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Seismic Analysis of InterlockingBlocks of Wall

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ABSTRACT— In this project, an attempt is made to analyse the structure when the infill wall is modelled using interlocking blocks. In this study building frame, wall, foundation, soil is modelled using ANSYS CIVIL FEM software. In analysing the building different conditions considered are (a) Single storey with single bay frame without considering the interlocking infill on well graded soil with earthquake load along x direction; (b) Single bay frame with interlocking infill walls built along x direction; (c) Single bay frame with brick infill walls built along x direction; (d) Single storey with single bay frame without considering the interlocking infill with earthquake load along z direction;(e) Single storey single bay frame with interlocking infill walls built along z direction; (f)) Single storey single bay frame with brick infill walls built along z direction on gravel well graded soil. The static nonlinear analysis is used to analyse the model. The displacement and stress results obtained along different co -ordinates are studied and compared. Comparison of results obtained is done between interlocking infill wall, brick infill walls and single storey single bay frame without any infill.

I. INTRODUCTION:

In most of the developing countries with the increase in population the housing facility is inadequate. Due to high rate of urbanization the cost of land and materials of construction are increasing rapidly. Hence the poor class of society cannot afford for proper housing. The new structural component desired to be developed in masonry buildings construction is new interlockingmortar concrete masonry blocks. Based on previous studies it was found that because of the use of interlocking blocks the cost and time required for construction gets reduced. Mortar less load bearing wall built using interlocking block is dissimilar from usual mortared brickwork systems in which there is no mortar layer and instead of that each block are connected to each other by groves and protrusion. Interlocking blocks produced from compressed stabilized soil will have good fire resistant and insulation properties [1]. When the climate condition is dry, wall constructed using stabilized soil gave good compressive strength. Expansion of interlocking earth block is one of the best technologies for the production of low cost building material. In load bearing system of the building wall will also act considerably in resisting the lateral loads acting on building. Hence walling material is very essential in construction. It was found that it constitute about 22% total cost of the building. Hence it is necessary to find the material whichis cost effective. Interlocking stabilized earth blocks have satisfactorily reduced the cost of construction by reducing the mortar joints. If the interlocking blocks are well stabilized they will serve the aesthetic property also. Different types of interlocking blocks are being developed worldwide. The aim of this project is to check how effectively a wall built using interlocking block will resist the lateral loading like earthquake load. Interlocking blocks are developed with various shapes, dimension and also with various interlocking mechanism.

Objectives of project:

1. To study the problems occurs with the normal brick walls during the earth quake.
2. To design the structure using conventional brick walls and interlocking blocks.
3. To calculate analytically the boundary loading conditions on frequency of earthquake to apply on the model.
4. To analyse the model using FEM analysis
5. To compare the two structure results.

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II. PROBLEM STATEMENT

Day by day as the population increases in the country like India, the building heights get increases and natural disasters like earthquake can damage to the buildings to the huge extent. The bricks structure in the building or tower construction has a less sustainability during the earthquake conditions; it results to the serious human and economic loss. It is important to improve the constructability in civil engineering without increases the cost of construction. This project deals with the seismic analysis of interlocking blocks to minimize the damages to the constructions.

III. METHODOLOGY OF THE PROJECT

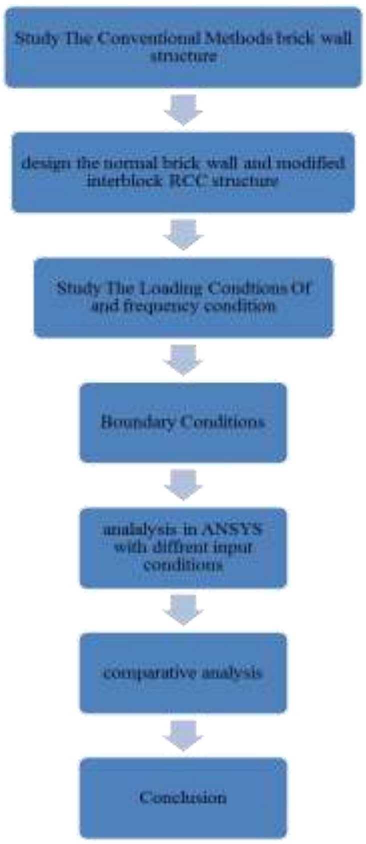
In the present project study, ANSYS Civil FEM Software is used for Seismic Analysis of structure. Interlocking block is modelled using CREO design software. Dimension of building is will be selected by the literature study and analysed in the ANSYS software. The design parameters are building height, area, each floor height, thickness of slab, Soil layer depth is also considered in this study. Material used for analysis is Fe 415 steel and M25 grade of concrete.

After defining all the parameters of analysis, apply self-weight and also live load to the structure. Then nonlinear static analysis is conducted. After static analysis define all the parameters as mentioned in table 2 and seismic analysis is done.

In this study, six different models are created as mentioned below:

1. Model 1: Here only frame model is considered for study and load is applied on all beams. The brick load calculated is applied on plinth beam. Earthquake load is applied in x direction.
2. Model 2: In this case wall using interlocking block is modelled only along longer length of building and earthquake load is applied along x direction.
3. Model 3: In this wall is modelled using brick along x direction and earthquake load is applied along x direction.
4. Model 4: Here only frame model is considered for study and load is applied on all beams. Earthquake load is applied in z direction.

