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THE BEHAVIOR OF R.C.C HIGH-RISE BUILDING, UNDER EARTHQUAKE LOAD BY ADOPTING LINEAR DYNAMIC ANALYSIS

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ABSTRACT*:-The result of masonry infill panel on the response of RC frames subjected to seismic action is widely known and has been subject of numerous new investigations, while several attempts to model it analytically have been reported.* In this thesis, *THE BEHAVIOR OF R.C.C HIGH-RISE BUILDING,UNDER EARTHQUAKE LOAD BY ADOPTING LINEAR DYNAMIC ANALYSIS* is being done and the behavior of building with and without in filled wall under seismic load actions is explored. *Infill behaves like density strut between column and beam and compression forces transfers from one node to another. In this study, the effect of masonry walls on high-rise building is studied. active analysis i.e., response spectrum analysis on high-rise building with and without infill walls is carried out. For the analysis+ 20-story R.C.C. framed building is modeled. Earthquake response spectrum is applied to the models. Various cases of analysis in zone II & IV are full.All analysis is carried out by software ETABS. Base shear, storey disarticulation, story float is calculated and compared for all model. The results show that infill walls decrease displacements, flow and time-period and increases base shear. Therefore, it is essential to consider the effect of masonry infill for the seismic evaluation of moment resisting reinforced tangible frame.*

1. INTRODUCTION

It has always been a human aspiration to create taller and taller structures. Development of metro towns in our country there is increasing demand in huge Building. The reinforced cement concrete moment resisting frames are in filled with unreinforced brick masonry walls are common in our country and in other countries. And commonly Masonry used for construction material in the world for reason that includes accessibility, functionality, and cost. The initial function of masonry is either to protect inside of the structure from the nature or to separate inside spaces The main objective of this work is to find out the result of masonry infill walls on the seismic performance of R.C.C. High-Rise building with linear dynamic analysis method i.e. response spectrum analysis. Following results would be compared for G+ 20-storey building for bare frame and in filled frames. The analysis results would be compared in terms of i) Joint Displacement ii) Storey drift iii) Base shear.

The masonry infill's are having unreinforced clay bricks or hollow masonry blocks. These masonry infills are commonly used because:For under developed or developing countries,the use of these

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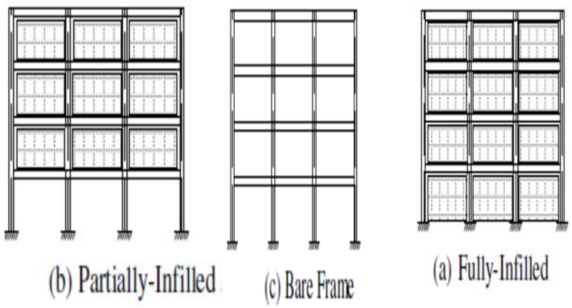
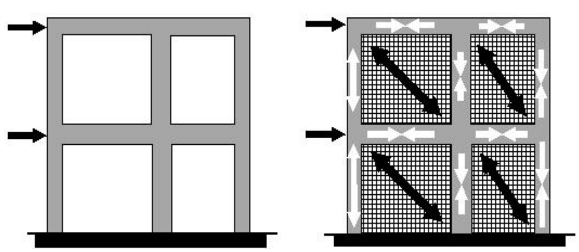
materials is rapidly increasing dust materials with low cost labor availability make this material the preferred choice.



Frames with infill's.

Depending on relative properties of frame and infill, failure modes of masonry infilled frame show variety. In other words, failure can occur in the frame elements or in the infill. In estimating the lateral strength and lateral rigidity of masonry in filled frame, it is necessary to find the most critical of the various modes of failure of the frame and infill. The usual modes for frame failure are tension failure of surrounding column elements or shear failure of the columns or beams. Tension failure of the column results from applied overturning moments.



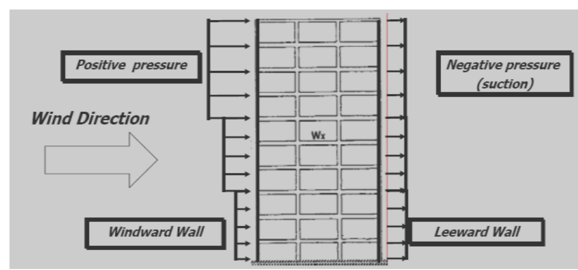
(a) Frame action in bare frame (b) Predominant truss action in infilled frame.

