

ANALYSIS OF G+3 R.C.C BUILDING WITH BOTH CIRCULAR AND RECTANGULAR COLUMNS

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ABSTRACT

In this ever-growing market of Civil engineers, it is very important for a structural engineer to save time. For this, an attempt is made to analyze and design a Multistoried building by using the software Staad Pro. The present project deals with the analysis of a multi storied residential building of G+3 and comparison between circular and rectangular columns. The dead load & live loads are applied and the design for beams, columns, footing is obtained with the help of STAAD Pro and its features which help us conclude if the building is safe to carry the loads acting on it. The features of Staad Pro surpassed those of software like AutoCAD, and MS Excel. We conclude that Staad Pro is a very powerful tool which can help us save time and is very accurate in Designs and analysis. Thus, it can be concluded that Staad Pro is quite suitable for the design of a multistoried building.

1. INTRODUCTION OF STAAD PRO

1.0 Introduction

STAAD or (**STAAD Pro.**) is a Structural Analysis and design software application originally developed by Research Engineers International in 1997. In late 2005, Research Engineers International was bought by **Bentley Systems**

STAAD Pro. is one of the most widely used structural analysis and design software products worldwide. It supports over 90 international steel, concrete, timber & aluminium design codes.

It can make use of various forms of analysis from the traditional static analysis to more recent analysis methods like p-delta analysis, geometric non-linear analysis, Pushover analysis (Static-Non-Linear Analysis) or a buckling analysis. It can also make use of various forms of dynamic analysis methods from time history analysis to response spectrum analysis. The response spectrum analysis feature is supported for both user defined spectra as well as a number of international code specified spectra.

Additionally, STAAD Pro. is interoperable with applications such as RAM Connection, Auto PIPE, SACS and many more engineering design and analysis applications to further improve collaboration between the different disciplines involved in a project. STAAD can be used for analysis and design of all types of structural projects from plants, buildings, and bridges to towers, tunnels, metro stations, water/wastewater treatment plants and more.

1.1 Advantages

It offers a flexible modelling environment to the user that facilitates creating the best structure.

It provides the user with multiple design codes to choose from; the user can use the most appropriate code for the structure by the virtue of STAAD Pro training.

Being a feature-rich building design software, STAAD Pro provides a wide range of tools for the designer to choose from.

STAAD Pro provides an open architecture called OpenSTAAD, which is like a resource library for the STAAD professionals that provides Application Process Interface (API) and other useful resources.

Though STAAD pro is a sophisticated structural designing software, it comes with many benefits and can be easily used by a certified STAAD professional

1.2 Features

STAAD building planner

STAAD provides a visualization module of the building planner which generates models of the building that can be designed and analysed in the software program. This software is interactive and intuitive that makes easy the work on making changes in the geometry specification operations with fewer mouse clicks in the workflow.

Physical modelling

Physical modelling is one of the most significant features used in the software. It is simplified physical modelling process of a structure. This software Visualize Beams, columns and surfaces placed in the model corresponding to which they appear in the physical world spanning multiple floors and a surface representing an entire floor of a building. The visualization of generated joint where two physical objects meet in the model.

Analytical Modelling

Analytical model can be created employing the ribbon- based user interface by making changes and editing the command file which are of types like dxf, cis/2. The model geometry can even be generated from the data of macro- enabled applications (Like Microsoft Excel, Micro stations etc) by using Macros.

Steel Auto Drafter

Steel Auto Drafter produces excellent workflow plan that extracts planar drawings at any level and sections in any of the orthogonal material from structural steel model prepared in STAAD. Pro.

Advanced Slab Design

The STAAD. Pro Advanced Slab Design works within the STAAD Pro. environment which is an integrated software design tool workflow. In this software concrete slabs can be defined and the data can be passed to RAM Concept which includes all the design requirements of structural and civil design consisting of the geometry, material, loads and analysis

Advanced concrete Design

The advanced concrete design workflow software application powered by RCDC application provides direct access for STAAD. Pro models. This software application is standalone requiring a model and results data from a suitable analysis, operating outside the STAAD. Pro software environment. The model is made up of beams and columns as plates are not currently supported. RCDC software application can be utilized to design the objects such as Pile caps, Footings, columns and walls, beams and slabs. This software works in within the projects as each design created in RCDC is retained and displayed when RCDC is re-entered balancing the previous design which can be recalled and continued. The BBS of perfect quality can be generated as required which can be executed instantly.

II.G+3 R.C.C BUILDING with both circular and rectangular columns

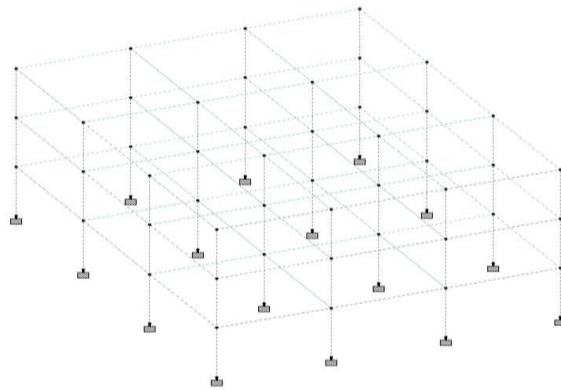
2.0 Overview of the Structure

Here We Are Designing a G+3 RCC Building whose length (X direction) about 8 Metres, height about 8 Metres each floor of 3 metres and in width (Z direction) about 10 Metres

No of Bays in length are 3 each of 2.66 metres

No of Bays in width are 4 each of 3.33 metres

No of Bays in height are 3 each of 2.66 metres



Select Parameters [X]

Model Name:

Length: m No. of bays along length: ...

