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# A Comparative Analysis of G+30 High Rise Structure with Horizontal Connection at Various Floor Levels for Response Spectrum Method using ETABS for Seismic Forces

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**ABSTRACT:** In the present scenario, construction of high-rise structures is being preferred rapid increase in the cost of land, lack of land availability and to preserve land in rural areas for agricultural use. The design of high rise horizontally connected structures is primarily governed by wind and seismic loads. In the present study analyzing and modeling G+30 twin horizontal connected structures in various floor level and to investigate the seismic forces by using Response spectrum method using Etabs and to determine the Storey Displacement, Storey Drift, Storey shear, & Bending moment and Shear forces. The study results suggested that with horizontal connection has withstand all seismic forces comparing to without horizontal connection. Based on the results we concluded that Multistorey parallel structures can adopt the 25<sup>th</sup> and 15<sup>th</sup> horizontal connection for more resistant of seismic forces.

**KEYWORDS:** Horizontal connection, Seismic Zone, High rise structures, Response Spectrum Method, Seismic Forces

## I. INTRODUCTION

A building is an enclosed structure that has walls, floors, a roof, and usually windows. “A ‘tall- building ’is a multi-storey structure in which most occupants depend on elevators [lift] to reach their destinations. The most prominent tall buildings are called ‘Hise-rise buildings’ in most countries and ‘tower blocks’ in Britain and some European countries. The term does not have internationally agreed detitanations High-rise buildings are increasingly becoming a prominent feature in urban areas, driven by the need to maximize space and accommodate growing populations. This trend has spurred innovative architectural designs, including the use of connecting beams and sky bridges. These elements enhance both functionality and aesthetics, facilitating the movement of people and goods between buildings while contributing to the urban skyline's visual appeal. Indeed, the mechanical behaviour of high-rise interconnected building structures, especially under seismic activity, poses significant challenges and requires careful consideration from both architects and researchers. The design of features such as seismic isolation schemes and corridor connections can greatly influence the force distribution, dynamic characteristics, and overall seismic performance of these complex structures. Understanding and addressing these challenges are crucial for ensuring the safety and stability of interconnected buildings in various regions worldwide.

### 1.1 SEISMIC FORCES

Seismic forces are the forces generated by the energy released during an earthquake. These forces cause the ground to shake, which in turn can lead to deformation of structures. Understanding seismic forces is crucial in designing buildings and infrastructure to withstand earthquakes and minimize damage.

### 1.2 RESPONSE SPECTRUM METHOD

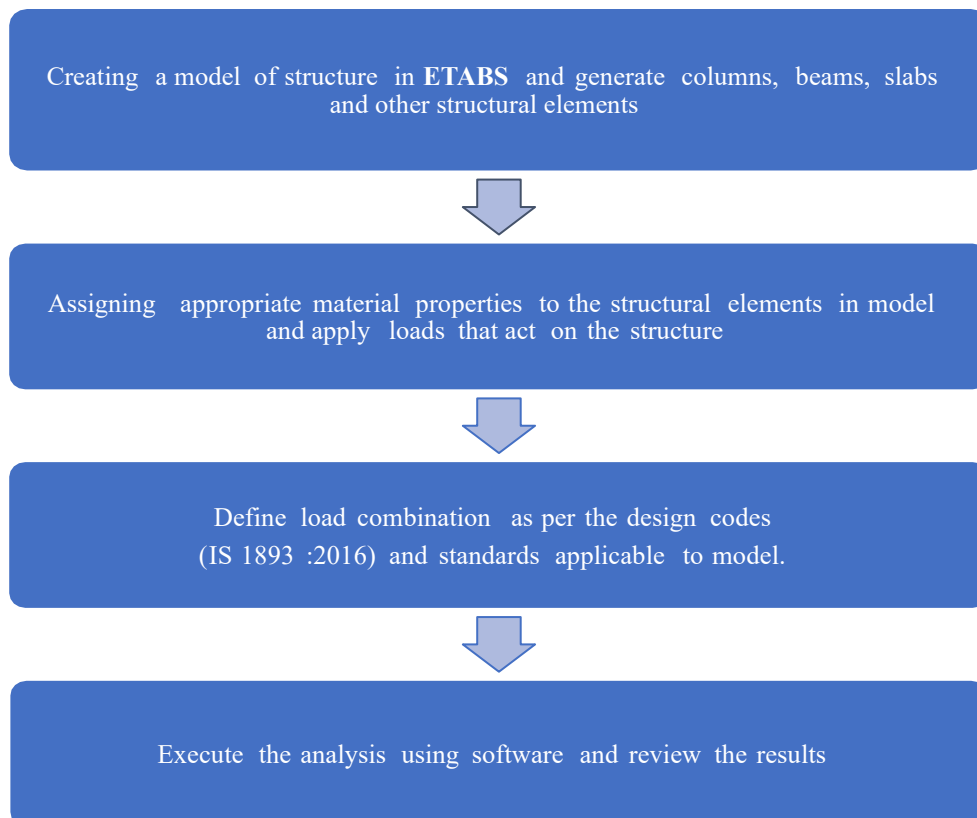
This method refers to modal analysis used in structural dynamics and earthquake engineering. Modal analysis is essential for structures where higher modes significantly influence the response. In this approach, the response of a Multi-Degree-of-Freedom (MDOF) system is expressed as the sum of individual modal responses. Each modal

