DESIGN OF A STRUCTURE SUPPORTED ON A SINGLE COLUMN

G.Pradeep[1], Dr.H.Sudarsana Rao [2], Dr.Vaishali.G.Ghorpade[3]

[1]M. Tech (Computer Aided structural Engineering), Department of Civil Engineering, J.N.T.U.A College of Engineering, Anantapur, Ananthapuramu,515002, Andhra Pradesh, India.

[2] Professor of Civil Engineering and Director (I.C.S), J.N.T.University Anantapur, Ananthapuramu, 515002, Andhra Pradesh, India.

[3] Professor of Civil Engineering, J.N.T.U.A College of Engineering, Anantapur, Ananthapuramu, 515002, Andhra Pradesh, India.

ABSTRACT:

The design and analysis of RCC structure supported on single column is done in this project. Cost comparison is done between RCC single column and RCC multi column structure. This paper presents structural modeling, stress, Bending moment, Shear force and displacement design considerations for a structure and it is analyzed using STAAD 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 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 earth quake 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.

KEY WORDS: RCC structure, STAAD Pro, single column, earth quake load etc,.

1. INTRODUCTION

1.1 INTRODUCTION

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 a 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 is having relatively low tensile strength and ductility, which 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.

1.2 SINGLE COLUMN BUILDING

The modeling of single column structure is done by using STAAD Pro software. The height of the structure is taken as 24.5 m. Structure is supported on a single column. It is a 7 storey building. Height of each storey is 3 m. First storey starts at a height of 3.5m above ground level. Single column keeps the building at a height of 3.5 m above ground level. Width and breadth of each storey is 12 m. Column is provided at the centre of structure starting from groundlevel to a height of 24.5 m above ground.

Fig.1 Various ways of supporting a structure on one single column

1.3 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.

2. 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.

3.MODELING METHODALODY OF SINGLE COLUMN BUILDING

3.1 PROBLEM STATEMENT

A Model of G+7 storied is created, investigation and configuration is done by 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:

All columns	=	0.6Mx0.6m
Single column	=	3mx3m
All Beams	=	0.4mX0.4m
Slab	=	0.12m

Physical parameters of Building:

Length	=	4 bays @3.0m =12m
Width	=	4 bays @3.0m =12m
Height of Building	=	3.5+3X7=24.5m
Live load on the floor	=	$3.5kN/m^2$
Floor load	=	$1kN/m^2$

Grade of concrete and steel used:

Used M25 concrete and Fe 415 steel

3.2 TYPES OF LOADS ACTING ON THE STRUCTURE

In an advancement of building two essential issue considered are security and economy. If the piles are adjusted and taken higher then economy is affected. In case economy is considered and stacks are taken lesser then the security is bartered. So the estimation of various weights acting is to figured unequivocally. Indian Standard code IS: 875-1987 and American Standard Code ASCE 7: Minimum Design Loads for Buildings and Other Structures decides distinctive layout loads for structures.

Sorts of weights falling up on the structure are:

- Dead loads
- Imposed loads
- Wind loads
- Snow loads
- Earthquake loads
- Special loads

4.PLAN MODELING AND ELEVATION OF SINGLE COLUMN BUILDING

4.1 PLAN

The general plotting represents the plan of a g+7, the single column building.

The Apartments are located at Anantapur city which is surrounded by many apartments. In each block the entire floor consists of a three bed room house which occupies entire floor of a block. The plan shows the details of dimensions of each and every room and the type of room andorientation of the different rooms like bed room, bathroom, kitchen, hall etc.. All the stories have similar room arrangement.

The entire plan area is about 144 sq.m. There is some space left around the building for parkingof cars. The plan gives detail of arrangement of various furniture like sofa etc.So these represent the plan of our building and detailed explanation of remaining parts likeelevations and designing is carried in the next sections.

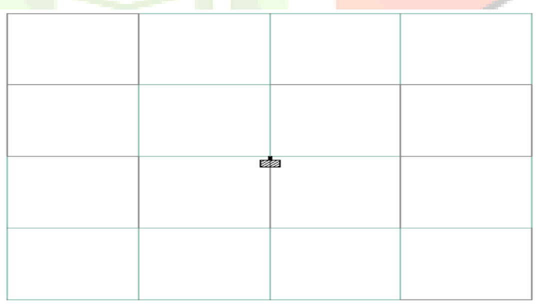


Fig.2 Plan of Single column building

4.2 ELEVATION

Fig.2 represents the proposed elevation of building. It shows the elevation of a g+15 building representing the front view which gives the overview of a building block.

