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Design of RCC structure single column multi-story building using STAAD Pro

Siddharth Pal[1], Prashant Kumar[2], Siddharth Jain[3], Anurag Chaubey[3]

[1]Postrgraduate Scholar, Department of Civil Engineering, School of Engineering & Technology, IIMT University, Meerut
[2]Supervisor, Assistant Professor, Department of Civil Engineering, School of Engineering & Technology, IIMT University, Meerut
[3]Assistant Professor, Department of Civil Engineering, School of Engineering & Technology, IIMT University, Meerut

Abstract
This research work analysis the design of a Rcc structure of 7 story building supported by a single column (Pillar). The work consist of analysing bending moment ,shear force, displacement ,stress and structural modelling. The Stadd pro software is used to design the structure. The steps to design the Rcc structure of 7 story building supported by single column as follows modelling, Assigning material , section property, fixing support, boundary conditions assigning loads , combination of load analysis specification and design command. Dead load , live load , Earth Quake load, Wind Load and Floor Load has been assigned to the Rcc structure.

1. Introduction
A building can be supported by a single column carrying load of 7 story Rcc Structure. In single column Rcc structure the other column which are in building are considered as point load and column are also known as floating column. In this type of structure the space is need less for foundation , the foundation can be used pile raft foundation according to the type of soil and earth quake zone. The design can be performed with both steel and Rcc. This type of building can be construct economically if deigned is planed. The stadd pro software is used to design the model. The building height is 24.5 m. The single column height is 9 mtr . The building each floor height is considered 3 m . width of the floor 12 m.

Figure 1 Astra house building (Source: Google).

2. Literature Review

Pradeep et al. (2018) proposed a comparative analysis of columns in multicolumn buildings. A single row of buildings is less distracted. The support response of multicolumn building columns is significantly lower than for single rows of single row buildings. Individual column structures are 27.260% higher than multi-column structures. While preparing and development, the most efficient use of the room is considered to ensure alternate maintenance. Pandey et al. (2018) examined the structure under static stress conditions and the RCC columns function well. The maximum voltage is created in a single column by a large bed effect in the context of the soil. Additionally, node shifts increase as boom size increases. The large interpretation range is supported by members of the sloped steel structure that control distractions through the base of the boom. Compared to RCC structures, the weight of composite structures is reduced

Ambati Venu Babu et.al. (2016) [1]
A single column constructed is subjected to symmetry and eccentrical loading condition it is pivotal according to survey of a triangular-shaped building in which the mono column is located at the edges of the triangle rather than at its centre because a single- column supports the entire structure and all other elements as cantilevers. Reducing the cantilever span for the structural beams by transforming two dimensions of the length as supported by two rings in the beams

Madireddy Satyanarayana (2016) [2]
A multi storied structure supported a single column its designed with the help of several IS codes. The structure, which consists of seven floors and a ground floor, was studied in accordance with Indian standard code criteria. Limit State Method R.C.C. structure is manually evaluate building frames and offer structural details

Przewlockia J., Zielinskab M. (2016) [3]
Case studies are conducted by researchers on the basic building behavior. The analysis is carried out under methods, materials and other basic designs. The effects of mixed soil on bed depth and width were compared. Mixed floor designs can influence the results of numerical analysis, helping in economic ground design and selecting corresponding dimensions. Based on the research, the conclusions have been drawn that the results of numerical analysis predict geological and structural technology codes, perceptions of natural disasters, prevention and understanding of basic soil behavior, structural stability, and age differences. This research approach supports the use of integrated countries for basic land planning purposes.

Namdar A., Feng X. (2014)[4]
In these studies, various soil layers were made to form mixed beds. Floor-based load capacity was calculated by changing the mixed bed parameters and foot size. 180 feet of 15 different varieties made from soil. Groundwater is thought to have no effect on the strength of the ground. Numerical analysis and results from mixed bed technology were combined.

