A Study of the Influence of Various Lateral Load Resisting System in Steel Building

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Abstract - *Steel is material which is good in tension as well as in compression. It is widely used material in construction. It shows high strength, toughness and ductility than reinforced cement concrete structure. Structural special moment resisting frame are often used to resist the seismic force resisting force in building. In present paper buildings are made up of tapered I-section with different types of bracing system is used along with special moment resisting frame in different heights of building at different earthquake zones II, III IV.V as per IS 1893 (Part I):2002 to resist the seismic force by keeping the same plan and loading for all models. The seismic analysis and design of building is done as per IS 800:2007 by using software STAAD V8i. This paper work is focused on different lateral load resisting system to get best lateral load resisting system for a particular height of building in particular earthquake zone.*

Key Words: STAAD.Pro V8i, steel bracing, seismic analysis, IS 1893 (part-1)-2002,

1.0 Introduction

Steel is a material which has high strength per unit mass. It is a most common material used in a construction industry [1]. The dominance of steel in the multi-storey commercial sector is based on tangible client-related benefits including the ability to provide column free floor spans, efficient circulation space, integration of building services, and the influence of the site and local access conditions on the construction process. For inner city projects, speed of construction and minimum storage of materials on-site require a high level of pre-fabrication, which steel-framed systems can provide [11].

In present study seismic performance of steel buildings is investigated for different lateral load resisting system like rigid frames and bracing system at different height of structure like 9.0m, 18.0m, 27.0m, 36.0m and in different earthquake zones II, III, IV, V as per IS 1893 (Part I):2002 of India, wind load is applied as per IS 875 (Part III):1987 and all structure are analyzed for IS 800:2007 using STAAD V8i software. Tapered I-section are used for primary, secondary beams and columns. It's also concern about the cost of building because as a building made up of steel will be costly compare with building made up of reinforced cement concrete, so for that we can optimize the size of sections to reach the maximum passing ratio of a member instead of using available hot rolled Indian section. So it was found that sections used in assembly of elements of building, beams and columns are tapered I-sections. Rigidly jointed frames may be used economically to provide lateral load resistance for low-rise buildings. Generally, it is less stiff than other systems [12]. The most effective and practical method of enhancing the seismic resistance is to increase the energy absorption capacity of structures that can be done by providing the different kinds of bracing system and shear wall which reduces the maximum lateral displacement of building and resist a part of seismic load.

2.0 Objectives of present work

- To know the requirement of lateral load system in particular height and particular earthquake zone of all four models are analysed in different earthquake zones.
- To identify the best bracing system for particular height and particular zone of earthquake.

3.0 Modelling and Analysis of Building

Structure	SMRF
No. of stories	3, 6, 9, 12
Heights of buildings	9.0m, 18.0m, 27.0m, 36.0m
Height of Storey	3.0m
Type of Sections for Frame	Tapered I-section
Sections for Bracing	Hollow square tubular shape
Young's Modulus of Elasticity	2.05x105 N/mm2
Density of Steel	76.8 kN/mm3
Dead Load Intensity	4.625kN/mm2
Live Load Intensity	3.0kN/mm2
Seismic Zone, Z	II, III, IV, V as per IS1893 (Part I):2002
Importance Factor, I	1
Response Reduction Factor, R_f	5
Wind Load	Hyderabad (Intensity = 44m/s) as per IS875 (Part III)

3.1Types of bracing system

i) V – braci

ii) K- bracing

iii) Cross bracing [8]

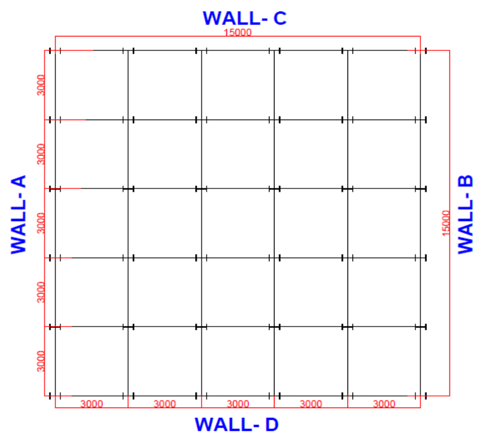
iv) Cross bracing in core of building [9]

Lateral load resisting system are provided in models to reduce the maximum lateral displacement. This system came into action when low rise building are subjected to high seismic load, in high rise building in which wind intensity is very high as compare with seismic load. Bracing is efficient because the diagonals work in axial stress and therefore call for minimum member sizes in providing the stiffness and strength against horizontal shear.

