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COMPARATIVE STUDY OF HIGH RISE BUILDING SUBJECTED TO SEISMIC AND WIND LOADING USING CYPECAD AND ETABS

Shiva Malasree[1], Nikhil I M[2], Sai Surendranath Reddy[3], Prakasha[4], Shiva Kumar[5]

[1]*Assistant Professor, Department of Civil Engineering, RYMEC, Ballari*
[2,3,4,5]*Students, Department of Civil Engineering, RYMEC, Ballari*

Abstract - *: The spectacular increase in population, living in urban areas and their demands leads to housing problem in India. This results in the rise of multi-storey and high-rise building with regular or irregular configuration. As the height of a building becomes taller, the amount of structural material required to resist lateral loads increases drastically. The design of buildings essentially involves a conceptual design, approximate analysis, preliminary design and optimization, to safely carry gravity and lateral loads. In the present study, the limit state method of analysis and design has carried out by an integrated computational program "CYPECAD software" and "ETABS software" which works on FE methods were a 7-story reinforced concrete tall structure under wind loads as per IS 456:2000 and IS 875 (part-3) codes of practice respectively and seismic loads as per IS 1893(part-1):2002 is described. The comparison of results is carried out for shear force, bending moment, Storey Displacement, Storey drift. The results are obtained and represented in the forms of graphs and tables.*

Key Words: High rise building, CYPECAD, ETABS, Storey displacement and storey drift.

1. INTRODUCTION

ETABS and CYPECAD are the two design software's to design and analyse any kind of structure in static and dynamic approach. However these software's will give different design and analytical results for the same structural configurations as their analytical mechanism and the way they analyse the structure is different. This paper carry out a comparative study of design results of ETABS and CYPECAD software's. To conclude the feasibility of these software's a 7-storey building has been analysed, designed and compared the results.

1.1 OBJECTIVES OF THE PROJECT

- To carry out modelling and analysis of 7 storey R.C.framed structures using CYPECAD and ETABS.
- To design the multi storey building using CYPECAD and ETABS.
- To compare the results of CYPECAD and ETABS.
- To compare the storey displacement and storey drift.

1.2 OVERVIEW OF THE SOFTWARE

1.2.1 ETABS

ETABS provides an unequaled suite of tools for structural engineers designing buildings, whether they are working on one-story industrial structures or the tallest commercial high-rises. Immensely capable, yet easy-to-use, has been the hallmark of ETABS since its introduction decades ago, and this latest release continues that tradition by providing engineers with the technologically-advanced, yet intuitive, software they require to be their most productive.

1.2.2 CYPECAD

CYPECAD comes with a plethora of design elements to ensure maximum analysis reliability and highest drawing precision. These elements include floor slabs, beams, supports, stairs, and foundation. It also takes into account natural forces such as earthquakes and wind speed so users can further improve their designs and meet the prevailing building standards and codes. CYPECAD has numerous analysis options, with explanations-and on screen graphs, to personalize the analysis, design and-reinforcement by means of tables.

2. METHODOLOGY

2.1 EQUIVALENT STATIC METHOD

The equivalent static lateral force method is a simplified technique to substitute the effect of dynamic loading of an expected earthquake by a static force distributed laterally on a structure for design purposes. The total applied seismic force V is generally evaluated in two horizontal directions parallel to the main axes of the building. It assumes that the building responds in its fundamental lateral mode. For this to be true, the building must be low rise and must be fairly symmetric to avoid torsional movement under ground motions. The structure must be able to resist effects caused by seismic forces in either direction, but not in both directions simultaneously

2.2 MODELLING OF THE STRUCTURE

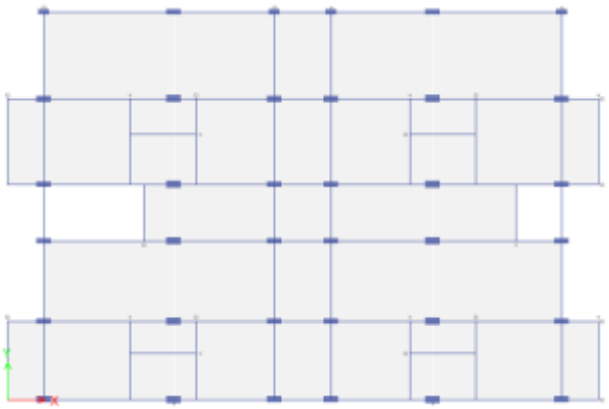

Fig -1: Plan of the structure.

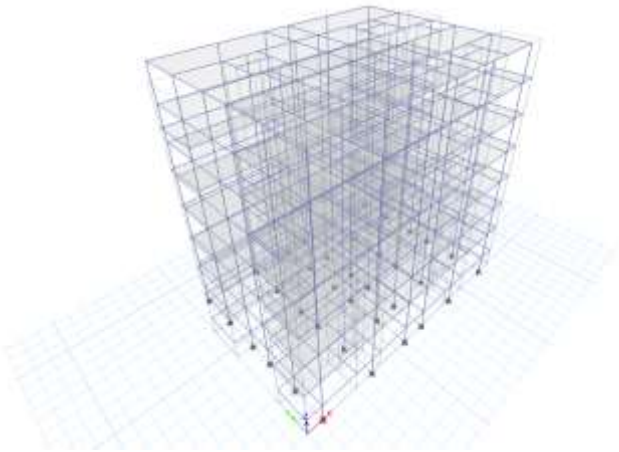

Fig -2: 3-D view of the structure in ETABS.

