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Analysis of a High Rise Structure Using E-Tabs Software

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ABSTRACT

Now-a-days, the architects often prohibit the widths of the columns so that more free space is available and for the good aesthetic look of the building without columns protruding out of the walls and corners. Advances in structural members and techniques to resist lateral forces are generally used now days to pretend more stable and safe structure. Solid structures with non-rectangular uncommonly formed flimsy segments discovered as an option in contrast to the above said issue and it is discovered that non-rectangular uniquely molded dainty segments performs well basically with all investigation results inside satisfactory cutoff points.

In present work with the end goal to contrast fortified solid structure using traditional columns against structure designed with special shaped columns considering seismic loads on G+12 multi-story building having plan measurement 63.20 m x 29.50 m is displayed and dissected in ETABS (2018) adaptation coordinated building outline programming. Proportionate static investigation and dynamic reaction range examination are performed on the structure.

KEYWORDS: *Structural stability, analysis, software, columns, lateral forces*

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I. INTRODUCTION:

Concrete structures with non-rectangular specially shaped thin columns found out as an alternative to the above said problem and it is found out that non-rectangular specially shaped thin columns performs well structurally with all analysis results within acceptable limits. This kind of structure satisfies spatial requirements of corners as well as intersection of corners so that no visible edges or prominent column would appear in the buildings. This expands the actual usable floor area and more furniture can be placed into the buildings. For this reason, frame structure with specially shaped column is suitable blooms, especially for villa and multi-storey buildings. This paper explains the behaviour of buildings with Rectangular columns and buildings with specially shaped columns and values of various parameters like story drift, story displacement, story stiffness etc. on the basis of lateral loads.

Structural design is a science and art of understanding the behavior of structural members subjected to loads and designing them with economy along with safety, serviceability and as a durable structure. The present dissertation work will be dealing with such a study of structural members made of RCC as it is widely used because of its adaptability. Column is basically a structural member assigned for carrying compressive loads. It carries axial loads from beams and transfers it to footing. The columns are distinguished in many ways and many types are observed. Based on the slenderness ratio columns are called as short or long columns. The short column fails by crushing and long column fails by buckling. Considering the loading pattern there are axially loaded column, axial column with uniaxial bending, axial column with biaxial bending. Columns behave differently under static and dynamic loading conditions. The dynamic load consideration is must for places where the seismic activity is high. Therefore when seismic loads are considered the combined approach of ductility and strength must be applied The wind loads, snow loads, creep, shrinkageand temperature effects are considered where they are necessary.

Specially Shaped Columns

In the RCC buildings, columns are structural elements which are predominantly subjected to axial compressive forces, moments, and transfers total load

from the super structure to sub-structure. Various shapes of the columns are used. Some common shapes are square, rectangular, circular columns and some special shapes of columns are L-shaped, T-shaped and plus (+) shaped columns as shown in figure 1.1 which are not commonly used but gives more indoor space than commonly used shapes of columns. Special shaped columns avoid prominent corners in a room which increases usable floor area.

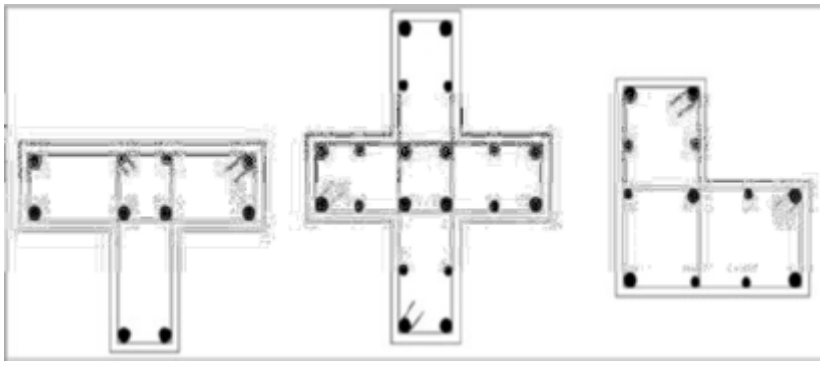


Figure 1.1 Specially shaped (T, Plus, L) columns with Longitudinal and lateral reinforcement

II. LITRATURE RIVEW

Shivaranjitha and Kumar (2017) The research paper presented the comparative investigation of Y-shaped columns against customary (rectangular or square) sections,8 storey business structures were considered for investigation and comparative r investigation among standard and Y-shaped column where the plan and examination were led utilizing application ETABS 2015 rendition. Results indicated that by embracing Y-shaped columns about 20.53% of floor territory was expanded. Consequently, the Y-shaped column can be effectively received to expand the utility of

the floor zone of private/business structure. The essential target of the examination depended on the decrease of a few columns without any decrease in strength of the structure and generate free space for the parking space.

