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Seismic Performance Study and Analysis of Confinement of Brick Masonry with Openings

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Abstract— In this research the Inertia force due to the earthquake is resisted and the brick masonry is confined by confining the masonry with some of the steel sections like, Circular steel Rods and with thin steel plates. Where as in the previous research they were trying to confine the masonry to resist the, Inertia force during the earthquakes by using the materials like, Steel Plates, FRP Strips, Steel Strips, Glass Fibers etc.,

These structures were analyzed with one of the FEM (Finite Element Method) software named ANSYS. The FEM will give the more accurate results as like original tests done in a specimen. The virtual prototype is modeled in the ANSYS itself and its further analyzed. In this analysis the Deformation of the model, the Crack Patten, the Stress of the model and the Strain induced in the model are analyzed and the comparative study is made then the Efficient of the each patterns are plotted. And in this result the possible locations of this fittings to resist the seismic vulnerability.

Index Terms— Earthquakes, Seismic Loads, Crack, Confinement, Brick Masonry, Steel Sections, Openings, FEM, ANSYS.

1 Introduction

The recent earthquakes that happens in India and in different parts of the world and the resulting losses, especially human lives and the important structures like Power Plants, Atomic Stations, etc., have spotlit the structural inadequacy of buildings to carry seismic loads. The buildings whichever they may be, a framed structure or a masonry structure they has no tendency to confine the bricks and to protect from the crack formation during the past earthquakes in India

Figure 1.1 Damage of brick masonry building in Bhuj Earthquake (2001)

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2 Need For The Present Study

To characterize the structural action and load-sharing mechanism of confined masonry (CM) system under in-plane as well as out-of-plane seismic loads, requiring both experimental as well analytical studies.

2.1 *Modeling issues*

- ❖ Idealization of CM system (modeling) for the analysis procedure for both in-plane and out-of-plane response (e.g., system of strut and tie, wide beam-column model for coupling beams, macro-modeling as assemblages of rigid blocks, FEM, etc.)

2.2 Simplified analysis procedure

- ❖ Qualifying criteria, such as limitations on building size, layout of openings in walls, expected seismic loading, etc.
- ❖ Leads to prescriptive design and detailing of CM components

2.3 Capacity and fragility curves

- ❖ Structural behavior of CM in terms of 'generic' load-deformation response (pushover curve) and failure pattern/mechanisms
- ❖ Fragility curves for comparison with other structural systems and for loss estimation studies

ISSN 2229-5518

3 Sections Methodology

This research has the following methodologies;

Stage 1 (Detailed Study of Confined Masonry)

In this stage the detailed study of the confinement of the masonry with reference to the appropriate IS codes.

Stage 2 (Modeling of the 3 Virtual Model with Auto CAD)

In this stage the brick masonry walls of size 3m x 3m are drafted. Then after they are converted to the .dwg format to the .sat format which the ANSYS will able to work.

Stage 3 (Analyzing with ANSYS)

After conversion of the sat model they are imported to ANSYS and the analysis in done as like the Dynamic Condition.

Stage 4 (Study of Results)

In this stage the study of the confinement of the masonry failures are studied, in terms of

- Deformation
- Stress
- Strain

Stage 5 (Conclusion)

In this final stage the best model is by comparing the results from ANSYS analysis.

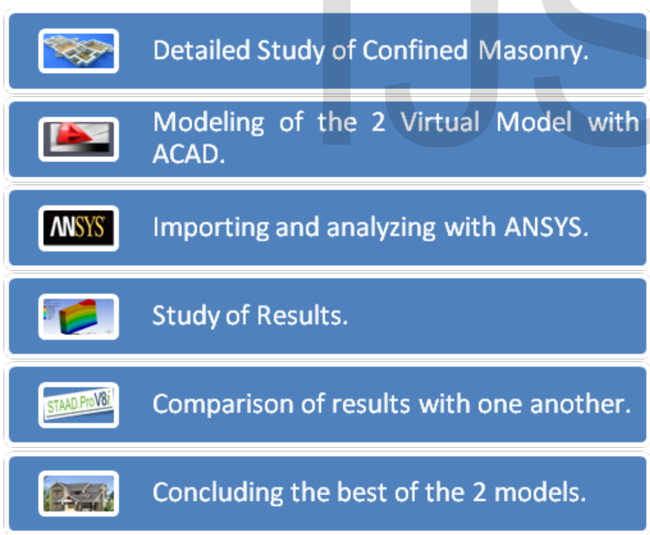

Figure 3.1 Methodology

4 Modeling of the 3 Virtual Model with Auto CAD

In this the 3 models, Model A (Unbrazed Brick Masonry Model), Model B (Brazed Brick Masonry with circular steel rods Model) and Model C (Brazed Brick Masonry with thin steel plates Model) as shown in the figures 5.1 and 5.2

