

A Comparartive Study on Effects of Fly Ash on the Properties of Bricks

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ABSTRACT

In the present study, the effects of fly ash on the properties of bricks are studied and the behavior of fly ash bricks is compared with conventional burnt clay bricks. The various properties of fly ash bricks with different materials were tested. The properties studied water absorption, hardness, efflorescence, soundness, shape and size, crushing strength and basic compressive strength of the prism using different mortar mixes normally 1: 3, 1: 4 and 1: 5 cement-sand mortars. The bricks produced were about 29% lighter than clay bricks. The compressive strength of bricks manufactured from fly ash possessed higher than 20 MPa. This generally exceeds the best of load carrying clay bricks available by more than 25% and is several times better than acceptable commercially available common clay bricks. Other important characteristics of the fly ash bricks have been evaluated. The values of these characteristics for fly ash bricks are excellent and have exceeded those pertaining to clay bricks. In general bricks are made by top fertile agricultural soil but by using fly ash, 28 percent of top fertile agricultural soil is saved. Use of fly ash in brick making also is beneficial in diverse ways. As compared to conventional clay bricks fly ash bricks are stronger, more durable and yet more economical. Also, the process of fly ash brick manufacturing results in lesser pollution. Being less permeable as compared to clay bricks dampness related issues are far lesser in case of fly ash bricks than their clayey counterparts.

1. INTRODUCTION

1.1 Importance

Burnt clay bricks are being used extensively almost throughout India and are perhaps the most important building construction material. but the unlimited use of clay is harmful to society as all the bricks kilns in India depend on good quality clay available from agricultural fields and presuming a weight of 3 kg. per brick. The total clay taken out from the agricultural fields per day for over 10,000 Crore bricks works out to be over 300 million tones. At present, India has production capabilities of over 10,000 Crore bricks through around 45,000 local kilns (bhattas), in the unorganized sector. So the use of industrial waste products such as fly ash, for making bricks is ecologically and economically advantageous since apart from saving precious top agricultural soil, it meets the social objective of disposing industrial waste i.e. fly ash which otherwise is a pollutant and a nuisance.

1.2. Manufacturing of Fly Ash Bricks

Fly ash, Hydrated lime, Quarry dust and Gypsum are manually fed into a pan mixer where water is added in the required proportion for intimate mixing. The proportion of raw material is generally in the ratio depending upon the quality of raw materials.

62%	Fly ash
8%	Lime
5%	Gypsum
25%	Quarry Dust

Following are the phases for the making of fly ash bricks

1. Procurement of Raw Material
2. Storage of Raw Material
3. Batch Mining of Raw Material
4. Mechanized transfer from pan mixer to automatic brick making machine
5. Drying and Curing

1.3 Objective And Scope

The objective of the present study is to examine the effect of fly ash bricks on the performance and the properties of bricks with the view to study the comparison between clay bricks and a fly ash brick because fly ash is enriched with silica, is the main constituent for conventional building material. From the experiment, it is further desired to compare the strength of fly ash brick by that of the conventional clay brick. The salient properties of bricks like crushing strength, water absorption, shape and size, soundness, hardness and efflorescence are to be determined.

2. EXPERIMENTAL PROGRAMME

In the present study, fly ash bricks are subjected to the following tests to find out its suitability for the construction work:

1. Absorption Test
2. Hardness Test
3. Efflorescence Test
4. Soundness Test
5. Shape and Size Test
6. Crushing Strength Test
7. Prism Test



Figure: 1 (Prism test for fly ash bricks)

3. ANALYSIS OF RESULTS

All these bricks were treated to be sufficiently hard as no impression was left on the surface when a scratch was made on brick surface with the help of finger nail. Absence of grey or white deposits on brick surface indicates absence of soluble salts so efflorescence is said to be slight. These bricks when tested for soundness test were found sufficiently sound because on striking with each other, these brick did not break and a clear ringing sound was produced. When structure of fly ash bricks were examined these are found to be homogeneous and compact

3.1.1 Absorption Test

Water absorption test for clay bricks and fly ash bricks was conducted and the result are compared in Table: 1