Each floor consists of height 3m which is taken as per municipal corporation rules for single column buildings. The building is not designed for increasing the number of floors in future. So the number of floors is fixed for future also for this building due to unavailability of the permissions of respective authorities.

Also special materials like fly ash and self compacted concrete were also used in order to reduce the dead load and increase life of the structure and also improve economy. But these materials were not considered while designing in STAAD Pro to reduce the complexity and necessary corrections are made for considering the economy and safety of the structure.

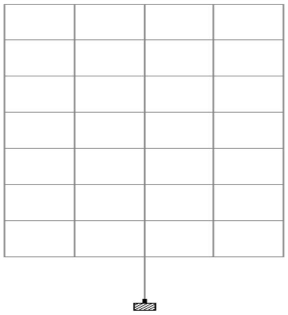
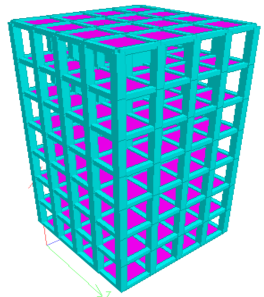
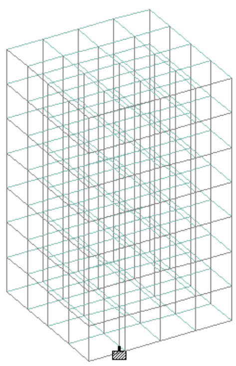



Fig. 3 Elevation of single Column Building **Fig.4 3D View of the Building**

4.3 MODELING IN STAAD Pro:
The whole process of the analysis and design are given below:



1. **Inputting the job Information:**
Firstly the information of the project is written after opening the STAAD Pro. As the name of the project/job, Client's name and the date when project started and the name of the Engineer as well and much more information is inputted.

2. **Generating the 3d model geometry:**
There are two methods of creating a structure data in STAAD.
   - **a.** Using the command file also called "The STAAD editor method".
   - **b.** Using the graphical user interface (GUI).

We have done our whole of the programming with the help of GUI method because it is easier and much advance tool of STAAD. The model of the framed structure is generated in STAAD by *Snap Node/Beam* dialog box which appears when we select the grid from the **Fig.5 The Model of Structure with All** top menu bar. Then the nodes and beams are created
Beams and Nodes
by this command at the suitable distances as per our need. .

3. **Assigning the material:**
As after creating the beams and columns we will assign material to them as we require. Our design is concrete design hence we have assigned the concrete material to the beams and columns.

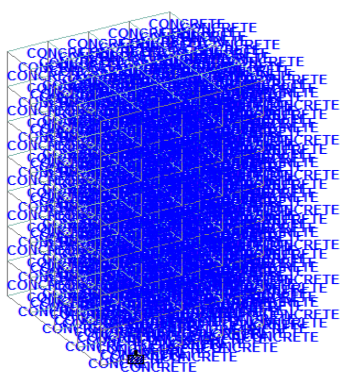


Fig.6 Assigning Concrete Material to the Multi Storey Building

4. Specifying member properties:
The properties of the beams and columns is their size(width, depth of cross-section).So with the help of this command we have inputted the different properties (as circular, rectangular, square) and assign these properties to specified members.

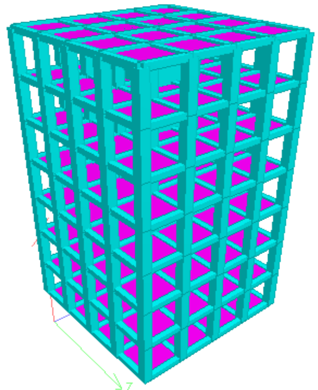


Fig.7 3d Rendered model after specifying the properties to member

5. Specifying material constants:
As we assigned the concrete material so by default we have the constants of concrete and we don't need to use this command separately. Or if we need to change the constants we can do so by this command.

6. Specifying member offset: As default in the STAAD design of model and after assigning properties, the STAAD takes the beams and columns center to center and if we want to have beams end to end over the columns then we use Beam offset command.

7. Printing member information: As if we would like to get a report consisting of information about all the members including start and end joint numbers, members length in STAAD output file then we use this command as by going to Commands Pre-Analysis Print Member information from top menu bar.

8. Specifying Supports: The supports are first created (as we created fixed supports) and then these are assigned to all the lowermost nodes of structure where we are going to design the foundation.