Results expressed that the number of segments was diminished by practically 40% prompting the end more sections free zone can be acquired by lessening the number of columns. It serves to the free development of vehicles in the parking garage. Results displayed that about 20.53% of the floor region was expanded utilizing Y-molded. The slanted help individuals from the Y-formed section was exposed to higher moment while moving the pivotal loads to the focal point of the vertical part of segments. The pillars encountered the resultant forces as hub loads at the intersection. The Y-molded sections can be utilized for the architectural purpose by giving a satisfying appearance to inclined support members, which expands the stylish appearance of the structure. As the quantity of column decreases, the economy in the development of footing for sections can be accomplished.

Shet et al. (2018) The research paper introduced an examination of the interaction curve of the C-shaped equivalent legged RC segment utilizing an investigative technique designed using ETABS.The results concluded that most extreme load and moment conveying limit increments with expanding the evaluation of steel and grade of cement in C-molded RC concrete. For the manual analytical estimation, parabolic pressure square was considered however ETABS takes Whitney's proportionate pressure block for calculus, henceforth variations in results were found in loads and moment. The manual diagnostic computation for loads in steel was finished utilizing TABLE-A of SP 16 codebook, however ETABS gave strain in steel and modulus of flexibility. For manual diagnostic estimation, the estimation of K extended in the middle of 1.05 to 4, however, ETABS considered the estimation of K went in the middle of the 1.05 to 1.2.

Paul and Vargheese (2019) The research paper dissected Crisscrossed moulded columns associated by the lacing bar, Single vertical steel plate with stiffeners, Double vertical steel plate, Effect of tallness, Effect of width and axial compressive conduct. The characteristics of the finite element investigation were utilized on the applied limit conditions and material properties utilizing ANSYS 16.2.

Pechorskaya et.al (2021) There are numerous software applications available to analyze and design massive projects in short time. Most of the software have 2- dimensional and 3-dimen- sional tools, while various structural engineers employ the use of the 3D analysis and design tools in their day-to-day tasks because of its ease to operate and graphical user interface. These tools help in modeling, analyzing, and design of structures much more efficient. Despite the availability of numerous software products, there are confusions on the software to be used in the analysis and design of specific building structures. There is a need of studying the strength and weakness of some of these software tools to help structural engineers in the selection of the best application in

their daily tasks. The aim of this study is to investigate the structural analysis of high-rise building with ETABS and RSA software and compare the influences of the structural analysis results from the two software in design.

III. METHODOLOGY

In present work with the end goal to contrast fortified solid structure using traditional columns against structure designed with special shaped columns considering seismic loads on G+12 multi-story building having plan measurement 63.20m x 29.50m is displayed and dissected in ETABS (2018) adaptation coordinated building outline programming. Proportionate static investigation and dynamic reaction range examination are performed on the structure. Following three models of structures are displayed:

The explained 3D building model is analyzed using Equivalent Static Method. The building models are then analyzed by the software ETABS (2018). Different parameters such as deflection, shear force & bending moment were presented for the models. Seismic codes are unique to a particular region of country. In India, Indian standard criteria for earthquake resistant design of structures IS 1893 (PART-1): 2016 is the main code that provides outline for calculating seismic design force

Building Geometry

Table 3.1 Details and Dimension of the Building Models

Type of structure	Ordinary moment resisting RC frame
Grade of concrete	M 25
Grade of reinforcing steel	Fe 415
Plan area	63.20m x 29.50m
Number of stories	G+12
Total Height of Building	43.2 m
Floor height	3.6 m
Rectangle Shaped Column	230mm x 600mm
Plus Shape column	350mm x 750mm
T Shape Square column	350mm x 600mm
Beam size	500mm x 300mm
Wall thickness	230mm
Thickness of Slab	200 mm
Density of concrete	25N/ mm^3
Live Load on Floor and roof	3 kN /mm^2 and 1.5 kN/ mm^2
Plan irregularity	T Shape and Plus Shape
Seismic Zone	II
Soil Condition	Medium Soil
Floor Finish	1.0 kN/m^2

Table 3.2Material properties of structure

S. no	Description	Values
1	Material property	Values
2	Grade of concrete	M-25
3	Young's modulus of concrete, E_c	2.17 x 10^4 N/mm^2
4	Poisson ratio	0.17
5	Tensile Strength, Ultimate steel	505 MPa
6	Tensile Strength, Yield steel	215 MPa
7	Modulus of Elasticity steel	193 - 200 GPa

