Behaviour Analysis of High Rise Irregular Structure with Change in Orientation of Columns

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ABSTRACT:- *In the present generation, the construction statement as changed and got a new style of constructing the irregular structures with various architectural ideas especially for greater aesthetical view. Structure with irregularities is very prone to seismic activities are extremely dangerous. Structures with mass irregularities has considered for the analysis. Various research works have been carried on structure built with irregularities and to study their response with respect to the seismic forces and effect of irregularities on structure under dynamic loads.*

The present study investigates the Response spectrum analysis of G+17 multi- storey building, it is modelled using SAP2000. It includes the behaviour of irregular structure with different zone conditions. Study also includes 24 models with varying zone factor and reduction factors (2 and 3). The multi-storey irregular structure is modelled by considering soil type 2 & 3. Twelve models are modelled without change in column orientation, remaining models are modelled without change in orientation of columns. Finally, the outcomes of response of all these models are studied with respect to seismic parameters such as storey displacement, storey drift, storey shear, overturning moments and base shear. Parameters like angle of twist versus displacement and stiffness are studied.

Key Words: Stiffness, Irregularities, Angle of twist, Base Shear, Overturning Moment, Orientation.

1.INTRODUCTION

During earthquake motion the behaviour of high rise structures depends on distribution of strength, stiffness, & mass in both horizontal & vertical planes. The response of structure depends with respect to regularity or irregularity of structures. Urbanization of cities leads to increase growth in population of cities which leads to insufficient land & area for agriculture use is restricted & also in cities land prices is increased. Several structures in present days have ir-regular formation in plan & height, when it is subjected to distractive earthquake, it is important to determine those structure performances under distractive earthquake. Twisting force caused due to ir-regularity & unequal distribution of mass, stiffness & strength in structure. eccentricity in structure layout. & this distribution doesn't coincide with centre of rigidity of structure in this case torsion arises. It can eliminate by choosing regular plan, & by coinciding to centre of rigidity.

2. Objective & Scope

- To Study the performance of high-rise structure with irregularities.
- To study performance of high-rise structure under dynamic load using dynamic analysis of structure with oriented and without oriented columns.
- To study behaviour of high-rise structure with different zones, soil-type and reduction factors.
- To estimate behaviour of irregular high-rise structure exposed to seismic & wind loads.
- To extract the results and compare the behaviour of High-rise structure.
- To study condition of High-rise structure in terms of base shear, lateral displacements, storey drift, storey stiffness, storey shear and angle of twist.

3.Methodology

In this project 24 models are considered in which 12 models without change in orientation of columns, remaining models with change in orientation of columns (10,20,30,40,45, and 50 degree with linearly varying with floors). Initial material properties, and frame sections are defined, after it load cases, combinations and pattern are defined, Outcomes of response of all these models are studied with respect to seismic parameters such as storey displacement, storey drift, storey shear, overturning moments and base shear. Parameters like angle of twist versus displacement and stiffness are studied.

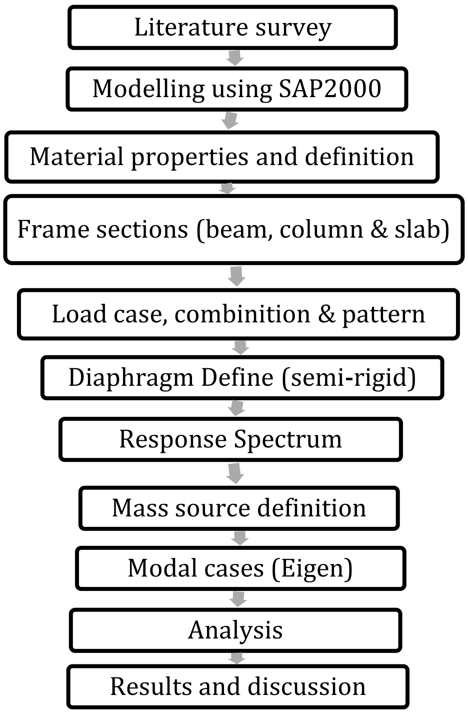

Chart-1: Methodology

4. Response method of analysis

In order to accomplish seismic investigation and design of a structure to be construct in specific place, time history record is essential. if it is not achieved to have such data seismic investigation of structure not possible to carry out in such case response spectrum analysis can implement. It is graph obtain by plotting maximum response of structure exposed to specified earthquake ground motion and its time period or frequency

It is dynamic method used to analysis the structure. in this method structure response for each mode can be found for high and low-rise buildings. Total response of structure is mixture of entire modal resp*onses. It is experienced since long period because of easy calculation and lesser consumption of time. By computer analysis mode of building obtain. From the design spectrum response can be obtain with respect to modal mass & modal frequency, by adding them response of structure is obtain. To obtain higher values of response of structure Absolute sum (ABSUM) method, Square root of sum of squares (SRSS)method and complete quadratic combination (CQC)method one of these methods used.in this project analysis is done with different zones, soil-type, Reduction -factor and Importance factor 1.2.

