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UTILIZATION OF ADVANCE TECHNOLOGY AND TECHNIQUES IN ANALYSIS OF A TALL STRUCTURE

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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.

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 63.20mx29.50m m is displayed and dissected in Etab adaptation coordinated building outline programming. Proportionate static investigation and dynamic reaction range examination are performed on the structure.

Keywords: Structural stability, analysis, advance techniques, software's, columns, lateral forces.

Introduction:

Presently a-days, the designers regularly disallow the widths of the segments so more free space is accessible and for the great stylish look of the structure without sections projecting out of the dividers and corners.

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. This sort of structure fulfills spatial necessities of corners just as crossing point of corners with the goal that no obvious edges or conspicuous segment would show up in the structures. This grows the real usable floor territory and more furniture can be put into the structures. Consequently, outline structure with uncommonly formed segment is appropriate blossoms, particularly for manor and multi-story structures. This paper clarifies the conduct of structures with Rectangular segments and structures with extraordinarily molded segments and estimations of different boundaries like story float, story relocation, story firmness and so on based on parallel burdens.

Basic plan is a science and specialty of understanding the conduct of auxiliary individuals exposed to burdens and planning them with economy alongside wellbeing, usefulness and as a strong structure. The current thesis work will manage such an investigation of basic individuals made of RCC as it is generally utilized due to its versatility. Section is fundamentally an auxiliary part allocated for conveying compressive burdens. It conveys hub loads from shafts and moves it to balance. The sections are recognized from multiple points of view and numerous sorts are watched. In view of the slimness proportion sections are called as short or long segments. The short segment falls flat by pulverizing and long segment bombs by clasping. Considering the stacking design there are pivotally stacked segment, hub segment with uniaxial bowing, hub segment with biaxial twisting. Segments carry on diversely under static and dynamic stacking conditions. The dynamic burden thought is must for places where the seismic movement is high. Thusly when seismic burdens are viewed as the joined methodology of pliability and quality must be applied. The breeze loads, snow loads, creep, shrinkage and temperature impacts are viewed as where they are essential. The snow load thought differs on nation to nation, and locale to area. It must be considered according to important plan codes of significant codes.

The thought of wind stacks chiefly relies upon elevation of structure and the bearing and speed of the breeze in the locale. The segments ought to be intended to convey the breeze loads in such conditions. A portion of the complex mathematical conditions and building abnormalities requires test and systematic methodologies for various material properties and sectional properties. Such boundaries can't be legitimately secured by the structure code books and rules. The structural prerequisite leads the architect to consider various shapes and cross areas of the pillars, segments, plates and so on. This prompted distinctive cross segments of segments dependent on the spot and capacity, for example, L-shape, T shape, C-shape, +shape and so forth. Indeed, even the various states of segments are additionally by and by, for example, shaft, trapezoid, pinnacle and cross section. Every one of these segments ought to be structure and cast with wellbeing, economy and stylish appearance. Normally the distinctive cross segments of segments, for example, L-shape, T shape, C-shape, cross shape have made a change in basic designing by which they gives the simple answer for areas in extraordinary cases.

In the RCC structures, segments are auxiliary components which are dominatingly exposed to pivotal compressive powers, minutes, and moves all out burden from the super structure to sub-structure. Different states of the segments are utilized. Some normal shapes are square, rectangular, round sections and some extraordinary states of segments are L-molded, T-formed and in addition to (+) molded segments as appeared in figure 1.1 which are not regularly utilized yet gives more indoor space than usually utilized states of segments. Exceptional molded segments dodge conspicuous corners in a room which increments usable floor zone.

The fortified solid structure framework with uncommonly molded sections is a framework generally received in private structures because of no uncovered shafts and segments in the room. The practicality and comfort of strengthened cement (RC) outline with extraordinary molded sections in auxiliary structure and its positive assistance make it generally utilized in development industry.

