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Dynamic Analysis of Different Shapes of Multistorey Building By Using Response Spectrum Method In Staad Pro V8i

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ABSTRACT

The important objective of engineers is to design and build a structure in such a way that damage to the structure and its structural component during the earthquake is minimize. The most sensitive issues that the Structural Engineers face is the selection of proper procedure for estimating the seismic performance of the structure. This is very important when they are dealing with high rise structures as the improper selection of the method ultimately leads to the results which are far away from the correct results. Dynamic analysis is one of the effective procedures for evaluating the seismic performance of the building. The damage control is one of important design considerations which is increasing its influence and can be achieved only by introducing dynamic analysis in the design. The dynamic analysis can be done by software. Stadd Pro is one of the leading software which is presently using by many companies and Structural Engineers for their projects. In this paper, for the dynamic analysis, a plan of a multi-storey building is taken and it has been modeled with different structural elements for minimum storey displacement. The multi-storey building is R.C.C. structure with G +15 storey in zone V.

Keywords - Multi-storey Building, Non-linear Analysis, Base Shear, Displacements, Story Drift, STAAD Pro V8i.

1. INTRODUCTION:-

1.1 Brief Introduction :- Earthquake has always been a threat to human civilization from the day of its existence, devastating human lives, property and man-made structures. Earthquake causes random ground motions, in all possible directions emanating from the epicentre. Vertical ground motions are rare, but an earthquake is always accompanied with horizontal ground shaking. The ground vibration causes the structures resting on the ground to vibrate, developing inertial forces in the structure. As the earthquake changes directions, it can cause reversal of stresses in the structural components, that is, tension may change to compression and compression ma change to tension. Earthquake can cause generation of high stresses, which can lead to yielding of structures and large deformations, rendering the structure non-functional and unserviceable. There can be large storey drift in the building, making the building unsafe for the occupants to continue living there. Reinforced Concrete frames are the most common construction practices in India, with increasing numbers of high-rise structures adding up to the landscape. There are many important Indian cities that fall in highly active seismic zones.

1.2 OBJECTIVES

- The goal of this project is the to investigate and determining the various structural response of the rc framed structure.
- To find the appropriate methods for dynamic analysis • Check the seismic response of building using Software.
- To analyze lateral displacement, storey drifts under loads. To find the relationship between earthquake intensities and response.

2. LITERATURE REVIEW:

Pralobh S. Gaikwad and Kanhaiya K. Tulani (2015) The paper aims towards the dynamic analysis of RCC and Steel building with unsymmetrical configuration. For the analysis purpose models of G +9 stories of RCC and Steel with unsymmetrical floor plan is consider. The analysis is by carried by using F.E based software E TABS. Various parameters such as lateral force, base shear, story drift, story shear can be determined .For dynamic analysis time history method or response spectra method is used. .If the RCC and Steel building are unsymmetrical, torsional effect will be produce in both the building and thus are compared with each other to determine the efficient building under the effect of torsion.

A.M. Mwafy, A.S. Elnashai In this paper, the applicability and accuracy of inelastic static pushover analysis in predicting the seismic response of RC buildings are investigated. The dynamic pushover' idealised envelopes are obtained from incremental dynamic collapse analysis. This is undertaken using natural and artificial earthquake records imposed on 12 RC buildings of different characteristics. The results of over one hundred inelastic dynamic analyses using a detailed 2D modelling approach for each of the twelve RC buildings have been utilised to develop the dynamic pushover envelopes and compare these with the static pushover results with different load patterns.

P. Mendis Bhagwat et.al has investigated that the paper provides an outline of advanced levels of wind design in the context of the Australian Wind Code and also explain the exceptional benefits it offers over simplified approaches. Wind tunnel testing, which has the potential benefits of further refinement in deriving design wind loading and its effects on tall buildings is also emphasized. He the conclusion is made on various key factors with the design of tall buildings to the effects of wind loading. The general design requirements for structural strength and serviceability are assume particular importance in the case of tall building design as significant dynamic response can result from both buffeting and cross-wind loading excitation mechanisms.

3. METHODS OF ANALYSIS:

3.1 Response spectrum method: The representation of maximum response of idealized single degree freedom system having certain period and damping, during earthquake ground motions. This analysis is carried out according to the code IS 1893-2002 (part1). Here type of soil, seismic zone factor should be entered from IS 1893-2002(part1). For each mode, a response is read from the design spectrum, based on the modal frequency and the modal mass, and they are then combined to provide an estimate of the total response of the structure. Modal combination methods are:

A. Absolute Sum Method (ASM): combines the modal results by taking the sum of their absolute values.

B. Square Root of the Sum of the Squares (SRSS): combines the modal results by taking the square root of the sum of their squares.

C. Complete Quadratic Combination (CQC): method takes into account the statistical coupling between closely spaced modes caused by modal damping and also it is a method that is an improvement on SRSS for closely spaced modes.