Height: m No. of bays along height: ...

Width: m No. of bays along width: ...

2.1 Modelling

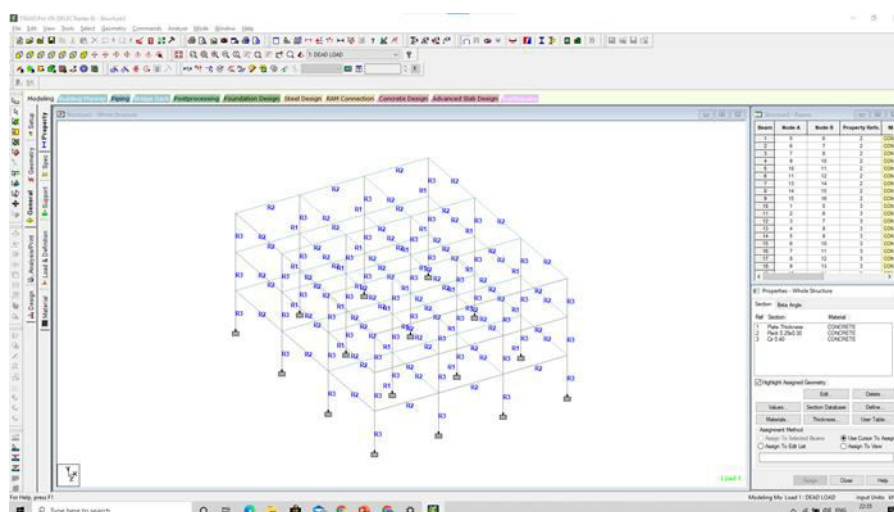
Modelling in staad is done in geometry tab you can locate it on your screen.

You can find two options of geometry their and additionally a grid option is available for easy modelling or you can do it manually by adding nodes co-ordinates.

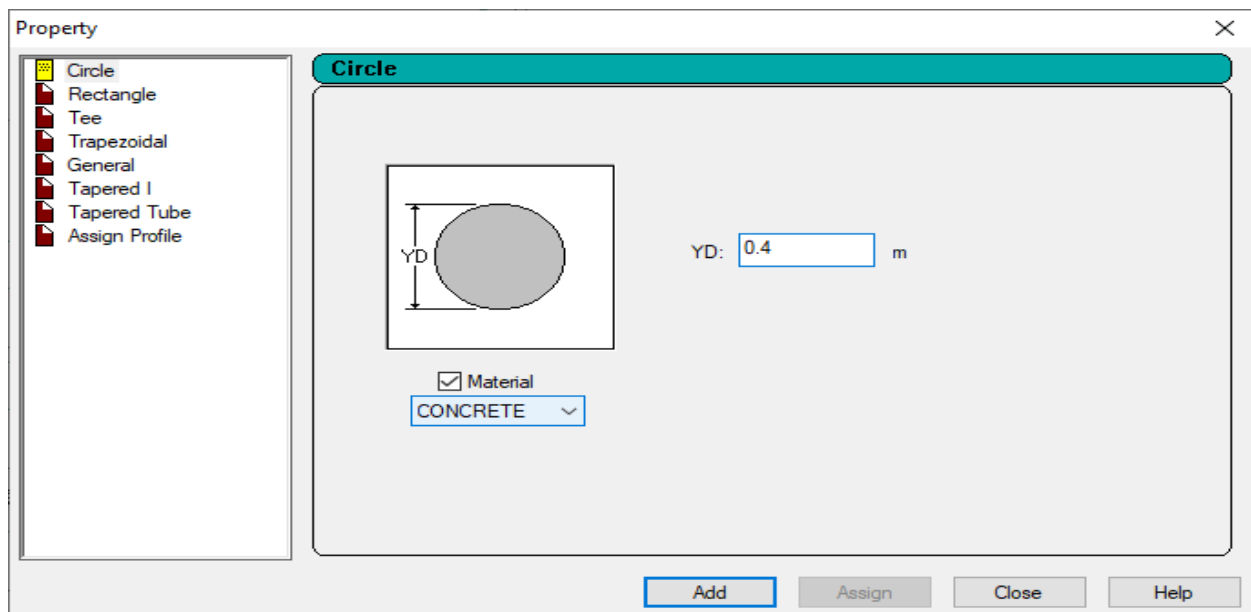
2.1.1 Properties

After completion of geometry tab, the next step is to define the properties of the structure in general tab.