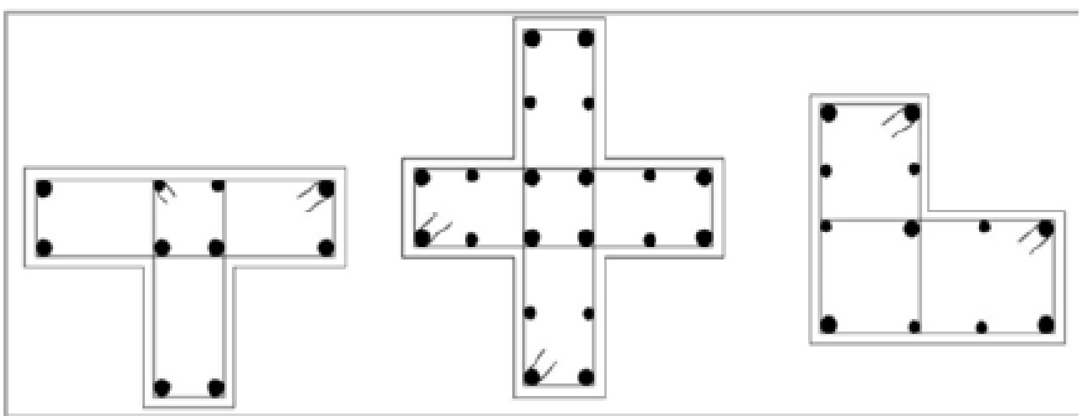


Fig 1 Specially shaped (T, +, Plus) columns with Longitudinal and lateral reinforcement.

Literature Review

Yuzhuo WANG et al (2019) The exploration paper introduced testing of three T-framed steel-fortified strong sections analyzed under high temperature and vertical burdens, to impersonate fire sway. The outcomes presumed that disappointment qualities, circulation of temperature field, vertical disfigurement credits and impenetrability to fire were likewise explored under different center tension extents and various flightiness. The test moreover showed that the breaks extended with the extension of center point pressure extent and unusualness. The harms of the web were severer than the rib. The breaks were for the unusual side on the whimsical side and by and large inclined parts in the model. The vertical augmentation ended up being progressively apparent as the eccentricism decreased. The impenetrability to fire reduced as the pivotal weight extent extended. Differentiated and, the impenetrability to fire of huge hub pressure models (the urgent weight extent was 0.6) was reduced by 57% than less hub pressure models (the center weight extent was 0.2). The impenetrability to fire reduced by about 30min as flightiness extended by 20mm.

Mary Paul V and Nisha Vargheese (2019) The examination paper dismembered Crisscrossed formed segments related by the binding bar, Single vertical steel plate with stiffeners, Double vertical steel plate, Effect of height, Effect of width and pivotal compressive lead. The attributes of the limited component examination were used on as far as possible conditions and material properties using ANSYS 16.2.

The results derived that Mono fragments related with twofold vertical steel plate had more burden passing on limit however Mono segments related by a binding bar had a less burden conveying limit. Mono sections related by single vertical steel plate with stiffeners have more weight passing on limit than restricting bars. Burden passing on limit oppositely propositional to the height of the fragments. Burden passing on limit depends on the width of the steel plate. The proportion of repression concrete expanded burden conveying limit.

Objectives of the study:

The main objectives of this study are to evaluate the performance of building with special shaped column.
Followings are the specific objectives of this study.

(1) To study the behavior of the building under lateral loads like seismic and wind loads.

(2) Determination of deflections, storey drifts, storey stiffness and storey overturning moment of the buildings under wind and seismic conditions.

(3) To compare the performance of the special shaped column building with building of rectangular columns.

(4) To determine the effect of shaped column over stability of the structure.

(5) To compare cost analysis of all the cases as per S.O.R.

Methodology:

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 Sample of light weight concrete to determine its properties to be Assign in ETABS.

