

Analysis of A 3-Dimensional Structure with F.E.M. and P-Delta Method Considering Lateral Forces Using ETABS

Shiv Shankar Tiwari¹, Rahul Sathbhaiya²

¹P.G. Scholar, Department of Civil Engineering, Infinity Management & Engineering College, Sagar, ,
Madhya Pradesh, India

²Associate Professor, Department of Civil Engineering, Infinity Management & Engineering College, Sagar, ,
Madhya Pradesh, India

ABSTRACT

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Limited component strategy is a notable and profoundly successful procedure for the calculation of rough arrangements of complex limit esteem issues. Limited component strategies are at present broadly utilized in designing examination, and we can anticipate that this use should increment altogether in the years to come. The methodology are utilized broadly in the investigation of solids and structures and of warmth move and liquids, and surely, limited component strategies are valuable in for all intents and purposes each field of designing examination..

The best numerical model for the examination is clearly that one which yields the necessary reaction to an adequate precision 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 exactness estimated on the reaction of the thorough numerical model.

In this examination we are proposing investigation of a 3-d edge structure considering two diverse cross breed numerical models for example F.E.M and P-delta examination to recognize both utilizing investigation device.

Keywords: Analysis, Forces, Displacement, Mathematical Equations, Software.

I. INTRODUCTION

Although a most energizing field of movement, designing investigation is plainly just a help action in the bigger field of designing plan. The investigation cycle assists with distinguishing great new plans and can be utilized to improve a plan as for execution and cost. In the early utilization of limited component

techniques, just explicit designs were dissected, primarily in the aviation and structural designing businesses. Be that as it may, when the maximum capacity of limited component strategies was acknowledged and the utilization of PCs expanded in designing plan conditions, accentuation in innovative work was set after utilizing limited component techniques a fundamental piece of the plan cycle in mechanical, common, and aeronautical designing.

The utilization of vectors, networks, and tensors is of principal significance in designing investigation since it is just with the utilization of these amounts that the total arrangement interaction can be communicated in a conservative and rich way. The target of this section is to introduce the basics of grids and tensors, with accentuation on those angles that are significant in limited component examination. From a shortsighted perspective, grids can just be taken as requested varieties of numbers that are exposed to explicit principles of expansion, duplication, etc. It is obviously imperative to be completely acquainted with these principles.

P-delta Analysis:

P-delta is a second-order effect on a structure which is loaded laterally. One first-order effect is the initial deflection of the structure in reaction to the lateral load. The magnitude of the P-delta effect depends on the magnitude of this initial deflection. P-delta is a moment found by multiplying the force due to the weight of the structure and applied axial load, P, by the first-order deflection, Δ or δ.

The term "P-Δ analysis" itself explains the meaning, when a structural member is loaded, then its shape changes and due to this additional forces & moments are induced. It is second order analysis.

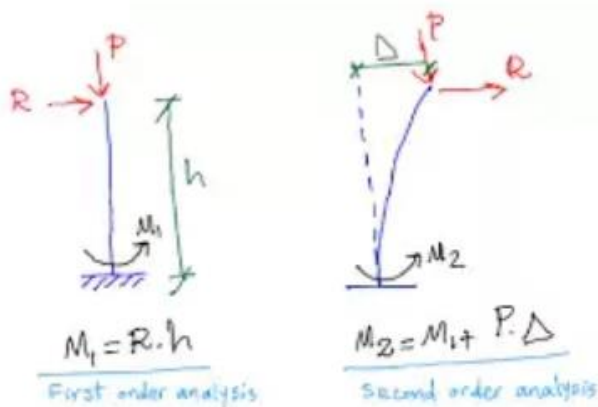


Fig 1: P-delta Analysis

Earthquake:

India is divided in 5 different seismic zones in which zone V is the most severe with intensity of 0.36. So in this zone we require more stable structures to resist the dynamic forces.

We try to provide a structural frame with consideration of slab stiffness in earthquake zone with medium type of soil condition and analysis its behavior and make it as economical as possible in comparison with the bare frame structure (without slab stiffness).

