**ANALYSIS OF HIGHRISE BUILDING FOR P DELTA EFFECT USING E TABS**

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**Abstract**—P-delta effect is secondary or second order effect on structure. It is also known as Geometric Nonlinearity effect. As number of story’s increases, P-delta effect becomes more important. If the change in bending moments, shear forces and displacements is more than 10%, P-delta effect should be considered in design. In first order analysis of a structure both kinematic as well as equilibrium relationships are taken with respect to un-deformed shape of the structure. But this does not consider the load which caused due to deflection of the structure. For stability design of a structure second order analysis is required which counteracts equilibrium and kinematic relationship of a structure. In a deformed structure in addition to the applied loads many additional loads due to deformation which develops second order or P-delta effects in the structure. In the present study seismic analysis of multi-story RC building with and without P Delta effects is analyzed by using ETABS structural analysis software.

**Key words:** P delta effect, Non linearity, E tabs

**I. INTRODUCTION**

In structural engineering p delta effect refers to the abrupt changes in ground shear, overturning moment or the axial force distribution at the base of a sufficiently tall structure component when it is subject to a critical lateral displacement. P-delta effect is secondary or second order effect on structure. It is also known as Geometric Nonlinearity effect. As number of story’s increases, P-delta effect becomes more important. If the change in bending moments, shear forces and displacements is more than 10%, P-delta effect should be considered in design. As the structure becomes slenderer and less resistant to deformation, it is necessary to consider 2nd order and to be more specific, P-delta effects arises. As a result, Codes of Practice are referring engineers more and more to the use of 2nd order analysis in order that P-delta and stress stiffening effects are accounted for when appropriate in design. Various building frame models are formed with the help of e tabs software and it is analysed for seismic response through response spectrum analysis and the result are obtained without considering the p delta analysis. Then again analyzed by considering p delta effect, the result obtained are compared with initial analysis result and studied the effect and importance of p delta effect on high rise asymmetric building delta effects are also known as second-order effects since their magnitude depends on the amount of initial displacement or deflection. The P delta effect is a destabilizing moment equal to the force of gravity multiplied by the horizontal displacement a structure undergoes when loaded laterally.

**II. P-DELTA EFFECT**

When a model is loaded, it deflects. The deflections in the members of the model may induce secondary moments since the ends of the member may no longer be collinear in the deflected position. These secondary effects for more members can be accurately approximated through the use of p delta analysis. This type of analysis is called p delta effect because the magnitude of the secondary moment is equal to p, the axial force in the member times deflection the distance one end of the member is offset from the other end. P delta analysis is quite a traditional form of force follower analysis, as the deflection increases you again must test the additional forces generated by p delta effects. A force follower analysis is the one in which, when a member loses its stability the force follows the member and creates further more instability very quickly. A p delta effect is not is not simple as it sounds, and its effects will be more severe in case of soft lateral force resisting system like moment frame compared to stiff system like core wall system and braced system. P that is load and delta is the lateral deformation. These lateral deformations are more lethal in case of earthquake and not so much in case of wind. As in case of earthquake a building deforms.

**III. MODELLING AND ANALYSIS.**

**A. E TABS**

E tabs is a highly efficient analysis and design program developed especially for building system. It is loaded with an integrated system with an ability to handle the largest and most complex building models and configuration. E tabs is a structural analysis and design software used by civil engineers. It can be used to design civil engineering structures...
B. RESPONSE SPECTRUM ANALYSIS

This method is also known as Modal Method or Mode Superposition Method. In this method we are getting the maximum response of any structure due to earthquake. Basically, it is a application of structure in which building response with respect to time and give the accurate result. As per IS18932002 the value response spectrum can be calculated according to the zone factors and importance factor, there are values of Z, I and R have been given in Indian codes and the computational program can calculate the time period according to the soil condition. Generally, this method is applicable to analysis of the dynamic response of structures, which are asymmetrical or have geometrical areas of discontinuity or irregularity, in their linear range of behaviour. Response spectrum method is used to calculate the earthquake forces. Response spectrum plots a graph of peak-steady acceleration. Sinusoidal graph have been taken for response spectrum to calculate earthquake forces. The reversal of load should be taken for response spectrum dynamic analysis because this load is dangerous and will be responsible of building collapse. Response spectra are curves which plots maximum response of SDOF subjected to specified earthquake ground motion. The damping ratio of building are constant for RCC framed structure which is 5% and the value of static base shear should be equal to dynamic base shear for initial analysis to calculate the time period of the building. The models are created with the help of e tab software as follows. It is shown in Fig 1,2,3,4.

