Analysis and Design of A Structure Supported On A Single Column

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ABSTARCT : The design and analysis of RCC structure supported on single column is done in this project. This paper presents structural modeling, stress, Bending moment, Shear force and displacement design considerations for a structure and it is analyzed using STAAO Pro. Various steps involved in designing of RCC structure supported on a single column using STAAD Pro are Geometric modeling, providing material properties and section properties, fixing supports and boundary conditions, providing loads and load combinations, special commands, analysis specification and Design Command.

The design and analysis of RCC high rise structure supported on a single column is done in this project.. This paper presents structural modeling, stress, bending moment, shear force and displacement design considerations for a structure and it is analyzed using ETABS V9.7.2. Various steps involved in designing of RCC structure supported on a single column using ETABS V 9.7.2 are Geometric Modeling, providing material properties and sectional Properties, fixing supports and boundary Conditions, providing loads & load combinations, Special Commands, Analysis Specification and Design Command. The influence of plan geometry has an important role in response spectrum analysis. Maximum values of stresses, bending moments, shear forces and displacements are presented. The acting loads considered in the present analysis were self weight, floor load, wind load and earthquake load under the different zones ZONE IV, ZONE V was compared . In these cases the floor load was applied perpendicular to the RCC structure. Comparison of RCC single column and RCC multi column is done.

Keywords: single column, lateral loads, earthquake loads, wind loads, ETABS, response spectrum analysis etc,.

I. INTRODUCTION

A large number of structures that are being constructed at present tend to be wind-sensitive because of their shapes, slenderness, flexibility, size and lightness. Added to these are the uses of materials which are stressed too much higher percentage of their ultimate strength than the in earlier days because of better assurance of quality of materials. In the social environment that is developing world over , the ancient philosophy of accepting continuing disasters due to wind as ordained by ‘fate’ and gods is giving place to demands for economical wind resistant Updating of some international codes of practice, notably the British, Australian, Canadian , American and French

has been effected fairly frequently over the last two decades and the present versions incorporate most of the advances made in understanding the wind characteristics and its effect on structures.

The new discoveries are such that it is clear mere issue of amendments to the earlier code IS 875:1964 will not be justifiable. The recently issued wind code of practice for design loads (other than earthquake) for buildings and structures IS875 (part 3):1987 differs in many ways from the previous code first issued in 1964 and attempts not only to rectify the shortfalls of the 1964 code but incorporates recent knowledge of wind effect on structures. The height up to which velocities are given has now been raised to 500m and the loadings on as many of the commonly encountered buildings and structures, for which there are no other Indian standards , have been included .Although not explicitly stated , the code recognizes the fact that most of the high winds in India occur due to short duration rotating winds like tropical cyclones along the coasts or tornadoes elsewhere, and nearly rectilinear winds of short duration like thunderstorms at many places.

SINGLE COLUMN BUILDING:

Structure supported on a single column provides better architectural view compared to structure supported on many columns. They save ground space as requires less area for providing foundation and provides more space for parking. They are also unique. Single column structure can be made either by using RCC or Steel. RCC structures are more common now days in India. Reinforced concrete as a structural material is widely used in many types of structures. It is competitive with steel if economically designed and executed. It has a relatively high compressive strength and better fire resistance than steel. It has long service life with low maintenance cost.

It can be cast into any required shape. Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and ductility. The modeling and analysis of structure supported on a single column is done by using STAAD Pro software. STAAD Pro is a structural analysis and design computer program originally developed by Research Engineers International in Yorba Linda. Various ways of supporting a structure on one single column. Various steps involved in designing of reinforced concrete structure supported on a single column using STAAD pro.

Single column Building in Germany

OBJECTIVE OF THE STUDY

1. To study the performance of lateral displacement for RCC framed building and RCC single column Building.
2. To study the behavior of earth quake on RCC framed building and RCC single column building.
3. To study the maximum stress, bending moments and shear force RCC framed building and RCC single column building.