Xia H ,Zhang J. & et. al. (2020) [5]
The literature examines AEOL -SAND to ensure security and technical use, and it is necessary to examine the components of AEOL -sand. This paper focuses on the ability to wear Aeolian sand in the Mu Us desert and select six minimal websites. A large number of soil machines were collected at the SLT and CCT Institutes. First-line treatment shows mixing and merely mixing (this affects water and water, and affects the ability of Aeol -sand**.**

Amornfa K., Phienwej N.(2012) [6]
Researchers are using the High Ranking Project in Bangkok, Thailand to explore development areas. Well-researched research shows that modern design techniques are dominated by design engineers. They often used standard testing methods that represented consistent tension and panel testing in the wells. The results of this study show that the implementation of the current plan does not promote the correct outcome of the plan in terms of economic potential. The second part of this study is examining the benefits of taking over the idea of laying the foundations of pile lines. A comparative study of three dimension test results (3D FEM) and the various test methods currently used. The results show that the pile fountain plate method that does not deal with interactions between pile and stakes has very different outcomes as a result of 3D memes. 3D-FEM shows that only 70-80% of the total construction load is stacked when the raft is placed in a hard layer of clay. The number of piles at the base of the stack can be significantly reduced, especially if the actual basic concept of stacking heap is accepted.

J.E Bowles[7]
A study based on the settlement rate of the stake and surrounding soil was proposed for testing negative skin deficiencies. If the rate of subsidence of the surrounding soil is greater than the rate of subsidence of the mountain, negative skin irritation occurs. Several relative equations have been found to define the negative friction zone of the pile. Negative skin stimulation depends on the degree of integration of time coefficients and ground volumes, and can be negligible if the ground is almost completely integrated.

3. Objective of the study

The study takes into account the following object
1. Examining how RCC single row buildings and RCC frame Buildings involve lateral displacement
2. Investigation of earthquakes behaviour on framed structure of RCC and single column structure RCC .
3. The RCC structure & RCC single column structure are examined for maximum stress bending moment and shear force.

4. Modelling Methodology of Single Column Building Structure

4.1 Problem Statement

A Model for G+7 storied is created, inspection and configuration is used STAAD-Pro programming. The Building is design is 12m X12m. The building is located in earthquake zone 4. The structure is given the following details:
All columns = 0.7mx0.7m, Single column = 0.4mx0.4m, All Beams = 0.6mX0.6m, Slab thickness = 0.125m,

Measurement of the Building:
Height = 9+3X7 = 30m.
Length = 4 side 3.0m =12m, Width = 4 side 3.0m =12m,
Live load on the floor = 4.1kN/m^2
Grade of concrete and steel used: Used M30 concrete and Fe 550 steel foundation of the building is consider pile foundation.

Elevation: The building elevation are as follows storey=9m Height of each storey=3m (From 1st floor to 7th floor) The elevation of the single and multi-column building is generated using the STAAD pro software, where the dimensions of single and multi-column building are same. The only difference is the number of columns. The elevation view of the single column building.

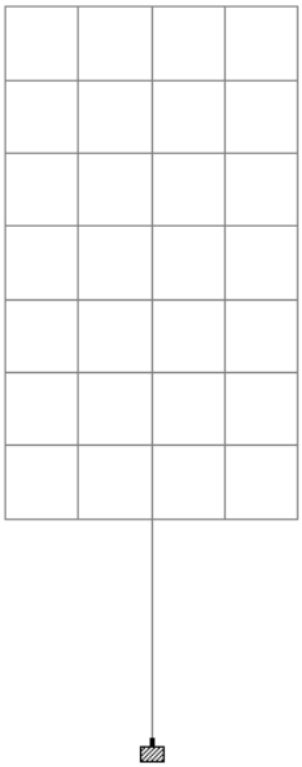


Figure 2 The elevation view of the single column structure building.

4.2 Modelling in STAAD-Pro:

The analysis and designing are as follows1. Input information: Open STAAD Pro, the project information need to be feed. lot of information is entered, including the name of the project, clint name , the start date of the project, the name of the engineer, etc. 2. Generating 3D Model Geometry: STAAD allows you to create structural data in one of two approaches. A. Use a command file commonly known as the "Staad -Editor method." B. Use the GUI or graphical user interface. STAAD's GUI tools are more user-friendly and refined, so used them for all my programs. In STAAD, the Snap Node, dialog box that occurs when you select a grid creates a model for the frame structure. The knot and rays are then constructed. This command places the beam and nodes at corresponding distances based on our needs. 3. Assigning materials: How to assign corresponding materials to rays and columns, depending on the building. Our designs are made of concrete, so the rays and pillars are also made of concrete. 4. Members Specified Properties: Beam and column dimensions (width and depth of intersecting sections) are their properties. So we entered the various qualities (such as circular, rectangular, and square) and assigned these properties to the designated members with the use of this command.