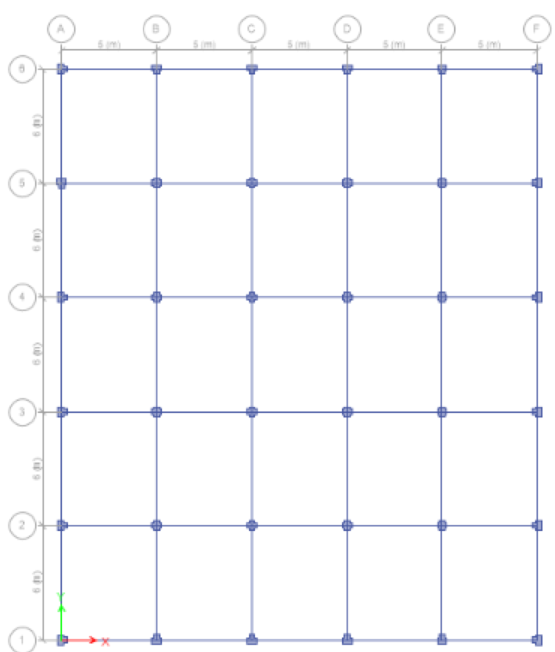


Fig 2 plan of structure

Step-3 To prepare modelling of a symmetrical building frame (G+12) using ETABS"17.

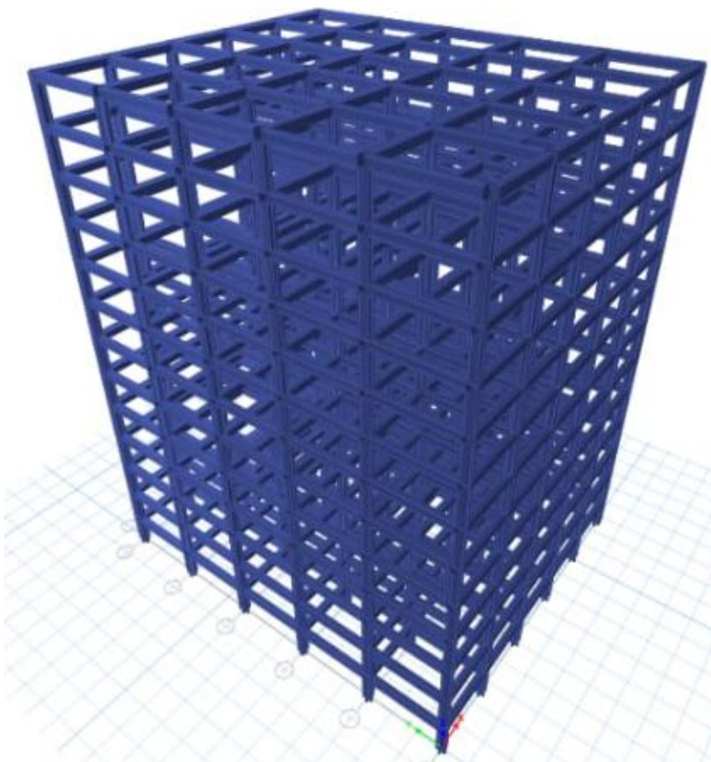


Fig 2 Model of the structure

Step-4 To assign properties and support conditions.

