COMPARATIVE STUDY ON SEISMIC BEHAVIOR OF G+7 STEEL BUILDING BY USING DAMPERS AND STEEL BRACINGS

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Abstract *In day to day life, it is needed to study the behavior of every multi-storyed building structure subjected to ground motion which is the common problem for construction. The earthquake creates the vibrating forces at the base of structure. These vibrations create the oscillations in building which may damage the structure tremendously. These vibrations created at the ground level gets transferred up to the top of building and because of mass of structure which produces the lateral forces on the frame which finally reduces the moment resistance capacity of building parameters such as columns beams etc. Paper gives the idea about different researches carried out on multistoried building considering various parameters. All previous studies, observations, and conclusions show that response spectrum method is useful for determination of structural response in particular cases of ground motions. This study describes the results of a study on the seismic behavior of a structure G+7are analyzed with and without bracings and damper. The current version of the IS: 1893-2002 requires that practically all multi storied buildings be analyzed as three-dimensional systems.*

Earthquake load is changing into an excellent concern in our country as a result of not one zone may be selected as earthquake resistant zone. One of the most important aspects is to construct a building structure, which can resist the seismic force efficiently. In the present analysis, a residential building with 8 stories is analyzed with columns having bracings and dampers at different locations with medium soil condition. The building is analyzed in Zone 5 with Time history analysis.

KEY WORDS: *earthquake, damper, bracings, Time history, Moments, shear values, axial load, time period, frequency.*

1. INTRODUCTION

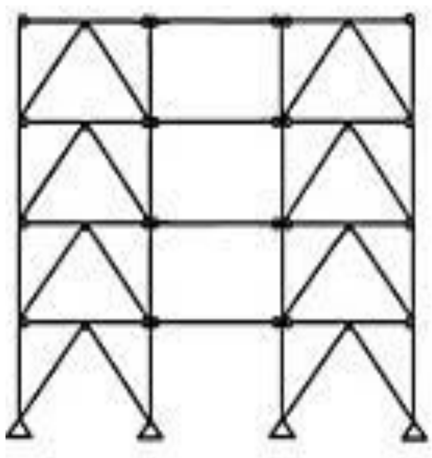
In last decades Steel structure plays an important role in the construction industry. It is necessary to design a structure to perform well under seismic loads. Shear capacity of the structure can be increased by introducing Steel bracings in the structural system. Bracings can be used as retrofit as well. There are „n" numbers of possibilities are there to arrange Steel bracings. Such as D, K, and V type eccentric bracings. Design of such structure should have good ductility property to perform well under seismic loads. To estimate ductility and other properties for each eccentric bracing Push over analysis is performed.

A simple computer-based push-over analysis is a technique for performance-based design of building frameworks subject to earthquake loading. Push over analysis attains much importance in the past decades due to its simplicity and the effectiveness of the results. The present study develops a push-over analysis for different eccentric steel frames designed according to IS-800 (2007) and ductility behaviour of each frame.

Bracing system

A braced frame is a structural system commonly used in structures subject to lateral loads such as wind and seismic pressure. The members in a braced frame are generally made of structural steel, which can work effectively both in tension and compression.

The beams and columns that form the frame carry vertical loads, and the bracing system carries the lateral loads. The positioning of braces, however, can be problematic as they can interfere with the design of the façade and the position of openings. Buildings adopting high-tech or post-modernist styles have responded to this by expressing bracing as an internal or external design feature.



V bracing system

Dampers

In seismic structures upgrading, one of the lateral force reduction caused by the earthquake is use of dampers. During an earthquake, high energy is applied to the structure. This energy is applied in two types of kinetic and potential (strain) to structure and it is absorbed or amortized. If structure is free of damping, its vibration will be continuously, but due to the material damping, vibration is reduced.

