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STUDY ON COMPRESSIVE STRENGTH OF CONCRETE BY USING WASTE MATERIAL

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Abstract — The utilization on fly ash in concrete as a partial replacement of cement is gaining immense importance today, mainly on account of the improvements in the compressive strength of concrete combined with ecological benefit. Technological improvement of thermal power plant operation and fly ash collection system have resulted the improving consistency of fly ash. To study the effect of partial replacement of cement by fly ash, studies are conducted on concrete mixes with cementitious material at 5% , 10% , 15% replacement levels. In this study the effect of fly ash and waste material on compressive strength are undertaken. Chemical admixture is used for improving workability of concrete. sikament 600HP NPC (C01) as a plasticizer. The utilization of brick (waste material) as a partial replacement of aggregates is another aspect undertaken. The proportion of bricks used in concrete mixes shall be 5% , 10% , 15%.The concrete mix design for standard concrete that is grade M40 with different percentage of fly ash can be directly designed & than it will be compared with normal concrete.

Keywords-component; ***brick bats, cement, concrete mix design, compressive strength, fly ash,***

I. INTRODUCTION

In view of global warming, efforts are made to reduce the emission of CO2 in the environment. Cement industry is a major contributor in the production of cement.

By replacing cement with a material of pozzolanic characteristic, such as the fly ash, the cement & concrete industry together can meet the growing demand in construction industry as well as help in reducing the environmental pollution.

India is a resourceful country for fly ash generation with an annual of over 110 million tones, but utilization is still below 20% in spite of quantum jump in last three to four year. Availability of consistent quality fly ash across the country & awareness of positive effects of using fly ash in concrete are pre requisite for change of perception of fly ash from “A waste material” to “A resource material”.

Technological efforts have been made to improve the quality of fly ash. At present most of the power plants are using electro static precipitator (ESP) through which fly ash is collected in different chambers according to its particle size. Hence a uniform good quality of fly ash can be collected from these power plants. Some of the power plants have gone a step further by developing a collection system, in which the fly ash collected from different fields is combined & the final product is taken to an air classifying plant were coarse particles are removed. The final beneficial product is then stored in a silo to be used in a cement and concrete industry.

To study the impact of replacement of cement by fly ash on the properties of concrete, experiments were conducted on different concrete mixes.

II.MECHANRICAL PROPERTIES OF BRICKS

Strength and durability of concrete depend on various factors, among which the most important is the quality and properties of aggregate, such as porosity, water absorption, specific gravity, soundness, freezing and thawing resistance, and finally compressive strength. The following sections describe the necessary tests and the pertaining results for more identification the properties of clay bricks.

Figure 1 Brick bats

Table 1 Compressive Strength of Bricks in original form and rock[6]

Material	Unconfined compressive strength (UCS) kg/cm^2	Specific Gravity in gm/cm^3
Brick (in original form)	30-70	1.9-2
Basalt	1750-4200	2.8-2.9
Granite	700-2800	2.65-2.75
Limestone	350-1750	2.65-2.75
Sandstone	280-1400	2.3-2.4

Table 2 Chemical analysis of soil used to make bricks[6]

SiO2 (%)	Al2O3 (%)	CaO (%)	MgO (%)	K2O (%)	Na2O (%)	Fe2O3
50-55	13-18	8-12	2.5-4	0-1.5	0.2-0.5	4-6

A.Porosity and water absorption

The water absorption of brick (in original form) and crushed brick performed in accordance with ASTM 128 and ISIRI 2000, as shown in Table 4. The water absorption for crushed brick and natural aggregate was about 28 and 1.5 percent (in average) respectively. This significant difference is thought to be the main reason of reduction in strength and durability of concrete made with crushed brick. Low specific gravity of brick in comparison with natural aggregate resulted in the concrete made with crushed bricks to be lighter that normal concrete.

Table 3 Soundness test result of crushed brick[6]

Aggregate type	Coarse (9.5 mm to 50 mm)	Fine (0.3 mm to 9.5 mm)
Loss in weight (%) for crushed brick	10.9	4.1
Loss in weight (%) for cement mortar/concrete	65.9	38.5

III.MECHANICAL PROPERTY OF FLY ASH[6]:

A.Particle Morphology

As per morphological studies, fly ash particles usually consist of clear glassy spheres & spongy aggregate ranging in diameter from 1 to 150 µm as seen under energy dispersive X-ray analysis (EDXA).

