DESIGN OF A
BG+3 RESIDENTIAL BUILDING

A PROJECT REPORT

is submitted in partial fulfilment of the

requirement for the award of the degree

of

BACHELOR OF TECHNOLOGY

in

CIVIL ENGINEERING

By

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CONTENTS

1. INTRODUCTION

The aim of the project is the designing and analysis of a BG+3 Residential Building having a basement, a ground floor, first, second, and third floor. The designing of floor plan for the same is done using the AutoCAD and the analysis is performed using the STAAD.Pro and RCDC software of Bentley Inc.

1.1 DIMENSIONS OF BUILDING

Plot Length	: 16.1 m
Plot Breadth	: 12.1 m
Plot Area	: 194.81 m^2
Column	: 0.4m x 0.4m
Beam	: 0.4m x 0.3m
Outer wall	: 0.3m

Each floor of this 3 BHK flat consists of:-

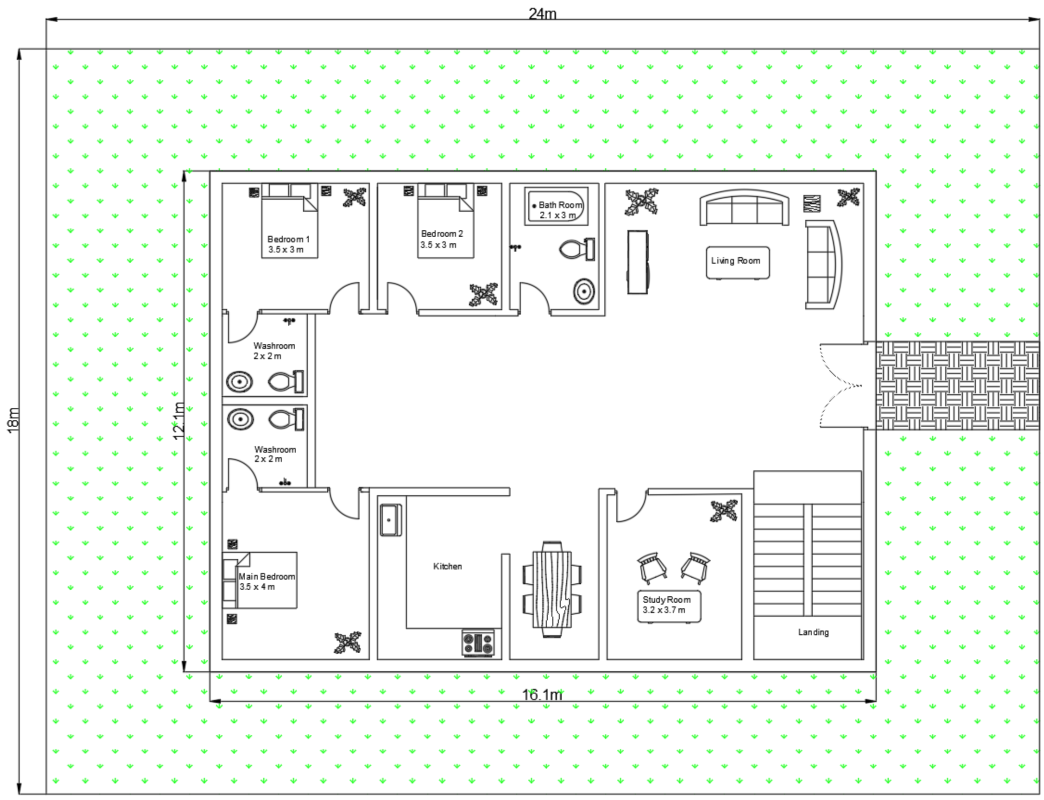
Main Bedroom	: 3.5m x 4m
Bedroom 1	: 3.5m x 3m
Bedroom 2	: 3.5m x 3m
Washroom	: 2m x 2m
Washroom	: 2m x 2m
Washroom	: 2.1m x 2m
Kitchen	: 3.5m x 4m
Dining Area	: 2.1m x 4m
Study Room	: 3.2m x 3.7m
Living Room	: 6.1m x 3m

Assumptions and Notations used:
The notations adopted throughout the work are the same IS-456-2000.

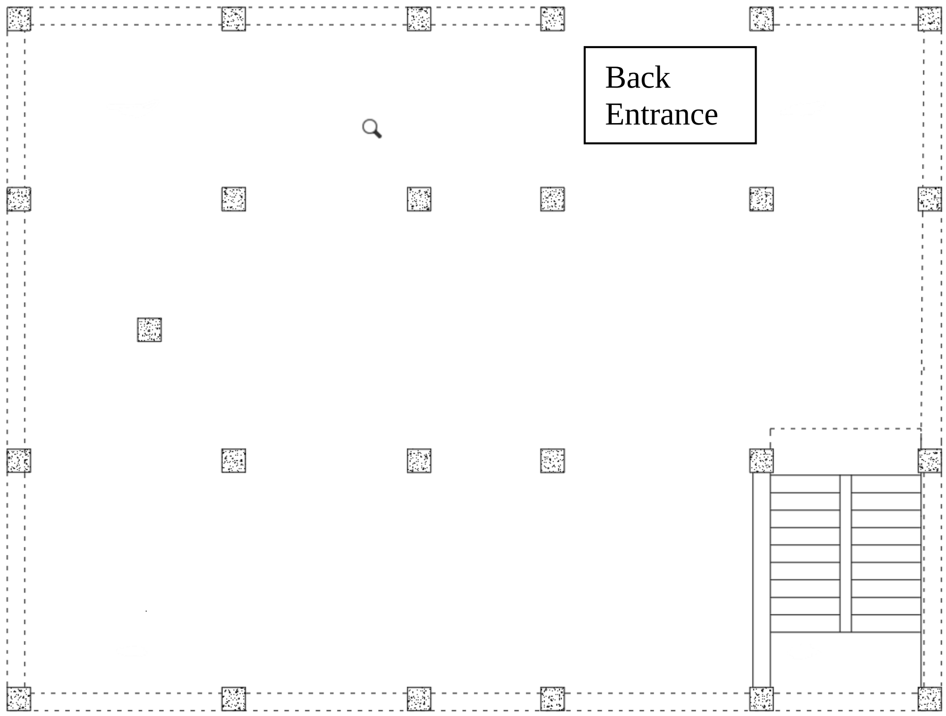
Assumptions in Design

- Using partial safety factor for loads in accordance with clause 36.4 of IS-456- 2000 as ϒt=1.5
- Partial safety factor for material in accordance with clause 36.4.2 is IS- 456-2000 is taken as 1.5 for concrete and 1.15 for steel.
- Using partial safety factors in accordance with clause 36.4 of IS456-2000 for combination of load.
- Slab is assumed to be continuous over interior support and partially fixed on edges, due to monolithic construction and due to construction of walls over it.
- Beams are assumed to be continuous over interior support and they frame in to the column at ends.
- M30 grade is used in designing unless specified.
- Tor steel Fe 500 is used for the main and distribution reinforcement.

1.2 PLAN

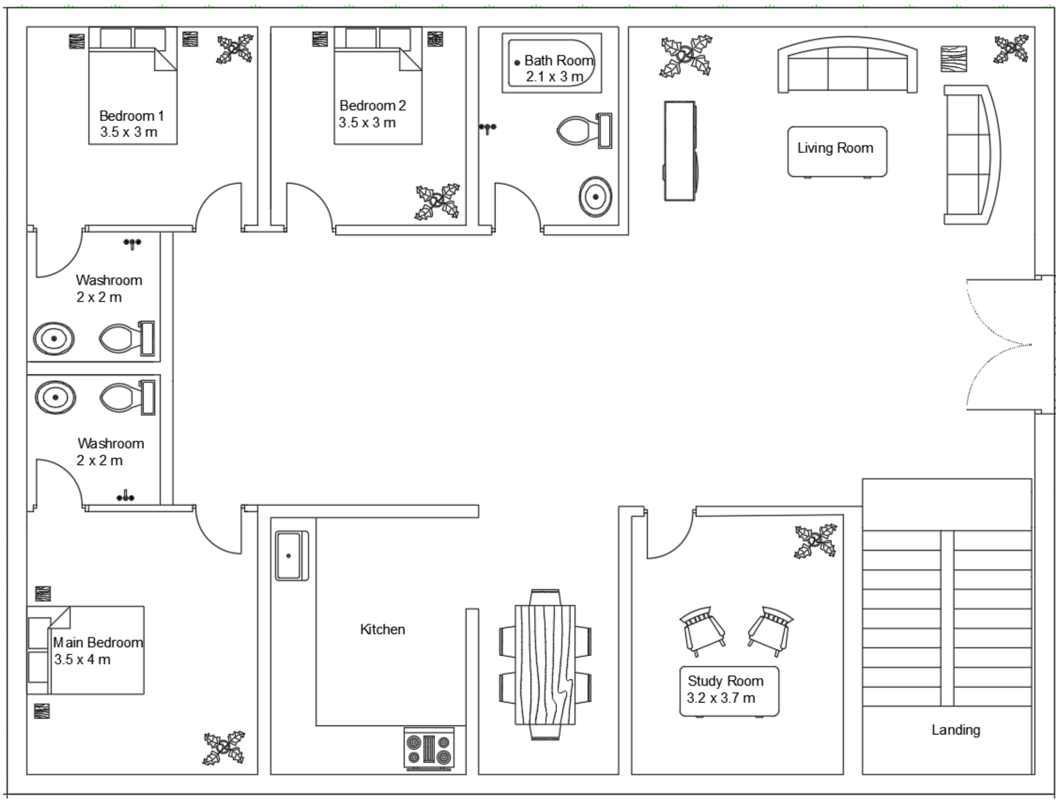


1.2.1 Basement



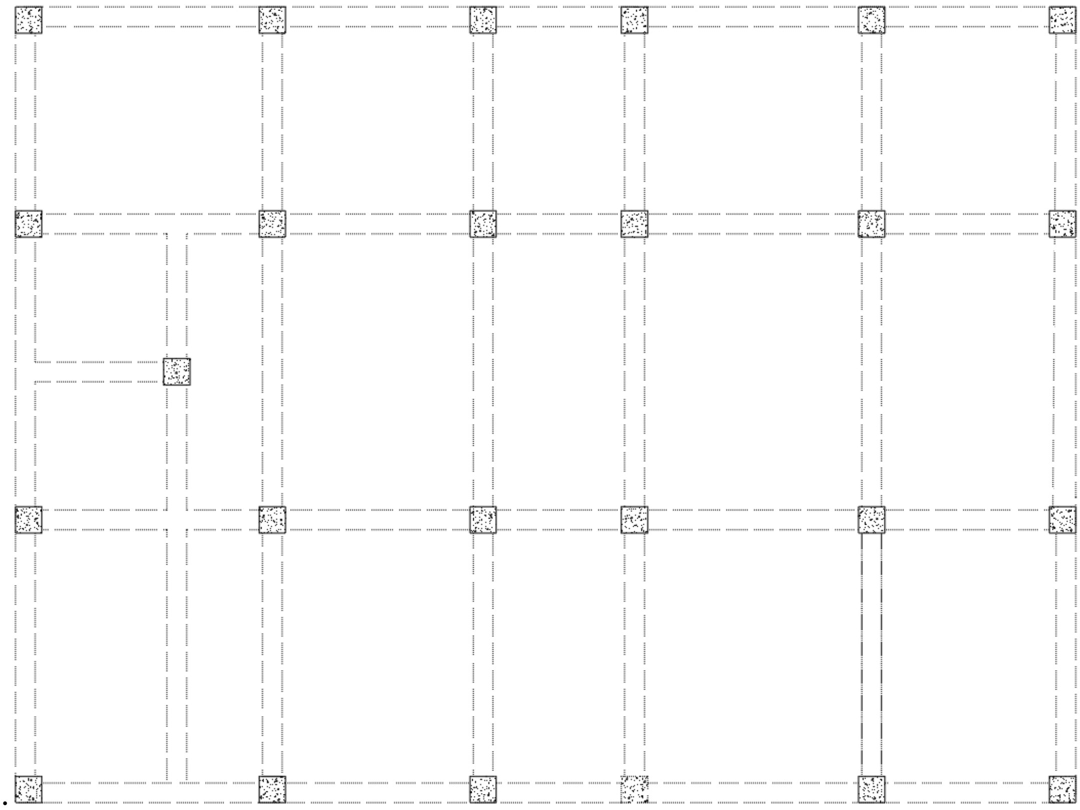
Basement Plan

1.2.2 Ground, 1st, 2nd and 3rd Floor

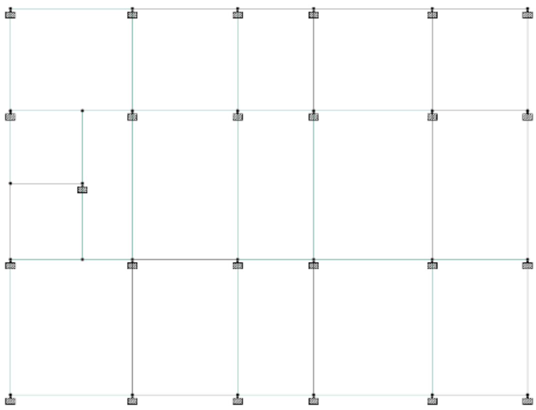


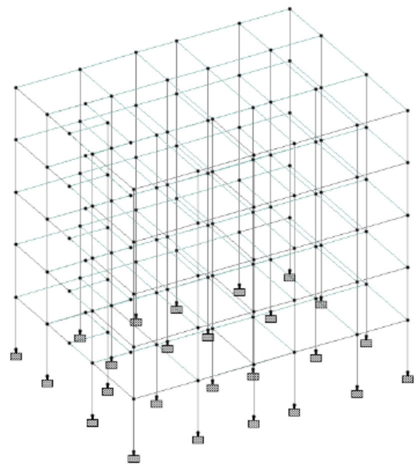
Floor Plan

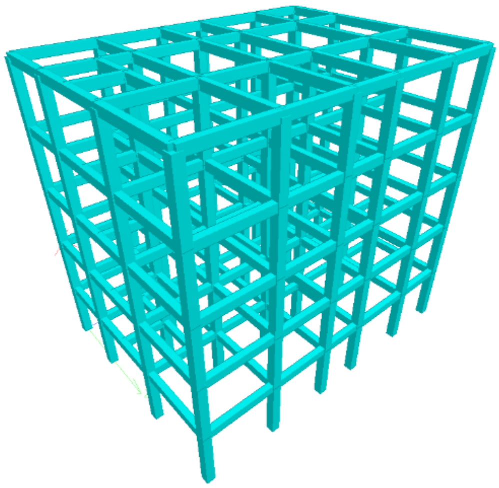
1.2.3 Beam-Column Layout

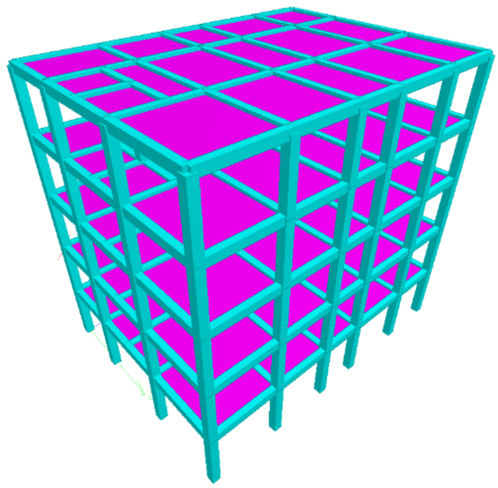


Beam-Column Grid Layout









3D Rendering in STAAD.Pro (Colored)