9. Specifying Loads: This is done in following steps:

a. Firstly creating all the load cases.

b. Then assigning them to respective members and nodes**.**

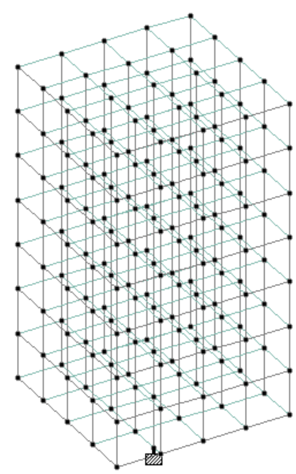


Fig.8 The model with the fixed supports

The STAAD program can produce all types of loads and can assign them to the structure. It also has the capability to apply the dead load on the structure. There are some definitions of loads which are firstly created according to IS codes before creating specific load cases (As Seismic or wind load). Here below are some types of loads as we have assigned.

c.Load Combinations.

The load combinations have been created with the command of auto load combinations. By selecting the Indian code we can generate loads according to that and then adding these loads. These combinations do not require to be assigned on members.
Hence all the loads are assigned on the structure we will move towards forward step.

10. Specifying the analysis type: Before doing the analysis for the loads we require specifying analysis command which we need is linear static type. Choosing statics check, we will add this command.

4.4LOADS ACTING ON THE STRUCTURE

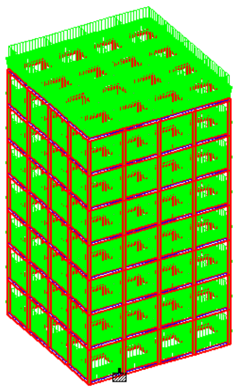


Fig.9 DEAD LOAD

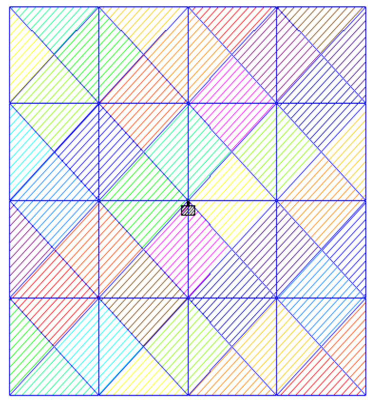


Fig.10 LIVE LOAD

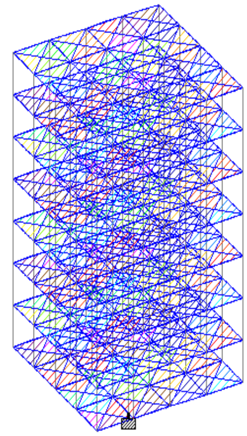


Fig.11FLOOR LOAD

4.4.1 Dead load:A constant load in a structure (such as a bridge, building, or machine) that is due to the weight of the members, the supported structure, and permanent attachments or accessories.

4.4.2 Live load: The second vertical load that is considered in plan of a structure is forced loads or live loads. Live loads are either portable or moving burdens with no quickening or effect. These heaps are thought to be delivered by the planned utilize or inhabitance of the building including weights of versatile parcels or furniture and so forth.

Live load continues changing now and again. These heaps are to be reasonably expected by the planner. It is one of the significant loads in the plan. The base estimations of live loads to be expected are given in IS 875 (section 2) – 1987. It relies on the expected utilization of the building.

4.4.3 Floor load: The load that a floor (as of a building) may be expected to carry safely if uniformly distributed, usually calculated in KN per square meter of area.

4.4.4 SESMIC LOAD

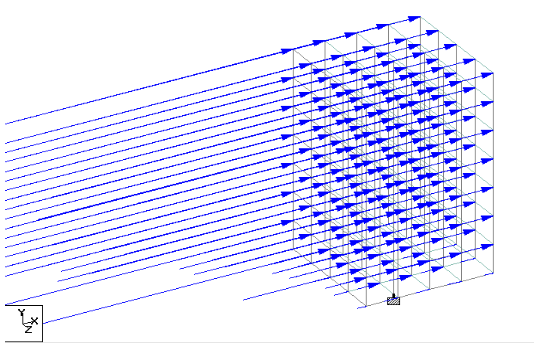


Fig.12IN X DIRECTION

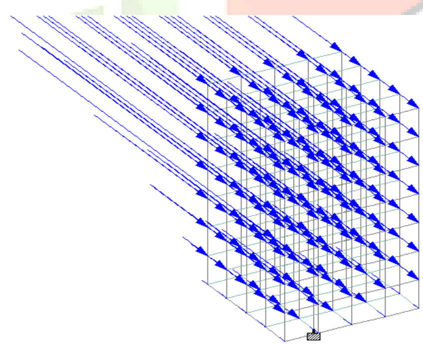


Fig.13IN Z DIRECTION

Sesimic load: Seismic loading is one of the basic concepts ofearthquake engineering which means application of an earthquake generated agitationto a structure. It happens at contact surfaces of a structure either with the ground or with adjacent structures or with gravity waves from tsunami.