B.Fineness

Fineness is one of the primary physical characteristics of fly ash that relates to its pozzolanic activity. A large fraction of fly ash particles is smaller than 3 µm in size. In bituminous ashes, the particles sizes range from less than 1 to 100 µ.

C.Specific gravity

The specific gravity of fly ash is related to shape as well as chemical composition of particles. Specific gravity of fly ash usually varies from 1.3 to 4.8.Coal particles with some minerallic impurities have specific gravity in between 1.3 to 1.6.Opaque spherical magnetite (ferrite spinal) and hematite particles, light brown to black in colour, when present in sufficient quantity in fly ash increases the specific gravity to about 3.6 to 4.8.

D.Chemical Properties of Fly ash

Chemical constituent in fly ash reported in terms of oxides include silica (SiO2), alumina (Al2O3), and calcium oxides (CaO), iron oxide (Fe2O3),magnesium oxides (MgO), and Oxides of titanium (TiO2), sulphur (SO3), Sodium (Na2O), and potassium (K2O).Unburned carbon is another major constituent in all the ashes. Amongst these SiO2 and Al2O3 together make up about 45 to 80% of the total ash. The sub-bituminous and lignite coal ashes have relatively higher proportion of CaO and MgO and lesser Proportion of SiO2, Al2O3 and Fe2O3as compared to the bituminous coal ashes.

IV.PHYSICAL PROPORTION AND PROPERTIES OF CEMENT, AGGREGATES AND FLY ASH AND PROPORTION OFG MIX DESIGN

Specific gravity of Sand: 2.67
Specific gravity of Aggregate(10): 2.72 and (20):2.78

For Fine Aggregates:	For Coarse Aggregates:
Compacted Bulk Density: = 1453 kg/m3	Compacted Bulk Density: = 2000 kg/m3
Loose Bulk Density: = 1470 kg/m3	Loose Bulk Density: = 1900 kg/m3

Finenese Modulus of fine aggregate: 2.87
Finenese Modulus of coarse aggregate(20mm): 6.94
Finenese Modulus of coarse aggregate(10mm) : 6.59

Proportion of concrete mix design:

Cement	:	460 kg
Sand	:	694 kg

CA : 1191.6 kg
Water : 184 litres
Plasticizer : 4.6 litres

Water (litre)	:	Cement (kg)	:	Sand (kg)	:	CA(kg)	:	Plasticizer(litre)
0.4	:	1	:	1.5	:	2.59	:	0.01

Table 4 Property of materials

Property	Average value for OPC used in present investigation	Standard value for OPC
Specific gravity	3.15	-
Consistency (%)	32%	-
Initial setting time (min)	48	>30
Final setting time (min)	225	<600
Soundness (mm)	2.0	<10
Fineness By Dry sieving /Blaines Air permeability's	8% (364.6 N/mm2)	<10%
Compressive strength (N/mm2)		
3-days	28.7	>27
7-days	39.63	>37
28-days	55.94	>53

V.RESULT COMRESSIVE STRENGTH OF CONCRETE

Table 5 compressive strength of concrete

Type of Mixing	3 days	14 days	28 days
B1 (MPa)	20.23	38.37	45.82
B2 (MPa)	23.16	35.84	42.5
B3 (MPa)	21.78	31.78	32.17
B4 (MPa)	38.43	45.3	43.83

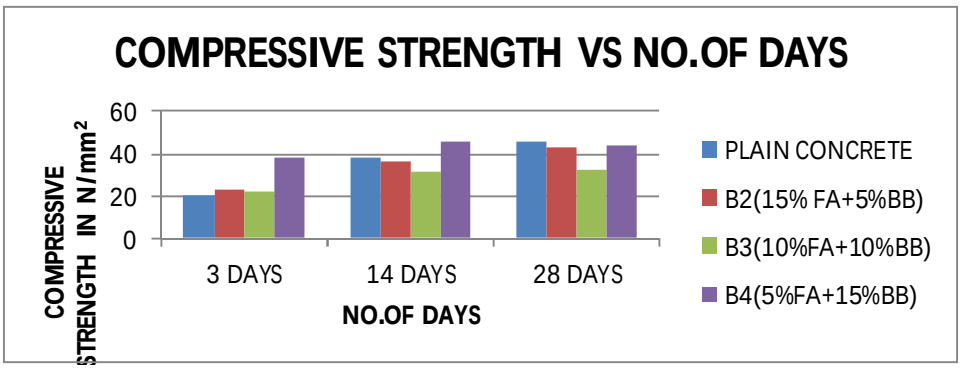

figure 2 Compressive Strength vs No. of Days (combine 3, 14, 28 Days)

