Experimental Study on Concrete with Partial Replacement of Cement with Fly Ash & Coarse Aggregate by Ceramic Tiles

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Abstract

Concrete is the most undisputable and indispensable material being used in infrastructure development throughout the world. Umpteen varieties of concretes (FAC, HVFAC, FRC, HPC, HSC, and others) were researched in several laboratories and brought to the field to suit the specific needs. Marble, granite and Siramic tiles industry has grown significantly in the last decades with the privatization trend in the early 1990s, and the flourishing construction industry. Accordingly, the amount of mining and processing waste has increased. Stone waste is generally a highly polluting waste due to both its highly alkaline nature, and its manufacturing and processing techniques, which impose a health threat to the surroundings. The objective of this paper is to ceramic tiles waste of different sizes in the manufacturing of concrete bricks, with partial replacement of conventional coarse and cement with silica fume and ceramic tiles waste content up to 20%.The produced bricks are tested for physical and mechanical properties according to the requirements of the American Standards for Testing Materials (ASTM) and the IDIAN Code. The test results revealed that the recycled products have physical and mechanical properties that qualify them for use in the building sector.

Keywords: Cement of Grade 53, Silica Fume, Water, Sand and Coarse Aggregate

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I. INTRODUCTION

There is an era of industrial explosion. So, it may lead to increasing demand of natural resources. The cost of natural resources is also increased. They have forced to focus on recovery, reuse of natural resources and find other alternatives. Stone waste/Granite has been commonly used as a building material. Today industry's disposal of the stone waste/Granite powder material is one of the environmental problems around the world. Stone waste/Granite blocks are cut into smaller blocks in order to give them the desired shape and size. During the process of cutting, in that original stone waste/Granite mass is lost by 30% in the form of dust. Every year 250-400 tons of stone waste/Granite waste is generated at site. The stone waste/Granite cutting plants are dumping the powder in any nearby pit or vacant spaces, near their unit although notified areas have been marked for dumping. This leads to serious environmental and dust pollution and occupation of vast area of land especially after the powder dries up .so it is necessary to dispose the stone waste/Granite waste quickly & use in construction industry.

II. RESULTS AND DISCUSSIONS

S.No	*Mix*	*Cement %*	*Fly ash %*	*Fine aggregate %*	*Coarse aggregate %*	*Ceramic tiles %*	*No. of Cubes & cylinders*			
							7 days	*28 days*	*60 days*	*90 days*
1	*AK 0*	*100*	*0*	*100*	*100*	*0*	*3*	*3*	*3*	*3*
2	*AK 1*	*90*	*10*	*100*	*100*	*0*	*3*	*3*	*3*	*3*
3	*AK 2*	*80*	*20*	*100*	*100*	*0*	*3*	*3*	*3*	*3*
4	*AK 3*	*70*	*30*	*100*	*100*	*0*	*3*	*3*	*3*	*3*
5	*AK 4*	*60*	*40*	*100*	*100*	*0*	*3*	*3*	*3*	*3*
6	*AK 5*	*50*	*50*	*100*	*100*	*0*	*3*	*3*	*3*	*3*
7	*AK 6*	*90*	*10*	*100*	*90*	*10*	*3*	*3*	*3*	*3*
8	*AK 7*	*90*	*10*	*100*	*80*	*20*	*3*	*3*	*3*	*3*

9	*AK 8*	*90*	*10*	*100*	*70*	*30*	*3*	*3*	*3*	*3*
10	*AK 9*	*90*	*10*	*100*	*60*	*40*	*3*	*3*	*3*	*3*
11	*AK10*	*90*	*10*	*100*	*50*	*50*	*3*	*3*	*3*	*3*

A. Conventional Concrete Mix design (as per is 10262: 1982)

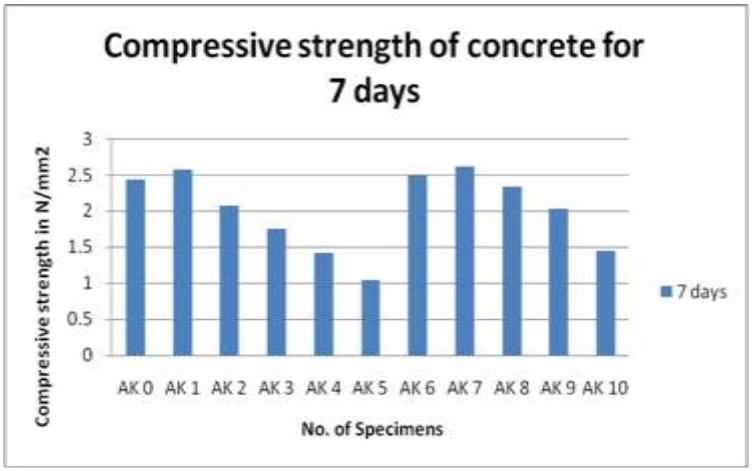
S.No	*Mix*	*7 days Compressive strength N/mm2*	*28 days Compressive strength N/mm2*	*60 days Compressive strength N/mm2*	*90 days Compressive strength N/mm2*
1	*AK 0*	*38.37*	*45.12*	*47.30*	*50.98*
2	*AK 1*	*39.68*	*49.72*	*50.54*	*53.87*
3	*AK 2*	*34.20*	*44.72*	*45.76*	*49.14*
4	*AK 3*	*25.53*	*40.04*	*42.34*	*46.27*
5	*AK 4*	*22.32*	*33.49*	*35.40*	*37.89*
6	*AK 5*	*16.13*	*27.68*	*28.34*	*31.05*
7	*AK 6*	*39.73*	*46.84*	*47.14*	*50.87*
8	*AK 7*	*40.27*	*48.11*	*49.11*	*53.43*
9	*AK 8*	*34.91*	*39.94*	*40.15*	*44.21*
10	*AK 9*	*28.51*	*36.48*	*38.14*	*40.19*
11	*AK 10*	*26.26*	*32.24*	*34.16*	*39.78*