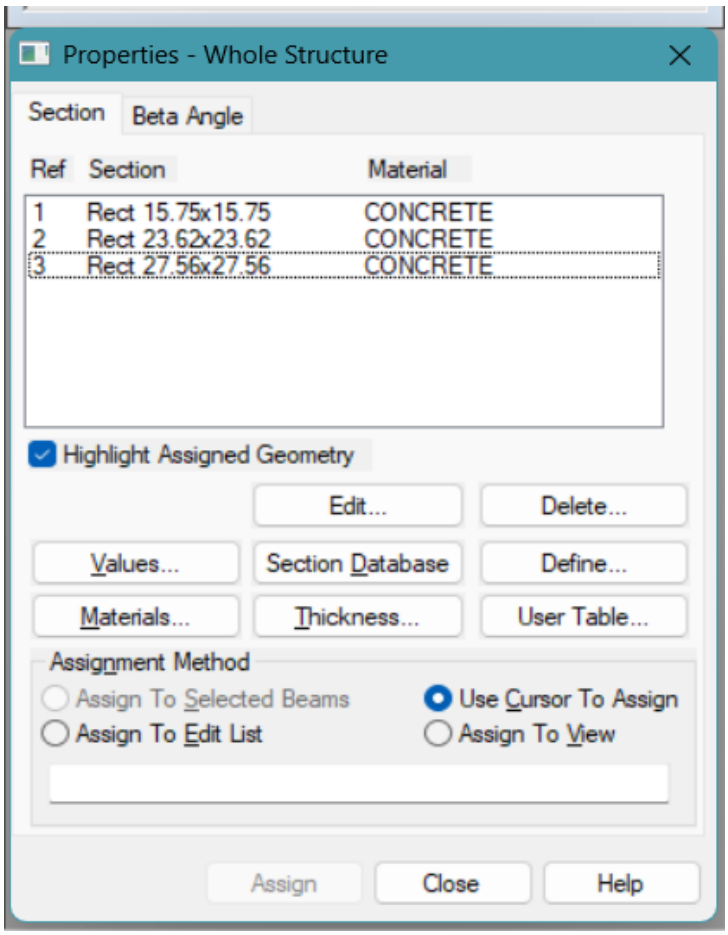


Figure 3 Cross-section details of the column.

The beam size is 0.7 mx0.7 m, the column size is 0.4 mx0.4 m, and the plate thickness is 125 mm for the column cantilever building. For individual pillar buildings, the central row size is 0.4 mx0.4 m. 5. Material constant specifications: Concrete constants are already known as you assigned concrete materials so that you do not need to use this command individually. Alternatively, you can use this command if you need to update the constants. 6. Member-Offset:

STAAD takes rays and columns into the model design that is at the center of the model design. If you want the ray above the gap to reach the end, you must use the beam offset command. Print Membership Information: If you would like a report containing details about each member, for example, in the general numbers and lengths and ending of B. Start, you can use this command by selecting the information before analyzing the print member information in the top menu bar. Support Specification: A method using fixed support is first created and then assigned to all lower nodes in the structure where the foundation is designed. First create all the road cases. B. Finally, add it to the corresponding element and node. All types of loads are generated by the STAAD program and allocated to the structure. It provides the possibility of applying dead loads to the structure.

Prior to generating specific load instances (such as seismic or wind loads), some definitions of loads are first defined in accordance with IS standards. Load Combinations. With the help of

Automatic combination of load commands, load combination have been constructed. loads can be created according to Indian code, but you can add them. These combinations can be used without assigning them to members. The structure has all the weights, so it progresses. 10. Specification of analysis type: e must indicate an analysis command that must be linear static type before analyzing the load. Select Statics Examination to add this command.