response is derived from the spectral analysis of a corresponding Single-Degree-of-Freedom (SDOF) system. These modal responses are then combined to determine the overall structural response.

## II. OBJECTIVES

1. To compare the behaviour between multi storey building with and without horizontal connections for maximum Storey displacement, Storey shear, & Storey drift at various floor levels.
2. To compare the Shear forces, and Maximum bending for multistorey building with and without horizontal connections at various floor level.

## III. METHODOLOGY



**IV. GENERAL SPECIFICATIONS OF BUILDING**

CONTENT	
Material property	Concrete: For all Column and beams M30.
	Steel: HYSD reinforcement of grade Fe500 confirming to IS: 1786 (2008) is used
Column size	300x900 mm
Main beam	300x600 mm
Slab thickness	150 mm
Storey height	3m
Size of the bay	50 X 50 m
Length of sky bridge	10 m
Seismic Zone	III
Type of Soil	Medium
Type of Structure	SMRF
Importance Factor (I)	1.0
Response Reduction Factor	5.0
Density of Concrete (fck)	25 KN/m <sup>3</sup>
Density of Brick Wall	22 KN/m <sup>3</sup>
Floor Finish	1 KN/m <sup>2</sup>
Live Load on Floor	3 KN/m <sup>2</sup>
Live Load on Roof	1.5 KN/m <sup>2</sup>

**4.1 Proposed study**

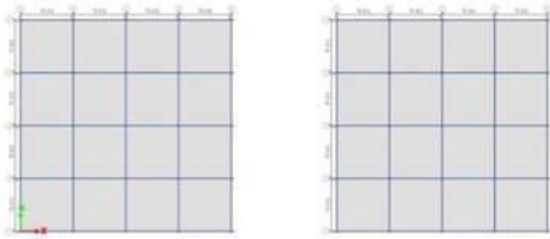
Two high rise twin buildings are taken into consideration for this study. Both buildings are of G+30. The base of both buildings is fixed. A horizontal connection is used to connect two buildings depending upon the floor location for the connection, buildings are categorized in four different cases

**V. DIFFERENT CASES FOR MODELLING AND ANALYSIS**

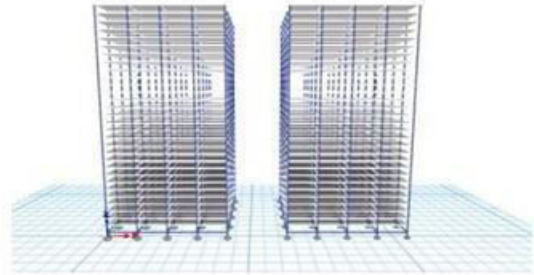
Case	Model G+30	
Case -1	No connection	
Case -2	15 <sup>th</sup> floor connection	25 <sup>th</sup> floor connection