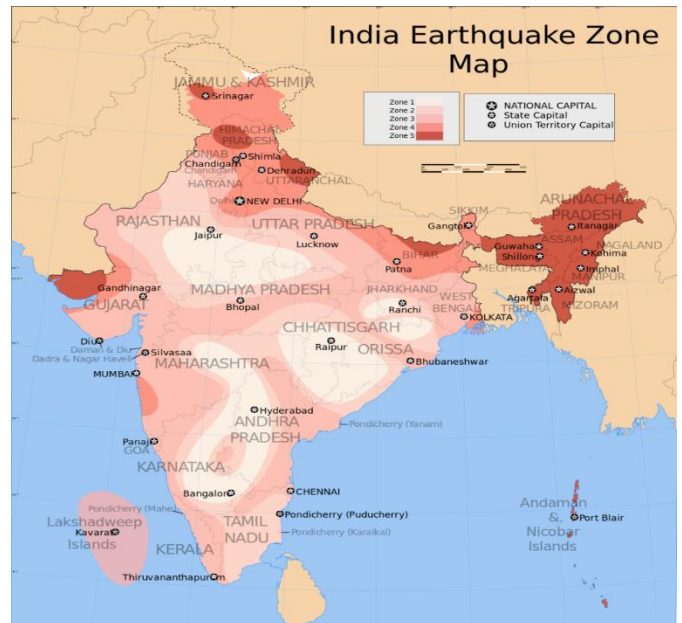


Fig 2: Seismic regions as per I.S. 1893-I:2016

II. LITERATURE REVIEW

Castro et. al. 2019 Author Illustrated a cross breed blended pressure (HMS) limited component model for the powerful examination of designs. It is expected a genuinely and mathematically direct conduct.

In this examination work physically determined the powers, stresses and dislodging utilizing limited component investigation technique to decide the exactness of the numerical equation.

The utilization of these capacities empowers the utilization of scientific shut structure answers for the calculation of every single underlying administrator

and prompts the advancement of successful investigation systems.

The direct powerful examination is additionally performed utilizing time reconciliation systems.

Here Author find that its latent capacity and to survey its precision and productivity, a few mathematical models are talked about and correlations are made with scientific arrangements and arrangements given by other mathematical methods.

Ferdinando et. al. 2018 Stated that Finite component strategy is a notable and profoundly compelling procedure for the calculation of estimated arrangements of complex limit esteem issues.

In this examination creator performed show numerical investigation of a 2-dimensional construction considering Finite component numerical instrument for a plate surface and saw that conditions present are proposed the significant reality about the discretization of the Stokes issue. Any sensible

intermittent pressing factor estimate contains in any event all the piecewise consistent capacities.

Creator zeroed in on consistent state field issues characterized in an area $\subset \mathbb{R}^d$, with d the Euclidean space measurement. Additionally, we start from the least difficult class of actual issues, that is, the one related to dispersion instruments.

Along these lines expressed that limited component examination strategy (numerical condition can be use to perform primary investigation.

Objectives:

The main objective of this work are as follows:

- To perform comparative analysis of the structure considering F.E.M & P-delta method.
- To perform Structure analysis considering seismic analysis.
- To determine the stability of structure under lateral forces in terms of Forces, Moment, Deflection and Cost.

III. Methodology

Step-1: First step is collection of data related to utilization of analysis mathematical equations in structural analysis and methods.

Step-2: Second step is to select cases and model it in ETAB.

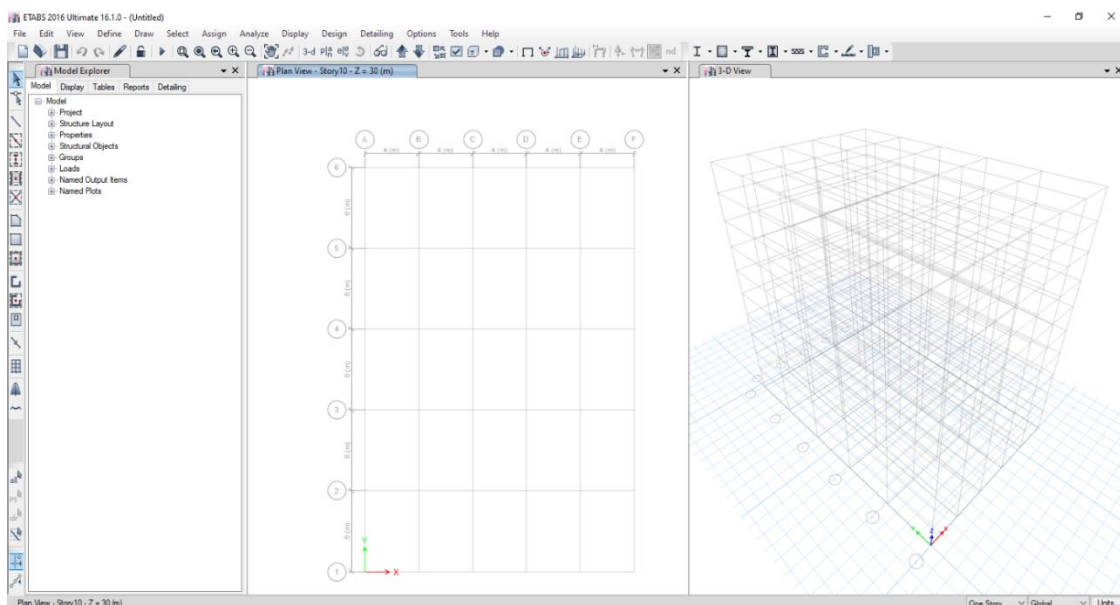


Fig 3: Modelling of structure

Step-3: To assign section data and material properties.