2. LOADS

In a building, different types of loads are acting all together. Here we are applying loads according to IS456 (for designing and load combination), IS 875(for load calculation (dead, live, wind) & IS 1893 (for earthquake load).

2.1 DEAD LOAD

The dead load contains of the weight of walls, partitions floor finishes, false ceilings, floors and the other permanent standing construction in the buildings. The dead load loads are estimated from the dimensions of various members of building and their unit weights. The unit weights of plain concrete and reinforced concrete taken as 25kN/m3. The unit weight of masonry taken as 19kN/m3.

19.2 Dead Loads

Dead loads shall be calculated on the basis of unit weights which shall be established taking into consideration the materials specified for construction.

19.2.1 Alternatively, the dead loads may be calculated on the basis of unit weights of materials given in IS 875 (Part 1). Unless more accurate calculations are warranted, 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^3 and 25 kN/m^3 respectively.

2.2 LIVE LOAD

As per IS:875 (part 2)-1987, live load 3 KN/m^2 has been assigned to the members.

IS : 875 (Part 2) - 1987

TABLE 1 IMPOSED FLOOR LOADS FOR DIFFERENT OCCUPANCIES

(Clauses 3.1, 3.1.1 and4.1.1)

SL No.	Occupancy Classification	Uniformly Distributed Load (UDL)	Concentrated Load
(1)	(2)	(3)	(4)
		kN/m^2	kN
i)	RESIDENTIAL BUILDINS		
	a) Dwelling houses:		
	1) All rooms and kitchens	2'0	1·8
	2) Toilet and bath rooms	2·0	—
	3) Corridors, passages, staircases including tire escapes and store rooms	3·0	4.5
	4) Balconies	3.0	1·5 per metre run concentrated at the outer edge

2.3 WIND LOAD

As per IS:875 (part 3)-1987, wind load can be calculated.

The basic wind speed for any site shall be obtained from Fig. 1 and shall be modified to include the following effects to get design wind speed, Vz at any height, Z for the chosen structure: (a) Risk level, (b) Terrain roughness and height of structure, (c) Local topography, and (d) Importance factor for the cyclonic region. It can be mathematically expressed as follows:

$$V_z = V_b\, k_1\, k_2\, k_3\, k_4,$$

where

V_z = design wind speed at any height z in m/s,

k_1 = probability factor (risk coefficient) (see 5.3.1),

k_2 = terrain roughness and height factor (see 5.3.2),

k_3 = topography factor (see 5.3.3), and

k_4 = importance factor for the cyclonic region (see 5.3.4).

NOTE: The wind speed may be taken as constant upto a height of 10 m. However, pressures for buildings less than 10m high may be reduced by 20% for stability and design of the framing.

Table 1: Risk coefficients for different classes of structures in different wind speed zones [*Clause* 5.3.1]

Class of Structure	Mean Probable design life of structure in years	k_1 factor for Basic Wind Speed (m/s) of					
		33	39	44	47	50	55
All general buildings and structures	50	1.0	1.0	1.0	1.0	1.0	1.0
Temporary sheds, structures such as those used during construction operations (for example, formwork and false work), structures during construction stages, and boundary walls	5	0.82	0.76	0.73	0.71	0.70	0.67
Buildings and structures presenting a low degree of hazard to life and property in the event of failure, such as isolated towers in wooded areas, farm buildings other than residential buildings, etc.	25	0.94	0.92	0.91	0.90	0.90	0.89
Important buildings and structures such as hospitals, communication buildings towers and power plant structures	100	1.05	1.06	1.07	1.07	1.08	1.08

Table 2: k_2 factors to obtain design wind speed variation with height in different terrains *[Clause 5.3.2.2]*

Height (z) (m)	Terrain and height multiplier (k_2)			
	Terrain Category 1	Terrain Category 2	Terrain Category 3	Terrain Category 4
10	1.05	1.00	0.91	0.80
15	1.09	1.05	0.97	0.80
20	1.12	1.07	1.01	0.80
30	1.15	1.12	1.06	0.97
50	1.20	1.17	1.12	1.10
100	1.26	1.24	1.20	1.20
150	1.30	1.28	1.24	1.24
200	1.32	1.30	1.27	1.27
250	1.34	1.32	1.29	1.28
300	1.35	1.34	1.31	1.30
350	1.37	1.36	1.32	1.31
400	1.38	1.37	1.34	1.32
450	1.39	1.38	1.35	1.33
500	1.40	1.39	1.36	1.34

NOTE: For intermediate values of height z and terrain category, use linear interpolation.

Effect of a Cliff or Escarpment on Equivalent Height above Ground

(k_3 FACTOR)

C-1. The influence of the topographic feature is considered to extend 1.5 L_e upwind and 2.5 L_e downwind of the summit of crest of the feature where L_e is the effective horizontal length of the hill depending on slope as indicated below (see Fig. 15).

Slope	L_e
$3^\circ < \theta \leq 17^\circ$	L
$> 17^\circ$	$Z/0.3$

where

L = actual length of the upwind slope in the wind direction,

Z = effective height of the feature, and

θ = upwind slope in the wind direction.

5.3.4 –

Importance Factor for Cyclonic Region (k_4)

Cyclonic storms usually occur on the east coast of the country in addition to the Gujarat coast on the west. Studies of wind speed and damage to buildings and structures point to the fact that the speeds given in the basic wind speed map are often exceeded during the cyclones. The effect of cyclonic storms is largely felt in a belt of approximately 60 km width at the coast. In order to ensure greater safety of structures in this region (60 km wide on the east coast as well as on the Gujarat coast), the following values of k_4 are stipulated, as applicable according to the importance of the structure:

Structures of post–cyclone importance	1.30
Industrial structures	1.15
All other structures	1.00

5.4 – Design Wind Pressure

The wind pressure at any height above mean ground level shall be obtained by the following relationship between wind pressure and wind speed:

$$p_z = 0.6\ V_z^2$$

where

p_z = wind pressure in N/m^2 at height z, and

V_z = design wind speed in m/s at height z.

The design wind pressure p_d can be obtained as,

$$p_d = K_d.\ K_a.\ K_c.\ p_z$$

where

K_d = Wind directionality factor

K_a = Area averaging factor

K_c = Combination factor (See 6.2.3.13)

NOTE 1 – The coefficient 0.6 (in SI units) in the above formula depends on a number of factors and mainly on the atmospheric pressure and air temperature. The value chosen corresponds to the average Indian atmospheric conditions.

NOTE 2 – K_a should be taken as 1.0 when considering local pressure coefficients.

Table 4: Area averaging factor (K_a) *[Clause 5.4.2]*

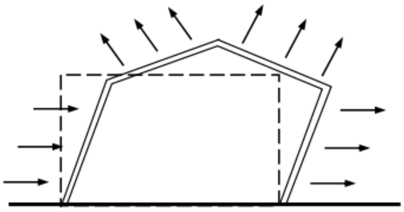
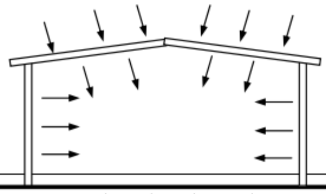
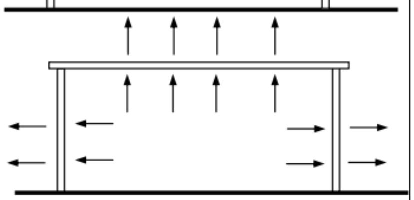
Tributary Area (A) (m^2)	Area Averaging Factor (K_a)
≤ 10	1.0
25	0.9
≥ 100	0.8

Wind Directionality Factor, K_d

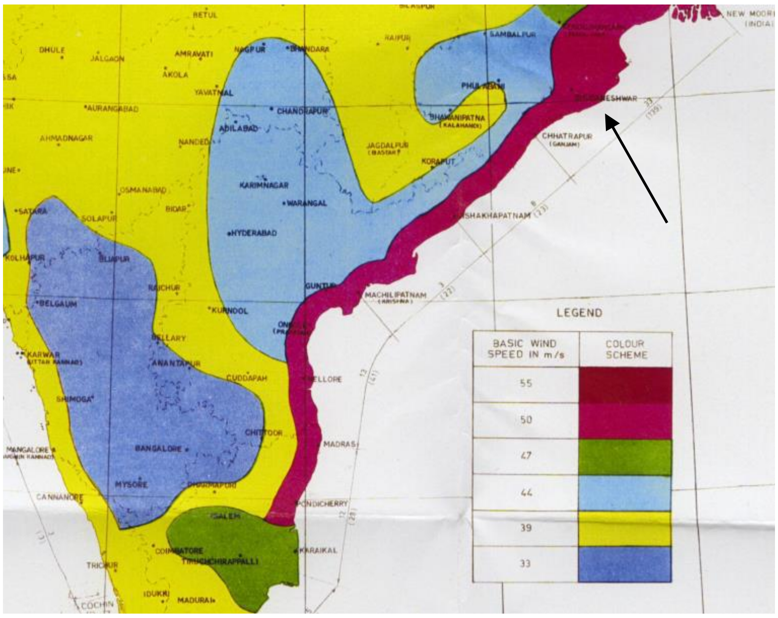
Considering the randomness in the directionality of wind and recognizing the fact that pressure or force coefficients are determined for specific wind directions, it is specified that for buildings, solid signs, open signs, lattice frameworks, and trussed towers (triangular, square, rectangular) a factor of 0.90 may be used on the design wind pressure. For circular or near – circular forms this factor may be taken as 1.0.

For the cyclone affected regions also, the factor K_d shall be taken as 1.0.

Table 19: **Combination factors for wind pressure contributed from two or more building surfaces to effects on major structural elements [*Clause 6.2.3.13*]**

Design case	**Combination factor (K_c)**	**Example diagrams**
(a) Where wind action from any single surface contributes 75 percent or more to an action effect.	1.0	----
(b) Pressures from windward and leeward walls in combination with positive or negative roof pressures	0.8	
(c) Positive pressures on roofs in combination with negative internal pressures (from a wall opening)	0.8	
(d) Negative pressures on roofs or walls in combination with positive internal pressures	0.95	
(c) All other cases	1.0	----
NOTE: The action combination factors less than 1.0 can be justified because wind pressures are highly fluctuating and do not occur simultaneously on all building surfaces.		

Basic Wind Speed (V_b)= 50m/s
(Considering the location of structure in Bhubaneswar)



Map for Basic wind speed in m/s (based on 50 year return period) (from IS 875 part 3)

2.4 EARTHQUAKE LOAD

The Equivalent Static Lateral Force Method of analysis is chosen for the following structure. This approach defines a series of forces acting on the building to exhibit the effect of earthquake vibrations, defined by a seismic design response spectrum. It is considering that the building vibrates in its fundamental mode. For this to be true, the building must be low-rise and must not twist meaningfully when the ground moves.

We have to find total seismic load of the building i.e. comprise of dead and live loads.

6.4 Design Acceleration Spectrum

6.4.1 For the purpose of determining design seismic force, the country is classified into four seismic zones as shown in Fig. 1.

6.4.2 The design horizontal seismic coefficient A_h for a structure shall be determined by:

$$A_h = \frac{\left(\frac{Z}{2}\right)\left(\frac{S_a}{g}\right)}{\left(\frac{R}{I}\right)}$$

where

Z = seismic zone factor given in Table 3;

I = importance factor given in IS 1893 (Parts 1 to 5) for the corresponding structures; when not specified, the minimum values of I shall be,

a) 1.5 for critical and lifeline structures;

b) 1.2 for business continuity structures; and

c) 1.0 for the rest.

