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ANALYSIS OF A HIGH RISE BUILDING FRAME CONSIDERING TWO DIFFERENT MATHEMATICAL METHODS USING ETABS

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Abstract

Numerous techniques have been developed for computation of approximate solutions in order to valuate complex boundary value problems and Finite Element method is one of the advance tool. Finite component strategies are at present broadly utilized in designing examination, and we can anticipate that this use should increment fundamentally in the years to come. The techniques are utilized broadly in the investigation of solids and designs and warmth move and liquids, and undoubtedly, limited component strategies are valuable for all intents and purposes in each field of designing examination.

The best numerical model for the examination is most likely the one that yields the necessary reaction to adequate exactness and at any rate cost. Dependability of a numerical model. The picked numerical model is solid if the necessary reaction is known to be anticipated inside a chose level of precision estimated on the reaction of the thorough numerical model.

In this investigation, we are proposing an examination of a 3-d casing structure considering hybrid mathematical models i.e. F.E.M and P-delta investigation to recognize both utilizing examination methods.

Keywords: Hybrid, Mathematical model, structure, analysis, ETABS lateral forces.

Introduction:

Although a most exciting field of activity, engineering analysis is clearly only a support activity in the larger field of engineering design. The analysis process helps to identify good new designs and can be used to improve a design with respect to performance and cost. In the early utilization of limited component techniques, just explicit designs were examined, primarily in the aviation and structural designing ventures. In any case, when the maximum capacity of finite element strategies was acknowledged and the utilization of PCs expanded in designing plan conditions, accentuation in innovative work was put after utilizing limited component techniques an essential piece of the plan cycle in mechanical, common, and aeronautical designing.

The use of vectors, matrices, and tensors is of fundamental importance in engineering analysis because it is only with the use of these quantities that the complete solution process can be expressed in a compact and elegant manner. The objective of this chapter is to present the fundamentals of matrices and tensors, with emphasis on those aspects that are important in finite element analysis. From a simplistic point of view, matrices can simply be taken as ordered arrays of numbers that are subjected to specific rules of addition, multiplication, and so on. It is of course important to be thoroughly familiar with these rules.

Objectives:

The primary objectives of the research are stated below:

- To analyse the building frames considering lateral forces
- To determine the effectiveness of analysis mathematical tools Finite Element Analysis & P-Delta Analysis.
- To evaluate the enhancement of the mathematical tool using Analysis tool ETABS.
- To determine the stability of structure under lateral forces in terms of Forces, Moment, Deflection and Cost.

Literature Review

Prashant Dhadve et.al (2015) in the examination, the P-delta impact on the tall structure was researched. Direct static examination (without P-delta impact) on a tall structure having an alternate number of stories was completed. For the investigation G+14, G+19, G+24, (i.e 15, 20, and 25storey) R.C.C. outlined structure was demonstrated. Quake load was applied on the model of construction according to IS-18939(2002) for zone III in E-Tab programming. The burden mix for investigation was set according to IS-456(200 0). All examination was done in programming ETAB. Bending Moment, story relocation with and without p-delta impact is determined and looked at for every one of the models. At that point by experimentation technique reasonable cross-segment was accommodated risky structure to bring inside adequate cutoff by expanding firmness of a structure.

The outcome shows that it is fundamental to consider the P-delta impact or 25storey structure. So structures having tallness more than or equivalent to 75m, ought to be planned considering P-delta impact. Likewise, we can say that up to 25 story building, it isn't important to consider P-delta impact in the plan and essential first-order examination is adequate for the plan. By expanding solidness of working by giving appropriate cross area or by expanding firmness building can bring inside worthy breaking point. The end is legitimate for RCC private structures for seismic stacking altogether the zones of India and may not be material for business, instructive or mechanical structures. As the cross segments of individuals build firmness of a design additionally increments.

Priyanka Soni et.al (2016) in the exploration paper, a multistory structure was displayed and investigate considering all loads like Dead burden, Live burden, Wind Load according to IS standard and Seismic burden according to IS standard. Distinctive shear divider area in various multistory structure (G+10, G+20 and G+26) was displayed and examined utilizing STAAD.Pro.

The outcomes inferred that avoidance of the multi-story building structure is more for G+10, G+20 and G+26 (approx. 6% less in general diversion). The pressure and diversion or deformity of the shear divider structure were expanding.