3.1.1 Plan of all models without lateral load resisting system.

This is the plan for four models made up of steel by using tapered I-section for beams and columns with orientation of columns and without any lateral load resisting system in which primary beams are rigidly connected with columns. Rigid connection are provided to resist lateral load. Models are subjected to different earthquake zones II, III, IV, V as per IS 1893 (Part I):2002, dead load, live load and wind load analysed over IS800:2007 by using STAAD V8i. Analysis is done on normal models and models having lateral load resisting system to find out the best bracing system for particular model in particular earthquake zone. Out of four models I showed the elevation of 3 storey model in all cases rest of the models have same elevation.

Fig -1 Plan of all models with Orientation of column.



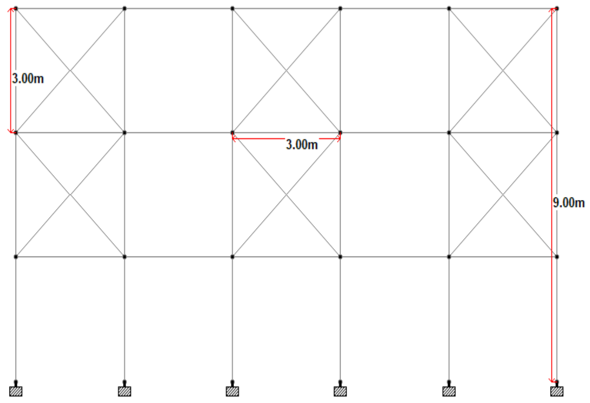


Fig -2 Elevation of 3 storey with X bracing.

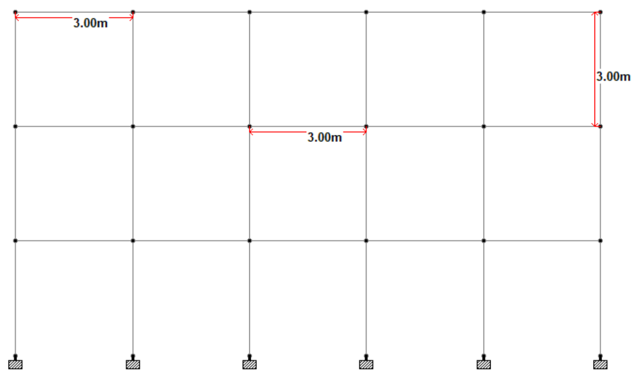


Fig -3 Elevation of 3 storey.

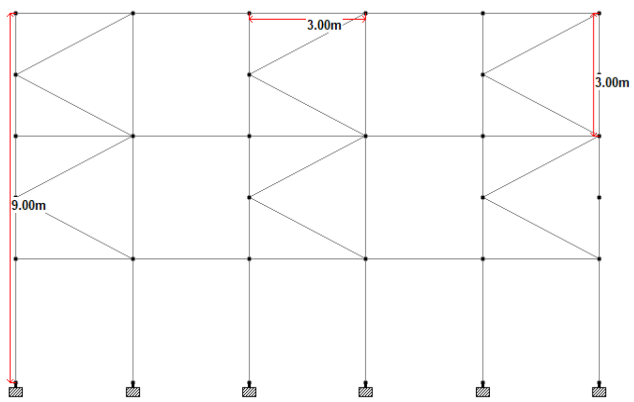


Fig -4 Elevation of 3 storey with K bracing.

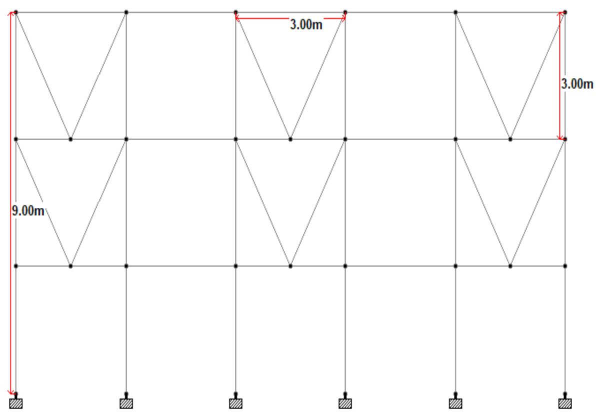


Fig -5: Elevation of 3 storey with V bracing.