R = response reduction factor given in IS 1893 (Parts 1 to 5) for the corresponding structures; and

$\left(\frac{S_a}{g}\right)$ = design acceleration coefficient for different soil types, normalized with peak ground acceleration, corresponding to natural period T of structure (considering soil-structure interaction, if required). It shall be as given in Parts 1 to 5 of IS 1893 for the corresponding structures; when not specified, it shall be taken as that corresponding to 5 percent damping, given by expressions below:

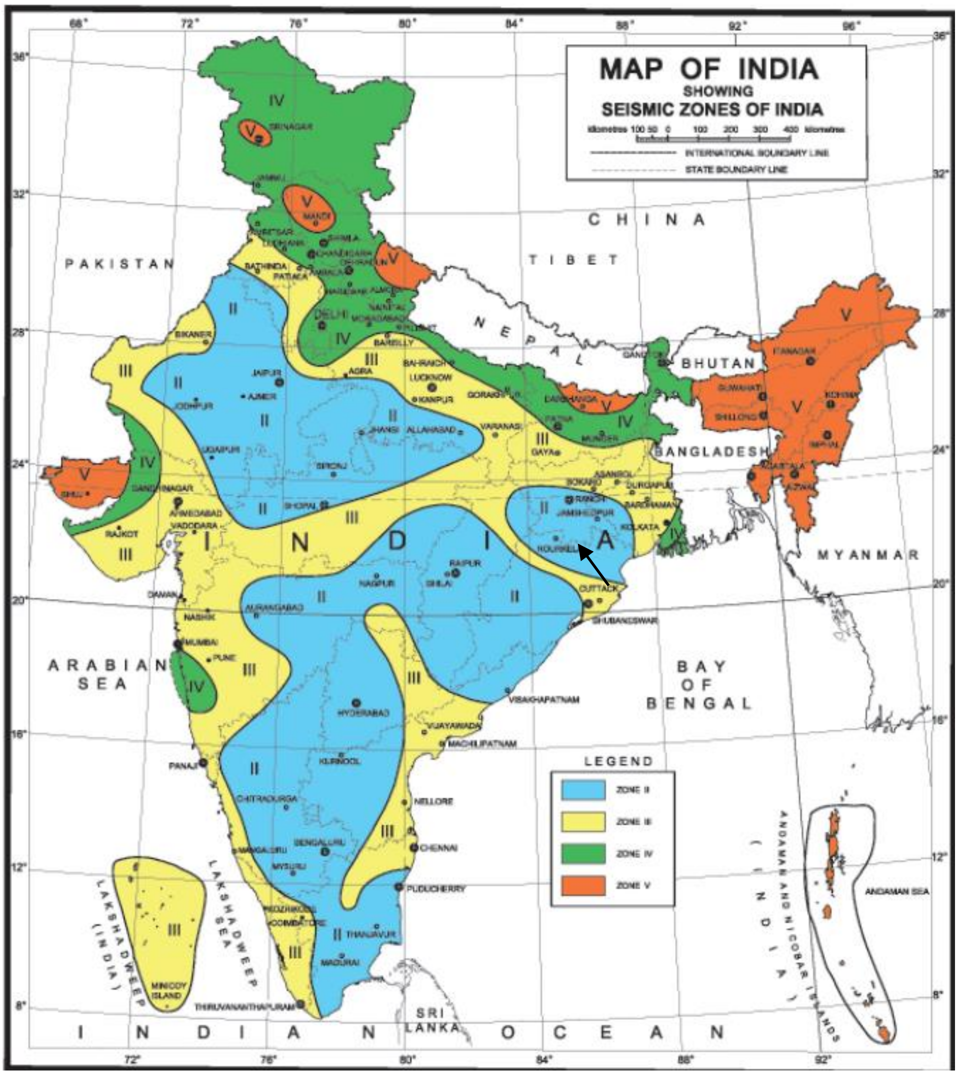
a) For use in equivalent static method [*see* Fig. 2(a)]:

$$\frac{S_a}{g} = \begin{cases} \text{For rocky or hard soil sites} & \begin{cases} 2.5 & 0 < T < 0.40\ \text{s} \\ \frac{1}{T} & 0.40\ \text{s} < T < 4.00\ \text{s} \\ 0.25 & T > 4.00\ \text{s} \end{cases} \\ \text{For medium stiff soil sites} & \begin{cases} 2.5 & 0 < T < 0.55\ \text{s} \\ \frac{1.36}{T} & 0.55\ \text{s} < T < 4.00\ \text{s} \\ 0.34 & T > 4.00\ \text{s} \end{cases} \\ \text{For soft soil sites} & \begin{cases} 2.5 & 0 < T < 0.67\ \text{s} \\ \frac{1.67}{T} & 0.67\ \text{s} < T < 4.00\ \text{s} \\ 0.42 & T > 4.00\ \text{s} \end{cases} \end{cases}$$

b) For use in response spectrum method [*see* Fig. 2(b)]

$$\frac{S_a}{g} = \begin{cases} \text{For rocky or hard soil sites} & \begin{cases} 1+15T & T < 0.10\ \text{s} \\ 2.5 & 0.10\ \text{s} < T < 0.40\ \text{s} \\ \frac{1}{T} & 0.40\ \text{s} < T < 4.00\ \text{s} \\ 0.25 & T > 4.00\ \text{s} \end{cases} \\ \text{For medium stiff soil sites} & \begin{cases} 1+15T & T < 0.10\ \text{s} \\ 2.5 & 0.10\ \text{s} < T < 0.55\ \text{s} \\ \frac{1.36}{T} & 0.55\ \text{s} < T < 4.00\ \text{s} \\ 0.34 & T > 4.00\ \text{s} \end{cases} \\ \text{For soft soil sites} & \begin{cases} 1+15T & T < 0.10\ \text{s} \\ 2.5 & 0.10\ \text{s} < T < 0.67\ \text{s} \\ \frac{1.67}{T} & 0.67\ \text{s} < T < 4.00\ \text{s} \\ 0.42 & T > 4.00\ \text{s} \end{cases} \end{cases}$$

There is four seismic zone divided in India are given below categorizing every zone as zone I, II, III and IV. For this seismic analysis we are considering zone II.



7.6.1 The design base shear V_B along any principal direction of a building shall be determined by:

$$V_B = A_h W$$

where

A_h = design horizontal acceleration coefficient value as per **6.4.2**, using approximate fundamental natural period T_a as per **7.6.2** along the considered direction of shaking; and

W = seismic weight of the building as per **7.4**.

7.6.2 The approximate fundamental translational natural period T_a of oscillation, in second, shall be estimated by the following expressions:

a) Bare MRF buildings (without any masonry infills):

$$T_a = \begin{cases} 0.075h^{0.75} & \text{(for RC MRF building)} \\ 0.080h^{0.75} & \text{(for RC-Steel Composite MRF building)} \\ 0.085h^{0.75} & \text{(for steel MRF building)} \end{cases}$$

$$T_a = \frac{0.09h}{\sqrt{d}}$$

h = height of building as defined in **7.6.2**(a), in m;

A_{wi} = effective cross-sectional area of wall i in first storey of building, in m²;

L_{wi} = length of structural wall i in first storey in the considered direction of lateral forces, in m;

d = base dimension of the building at the plinth level along the considered direction of earthquake shaking, in m;

$$Q_i = \left(\frac{W_i h_i^2}{\sum_{j=1}^{n} W_j h_j^2} \right) V_B$$

where

Q_i = design lateral force at floor i;

W_i = seismic weight of floor i;

h_i = height of floor i measured from base; and

n = number of storeys in building, that is, number of levels at which masses are located.

Table 3 Seismic Zone Factor Z
(*Clause* 6.4.2)

Seismic Zone Factor (1)	II (2)	III (3)	IV (4)	V (5)
Z	0.10	0.16	0.24	0.36

After defining the seismic load as per requirement of IS: 1893 (Part 1): 2016, the seismic load has been assigned with respect to +X, -X, +Z, and –Z directions with their respective appropriate seismic factor.

2.5 COMBINATIONAL LOAD

All live, dead, wind and earthquake load can not act simultaneously. So load combination are considers. As per IS456 :

Table 18 Values of Partial Safety Factor γ_f for Loads
(*Clauses* 18.2.3.1, 36.4.1 *and* B-4.3)

Load Combination	Limit State of Collapse			Limit States of Serviceability		
	DL	*IL*	*WL*	*DL*	*IL*	*WL*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
DL + *IL*	1.5	1.5	1.0	1.0	1.0	–
DL + *WL*	1.5 or 0.9[1)]	–	1.5	1.0	–	1.0
DL + *IL* + *WL*	1.2	1.2	1.2	1.0	0.8	0.8

NOTES

1 While considering earthquake effects, substitute *EL* for *WL*.

2 For the limit states of serviceability, the values of γ_f given in this table are applicable for short term effects. While assessing the long term effects due to creep the dead load and that part of the live load likely to be permanent may only be considered.

[1)] This value is to be considered when stability against overturning or stress reversal is critical.

Combinational load is auto generated in Staad Pro.

3. ANALYSIS IN STAAD PRO

We transferred the structure to STAD Pro using .dxf file. This way there was no need to redraw the plan. Then properties and materials were defined for beam, column and slabs. The loading for Dead Load, Live Load, Wind Load, and Earthquake Load was given and suitable load combinations were generated.

3.1 LOAD COMBINATION

```
INT 1.654 1.654 1.654 1.782 HEIG  0
5  10  15
EXP 1 JOINT 1 TO 26 30 TO 174
DEFINE IS1893 2016 LOAD
ZONE 0.16 RF 5 I 1.2 SS 2 ST 1 DM
0.05
SELFWEIGHT 1
FLOOR WEIGHT
YRANGE 0 15 FLOAD -3.75
LOAD 1 LOADTYPE Seismic-H
TITLE EQX
1893 LOAD X 1
LOAD 2 LOADTYPE Seismic-H
TITLE EQ-X
1893 LOAD X -1
LOAD 3 LOADTYPE Seismic-H
TITLE EQZ
1893 LOAD Z 1
LOAD 4 LOADTYPE Seismic-H
TITLE EQ-Z
1893 LOAD Z -1
LOAD 5 LOADTYPE Dead  TITLE
DL
SELFWEIGHT Y -1
MEMBER LOAD
71 TO 90 92 TO 101 103 TO 111 141
TO 160 162 TO 171 173 TO 181 211
TO 230 -
232 TO 241 243 TO 251 281 TO 300
302 TO 311 313 TO 321 351 TO 370 -
372 TO 381 383 TO 391 UNI GY -
17.1
FLOOR LOAD
YRANGE 0 15 FLOAD -3.75 GY
YRANGE 0 15 FLOAD -0.5 GY
LOAD 6 LOADTYPE Live  TITLE
LL
FLOOR LOAD
YRANGE 0 15 FLOAD -3 GY
```

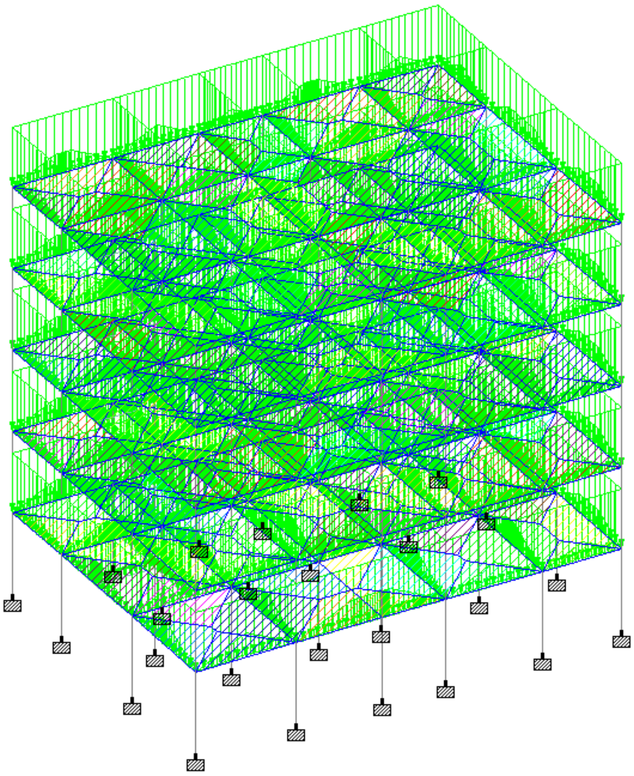
```
LOAD 7 LOADTYPE Wind  TITLE
WLZ
WIND LOAD Z 1 TYPE 1 YR 0 15
WIND LOAD Z -1 TYPE 1 YR 0 15
LOAD 8 LOADTYPE Wind  TITLE
WLX
WIND LOAD X 1 TYPE 1 YR 0 15
WIND LOAD X -1 TYPE 1 YR 0 15
LOAD COMB 9 COMB - 1.5 DEAD
+ 1.5 LIVE
5 1.5 6 1.5
LOAD COMB 10 COMB - 1.2 DEAD
+ 1.2 LIVE + 1.2 WIND (1)
5 1.2 6 1.2 7 1.2
LOAD COMB 11 COMB - 1.2 DEAD
+ 1.2 LIVE + 1.2 WIND (2)
5 1.2 6 1.2 8 1.2
LOAD COMB 12 COMB - 1.2 DEAD
+ 1.2 LIVE + -1.2 WIND (1)
5 1.2 6 1.2 7 -1.2
LOAD COMB 13 COMB - 1.2 DEAD
+ 1.2 LIVE + -1.2 WIND (2)
5 1.2 6 1.2 8 -1.2
LOAD COMB 14 COMB - 1.2 DEAD
+ 1.2 LIVE + 1.2 SEISMIC-H (1)
5 1.2 6 1.2 1 1.2
LOAD COMB 15 COMB - 1.2 DEAD
+ 1.2 LIVE + 1.2 SEISMIC-H (2)
5 1.2 6 1.2 2 1.2
LOAD COMB 16 COMB - 1.2 DEAD
+ 1.2 LIVE + 1.2 SEISMIC-H (3)
5 1.2 6 1.2 3 1.2
LOAD COMB 17 COMB - 1.2 DEAD
+ 1.2 LIVE + 1.2 SEISMIC-H (4)
5 1.2 6 1.2 4 1.2
LOAD COMB 18 COMB - 1.2 DEAD
+ 1.2 LIVE + -1.2 SEISMIC-H (1)
5 1.2 6 1.2 1 -1.2
```

