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SEISMIC RESPONSE OF STEEL STRUCTURE WITH MEGA BRACING SYSTEM

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ABSTRACT

In General, the structure in high seismic areas may be susceptible to the severe damage. Along with gravity load structure has to withstand the lateral load which can develop high stresses. Now a day, shear wall in R.C. structure and steel bracings in steel structure are most popular system to resist lateral load due to earthquake, wind, blast etc. The bracing is one of the best lateral load resisting systems and it will be the viable solution for enhancing earthquake resistance. A Bracing is a system that is provided to minimize the lateral deflection of structure. The members of a braced frame are subjected to tension and compression, so that they are provided to take these forces similar to a truss. Braced frames are always designed of steel members. Use of the braced frames has become very popular in high rise structure and also in seismic design of them. So there is a need of precise and exact modeling and analysis using software ETABS to interpret relation between brace frame and without brace frame aspects. The present study assesses the seismic response of steel structure with concentric bracing system. Two structural configurations were utilized; vertical irregular model (VIRM), vertical irregular model with mega bracing (VIRM_MB). A 15 storey steel moment resisting frame was analyzed for all zones of soil type-II (medium). The analyses were carried out to assess the structural performance under earthquake ground motions. These models are compared in different aspects such as storey drift, storey displacement and base shear.

KEYWORDS: base shear ,mega brace,storey drift, storey displacement.

INTRODUCTION

Bracing is a very effective global upgrading strategy to enhance the global stiffness and strength of steel un-braced frames. It can increase the energy absorption of structures and/or decrease the demand imposed by earthquake loads whenever hysteretic dampers are utilized. Structures with augmented energy dissipation may safely resist forces and deformations caused by strong ground motions. Under awesome earthquake ground movements, the flexibility of steel minute opposing frames may bring about incredible lateral drift impelled nonstructural damage. In steel frames, the inter storey float proportion should be constrained in configuration because of the weak seismic execution to oppose earthquake identified with geometric non linearity and brittle failure of beam-to-column connections. Steel braced frame is one of the structural systems used to resist lateral loads in multi-storied buildings. Steel bracing is economical, easy to erect, occupies less space and has flexibility to design for meeting the required strength and stiffness. Braced frames are often used to resist lateral loads but braces can interfere with architectural features. The steel braces are usually placed in vertically aligned spans. This system allows obtaining a great increase of stiffness with a minimal added weight, and so it is very effective for existing structure for which the poor lateral stiffness is the main problem. Bracings are usually provided to increase stiffness and stability of the structure under lateral loading and also to reduce lateral displacement significantly. Steel bracing members are broadly utilized as a part of steel structures to reduce horizontal displacement and disperse vitality during seismic movements. Mega steel supporting give a great way to deal with reinforcing and hardening steel structures. Utilizing these supports the creator can scarcely modify the stiffness together with flexibility as required due to buckling of braces in compression. Because of the high productivity and monetarily, braced steel frameworks are broadly utilized. Propped steel framework ineffectual if the

braces in linear stage. The deviated reaction is created when at the nonlinear stage begins while, the lateral stiffness starts to decrees.

Steel bracing is a highly efficient and economical method of resisting horizontal forces in a frame structure. Bracing is efficient because the diagonals work in axial stress and therefore call for minimum member sizes in providing stiffness and strength against horizontal shear. A bracing system improves the seismic performance of the frame by increasing its lateral stiffness and capacity. To oppose seismic loads, supported steel frames have numerous propping frameworks, for example, concentric bracing system, eccentric bracing system, knee bracing system and mega bracing system.

The mega bracing system (MBS) is considered as viable solution to augment both global lateral stiffness and strength of steel frames. MBS is most cost-effective than other types of bracing. Mega-braces can be installed without business interruption within the building thus preventing loss of use (downtime) caused by the structural retrofitting strategy. MEGA Brace is a proprietary mechanical or hydraulic strutting system increasing the overall load capacity of the waling beam. The Mega beam can also be used as the waling in raking strut systems.

Fig: 1. Mega-bracing

METHODOLOGY

The methodology includes:

- Firstly a detailed introduction regarding the steel building frames, its structural and constructional aspects, its effects on the analysis, method of analysis and seismic behavior are collected along with organization of the report.
- A detailed literature survey is carried out on analysis of moment resisting steel frames.
- The design of 3D steel frame using IS 456-2000 considering dead load, live load and earthquake load.

The modal analysis of 3D steel frames is carried out to get the response of steel structure. The steel frame models are of five bay with fifteen storey for with and without bracing system.

MODELING

ETABS is a full-featured program that can be used for the simplest problems or the most complex projects. This topic briefly describes the newer features in the program and directs you to manuals and technical support to help you get started using this version of the program.

