



# AN EXPERIMENTAL STUDY OF CHARACTERISTICS OF FLY ASH BRICKS USING SILICA FUME

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## Abstract

This paper presents the work carried out for the improvement of mechanical properties of fly ash bricks by adding a binder. Here we added silica fume as a binder to the different weight fractions of fly ash, sand, lime, and gypsum mixture. Although the use of fly ash has many advantages. However the bricks specimen of size 230mm x 110mm x 70mm were cast for different mix percentage of fly ash (30), gypsum (3), lime (15), sand stone (50) and silica fume (2). The fly ash brick testes by compression test, water absorption test, efflorescence test, structure test, soundness test, shape and size test, and color test. The experiment in our studies encourage future research in the direction for long term performance for the use of structural application. Compressive strength were studied for different mix proportions. The compressive strength were investigated. The result shows the variation of compressive strength for different mix proportions. It was observed that the compressive strength of fly ash increase with addition of silica fume. This paper present in details for experimental study done by using silica fume with fly ash and conclusion various strength parameters.

**Keywords:** Manufacture sand (M sand), silica fume, flyash , gypsum, lime.

## 1. INTRODUCTION

Brick is an at vital requirement of construction material. In this demand of clay we try to replacement of the Manufacture Sand and making a fly ash brick.

It is a waste material and to produce by a from thermal power generation. It is creating

severe environmental pollution. So much research is being conducted from more than two decades for its proper utilization in cement and brick production as well as to control environmental pollution in the surroundings areas of the power plant.

Using fly ash to make bricks instead of cement and clay reduces greenhouse gas and slows down global warming, because large amount of carbon dioxide is produced for manufacture cement and clay bricks production much energy burned by fossil fuel.

The fly ash particles are spherical and have same fineness as cement so that the silica is readily available for reaction. Fly ash generally grey in color, abrasive mostly alkaline and refractory in nature.

The pozzolanic properties and lime binding capacity of fly ash makes it useful for the production of brick, cement and concrete. Fly ash brick are more strength and an economical alternation to convention burnt clay bricks clay bricks. Due to high availability and excellent properties presently in Indian sceneries fly ash is utilized in different sectors such as cement manufacture, substitution, road and embankment, low lying area filling brick manufacturing.

It exhibits excellent physics chemical properties including low density, micro porosity, high surface hardness, negligible shrinkage, high strength, thermal stability, fire and chemical resistance then conventional clay bricks.

In the investigation bricks of various percentage of fly ash (30), gypsum (30), lime (15), sand stone (50), silica fume (2), and compressive strength were studied for different

mix proportions. Determine the compressive strength of the fly ash bricks.

### 1.1 OBJECTIVE

- ✓ study the effect of partial replacement of M sand with fly ash and silica fume.
- ✓ To know the strength variation with use of fly and silica fume to normal brick.
- ✓ To increase the compressive strength of fly ash bricks.
- ✓ To reduce the pores in the fly ash bricks by using silica fume.
- ✓ To improve the material properties of fly ash bricks by adding silica fume as binder.

### 1.2 SCOPE OF OUR PROJECT

To use of good quality fly ash with a high fineness and low carbon content reduces the water demand of bricks.

Fly ash bricks are light in weight compared to the convention bricks and have more strength.

To develop the engineering properties such as workability, plasticity and water tightness.

To improve the compressive strength to estimate the stability and durability of the brick.

To maintain the uniform the uniform size and shape of fly ash bricks and to reduce the plastering thickness.

### 1.3 METHODOLOGY

- Literature Collection And Study
- Material Collection And Study
- Test On Material Properties
- Mix proportion
- Casting of Specimens
- Curing of Specimens
- Testing of specimens
- Result And Discussions
- Conclusion

## 2. MATERIAL PROPERTIES

### 2.1 MATERIAL USED

- a) fly ash
- b) M- sand
- c) lime
- d) gypsum
- e) silica fume

#### 2.1.2 fly ash

Fly ash finely divided residue resulting from the combustion of powdered coal and transported by the flue gases and collected by electrostatic precipitator.

It broadly classify fly ash into two classes

Class F: fly ash normally produced by burning anthracite or bituminous coal, usually has less than 5% Cao. Class F fly ash has pozzolanic properties only.