LOAD COMB 19 COMB - 1.2 DEAD
+ 1.2 LIVE + -1.2 SEISMIC-H (2)
5 1.2 6 1.2 2 -1.2
LOAD COMB 20 COMB - 1.2 DEAD
+ 1.2 LIVE + -1.2 SEISMIC-H (3)
5 1.2 6 1.2 3 -1.2
LOAD COMB 21 COMB - 1.2 DEAD
+ 1.2 LIVE + -1.2 SEISMIC-H (4)
5 1.2 6 1.2 4 -1.2
LOAD COMB 22 COMB - 1.5 DEAD
+ 1.5 WIND (1)
5 1.5 7 1.5
LOAD COMB 23 COMB - 1.5 DEAD
+ 1.5 WIND (2)
5 1.5 8 1.5
LOAD COMB 24 COMB - 1.5 DEAD
+ -1.5 WIND (1)
5 1.5 7 -1.5
LOAD COMB 25 COMB - 1.5 DEAD
+ -1.5 WIND (2)
5 1.5 8 -1.5
LOAD COMB 26 COMB - 1.5 DEAD
+ 1.5 SEISMIC-H (1)
5 1.5 1 1.5
LOAD COMB 27 COMB - 1.5 DEAD
+ 1.5 SEISMIC-H (2)
5 1.5 2 1.5
LOAD COMB 28 COMB - 1.5 DEAD
+ 1.5 SEISMIC-H (3)
5 1.5 3 1.5
LOAD COMB 29 COMB - 1.5 DEAD
+ 1.5 SEISMIC-H (4)
5 1.5 4 1.5
LOAD COMB 30 COMB - 1.5 DEAD
+ -1.5 SEISMIC-H (1)
5 1.5 1 -1.5
LOAD COMB 31 COMB - 1.5 DEAD
+ -1.5 SEISMIC-H (2)
5 1.5 2 -1.5
LOAD COMB 32 COMB - 1.5 DEAD
+ -1.5 SEISMIC-H (3)
All the applied loads as per Staad pro.
5 1.5 3 -1.5
LOAD COMB 33 COMB - 1.5 DEAD
+ -1.5 SEISMIC-H (4)
5 1.5 4 -1.5
LOAD COMB 34 COMB - 0.9 DEAD
+ 1.5 WIND (1)
5 0.9 7 1.5
LOAD COMB 35 COMB - 0.9 DEAD
+ 1.5 WIND (2)
5 0.9 8 1.5
LOAD COMB 36 COMB - 0.9 DEAD
+ -1.5 WIND (1)
5 0.9 7 -1.5
LOAD COMB 37 COMB - 0.9 DEAD
+ -1.5 WIND (2)
5 0.9 8 -1.5
LOAD COMB 38 COMB - 0.9 DEAD
+ 1.5 SEISMIC-H (1)
5 0.9 1 1.5
LOAD COMB 39 COMB - 0.9 DEAD
+ 1.5 SEISMIC-H (2)
5 0.9 2 1.5
LOAD COMB 40 COMB - 0.9 DEAD
+ 1.5 SEISMIC-H (3)
5 0.9 3 1.5
LOAD COMB 41 COMB - 0.9 DEAD
+ 1.5 SEISMIC-H (4)
5 0.9 4 1.5
LOAD COMB 42 COMB - 0.9 DEAD
+ -1.5 SEISMIC-H (1)
5 0.9 1 -1.5
LOAD COMB 43 COMB - 0.9 DEAD
+ -1.5 SEISMIC-H (2)
5 0.9 2 -1.5
LOAD COMB 44 COMB - 0.9 DEAD
+ -1.5 SEISMIC-H (3)
5 0.9 3 -1.5
LOAD COMB 45 COMB - 0.9 DEAD
+ -1.5 SEISMIC-H (4)
5 0.9 4 -1.5

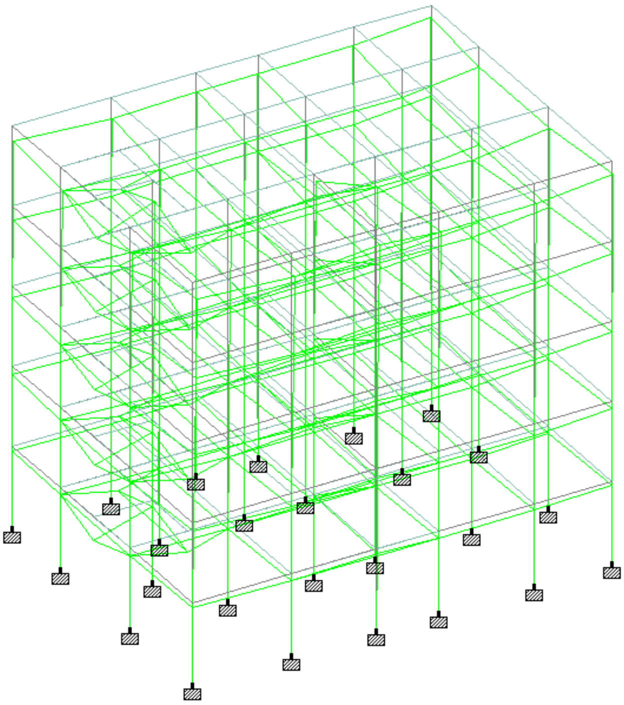
3.2 ANALYSIS

The analysis of structure was done by STAAD Pro.

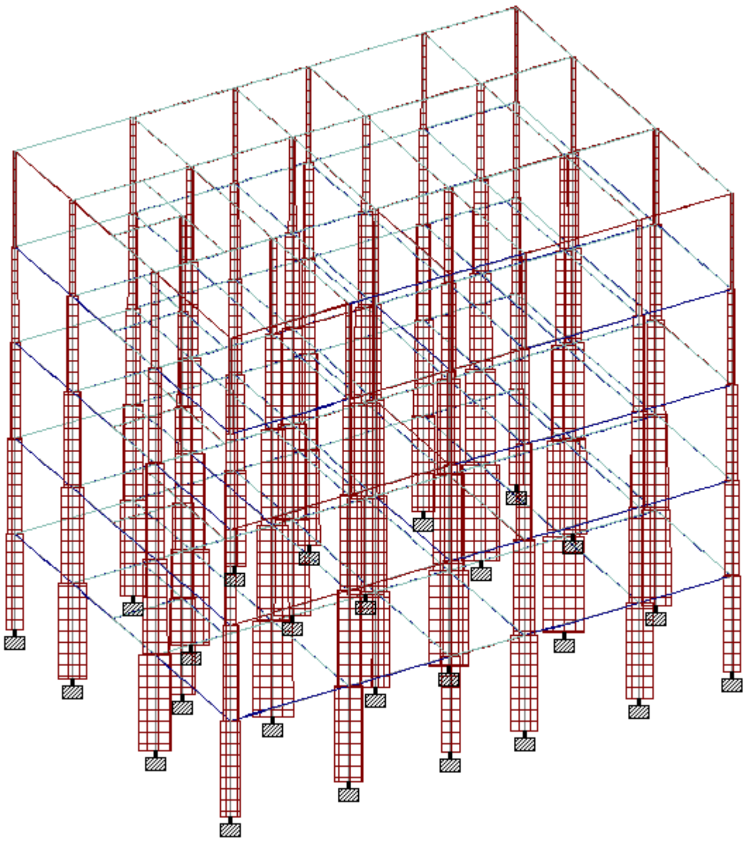
3.2.1 Dead Load



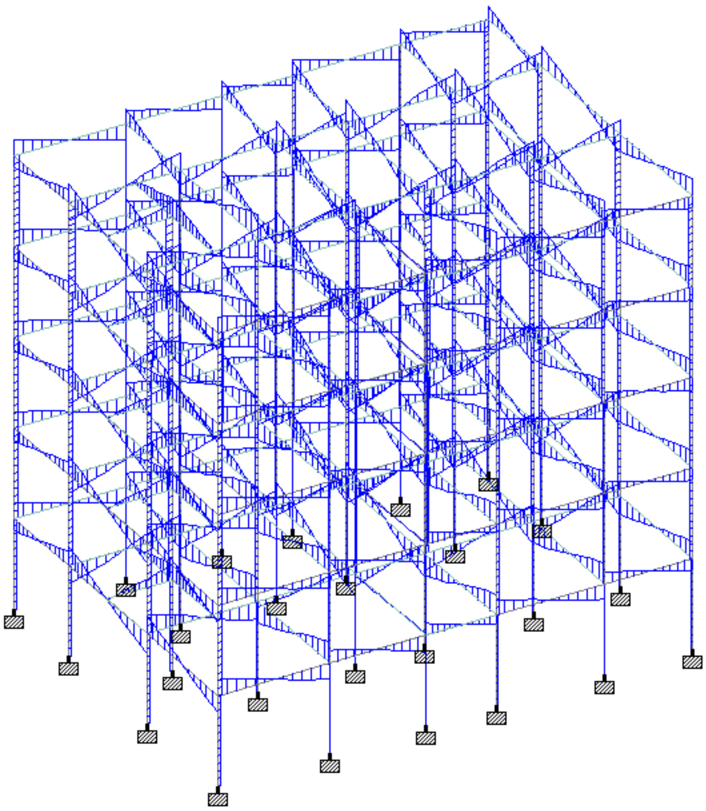
DL Loading Diagram (Colored)



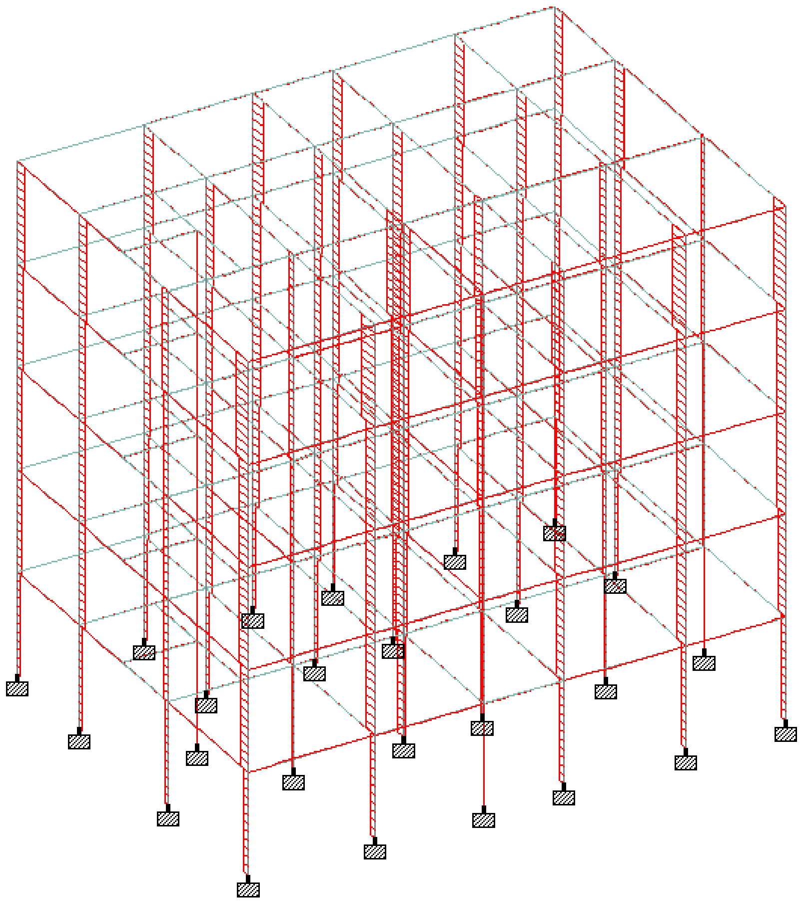
DL Deflection (Colored)



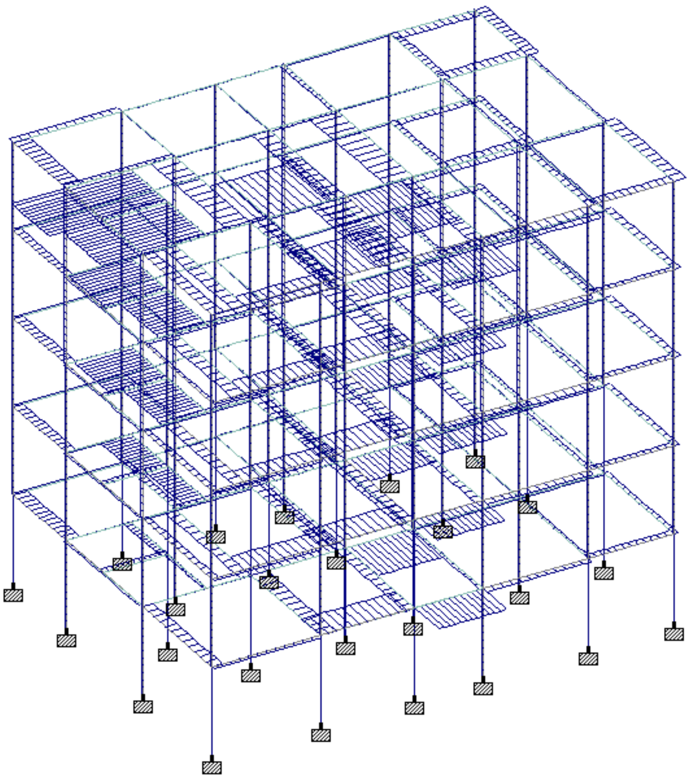
DL Axial Force (Colored)



