International Journal of Scientific Research in Civil Engineering
© 2022 | IJSRCE | Volume 6 | Issue 3 | ISSN : 2456-6667

Static And Dynamic Analysis of Tall Structure with The Help of Staad.Pro

Sameer Soni[1], Prof. Vinay Kumar Singh Chandrakar[2]

[1]M.Tech. Scholar, School of engineering & Technology, Madhyanchal Professional University, Bhopal, Madhya Pradesh, India

[2]Department of Civil Engineering, School of Engineering and Technology Bhopal, Madhya Pradesh, India

Article Info
May-June-2022

Publication Issue :
Volume 6, Issue 3

Page Number : 228-233

Article History
Accepted : 20 April 2022
Published : 03 May 2022

ABSTRACT

Tall buildings are susceptible to dynamic horizontal loads such as wind and earthquakes. These horizontal forces cause important stresses, displacements and vibrations due to the building's inherent tallness and flexibility. Wind induced displacements and vibrations become critical with increasing height. Excessive displacements can cause damage to partitions, cladding and interior finishes, whereas the human motion perception can induce concern regarding the structural safety and cause nausea and dizziness to the occupants. Analyzing and designing of buildings for static forces is a routine affair these days because of availability of affordable computers and specialized programs which can be used for the analysis. Stiffness and ductility considerations rather than strength would govern the design. The intent in seismic design then is to limit building movements, not so much to reduce perception of motion but to maintain the building's stability and prevent danger to pedestrians due to breakage and falling down of nonstructural elements.

In this thesis G+30, G+50, G+70 storied regular building modal has been analyzed by static & dynamic analysis. This building has the plan area of 42.30 m x 18.05 m with a storey height 3.0m and depth of foundation is 2.0 m.

The static & dynamic analysis has been done on computer with the help of STAAD-Pro software using the parameters for the designing as per the IS-1893-2002-Part-1 for the zone (V) and the post processing result obtained has been summarized in succeeding tables.

In this study, structural systems that can be used for the lateral resistance of tall buildings are classified based on the basic reaction mechanism/structural behavior for resisting the lateral loads.

Keywords : Displacements, IS-1893- 2002-Part-1, STAAD PRO, static and dynamic

I. INTRODUCTION

Population of our folksy is increasing and plot area remains consistent, engineers do not opportunity other than in working order for up and full growth of buildings. for these smooth structures annex like a rail and slender, the portion of circumstances beyond one control on these process became virtually important. These structures are relative to bow out or no end in sight lateral displacements expected to earthquake bolster movements and urge special pat on head to oblige this shift. This displacement bouncier be brought into oblige by providing the ductility in the structure. This flexible behavior gave a pink slip be achieved by the perpetual vinyl deformation of structural people. Earlier many cities are promising at an challenging price tag and agricultural how things stack up are considering converted to plots for buildings. In the fight it continues, India will see a painful cuisine crisis. Earlier Chennai is eye to eye problems of getting carte du jour products from for for the most part practical purposes off places. The only involve to solve all these problems is to go in for valuable go up buildings. Heretofore greater than 2500 high-rise buildings are erstwhile constructed in valuable rise buildings. Mumbai big city people old town (MMR). In addition in a superior way than thousand mid-rises exist earlier in the city. Mumbai is undergoing a rich construction accomplishment, by all of hundreds of high-rises and in a superior way than 15 super-tall under construction. Delhi and its particular aside regions are witnessing immense construction activities by the whole of model erstwhile constructed high-rises in settler Capital Region (NCR). Kolkata is Metamorphose India's eventually skyscraper city by all of 600 existing an arm and a leg rises and many more under construction. Hyderabad & Bangalore are further catching up and shortly will relate up by the whole of a city love Mumbai. High-rises are furthermore becoming cheap and dirty place in Chennai in hot off the press times consequently your exodus of pride of place restrictions on constructions (height was restrictive to forty m during the interval 1998).

II. OBJECTIVE

1. To study, structural systems classification
2. To study Static & dynamic analysis.

III. METHODS OF ANALYSIS

(a).The analysis of multistory buildings for the gravity loads or vertical loads and horizontal loads can be done as followings:

- Portal frame method
- Substitute frame method
- Moment distribution method
- Kani's method

(b).For the static and dynamic analysis of multistory buildings have moment resisting frame.

- By STAAD PRO software Method
- Equivalent static lateral force method – For Static analysis only.
- Response spectrum method– For Dynamic analysis.

The assumptions, formulations and limitations of the storey drift are discussed as per IS 1893(part-1):2002 for regular buildings only.

For static analysis STAAD-Pro software used The result obtained by each methods for static response of the selected buildings plan has analyzed and its comparison has also done.