TYPES OF INFILL VALVES

- Masonry infill walls
- Concrete infill walls
- Timber framed infill walls
- Light steel framed infill walls
- Stone walls

2. LATERAL FORCES ON INFILLED WALLS

Typically considered to be those which act parallel to the ground plane May occur at many angles other than perfectly horizontal generally considered to act transversely to the primary structural system.Wind is a moving air. The air has a particular mass and moves in a particular direction at a particular velocity. When the moving air encounters a stationary object air exerts pressure on the object. Movement of air near the surface of the earth is a three dimensional with horizontal motion much higher than the vertical motion. The horizontal motion of the wind near the ground surface is of much importance for building design than the vertical motion because of its turbulent nature.



Fig;- showing the direct pressure on the building

EARTHQUAKE LOADS

What is an earthquake?

Earthquakes occur within the Earth's crust along faults that suddenly release large amounts of energy that have built up over long periods. The shaking during an **earthquake** is caused by seismic waves. When rock is within the crush brakes then seismic waves are automatically generated, producing a tremendous amount of energy. The energy released moves out in all directions as waves, much like ripples radiating outward when you drop a pebble in a pond. The Earth's crust near tectonic plate edges are forced to bend, Compress, and stretch due to the internal forces within the earth, causing earthquakes.

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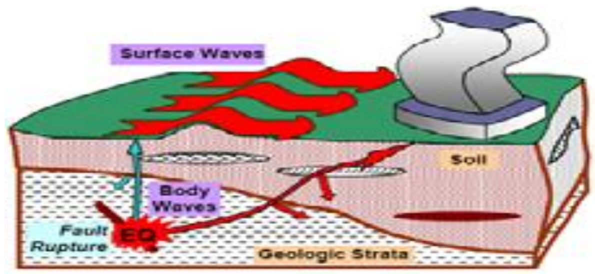
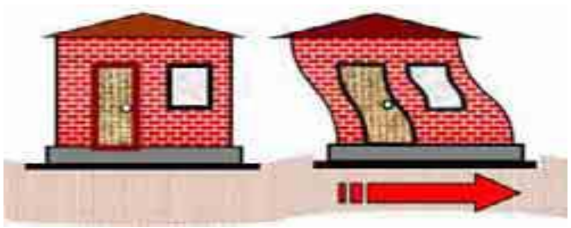


Arrival of Seismic Waves at a Site



Fig;- Effect of Inertia in a building when shaken at its base

Magnitude:-Magnitude is a quantitative measure of the actual size of the earthquake.

(a) At the same distance seismograms (records of earthquake ground vibration)of small earthquakes have low wave amplitude than the larger earthquakes; and

(b) For a given earthquake, seismograms at close distances have high wave amplitude than those at farther distances. These commonly used magnitude scale, the Richter scale. It is obtained from the seismograms and accounts for the dependence of waveform amplitude on epicentral distance. This scale is also called Local Magnitude scale.

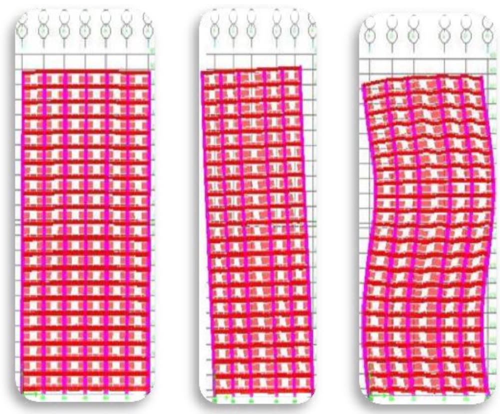
I.S: 1893, clause 7.5.3.The total design lateral force or design seismic base shear (Vb), According to IS 1893(part1): 2002, the base shear V_b is given by the following formula:

$$V_b=A_hW \quad A_h = \left(\frac{Z}{2}\right)\frac{I}{R}\frac{S_a}{g}$$

(4.1)

Here,A_h = Design horizontal acceleration spectrum value using the fundamental natural period 'T' considered in the direction of vibration. W = seismic weight of the building. The approximate fundamental natural period of vibration T_a in seconds, of a moment resisting frame building without brick infill panels may be estimated by the following empirical formula (IS 1893 (Part 1):2002 (Clause 7.6.1))$T_a=0.075h^{0.75}$ for R.C building

The figure below shows the behavior of tall buildings during earthquake.



