# ANALYSIS AND DESIGN OF MULTI-STOREY BUILDING BY USING STAADPRO

A MAJOR PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF DEGREE OF

## BACHELOR OF TECHNOLOGY

IN

## CIVIL ENGINEERING


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**2017 - 2021**

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# CERTIFICATE

This is to certify that the Project Report entitled "ANALYSIS AND DESIGN OF MULTI-STOREY BUILDING BY USING STAADPRO" that is being submitted by

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In partial fulfillment of the requirement for the award of B.Tech in Civil Engineering in the **RAJEEV GANDHI MEMORIAL COLLEGE OF ENGINEERING AND TECHNOLOGY**,Nandyal (Affiliated to J.N.T University, Anantapur) is a bonafide record of confide work carried out by her under our guidance and supervision. The results embodied in this technical report have not been submitted to any other university or institute for the award of any Degree.

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**Professor and HOD**

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**Date:**

*Dedicated to my beloved parents, and teachers who have worked hard throughout my education.*

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At the end, we proudly acknowledge our father and mother for their constant motivation which have been valuable assets of our life.



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# Abstract

In the last few decades tall or multi-storey buildings has gain very much importance, because in metro cities there is a rapid increase in population with limited land. Most of the people require good accommodations, aesthetic, comfort and safety. Thats the reason for increase in construction of multi-storey buildings. Earthquake will cause more severe effect on tall buildings compare to small buildings. Due to earthquake asymmetrical buildings will damage more than symmetrical buildings.

A review of the analysis and design of a multi-storey building with STAAD Pro is carried out. Planning is done by using AutoCAD and load calculations were done manually and then the structure was analysed using STAAD Pro. The dead load, imposed load and wind load with load combination are calculated and applied to the structure. Overall, the concepts and procedures of designing the essential components of a multistory building are described. STAAD Pro software also gives a detailed value of shear force, bending moment and torsion of each element of the structure which is within IS code limits..

**KEYWORDS**: Staad pro, multi-storey building, shear force, bending moment.

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# Chapter 1

# INTRODUCTION

Now a days tall or multi-storey buildings has gain very much importance, because in metro cities there is a rapid increase in population with limited land. All people require good accommodations, aesthetic, comfort and safety. Thats the reason for increase in construction of multi-storey buildings.

Structural design of multi-storey buildings is basically worried with safety during ground motion, serviceability what's more, potential for monetary misfortune. Design of structures using Limit State method Design the members are designed for the limiting bending moment and serviceability limits, hence the structures are left with minimum reserve energy. Earthquake will cause more severe effect on tall buildings compare to small buildings. Due to earthquake asymmetrical buildings will damage more than symmetrical buildings. In case of high rise structures horizontal loads produce develop high lateral displacements which is not desirable for the occupants and the structure itself.

The enormous increase in population and scarcity of land makes the people to move from rural areas to urban paces and construction of multi-storied buildings in small areas is being common now-a-days. Functional designing of the building has become very important and the requirements vary from one building to another. Every Civil Engineer should know the usage of the buildings by contacting the people and basic principles of designing of the R.C.C structures. This is project is intended at Analyzing and designing the multi-storey structure using STAAD. PRO V8i and STAAD. ETC. In this project, we adopted limit state method of analysis and design the structural members manually and using STAAD.PRO.V8i and STAAD.ETC. Manually design is done for particular beam, column and slab by using IS456:2000 and loads are dead load, imposed load and external load considered according to IS 875:1987 (PART III).It is then checked in STAAD.P RO.V8i and STAAD.

Few standard problems also have been solved to show how STAAD. Pro can be used in different cases. These typical problems have been solved using basic concept of loading, analysis, condition as per IS code. These basic techniques may be found useful for further analysis of problems.

## 1.1 OBJECTIVES

- Generating structural framing plan.
- Creating model in STAAD PRO.
- Analysis of the structure.
- Design the structure.

# Chapter 2

# LITERATURE REVIEW

- **Ibrahim, et.al (April 2019)1: Design and Analysis of Residential Building(G+4):**
  After analyzing the G+4 story residential building structure, conducted that the structure is rate in loading like dead load, live load, wind load and seismic loads. Member dimensions (Beam, column, slab) are assigned by calculating the load type and its quantity applied on it. Auto CAD gives detailed information at the structure members length, height, depth, size and numbers, etc. STADD Pro. has a capability to calculate the program contains number of parameters which are designed as per IS 456: 2000. Beams were designed for flexure, shear and tension and it gives the detail number, position and spacing brief..

- **Dunnala Lakshmi Anuja, et.al (2019)2: Planning, Analysis and Design of Residential Building(G+5) By using STAAD Pro:**
  Frame analysis was by STAAD-Pro. Slab, Beams, Footing and stair-case were design as per the IS Code 456-2000 by LSM. The properties such as share deflection torsion, development length is with the IS code provisions. Design of column and footing were done as per the IS 456-2000 along with the SP-16 design charts. The check like oneway shear or two-way shear within IS Code provision. Design of slab, beam, column, rectangular footing and staircase are done with limit state method. On comparison with drawing, manual design and the geometrical model using STADD Pro.

- **Mr K. Prabin Kumar, et.al (2018)3:**

  A Study on Design of Multi-Storey Residential Building: They used STADD Pro. to analysis and designing all structure member and calculate quantity of reinforcement needed for concrete section. Various structure action is considered as members such as axial, flexure, shear and tension. Pillar are delineated for axial forces and biaxial ends at the ends. The building was planned as per IS: 456- 2000.

- **Deevi Krishna Chaitanya, et.al (January, 2017)4: Analysis and Design of a (G+6) Multi-Storey Building Using STAAD Pro:**

  They used static indeterminacy methods to calculate numbers of unknown forces. Distributing known fixed and moments to satisfy the condition of compatibility by Iteration method. Kanis method was used to distribute moments at sucessire joints in frame and continues beam for stability of members of building structure. They used the designing software STADD Pro. which reduced lot of time in design, gives accuracy.

- **R. D. Deshpande, et.al (June, 2017)5: Analysis, Design and Estimation of Basement+G+2 Residential Building:**

  They found that check for deflection was safe. They carried design and analysis of G+2 residential building by using E-Tabs software with the estimation of building by method of center line. They safely designed column using SP-16 checked with interaction formula.

# Chapter 3

# METHODOLOGY

## 3.1 ABOUT STAADPRO

Our project involves analysis and design of multi-storeyed [G+5] using a very popular designing software STAAD Pro. We have chosen STAAD Pro because of its following.

**Advantages**

- easy to use interface,
- conformation with the Indian Standard Codes,
- versatile nature of solving any type of problem,
- Accuracy of the solution.

STAAD.Pro features a state-of-the-art user interface, visualization tools, and powerful analysis and design engines with advanced finite element and dynamic analysis capabilities. From model generation, analysis and design to visualization and result verification, STAAD.Pro is the professionals choice for steel, concrete, timber, aluminum and cold-formed steel design of low and high-rise buildings, culverts, petrochemical plants, tunnels, bridges, piles and much more.

The STAAD.Pro Graphical User Interface: It is used to generate the model, which can then be analyzed using the STAAD engine. After analysis and design is completed, the GUI can also be used to view the results graphically.

The STAAD analysis and design engine: It is a general-purpose calculation engine for structural analysis and integrated Steel, Concrete, Timber and Aluminum design.

To start with we have solved some sample problems using STAAD Pro and checked the accuracy of the results with manual calculations. The results were to satisfaction and were accurate. In the initial phase of our project we have done calculations regarding loadings on buildings and also considered seismic and wind loads.

Structural analysis comprises the set of physical laws and mathematics required to study and predicts the behavior of structures. Structural analysis can be viewed more abstractly as a method to drive the engineering design process or prove the soundness of a design without a dependence on directly testing it.

To perform an accurate analysis a structural engineer must determine such information as structural loads, geometry, support conditions, and materials properties. The results of such an analysis typically include support reactions, stresses and displacements. This information is then compared to criteria that indicate the conditions of failure. Advanced structural analysis may examine dynamic response, stability and non-linear behavior.

## 3.2 LOADS CONSIDERED

### 3.2.1 DEAD LOAD

All permanent constructions of the structure form the dead loads. The dead load comprises of the weights of walls, partitions floor finishes, false ceilings, false floors and the other permanent constructions in the buildings. The dead load loads may be calculated from the dimensions of various members and their unit weights. the unit weights of plain concrete and reinforced concrete made with sand and gravel or crushed natural stone aggregate may be taken as 24 kN/m$^{2} and 25 kN/m^{2} respectively.$

### 3.2.2 IMPOSED LOAD

Imposed load is produced by the intended use or occupancy of a building including the weight of movable partitions, distributed and concentrated loads, load due to impact and vibration and dust loads. Imposed loads do not include loads due to wind, seismic activity, snow, and loads imposed due to temperature changes to which the structure will be subjected to, creep and shrinkage of the structure, the differential settlements to which the structure may undergo.

### 3.2.3 WIND LOAD

Wind is air in motion relative to the surface of the earth. The primary cause of wind is traced to earths rotation and differences in terrestrial radiation. The radiation effects are primarily responsible for convection either upwards or downwards. The wind generally blows horizontal to the ground at high wind speeds. Since vertical components of atmospheric motion are relatively small, the term wind denotes almost exclusively the horizontal wind, vertical winds are always identified as such. The wind speeds are assessed with the aid of anemometers or anemographs which are installed at meteorological observatories at heights generally varying from 10 to 30 meters above ground.

### 3.2.4 SEISMIC LOAD

Seismic Load can be calculated taking the view of acceleration response of the ground to the super structure. According to the severity of earthquake intensity they are divided into 4 zones.

1. Zone I and II are combined as zone II.
2. Zone III.
3. Zone IV.
4. Zone V.

# 3.3 WORKING WITH STAADPRO

## 3.3.1 Types of structures

A structure can be defined as an assemblage of elements. STAAD is capable of analyzing and designing structures consisting of frame, plate/shell and solid elements. Almost any type of structure can be analyzed by STAAD. A SPACE structure, which is a three dimensional framed structure with loads applied in any plane, is the most general.

A PLANE structure is bound by a global X-Y coordinate system with loads in the same plane.

A TRUSS structure consists of truss members who can have only axial member forces and no bending in the members.

A FLOOR structure is a two or three dimensional structure having no horizontal (global X or Z) movement of the structure [FX, FZ MY are restrained at every joint]. The floor framing (in global X-Z plane) of a building is an ideal example of a FLOOR structure. Columns can also be modeled with the floor in a FLOOR structure as long as the structure has no horizontal loading. If there is any horizontal load, it must be analyzed as a SPACE structure.

## 3.3.2 Generation of the structure

The structure may be generated from the input file or mentioning the co-ordinates in the GUI.

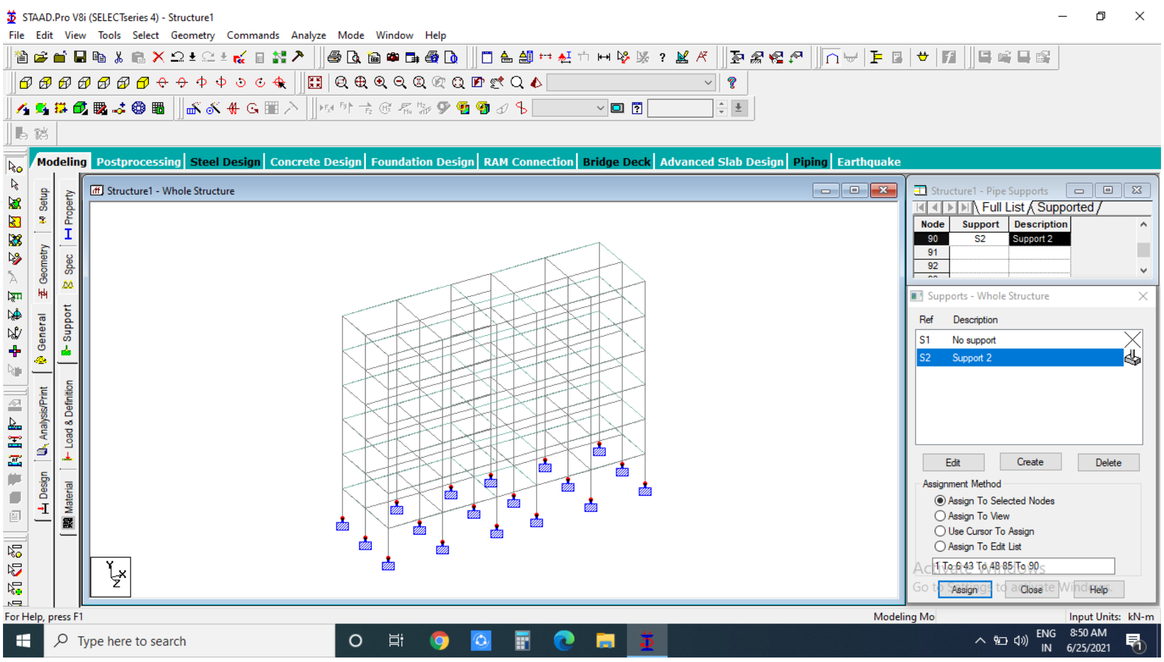



Figure 3.1: Generation of the structure

### 3.3.3 Material constants

The material constants are: modulus of elasticity (E); weight density (DEN); Poisson's ratio (POISS); co-efficient of thermal expansion (ALPHA), Composite Damping Ratio, and beta angle (BETA) or coordinates for any reference (REF) point. E value for members must be provided or the analysis will not be performed. Weight density (DEN) is used only when self-weight of the structure is to be taken into account. Poisson's ratio (POISS) is used to calculate the shear modulus (commonly known as G) by the formula, G = 0.5 x E/ (1 + POISS) If Poisson's ratio is not provided, STAAD will assume a value for this quantity based on the value of E. Coefficient of thermal expansion (ALPHA) is used to calculate the expansion of the members if temperature loads are applied. The temperature unit for temperature load and ALPHA has to be the same.

### 3.3.4 Supports

Supports are specified as PINNED, FIXED, or FIXED with different releases (known as FIXED BUT). A pinned support has restraints against all translational movement and none against rotational movement. In other words, a pinned support will have reactions for all forces but will resist no moments. A fixed support has restraints against all directions of movement.Translational and rotational springs can also be specified. The springs are represented in terms of their spring constants. A translational spring constant is defined as the force to displace a support joint one length unit in the specified global direction. Similarly, a rotational spring constant is defined as the force to rotate the support joint one degree around the specified global direction.

### 3.3.5 Loads

Loads in a structure can be specified as joint load, member load, temperature load and fixed-end member load. STAAD can also generate the self-weight of the structure and use it as uniformly distributed member loads in analysis. Any fraction of this self-weight can also be applied in any desired direction.

### Joint loads

Joint loads, both forces and moments, may be applied to any free joint of a structure. These loads act in the global coordinate system of the structure. Positive forces act in the positive coordinate directions. Any number of loads may be applied on a single joint, in which case the loads will be additive on that joint.

