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AN ANALYSIS OF MULTISTORIED STRUCTURES USING DIFFERENT BRACINGS AND DYNAMIC PERFORMANCE IN A SEISMIC ZONE

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ABSTRACT

In highly crowded urban areas, provision for the accommodation of parking locations, reception lobbies, terrace gardens, etc are of great concern. Building with a floating column can be a viable option and can be advantageous, but it is necessary to investigate its cost-effectiveness and structural performance during strong ground motion resulting from earthquake excitation. The overall shape, size, and geometry of a building influence its characteristics and behavior under seismic loading. That is why the performance of floating column buildings with respect to normal buildings in seismic-prone areas needs to be evaluated. In this study, both the static and dynamic analysis methods are engaged to observe the performance of the buildings having floating columns for seismic loading in accordance with the provision stated in BNBC 2020. Four different cases where buildings with varying locations of floating columns are analyzed along with the normal building that has no floating column. From the analytical results, it is observed that story displacement, story drift, and base shear are increasing quite rapidly in those buildings that have floating columns (Case II, III, and IV) compared to a normal building. Floating column buildings undergo relatively more horizontal displacements due to an increase in the fundamental time period which can cause damages to structural and non-structural members if the lateral displacement exceeds the code stipulated maximum limit.

I. INTRODUCTION

Earthquake is defined as any seismic event that produces seismic waves, whether natural or caused by humans. Earthquakes are usually generated by ruptures in geological faults, although they can also be caused by volcanic activity, mine blasts, landslides, and nuclear explosions. The earthquake generates seismic waves, which are also known as seismic force or lateral stresses. Sideways loads reduce the structure's stability by creating a sway moment and strains in the frame. In this circumstance, the structure's tightness is more significant than its ability to withstand lateral loads.

There have been several earthquakes in India that have seriously damaged homes, businesses, and people's infrastructure.

1.1 Moment Resisting Frame

Because of the components' stiffness, a rectangular arrangement of beams and columns acts as a frame that resists movement. Frames can be made of steel or concrete.

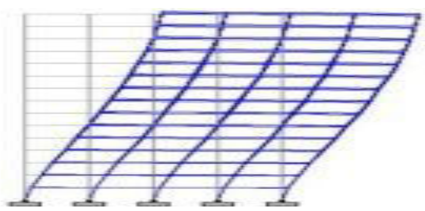

Fig.1.1 Moment Resisting Frame

For partitioning purposes, masonry panels in the form of in fills are attached to the frames.

These partitions are categorized as non-structural elements and are usually disregarded because of their inability to withstand lateral loads and their intricate panel movement.

1.2 Strengthening of RC Structures for Earthquake Resistance

Earthquakes are common all over the world, and their intensity, location, and timing are very difficult to predict. Regular loads, like dead, live, wind, etc., cannot always be protected from the lateral loads caused by earthquakes

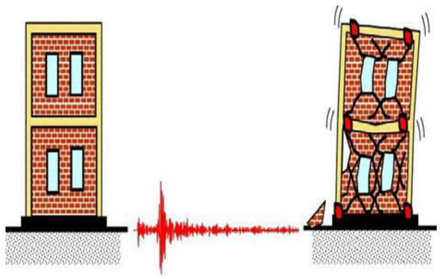

Fig 1.2 An earthquake in normal constructions

1.3 Conventional Method

Traditional methods are utilized to increase a building's seismic resistance by lessening the negative effects of design and construction. Steel bracing, infill walls, and shear wall addition are some of the alternatives included in the approaches.

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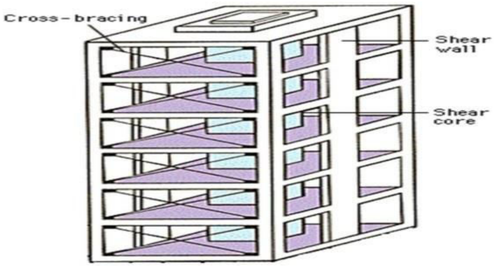

Fig.1.3 Building with bracing and shear wall

1.4 Non-Conventional Method

Given that the horizontal seismic forces are essentially thought to be reduced, these approaches continue with quite different beliefs. Figure 1.4 illustrates a non-traditional technique called base isolation.

1.5 Member Level Methods

Making these essentially weak members stronger is the goal of the member-level strengthening plan.

Compared to the structure-level solution, this approach is more cost-effective. Jacketing is usually used to boost each member's strength. It entails enclosing columns, beams, joints, and reinforced concrete foundations.