5. RESULTS AND DISCUSSIONS

Obtain results from the analysis are discussed in this chapter Graphs are plotted with respective to storey responses (Storey-Displacements, Storey-Drifts, Storey-Shear and Storey-Stiffness). i.e. load cases and defined response spectrum such as EQ-X, EQ-Y, RS-X and RS-Y. Following graphs are plotted against storey number vs different storey responses.

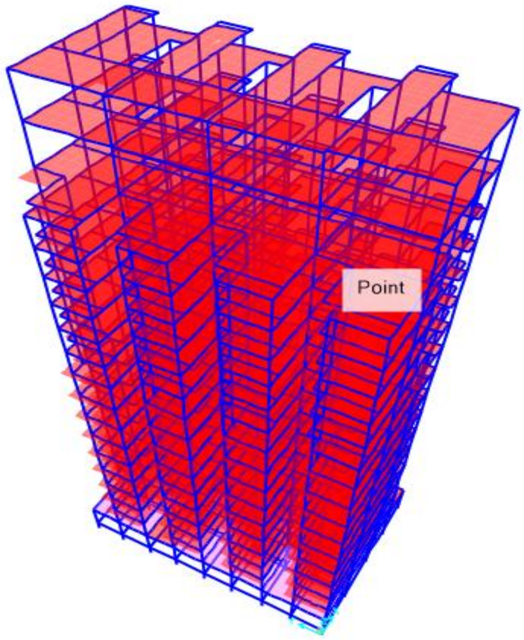

FIG-1: 3D VIEW OF MODEL

5.1 STOREY DISPLACEMENT

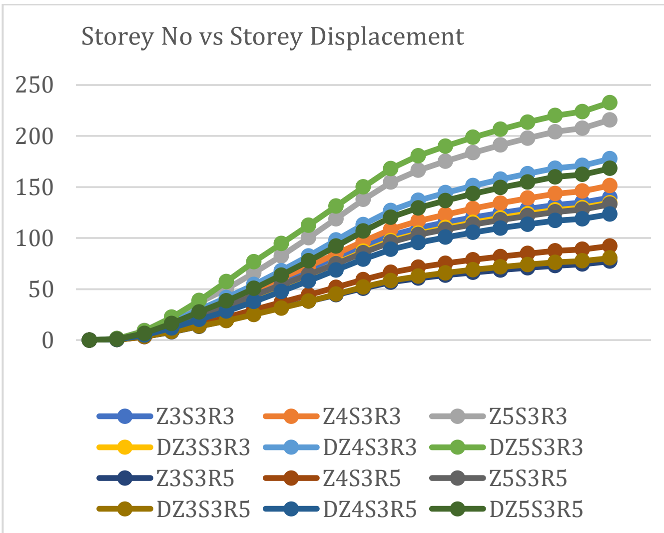

FIG-2: Storey Displacement

From plotted we noticed that the storey displacement least for zone3 soil type3 reduction factor 5 and maximum for zone 5 soil type3 reduction factor3 with oriented columns. And displacement varies linearly wrt stories in all zones.