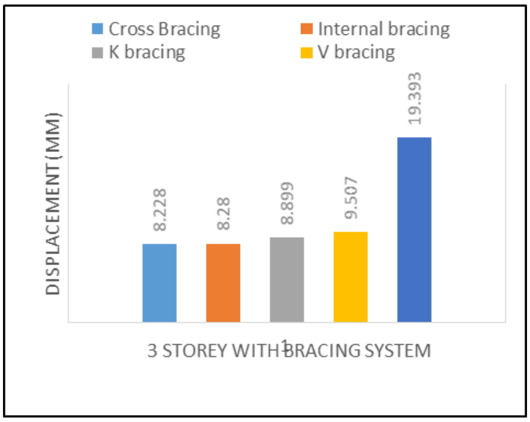


Fig -6 Comparison of displacement for 3 storey model with bracing system.

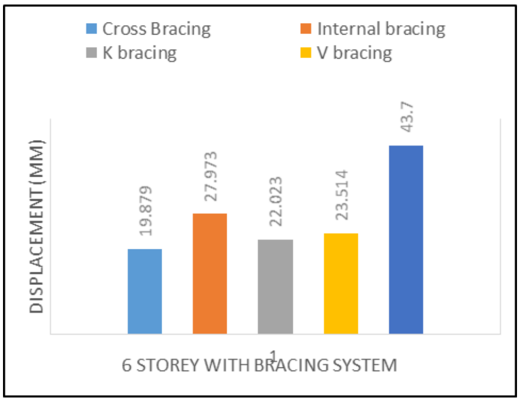


Fig -7 Comparison of displacement for 6 storey model with bracing system.

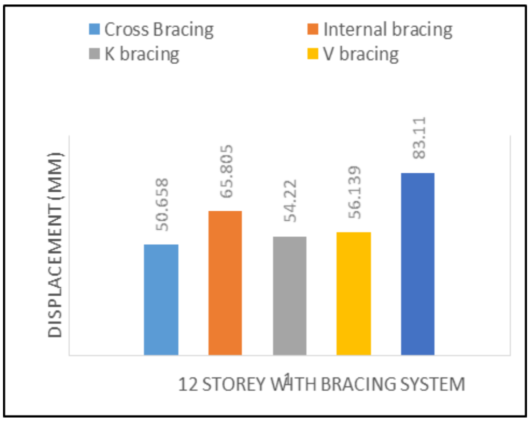


Fig -8 Comparison of displacement for 9 storey model with bracing system.

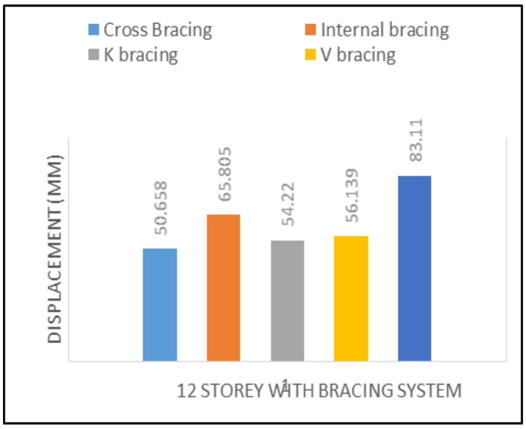


Fig -9 Comparison of displacement for 12 storey model with bracing system.

4.0 Discussion and results

It was observed that cross bracing system is more effective in resisting the lateral load for earthquake zone V among all the bracing system. K bracing can be applied in 3, 6, 9, 12 storey instead of cross bracing system in all earthquake zones so that we can reduce the consumption of steel.

Cross bracing in core was found to best suitable lateral load resisting system for 3, 6, 9, 12 storey model in all the respective earthquake zone, V bracing, K bracing and cross bracing was good for all the models in earthquake zone V.

5.0 Conclusions

In the present study analysis of steel buildings with different parameters like height of building, type of lateral load resisting system at different locations in a building are considered and in all the cases it was attempted to optimize the I-section of columns and beams so that the overall cost of the structure reduces. Some of the major conclusions are

1. With increase in the height of the building from 9.0m to 36.0m, the governing load remains earthquake load only.
2. Of the different models considered all have exceeded the permissible limits of maximum lateral displacement in earthquake zone V.
3. The four types of bracing systems suggested could efficiently reduce the maximum lateral displacement in case of all the models. An effective type of bracing system was identified and found that it was dependent on height and zone for which the model was analysed.
4. Cross bracing, Internal bracing, K bracing, V bracing system was effective for all storey models in earthquake zone V.
5. Internal bracing system found to be most cost effective type of bracing system

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