II.LITERATURE REVIEW

Current literature survey includes earthquake response of multi storey building frames with single column buildings. Some of the literatures emphasized on strengthening of the existing buildings in seismic prone regions.

Ambati venu babu[1], Dr. Dumpa venkateswarlu[2] (2016) et al., This paper studied about the single column is supporting whole structure; all other members will act as cantilevers. To reduce the cantilever span for the structural beams converting two-third of the length as simply supported by providing the two ring beams and inclined beams. The structure is analyzed and designed using Staad pro (structural analysis package), which is based on stiffness matrix method. The above structure has been analyzed for various possible loading conditions and the critical has been selected for design purpose. From this paper it was concluded that the project Office Building with Mono Column (single supported building) is analyzed and designed with special attention and it is completed. Maximum space utilization is considered while planning and designing and we assure it will serve its maximum serviceability.

Madireddy Satyanarayana[1] (2016) et al., He studied to analyze and design of multi-storey building resting on the single column by using different code provisions. A lay out plan of the proposed building is drawn by using AUTO CADD 2010.The structure consist of ground floor plus five floors, each floor having the one house .Staircase must be provides separately. The planning is done as per Indian standard code provisions. The building frames are analyzed using the various text books. Using this so many standard books analysis of bending moment, shear force, deflection, end moments and foundation reactions are calculated. Detailed structural drawings for critical and typical R.C.C. members are also drawn. Co-ordinates for all structural members are tabulated for ready reference.

From his research it was concluded that the limit state method of design is adopted. He had done the design aspects of the structure manually and software. In our project He also used the code provision of the SP 16 and SP 34 (the design aids for concrete and detailing). Finally learn detailing of various structural members by using SP 34 design aids.

Badikala sravanthi[1],Dr. K.rajasekhar[2] (2016) et al., In This paper the design and analysis of RCC structure supported on a single column is done in this project. Cost Comparison is done between RCC single column and RCC multi column structure. This paper presents structural modelling, stress, bending moment, shear force and displacement design considerations for a structure and it is analyzed using STAAD Pro. The influence of plan geometry has an important role in static analysis. Maximum values of stresses, bending moments, shear forces and displacements are presented. The acting loads considered in the present analysis were self weight, floor load, wind

load and earthquake load. In these cases the floor load was applied perpendicular to the RCC structure. Comparison of RCC single column and RCC multi column is done. From this paper it was concluded that Single column structure has been designed successfully to withstand all loads including earthquake and wind load. Single column structure is 20% more costly when compared with multi column structure. Single column structure provides better architectural view and free ground space even though it costs bit more than multi column structure.

III.METHODOLOGY

Problem statement

A Model of G+6 storied is created, investigation and configuration utilizing STAAD-Pro programming. Building design measure is 12m X12m. The building is arranged in seismic zone II. Seismic zone coefficient is taken as 0.06 according to IS code. Following particulars are given to the structure:

1. All columns = 0.6Mx0.6m

2. And single column of 3mx3m

3. All Beams =0.4mX0.4m

4. Slab =0.12m

5. Physical parameters of Building:

6. Length = 5 bays @3.0m =12m

7. Width = 5 bays @3.0m =12m

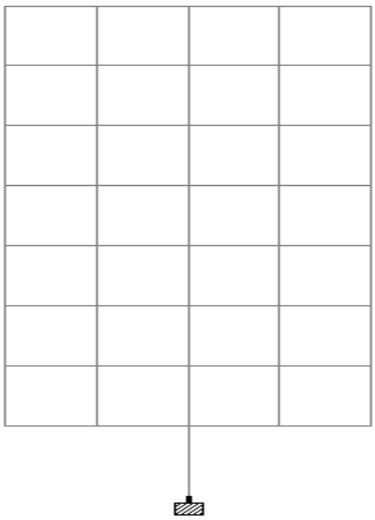
8. Height of Building =4+3X6 =22m

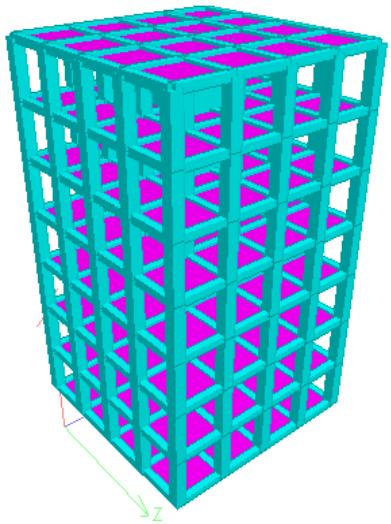
9. Live load on the floor =3.5kN/m^2

10. Floor load =1kN/m^2

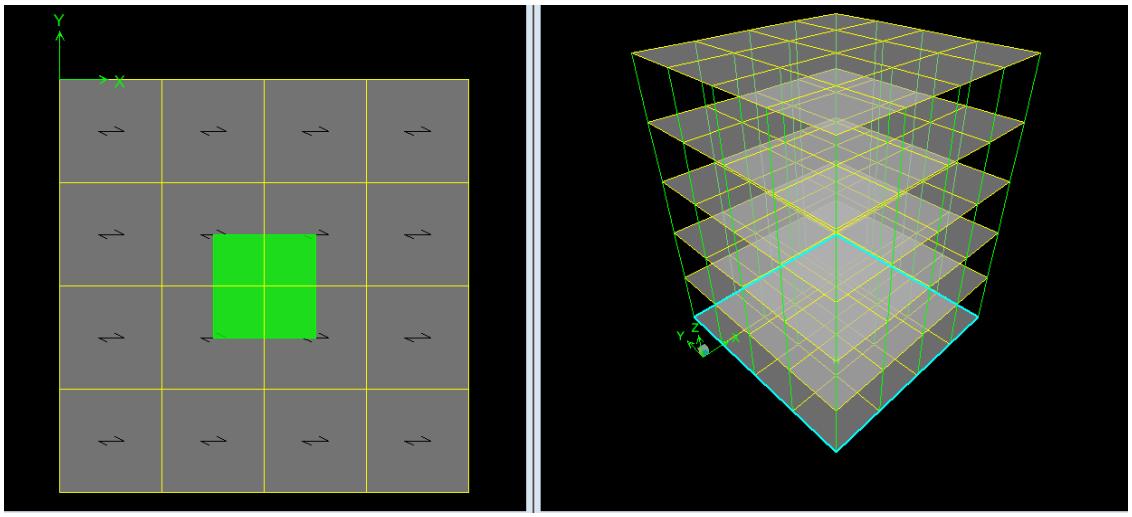
Grade of concrete and steel used:

1. Used M40 concrete and Fe 415 steel





STRUCTURAL ANALYSIS IN ETABS



RESPONSE SPECTRUM METHOD

The representation of maximum response of idealized single degree freedom system having certain period and damping, during earthquake ground motions. This analysis is carried out according to the code IS 1893-2002 (part1). Here type of soil, seismic zone factor should be entered from IS 1893-2002 (part1). The standard response spectra for type of soil considered is applied to building for the analysis in ETABS 2013 software. Following diagram shows the standard response spectrum for medium soil type and that can be given in the form of time period versus spectral acceleration coefficient (Sa/g).

This approach permits the multiple modes of response of a building to be taken in to account (in the frequency domain). This is required in many building codes for all except very simple or very complex structures. The response of a structure can be defined as a combination of many special shapes (modes) that in a vibrating string

correspond to the "harmonic" computer analysis can be used to determine these modes for a structure. For each mode, a response is read from the design spectrum, based on the modal frequency and the modal mass, and they are then combined to provide an estimate of the total response of the structure. In this we have to calculate the magnitude of forces in all directions i.e. X, Y & Z and then see the effects on the building. Combination methods include the following:

- absolute - peak values are added together
- square root of the sum of the squares (SRSS)
- complete quadratic combination (CQC) - a method that is an improvement on SRSS for closely spaced modes