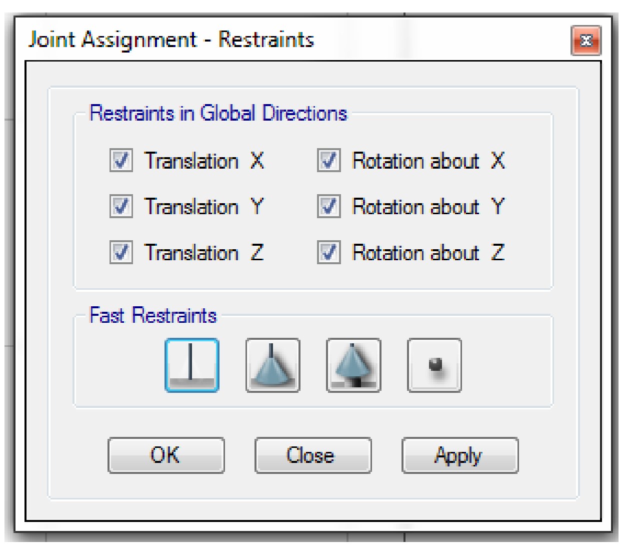


Fig 3 Assigning support conditions

Step 5 Defining and Assigning section Properties

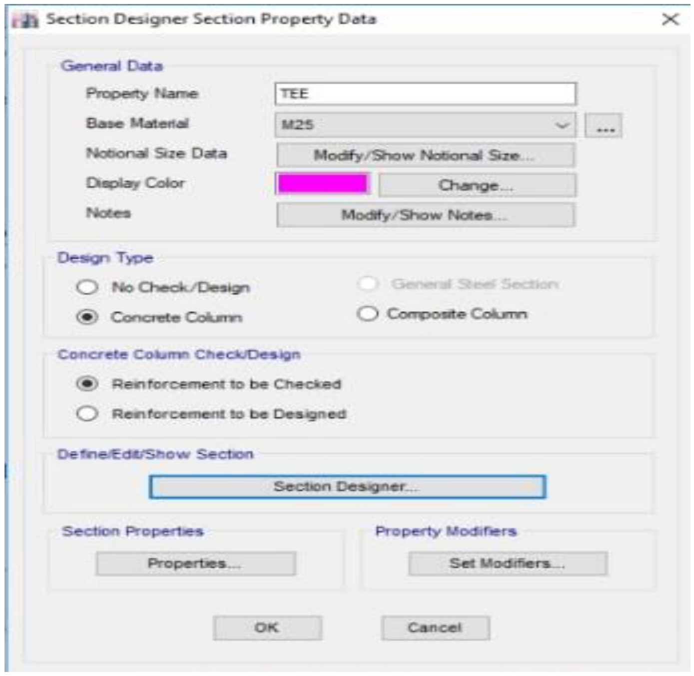
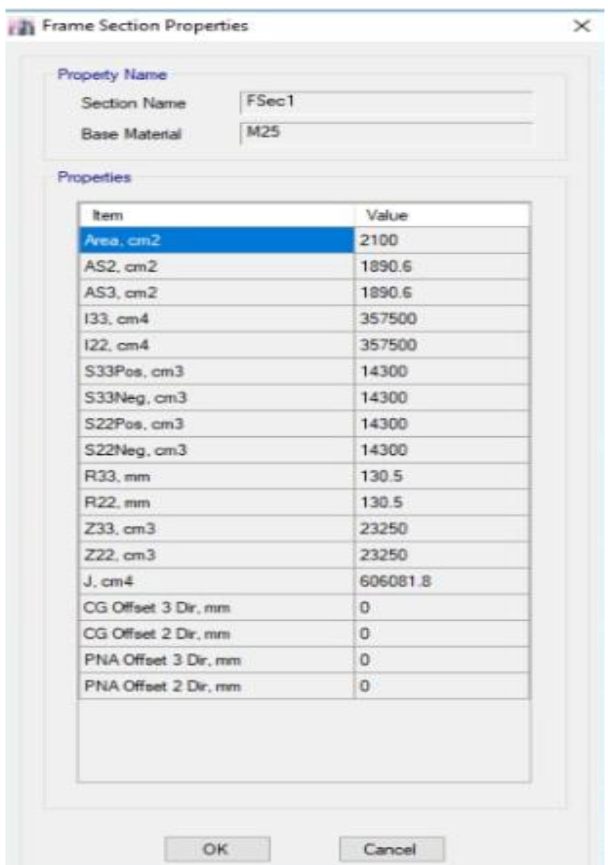