Nikunj Mangukiya et.al (2016) the research paper presented"P-Delta" analysis which incorporates geometric nonlinearity in the analysis and was performed on structural software ETABS. In the investigation of G + 24 story structure, was analyzed with static linear and static non-liner analysis, here Geometric non linearity is considered by accounting, p-delta effect it is shown from displacement comparison that there is about 12% to 20% variation in the result. Similarly, the bending moment for

the load combination (EQ Y-) shows 5% to 20% variation, value of modal period, in the different mode shapes are also variable. It is advisable to account such effect in tall structures.

Table 1: Building Description

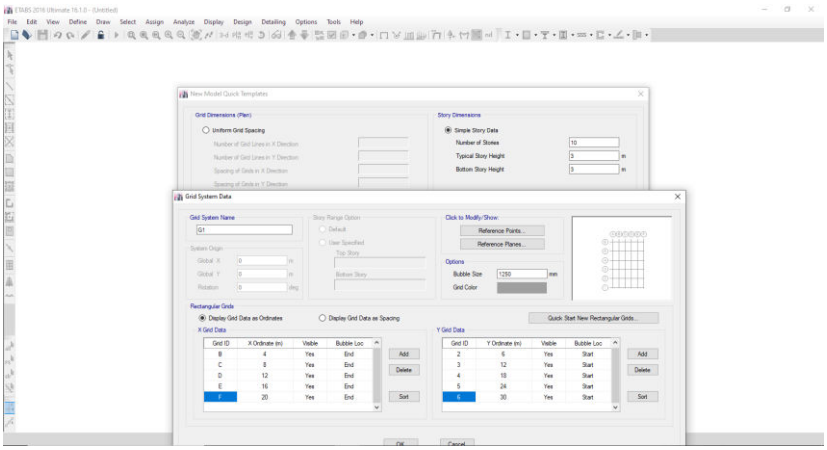
S.NO	Description	Value
1	Built-up Area	20m x 30m
2	Number of bays in X direction	5.0 spans
3	Number of bays in Z direction	6.0 spans
4	Height of Floors	3.0 m
5	Overall height	G+10 (24.6 m)
6	Analysis	F.E.M & P-DELTA
7	Support	Fixed end

Methodology:

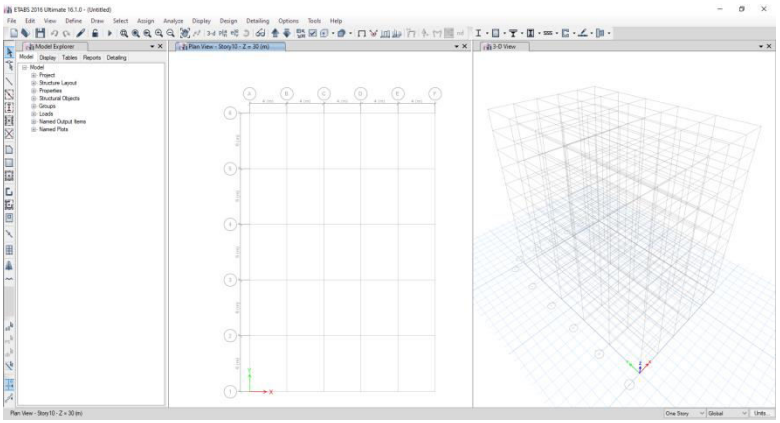
Steps in the Methodology

Step 1: the initial step is to review research papers from various authors in relation to the work of this project.

Step 2: This step is the initial part of modelling where the frame of the structure is defined as per the grip system all the three axis, where the X axis is coordinated with initials as A, B, C and D , while the Y axis is coordinated with initials as 1, 2,3 and 4. Here symmetrical coordinates were considered.