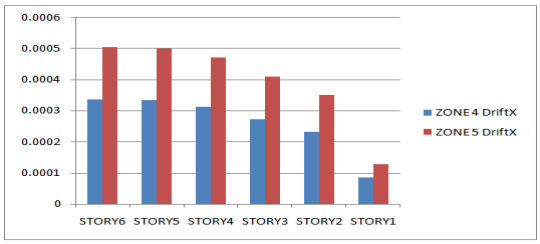
The result of a response spectrum analysis using the response spectrum from a ground motion is typically different from that which would be calculated directly from a linear dynamic analysis using that ground motion directly, since phase information is lost in the process of generating the response spectrum.

In cases where structures are either too irregular, too tall or of significance to a community in disaster response, the response spectrum approach is no longer appropriate, and more complex analysis is often required, such as non-linear static analysis or dynamic analysis.

IV. RESULTS AND ANALYSIS

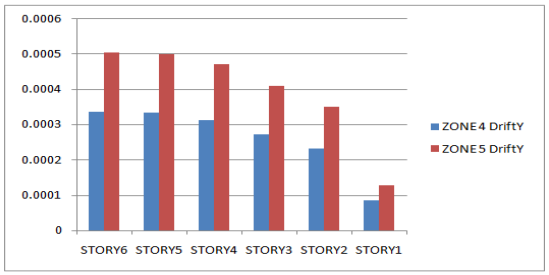
STORY DRIFT IN XDIRECTION

Story	Load	ZONE 4 Drift X	ZONE 5 Drift X
STORY6	RSA	0.000335	0.000503
STORY5	RSA	0.000332	0.000498
STORY4	RSA	0.000312	0.000469
STORY3	RSA	0.000272	0.000409
STORY2	RSA	0.000232	0.000349
STORY1	RSA	0.000084	0.000127



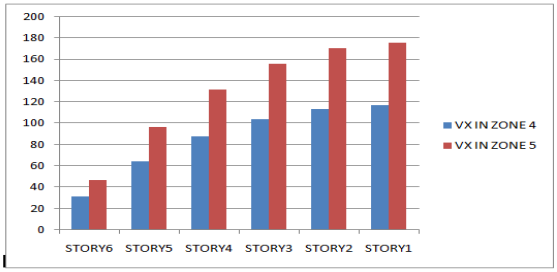
STORY DRIFT IN Y DIRECTION

Story	Load	ZONE 4 Drift Y	ZONE 5 Drift Y
STORY6	RSA	0.000335	0.000503
STORY5	RSA	0.000332	0.000498
STORY4	RSA	0.000312	0.000469
STORY3	RSA	0.000272	0.000409
STORY2	RSA	0.000232	0.000349
STORY1	RSA	0.000084	0.000127



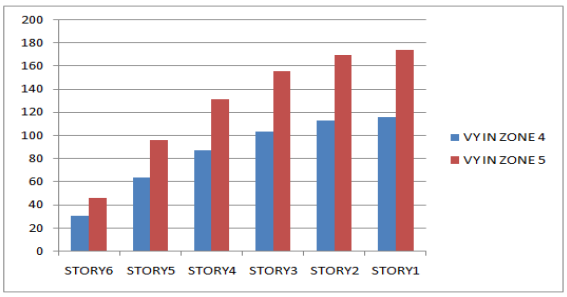
SHEAR FORCE IN XDIRECTION

Story	Load	Loc	VX IN ZONE 4	VX IN ZONE 5
STORY6	RSA	Bottom	31.13	46.69
STORY5	RSA	Bottom	64.12	96.17
STORY4	RSA	Bottom	87.49	131.23
STORY3	RSA	Bottom	103.44	155.16
STORY2	RSA	Bottom	113.14	169.71
STORY1	RSA	Bottom	116.56	174.84



