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RESEARCH ARTICLE

STUDY ON SEISMIC ANALYSIS OF HIGH-RISE BUILDING BY USING SOFTWARE

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To understand the results by using software bu applying relevent Indian standarad codes.

ABSTRACT

This paper addresses the Case study on seismic analysis of high rise building system (Ground+ 3Basements+50) storey RCC by STAAD pro v8i with application of Indian standard provisions. One of the most frightening and destructive phenomena of a nature is a severe earthquake and it terrible after effect. It is highly impossible to prevent an earth quake from occurring, but the damage to the buildings can be controlled through proper design and detailing. Hence it is mandatory to do the seismic analysis and design to structures against collapse. Designing a structure in such a way that reducing damage during an earthquake makes the structure quite uneconomical, as the earth quake might or might not occur in its life time and is a rare phenomenon. This study mainly on to understanding the results from STAAD Pro v8i software under gravity loads provision made in IS 456:2000, Results shall satisfy the general criteria from being a failure after analysis Results to improve The accuracy as per IS code 1893 : 2002.

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INTRODUCTION

High-rise buildings are constructed everywhere in the world. The height and Size of high-rise buildings gets larger and larger. The structural design of high-rise buildings depends on dynamic analysis for winds and earthquakes. Since today performance of computer progresses remarkably, almost structural designers use the software of computer for the structural design of high-rise buildings. Hence, after that the structural plane and outline of high-rise buildings are determined, the structural design of high-rise buildings which checks structural safety for the individual structural members is not necessary outstanding structural ability by the use of structural software on the market. However, it is not exaggeration to say that the performance of high-rise buildings is almost determined in the preliminary design stages which work on multifaceted examinations of the structural form and outline. Traditionally, seismic design approaches are stated, as the structure should be able to ensure the minor and frequent shaking intensity without sustaining any damage, thus leaving the structure serviceable after the event. The structure should withstand moderate level of earthquake ground motion without structural damage, but possibly with some structural as well as non-structural damage.

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This limit state may correspond to earthquake intensity equal to the strongest either experienced or forecast at the site. In present study the effect of bare frame, brace frame and shear wall frame is studied under the earthquake loading. The results are studied for response spectrum method. The main parameters considered in this study to compare the seismic performance of different models are storey drift, base shear, story deflection and time period.

Objective of the work

The main objective of high rise structure:

- To analyze the building as per code IS 1893-2002 part I criteria for earthquake resistant structure.
- Dynamic analysis of the building using response spectrum method.
- Building with different lateral stiffness systems.
- To get economical and efficient lateral stiffness system.
- To control the future population.
- To deal with energy and environmental challenges.
- Development of a city.

Scope of the work

- Recently there has been a considerable increase in the number of tall buildings, both residential and commercial, and the modern trend is towards taller structures. Thus the effects of lateral loads like winds loads, earthquake forces are attaining increasing importance and almost every designer is faced with the problem of providing adequate strength and stability against lateral loads. For this reason to estimate wind load and earthquake loading on high-rise building design.

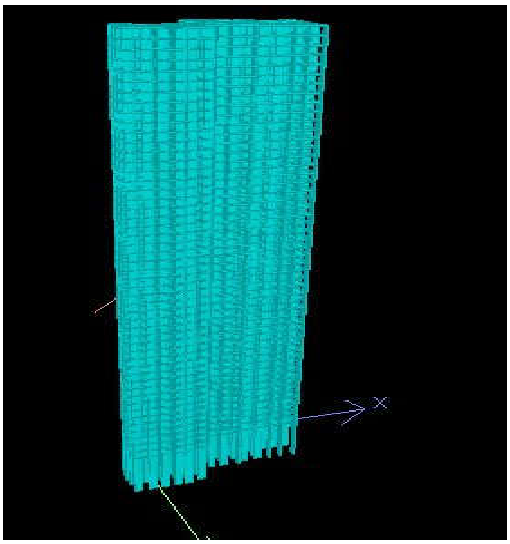
- Considering the ever increasing population as well as limited space, horizontal expansion is no more a viable solution especially in metropolitan cities. There is enough technology to build super-tall buildings today, but in India we are yet to catch up with the technology which is already established in other parts of the world.
- Many times, wind engineering is being misunderstood as wind energy in India. On the other hand, wind engineering is unique part of engineering where the impact of wind on structures and its environment being studied. More specifically related to buildings, wind loads on claddings are required for the selection of the cladding systems and wind loads on the structural frames are required for the design of beams, columns, lateral bracing and foundations. Wind in general governs the design