**5.1 WITHOUT HORIZONTAL CONNECTION**

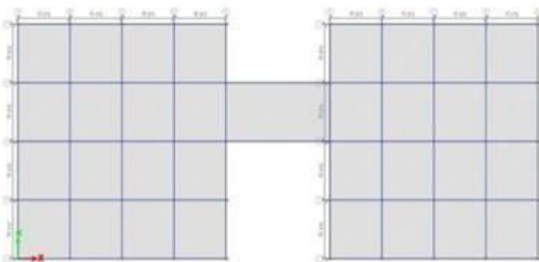


**PLAN VIEW**

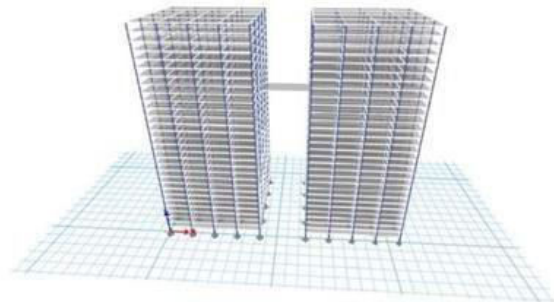


**3D VIEW**

**5.2 25<sup>th</sup> FLOOR HORIZONTAL CONNECTION**

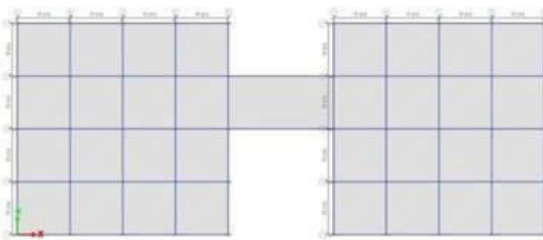


**PLAN VIEW**

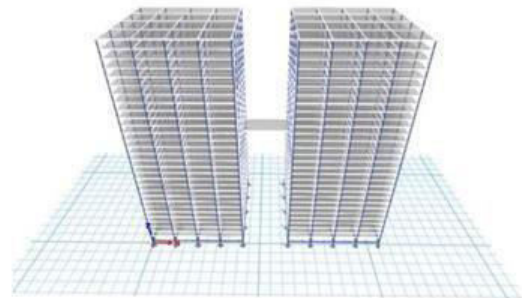


**3D VIEW**

**5.3 15<sup>th</sup> FLOOR HORIZONTAL CONNECTION**



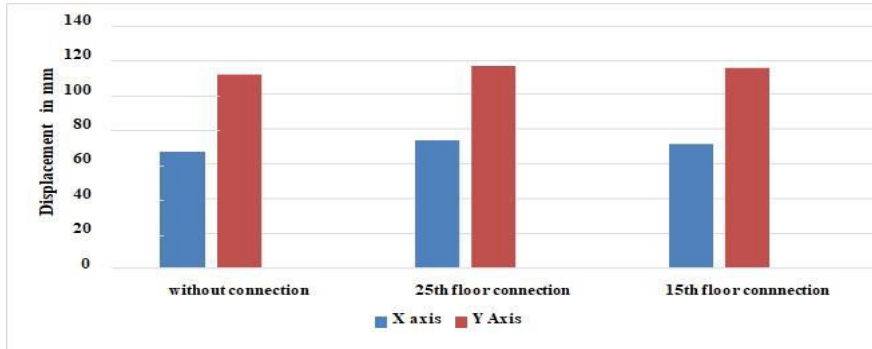
**PLAN VIEW**



**3D VIEW**

VI. OVERALL RESULTS

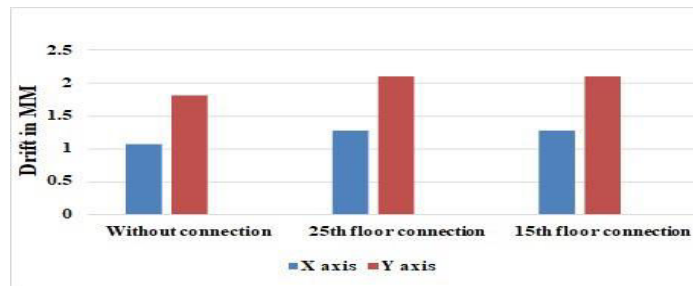
6.1 MAXIMUM STOREY DISPLACEMENT



Graph 1: Overall Variations of storey displacement with different horizontal connection

As per the above results the displacement of without connection has decreased from comparing to with horizontal connection has increased, and the maximum displacement at the 25<sup>th</sup> floor connection and Minimum at the 15<sup>th</sup> floor horizontal connection

