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Cost Comparative Study of Fly Ash Brick Masonry and Conventional Masonry

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ABSTRACT - In the present study we are making three types of fly ash bricks in the different percentage of cement such as 3%, 5% and without cement. And after making these bricks various tests were performed such as compressive strength test, water absorption test, efflorescence, weight test, structural test and cost analysis and these results were compared with conventional bricks results.

In the experimental study it is found that the compressive strength of fly ash brick containing 5% cement is 152.1 kg/cm2 which is more than that of class I conventional bricks by 63% approximately. Water Absorption of fly ash brick added 5% cement is 48% less than the conventional brick and the Effloresce value is half of the conventional brick. The Effort has been made by making different proportions of ingredients having composition of fly ash, cement, lime, gypsum, and sand.

1. INTRODUCTION

Fly Ash bricks are made of fly ash, lime, gypsum cement and sand. These can be extensively used in all building constructional activities similar to 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, it utilization as main raw material in the manufacture of bricks will not only create ample opportunities for its proper and useful disposal but also help in environmental pollution control to a greater extent 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 nation's 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 produce steam to run electricity-generating turbine but also produces a large quantity of by-products like fly ash etc.

These are about 80 thermal power plant in India are sources of fly ash, where around millions of tonnes of coal is used annually. India currently generates 100 million tones of fly ash every year. This produces 30-40 million tonnes of fly ash unused every year. This disposal will need thousands hectares of storage land, which may cause further ecological imbalance

2. OBJECTIVE OF THIS STUDY

The objective is to compare the structural of fly ash brick with conventional brick and to determine the most suitable brick and cost optimization of fly ash brick.
FLY-ASH Bricks are eco friendly as it protects environment though Conservation of top soil and utilization of waste products of coal or lignite based Thermal Power Plants. It is stronger than the conventional burnt clay bricks. It plays a vital role in the abetment of carbon-die-oxide a harmful green house gas mass emission of which is threatening to throw the earth's atmosphere out of balance.
Motive of this study is to prepare material used for low cost housing project without compromising with the durability and compressive strength. Effort has been made by making different proportions of ingredients having composition of fly ash , cement, lime, gypsum, and sand these standard size of brick used in structural work has been adopted low cost light weight brick will be easy to handle and transport and it will required less labour used for handing during industrial work. That will reduce the cost of construction without compromising the strength of construction.
Manufacturing of commercial brick produce a lot of air pollution. In India around 80 thermal power plants which produce a lot of fly ash as a waste material. But in light weight bricks manufacturing any kind of pollution not produced. It is eco friendly. As the fly ash used in manufacturing of light weight bricks the storage of waste reduces and reduced the soil pollution.

3. COMPARISON BETWEEN CLAY BRICK AND FLY ASH BRICK

Clay Brick	Fly Ash Brick
Varying colour as per soil	Uniform pleasing colour like cement
Lightly bonded	Dense composition
Plastering required	No plastering required
Heavier in weight	Lighter in weight
Compressive strength is around 95 Kg/Cm^2	Compressive strength is around 130 Kg/Cm^2

More porous	Less porous
Thermal conductivity 1.25 – 1.35 W/m2 ºC	Thermal conductivity 0.90-1.05 W/m2 ºC
Water absorption 20-25%	Water absorption 6-12%

4. TESTING OF BRICKS

In the present study, fly ash brick is developed with different composition

A. Lime (20%), Cement (5%), Sand (20%), Gypsum (5%) and Fly ash (50%).

B. Lime (20%), Cement (3%), Sand (20%), Gypsum (5%) and Fly ash (52%).

C. Lime (20%), Cement (0%) Sand (20%), Gypsum (5%) and Fly ash (55%).

5. TEST CONDUCTED

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 Test
- Water absorption Test
- Efflorescence Test

6. RESULT ANAYLSIS

Compressive Strength test:

As per the Table 2 & Fig 1 the compressive strength of conventional brick is found to be 92.85 kg/cm², for fly ash brick without cement is found to be 125.9 kg/cm², fly ash brick with 3% cement is found to be 141 kg/cm² and fly ash brick with 5% cement is found to be 152 kg/cm².

Table 2 Compressive strength Test Results

Type of specimen	Mean load at failure	Average compressive Strength (kg/cm²)	% Increase Average compressive strength
Conventional brick	208.3	92.85	-
Fly ash brick (0%)	281.8	125.9	35%
Fly ash brick (3%)	314.7	141	51.8%
Fly ash brick (5%)	342.2	152.1	63.3%

