



Govt. & UGC Approved
UNIVERSITY OF GLOBAL VILLAGE (UGV), BARISHAL

THE UNIVERSITY FOR HI-TECH AND HUMANITY

STAAD Pro

(Complete Steel Building Project Development)

Content of Laboratory Course

Prepared By

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Department of Civil Engineering

University of Global Village (UGV), Barishal

Program: B.Sc. in Civil Engineering





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BASIC COURSE INFORMATION

Course Title	STAAD Pro (Complete Steel Building Project Development)
Course Code	CE 0732-4108
Credits	01
CIE Marks	30
SEE Marks	20
Exam Hours	2 hours (Semester Final Exam)
Level	8th Semester

STAADPro (Complete Steel Building Project Development)
COURSE CODE: CE 0732-4108

CREDIT: 01
CIE MARKS: 30
SEE MARKS: 20



- CLO 01 **Identify** the key parameters/ factors for analysis and design of a Steel Building/ Frame
- CLO 02 **Define** the applicable load cases and load combinations for the steel Buildings/Frame as per code.
- CLO 03 **Analyze** Steel Building/Frame through computer software
- CLO 04 **Design** various components of the Low-Rise Steel Building/Frame

Sl.	Course Contents	Hours	CLOs
1	Introduction to STAAD Pro, Geometrical Modeling of Steel Frame	15	CLO 1,CLO2
2	Modeling of loads and load combinations on Steel Frame , Analysis and Interpretation of Results of Analysis of Steel Frame	30	CLO 1,CLO2
3	Case Study of Design of a steel Industrial Building in Staad Pro.	40	CLO 3,CLO4

Week	Topic	Teaching Learning Strategy	Assessment Strategy	CLOs
1	Introduction to STAAD Pro	Lecture, Oral presentation	Lab Test, Quiz and Report	CLO 1
2	Geometrical Modeling of Steel Frame, Modeling of loads and load combinations on Steel Frame	Lecture, Discussion	Lab Test, Quiz and Report	CLO 2
3	Analysis and Interpretation of Results of Analysis of Steel Frame	Lecture, Discussion	Lab Test, Quiz and Report	CLO 2
4-9	Case Study of Design of a steel Industrial Building in Staad Pro.	Lecture, Discussion	Lab Test, Quiz and Report	CLO 3, CLO4

10-11	Practice, Review/Reserved Day	Lecture, Discussion	Lab Test, Quiz and Report	CLO 4
12-13	Lab Report Assessment, Self study	Lecture, Discussion	Lab Test, Quiz and Report	CLO 4
14-17	Lab Test, Viva, Quiz, Overall Assessment, Skill Development Test (Competency)	Lecture, Discussion	Lab Test, Quiz and Report	CLO 4

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ASSESSMENT PATTERN

CIE- Continuous Internal Evaluation (30 Marks)

SEE- Semester End Examination (20 Marks)

SEE- Semester End Examination (40 Marks) (should be converted in actual marks (20))

Bloom's Category	Tests
Remember	05
Understand	07
Apply	08
Analyze	07
Evaluate	08
Create	05

CIE- Continuous Internal Evaluation (100 Marks) (should be converted in actual marks (30))

Bloom's Category Marks (out of 100)	Lab Final (30)	Lab Report (10)	Continuous lab performance (30)	Presentation & Viva (10)	External Participation in Curricular/ Final Project Exhibition (10)
Remember/ Imitation	05		05	02	Attendance 10
Understand/ manipulation	05	05	05	03	
Apply/ Precision	05		05		
Analyze/ Articulation	05		05		
Evaluate/ Naturalisation	05	05	05		
Create	05		05	05	

Introduction to Staad Pro

Week 1

EXP NO 1 : INTRODUCTION TO STAAD PRO.

Aim:

To study the introduction of STAAD PRO.

Overview:

STAAD or (STAAD Pro) is a structural analysis and design computer program originally developed by Research Engineers International in Yorba Linda, CA. In late 2005, Research Engineer International was bought by Bentley Systems. The commercial version STAAD Pro is one of the most widely used structural analysis and design software. It supports several steel, concrete and timber design codes. It can make use of various forms of analysis from the traditional 1st order static analysis, 2nd order p-delta analysis, geometric nonlinear analysis or a buckling analysis. It can also make use of various forms of dynamic analysis from modal extraction to time history and response spectrum analysis.

Advantages:

1. Easy to use interface,
2. Conformation with the Indian Standard Codes,
3. Versatile nature of solving any type of problem,
4. Accuracy of the solution.

STAAD Pro features a state-of-the-art user interface, visualization tools, 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 professional's 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.

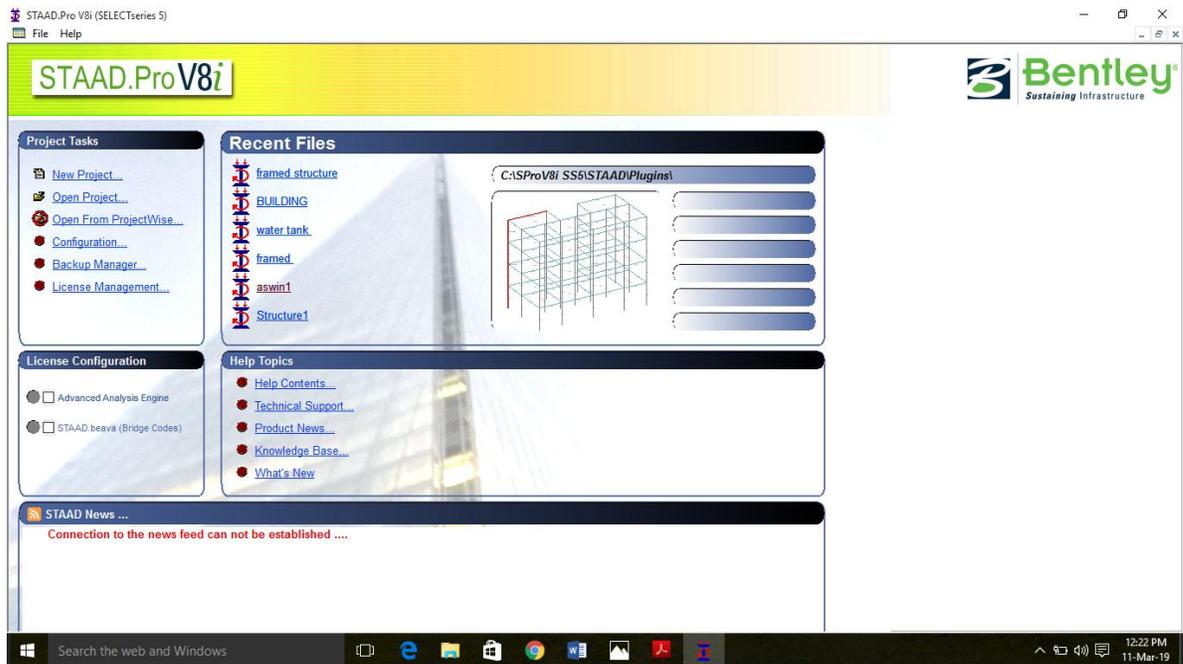
Starting STAAD Pro

There are two possible ways to start STAAD Pro:

1. Go to Start/All Programs/STAAD.Pro.
2. Double-click the shortcut on the Windows Desktop.

The Opening Screen

Either way you will see the following screen (this screen will pop-up each and every time you close a file.



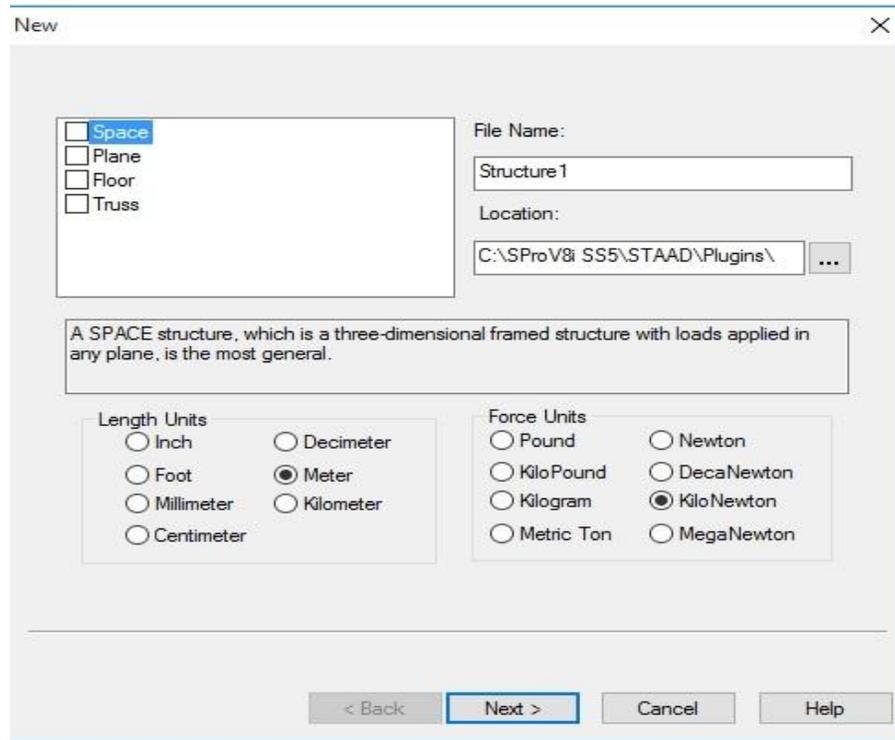
Under Project Tasks you can:

1. Create New file
2. Open an existing file
3. Configure STAAD Pro for the next input file
4. Configure the Backup Manager.

Creating new file

To create a new file use one of the following methods:

1. Under **Project Tasks**, click **New Project**
2. From menus select **File/New**, or click the **New Structure** button in the **File** toolbar. The following dialog box will be displayed.



File Name

Specify the name of the new file (no need to type .STD, STAAD will do that for you); file names in STAAD Pro can take long filenames.

Location

Specify where you will save this file in your local hard drives, or any network hard drive, and then specify the folder name (subdirectory) (example C:\SProV8i SS5\ STAAD\Examp), To change these settings, simply click the three dots button, and the following dialog will appear:

Type of Structure

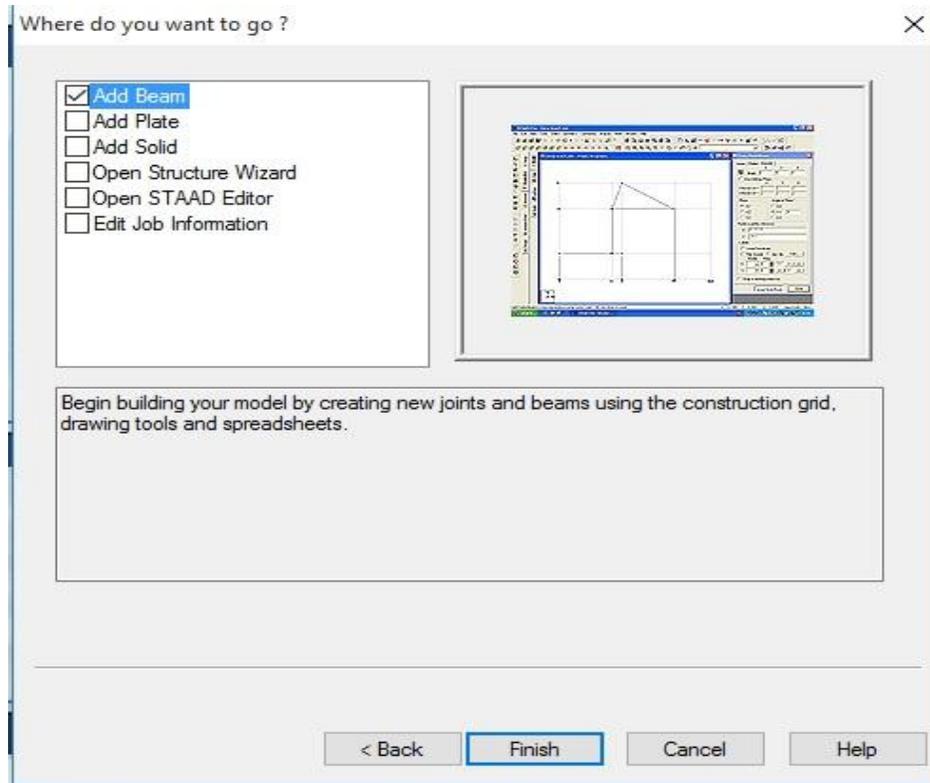
STAAD Pro provides 4 different structure types.

1. **Space:** Three-dimensional framed structure with loads applied in any plane (The most general).
2. **Plane:** Two-dimensional structure framed in the X-Y plane with loads in the same plane.
3. **Floor:** Two, or three-dimensional structure having no horizontal (global X or Z) movement of the structure (FX, FZ & MY, are restrained at every joint).
4. **Truss:** Any structure consists of truss members only, which can have only axial member forces and no bending in the members.