### Member loads

Three types of member loads may be applied directly to a member of a structure. These loads are uniformly distributed loads, concentrated loads, and linearly varying loads (including trapezoidal). Uniform loads act on the full or partial length of a member. Concentrated loads act at any intermediate, specified point. Linearly varying loads act over the full length of a member. Trapezoidal linearly varying loads act over the full or partial length of a member. Trapezoidal loads are converted into a uniform load and several concentrated loads. Any number of loads may be specified to act upon a member in any independent loading condition. Member loads can be specified in the member coordinate system or the global coordinate system. Uniformly distributed member loads provided in the global coordinate system may be specified to act along the full or projected member length.

### Area/floor load

Many times a floor (bound by X-Z plane) is subjected to a uniformly distributed load. It could require a lot of work to calculate the member load for individual members in that floor. However, with the AREA or FLOOR LOAD command, the user can specify the area loads (unit load per unit square area) for members. The program will calculate the tributary area for these members and provide the proper member loads. The Area Load is used for one way distributions and the Floor Load is used for two way distributions.

### Fixed end member load

Load effects on a member may also be specified in terms of its fixed end loads. These loads are given in terms of the member coordinate system and the directions are opposite to the actual load on the member. Each end of a member can have six forces: axial; shear y; shear z; torsion;

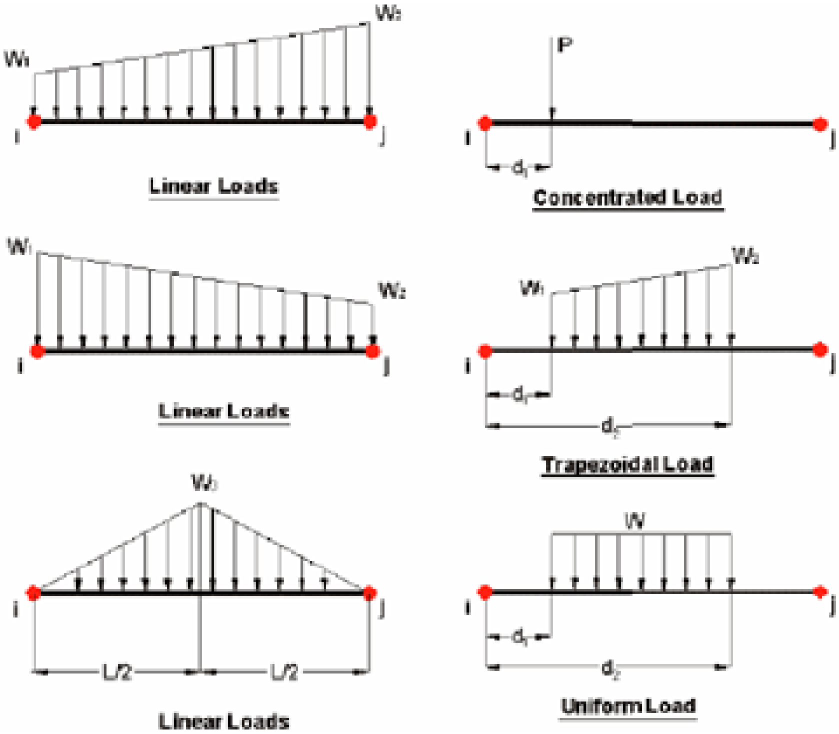



Figure 3.2: Member load configuration

moment y, and moment z.

### Load Generator Moving load, Wind Seismic

Load generation is the process of taking a load causing unit such as wind pressure, ground movement or a truck on a bridge, and converting it to a form such as member load or a joint load which can be then be used in the analysis.

### Moving Load Generator

This feature enables the user to generate moving loads on members of a structure. Moving load system(s) consisting of concentrated loads at fixed specified distances in both directions on a plane can be defined by the user. A user specified number of primary load cases will be subsequently generated by the program and taken into consideration in analysis.

### Seismic Load Generator

The STAAD seismic load generator follows the procedure of equivalent lateral load analysis. It is assumed that the lateral loads will be exerted in X and Z directions and Y will be the direction of the gravity loads. Thus, for a building model, Y axis will be perpendicular to the floors and point upward (all Y joint coordinates positive). For load generation per the codes, the user is required to provide seismic zone coefficients, importance factors, and soil characteristic parameters. Instead of using the approximate code based formulas to estimate the building period in a certain direction, the program calculates the period using Raleigh quotient technique. This period is then utilized to calculate seismic coefficient C. After the base shear is calculated from the appropriate equation, it is distributed among the various levels and roof per the specifications. The distributed base shears are subsequently applied as lateral loads on the structure. These loads may then be utilized as normal load cases for analysis and design.

**Wind Load Generator**

The STAAD Wind Load generator is capable of calculating wind loads on joints of a structure from user specified wind intensities and exposure factors. Different wind intensities may be specified for different height zones of the structure. Openings in the structure may be modeled using exposure factors. An exposure factor is associated with each joint of the structure and is defined as the fraction of the influence area on which the wind load acts. Built-in algorithms automatically calculate the exposed area based on the areas bounded by members (plates and solids are not considered), then calculates the wind loads from the intensity and exposure input and distributes the loads as lateral joint loads.

# 3.4 ANALYSIS OF G+5 RCC FRAMED BUILDING USING STAAD.PRO

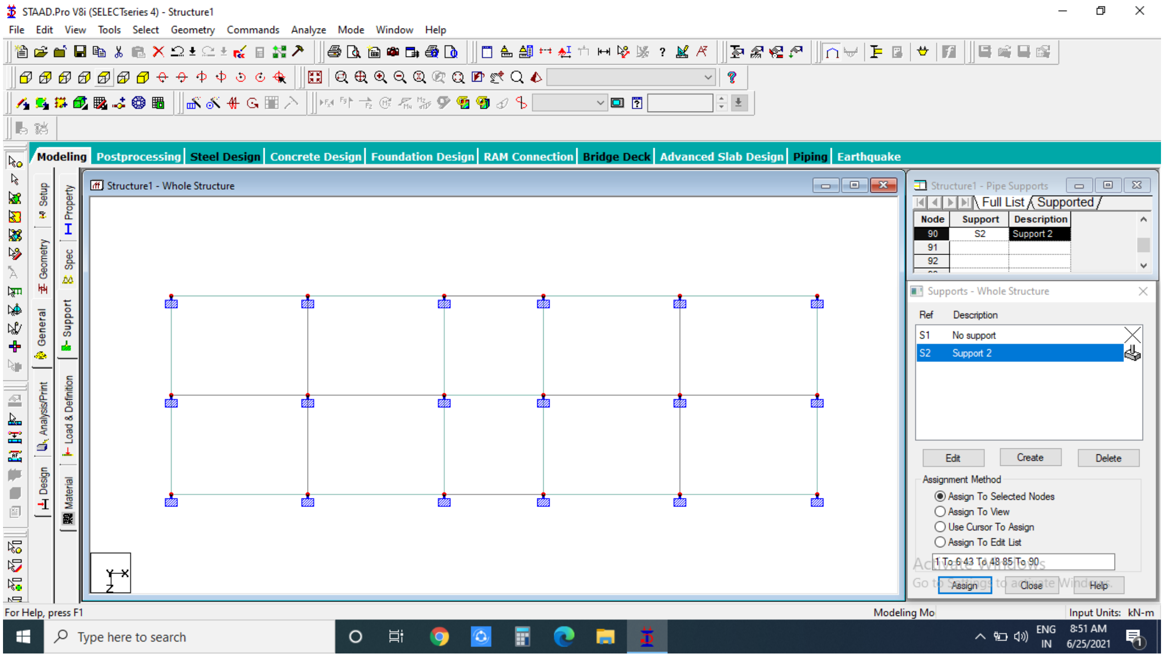



Figure 3.3: Plan of the G+5 story building

All columns = 0.40 * 0.60 m

All beams = 0.3 * 0.5 m

All slabs = 0.125 m thick

## 3.4.1 Physical parameters of building

Length = 4 bays @ 5.5m + 1 bay @ 4m =26m

Width = 2 bays @ 4 m =8.0m

Height = 3m + 5 storeys @ 3.5m = 20.5m

Live load on the floors is 2kN/m2

Live load on the roof is 1.5kN/m2

### Grade of concrete and steel used

Used M25 concrete and Fe 415 steel

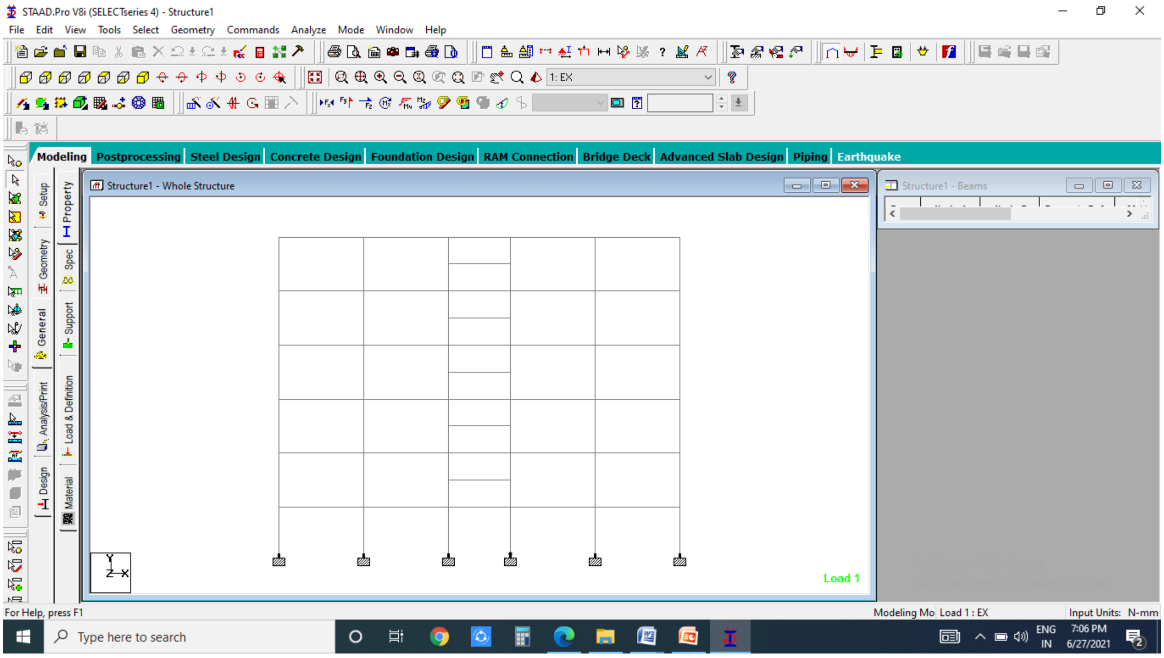



Figure 3.4: Elevation of the G+5 story building

### 3.4.2 Generation of member property

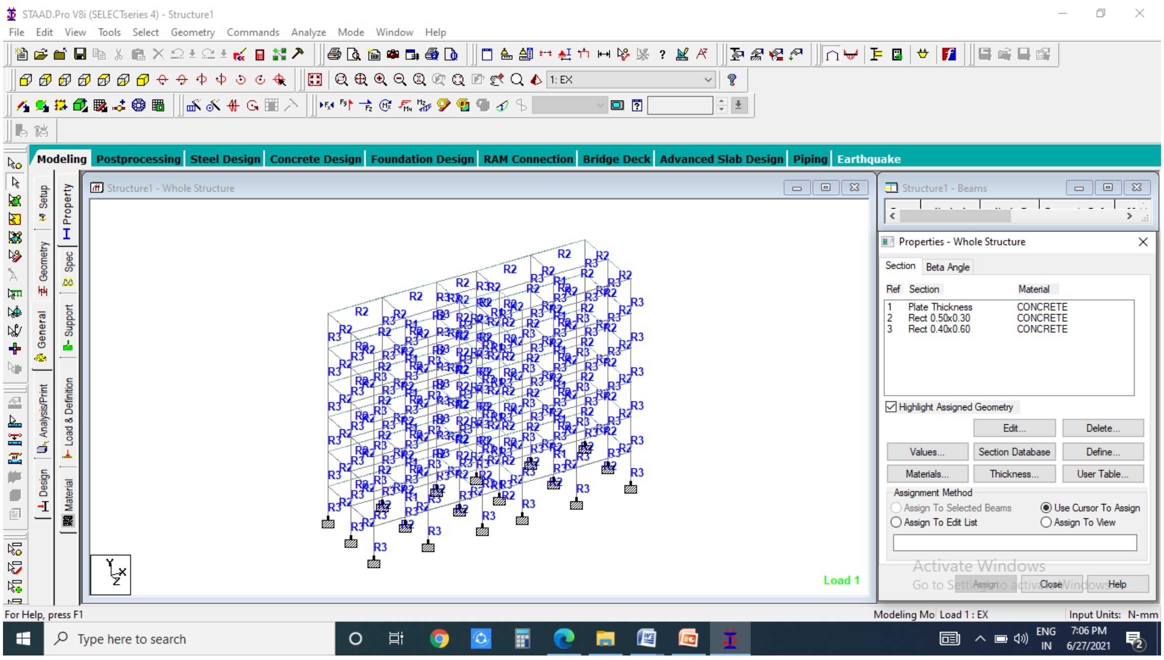



Figure 3.5: Generation of member property

Generation of member property can be done in STAAD.Pro by using the window as shown above. The member section is selected and the dimensions have been specified. The beams are having a dimension of 0.3*0.5 m and the columns are having a dimension of 0.4*0.6 m.

### 3.4.3 Supports

The base supports of the structure were assigned as fixed. The supports were generated using the STAAD.Pro support generator.

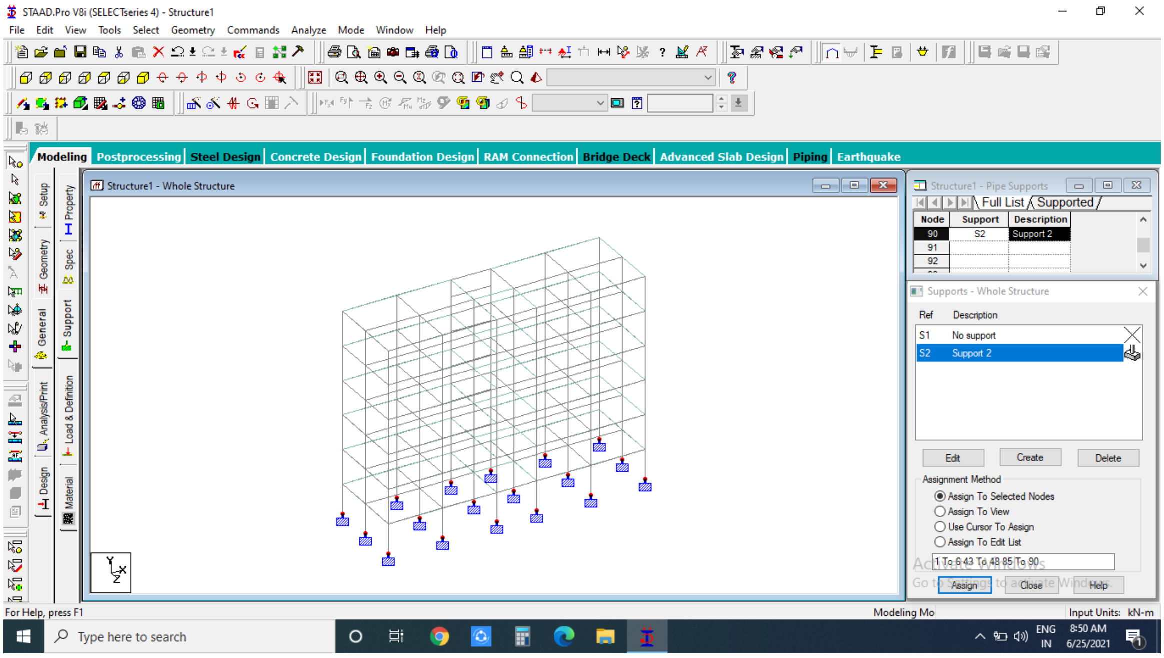



Figure 3.6: Fixing supports of the structures

### 3.4.4 Materials of the structure

The materials for the structure were specified as concrete with their various constants as per standard IS code of practice.