Table: 1

Type of Bricks	% Average Water Absorption	% Decrease Water Absorption
Clay Bricks	11.93	---
Fly Ash Bricks	9.77	18.10

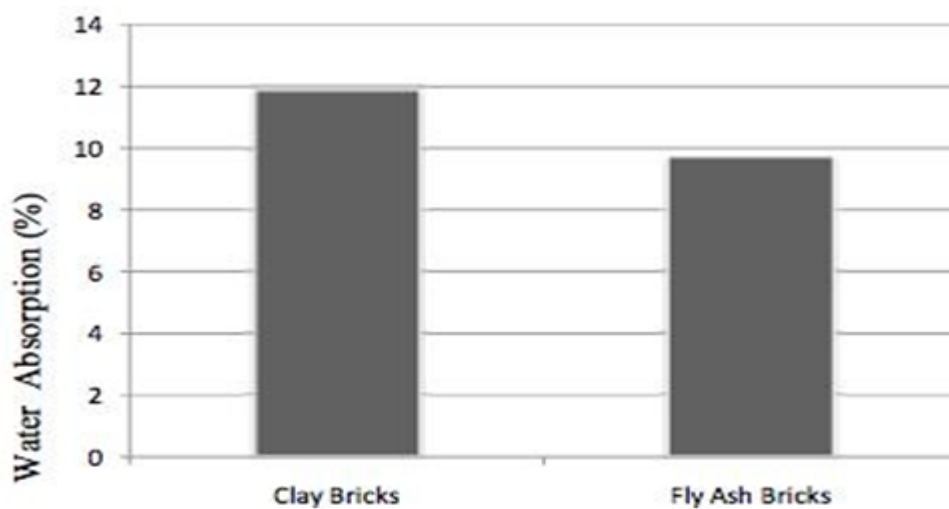


Figure: 2. Water Absorption (%)

As per the above table, the average absorbed moisture content of clay bricks is found to be 11.93% and for fly ash bricks is found to be 9.77%. Thus there is net 18.10% decrease in moisture absorbed for fly ash bricks as a part to clay bricks.

3.1.2. Hardness Test

The hardness test for clay bricks and fly ash bricks was conducted, test brick was taken and scratch was made on bricks surface with the help of finger nail and found no impression after scratching in both the cases.

3.1.3. Efflorescence Test

The Efflorescence test for clay bricks and fly ash bricks was conducted and the results were compared in which Grey or white deposits are slight to moderate in normal bricks and less than 10% on the surface area in fly ash bricks.

3.1.4. Soundness Test

The Soundness test for clay bricks and fly ash bricks was conducted and the results were compared in which two bricks are struck with each other, It was found that a normal brick shows good results when struck with each other but fly ash bricks show clear ringing sound.

3.1.5. Shape and Size Test

The Shape and Size test is done for clay and fly ash bricks to examine the structure of a brick when the brick is broken and it was found both type of bricks are free from any defects such as holes, lumps etc. but fly ash bricks are compact and homogeneous.

Table: 2

Type of Bricks	Average Crushing Strength ² (N/mm)	% Increase Average Crushing Strength
Class A Clay Bricks	8.14	---
Fly Ash Bricks	18.81	56.72

3.1.6. Crushing Strength Test

Crushing strength test for clay bricks and fly ash bricks was conducted and the result are compared in Table: 2

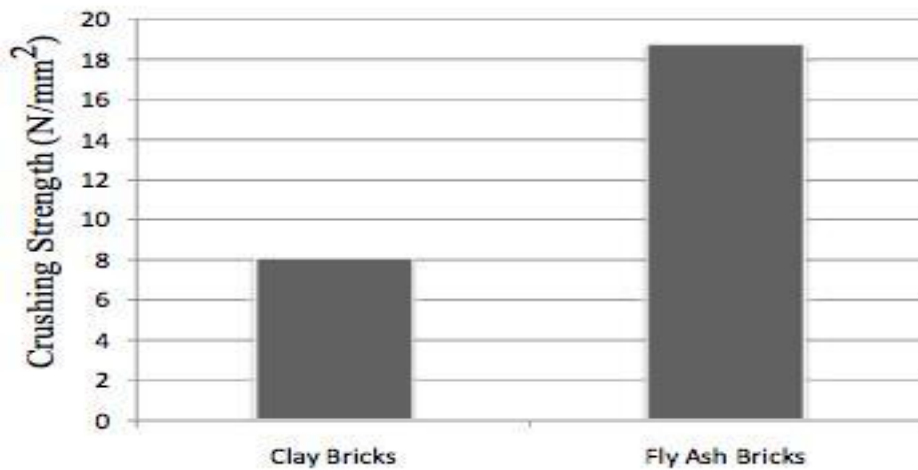


Figure: 3. Crushing Strength (N/mm²)