4.4.5 WIND LOAD

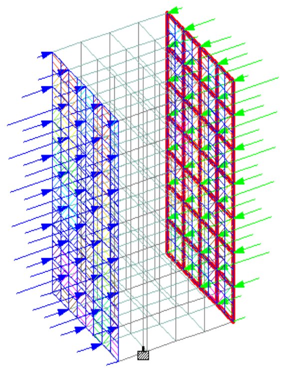


Fig.14IN X DIRECTION

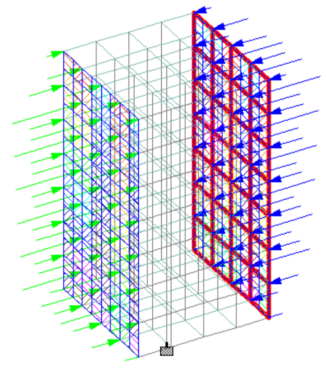


Fig.15IN – X DIRECTION

Wind load: Wind is a mass of air that moves in a mostly horizontal direction from an area of high pressure to an area with low pressure.The wind load is defined as the load on a structure due to the action of wind. High winds can be very destructive because they generate pressure against the surface of a structure. The effect of the wind is dependent upon the size and shape of the structure. Calculating wind load is necessary for the design and construction of safer, more wind-resistant buildings and placement of objects such as antennas on top of buildings.

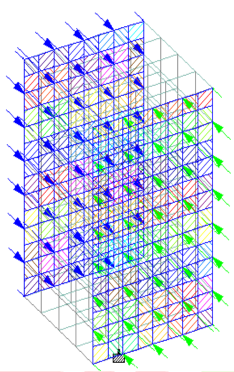


Fig.16 IN Z DIRECTION

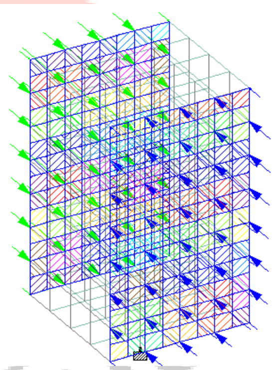
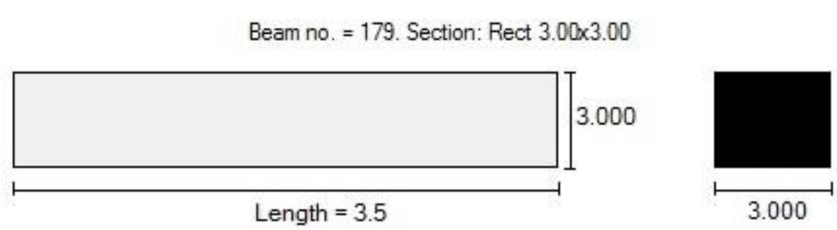


Fig.17 IN –Z DIRECTION

5. RESULTS AND ANALYSIS

5.1 SINGLE COLUMN BUILDING

5.1.1 SINGLE COLUMN RESULTS:



Fy(Mpa)	415
Fc(Mpa)	25
As Reqd(mm²)	72000.000000
As (%)	0.807000
Bar Size	25
Bar No	148

SINGLE COLUMN PROPERTIES

DESIGN PARAMETRES

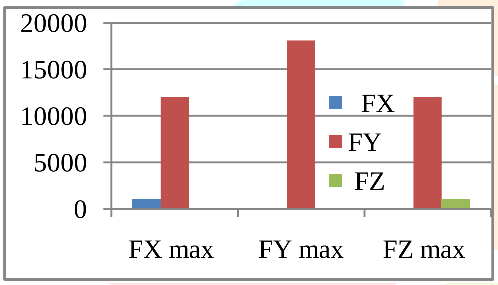
5.1.2 SUPPORT REACTIONS:

Table.1: Maximum and Minimum support reactions

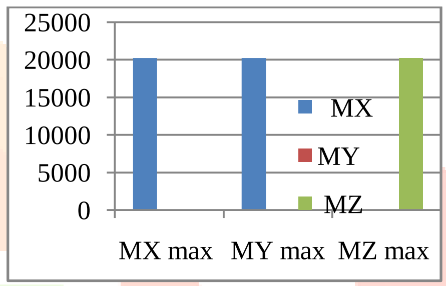
	Node	L/C	Horizontal Fx kN	Vertical Fy kN	Horizontal Fz kN	Moment Mx kNm	My kNm	Mz kNm
Max Fx	93	28 GENERAT	1061.699	12061.442	-0.000	-0.000	-0.000	-20230.768
Min Fx	93	27 GENERAT	-1061.699	12061.442	-0.000	-0.000	0.000	20230.768
Max Fy	93	10 GENERAT	-0.000	18109.443	-0.000	-0.000	0.000	0.000
Min Fy	93	3 EQ+Z	-0.000	-0.000	-707.799	-13487.178	-0.000	0.000
Max Fz	93	30 GENERAT	-0.000	12061.442	1061.699	20230.768	0.000	0.000
Min Fz	93	29 GENERAT	-0.000	12061.442	-1061.699	-20230.768	-0.000	0.000
Max Mx	93	30 GENERAT	-0.000	12061.442	1061.699	20230.768	0.000	0.000
Min Mx	93	29 GENERAT	-0.000	12061.442	-1061.699	-20230.768	-0.000	0.000
Max My	93	30 GENERAT	-0.000	12061.442	1061.699	20230.768	0.000	0.000
Min My	93	29 GENERAT	-0.000	12061.442	-1061.699	-20230.768	-0.000	0.000
Max Mz	93	27 GENERAT	-1061.699	12061.442	-0.000	-0.000	0.000	20230.768
Min Mz	93	28 GENERAT	1061.699	12061.442	-0.000	-0.000	-0.000	-20230.768

The table shows the maximum value of support reactions developed for the critical load combination which may possible to act on the single column building. They are as listed below:

MAX $\mathbf{F_X}$ = 1061.69 **KN**
MAX $\mathbf{F_Y}$ = 18109.44 **KN**
MAX $\mathbf{F_Z}$ = 1061.69 **KN**
MAX $\mathbf{M_X}$ = 20230.76 **KN-m**
MAX $\mathbf{M_Y}$= 0 **KN-m**
MAX $\mathbf{M_Z}$= 20230.768 **KN-m**



Graph.1: Graph showing Maximum forces



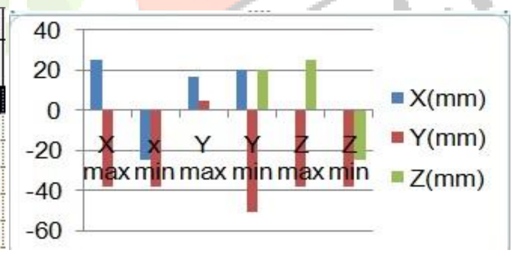
Graph.2: Graph showing Maximum moments

From the above graphs it was observed that the support reactions F_Y, moments M_X and M_Z were found to be maximum and the moment M_Y was found to be zero in all cases.

5.1.3 DISPLACEMENTS

Table.2: Maximum and Minimum displacements

	Node	L/C	Horizontal X mm	Vertical Y mm	Horizontal Z mm
Max X	45	27 GENERAT	24.750	-38.633	-0.052
Min X	41	28 GENERAT	-24.750	-38.633	-0.052
Max Y	41	1 EQ+X	16.458	4.605	-0.008
Min Y	225	43 COMBINA	19.807	-50.968	19.807
Max Z	221	29 GENERAT	-0.052	-38.633	24.750
Min Z	41	30 GENERAT	-0.052	-38.633	-24.750



Graph.3: Graph showing Maximum andMinimum displacements

The above graph shows the maximum value of Displacements for the critical load combination which may possible to occur in the single column building. They are as listed below:

Maximum Displacement in **X** direction = 24.75 **mm**
Maximum Displacement in **Y** direction =-50.97 **mm**
Maximum Displacement in **Z** direction = 24.75 **mm**

5.1.4 FORCES:

Table.3: Maximum and Minimum forces acting on single column building

	Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
Max Fx	179	10 GENERAT	93	**18109.443**	0.000	-0.000	0.000	0.000	0.000
Min Fx	174	10 GENERAT	132	**-536.517**	-485.615	0.000	0.000	-0.000	-706.684
Max Fy	184	27 GENERAT	98	10618.038	**1304.849**	-0.000	0.000	0.000	16404.248
Min Fy	184	28 GENERAT	98	10618.038	**-1304.849**	-0.000	-0.000	0.000	-16404.246
Max Fz	184	30 GENERAT	98	10618.038	0.000	**1304.849**	0.000	-16404.246	0.000
Min Fz	184	29 GENERAT	98	10618.038	0.000	**-1304.849**	-0.000	16404.248	0.000
Max Mx	74	10 GENERAT	52	207.793	-105.807	-5.729	**20.035**	8.593	-163.703
Min Mx	75	10 GENERAT	53	207.793	146.712	5.729	**-20.035**	-8.593	215.076
Max My	179	29 GENERAT	93	12061.442	0.000	-1061.699	-0.000	**20230.768**	0.000
Min My	179	30 GENERAT	93	12061.442	0.000	1061.699	0.000	**-20230.768**	0.000
Max Mz	179	27 GENERAT	93	12061.442	1061.699	-0.000	0.000	0.000	**20230.768**
Min Mz	179	28 GENERAT	93	12061.442	-1061.699	-0.000	-0.000	0.000	**-20230.768**