Fig;- elevation with different mode shapes.

The behavior of a building during an earthquake is a vibration problem. The seismic motion of the ground do not damage a building by impact, or by externally applied pressure such as wind, but internally generated inertial forces cause by vibration of the building mass. this effect is known as the p-delta effect. In addition, the greater the vertical forces, the greater the movement due to p-delta. It is usually the vertical load that causes buildings to collapse in earthquake, buildings very rarely fall over-they fall down. The distribution of dynamic deformationscause

Wind forces;-The application of wind forces to a closed building in the form of pressure applied normal to the exterior surfaces of the building. Since the building is closed by cladding and it obstructs when wind is acting on the building.

3. LITERATURE REVIEW

Past relevant studies on masonry and masonry unfilled concrete frames and their lateral load performance are presented in this part.

Sucuoglu&Erberik;- Sucuoglu and erberikStudied seismic performance of a three-story unreinforced masonry building which survived in 1992 Erzincan earthquake without damage. First, a set of experiments were performed to determine the mechanical properties of the masonry walls. Then an accurate model was developed for the non-linear dynamic analysis of masonry building with the help of a computer program. Agarwal and shrikhan deproposed range of contact length is between one-fourth and one-tenth of the length of panel. There have been many research works related to infilled framed structures with micro and macro modeling. Most of the researchers have adopted single and some have adopted multiple struts in their studies.

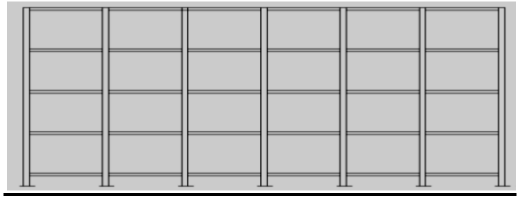


Fig 3.1 bare frame model

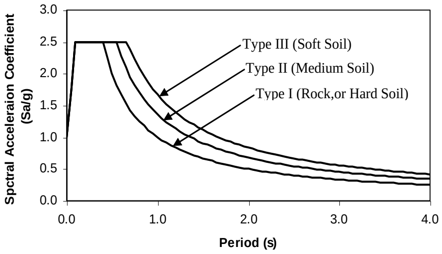
4. METHODOLOGY

When a earthquake is attacked then so many vibrations are attacked. An earthquake force can be divided into three mutually perpendicular directions these are one is X and another two is Y and Z also this three direction having shakes and vibrations the predominant direction of shaking is horizontal. These three directions are designed for gravity load forces equal to mass time's gravity in the vertical direction. Because of the inherent factor of safety used in the design specifications, most structures tend to be adequately protected against vertical shaking. Vertical acceleration should also be considered in structures with large spans, those in which stability for design, or for overall stability analysis of structures.

Base shear:- According to is 1893(part1): 2002, the base shear v_b is given by the following formula:

$$V_b = A_h W$$

$$A_h = \left(\frac{Z}{2}\right) \frac{I}{R} \frac{S_a}{g}$$



TIME PERIOD;-The approximate fundamental natural period of vibration T_a in seconds, of a moment resisting frame building without brick infill panels may be estimated by the following empirical formula (IS 1893 (Part 1):2002 (Clause 7.6.1))

$T_a = 0.075h^{0.75}$ For RC frame building

$T_a = 0.085h^{0.75}$ For steel frame building

The approximate fundamental natural period of vibration in seconds of all other, buildings including moment resisting frame buildings with brick infill panels may be estimated by the following expression. (IS 1893 (Part 1):2002 (Clause 7.6.2))

$$T_a = \frac{0.09h}{\sqrt{d}}$$

5. INRODUCTIN OF ETABS

Etabs is very important software product its used for analyzing and designing of building and also it is used for the Modeling tools and templates, code-based load prescriptions, analysis methods and solution techniques, and also its useful for basic and dynamic function of the buildings. Interoperability with a series of design and documentation platforms makes ETABS a coordinated and productive tool for designs, which range from simple 2D frames to elaborate modern high-rises.