### 3.4.5 Loading

The loadings were calculated partially manually and rest was generated using STAAD.Pro load generator. The loading cases were categorized as

- Self-weight
- Dead load from slab
- Live load

- Wind load
- Seismic load
- Load combinations

**Self weight:**

The self-weight of the structure can be generated by STAAD.Pro itself with the self-weight Command in the load case column.

**Dead load:**

Dead load from slab can also be generated by STAAD.Pro by specifying the floor thickness and the load on the floor per sqm. Calculation of the load per sq m was done considering theweight of beam, weight of column, weight of RCC slab, weight of terracing, external walls.

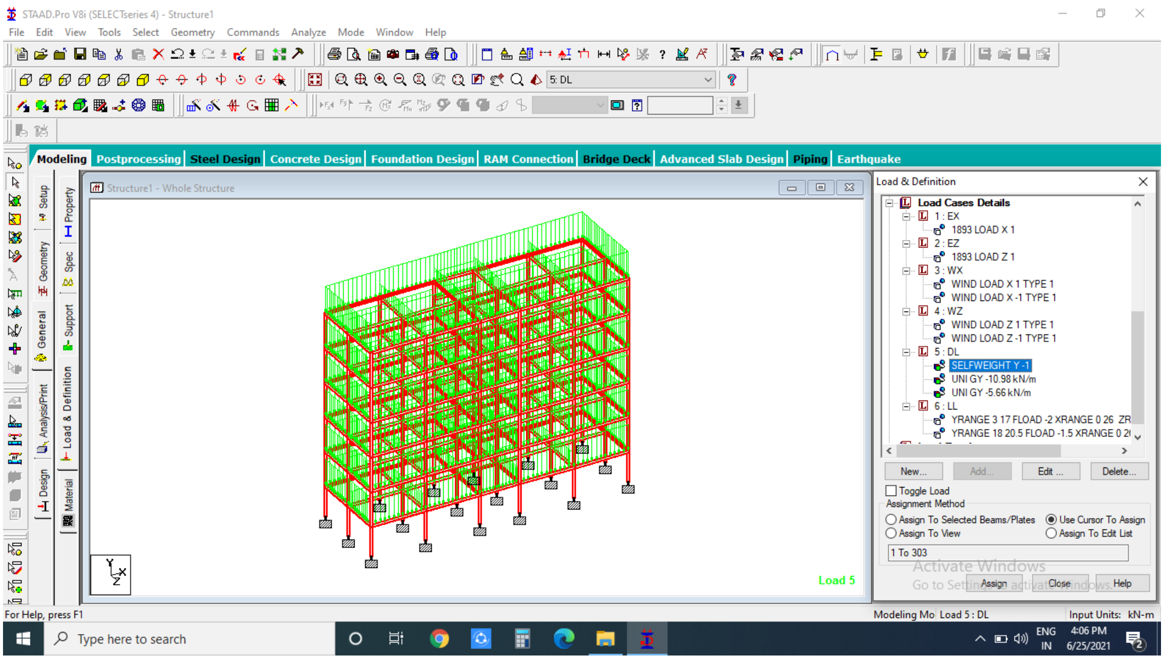



Figure 3.7: Dead load

**Live load:**

The live load considered in each floor was 2.0 KN/sq m and for the terrace level it was considered to be 1.5 KN/sq m. The live loads were generated in a similar manner as done in the earlier case for dead load in each floor. This may be done from the member load button from the load case column.

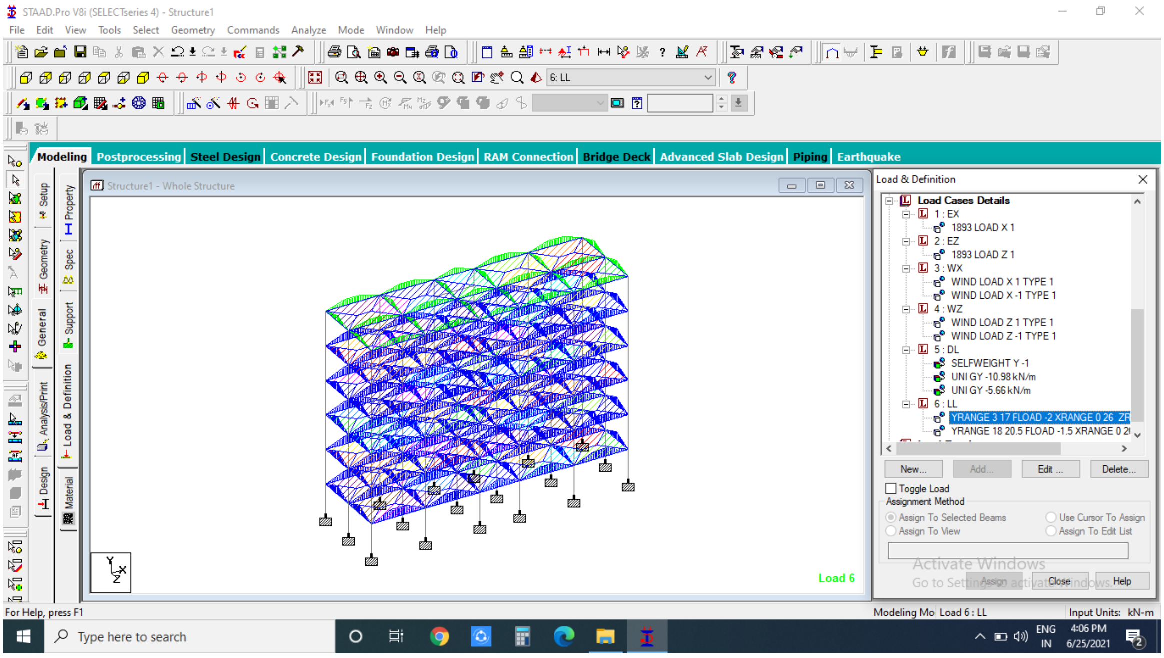


Figure 3.8: Live load

## Wind load:

The wind load values were generated by the software itself in accordance with IS 875.Under the define load command section, in the wind load category; the definition of wind load was supplied. The wind intensities at various heights were calculated manually and feed to the software. Based on those values it generates the wind load at different floors.

Table 3.1: Design wind pressure at various heights

| Height [h] | Design Wind speed[V] | Design wind pressure[P] |
|---|---|---|
| Up to 10 m | 36.379 m/s | 0.793 KN/sq m |
| 15 m | 38.85 m/s | 0.905 KN/sq m |
| 20 m | 40.51 m/s | 0.984 KN/sq m |
| 30 m | 42.58 m/s | 1.087 KN/sq m |

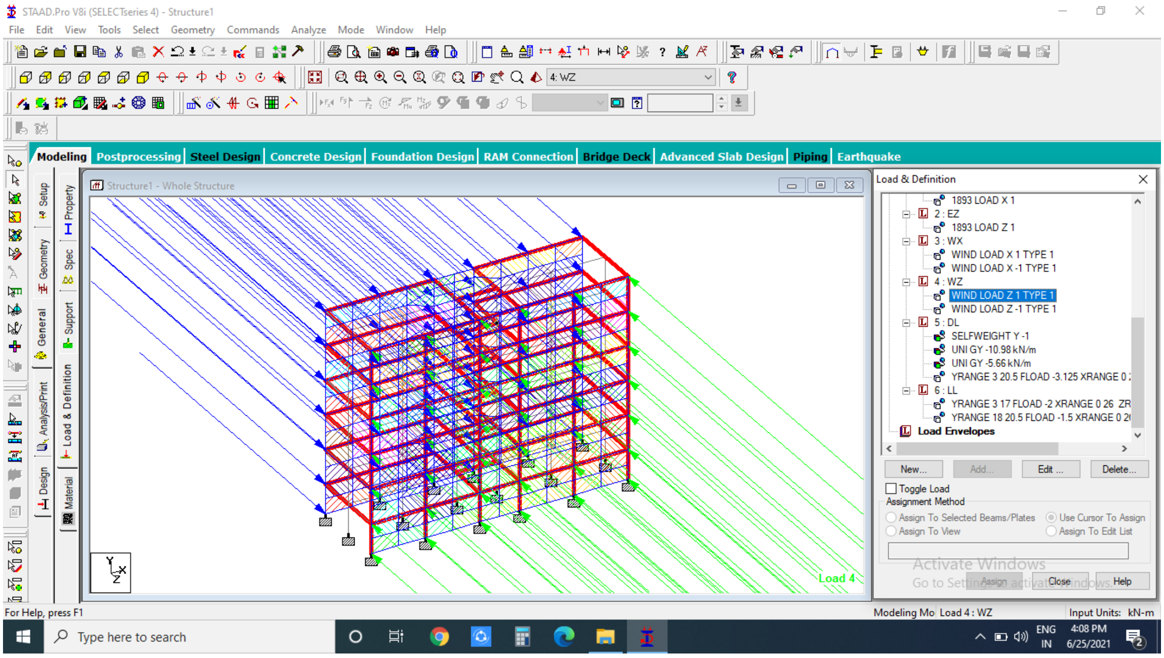



Figure 3.9: Wind load effect on structure

### Seiesmic load

The seismic load values were calculated as per IS 1893-2002. STAAD.Pro has a seismic load generator in accordance with the IS code mentioned.

### General format

DEFINE 1893 LOAD

ZONE f1 1893-spec

SELFWEIGHT

JOINT WEIGHT

Joint-list WEIGHT w 1893-Spec= RF f2, I f3, SS f4, (ST f5), DM f6, (PX f7), (PZ f8), (DT f9)

Where,

- Zone f1 = Seismic zone coefficient.
- RF f2 = Response reduction factor.
- I f3 = Importance factor depending upon the functional use. of the structures, characterized by hazardous consequences of its failure, post-earthquake functional needs, historical value, or economic importance.

- SS f4 = Rock or soil sites factor (=1 for hard soil, 2 for medium soil, 3 for soft soil). Depending on type of soil, average response acceleration coefficient Sa/g is calculated Corresponding to 5

- ST f5 = Optional value for type of structure (=1 for RC frame building, 2 for steel frame building, 3 for all other buildings).

- DM f6 = Damping ratio to obtain multiplying factor for calculating Sa/g for different damping. If no damping is specified 5% damping (default value 0.05) will be considered corresponding to which multiplying factor is 1.0.

- PX f7 = Optional period of structure (in sec) in X direction. If this is defined this value will be used to calculate Sa/g for generation of seismic load along X direction.

- PZ f8 = Optional period of structure (in sec) in direction. If this is defined this value will be used to calculate Sa/g for generation of seismic load along Z direction.

- DT f9 = Depth of foundation below ground level. It should be defined in current unit. If the depth of foundation is 30 m or below, the value of Ah is taken as half the value obtained. If the foundation is placed between then ground level and 30 m depth, this value is linearly interpolated between Ah and 0.5Ah.

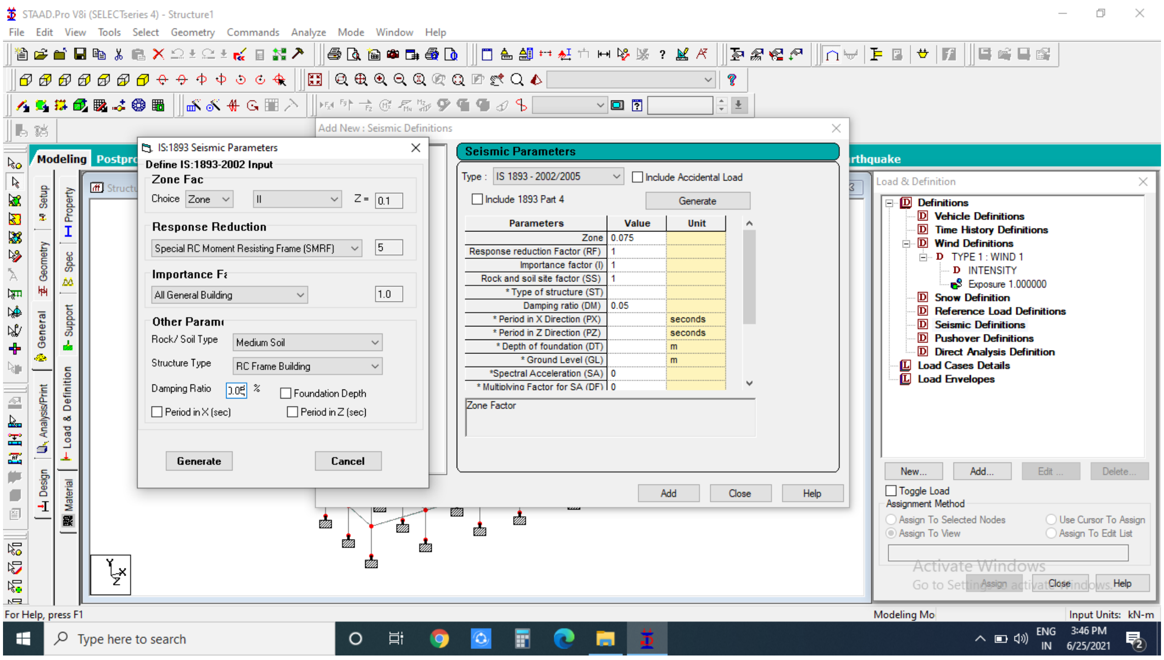


Figure 3.10: Seismic load defination

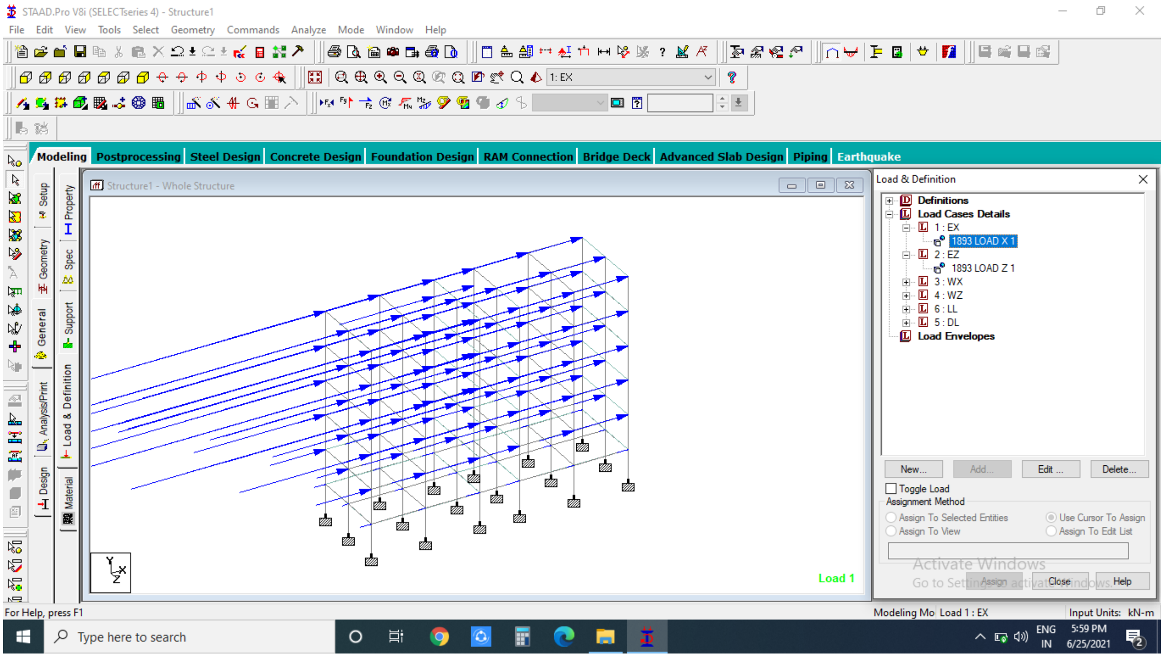



Figure 3.11: Structure under seismic load

### Load combination

The structure has been analyzed for load combinations considering all the previous loads in proper ratio. In the first case a combination of self-weight, dead load, live load and wind load was taken in to consideration. In the second combination case instead of wind load seismic load was taken into consideration.