The above table shows the maximum value of external forces for the critical load combination which may possible to act on the single column building. They are as listed below:

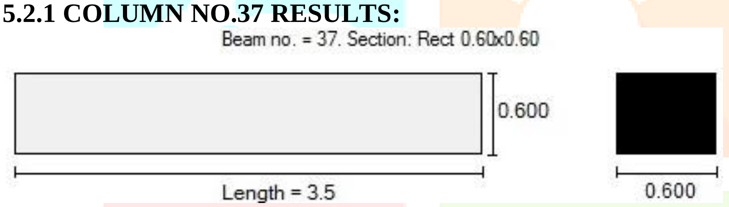
Maximum value of force **F_X** = 18109.44**KN**
Maximum value of force **F_Y** = 1304.85 **KN**
Maximum value of force **F_Z** = 1304.85 **KN**
Maximum value of Moment **M_X** = 20.04 **KN-m**
Maximum value of Moment **M_Y** = 20230.77 **KN-m**
Maximum value of Moment **M_Z** = 20230.77 **KN-m**

5.1.5 COST ANALYSIS:

From STAAD Pro output file the total volume of concrete needed for Single columnBuilding = **514.3 cu.m**

5.2 MULTI COLUMN BUILDING

5.2.1 COLUMN NO.37 RESULTS:



Design Parameter	
Fy(Mpa)	415
Fc(Mpa)	25
As Reqd(mm²)	2880
As (%)	0.88
Bar Size	12
Bar No	28

COLUMN PROPERTIES

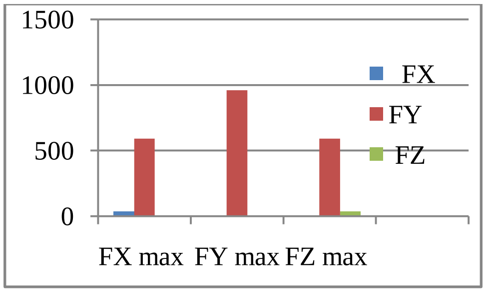
5.2.2 SUPPORT REACTIONS:

Table.4: Maximum and Minimum support reactions

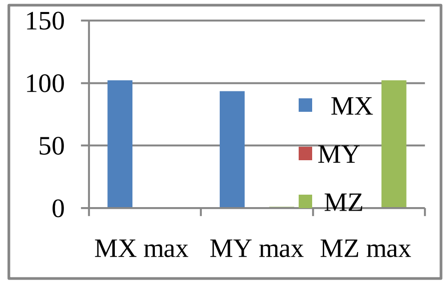
			Horizontal	Vertical	Horizontal	Moment		
	Node	L/C	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
Max Fx	93	28 GENERAT	**37.056**	591.133	0.000	0.000	-0.000	-102.138
Min Fx	93	27 GENERAT	**-37.056**	591.133	0.000	0.000	0.000	102.138
Max Fy	93	10 GENERAT	0.000	**961.066**	0.000	0.000	0.000	-0.000
Min Fy	91	1 EQ X	-19.415	**-147.671**	0.000	0.000	0.000	61.976
Max Fz	93	30 GENERAT	0.000	591.133	**37.056**	102.138	0.000	-0.000
Min Fz	93	29 GENERAT	0.000	591.133	**-37.056**	-102.138	-0.000	-0.000
Max Mx	93	30 GENERAT	0.000	591.133	37.056	**102.138**	0.000	-0.000
Min Mx	93	29 GENERAT	0.000	591.133	-37.056	**-102.138**	-0.000	-0.000
Max My	5	30 GENERAT	-0.849	690.647	29.824	93.477	**0.067**	1.018
Min My	185	29 GENERAT	-0.849	690.647	-29.824	-93.477	**-0.067**	1.018
Max Mz	93	27 GENERAT	-37.056	591.133	0.000	0.000	0.000	**102.138**
Min Mz	93	28 GENERAT	37.056	591.133	0.000	0.000	-0.000	**-102.138**

The table shows the maximum value of support reactions developed for the critical load combination which may possible to act on the multi column building. They are as listed below:

MAX **F_X** =37.056 **KN**
MAX **F_Y** =961.066 **KN**
MAX **F_Z** =37.056 **KN**
MAX**M_X**=102.138 **KN-m**
MAX **M_Y**=0.067 **KN-m**
MAX **M_Z**=102.138 **KN-m**



