Critical Study of Lime Treated Fly Ash Bricks

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Abstract – Fly ash has proven itself to be a highly effective puzzolonic material. It has been, and will continue to be, an important component in the modern world of construction. Companies and researchers around the world are now looking at new and innovative uses for this material. Through this study, it was found that the Fly ash generated from Thermal Power Plants in combination with lime, sand and stone dust can be compacted into dense and strong bricks by using the high-pressure compaction technique. With appropriate compaction pressure and proper proportioning of raw material, high quality bricks without using any binder or heat can be obtained. The bricks can be used in place of conventional burnt clay bricks. These bricks meet most of the important property requirements for use as commercial bricks. In this paper Optimum moisture content, compressive strength of various fly ash bricks were determined and compared.It was observed that Optimum moisture content for fly ash was 30% for fly ash and optimum moisture content for mix with lime was found to be 28%. The compressive strength of fly ash lime brick (FALB) was more than that of plain fly ash bricks (FAB) at all percentage of fly ash content. The increase in strength was more significant in bricks with 60% and 70% fly ash. Lime was added in plain fly ash bricks by replacing 10% fly ash with lime in the mix. Thus with the addition of lime to the fly ash, pozzolonic properties of fly ash were increased and thereby resulted in good compressive strength of the bricks. The compressive strength of fly ash sand lime bricks (FALB) increased with replacement of sand with stone dust (FALSDB) and was found to be maximum at 50% replacement of sand with stone dust for fly ash bricks (FALSDB) with 50% fly ash content.

Index Terms – Fly Ash Bricks, Puzzolonic, Thermal Power.

1. INTRODUCTION

The increasing scarcity of raw materials and urgent need to protect the environment against pollution has accentuated the significance of developing new building materials. The fly ash is an industrial by- product resulting from the combustion of pulverized coal Disposal by dumping fly ash into rivers or sea is not safe as it creates silting and a host of the other problems for human and aquatic life, disposal on land results in the formation of ugly mosquito breeding lagoons. So it is important that waste like fly ash should be used well so that it does not hamper the environment. Fly ash because of its mineralogical composition, fine particle size and amorphous character is generally pozzolanic and in some casesself-cementitious.

The main objective of this paperis to study the technical feasibilities of compacting fly ash with lime and sand to form brick, which can be further used as building products.

2. WHAT IS FLY ASH

Ash is a residue resulting from combustion of pulverised coal or lignite in thermal power plants.. Fly ash consists of inorganic materials mainly silica and alumina with some amount of organic material in the form of unburnt carbon. Its fineness is comparable to cement, however, some particles have size less than 1 micron in equivalent diameter. It possesspozzolanic characteristics.

3. MATERIALS

Fly Ash

In the present investigation fly ash sample from Guru Nanak Dev Thermal Power Plants of Bathinda (Punjab) was collected.

Cement

The cement used for research work was Ordinary Portland Cement IS mark 43 grade cement (Brand- J.K. Lakshmi cement) for all concrete mixes.

Fine Aggregate : The sand used for the experimental program was locally procured. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm and then was washed to remove the dust.

Water: Potable tap water was used for the concrete preparation and for the curing of specimens.

Stone Dust: The stone dust used will be locally procured

Lime: The lime used will be locally procured

Moulds: Rectangular Moulds of size 230 x 115 x 160 mm were used to prepare the brick specimens for the determinations of compressive strength of bricks. All the moulds were cleaned and oiled properly.

Brick designation

* FAB – Fly ash Bricks

** FALB - Fly ash Lime Bricks

*** FALSDB - Fly ash Lime Stone Dust Bricks

4. RESULTS

Effect of Compaction Force on Fly ash bricks

The effect of compaction pressure on the flyash bricks was studied by using three different forces (100 kN, 200 kN and 300 kN) at the optimum water content for different ratios of fly ash and sand. The results have been compared in fig. 1 below.

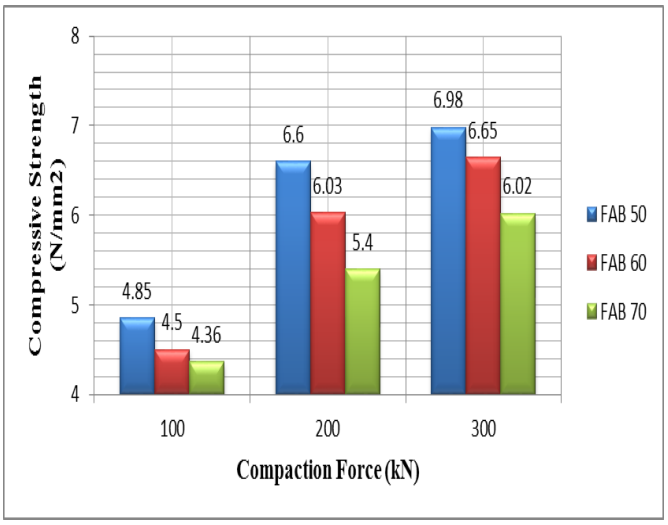

Fig. 1 Variation in Compressive Strength with variation in Compaction Force at different percentages of fly ash content for Fly ash Sand bricks

Fig. 1 shows the effects of compaction force on compressive strength of the bricks made of 50%, 60% and 70% fly ash content.