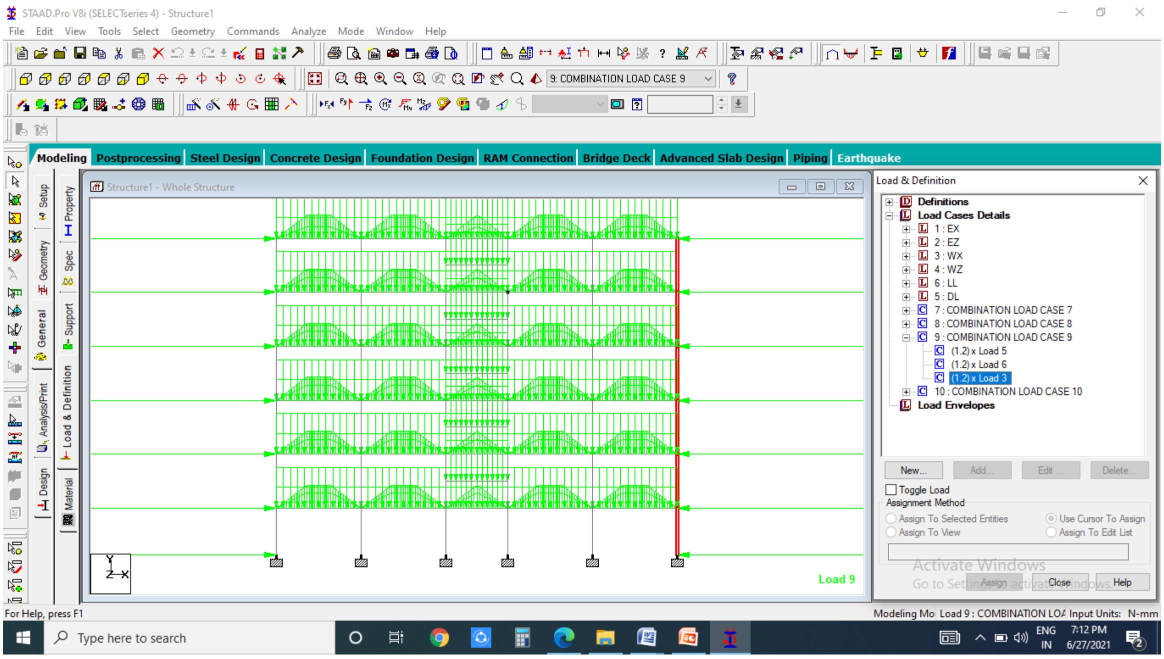



Figure 3.12: Combination under wind load

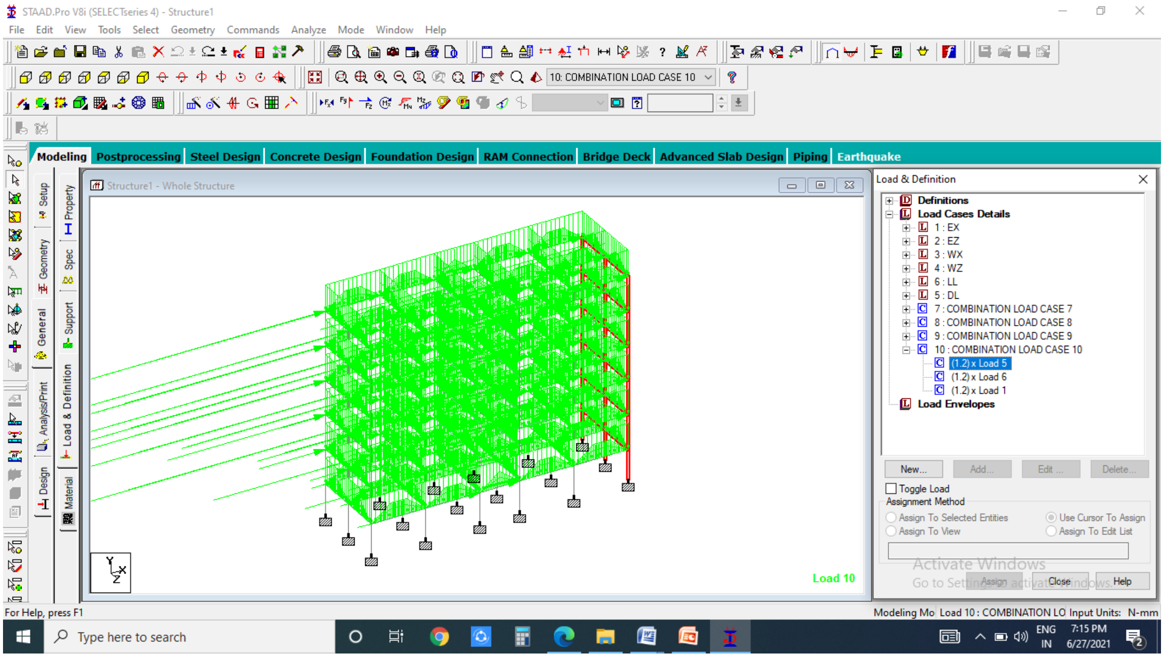



Figure 3.13: Combination under seismic load

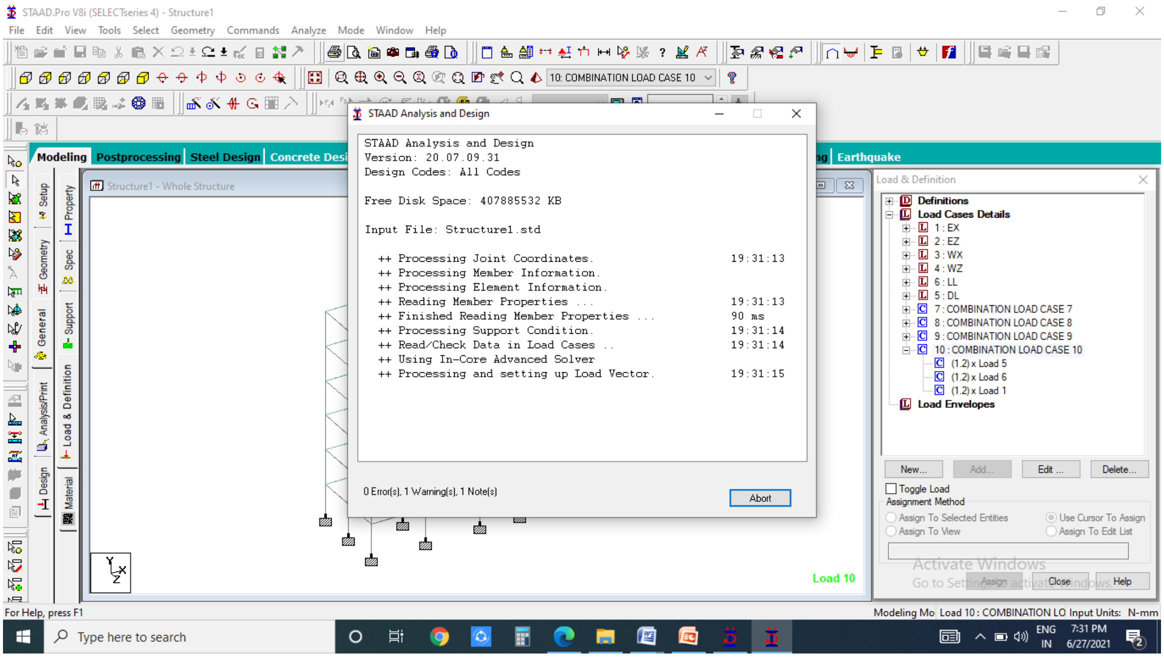



Figure 3.14: showing the analyzing window

## 3.5 Design of G+5 RCC Bulding

### 3.5.1 Beam Design

The beam is designed in Staadpro software by using IS code 475

There are two types of reinforced concrete beams

1. Single reinforced beams 2. Double reinforced beams.

1. Single reinforced beams: In singly reinforced simply supported beams steel bars are placed near the bottom of the beam where they are effective in resisting in the tensile bending stress.

2. Double reinforced beams: It is reinforced under compression tension regions. The necessities of steel of compression region arise due to two reasons. When depth of beam is restricted. The strength availability singly reinforced beam is in adequate.

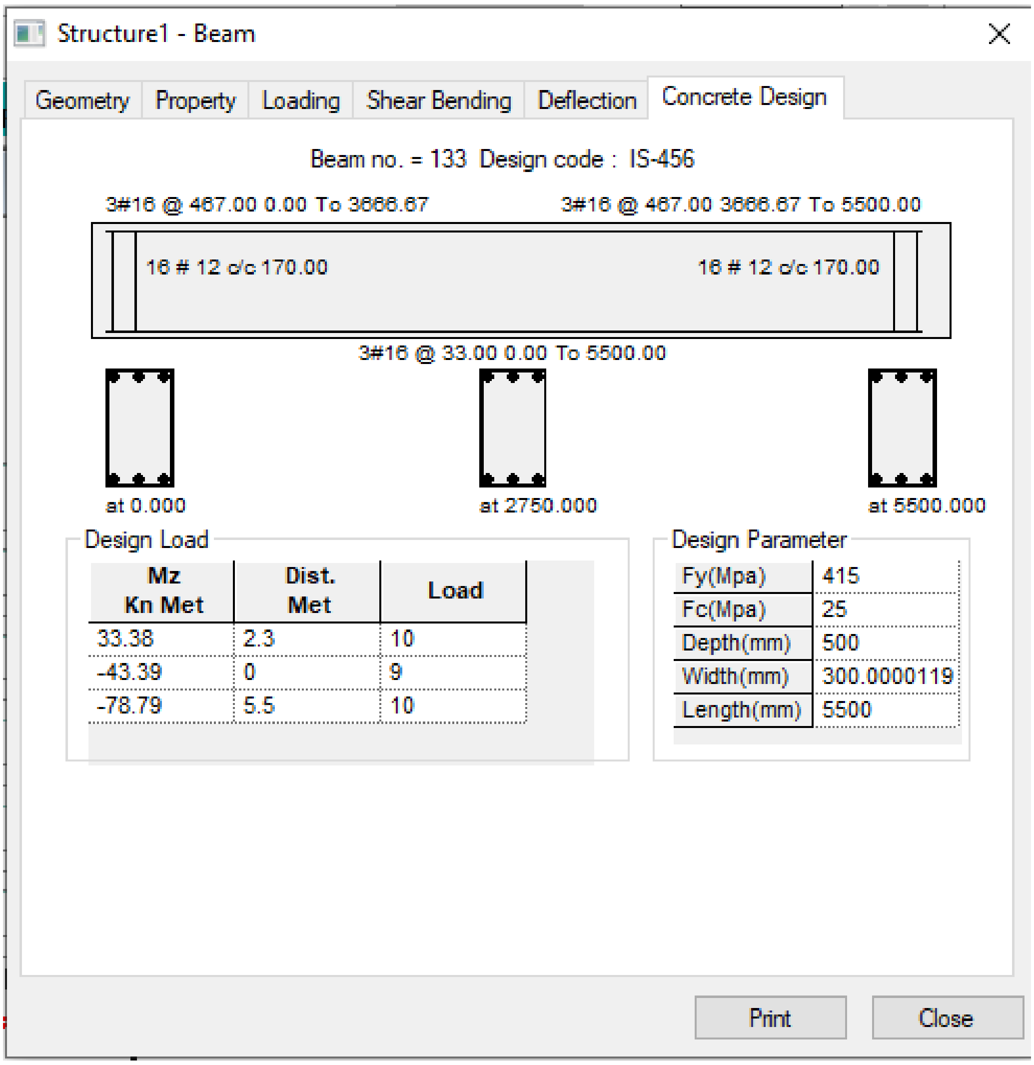



Figure 3.15: Beam Design

### 3.5.2 Column Design

A column may be defined as an element used primarily to support axial compressive loads and with a height of a least three times its lateral dimension. The strength of column depends upon the strength of materials, shape and size of cross section, length and degree of proportional and dedicational restrains at its ends.