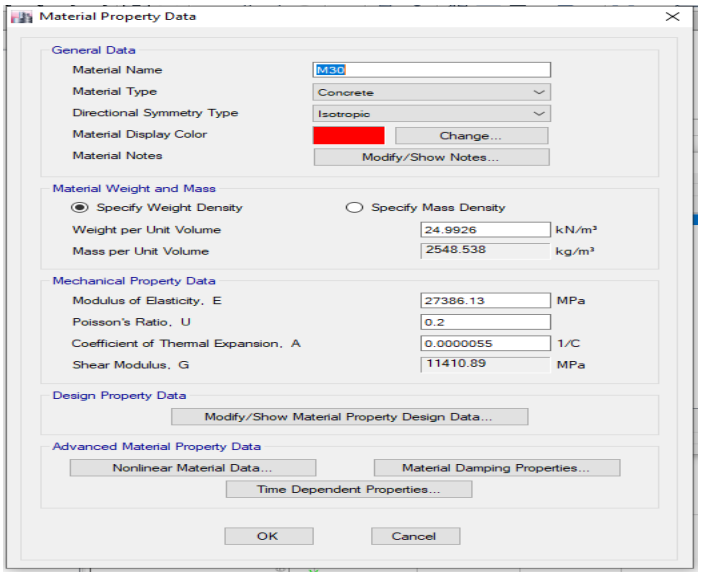
(A)



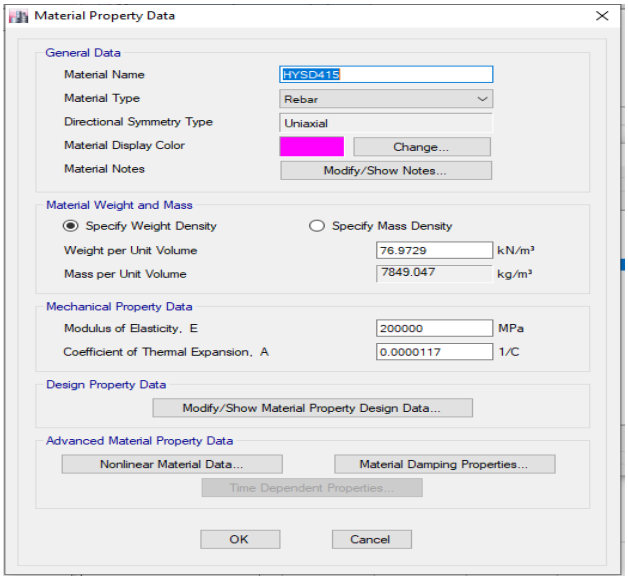
(B)

Fig 1 (A) Defining the coordinates and grid of the frame and (A) is the 3d Frame.

Step 3: Defining material data to the G+10 storey frame, as in the case we have assigned M30 concrete where the specific weight density was assigned and the directional symmetric type was isotropic (A). Where assigning rebar, grade HYSD415 was used, here the directional symmetric type was Uniaxial (B).



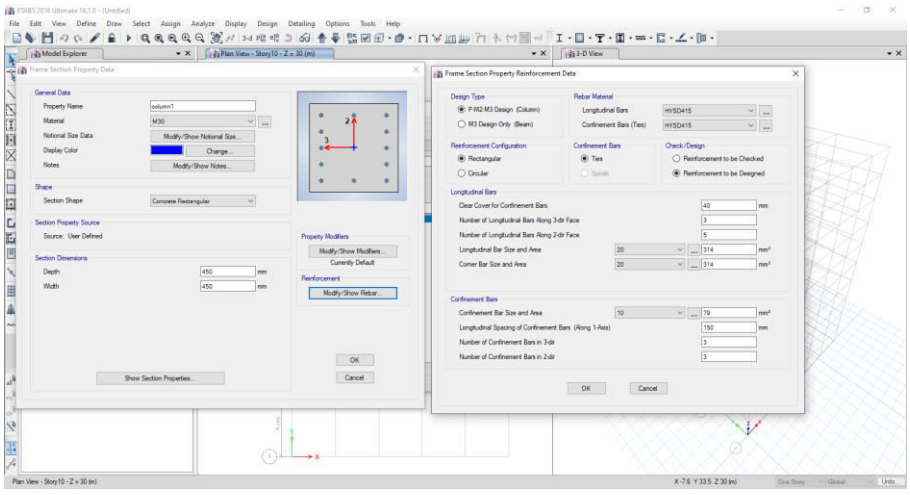
(A)



