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A comparative study of seismic response of bare, masonry infilled & braced RC framed tall structures considering the effect of soft story

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Abstract — *The tall structures not only subjected to gravity load but also subjected to dynamic and wind load. If the structures are not designed to resist the additional earthquake and wind load due to earthquake and wind, they may fail causing loss of life and property. So, it is important to provide adequate strength and stability against the lateral load and dynamic load. In present work, the earthquake and wind response of bare, masonry and braced framed buildings with and without soft story are studied considering various parameters. RC Buildings are analyze for earthquake loading as per IS 1893 (Part 1): 2002. ETABS is used for modelling and analysis RC buildings.*

Keywords- *Soft story, Bare frame, Masonry infill RC frame, Braced RC frame, Displacement, Story Drift, Base shear*

I. INTRODUCTION

Now a days there is scarcity of land area, with faster rate of growth in the vertical construction is given importance as a result of that tall structures are being built on a considerable scale. The tall structure requires a realistic technique of transporting people vertically and economical method of construction. The improvement in technologies of elevators and modern RC frame constructions removed the limitation on the height of the structure. Today with the advantage of computers, new structural systems are conceivable and applied to especially tall structures allowing the engineer to assess the new configuration for economic aspects. A structure needs to execute several functions satisfactorily. Amongst these functions of the structure, the cognizant use and occupancy, structural safety, fire safety grades. The minimum demands of structural safety of structure being covered in codes by approach of laying down minimum design loads which have assumed for dead loads, imposed loads, wind load, seismic loads and other external loads.

II. SEISMIC RESISTANT DESIGN OF RC STRUCTURE

Structures designed to resist a load combination of actions; such as self-weight (i.e. dead load), superimposed load (i.e. live load), wind force and earthquake forces. Where natural hazards such as earthquake, wind, snow do not pose a major threat, structural design is mainly governed by the dead and live loads. Such designs called gravity design. The earthquake generated ground shaking is a major hazard, the design load dominated by seismic forces and such design known as seismic design. Thus, it is uneconomical design structures to sustain the maximum probable ground motion, an earthquake rupture can produce, and therefore, a common practice to design structures to respond to earthquake shaking, but allow enough ductility to prevent structural collapse.

III. SOFT STORY

A tall structure in which one or more story has windows, wide doors, large commercial spaces without obstacles, other openings where shear wall, masonry infill walls and bracing which required stability as a matter of seismic resistance design. A tall structure of 3 or more story located over a ground with large openings, such as series of retail business with large windows or parking garage which is called as typical soft story. Soft story collapse is soft story structures which are exposed to collapse in a moderate to severe earthquake. The inadequate braces is related to less resistance then all other story to lateral shaking of ground motion, so disproportionate quantity of the structure's overall drift is focused on that story. Structural damage or total failure may occur due to story becomes a weak point subjected to disproportionate lateral stress, which results in the collapse of the structure.

IV. STUDY METHODOLOGY

For the analysis and modelling, the suitable input details of the building. For analysis, response spectrum method is adopted. Typical 3D model of bare frame, masonry infill frame & braced frame with soft story at multiple story like Ground, 5th , 10th, 15th, 20th, 25th & 30th Floor are presented in case study Fig 2, Fig 3, Fig 4.

"Table 1. Geometric material property"

Component	Description	Data
Model detail	No. of Story	30
	No. of bays in X & Y direction	5 * 5
	Story height	3m
	Soft story height	5m
	Bay width in X & Y direction	5m
	Thickness of slab	125mm
	Wall thickness	300mm
	Size of bracing	200mm * 750 mm
	Size of beam	250mm * 300mm for GF to 10th story
		250mm * 250mm for 11th to 20th story
		200mm * 200mm for 21th to 30th story
	Size of column	600mm * 600mm for GF to 10th story
		500mm * 500mm for 11th to 20th story
		400mm * 400mm for 21st to 30th story
Material	Grade of steel	Fe415 & Fe500
	Grade of concrete	M25
Details	Seismic zone	III
	Importance factor	1
	Response reduction factor	3