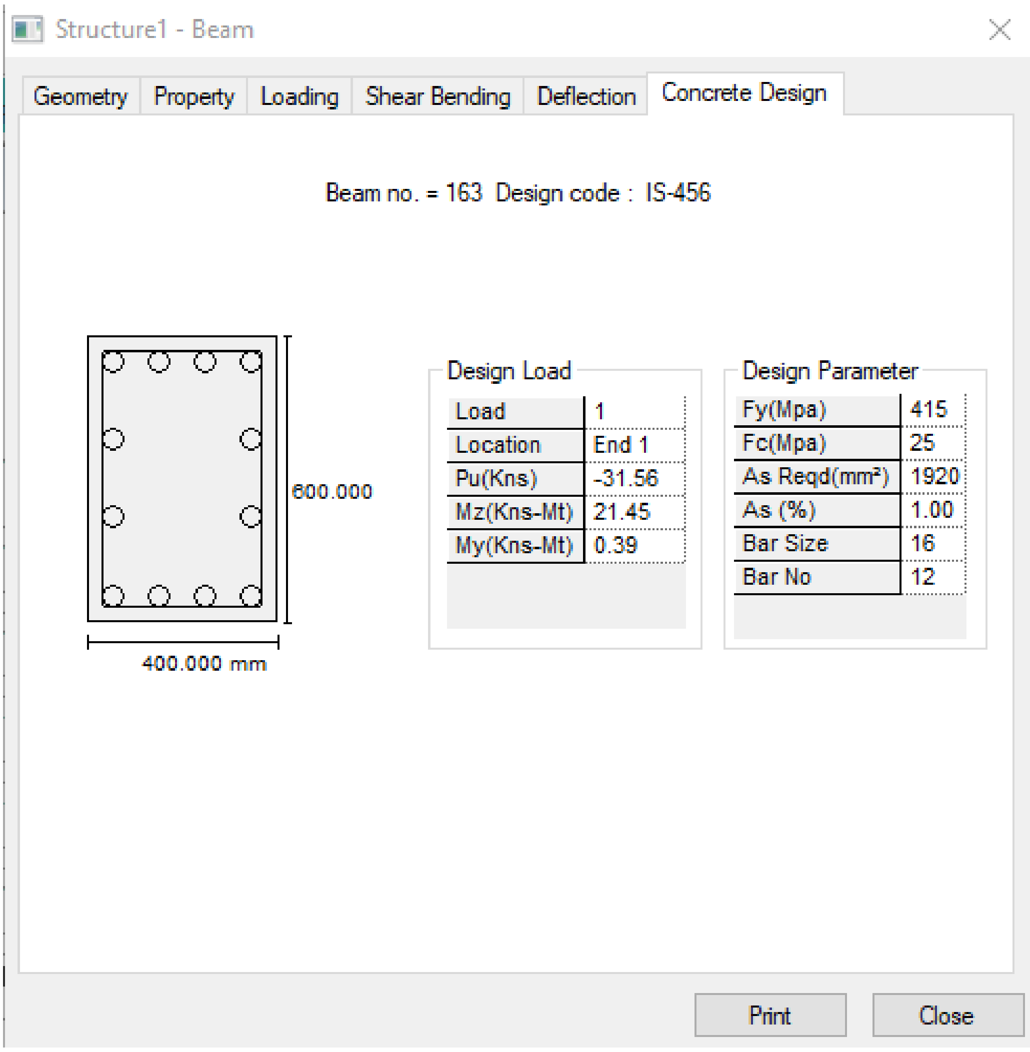
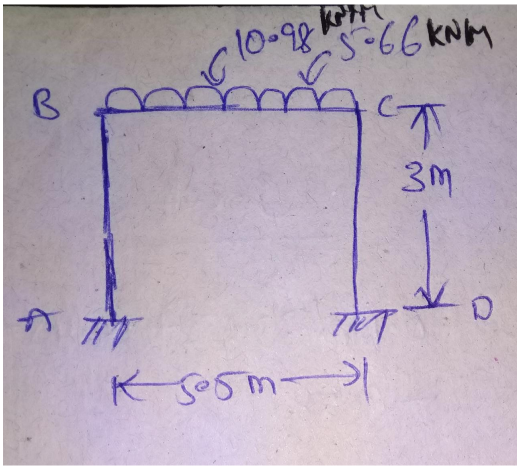



Figure 3.16: Column Design

## 3.6 Manual Analysis (Kanis Method)




**Step 1: Fixed End Moments**

MFAB, MFBA, MFCD, MFDC = 0

MFBC = -wl2/12 = -10.985.52/12-5.665.52/12 = -41.946 KNm

**Step 2: Rotation Factor**

| Joint | Member | Relative stiffness(k) | summK | RF = -0.5(k/summK) |
|---|---|---|---|---|
| B | BA | (4EI/l)=1.33EI | 2.057EI | -0.323 |
| - | BC | (4EI/l)= 0.727EI | - | -0.176 |
| C | CB | (4EI/l)= 0.727EI | 2.057EI | -0.176 |
| - | CD | (4EI/l)= 1.33EI | - | -0.323 |

**Step 3: Kanis scheme and Rotation Contribution**

Rotation Contribution = RF [FEM + Near end contribution + Far end contribution]

RC for BA1=- 0.323[-41.946 + 0 + 0] = 13.54

RC for BC1= -0.176[-41.946 + 0 + 0] = 7.38

RC for CB1= -0.176 [41.946 + 7.38 + 0] = -8.68

RC for CD1= -0.323[41.946 + 7.38 + 0] = -15.93

RC for BA2=- 0.323[-41.946 8.68 + 0] = 16.35

RC for BC2= -0.176[-41.946 8.68 + 0] = 8.91

RC for CB2= -0.176 [41.946 + 8.91 + 0] = -8.95

RC for CD2= -0.323[41.946 + 8.91 + 0] = -16.42

RC for BA3=- 0.323[-41.946  8.95 + 0] = 16.43

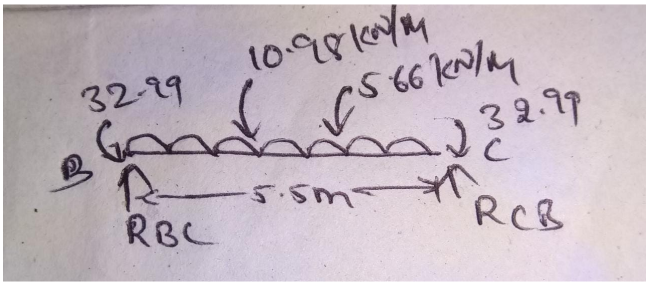
RC for BC3= -0.176[-41.946  8.95 + 0] = 8.95

RC for CB3= -0.176 [41.946 + 8.95 + 0] = -8.95

RC for CD3= -0.323[41.946 + 8.95 + 0] = -16.43

**Step 4: Final Moments**

| Joint | A | B | B | C | C | D |
|---|---|---|---|---|---|---|
| Members | AB | BA | BC | CB | CD | DC |
| FEM | 0 | 0 | -41.946 | -41.946 | 0 | 0 |
| 2NEM | 0 | 32.86 | 17.9 | -17.9 | -32.86 | 0 |
| 2FEM | 16.43 | 0 | -8.95 | 8.95 | 0 | -16.43 |
| Final Moments | 16.43 | 32.86 | -32.99 | 32.99 | -32.86 | -16.43 |




SummMbc = 0

-Rcb*5.5+32.99+5.66*5.5*2.75+10.98*5.5*2.75 = 0

Rcb = 51.75 KN/m

SummV = 0

Rbc+Rcb = 10.98*5.5+5.66*5.5

Rbc = 91.52-51.75 = 39.77KN/m

BM at center, 91.52*2.75-32.99-10.98*2.75*1.375-5.66*2.75*1.375 = 155.77KNm

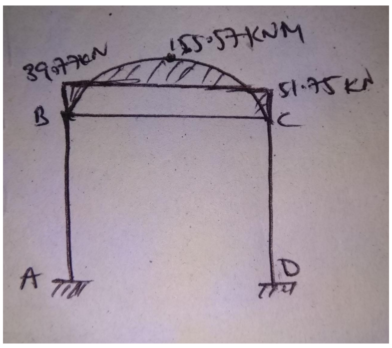
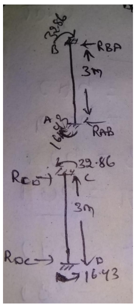



Figure 3.17: BMD



-Rba*3+32.86 = 0

Rba = 10.95KN/m, Rab = -10.95KN/m

Rcd*3-32.86 = 0

Rcd = 10.95KN/m, Rdc = -10.95KN/m

For Bc, at 0m, Rbc = 39.77KN/m

At 5.5m, Rbc - 10.95*5.5-5.66*5.5 = -26.28KN/m

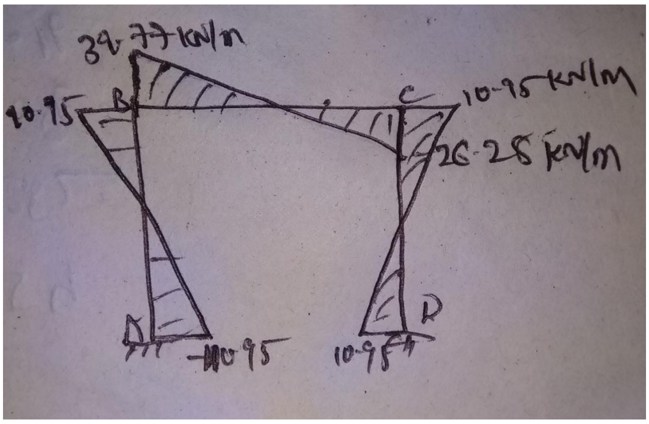



Figure 3.18: SFD

## 3.7 Beam Design(IS 456:2000)

Width of support = 400mm

Clear span = 5.5m

Load = 21.16 KN/$m^2$

$b = 300mm, D = 500mm$

$fck = 25N/mm^2, fy = 415N/mm^2$

**Step1: Effective Length**

d = D d = 500-25 = 475mm

1. clear span + Effective depth = 5.5+0.475 = 5.975m

2. clear span + c/c distance between supports = 5.5+0.2+0.2 = 5.9m

**Step2: Ultimate Moment**

Self Weight of Beam (Wb )= b*D*25 = 0.3*0.5*25 = 3.75 KN/m

Total load (W) = Wb+ w = 3.75+21.16 = 24.98 KN/m

Now, Ultimate Load (wu )= 1.5*24.98 = 37.337 KN/m

Now, Ultimate Moment (Mu) = Wul2/8 = 37.337*5.92/8 = 162.63 KNm

Now, From page 96 IS 456

Mulim = 0138*fckbd2 = 0138*25*300*4752 = 233.52 KNm

Mu less than Mulim, Hence it is Under reinforced beam

**Step3: Calculation of area of steel**

Mu = 0.87fyAstd[1- (fyAst/fckbd)

162.63*$10^6$ $= 0.87 * 415 * Ast * 475 * [1 - (415 * Ast/25 * 300 * 475)$

Ast = 1085.56 mm2

Using 20 mm dia bars, ast = (pi/4)*202 = 314.45 $mm^2$

No of bars = (Ast/ast) = (1085.56/314.45) = 3.45 = 3

Provide 3 no 20mm dia bars

Actual Ast = 3*(pi/4)*202 = 942.47$mm^2$

Min Ast = 0.85bd/fy = (0.85*300*475)/415 = 291.86$mm^2$

Max Ast = 0.04bd = 0.04*300*475 = 6000$mm^2$

**Step4: Shear Reinforcement**

Factored Shear force = Wul/2 = 37.377*5.9/2 = 110.26 KN/m

From page 72, IS 456,

Nominal shear stress (Tv) = (Vu/bd) = (110.26*$10^3/300*475) = 0.77 N/mm$

Now, % of tension Reinforcement

P = (Ast/bd)*100 = (942.47/300*475)*100 = 0.66%

**Step5: Design Shear strength of concrete**

Page 73, table 19 IS 456

0.50, 0.49

0.75, 0.57

By interpolation, Tc = 0.49 + ((0.57-0.49)/(0.75-0.50))*(0.66-0.5)

Tc = 0.54 N/mm

Tv grater than Tc, Shear reinforcement required

**Step6: Shear Reinforcement**

Vuc = Tcbd = 0.54*300*475 = 76.95 KN

Now, Shear to be carried by stirupps

Vus = Vu  Vuc = 110.26  76.95 = 33.31 KN

Provide 8mm diameter 2 legged vertical stirrups

Asv =(pi/4)*$8^2 * 2 = 100.53mm^2$

Spacing Sv =(0.87*415*100.53*475/33.31*1000) = 517.5 mm

From page 48, IS 456,

1. Minimum Spacing = (ASv/bSv) ? (0.4/0.87fy)

   Sv = (ASv0.87fy/0.4b) = (100.53*0.87*415/0.4*300)

2. Spacing = 0.75d = 0.75*475 = 356.25mm

3. 300mm

   provide 8mm dia 2 legged vertical stirrups @300mm c/c spacing.

**Step7: Check for Deflection**

From page 38, IS 456

% of steel = 0.66%

Fs = 0.58fy*(Astreq/Astprov) = 0.58*415*(1058.6/942.47) = 277.24 $N/mm^2$

From fig 4, IS 456

Modification factor (k) =1.05

**Step 7: Development Length**

(l/d)max = 20k = 20*1.05 = 22

(l/d)prov = (5000/475) = 12.42

(l/d)max greater than (l/d)prov, Safe in Deflection.

## 3.8 Column Design (IS 456: 2000)

Axial load = 2392 KN

Size of column, L=300mm, b = 400mm

**Step 1 : % of Steel**

Pt greater then 08%, Pt less than 6%

Assuming % = 1.0

Asc = 0.01 Ag

Ac = Ag - Asc = Ag-0.01Ag = 0.99Ag

**Step 2: Depth Required**

Pu = 0.4fckAc + 0.67fyAsc

2392*$10^3 = 0.4 * 25 * 0.99Ag + 067 * 415 * 0.01Ag$

Ag = 188636.09 mm

D = (188636.09/400) = 471.59

Provide D =480mm

Provide Ag = 192000$mm^2$

**Step 3 : Check for eccentricity and Slenderness ratio**

Emin = (L/500) + (D/30) = (3000/500) + (6000/30) = 26mm

Emin greater than 20

Emax = 0.05D = 0.05*480 = 24mm

Emin less than Emax, ok

Effective length/least lateral dimension = 3000/400 = 7.5 less than 12

Hence, it is a short column

**Step 4: Area of steel**

2392*$10^3 = 0.4 * 25 * 0.99 * 192000 + 0.6 * 415 * Asc$

Asc = 1972.69 $mm^2$

Use 16mm dia bars, No of bars = (1972.69/(pi/4)*162 = 9.81 = 12 bars

**Step 5: Design of Lateral Ties**

Dia of lateral ties not less than (1/4)*dia of reinforcement = (1/4)*16 = 4mm

6mm

Then provide 6mm dia of lateral ties

Spacing not greater than b = 400mm

16*16 = 256mm

300mm

Provide 6mm dia, 256 mm spacing of lateral ties

## 3.9 Slab Design (IS 456)

**Step1.**

Lx = 4m Ly = 5.5m.

Ly/Lx = 1.37 less than 2.

Hence, it is two-way slab.

Live load = 2 KN/$M^2$

fck = 25 N/$mm^2$, $fy = 415 N/mm^2, b(width) = 1000mm$

**Step2. Estimations of slab thickness**

As lx grater than 3.5, Hence (l/d) is assumed as same for one way slab.