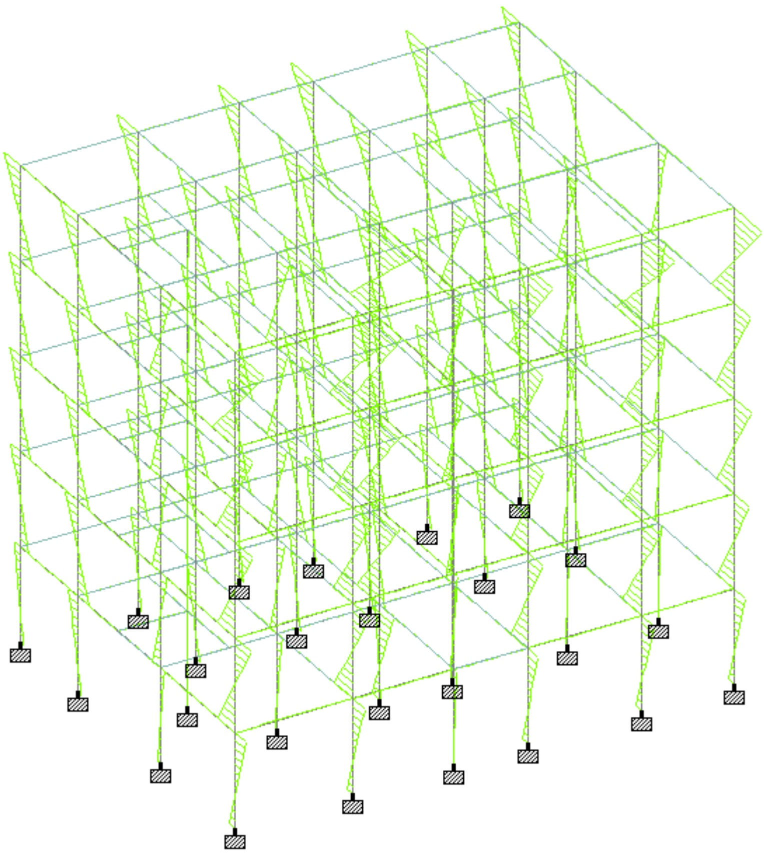
DL Shear Y (Colored)



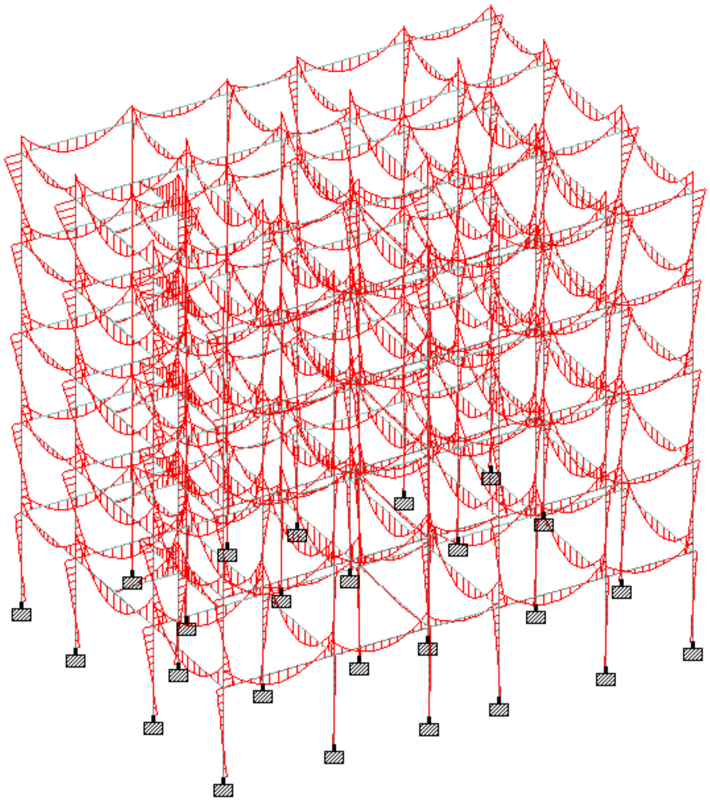
DL Shear Z (Colored)



DL Moment X (Colored)

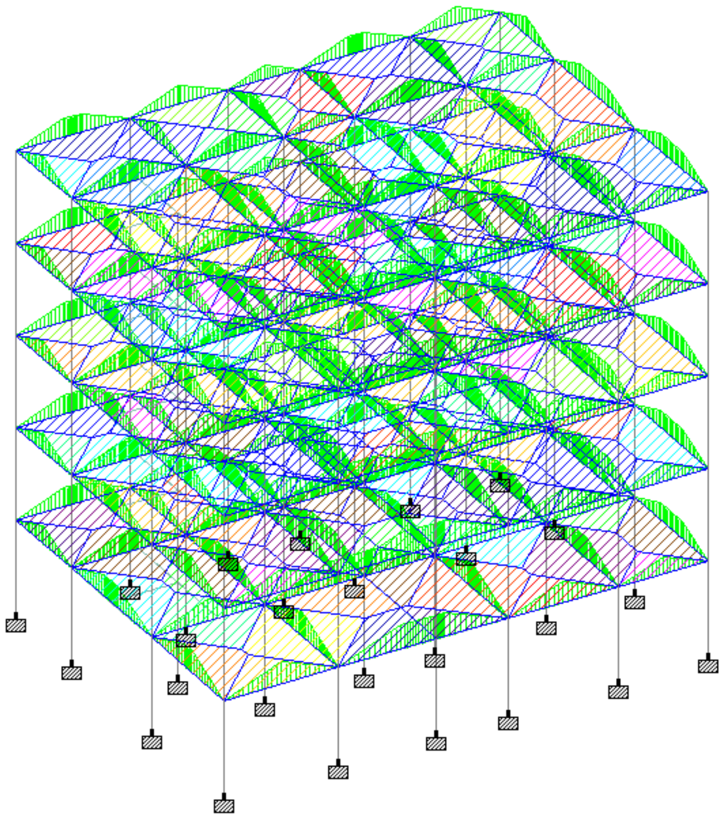


DL Moment Y (Colored)

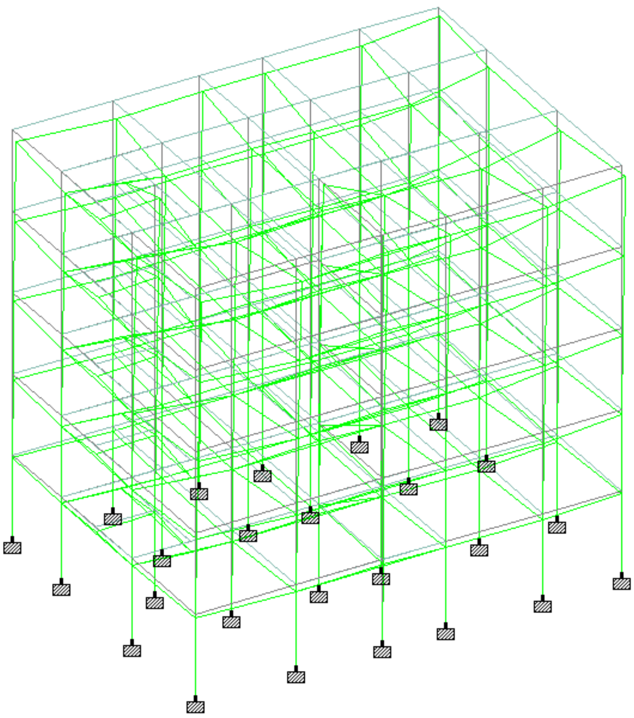


DL Moment Z (Colored)

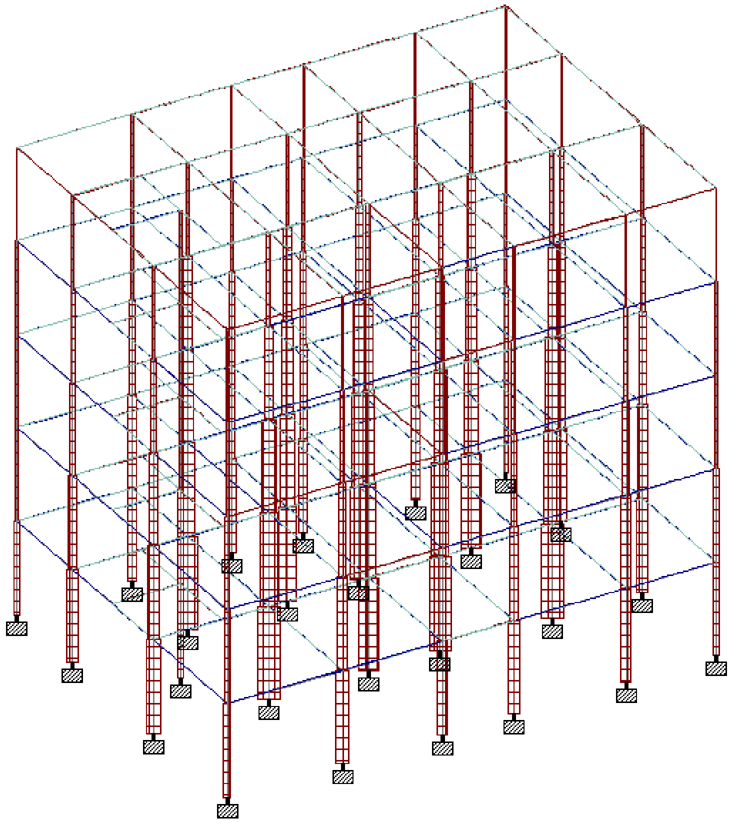
3.2.2 Live Load



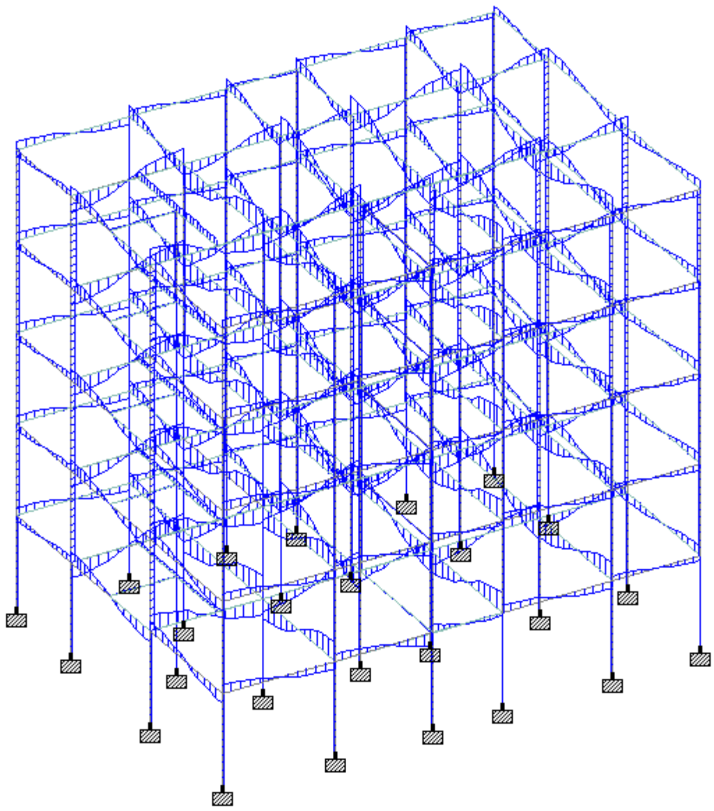
LL Loading Diagram (Colored)



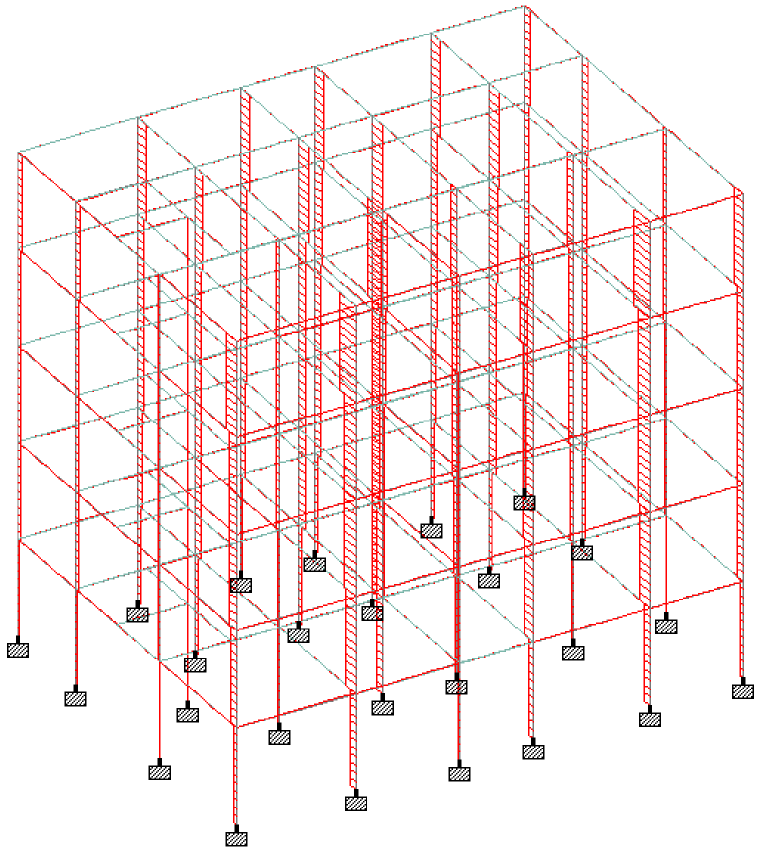
LL Deflection (Colored)