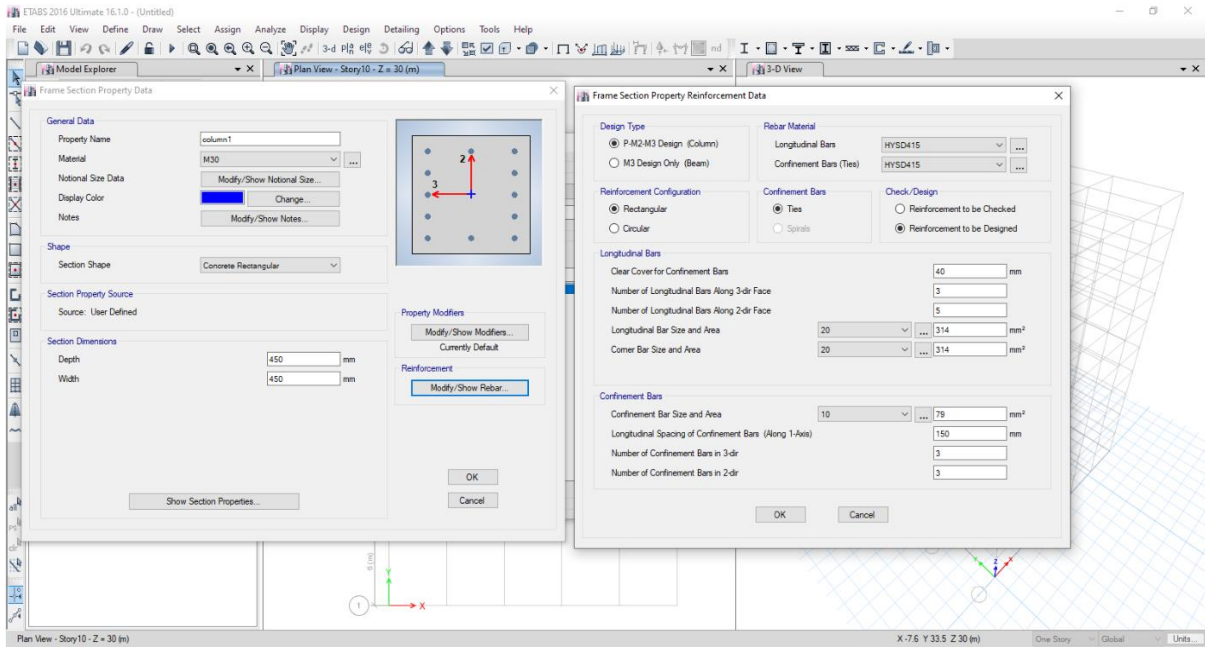


Fig 4: Sectional Description

Step-4: To Assign support conditions

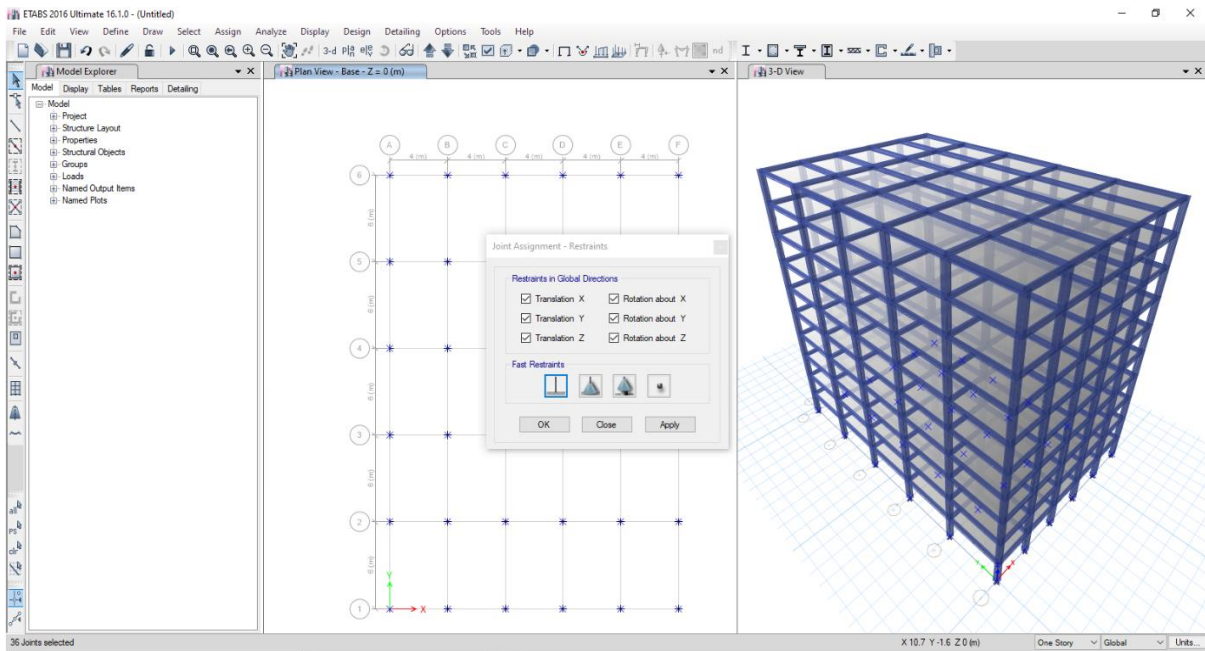


Fig 5: Support Condition