As per the above table, the crushing strength of clay bricks is found to be 8.14 N/mm² and for fly ash bricks is found to be 18.81 N/mm². Thus there is net 56.72% increase in crushing strength for fly ash bricks as a part to clay bricks.

3.1.7. Prism Test

Table: 3 Cement Sand Mortar 1:3

Type of Bricks	Average Crushing Strength ² (N/mm)	% Increase Average Crushing Strength
Clay Bricks	1.31	---
Fly Ash Bricks	1.8	27.22

As per the above table, the crushing strength by prism of clay bricks is found to be 1.31 N/mm² and for fly ash bricks is found to be 1.8 N/mm². Thus there is net 27.22% increase is crushing strength by prism for fly ash bricks as compared to clay bricks.

Table: 4. Cement Sand Mortar 1:4

Type of Bricks	Crushing Strength (N/mm ²)	% Increase Crushing Strength
Clay Bricks	1.19	---
Fly Ash Bricks	1.56	23.71

As per the above table, the crushing strength by prism of clay bricks is found to be 1.19 N/mm² and for fly ash bricks are found to be 1.56 N/mm². Thus there is net 23.71% increase is crushing strength by prism for fly ash bricks as compared to clay bricks

Table: 5 Cement Sand Mortar 1:5

Type of Bricks	Crushing Strength (N/mm ²)	% Increase Crushing Strength
Clay Bricks	1.21	---
Fly Ash Bricks	1.59	23.90

As per the above table, the crushing strength by prism of clay bricks is found to be 1.21 N/mm² and for fly ash bricks are found to be 1.59 N/mm². Thus there is net 23.90% increase is crushing strength by prism for fly ash bricks as compared to clay bricks.