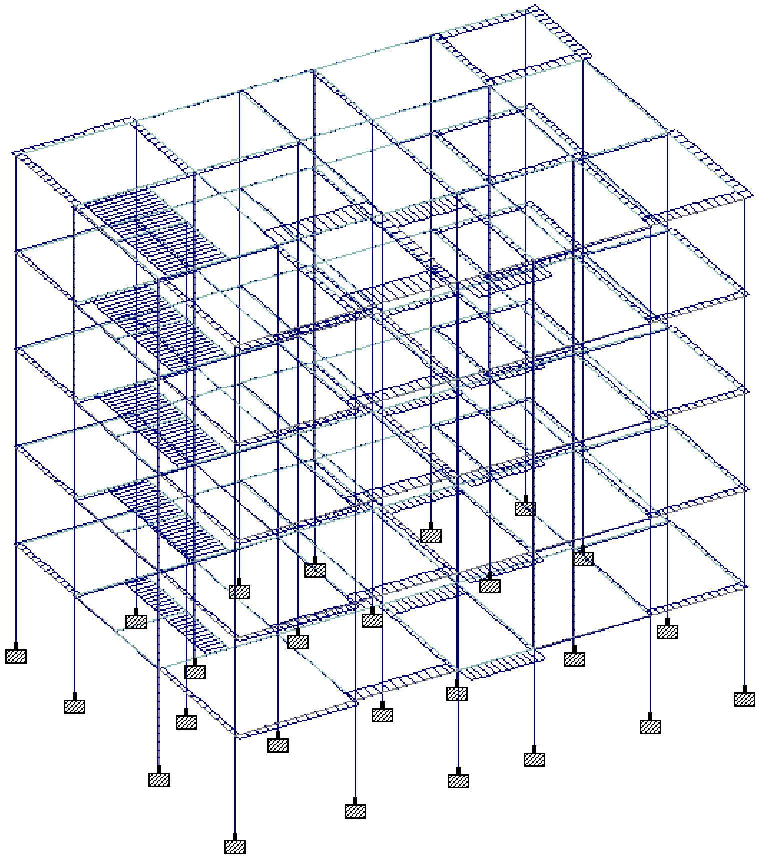
LL Axial Force (Colored)



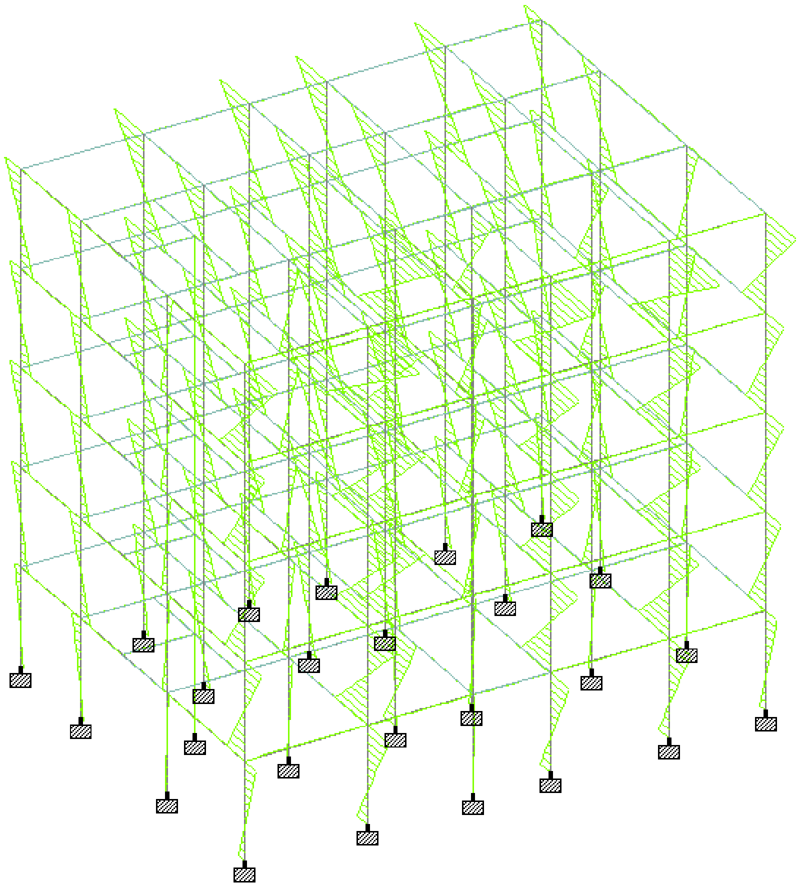
LL Shear Y (Colored)



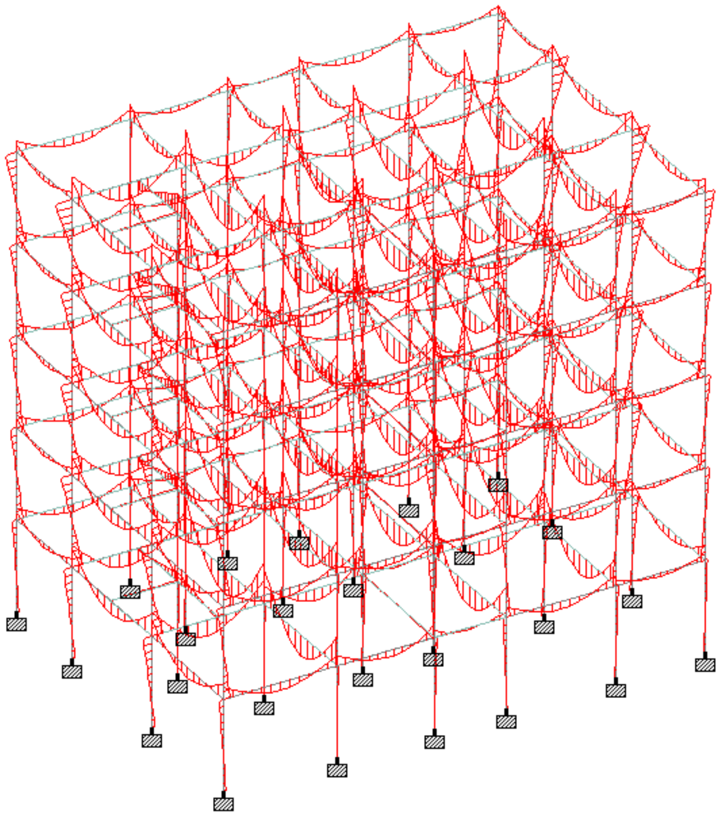
LL Shear Z (Colored)



LL   Moment X (Colored)

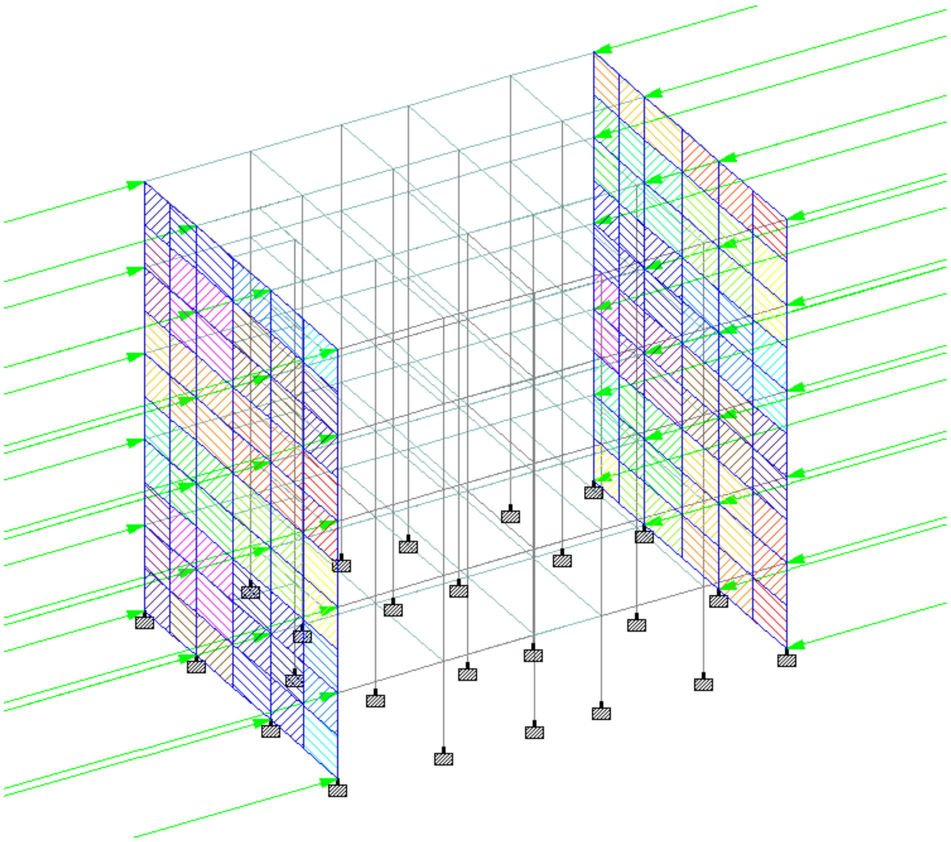


LL Moment Y (Colored)

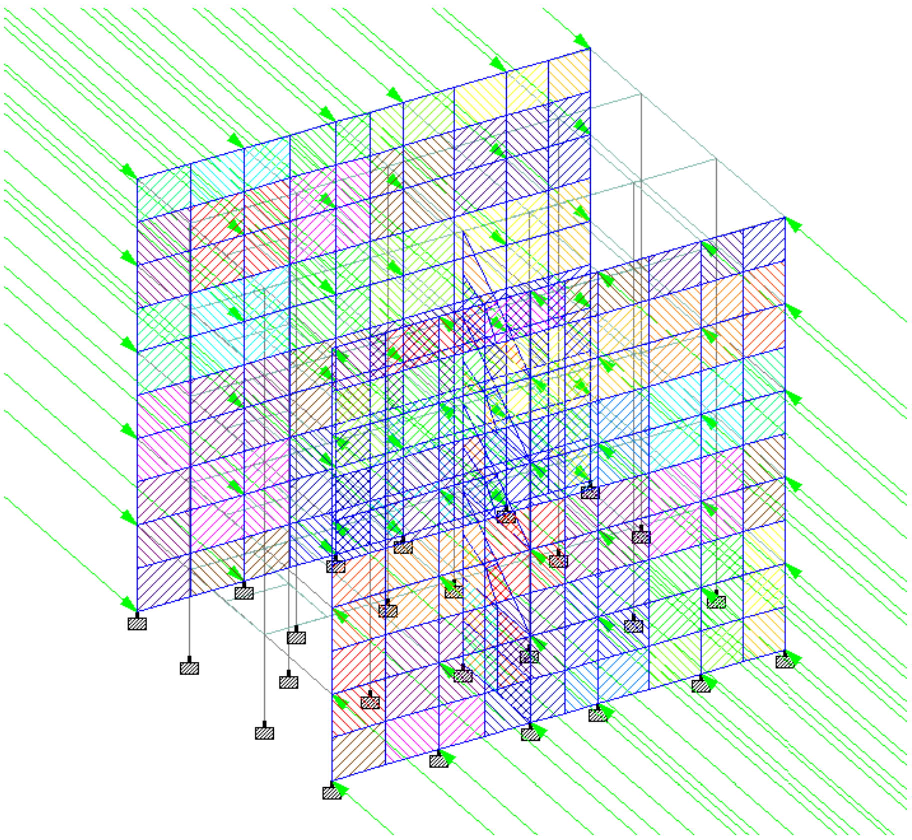


LL Moment Z (Colored)

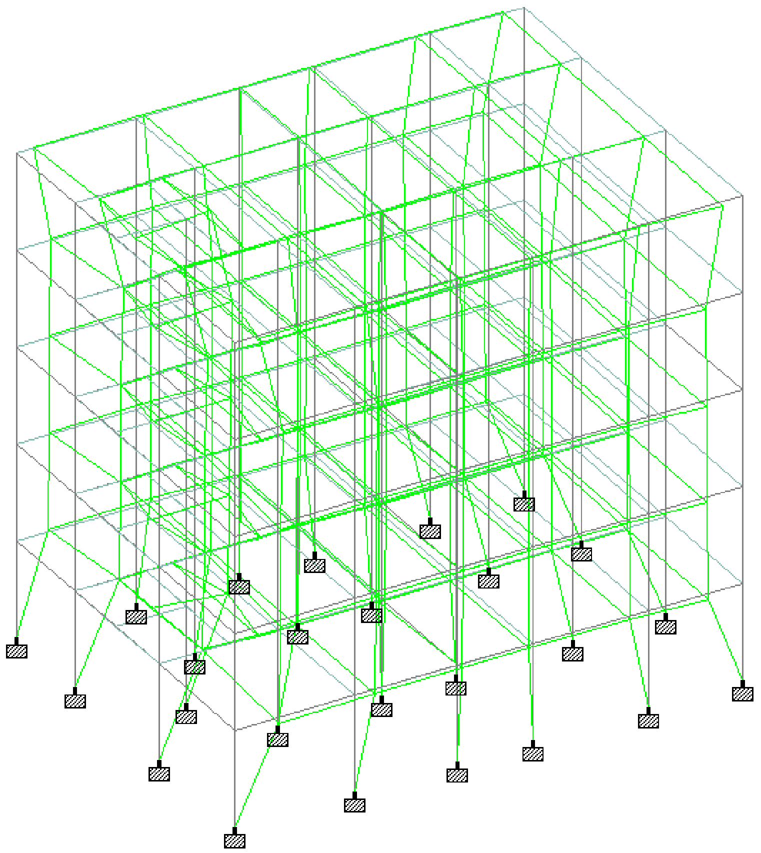
3.2.3 Wind Load



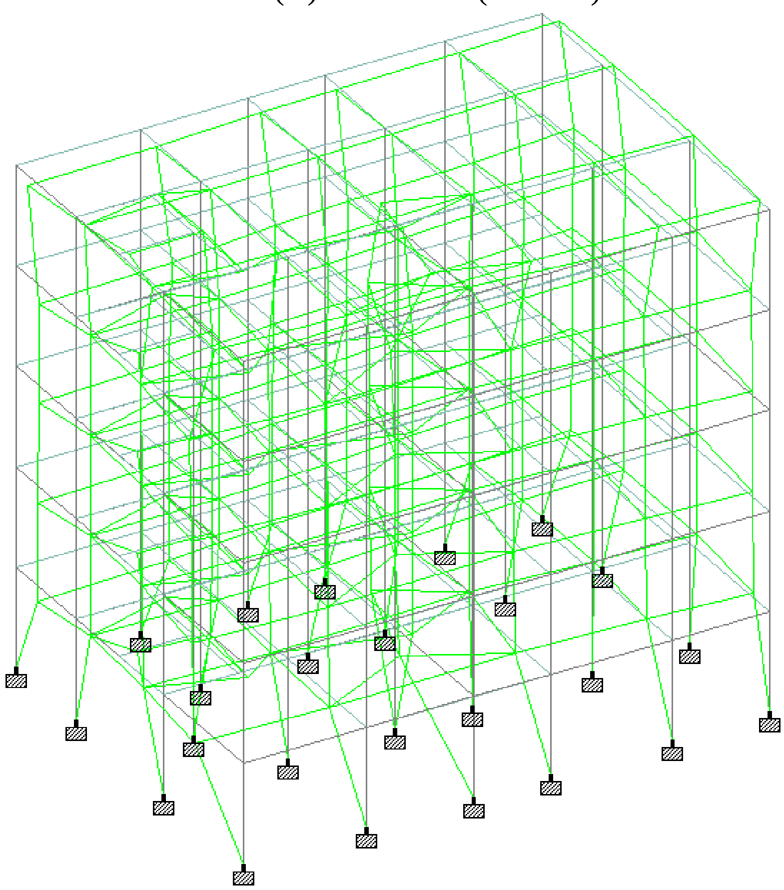
Wind (X) Loading Diagram (Colored)



