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Seismic Analysis of High Rise Building Using Outriggers and Belt- Truss System

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Abstract –

Tall building development has been hastily growing international introducing new demanding situations that want to be met thru engineering judgment. In cutting-edge tall buildings, lateral loads induced by wind or earthquake are regularly resisted with the aid of using a machine of coupled shear walls. But while the constructing will increase in height, the stiffness of the shape will become extra crucial and creation of outrigger beams among the shear walls and outside columns is regularly used to offer enough lateral stiffness to the structure. A variety of various techniques has been hired to pick out the premier places of those outrigger beams under wind load. However, there may be a scarcity of clinical studies or case research coping with premier outrigger region beneathneath earthquake hundreds. This have a look at objectives to pick out the premier outrigger region in tall homes beneathneath earthquake hundreds. A 25 storey constructing changed into investigated and 3 extraordinary top floor acceleration to top floor speed ratios in every class of earthquake data have been included on this studies have a look at to offer a constant stage of approach. Response spectrum evaluation changed into performed and the behaviour of the constructing changed into decided thinking about reaction parameters along with lateral displacement and inter storey drift.

1. INTRODUCTION

In standard the edifice of large constructing is developing swiftly across the world, elevating new problems that require being deal with the use of a variety of architectural/structural engineering techniques. The related shear wall structures withstand the lateral seismic hundreds of cutting-edge skyscrapers. However, because the peak of the constructing increases, the tension of the shape will become extra and further important. In common, earthquakes be capable of occur everywhere withinside the world, apart from due to the fact greater human beings stay in skyscrapers, unique interest have to be paid to the dangers related to skyscrapers, mainly beneathneath extreme seismic pressure. When with a outrigger structural device in a high-upward thrust edifice, the cantilever should be positioned withinside the excellent in all likelihood vicinity to create the shape stronger. The outrigger is the bounds that join the outside help to the primary middle partition of the skyscraper and gets lateral forces past the primary shape. Most ships use wood outriggers to counter the wind pressure of the sails. The middle of a tall shape may be likened to a deliver's mast, with outriggers performing as spreaders & outer pillars performing as deliver envelopes. The help enterprise can take in the lateral forces resulting from the earthquake & switch the burden to the inspiration through outside supports. Outriggertrusses in wall frames are one of the maximum green and cost-powerful systems in skyscrapers, with outer columns regarding the outer finishing as a bottom. Cantilever beams (outriggers) are used to govern the overturning second of the middle and switch the instant from the middle to the outer column via way of means of connecting the two. When a horizontal load is carried out to the shape, the partitions and cantilever trusses rotate, inflicting compression at the leeward columns and anxiety at the leeward columns. The cantilever brace is placed at the outer circumference and is hooked up to the inspiration through the outer help and is known as a belt trusses. The outrigger braces related among the centre & the outer column acts as a inflexible beam that falls beneathneath the transferring of the lateral load. The belt binder connects the outer peripheral column of the shape and affords a superb deal large circumference to set the aspect deflection of the layout deduction. This inexperienced structural form connects persuasive facilities and growth conflict to the outward column. The primary located primary targeted on every aspect and middle extending at the aspect of the configuration is detected.

2. METHODOLOGY

This chapter deals with the line of action of project study i.e. the methodology need to contribute to the achievement of desired goals of it. These methodologies basically have number of steps or set of procedures discussed in this section.

The section sizes were decided first then the material properties were found out. In this section, methods of analysis and details of model are described. This study is carried out to nvestigate the effect of outrigger structural system on response of high-rise steel building under the seismic forces modeling is done using ETABS software.

2.1 MODELLING AND ANALYSIS

2.1.1 Input Data of Building:

- Type of Structure- High-rise G+25 story building
- Outrigger bracing system- X-type , V-type and V Inverted V-type
- Bracing section – L section
- Size of beam- ISWB300
- Size of column- ISWB600
- Floor height- 3m

2.1.2 Material properties:

The basic material properties used are as follows:

- Yield strength of steel – 250N/mm2 mild steel

Modulus of elasticity of steel Es – 200

2.1.3 Details of model:

Type of frame	Ordinary braced frame
Building plan dimensions	30 x 30 m
Bays in X- and Y-direction	5 bays of 6m each
No. of floors	G+25
Seismic zone	IV
Seismic zone factor	0.24
Soil type	Medium
Importance factor	1.2
Response reduction factor	5
Height of floor	3 m
Slab thickness	200 mm
Type of outrigger brace	L section
Thickness of L section	10mm
Size of brace	110x110mm