(l/d) = 25

Effective depth (d) = 4000/25 = 160mm

Overall depth (D) = 160+25 = 185mm

**Step 3: Effective length**

Leff = 4+016 = 4.16m

**Step 4: Self weight**

Self weight of the slab = D25 = 18525 = 4.625 KN/$m^2$

Live load = 2KN/$m^2$

Floor finish = 1KN/$m^2$

Total load = 7.625KN/$m^2$

Wu = 1.57.625 = 11.43KN/$m^2$

**Step 5: Calculation of ultimate moment**

From table 26, IS 456 alphax = 0.083, alphay = 0056

Mx = alphaxWuleffx$^2$ $= 0.083 * 11.43 * 4.162 = 16.41 KNm$

My = alphayWuleffx$^2$ $= 0.056 * 11.43 * 4.162 = 11.07 KNm$

Vu = (Wuleff)/$^2$ $= (11.4 * 4.16)/2 = 23.77 KN$

**Step 6: Check for depth**

Mulim = 0138fckbd$^2$

Mulim is maximum of Mx and My = 16.41KN/m$^2$

16.41*10$^6$ $= 0.138 * 25 * 103 * d^2$

d = 68.96mm less than dprov

**Step 7: Calculation of reinforcement**

Mu = 0.87*fy*Ast*d*(1-(fyAst)/(fckbd))

16.41*10$^6$ $= 0.87 * 415 * Ast * 160(1 - (415Ast)/(25 * 1000 * 160))$

Ast = 292.97 mm$^2$

Adopt 10mm dia, Spacing = (ast1000/Ast) = ((pi/4)*10$^2$ $* 1000/292.97) = 268mm$

Provide 10mm diameter @268mm c/c spacing as main reinforcement

**Step 8: Calculation of distribution Reinforcement**

Mu = 11.04 KNm, d = 150mm (160-10)

11.04*10$^6$ $= 0.87 * 415 * Ast * 150 * (1 - (415Ast)/(25 * 1000 * 150))$

Ast = 208.66mm$^2$

Assume 8mm dia , spacing = ((pi/4)*8$^2$ $* 100/208.66) = 240mm$

Provide 8mm diameter @240 mm c/c spacing as distribution reinforcement.

**Step 9: Check for Shear**

Tv = (Vu/bd) = (23.77*103/1000*160) = 0.14 N/mm$^2$

Tc, Pt = 100Ast/bd = (100*292.97)/1000*160 = 0.18 and M25 grade

Tc = 0.31N/mm$^2$

Tv less than Tc, Hence satisfied the criteria.

**Step 10: Check for Deflection**

(l/d)prov = (4160/160) = 26

(l/d)permitted = (l/d)basic*k*t = 20kt

Kt = fs = 0.58fy(Astreq/Astprov) = 0.58*415*(292.97/314.15) = 224.47 N/mm$^2$

Kt = 2.0

(l/d)permitted = 20*2.0 = 40

(l/d)permitted greater than (l/d)prov

**Step 11:Calculation of reinforcement in edge strip**

Astprov = (0.12/100)*1000*185 = 222 $mm^2$

Assume 6mm diameter, spacing = (ast1000)/Ast = (pi*62*1000/4)/222 = 230mm

Provide 6mm dia @230 mm c/c in edge strip.

**Step 12: Torsion steel at the corner**

Area of reinforcement to be provided = (3/4)*Ast = (3/4)*292.97 = 219.20$mm^2$

Distance upto which torsion reinforcement is to be provided

(lx/5) = (4000/5) = 800mm

Assume 6mm dia bars,

Spacing = ((ast*1000)/Ast) = ((pi/4)*$6^2 * 1000)/292.27) = 96.7 = 100mm$

Provide 6mm dia @100mm c/c in both the direction at a distance of 800mm @ 4 corners.

# Chapter 4

# ANALYSIS RESULTS

Some of the sample analysis results have been shown below for beam number 64 which is at the roof level of 1st floor

