Experimental Study on Mechanical Property of Concrete Containing Red Mud & Silica fume as a Partial Replacement of Cement

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Abstract : Red mud is a waste material generated by the Bayer process widely used to produce alumina from bauxite throughout the world. Significant research has been done to utilize red clay as a raw material for the production of various products. It can be used as building / building material in brick, block, lightweight aggregate, cement industry and special cement and concrete industry. The aim this thesis to investigate Strength Formula by replacing the Portland cement by red mud & Silica Fume. Because of storing issues, the waste negatively affects the environment. To solve this problem, Portland cement will be replaced by Red mud and silica fume and evaluating its fresh properties of concrete. Durability study will be carried out to investigate the effect of red mud powder on strength and weight of concrete specimen. The Proportion use to be verified to strength by different percentage of Red Mud and Silica Fume. By Varying Percentage of Cement is Normal, 10 % RM, 20 % RM, 30 % RM, 40 % RM, 4 % SF + Normal, 4 % SF + 10 % RM, 4 % SF + 20 % RM, 4 % SF + 30 % RM, 4 % SF + 40 % RM, 6 % SF + Normal, 6 % SF + 10 % RM, 6 % SF + 20 % RM, 6 % SF + 30 % RM, 6 % SF + 40 % RM, 8 % SF + Normal, 8 % SF + 10 % RM, 8 % SF + 20 % RM, 8 % SF + 30 % RM, 8 % SF + 40 % RM. In this Research Paper to find out above all Varying Percentage to Slump Test, Compressive Strength Test & Flexural Strength Test. Also Found out the Durability Test on Concrete, the durability test is Carbonation Test, Depth of Water Penetration, Resistance Against Alkali Attack, Chloride Attack Test. In this research Paper to we find all test result and Data Analysis to Maximum 20 % Red mud are used for construction Purpose.

Keywords : Red Mud, Silica Fume, Flexural Strength, Slump, Compressive Strength, Alkali Resistance, Sulphate Attack, Depth of Penetration, Carbonation Test all test for Durability.

I. INTRODUCTION :

Concrete is literally the material that forms the basis of modem history. More than 15 billion tons of concrete are produced each year, which is considered to be the most important building material. With the world population growing, concrete demand is expected to increase to about 20 billion tons per year

by 2050. In modern society, new roads / skyscrapers, high-rise buildings and concrete that are fascinated by buildings are absolutely indispensable. Other consumption Concrete constructions include life, play and work, the movement of roads and bridges, the transport of trucks running on concrete highways, the running of rails that support concrete slippers, the mooring of ships (moorings / boats tied and protected by concrete breakwaters And is distributed by a system of concrete piers, pipes, etc., using landing and takeoff aircraft using concrete piers or concrete runways in the port.

i. Red Mud :

Red clay is rich in iron-rich residue of bauxite. It is one of the major by-products of Bayer's alumina production process. Since red clay is produced in large quantities, it must be stored in large trapped and impermeable ponds, so bauxite refinement is slowly surrounded by the reservoir pond. Currently, 60 million tons of red mud is produced annually worldwide, which is not satisfactorily discarded or recycled.

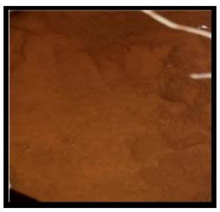

Fig. 1.1 Red Mud

Fig. 1.2 Silica Fume

ii. Silica Fume :

Silica fume is a byproduct of producing silicon metal or ferrosilicon alloys. One of the most beneficial uses for silica fume is in concrete. Because of its chemical and physical properties,

II. HARDENED CONCRETE :

i. Compressive Strength Test :

Compressive strength (MPa) = (Failure load) / (c/s area of cube specimen)

Fig. 1.3 Cube Compressive Strength Test

ii. Flexural Strength Test :

Flexural Strength, $F_b = [(P \times l) / (b \times d^2)]$

When ‘a’ is greater than 20.0 cm for 15.0 cm specimen, or greater than 13.3 cm for a 10.0 cm specimen, or

Flexural Strength, $F_b = [(3P \times a) / (b \times d^2)]$

When ‘a’ is less than 20.0 cm but greater than 17.0 cm for 15.0 cm specimen, or less than 13.3 cm but greater than 11.0 cm for a 10.0 cm specimen. Where,

b = measured width in cm of the specimen,

d = measured depth in cm of the specimen at the point of failure,

l = length in cm of the span on which the specimen was supported and,

p = maximum load in kg applied to the specimen

Fig. 1.4 Beam Flexural Strength Test

iii. Durability Test :

a. Alkali Resistance Test :

The resistance of the concrete to sulfate attack was studied by determining the loss of compressive strength or compressive strength of concrete cubes immersed in sulfate water containing 5% sodium sulfate ($Na2SO4$) and 5% magnesium sulfate ($MgSO4$) Sulfates Not immersed in water.

b. Sulphate Attack Test :

A 5% sodium chloride (NaCl) solution was used as the standard exposure solution for all tests.

c. Carbonation Test :

Carbonation of a concrete is a process by which carbon dioxide from the air penetrates into concrete through pores and reacts with calcium hydroxide to form calcium carbonates. It has been seen that the conversion of $Ca(OH)_2$ in to $Caco_3$ by the action of Co_2 results $Ca(OH)_2 + Co_2 = CaCo_3 + H_2O$. The measurement of Carbonation depth using the phenolphthalein Solution. Spraying the indicator on the Surface of the concrete Cube. The Solution became a Pink Colour in the Carbonated Concrete.