Step-5: To assign lateral forces (seismic) Loading.

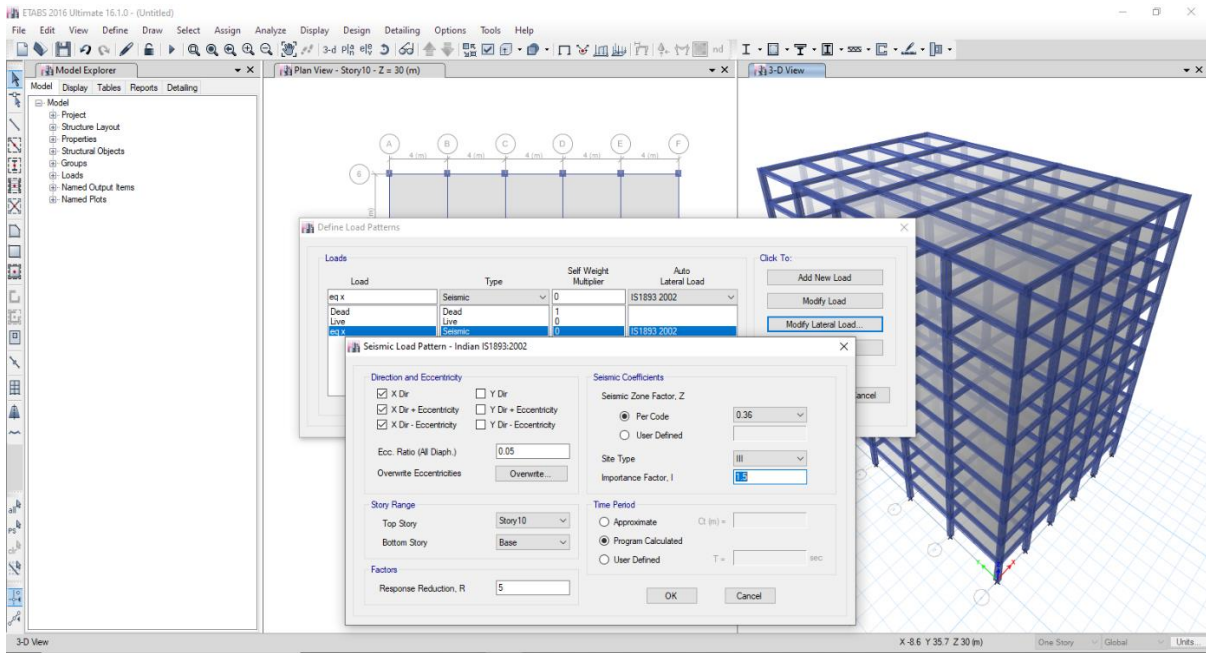


Fig 6: Seismic Loading

Step-6: To perform finite element analysis & P-delta Analysis for comparison.