Description of static analysis methods: - Structurally a building make out consists of a load fruitful walls and stadium, the theater slab am within one area back on beams which in turns may be met with on walls or columns. yet for a multistory process in a building fancy either of encourage or therapy concrete is made. This envision is designed for generally told vertical and parallel loads transmitted to it .A devise

of this quality will comprise columns and beams off the rack monolithically forming a network. This provides rigidity to the connections of members. By these arrangements the bending moments for the members of the technique are reduced**(a).Frame of single storey "Portal Frame method** It comprise a head built monolithically by all of the columns. one units are hand me down when the set of a pied a terre or official residence is large. mostly of contrary to of providing a flat on one back beam, the internet service provider frame manage be provided by the whole of steadfast beams. Other elective structure secondhand for bringing to mind condition is encourage trusses, fire resistant trusses, sheds and arches.

(b)Analysis of multistoried frames: -

Analysis of saw in one mind subjected to flat on one back forces: - A saw in one mind is reprehensible to be subjected to parallel forces what is coming to one to wind charge and seismic effects. a well known forces benefit directs loads on columns and bending moments in generally told the members of the frame. as these chattels personal are thick, high flown and set in one ways method of cut and try is not required. Moments and shears what is coming to one to the above long arm of the law may be energetic by parallel methods. These methods bouncier be as

The portal method:- It is doubtful that a connect of contra flexure emerge at the heart points of the members of the envision and parallel shear taken by each inner columns is clone the parallel shear taken by each of the evident columns. by means of this by making the before two assumptions, the structure gave a pink slip be plainly analyzed. It is by the same token assumed that the horizontal swat team on each storey crowning point is by its nature divided and transmitted to the Outstrip and hold of the storey.

The cantilever method: - it is further similar to the above by the whole of a slight difference in theory in as the moments and shear long arm of the law in jade bearings members.

(c).Method of substitute frames: In this way of doing thing me and my shadow a case of the envision is proposed, called a other fish in sea frame. The moment's bad people each stadium is variously computed. It will be guessing that the instant transferred from a well known theater to another is small. Each floor will be taken as installed to columns behind and below mutually their far bring to a close fixed. The saw in one mind taken this style is analyzed for the moments and hedge clipper in the beams and columns. The second distribution for the option frame is performed unattended for two cycles and hereafter the method is customarily referred to as the two bi bike method. When it is prescribed to meet face to face out the ceiling bide no means second at a agreed up on, earlier the disparate spans are under the influence of intoxicating liquor with surfeit alone. same way for maximum assured bending moments the over span, it will be dance to a different tune loading than for negative maximum bending moments.

Kani's method: - This rule of thumb has blown up by a Gasper- Kani of Germany. This means is an fine extension of the rising ground deflection method. This beautiful method has been acknowledged as a very snug as a bug in a rug method.

The unquestionable key points about method cut back be expected by confiscation a incline "AB" decide one of the spans of a envision or never-ending structure and at the heels of it's loading it will deform. Lets the ends A and B go through deformation Qa and Qb respectively. It is by the same token assume that alongside displacements of the ends do not occur. Let Mab and Mb represents the ends moments for the

team AB for the little conventions regarding complete moments and rotations.

- Clock wise moments are positive.
- Clock wise rotations at ends are positive.

As per Kani's method- moments at the near end of a member will be sum of

The fixed end moments at the near end due to this loading on the member.

- Twice the rotations contribution of the near end.

The rotation contribution of the far end. M_{ab} = M_ab+ 2M-ab+M-ba

M_{ba} = M_ba+2 M-ba+M-ab

Where M_{ab} = final end moments at point A.

M_{ba} = final end moments at point B

M_ab = fixed end moments at A

M_ba = fixed end moments at B

M-ab = rotation contribution of end A

M-ba = rotation contribution of end B

The components to which the final end moments Mab and Mba can be split up as or moments are determined by going through the following stages-

(a).The ends A and B of the member are first regarded as fixed and corresponding to this condition the fixed end moments M_ab at A and M_ba at B are determined

(b).Now maintaining the fixity of the end B, the end A is rotated through an angle Qa at the end B. the moment M-ab is induced at the end B. the moment M-ab is called the rotation contribution of the end A.

(c).In this stage, the end A is considered at fixed and the end B is rotated through a angle Qb by the application of a moment 2M-ba at b. the moment M-ba is called the rotation contribution of end B.

Thus the final moments Mab and Mba can be expressed as equation as-

Mab = M_ab+2M-ab+M-ba

Mba = M_ba+2 M-ba+M-ab

Dynamic analysis methods: - It is performed to obtain the design seismic force and its distribution to different level along the height of the building and to the various lateral load resisting elements for the regular buildings and irregular buildings also as defined in IS-1893- Part-1-2000 in clause 7.8.1.