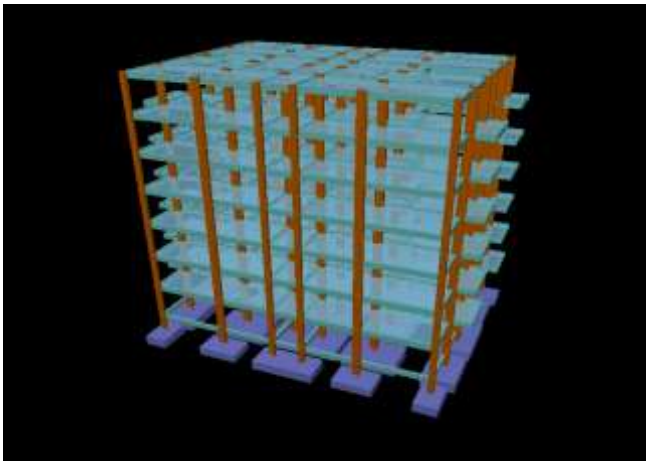

Fig -3: 3-D view of the structure in CYPECAD.

2.3 PRELIMINARY DATA:

Height of building: 21.6m
Built up area: 396.9 m².

Purpose of the building: Residential Apartment
Number of storey's: G+6
Floor height: 3.0m
Type of structure: RCC framed structure
Type of footing: Isolated rectangular footing, combined footing.
SBC of soil: 188 kN/m²

2.3.1 Dead load(IS 875 part-1)

- 230mm thick beam = (3-0.45)*0.23*20 = 11.73 kN/m
- 100mm thick beam = (3-0.45)*0.1*20 = 5.1 kN/m
- Parapet wall = 0.1*20*1 = 2 kN/m

2.3.2 Live load (IS 875 part-2)

- All rooms and kitchen = 2kN/m²
- Toilets and bath rooms = 2kN/m²
- Corridor, passage, staircase, balconies = 3kN/m²
- Roof load = 1.5kN/m²

2.3.3 Wind load (IS 875 part-3)

- Basic wind speed: 33.00 m/s
- Terrain category: II
- Structure class : B
- Service period (years): 50 years

2.3.4 seismic load (IS 1893 part-1)

- Seismic zone : II
- Soil type : Type II: Medium or stiff soil

3. RESULTS

Table -1: Shear Force and Bending Moments of Sample Beam by Load Case

LOAD CASES	ETABS		CYPECAD	
	Shear (kN)	Moment (kN-m)	Shear (kN)	Moment (kN-m)
Dead load	16.41	12.25	12.14	10.98
Live load	6.45	5.024	5.19	5.0
Seismic load	10.141	24.61	15.51	31.63
Wall load	28.82	20.212	31.36	25.30

- Maximum shear force and bending moment is found to be in ETABS for load cases dead load and live load, whereas for seismic and wall loading it is found to be in CYPECAD.
- Maximum shear force and bending moment in both the software's is found for the seismic loading.

TABLE -2: Shear Force and Bending Moments of Sample Beam by Load Combination.

LOAD COMBINATION	ETABS		CYPECAD	
	Shear (kN)	Moment (kN-m)	Shear (kN)	Moment (kN-m)
1.5(DL+LL)	24.61	18.37	25.9	23.9
1.5(SW+DL)	67.84	48.68	64.13	54.42
1.5(SW+DL+LL)	77.511	56.224	71.92	61.88
1.2(SW+DL+LL)	32.81	20.01	57.54	36.61
.9SW+.9DL+1.5W	24.61	15.01	33.41	13.70

- Maximum bending moment is found to be in CYPECAD for all the load combinations except for 0.9SW+0.9DL+1.5W which is found in ETABS.
- Maximum shear force is found to be in CYPECAD for the load combinations 1.5(DL+LL), 1.2(SW+DL+LL) and 0.9SW+0.9DL+1.5W
- Maximum shear force and bending moment in both the software's is found for the load combination 1.5(SW+DL+LL).Hence, this combination can be used for the design

Chart 1: Storey displacement graph.

- Maximum storey displacement is found to be in CYPECAD when compared to ETABS.

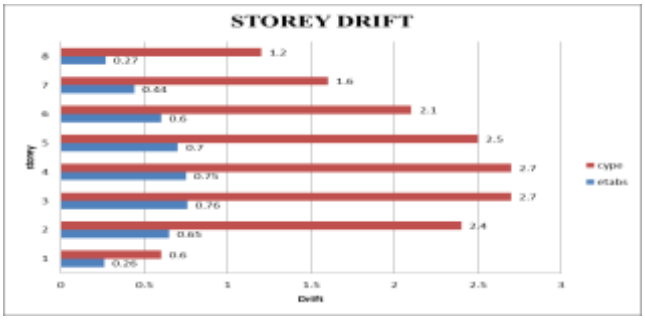

Chart 2: Storey drift graph.

- Maximum storey drift is found to be in storey 4 in CYPECAD and storey 3 in ETABs.
- The drift value is almost same in storey 1 and 8 in ETABS and storey 3 and 4 in CYPECAD.

4. CONCLUSIONS

- CYPECAD consumes less time for Analysis and design hence this can be highly useful for quicker work &time bound projects.
- CYPECAD and ETABS both enable to check the safety of design and modification in individual structural elements.
- Maximum storey drift and displacement is achieved in CYPECAD when compared to ETABS.
- Reinforcement detailing, drawing are generated along with the results automatically by CYPECAD whereas in ETABS the drawings have to be generated separately.
- As per the results obtained accuracy is increased in the CYPECAD software.

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