A. Dead load

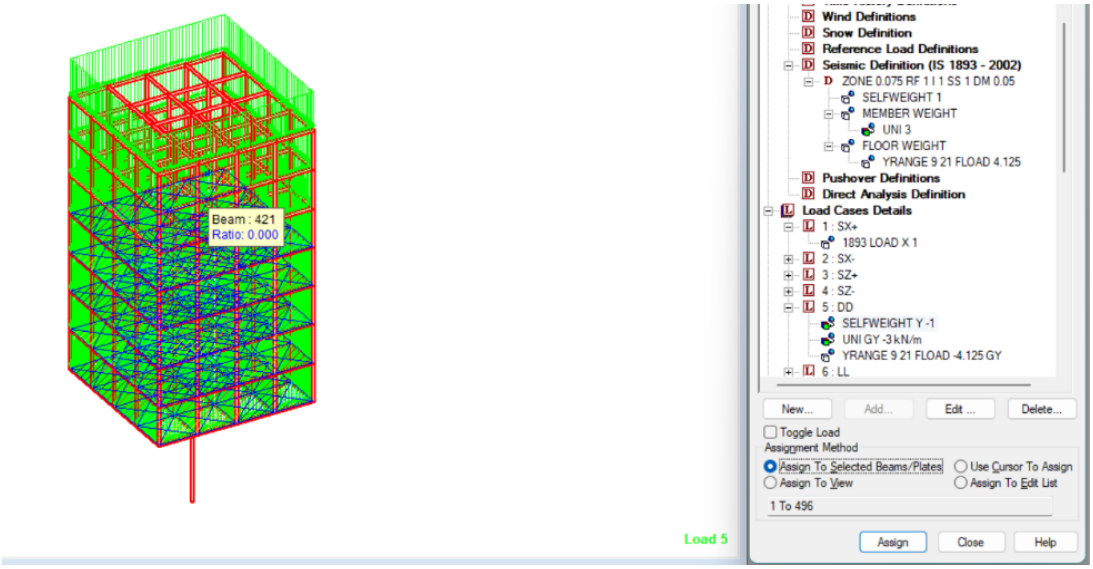
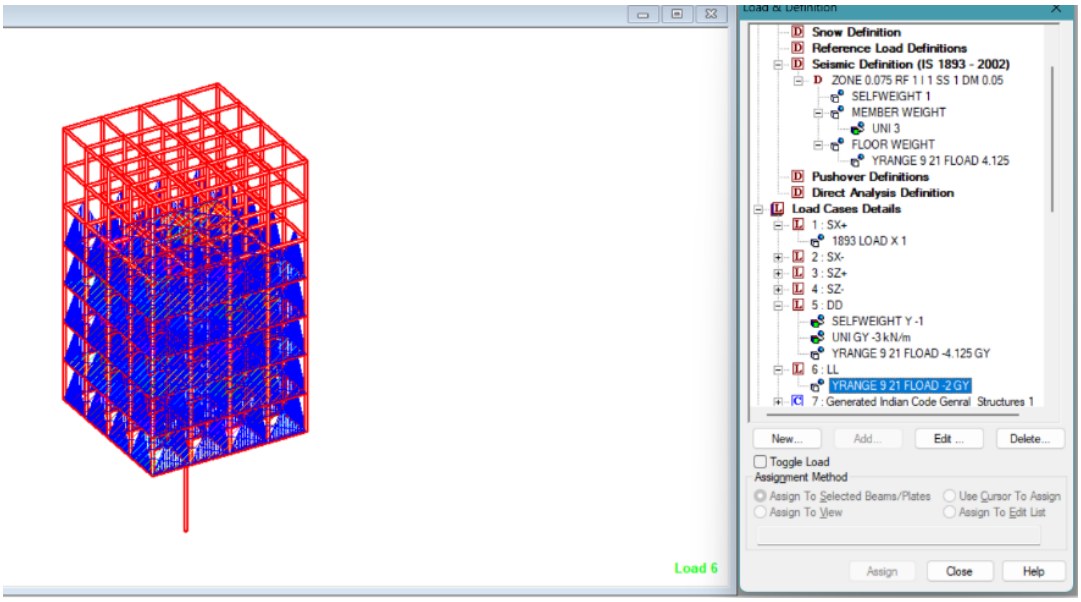


Figure 4 Generating Dead load**.**



B. Live load

Figure 5 Generating live load.

c. Load Combination:

The self-weight, seismic load and load combination is generated with the coefficient.