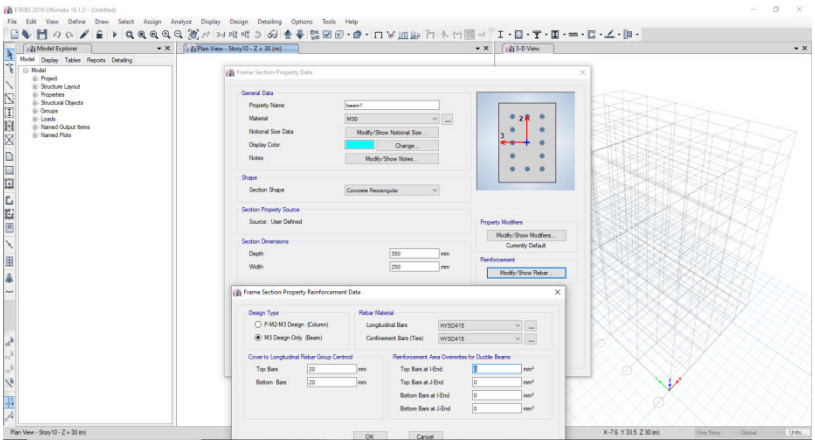
(B)

Fig 2 Assigning Material Properties to the frame. (A) Concrete and (B) Rebar.

Step 4: Defining Shape of the Frame section as column and beam from the various pre-defined shapes available with the ETABS application namely square, rectangular, circular etc.



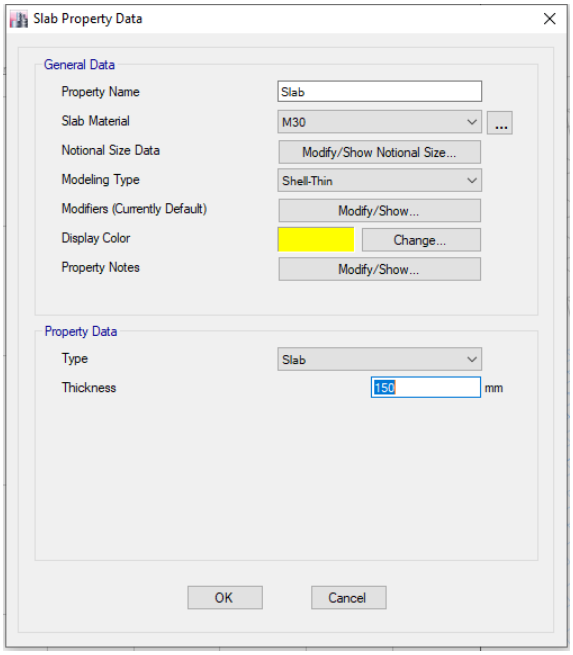
(A)



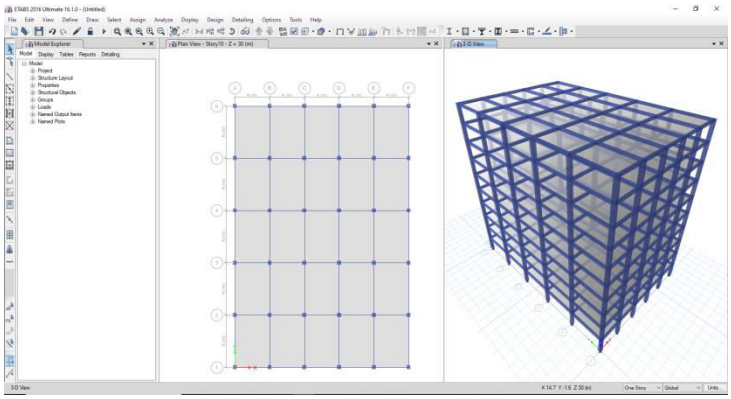
(B)

Fig 3 Assigning Frame Section Property Data, (A) Column and (B) Beam.

Step 5: Defining Slab properties and assigning it to the frame of the structure which is G+10 in this case. Here the slab size is considered as Shell thin with 150 mm as material is M30.



(A)



(B) Assigning Slab

Fig 4 (A) Defining Slab Condition and (B) Assigning Slab to the Model

Step 6: Assigning Fixed Support to the model with the translation and rotation considered in all the three direction.

