International Journal of Advance Research in Science and Engineering
Volume No.07, Issue No.10, October 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

THE STABILITY OF HIGH RISE BUILDINGS

Mohd Zeeshan[1] , Mohd Sadiq[2] , Masoom Mazhar[3] , Ahsan Khan[4]

[1,2,3,4]*(Civil Engineering, NIET, Greater Noida, Uttar Pradesh, India)*

ABSTRACT

This paper summarizes the concept of stability for the high rise mega structures affected by the seismic and wind activities happening at the bottom or at the certain height. Since, the high rise buildings are to be made in such a manner that they can bear the wind loads and seismic forces. The building with discontinuity in the stiffness and mass subjected to concentration of forces and deformations at the point of discontinuity which may leads to failures of members at the junction and collapse of building. The method used for stability analysis of columns, shears walls, coupled and coupled components, cores, single storey and multi storey structures are studying. Buildings and structures are consider stable with lateral supports by using either bracing systems or shear system or both such as wall to ensure the stability of the building. There have been so many cases in which the structures failed due to instability which require P-Delta analysis. One of the problems is affected from wind load. The calculation methods are computer assisted through the use of the software, ETAB/SAP2000. Comparisons of results are made between the methodologies, software and different models with different parameters. The P-Delta Analysis of the walled framed structure is done by use of the software.

KEYWORDS – *high rise buildings, P-delta analysis, stability of high mega structures, seismic forces & wind loads.*

I. INTRODUCTION

Emporis standards define a high rise building as “A multi-storey structure between 35-100 meters tall, or a building of unknown height from 12-39 floors”. The international conference on fire safety in high rise buildings defined a high rise as “any structure where the height can have a serious impact on evacuation. Whereas, from a structural engineer’s perspective, a building is considered tall when, due to its height the lateral forces suffered by the structure play a significant role in the design.

1.1 General

The increase in demand for tall structures requires that a structural engineer is familiar with the buckling phenomena that can occur in a building. The engineer must have an understanding of working calculation methods for designing this type of structure and must having confident in using them. From the past earthquake it has been observed that a building with discontinuity in the stiffness and mass subjected to concentration of forces and deformations at the point of discontinuity which may leads to the failure of members at the junction and collapse of building. Most economical way to eliminate the failure of soft storey is by adding shear walls to the tall buildings.

2.1 Stability

The resistance offered by a structure to undesirable movement like sliding, collapsing and over turning etc. is called stability. Stability depends upon the support conditions and arrangements of members. Stability does not depend upon loading Structural stability can also be defined as "The power to recover equilibrium". It is an essential requirement for all structures.

Stable structure: A structure is said to be stable if it can resists the applied load without moving or a structure is said to be stable if it has sufficient number of reactions to resists the load without moving.

Unstable structure: A structure which has not sufficient number of reactions to resists the load without moving is called unstable structure.

2.2 Stability of frames:

A frame is said to be stable if the number of unknown reactions must be greater than or equal to available equations of equilibrium. Stability is a field of mechanics that studies the behavior of structures under compression. When a structure is subjected to a sufficiently high compressive force or stress, it will have a tendency to lose its stiffness, a noticeably change in geometry, and becomes unstable. When instability occurs, the structure loses its capacity to carry the applied loads and is incapable of maintaining a stable equilibrium configuration.

3.1 Stability Analysis of Steel Frame Structures

P-Delta Analysis

MallikarjunaB.N and Prof .Ranjith A. focused on P-delta analysis to be compared with linear static analysis. An 18 storey steel frame structure with 68.9m has selected to be idealized as multi storey steel building model is to taken for their research. The model is analyzed by using STAAD Pro 2007 structural analysis software with consideration of P-delta effect. At the same time the influence of different bracing patterns has been investigated. The steel brace are usually placed in vertically aligned spans. This system allows obtaining a great increase of stiffness with a minimal added weight, so it is very effective for existing structure for which the poor lateral stiffness. The loads considered for the analysis are Gravity load, Live load and Wind load. The frame structure is analyzed for Wind load as per IS875 (part 3)-1987. After analysis, the comparative study is presented with respective to maximum storey displacement and axial force.

