Study of Effect of Fly Ash & Silica Fume on Strength & Durability of Concrete

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Abstract- *Concrete is that the basic engineering material utilized in most of the engineering science structures. Its quality as basic artifactin construction is owing to, its economy of use, sensible sturdiness and ease with that it is factory-made at website. the flexibilityto mould it into any form and size, owing to its physical property in inexperienced stage and its resultant hardening to attainstrength, is especially helpful. Concrete like different engineering materials must be designed for properties like strength, durability, workability and cohesion. Concrete combine style is that the science of deciding relative proportions of ingredients of concrete, to attain the required properties within the most economical manner. With advent of high-rise buildings and pre-stressed concrete, use of upper grades of concrete is turning into a lot of common. The task of concrete combine style is to estimate totally different concrete compositions of sand and so to decide on the simplest variants of combine by examination their economical and mechanical properties likewise as sturdiness of the fabric. The M-35 concrete combine is style with totally different water cement quantitative relation by IS 10262-2009 technique. Compressive strength is set at the age of seven, twenty eight days from samples of size 150mm cubes.*

Keywords- Fly ash, silica fume, HCL, Compressive Strength

I. INTRODUCTION

Concrete may be a wide used construction material for varied sorts of structures thanks to its structural stability and strength. The usage, strength additionally because the sturdiness of concrete structures, built during the last half of the century with normal cement (OPC) and plain spherical bars of mild steel, the benefit of procuring the constituent materials (whatever is also their qualities) of concrete and the data that nearly any combination of the constituents results in a mass of concrete have bred contempt. Strength was stressed while not an idea on the sturdiness of structures. As consequence of the liberties taken, the sturdiness of concrete and concrete structures is on a southward journey; a journey that looks to possess gained momentum on its path to self– destruction. The Ordinary cement (OPC) is one among the most ingredients used for the assembly of concrete and has no different within the civil housing industry. sadly, production of cement involves emission of enormous amounts of carbon-dioxide gas into the atmosphere, a serious contributor for green-house result and also the warming, thus it's inevitable either to look for an additional material or part replace it by another material. The hunt for any such material, which may be used as an different or as a supplementary for cement ought to result in international property development and lowest potential environmental impact. Substantial energy and price savings may end up once industrially product are used as a partial replacement of cement. Fly ash, Ground coarse Blast furnace Slag, Rice husk ash, High Reactive Met porcelain clay, silicon dioxide fume are number of the pozzolanic materials which are often utilized in concrete as partial replacement of cement. variety of studies ar going onin Asian nation additionally as abroad to review the impact of use of those pozzolanic materials as cement replacements and also the results ar encouraging. Addition of ash silica fume to concrete has many advantages like high strength, sturdiness and reduction in cement production. Portland cement is that the most significant ingredient of concrete and may bea versatile and comparatively high value material. Large scale production of cement is inflicting environmental issues on one hand and depletion of natural resources on different hand. This threat to ecology has diode to researchers to use industrial by product as supplementary cementations material in creating concrete During the last 3 decades, nice strides are taken in rising the performance of concrete as a construction material. Significantly oxide Fume (SF) and ash separately or together square measure indispensable in production of high strength concrete fertilization. the employment of oxide fume as a pozzolana has enhanced worldwide attention over the recent years as a result of once properly used it as sure %, it will enhance numerous properties of concrete each within the recent still as in hardened states like cohesiveness, strength and sturdiness.The early work done received most of the eye, since it had shown that Portland cement-based-concretes containing ash &silica fumes had terribly high strengths and low porosities. Since then the analysis and development of oxide fume created it one among the world‘s most beneficial and versatile admixtures for concrete and cementious product.

II. LITERATURE REVIEW

K. Param Singh, U. Praveen Goud, S. Madan Mohan, Dr. S. Sreenatha Reddy [1], The main objective of the study was style|to style} M25 concrete combine and realize the compressive strength victimization totally different combine design strategies like IS10262-1982, IS 10262-2009 ,ACI technique and DOE technique. we have a tendency to conclude that in higher than four strategies minimum cement content employed in DOE strategies and it provides want compressive strength of concrete economical approach. Second object is to create the concrete within the most economical manner. the fundamental assumption created in combine style is that the compressive strength of executable concrete is, ruledby the water cement magnitude relation. Another most convenient relationship applicable to traditional concretes is that for a given sort, shape, size and grading of aggregates, the quantity of water determines its workability. However, there square measure varied alternative factors that have an effect on the properties of concrete.

Chinnakotti Sasidhar, G. Sujala [2], In the gift study the cement is part substituted by 2 hundredth and half-hour of ash and Nano-Silica two.0%, 4.0% and 6.0% by weight. to know the applying of ash and Nano-Silica varied literatures are reviewed and their influence on Compressive Strength, Bending Strength (Flexural Strength), modulus or Young’s Modulus and durability of M35 grade of concrete is investigated.