Fig 4 (a) Defining Section Properties



Item	Value
Area, cm2	2100
AS2, cm2	1890.6
AS3, cm2	1890.6
I33, cm4	357500
I22, cm4	357500
S33Pos, cm3	14300
S33Neg, cm3	14300
S22Pos, cm3	14300
S22Neg, cm3	14300
R33, mm	130.5
R22, mm	130.5
Z33, cm3	23250
Z22, cm3	23250
J, cm4	606081.8
CG Offset 3 Dir, mm	0
CG Offset 2 Dir, mm	0
PNA Offset 3 Dir, mm	0
PNA Offset 2 Dir, mm	0

Fig 4 (b) Defining Frame Section Properties

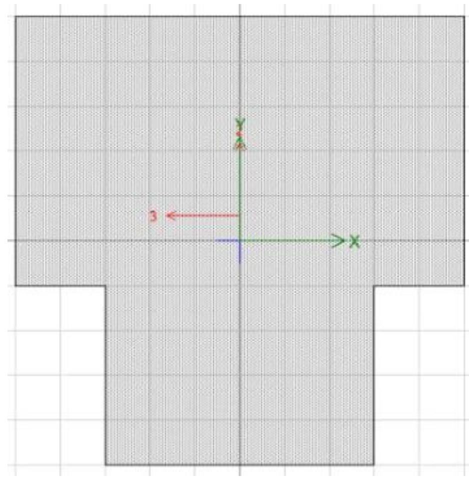


Fig 4 (c) Section Design T Shaped

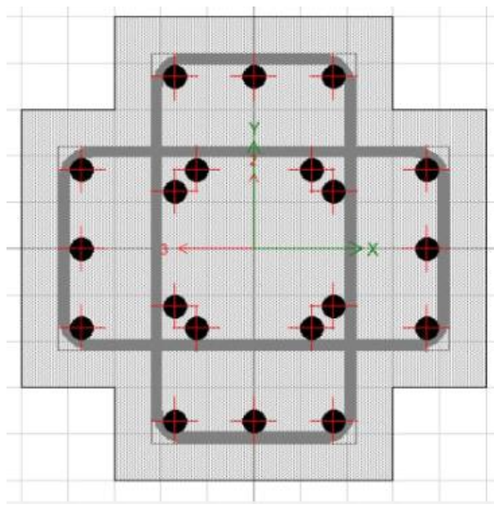


Fig 4 (d) Section design Plus Shaped

Step-6 To Assign lateral force (response spectrum) dynamic analysis as per I.S. 1893-Part-I: 2016.

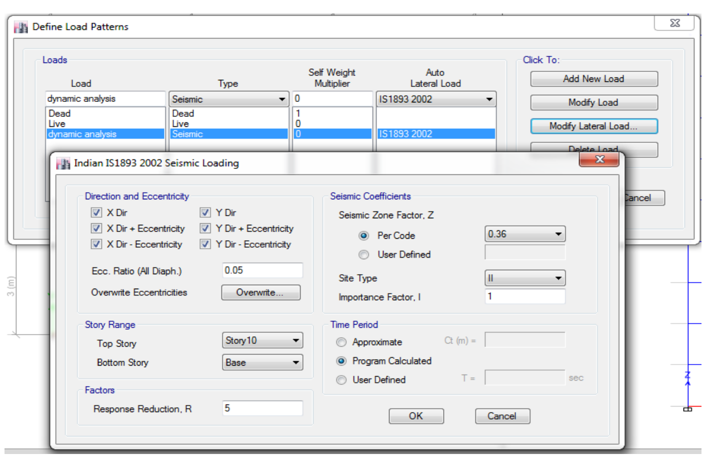


Fig 5 Defining loading conditions

Step-7 To analyze the structure for dynamic loading.