5.2 STOREY DRIFT

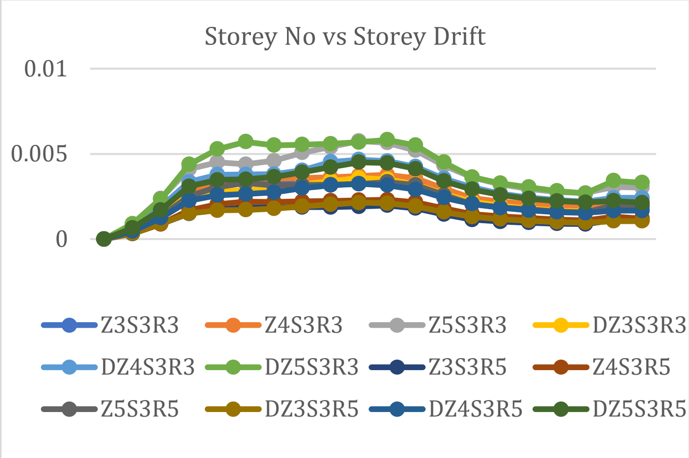

FIG-3: Storey Drift

5.2 STOREY STOREY STIFFNESS

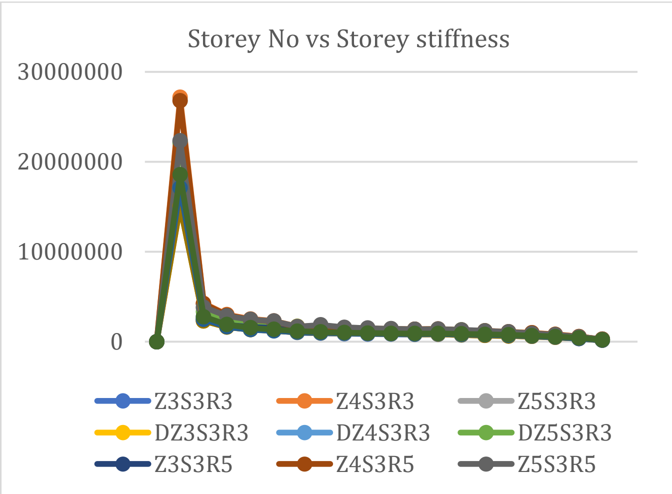

FIG-4: Storey stiffness

From above plotted graph we can noticed that the storey stiffness is least for zone3 soil type3 reduction factor5 with oriented column and maximum storey stiffness found for zone4 soil type3 reduction factor3 compare to other models.

4.2.3 Storey Shear

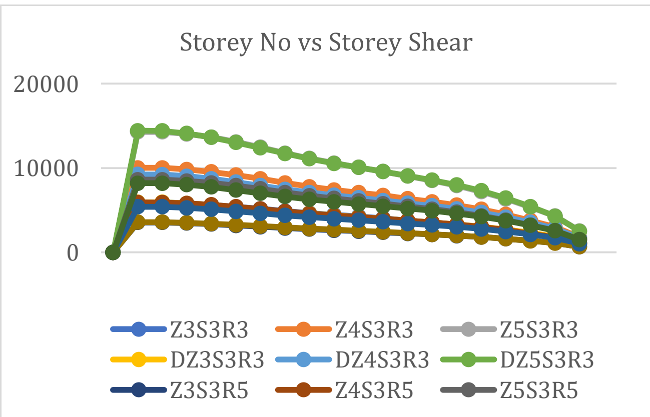

FIG-5: Storey Shear

From above graph we can noticed that the storey shear is least for zone3 soil type3 reduction factor5 at plinth level it has 3558.16kN at storey 17 is has 661.158kN. the maximum storey shear for zone5 soil type3 reduction factor3 with oriented column. Storey shear at plinth level it has 14429.9kN and in storey 17 it has 2511.18kN

5.3 OVERTURNING MOMENTS

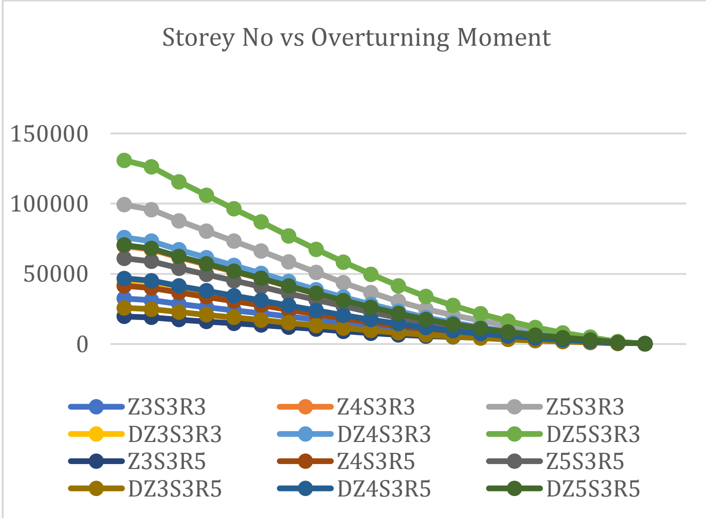

FIG-6: Overturning Moments

From above graph we can notice that the overturning moment is least for zone 3 soil type 3 reduction factor 5 and maximum for zone 5 soil type 3 reduction factor 3 with oriented columns. Linearly increase with decreasing storey height of structure.