Figure 1 Compressive Strength Test of Fly ash Brick

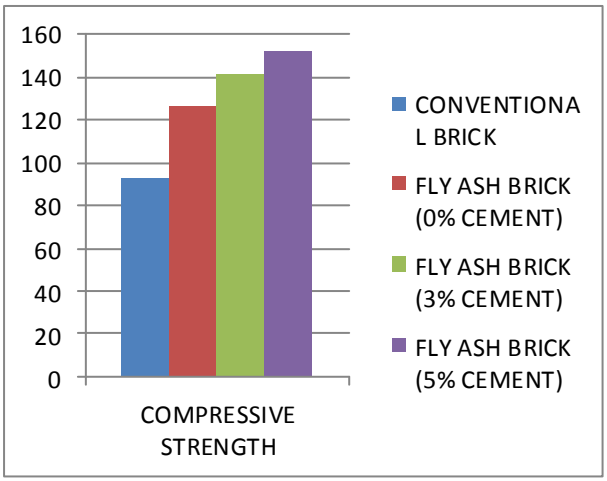

Figure 2 Compressive strength Test Results

Water absorption test:

As per the Table 3 & Fig 3 the average absorbed moister content of conventional brick is found to be 10.45%, for fly ash brick without cement is found to be 7.63%, fly ash brick with 3% cement is found to be 6.06% and fly ash brick with 5% cement is found to be 5.41%.

Table 3 Water Absorption Test Results

Type of specimen	Mean Dry Weight (Kg)	Mean Moist Weight (Kg)	Average Water Absorption %	% Decrease in Water Absorption
Conventional brick	3.12	3.45	10.45	-
Fly ash brick (0%)	2.57	2.77	7.63	27%
Fly ash brick (3%)	2.66	2.85	6.06	42%
Fly ash brick (5%)	2.83	2.99	5.41	48%

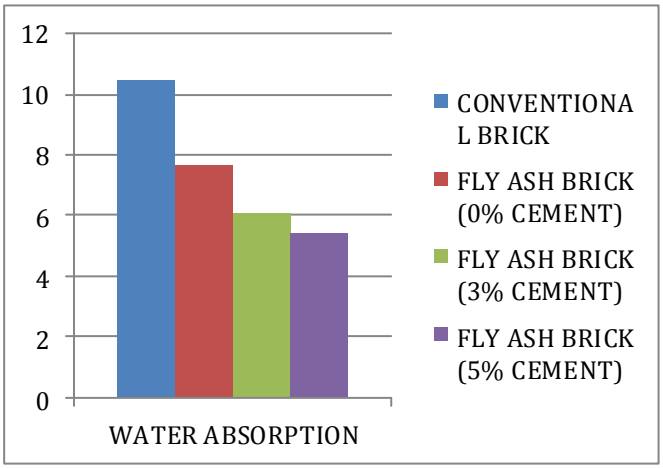

Figure 3 Water Absorption Test Results

Figure 3 Water Absorption Test

Efflorescence test:

The Efflorescence test of conventional brick, fly ash brick without cement, fly ash brick with 3% cement & fly ash brick with 5% cement and the result were compared in which grey or white deposits are slight to moderate in conventional brick, less than 10% on surface area in fly ash brick without cement, less than 8% on surface area in fly ash brick with 3% cement and less than 7% on surface area in fly ash brick with 5% cement.

Table 4 Efflorescence Test

Type of specimen	Water Effloresce %	% Decrease in Efflorescence
Conventional brick	15%	-
Fly ash brick (0%)	10%	5%
Fly ash brick (3%)	8%	7%
Fly ash brick (5%)	7%	8%

7. COST OPTIMIZATION

The cost of materials required for 1m^3 of brick using work using conventional bricks is considered for comparison of cost of brick with fly ash bricks as the cost of labour and other miscellaneous expenses are the same. The cost of bricks decreases with the use of fly ash bricks as the volume of fly ash bricks are 2.5% more than that conventional bricks.

Fly ash brick masonry in 1:7 cement mortars can replace conventional brick masonry in1:6 cement mortar and fly ash brick masonry in 1:5 can replace conventional brick masonry in 1:4 cement mortars thereby saving the consumption of cement and brick.

Type of Brick	Type of Cement mortar	No. of bricks required for cum of	Qty. of cement required for cum of brick work in (kg)	Cost of brick for cum of brick work (Rs.)	Cost of cement (Rs.)	Total cost (Rs.)	% age saving
Conventional brick masonry	1:4	500	96	2750	596	3346	
Fly ash Brick (0%) masonry	1:5	487	80	1461	496	1957	41.51
Fly ash Brick (3%) masonry	1:5	487	80	1694.7	496	2190.7	34.52
Fly ash Brick (5%) masonry	1:5	487	80	1860.3	496	2356.3	29.58