FLOWCHART



Design data collection

The data required for the project is collected from the internet mostly for this project, the required data is

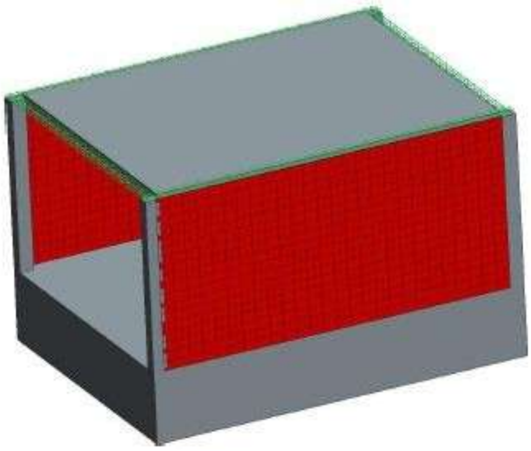
- Frequency of the earthquake,
- Start and stop time of earthquake,
- load on building considered
- base of building
- interlocking block structure

Some of the above data collected from the research paper given in literature review above and other data has to be calculated by considering height of building. The types of interlocking blocks studied on the internet and research paper will select the modified design and will make a design structure in the CREO software.

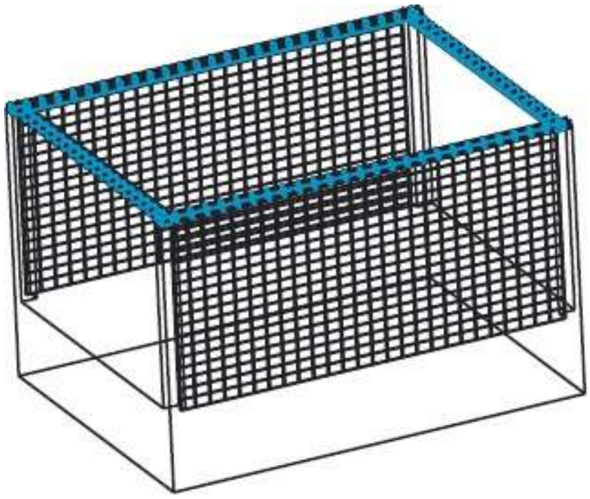
Modelling of project

In this chapter, the general description of how the finite element model is built is noted, and the calibration of the generated Finite Element Analysis (FEA) model is introduced. Finite element analysis proposes substantial benefits in accurateness over alternative methods of analysis such as grillage analysis or analytical methods in many specific types of structures. (O'Brien 1999, p. 185) For instance, FEA enables membrane forces to be modelled accurately in structures such as arch, box girder, folded plate or shell structures. In addition, FEA modelling allows greater analytical flexibility enabling the model to be manipulated by material characteristics, which can allow further study.