Fig.1.4 Column Jacketing

1.6 Toughen of RC structures with Steel Bracing

The most popular earthquake-resisting method in recent years is steel bracing applied to framed structures. It is a cost-effective method of fortifying the structure and resisting the lateral stresses that it is subjected to. Bracing solutions are available for buildings with higher heights.

II. LITERATURE SURVEY

Earthquakes have killed thousands of people and caused enormous costs for humanity due to the rise in seismic activity worldwide. As a result, efforts have been made to develop and renovate buildings and bridges, reduce seismic damage, and improve structural stability.

As a result, scientists have determined that bracing is a more economical and efficient method of lateral strengthening framed structures against wind and seismic loads. Review of Research Works.

Following paragraphs describing the research works and its finding carried by various researchers.

Kulkarni et al. (2013) According to research by Kulkarni et al (2013), bracing lessen the forces encountered by columns and beams while increasing the resistance to lateral forces experienced by inclined members. It is primarily stressed axially and behaves like a truss. Compared to moment-resistant frames, fewer moments are produced as a result, and beam and column sizes can be decreased. The seismic analysis of RCC frames with RC braced members arranged in a V-braced configuration is the main topic of the work. A 12-story building with five bay sin each direction is subjected to quantitative analysis.

Reddy and Kumar (2018) examined the effects of bracings on RCC-framed structures. Analysis and modeling were performed on the G+9-story reinforced concrete-framed structure. Three models were considered for this purpose: 1) The naked frame 2) A framed building having multiple bracing kinds 3. a framework with a frame and a shear wall. Additionally, two different bracing types the X and Chevron were employed

Katte and Kulkarni (2019) Katte and Kulkarni (2019) finished the seismic analysis for the steel-braced structure, which has steel bracings at different points throughout the structure. Bracing was used into the structural construction to increase the building's ability to withstand lateral loads.

III. SYSTEM ARCHITECTURE AND METHODS

An embraced frame is a kind of structural design that was mainly created to resist the stresses generated by earthquakes. Bracings support lateral load as inclined components. The current study evaluates the seismic impact on high-rise, multi-story RC buildings by employing different bracing strategies at different points along the structure. Because the structure is composed of both braced and un braced RC frame models, it is fully described in this chapter along with the various loads and their combinations.

3.1 Loading Description

The building should be built to resist the loads placed on it over the course of its existence. The application of load causes stress to build up and, in turn, causes a structure to shift, which ultimately results in the collapse of the building.

All kinds of loads are covered under the Indian Standard (IS) regulations for structural design.

The building's research took into account the following loads.

1.Gravity Loads

2.Dead Load (DL)

3. Live Load/Imposed Load (IL)

4. Earth quake Load

The following are the materials to bracing:

Steel: Strong and ductile, it is often employed in high-rise buildings and industrial constructions.

Timber: Used in small or traditional constructions.

Concrete: Shear resistance is built into the walls.

Composite Materials: Modern solutions for high-performance applications.

3.2 Parameters for Analysis

In the seismic zone, comparing the seismic behavior of a un braced and braced RC frame This is the main idea of the present study. To achieve the objectives, the following factors study must take into consideration the.

1. Time Period
2. Shear at base
3. Displacement of building storey
4. Storey drift
5. Maximum Bending Moment for Column
6. Peak Storey Shear

3.3 Introduction to Bracing

In frame construction, bracing is a dependable and affordable method of minimizing the effects of horizontal loads. The majority of the world's tallest structures rely on bracing to provide lateral stability. Diagonals are highly effective since they reduce member size and enhance stiffness and strength against horizontal shear. The building's earthquake resistance is also upgraded. The bracing system strengthens the building by moving the load away from the less sturdy columns.

Bracing Systems types: Concentric Bracings, Eccentric bracing

Concentric Bracings: Diagonal bracing, X- bracing, V- bracing, Inverted V bracing, Two-story X bracing.

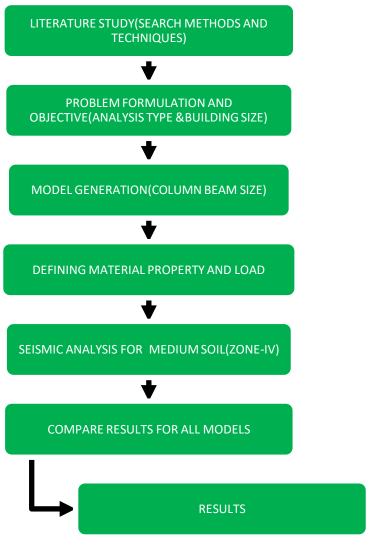

Fig.3.1 Flow chart of the analysis procedure

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IV RESULTS AND DISCUSSION

These seismic studies of the multi-story structure use several models and features that are taken into account for the analysis in The current study is based on The previously stated iambic methodology, also referred to as the response spectrum method, is used to assess the performance of the un braced and braced framework in the RC construction. The results of a study of multiple models, both with and without bracing, are described. For this, three different types of bracing systems X, inverted-V, and V-bracing as well as different bracing positions have been taken into consideration. STAAD. After taking the seismic zone IV, the analysis is continued using ProV8i. The outcomes are compared to those of an un braced frame.

