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Experimental study on fly ash bricks with addition of cement

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***Abstract* – In this paper, effort has been made to study the behavior of Fly ash brick by taking different proportions of Fly ash, Cement, Gypsum, Lime, Sand and Stone Dust. Ten different mixes of bricks have been designed. In five mix materials like: Fly ash, Lime, Gypsum, Sand and with different % of Cement, such as 2.5%, 5%, 7.5%, and 10%. In other mixes Stone dust has been replaced instead of Sand.**

Various tests such as Compressive Strength Test, Water Absorption Test were performed in order to have compression with conventional bricks. The result shows the variation of Compressive Strength for different mix proportions of materials mentioned earlier at different curing ages.

Key Words: Fly ash, Cement, Gypsum, Sand, Lime, Stone Dust.

I. INTRODUCTION

Fly ash bricks are made of Fly ash, Lime, Gypsum, Cement, Sand and Stone dust. These can be extensively used in all building constructional activities like that of common burnt clay bricks. The fly ash bricks are comparatively lighter in weight and stronger than common clay bricks. Since fly ash is being accumulated as waste material in large quantity near thermal power plants and creating serious environmental pollution problems, its utilization as main raw material in the manufacture of bricks will not only create sample opportunities for its proper and useful disposal but also help in environmental pollution control in the surrounding areas of power plants.

Manufacturing of commercial brick produce a lot of air pollution. The technology adopted for making. The fly ash bricks are eco-friendly. It is no need fire operation in production unlike the conventional bricks among the traditional fossil fuel sources, coal exists in quantities capable of supplying a large portion of nations energy need. That's why the power sector in India is a major consumer of coal in India and will continue to remain so far, many years to come.

Combustion of coal in thermal power plant not only produces-
steam to run electricity generating turbine but also produces a large quantity of by- products like fly ash etc.

About 80 thermal power plants in India are sources of fly ash, where around millions of tons of coal are annually. India currently generates 100 million tons of fly ash every year. This disposal will need thousands of hectares of storage land, which may cause further ecological imbalance. In fact, this waste material is simply disposed of in the form aqueous slurry on the adjoining areas. This type of disposal not only converts useful agricultural land to waste ones but also possesses a threat to the quality of environment. The human development of united nation development programmer indicates that annually 83-163 million hectares of land is eroded in India causing productivity loss of about 4 to 6.3% of the total agricultural output worth 2.4 billion. Therefore, using fly ash as a building material has assumed great significance like never. Several investigations have been carried out throughout the world to try to use fly ash in many civil engineering projects by its good properties as an ingredient of concrete.

Table 1: The comparison between conventional bricks and Fly ash bricks.

Clay Brick	Fly Ash Brick
Varying colour as per soil	Uniform pleasing colour like cement
Uneven shape as hand made	Uniform in shape and smooth in finish
Lightly bonded	Dense composition
Plastering required	No plastering required
Heavier in weight	Lighter in weight

Compressive strength is around 35 Kg/Cm2	Compressive strength is around 100 Kg/Cm2
More porous	Less porous
Thermal conductivity 1.25 – 1.35 W/m2ºC	Thermal conductivity 0.90-1.05 W/m2ºC
Water absorption 20-25%	Water absorption 6-12% 25%

II. MARKET DEMAND

The country consumes about 180 billion tones bricks, exhausting approximately 340 billion tones of clay every year and about 5000 acres of top soil land is made unfertile for a long period. The Government is seriously concerned over soil erosion for production of massive quantities of bricks, in the background of enormous housing needs. The excellent engineering property and durability of fly ash brick enlarges its scope for application in building construction and development of infrastructure, construction of pavements, dams, tanks, under water works, canal lining and irrigation work etc. Enormous quantities of fly ash are available in and around thermal power stations in all the states. The demand of bricks could be met by establishing small units near thermal power stations and to meet the local demand with less transportation costs

III. EXPERIMENTAL INVESTIGATION

In the present study we are making investigation on different percentage of cement such as without cement, 2.5%, 5%, 7.5% and 10% in the fly ash bricks. And after making these bricks various tests were performed such as compressive strength test, water absorption test, and these results were compared with conventional bricks results.