3.2 ZONE FACTORS:

TABLE 1- ZONE FACTOR Z

Seismic zones	II	III	IV	V
Seismic intensity	Low	Moderate	Severe	Very severe
Z	0.10	0.16	0.24	0.36

3.3 Load Cases:
Load cases are generated by software and are accordance with Indian standards.

- 1.5(DL+LL)
- 1.2(DL +LL +ELx)
- 1.2(DL+ LL -ELx)
- 1.2(DL+ LL+ ELz)
- 1.2(DL+LL- ELz)
- 1.5(DL+ ELx)
- 1.5(DL- ELx)
- 1.5(DL+ ELz)
- 1.5(DL - ELz)
- 0.9DL + 1.5 ELx
- 0.9DL - 1.5 ELx
- 0.9DL + 1.5 ELz
- 0.9DL - 1.5 ELz

4. Seismic weight of building:
The seismic weight of the building means that is calculated on the entire floors weight of the building Fundamental Natural period as per IS 1893(part1):2002

- 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 empirical expression
  $T_a=0.075h^{0.75}$ for RC framed building
  $T_a=0.075h^{0.75}$ for steel framed building
  Where h =height of building

- The approximate fundamental natural period of vibration (Ta) in seconds, of all other buildings, including moment – resisting frame buildings with brick infill panels, may be estimated by the empirical expression:
  $Ta = 0.09h/\sqrt{d}$
  Where h = height of building
  d = Base dimensions of the building at the plinth level in m, along the considered direction of lateral force

5. **Design Seismic Base Shear:** The total design lateral force or design seismic base shear (Vb) along any principal direction shall be determined by the following expression

$$Vb = Ah \times W$$

Where Ah = Design horizontal acceleration spectrum value as per clause 6.4.2 IS 1893(part1):2002 using the fundamental natural period Ta as per clause 7.6 IS 1893 (part 1):2002 in the consider direction of vibration W = Seismic weight of building Here

$Ah = (Z/2) \times (I/R) \times (Sa/g)$
Z = zone factor
I = Importance factor
Sa/g = is depending up on the Ta and type of soil

6. **PLAN OF THE BUILDINGS:**

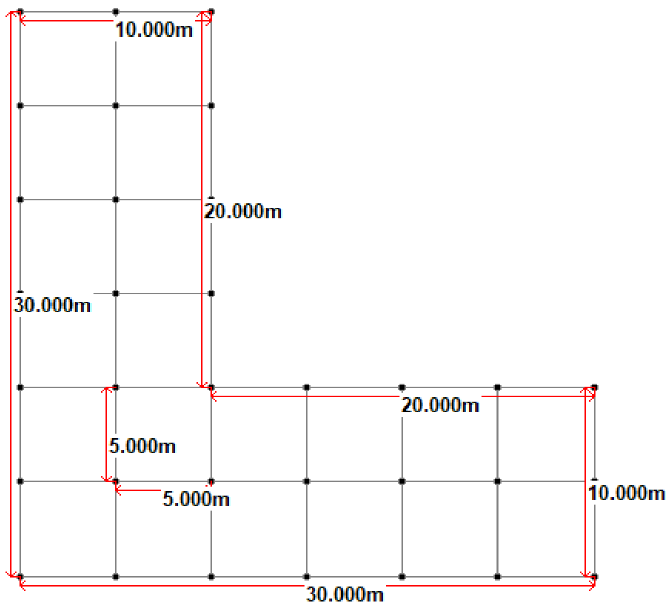

Figure1 – Plan of L-Shape building

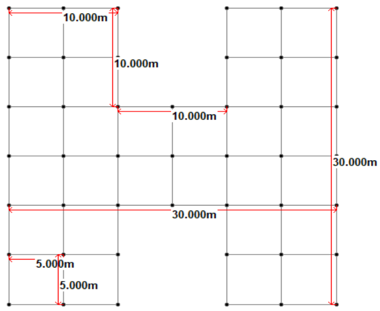

Figure2 – Plan of H-Shape building

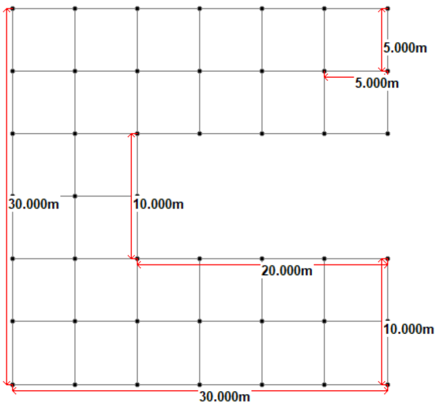

Figure3 – Plan of C-Shape building

RESULT:

1. **C SHAPE: Eigen solution for mode shapes:**

CALCULATED FREQUENCIES FOR LOAD CASE 1

MODE	FREQUENCY(CYCLES/SEC)	PERIOD(SEC)
1	0.391	2.55721
2	0.394	2.54022
3	0.423	2.36177
4	1.145	0.87332
5	1.198	0.83487
6	1.208	0.82768

2. **H SHAPE: Eigen solution for mode shapes:**

CALCULATED FREQUENCIES FOR LOAD CASE 3

MODE	FREQUENCY(CYCLES/SEC)	PERIOD(SEC)
1	0.378	2.64732
2	0.394	2.54042
3	0.418	2.38992
4	0.701	1.42606
5	1.154	0.86621
6	1.203	0.83153

3. **L SHAPE: Eigen solution for mode shapes:**

CALCULATED FREQUENCIES FOR LOAD CASE 3

MODE	FREQUENCY(CYCLES/SEC)	PERIOD(SEC)
1	0.392	2.55265
2	0.394	2.53603
3	0.404	2.47654
4	0.655	1.52662
5	0.946	1.05696
6	1.186	0.84338

7. CONCLUSION:

- Base shear in irregular shape buildings are lower and higher in regular buildings.
- From the dynamic analysis, mode shapes are generated and it is concluded that L, H & C shape building undergoes more deformation than rectangular building.
- Irregular shape building undergoes more deformation and hence regular shape building must be preferred.
- Results have been proved that C shape building is more vulnerable compare to all other different shapes.
- Response spectrum method allows a clear understanding of the contributions of different modes of vibration. It is also useful for approximate evaluation of seismic reliability of structures.

8. REFRENCES

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