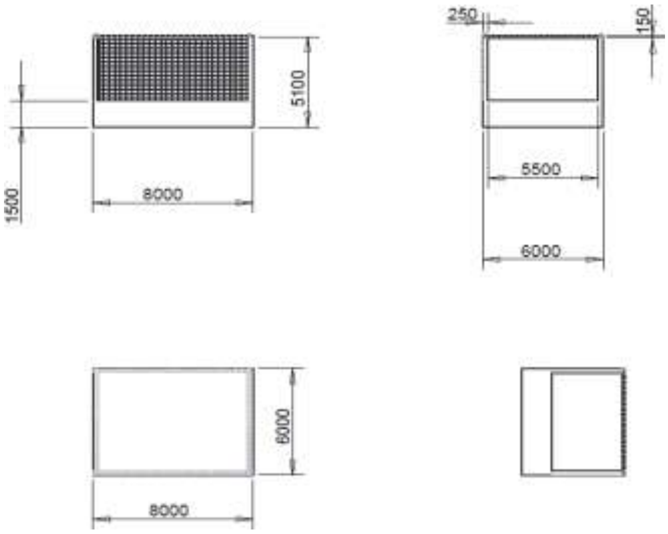
- **structure with Normal bricks**



- **Isometric view**

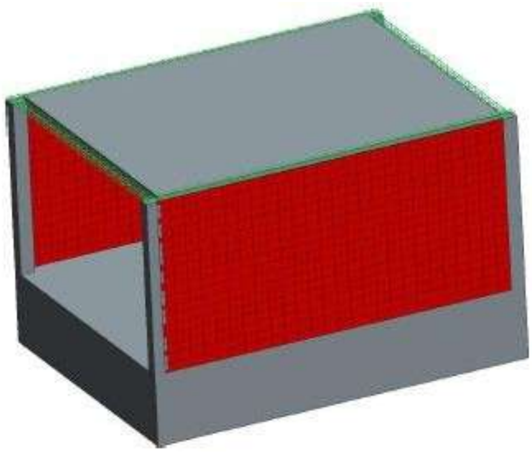


- **Dimensions**

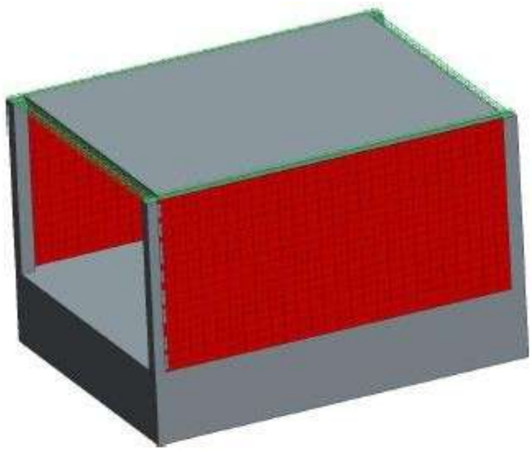


Parts of bridge

- **Normal brick**



- **Interlocking brick structure**



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Modelling Method

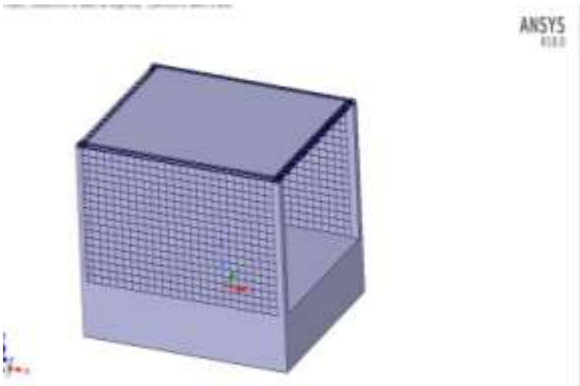
Measuring displacement from the live load test can be utilized in understanding the structure displacement behaviour. In addition, it can also become a good developmental tool of the accurate finite element model of the normal brick/ conventional brick structure. In performing a comparison of in-field measured data and calculated data by a finite element analysis program, it is essential that the created finite element model represents the identical displacement response as the actual behaviour.

IV. ANALYSIS OF STRUCTURE

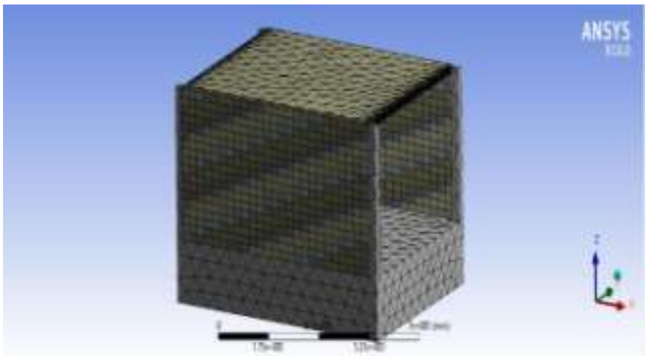
1. **Conventional bricks**
2. **Interlocking bricks**

1. Conventional Bricks

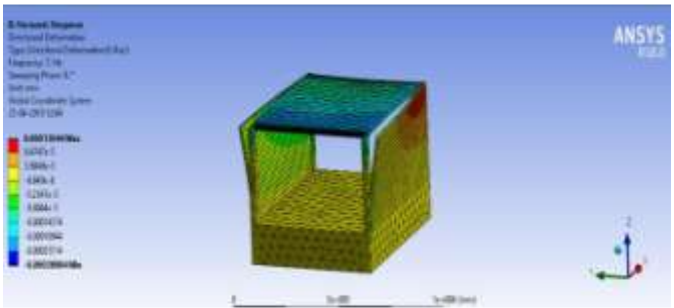
- **Modeling Of Bridge**



- **Meshing**



- **Analysis at 7 Hz**
- **Deflection In X Direction:**



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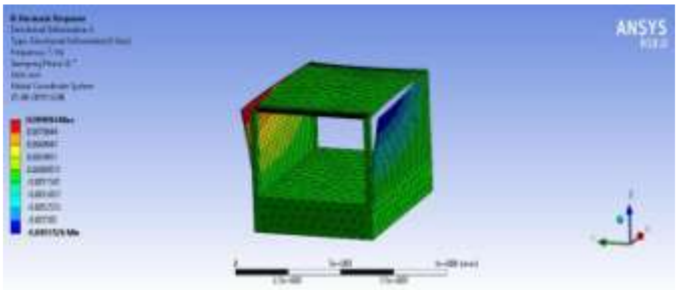
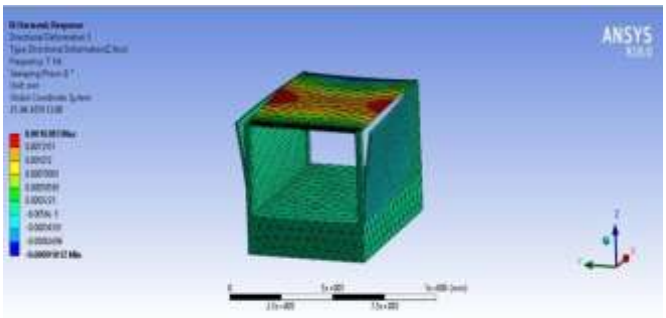
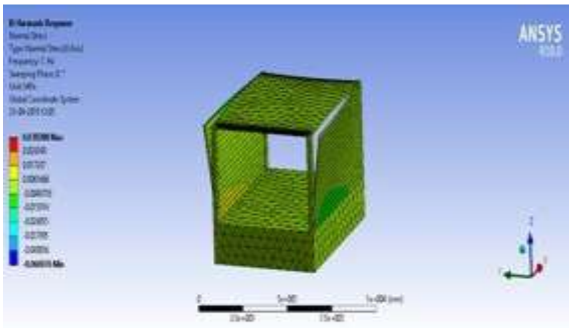
- **Deflection In Y Direction**