Note: Specifications as per IS: 456; 10262; SP 23 – codes for designing concrete mixes

1. MODEL A. G+12 using rectangular columns.

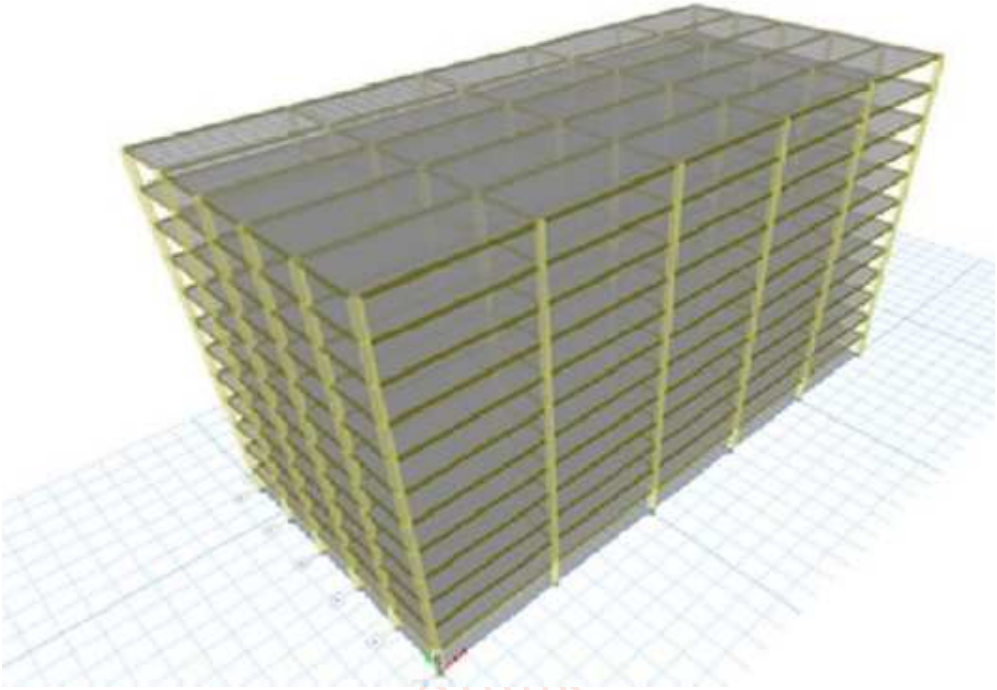


Figure 3.1 G+12 with Rectangular Column

MODEL B. G+12 using T Shaped square columns.

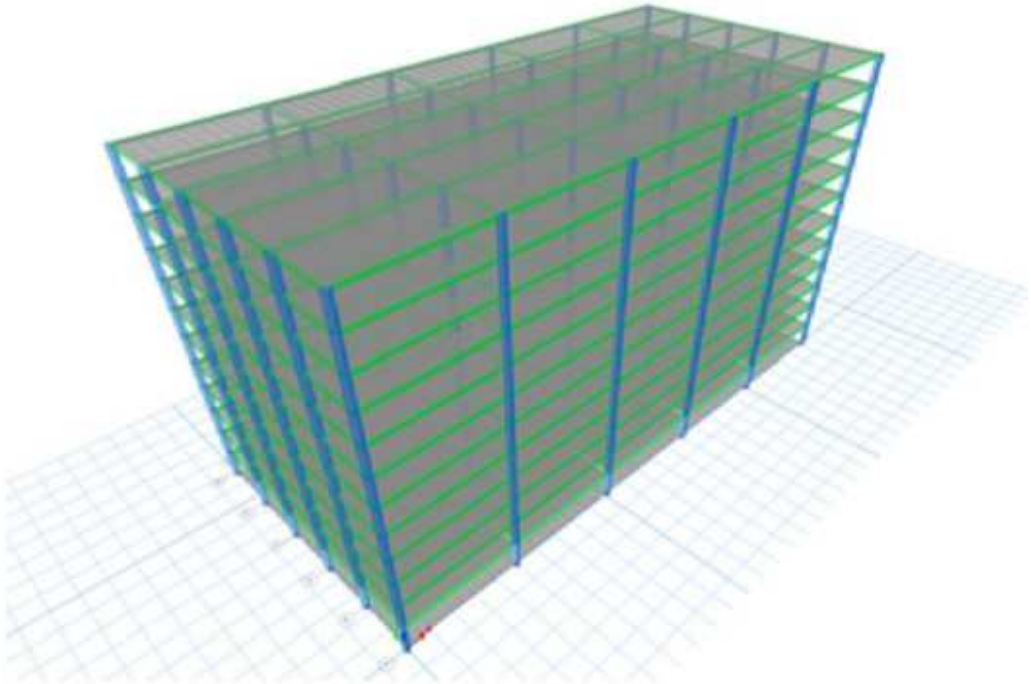


Figure 3.2 G+12 with T shaped Column

MODEL C. G+12 using Plus Shaped columns

Table 3.4 Seismic force parameters for proposed issue

S. No.	Parameter	Value
1	Zone (II)	0.10
2	Damping ratio	0.05
3	Importance factor	1
4	Response Reduction Factor	5
5	Soil site factor	Medium