IV. MATERIALS USED

Materials used are cement, fly ash, gypsum, sand, stone dust and lime.

A. Cement

Ordinary Portland cement of grade 43 was used for making the brick mortar. The quantity of cement was checked through various tests and was compared with specification given IS 269 – 1976 for OPC. The properties of cement used are given below in table 2.

Table 2: Physical Properties of Ordinary Portland Cement Used

SI. No	Characteristics	Value obtained Experimentally
1	Soundness	6 mm
2	Fineness by sieve through IS 90 micron standard sieve	8.68
3	Setting Times (minutes) i. Initial ii. Final	 32 mins 3 hours
4	Consistency Test	25%

B.Fine Aggregate

Locally available river sand was used. The sand was cleaned from all inorganic impurities and passed through 2.36 mm size sieve and retained on 150-micron sieve have been used. Particle size and other properties are listed in Table 3.

Table 3: Sieve Analysis of Fine Aggregate

Size of Sieve	Weight Retained in IS Sieve (gm)	Percentage Retained	Cumulative Weight Retained in IS Sieve	Percentage passing	Grading Limit according to IS :3831970
4.75 mm	60	6	6	94	Zone III
2.36 mm	50	5	11	89	
1.18 mm	120	12	23	77	
600 mic	210	21	44	56	
300 mic	410	41	85	15	
150 mic	140	14	99	1	
75 mic	10	1	100	0	

Fineness Modules = 868 / 100 = 8.68
Weight of sample taken = 1 Kg
Specific Gravity of Fine Aggregate = 2.59

V EXPERIMENTAL PROGRAM

In the present study, fly ash brick is developed with different composition is shown in the tables.

Mix	Fly Ash	Sand	Lime	Gypsum	Cement
1	60	20	10	10	0
2	60	20	10	10	2.5
3	60	20	10	10	5
4	60	20	10	10	7.5
5	60	20	10	10	10

Mix	Fly Ash	Stone Dust	Lime	Gypsum	Cement
1	60	20	10	10	0
2	60	20	10	10	2.5
3	60	20	10	10	5
4	60	20	10	10	7.5
5	60	20	10	10	10

The fly ash bricks were tested as per IS 12894-1990 that is coed for fly ash-lime bricks and the conventional bricks were tested as per procedure laid down in IS 3495-1973 for the following test:

- Compressive Strength
- Water absorption

1. Compressive Strength test

The red and fly ash bricks were tested on the compressive testing machine of capacity 100 tones which read to the nearest 0.5 tonne. The load was applied steadily and uniformly. 6 bricks of each type were tested for compressive strength. The average compressive strength was calculated.

2. Water absorption test

The red and fly ash bricks were dried and weighted. These were then immersed in water for 24 hours and then weighted again. The bricks were tested in accordance with procedure laid down in IS 3495 (Part-II) 1976 (36).

VI EXPERIMENTAL RESULT & DISCUSSION

A. Compressive Strength Test

As per the Table 4 the compressive strength of conventional brick is found to be 4.67 N/mm2 , for fly ash brick without cement is found to be 7.3 N/mm2, fly ash brick with 2.5% cement is found to be 7.91 N/mm2, fly ash brick with 5% cement is found to be 8.52 N/mm2, fly ash brick with 7.5% cement is found to be 8.93 N/mm2 and fly ash brick with 10% cement is found to be 9.7 N/mm2.

Table 4: Compressive strength

Type of specimen	Mean load at failure (KN)	compressive Strength (N/mm2)
Conventional brick	80	4.67
Fly ash brick mix 1 (0%)	180	7.3
Fly ash brick mix 2 (2.5%)	195	7.91
Fly ash brick mix 3 (5%)	210	8.52
Fly ash brick mix 4 (7.5%)	220	8.93
Fly ash brick mix 5 (10%)	240	9.7
Fly ash brick mix 6 (0%)	170	6.9
Fly ash brick mix 7 (2.5%)	185	7.5
Fly ash brick mix 8 (5%)	205	8.3
Fly ash brick mix 9 (7.5%)	210	8.52
Fly ash brick mix 10 (10%)	225	9.13

B. Water absorption test

As per the Table 5 the average absorbed moister content of conventional brick is found to be 7.14%, for fly ash brick without cement is found to be 5.6%, fly ash brick with 2.5% cement is found to be 6.23%, fly ash brick with 5% cement is found to be 8.22%, fly ash brick with 7.5% cement is found to be 7.09% and fly ash brick with 10% cement is found to be 12.6%.