V. MODEL DESCRIPTION

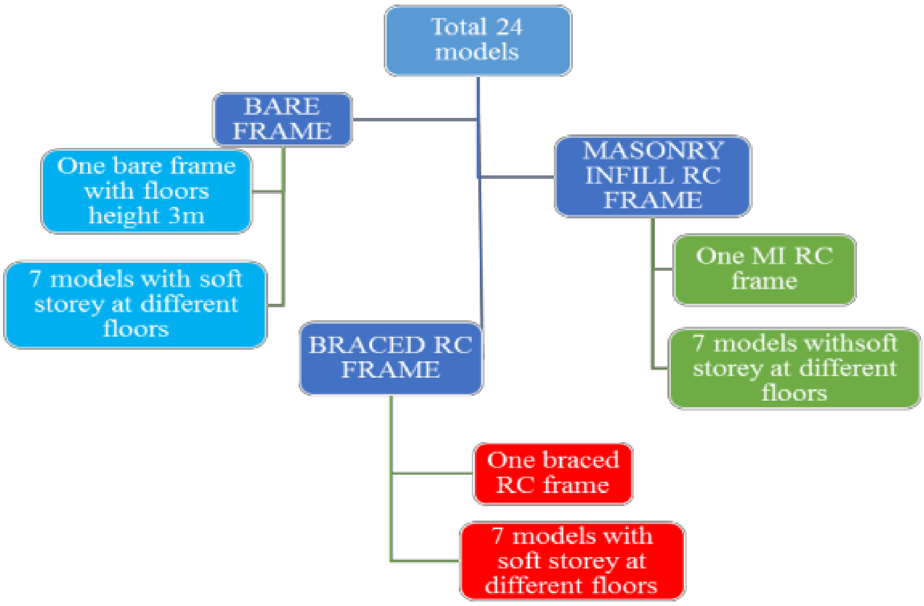


Fig 1. Model description

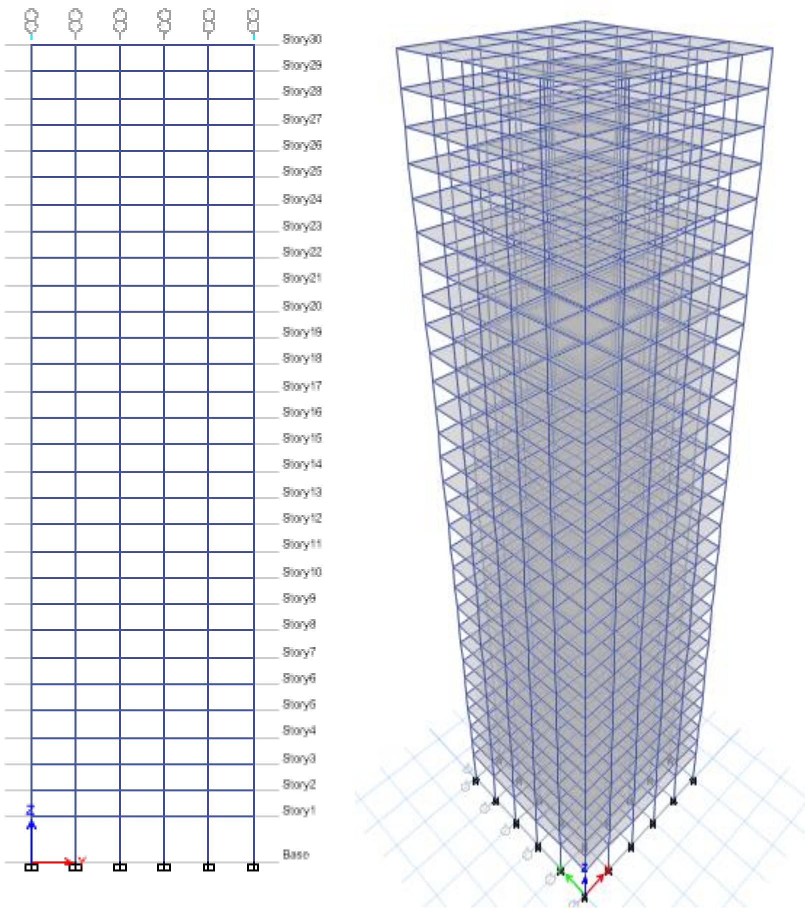


Fig 2. Bare frame

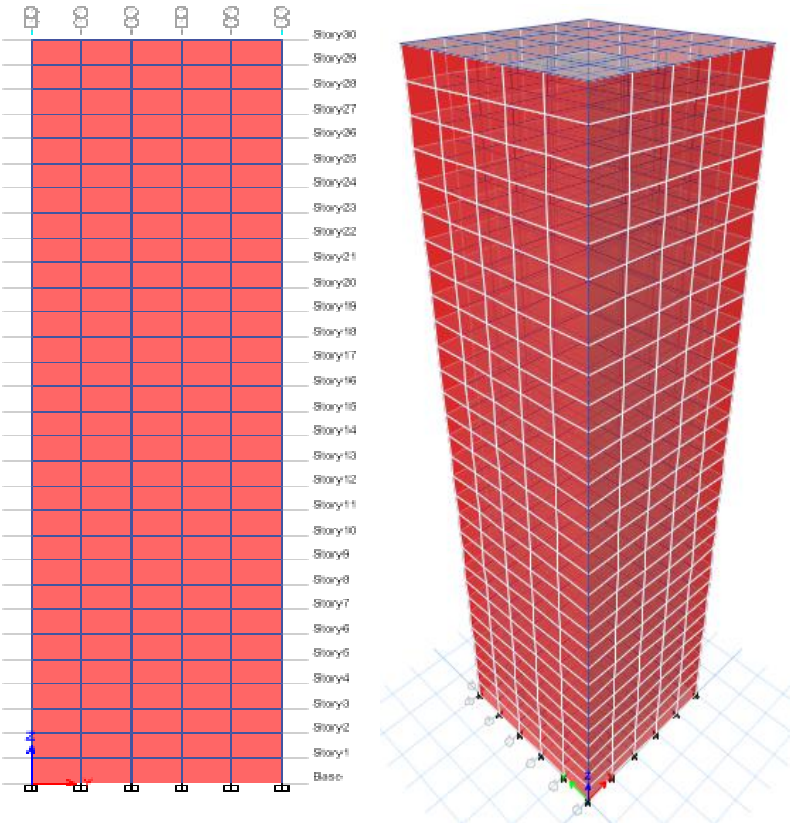