Length, and Force Units

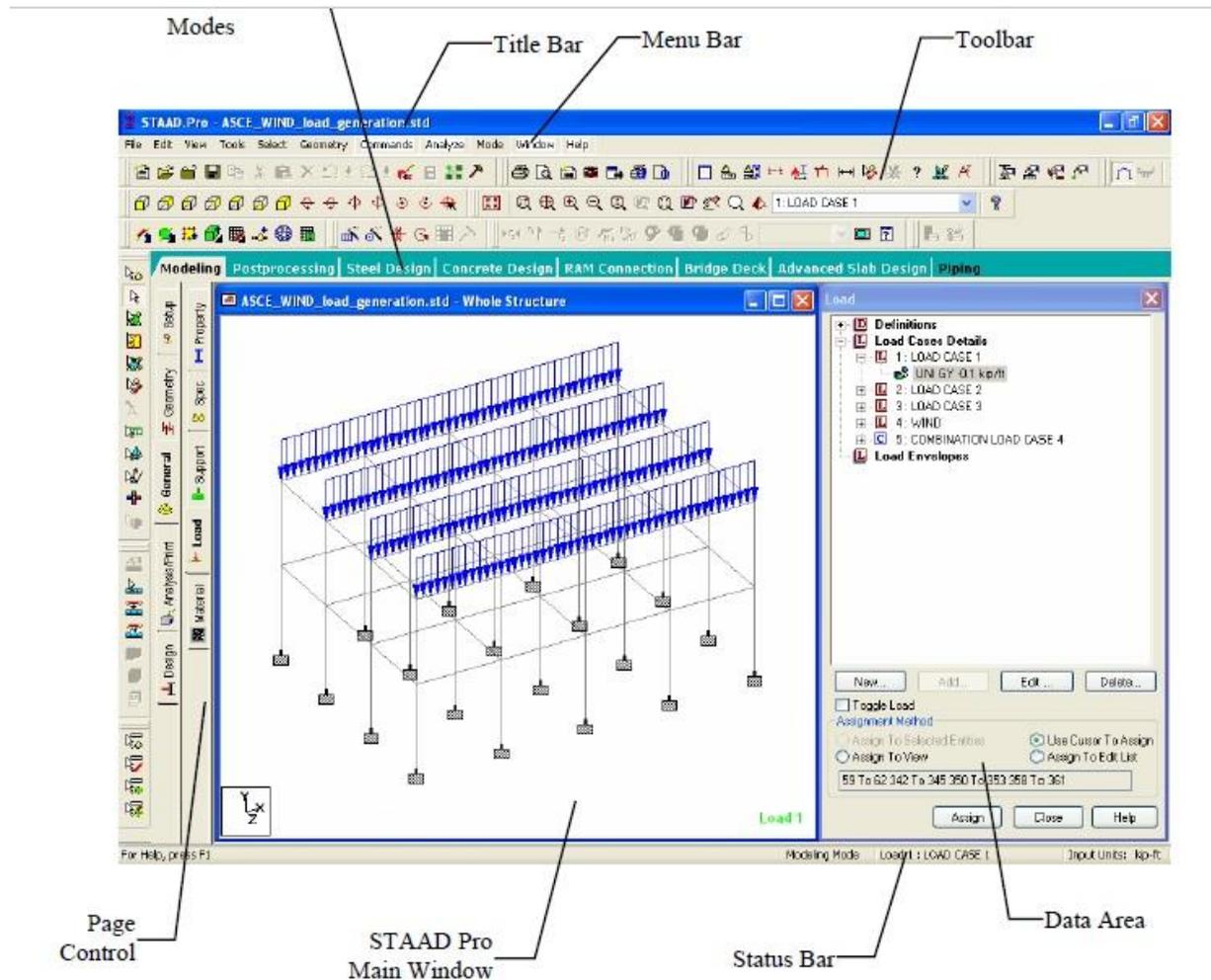
When you install the software at your hard drive, the installation software will ask you to specify what is your default unit system, English (ft, inch, kips) or Metric (m, mm, KN). For this courseware we chose Metric, hence the default Length and Force Units are Meter, and Kilo Newton respectively.

5. This will be to-start-with units, and not the only units you can use while you are creating the input file. As a user you have the ability to change the units at any point to whatever desired units (STAAD internally will make the necessary conversion).
6. When you are done click **Next** in order to proceed. The following dialog box will be displayed:



7. The only purpose of this dialog box is to ask the user what is the first step to be done in creating the input file.
8. To finish creating a file in STAAD Pro, click **Finish**.

STAAD Pro Screen



Notes on Page Control & Data Area

9. Page Control is another way (after menus, and toolbars) to execute commands in STAAD Pro.
10. Page Controls are:
 11. The tabs that appear at the left of the main window.
 12. Each Page Control has its own sub-pages.
 13. Each Page Control has its own function,

Exiting STAAD Pro

To exit STAAD Pro select **File/Exit** and STAAD Pro will close the current file, and exit the software. The only difference between closing a file and exiting STAAD Pro is the closing of the software, and the rest is the same.

Saving and Saving As

1. To save the current file, you can select **File/Save**, or click the **Save** button in the File toolbar
2. To save the current file under a new name, simply select **File/Save As**, a dialog box will be displayed.
3. First select the desired drive, and folder. Then, type in the file name, leave the file type to be STAAD Space File (*.std), click **Save**.

Result:

Thus the introduction about STAAD Pro is studied successfully.

Viva Questions

1. **How to start this software for truss designing ?**
2. **How to start this software for Frame designing ?**
3. **Tell me the difference between truss and frame ?**
4. **What is a hybrid truss structure ?**
5. **Tell me the full procedure of creating a new file .**

Geometric Modeling Of Steel Frame

Modeling of loads and load combinations on Steel Frame

Week 2

EXPERIMENT NO. 2 : Geometrical Modeling of Steel Frame

AIM: Geometrical Modeling of Steel Frame .

SOFTWARE USED:

STAAD Pro

PROCEDURE:

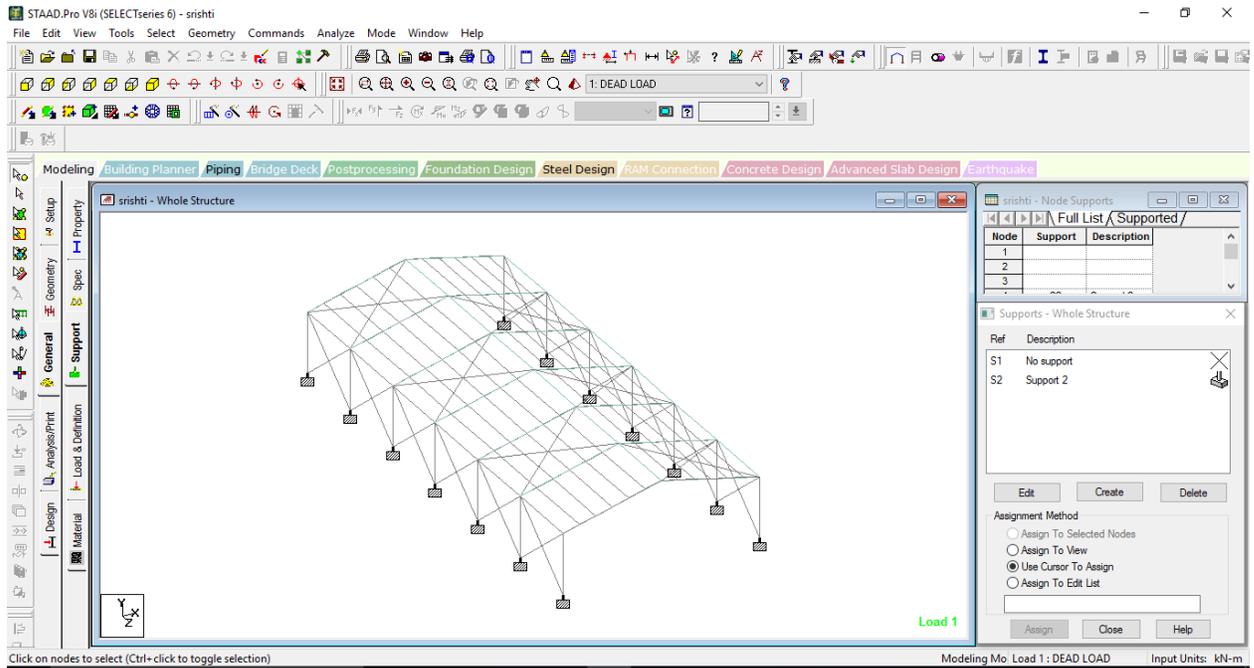
- Under Project Tasks, click New Project.
- Specify the name of the new file.
- Specify where you will save this file or location of the file.
- Select Space as the appropriate structure.
- Click on next to proceed.
- Take the default length in metre and force unit in Kilo Newton.
- Click on add beam and then click finish option.
- Select the front view of the snap node beam.
- click on edit on the snap node grid option and take right X Co-ordinate as 20.
- Now join the coordinate (0,0), (0,5), (8,7), (16,5), (16,0).
- select any of the beam to split the beam and click on the geometry option given on the top.
- click on insert node.
- take the value of 'n' as 5 and then click on 'add n points' and then click on ok. Similarly split the another beam.
- select the structure and click on transitional repeat option given on the top.

Take no. of steps -6

step spacing-6

select the global direction as Z and click on the link steps and open base and then click on ok.

- click on isometric view to view the structure.
- select add beam option and create the bracings.



- Go to the property by clicking on general, and then click on the section database option.
- click on Indian and select I Shape and click on add.
- Select Pipe and then click on add.
- Click on S- Shape and select ISHB 400, and then click on add. Likewise select the angle section.
- Click on SUPPORT and then click on create to select pinned support.

RESULT : Geometrical modelling of steel frame is studied successfully.

VivaQuestion

1. Tell about your experiment in short .
2. Explain the full procedure of steel design in brief .
3. Which code is used for live load designing .
4. Which codebook is used to design wind load .
5. Written any five I.S. codes .
6. What are shear forces
7. Explain bending moment diagrams .
8. Why there is need to draw BMD and SFD .
9. How bending works to affect a building .

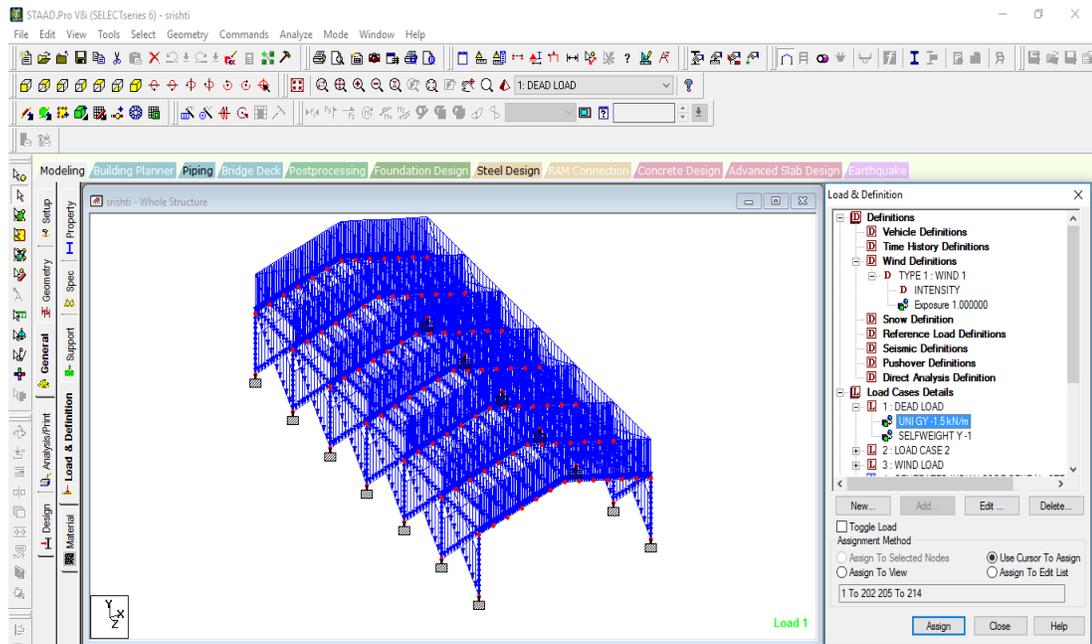
EXPERIMENT NO.-3 Modeling of loads and load combinations on Steel Frame .

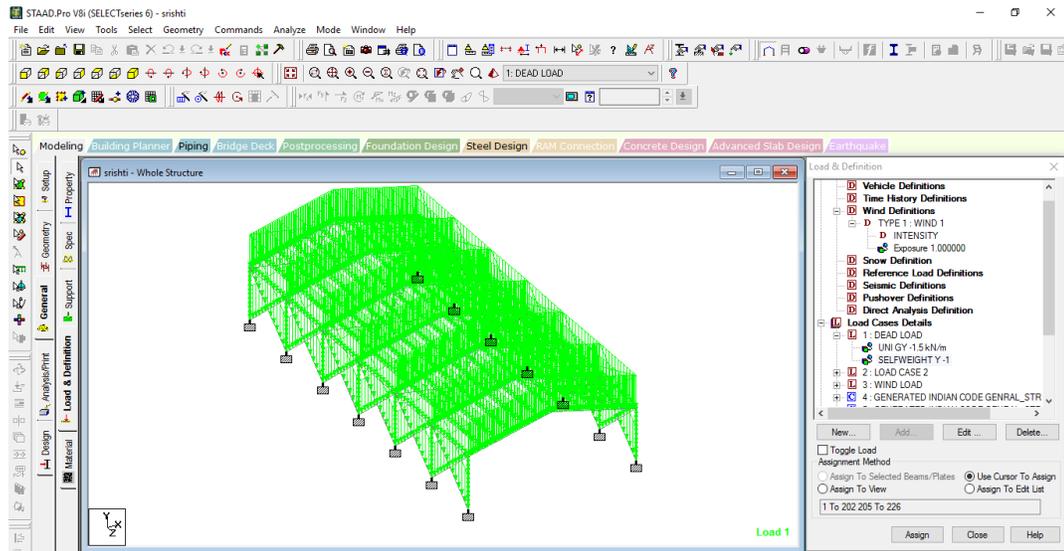
AIM: Modeling of loads and load combinations on Steel Frame .

Procedure:

LOADS AND DEFINITIONS-

- Click on definition and then click on the add option.
- Select the wind option and then click on add and take the factor as 1 and then assign it.
- Now click on load case details and then add.
- Then add the dead load, selfweight taking the factor as -1, and the member load taking the factor as -1 and the click on add and then assign it.



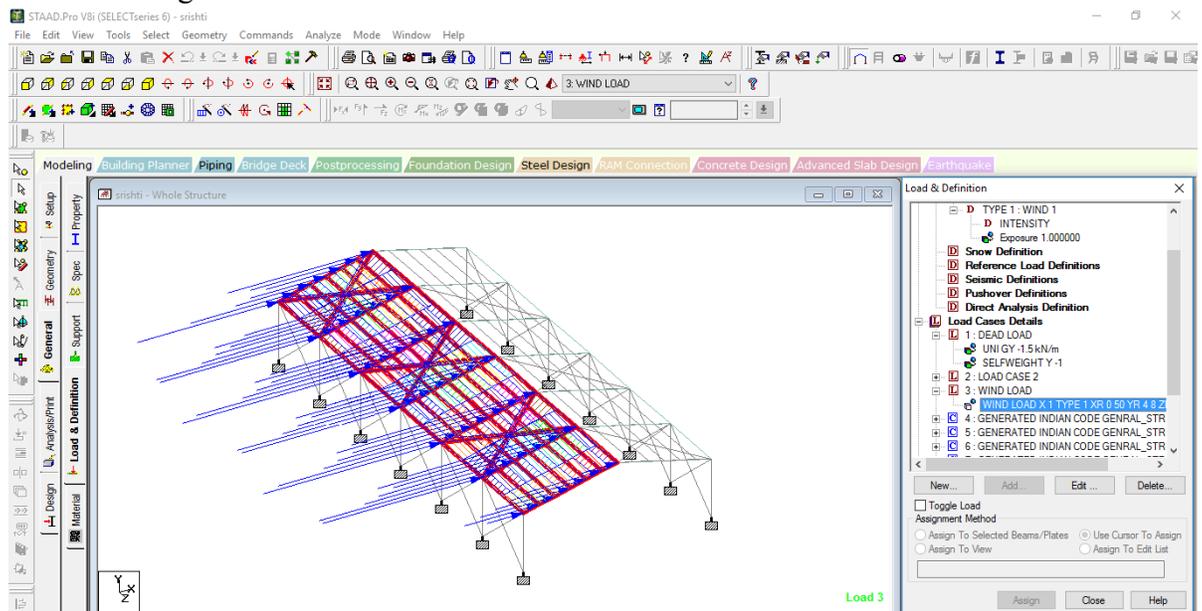


- Likewise click on the live load and then click on add then again click on the plate load option where the value of $w=-0.05$ in GY –direction and then add and assign it.
- Likewise click on wind load and then add

Minimum- 4

Maximum- 8

And then assign it.