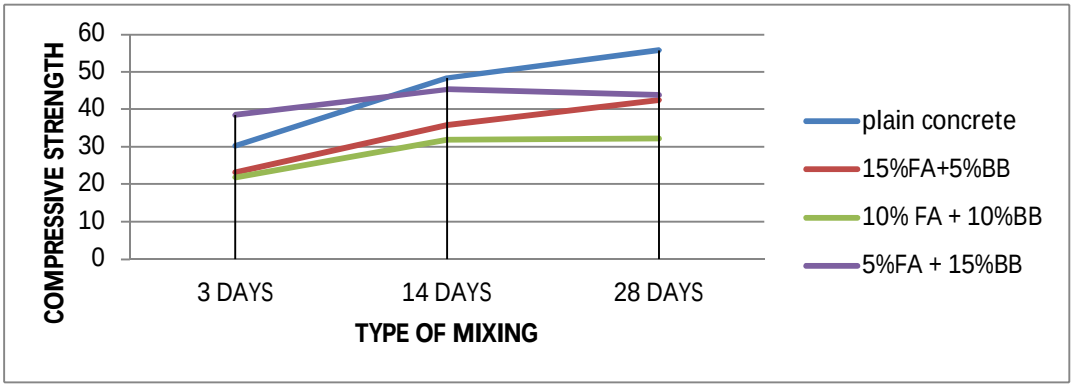

Figure 3. Compressive strength of concrete

B1 = Normal (Plain Concrete) Concrete
B2 = 15% Fly ash with replacement of Cement + 5% Brickbats(Size of 2.36 mm Retained) with Replacement of Sand + 1% Brickbats (10 mm Retained) with Replacement of Coarse Aggregate
B3 = 10% Fly ash with replacement of Cement + 10% Brickbats(Size of 2.36 mm Retained) with Replacement of Sand + 2% Brickbats (10 mm Retained) with Replacement of Coarse Aggregate
B4 = 5% Fly ash with replacement of Cement + 15% Brickbats(Size of 2.36 mm Retained) with Replacement of Sand + 3% Brickbats (10 mm Retained) with Replacement of Coarse Aggregate

VI.CONCLUSION:

A.Based on property of harden concrete

For hardened concrete, its performance and life is decided on the characteristics of its properties such as Compressive strength, Tensile strength, Modulus of Elasticity, Flexural strength etc. In this investigation program, compressive strength were checked critically and concluded from the results obtained as follows:
The Compressive Strength of plain concrete (B1) is 30.23 MPa, 48.37 MPa, 51.26MPa in order to 3 days, 14 days, 28 days.Whenever, the type of mixing B2 (i.e. 15% FA + 5% BB (2.36mm) + 1% BB (10mm)) is used in concrete mix the strength is reduced compare to plain concrete and that strength is 23.16 MPa, 35.84MPa, 42.5 MPa in order to 3 days, 14 days, 28 days.Whenever, the type of mixing B3 (i.e. 10% FA + 10% BB (2.36mm) + 2% BB (10mm)) is used in concrete mix the strength is reduced again compare to plain concrete and that strength is 21.78 MPa, 31.78MPa, 45.5 MPa in order to 3 days, 14 days, 28 days.Whenever, the type of mixing B4 (i.e. 5% FA + 15% BB (2.36mm) + 3% BB (10mm)) is used in concrete mix the strength is reduced in particular mixes of 14 days, 28 days. The compressive strength of 23.16 MPa, 35.84MPa, 42.5 MPa in order to 3 days, 14 days, 28 days.so it conclude that this proportion of waste material is not decent for concrete.

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