Seismic Evaluation of Multi Storeyed Building on a Sloped Ground
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Abstract— Most of the hilly regions of India are highly seismic. Buildings on hill slopes differ in a way from other buildings. The various floors of such building steps back towards the hill slope and at the same time buildings may have setbacks also. Due to varied configurations of buildings in hill areas, these buildings become highly irregular and asymmetric. Buildings situated in hilly areas are much more vulnerable to seismic environment. The performance of structures during past earthquakes has shown that asymmetric-plan buildings are especially vulnerable to earthquake damage. In this study, 3D analytical model of 13 storied Ascending & Descending slope buildings have been generated & analyzed using structural analysis tool “ETABS Non-linear”. To study the effect of infill and concrete core wall during earthquake, seismic analysis using both linear dynamic (response spectrum method) as well as non-linear static procedure (pushover) has been performed. From the above studies it has been observed that nonlinear pushover analysis provide good estimate of global as well as local inelastic deformation demands and also reveals design weakness that may remain hidden in an elastic analysis. Storey drifts are found within the limit as specified by code (IS: 1893-2002 part-1) in both linear dynamic and non-linear static analysis.

Key words: ETABS Non-linear, Seismic Evaluation

I. INTRODUCTION
Quake calamity had dependably been one of the immense regular calamities trust upon the humanity since time immemorial and acquiring its wake untold tragedies and hardship to the general population influenced. Indian subcontinent has been knowledgeable about the absolute most extreme seismic tremor on the planet. The most youthful mountain arrangement of Himalayas covers entire Northeast limit locale of India.

In uneven territories, avalanches are frequent and dangerous. In developing slope ranges, numerous multistoried R.C.C structures are developed on slope slant. R.C.C structures are getting prevalent in hilly areas as result of expansion in area cost and in unavoidable circumstances. Therefore, a considerable lot of them are built over hilly slopes. Setback multistoried buildings are occasional above level grounds while stepback structures are very regular at hilly slopes. Blends of stepback & setback structures are additionally prevalent on hilly slope. Structures in sloping ranges are irregular & asymmetric and in this manner are subjigated to strong torsion under the activity of quake forces. Structure loads pass on to foundation level to slope induces issue of incline insecurity and may come about into collapse or breakdown of the given building.

here, hypothetical multistoried structures (i.e., 13 storied, with & without infill) situated in zone II of the medium soil areas has been analyzed & designed for load combinations given in code & evaluated.

II. THE OBJECTIVES OF THE STUDY
To study the impact of infill wall and concrete core wall provided at the centre in tall structures under seismic zone II considering parameters like displacement, drift, base shear and time period.

III. METHODOLOGY
1) Creating 3D models of the building in Etabs.
2) Design the buildings as per prevailing Indian standards for dead load, live load and earth quake load in Etabs.
3) Analyze the building using, Equivalent static, Response spectrum, Pushover analysis methods.
4) Analyze the results and arrive at conclusions.

IV. DETAILS OF THE BUILDING
For study purpose, the layout of the plan having 7x7 bays of 5x3.5m is considered. The building parameters are as follows,
1) Number of stories: 20
2) Seismic zone: II
3) Floor height: 3 m
4) Grade of Concrete: 25 Mpa
5) Grade of steel: Fe415
6) Beam dimension : 250mm x 600mm
7) Column size for first 8 storey’s= 0.30mx1.00m
8) Column size for next 5 storey’s= 0.30mx0.60m
9) Slab depth: 120mm
10) Dead load: 1.5 Kn/m²
11) Live load : 2 Kn/m²
12) Importance factor(IF): 1
13) Response reduction factor:3

V. MODELS

Fig. 1: Plan Layout of model 1(Ascending,A1 & Descending,D1)
VI. DESCRIPTION OF SAMPLE BUILDING

A. **Model 1**
Structure is a 13 storied ascending slope building. It is modeled as 'bare framed.'

B. **Model 2**
Structure is a 13 storied ascending slope building on a slope hill. Structure has 230mm masonry infill wall in all stories.

C. **Model 3**
Structure is a 13 storied ascending slope building on a slope hill. Structure has no infill - masonry but a 250mm concrete core at the center of the building.

D. **Model 4**
Structure is a 13 storied descending slope building. It is modeled as bare-framed.

E. **Model 5**
Structure is a 13 storied descending slope building on a slope hill. Structure has 230mm infill-masonry-wall in all stories.

F. **Model 6**
Structure is a 13 storied descending slope building on a slope hill. Structure has no infill-masonry but a 250mm concrete core at-the-center of the building.

VII. RESULTS

![Fig. 6: Plot of Maximum Displacement VS Models for static, dynamic and pushover analysis in X direction](image-url)

- **Fig. 6:** Plot of Maximum Displacement VS Models for static, dynamic and pushover analysis in X direction.
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Conclusions

1) The presence of infill impacts the general conduct of structures when subjected to earthquake forces. Joint displacement and story drift are noticeably reduced.

2) Story Drift are within limits determined by code (IS1893-2002Part-1).

3) The presence of Shear wall at the middle has not influenced much on the general conduct of the building structure when subjected to seismic Forces, when contrasted with different models.

4) Base shear and relocation at first pivot are less in ascending structures contrasted with Descending structures.

5) Fundamental Natural period reduces when impact of infill and solid Shear wall is considered.

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REFERENCES


