THE STUDY OF STRUCTURAL BEHAVIOR OF A HIGH RAISED R.C.C SKELETON STRUCTURE BY MEANS OF E-TABS FOR DISSIMILAR PLAN ARRAYS

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ABSTRACT: ETABS stands for Extended Three dimensional Analysis of Building Systems. ETABS is a special-purpose computer program developed specifically for building structures. ETABS is commonly used to analyze parking garages, sky scrapers, steel and concrete structures, low and high rise buildings and portal frame structures. These features are fully included in a single, Windows-based, graphical user interface that is unmatched in terms of ease-of-use, productivity, and capability. The case study in this paper mainly emphasizes on structural behavior of multi-storey building for different plan configurations like T shape and L shape. Modeling of 10-storey's R.C.C. framed building is done on the ETABS software for analysis and design. Post analysis of the structure, maximum shear forces, bending moments, maximum storey displacement and design results are computed and then compared for all the analyzed cases.

Keywords: Structure Design & ETABS.

1.0 INTRODUCTION

ETABS is an advanced, still easily operated, special purpose analysis and design program developed exclusively for building systems. ETABS is a spontaneous and powerful graphical interface coupled with unique modeling, analytical, design, and detailing procedures, all integrated using a common database. Even though it is quick and easy for simple structures. ETABS can also design the largest and most composite building models, including a wide range of nonlinear behavior of buildings necessary for Performance based design, making it the tool of choice for structural engineers in the building industry.

This analysis mainly deals with the study of a L shaped and T shaped plan using ETABS. The height of each storey is taken as 3m, making total height of the building as 30m. Loads considered are taken in accordance with the IS-875(Part1, Part2), IS-1893(2002) code and combinations are acc. to IS 875(Part5). Post analysis of the building, maximum shear forces, bending moments, and maximum storey displacement are computed and then compared for all the analyzed cases.

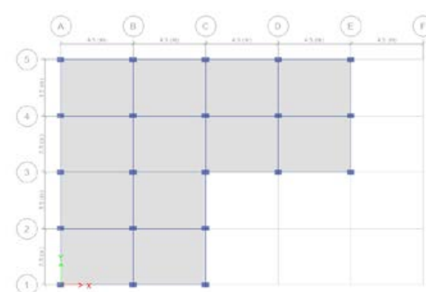

Fig 1: Shows Plan configuration for L-shaped building.

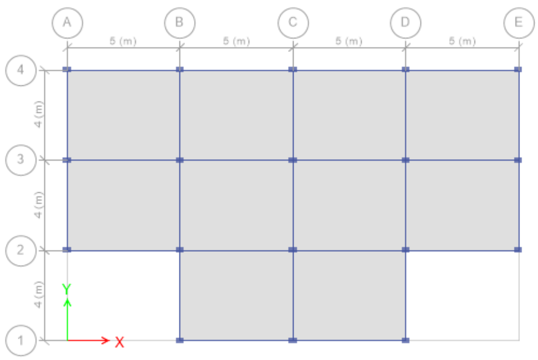

Fig 2 :Shows Plan configuration for T-shaped building

1.2 Load Cases

A load case defines how to apply the loads to a structure, and how the structural response is to be calculated. Several types of load cases are available. Most commonly, load cases are classified as two types. They are linear and nonlinear, based on how the structure responds to the loading. The results of linear analyses can be superposed, i.e., added together, after analysis. There are some types of load cases given below:

- Static loads: These are the most common type of load given to a structure. These loads are applied without dynamical effects.
- Response-Spectrum: The Statistical calculation of a response caused by moving loads. This calculation requires response-spectrum functions.
- Time-History: Time-varying loads are also applied. But they requires time history functions. The resolution can be done by modal superposition or direct integration methods.
- Buckling: The calculation of buckling under the application of loads will be done. The results of nonlinear load cases generally should not be superposed. Instead, all loads acting together on the structure can be combined directly within the particular nonlinear load case. Nonlinear load cases can be grouped together to represent complex loading sequences. These are the types of nonlinear load cases given below:
- Nonlinear Static: These loads are applied without dynamical effects.
  And they can be used for pushover analysis.
- Nonlinear Staged Construction: These loads are also applied without dynamical effects, with some parts of the structure being added or removed. The time-dependent effects like creep, shrinkage, and aging can be included.

1.3 Load Combinations

ETABS allows any named combination of one or more load cases or load combinations. If a combination is defined, it is applicable to the results for every object in the model.