MATERIALS AND METHODS

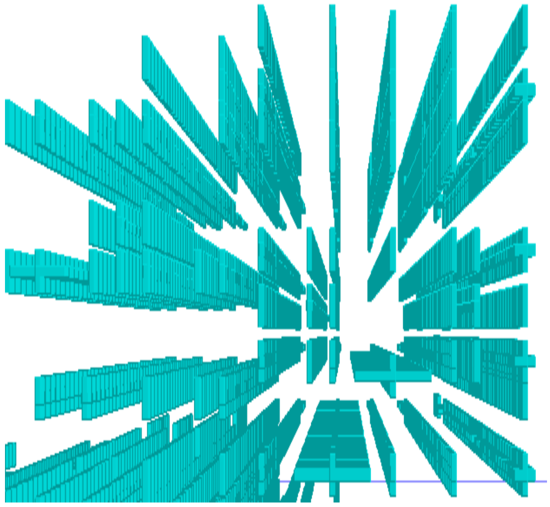
A. Framing of plan

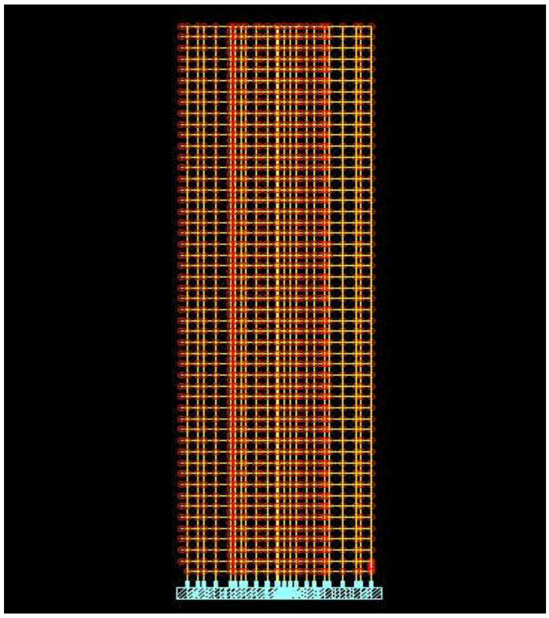
Plan that will require in order to analyse the respective structure as for understanding the result properly as height goes above further practices create complications for that proper biferfication is necessary with proper practices

G+3B+50
STOREY



Key Plan Model





Long walls skeletal structure

B. Input loading

Dead load and live loads (AS PER IS 875 PART II , IS 1893:2002)
Load descriptionvalue/units

Superimposed load on each floor

- Live load2 Kn /m^2
- 230 mm thickness external wall 13.12Kn/m
- 115 mm thickness internal wall 6.6 KN/M Additional service load over roof top
- Water proofing load3 Kn /m^2
- Live load2 Kn/m^2
- Service load5 Kn/M^2 Material properties

Concrete: - M40 N/mm^2,

Steel: 500 N/MM^2

Concrete density: - 25, Kn/ m^3: brick work - 22 Kn/ m^3
Load combination will be as per IS 1893:2002 PART 1

For general RCC purpose will be as per IS 456:2000

Site details

Seismic zone: - 4 (as per IS 1893:2002 fifth revision)
City: - Mumbai, Maharashtra region
Floor height = 3m

Load combinations that been considered As per IS

1893:2002 PART 1
1.1.5 (DL + LL)
2.1.2 (DL + LL + EQ X)
3.1.2 (DL + LL - EQ X)
4.1.2 (DL + LL + EQ Z)
5.1.2 (DL + LL - EQ Z)
6.1.5 (DL - EQ X)
7.1.5 (DL + EQ X)
8.1.5 (DL + EQ Z)
9.1.5 (DL - EQ Z)
10.0.9 DL + 1.5 EQ X
11.0.9 DL - 1.5 EQ X
12.0.9 DL +1.5 EQ Z
13.0.9 DL -1.5 EQ Z