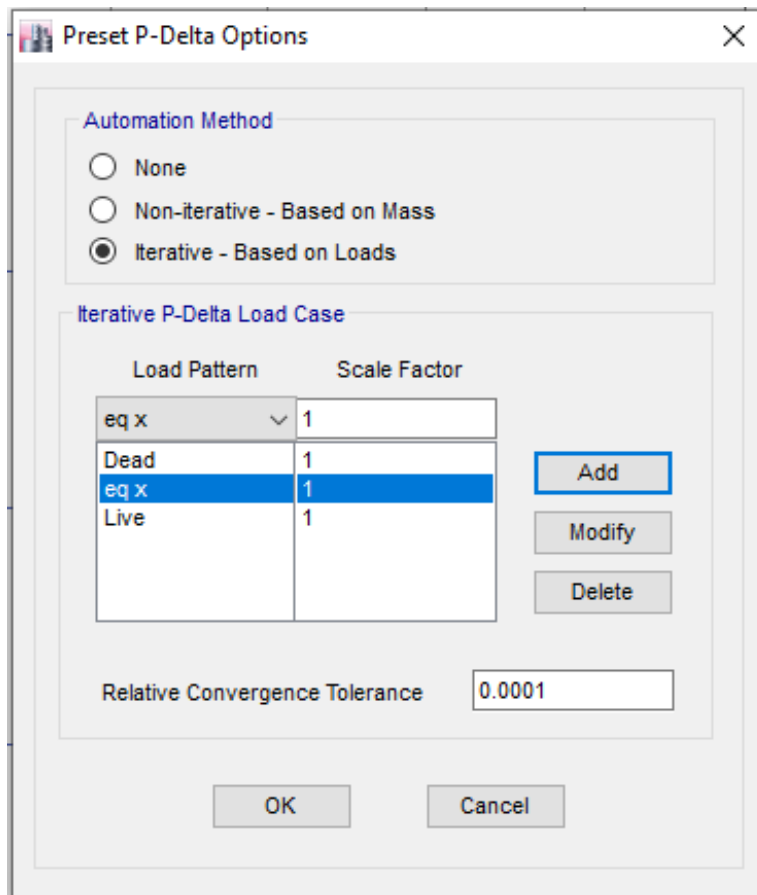


Fig 7: Analysis Methods

Step-7: To prepare comparative result in M.S. excel.

Step-8: To provide conclusion as per results.

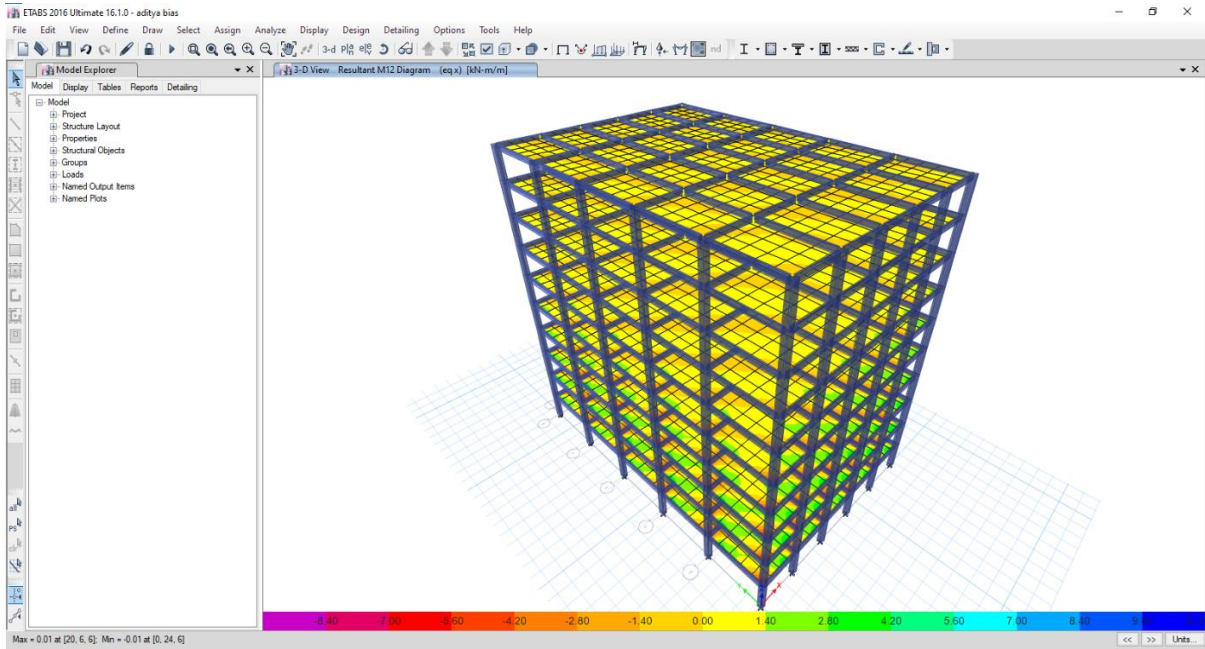
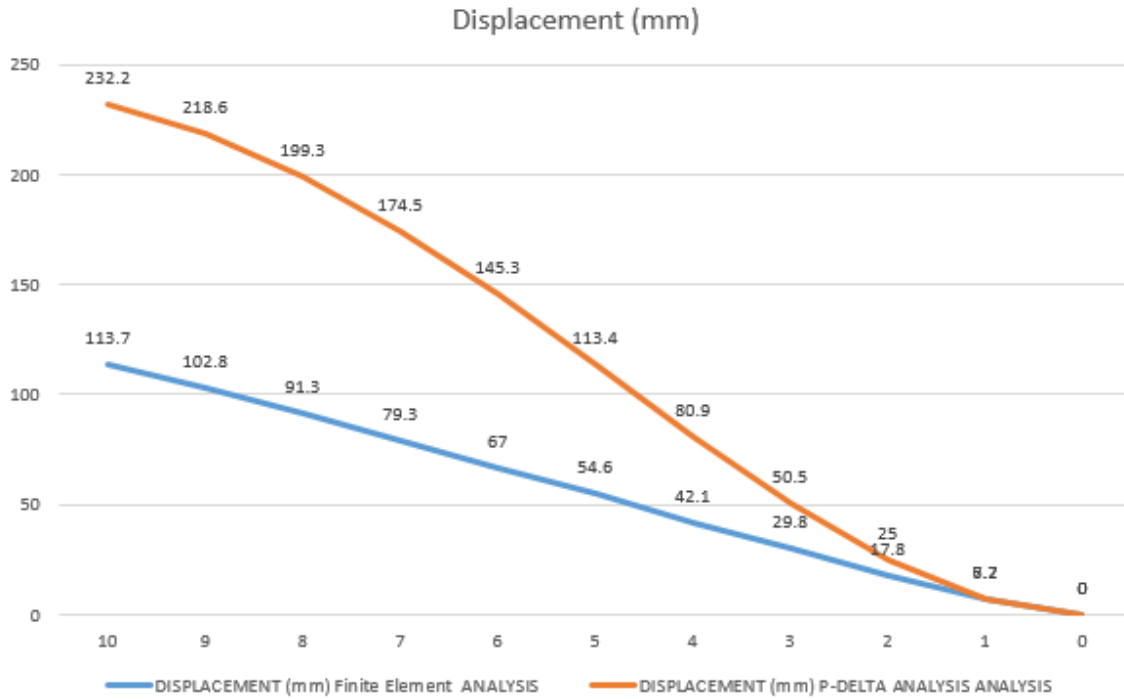