Fig. 1.5 Carbonation Test

d. Depth of Penetration Test :

For dense and, hence, low permeability concrete, the depth of penetration method is usually a more practical proposition than permeability flow tests. The method is covered by BS EN 12390 – 8 : 2000 Testing hardened concrete – Part 8 Depth of Penetration of water under Pressure.

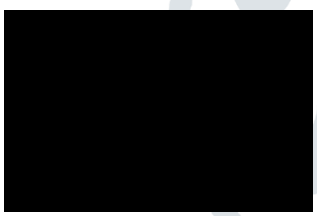

Fig. 1.6 Depth of Penetration Test

III. MIX DESIGN :

AS PER MIX DESIGN QUANTITY OF MATERIAL PER M^3 OF CONCRETE

1. Cement = 400.3 Kg/ m^3
2. Water = 180.1 Kg/ m^3
3. 20 mm coarse Aggregate = 774.2 Kg/ m^3
4. 10 mm coarse Aggregate = 416.9 Kg/ m^3
5. Fine Aggregate = 702.6 Kg/ m^3
6. Chemical Admixture = 0.000 Kg/ m^3

MIX PROPORTION OF CONCRETE

Cement	20mm C.A.	10mm C.A.	Fine Sand	Water
1	1.93	1.04	1.76	0.45

IV. RESULTS AND DISCUSSION :

MIX	28 DAYS CUBE COMPRESSIVE STRENGTH	28 DAYS BEAM FLEXURAL STRENGTH
Normal	41.97	6.56
10%RM	40.46	4.04
20%RM	32.45	3.85
30%RM	29.68	2.6
40%RM	28.48	2.49
4 % SF + Normal	41.73	6.52
4%SF+10%RM	34.21	3.9
4%SF+20%RM	31.18	3.86
4%SF+30%RM	25.42	2.58
4%SF+40%RM	23.95	2.44
6 % SF + Normal	39.13	6.49
6%SF+10%RM	33.46	3.84
6%SF+20%RM	30.94	3.85
6%SF+30%RM	24.44	2.55
6%SF+40%RM	23.15	2.44
8 % SF + Normal	34.35	6.43
8%SF+10%RM	33.75	3.87
8%SF+20%RM	30.33	3.83
8%SF+30%RM	24.39	2.7
8%SF+40%RM	22.62	2.3

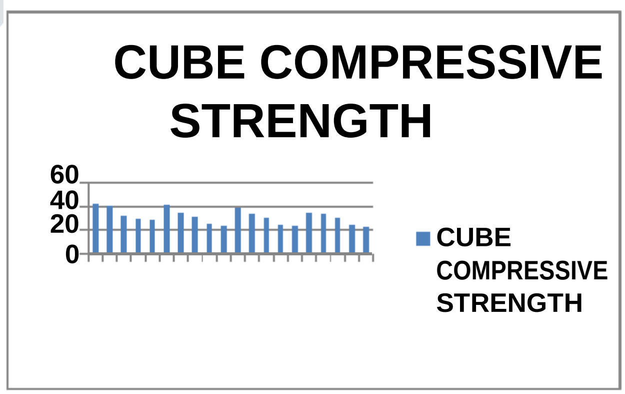

Fig. 1.7 Cube Compressive Strength

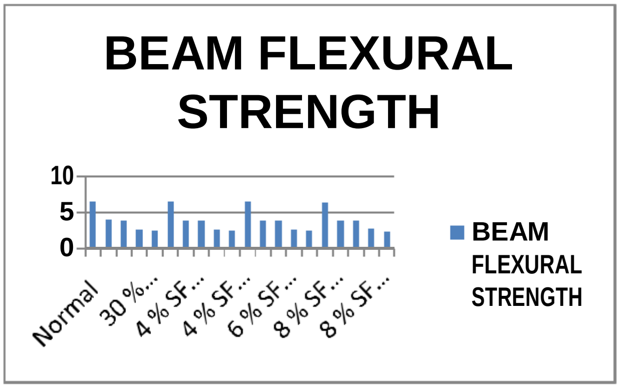

Fig. 1.8 Beam Flexural Strength

V. CONCLUSION :

Compressive strength of concrete produced by replacing cement by red mud goes on increasing up to 20% replacement of cement by red mud and reaches peak at 20%.

Compressive strength of concrete produced by replacing cement by red mud and silica fume goes on increasing up to 20% replacement of cement and 4, 6 & 8 % silica fume reaches peak at 20%.

For 20% replacement of cement by red mud gives the optimum content of red mud which gives highest strength of concrete.

For 20% red mud and 8% silica fume replaced with cement gives optimum dosage which gives higher compressive strength of concrete as compare to concrete mix in which cement was only replaced by 20% Red mud and cement was replaced by 20% Red mud along with 4% and 6% Silica fume mud.

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