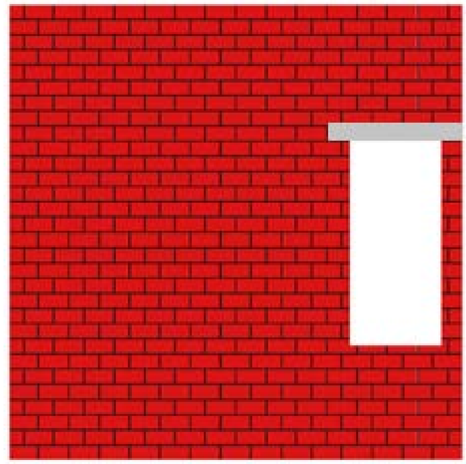

Figure 4.1 Unbrazed Brick Masonry Model

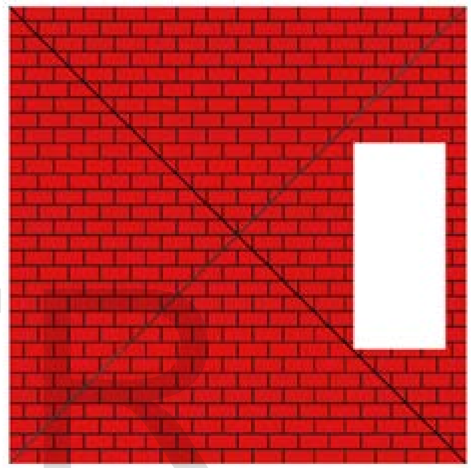

Figure 4.2 Brazed Brick Masonry with circular steel rods Model

5 Material Properties

The materials used for this research are 1st class burned bricks, mortar of mix 1:3 and Graded steel rods and plates having the following Engineering properties,

Material	Youngs Modulus (MPa)	Poisons Ratio
Steel	2.10×10^5	0.22
Brick	3.02×10^3	0.09
Mortar	3.65×10^3	0.17

Table 5.1 Materials Engineering properties

6 ANSYS Analysis

ANSYS is one of the FEM based program . In recent years, numbers of studies have been made in designing the unbraced multi-storey steel frames and the development in this type is still continued until now. Many researchers try to present the

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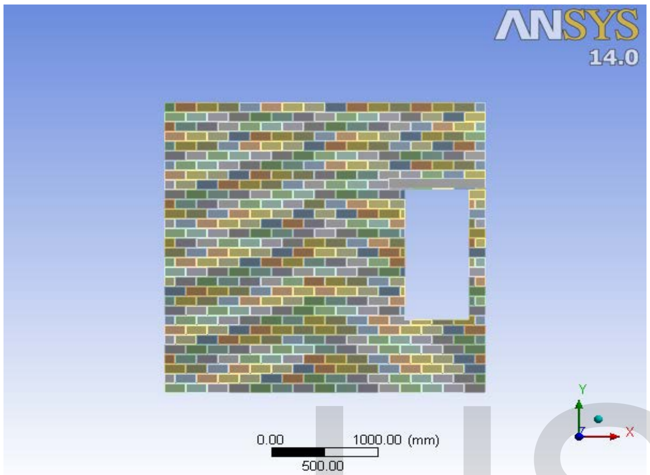
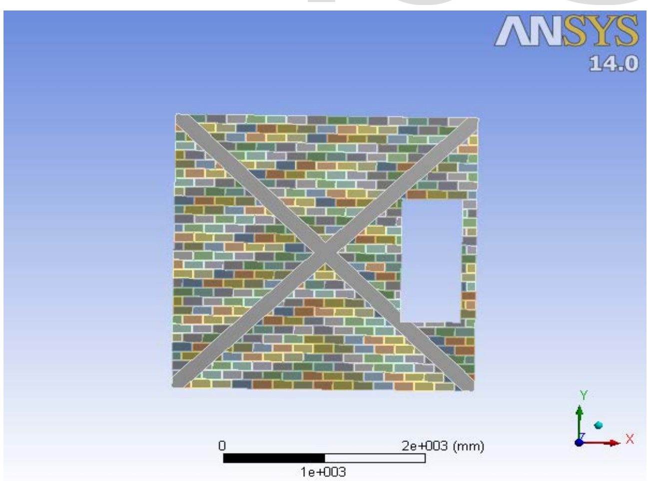
easier and simple way for example comes out with software such as ANSYS, Visual Basic and so on for determination of the section sizes which meet the principals and limitations as stated in IS Codal provisions.