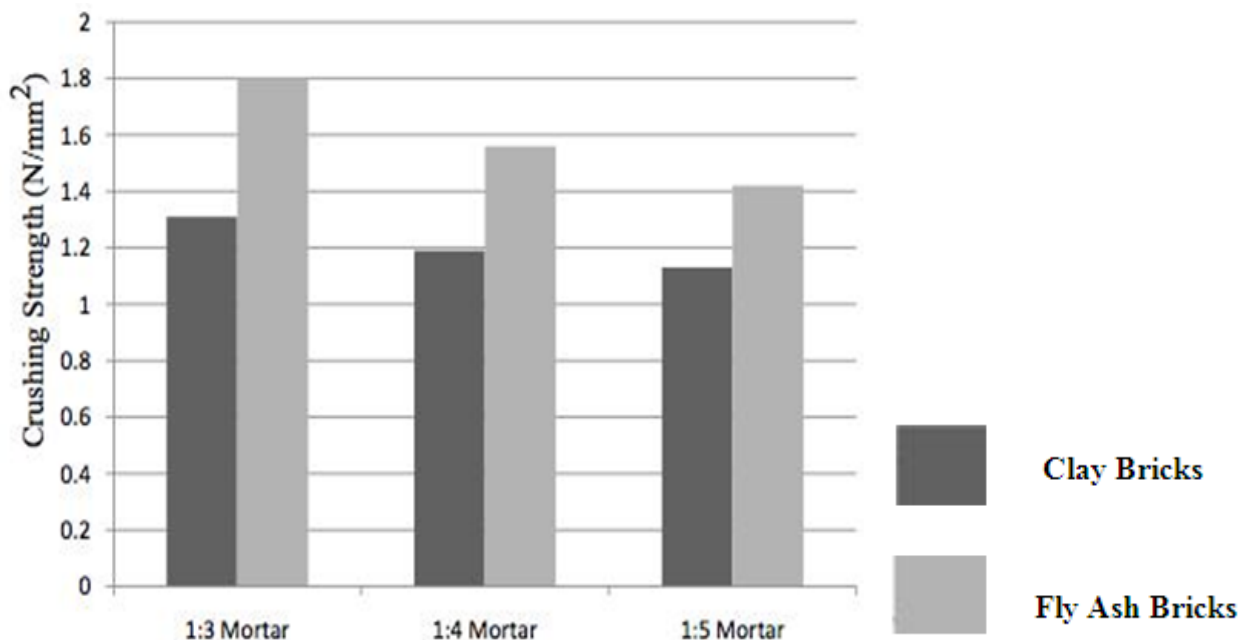
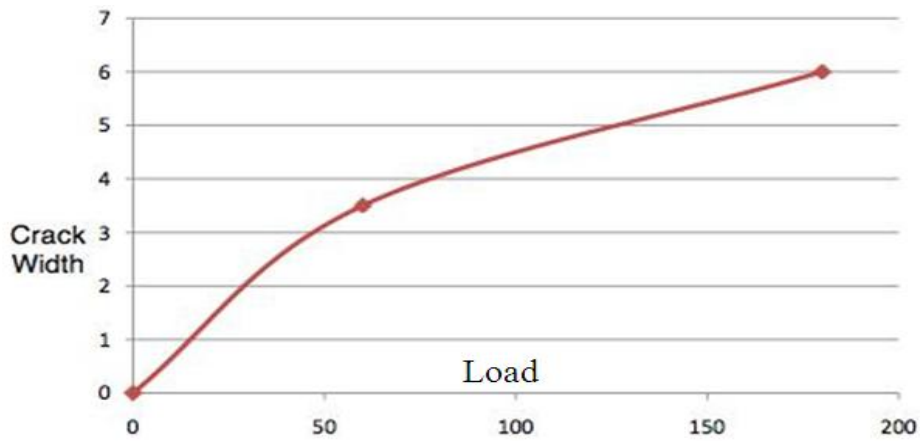


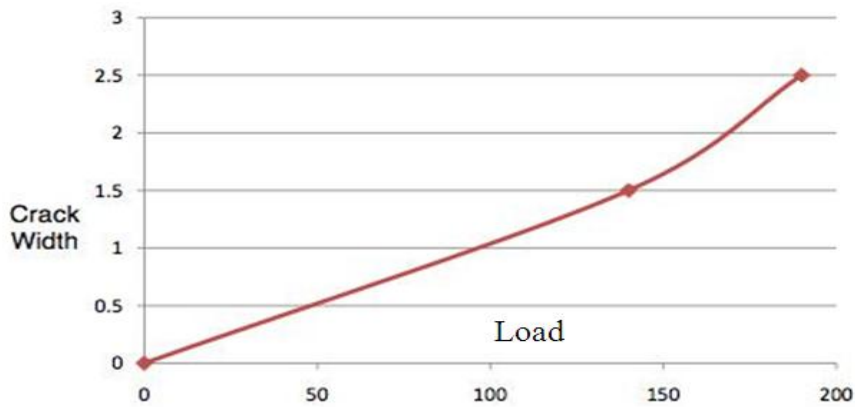
Figure: 4. Crushing Strength by Prisms (N/mm²)

