A STUDY ON PERFORMANCE OF CONFINED MASONRY BUILDING OVER UNCONFINED MASONRY BUILDING

Ramesh.A.M[1], Sivan P.P. [2], Dr. Sunilaa George[3]

[1]P. G. Student, [3]Prof. and Head, Department of Civil Engineering, EASA College of Engineering and Technology, India, [2]Asst. Prof., Department of Civil Engineering, Govt. Engineering College Trichur, India

ABSTRACT: **The performance of masonry structures in the past few earthquakes reveal that they are not much efficient in taking earthquake loads without damage. They undergo heavy damage or even collapse of whole structure during earthquake. Their efficiency can be increased by providing reinforcement as columns and beams around the opening and wall panels. This type of construction is known as confined masonry construction. The reinforcement provides ductility to the structure and thus increases the shear capacity. This paper presents the studies on the effect of confinement over unconfined masonry building by analyzing different buildings using *Tremuri* software.**

KEYWORDS – Base shear, Confinement, Masonry, Tie beams, Tie columns, Tremuri, Unconfinement.

I. INTRODUCTION

Masonry buildings belong to the most vulnerable class of structures which have experienced heavy damage or even total collapse in earthquakes. Performance objective of any seismic resistant building is to safeguard the life of the occupants during a severe earthquake without the collapse of the building and with allowable structural damage. In order to make them seismic resistant, confinement is provided in terms of tie beams and tie columns. Hence the masonry buildings are classified into confined masonry buildings and unconfined masonry buildings. With reference to the previous studies on existing confined masonry buildings, properly designed and constructed, confined masonry buildings with sufficient wall density are not expected to experience damage due to moderate earthquakes.

There have been studies based on this in the past. A study on performance and seismic vulnerability of masonry housing types in Chile by Moroni, M.O., Astroza, M., and Acevedo, C. (2004)[1] reveals that the confined masonry buildings had more strength and less damage during the 1985 earthquake. The study concluded that evidence of damage shows that confined masonry buildings have appropriate seismic behavior.

Hussein Okail et al. (2014)[2] evaluate the effect of lateral loads in confined masonry. Six full-scale wall assembles, consisting of a clay masonry panel, two confining columns and a tie beam, were tested under a combination of vertical load and monotonic pushover up to failure. The lateral load capacity is inversely proportional to the width of the wall openings. Confining the openings with tie columns helps restore the reduced capacity and significantly enhance the wall ductility.
The TREMURI software is used for analysis of the designed model. With the innovative computation method, TREMURI provides precise evaluation of masonry structures and their degree of seismic vulnerability.

This paper discusses the shear capacity of confined masonry building versus unconfined masonry during an earthquake. Masonry buildings are designed and analyzed with and without confinement in TREMURI software and the base shear values are compared to study the effect of lateral shear force.

II. MODELLING AND ANALYSIS

In confined masonry, confining elements are constructed on the four sides of a wall panel and the vertical members are called tie columns and horizontal members are called tie beams. These members are reinforced concrete members but their behavior is entirely different from the column and beam members in framed construction. They are of smaller cross sections, with thickness as same as the wall thickness and another factor which makes them distinct is they are constructed after the masonry wall construction has been completed. The sizes of confining members provided are 24cm x 24cm.

At first plan of the building was made. The 3D model was then prepared for both confined and unconfined type. The later has RC beam and column around the openings and the four sides of the wall panel. The design is as per Euro code 8 provisions. By keeping the performance objective as displacement, the lateral force is kept changing until the displacement is exceeded i.e., the maximum allowable damage level. Then the structure is said to be collapsed at this state. From the analysis, lateral force versus lateral displacement curve is obtained, known as capacity curve. This curve is independent of earthquakes as it is a characteristic intrinsic to the structure a function of geometry and resistance characteristics of materials. The analysis method followed is non linear seismic analysis. Non – linear seismic analysis is useful for assessing inelastic strength and deformation of the structure and it gives a better assessment considering the ductility and strength. Provision of confinement gives more ductile character to the structure, thus affecting the seismic resistant capacity.

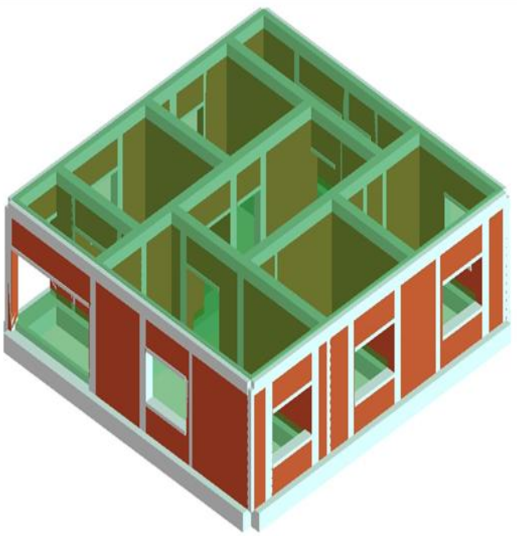

Fig .1: 3D model of building 1 in TREMURI software after providing confinement.