6.1. Modeling

In the modeling 3m x 3m wall is created with a window opening of size 600 mm x 1350 mm at a sill level of 750 mm is created with help of AUTO CAD tool then models are exported to the ANSYS in .sat format.



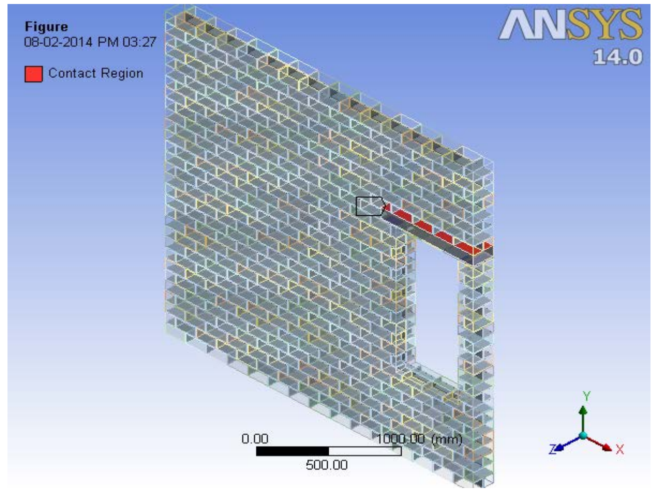
Model 1



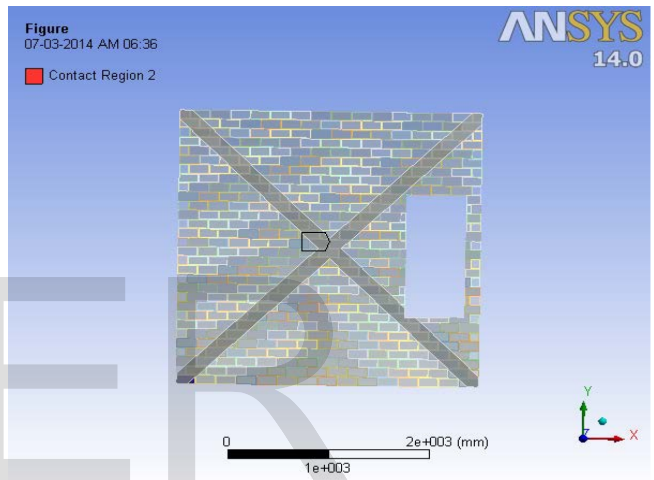
Model 2

6.2. Meshing & Contacts

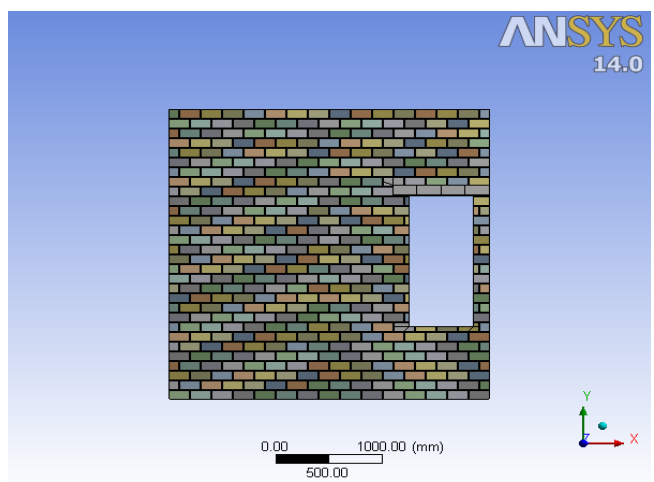
In the Meshing and contacts the appropriate meshing of different sizes the suitable contacts that are necessary to transfer the load throughout the wall are done.