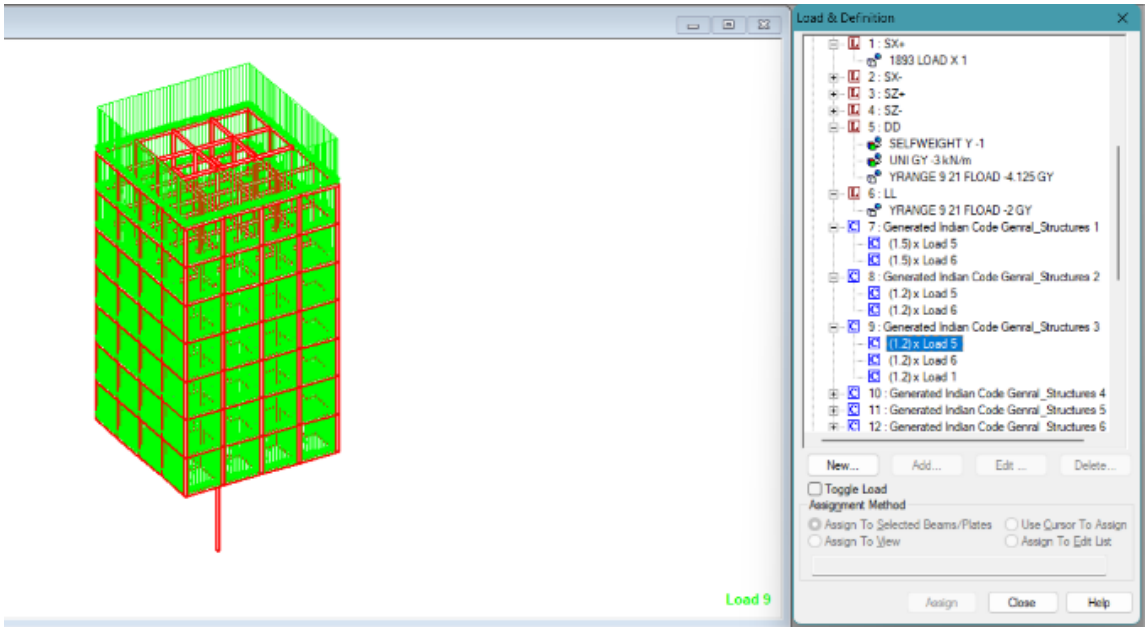


Figure 6 Load combination of self-weight.

d. Seismic Load:

According to IS 1893-2002, the seismic load values were determined. STAAD Pro has a seismic load generator that fits to the above IS code.

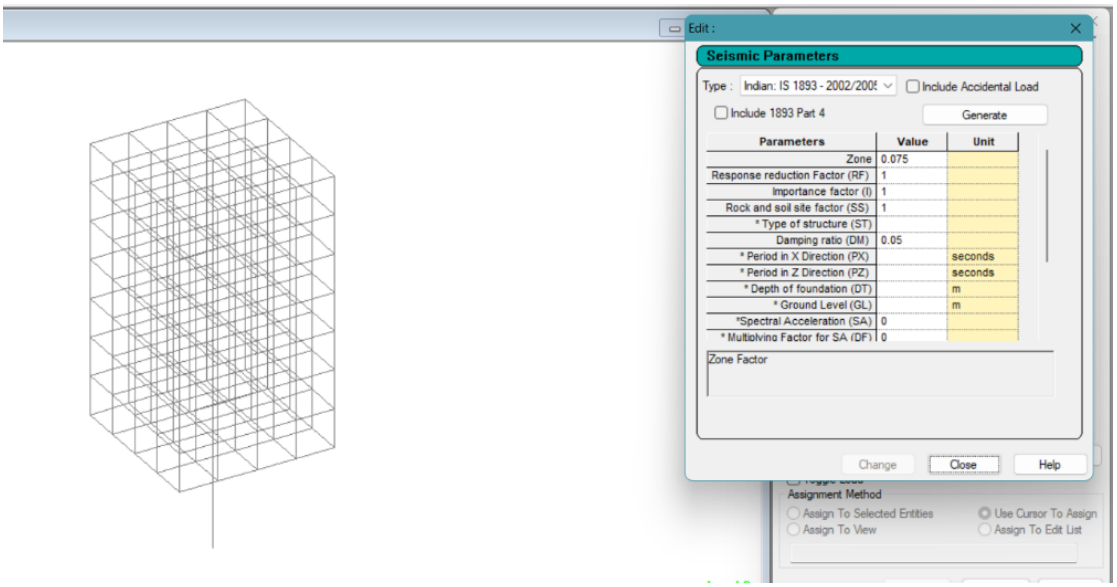


Figure 7 Seismic load definition.