Fig 8: Stress Analysis

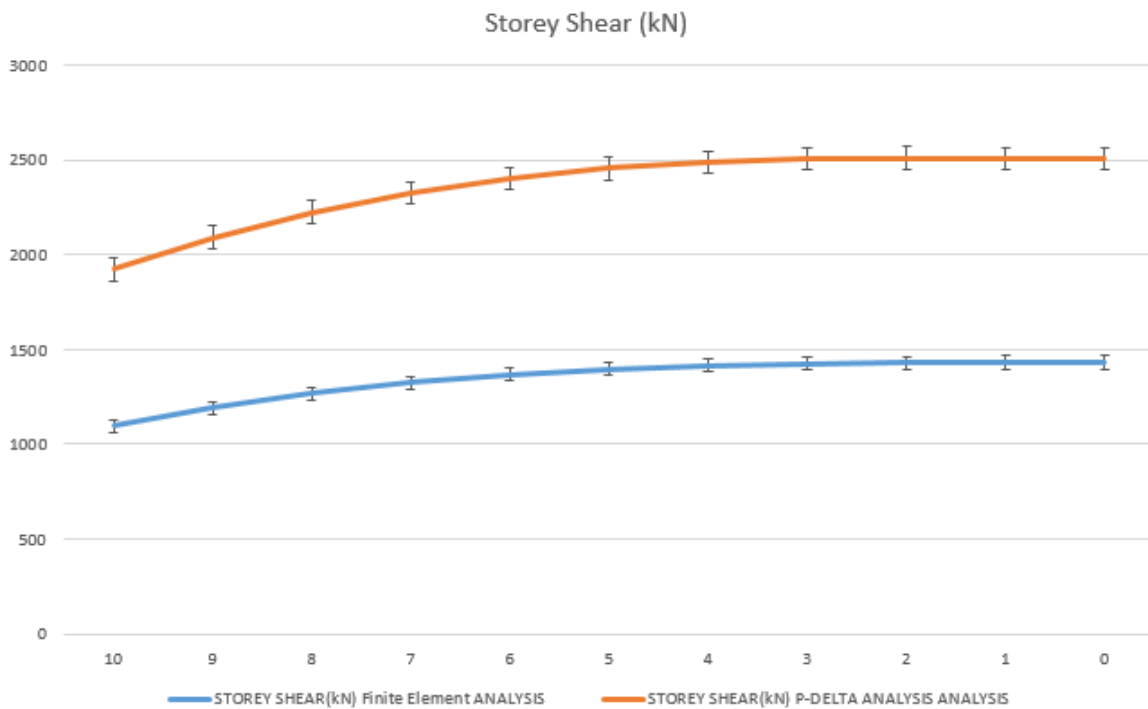
Table 1: Building Description

S.NO	Description	Value
1	Built-up Area	20m x 30m
2	Number of bays in X direction	5 spans
3	Number of bays in Z direction	6 spans
4	Height of Floors	3.2 m
5	Overall height	G+10 (36 m)
6	Analysis	F.E.M & P-DELTA
7	Support	Fixed end

