



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 11, November 2022

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.118

9940 572 462

6381 907 438

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Seismic Performance Evaluation of Industrial Junction Tower

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ABSTRACT:The Industrial towers carry heavy loads at a sufficient and safe height from ground. In addition to their self-weight, they have to withstand all forces of nature like strong wind, earthquake and snow load. Therefore, Industrial towers should be designed considering both structural and electrical requirements for a safe and economical design. A model of the Industrial towers used effective element types on various components of Industrial towers for static and dynamic analysis. Further determine the static response and corresponding stress resultants of Industrial towers structure one static instant time on vertical and transversely position of Industrial towers using ETABS. Also studied free vibrational or modal analysis characteristics of the transmission tower by determine the frequencies and mode shapes of transmission tower using ETABS and validating the finite element-based results with closed form solution. At last elaborate study on the transient dynamic analysis of transmission tower using ETABS with emphasis on the evaluation of dynamic response of transmission tower due to time varying wind load with various wind velocity like displacement and axial force.

KEYWORDS:Seismic Evaluation, Industrial Tower, Junction Tower.

I. INTRODUCTION

Earthquakes have occurred on our planet since the beginning of time. During a building's existence, it may be subject to earthquakes, which are otherwise a very uncommon force. The succession of vibrations is generated when lateral forces go through the ground. As a result of these oscillations, the earth and any buildings built upon it are subjected to dynamic loads or inertial forces that cause them to vibrate in a very intricate pattern. Structures might be damaged by these dynamic loads or inertial forces. Static (gravitational) and dynamic loads (such as wind load) are designed to be withstood elastically in the typical design method in places where seismicity is minor. However, if this design strategy is mandated in a situation where seismic excitation has to be considered, this might lead to energy inefficient and economically unfeasible design choices. The result of adopting such a tactic is increased mass and thus, seismic activity. Seismic design is based on the use of building methods, kinds, and criteria for constructing earthquake-prone buildings. The building might fall or be destroyed due to its inadequate seismic architecture. Structures are constructed to withstand the types of earthquakes that are expected to occur at the site of construction in compliance with applicable building rules to minimize the risk of collapse. Using seismic design, architects can ensure that structures are robust enough to withstand earthquakes without suffering damage. The ground, which is necessary before the structure type, the placement of the structure, and the application of seismic design and criteria, is the most fundamental necessity of seismic designs. The term "seismic resistant construction" describes the practice of using seismic design and building rules to create buildings that are resilient to earthquakes.

II. RELATED WORK

K.G. Vishwanath (2010) Publication in the International Journal of Civil and Structural Engineering (2010) on "Seismic reaction of Steel braced Reinforced Concrete Frames." As per IS 1893:2002, a four-story structure was photographed in a seismic zone 4 area. Story drift is used as a performance metric for buildings. The investigation is then expanded to include a total of eight and twelve stories. The most effective steel bracing is X, as determined by this study.

Seismic Analysis of High-Rise Steel Frame Building With and Without Bracing is the subject of study by K.K. Sangle, K.M. Bajori, and V. Mhalungkar (2012). The purpose of this research was to evaluate the effectiveness of seismic analysis for high-rise steel buildings with and without bracing systems. The study's findings, based on a time-history



analysis, indicate that earthquake-induced structural behaviour may be significantly altered by the addition of bracing elements.

III. METHODOLOGY

Linear static analysis

Usually this is the result of the dynamic phenomenon of the structure that undergoes an earthquake. This dynamic analysis is not often used as it is complex and time-consuming method in daily design. Most structures undergoing seismic forces are designed with the idea that the building is strained into the inelastic range.

Linear dynamic analysis

Static procedure is used only for short building, hence for tall structures having nonorthogonal or torsional irregularity the dynamic method of analysis is preferred. the seismic input is modelled, but in both cases by using linear elastic analysis the corresponding displacement and internal forces are determined. As compared to that of linear static procedure of analysis high modes can be used in case of linear dynamic analysis procedure.

Response spectrum analysis

This method makes use of damping level and time history to measure pseudo spectral acceleration, displacement or velocity to provide dynamic behaviour of a structure. For each structural period experienced by the structure there is a smooth curve on that gives peak response in a response spectrum for the dynamic response this method is related with the type of the structure selection this method is useful for the decision making for the design of a structure. This method requires many building codes except for simple structure or complex structure.

Non-linear static analysis

This method which can also known as an analysis of the push over. It defines the capacity curve. It includes the pattern of forces. These forces are applied to the structure comprising of properties which are nonlinear in nature. Then the total applied forces are plotted against a reference displacement.

Non-linear dynamic analysis

This method is a combination of structure and ground motion details and so that this method affects the less uncertainty. In this way of analysis, some of the majority of the analysis requires some codes for the generalization of the ground motion. To achieve structural response several different ground motion records are needed.