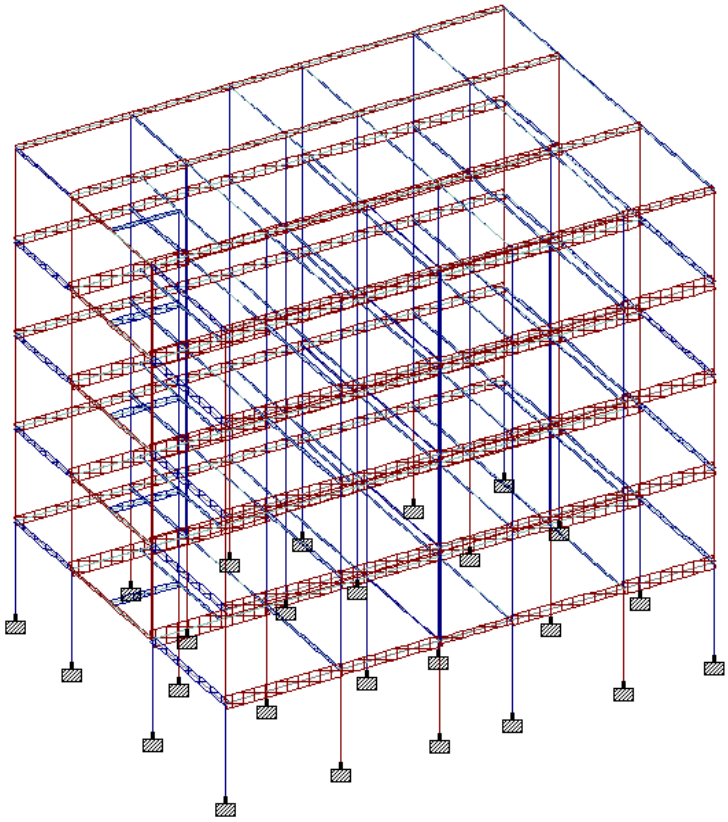
Wind(Z) Loading diagram (Colored)



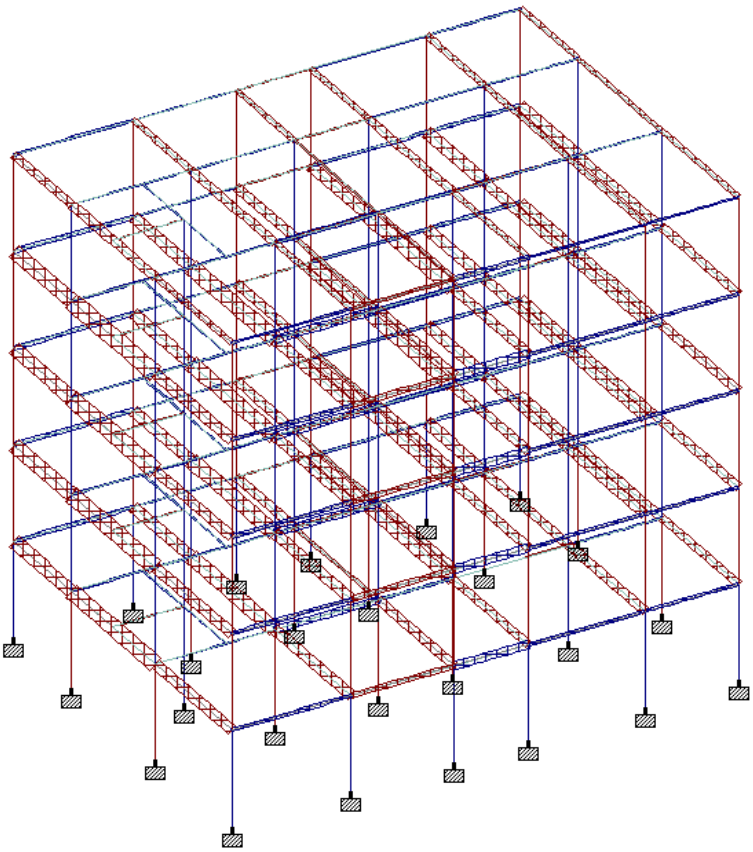
Wind (X) Deflection (Colored)



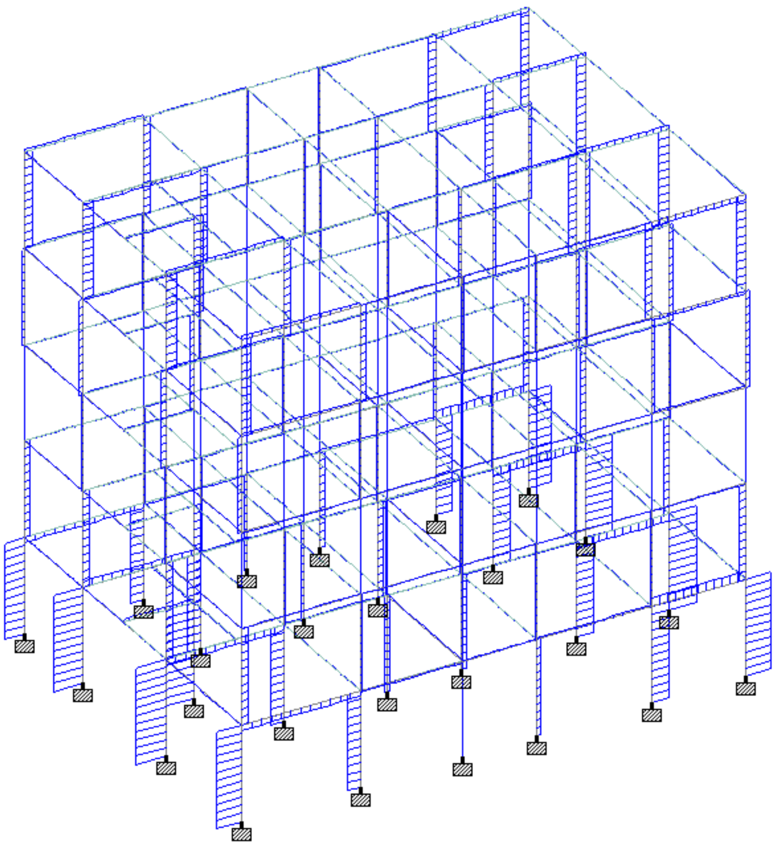
Wind (Z) Deflection (Colored)



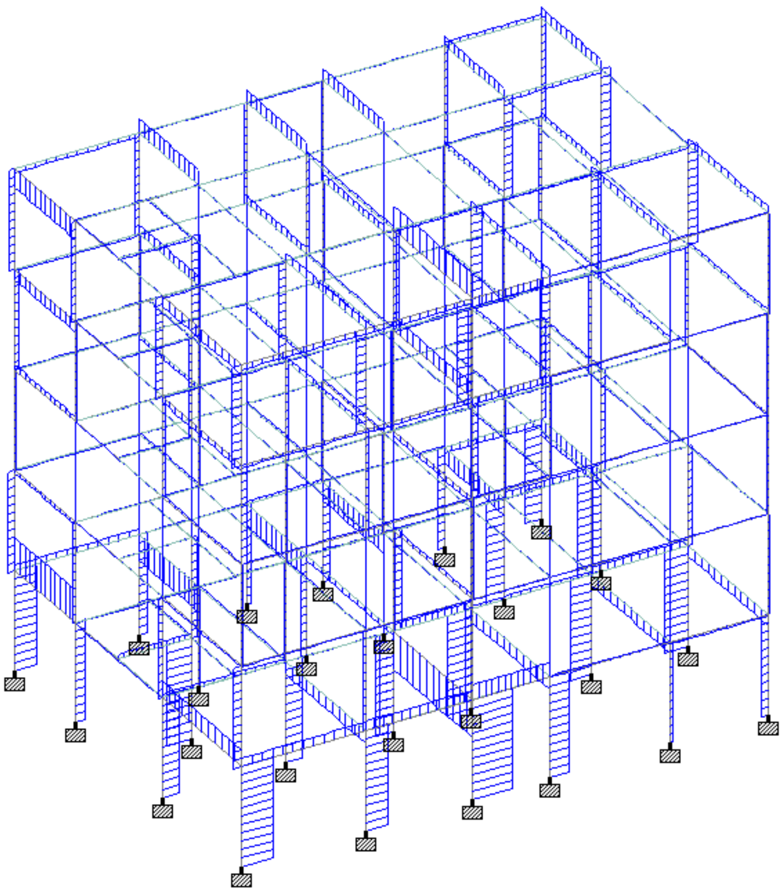
Wind (X) Axial Load   (Colored)



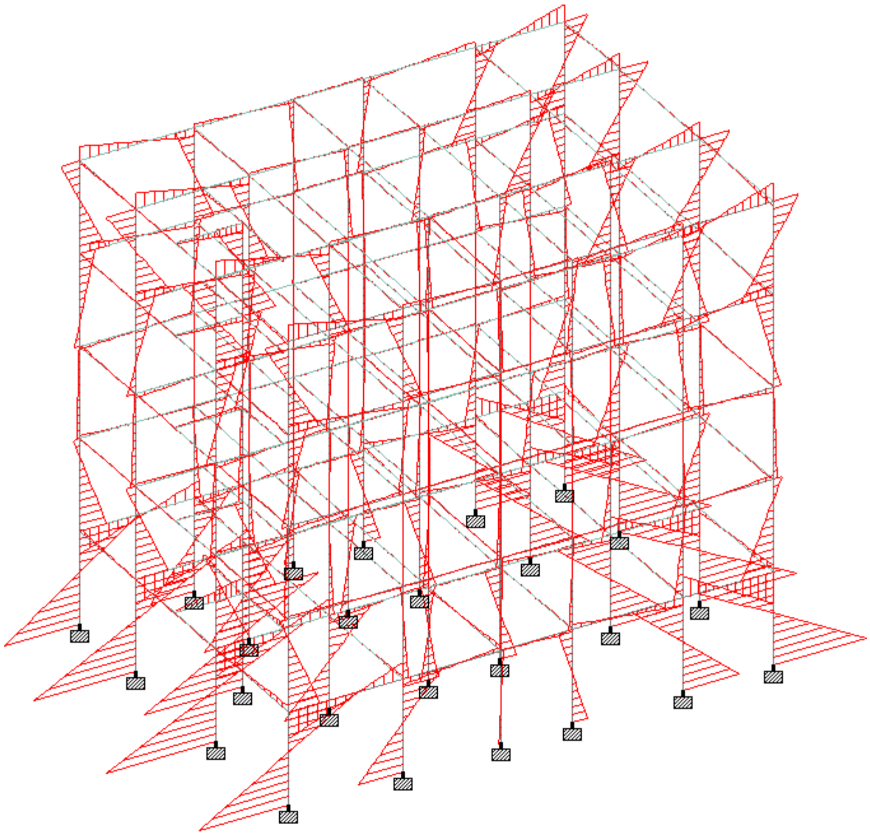
Wind (Z) Axial Load (Colored)