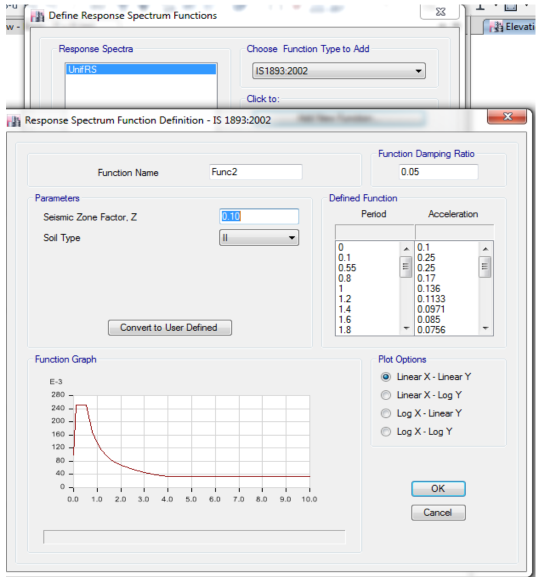


Fig 6 Dynamic analysis

Step-8 To compare the results of the structure.

Problem Formulation:

Table 1 Details and Dimension of the Building Models

Type of structure	Ordinary moment resisting RC frame
Grade of concrete	M 40 (fck= 40 N/mm2)
Grade of reinforcing steel	Fe 415
Plan area	63.20mx29.50m
Number of stories	G+12
Total Height of Building	43.2 m
Floor height	3.6 m
Rectangle Shaped Column	230x 600mm
Plus Shape column	350mmx750mm
T Shape Square column	350mmx600mm
Beam size	500x300mm
Wall thickness	230mm
Thickness of Slab	200 m
Density of concrete	25N/ mm3
Live Load on Floor and roof	3 kN/mm2 and 1.5 kN/ mm2
Plan irregularity	T Shape and Plus Shape
Seismic Zone	II
Soil Condtion	Medium Soil
Floor Finish	1.0 kN/m2

Table 2 Material 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	$2.17x10^4$ 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

Analysis Result:

Max. Bending Moment:

Table 3: Max. Moment in KN-m

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

Max. Shear Force

Table 4: Max. Shear Force in KN

Shear force in kN-m			
Storeys	Rectangular Shape	T Shape	Plus Shape
storey12	941.85	840.43	821.54
storey11	923.25	813.87	797.91
storey10	904.65	787.31	771.23
storey9	886.05	760.75	748.9
storey8	867.45	734.19	712.45
storey7	848.85	707.63	694.766
storey6	830.25	681.07	672.85
storey5	811.65	654.51	637.31
storey4	793.05	627.95	619.21
storey3	774.45	601.39	583.36
storey2	755.85	574.83	554.45
storey1	737.25	548.27	528.77