Dr Deepa A Sinha [3] the main objective of this study is style|to style} M25 concrete combine the compressive strength victimization totally different combine design ways like IS 10262-1982,IS 10262-2009, ACI method ,DOE method. in order that conclude that in higher than fourways minimum cement content employed in DOE ways & it offers need compressive strength of concrete economical approach

Wankhede t.al [4] studied the consequences of ash on the properties of concrete and all over that with ten try to two hundredth replacement of cement with ash, the compressive strength was accrued whereas for half-hour replacement, the compressive strength was slashed. it absolutely was additionally discovered that the slump loss of concrete unbroken on increasing with the rise of amount of ash

Patil et al [5] investigates the compressive strengths of concrete with partial replacement of cement with ash. The cement is replaced with ash from five-hitter to twenty fifth by associate increment of fifty. the speed of compressive strength development is most at sixty days for concrete with no replacement of cement with ash. Concrete with five-hitter ash has most rate of compressive strength development up to the age of twenty one days and so the speed decreases. it's determined that 100 percent ash addition provides the most strength at ninety days. Thus, for concrete with partial replacement of cement with ash, the initial rate of strength development is a smaller amount however ultimately the desired most strength is achieved.

Siddam Reddy Anilkumar Reddy et.al [6], main parameter investigated in his study is M20 grade concrete with partial replacement of cement by oxide fume by zero, 5, 10,15and by two hundredth. This paper presents a close experimental study on Compressive strength, split lastingness, at age of seven and twenty eight day. Sturdiness study on acid attack was additionally studied and proportion of weight loss is compared with traditional concrete.

Roy et.al [7] did a study on the character of silicon oxide Fume and discovered however it affected the properties of contemporary and hardened concrete. Properties like final compressive strength, Flexural strength, and cacophonic lastingness square measure determined for varied combine mixtures of siliconoxide fume then compar ed with the traditional concrete. it's complete that silicon oxide fume helps in achieving lower water-cement ration and higher association of cement particles. 100 percent replacement of cement with silicon oxide fume gave the most compressive strength and conjointly gave vital increase in tensile and flexural strength. silicon oxide Fume also can be utilized in construction places wherever chemical attack, frost action etc. are common. High early strength is achieved in silicon oxide fume concrete.

Srivastava et al [8] reviewed the results of oxide fume in concrete and came to the conclusion that adding oxide fume will increase the compressive strength and bond strength of concrete. The lastingness, flexural strength and modulus of physical property of oxide fume concrete square measure appreciate that of hydraulic cement concrete.

III. EXPERIMENTAL PROGRAM

Cement - Ordinary Portland cement of 53 grade RAMCO is use throughout the experiment.

Fine Aggregate- domestically on the market sand from man river with 4.75 mm maximum size. with specific gravity 2.55, Fineness Modulus = 2.65.confirming to IS 383– 1987.

Course Aggregate- The coarse aggregate use in this experiment is of size 20 mm.

FLY Ash- Fly ash is finely divided waste by product obtained from the combustion of small-grained coal in suspension dismissed furnaces of thermal power plants. it's collected by electrical or mechanical precipitators as well as cyclone precipitators or bag homes. it’s typically finer than cement and consists of largely spherical glassy particles of advanced chemical moreover as mineralogical composition. For this work ash was obtained from Thermal powerhouse, PARAS, Akola (M.S) India.

E.Silica Fume- Silica fume, conjointly called micro-silica, is associate amorphous (non-crystalline) being of silicon oxide, silica. it's associate ultrafine powder collected as a by-product of the atomic number 14 and ferrosilicon alloy production and consists of spherical particles with a median particle diameter of one hundred fifty nm. the most field of application is as pozzolanic material for superior concrete. it's generally confused with treated silicon dioxide. However, the assembly method, particle characteristics and fields of application of treated silicon dioxide ar all totally different from those of silicon dioxide fume. For this work silicon dioxide fume is obtained from Drug (Chhattisgarh) Bharat.

Figure 1: Silica Fume

HCL
Physical properties:

- Concentration – 32 kg Hcl/kg
- pH – 2.0
- Specific Heat – 2.55
- Boiling Point – 84°C
- Melting Point – - 43°C

Figure 2 : HCL

IV. MIX DESIGN

The procedures of the proposed mix design method can be Summarized in the following steps.