There are five types of load combinations are as follows:

- Linear Add: The results obtained from the included load cases and combinations are added.
- Envelope: The results obtained from the included load cases and combinations are enveloped to find the maximum and minimum values.
- Absolute Add: The complete values of the results from the included load cases and combinations are added.
- SRSS: The square root of the sum of the squares of the results from the included load cases and combinations is calculated.
- Range Add: The Positive values are added to the maximum and negative values are added to the minimum for the included load cases and combinations. Apart from for the

Envelope type, combinations should usually be applied only to linear load cases, because nonlinear results are not generally suitable.

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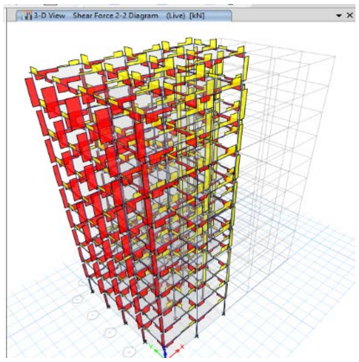

Fig 3: Shows bending moment for total Building

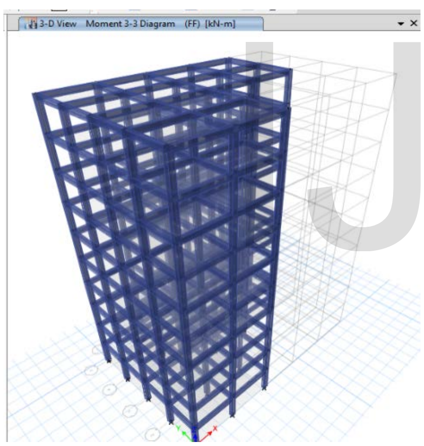

Fig 4 : Shows 3-D veiw of L-shaped building.

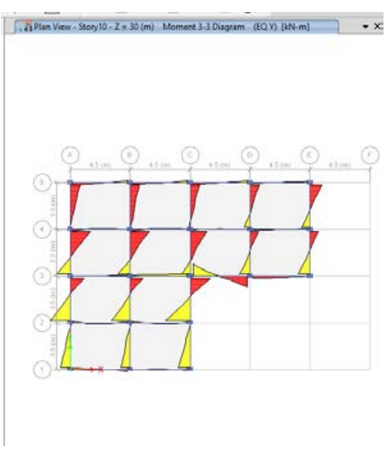

Fig 5:Shows Shear force diagram for 10th storey

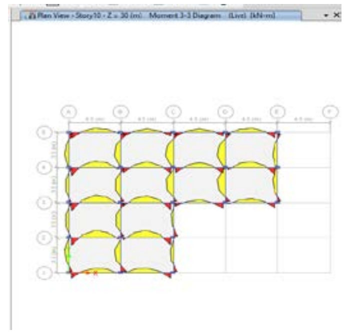

Fig 6: Shows bending moment diagram due to Live load

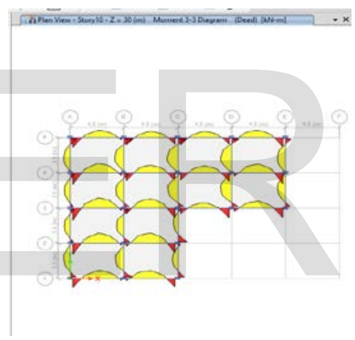

Fig 7 :Shows Bending moment diagram due to Dead load

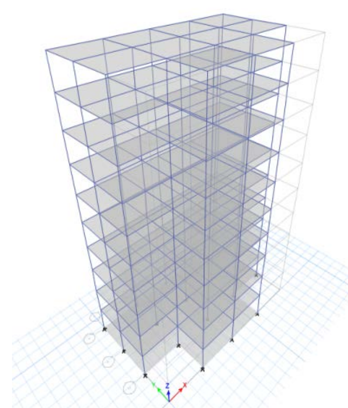

Fig 8 :Shows: 3-D view of T-shaped building.

Table1: Building Parameters

S No	Description	Dimensions	
		T-Shape	**L-Shape**
1	Length x Width	20m x 12m	18m x 12m
2	No. of storeys	10	10
3	Storey Height	3m	3m
4	Beam dimensions	230 x 350mm	300 x 450mm
5	Column 1-10 storeys	230 x 350mm	300 x 450mm
6	Slab thickness		200mm
7	thickness of main wall	250mm	250mm
8	support conditions	Fixed	Fixed
9	Grade of concrete	M30	M25
10	Grade of steel	Fe 415	Fe 415
11	Density of concrete	25 kn/cum	25 kn/cum

IS1893 2002 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern EQ X according to IS1893 2002, as calculated by ETABS.