The accompanying three exercises must be performed to accomplish that objective.

- Modelling of the diverse cases in ETABS (2018)
- Calculation and Provisions according to Indian gauges can be connected.
- Analysis of structure to analyze forces, dislodging and moment producing in a casing.

For this research work following steps should be followed:

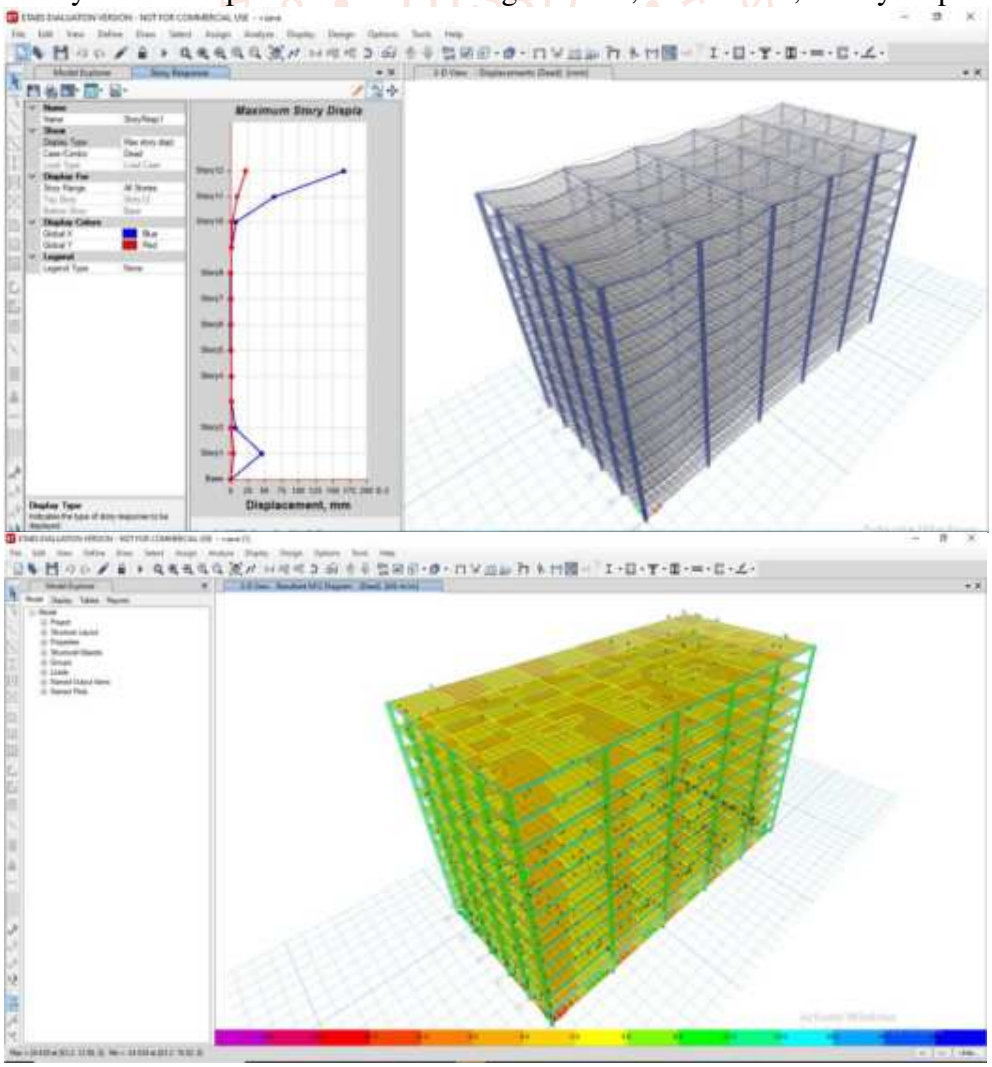
Step-1 Firstly literature survey should be done to determine the past research and Need of study.
Step-2 To prepare concrete and other materials in ETABS (2018) and assign them to structural members.
Step-3 To prepare modelling of a symmetrical building frame (G+12) using ETABS (2018).
Step-4 Defining and Assigning section Properties
Step-5 To analyze the structure for dynamic loading.
Step-6 To compare the results of the structure.