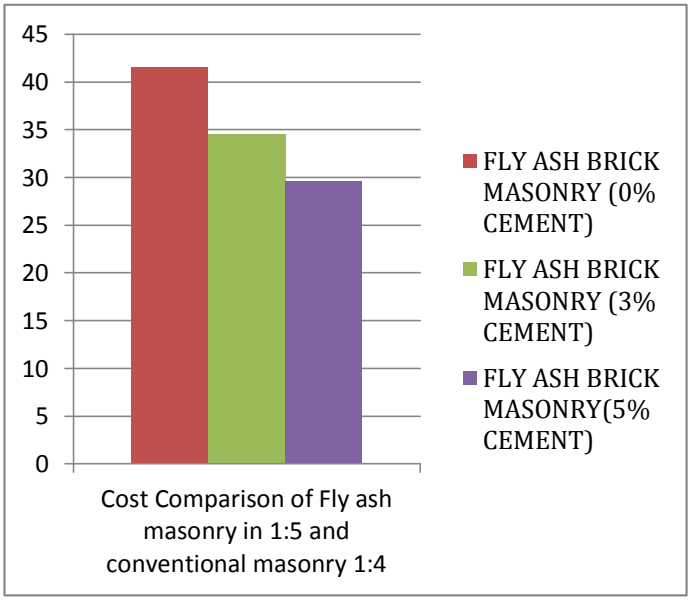

Figure 4 Cost Comparison of Fly ash masonry in 1:5 and conventional masonry 1:4

Type of Brick	Type of Cement mortar	No. of bricks required for cum of work	Qty. of cement required for cum of brick work in (kg)	Cost of brick for cum of brick work (Rs.)	Cost of cement (Rs.)	Total cost (Rs.)	% age saving
Conventional brick masonry	1:6	500	96	2750	396	3146	
Fly ash Brick (0%) masonry	1:7	487	80	1461	310	1771	43.25
Fly ash Brick (3%) masonry	1:7	487	80	1694.7	310	2004.7	36.27
Fly ash Brick (5%) masonry	1:7	487	80	1860.3	310	2170.3	31.01

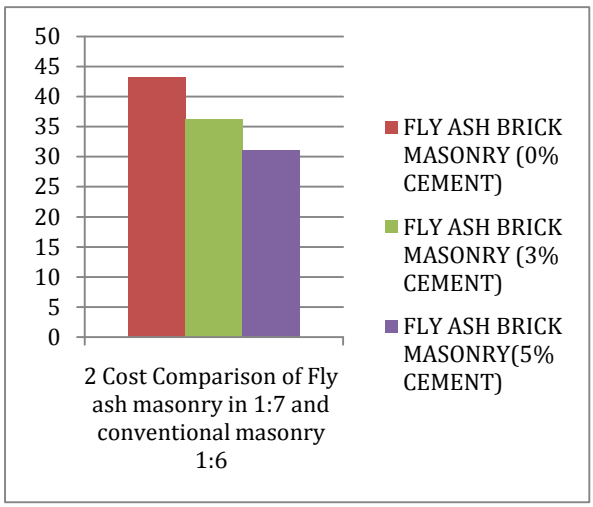

Figure 5 Cost Comparison of Fly ash masonry in 1:7 and conventional masonry 1:6

8. CONCLUSIONS

On the basis of the experimental work undertaken and discussion presented in the previous chapters the following conclusions are drawn:

- The compressive strength of fly ash brick with 0% cement is 27% more than that of class I conventional brick but when 3% cement is added in the fly ash brick then compressive strength is 51.8% more than that of class I conventional brick and also when 5% cement added in fly ash brick then the compressive strength is more than 63%.

- Water absorption of fly ash brick with 0% cement is 27% less as compared to that of conventional bricks and 42% less as compared to conventional brick when 3% cement is added and 48% less as compared to conventional brick when 5% cement is added.

- The Efflorescence test of conventional brick, fly ash brick without cement, fly ash brick with 3% cement & fly ash brick with 5% cement and the result were compared in which grey or white deposits are slight to moderate in conventional brick, less than 10% on surface area in fly ash brick without cement, less than 8% on surface area in fly ash brick with 3% cement and less than 7% on surface area in fly ash brick with 5% cement.

- Fly-Ash bricks are eco friendly as it protects environment though conservation of top soil and utilization of waste products of coal or lignite used in thermal power plants. It is three times stronger than the conventional burnt clay bricks. It plays a vital role in the abatement of carbon dioxide a harmful green house gas mass emission of which is threatening to throw the earth's atmosphere out of balance.

- Being lighter in weight as compared to conventional bricks, dead load on the structure is reduced and hence saving is overall cost of construction.

9. SCOPE OF FURTHER

The possibility of using innovative building materials and eco-friendly technologies, more so covering waste material like fly ash is the need of the hour. Fly ash affects the plastic properties of concrete by improving workability, reducing water demand, reducing segregation and bleeding, and lowering heat of hydration. It also increases strength, reduces permeability, reduces corrosion of reinforcing steel, increases sulphate resistance, and reduces alkali-aggregate reaction.

This study has been undertaken to prepare material for low cost housing project without compromising with the durability and compressive strength. Effort has been made to study the behavior of fly ash bricks by taking different proportions of fly ash, cement, lime, gypsum and sand. Properties of fly ash bricks for other proportions which have not been covered in my study can be carried out to check the durability and strength as a construction material. Research can be done for different composition of fly ash brick to improve its performance. There is an imperative need to produce more building materials for various elements of construction and the role of alternative and innovative options have come into sharp focus, considering the short supply, increasing cost and energy and environment considerations for traditional and conventional materials.

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