Graph.4: Graph showing Maximum forces



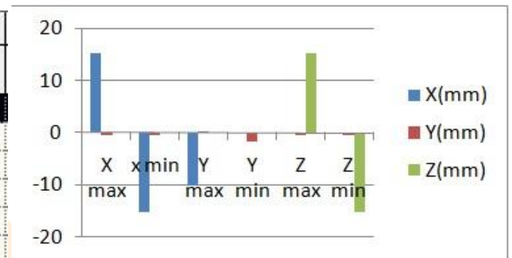
Graph.5: Graph showing Maximum moments

From the above graphs it was observed that the support reactions F_Y, moments M_X and M_Z were found to be maximum and the support reaction M_Y was found to be zero in all the cases.

5.2.3 DISPLACEMENTS:

Table.5: Maximum and Minimum displacements

	Node	L/C	Horizontal X mm	Vertical Y mm	Horizontal Z mm
Max X	131	27 GENERAT	15.236	-0.550	-0.000
Min X	135	28 GENERAT	-15.236	-0.550	-0.000
Max Y	135	2 EQ-X	-10.153	0.222	-0.000
Min Y	133	10 GENERAT	-0.000	-1.648	-0.000
Max Z	43	29 GENERAT	-0.000	-0.550	15.236
Min Z	223	30 GENERAT	-0.000	-0.550	-15.236



Graph.6: Graph showing Maximum and Minimum displacements

The above graph shows the maximum value of Displacements for the critical load combination which may possible to occur in the single column building. They are as listed below:

Maximum Displacement in **X** direction = 15.24**mm**
Maximum Displacement in **Y** direction =-1.65**mm**
Maximum Displacement in **Z** direction = 15.24**mm**

5.2.4 FORCES:

Table.6: Maximum and Minimum forces acting on the multi column building

	Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
Max Fx	179	10 GENERAT	93	961.066	-0.000	0.000	0.000	-0.000	-0.000
Min Fx	177	1 EQ X	91	-147.671	19.415	0.000	0.000	-0.000	61.976
Max Fy	153	16 GENERAT	106	-0.252	49.253	-0.000	0.000	0.000	59.392
Min Fy	156	15 GENERAT	110	-0.252	-49.253	0.000	-0.000	0.000	59.392
Max Fz	184	30 GENERAT	98	511.345	-0.000	41.351	0.000	-70.327	-0.000
Min Fz	184	29 GENERAT	98	511.345	-0.000	-41.351	-0.000	70.327	-0.000
Max Mx	61	30 GENERAT	29	241.801	0.757	16.951	0.265	-16.614	1.133
Min Mx	61	29 GENERAT	29	147.655	0.673	-12.822	-0.265	10.437	1.008
Max My	179	29 GENERAT	93	591.133	-0.000	-37.056	-0.000	102.138	-0.000
Min My	179	30 GENERAT	93	591.133	-0.000	37.056	0.000	-102.138	-0.000
Max Mz	179	27 GENERAT	93	591.133	37.056	0.000	0.000	-0.000	102.138
Min Mz	179	28 GENERAT	93	591.133	-37.056	0.000	-0.000	-0.000	-102.138

The above table shows the maximum value of external forces for the critical load combination which may possible to act on the single column building. They are as listed below:

Maximum value of force $\mathbf{F_X}$ = 961.07**KN**
Maximum value of force $\mathbf{F_Y}$ = 49.25**KN**
Maximum value of force $\mathbf{F_Z}$ = 41.35**KN**
Maximum value of Moment $\mathbf{M_X}$ = 0.27**KN-m**
Maximum value of Moment $\mathbf{M_Y}$ = 102.14**KN-m**
Maximum value of Moment $\mathbf{M_Z}$ = 102.14**KN-m**

5.2.5 COST ANALYSIS:

From STAAD Pro output files the total volume of concrete needed for multi column Building = **374.1 cu.m**

5.3 COMPARISON BETWEEN SINGLE COLUMN AND GENERAL COLUMN BUILDING

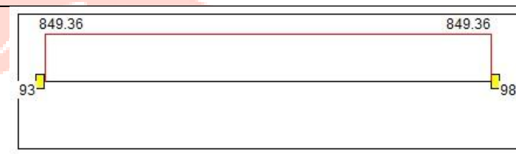
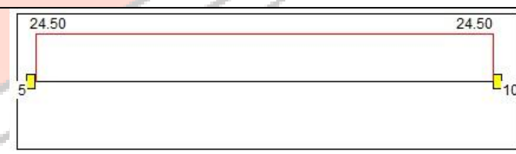
Comparison is done for single column (column no.179) in single column building and a general column (column no.37) in multicolumn building for a common load combination case of 1.2DL+1.2LL+1.2EL.