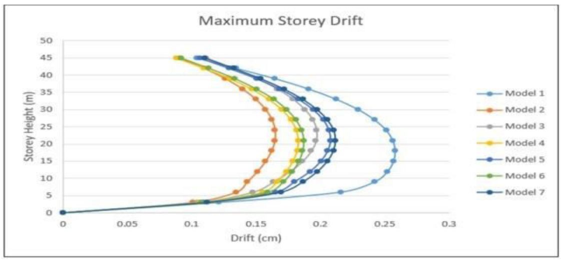

Fig.4.1 Maximum Storey Drift for Different models for different storey level

However, different bracing systems offered at different sites display the maximum storey drift value at different storey levels. Compared to other braced and un braced systems, the percentage increase in storey drift in Model-2 is extremely large.

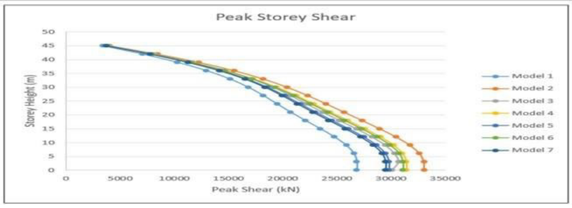

Fig.4.2 Peak storey shear for Different models

The graph has been given to indicate the comparable trend for the building's shear value decline from the bottom to the top. The storey shear values at the base were generally the highest, and as we went up to the next storey level, they declined. The topmost floor has the least amount of storey shear.

The comparison of the variables reveals the structure that is most practical and efficient for the maximum number of stories. The most appropriate braced frame is Model-2, and can tolerate high shear values at various storey levels in comparison to other braced and un braced systems.

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4.1 Execution Results

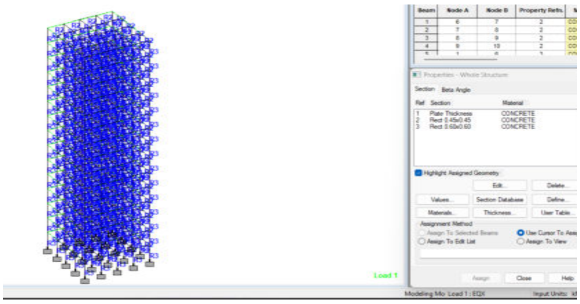


Fig. 4.3 Member Properties

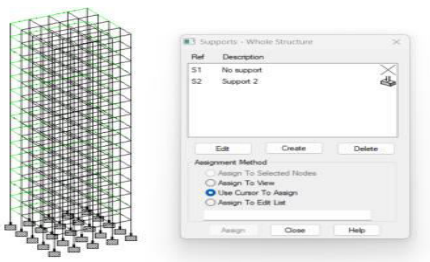


Fig.4.4 Supports

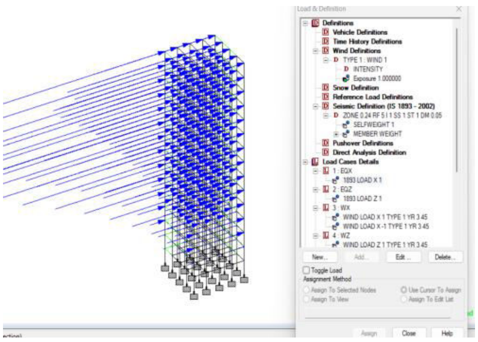
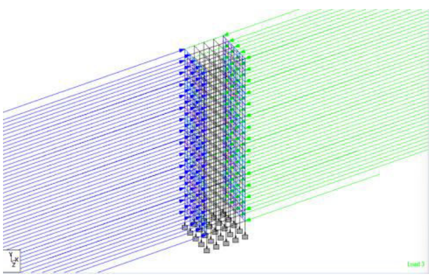