Reaction will be consider for worse load combination in analysis while designing vertical structural member (column / shear wall)

C. Calculations

As per clause 7.8.1 Dynamic analysis shall be performed to obtain the design seismic force, and its distribution to different levels along the height of the building and to the various lateral load resisting elements, for the following buildings:

In this study, G+3B+50 storied RC Building has been analyzed using the response spectra method in STAAD-Pro. The plan and elevation of the building taken for analysis is shown in above images. In the earthquake analysis along with earthquake loads, vertical loads are also applied. For the earthquake analysis, IS 1893-2002 code was used .The total design seismic base shear (Vb) along any principal direction shall be determined by multiplying the design horizontal acceleration in the considered direction of vibration (Ah) and the seismic weight of the building.

The Design base shear

(Vb) = Ah x W [IS 1893(Part I):2002, clause 7.5.3]

Ah = design horizontal acceleration in the considered direction of vibration =

(Z/2) x (I/R) x (Sa /g) [IS 1893(Part I):2002, clause 6.4.2]

W = total seismic value of the building

The design base shear (Vb) computed shall be distributed along the height of the building as per the following expression (BIS1893: 2000)

$$Q_i = V_B \frac{W_i h_i^2}{\sum_{j=1}^{n} W_j h_j^2}$$

[IS 1893(Part I):2002, clause 7.1.1]

Where,
Qi is the design lateral forces at floor i,
Wi is the seismic weights of the floor i, and
Hi is the height of the floor i, measured from base

Design seismic load

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 empirical expression:

Ta = 0.09 h /√d

[IS 1893(Part I):2002, clause 7.6.2]

Calculating value

In X direction for, Ta (d= 53.09 meter)

Ta = 0.09 x 150 / √53.09 = 1.852 seconds

In Z direction for, Ta (d= 20.65 meter)

Ta = 0.09 x 150 / √20.65 = 2.970 seconds

NOW,

Zone factor, Z = 0.24 for seismic zone IV
[IS 1893(Part):2002, table 2]

Importance factor, I = 1.0 table 6

Response reduction factor, R = 5.0 (SMRF – special moment resisting frame)

Soil type = medium soil

Damping % ratio = 5 % (assume)

For Sa / g value,

1.36 / Ta(X direction)= 1.36 /1.852 = 0.734 seconds
1.36 / Ta(X direction)= 1.36 /2.970 = 0.457 seconds

Value of Ah from above expression could we get,

Ah = 0.0176 (In x direction) ; Ah = 0.0109 (In z direction)

Therefore,
W = 100 % DL + 25 % LL .... Seismic weight of building

W = 680245.43 KN

Then,
Vb = Ah x W .... base shear
Vb = (Z/2) x (I/R) x (Sa /g) x W
= 0.0176 x 680245.43
= 11972.31 KN (x direction)
&

Vb = (Z/2) x (I/R) x (Sa /g) x W
= 0.0109 x 680245.4 = 7414.67 KN (z direction)

Conclusion

In our Case study we found that in table no.1.3 due to unsymmetrical of building geometry modes are not resisting 90 % as its satisfying in X direction successfully after carried out 300 iteration of analysis in such case cut off mode must be add in it & need to check either stiffness of building shall be increase or not. In table no. 1.4 after carried results of 6 modes the building seismic weight was found to be as 3.559350×10^4 KN. As we can see from table no. 1.1 the maximum story shear was found to be at the base as 10326.45 KN. Another important term clause like 7.8.2 from IS 1893:2002 (PART 1) The multiplying factor of static and dynamic equilibrium in X & Z direction was found to be vb/VB) = 11973 / 5363.64 = 2.23 (X direction) where as in z direction are , (vb/VB) = 7414 / 4882.47 = 1.51 (Z direction). Meaning of adopting tall building for Response spectra analysis is to study the results by using staad pro software with provision of IS 1893:2002 (PART 1) successfully and it is studied. Seismic analysis with Response Spectrum Method with CQC method are used for analysis of a 3Basement + Ground + 50 story RCC high rise building as per IS 1893(Part1):2002.

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