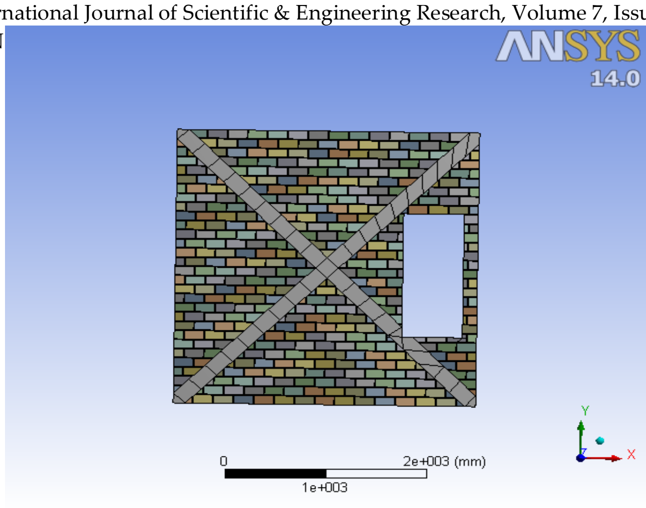
Contacts Model 1



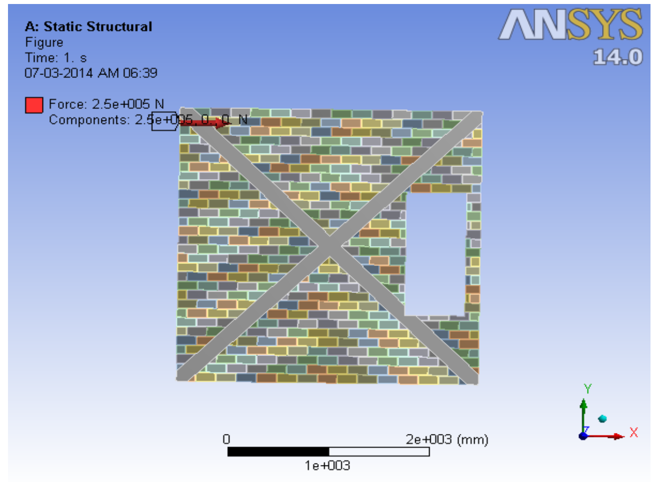
Contacts Model 2



Meshing Model 1



Meshing Model 2



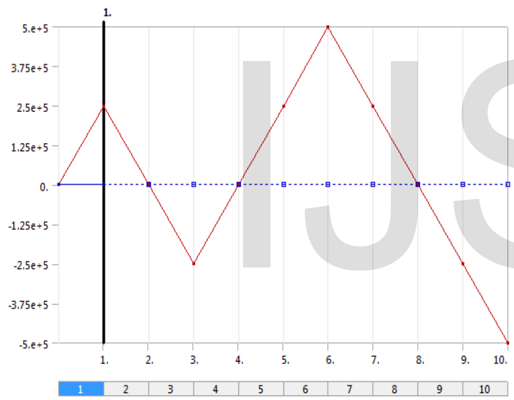
Loading Pattern Model 2

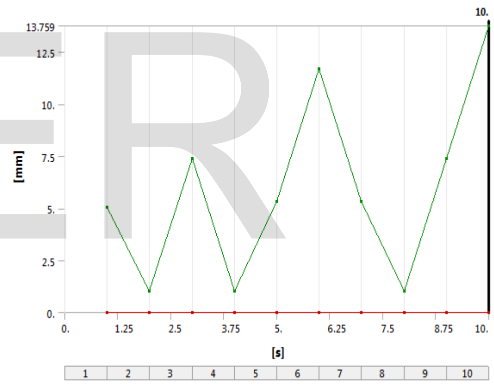
6.3. Loading Pattern

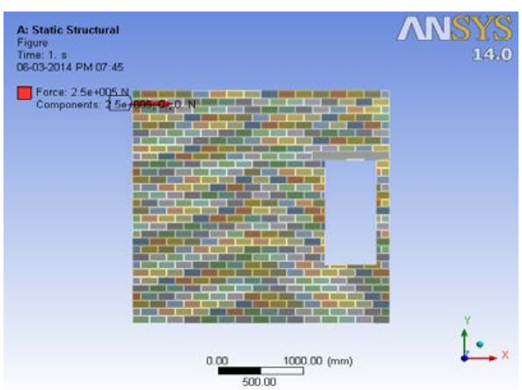
A dynamic loading pattern of a varying load of 2500 kN to 5000 kN which is equal to 6 Richter scale is applied to model.