ETABS (2018) software is exclusively made for modeling, analysis and design of buildings. Various facilities in the ETABS (2018) are listed below

- ETABS (2018) provide object based modeling. it takes slab as area object, column, beam, brace as a line object and support, mass, loads as point objects.
- ETABS (2018) has feature known as similar story. By which similar stories can be edited and modeled simultaneously. Due to which building is modeled very speedily
- ETABS (2018) can perform various P-delta, Response Spectrum, Static Non-linear, Time history, Construction sequence and many more analysis with good graphics.
- ETABS (2018) automates templates for typical structures like steel deck, waffle slab, flat stab, Ribbed Slab etc.
- ETABS (2018) can do optimization of steel section.
- ETABS (2018) has a facility to design composite beam. Also composite deck can be modeled in ETABS (2018).
- ETABS (2018) has powerful facility of Section designer. By which different types of composite sections can be made easily.

IV. RESULT & DISCUSSIONS

The results were analyzed on the parameters on bending moment, Shear force, Storey displacement.

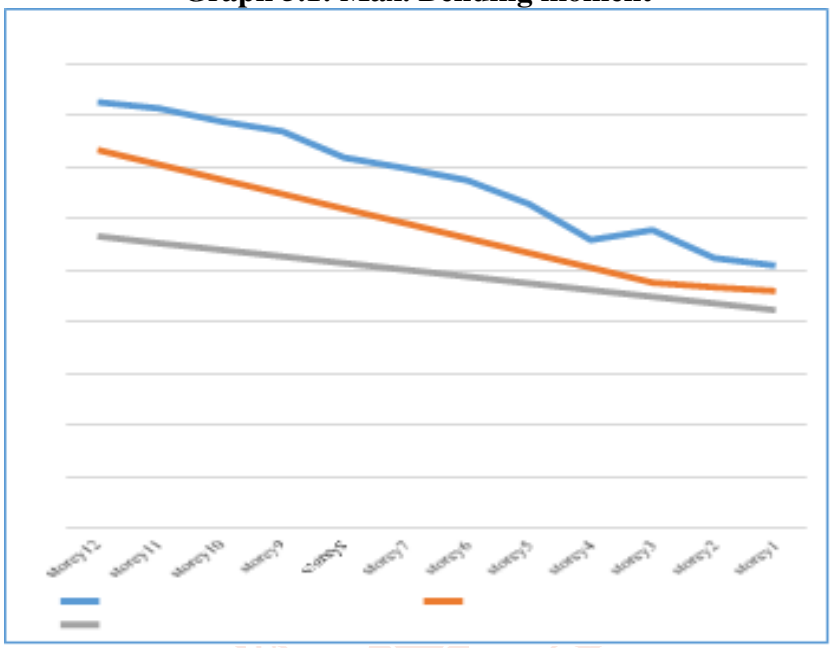


Result analysis by using ETABS (2018)
Max. Bending Moment kN-m

Table 5.1 Max. Bending moment in each storey

Moment in kN-m			
Storeys	Rectangular Column	T Shape	Plus Shape
Storey12	826.76	734.17	566.81
Storey11	814.58	705.63	553.84
Storey10	789.44	677.09	540.87
Storey9	770.21	648.55	527.9
Storey8	719.3	620.01	514.93
Storey7	698.67	591.47	501.96
Storey6	675.2	562.93	488.99
Storey5	629.1	534.39	476.02
Storey4	559.89	505.85	463.05
Storey3	578.9	477.31	450.08
Storey2	524.99	468	437.11
Storey1	510.22	461.05	424.14

Graph 5.1: Max. Bending moment



Conclusion

Maximum Bending Moment

In the chapter above, it is clearly observed that bending moment in structure using Rectangular column was 826.76 kN-m whereas structure using T shapes and Plus Shaped column showed less bending moment as 734.17 and 566.81 kN-m, thus Plus shaped case requires less reinforcement.

Maximum Shear force:

In above chapter it is observed that unbalance forces are maximum in rectangular case 941.85 kN whereas in Plus shaped case these are reduced to 840.43 kN which shows stability of the structure.

Maximum storey displacement:

It is observed that lateral stability is comparatively increased in structure with plus shaped column case comparing to structure using traditional rectangular column. In case of light weight structure displacement is minimised to 66.16 mm instead of 88.84 mm in bare frame.

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