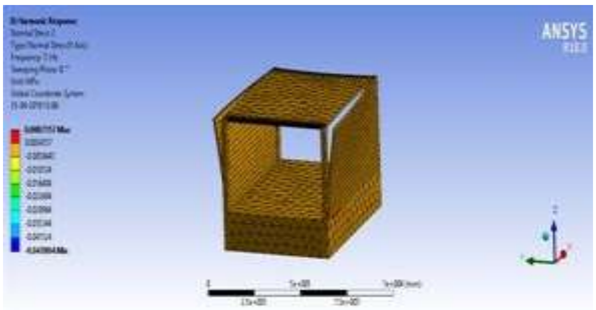
Deflection In Z Direction



- **Stress (at 7 hz):**
- **In x – direction**



- **In y – direction**



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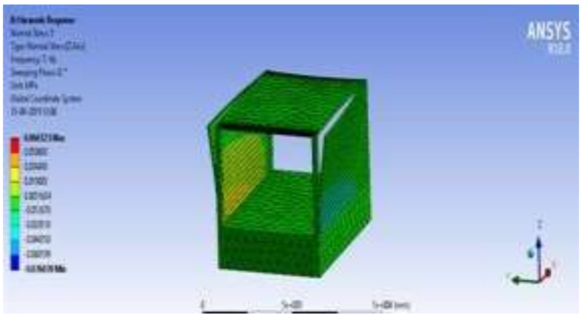
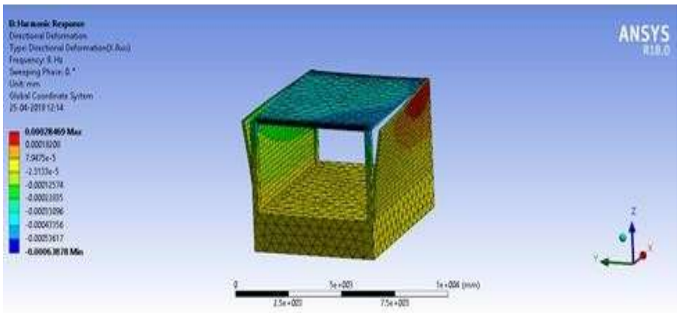
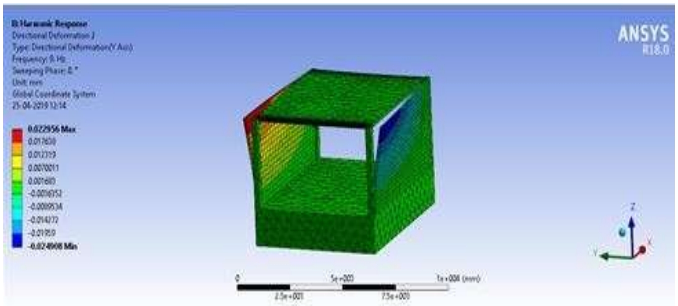
- **In z – direction**



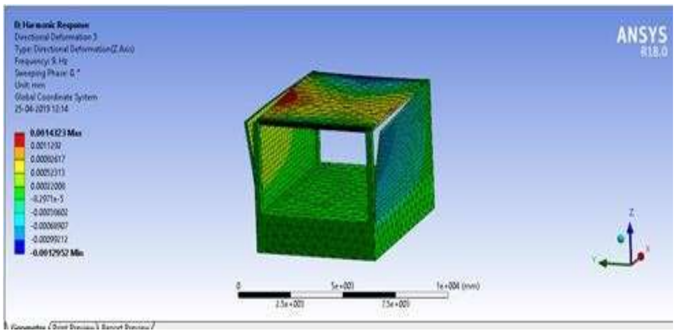
- **Analysis at 9 Hz**
- **Deflection In X Direction:**



- **Deflection In Y Direction**



- **Deflection In Z Direction**



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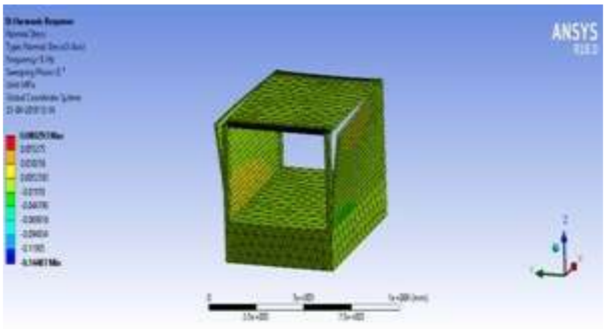
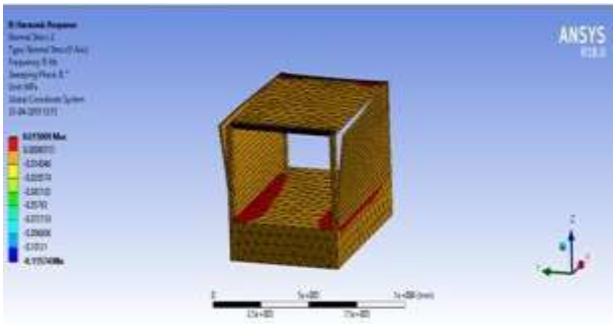
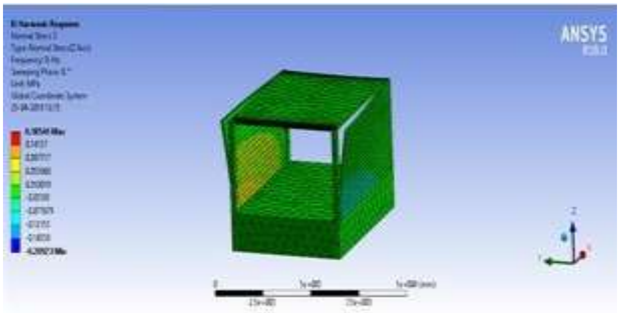
- **Stress (at 9 hz):**
- **In x – direction**