Table: 6 Cracks in 1: 5 Cement Sand Mortar Prism



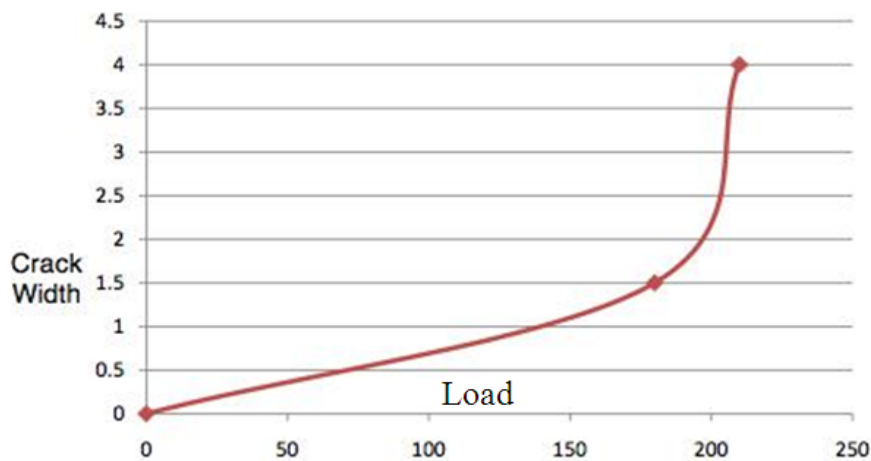
In prism testing of 1:5 cement sand mortar maximum width of crack appeared to be 3.5 mm and average width of crack was 1 mm on applying load of 60 KN . On again applying load crack were measured with the maximum width of 6 mm and average crack width of 2 mm by applying load of 180 KN. Prism of 1:5 cement sand mortar failed on applying load of 240 KN.

Table: 7. Cracks in 1: 4 Cement Sand Mortar Prism



In prism testing of 1:4 cement sand mortar maximum width of crack appeared to be 1.5 mm and average width of crack was 1 mm on applying load of 140 KN. On again applying load crack were measured with the maximum width of 2.5 mm and average crack width of 1.5 mm by applying load of 190 KN. Prism of 1:4 cement sand mortar failed on applying load of 264 KN.

Table: 8. Cracks in 1 : 3 Cement Sand Mortar Prism



In prism testing of 1:3 cement sand mortar maximum width of crack appeared to be 3.5 mm and average width of crack was 1.5 mm on applying load of 180 KN. On again applying load crack were measured with the maximum width of 6 mm and average crack width of 2 mm by applying load of 210 KN. Prism of 1:3 cement sand mortar failed on applying load of 290 KN.

CONCLUSION

1. The results are indicative of the satisfactory performance of fly ash Bricks as load bearing elements. This type of bricks uses 100% fly ash without mixing with clay and shale. It, therefore provides a large venue for the disposal of fly ash in a very efficient, useful and profitable way.
2. Fly Ash Bricks were found to be sufficiently hard as scratching by the finger nail on the surface left no impression on it as compared to normal bricks.
3. The Efflorescence of all bricks tested were found to be slight as white or grey deposits were less than 10% on surface of the bricks which is almost same as that in the normal bricks.
4. A ringing sound in the Fly ash Bricks was observed to be far better than that in normal bricks.
5. Structure of the bricks was found to be compact, homogeneous and free from any defects like holes, lumps etc as compared to normal bricks.
6. The average absorbed moisture content of clay bricks is found to be 11.93% and for fly ash bricks are found to be 9.77%. Thus there is net 18.10% decrease in moisture absorbed for fly ash bricks as a part to clay bricks.
7. The crushing strength of clay bricks is found to be 8.14 N/mm² and for fly ash bricks is found to be 18.81 N/mm². Thus there is net 56.72% increase is crushing strength for fly ash bricks as a part to clay bricks.
8. The crushing strength by prism of clay bricks is found to be 1.31 N/mm² and for fly ash bricks is found to be 1.8 N/mm². Thus there is net 27.22% increase is crushing strength by prism for fly ash bricks as compared to clay bricks.
9. The crushing strength by prism of clay bricks is found to be 1.19 N/mm² and for fly ash bricks is found to be 1.56 N/mm². Thus there is net 23.71% increase is crushing strength by prism for fly ash bricks as compared to clay bricks.
10. The crushing strength by prism of clay bricks is found to be 1.21 N/mm² and for fly ash bricks is found to be 1.59 N/mm². Thus there is net 23.90% increase is crushing strength by prism for fly ash bricks as compared to clay bricks.

FUTURE EXTENSION

Instead of Fly Ash, investigations can be done on waste material such as saw dust, lime sludge, rice husk etc. Thermal conductivity can also be investigated for such type of brick. Work can be extended by using Fly Ash. Fly ash bricks can be used partially with clay so that economically fly ash bricks can be better used. Fly ash bricks can be used partially with rice husk so that bonding with mortar will be stronger. Industrial wastes should be better used in brick making for strengthening purpose and also profitable for cleaning society.

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