5.4 ANGLE OF TWIST VS STOREY DISPLACEMENT

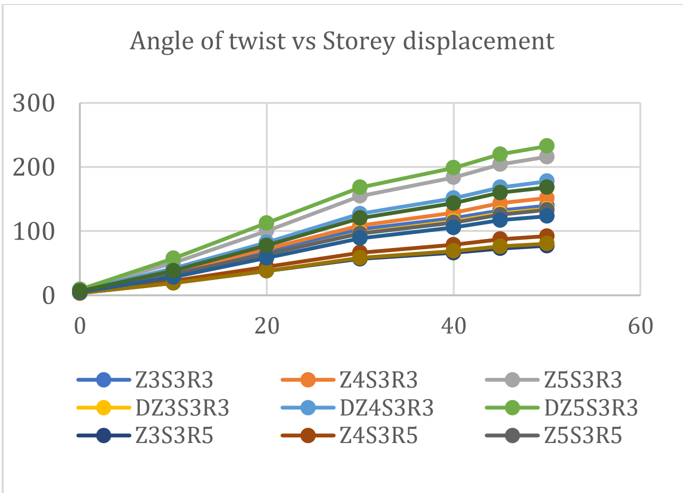

FIG-7: Angle of Twist Vs Storey Displacement

From above plotted graph we notice that storey stiffness least for zone 3 soil type 3 reduction factor 5 and maximum stiffness for zone 5 soil type 3 reduction factor 3 with oriented column. Storey displacement varies linearly with angle of twist.

5.5 Angle of Twist vs storey stiffness

From plotted graphs we can notice that the storey stiffness least for zone3 soil type3 reduction factor5 with oriented column and maximum storey stiffness for zone4 soil type3 reduction factor3. As increasing angle of twist decreasing stiffness in structure.

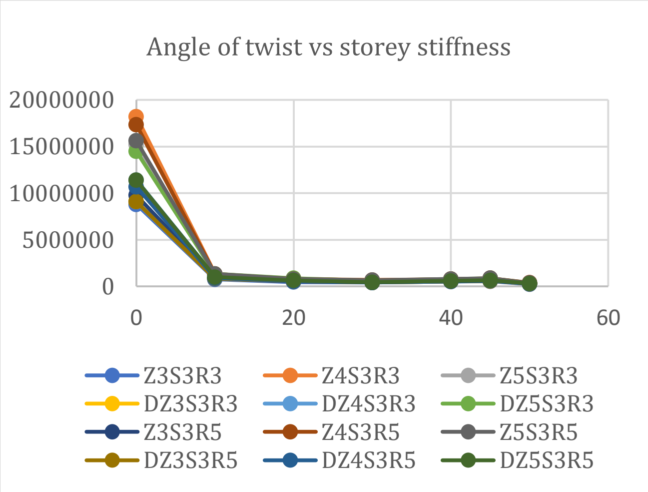

FIG-8: Angle of Twist vs storey stiffness

5.6 BASE SHEAR

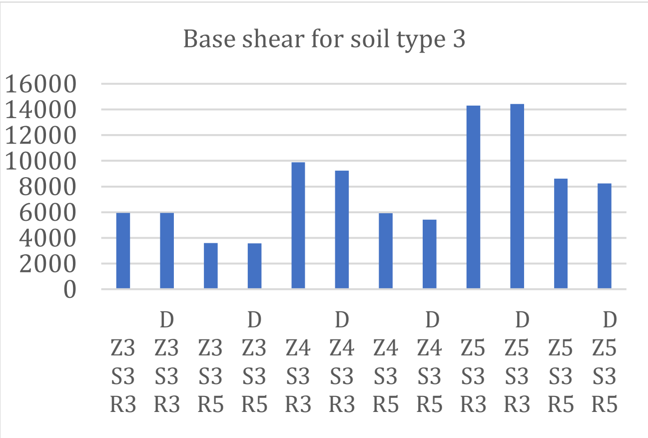

FIG-9: Base Shear

From above graph we can notice that the base shear for zone3 soil type3 reduction factor5 with oriented columns is 3568 kN which is lesser than other models. Maximum base shear for zone5 soil type3 reduction factor3 with oriented columns is 14424 kN.

6. CONCLUSIONS

1. From this research we conclude that behaviour of high rise structure with varying irregularities with SMRF & without SMRF has major change in response values which can be seen in graphs.
2. We can conclude that twisting of column can be done but it should be analysed by considering reduction factor as 3 & should be designed by considering OMRF has high torsion and comparatively weak lateral force.
3. From above graph twisting angles, we can observe that there is increase in torsional moment with increasing angles. So, it should be taken into consideration while twisting angle.
4. From this research we can conclude that twisting of column for tall structure can be done for different zone factor but it should be checked for twisting angles and moments and most importantly lateral displacement.
5. From this study conclude that stiffness of structure inversely proportion to angle of twist.

7. Scope of further study:

1. Column can be replaced with shear walls.
2. The research can further be carried for various critical angles of twist in columns.
3. Studying its behaviour due to wind loads and increasing number of storeys can be further studied.
4. The substructure soil interactions for above model can be taken up.

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