- **In y – direction**



- **In z – direction**



- **Analysis at 11 Hz**
- **Deflection In X Direction:**

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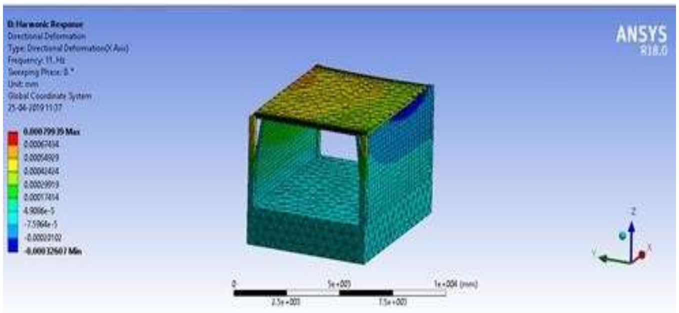
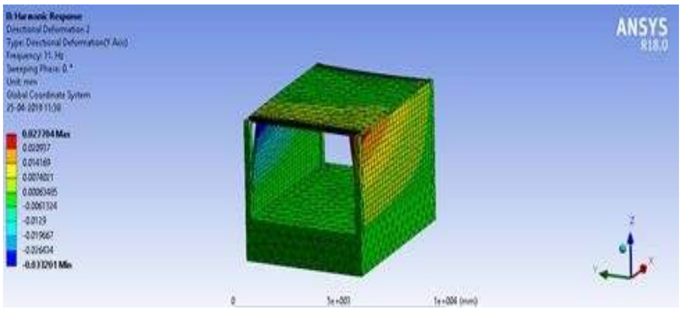
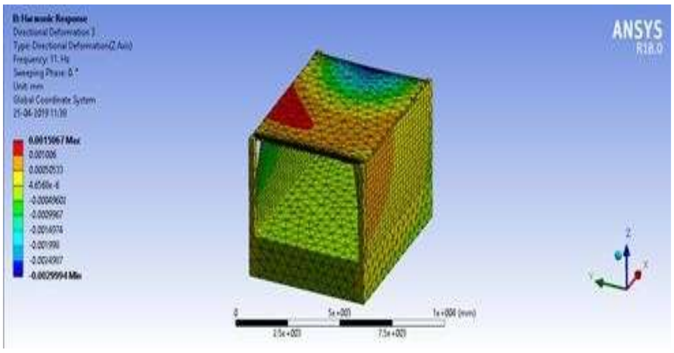


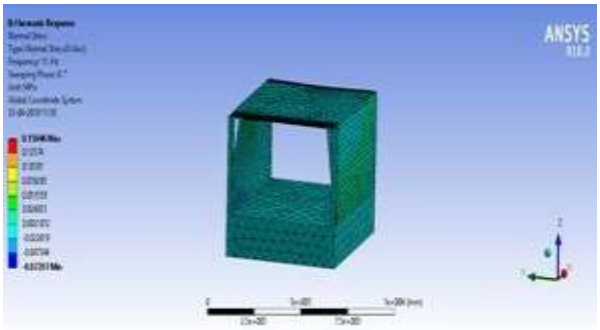
- **Deflection In Y Direction**



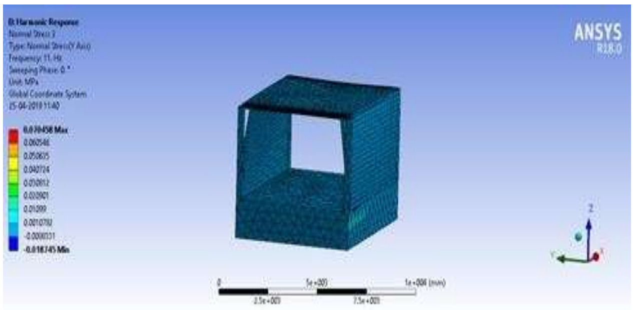
- **Deflection In Z Direction**



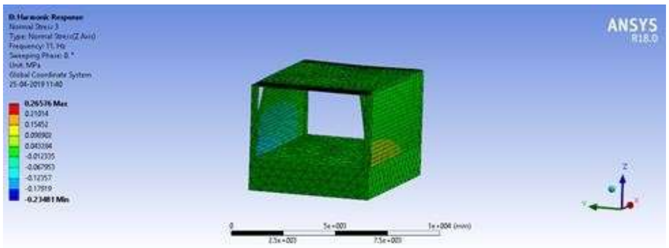
- **Stress (at 11 hz):**
- ➢ **In x – direction**