Storey Displacement in mm

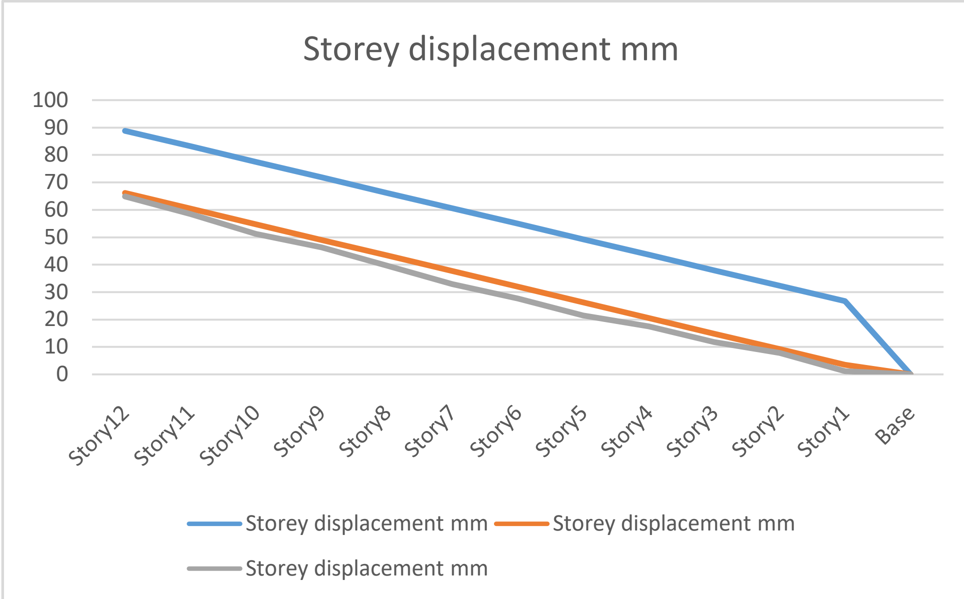


Fig 7: Storey Displacement

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.

Axial Force:

In the above chapter it is observed that there is very minute variation in axial force as it is considered for same loading condition in both the cases.

Future scope:

i) In the proposed work high rise building is considered which can be increased to some more floors in future with variation in floor to floor height.

ii) In this study seismic analysis is considered whereas in future study wind load can be considered.

iii) In this study analysis is done using etabs whereas in future SAP2000 can be prefer for P-delta analysis.

iv) In this study cost analysis is performed as per S.O.R. whereas in future one can adopt market rate for estimation.

Reference

1. Yuzhuo WANG ,Ying HUANG and Chuanguo FU, [Performance of T-Shaped Steel Reinforced Concrete Column under High Temperature], 6th International Workshop on Performance, Protection & Strengthening of Structures under Extreme Loading, PROTECT2017, 11-12 December 2017, Guangzhou (Canton), China.

2. Mary Paul V and Nisha Vargheese, [AXIAL COMPRESSIVE BEHAVIOUR OF CRISS CROSSED SHAPED CONCRETE COLUMNS FENCED WITH STEEL], International Journal of Scientific & Engineering Research Volume 10, Issue 5, May-2019, ISSN 2229-5518.

3. Dr.MD.Subhan, [An investigational behaviour of RCC Core Steel Composite Column], SSRG International Journal of Civil Engineering (SSRG - IJCE) – Volume 4 Issue 5 – May 2017.

4. Shital A. Navghare and Amey Khedikar, [Analysis of RCC Framed Structure for Column with Modelling Irregularities], International Journal of Innovative Research in Science, Engineering and Technology, Vol. 6, Special Issue 11, May 2017.

5. Shivaranjitha T H and Naveen Kumar S, [Comparative Study of Y-Shaped Columns with Conventional Rectangular Shaped Columns], International Research Journal of Engineering and Technology (IRJET), Volume: 04 Issue: 06 | June -2017.

6. Pu Yang, Hongxing Liu and Zongming Huang, [A COMPARISON OF SEISMIC BEHAVIOR BETWEEN SPECIALLY SHAPED COLUMN FRAME STRUCTURE AND RECTANGULAR COLUMN FRAME STRUCTURES], The 14 th World Conference on Earthquake Engineering October 12-17, 2008, Beijing, China.

7. Suraj Shet, Sabyath Shetty and Shanmukha Shetty, [Analysis of Pu-Mu Interaction Diagram of C-Shaped Equal Legged RC Column Developed using ETABS and Analytical Method], International Journal of Engineering & Technology, 7 (3.34) (2018) 835-839.

8. Tinu Mathew T. and Krishnachandran V.N., [Parametric Study on Tubed Steel Reinforced Concrete Columns under Axial Loading], International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 4 Issue VIII, August 2016, ISSN: 2321-9653.

9. Xiaowei Wang, Shihua Wei and Depeng Zhang, [The finite element analysis of L-shaped concrete columns confined by stirrups under axial repeated loads], Advances in Engineering Research (AER), volume 143, 6th International Conference on Energy and Environmental Protection (ICEEP 2017).