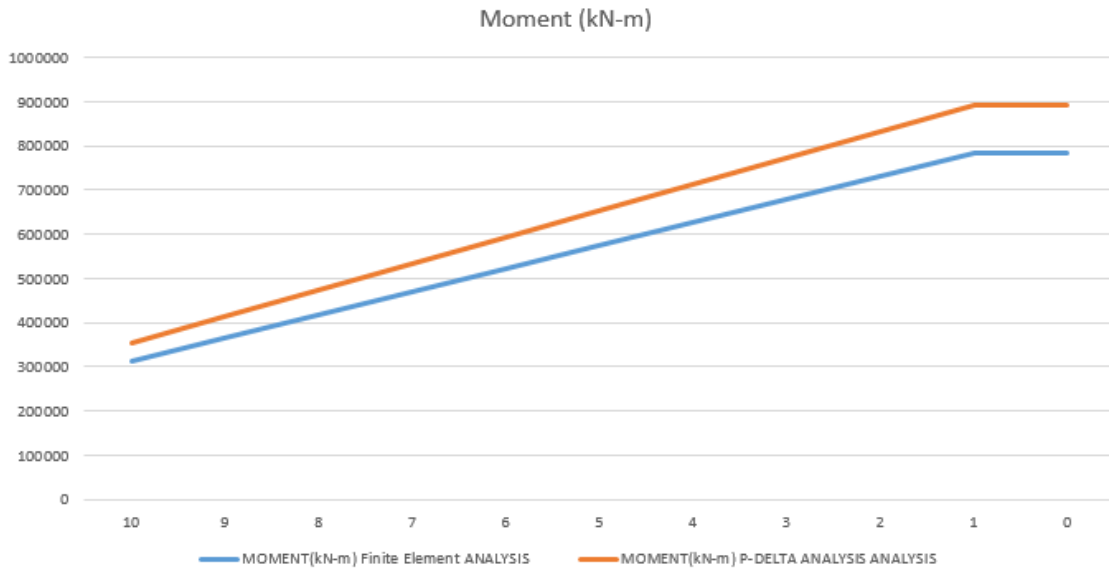
IV. ANALYSIS RESULT



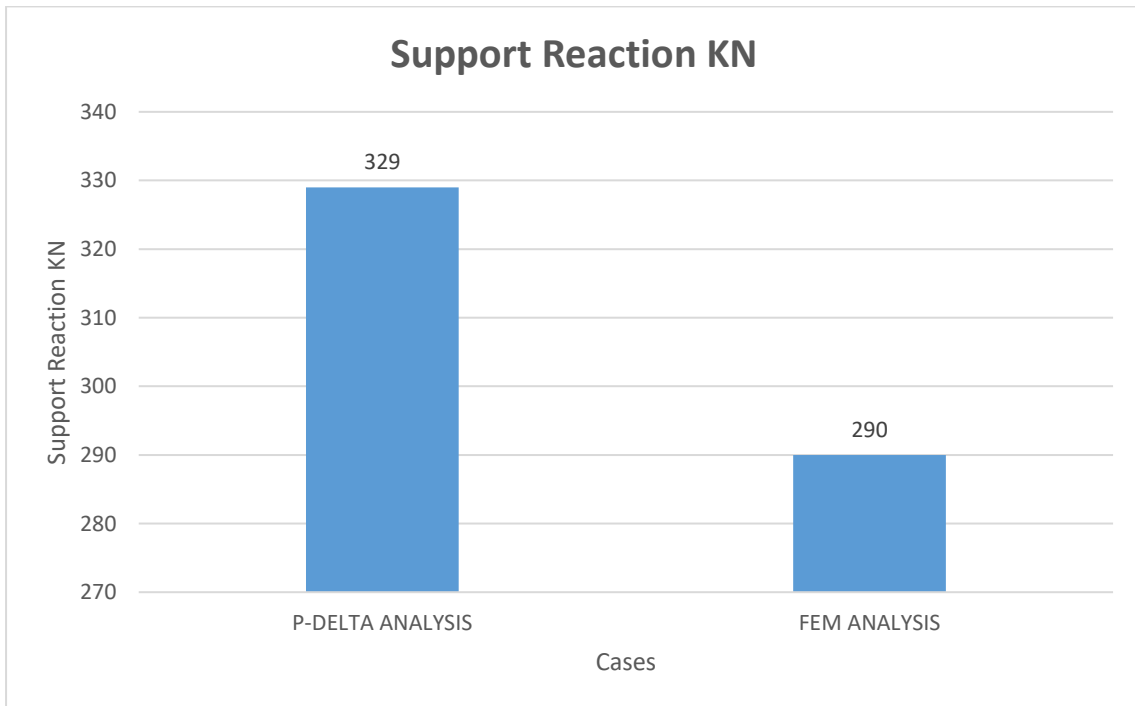
Graph 1: Displacement in mm



Graph 2: Storey Shear



Graph 3: Bending Moment KN-m



Graph 4: Support Reaction KN

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

V. CONCLUSION

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 (F_y) 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.

VI. REFERENCES

- [1]. Arruda, M. R.(2008) "Análise Dinâmica de Estruturas com Elementos Finitos Híbridos Mistos de Tensão". Lisboa, Instituto Superior Técnico. M.Sc Thesis.
- [2]. Barbosa, A. R.(2002) "Wavelets no Intervalo em Elementos Finitos". Lisbon, Instituto Superior Técnico. M.Sc Thesis.
- [3]. Bathe, K. J.(1982) "Finite Element Procedures In Engineering Analysis", Prentice-Hall Englewood Cliffs.
- [4]. Castro, L. M. S. S.(1996) "Wavelets e Séries de Walsh em Elementos Finitos". Lisboa, Instituto Superior Técnico. Ph.D Thesis.
- [5]. Castro, L. M. S. S. and Barbosa, A. R.(2006) "Implementation of an Hybrid-Mixed Stress Model Based on the use of Wavelets." Computer & Structures 84: 718-731.
- [6]. Castro, L. M. S. S. and Freitas, J. A. T.(2001) "Wavelets in Hybrid-Mixed Stress Elements." Computer Methods in Applied Mechanics and Engineering 190: 3977-3998.
- [7]. Chopra, A. K.(1995) "Dynamic of Structures, Theory and Applications to Earthquake Engineering". London, Prentice-Hall International Inc.
- [8]. Clough, R. W. and Penzien, J.(1993) "Dynamics of Structures". New York, Mc-Graw-Hill.