- Now go to the 3D Rendering view to view the structure.

RESULT : Modelling of loads and loads combination of steel frame is studied successfully.

ANALYSIS AND INTERPRETATION OF RESULTS OF STEEL FRAME.

Week 3

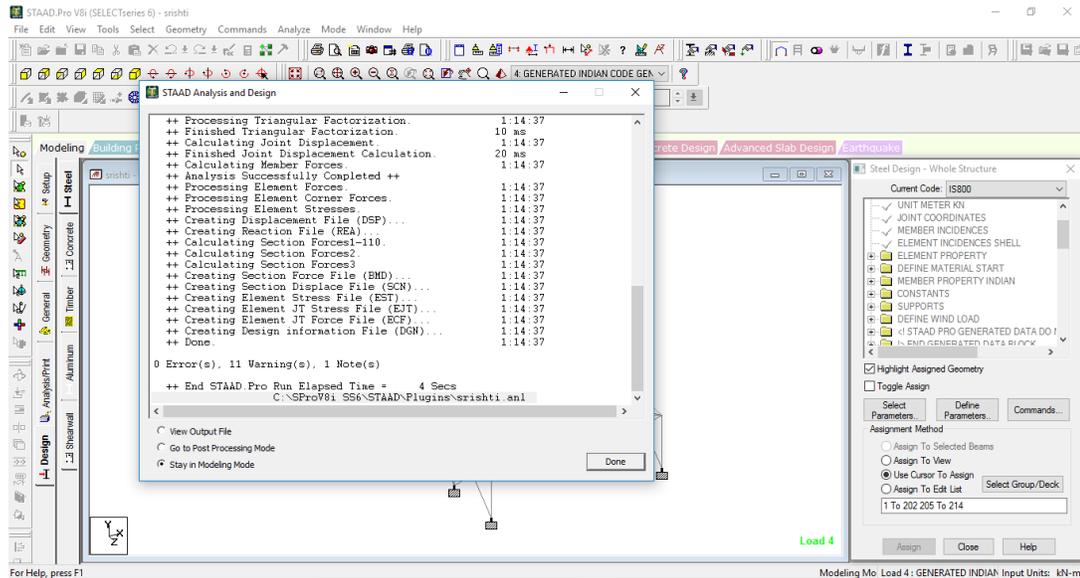
EXPERIMENT NO. 4 : ANALYSIS AND INTERPRETATION OF RESULTS OF STEEL FRAME.

AIM: To analyse and interpret the results of steel frame using STAAD PRO.

Procedure:

1. After assigning properties to the structure . Goto **loads and loads combination**
Goto definition and define the loads.
Select wind definition → add → close → select wind definition → add → AMERICA code → add → click on calculate as per → OK → close . select exposure select the suitable range → add → select → assign to view → assign.
2. Go to load case details → add **(dead load, live load and wind load)** and then add each of them
3. Select dead load → add self weight = 1 (change to steel) → add → member load = -1.5
Select live load → add plate load {P = -0.05 KN/m²}
Select GY option → add
Assign to view → assign
4. Goto **auto load combination** → select all the load combinations. After that see the combination of loads in the **STAADPRO main window.**
5. Goto **commands** → **analyse perform analysis.**
6. **Analyse** → **run analysis.**
7. After the modelling and loads combination of the steel structure we have to analyse the result of the steel structure.
8. For that Goto **commands** → **analyse perform analysis.**

Analyse → **run analysis.**



RESULT :

Thus the Analysis and interpretation of results of design of steel frame is studied successfully.

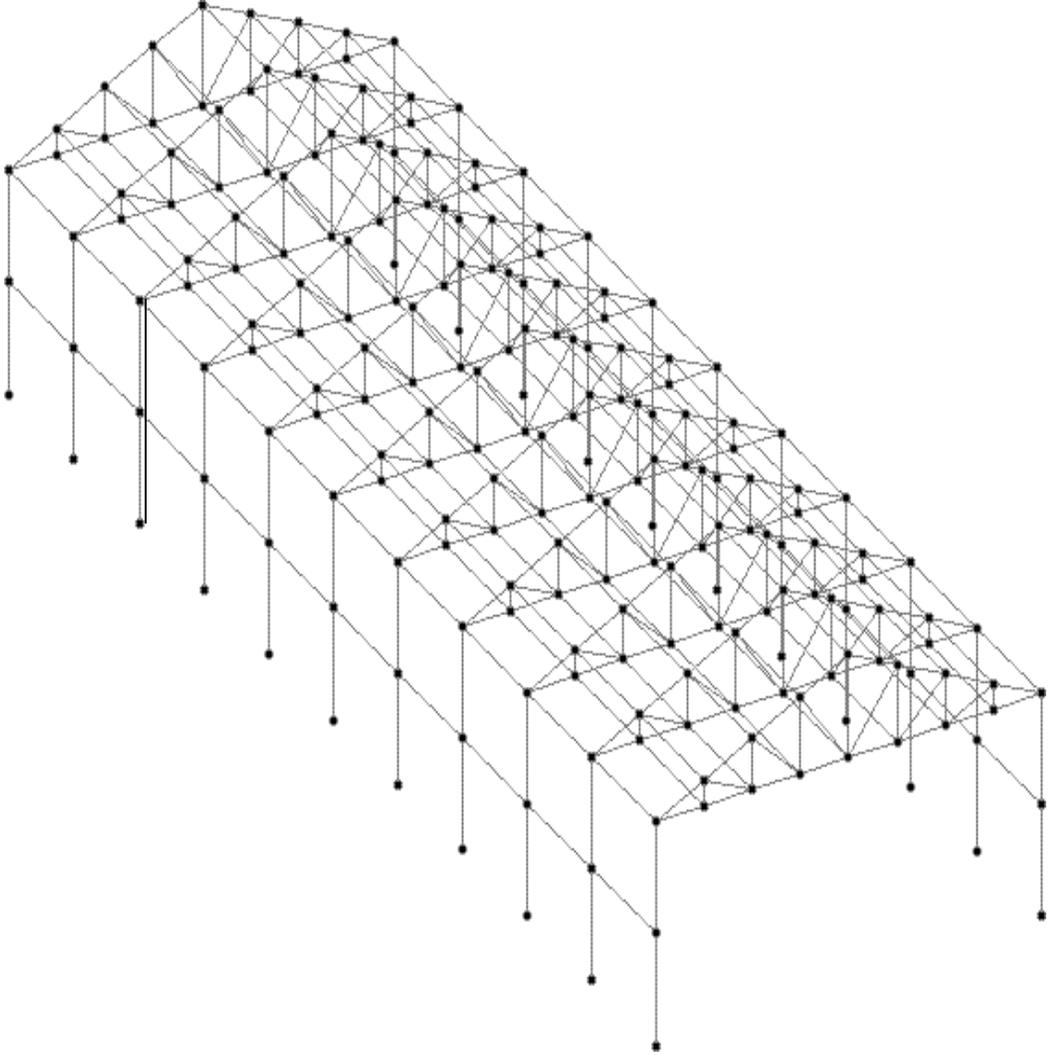
VivaQuestion

- 1. Tell about your experiment in short .**
- 2. Explain the full procedure of steel design in brief .**
- 3. Which code is used for live load designing .**
- 4. Which codebook is used to design wind load .**
- 5. Written any five I.S. codes .**
- 6. What are shear forces**
- 7. Explain bending moment diagrams .**
- 8. Why there is need to draw BMD and SFD .**
- 9. How bending works to affect a building .**

Case Study of Design of a Steel Industrial Building in Staad Pro

Week 4-9

Experiment 5 : Case Study of Design of a Steel Industrial Building in Staad Pro



MODELING

3.1 SOFTWARE'S USED

The following software are used for the analysis of the bridge deck slab in this project.

- AUTO CAD Software
- STAAD PRO Software

3.1.1 AUTO CAD SOFTWARE

AUTOCAD is a commercial computer-aided design (CAD) and drafting software application. Developed and marketed by AutoCAD was first released in December 1982 as a desktop app running on microcomputers with internal graphics controllers. Before AutoCAD was introduced, most commercial CAD programs ran on mainframe computers or minicomputers, with each CAD operator (user) working at a separate graphics terminal AutoCAD is used across a wide range of industries, by architects, project managers, engineers, graphic designers, and many other professionals. The main use of AUTOCAD software is to draw or drafting the plan, elevation and sections of structures in 2D or 3D view.

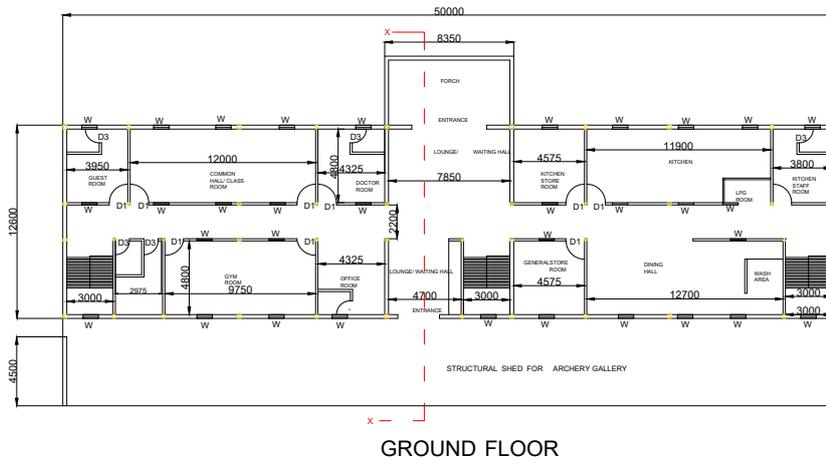


Figure 3.1: Ground Floor Plan

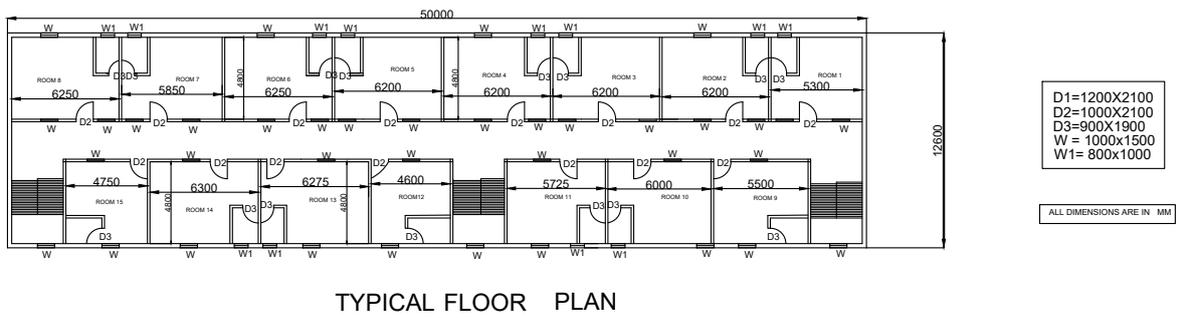


Figure 3.2: First Floor Plan

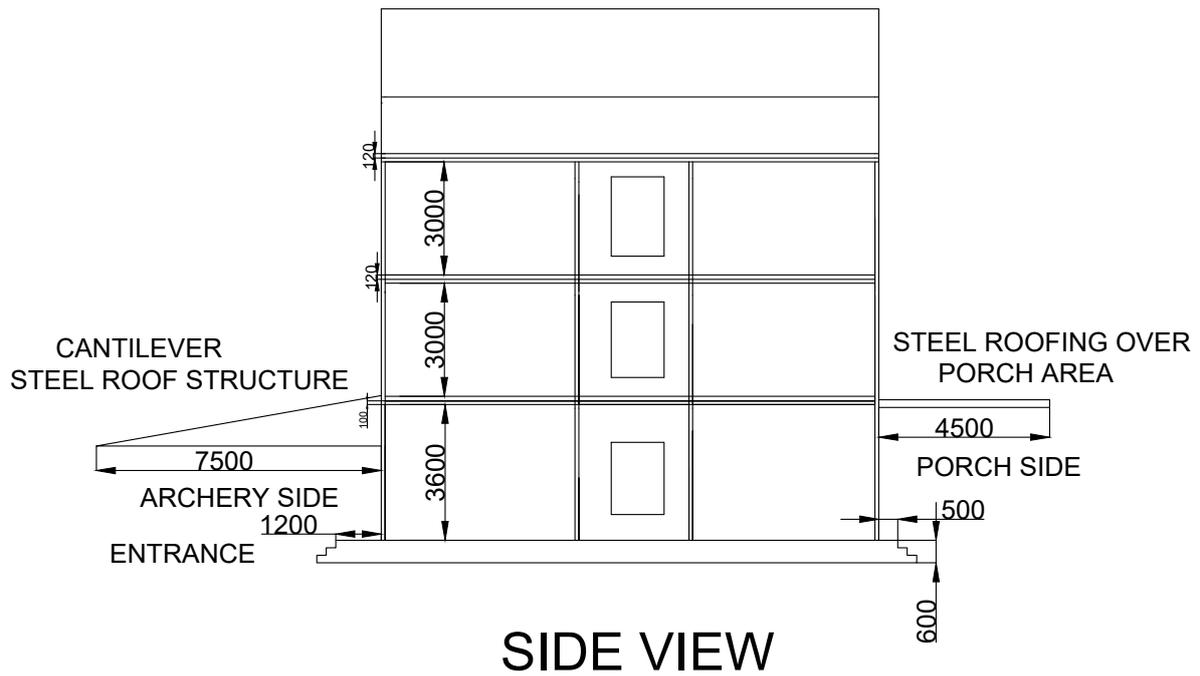


Figure 3.3: Side View

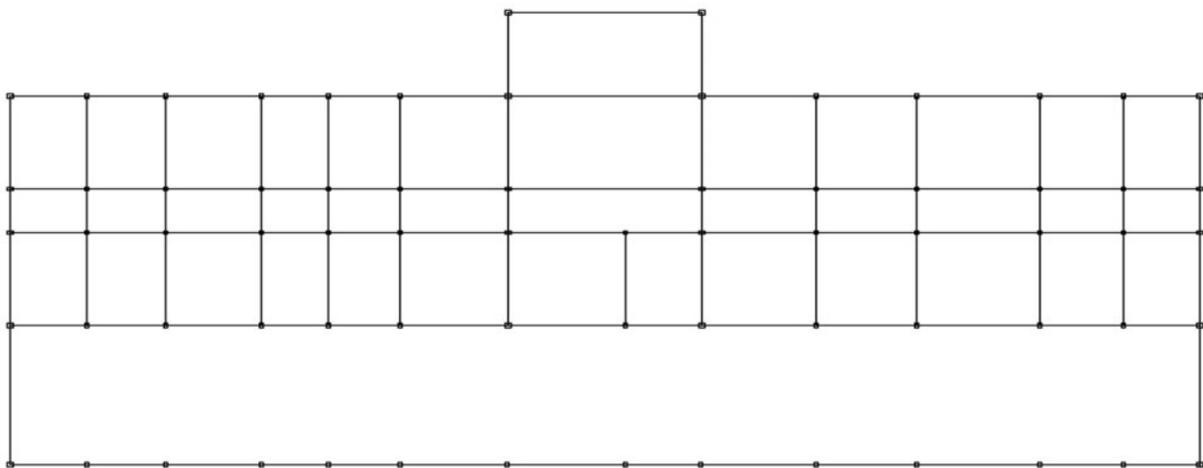


Figure 3.4: Column Marking

3.1.2 STAAD PRO SOFTWARE

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 stands for STructural Analysis And Design. STAAD.Pro

is one of the most widely used structural analysis and design software products worldwide. It can apply more than 90 international steel, concrete, timber and aluminium design codes. Today, STAAD Pro is one of the popular and widely used software for structural analysis and design across the globe by Civil engineers. It supports all types of various steel, concrete, and timber design codes.