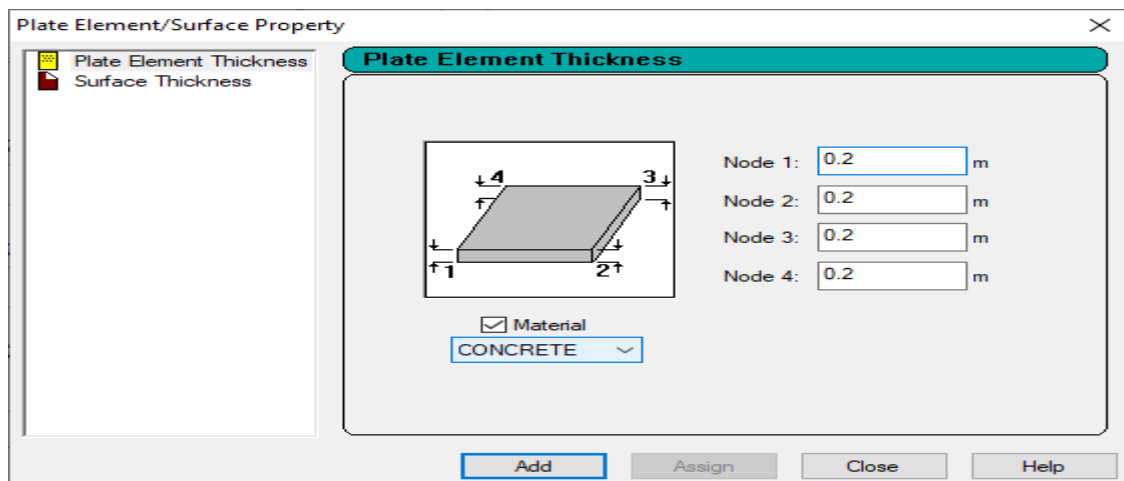
To assign a property, we have to select define option in properties tab.



