Influence of Silica fume on Split tensile Strength of Concrete

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Abstract-*The paper presents the study of the split tensile strength of concrete with different proportions of silica fume content which are compared with conventional concrete. Strength of concrete for the various combinations is studied for the four percentages of silica fume. The main parameter investigated in this paper is M35 grade concrete with partial replacement of cement by silica fume by 0, 5, 10,15 and 20%. This paper presents an experimental study on split tensile strength at age of 7 and 28 day. Test results indicate that use of Silica fume in concrete has improved the performance of concrete in tension and the optimum silica content being 10%.*

Keywords-Silica fume, Portland cement , concrete, split tensile strength

I. INTRODUCTION

The tensile strength of concrete is one of the basic and important properties. Splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. The concrete is very weak in tension due to its brittle nature and is not expected to resist the direct tension. The concrete develops cracks when subjected to tensile forces. Thus, it is necessary to determine the tensile strength of concrete to determine the load at which the concrete members may crack.

The Ordinary Portland Cement (OPC) is one of the main ingredients used for the production ofConcrete and till date has no alternative in the civil construction industry. Unfortunately, production of cement involves emission of large amounts of carbon-dioxide gas into the atmosphere, a major contributor for green house effect and the global warming, hence it is inevitable either to search for another material or partly replace it by some other material. The search for any such material, which can be used as an alternative or as a supplementary for cement should lead to global sustainable development and lowest possible environmental impact.

A large number of scientific research is going on to study the impact of use of these pozzolanic materials as cement replacements and the results are encouraging. In this paper use of silica fume with various percentages and its effect on split tensile strength has been studied.

Addition of silica fume to concrete has manyadvantages like high strength, durability and reduction in cement production. The optimum silicafume replacement percentage for obtaining maximum 28- days strength of concrete ranges from 10 to20 %.In this paper suitability of silica fume in respect to split tensile strength of concrete has been discussed at varying percentage and the strength parameters were comparedwith conventional concrete. It is found that Cement replacement up to 10% with silica fume leads to increase in split tensile strength, for M35 grade of concrete.

II. EXPERIMENTAL INVESTIGATION (Grade of Concrete M35.)

2.1 Materials

2.1.1 Cement: Ordinary Portland Cement of Ambuja brand of 43 grade confirming to I.S.–8112-1989 was used in the present study.

2.1.2 Coarse Aggregate: Crushed aggregate confirming to IS: 383-1987 was used.

2.1.3 Fine Aggregate: The river sand was used as fine aggregate.

2.1.4 Water: Water conforming to as per IS: 456- 2000 was used for mixing as well as curing of concrete specimens.

2.1.5 Silica Fume: The Silica fume is used as a partial replacement of cement. The chemical composition of silica fume are: Contains more than 90 percent silicon dioxide Other constituents are carbon, sulphur and oxides of aluminium, iron, calcium, magnesium, sodium and potassium The physical composition of silica fume are: Diameter is about 0.1 micron to 0.2 micron Surface area about 30,000 m^2/kg Density varies from 150 to 700 kg/m^3 .

The water binder ratio (W/B) (Binder = Cement + Partial replacement of silica fume) adopted was 0.35 and

weight of super plasticizer(Adoplast) was estimated as 0.6%of weight of binder.

III. EXPERIMENTAL PROCEDURE

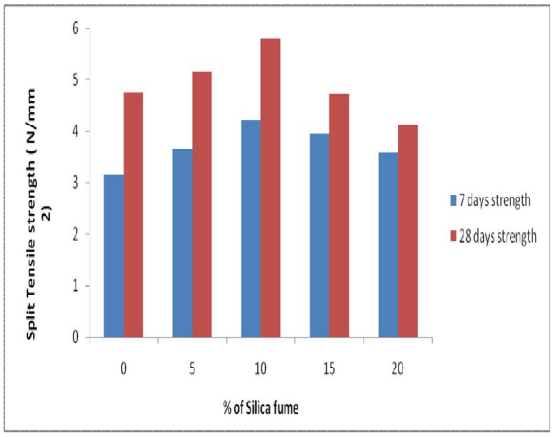
The specimen of standard cube of standard cylinders of (300mm x100mm) were used to determine the split Tensile strength of concrete. Three specimens were tested for 7 & 28 days with each proportion of silica fume replacement. Totally 30 cylinders were cast for the strength parameters .The constituents were weighed and the materials were mixed by hand mixing. The water binder ratio (W/B) (Binder = Cement + Partial replacement of silica fume) adopted was 0.35 and weight of super plasticizer was estimated as 0.6%of weight of binder. The concrete was filled in different layers and each layer was compacted. The specimens were demoulded after 24 hrs, cured in water for 7 & 28 days, and then tested for its split tensile strength as per Indian Standards.

IV. TEST RESULTS AND DISCUSSIONS

The results of Split Tensile strength were presented in Table 1. The test was carried out conforming to IS 516-1959 to obtain Split tensile strength of concrete at the age of 7 and 28 days. The cylinders were tested using Compression Testing Machine (CTM) of capacity 2000Kn.From fig 1 the increase in strength is 4.21N/mm2 and 5.8 N/mm2 at 7 and 28 days at the optimum lime content. The maximum increase in split tensile strength is observed at 10% replacement of silica fume.

Table 1 Result of split tensile strength at varying percentages of silica fume

MIX	%Silica Fume Added	Split Tensile Strength(N/mm2)	
		7 days	28 days
M1	0	3.15	4.75
M2	5	3.64	5.16
M3	10	4.21	5.80
M4	15	3.94	4.73
M5	20	3.58	4.12



Graph 1 Comparison of 7day & 28 day Split Tensile Strength of concrete

V. CONCLUSIONS

From the above experimentation it is evident that the optimum 7 and 28-day split tensile strength have been obtained in the range of 10 % silica fume replacement level. Gain in split tensile strength have occurred linearly up to 10 % replacements but after that is a drop in split tensile strength. Hence the optimum content of silica fume is 10%.Further silica fume seems to have a pronounced effect on the flexural strength as there is an increase of 38% in the split tensile strength of the silica fume stabilized concrete.

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