III. RESULT AND DISCUSSION

Here five masonry buildings with and without confinement are analyzed in TREMURI software to study the seismic behavior of buildings. The following design parameters have been given for the analysis of the structure. The details are given in Table 1

Table .1 Details of studied building

Sl No:	Description	Value
1	Wall thickness	240mm
2	Height of each floor	3m
3	The live load considered on the slab, Qk	0.75kN/m2
4	The dead load considered on the slab, Gk	3kN/m2
5	Shear modulus, G	200 Mpa
6	The compressive strength of mortar, fm	2.5Mpa
7	The compressive strength of the brick, fk	16 Mpa
8	The initial shear strength of the brick, fvm0	0.23 Mpa
9	Final shear strength of the brick, fvlim	3.764 Mpa
10	The young's modulus of brick, E	800 Mpa
11	Grade of concrete	M20
12	Grade of steel	Fe 415
13	Percentage steel reinforcement	0.54

Five different types of plans were created, modeled and analysed, among which two are presented in the paper. The capacity curve for building no:1 is given (Fig 2.a). From the graph, it can be seen that the base shear value has increased from 230kN to 630kN i.e., 173% increase in shear capacity.

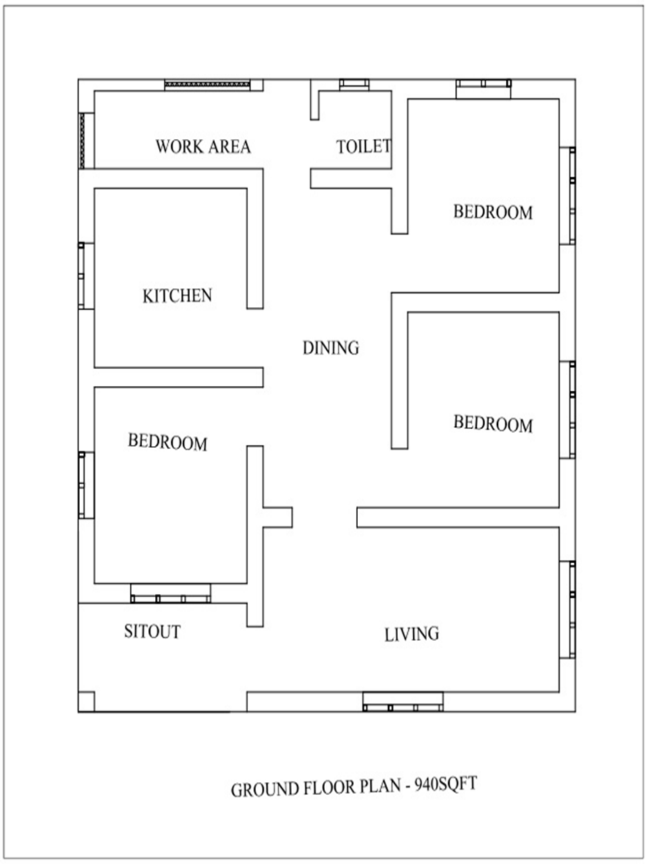

Fig.2: Building Plan No. 1

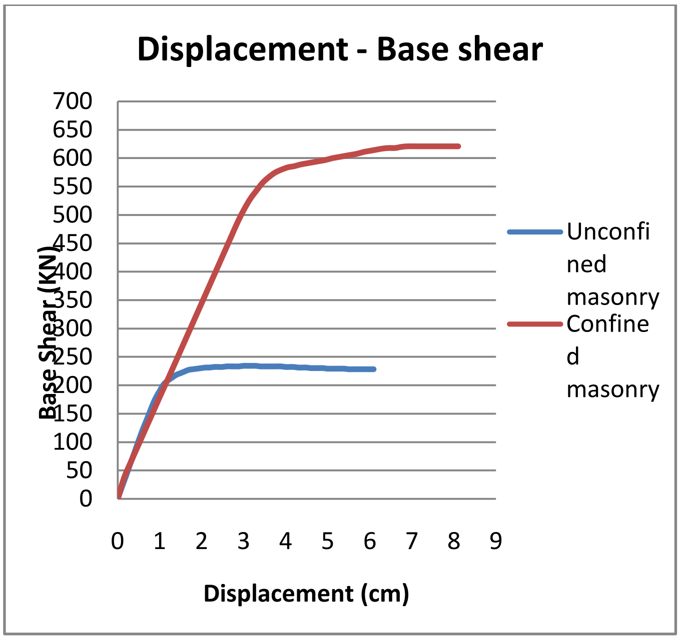

Fig.2.a: Capacity curves for unconfined and confined masonry building No.1.