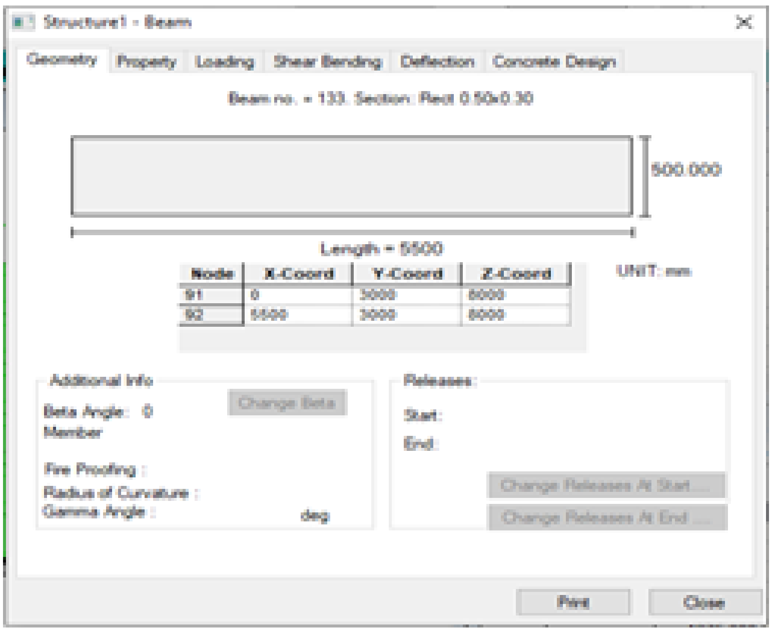



Figure 4.1: Geometry of beam no.133

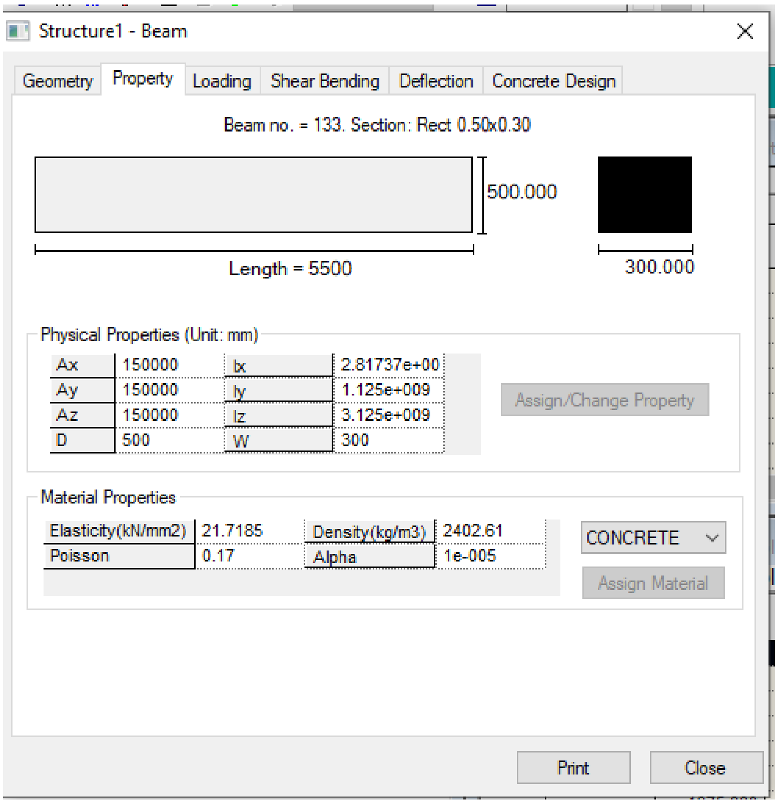



Figure 4.2: Property of beam no.133

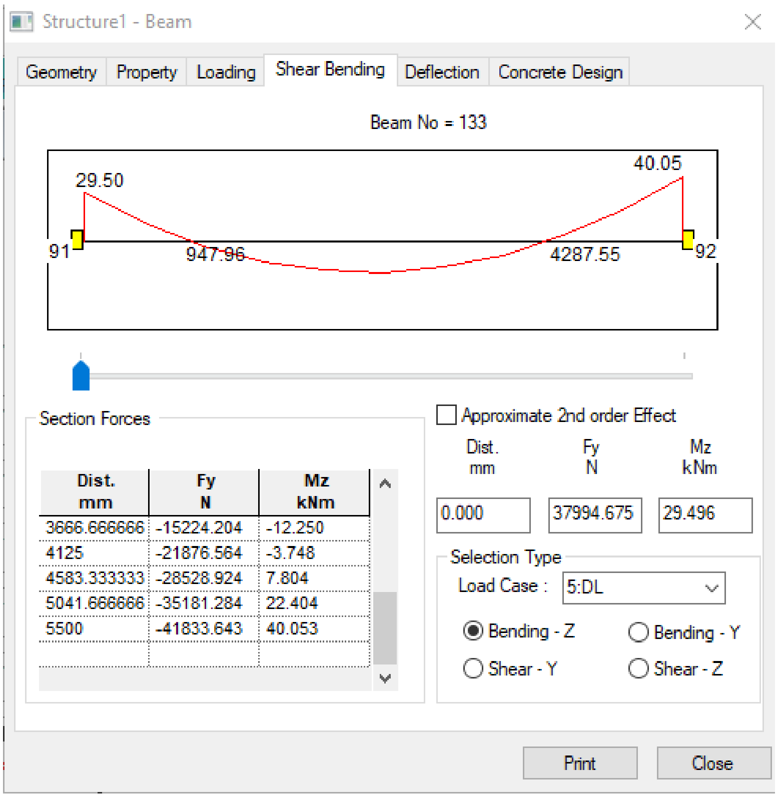



Figure 4.3: Shear bending of beam no.133

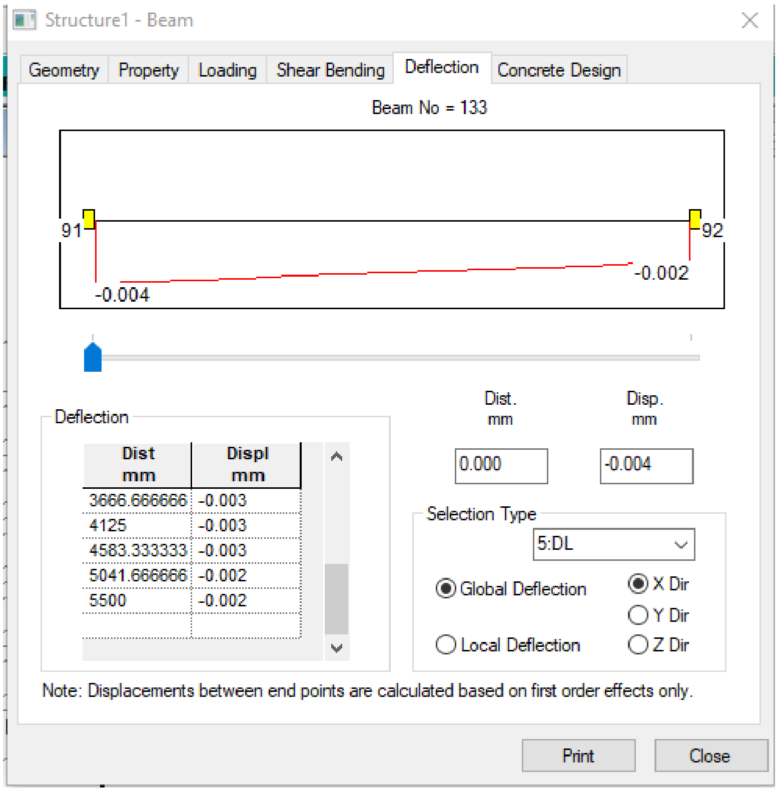



Figure 4.4: Deflection of beam no.133

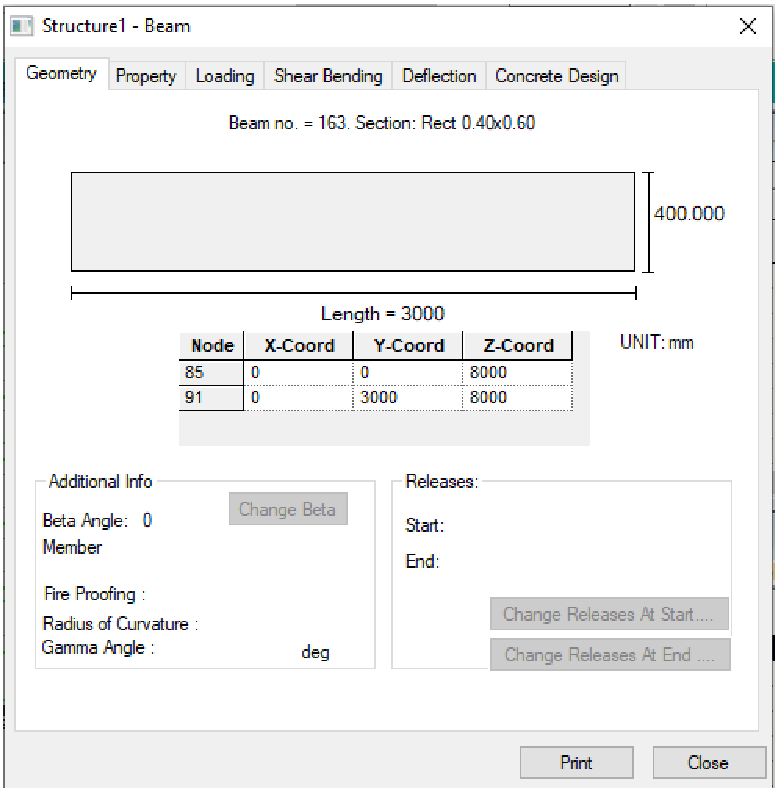



Figure 4.5: Geometry of column no.163

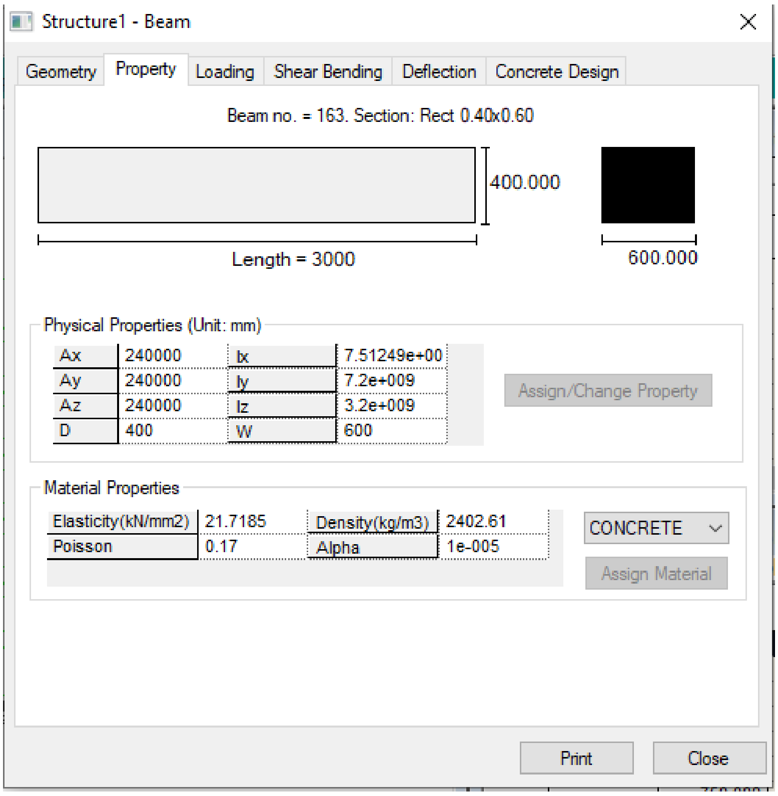



Figure 4.6: Property of column no.163

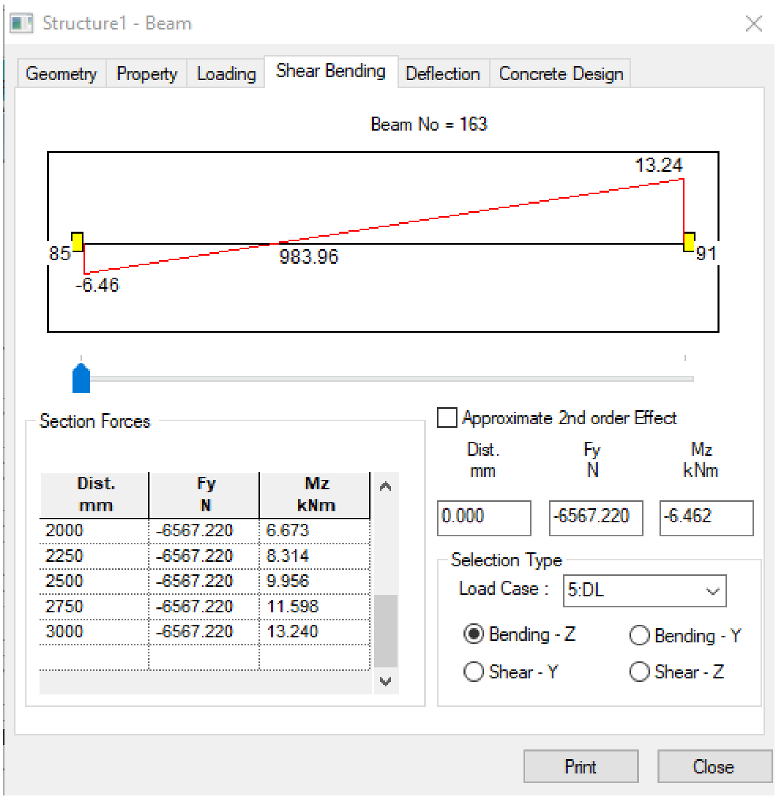



Figure 4.7: Shear bending of column no.163

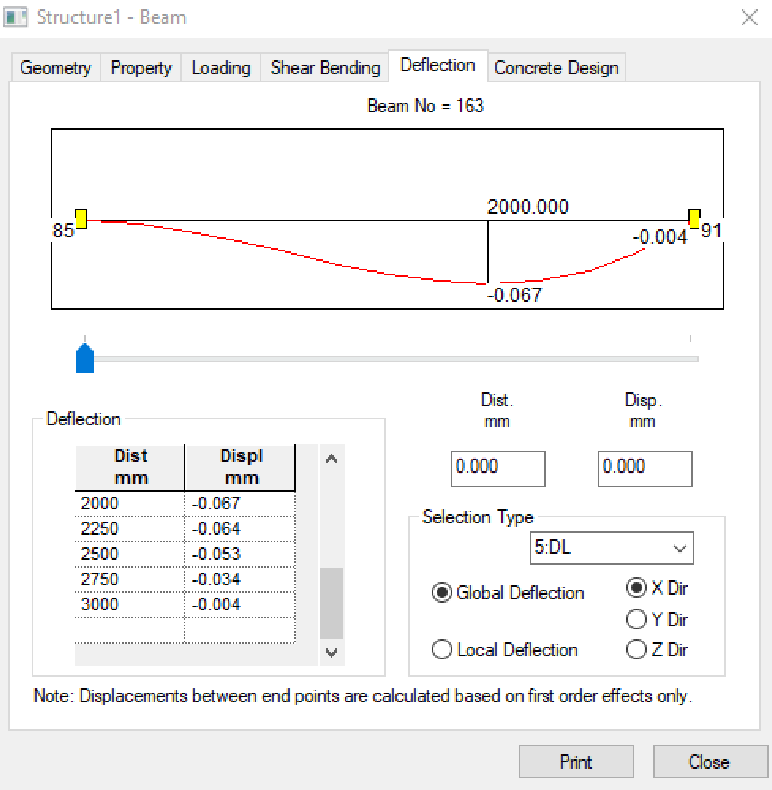



Figure 4.8: Deflection of column no.163

## POST PROCESSING MODE

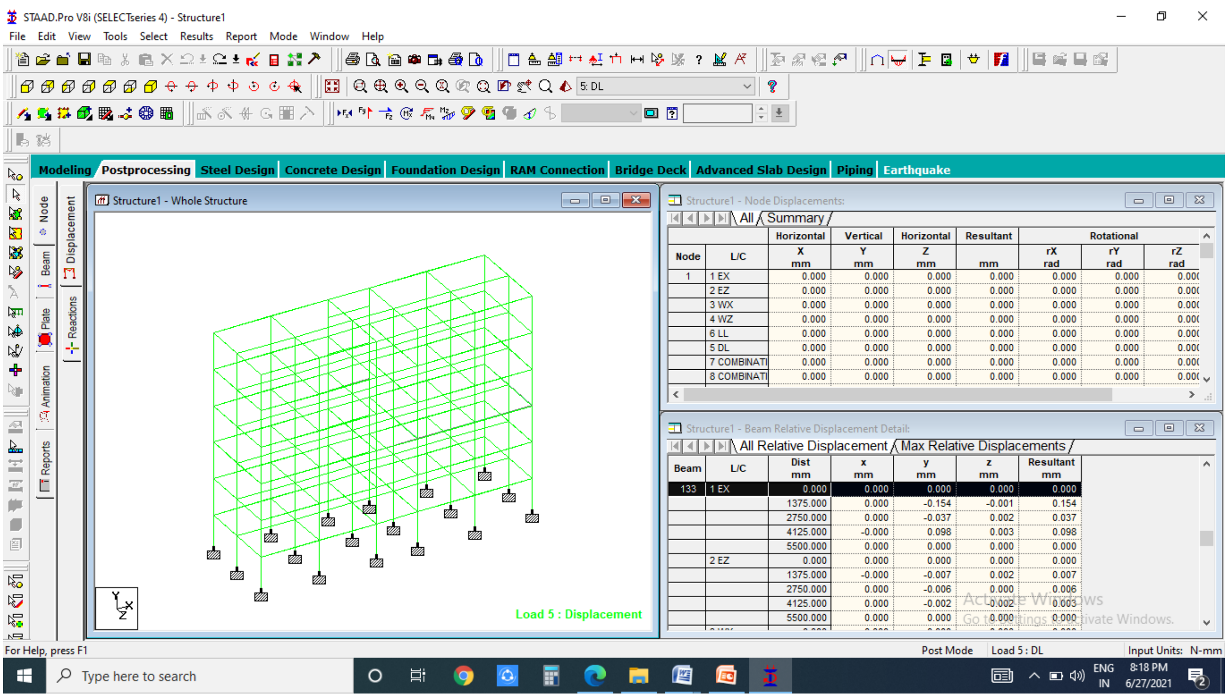



Figure 4.9: Post processing mode in STAAD.pro

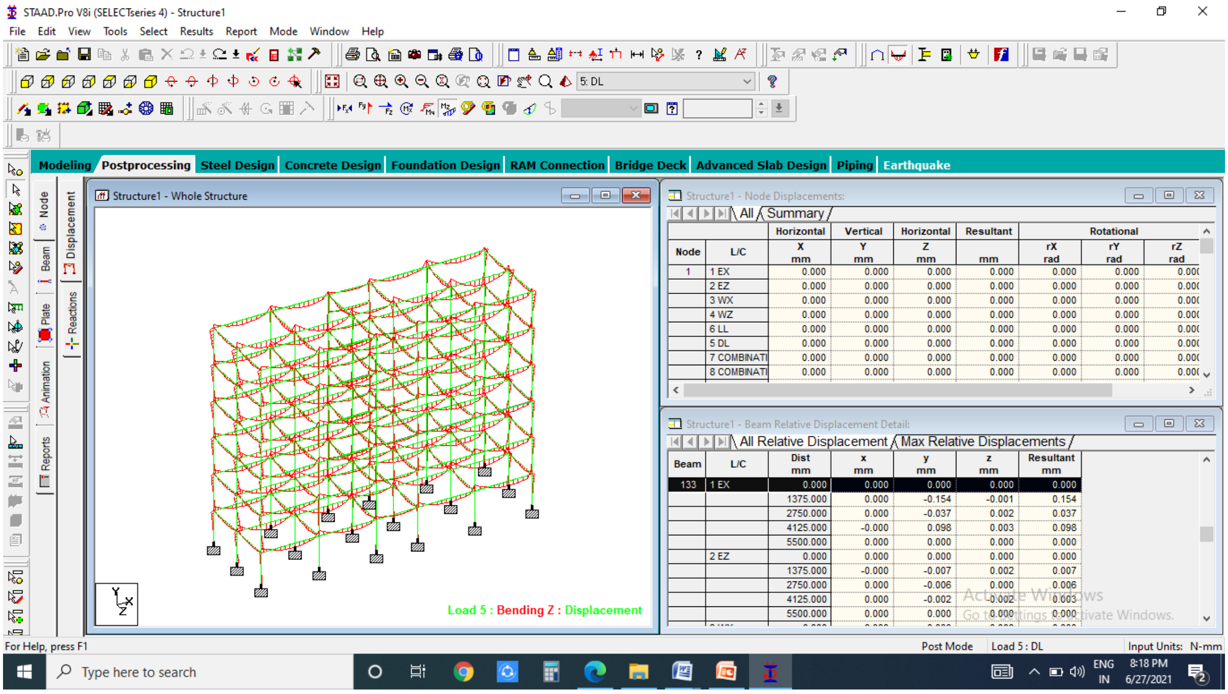



Figure 4.10: Bending in Z

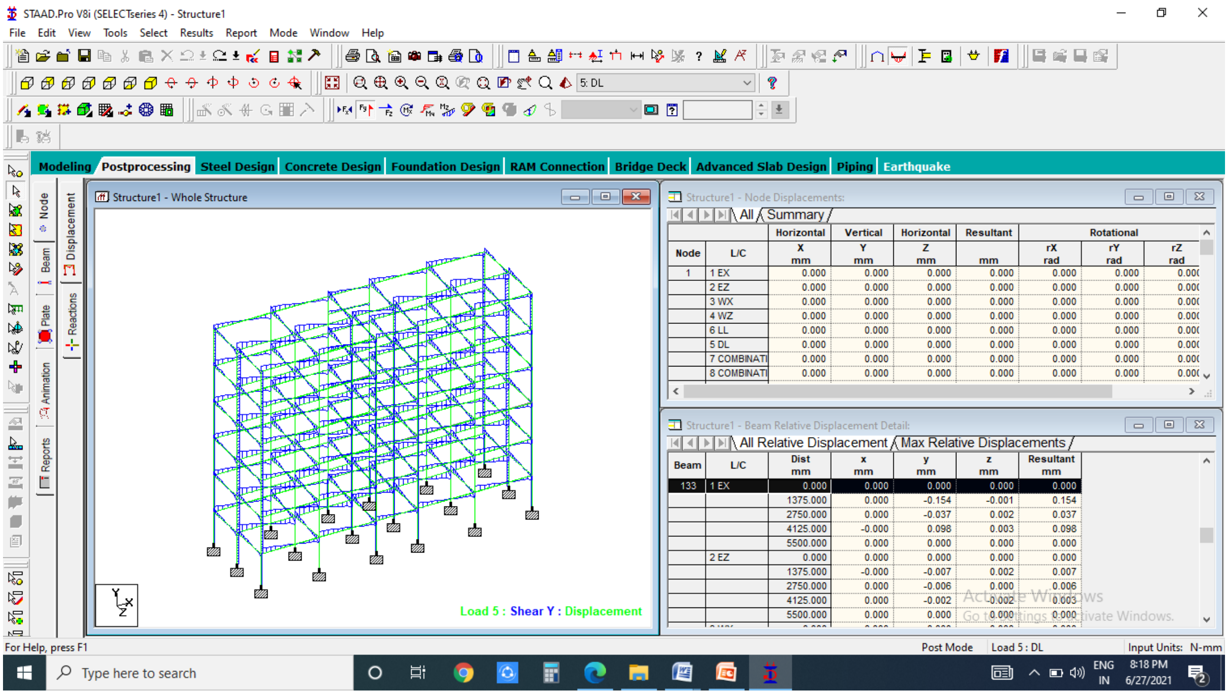



Figure 4.11: Shear force in Y

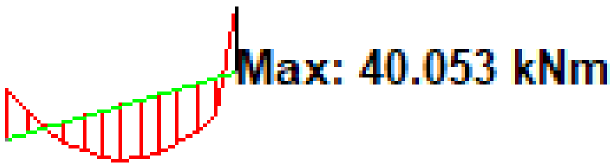



Figure 4.12: Bending moment diagram

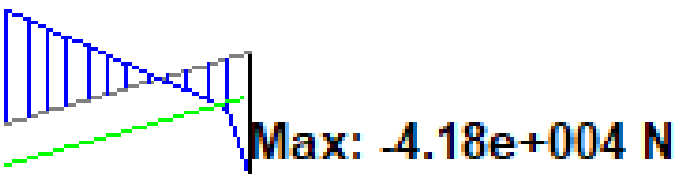



Figure 4.13: Shear force diagram

# Chapter 5

# DESIGN RESULTS

BEAM NO.133 DESIGNRESULTS

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 5500.0 mm SIZE: 500.0 mm X300.0 mm COVER: 25.0 mm

## 5.1 Summary of Reinforcement Area (Sq.mm)

Table 5.1: Summary of Reinforcement beam no.133

| Section | 0.0mm | 1375.0mm | 2750.0mm | 4125.0mm | 5500.0mm |
|---|---|---|---|---|---|
| TOP REINF. | 286.95(sq mm) | 286.95(sq mm) | 286.95(sq mm) | 286.95(sq mm) | 535.43(sq mm) |
| BOT REINF | 286.95(sq mm) | 286.95(sq mm) | 286.95(sq mm) | 286.95(sq mm) | 286.95(sq mm) |

## 5.2 Summary of Provided Reinforcement Area(Sq.mm)

Table 5.2: Summary of Provided Reinforcement beam no.133

| Section | 0.0mm | 1375.0mm | 2750.0mm | 4125.0mm | 5500.0mm |
|---|---|---|---|---|---|
| Top rein. | 3-16i 2 layers(s) | 3-16i 1 layers(s) | 3-16i 1 layers(s) | 3-16i 1 layers(s) | 3-16i 2 layers(s)) |
| Bot rein | 3-16i 2 layers(s) | 3-16i 1 layers(s) | 3-16i 2 layers(s) | 3-16i 1 layers(s) | 3-16i 2 layers(s)) |
| Shear rein | 2leg 12i @170mm c/c | 2leg 12i @170mm c/c | 2leg 12i @170mm c/c | 2leg 12i @170mm c/c | 2leg 12i @170mm c/c |

**Shear Design Results at Distance D (Effective Depth) from Face of the Support**

Shear Design Results at 665.0 mm away from STRAT SUPPOTS

VY = 41.27  MX = 0.30  LD = 9

Provide 2 legged 12i @170 mm c/c

Shear Design Results at 665.0 mm away from END SUPPOTS

VY = -56.55  MX = 0.35  LD = 10

Provide 2 legged 12i @ 170 mm c/c

**Column No.163 Design Results**

M20  Fe415 (Main)  Fe415 (Sec.)

LENGTH: 3000mm  CROSS SECTION: 600.0mm X 400.0mm  COVER: 40.0mm

** GUIDING LOAD CASE: 1 END JOINT: 85 SHORT COLUMN

REQD. STEEL AREA: 1920 Sq.mm.

REQD. CONCRETE AREA: 238080 Sq.mm.

