SEISMIC ANALYSIS OF MULTISTORY BUILDING CONSIDERING X TYPE BRACING

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ABSTRACT: Earthquake is the natural calamity known to mankind from many years, from the ancient time researches researched many ways to protect the buildings. There was a need to control the damage caused by earthquake to the both existing and newly to build structures. Bracing has been used to stabilize laterally the tallest building structures. Braced frames can resist large amount of lateral forces and have reduced lateral deflection and thus reduces devastation.Steel bracing framework expands the stiffness and strength of the RC multi-storey building and reduces their deformation.In present study we have used an H shaped irregular building with 36m along X and 36 m along Y direction. In order to be able to prevent or to minimize occurrence of cracks, it is necessary to understand basic causes of cracking and to have knowledge about certain properties of building materials, specification for mortar and concrete, Architectural design of building, structural design, foundation design, construction practices & techniques and environments.
Keywords: seismic analysis, earthquake excitation, ordinary moment resisting frame, member forces, joint displacement, support reaction, storey drift, STAAD PRO V8i.

I. STATEMENT OF THE PROBLEM

The vast majority of the fortified solid structures were composed basically for gravity loads. They were also designed for lateral forces that may be much smaller than that prescribed by the codes and this needs additional supporting element in the plan of RC frame such as; bracing RC frame by internal steel bracing which act as shear opposing component for the design of new RC building. And for retrofitting of existing structure on account of a deficient seismic load limit of existing RC structure. In such case some bracing frameworks are more successful or give preferable outcomes over other supporting framework in resisting all the horizontal loads, therefore among the main bracing systems which are most efficient in resisting seismic load?

At the point when a tall building is subjected to sidelong or torsional avoidances under the activity of fluctuating seismic burdens, the subsequent oscillatory development can instigate an extensive variety of reactions in the building's inhabitants from mellow inconvenience to intense sickness. As far as a definitive cutoff state is concerned, horizontal redirections must be constrained to anticipate second request p-delta impact because of gravity stacking being of such a size which might be adequate to encourage fall. To fulfill quality and usefulness restrain gazes, sidelong solidness is a noteworthy thought in the plan of tall structures. The straightforward parameter that is utilized to appraise the sidelong firmness of a building is the float file characterized as the proportion of the most extreme avoidances at the highest point of the working to the aggregate stature. Distinctive auxiliary types of tall structures can be utilized to enhance the sidelong solidness and to lessen the float file. In this exploration the investigation is led for supported edge structures. Bracing is a very effective and sparing strategy to along the side harden the edge structures against wind loads. A propped twisted comprises of common sections and braces whose basic role is to help the gravity stacking, and corner to corner supporting individuals that are associated with the goal that aggregate arrangement of individuals shapes a vertical cantilever bracket to oppose the even powers. Bracing is effective on the grounds that the diagonals work in pivotal pressure and in this manner call for least part sizes in giving the solidness and quality against level shear.

II. OBJECTIVE OF THE STUDY

The main objective is:

- To determine the effect of X type of Bracing system over a tall structure.
- To determine the lateral stability of the structure under seismic loading as per Indian Provision I.S. 1893-I:2002.
- To determine the utilization of analysis tool staad.pro for modelling and analysis of a tall structure.

III. MODELING DESCRIPTION

They considered a rectangular building for analysis symmetric in plan and elevation. Plan dimension of building to be modeled is 28 m x 40 m. It comprises of seven narrows of 4m with ten bayous of 4m in longer and shorter side individually and stature is G+20.

They considered those stories listed above according to the literatures which say steel propped fortified cement building is economical and efficient for building of any height. “The productivity of propping in having the capacity to deliver an along the side firm structure for at least extra material makes it an efficient auxiliary shape for any tallness of working, up to the exceptionally tallest. An extra favorable position of completely triangulated propping is that the shafts more often than not take an interest just insignificantly in the parallel supporting activity.

IV. RESULTS & DISCUSSION

4.1 Creating Cases for Comparative Analysis

Building frame is modelled in analysis tool Staad pro in which steel angel-shape X-type bracings are presented at the edges of a structure and seismic lateral forces are applied as per I.S. 1893 part-1 2002, Dead load as per 875 part-1 and Superimposed live load according to 875 part-2 is calculated and applied.

4.2 Geometrical properties

Following geometrical properties has been considered with materials in modeling:-

Material properties

Table no 4.1 Material Properties

Material property	Values
Grade of concrete	M-25
Young's modulus of concrete, E_c	$2.17x10^4$ N/mm^2
Poisson ratio,	0.17
Tensile Strength, Ultimate steel	505 MPa
Tensile Strength, Yield steel	215 MPa
Elongation at Break steel	70 %
Modulus of Elasticity steel	193 - 200 GPa

Materials assigned in staad pro is defined as per table 4.1, for steel sections FE 345 grade of steel is considered which is utilized in Indian steel sections.