➢ **In y – direction**

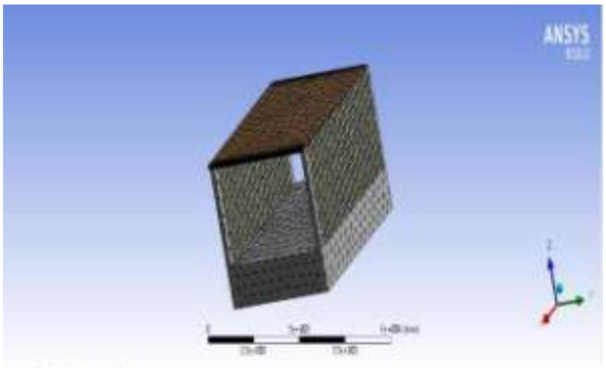


➢ **In z – direction**

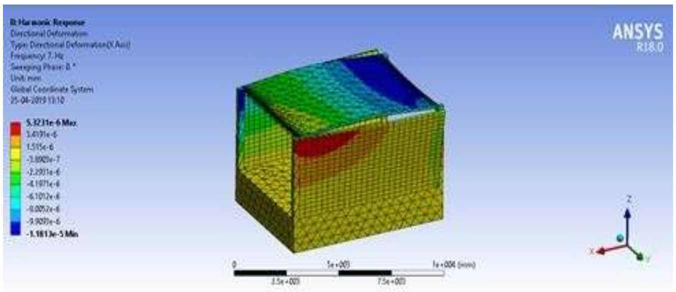


- **ANSYS ANALYSIS WITH INTERLOCKING BRICKS**
- **Modelling:**

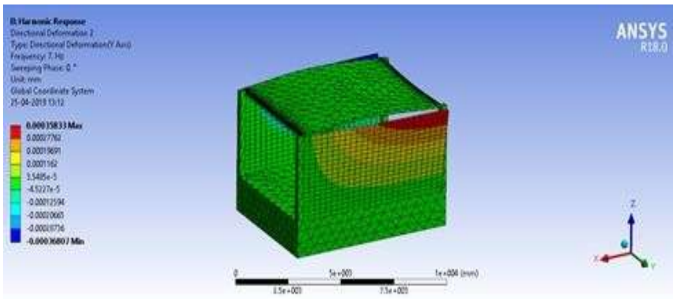
- **Meshing:**



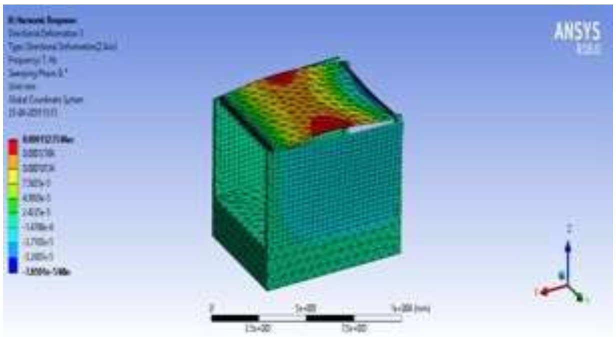
- **Analysis at 7 Hz**
- **Deflection In X Direction:**



- **Deflection In Y Direction**

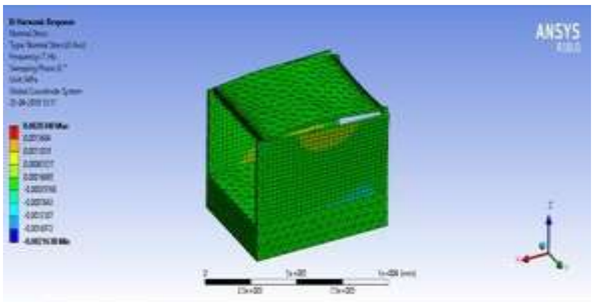


- **Deflection In Z Direction**



- **Stress (at 7 hz):**

➢ **In x – direction**



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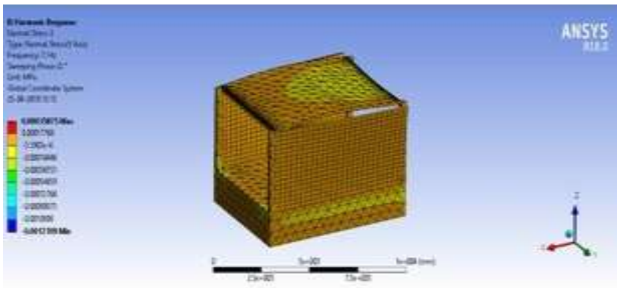
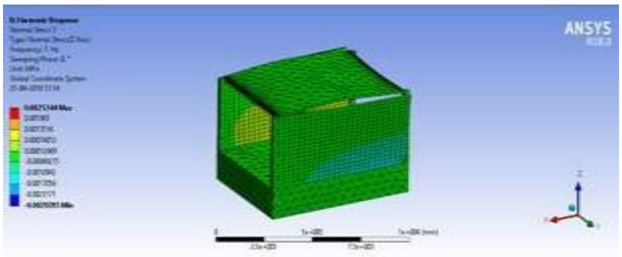
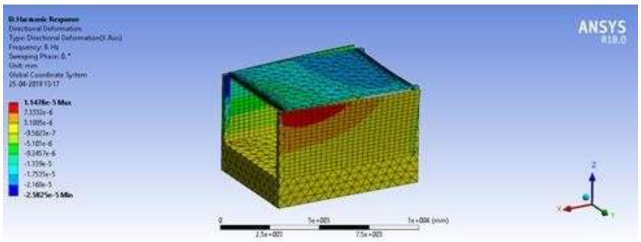
- **In y – direction**