Fig 3. Masonry frame

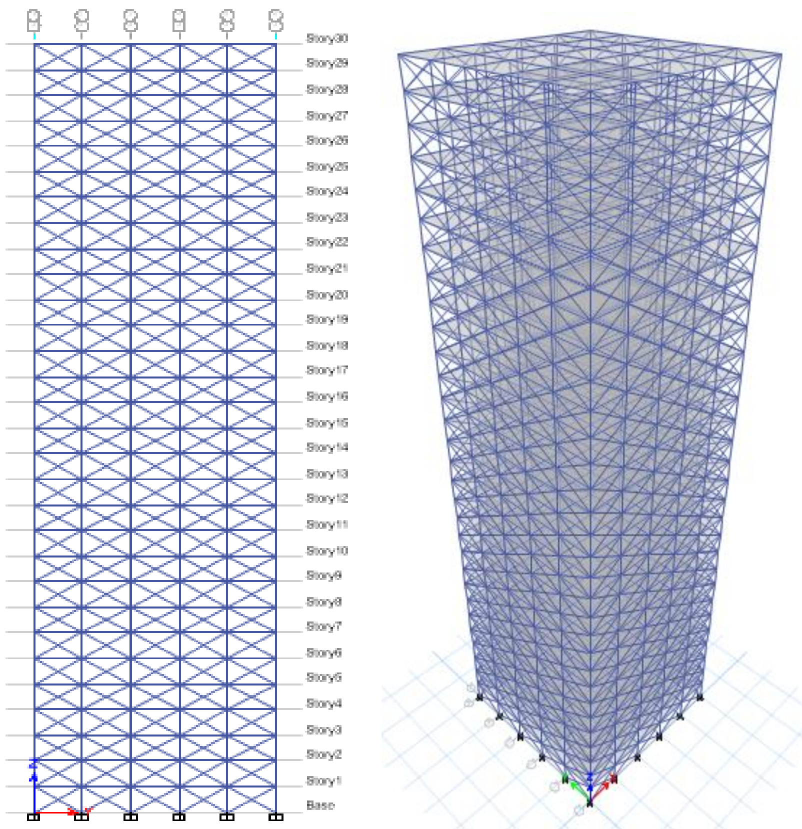


Fig 4. Braced frame

In this study Bare frame, MI RC frame and Braced RC frame is analyzed with & without soft story at different floor.