Geometric properties

Table no 4.2 GeometricProperties

Description	**Values**
Number of storey	Twenty
Number of bays in X direction	Seven
Number of bays in Z direction	Ten
Height of each storey	3.50 m
Bay width in X direction	4 m
Bay width in Z direction	4 m
Size of beam	250 x 350 mm
Size of column	350 x 350 mm
Thickness of R.C.C. slab	125 mm
Steel Bracings	Angel section 150 x 150 x 15

Symmetrical structure of G+20 Structure is considered, with specific sectional data of column, beam and slab in all the cases for comparison. Angel Section is considered for bracings.

4.3 Loading Conditions

Following loading is adopted for analysis:-

(a) Dead Loads: as per IS: 875 (part-1) -1987.

Table 4.3: Details of dead load

Brick masonry wall load					**Remark**
For floor height 3.5 m	=	0.18 m x (3.5 - 0.45) m x 18 kN/m^3	10.300	kN/m	U.D.L.
Parapet wall	=	0.18 m x (1.2) m x 18 kN/m^3	4.6.00	kN/m	U.D.L.
Floor Load					
Slab Load	=	0.125 m x 25kN/m^3	3.125	kN/m^2	slab thick. 125 mm adopted
Floor Finish	=		.96	kN/m^2	Flooring
Total Load	=		4.025	kN/m^2	

(b) Live Loads: as per IS: 875 (part-2) 1987.

Live Load on run of the mill floors = 3.00kN/m2

Live Load for seismic figuring according to I.S. code 1893-part1 = 0.75 kN/m2

(c) Earth Quake Loads: All edges are broke down for (IV) seismic tremor zone.

The seismic load estimation are according to IS be: 1893 (part-1)-2002.

Soil-Structure Cooperation is an attempting multidisciplinary subject which covers two or three areas of Civil Designing. In each reasonable sense each headway is associated with the ground and the participation between the old anomaly and the establishment medium may affect basically both the superstructure and the establishment soil.

Here we are considering medium type of soil.

Table 4.4: Seismic force parameters for proposed issue

S. No.	Parameter	Value
1	Zone (II, III, IV &V)	0.1, 0.16, 0.24 & 0.36
2	Damping ratio	0.05
3	Importance factor	1
4	Response Reduction Factor	5
5	Soil site factor	Soft

Movement in X direction (P_X) $=\frac{0.09Xh}{\sqrt{dx}}$seconds (Clause 7.6.2)

Movement towards X direction (P_X) = $\frac{0.09X15}{\sqrt{30}}$ = 0.667

Movement in Z direction (P_Z) = $\frac{0.09Xh}{\sqrt{dx}}$seconds (Clause 7.6.2)

Movement towards Z direction (P_Z) = $\frac{0.09X15}{\sqrt{30}}$ = 0.667

Where h: height of the frame.
dx = overall length of building towards X direction.
dz= overall length of building towards Z direction.

Therefore, Sa/g (acceleration coefficient) = 2.5 (as per IS code).

V. CONCLUSION & RECOMMENDATIONS

5.1Conclusion

The steel bracing system has not only improved displacement capacity of reinforced concrete structures, but also the horizontal solidness and quality limit of the structures by increasing its shear capacity.

- In the earthquake resistant design of RC framed building the steel quantity increased by 1.517% to the convention concrete design. The steel quantity increased in the structure ground floor to higher floor i.e level of the structure. Story displacement ought to be restricted on the grounds that diversion must be constrained during the earth shudder to ensure the harm of basic components, particularly nonstructural components, and thus the arrangements of steel propping for the RC structure give satisfactory solidness for the structure and among the pre-owned supporting X-supporting sorts have been given better outcome in decrease of story float.
- The base shear capacity of steel propped outline is expanded when contrasted with bare frame (without bracing) building which shows that the solidness of building has expanded.
- The Storey drift condition for considered building, the base drift=0.0 at every storey. This says that the structure is safe under drift condition. Hence shear walls, braced columns are not necessary to be provided. Hence storey drift condition is checked for the building.

Summary:
Finally we can conclude that both X-bracing system may be used to new design or retrofit for damage level earthquake, however, X-bracing system is more suitable to use The corner bracing configuration is better lateral displacement reduction arrangement from the other bay wise arrangement of steel propped fortified solid structures.

5.2 Recommendations
The following recommendations are suggested by us after the analysis of the results arising from the investigation was done on introduction of X type bracing for lateral load resisting structure:

- It is recommended to use X type Bracings which make structure rigid and stable to resist lateral forces without deformation or failure.
- For Tall structures where intensity of forces are comparatively more are recommended to assign X type bracings to keep the structure within permissible limit.
- It is recommended to use analysis tool staad.pro which is more precise and performing analysis in a short duration as compared to manual analysis and design.
- Results reveal that damage to the structure due to seismic forces are minimized by utilizing bracings at the outer periphery of the structure.

5.3 Future Scope

- In this study G+20 structure is considered whereas in future it can be extend to more tall structure.
- In this study seismic analysis is performed whereas in future wind load can be consider.
- In this study Staad.pro analysis tool is utilized whereas in future other analysis tool can be preferred.

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