3.1.3 Role of Staad Pro in Civil Engineering

STAAD Pro is a software widely used in the field of Civil engineering. It has more flexible and advanced features than Auto CAD, being used in the construction industry. AutoCAD allows candidates to work on two-dimension models; however, STAAD Pro will let you work on three-dimensional models. It requires lesser manual calculation and thus, you can save time and energy.

3.1.4 Purpose of Staad Pro in Civil Engineering

- With the help of STAAD Pro, civil engineers can easily analyze design civil engineering structures such as buildings, bridges, dams, canals, sewage systems, plane and space trusses.
- STAAD Pro can generate loads such as wind, or earthquakes as per building codes of selected countries.
- STAAD Pro can be used to design steel and reinforced concrete buildings as per the codes of selected countries.
- It can carry out linear elastic (static dynamic), and nonlinear dynamic analysis.
- It has a simple and easy-to-understand interface which makes learning quick for aspirants.
- At present, STAAD Pro is developed by Bentley Systems Inc. It was originally developed by Research Engineers Inc. in California.
- STAAD Pro was one of the earliest structural analysis and design software that was designed with user-friendly GUI and support for building codes of various nations such as India, the US, the UK, and other developed nations.

LOADS AND CALCULATIONS

DEAD LOAD:

Density of auto clayed aerated concrete = 6.374 KN/m^2

Load on External Walls :

Ground floor = $0.25 \times 3.6 \times 6.374 = 5.73 \text{ KN/m}^2$

First floor = $0.25 \times 3 \times 6.374 = 4.78 \text{ KN/m}^2$

Second floor = $0.25 \times 3 \times 6.374 = 4.78 \text{ KN/m}^2$

Load on Internal Walls:

Ground floor = $0.15 \times 3.6 \times 6.374 = 3.44 \text{ KN/m}^2$

First floor = $0.15 \times 3 \times 6.374 = 2.86 \text{ KN/m}^2$

Second floor = $0.25 \times 3 \times 6.374 = 2.86 \text{ KN/m}^2$

Load on slab = Self weight + Plastering = 4 KN/m^2

Self weight = $0.12 \times 25 = 3 \text{ KN/m}^2$

Plastering = 1 KN/m^2

Load on Porch area walls = $0.25 \times 3.6 \times 6.374 = 5.73 \text{ KN/m}^2$

Load on parapet walls = $1 \times 0.1 \times 6.374 = 0.63 \text{ KN/m}^2$

LIVE LOAD :

Taken as 3 KN/m for all general buildings and structures as per IS Code 875-1987 (part-3)

Live Load = 3 KN/m

WIND LOAD[IS 875-1987 Part-3]:

1.Design of Wind Speed:

$V_z = V_b \times K_1 \times K_2 \times K_3 \times K_4$

K_1 = Probability factor [Hostel is a General building]

K_2 = Terrain toughness factor

K3 = Topography factor

K4 = Importance factor

Vb = Basic wind speed = 47 m/s

K1=1.0

K2=1.0 [Terrain category 2]

K3=1.0 [K3 = 1+CS] Since building is located at level land CS=0

K4=1.0

Calculation of design wind speed:

Height of Ground floor = 3.6 m

Height of First floor = 6.6 m

Height of Second floor = 9.6 m

Design wind speed $V_z = V_b \times k_1 \times k_2 \times k_3 \times k_4$

= 47 x 1 x 1 x 1 x 1

= 47 m/s

2) Wind Pressure (Pz):

For Ground floor, First floor , Second floor

$V_z = 47 \text{ m/s}$

$P_z = 0.6 \times V_z^2$

= 0.6 x 47²

=1.325 KN/m²

3) Design wind Pressure(Pd):

$P_d = 0.70 \times P_z$

= 0.70 x 1.325

= 0.92 KN/m²

4) Wind Load along X and Y directions:

$F = C_f \times P_d \times b \times H_{\text{eff}}$ [Cf = Coefficient factor]

(A) wind forces along positive direction

Longer direction (a) = 50 m

Shorter direction(b) = 12.6 m

Ground floor = 3.6 m

First floor h1 = 6.82 m

Second floor h2 = 9.82 m

Ground floor = (0+h1)/2 = 3.82/2 = 1.91

Effective height ,h1 = (h1+h2)/2

$$= (3.82+3)/2$$

$$= 3.41\text{m}$$

$$\text{Effective height , } h_2 = h/2 = 3/2 = 1.5 \text{ m}$$

$$a = 12.6 - 0.25 = 12.35 \text{ m}$$

$$b = 10.26 \text{ m}$$

$$a/b = 12.35/10.26 = 1.20$$

$$A/h = 50 - 0.25 = 49.75/10.26 = 4.84$$

Force acting at center of slab at first floor

$$F = C_f \times p_d \times b \times h$$

$$C_f = 1.4$$

$$F = 1.4 \times 0.92 \times 10.26 \times 3.82$$

$$F = 50.48 \text{ KN}$$

(B) Wind Forces along Positive Z-direction:

where , $C_f = 1.4$

$$F = C_f \times P_d \times b \times h$$

$$= 1.4 \times 0.92 \times 10.26 \times 3$$

$$F = 39.64 \text{ KN}$$

First and Second Floor:

$$a/b = 10.26/12.35 = 0.83$$

$$a/h = 10.26/49.75 = 0.206$$

$$C_f = 0.5, b = 12.35$$

$$F = 0.5 \times 0.927 \times 12.35 \times 3.82 = 21.86 \text{ KN}$$

$$C_f = 0.5, b = 12.35$$

$$F = 0.5 \times 0.927 \times 12.35 \times 3 = 17.17 \text{ KN}$$

Table 4.1: WIND LOADS

Floor Type	Total height(m)	Vz(m/s)	Pz(kN/m ²)	Pd(kN/m ²)	Cf	Fx(±)	Cf	Fz(±)
Ground floor	3.82	47	1.325	0.927	1.4	50.48	1.4	39.64
First floor	6.82	47	1.325	0.927	0.5	21.86	0.5	17.17
Second floor	9.82	47	1.325	0.927	0.5	21.86	0.5	17.17

STAAD.PRO SOFTWARE

5.1 ANALYSIS AND DESIGN OF STEEL STRUCTURE PROCEDURE

- Double click on staad pro → IRC → new project select space → change units (M, KN) → ok → open structure wizard → finish.
- Model type → frame model → Bay frame → No of bays along length , height , width(L= 50 m, H = 10.26 m, W = 12.6 m) → ok → transfer model.

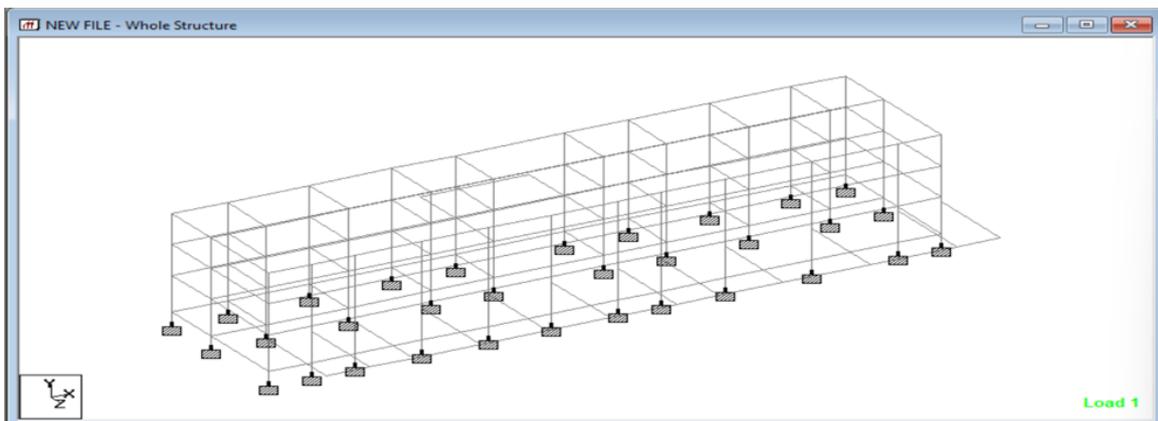


Figure 5.1: Isometric View

- General → property → section data base → Indian → S-shape → ISHB 450 (column) → ISHB 300 (beam) → assign to selected beams → select → beam parallel to x , z → beam parallel to y → assign.
- General → supports → create → fixed → add → use cursor to assign → assign → close.
- Load definitions → Dead load → primary → member → self weight(y -1) → add → assign.

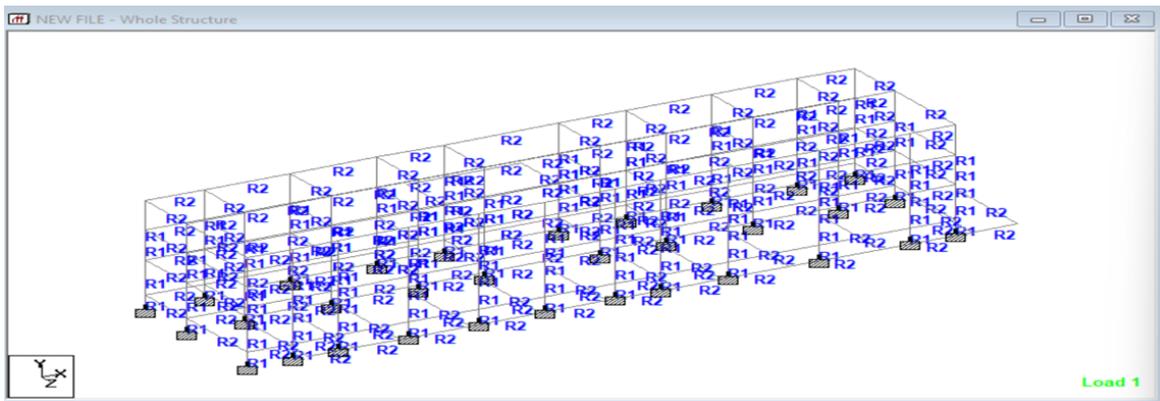


Figure 5.2: Properties

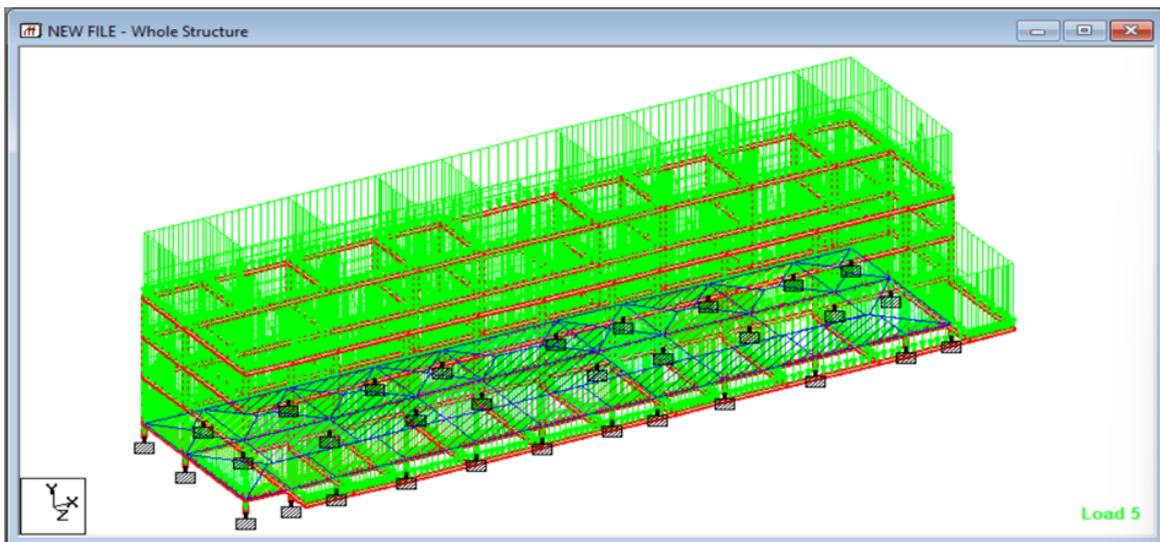


Figure 5.3: Dead Load:Self weight

- Load definitions → Dead load → primary → member → uniform force → $(G_y - 5.73 \text{ KN/m}^2)$ → add → assign.

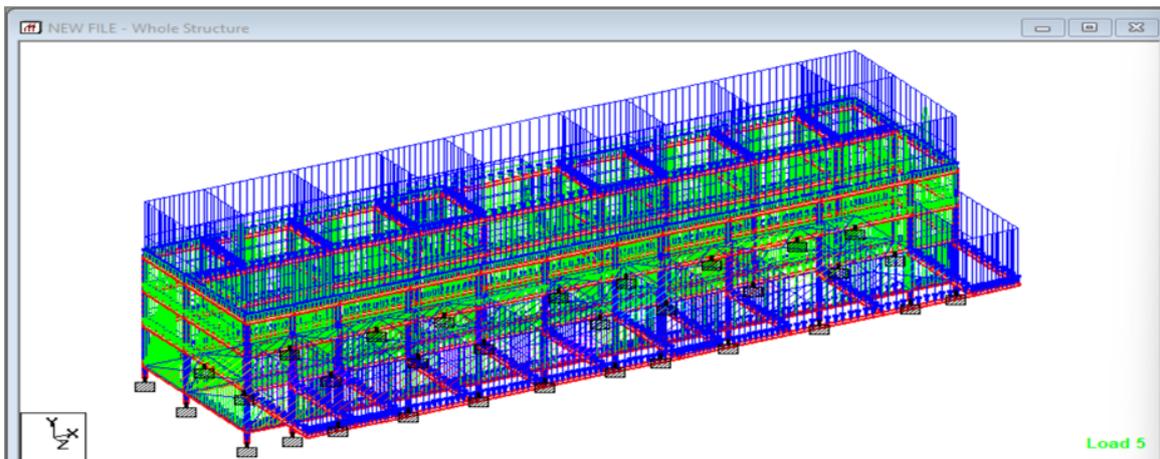


Figure 5.4: Dead Load:uniform force

- Load definitions → Dead load → primary → member uniform force → $(G_y - 4.78 \text{ KN/m}^2)$ → add → assign.