For beams dimensions are 0.25X0.3

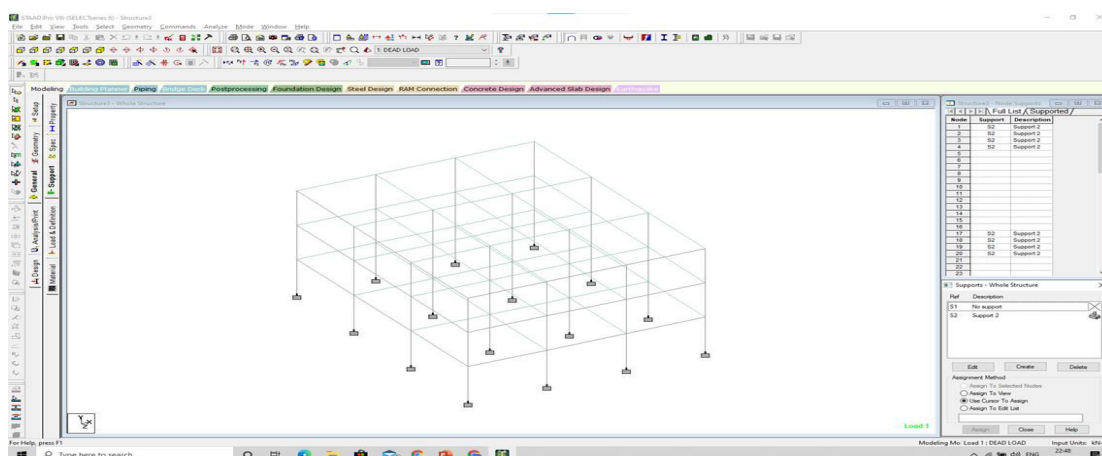


For structure with rectangular columns the dimensions are 3.544x3.544



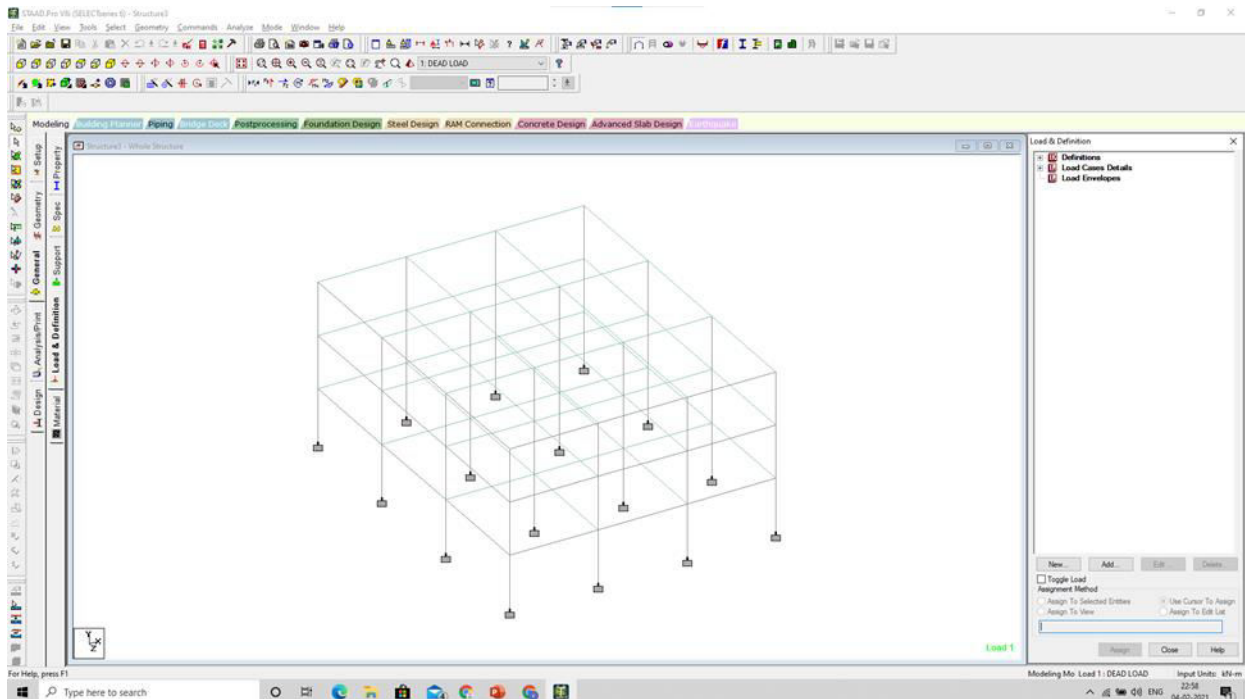
2.1.2 Supports

To add supports to the structure, select support option in general and new tab pops out at the right corner of the window, where we have to select create option to add the required supports.



2.1.3 Load and Definition

To assign loads we have to select Loads and Definition option in left side overlay and it will pop up in right side, then add loads.



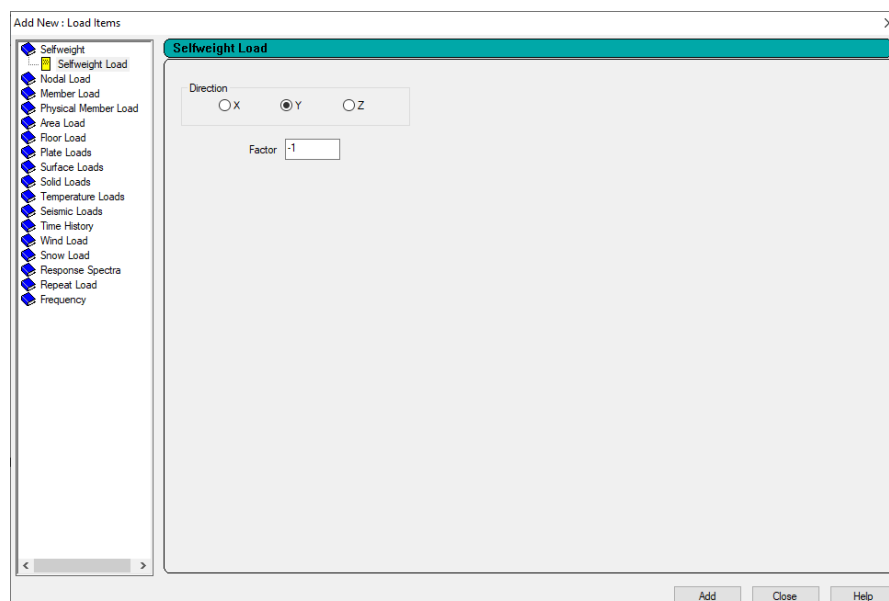
Then select add option after clicking Load case details

Dead loads are due to self-weight of the structure. Dead loads are the permanent loads which are always present. Dead loads depend upon the unit weight of the material
Here Dead load is taken as -4 KN/m^2 .

Live Load

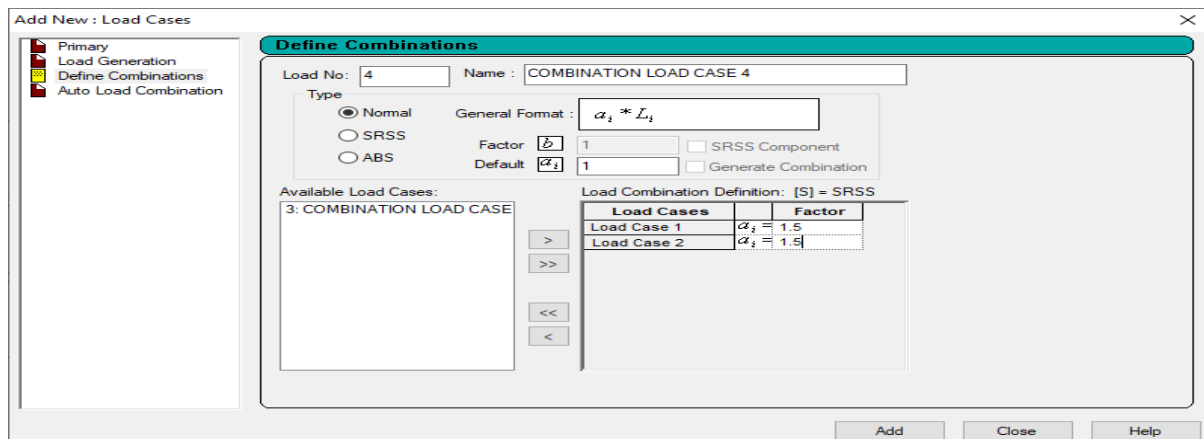
Live loads on floors and roofs consists of all the loads which are temporarily placed on the structure, for example, loads of people, furniture, machines etc.
here Live load is taken about -3 KN/m^2 .

