COMPERITIVE PARAMETRIC STUDY OF BRICK PANEL FOR LINEAR STATIC AND MODAL ANALYSIS

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Abstract

Brick walls are part of our structure since late 79th century B.C. Bricks is ideal material for construction due to its economical and it contains high compressive strength. Thus it is used in almost all structural construction in India. In this work 3D Finite element models of brick panels were developed using Sap2000 software. Parametric studies have been done for in plane loading. Linear Static and dynamic analysis was carried out. Main two types of bonds English bond and Flemish bond are considered here. Comparative study has been carried by developing load/deflection curve and by Modal analysis

Keywords—*English bond, Flemish Bond, Modal Analysis*

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1. INTRODUCTION

Bricks have been part of our life since ages. The oldest discovered bricks, originally made from shaped mud and dating before 7900 BC, were found at Tell Aswad, in the upper Tigris region and in southeast Anatolia close to Diyarbakir [8]. At Present, brick is most important undeniable function of structure. It is widely used in foundation to load bearing walls as structure component. In over 90% structures in India brick is main structural component. Easy availability of the material, economical in construction, high load bearing capacity and high compressive strength are reasons of its wide use among all type of structures. There are various types of brick bonds but most commonly used brick bonds are English bond and Flemish bond. Brick wall has a very good compressive strength. It can take high loads from the upper elements and distribute it to the soil. However, in present day practice of building design, buildings are designed as framed structures while effect of infill masonry walls is ignored and considered as non-structural elements. Brick walls are highly vulnerable against seismic loading. To study this vulnerability, effect of seismic loading has been studies by developing deflection curve, studying variance in frequency by change in mode shape.

2. METHODOLOGY

F.E.M. based software Sap2000 have been used for the modelling of the brick panel. Effect of the essential parameter like bond type and height to width ratio were studied by applying lateral in-plane load, which applied on concrete beam kept at top of the wall. Deflections of opposite end were measurement as check and modal analysis has been also carried out.

3. MATERIAL MODELLING

Following material properties were used for analysis

Table1. Material Characteristics [3] [4]

Term	Value
Unit weight of Brick	19.20KN/m^3
Elastic Modules Of Brick	2640 MPa
Poison's Ratio of Brick	0.16
Unit weight of mortar	14.76KN/m^3
Elastic Modules of mortar	545 MPa
Poisons Ratio of mortar	0.15
Grade Of Concrete	M20
Unit Weight of Reinforced Concrete	25KN/m^3
Modules of elasticity of Reinforced concrete	22360.7Mpa
Poison's Ratio	0.15

4. SCOPE OF THE WORK

To determine effect of various brick wall properties, here parametric study has been done. A lateral load is varied from 100KN to 400KN were applied on the top. To study the shear and bending behaviour of brick panel here height/width ratio varied 0.25 to 2. Based on output results load-deflection graph is prepared. First three predominant mode shapes are studied

5. RESULTS AND DISCUSSION

5.1 Bond Effect

To find out effect of the bond on brick panels during lateral loading, English bond and Flemish bond brick panel were loaded up to 200 kN, by various H/W ratios. In Fig-1 load-deflection curves were plotted for above cases. From Fig-1 it can be observed that for all H/W ratios, slope of load-defalcation curve for Flemish bond has higher slope. Thus these indicate that lateral stiffness of brick Flemish brick panel is higher than the brick panel with English bond.