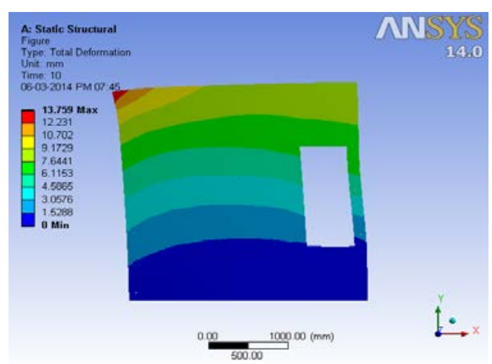
6.4. Total Deformation

Responses of the model with respect to the applied load were plotted below.









Loading Pattern Model 1

Deformation Model 1

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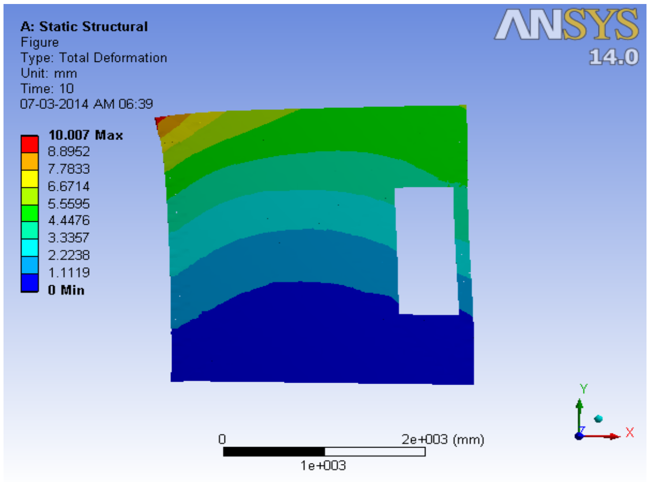
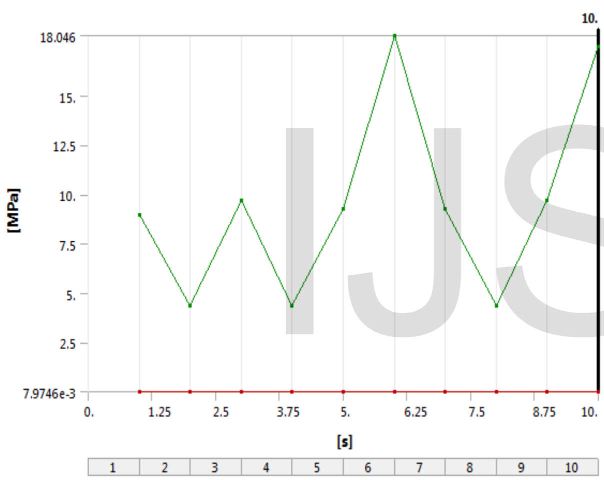
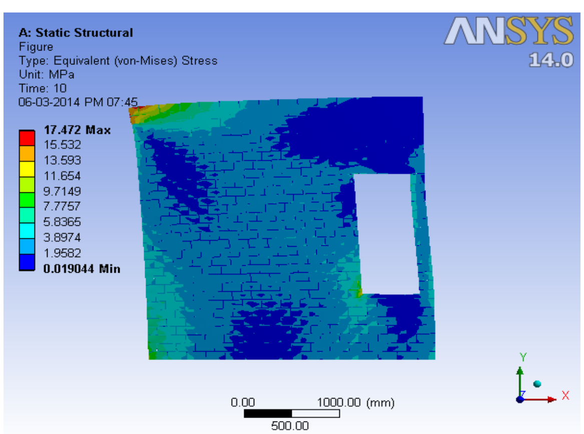