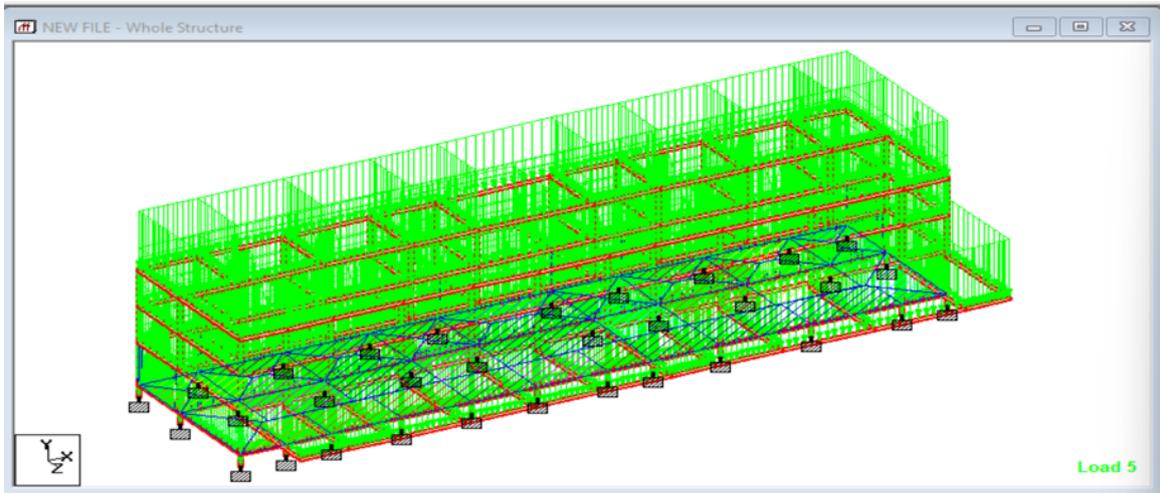


Figure 5.5: Dead Load: External walls (First second floors)

- Load definitions → Dead load → primary → member → uniform force → $(G_y - 2.8 \text{ KN/m}^2)$ → add → assign.

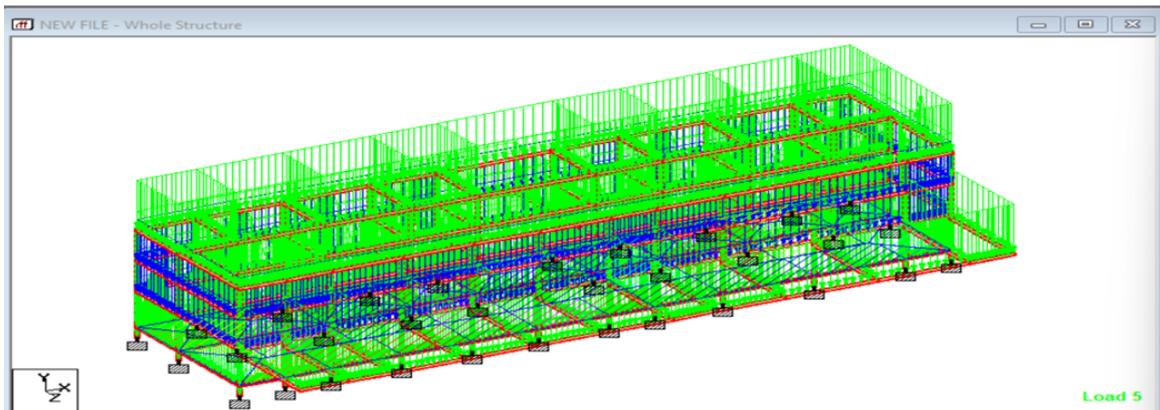


Figure 5.6: Dead Load: Internal walls (First second floors)

- Load definitions → Dead load → primary → member → uniform force → $(G_y - 0.63 \text{ KN/m}^2)$ → add → assign.
- Load definitions → Dead load → primary → member → uniform force $(y - 0.001 \text{ KN/mm}^2)$ → add → assign.
- Load definitions → Live load → primary → member → uniform force $(G_y - 0.003 \text{ KN/mm}^2)$ → add → assign.
- Load definitions → Wind load → Exposure surface direction(x) → ok → add → assign.
- Wind intensity → type(custom) → intensity (1.132 KN/mm^2) , Height $(3.82\text{m}, 3.22\text{m}, 3.22\text{m})$.

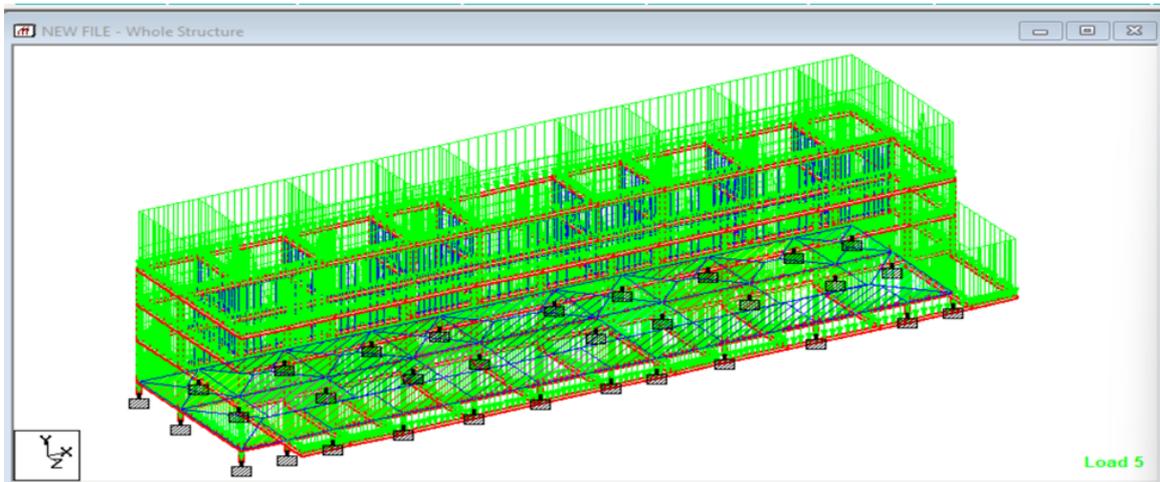


Figure 5.7: Load on Parapet walls

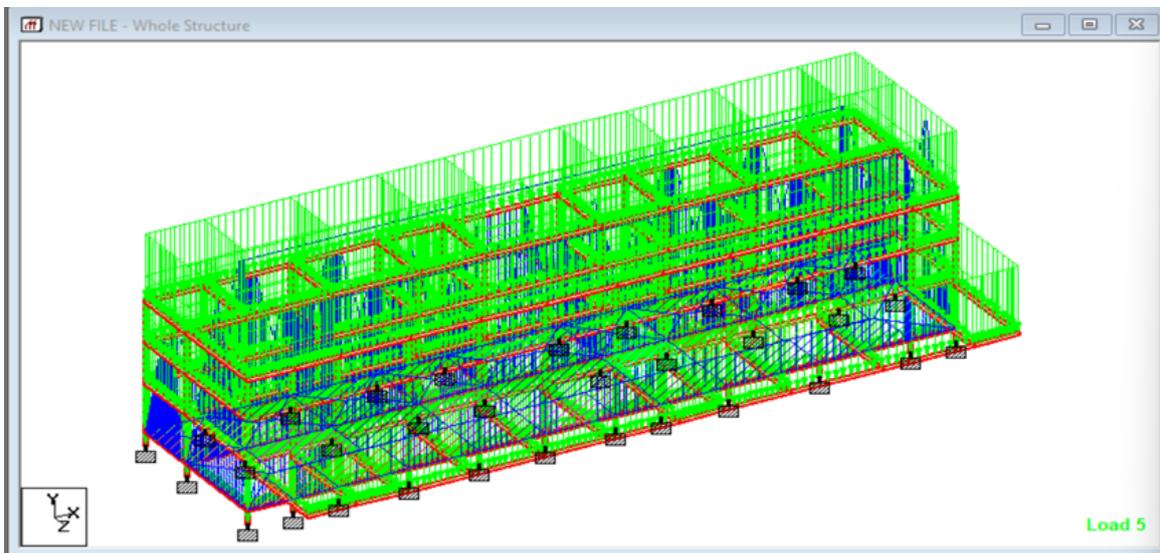


Figure 5.8: Floor Load

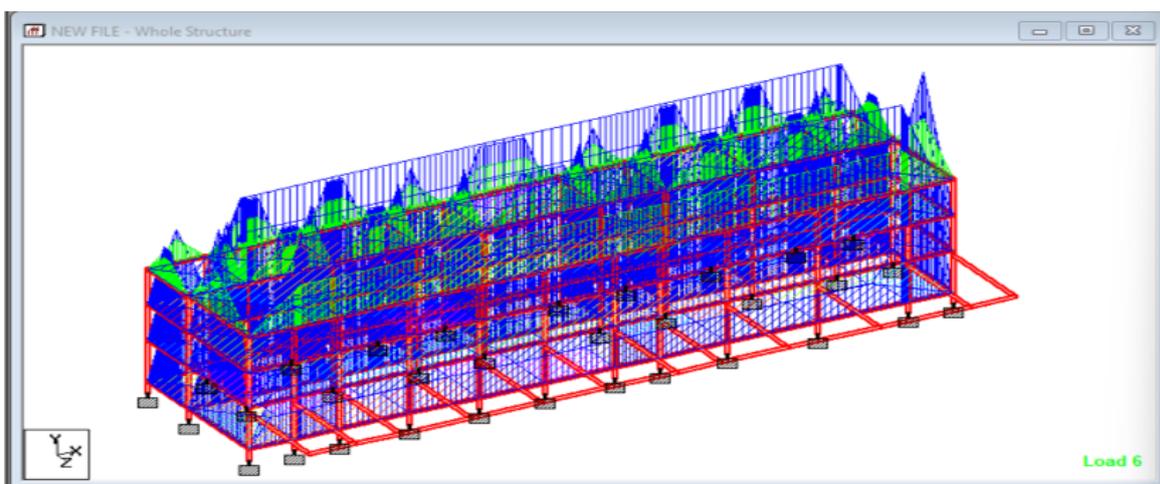


Figure 5.9: Live Load

- Load definitions → Wind load → Exposure surface direction(Z) → ok → add → assign.
- Define → combination loads → add live load(1) → dead load(1) → add → assign.

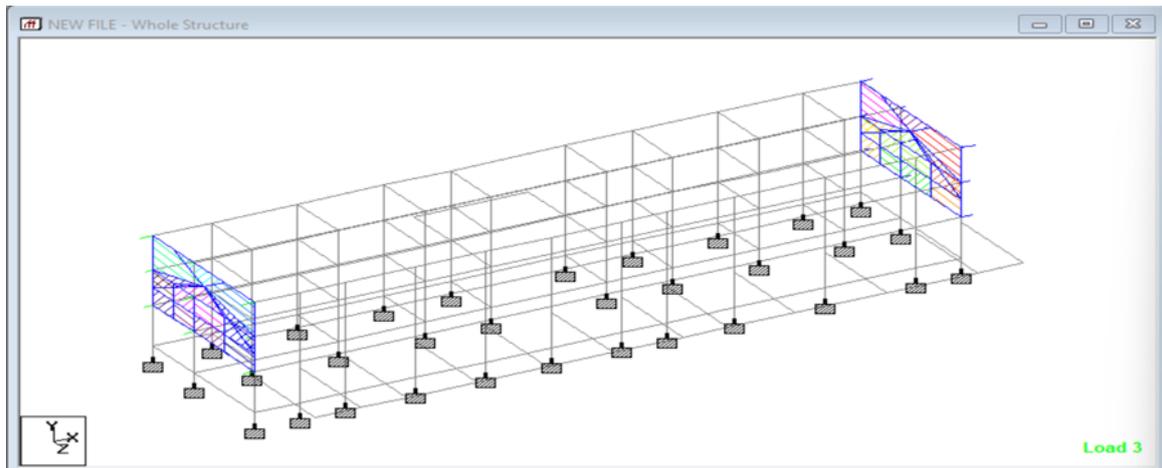


Figure 5.10: Wind Load at X-direction

- Load definitions → primary → seismic (XZ direction) → add → assign

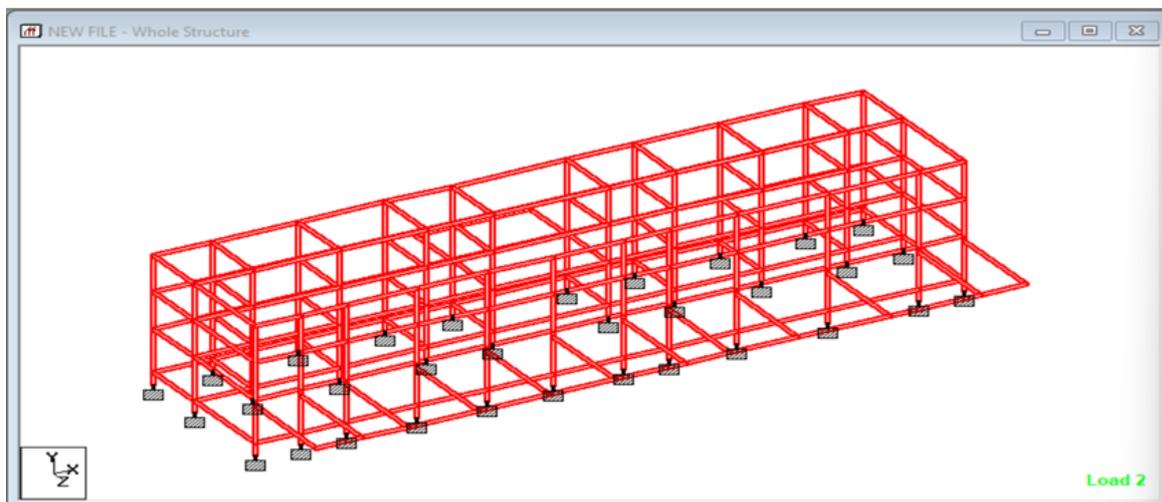


Figure 5.11: Seismic Load

- Analysis / Print → view → for all elements → add → run analysis → done.
- Post Processing → results → view value → beam results → shear force → annotate → close → bending moment → annotate → close → displacement → annotate – close → Analyze → run analysis → view output file → ok.
- Design Steel → IS 800 LSD → FYLD 250N/mm² → add → assign → track 2 → add → assign → close → commands → take off → add → assign → close.
- Double click on Beam member → Steel design → ok.
- Double click on Column member → Steel design → ok.