Direction and Eccentricity

Direction = X

Structural Period

Period Calculation Method = Program Calculated

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 2] $Z = 0.16$
Response Reduction Factor, R [IS Table 7] $R = 5$
Importance Factor, I [IS Table 6] $I = 1$
Site Type [IS Table 1] = II

Seismic Response

Spectral Acceleration Coefficient, S_a /g [IS 6.4.5] $\frac{S_a}{g} = \frac{1.36}{T}$ $\frac{S_a}{g} = 1.195905$

Equivalent Lateral Forces

Seismic Coefficient, A_h [IS 6.4.2] $A_h = \frac{ZI\frac{S_a}{g}}{2R}$

Table 2 - Base Reactions for T-Shaped building

Load Case/Combo	**FX kN**	**FY kN**	**FZ kN**	**MX kN-m**	**MY kN-m**	**MZ kN-m**
Dead	0	0	17747.012	144231.32	-134354	0
Live	0	0	6237	50935.5	-46777.5	0
FF	0	0	2079	16978.5	-15592.5	0
WIND 1	0	0	0	0	0	0
WIND 2	0	0	0	0	0	0
EQ X	-283.9564	0	0	0	-6658.9093	2309.43
EQ Y	0	-238.2085	0	5586.1001	0	-1801.0531
DCon1	0	0	29739.018	241814.73	-224920	0
DCon2	0	0	39094.518	318217.98	-295086	0
DCon3 Max	0	0	31275.6144	254574.384	-236069	0
DCon3 Min	0	0	31275.6144	254574.384	-236069	0
DCon4 Max	0	0	31275.6144	254574.384	-236069	0
DCon4 Min	0	0	31275.6144	254574.384	-236069	0
DCon5 Max	0	0	29739.018	241814.73	-224920	0
DCon5 Min	0	0	29739.018	241814.73	-224920	0
DCon6 Max	0	0	29739.018	241814.73	-224920	0
DCon6 Min	0	0	29739.018	241814.73	-224920	0
DCon7 Max	0	0	17843.4108	145088.838	-134952	0
DCon7 Min	0	0	17843.4108	145088.838	-134952	0
DCon8 Max	0	0	17843.4108	145088.838	-134952	0
DCon8 Min	0	0	17843.4108	145088.838	-134952	0
DCon9	-340.7477	0	31275.6144	254574.384	-244060	2771.316
DCon10	340.7477	0	31275.6144	254574.384	-228078	-2771.316
DCon11	0	-285.8503	31275.6144	261277.7041	-236069	-2161.2637
DCon12	0	285.8503	31275.6144	247871.0639	-236069	2161.2637
DCon13	-425.9347	0	29739.018	241814.73	-234908	3464.145
DCon14	425.9347	0	29739.018	241814.73	-214931	-3464.145
DCon15	0	-357.3128	29739.018	250193.8801	-224920	-2701.5796
DCon16	0	357.3128	29739.018	233435.5799	-224920	2701.5796
DCon17	-425.9347	0	17843.4108	145088.838	-144940	3464.145
DCon18	425.9347	0	17843.4108	145088.838	-124964	-3464.145
DCon19	0	-357.3128	17843.4108	153467.9881	-134952	-2701.5796
DCon20	0	357.3128	17843.4108	136709.6879	-134952	2701.5796