4.1 Wind effects on structures

Wind effects on structures can be classified as:

Static- static wind effect primarily causes elastic bending and twisting of structure.

Dynamic- for tall, long span and slender tentures a 'dynamic analysis' of the structure is essential. Wind gusts cause fluctuating forces on the structure which induce large dynamic motions, including oscillations.

4.2 Stabilizing the structure against wind loads

Wind is essentially the large scale horizontal movement of free air. It plays an important role in the designing of tall structures because it exerts loads on building. It is a phenomenon of great complexity because of the many flow situations arising from the interaction of wind with structures.

5.1 Seismic effects on high rise buildings

When earthquakes occur, a building undergoes dynamic motion. This is because the building is subjected to inertia forces that act in opposite direction to the acceleration of earthquake excitations. These inertia forces, called seismic loads, are usually dealt with by assuming forces external to the building. Time histories of earthquake motions are also used to analyze high-rise buildings, and their elements and contents for seismic design. The earthquake motions for dynamic design are called design earthquake motions. In the previous recommendations, only the equivalent static seismic loads were considered to be seismic loads. In ISO/TC98 which deals with "bases for design of structures", the term "action" is used instead of "load" and action includes not only load as external force but various influences that may cause deformations to the structures. In the future, "action" may take the place of "load".

5.2 Stabilizing the structure against seismic forces

The seismic performance of high-rise buildings is assessed in the present study through fragility relationships. Different approaches can be used to derive fragility functions (e.g. Rossetto and Elnashai 2005). The approach of generating damage data through analytical simulations is the most realistic option, particularly for the UAE, and hence it is adopted in the present study (Mwafy 2012). Several techniques for deriving vulnerability curves based on the numerically simulated structural damage statistics have been also proposed in the literature, with diversity in structural idealizations, analysis methods, seismic hazard and damage models. Most of these techniques require a large number of analyses to account for uncertainty. This is particularly true when adopting multi-degree-of freedom inelastic dynamic simulations for deriving the vulnerability relationships, which is the approach adopted herein. The present study aims at investigating the relationship between seismic performance and cost-effectiveness of tall buildings through designing and developing detailed simulation models for high-rise buildings with various concrete grades, ranging from 45 to 110 MPa. The construction cost is compared in terms of steel, concrete and formwork. Over 1600 inelastic pushover analyses (IPAs) and incremental dynamic analyses (IDAs) are performed using 20 natural and artificial earthquake records to derive vulnerability relationships and to provide insights into the seismic response of the reference structures up to collapse.

CONCLUSION

The most important factor in the designing of high rise buildings however is the building's need to withstand the lateral forces imposed by the winds and potential earthquakes. Most high-rises have frames made of steel or steel and concrete. Their frames are constructed of columns (vertical support members) and beams (horizontal support members). Cross-bracing or shear walls maybe used to provide a structural frame with greater rigidity in order to withstand wind stresses.

The shear force and bending moments are higher for ground storey columns with respect to first storey column. Behavior of square column is better than rectangular column, in terms of storey drift, base shear & roof displacement. The shear walls are used to eliminate the lateral load and soft storey effects, when the shear walls are kept centrally it is not affected much on the behavior of structures. The effect of masonry infill's in the structures increases the stiffness of the structural element

REFERENCES

[1] IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 pISSN: 2321-7308 Stability Analysis of Steel Frame Structures: P-Delta Analysis.

[2] The Tall Buildings Reference Book by David Parker and Antony Wood.

[3] Reinforced concrete design of tall buildings by Dr.bangale S.taranath

[4] Stability of Tall Buildings, DaivdGustafsson& Joseph Hehir Department of Civil and Environmental Engineering Master's Thesis 2005:12 Division of Structural Engineering Concrete Structures, Chalmers University of Technology Goteborg, Sweden 2005.