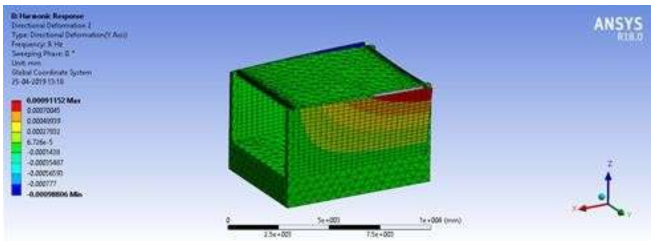
- **In z – direction**



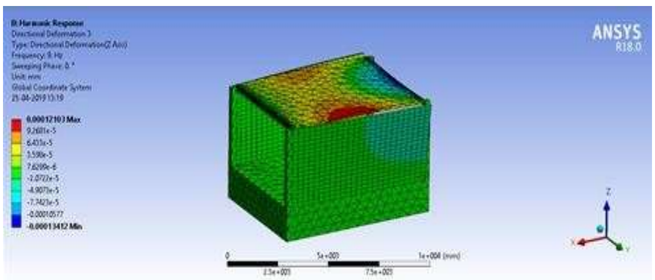
- **Analysis at 9 Hz**
- **Deflection In X Direction:**



- **Deflection In Y Direction**



- **Deflection In Z Direction**



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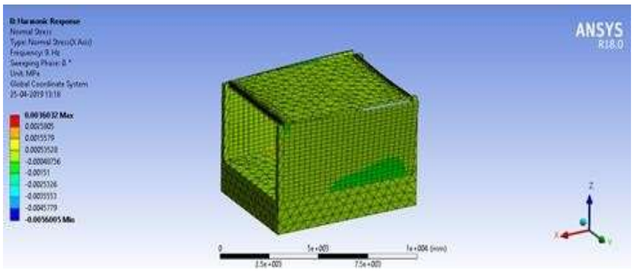
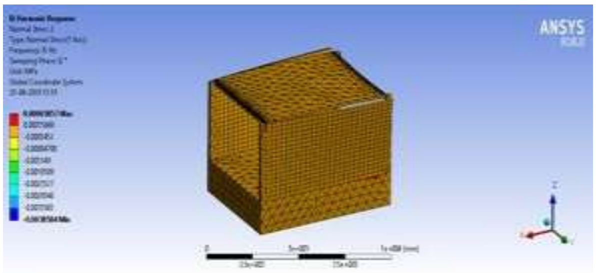
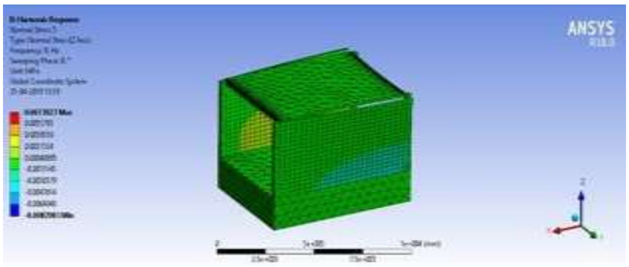
- **Stress (at 9 hz):**
- **In x – direction**



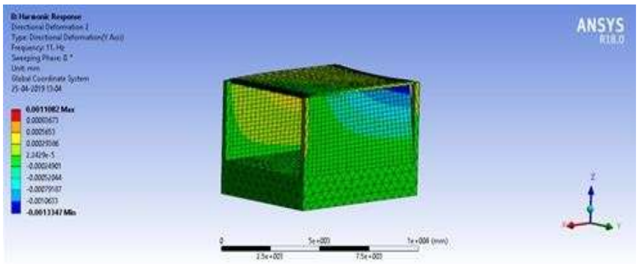
- **In y – direction**



- **In z – direction**



- **Analysis at 11 Hz**
- **Deflection In X Direction:**



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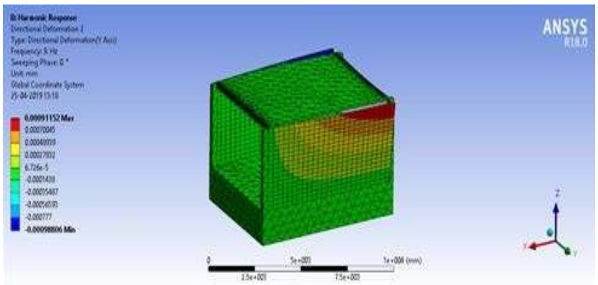
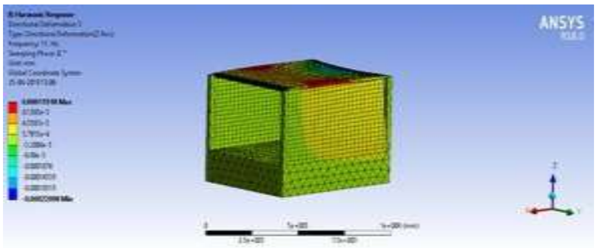
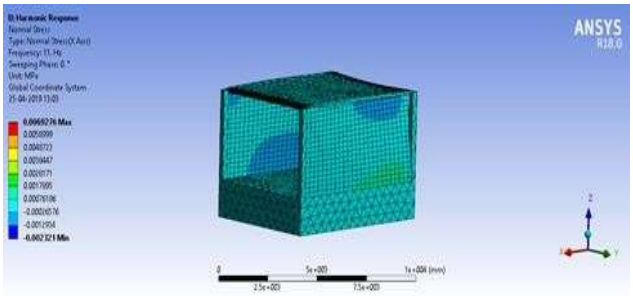
- **Deflection In Y Direction**