10. SHRUTIG. AGRAWAL and Dr. P. S. PAJGADE, [Response of Different Shapes of Columns on RC Buildings with and without Shear walls], International Journal of Innovative and Emerging Research in Engineering, Volume 3, Special Issue 1, ICSTSD 2016.

11. Aditya N. Gumble and Dr. Prakash S. Pajgade, [COMPARISON BETWEEN SPECIALLY SHAPED COLUMNS AND RECTANGULAR COLUMNS IN R.C. STRUCTURE], International Journal of Advance Engineering and Research Development, Scientific Journal of Impact Factor(SJIF): 3.134, Volume 2,Issue 5, May -2015.

12. André T. Beck and André S. Dória, [Reliability Analysis of I-Section Steel Columns Designed According to New Brazilian Building Codes], Vol.No. 2, April-June 2008.

13. Shruti S. Ladvikar and Ashok R. Mundhada, [Effect of Different Column Shapes on Seismic Performance of Buildings: A Review], INTERNATIONAL JOURNAL FOR RESEARCH IN EMERGING SCIENCE AND TECHNOLOGY, VOLUME-3, ISSUE-12, DEC-2016.

14. T. Zhou, M.Y. Xu, Z.H. Chen, X.D. Wang and Y.W. Wang, [ECCENTRIC LOADING BEHAVIOR OF L-SHAPED COLUMNS COMPOSED OF CONCRETE-FILLED STEEL TUBES], Advanced Steel Construction Vol. 12, No. 3, pp. 227-244 (2016).

15. ZHANG Shuai,CHEN Shao-ji,LI Zhe and ZHANG Jian-shan, [Research on Hysteretic Performance of Steel Reinforced Concrete T-shaped Column], MATEC Web of Conferences 03003 (2016).

16. Sumayya M Kareem and Linda Ann Mathew, [Seismic Analysis of Space Frame with T and Square Shaped Column], International Journal of Science and Research (IJSR), Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391, Volume 5 Issue 7, July 2016.

17. D.R. Panchal, P.M. Marathe (2011), "Comparative Study of RCC, steel and composite (G+30 storey) building", Nirma University, Ahmedabad, India.

18. D.R. Panchal, Dr. S.C. Patodi, "steel-concrete composite building under seismic forces", Vadodara, India.

19. LIU Jingbo, LIU Yangbing (2008), " Seismic behaviour analysis of steel-concrete Composite frame structure systems", Tsinghua University, Beijing, China,.

20. IS 456: 2000, "Code for practice of plain and reinforced concrete code of practice, Bureau of Indian Standards", New Delhi.

21. Wang, Zijun and Liu, Weiqing. (1999). Shaking table test for a mid high-rise big bay RC frame model with special shaped columns. Earthquake engineering and engineering vibration **19:3**, 59-64.

22. Liu, Junjin and Lu, Zhitao. (2002). Study on Shaking Table Test of a 9-story RC Frame Model with Specially Shaped Columns and Transfer Story. Journal of Building Structures **23:1**, 21-26.

23. Li, Jie. Xiao, Jianzhuang and Chen, Jianbing. (2002). Experimental study on RC structures with special-shaped columns. Journal of Civil Engineering **35:3**, 7-12.

24. Yang, Pu. Li, Yingming and Lai, Ming. (2000). A new method for selecting inputting waves for time-history analysis. Journal of Civil Engineering **33:6**, 33-37.

25. Huang, Zongming and Chen, Tao. (2003). Comparison between flexibility-based and stiffness-based nonlinear beam-column elements. Engineering Mechanics **20:5**, 24-31.

26. Chen, Tao, and Huang, Zongming. (2004). Flexibility based finite element method for inelastic seismic response analysis of reinforced concrete space frames. Journal of Building Structures **25:2**, 79-84.