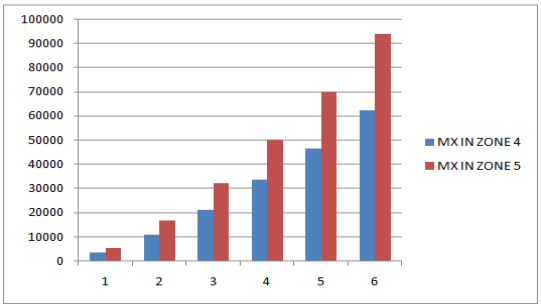
SHEAR FORCE IN Y DIRECTION

Story	Load	Loc	VY IN ZONE 4	VY IN ZONE 5
STORY6	RSA	Bottom	30.71	46.06
STORY5	RSA	Bottom	63.79	95.69
STORY4	RSA	Bottom	87.45	131.17
STORY3	RSA	Bottom	103.36	155.04
STORY2	RSA	Bottom	112.67	169.01
STORY1	RSA	Bottom	115.74	173.61



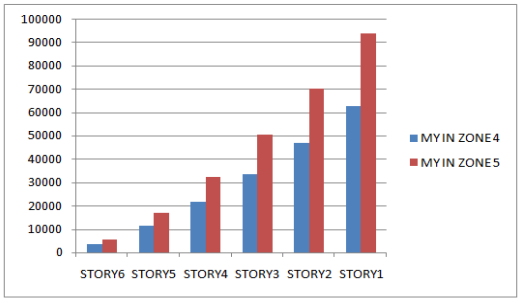
BUILDING MOMENT IN X DIRECTION

Story	Load	Loc	MX IN ZONE 4	MX IN ZONE 5
STORY6	RSA	Bottom	3627	5440.5
STORY5	RSA	Bottom	11149.8	16724.7
STORY4	RSA	Bottom	21427	32140.6
STORY3	RSA	Bottom	33517.3	50275.9
STORY2	RSA	Bottom	46657.1	69985.7
STORY1	RSA	Bottom	62420.2	93630.2



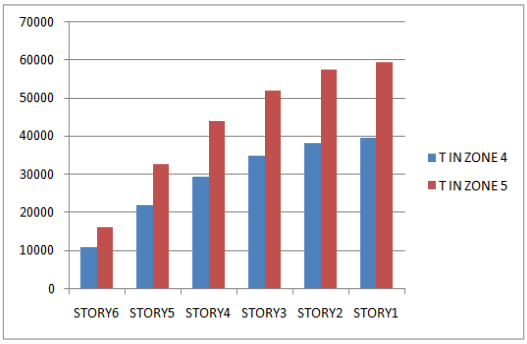
BUILDING MOMENT IN Y DIRECTION

Story	Load	Loc	MY IN ZONE 4	MY IN ZONE 5
STORY6	RSA	Bottom	3676.21	5514.31
STORY5	RSA	Bottom	11232.4	16848.6
STORY4	RSA	Bottom	21491.4	32237
STORY3	RSA	Bottom	33538.1	50307.1
STORY2	RSA	Bottom	46657.1	69985.7
STORY1	RSA	Bottom	62450	93675



BUILDING TORSION

Story	Load	Loc	T IN ZONE 4	T IN ZONE 5
STORY6	RSA	Bottom	10691.8	16037.6
STORY5	RSA	Bottom	21650.1	32475.2
STORY4	RSA	Bottom	29253.3	43879.9
STORY3	RSA	Bottom	34612.5	51918.7
STORY2	RSA	Bottom	38129.2	57193.7
STORY1	RSA	Bottom	39520.64	59281



V. CONCLUSIONS

From the above analysis the following conclusions were made

1. Single column structure has been designed successfully to withstand all loads including earthquake and wind load.
2. Single column structure provides better architectural view and free ground space even though it costs bit more than multi column structure.
3. The Drift values shows that the building with the increase in zone the drift values increases
4. The shear values also increases with the increases with zone increases
5. The moment forces, shear forces are also increases with the increase with the zones . the zone 5 the moment forces, shear forces shows major values.
6. By comparing all the above results the mono column building should be constructed only in the low zone and the building with mono column building is also high prices.

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