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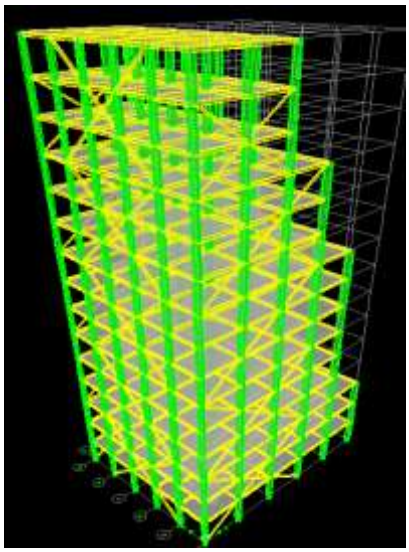

Fig: 2. Analytical Model

Table 1 DESCRIPTION OF STRUCTURE

No. of Floors	15
Shape Of Building, Plan, Elevation whether Symmetric in Elevation	Non symmetrical building
Maximum plan dimension in either direction in mt.	B=22.5m & L=17.5m
Ratio of plan dimension	Ratio=L/B=2.10
Typical Floor to floor height in mt. Maximum floor to floor height in entire height of building in mt.	3.5 m 3.5 m
Aspect ratio (Height of building till Terrace/ Minimum Dimension of Building)	Aspect Ratio =H/B=52.5m/22.5m=2.33
Type of floor slab	Beam slab
Average thickness of floor slab in mm.	150mm
Whether column are RCC, Composite or In structural steel	Structural steel
Whether the Geometry of Building is Symmetric/ Non symmetrical	Non symmetrical
Use of floor at different levels (Residential /Commercial / industrial)	Commercial

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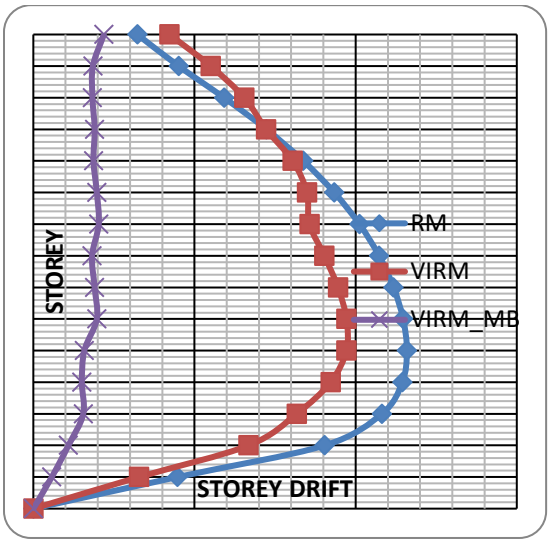
RESULTS AND DISCUSSIONS

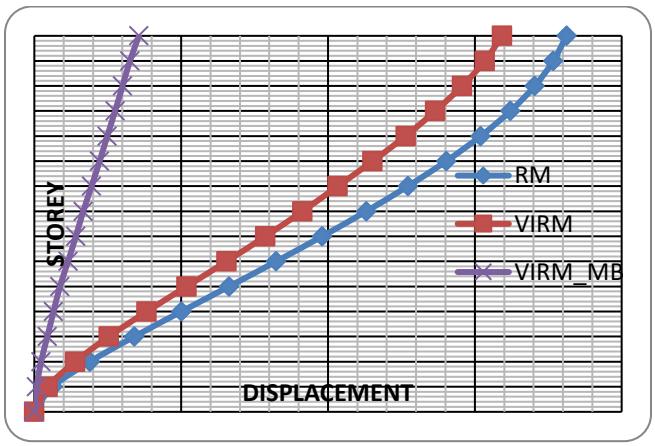
Storey drift:

For comparison of Storey drift of vertical irregular frame, the storey v/s storey drifts of various models without & with bracing system frame are shown in fig below. It is observed that storey drift is more in without brace frame as compared to mega brace frame. It shows that 48.20% of storey drift for mega brace frame decreased compare to without brace frame.



Storey displacement:

The values obtained for displacement from analysis, storey v/s storey displacement graph as been ploted. It clear that the percentage decrease compare to without bracing system, displacement for mega brace it is decreased upto 77.64%.



Base shear:

The maximum base shear for concentric brace frames as shown in fig below. From this result observed that maximum base shear for concentric (VIRM_MB) bracing frame decreased by 23.42% in compared without brace frame.

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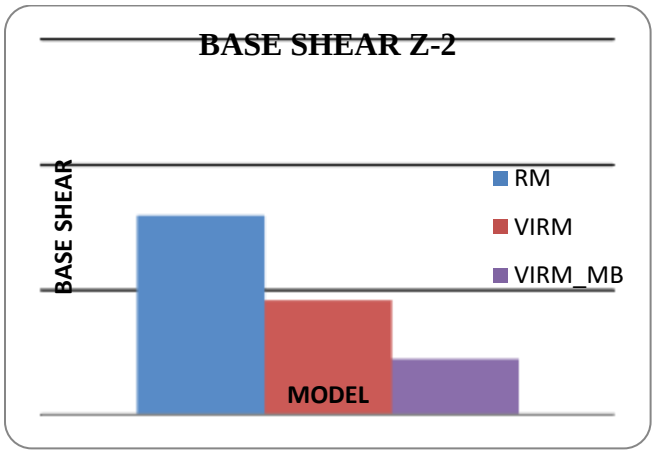

CONCLUSIONS

The following conclusions have been drawn based on the results obtained from present study:

1) The results of the performed inelastic analyses demonstrate that mega bracing frames are most effective to resist earthquake.
2) It concludes that the reduction of storey drifts in mega braced frame occurs with respect to the without braced frame.
3) The storey displacement of the vertical irregular structure is reduced 77.64% by the use of mega bracing system in comparison to without bracing system. As a result, it can be said that bracing system has more influence on the restriction to relative to floor displacement.
4) The maximum base shear for mega (VIRM_MB) bracing frame are decreased by 23.42% as compared to VIRM without bracing frame.

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