Analysis of Multi-Storey Steel Structure with Different Infills and Steel Bracings

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Abstract - *Sudden release of stored energy in the earth crust will cause seismic waves these cause impact on the surface of earth .Based on past seismic history these are classified into different zones as zone-II, zone-III, zone-IV and zone-V .Structure which are located in zone-V has more impact on structure due to maximum movement in the ground. Seismic loads these lateral loads causes more impact on structure. Seismic loads cause base shear, story drift, base moment in structure this impact will affect on stiffness and strength of structure. Modern days shear wall, bracing systems, infills, tubular system are more effective in resisting lateral loads. Steel multi story structures show appropriate seismic response As impact of Lateral load increases tension in structural membrane gradually increases. There is different type of steel Bracing systems X bracings, V bracings, inverted V bracings, single diagonal bracings. X bracings reduces more amount of base movement and lateral displacement of structure is reduced by single diagonal bracing and X bracing. Infills walls are placed in between the Coloums and beams help to carry a large amount of uniform vertical loads from the beams give stiffness to structural members and lateral rigidity. Brick infills, concrete infills, timber infills, lightweight steel infills in these brick masonry infills and concrete infills provides more stiffness and rigidity to members. In this mentioned software's I have prefer to use SAP2000 and ETABS to compare the results. To achieve economic design with better stiffness, Lateral strength in a preferred seismic zone*

***Key Words*: steel sections, bracings, infills, base shear, story displacement, story drift,**

1. INTRODUCTION

Earthquake produces large amount of energy to the surface of earth these energy causes large motion due to which structures gets large amount of lateral forces and due to which it causes high risk in the structure. Steel is most useful material for building construction in world. Strength ten times more than concrete and ideal material of recent construction. Its main advantage of steel is strength and fast construction. Structural steel is employed in load-bearing frames in buildings. In steel buildings, claddings and dividing walls are made up of masonry or other materials, and often a concrete foundation is provided. Due to its large strength to weight ratio, steel structures tend to more economical than concrete structures. Steel structures can be constructed very fast and this permits structure to be used early there by resulting in overall economy steel offers much better compressive and tensile strength than concrete and enables lighter constructions.

1.1 FRAMES

Generally these composed of beams and columns and these have ability to resist lateral loads is entirely because rigidity of the beam-column connections. They are called 'rigid frames', because ends of the members are joint are rigidly connected in such a way that they all undergo constant rotation under the action of loads.

1.2 INFILL

Infill wall is the supporting wall that closes the perimeter of a building. Therefore structural frame ensures the bearing function, where infill wall serves to separate inner and outer space, filling up the boxes of the outer frames. Infill wall has unique static function to bear its own weight. With reference to other categories of the wall, the infill wall differs from the non-load bearing, and from the load-bearing wall, but performs static functions too. Infill walling is that the generic name given to a panel i.e., inbuilt between floors of the primary structural frame of a building and provides supporting system. Infill walls resist wind loads applied to the facade.

1.3 BRACE

Steel bracing is economical, occupies minimum space, easy to set up and also have flexibility in nature for design to reach required stiffness and strength. Braced frames in structures are usually considered to resist lateral forces and gravity loads. They provide more stiffness against horizontal shear because of the diagonal member elements work in axial stress. Buildings are designed as per the code standards at the time of their erection to avoid the damage of building even from large scale earthquake. Buildings don't have lateral strength as well as ductility even if they are designed as per code standards. To satisfy strength and serviceability lateral stiffness is a major consideration for design a tall building. A simple parameter that can be used to estimate the lateral stiffness of a building is by the drift index is defined as ratio of total height to the maximum deflections at top of the building. Different structural system to tall buildings can be used to improve its lateral stiffness and can reduce a drift index.

1.4 STRUCTURAL MODELING AND ANALYSIS

In this study an analytical model of G+ 8 Storys with width 4 and 4m in both X and Y directions respectively. With story height of 4m total height of the building is 40 m analysis compression done with bare frame model, framed with bracings, frame with infills and frame with pre-cast infill and X-brace models with different column sections to make structure element safe. Pushover analysis considered in the study. Structure columns base are fixed. The models are analyzed as per Indian Standard Code and ATC – 40 and FEMA356.