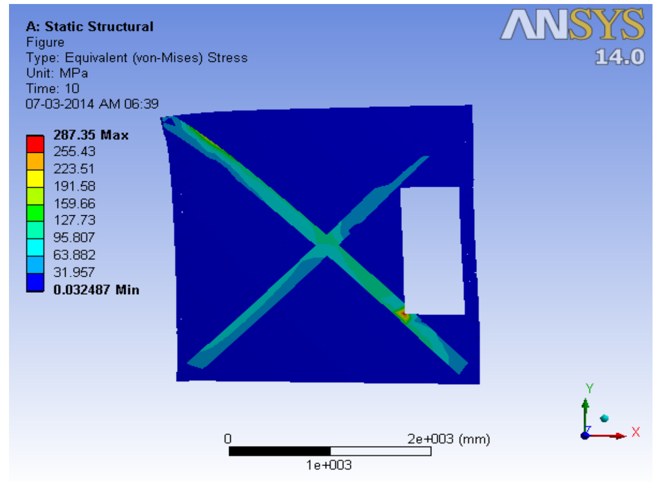
Deformation Model 2

6.5. Equivalent Stress



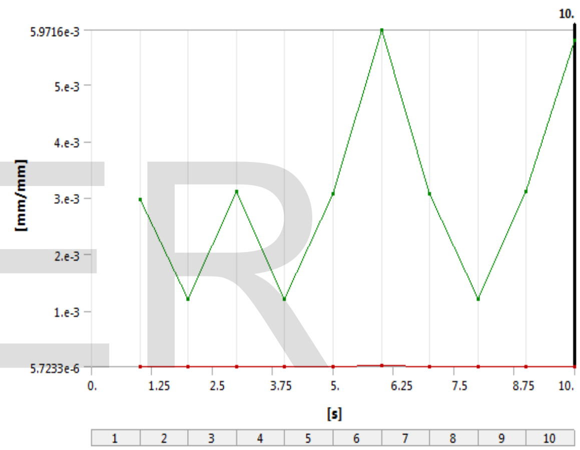


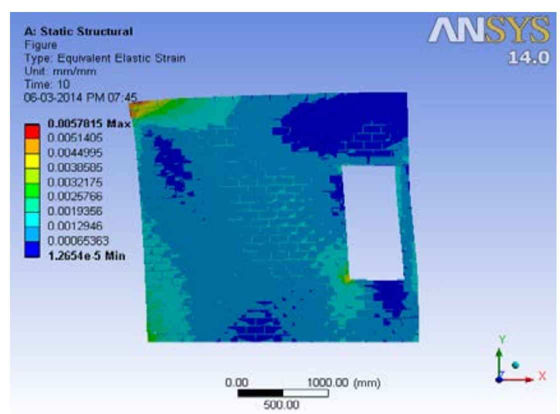
Equivalent Stress Model 1



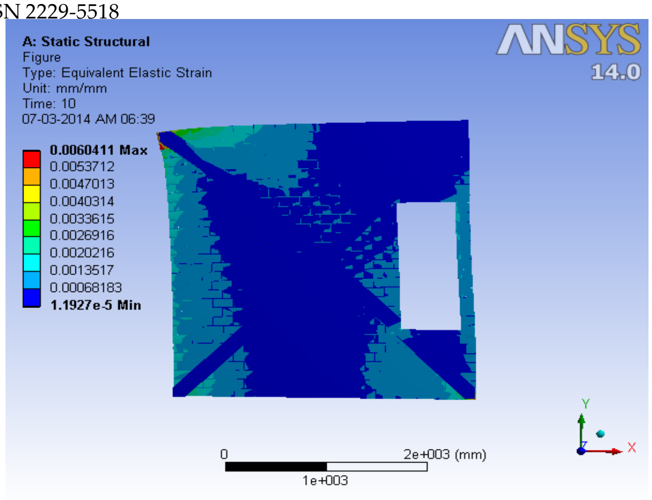
Equivalent Stress Model 2

6.6. Equivalent Strain





Equivalent Strain Model 1



Equivalent Strain Mode2

7 Comparison of Results

PARAMETERS	PLAIN MASONRY	BRACED MASONRY
Total Deformation	13.759 mm	10.007 mm
Equivalent Strain	0.0005 mm/mm	0.0006 mm/mm
Equivalent Stress	17.472 MPa	28.7 MPa

8 Conclusion

The analysis report shows that:

- Deformation is low in braced masonry compared to plain masonry. The duration of damage is prolonged for longer time in braced masonry.
- The stress strain values are comparatively good compared to normal masonry.

The above study reveals the idea that providing bracing has good damage preventing quality. The further studies are to be continued by experimental modeling and testing since the analysis has provided a better solution for a seismic resisting structure.

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