In dead load select self weight with factor



2.1.4 Load Combinations

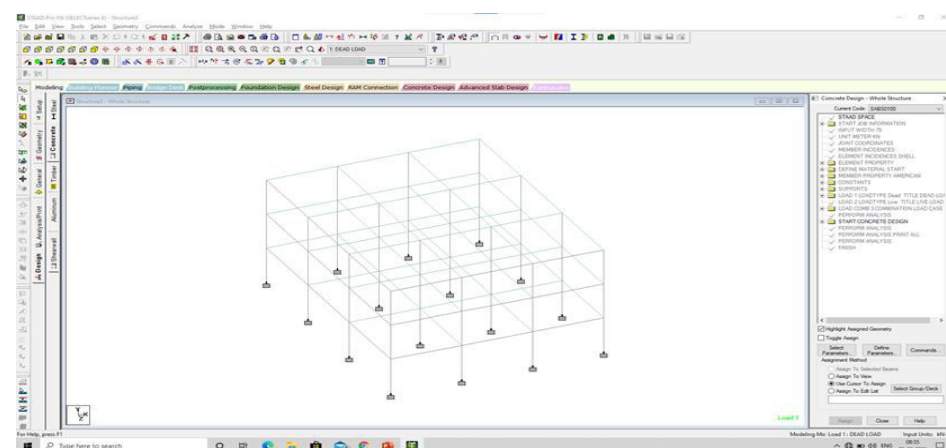
Select add option in Load case details and click define combination and give factor of safety.



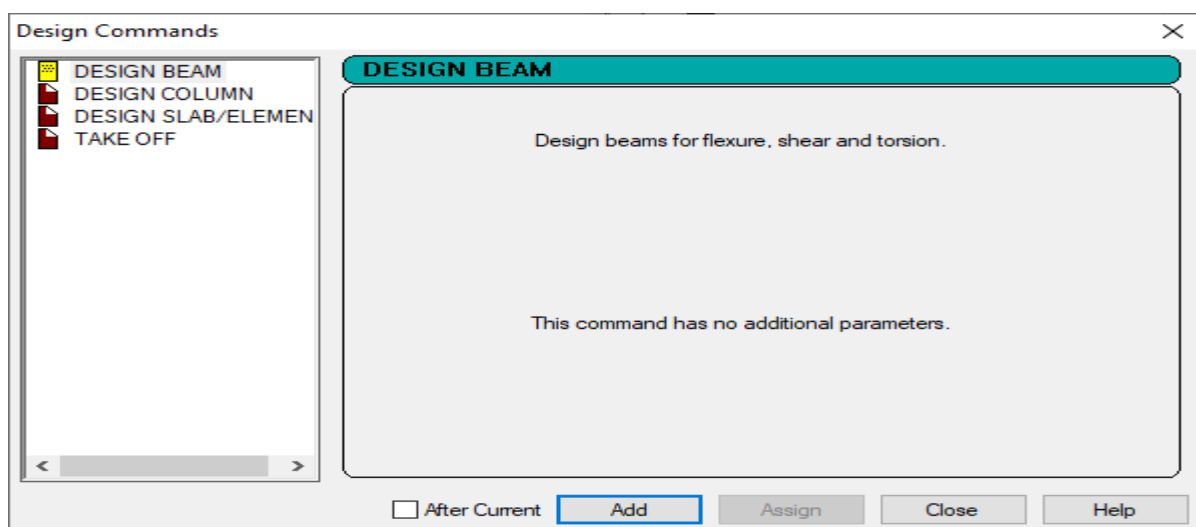
2.2 Design

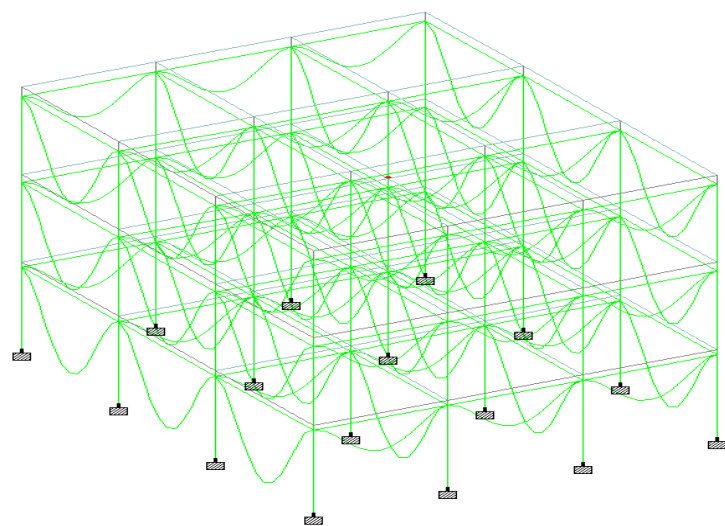
To design we have to select the design option In left side, and select concrete design.

Select IS code in right tab.

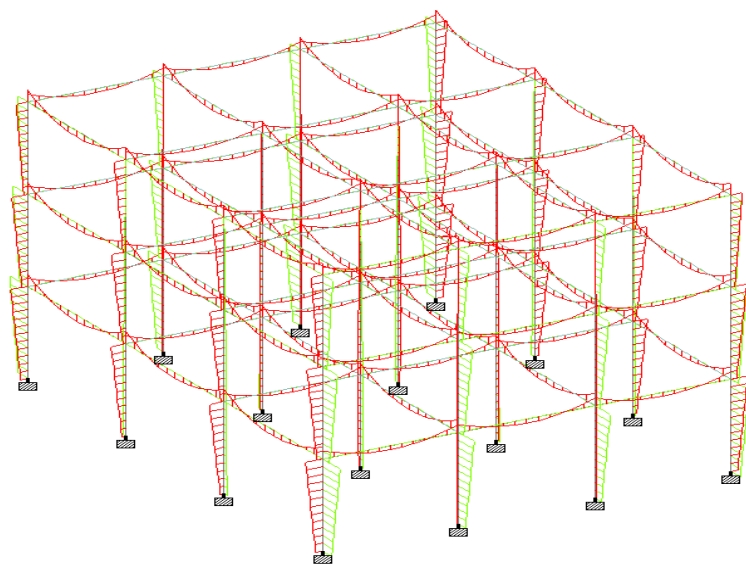


After that select the design parameters in right tab and after define parameters.