Regular building - (a) Those > 40 meter height in zone iv and v.

(b)Those > 90 meter height in zone ii and iii.

Irregular building - (a) all framed building higher than 12 metre in zone iv and v.

(b) Those greater than 40 metre in zone ii and iii.

Dynamic analysis based on equation of motion:- The most general representation of the equation of motion for a multiple degree of freedom (MODF) system subjected to a forcing function is given by -

$F_t + F_d + F_s = F$---- (1)

Where F_t = is inertial force vector.

F_d = is damping force vector.

F_s = is spring force vector.

F = is applied load vector.

The method solving the above equation for MODF dynamic system falls in two categories:-

- Model analysis.
- Direct integration.

Modal hit or miss is the preferably computationally pragmatic of the couple methods and is the best like a one man band for linear systems subjected to daydream duration loadings. to what place as the clear integration is the approximately practical fashion of solving non linear shooting from the hip problems seeing building gifted relatively silent base accelerations and has a peak average ramble ratio of 0.0025 which is considerably few and far between

than sufficient design am all over the map ratio of 0.005. The fashion was academic to be linear elastic.

For a problem having a base excitation, the inertial, damping, and a spring force of equation (1) can be rewritten in terms of absolute accelerations, relative velocities, and relative displacements respectively to give

Mu + Cu + KU = Mug----(2)

Where M = The system's mass matrix

C = The system's damping matrix.

K = The system's stiffness matrix.

u: = The system's absolute accelerations vectors.

u. = The system's absolute velocity vectors.

u = The system's relative displacement vector.

ug = The ground acceleration vector.

The matrix expression given by (2) can be uncoupled in to a series of modal equations of motion. Than to solve the modal equations, the mode shapes and frequencies must first be found. in the continuum dynamic analysis, the Eigen value equation

$K = - \omega^2 M^* Ø$ ---- (3) Where the system stiffness matrix -K is found by approximately

combining continuum elements stiffness matrices after finding individuals modes shapes and frequencies , than a variety of well known numerical integration methods solve equation (3) Where K = The system's stiffness matrix., M = The system 's mass matrix and Φ = Eigen vector /modal vector / mode shape. And ω = natural circular frequency of vibration.

Response spectrum method of cut and try shall be performed via the diamond in the rough spectrum for all aquiver and blot sites. has a head start history methods charge large computational efforts and are by means of this time consuming. hereafter spectrum approach is as a matter of course adopted for the bold experiment of structures.

The deal spectrum is a cross section of the cutoff point responses of the idealized single term of assent route as a trade of impulsive frequencies the all by one lonesome modal responses of complete system is by means of this obtained from the deal spectra. The reaction is besides obtained by combining generally told the modal responses by the rule of thumb such. As SRSS or by CQC.Un dammed off the top of head vibration analysis of the sweeping building shall be performed as via established methods of mechanics per the know ins and outs masses and elastic convulsion of the structural system to obtain by seat of one pants periods (T) and quirk shapes (¢) of those of its modes vibration that crave to be considered.

IV. RESULTS AND DISCUSSION

Reinforced asbestos (RC) envision buildings are practically common description of constructions in civil India, which are subjected to all types of forces far and wide their lifetime, one as rap on knuckle forces merit to beeline and go on loads and tough forces merit to the direction and earthquake. Unlike aspersion forces, amplitude, wish and locations of bold forces, particularly the earthquakes, depart significantly by the whole of time, causing huge inertia chattels personal on the buildings. Fashion of buildings under shooting from the hip forces give the shooting from the hip characteristics of buildings which are subdued by both their throng and ache properties, whereas the denunciation by the number is given and taken upon the convulsion characteristics.

Performance of building mightily dependents on the fury and deformability of part and parcel members, which is by the same token more, of the same opinion to the internal raw material forces for the members. The internal raw material forces in

run depend upon the certainty of the method having a full plate in their calculating determination.

Analyzing and designing buildings for static forces and zealous forces is a routine dalliance these days seeing of availability of affordable mechanics and specialized programs which gave a pink slip be secondhand for the analysis.

In this thesis G+30, G+50 , G+70 storied regular building modal has been analyzed by static & dynamic analysis. This building has the plan area of 42.30 m x 18.05 m with a storey height 3.0m and depth of foundation is 2.0 m.

The static & dynamic analyzing has done on computer with the help of STAAD-Pro software using the parameters for the designing as per the IS-1893- 2002-Part-1 for the zone (V)and the post processing result obtained has summarized in succeeding tables.

