%,3.48%,7.71%,4.07% when Course and fine aggregates mixes increases from 0%,5%,10%,15% and 20% for CTM when it is compared with conventional concrete at 7 days and 28 days with sea water.

It is observed that the optimum dosage of compression strength of the concrete is 15%.

C. Split Tensile Strength Values of Partial Replacement of CA & FA with Different Mixes at 7 & 28 Days (Normal Water)

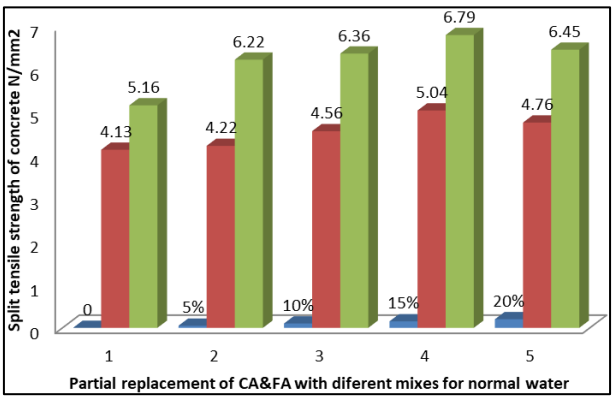

Fig: 3.3

D. Split Tensile Strength Values of Partial Replacement of CA & FA with Different Mixes at 7 & 28 Days (Sea Water)

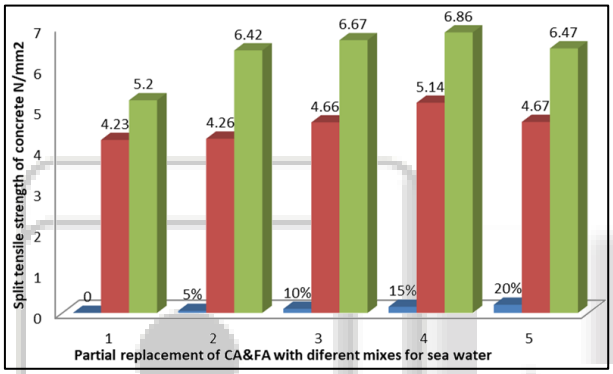

Fig: 3.4

From Fig:3.3 It is observed that the split tensile strength of the concrete increases to 2.17%,1041%,22.03%,15.25% and 20.54%,23.25%,32.58%,25% when Course and fine aggregates mixes increases from 0%,5%,10%,15% and 20% for CTM when it is compared with conventional concrete at 7 days and 28days with normal water.

From Fig:3.4It is observed that the split tensile strength of the concrete increases to 0.7%,10%,21.51%,10.40%and23.46%,28.26%,31.9%,24.42 % when Course and fine aggregates mixes increases from 0%,5%,10%,15% and 20% for CTM when it is compared with conventional concrete at 7 days and 28 days with sea water.

It is observed that the optimum dosage of split tensile strength of the concrete is 15%.

IV. Conclusions

1) From Fig:3.1 It is observed that the compressive strength of the concrete increases to 16.44%,24.63%,30.03%,25.69% and 3.87%,9.57%,12.86%,10.27% when Course and fine aggregates mixes increases from 0%,5%,10%,15% and 20% for CTM when it is compared with conventional concrete at 7 days and 28days with normal water.
2) From Fig 3.2 It is observed that the compressive strength of the concrete increases to 15.3%,26.20%,29.78%,19.44% and 1.05%,3.48%,7.71%,4.07% when Course and fine aggregates mixes increases from 0%,5%,10%,15% and 20% for CTM when it is compared with conventional concrete at 7 days and 28 days with sea water.
3) It is observed that the optimum dosage of compression strength of the concrete is 15%.
4) From Fig 3.3 It is observed that the split tensile strength of the concrete increases to 2.17%,1041%,22.03%,15.25% and 20.54%,23.25%,32.58%,25% when Course and fine aggregates mixes increases from 0%,5%,10%,15% and 20% for CTM when it is compared with conventional concrete at 7 days and 28days with normal water.
5) From Fig 3.4 It is observed that the split tensile strength of the concrete increases to 0.7%,10%,21.51%,10.40% and 23.46%,28.26%,31.9%,24.42% when Course and fine aggregates mixes increases from 0%,5%,10%,15% and 20% for CTM when it is compared with conventional concrete at 7 days and 28 days with sea water.
6) It is observed that the optimum dosage of split tensile strength of the concrete is 15%.
7) Finally it concludes that when we are adding above 15% partial replacement of coarse aggregate and fine aggregate with crushed tiles and granite powder the strength of the concrete will be decreased gradually.

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