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## Studies into structural and thermal properties of building envelope materials

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### Abstract

The structural and thermal properties of masonry units influence the behaviour of masonry. In load bearing masonry, wall elements play a major role in supporting the structure through load transfer mechanism from roof to foundation. Also, wall elements regulate the thermal interaction between the indoor and outdoor environment. A variety of masonry units are available as an alternative to burnt clay brick masonry. Fly ash-Lime-Gypsum (FaL-G) brick is one such alternative, which is a low carbon and energy efficient brick made of industrial waste fly-ash. The current paper investigates the characteristic properties of FaL-G bricks and compares them with the locally available conventional table moulded brick (TMB). The characteristic results reveal that the FaL-G brick performs better as a masonry unit and also for building envelopes in tropical conditions. Based on investigations regarding structural and thermal performance, suitable guidelines can be issued to integrate this material in the building envelope.

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*Keywords:* Burnt clay brick; FaL-G brick; Masonry unit; Low carbon material; Building envelope.

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### 1. Introduction and scope of the investigation

Studies into the structural and thermal properties of masonry units are fundamental in understanding building envelope performance in buildings. Several separate studies have been carried out with respect to structural and thermal characteristic properties of masonry materials. An attempt has been made in the current study towards understanding both properties together.

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The objective of the current project is to study the structural and thermal properties of two masonry units, viz. table moulded bricks and Flyash blocks, and to compare their performance.

### Nomenclature

$\gamma$	Density
$C_p$	Specific heat capacity
$C$	Thermal Mass
$k$	Thermal conductivity in W/(m K)
FaL-G	Fly ash-Lime-Gypsum brick
TMB	Table moulded brick

## 2. Methodology

### 2.1. Selection of materials

The main objective is to study the structural and thermal properties of the masonry units (building envelope materials). This was necessitated by choosing a low and high embodied energy masonry material. Table 1 shows the material selected for the study, as shown in the studies of Balaji et.al. [1].

Table 1. Selection of building envelope materials

Particulars	Designation	Material selection criteria
Table Moulded Brick	TMB	High embodied energy material
Fly ash-Lime-Gypsum Brick	FaL-G	Low embodied energy material

Fly ash bricks are made from a combination of fly ash, sand, lime, and gypsum in proportions and compacted design for the requisite structural performance. Fly ash is a waste product from coal based thermal power plants. India produces about 170 million tons of fly ash with only 67.63 percent of fly ash being utilized [2]. Fly ash is being used in the construction industry for making bricks and other applications. Venkatarama Reddy & Gourav [3] extensively studied the structural and durability characteristics of fly ash bricks.

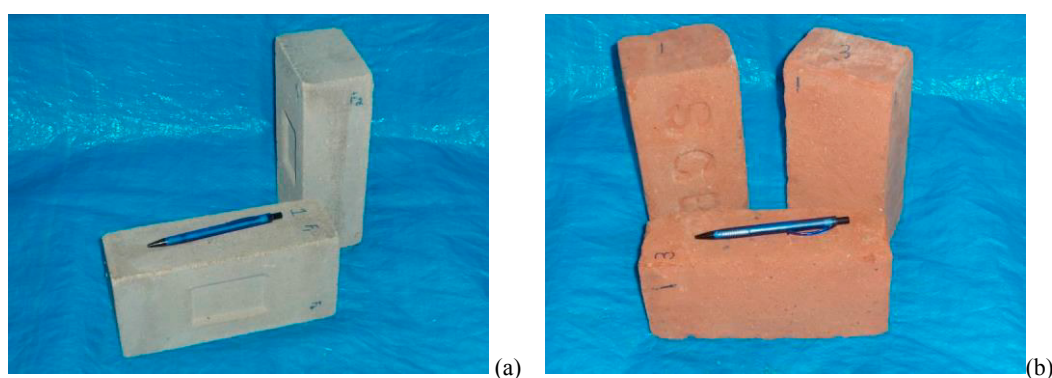


Fig. 1. (a) Fly ash bricks (FaL-G) and (b) Table moulded bricks (TMB)

In the current study, compressed stabilized fly ash bricks of size 230 x 100 x 75 mm, with a proportion of fly ash and sand (0.35 fly ash : 0.65 sand, by weight) + 10.5% lime + 2% gypsum (mineral), and with a dry density of 1.65

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