Chapter 7

Assessment of masonry property and mortar mix on the CBM wall

7.1 General Discussion

The construction of confined brick masonry (CBM) walls involves the use of concrete to confine the masonry, providing necessary confinement, while the masonry walls themselves bear both gravitational and seismic loads. A deep understanding of how different masonry properties affect the performance of CBM walls is essential for ensuring their structural safety and integrity under these loads. However, the current Indian masonry design standard, IS 1905 [145], does not offer specific guidelines for confined masonry construction. To address this gap, the project team employed the Earthquake Engineering Research Institute (EERI) guidelines for designing low-rise confined masonry buildings [139], along with additional references [5], [146]. These resources were adapted to account for the seismicity of the site and the properties of the materials used. The reinforced concrete design followed the specifications outlined in the IS 456 standard [147]. Moreover, this study explores the impact of varying mortar properties on the overall behaviour of the masonry, attempting to gain insights into how changes in masonry materials influence CBM wall performance.

Table 7.1: Types and properties of the bricks

Type	**Density** (Kg/m^3)	$f_{cm}^{'}$ (MPa)	**E** (MPa)	f_y (MPa)
CB(1:1:6)	1764	3.9	975	0.05
CB(1:4)	1764	3.8	950	0.05
FA Set1 (1:1:6)	1614	3.0	1650	0.07
FA Set1 (1:4)	1614	3.6	1980	0.05
FA Set2 (1:1:6)	1498.5	7.6	4180	0.07
FA Set2 (1:4)	1498.5	6.8	3740	0.05

7.2 Parametric study

The use of CBM walls in construction requires concrete to confine the walls, while the masonry walls support both gravitational and seismic loads. Understanding the effect of masonry properties on the performance of CBM walls is crucial for ensuring their structural integrity and safety. To examine this effect, we utilise the masonry properties from a previous study by Jain et al. [148], which analysed two types of masonry units: burnt clay and fly ash (FA). The study divided each type into three sets to determine their mechanical properties, which are presented in Table 7.1. To determine the compressive strength of the masonry, Jain et al. [148] fabricated masonry prisms using two different mortar mix proportions: 1:1:6 (cement: lime: sand) and 1:4 (cement: sand). The prisms are constructed using both burnt clay and FA masonry units. The impact of different masonry properties on the pushover curves have been analysed and is depicted in Fig. 7.1. By using these curves, we calculate the seismic response and tabulated them in Table 7.2. This table shows the variation in the ultimate strength and stiffness parameters for each type of masonry unit and mortar mix proportion.

The results indicate that the CBM wall with FA Set 2 masonry, using a 1:1:6 mortar mix proportion, exhibits 28.24% and 54.50% higher ultimate strength compared to the CBM wall with FA Set 1 and CB masonry, respectively. Similarly, for the 1:4 mix, the CBM wall with FA Set 2 masonry shows 5.6% and 61.20% higher ultimate strength compared to the CBM wall with FA Set 1 and CB masonry. The study also reveals that as the compressive strength of Clay and FA bricks increases, the ultimate strength also increases.

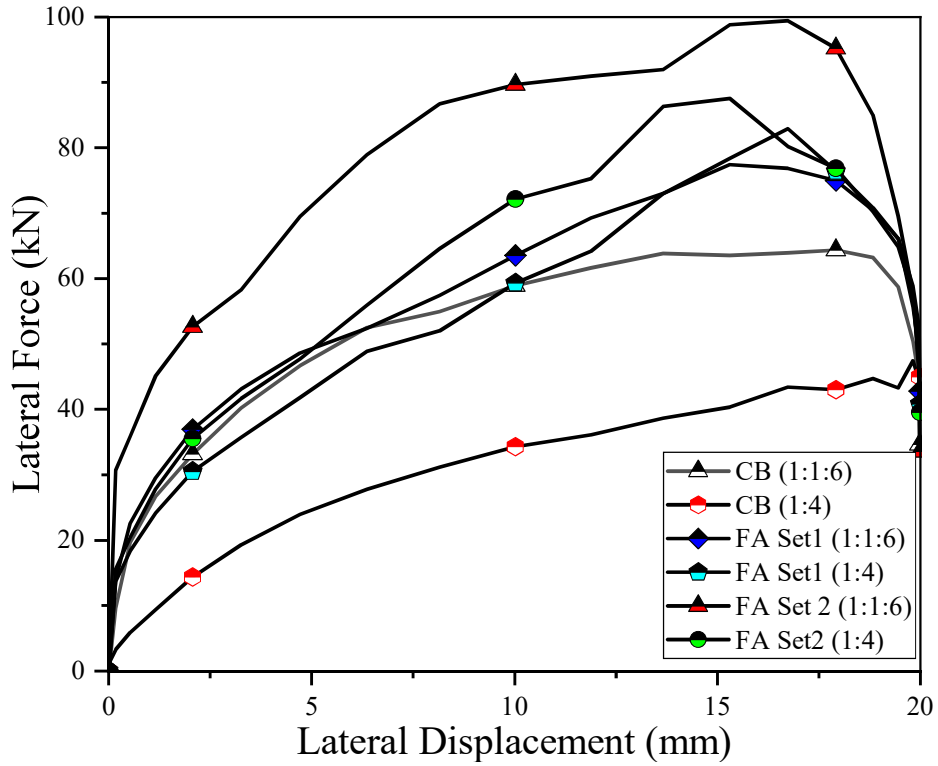

Figure 7.1: Pushover Curves for varying mechanical properties of masonry

Additionally, it is evident that CBM walls constructed using lower compressive strength, FA bricks exhibit higher values of ultimate strength in comparison to the CBM wall constructed with clay bricks. Also, the ductility of the CBM wall increases as the compressive strength increases for all brick specimens except for FA Set 1, where the stiffness decreases as the compressive strength increases compared to the Clay brick and FA Set 2.

Table 7.2: Seismic parameters of the CBM wall with different masonry properties

Type	**Ultimate strength** (kN)	**Stiffness** (MN/m)
CB(1:1:6)	64.35	55.9
CB(1:4)	54.3	37.2
FA Set1(1:1:6)	77.43	83.54
FA Set1(1:4)	82.9	88.4
FA Set2(1:1:6)	99.43	181.20
FA Set2(1:4)	87.55	104.55

7.3 Concluding Remarks

In CBM structures, masonry plays a crucial role as the primary load-bearing component. The mortar mix proportion and masonry compressive strength directly impact the structure's ultimate strength. Increasing the compressive strength of fly ash (FA) and clay bricks results in an expected rise in ultimate strength. However, it is noteworthy that clay bricks with a compressive strength of 3.8 exhibit lower seismic performance compared to FA (Set 1) with a compressive strength of 3. These findings underscore the significance of carefully choosing the masonry type and mortar mix proportions in the design of CBM walls for optimal seismic resistance.