The capacity curve for building no 2 is given (Fig 3.a). From the graph, it can be seen that the base shear value has increased from 190kN to 510kN ie.,168% increase in shear capacity.

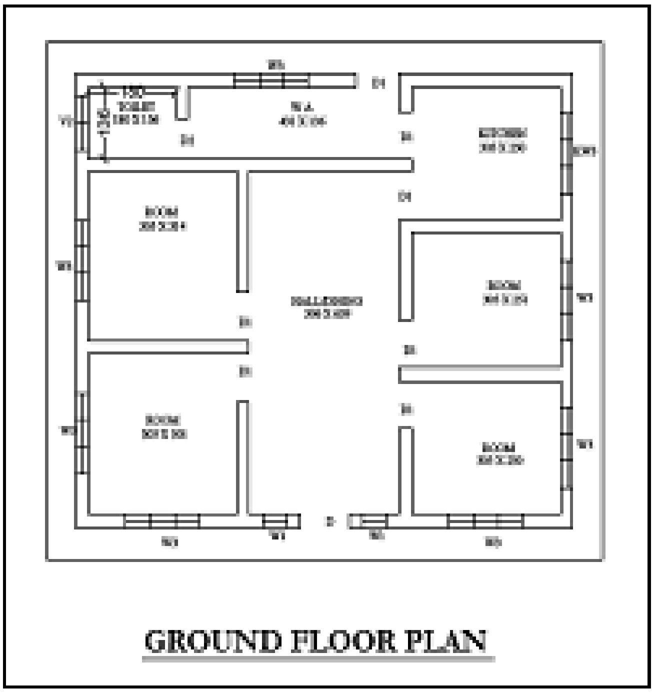

Fig.3: Building Plan No. 2

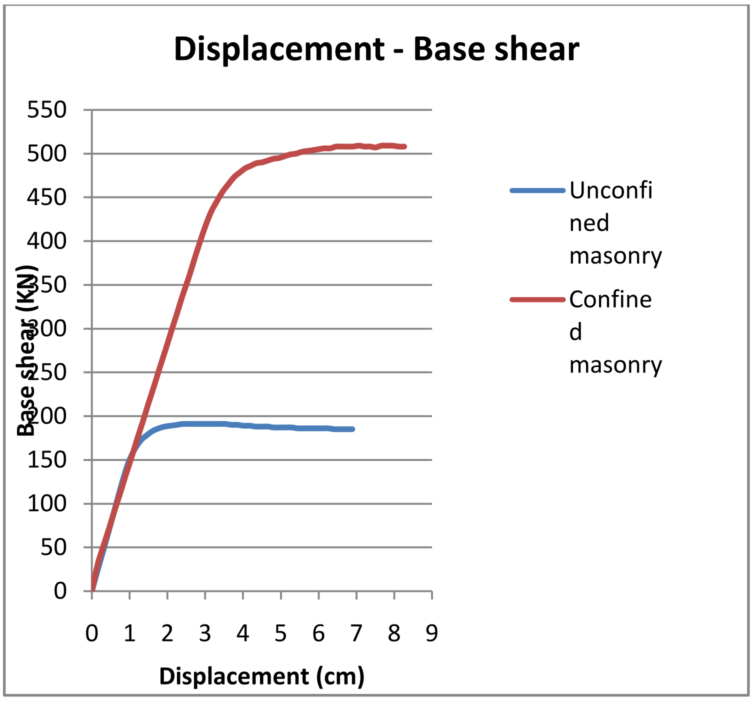

Fig.3.a: Capacity curves for unconfined and confined masonry building No.2.

IV. CONCLUSION

From the analysis of five masonry buildings, with and without confinement, it is clear that confined masonry is more efficient in seismic resistance than unconfined masonry. The analysis results say that there is significant increase in the base shear value as we provide confinement. Each building shows more than 50 percent increase in shear capacity after the confinement. The risk factor during a seismic action can be reduced to a large extent by the provision of confining elements. Further studies can be done in this field to study the effect of different factors affecting the performance of confined masonry building.

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