Table 5: Water Absorption Test

Type of specimen	Mean Dry Weight (Kg)	Mean Moist Weight (Kg)	Average Water Absorption %
Conventional brick	3.22	3.45	7.14
Fly ash brick mix 1 (0%)	3.21	3.39	5.6
Fly ash brick mix 2 (2.5%)	3.05	3.24	6.23
Fly ash brick mix 3 (5%)	3.04	3.29	8.22
Fly ash brick mix 4 (7.5%)	2.96	3.17	7.09
Fly ash brick mix 5 (10%)	3.02	3.40	12.6
Fly ash brick mix 6 (0%)	2.67	2.89	8.24
Fly ash brick mix 7 (2.5%)	2.66	3.03	13.9
Fly ash brick mix 8 (5%)	2.97	3.16	6.4
Fly ash brick mix 9 (7.5%)	2.65	2.87	8.3
Fly ash brick mix 10 (10%)	2.56	2.73	6.64

VII CONCLUSION

It is found that the temperature distribution over the reinforcement of slab with 25mm cover and temperature distribution over the reinforcement of beam with 35mm cover is sufficient than others.

It is found that the maximum deflection for SLAB15 model without subjecting it thermal load is 0.7% and 1% greater than that of deflection of SLAB20 and SLAB25 models respectively. The maximum deflection for SLAB15 model after subjecting it to Thermal load is 1% and 3.2% greater than that of SLAB20 and SLAB25 models respectively.

It is found that the maximum deflection for BEAM25 model without subjecting it thermal load is 1% and 1.37% greater than that of deflection of BEAM30 and BEAM35 models respectively. The maximum deflection for BEAM25 model after subjecting it to Thermal load is 1.74% and 3.6% greater than that of BEAM30 and BEAM35 models respectively.

REFERENCES

[1]Gupta P.C, Ray S. C.," Commercialization of Fly ash", The Indian Concrete Journal, 167, 1993, 554-560.
Sengupta J, "Availability of Fly ash and its Application in Construction Industry", NBO Journal, XXXIX, 1984, 17-22.

[2]Thorne, D.L. , Watt , J.D. , "Composition and Properties of pulverized fuel ashes", Part II, Journal of Applied Chemistry, London,15 ,1965, 595-604.
Arya D. S., "Steel and Masonry Structure", ISBN 086186168X.

[3]Butterworth B., "Bricks made with pulverized Fuel Ash.", Trans. Brit. Ceram.Soc' ENGLAND, 53 (5), 1954, 293313. Gupta, R.L, Bhagwan, Gautam, D.K., Garg, S.P., "A Press for Sand Lime Bricks Research and Industry", 22(40), 1977, 246-249.

[4]Parul, R. Patel, "Use of Fly ash in Brick Manufacturing", National Conference On Advances in Construction Materials, "AICM-India, 2004, 53-56.

[5]Peter George Kenneth Kingth, "Pulverized fuel ash as a construction material", proceedings of institution of Civil Engineers, 16, 1960, 419-432.

[6]Rai, Mohan, Gupta, R. L., "Energy Conservation in the Manufacture of sand Lime Bricks", Proc. of National Seminar on Energy Conservation in Process Industries, Institution of Engineers India, 1985.

[7]I.S Code 12894-1990 for Fly ash – Lime Bricks- Specification.

[8] I.S Code: 8112-1989, Ordinary Portland Cement, 43 Grade-Specifications.

[9] IS: 3495(P-I)-1976, Determination of Compressive Strength (Second Revision).

[10] IS: 3495 (P-II) -1976, Determination of Water Absorption (Second Revision).

[11] IS: 3495 (P-II)-1976, Determination of Effloresce (Second Revision).

[12] S.C Rangwala, "Engineering Material", Charotar Publications, 15th Edition, 1991, 72-112.

[13] Bhanumathidas, N., "Fly ash in precast products- The Indian Scenario", 1999, 3135.