Table 1 Details of the building

<table>
<thead>
<tr>
<th>Table 1 Details of the building</th>
<th></th>
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<tr>
<td>No of floors</td>
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<tr>
<td>Base Area</td>
<td>900m</td>
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<tr>
<td>Column</td>
<td>550x550mm</td>
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<tr>
<td>Beam</td>
<td>450x450</td>
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<td>Slab thickness</td>
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<td>Grade of concrete</td>
<td>M30</td>
</tr>
<tr>
<td>Grade of steel</td>
<td>Fe415</td>
</tr>
<tr>
<td>Floor height</td>
<td>3m</td>
</tr>
<tr>
<td>Support</td>
<td>Fixed support</td>
</tr>
</tbody>
</table>

Fig 1. model 1. Box type structure

Fig 2. model 2 L type (plan irregularity) model

Fig 3. Model 3 L shaped (elevation irregularity)

Fig 4 Model 4
IV. RESULT AND DISCUSSION

A. MODEL 1

The maximum storey displacement obtained for the first model without considering the p delta effect is obtained as 835.874mm and with considering the p delta effect it is obtained as 1441mm. So, the % increase is obtained as 72% as shown in Fig 6.

The maximum shear obtained without considering the p delta effect is 5600N and with considering p delta effect is obtained as 5770N as shown in Fig 7 & 8. The percentage increase is obtained as 3 percentage. In the case of overturning moment without considering p delta effect it is obtained as 329723Nmm and with considering p delta effect it is obtained as 569227Nmm and the % increase is 72%.

B. MODEL 2

The maximum story displacement obtained for model 2 without considering p delta effect is 101.21mm and with p delta effect is 158.99 and the % increase is obtained as 57%. The maximum story shear is obtained as 571.4N without p delta and with p delta it is obtained 577.65N and the % increase is obtained as 1.09. In the case of overturning moment without considering p delta effect it is obtained as 30455 Nmm and with considering p delta effect it is obtained as 46450Nmm and the % increase is 52%.

C. MODEL 3

The maximum story displacement obtained for the third model without considering the p delta effect is obtained as 193 mm and with considering the p delta effect is obtained as 229.6mm. So, the % increase is obtained as 18.9%.

The maximum story shear is obtained as 687.76N without p delta and with p delta it is obtained 691.9N and the % increase is obtained as 0.6. In the case of overturning moment without considering p delta effect it is obtained as 39694 Nmm and with considering p delta effect it is obtained as 47474 Nmm and the % increase is 19%.

D. MODEL 4

The maximum storey displacement obtained for the model without considering the p delta effect is obtained as 718.12 mm and with considering the p delta effect is obtained as 1673mm as in the Fig 6.9 a &b. So, the % increase is obtained as 153%. The maximum story shear is obtained as 4933N without p delta and with p delta it is obtained 5584N as in the Fig 6.10 a &b and the % increase is obtained as 13.19. In the case of overturning moment without considering p delta effect it is obtained as 329 KNm and with considering p delta effect it is obtained as 690 KNm as in Fig 6.11 a &b and the % increase is 109%.

V. CONCLUSIONS

P delta effect is a secondary effect. It is the abrupt change in the base shear or overturning moment of a tall structure when it is subjected to a lateral displacement. Usually it is not considering in the analysis of structure. From this project I conclude that P delta effect is very important in the case of high-rise building. So, designing without
considering this effect will lead to the collapse of buildings in earthquake or heavy wind. Since there is a change of base shear overturning moment and story displacement with and without considering the P delta effect with a maximum of 187%. There is variation in % values for different models. If the variation is more than 10% P delta effect should be considered in analysis. P delta effect have importance in designing of high-rise building than 1st order analysis. For regular building the p delta effect will increase the displacement, shear, moment. For irregular buildings the effect may increase or decrease the displacement, shear, moment. The effect of p delta effect on irregular buildings is unpredictable. It will depend on irregularity. From the result model 3 have minimum variations with and without considering the P delta effect and model 4 have maximum average variations.

REFERENCE