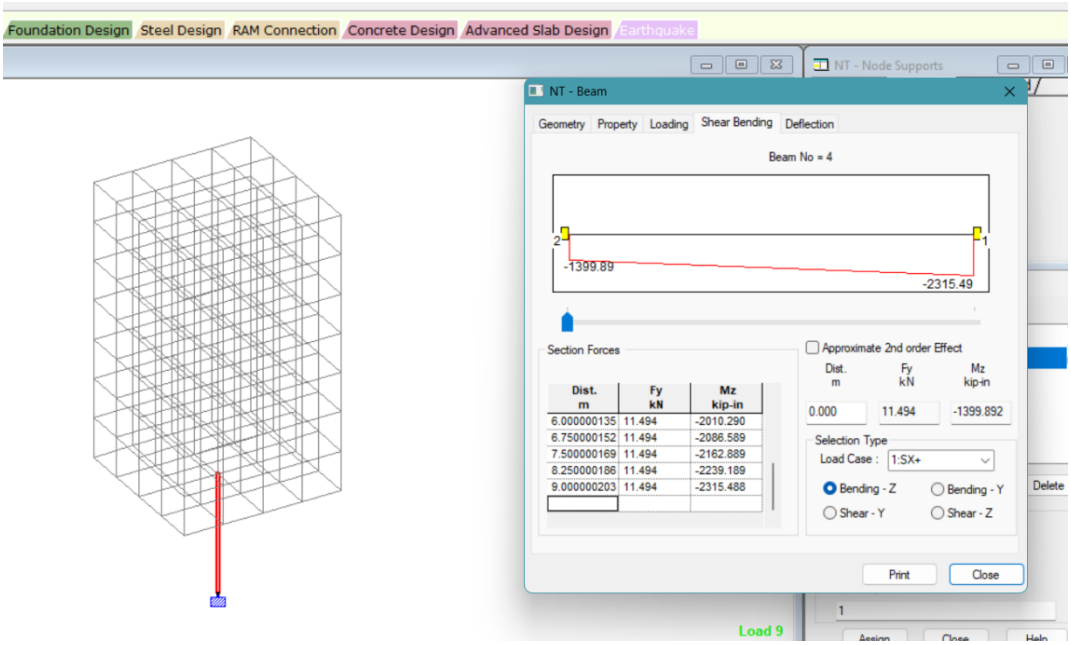


Figure 8 Shear Force Diagram.

4.3. Comparison of stress

Load combination = 1.2DL+1.2EL+1.2WL.Fig.8shows the stress comparison of the Single Column Building. It has the minimum stress of 0.08N/mm2 and maximum stress of0.415N/mm^2.

4.3.1 Deflection

The deflection in single column building structure is 0.500mm.

4.3.2 Support Reactions

Maximum value for support reactions developed with combination of loads that can act on single column .
As listed below:

Table 1. Support Reactions for single column building

S.No.	Direction	Maximum Value (mm)
1	FX	700.215
2	FY	2100
3	FZ	721.846
4	MX	20100
5	MY	0
6	MZ	15200

4.3.3Displacement

The maximum value of displacements for load combination which will act in the single column building structure . listed below:

Table 2.Displacements of the single column buildings.

S.No.	Direction	Maximum Displacement (mm)	Maximum Displacement (mm)
1	X direction	16.079	17.550 mm
2	Y direction	42.537	3.289 mm
3	Z direction	11.528	14.888 mm

4.3.4 Forces

The maximum value of external force for the load combination which will act on the single column building structure. listed below:

Table 4 External force and moment for the single column building.

S.No.	Direction	Maximum Value of Force (KN)	Maximum Value of Moment (KN-m)
1.	X	20600	16.832
2.	Y	885.764	20200
3.	Z	754.616	23400

The above result in tabular are shown the result of single column building of g+7. In this result the support reaction, displacement and external forces are considered

5. Conclusion

1. The analysis follows the followings:
2. All loads, including seismic load , have been successfully designed to bear the single column structures.
3. Using software the analysis of the, shear force, bending moment,deflections, end moments, and foundation responses are determined.
4. The shear force and bending moment values in a single column structure are significantly larger
5. A single column has less deflection.

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