Infilled walls:

W230 mm (9 inch) thick wall is provided all around the structure with no walls inside the structure, because the inner walls which are 115 mm thick do not play an important role in resisting the lateral loads so they are not considered in the analysis.

Columns :C750x750 mm of M35 grade concrete from 11th story and above ,

C 900x900 mm of M40 grade concrete from 10th story and below,

Beams :B300x450 mm of M35 grade concrete at 11th story and above

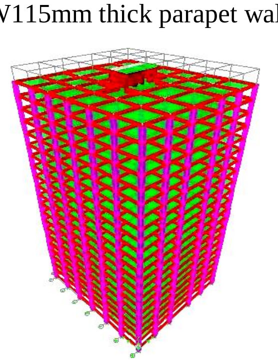
B300x600 mm of M40grade concrete at 10th story and below

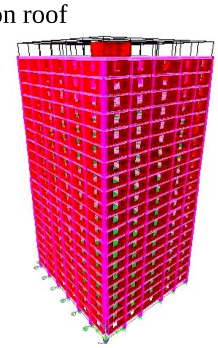
Slab :S 200 mm of M35 grade concrete for all story

Staircase:S125 mm of M 35 grade concrete for all story

Wall : W230 mm upto 20th story

W115mm thick parapet wall on roof





6. DESCRIPTION AND LOAD CALCULATIONS

Dead loads considered as per IS 875(part 1)1987.

1) Structure**:** G+ 20-story building rectangular in plan
2) Plan dimensions **:** 32.65mX36.3m.
3) Column size **:** C750x750 mm of M35 grade concrete from 11th
   Story and above, C 900X900 mm of M40 grade Concrete from 10th story and below
4) Beam size **:**B300x450 mm of M35 grade of concrete at 11th story
   and above, B300x600 mm of M40 grade concrete at
   10th story and below.

5) Slab thickness: S 200 mm of M35 grade concrete for all story.

6) Staircase **:** S125 mm of M 35 grade concrete for all story

7) Wall**:** W230 mm upto 20th story, parapet wall W115mm

8) Typical floor Height: 3m

9) Plinth level Height **:** 1.5m

10) Floor: G+ 20 story

11) Support: Fixed

12) Type of Soil**:** Medium Type (1S:1893)

13) Zone **:** II & IV

7. DISCUSSION OF RESULTS

The result of the present study shows that structural infill wall have very determinant effect on structural behavior and structural capacity under lateral loads and effects. Displacement and relative story drifts are affected by the structural irregularities. Regarding with the result, infill walls have a very important effect on structural behavior.

DISPLACEMENT:-The displacements at top story of the building with infill's wall in zone II reduces by12.27% along X-direction and 9.70% along Y-direction, whereas in zone IV displacement at the top story with infill walls is reduced to 15.41% along X-direction and 12.68% along Y-direction when compared with the model without infill's.

STORY DRIFT:-Storey drift for in filled wall model is within permissible limit as per the code provisions. The drift at top story of the building with infill walls in zone II reduces by 22.34% along X-direction and 18.55% along Y-direction, whereas in zone IV drift at the top story with infill walls is reduced to 28.23% along X-direction and 26.38% along Y-direction when compared with the model without infill's

BASE SHEAR:- From the results, it is shown that due to infill walls in building the base shear is increased to 19.46% as compared to the model without infill's

8. CONCLISION

1. Time period in zone II with infill wall is 0.7949sec and in without infill walls is 2.681sec.
2. Time period in zone IV with infill wall is 0.7932sec and in without infill walls is 2.661sec.
3. Base shear is increased by 19.46% due to the effect of infill walls.
4. Due to infill walls in the High Rise Building top storey displacement, time-period and drift is reduced. Base shear is increased. The presence of non-structural masonry infill walls can modify the seismic behavior of R.C.C. Framed High Rise building to large extent.
5. The displacement at top storeyof a building with infill wall in zone II is reduced by 12.27% along x-direction and 9.7% in y-direction.
6. Whereas in zone IV it is reduced by 15.4% and 12.63% respectively
7. The drift with infill walls in zone II reduced by 22.34% along x-direction and 18.55% along y-direction.

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