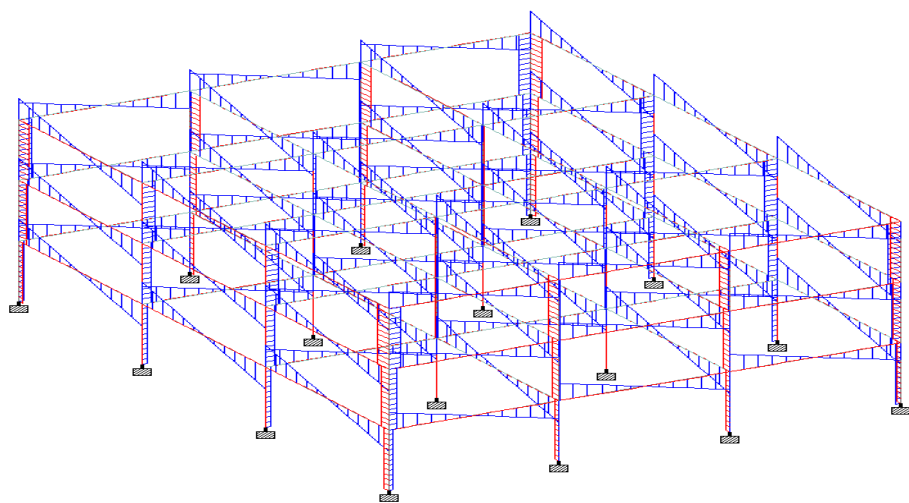




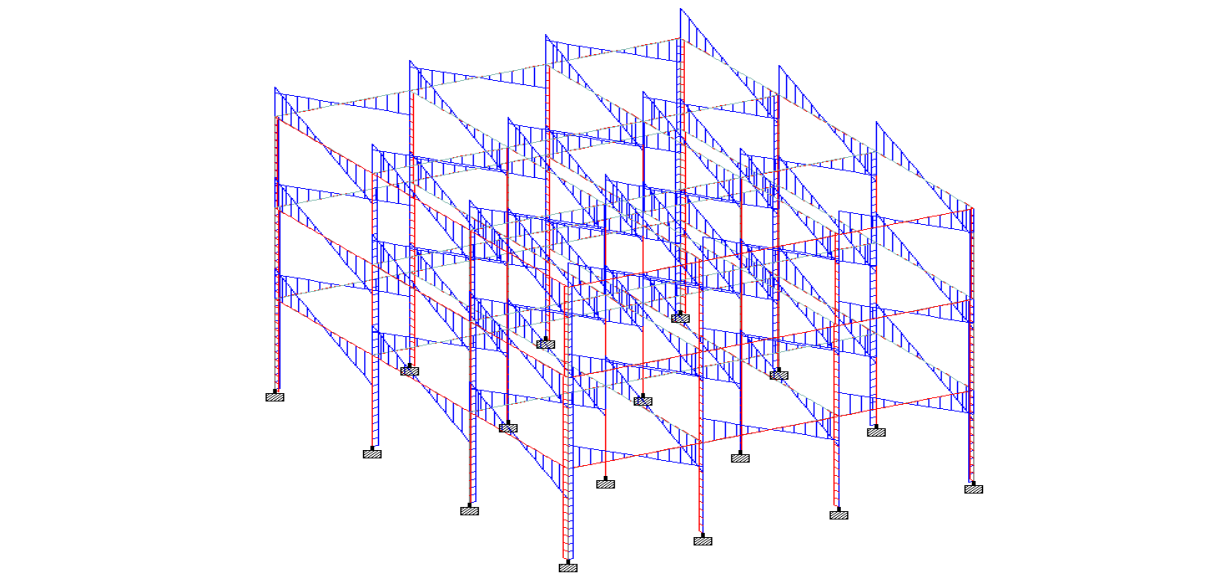
Bending moment of structure with circular column