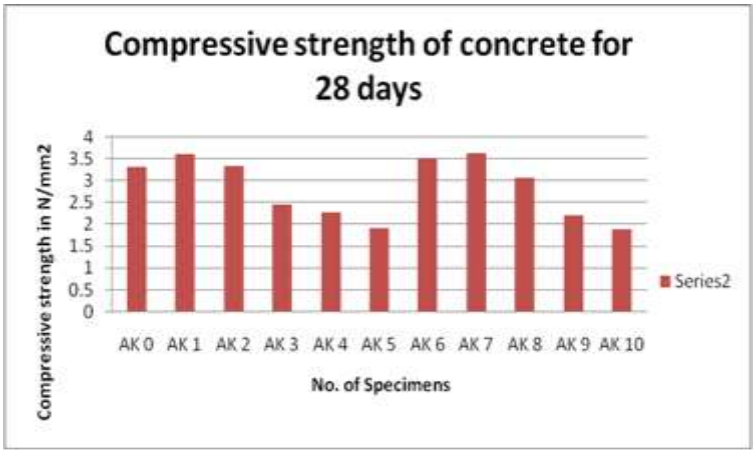
In the present investigation mix proportioning is done using BIS method for, M35 grade concrete. The resulting mixes are modified after conducting trials at laboratory by duly following the Indian standards guidelines to achieve following Mix proportion by weight:

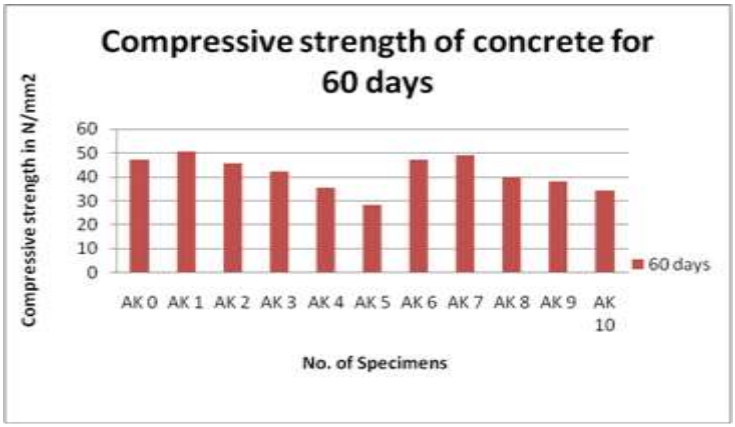
Table - 4.10
Mix Proportions by Weight (PER M3)

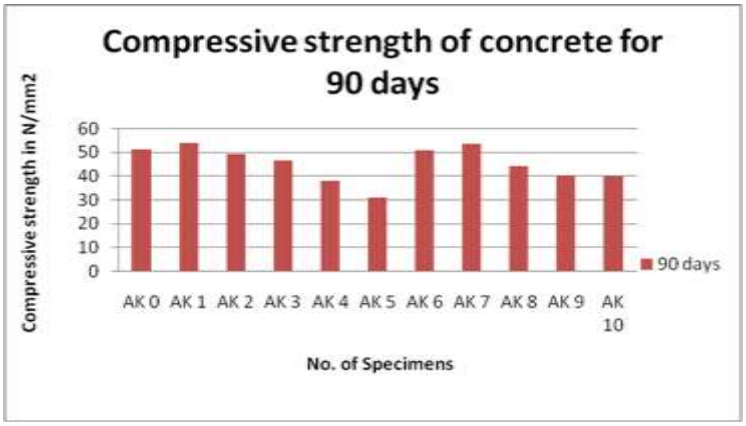
Cement(kgs)	*Fine Aggregate (kgs)*	*Coarse aggregate (kgs)*	*w/c ratio*
450	*523.68*	*1229.86*	*187.78*
1	*1.16*	*2.73*	*0.41*