MAIN REINFORCEMENT: Provide 12 - 16 dia. (1.01%, 2412.74 Sq.mm.)

(Equally distributed)

TIE REINFORCEMENT: Provide 12 mm dia. rectangular ties @ 225 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)

Puz: 3276.00  Muz1: 107.30  Muy1: 169.13 INTERACTION RATIO: 0.20 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)

WORST LOAD CASE: 1

END JOINT:85  Puz: 3423.82  Muz: 133.16  Muy: 212.46  IR: 0.16

**ELEMENT DESIGN SUMMARY**

ELEMENT  LONG. REINFMOM-X /LOADTRANS. REINFMOM-Y /LOAD

(SQ.MM/ME)(KN-M/M)(SQ.MM/ME)(KN-M/M)

286 TOP :126.0.17 / 10126.0.11 /10

BOTT:126.0.00 / 2126.0.00 / 3

287 TOP :126.0.14 / 9126.0.10 / 9

BOTT:126.-0.03 / 1126.0.00 / 1

288 TOP :126.0.00 / 3126..07 / 10

BOTT:126.-0.26 / 10126.-0.04 / 2

289 TOP :126.0.16 / 10126.0.10 / 10

BOTT:126.0.00 / 2126.0.00 / 4

290 TOP :126.0.13 / 9126.0.09 / 9

BOTT:126.-0.03 / 1126.0.00 / 1

291 TOP :126.0.00 / 0126.0.07 / 9

BOTT:126.-0.23 / 10126.-0.05 / 2

292 TOP :126.0.16 / 10126.0.10 / 10

BOTT:126.0.00 / 2126.0.00 / 3

# Chapter 6

# CONCLUSIONS

1. By Using STADD Pro., analysis and design of multistorey building is easier and quick process than manual process.
2. Proposed size of the beam and coloumn can be safely used in the structure.
3. The structure is safe in shear bending and deflection.
4. There is no hazardous effect on the structure due to wind load and seismic load on the structure.
5. The structure we taken is stable and structurally defined using various loads and combination.
6. The deflection value is more in WL (Wind Load) combination than the SL (Seismic Load) combination.
7. To know the behavior of the structure by applying various loads like dead load, live load, wind load and seismic load by using staad.pro. And also find out the Shear forces, displacement, bending and reactions of structure.
8. By using staadpro ,we performed dynamic analysis. So that, the results obtained in staadpro is more effective as compared to analysis and design performed by theoretical method.

**APPENDIX**

**STAAD EDITOR**

STAAD SPACE

START JOB INFORMATION

ENGINEER DATE 25-Jun-21

END JOB INFORMATION

INPUT WIDTH 79

UNIT METER KN

JOINT COORDINATES

1 0 0 0; 2 5.5 0 0; 3 11 0 0; 4 15 0 0; 5 20.5 0 0; 6 26 0 0; 7 0 3 0;

8 5.5 3 0; 9 11 3 0; 10 15 3 0; 11 20.5 3 0; 12 26 3 0; 13 0 6.5 0;

14 5.5 6.5 0; 15 11 6.5 0; 16 15 6.5 0; 17 20.5 6.5 0; 18 26 6.5 0; 19 0 10 0;

20 5.5 10 0; 21 11 10 0; 22 15 10 0; 23 20.5 10 0; 24 26 10 0; 25 0 13.5 0;

26 5.5 13.5 0; 27 11 13.5 0; 28 15 13.5 0; 29 20.5 13.5 0; 30 26 13.5 0;

31 0 17 0; 32 5.5 17 0; 33 11 17 0; 34 15 17 0; 35 20.5 17 0; 36 26 17 0;

37 0 20.5 0; 38 5.5 20.5 0; 39 11 20.5 0; 40 15 20.5 0; 41 20.5 20.5 0;

42 26 20.5 0; 43 0 0 4; 44 5.5 0 4; 45 11 0 4; 46 15 0 4; 47 20.5 0 4;

48 26 0 4; 49 0 3 4; 50 5.5 3 4; 51 11 3 4; 52 15 3 4; 53 20.5 3 4; 54 26 3 4;

55 0 6.5 4; 56 5.5 6.5 4; 57 11 6.5 4; 58 15 6.5 4; 59 20.5 6.5 4; 60 26 6.5 4;

61 0 10 4; 62 5.5 10 4; 63 11 10 4; 64 15 10 4; 65 20.5 10 4; 66 26 10 4;

67 0 13.5 4; 68 5.5 13.5 4; 69 11 13.5 4; 70 15 13.5 4; 71 20.5 13.5 4;

72 26 13.5 4; 73 0 17 4; 74 5.5 17 4; 75 11 17 4; 76 15 17 4; 77 20.5 17 4;

78 26 17 4; 79 0 20.5 4; 80 5.5 20.5 4; 81 11 20.5 4; 82 15 20.5 4;

83 20.5 20.5 4; 84 26 20.5 4; 85 0 0 8; 86 5.5 0 8; 87 11 0 8; 88 15 0 8;

89 20.5 0 8; 90 26 0 8; 91 0 3 8; 92 5.5 3 8; 93 11 3 8; 94 15 3 8;

95 20.5 3 8; 96 26 3 8; 97 0 6.5 8; 98 5.5 6.5 8; 99 11 6.5 8; 100 15 6.5 8;

101 20.5 6.5 8; 102 26 6.5 8; 103 0 10 8; 104 5.5 10 8; 105 11 10 8;

106 15 10 8; 107 20.5 10 8; 108 26 10 8; 109 0 13.5 8; 110 5.5 13.5 8;

111 11 13.5 8; 112 15 13.5 8; 113 20.5 13.5 8; 114 26 13.5 8; 115 0 17 8;

116 5.5 17 8; 117 11 17 8; 118 15 17 8; 119 20.5 17 8; 120 26 17 8;

121 0 20.5 8; 122 5.5 20.5 8; 123 11 20.5 8; 124 15 20.5 8; 125 20.5 20.5 8;

126 26 20.5 8; 127 11 4.75 0; 128 15 4.75 0; 129 11 8.25 0; 130 15 8.25 0;

131 11 11.75 0; 132 15 11.75 0; 133 11 15.25 0; 134 15 15.25 0; 135 11 18.75 0;

136 15 18.75 0;

MEMBER INCIDENCES

1 7 8; 2 8 9; 3 9 10; 4 10 11; 5 11 12; 6 13 14; 7 14 15; 8 15 16; 9 16 17;

10 17 18; 11 19 20; 12 20 21; 13 21 22; 14 22 23; 15 23 24; 16 25 26; 17 26 27;

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63 33 135; 64 34 136; 65 35 41; 66 36 42; 67 49 50; 68 50 51; 69 51 52;

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142 101 102; 143 103 104; 144 104 105; 145 105 106; 146 106 107; 147 107 108;

148 109 110; 149 110 111; 150 111 112; 151 112 113; 152 113 114; 153 115 116;

154 116 117; 155 117 118; 156 118 119; 157 119 120; 158 121 122; 159 122 123;

160 123 124; 161 124 125; 162 125 126; 163 85 91; 164 86 92; 165 87 93;

166 88 94; 167 89 95; 168 90 96; 169 91 97; 170 92 98; 171 93 99; 172 94 100;

173 95 101; 174 96 102; 175 97 103; 176 98 104; 177 99 105; 178 100 106;

179 101 107; 180 102 108; 181 103 109; 182 104 110; 183 105 111; 184 106 112;

185 107 113; 186 108 114; 187 109 115; 188 110 116; 189 111 117; 190 112 118;

191 113 119; 192 114 120; 193 115 121; 194 116 122; 195 117 123; 196 118 124;

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204 12 54; 205 13 55; 206 14 56; 207 15 57; 208 16 58; 209 17 59; 210 18 60;

211 19 61; 212 20 62; 213 21 63; 214 22 64; 215 23 65; 216 24 66; 217 25 67;

218 26 68; 219 27 69; 220 28 70; 221 29 71; 222 30 72; 223 31 73; 224 32 74;

225 33 75; 226 34 76; 227 35 77; 228 36 78; 229 37 79; 230 38 80; 231 39 81;
232 40 82; 233 41 83; 234 42 84; 235 49 91; 236 50 92; 237 51 93; 238 52 94;
239 53 95; 240 54 96; 241 55 97; 242 56 98; 243 57 99; 244 58 100; 245 59 101;
246 60 102; 247 61 103; 248 62 104; 249 63 105; 250 64 106; 251 65 107;
252 66 108; 253 67 109; 254 68 110; 255 69 111; 256 70 112; 257 71 113;
258 72 114; 259 73 115; 260 74 116; 261 75 117; 262 76 118; 263 77 119;
264 78 120; 265 79 121; 266 80 122; 267 81 123; 268 82 124; 269 83 125;
270 84 126; 271 127 15; 272 128 16; 273 127 128; 274 129 21; 275 130 22;
276 129 130; 277 131 27; 278 132 28; 279 131 132; 280 133 33; 281 134 34;
282 133 134; 283 135 39; 284 136 40; 285 135 136;

ELEMENT INCIDENCES SHELL

286 7 9 93 91; 287 10 12 96 94; 288 51 52 94 93; 289 13 15 99 97;
290 16 18 102 100; 291 57 58 100 99; 292 19 21 105 103; 293 22 24 108 106;
294 63 64 106 105; 295 25 27 111 109; 296 28 30 114 112; 297 69 70 112 111;
298 31 33 117 115; 299 34 36 120 118; 300 75 76 118 117; 301 37 39 123 121;
302 40 42 126 124; 303 81 82 124 123;

SURFACE INCIDENCE

7 9 93 91 SURFACE 1

10 12 96 94 SURFACE 2

51 52 94 93 SURFACE 3

13 15 99 97 SURFACE 4

16 18 102 100 SURFACE 5

57 58 100 99 SURFACE 6

19 21 105 103 SURFACE 7

22 24 108 106 SURFACE 8

63 64 106 105 SURFACE 9

25 27 111 109 SURFACE 10

28 30 114 112 SURFACE 11

69 70 112 111 SURFACE 12

31 33 117 115 SURFACE 13

34 36 120 118 SURFACE 14

75 76 118 117 SURFACE 15

37 39 123 121 SURFACE 16

40 42 126 124 SURFACE 17

81 82 124 123 SURFACE 18

ELEMENT PROPERTY

286 TO 303 THICKNESS 0.125

DEFINE MATERIAL START

ISOTROPIC CONCRETE

E 2.17185e+007

POISSON 0.17

DENSITY 23.5616

ALPHA 1e-005

DAMP 0.05

TYPE CONCRETE

STRENGTH FCU 27579

END DEFINE MATERIAL

MEMBER PROPERTY AMERICAN

1 TO 30 67 TO 96 133 TO 162 199 TO 270 273 276 279 282 285 PRIS YD 0.5 ZD 0.3

31 TO 66 97 TO 132 163 TO 198 271 272 274 275 277 278 280 281 283 -

284 PRIS YD 0.4 ZD 0.6

SURFACE PROPERTY

1 TO 18 THICKNESS 0.125

CONSTANTS

MATERIAL CONCRETE ALL

SURFACE CONSTANTS

MATERIAL CONCRETE LIST ALL

SUPPORTS

1 TO 6 43 TO 48 85 TO 90 FIXED

DEFINE 1893 LOAD

ZONE 0.1 RF 5 I 1 SS 2 ST 1 DM 0.05

SELFWEIGHT 1

MEMBER WEIGHT

1 TO 30 67 TO 96 133 TO 162 199 TO 270 273 276 279 282 285 UNI 3.75

DEFINE WIND LOAD

TYPE 1 WIND 1

INT 0.793 0.905 0.984 1.087 HEIG 10 15 20 30

EXP 1 JOINT 1 TO 136

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LOAD 1 LOADTYPE Seismic TITLE EX
1893 LOAD X 1
LOAD 2 LOADTYPE Seismic TITLE EZ
1893 LOAD Z 1
LOAD 3 LOADTYPE Wind TITLE WX
WIND LOAD X 1 TYPE 1
WIND LOAD X -1 TYPE 1
LOAD 4 LOADTYPE Wind TITLE WZ
WIND LOAD Z 1 TYPE 1
WIND LOAD Z -1 TYPE 1
LOAD 6 LOADTYPE Live TITLE LL
FLOOR LOAD
YRANGE 3 17 FLOAD -2 XRANGE 0 26 ZRANGE 0 8 GY
YRANGE 20.5 20.5 FLOAD -1.5 XRANGE 0 26 ZRANGE 0 8 GY
LOAD 5 LOADTYPE Dead TITLE DL
SELFWEIGHT Y -1
MEMBER LOAD
1 TO 30 67 TO 96 133 TO 162 199 TO 270 273 276 279 282 285 UNI GY -10.98
67 TO 96 200 TO 203 206 TO 209 212 TO 215 218 TO 221 224 TO 227 230 TO 233 -
236 TO 239 242 TO 245 248 TO 251 254 TO 257 260 TO 263 266 TO 268 -
269 UNI GY -5.66
LOAD COMB 7 COMBINATION LOAD CASE 7
5 1.2 1 1.2 3 1.2
LOAD COMB 8 COMBINATION LOAD CASE 8
5 1.2 4 1.2 2 1.2
UNIT MMS NEWTON
LOAD COMB 9 COMBINATION LOAD CASE 9
5 1.2 6 1.2 3 1.2
LOAD COMB 10 COMBINATION LOAD CASE 10
5 1.2 6 1.2 1 1.2
UNIT METER KN
PERFORM ANALYSIS PRINT ALL
PERFORM ANALYSIS
START CONCRETE DESIGN
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CODE INDIAN
UNIT MMS NEWTON
FC 25 ALL
FYMAIN 415 ALL
FYSEC 415 ALL
MAXMAIN 16 ALL
MAXSEC 12 ALL
MINMAIN 16 ALL
MINSEC 12 ALL
DESIGN BEAM 1 TO 30 67 TO 96 133 TO 162 199 TO 270 273 276 279 282 285
DESIGN COLUMN 31 TO 66 97 TO 132 163 TO 198 271 272 274 275 277 278 280 281 -
283 284
CONCRETE TAKE
UNIT METER KN
DESIGN ELEMENT 286 TO 303
END CONCRETE DESIGN
UNIT MMS NEWTON
PERFORM ANALYSIS
UNIT METER KN
PERFORM ANALYSIS PRINT ALL
FINISH
```

**REFERENCS**


1. Design and Analysis of Residential Building(G+4), Ibrahim, et.al (April 2019).
2. Planning, Analysis and Design of Residential Building(G+5) By using STAAD Pro, Dunnala Lakshmi Anuja, et.al (2019).
3. A Study on Design of Multi-Storey Residential Building, Mr K. Prabin Kumar, et.al (2018).
4. Analysis and Design of a (G+6) Multi-Storey Building Using STAAD Pro, Deevi Krishna Chaitanya, et.al (January, 2017).
5. R. D. Deshpande, et.al (June, 2017): Analysis, Design and Estimation of Basement+G+2 Residential Building.
6. IS 456-2000, Design of RCC elements
7. IS 1893(part 1):2002 - for earthquake design
8. IS 875 part1 - dead loads
9. IS 875 part2 - live loads
10. IS 875 part3 - wind loads
11. sp-16.