IV. EXPERIMENTAL RESULTS

1) DISPLACEMENT ALONG X AXIS

MODEL	X IN MM
ZONE 4	2.298
ZONE 5	3.446

In this Junction Tower Model in X direction in Displacement Loads Results for the model at Zone 4 and Zone 5 as we can clearly see the Displacement Increases with the increase of the Zone also. Hence Zone 4 is the safer Zone for this Model for the consideration of the Displacement along X Direction.

2) DISPLACEMENT ALONG Y AXIS

MODEL	Y IN MM
ZONE 4	3.321
ZONE 5	4.981

In this Junction Tower Model in Y direction in Displacement Loads Results for the model at Zone 4 and Zone 5 as we can clearly see the Displacement Increases with the increase of the Zone also. Hence Zone 4 is the safer Zone for this Model for the consideration of the Displacement along Y Direction.



3) STOREY SHEAR ALONG X AXIS

MODEL	Y IN MM
ZONE 4	4.0898
ZONE 5	6.1347

In this Junction Tower Model in X direction in Story Shear Loads Results for the model at Zone 4 and Zone 5 as we can clearly see the Story Shear increases with the increase of the Zone also. Hence Zone 4 is the safer Zone for this Model for the consideration of the Story Shear along X Direction.

4) STOREY SHEAR ALONG Y AXIS

MODEL	Y IN MM
ZONE 4	5.3894
ZONE 5	5.3894

In this Junction Tower Model in Y direction in Story Shear Loads Results for the model at Zone 4 and Zone 5 as we can clearly see the Story Shear increases with the increase of the Zone also. Hence Zone 4 is the safer Zone for this Model for the consideration of the Story Shear along Y Direction.

5) AUTOLATERAL ALONG X AXIS

MODEL	X IN KN
ZONE 4	6.7165
ZONE 5	10.0747

In this Junction Tower Model in X direction in Auto-lateral Loads Results for the model at Zone 4 and Zone 5 as we can clearly see the Story Shear increases with the increase of the Zone also. Hence Zone 4 is the safer Zone for this Model for the consideration of the Autolateral along X Direction.

6) AUTOLATERAL ALONG Y AXIS

MODEL	X IN KN
ZONE 4	6.7165
ZONE 5	10.0747

In this Junction Tower Model in Y direction in Auto-lateral Loads Results for the model at Zone 4 and Zone 5 as we can clearly see the Story Shear increases with the increase of the Zone also. Hence Zone 4 is the safer Zone for this Model for the consideration of the Autolateral along Y Direction.

V. CONCLUSION

- 1) In this Junction Tower Model in X & Y direction and considering the Results of the zone 4 for in X direction is found to be 2.298 mm and in Y direction it is found to be 3.321 mm. And the Graph Plotted Below Represents the Curve along X and Y axis with their Respective Colours which can be Easy to compare for further Analysis.
- 2) In this Junction Tower Model in X & Y direction and considering the Results of the zone 4 for in X direction is found to be 4.0898 mm and in Y direction it is found to be 4.3115 mm. And the Graph Plotted Below Represents the Curve along X and Y axis with their Respective Colours which can be Easy to compare for further Analysis.
- 3) In this Junction Tower Model in X & Y direction and considering the Results of the zone 4 for in X direction is found to be 6.7165 mm and in Y direction it is found to be 6.7165 mm. And the Graph Plotted Below Represents the Curve along X and Y axis with their Respective Colours which can be Easy to compare for further Analysis.
- 4) In this Junction Tower Model in X & Y direction and considering the Results of the zone 5 for in X direction is found to be 3.446 mm and in Y direction it is found to be 4.981 mm. And the Graph Plotted Below Represents the Curve along X and Y axis with their Respective Colours which can be Easy to compare for further Analysis.
- 5) In this Junction Tower Model in X & Y direction and considering the Results of the zone 5 for in X direction is found to be 6.1347 mm and in Y direction it is found to be 6.4673 mm. And the Graph Plotted Below Represents the Curve along X and Y axis with their Respective Colours which can be Easy to compare for further Analysis.
- 6) In this Junction Tower Model in X & Y direction and considering the Results of the zone 5 for in X direction is found to be 10.0747 KN and in Y direction it is found to be 10.0747 KN. And the Graph Plotted Below Represents the Curve along X and Y axis with their Respective Colours which can be Easy to compare for further Analysis.



- 7) Hence we can Conclude that the this Industrial Tower Design model is capable to withstand in Zone 4 only. Seeing all the Results we can clearly see that as increase in zone 5 is effects the life span of Tower model. Hence the Tower model at Zone 4 is Better to be Considered as per Results.

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Impact Factor: 8.118



ISSN INTERNATIONAL
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