#### 2.1.3 M-sand

As per IS 383:1970 fine aggregate properties were tested. Water absorption is 1.6%, Specific gravity of fine aggregate is 2.7, fineness of modulus is 2.4

#### 2.1.4 Lime

lime is an important binding material in building construction. It is basically calcium oxide (Cao) in natural association with magnesium oxide (Mgo). Lime reacts with fly ash at ordinary temperature and forms a compound possessing cementations properties. After reaction between lime and fly ash calcium silicate hydrates are produced which are responsible for the high strength of the compound.

#### 2.1.5 Gypsum

Gypsum is a non hydraulic binder occurring naturally as a soft crystalline rock or sand. Gypsum have a valuable properties like small bulk density, incombustibility, good sound absorbing capacity, good fire resistance rapid drying and hardening with negligible shrinkage, superior surface finish. In addition it can strengthen material or increase viscosity. It has a specific gravity of 2.31 grams per cubic centimeter. The density of gypsum powder is 2.8 to 3 grams per cm<sup>3</sup>.

#### 2.1.6 Silica fume

Silica fume is an ultrafine material with spherical particle less than 1 micron in dia. The average being about 0.15 micron. This makes it approximately 100 times of smaller then the average cement particle. The bulk density of silica fume is 130 to 600 kg/m<sup>3</sup>. The specific gravity of silica fume is range of 2.2 to 2.3. the specific surface area of silica fume can be measured with the BET method or NITROGEN method. The main field of application as micro silica pozzalanic material for high performance of concrete.

## 3. MIX DESIGN

### 3.1 Brick mix proportion

To make a fly ash brick following mix proportion are arrived by trial and error method. The table shows the various mix proportion.

**VARIOUS MIX PROPORTIONS:**

PROPORTIONS	FLY ASH (%)	SANDSTONE (%)	LIME (%)	GYPSUM (%)	SILICA FUME (%)
I	30	50	15	3	2
II	60	25	10	4	3
III	40	40	10	4	6

**3.1.2 Quantity of material**

The quantity of material required to cast a brick is arrived by taking a brick weight of 4kg

PROPORTIONS	FLY ASH (kg)	SANDSTONE (kg)	LIME (kg)	GYPSUM (kg)	SILICA FUME (kg)
I	1.2	2	0.6	0.12	0.08
II	2.4	1	0.32	0.16	0.12
III	1.6	1.6	0.4	0.16	0.24

**4. CASTING OF SPECIMEN**

The normal mould is used to cast the bricks with the standard size of 230mm x 110mm x 70mm. they were cast according to the standard procedure with various mix proportions arrived.

The required of fly ash, lime, gypsum, sand stone, silica fume, is calculated previously, according to that the materials mixed properly. Then required quantity of water was added. Then the mixed thoroughly.

Then the prepared mix was poured in the mould and it is compacted. After compacting gets over then the mould is removed. Then the bricks cured for period of 7, 14 days.

**5. CURING OF THE SPECIMENS**

Bricks shall be air dried for 1-2 days. Thereafter, air dried bricks should be water cured for a minimum period of 14 days. Curing is carried out by sprinkling water manually

**6. TESTING OF SPECIMENS**

- Compressive strength test
- Water absorption test

**7 RESULTS**

7.1 Mean value of compressive strength (N/mm<sup>2</sup>)

PROPORTION	LOAD (KN)	AREA (mm)	14 DAYS VALUE (N/mm <sup>2</sup> )	MEAN VALUE (N/mm <sup>2</sup> )
I	150	230 x 110	5.92	6.5
	180	230 x 110	7.11	
	170	230 x 110	6.719	
II	280	230 x 110	11.06	11.32
	270	230 x 110	10.67	
	310	230 x 110	12.25	
III	180	230 x 110	7.11	7.77
	200	230 x 110	7.90	
	210	230 x 110	8.30	