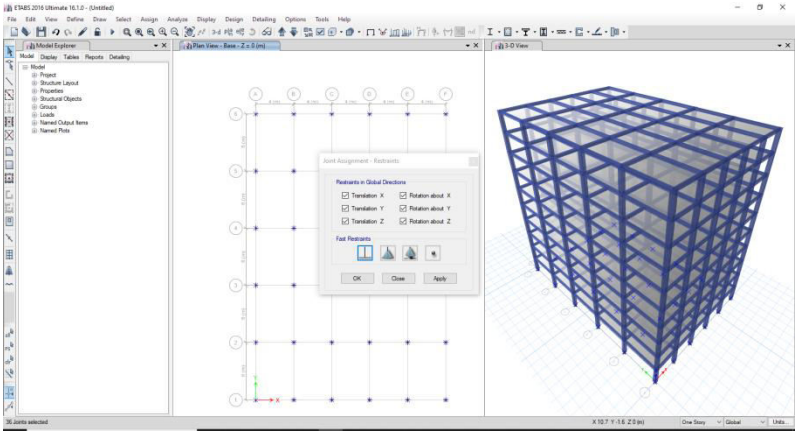


Fig 5 Assigning Fixed Support

Step 7. Defining Loading condition for the G+10 structure frame considering Dead, live and seismic Load. The Z factor was 0.36 as per code seismic zone III.

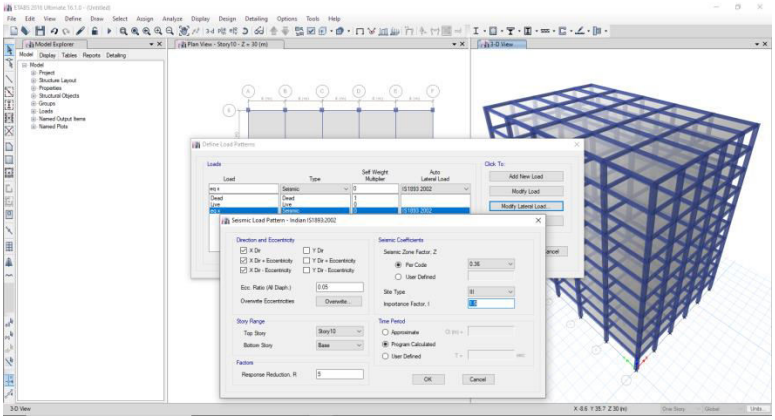


Fig 6 Defining Load Pattern considering seismic load as per IS 1893-2002.

Step 8: Defining Iterative P Delta Analysis with relative convergence tolerance valued as 0.0001.

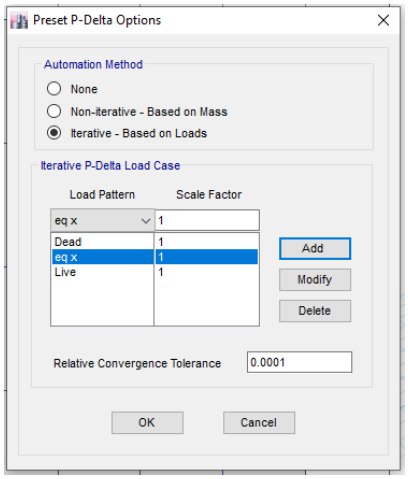


Fig 7 Defining P Delta Code.

Step 9: Defining Load case data as in this case, load case type is non linear static and acceleration load type is considered in UX, UY and UZ direction.