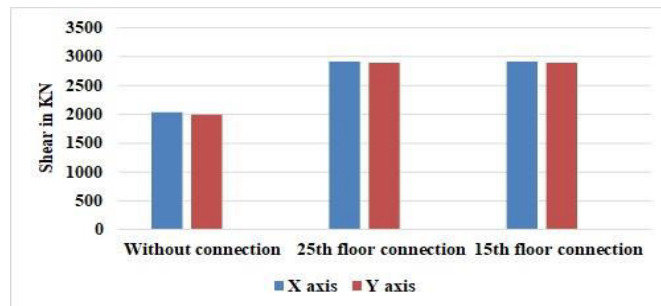
6.2 MAXIMUM STOREY DRIFT



Graph 2 Overall variations of Storey drift with different horizontal connection

As per above graph the storey drift of without connection has decreased from comparing to with horizontal connection has increased, and the maximum drift at the 25<sup>th</sup> floor connection and Minimum drift is at the 15<sup>th</sup> floor horizontal connection

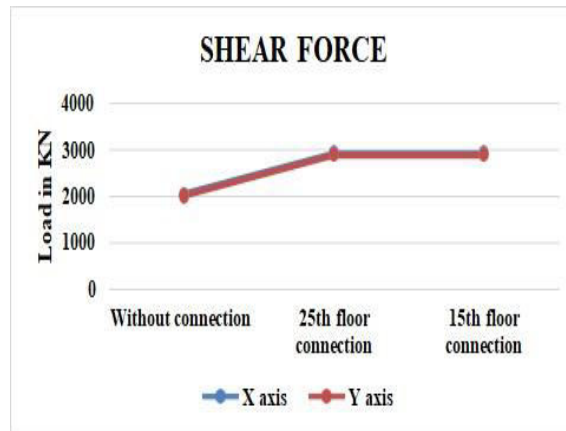
6.3 MAXIMUM STOREY SHEAR



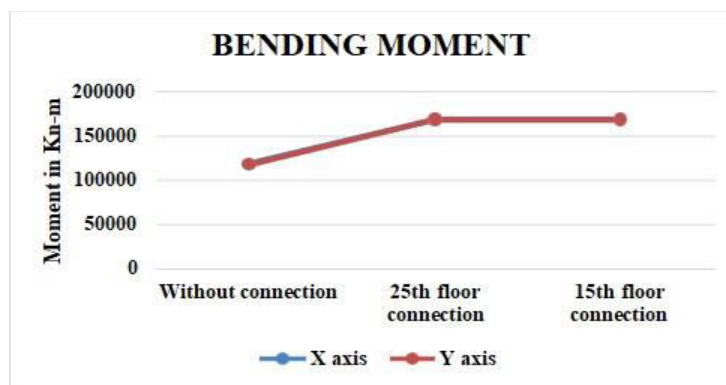
Graph 3 overall variations of storey shear with different horizontal connection

As per above results the storey shear of without connection has decreased from comparing to with horizontal connection has increased, and the maximum 15<sup>th</sup> floor connection and the Minimum shear is at the 25<sup>th</sup> floor horizontal connection.

#### 6.4 SHEAR FORCE AND BENDING MOMENTS



Graph 4: Overall variations of Shear forces



Graph 5: Overall variations of Bending moment

#### VII. CONCLUSION

1. It has been observed that the value of Maximum storey displacement occurs in Multistorey building with horizontal connection provided at 25<sup>th</sup> floor connection and the value is least for multistorey building without horizontal connection.
2. The data clearly indicate that Maximum storey drift occurs in Multistorey building with horizontal connection provided at 25<sup>th</sup> floor connection and the value is least for multistorey building without horizontal connection.
3. Thus, the Maximum storey shear occurs for Multistorey building with horizontal connection provided at 15<sup>th</sup> floor connection and the value of least for multistorey building without horizontal connection.
4. The shear forces and bending moment of without connection has decreased from comparing to the 25<sup>th</sup>, 15<sup>th</sup>, floor horizontal connection has linearly increased.
5. Based on the results we concluded that Multistorey parallel structures can adopt the 25<sup>th</sup> and 15<sup>th</sup> horizontal connection for more resistant of seismic forces.
6. Based on the above results, it is observed that maximum displacement, max drift, max shear & BM, SF increases when the horizontal connection is provided at higher storey. It would be ideal to provide the horizontal connection at lower stories when it absolutely necessary.

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