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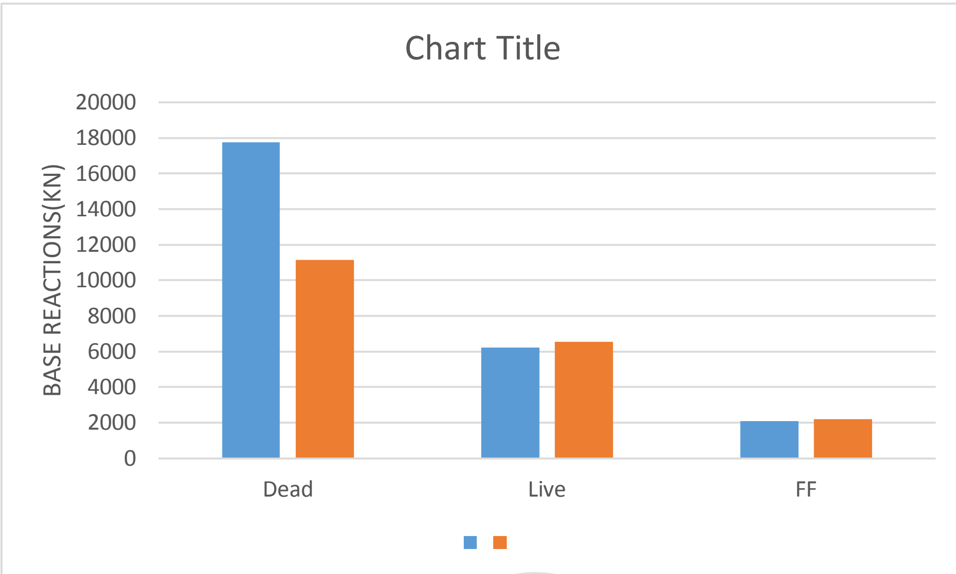
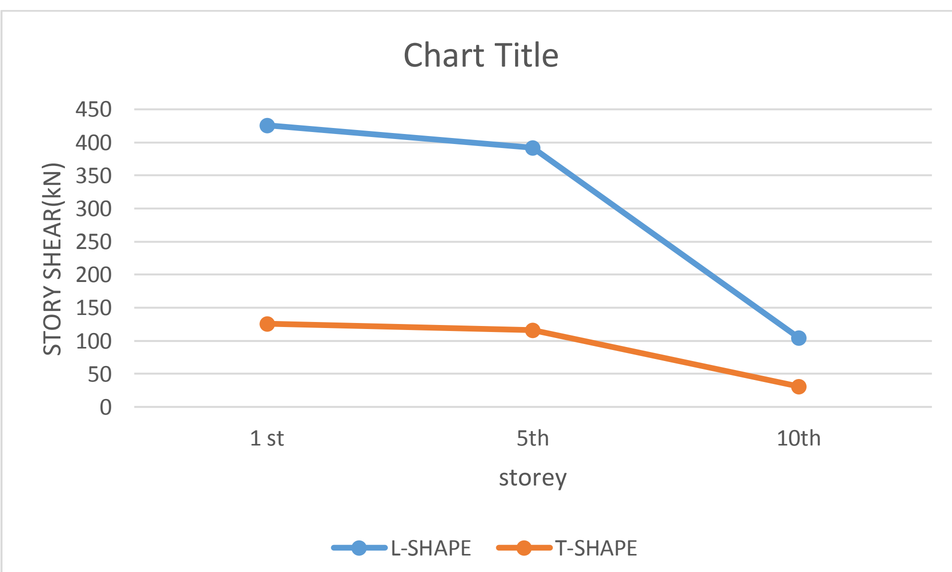
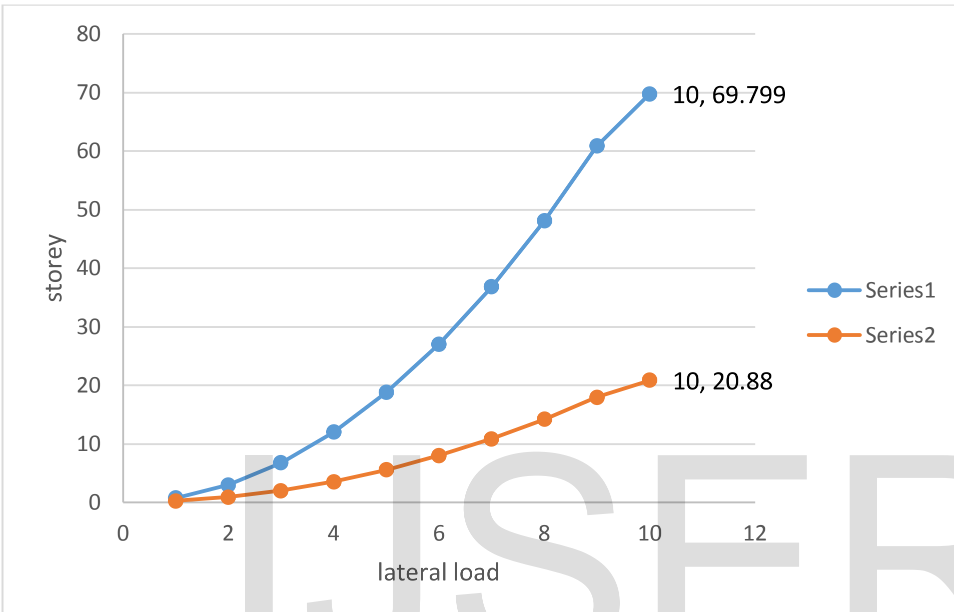
Graph:1 Comparative results of L & T Shape structure for base reactions



Graph: 2 Comparative results of L & T Shape structure for shear forces



Graph.3 shows the comparative results of L & T Shape structure for Earth quake forces



CONCLUSIONS

From our results obtained from the analyses outputs, the elements are in accordance to our objectives of the study which are:

1. The dead, live and floor finish loads obtained by the ETABS are similar to the manually calculated values
2. Analysis of the structural integrity of these buildings in withstanding the design earthquake loadings was conducted and was judged to be safe
3. The L shaped building plan undergo more deformations than T shaped building plan.

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