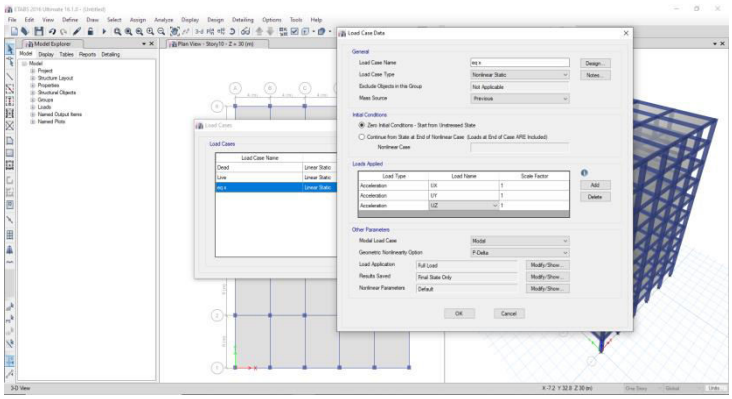
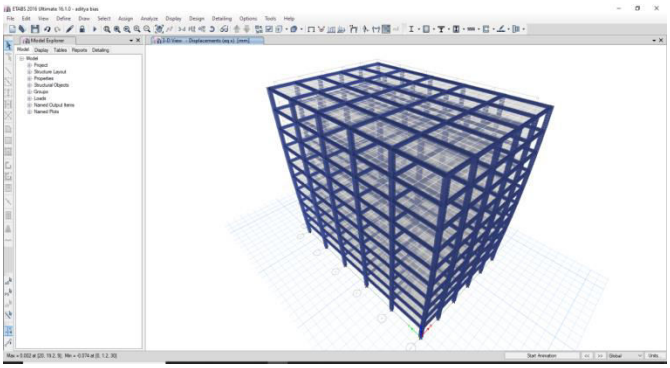
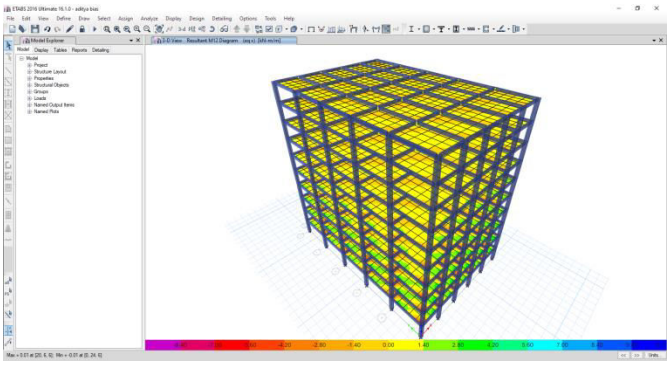


Fig 8 Assigning P Delta code case acceleration.

Step 10: Results generated on FEM analysis and and P delta analysis.



(A)



(B)

Fig 9 Results extracted on parameters (A) FEM Analysis and (B) P Delta Analysis.

Step 11: Results were computed using ETABS and were tabulated on MS Excel.

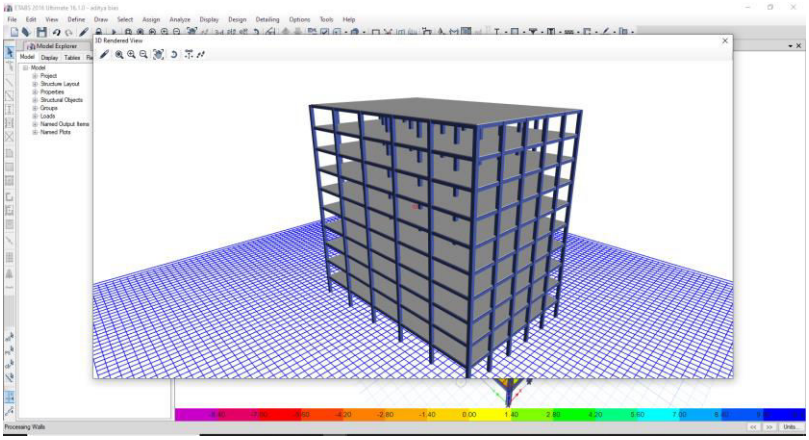
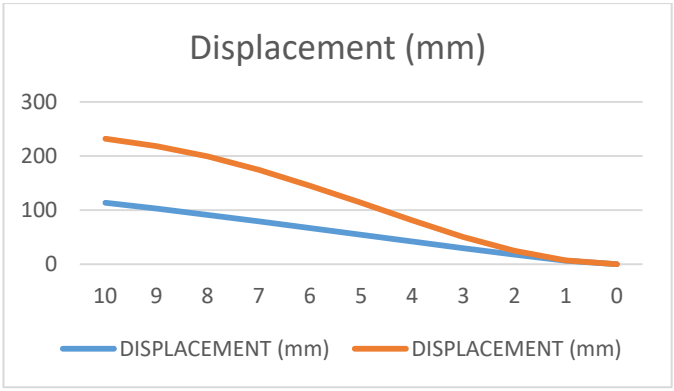
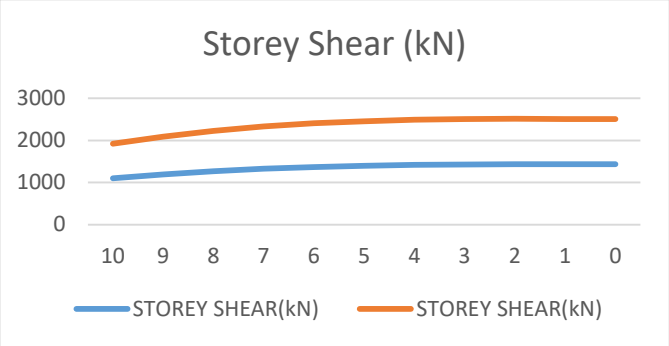