Step-1: Target Strength for Mix Proportioning

$f'_{ck} = f_{ck} + 1.65s$
f'_{ck} = target average compressive strength at 28 days,
f_{ck} = characteristic compressive strength at 28 days, and
s = standard deviation.
From Table I, standard deviation, s = 5 N/mm^2 (IS456)
Therefore, target strength = 35 + 1.65 x 5 = 43.25 N/mm^2

Step 2: Selection of Water-Cement Ratio

From Table 5 of IS 456, maximum water-cement ratio= 0.45

Based on experience, adopt water-cement ratio as 0.40
0.40 < 0.45, hence OK

Step 3: Selection of Water Content

From Table 2, maximum water content =186 liter (for 25 to 50 mm slump range) for 20mm aggregate

Estimated water content for 100 mm slump =186+(6/100) X 186
=197 liter

Step 4: Calculation of Cement Content

Water-cement ratio= 0.40
Cement content = 197/0.40 = 492.5kg/m^3

From Table 5 of IS 456, minimum cement content for 'severe' exposure condition = 340kg/m^3 492.5 kg/m^3> 340 kg/m^3, hence, O.K.

Step 5: Proportion of Volume of Coarse Aggregate and Fine Aggregate Content

From Table 3.volume of coarse aggregate corresponding to 20mm size aggregate and fine aggregate (Zone II) for water-cement ratio of 0.40 =0.62

In the present case water-cement ratio is 0.40. Therefore, volume of coarse aggregate is required to be increased to decrease the fine aggregate content. As the water-cement ratio is lower by 0.10. The proportion of volume of coarse aggregate is increased by0.02 (at the rate of -/+ 0.01 for every • } 0.05 change in water-cement ratio).

Therefore, corrected proportion of volume of coarse aggregate for the water-cement ratio of 0.40 = 0.62

For pump able concrete these values should be reduced by 10 percent. Therefore, volume of coarse aggregate = 0.62 x 0.9 = 0.56
Volume of fine aggregate content = 1 - 0.56 =0.44

Step 6: Mix Calculations

The mix calculations per unit volume of concrete shall be as follows:

a) Volume of concrete = 1 m^3

b) Volume of cement $= \frac{\text{Mass Of Cement}}{\text{Specific Gravity Of Cement}} \times \frac{1}{1000}$

$= \frac{492.5}{3.15} \times \frac{1}{1000}$

$= 0.156$ m^3

c) Volume of water $= \frac{\text{Mass Of Water}}{\text{Specific Gravity Of Water}} \times \frac{1}{1000}$

$= \frac{197}{1} \times \frac{1}{1000}$

$= 0.197$ m^3

d) Volume of all in aggregate = [a- (b +c)]
= 1-(0.156 +0.197) = 0.647 m^3

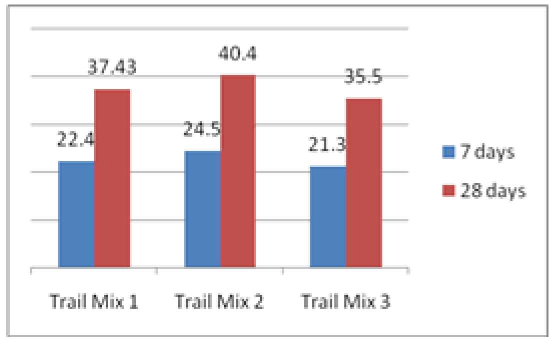
e) Mass of coarse aggregate = D x Volume of coarse aggregate X Specific Gravity of fine aggregate X 1000
=0.647 X0.56 X 2.74 X 1000
= 992.75 kg/m^3

f) Mass of fine aggregate = d X Volume of fine aggregate X Specific Gravity of fine aggregate X 1000
= 0.647 X 0.44 X 2.74 X 1000
= 780kg/m^3

Cement= 492.5 kg/m^3
Water = 197 kg/m^3
Fine aggregate= 780 kg/m^3
Coarse aggregate= 992.75 kg/m^3
Water-cement ratio= 0.4.

Table1 : Mix Proportion For SCC for 3 trials

Mix Proportion	Cement (kg/m3)	Fine Aggregate (kg/m3)	Coarse Aggregate (kg/m3)	Water (kg/m3)
1	492.5	780	992.75	197
2	547	731.90	994.291	197
3	448	833.1	978	197



Graph 1 : Compressive Strength

V. CONCLUSION

From these three trials we conclude that the compressive strength for trial-2 is maximum as compared to other trials. So, I used trial-2 proportions. In three trials it is seen that the compressive of concrete is maximum at 0.44 water cement ratio & as water cement ratio increases compressive strength decreases.

VI. FUTURE SCOPE

Compressive strength of concrete can be evaluated by using admixture. Admixture will help in maintain bond between materials especially in cement hence bond strength can be evaluated. There is further scope of research to mix design using industrial wastes such as fly ash, Silica fume, etc.

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