Fig.4.5 EQX Loading



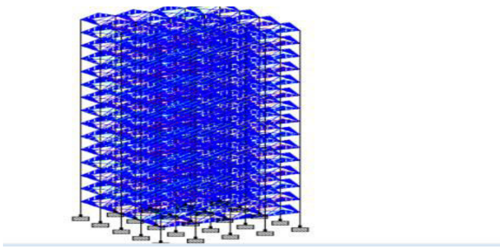


Fig.4.6 Wind load

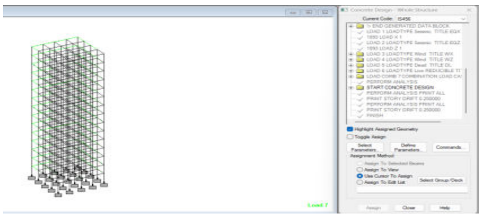


Fig.4.7 Live load

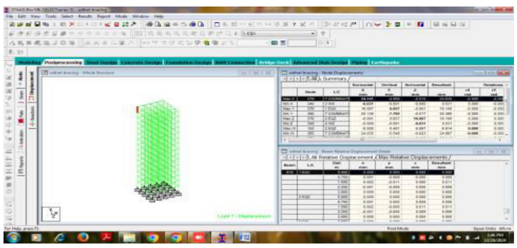


Fig.4.8 Design Components

Fig.4.9 All Relative Displacement Without Bracing

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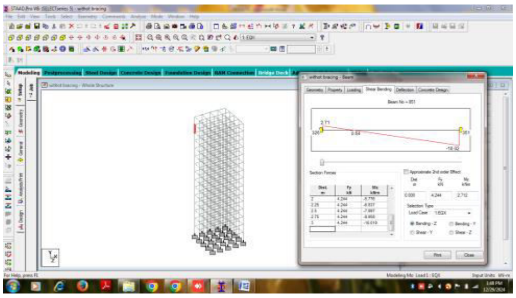

Fig.4.10 Beam shear bending Without Bracing

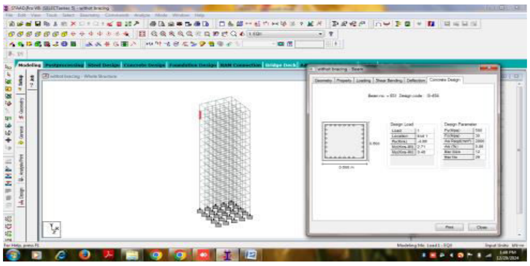

Fig.4.11 Concrete Design Without Bracing

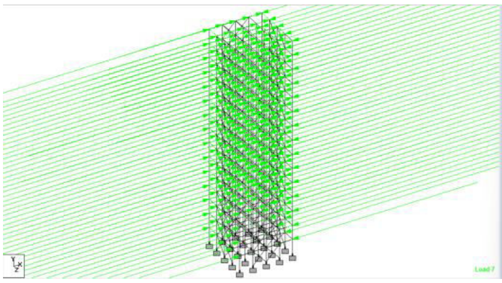

Fig.4.12 Load Combinations X-Bracing

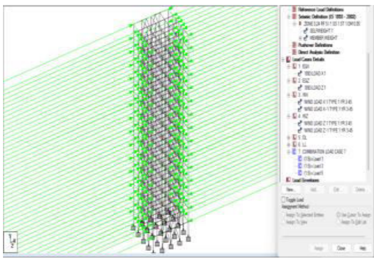

Fig.4.13 Load Combinations V-Bracing

V.CONCLUSION

STAAD.Pro V8i software was used to conduct reaction spectrum analyses on all braced frame models for all the required parameters, including peak storey shear, base shear, maximum bending force, and storey displacement. Braced structures demonstrated greater seismic resistance than un braced structures in the specific seismic zone under consideration, i.e., zone IV, according to the analysis of braced models. In order to provide better results, a better place for providing the various bracing was also identified. Comparatively speaking, it was discovered that model-2, or the model with X-Bracing offered on the exterior of the building and on the mid bays, is the greatest option among all models taken into consideration from a structural standpoint

FUTURE SCOPE

The most comprehensive research study in this sector for future research. The following options can be utilized in research projects for further analysis:

1. In a further study, we can consider irregularity in the building.
2. Instead of steel bracing, the performance of a building can also be studied by

using concrete bracing.

3. Eccentrically braced frame (EBF's) can also studies in the future study.
4. We can use the time history method for analysis in further studies.
5. Different soil conditions can be considered for the further research work.
6. Different zones can be considered and which bracing system will be more advantageous can be evaluated in the further studies.
7. These CBF's and EBF's can also be taken as retrofitting techniques for further studies.

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