Friction damper

Objectives of the study

The following are the main objectives of the project

1. To study the seismic behavior of building by using IS 1893:2002
2. To design the earth quake resistant structure by using steel bracings and dampers in zone V.
3. To compare the results of axial load, shear , bending, building time period and frequency of buildings for earth quake resistant buildings.
4. To study the multi story buildings of G+7 in SAP 2000 V19 by using Time history analysis.

2. LITERATURE STUDIES

Jayaram Nayak B[1], Kiran Kamath[2], Avinash A R[3] et al.,(2018)

The present study focuses on seismic performance of three dimensional braced steel frame structures by varying height of bracings in frame structure. The braces have been applied in three levels: one story bracing, two story bracing and three story bracings. For the study X-braced frames and Diamond braced frames with varying aspect ratios (ratio of height of structure to base width) ranging from one to four are considered and seismic performance is compared with bare frame structure. From this study it was concluded that, aspect ratio of one shows a better seismic performance when compared with rest of the models considered. All braced frame structures have shown better seismic performance when compared to bare frame structure.

Shaik Kamal Mohammed Azam, Vinod Hosur

The dual structural system consisting of special moment resisting frame (SMRF) and concrete shear wall has better seismic performance due to improved lateral stiffness and lateral strength. A well designed system of shear walls in a building frame improves its seismic performance significantly. The configurations of RC moment resisting framed building structure with different arrangements of shear walls are considered for evaluation of seismic performance, so as to arrive at the suitable arrangement of shear wall in the structural framing system for better seismic resistance. A comparison of structural behaviour in terms of strength, stiffness and damping characteristics is done by arranging shear walls at different locations/configurations in the structural framing system. The elastic (response spectrum analysis) as well as in-elastic (nonlinear static pushover analysis) analyses are carried out for the evaluation of seismic performance. The results of the study indicate that the provision of shear walls symmetrically in the outermost moment resisting frames of the building and preferably interconnected in mutually perpendicular directions forming a core will lead to better seismic performance.

3. METHODOLOGY USED

Time history analysis

In this analysis dynamic response of the building will be calculated at each time intervals. This analysis can be carried out by taking recorded ground motion data from past earthquake database. This analysis overcomes all disadvantages of response spectrum analysis if there is no involvement of nonlinear behavior. Hence this method requires greater efforts in calculating response of buildings in discrete time intervals. In this project work BHUJ earthquake of magnitude 7.7 with ground acceleration 0.106g is taken for the time history analysis.

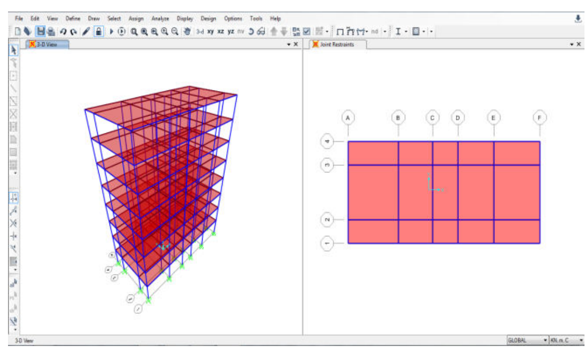
The usage of this method shall be on an appropriate ground motion and shall be performed using accepted principles of dynamics. In this method, the mathematical model of the building is subjected to accelerations from earthquake records that represent the expected earthquake at the base of the structure.

SPECIFICATIONS AND MODELS OF THE BILDING

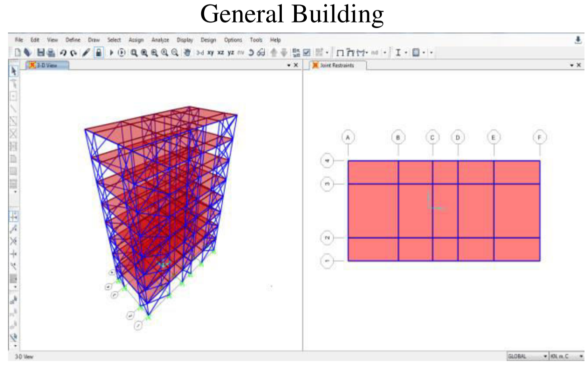
In building plan was taken in seismic zone V for seismic analysis of the building (G+30) with braced building and unbraced building (general building). The basic specifications of the building are:

Plan Size	= 21 m x 27 m
Beam Size	=ISMB 300;
Column size	= ISMB450
Storey Height	=ISMB250;
Bottam storey	= 3.5 mts
Materials used	= M30 & Fe415;
Depth of slab	=125 mm
Floor finish	=1.5 kN/m^2,
Imposed load	=3.5 kN/m^2;
Unit weight of concrete	= 24 kN/m^3

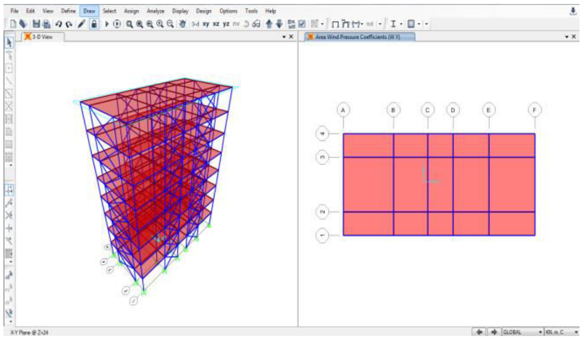
Building models



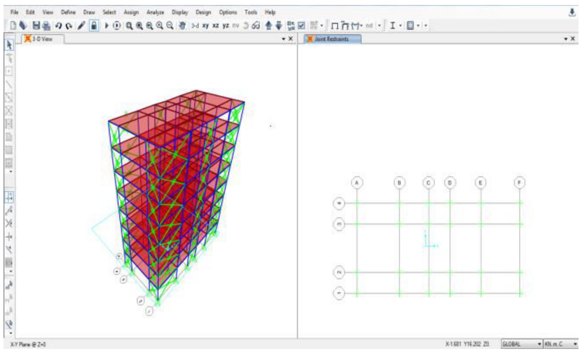
General Building



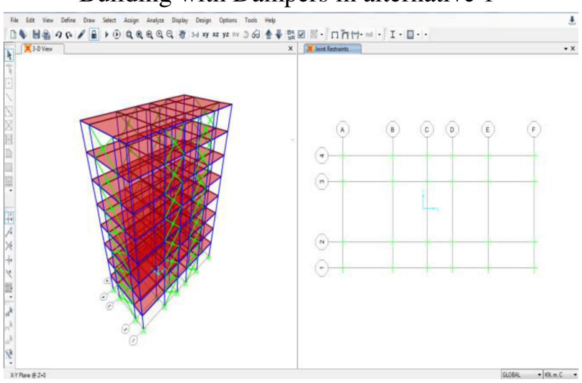
Building with Bracings in alternative 1



Building with Bracings in alternative 2



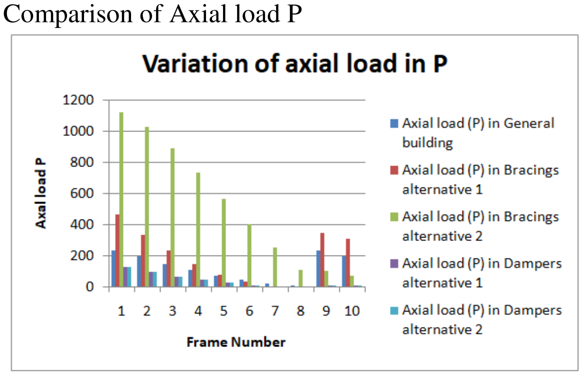
Building with Dampers in alternative 1



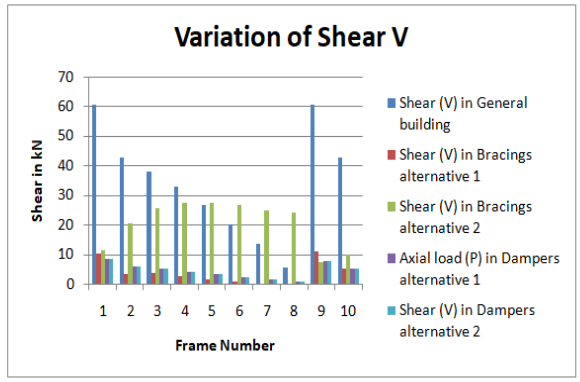
Building with Dampers in alternative 2

4. RESULTS AND ANALYSIS

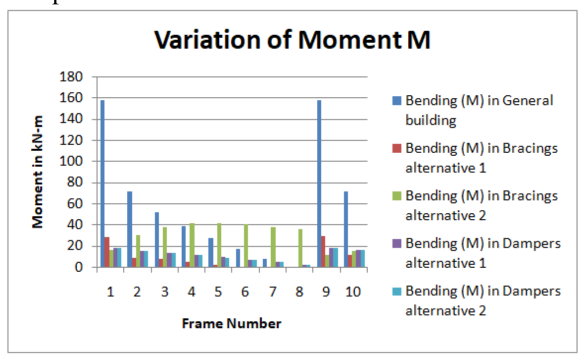
Comparison of Axial load P



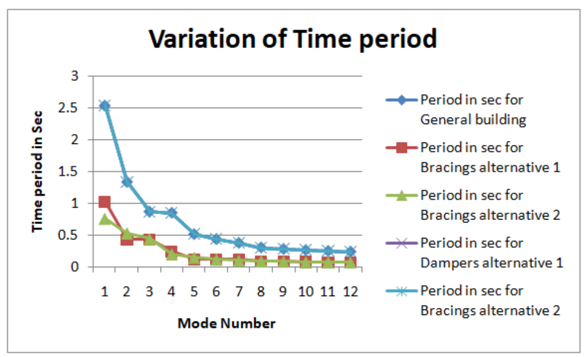
Comparison of Shear V



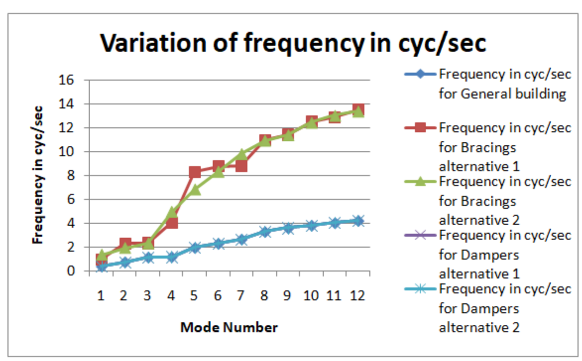
Comparison of Moment M



Comparison of time period (T)



Comparison of frequency



5. CONCLUSIONS

From the above study the following conclusions were made

1. By providing dampers and bracing for G+7 building we can reduce the seismic load action on building and we can design the earth quack resistant structure.
2. The value of axial load decreases from frame 1 to frame 10 and the maximum value of axial load was observed for building with bracings in alternative 2 than reaming cases (general building, bracings with alternative 1, building with dampers alternative 1, building with dampers alternative 2.
3. The maximum value of shear was observed for building with dampers in alternative 1 than reaming cases (general building, bracings with alternative 1, building with bracings alternative 2, building with dampers alternative 2).
4. The maximum value of moment was observed for building with dampers in alternative 1 than reaming cases (general building, bracings with alternative 1, building with bracings alternative 2, building with dampers alternative 2).
5. The value of time period decrease from node point 1 to node point 12. The maximum value is observed for building without bracings and dampers
6. The value of frequency increase from node point 1 to node point 12. The less value is observed for building without bracings and dampers
7. The friction devices like dampers limit the amount of energy that is input into the structure.
8. The amplitude of displacements, natural time periods, storey drifts and accelerations is considerably reduced.
9. The result shows that, the buildings with friction dampers and bracing are more vulnerable compared to other buildings.

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