- [9]. "COMPARATIVE STUDY ON ANALYSIS, DESIGN AND COST OF R.C.C. AND STEELCOMPOSITE STRUCTURE", Yogesh R. Suryavanshi, Prashant S. Patil, Deshmukh Siddheshwar Shrikant, Gaikwad Amol Ramrao, Inamdar Firoj Najmoddin, Puri Sujay Uttam, International Journal of Engineering Research-Online, <http://www.ijoer.in>, Vol.3., Issue.2, 2015.
- [10]. "Comparitive study on the behavior of R.C.C, Steel & Composite Structures (B+G+20 Storey)", Sattainathan.A, Nagarajan.N, International Journal on Applications in Civil and Enviornmental Engineering, Volume 1: Issue 3: March 2015, pp 21-26. www.aetsjournal.com.
- [11]. "Cost, Analysis and Design of Steel-Concrete Composite Structure Rcc Structure", Anamika Tedia, Dr. Savita Maru, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), e-ISSN: 2278-1684,pISSN: 2320-334X, Volume 11, Issue 1 Ver. II (Jan. 2014), PP 54-59, www.iosrjournals.org.
- [12]. "Comparative Study of RCC and Composite Multi-storey Buildings", Shashikala. Koppad, Dr. S.V.Itti, International Journal of Engineering and Innovative Technology (IJEIT), Volume 3, Issue 5, November 2013
- [13]. "Design of Steel Frame Industrial Building Compared With Reinforced Cement Concrete Industrial Building", Ms. S. D. Ambadkar, Prof. Dr. P. S. Pajgade, International Journal of Scientific & Engineering Research, Volume 3, Issue 6, June-2012
- [14]. IS: 456, Code of practice for plain and reinforced concrete code of practice, Bureau of Indian Standards, New Delhi, 2000.

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