Shear force of structure with circular column

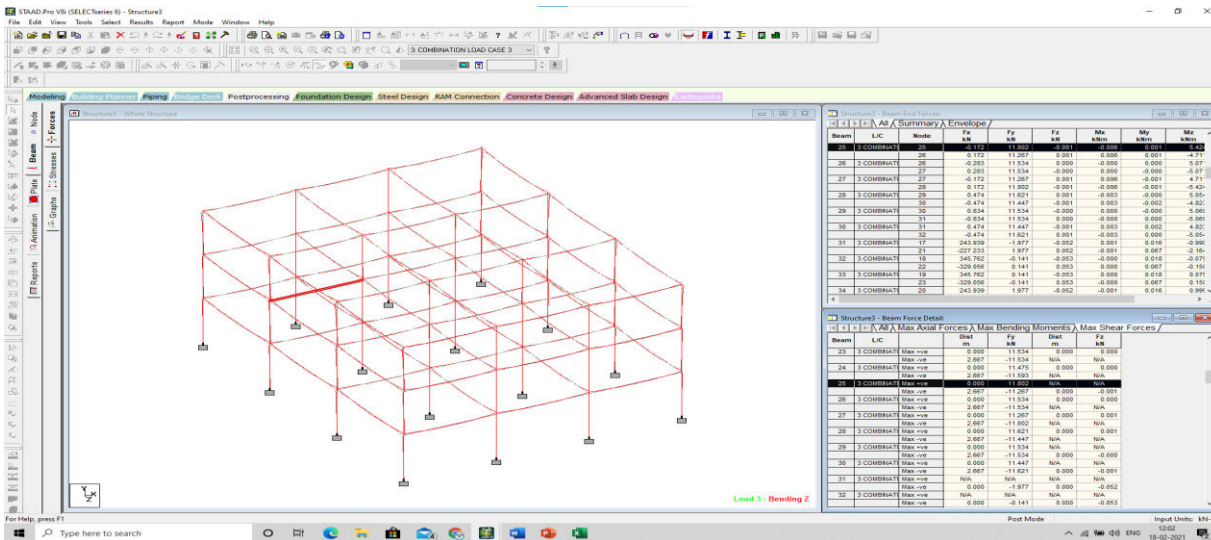


Shear force of structure with rectangular column



2.5.1 Comparing the beam with max shear force in both circular and rectangular columns

The beam with maximum shear force in circular column is load combination 25



Details of beam no 25

Structure3 - Beam

Geometry

Property

Loading

Shear Bending

Deflection

Concrete Design

Beam no. = 25. Section: Rect 0.25x0.30

0.250

Length = 2.66667

Node	X-Coord	Y-Coord	Z-Coord
25	0	3.2	3.33333
26	2.66667	3.2	3.33333

UNIT: m

Additional Info

Beta Angle: 0

Member

Fire Proofing :

Radius of Curvature :

Gamma Angle :

deg

Change Beta

Releases:

Start:

End:

Change Releases At Start....

Change Releases At End

Print

Close

Structure3 - Beam

Geometry

Property

Loading

Shear Bending

Deflection

Concrete Design

Beam no. = 25. Section: Rect 0.25x0.30

0.250

Length = 2.66667

0.300

Physical Properties (Unit: m)

Ax	0.075	Ix	0.000775154
Ay	0.075	Iy	0.0005625
Az	0.075	Iz	0.000390625
D	0.25	W	0.3

Assign/Change Property

Material Properties

Elasticity(kN/mm2)	21.7185	Density(kg/m3)	2402.61
Poisson	0.17	Alpha	1e-005

CONCRETE

Assign Material

Print

Close

B E A M N O. 25 D E S I G N R E S U L T S					
M25	Fe415 (Main)		Fe415 (Sec.)		
LENGTH:	2666.7 mm	SIZE:	300.0 mm X	250.0 mm	COVER: 25.0 mm
SUMMARY OF REINF. AREA (Sq.mm)					
SECTION	0.0 mm	666.7 mm	1333.3 mm	2000.0 mm	2666.7 mm
TOP REINF.	135.18 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	135.18 (Sq. mm)
BOTTOM REINF.	0.00 (Sq. mm)	135.18 (Sq. mm)	135.18 (Sq. mm)	135.18 (Sq. mm)	0.00 (Sq. mm)

STAAD SPACE

-- PAGE NO. 17

SUMMARY OF PROVIDED REINF. AREA					
SECTION	0.0 mm	666.7 mm	1333.3 mm	2000.0 mm	2666.7 mm
TOP REINF.	3-10i 1 layer(s)	2-10i 1 layer(s)	2-10i 1 layer(s)	2-10i 1 layer(s)	3-10i 1 layer(s)
BOTTOM REINF.	2-10i 1 layer(s)	3-10i 1 layer(s)	3-10i 1 layer(s)	3-10i 1 layer(s)	2-10i 1 layer(s)
SHEAR REINF.	2 legged 8i @ 115 mm c/c	2 legged 8i @ 115 mm c/c	2 legged 8i @ 115 mm c/c	2 legged 8i @ 115 mm c/c	2 legged 8i @ 115 mm c/c

SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT

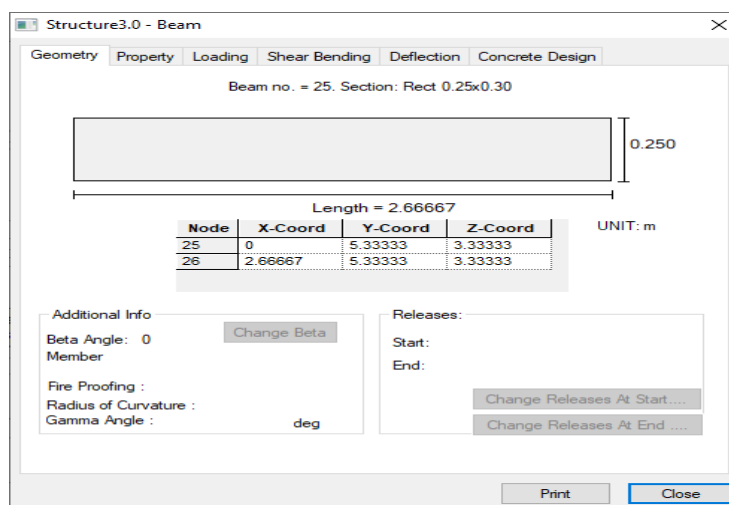
SHEAR DESIGN RESULTS AT 420.0 mm AWAY FROM START SUPPORT

VY = 8.21 MX = -0.01 LD= 3
Provide 2 Legged 8i @ 115 mm c/c

SHEAR DESIGN RESULTS AT 420.0 mm AWAY FROM END SUPPORT

VY = -7.68 MX = -0.01 LD= 3
Provide 2 Legged 8i @ 115 mm c/c


The details of beam no 25 in rectangular column



Structure3.0 - Beam

Geometry Property Loading Shear Bending Deflection Concrete Design

Beam no. = 25. Section: Rect 0.25x0.30



Length = 2.66667

Physical Properties (Unit: m)

Ax	0.075	bx	0.000775154
Ay	0.075	by	0.0005625
Az	0.075	bz	0.000390625
D	0.25	W	0.3

Assign/Change Property

Material Properties

Elasticity(kN/mm ²)	21.7185	Density(kg/m ³)	2402.61
Poisson	0.17	Alpha	1e-005

CONCRETE

Assign Material

Print Close

BEAM NO. 25 DESIGN RESULTS

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 2666.7 mm SIZE: 300.0 mm X 250.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	666.7 mm	1333.3 mm	2000.0 mm	2666.7 mm
TOP REINF.	135.18 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	135.18 (Sq. mm)
BOTTOM REINF.	0.00 (Sq. mm)	135.18 (Sq. mm)	135.18 (Sq. mm)	135.18 (Sq. mm)	0.00 (Sq. mm)

< PAGE 16 Ends Here >

STAAD SPACE -- PAGE NO. 17

SUMMARY OF PROVIDED REINF. AREA

SECTION	0.0 mm	666.7 mm	1333.3 mm	2000.0 mm	2666.7 mm
TOP REINF.	3-10i 1 layer(s)	2-10i 1 layer(s)	2-10i 1 layer(s)	2-10i 1 layer(s)	3-10i 1 layer(s)
BOTTOM REINF.	2-10i 1 layer(s)	3-10i 1 layer(s)	3-10i 1 layer(s)	3-10i 1 layer(s)	2-10i 1 layer(s)
SHEAR REINF.	2 legged 8i @ 115 mm c/c	2 legged 8i @ 115 mm c/c	2 legged 8i @ 115 mm c/c	2 legged 8i @ 115 mm c/c	2 legged 8i @ 115 mm c/c

SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT

SHEAR DESIGN RESULTS AT 1992.5 mm AWAY FROM START SUPPORT

VY = -8.59 MX = -0.00 LD= 3

Provide 2 Legged 8i @ 115 mm c/c

SHEAR DESIGN RESULTS AT 1992.5 mm AWAY FROM END SUPPORT

VY = 8.61 MX = -0.00 LD= 3

Provide 2 Legged 8i @ 115 mm c/c

III.CONCLUSION

Based on the results we got from staad pro we can conclude that

Circular columns are more stronger than rectangular columns.

The circular or cylindrical shape is symmetry. Whereas a square has 4 axes of symmetry, and a rectangle has 2 axes of symmetry. So circular columns will have the same moment of inertia at all axes to avoid buckling failure.

- The load requirement to buckle the circular column is equal to the perimeter of the column, but the rectangular column may deflect through both axes.
- The rectangular or square column has four weak points (corner edge), but the circular is in the shape of a cylinder, so there are no weak points.
- The circular column is strong in compression compared to the square column in the same cross-sectional area.
- Circular column occupies a smaller area; If you construct a circular column having the same diameter of a square column's side length, the circular column holds only 0.785 times of the square column area.
- Circular column requires a minimum of six numbers of reinforcement whereas square or rectangular column only need four numbers of reinforcement
- Formwork is easy for a rectangular column due to its straight sides. Circular column shuttering is a little bit difficult
- Circular Columns are aesthetically pleasing compared with other geometrical types of columns.
- The reason we choose rectangular or square columns is because of our wall construction. Most of our outer walls are constructed as 9" walls. So we tend to form 9×9 square columns because it does not project anywhere inside.

1. Using STAAD Pro. the analysis of multi storey building has completed much quicker when compared with manual analysis.

2. It is observed that the reinforcement percentage in the sections is more in the case of software design when compared to manual calculations.

3. Designing using Software like STAAD reduces lot of time in design work.

4. Reinforcement Details of each and every member can be obtained using STAAD pro.

5. All the List of failed frame sections can be Obtained in the report given by STAAD Pro so that we can change the property data for a better section.

6. Shear variation and moment variation of particular section can be observed clearly on the building.

7. Accuracy is improved by using software.

REFERENCES

Video lectures of STAAD Pro on InternShala

Code Books :

IS 456-2000 Plain and Reinforced Concrete

IS 875 (PART-1)-1987 Dead Loads

IS 875 (PART-2)-1987 Live Loads

IS 875 (PART-3)-1987 Wind Loads

Dr. S.R. Karve & Dr. V.L. Shah - "Illustrated design of Reinforced concrete Buildings"

N. Krishna Raju - "Advanced Reinforced Concrete design"