**7.1.2 Water absorption test**

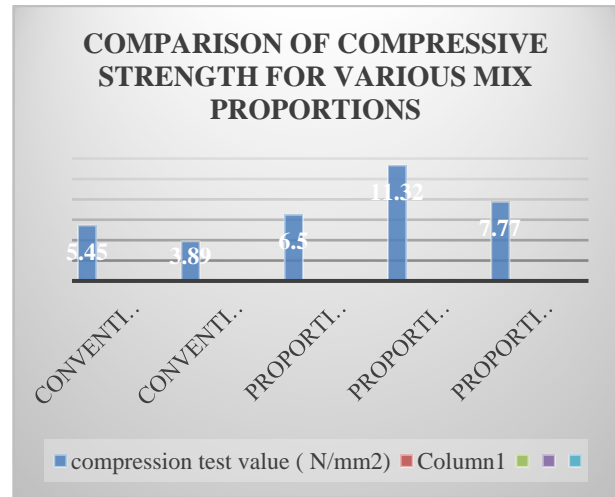
PROPORTIONS	W1	W2	W2-W1	$\frac{W2 - W1}{W1}$	$\frac{W2 - W1}{W1}$
I	3.938	4.294	0.356	0.090	9.04
	3.750	4.182	0.432	0.115	11.52
	3.903	4.310	0.407	0.104	10.42
II	3.866	4.224	0.358	0.092	9.26
	3.802	4.200	0.398	0.104	10.46
	3.778	4.218	0.44	0.116	11.64
III	3.934	4.386	0.452	0.114	11.48
	3.792	4.282	0.49	0.129	12.92
	3.888	4.352	0.464	0.119	11.93

**CONVENTIONAL FLY ASH BRICK TEST**

7.1.3 Mean value compressive strength (N/mm<sup>2</sup>)

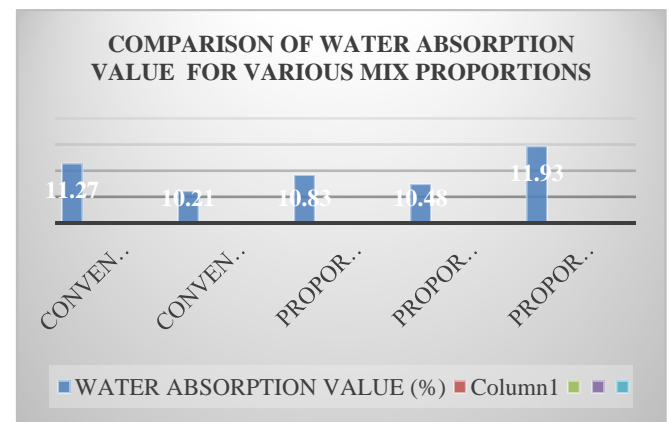
PROPORTION	LOAD (KN)	AREA (mm)	14 DAYS VALUE (N/mm <sup>2</sup> )	MEAN VALUE (N/mm <sup>2</sup> )
I	90	190 x 90	5.26	5.45
	100	190 x 90	5.84	
	90	190 x 90	5.26	

7.1.7 Compressive strength result



7.1.4 Water absorption test

PROPORTIONS	W1	W2	W2 - W1	$\frac{W2 - W1}{W1}$	$\frac{W2 - W1}{W1}$
I	2.914	3.358	0.444	0.152	15.23
	3.218	3.684	0.466	0.144	14.48
	3.104	3.454	0.35	0.112	11.27



CONVENTIONAL CLAY BRICK TEST

7.1.5 Mean value compressive strength (N/mm<sup>2</sup>)

PROPORTION	LOAD (KN)	AREA (mm)	14 DAYS VALUE (N/mm <sup>2</sup> )	MEAN VALUE (N/mm <sup>2</sup> )
I	90	190 x 90	5.26	3.893
	50	190 x 90	2.92	
	60	190 x 90	3.50	

RESULT

From the above experimental results proportion-II shows the maximum compressive strength value. So that proportion-II was a optimal mix percentage.

8 CONCLUSION

Based on the Experimental study, following conclusion can be drawn regarding the strength behavior of fly ash bricks.

From the above investigation, the study was conducted to find the optimum mix percentage of fly ash bricks. It is found the compressive strength of the fly ash bricks increasing with addition of sodium silicate, because it produce an increasing in the strength of the bonds.

Hazardous effects and disposal problems of waste materials can be reduced through this study.

It is expected that these guidelines will serve the purpose of manufacturing good quality fly ash bricks.

7.1.6 Water absorption test

PROPORTIONS	W1	W2	W2 - W1	$\frac{W2 - W1}{W1}$	$\frac{W2 - W1}{W1}$
I	2.834	3.178	0.334	0.121	12.13
	3.030	3.410	0.38	0.125	12.54
	3.156	3.498	0.342	0.108	10.83

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