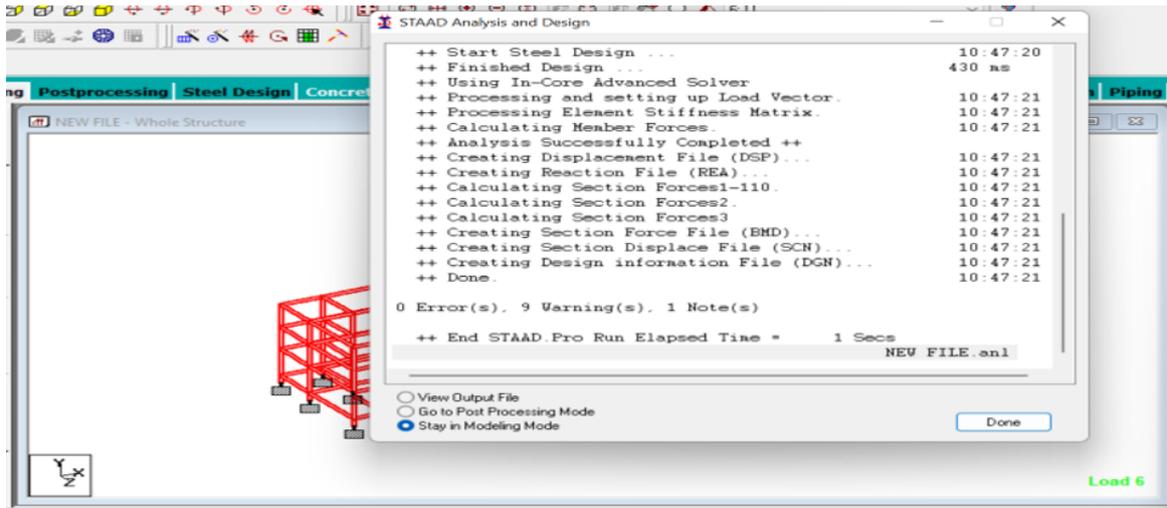


Figure 5.12: Output Result

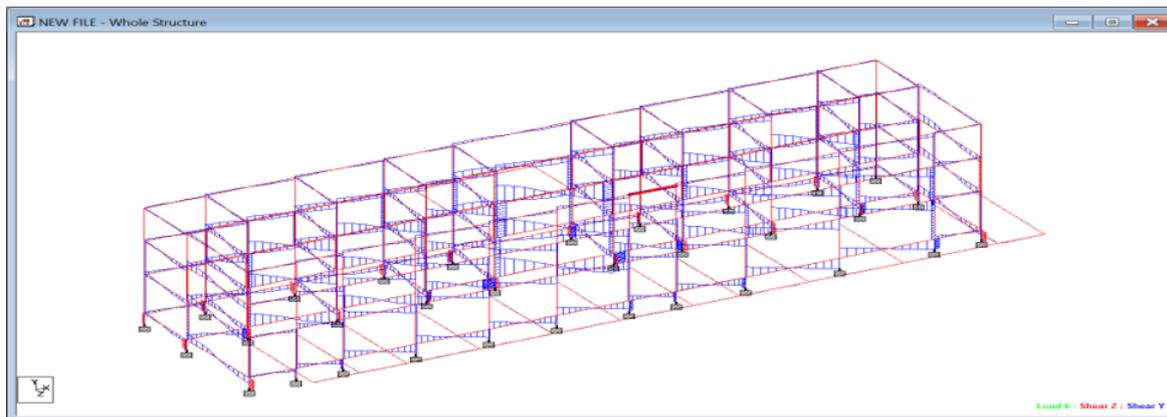


Figure 5.13: Shear force diagram

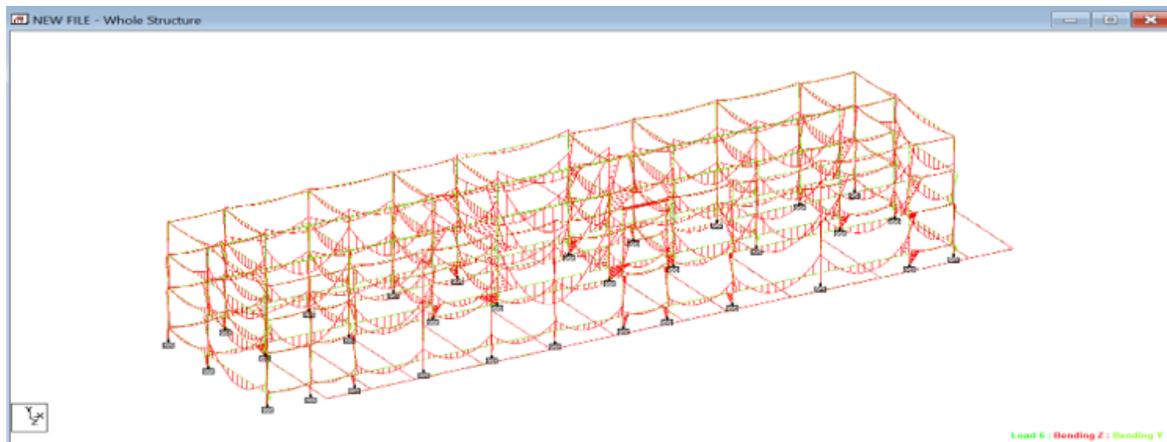


Figure 5.14: Bending moment diagram

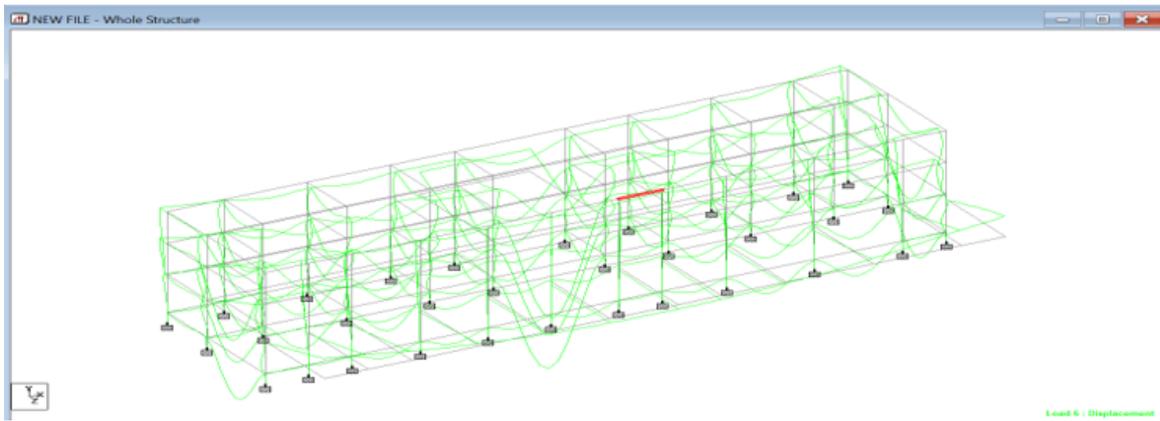


Figure 5.15: Deflection diagram

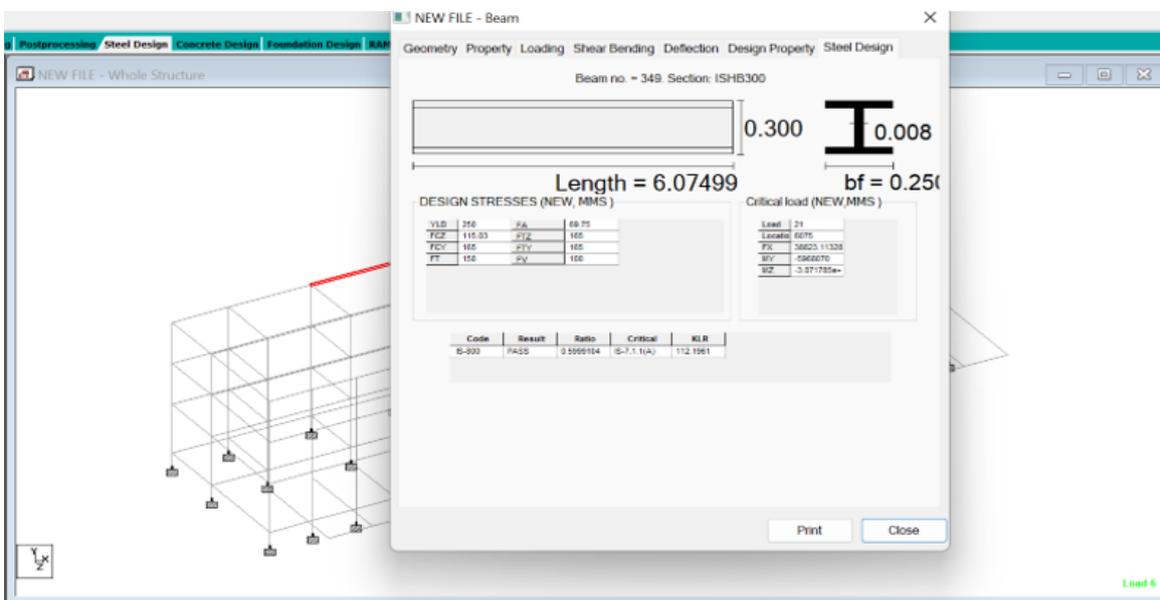


Figure 5.16: Beam Result @ 340 ISHB 300

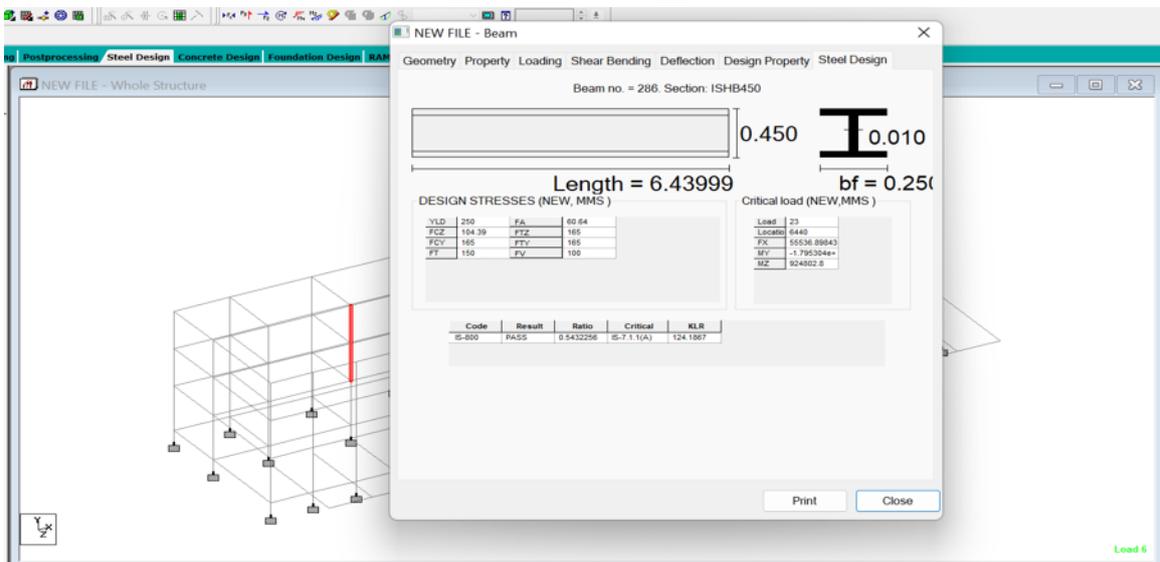


Figure 5.17: Column Result @ 286 ISHB 450

MANUAL DESIGN AND CALCULATIONS

TWO WAY SLAB:

Take as Guest 100 m Lx = 3.95 m, Ly = 4.8 m

Live Load = 3KN/m² Floor Finish = 1KN/m²

fck = 20 N/mm² fy = 500 N/mm² Condition is corners are held down

Ly/Lx=4.2/3.95 = 1.21 < 2

Hence, the slab is to be designed as a two way slab.

1.Data:

Short span, Lx = 3.95 m, Ly = 4.8 m

Live Load = 3 KN/m²

Floor finish = 1 KN/m²

fck = 20 N/mm²

fy = 500 N/mm²

2.Thickness of Slab:

Overall Depth = 120 mm

Effective Depth = 100 mm

3.Effective Span:

Lx = 3.95+0.1 = 4.05 m

Ly = 4.8+0.1 = 4.9 m

Ly/Lx=4.9/4.05 = 1.209

4.Loads:

Self Weight of the slab = 0.12 x 25 = 3 KN/m²

$$\text{Live Load} = 3 \text{ KN/m}^2$$

$$\text{Floor Finish} = 1 \text{ KN/m}^2$$

$$\text{Total Load} = 7 \text{ KN/m}^2$$

$$\text{Factored Load} = 1.5 \times 7 = 10.5 \text{ KN/m}^2$$

5. Design Moments and Shear force:

The slab is simply supported on all the four sides. The corners are held down. Hence moment coefficients are obtained from table 27 of IS 456

$$\alpha_x = 0.072 + (0.079 - 0.072) / (1.31 - 1.2) \times (1.21 - 1.2)$$

$$\alpha_x = 0.0727$$

$$\alpha_y = 0.056$$

$$M_{ux} = \alpha_x W L_x^2 = 0.0727 \times 10.5 \times 4.05^2 = 12.52 \text{ KN m}$$

$$M_{uy} = \alpha_y W L_y^2 = 0.056 \times 10.5 \times 4.05^2 = 9.64 \text{ KN m}$$

$$V_u = W_u L / 2 = 10.5 \times 4.05 / 2 = 21.26 \text{ KN}$$

6. Minimum Depth Required:

The minimum depth required to resist Bending moment

$$M_u = 0.138 F_{ck} b d^2$$

$$12.52 \times 10 = 0.138 \times 20 \times 1000 \times d^2$$

$$d = \sqrt{(12.52 \times 10) / (0.138 \times 20 \times 1000)} = 67.35 \text{ mm} < 110 \text{ mm}$$

Hence provided depth is adequate

7. Reinforcement:

Along x-direction (short span)

$$M_{ux} = 0.87 \times f_y \times A_{st} \times d (1 - (f_y \times A_{st}) / (f_{ck} \times b \times d))$$

$$12.52 \times 10 = 0.87 \times 500 \times A_{st} \times 110 (1 - 500 \times A_{st} / (20 \times 1000 \times 110))$$

$$A_{st} = 280 \text{ mm}^2$$

using 8 mm diameter bars, spacing of bars

$$S = a_{st} / A_{st} \times 1000$$

$$= 180 \text{ mm}$$

maximum spacing is (i) $3d = 3 \times 110 = 330 \text{ mm}$

(ii) 300 mm which ever is less

Hence, provide 8 mm bars at 180 mm c/c

Along y-direction:

These bars will be placed above the bars in x-direction

$$\text{Hence, } d = 110 - 8 = 102 \text{ mm}$$

$$M_u = 0.87 f_y \times A_{st} \times d (1 - (f_y \times A_{st}) / (f_{ck} \times b \times d))$$

$$9.64 \times 10^6 = 0.87 \times 500 \times A_{st} \times 102 (1-500 \times A_{st}/20 \times 1000 \times 102)$$

$$A_{st} = 230.26 \text{ mm}^2$$

using 8 mm diameter bars, spacing of bars

$$=ast/A_{st} \times 1000 = 218.3 \text{ mm}$$

Maximum spacing is (i) $3d = 3 \times 102 = 306\text{mm}$

(ii) 300 mm which ever is less

Hence, provide 8 mm bars at 218 mm c/c

8.Reinforcement in Edge Step:

$A_{st} = 0.12 = 0.12$ using 8 mm diameter bars spacing of bars

$$S = 349 \text{ mm}$$

Maximum spacing is (i) $5d = 5 \times 110 = 550$

(ii) 450 mm which ever is less

Hence provide 8 mm bars at 300 mm c/c in edge strip in both direction

9.Torsion Reinforcement

Area of reinforcement in each layer

$$A_t = 3/4 \times A_{st} = 3/4 \times 280 = 210 \text{ mm}^2$$

Distance over which torsion reinforcement is to be provided = $1/5 \times$ short span

$$= 1/5 L_x = 4050/5 = 810\text{mm}$$

Using 6mm bars, spacing

$$\text{Spacing} = 134.63 \text{ mm}$$

Hence, provide 6 mm bars at 130 mm c/c at all the four corners in four layers

9. Check for Deflection:

For simply supported slabs basic value of L/d ratio modification factor for tension steel F1

$$Pt = 0.28$$

$$Fs = 0.58 \times f_y = 0.58 \times 500 = 290 \text{ N/mm}^2$$

from fig 4 of IS 456, modification factor = 1.7

$$\text{maximum permitted L/d ratio} = 1.7 \times 20 = 34$$

$$L/d \text{ provided} = 4050/120 = 34$$

Hence deflection control is safe.

$$P = 173.458 \text{ KN, both ends are hinged, ISHB 400, } f_{cd} = 135 \text{ N/mm}^2$$

Gusset base, diameter of bolt = 20mm; ISHB 400

COLUMN DESIGN:

Height of Ground floor = 3600 mm, Slab thickness = 100 mm, Height of column = 3710 mm

Given $e = 3710$ mm, $P = 1198$ KN, Section = ISHB 450,

Assume $f_{cd} = 135$ N/mm²

1. ISHB 450 @872N/m

$h = 450$ mm $a = 11714$ mm², $b = 250$ mm

$T_f = 13.7$ mm, $T_w = 9.8$ mm

$R_{yy} = 51.8$ mm, $R_{zz} = 187.8$ mm

2. Buckling class:

$h/b_f = 450/250 = 1.8 > 1.2$

$T_f = 13.7 < 40$

The chosen section belongs to buckling class 'a' about z-z axis and 'b' about y-y axis

3. Effective length (KL) = $0.65L = 0.65 \times 3.71 = 2.412$ m

(both ends are restrained = $0.65L$)

(From IS: 800: 2007, Table 11)

4. Effective slenderness ratio = $KL/R_{min} = 2412/51.8 = 46.56 < 100$

5. Design compressive stress (f_{cd}):

Take from table 9(b) of IS 800

For $KL/R_{min} = 40$, $f_y = 250$ N/mm², $f_{cd} = 206$

$KL/R_{min} = 50$, $f_y = 250$ N/mm², $f_{cd} = 194$

$KL/R_{min} = 46.56$, $f_y = 250$ N/mm², $f_{cd} = 1$

$f_{cd} = 206 - [(206 - 194)/(50 - 40)] \times (46.56 - 40) = 198.128$ N/mm²

6. Design Compressive Strength: $P_d = A_e \times f_{cd} = 1198 \times 198.128 = 237.4$ KN $>$
1198KN Hence safe

Use ISHB 450@ 872N/m as a column

COLUMN BASE:

Load = 1198KN, ISHB 450@872KN/m, Diameter = 20mm

Properties:

$h = 450$ mm; $a = 11114$ mm² $b = 250$ mm; $T_f = 13.7$ mm; $T_w = 9.8$ mm

1. Allowable bearing pressure of concrete:

Bearing strength of concrete = $0.45 \times f_{ck} = 0.45 \times 20 = 9$ N/mm²

2. Area of Gusseted base:

$A = P/0.45 \times f_{ck} = 1198 \times 10^3 / 0.45 \times 20 = 133111.11$ mm²

3. Gusset plate and Gusset angle:

Assume gusset plate of thickness 10 mm and gusset angled ISA 150 x 170 x 10 mm

4. Size of base plate:

$L = \text{width of column section} + 2 \times \text{thickness of gusset plate} + 2 \times \text{width of gusset plate} + 2 \times$
Assumed projection

(Assume projection as 5 mm in one side)

$$L = 450 + 2 \times 10 + 2 \times 75 + 2 \times 5 = 630 \text{ mm}$$

$$B = A/L = 133.11 \times 10^3 / 630 = 220 \text{ mm}$$

Size of the gusset base provided = 630 mm x 220 mm

It is equal to = $138.6 \times 10^3 \text{ mm}^2 > A \text{ required}$

5. Actual bearing pressure of concrete:

$$W = P / (\text{area provided}) = 1198 \times 10^3 / 138.6 \times 10^3 = 8.64 \text{ N/mm}^2$$

6. Combined thickness of base plate and gusset angle:

$$8.64 \times 630 = 5443.2 \text{ N/mm}$$

Consider section x-x

$$\text{Bending moment at x-x} = WL^2/2 = (5443.2 \times (7510)^2) / 2 = 11498.76 \times 10^3 \text{ N/mm}$$

Moment capacity of base plate

$$M = (1.2 \times z_e \times f_y) / \gamma_{mo}$$

for rectangle section, $Z_e = b^2/6$

$$11498.76 \times 10^3 = (1.2 \times b^2 \times 250) / 1.1$$

$$Z_e = 42162.12 \text{ mm}^3$$

$$bd^2/6 = 42162.12$$

$$d = 33.9 \text{ mm}$$

$$\text{thickness of base} = 33.9 - 10 = 23.9 \text{ mm}$$

$$t = 24 \text{ mm}$$

Size of gusset base = 630 x 220 x 24 mm

Chapter 7

ESTIMATION AND COSTING

REINFORCEMENT COST ESTIMATION

S.No	Length	Dia	Spacing1	Spacing2	No of bars mz	No of bars mx	Wt in mz	Wt in mx	Total Wtkg	Total wt	Cost per kg	Total cost
1	1.55	12	70	65	24.84615385	23.14285714	34.19026842	31.84639775	66.03666617			
	1.55	16	70	70	23.14285714	23.14285714	56.61581821	56.61581821	113.2316364	179.2683026	77	13803.6593
	2.35	16	80	70	34.57142857	30.375	128.2254712	112.6609125	240.8863837			0
2	2.35	12	70	70	34.57142857	34.57142857	72.12682755	72.12682755	144.2536551	385.1400388	77	29655.78298
	1.9	12	55	55	35.54545455	35.54545455	59.95830064	59.95830064	119.9166013			0
	2.25	16	85	70	28.14285714	28.14285714	47.47155188	47.47155188	94.94310375	214.859705	77	16544.19729
3	1.9	12	70	70	33.14285714	27.47058824	117.6959662	97.5527671	215.2487333			0
	2.25	12	70	70	33.14285714	33.14285714	66.20398098	66.20398098	132.407962	347.6566952	77	26769.56553
	2.2	16	90	75	30.33333333	25.44444444	105.325113	88.34963694	193.67475			0
4	2.2	12	70	70	32.42857143	32.42857143	63.33767835	63.33767835	126.6753567	320.3501067	77	24666.95821
	3.2	16	60	55	59.18181818	54.33333333	298.9010201	274.4134813	573.3145014			0
	3.2	12	75	75	43.66666667	43.66666667	124.054254	124.054254	248.108508	821.4230094	77	63249.57172
5	3.2	16	60	50	54.33333333	65	328.2860666	274.4134813	602.6995479			0
	3.2	12	75	75	43.66666667	43.66666667	124.054254	124.054254	248.108508	850.8080559	77	65512.2203
	2.25	16	85	70	33.14285714	27.47058824	117.6959662	97.5527671	215.2487333			0
6	2.25	12	70	70	33.14285714	33.14285714	66.20398098	66.20398098	132.407962	347.6566952	77	26769.56553
	2.25	16	85	70	33.14285714	27.47058824	117.6959662	97.5527671	215.2487333			0
	2.25	12	70	70	33.14285714	33.14285714	66.20398098	66.20398098	132.407962	347.6566952	77	26769.56553
7	1.9	12	55	55	35.54545455	35.54545455	59.95830064	59.95830064	119.9166013			0
	1.9	12	70	70	28.14285714	28.14285714	47.47155188	47.47155188	94.94310375	214.859705	77	16544.19729
	2.9	12	55	50	59	53.72727273	151.9013564	138.3261966	290.227553			0
8	2.45	12	70	70	42.42857143	42.42857143	109.2365686	109.2365686	218.4731372	508.7006902	77	39169.95314
	2.45	16	65	55	45.54545455	38.69230769	176.1165789	149.6166177	325.7331965			0
	2.45	12	75	75	33.66666667	33.66666667	73.22811344	73.22811344	146.4562269	472.1894234	77	36358.5856
9	2.55	16	80	70	37.42857143	32.875	150.6373084	132.3107275	282.9480359			0
	2.55	12	75	75	35	79.23551171	79.23551171	158.4710234	441.4190594			0
	2.45	16	70	65	38.69230769	36	149.6166177	139.2059186	288.8225363			0
10	2.45	12	70	70	36	78.30332922	78.30332922	156.6066584	445.4291947			0
	3.1	16	70	70	45.28571429	45.28571429	221.5705478	221.5705478	443.1410956			0
	3.1	12	75	75	42.33333333	42.33333333	116.5080148	116.5080148	233.0160296	676.1571252	77	52064.09864
11	3.15	16	75	50	64	43	318.1849568	213.7805179	531.9654747			0
	3.15	12	70	70	46	128.6411837	128.6411837	257.2823674	789.2478422			0
	2.5	16	60	55	46.45454545	42.66666667	183.2978366	168.351829	351.6496656			0
12	2.5	12	75	75	34.33333333	34.33333333	76.20221948	76.20221948	152.404439	504.0541045	77	38812.16605
	2.55	16	70	70	37.42857143	37.42857143	150.6373084	150.6373084	301.2746169			0
	2.55	12	70	70	37.42857143	37.42857143	84.733486	84.733486	169.466972	470.7415889	77	36247.10234
13	2.4	16	70	65	37.92307692	35.28571429	143.6494356	133.6593271	277.3087628			0
	2.4	12	70	70	35.28571429	35.28571429	75.1833715	75.1833715	150.366743	427.6755058	77	32931.01394
	2.9	16	80	70	42.42857143	37.25	194.1983442	170.4956843	364.6940285			0
14	2.9	12	70	70	42.42857143	42.42857143	109.2365686	109.2365686	218.4731372	583.1671658	77	44903.87176
	1.9	12	55	50	39	35.54545455	65.78545006	59.95830064	125.7437507			0
	1.9	12	75	75	26.33333333	26.33333333	44.41923551	44.41923551	88.83847102	214.5822217	77	16522.83107
15	1.85	16	65	55	34.63636364	29.46153846	101.1330568	86.02333302	187.1563898			0
	1.85	12	75	75	25.66666667	25.66666667	42.15536375	42.15536375	84.3107275	271.4671173	77	20902.96804
	2.9	16	80	70	42.42857143	37.25	194.1983442	170.4956843	364.6940285			0
16	2.9	12	75	75	39.66666667	39.66666667	102.1257707	102.1257707	204.2515413	568.9455698	77	43808.80888
	2.45	16	70	65	38.69230769	36	149.6166177	139.2059186	288.8225363			0
	2.45	12	70	70	36	78.30332922	78.30332922	156.6066584	445.4291947			0
17	2.55	16	70	70	37.42857143	37.42857143	150.6373084	150.6373084	301.2746169			0
	2.55	12	70	70	37.42857143	37.42857143	84.733486	84.733486	169.466972	470.7415889	77	36247.10234
	2.5	16	70	60	42.66666667	36.71428571	168.351829	144.8652457	313.2170747			0
18	2.5	12	75	75	34.33333333	34.33333333	76.20221948	76.20221948	152.404439	465.6215137	77	35852.85656
	2.7	16	80	75	37	34.75	157.6720099	148.0838471	305.755857			0
	2.7	12	70	70	39.57142857	39.57142857	94.85432447	94.85432447	189.7086489	495.4645059	77	38150.76695
19	2.35	16	70	60	40.16666667	34.57142857	148.9782162	128.2254712	277.2036874			0