From fig.1 it was observed that upon increasing the compaction force the compressive strength of bricks also increased. When compressive force was increased from 100 kN to 200 kN, there was increase of 36.08%, 34.00% and 26.35% in compressive strength for 50%, 60% and 70% fly ash content respectively. When the force was further increased from 200 kN to 300 kN the compressive strength increased by 5.75%, 10.28% and 12.10% for 50%, 60% and 70% fly ash content respectively in bricks.

Effect of Compaction Force on lime – Fly ash Bricks

From fig. 2 it was observed that upon increasing the compaction force the compressive strength of bricks also increased. When compressive force was increased from 100 kN to 200 kN, there was increase in compressive strength by 34.60%, 28.42% and 31.71% for 50%, 60% and 70% fly ash content respectively. When the force was further increased from 200 kN to 300 kN the compressive strength of bricks decreased by 1.84%, 2.98% and 1.92% for 50%, 60% and 70% fly ash content respectively in bricks.

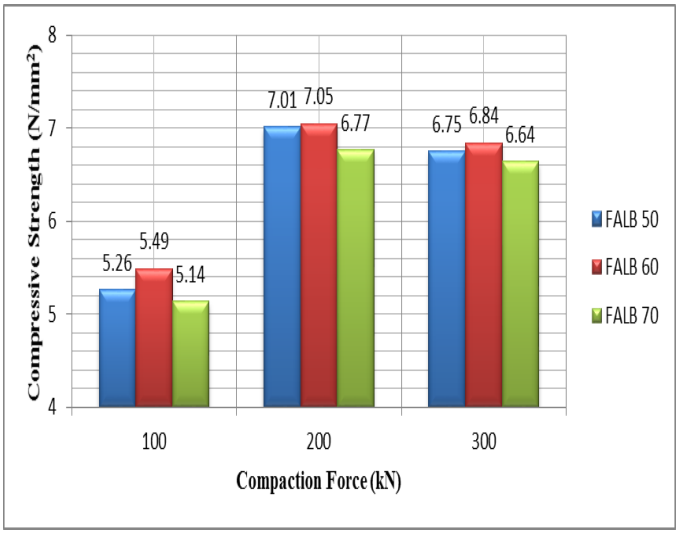

Fig. 2 Variation in Compressive Strength with variation in Compaction Force at different percentages of fly ash content for Fly ash Sand Lime bricks

Effect of Compaction Force on stone dust – Fly ash Bricks

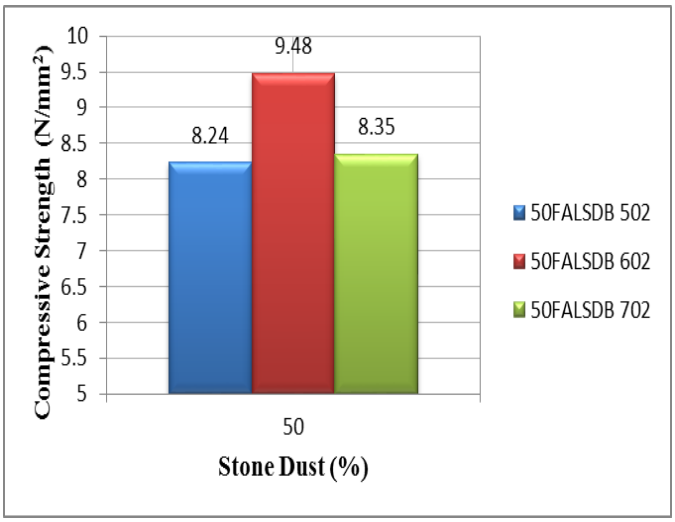

Fig. 3 Variation in Compressive Strength by 50% replacement of Sand with Stone Dust at different percentages of fly ash for bricks compacted at 200 kN.

From fig. 3 it was observed that upon increasing the Fly Ash Content the compressive strength of bricks increased upto 60% Fly ash Content and with further increase in Fly ash percentage Compressive Strength of the bricks decreased. When 50% sand was replaced by Stone dust and treated fly ash content was increased from 50% to 60% the compressive strength increased

by 15.05% On further increasing the fly ash content upto 70% and keeping sand to stone dust ratio same, i.e 50:50 the compressive strength was practically decreased by 11.92% of the strength at 60% fly ash.

5. CONCLUSION

From the present investigation, important conclusions are summarized as follows:

1. Bricks produced at 300 kN compaction force and 50% fly ash in plain fly ash brick, posses maximum compressive strength of about 6.98 kN/mm^2.
2. The compressive strength of fly ash lime brick (FALB) was more than that of plain fly ash bricks (FAB) at all percentage of fly ash content. The increase in strength was more significant in bricks with 60% and 70% fly ash. Lime was added in plain fly ash bricks by replacing 10% fly ash with lime in the mix. Thus with the addition of lime to the fly ash, pozzolonicproperties of fly ash were increased and thereby resulted in good compressive strength of the bricks.
3. Maximum compressive strength of fly ash sand lime bricks (FALB) was achieved at 50% fly ash content compacted at 200kN of 7.08 N/mm^2.
4. The compressive strength of fly ash sand lime bricks (FALB) increased with replacement of sand with stone dust (FALSDB) and was found to be maximum at 50% replacement of sand with stone dust for fly ash bricks (FALSDB) with 50% fly ash content.

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