Fig 10 Rendered View of the Model

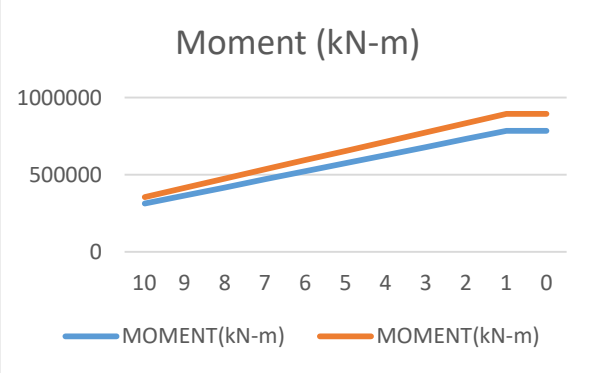
Analysis Results:



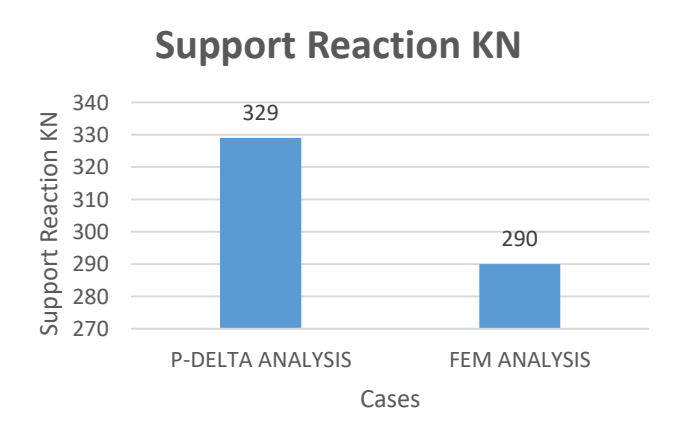
Graph 1: Displacement



Graph 2: Storey Shear



Graph 3: Moment



Graph 4: Support reaction

Table 2: Cost Analysis

Cost Analysis (PWD Rates)						
S.no.	**concrete volume in cu.m**	**S.O.R rates (concrete)**	**Rebar in (Kg)**	**S.O.R. rates (Rebar)**	**Total cost of concrete**	**Total cost of Rebar**

P-DELTA ANALYSIS	360	3850	6400	60.5	1386000	387200
FEM ANALYSIS	312	3850	5948	60.5	1201200	359854

Conclusion

In this study we are proposing analysis of a 3-d frame structure considering two different hybrid mathematical models i.e. F.E.M and P-delta analysis to distinguish between both using analysis tool ETABS.

Storey Shear

The results of storey shear obtained from both the cases, when analysed for P-delta effect shows respectively 43.12% more than that obtained from FEM analysis.

Axial Force

The results of axial force obtained from both the models, when analysed for P-delta effect shows respectively 12.31% more than that obtained from FEM analysis.

Storey Displacement

The results of displacements obtained from both the model, when analysed for P-delta effect shows respectively 48.9 % more than that obtained from FEM analysis. The maximum displacement of the model is 232.2 mm and 113.8 mm obtained from P- delta analysis and FEM respectively.

Bending Moment

The results of bending moments obtained from both the models, when analysed for P-delta effect shows respectively 12.31% more than that obtained from FEM analysis

From the results obtained, it can be concluded that the F.E.M. effect should be considered in analysis of multi- storied buildings.

Support Reaction

the Support Reaction (Fy) is observed 26.47 % more in P-delta case due to double iteration analysis of second order. Thus it can be said in analysis F.E.M analysis method will show less reactions.

Cost Analysis

In this study, it can be concluded that F.E.M. analysis results in economical section also rate analysis of both can show the Variation in cost of both.

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