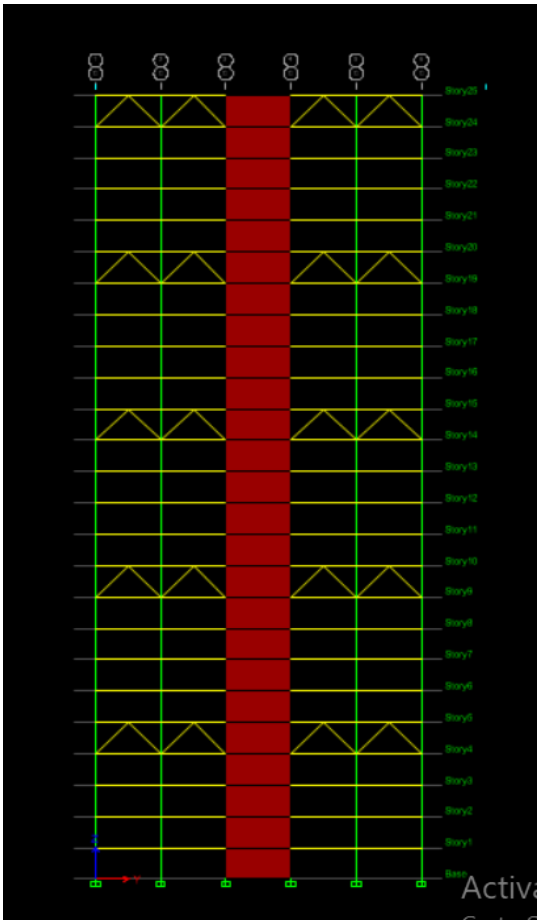


FIG-1 Model with V-Inverted type braced outriggers located

3. RESULTS AND DISCUSSION

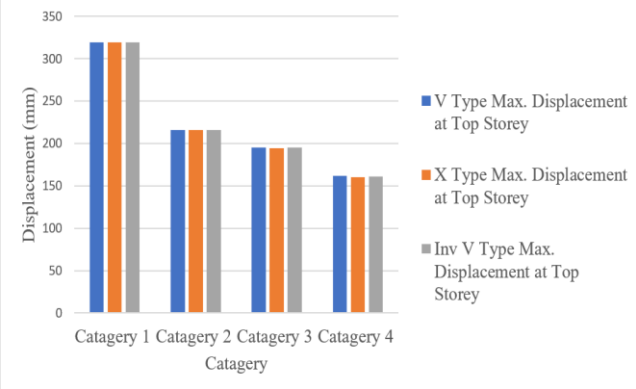


Fig 2 Graph Displacement in mm vs Category

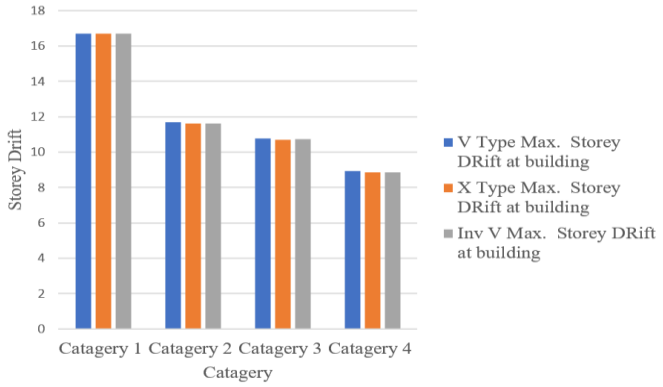


Fig 3 Graph Drift in mm vs Category

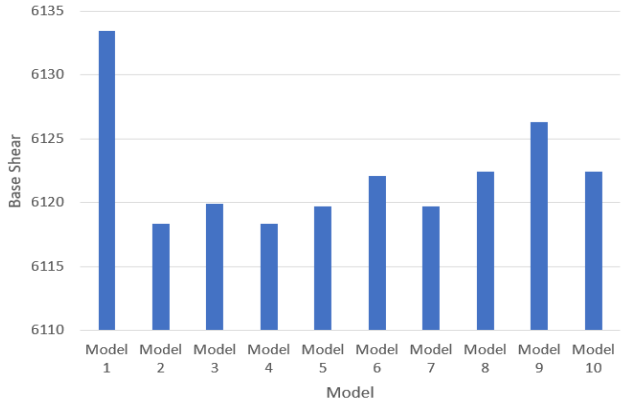
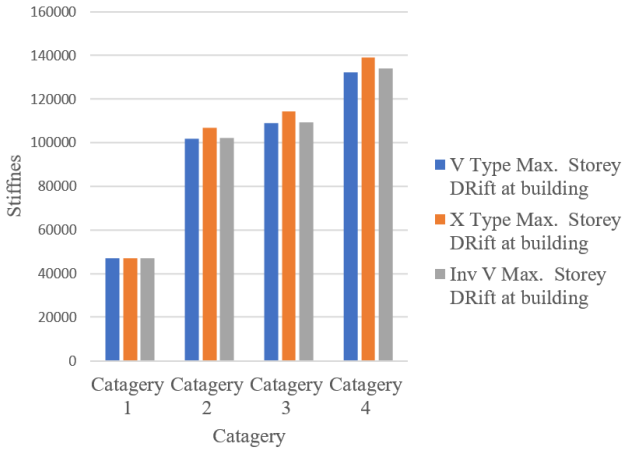


Fig. 4 Graph Model vs Base shear in KN



3. CONCLUSIONS

From the seismic analysis of G+ 25 storeys building provided with outrigger and belt truss structural system, following conclusions can be drawn:

1. The seismic behavior of G+25 storey building with outrigger and belt truss system shows reduction in responses such as lateral displacement, storey drift, base shear.
2. From analysis of the G+25 storey building provided with the outrigger and belt truss systems using X, V, and V Inverted type bracing, it is observed that X type bracings are more effective than V and V Inverted type bracings as are giving minimum displacement and drift values also gives maximum stiffness.
3. In the analysis of the G+25 storey building, provided with outrigger and belt truss system with X type bracings, the lateral displacement and maximum storey drift gets reduced by 49.76 % and 46.91% respectively and stiffness increases by 295.04% compared to the values obtained from the analysis of conventional frame type building.
4. But as we compare the result of all type of bracing and belt truss, V Inverted is convenient than the X bracing and belt truss, because the value of lateral displacement, story drift obtained by V Inverted bracing and belt truss is 49.64 % and 46.81% and stiffness is 284.66% which is similar to the X bracing and belt truss
5. As X bracing has more connection between them as compared to V Inverted bracing, even the X bracing is only connected to the column but V Inverted bracing is connected to column and beam so that beam get's the supported.
6. The effective numbers of outriggers and belt truss in the structure for safety were observed as 3,5.

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