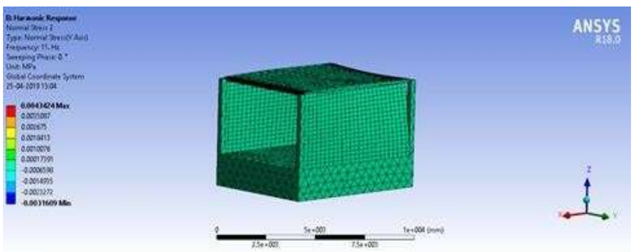
- **Deflection In Z Direction**



- **Stress (at 11 hz):**
- **In x – direction**



- **In y – direction**



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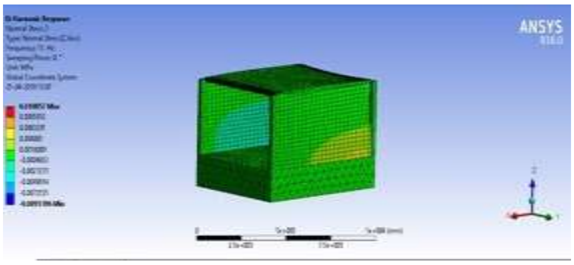
- **In z – direction**



V. RESULT

Structure with Normal BricksDisplacement & stress

Sr. no.	x direction values (mm)		y direction displacement values (mm)		z direction displacement values (mm)	
	displacement	**stress**	**displacement**	**stress**	**displacement**	**stress**
1)	0.000130	0.03928	0.00909	0.0087	0.00163	0.0665
2)	0.000284	0.08029	0.0229	0.015	0.00143	0.185
3)	0.000799	0.150	0.02779	0.0704	0.00150	0.2657

Structure with Interlocking Bricks

Sr. no.	x direction values (mm)		y direction displacement values (mm)		z direction displacement values (mm)	
	displacement	**stress**	**displacement**	**stress**	**displacement**	**stress**
4)	5.323e-6	0.00203	0.0003583	0.0003587	0.0001527	0.002574
5)	1.147e-5	0.0036	0.000911	0.000658	0.000121	0.0073
6)	3.169e-5	0.006927	0.00110	0.004342	0.0001191	0.01085

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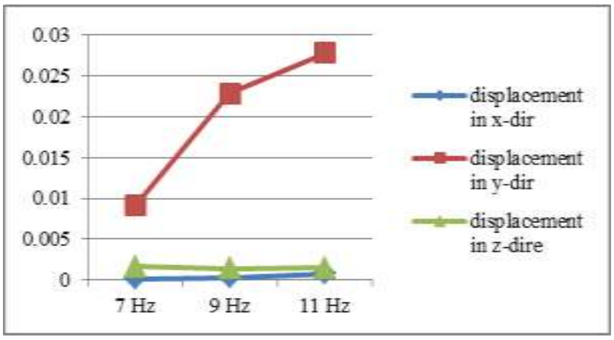
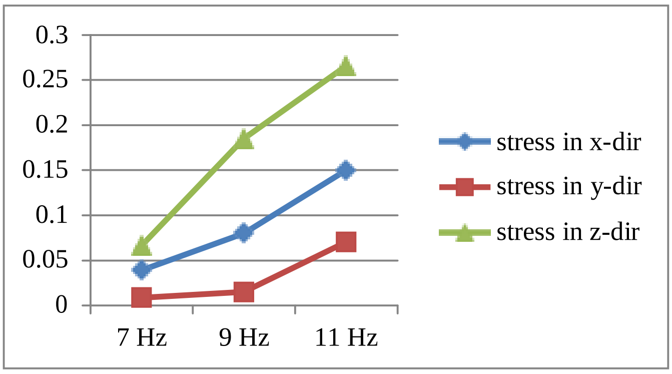
Graphical analysis of results

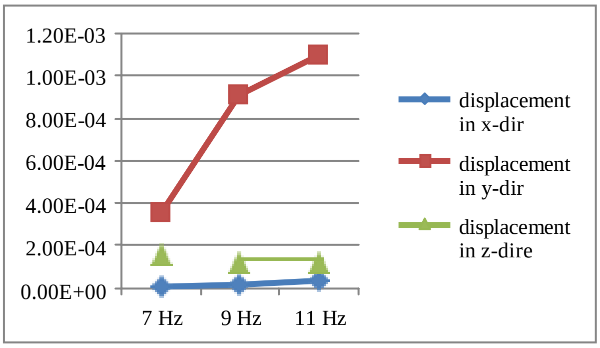
- **Normal brick structure (displacement)**



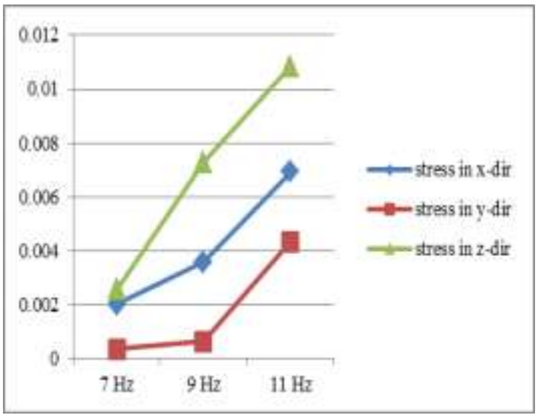
- **Normal brick structure (stress)**



- **interlocking brick structure (displacement)**



- **interlocking brick structure (stress)**



VI. CONCLUSION

The seismic analysis of single storey single bay frame with infill wall built using interlocking block and brick are conducted and compared. In order to obtain more realistic value for stress and displacement results, we have conducted 3D analysis of structure. When compared the displacement result of the frame with interlocking block wall, brick wall and frame without any infill wall (bare frame) it has been observed

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