VI. PARAMETRIC STUDY

Different parameters considered are Displacement, Storey drift, Base shear. They are discussed as follow:

- **DISCPLACEMENT:**

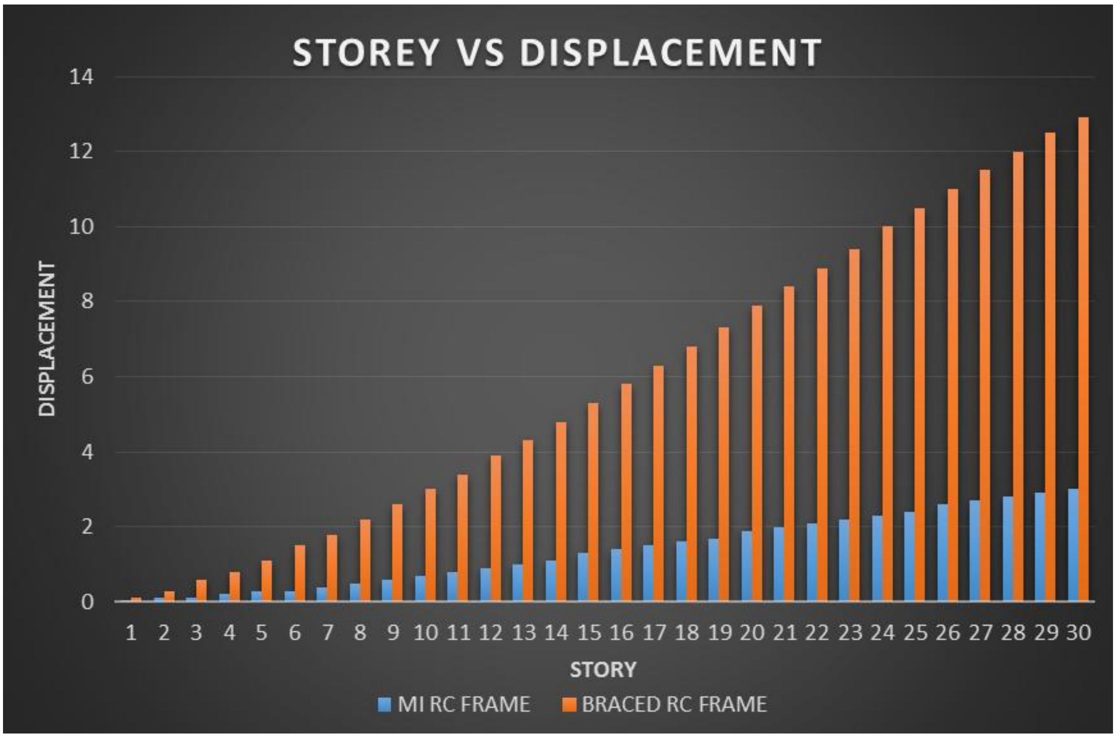


Fig 5. Story vs Displacement chart for without soft story

From above graph, braced frame displacement is more than masonry infill frame.