III. COMPRESSIVE STRENGTH TEST RESULTS AND GRAPHS





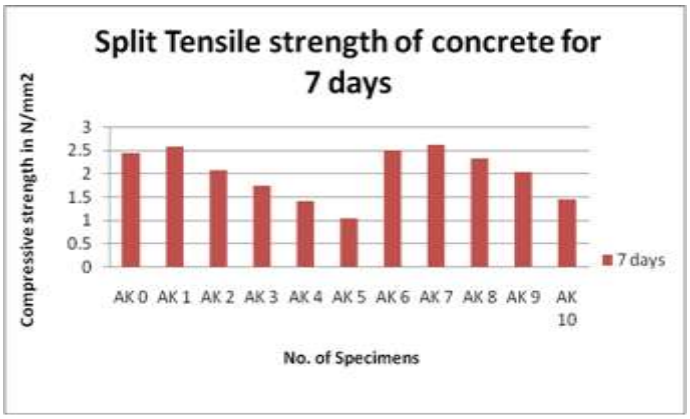


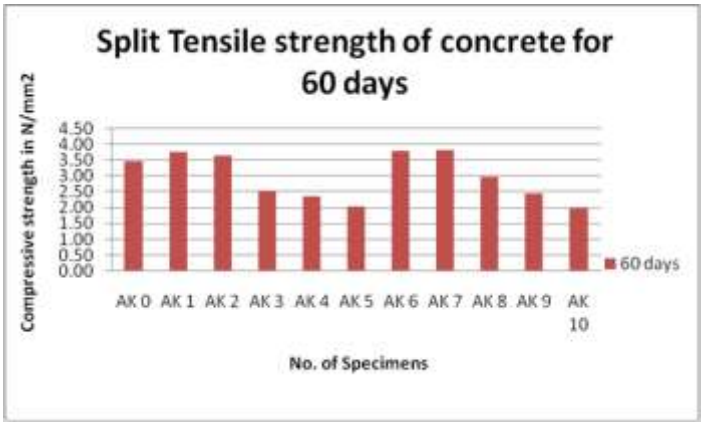


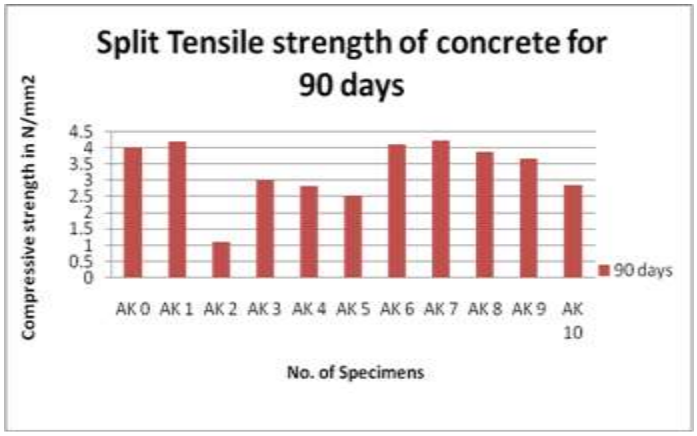
IV. SPLIT TENSILE STRENGTH

S.No	*Mix*	*7 days Split Tensile strength N/mm2*	*28 days Split Tensile strength N/mm2*	*60 days Split Tensile strength N/mm2*	*90 days Split Tensile strength N/mm2*
1	*AK 0*	*2.43*	*3.3*	*3.45*	*4.01*
2	*AK 1*	*2.57*	*3.59*	*3.75*	*4.17*
3	*AK 2*	*2.07*	*3.33*	*3.64*	*1.09*
4	*AK 3*	*1.75*	*2.46*	*2.54*	*2.98*
5	*AK 4*	*1.42*	*2.26*	*2.35*	*2.81*
6	*AK 5*	*1.04*	*1.9*	*2.02*	*2.54*
7	*AK 6*	*2.49*	*3.51*	*3.76*	*4.09*
8	*AK 7*	*2.61*	*3.61*	*3.81*	*4.21*
9	*AK 8*	*2.33*	*3.06*	*2.97*	*3.87*
10	*AK 9*	*2.03*	*2.2*	*2.43*	*3.66*
11	*AK 10*	*1.45*	*1.89*	*1.98*	*2.84*

V. SPLIT TENSILE STRENGTH RESULTS AND GRAPHS







VI. CONCLUSION

After completion of total project work, from the above investigations and from the test results some variations observed in compressive strength of different concrete mixes having different percentages of replacing ceramic tiles in place of coarse aggregate as mentioned below.

1) The concrete is cast by partially replacing coarse aggregate with ceramic tiles in various proportions such as 10%, 20%, 30%, 40% and 50%.
2) The compressive strength and split tensile strength reveals high strength of 20% replacement of ceramic tiles as a coarse aggregate.
3) At the age of 28 days curing, the compressive strength of 10% replacement is 3.81% higher; at 20% replacement is 6.62% higher than the conventional concrete.
4) At the age of 28 days curing, the split tensile strength of 10% replacement is 6.36% higher; at 20% replacement is 9.39% higher than the conventional concrete.
5) Thus ceramic tiles can be utilized in the manufacture of concrete at replacement of 20%.

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