Table.7: Comparison of single column and general column.

Description	**Single column (3m*3m)**	**General column (0.6m*0.6m)**
Shear force(KN)	849.36	24.503
Bending moment(KN-m)	16184.614 to 13211.86	75.55 to -10.203
Deflection (mm)	0 to 0.677	0 to 1.257
Stress (N/mm^2)	7.645	-3.598
Support reaction F_X(KN)	-849.36	-24.503
F_Y(KN)	14487.55	648.27
M_Z(KN-m)	16184.614	75.56
Area of steel required(mm^2)	72000 :148 bars @25mm	2880:28 bars @12mm

5.3.1 SHEAR FORCE COMPARISON

The graphs shown are the Shear force diagrams for the single column (column no. 179) in single column building and a column (column no.37) in the multi column building. From the above graphs we conclude that the Shear force was constant throughout the length of the beam in both single column and multi column building and the Shear force is maximum in single column building,that is **849.36 KN** while the Shear force in multi column building is **24.50KN**.

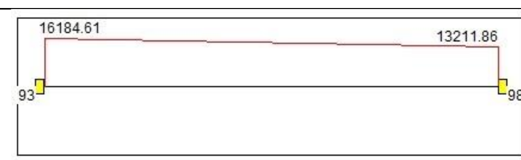
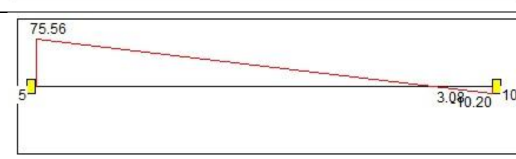
Description	**Shear force(KN)**
Single column	
General column	

Graph.7: Shear force comparison for single column and general column.

5.3.2 BENDING MOMENT COMPARISON

The graphs shown are the Bending moment diagrams for the single column (column no. 179) in single column building and a column (column no.37) in the multi column building. From the above graphs we conclude that the Bending moment was varying linearly throughout the length of the beam in both single column and multi column building. The maximum Bending moment in single column building is occurring at 0 m that is **16184.61 KN-m** which is greater than the maximum Bending moment in multi column building occurring at 0 m that is **75.56 KN-m**.

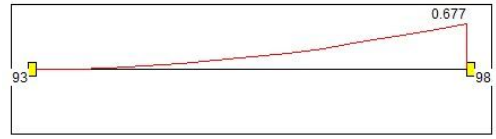
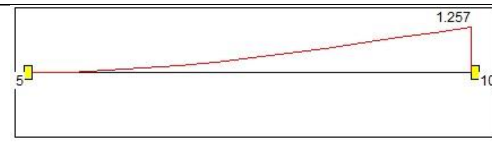
The Bending moment in single column building is purely Sagging Bending moment with no point of contra flexure while there was a little Hogging Bending moment in multi column building with a point of contra flexure occurring at **3.08 m** from the left end of the beam.

Description	**Bending moment(KN-m)**
Single column	
General column	

Graph.8: Bending moment comparison for single column and general column.

5.3.3 DEFLECTION COMPARISON

The graphs shown are the Deflection curves for the single column (column no. 179) in single column building and a column (column no.37) in the multi column building. From the above graphs we conclude that the Deflection curve was a 2^0 curve throughout the length of the beam in both single column and multi column building. The maximum Deflection is observed in multi column building, occurring at 3.5 m that is **1.257 mm** while the Deflection in single column building occurring at 3.5 m is **0.677 mm**.

Description	Deflection(mm)
Single column	
General column	

Graph.9: Comparison of deflection for single column and general column.

5.3.4 COST COMPARISON:

Total percentage cost saving of multi column building in comparison to single column building.

% cost calculation= (514.3-374.1)/514.3

= 0.2726

= 27.26%

Therefore in economical point of view single column building is uneconomical when compared to the multi column building.

6. 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 is 27.260 % more costly when compared with multi column structure.
3. Using of this software analysis of bending moment, shear force, deflections, end moments and foundation reactions are calculated.
4. Shear force and bending moment values in single column for a single column building are much higher than the Shear force and bending moment values for a column in multi column building.
5. Deflections for single column in single column building are less when compared to a column in multi column building.
6. Support reactions in single column for a single column building are much higher than the Support reactions for a column in multi column building.
7. Details of each and every member can be obtained using STAAD Pro.
8. Single column structure provides better architectural view and free ground space even though it costs bit more than multi column structure.
9. Maximum space utilization is considered while planning and designing and it assure that it will serve its maximum serviceability.

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