Figure 7.1: Reinforcement Estimation

28	2.35	12	70	70	34.57142857	34.57142857	72.12682755	72.12682755	144.2536551	421.4573425	77	32452.21537
	2.65	16	70	65	41.76923077	38.85714286	174.6994214	162.5196407	337.2190621			0
29	2.65	12	70	70	38.85714286	38.85714286	91.41729787	91.41729787	182.8345957	520.0536578	77	40044.13165
	2.55	16	70	65	40.23076923	37.42857143	161.9152044	150.6373084	312.5525128			0
30	2.55	12	70	70	37.42857143	37.42857143	84.733486	84.733486	169.466972	482.0194848	77	37115.50033
	2.55	16	80	70	37.42857143	32.875	150.6373084	132.3107275	282.9480359			0
31	2.45	12	75	75	35	35	79.23551171	79.23551171	158.4710234	441.4190594	77	33989.26757
	2.45	16	65	55	45.54545455	38.69230769	176.1165789	149.6166177	325.7331965			0
32	2.45	12	75	75	33.66666667	33.66666667	73.22811344	73.22811344	146.4562269	472.1894234	77	36358.5856
	2.9	12	55	50	53.72727273	53.72727273	151.9013564	138.3261966	290.227553			0
33	2.9	12	75	75	39.66666667	39.66666667	102.1257707	102.1257707	204.2515413	494.4790943	77	38074.89026
	1.85	12	70	65	29.46153846	27.42857143	48.38812482	45.04914568	93.4372705			0
34	1.85	12	70	70	27.42857143	27.42857143	45.04914568	45.04914568	90.09829135	183.5355618	77	14132.23826
	1.55	16	80	70	23.14285714	20.375	56.61581821	49.84463625	106.4604545			0
35	1.55	12	70	70	23.14285714	23.14285714	31.84639775	31.84639775	63.69279549	170.15325	77	13101.80025
	2.35	12	55	55	43.72727273	43.72727273	91.22878601	91.22878601	182.457572			0
36	2.35	12	70	70	34.57142857	34.57142857	72.12682755	72.12682755	144.2536551	326.7112271	77	25156.76449
	1.9	16	85	70	28.14285714	23.3594118	84.39987	70.03007829	154.4338883			0
37	1.9	12	70	70	28.14285714	28.14285714	47.47155188	47.47155188	94.94310375	249.367002	77	19201.25916
	2.25	16	85	80	29.125	27.47058824	103.4278668	97.5527671	200.9806339			0
38	2.25	12	75	75	31	31	61.92355117	61.92355117	123.8471023	324.8277363	77	25011.73569
	2.15	16	85	75	29.66666667	26.29411765	100.6691328	89.22492203	189.8940548			0
39	2.15	12	75	75	29.66666667	29.66666667	56.62638718	56.62638718	113.2527744	303.1468291	77	23342.30584
	2.15	16	90	80	27.875	24.88888889	94.58939581	84.45650089	179.0458967			0
40	2.15	12	70	70	31.71428571	31.71428571	60.5347895	60.5347895	121.069579	300.1154757	77	23108.89163
	2.2	12	55	75	30.33333333	41	59.24537608	80.07891492	139.324291			0

Figure 7.2: Reinforcement Estimation

41	2.2	12	70	70	32.42857143	32.42857143	63.33767835	63.33767835	126.6753567	265.9996477	77	20481.97287
	2.05	16	90	70	30.28571429	23.77777778	97.98978334	76.93327853	174.9230619			0
42	2.05	12	70	70	30.28571429	30.28571429	55.11925313	55.11925313	110.2385063	285.1615681	77	21957.44075
	2.2	16	85	55	41	26.88235294	142.3625154	93.34242402	235.7049394			0
43	2.2	12	70	70	32.42857143	32.42857143	63.33767835	63.33767835	126.6753567	362.3802961	77	27903.2828
	2.25	12	55	70	33.14285714	41.90909091	66.20398098	83.71483018	149.9188112			0
44	2.25	12	70	70	33.14285714	33.14285714	66.20398098	66.20398098	132.407962	282.3267731	77	21739.16153
	1.9	16	80	65	30.23076923	24.75	90.65503177	74.21948212	164.8745139			0
45	1.9	12	70	70	28.14285714	28.14285714	47.47155188	47.47155188	94.94310375	259.8176176	77	20005.95656
	2.35	12	70	70	34.57142857	34.57142857	72.12682755	72.12682755	144.2536551			0
46	2.35	12	70	70	34.57142857	34.57142857	72.12682755	72.12682755	144.2536551	288.5073102	77	22215.06289
	1.55	16	85	65	24.84615385	19.23529412	60.78269942	47.0565025	107.8392019			0
47	1.55	12	70	70	23.14285714	23.14285714	31.84639775	31.84639775	63.69279549	171.5319974	77	13207.9638
	1.9	12	55	65	30.23076923	35.54545455	50.99345537	59.95830064	110.951756			0
48	1.9	12	70	70	28.14285714	28.14285714	47.47155188	47.47155188	94.94310375	205.8948598	77	15853.9042
	2.35	16	80	70	34.57142857	30.375	128.2254712	112.6609125	240.8863837			0
49	2.35	12	70	70	34.57142857	34.57142857	72.12682755	72.12682755	144.2536551	385.1400388	77	29655.78298
	1.55	12	70	65	24.84615385	23.14285714	34.19026842	31.84639775	66.03666617			0
50	1.55	12	70	70	23.14285714	23.14285714	31.84639775	31.84639775	63.69279549	129.7294617	77	9989.168548
												1509714.139

Total cost Rs.160000/-

Figure 7.3: Reinforcement Estimation

SOIL EXACAVATION COST ESTIMATION

S.no	Length	Breadth	Depth	Cutting	Qty in cubic m	rate per cubic m	Total cost Rs
1	1.55	1.55	0.305	2	5.5377625	192.38	1065.35475
2	2.35	2.35	0.506	2	13.839385	192.38	2662.420886
3	1.9	1.9	0.405	2	8.68205	192.38	1670.252779
4	2.25	2.25	0.456	2	12.4335	192.38	2391.95673
5	2.2	2.2	0.456	2	11.88704	192.38	2286.828755
6	3.2	3.2	0.656	2	27.19744	192.38	5232.243507
7	3.2	3.2	0.656	2	27.19744	192.38	5232.243507
8	2.25	2.25	0.456	2	12.4335	192.38	2391.95673
9	2.25	2.25	0.456	2	12.4335	192.38	2391.95673
10	1.9	1.9	0.405	2	8.68205	192.38	1670.252779
11	2.35	2.35	0.506	2	13.839385	192.38	2662.420886
12	1.55	1.55	0.305	2	5.5377625	192.38	1065.35475
13	1.9	1.9	0.405	2	8.68205	192.38	1670.252779
14	2.9	2.9	0.606	2	21.91646	192.38	4216.288575
15	2.45	2.45	0.506	2	15.042265	192.38	2893.830941
16	2.55	2.55	0.556	2	16.62039	192.38	3197.430628
17	2.45	2.45	0.556	2	15.34239	192.38	2951.568988
18	3.1	3.1	0.656	2	25.52416	192.38	4910.337901
19	3.15	3.15	0.656	2	26.35416	192.38	5070.013301
20	2.5	2.5	0.556	2	15.975	192.38	3073.2705
21	2.55	2.55	0.556	2	16.62039	192.38	3197.430628
22	2.4	2.4	0.506	2	14.43456	192.38	2776.920653
23	2.9	2.9	0.606	2	21.91646	192.38	4216.288575
24	1.9	1.9	0.405	2	8.68205	192.38	1670.252779
25	1.85	1.85	0.405	2	8.2311125	192.38	1583.501423
26	2.9	2.9	0.606	2	21.91646	192.38	4216.288575
27	2.45	2.45	0.506	2	15.042265	192.38	2893.830941
28	2.55	2.55	0.556	2	16.62039	192.38	3197.430628
29	2.5	2.5	0.556	2	15.975	192.38	3073.2705
30	2.7	2.7	0.556	2	18.63324	192.38	3584.662711
31	2.35	2.35	0.506	2	13.839385	192.38	2662.420886
32	2.65	2.65	0.556	2	17.94951	192.38	3453.126734
33	2.55	2.55	0.556	2	16.62039	192.38	3197.430628
34	2.55	2.55	0.556	2	16.62039	192.38	3197.430628
35	2.45	2.45	0.506	2	15.042265	192.38	2893.830941
36	2.9	2.9	0.606	2	21.91646	192.38	4216.288575
37	1.85	1.85	0.405	2	8.2311125	192.38	1583.501423
38	1.55	1.55	0.405	2	5.7780125	192.38	1111.574045
39	2.35	2.35	0.405	2	13.2816125	192.38	2555.116613
40	1.9	1.9	0.405	2	8.68205	192.38	1670.252779
41	2.25	2.25	0.405	2	12.1753125	192.38	2342.286619
42	2.15	2.15	0.405	2	11.1171125	192.38	2138.710103
43	2.15	2.15	0.405	2	11.1171125	192.38	2138.710103
44	2.2	2.2	0.405	2	11.6402	192.38	2239.341676
45	2.05	2.05	0.405	2	10.1070125	192.38	1944.387065
46	2.2	2.2	0.405	2	11.6402	192.38	2239.341676
47	2.25	2.25	0.405	2	12.1753125	192.38	2342.286619
48	1.9	1.9	0.405	2	8.68205	192.38	1670.252779
49	2.35	2.35	0.405	2	13.2816125	192.38	2555.116613
50	1.55	1.55	0.405	2	5.7780125	192.38	1111.574045
							136379.0944

Total cost Rs.140000/-

Figure 7.4: Soil Excavation Estimation

CONCRETE COST ESTIMATION

S.No	Length	Width	Depth	Quantity	Cost /Cubic m	Total Cost
1	1.55	1.55	0.305	0.732763	4845	3550.234313
2	2.35	2.35	0.506	2.794385	4845	13538.79533
3	1.9	1.9	0.405	1.46205	4845	7083.63225
4	2.25	2.25	0.456	2.3085	4845	11184.6825
5	2.2	2.2	0.456	2.20704	4845	10693.1088
6	3.2	3.2	0.656	6.71744	4845	32545.9968
7	3.2	3.2	0.656	6.71744	4845	32545.9968
8	2.25	2.25	0.456	2.3085	4845	11184.6825
9	2.25	2.25	0.456	2.3085	4845	11184.6825
10	1.9	1.9	0.405	1.46205	4845	7083.63225
11	2.35	2.35	0.506	2.794385	4845	13538.79533
12	1.55	1.55	0.305	0.732763	4845	3550.234313
13	1.9	1.9	0.405	1.46205	4845	7083.63225
14	2.9	2.9	0.606	5.09646	4845	24692.3487
15	2.45	2.45	0.506	3.037265	4845	14715.54893
16	2.55	2.55	0.556	3.61539	4845	17516.56455
17	2.45	2.45	0.556	3.33739	4845	16169.65455
18	3.1	3.1	0.656	6.30416	4845	30543.6552
19	3.15	3.15	0.656	6.50916	4845	31536.8802
20	2.5	2.5	0.556	3.475	4845	16836.375
21	2.55	2.55	0.556	3.61539	4845	17516.56455
22	2.4	2.4	0.506	2.91456	4845	14121.0432
23	2.9	2.9	0.606	5.09646	4845	24692.3487
24	1.9	1.9	0.405	1.46205	4845	7083.63225
25	1.85	1.85	0.405	1.386113	4845	6715.715063
26	2.9	2.9	0.606	5.09646	4845	24692.3487
27	2.45	2.45	0.506	3.037265	4845	14715.54893
28	2.55	2.55	0.556	3.61539	4845	17516.56455
29	2.5	2.5	0.556	3.475	4845	16836.375
30	2.7	2.7	0.556	4.05324	4845	19637.9478
31	2.35	2.35	0.506	2.794385	4845	13538.79533
32	2.65	2.65	0.556	3.90451	4845	18917.35095
33	2.55	2.55	0.556	3.61539	4845	17516.56455
34	2.55	2.55	0.556	3.61539	4845	17516.56455
35	2.45	2.45	0.506	3.037265	4845	14715.54893
36	2.9	2.9	0.606	5.09646	4845	24692.3487
37	1.85	1.85	0.405	1.386113	4845	6715.715063
38	1.55	1.55	0.405	0.973013	4845	4714.245563
39	2.35	2.35	0.405	2.236613	4845	10836.38756
40	1.9	1.9	0.405	1.46205	4845	7083.63225
41	2.25	2.25	0.405	2.050313	4845	9933.764063
42	2.15	2.15	0.405	1.872113	4845	9070.385063
43	2.15	2.15	0.405	1.872113	4845	9070.385063
44	2.2	2.2	0.405	1.9602	4845	9497.169
45	2.05	2.05	0.405	1.702013	4845	8246.250563
46	2.2	2.2	0.405	1.9602	4845	9497.169
47	2.25	2.25	0.405	2.050313	4845	9933.764063
48	1.9	1.9	0.405	1.46205	4845	7083.63225
49	2.35	2.35	0.405	2.236613	4845	10836.38756
50	1.55	1.55	0.405	0.973013	4845	4714.245563
						704437.5274

Figure 7.5: Concrete Estimation

TOTAL COST OF THE FOUNDATION

Excavation	Concrete	Reinforcement	Total cost
1400000	705500	1600000	3705500

WALLS ESTIMATION

	Length	Width	Depth	No's	Quantity	Total Quantity	Cost / Cubic me	Overall Cost
GF								
long wall	50	0.25	3.6	4	45	180	1872	336960
short wall	12.6	0.25	3.6	12	11.34	136.08	1872	254741.76
Interior	5.03	0.25	3.6	14	4.527	63.378	1872	118643.616
FF,SF		0.25						0
long wall	50	0.25	3	8	37.5	300	1872	561600
short wall	12.6	0.25	3	24	9.45	226.8	1872	424569.6
Interior	5.03	0.25	3	28	3.7725	105.63	1872	197739.36
								Total cost Rs.1900000/-
								1894254.336

DEDUCTIONS

Dining hall	3	0.25	3.6	1	2.7	2.7	1872	5054.4
Staircase	3	0.25	3.6	3	2.7	8.1	1872	15163.2
Staircase	3	0.25	3	6	2.25	13.5	1872	25272
Entrance	2	0.25	3.6	1	1.8	1.8	1872	3369.6
Windows	1.2	0.25	1.2	90	0.36	32.4	1872	60652.8
Doors	1.2	0.25	2.1	36	0.63	22.68	1872	42456.96
Ventilators	0.5	0.25	0.4	40	0.05	2	1872	3744
								Total cost Rs.1600000/-
								155712.96

Figure 7.6: Total Cost Estimation

STEEL STRUCTURES

	Length	Wt per m	Total Wt in metric ton	Cost per metric ton	Total cost
ISMB450	480	1.207	59.19	56000	3314646
ISMB300	257	0.604	16	53411	854576
ISA60606	123.7	5.4	0.668	56000	37408
ISA90606	250	6.8	1.7	56000	95200
					4301830

Total Cost Rs.4400000/-

CONCRETE SLAB ESTIMATION

Length	Width	Depth	Qty	Cost per cubic met	cost for one slab	No's	Total cost
50	12.6	0.15	94.5	4845	457852.5	3	1373557.5
							Total Cost Rs.1400000/-

Total cost of the Project = Rs.13005500/-

Considering 15% allowance =Rs.1950825/-

Total cost required = Rs.14956325/-

Figure 7.7: Total Cost Estimation

CONCLUSION

- In the archery building of steel structure, the Beam member (ISHB-300) having the satisfied results for deflection, shear and bending in software analysis.
- The Column member (ISHB-450) having the satisfied results for deflection, shear and bending in software analysis.
- The manual design of Two way slab calculations are satisfied with check for deflection.
- For steel structure of column and column base design calculations done by manually.
- The total estimation of an archery steel structures completed in the structural components(columns,beams,truss members,footings etc).

From the results of the conclusion part,the software analysis of an archery steel structure on staad.pro and manual design calculations have satisfied with the output results.

Practice and Reserved Day
Week 10-11

Lab Report Assessment & Self Study
Week 12-13

Lab Test, Viva, Quiz, Overall Assessment,
Skill Development Test (Competency)
Week 14-17