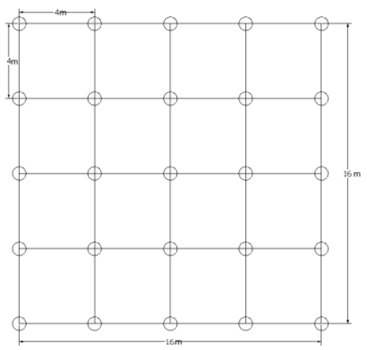

Fig -1: Common plan for the entire building mode

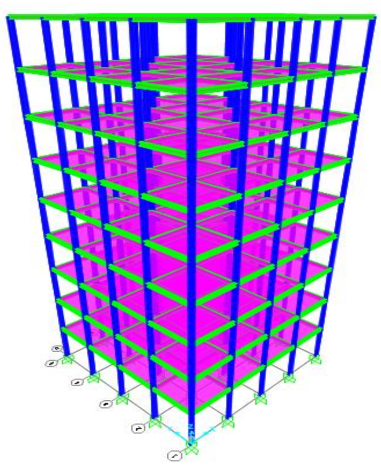

Fig -2: Bare Frame

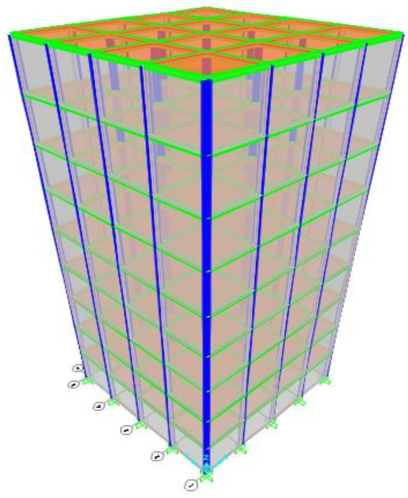

Fig -3: Bare frame with pre-cast pane infill

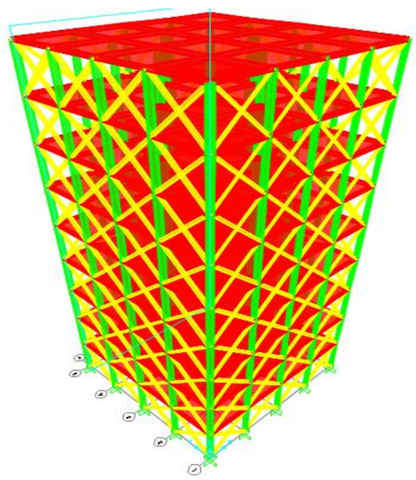

Fig -4: Bare frame with X-brace

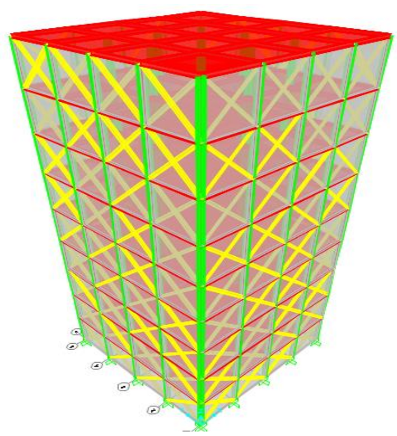

Fig -5: Bare frame with X-Brace and pre- cast infill

Table -1: Models Considered For the Analysis

Sl/No	Model	Bold
1	Steel Bare Framed Model with ISMC400 channel laced with flats 12mm thickness width of 250mm as a column and beam ISWB300.	SFM 1
2	Steel Bare Framed Model with ISMC400 channel laced with flats 12mm thickness width of 250mm as a column and beam ISWB300 with pre-cast panel infills.	SFM 2
3	Steel Bare Framed Model with ISHB450-2 with flats 10mm thickness width of 250mm as a column and beam ISWB300 with X-brace.	SFM 3
4	Steel Bare Framed Model with ISHB450-2 with flats 10mm thickness width of 250mm as a column and beam ISWB300 with X-brace and pre-cast panel infills.	SFM 4

1.5 MATERIAL PROPERTIES

The structure beam, column and brace members are Fe345 grade of steel and concrete for slab and infill panel grade of M_{25} respectively. Models used in this study. Parameters considered for this study is given below.

Table -2: Building Parameter Considered In This Study

Sl/No	Model	Nomenclature
1	Slab (thickness)	150 mm
2	Beams	ISWB300
3	Columns	ISMC400 channel laced with flats 12mm thickness width of 250mm with ISHB450-2 with flats 10mm thickness width of 250mm
4	Pre-cast panel infill (thickness)	160 mm
5	bracing	ISA 200X200X25
6	Live Load	4 kN/m^2 for all the floors
7	Earthquake Load	As per IS 1893 (Part – 1): 2016
8	Type of Soil.	Type II, Medium
9	Importanc e Factor	1
10	Response Reduction Factor	5

1.6 ANALYSIS AND RESULTS

Base shear due to seismic ground motion at the base of a structure. The structure is analyzed with Dead, Live loads, static earthquake loading method and the resulting base shear in the table below.

Table -3: Base Shears along X and Y – Direction

Structure Type	Ex. (kN)	Ey (kN)
SFM 1	572.681	572.681
SFM 2	1409.72	1409.72
SFM 3	611.907	611.907
SFM 4	1470.25	1470.25

Storey drift is defined as the ratio of displacement of two consecutive floors to height of that floor Storey drift obtained from both response spectrum in both X and Y direction maximum story drift for bare frame, pre-cast panel infill, X-brace, and pre-cast panel infill with X-brace are shown in Table respectively.

Table -4: Storey Drift for Response Spectrum Analysis along X- Direction.

Structure Type	RSX	RSY
	Along X-direction	Along Y-direction
SFM 1	0.0115993	0.026736
SFM 2	0.0004265	0.000428
SFM 3	0.0007761	0.000784
SFM 4	0.0004068	0.000408

1.7 CONCLUSIONS

Use of infills and bracings it helps in reduce displacement, and story drift in the model by use brace it help to reduce the section. Displacement and story drift was observed to be maximum for Bare Frame, Pre-cast panel infills, X-brace models and displacement is reduced for X-brace with Pre-cast panel infill models this condition is observed because infill and bracing system causing minimum displacement and story drift. From the above, it can be seen that the framed model with pre-cast panel infill with X-brace shows much better performance than bare frame, Pre-cast infill and X-brace models

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