- **STORY DRIFT**

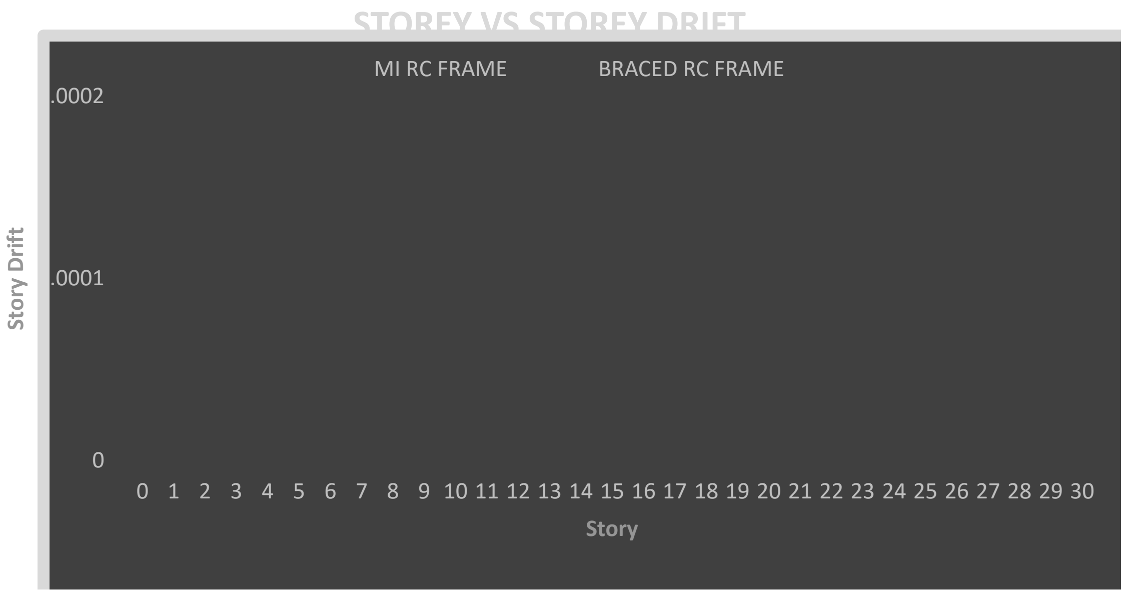
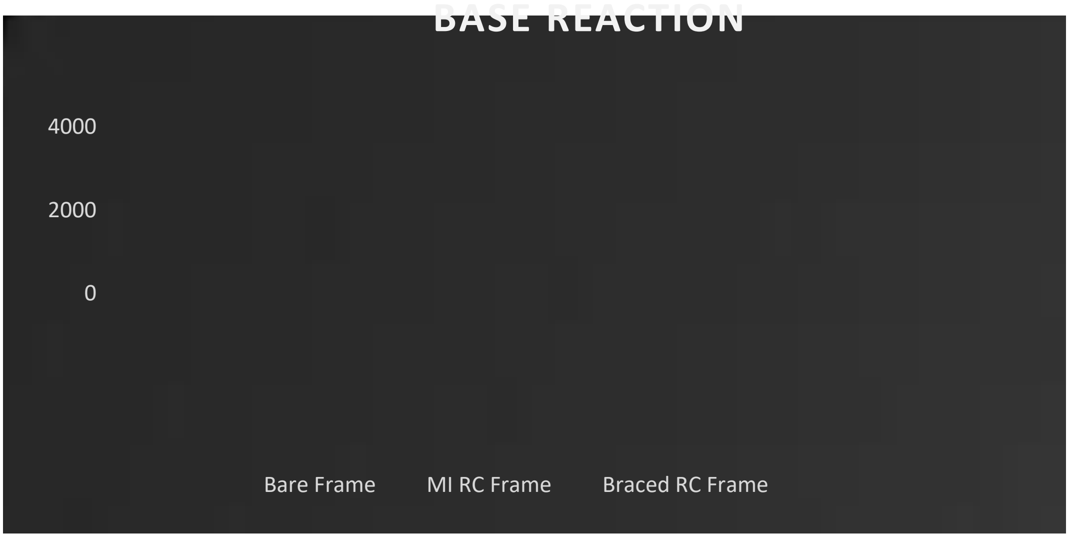


Fig 6. Story vs Story Drift chart for without soft story

From above graph, braced frame story drift is more than masonry infill frame.

- **BASE REACTION**



From above chart, base shear of masonry infill frame is more than base reaction and braced RC frame for all different models.

VII. CONCLUSION

The results of the analysis conclude the following:

1. When the parameter displacement is considered, masonry infill frame displacement is less than bare frame and braced RC frame displacement.
2. It is observed that the story drift is minimum for masonry infill frame than the story drift of bare frame and braced RC frame.
3. Magnitude of base reaction is found maximum for the masonry RC frame than base reaction of bare frame & braced RC frame.

Thus, Masonry infill Frame & Braced RC Frame are very compatible to design soft story structure as compared to Bare Frame.

VIII. ACKNOWLEDGEMENT

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