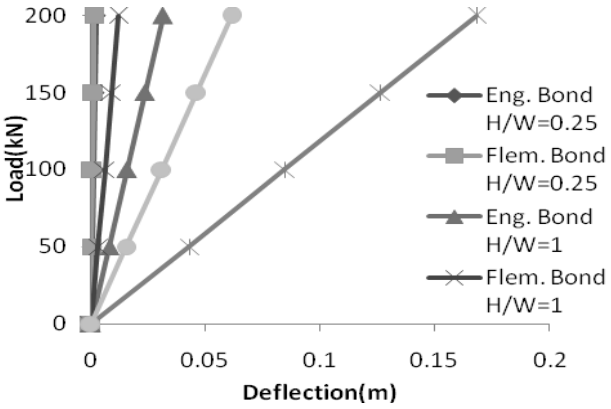

Fig 1 Effect of Different Bonds under Various Loading

In general it is expected that English bond performs better than Flemish bond. This result may be due to assumption of perfect bond between brick and mortar.

5.2 Modal Analysis

The 3D F.E.M models are used to access the modal behaviour of English and Flemish bond masonry panels. Frequency and time periods of first three mode shapes are mentioned in table 2. The first and second modes are translational in transversal and longitude directions. Third mode shape shows the tortional mode. Fig 2, 3 and 4 shows the three mode shapes respectively of both English and Flemish bond.

Table2. Time period and frequency of English bond and Flemish bond brick panel for 3 mode shapes

Mode Shape	**English Bond**		**Flemish Bond**	
	Time Period(Sec)	***Frequency (Hz)***	***Time Period(Sec)***	***Frequency (Hz)***
Mode Shape 1	0.96766	1.03343	0.81545	1.22631
Mode Shape 2	0.18966	5.27269	0.15933	6.27625
Mode Shape 3	0.11781	8.48798	0.1218	8.20465

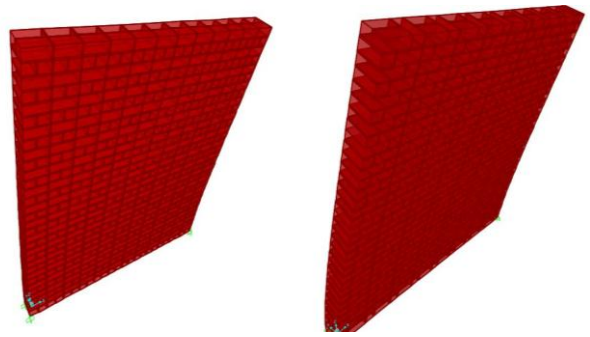

Fig2. First mode shape of English and Flemish Brick panel

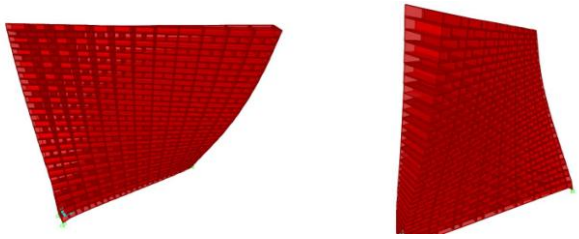

Fig3. Second mode shape of English and Flemish Brick panel

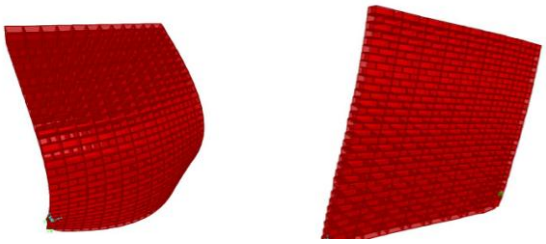

Fig4. Third mode shape of English and Flemish Brick panel

The mode shapes demonstrate that brick panels moderate deformations due to reasonable tortional and transverse stiffness. English bond have slightly high transverse stiffness whereas Flemish bond has slightly high tortional stiffness.

6. CONCLUSIONS

Parametric study has been done to determine effect of type of brick bond and modal analysis has been studied to understand mode shape behaviour of bonds. To do this F.E.M. based models were developed using SAP2000. Flemish bond found to be stronger than English Bond for lateral loading. For height/width ratio more than 1 rate of deflection were increased due to bending deformation. Whereas in modal analysis study English bond have slightly high transverse stiffness and Flemish bond has slightly high tortional stiffness compare to each other.

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