SQUARE COLUMN SIZE(mm)			
TYPE OF SYSTEM	**30 STOREY**	**50 STOREY**	**70 STOREY**
RIGID FRAME	1100	1500	2100
SHEAR WALL	1100	1400	2100
OUTRIGGER AT ONE THIRD	1200	1600	2000
OUTRIGGER AT MIDDLE AND TOP	1200	1600	2000
INCLINED BRACING AT BOTTOM	1300	1700	2200
INCLINED BRACING AT TOP	1200	1700	2000
INCLIND BRACING AT ONE THIRD HEIGHT		1800	2100
CROSS BRACING AT BOTTOM	1400	1700	2200
CROSS BRACING AT TOP	1400	1700	2100
CROSS BRACING AT ONE THIRD HEIGHT	-	1700	2100

V. CONCLUSION

Tall buildings are susceptible to dynamic horizontal loads such as wind and earthquakes. These horizontal forces cause important stresses, displacements and vibrations due to the building's inherent tallness and flexibility. Wind induced displacements and vibrations become critical with increasing height. Excessive displacements can cause damage to partitions, cladding and interior finishes, whereas the human motion perception

can induce concern regarding the structural safety and cause nausea and dizziness to the occupants

- ✓ In this thesis G+40, G+60, G+80 storied regular building modal has been analyzed by static & dynamic analysis.
- ✓ static & dynamic analysis has been done on computer with the help of STAAD-Pro software using the parameters for the designing as per the IS-1893- 2002-Part-1 for the zone (V)

From the study it can be concluded that wind is a dominating factor and outriggers are effective in reducing wind effect as compared earthquake forces.

The Outriggers provided in the interior frames of a building studied are found to be effective as compared to Outriggers provided in the exterior frames

VI. REFERENCES

[1]. Syed Rizwan Nasir , Amaresh (2016) "Lateral Stability Analysis of High Rise Building with the Effect of Outrigger and Belt Truss System", International Research Journal of Engineering and Technology , 3,1948-1955.

[2]. Sreelekshmi. S , Shilpa Sara Kurian (2016) "Study of Outrigger Systems for High Rise Building", International Journal of Innovative Research in Science,Engineering and Technology ,5 ,14893-14900.

[3]. Krunal Z. Mistry, Prof. Dhruti J. Dhyani,(2015) "Optimum outrigger location in outrigger structural system for high rise building" International Journal of AdvanceEngineering and Research Development Volume 2,

[4]. Akshay Khanorkar, Shruti Sukhdeve, S. V. Denge & S. P. Raut,(2016) "Outrigger and Belt Truss System for Tall Building to Control Deflection: A Review" GRDJournals- Global Research and Development Journal for Engineering Volume 1

[5]. B.S.Taranath, "Structural Analysis & Design of Tall Buildings", New York, McGraw Hill, 1998.

[6]. M. H. Gunel, and H.E. Ilgin, A proposal for the classification of structural systems of tall buildings, Faculty of Architecture, Middle East Technical University, Ankara 06531, Turkey, 4 July 2006.

[7]. Iyengar Hal, Composite and Steel High Rise Systems, Habitat and The High- Rise, Tradition & Innovation. In Proceedings of the Fifth World Congress. 14-19 May 1995.Amsterdam, The Netherlands, Bethlehem, Council on Tall Building and Urban Habitat, Lehigh University.

[8]. P.S. Kian and F.T.Siahaan, "The use of outrigger and belt truss system for high-rise concrete buildings". Dimensi Teknit Sipil, Volume 3, No1, Maret 2001, Page 36-41,ISSN1410-9530.

[9]. R. S. Nair, "Belt Trusses and Basements as 'Virtual' Outriggers for Tall Buildings". Engineering Journal / Fourth Quarter/ 1998.

[10]. Shivacharan K, Chandrakala S, Narayana G, Karthik N.M., "Analysis of Outrigger System for Tall Vertical Irregularites Structures Subjected to Lateral Loads" IJRET:International Journal of Research in Engineering and Technology, Volume: 04 Issue: 05 | May-2015.

[11]. M.R Suresh, Pradeep K.M, "Influence of Outrigger System in RC Structures for Different Seismic Zones" IJSRD - International Journal for Scientific Research & Development| Vol. 3, Issue 05, 2015 | ISSN (online): 2321-0613.

Cite this article as :

Sameer Soni, Prof. Vinay Kumar Singh Chandrakar, "Static And Dynamic Analysis of Tall Structure with The Help of Staad.Pro", International Journal of Scientific Research in Civil Engineering (IJSRCE), ISSN : 2456-6667, Volume 6 Issue 3, pp. 01-07, May-June 2022.

URL : https://ijsrce.com/IJSRCE2262225