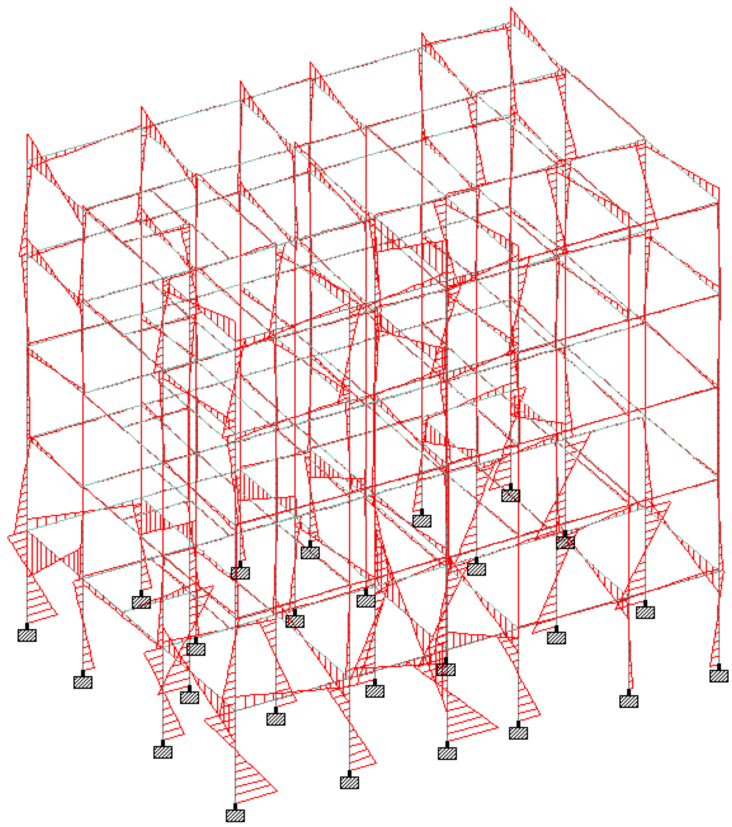
Wind (X) Shear Y (Colored)



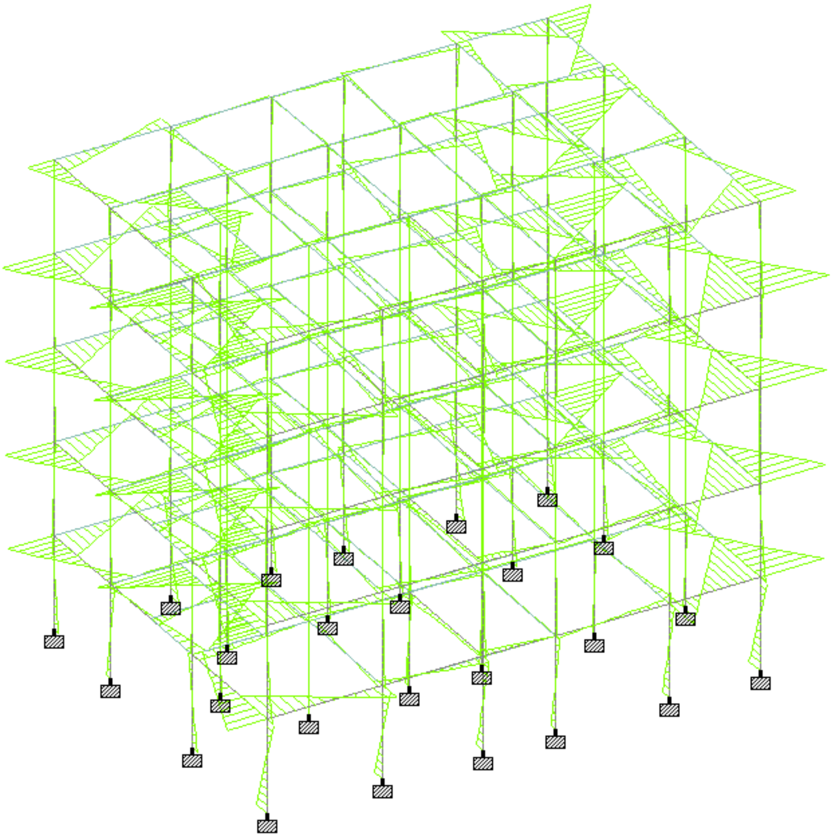
Wind (Z) Shear Y (Colored)



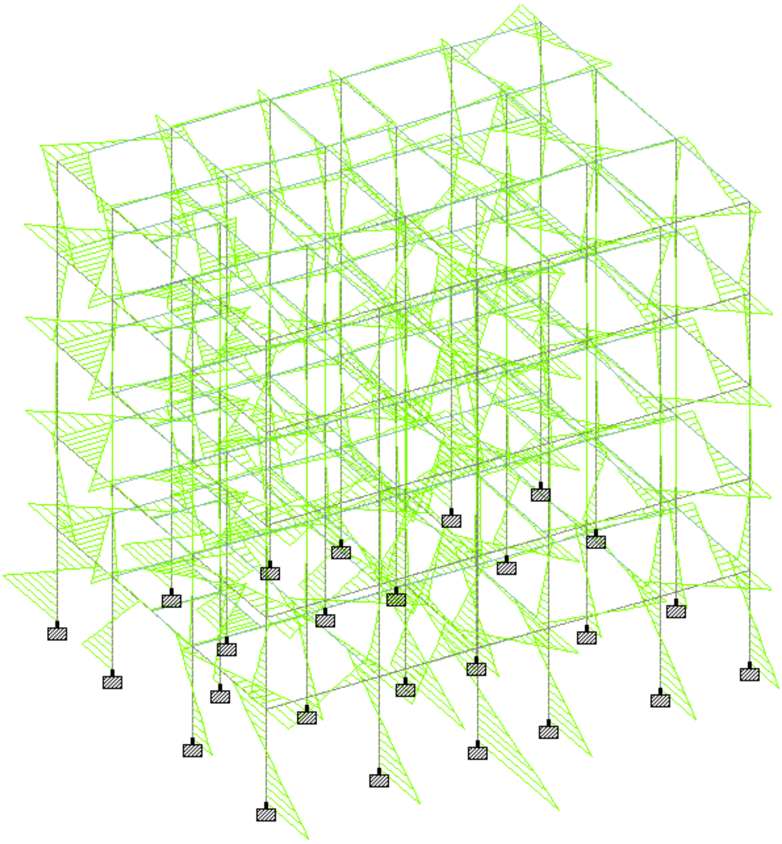
Wind (X) Moment Z (Colored)



Wind (Z) Moment Z (Colored)

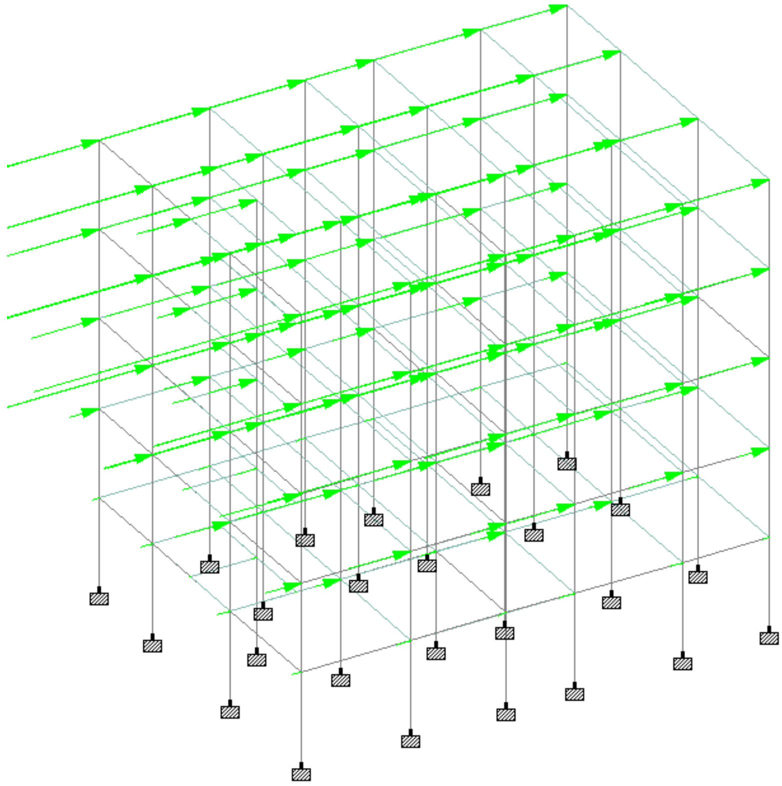


Wind (X) Moment Y (Colored)

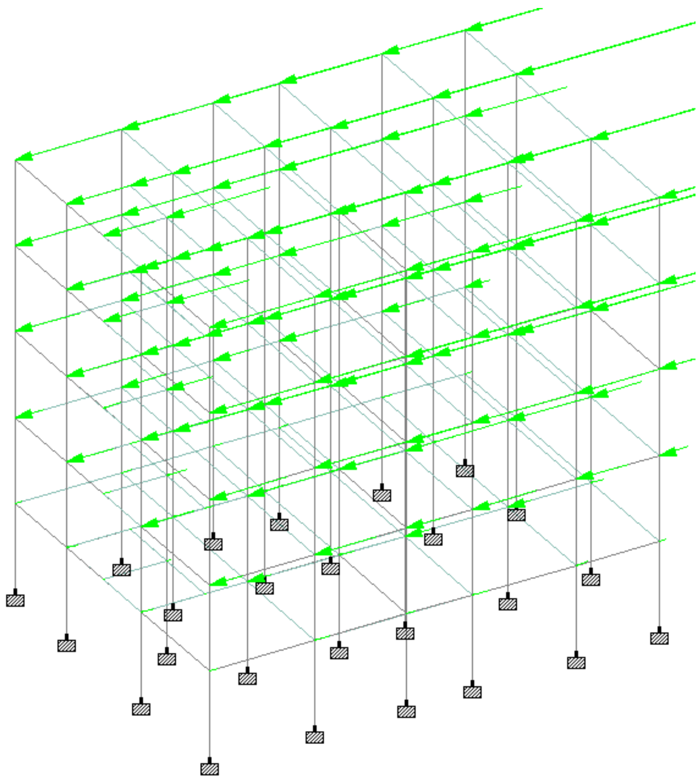


Wind (Z) Moment Y (Colored)

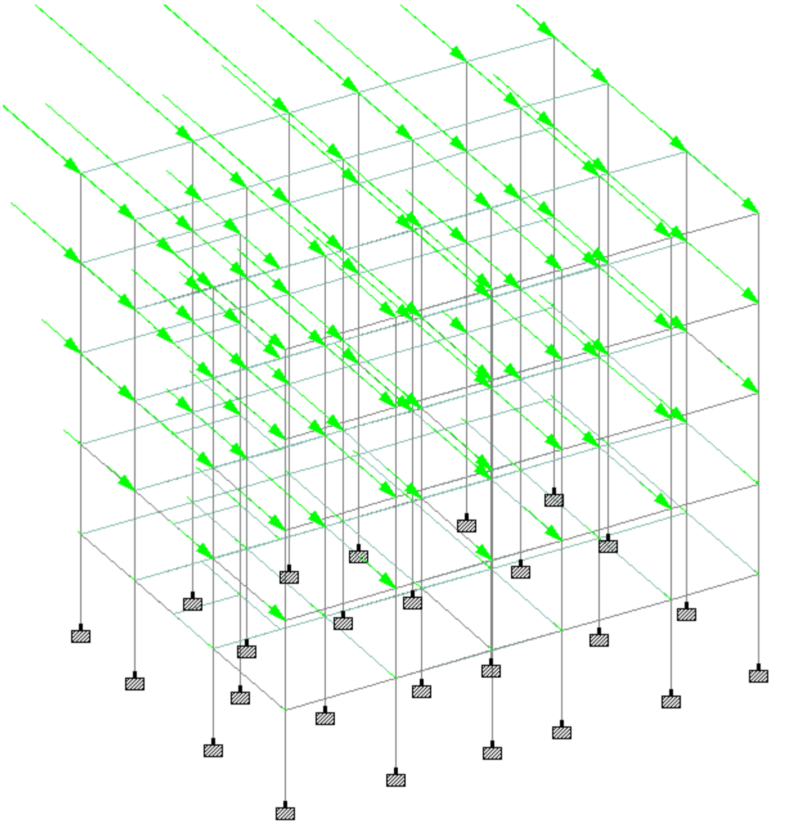
3.2.4 Earthquake Load



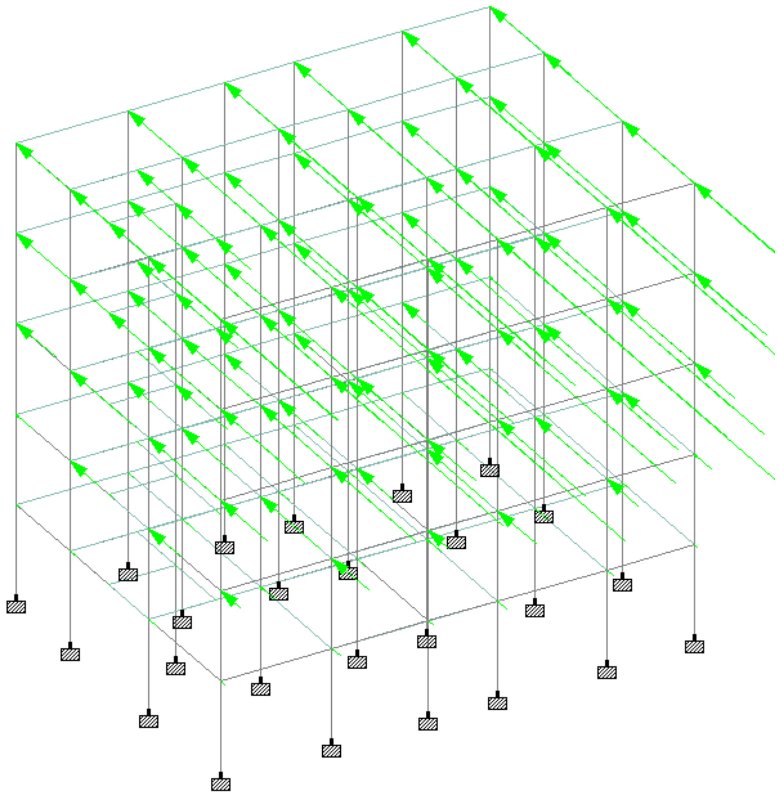
EQ (X) Loading Diagram (Colored)



EQ (-X) Loading diagram (Colored)



EQ (Z) Loading Diagram (Colored)



EQ (-Z) Loading diagram (Colored)

3.2.5 Plate

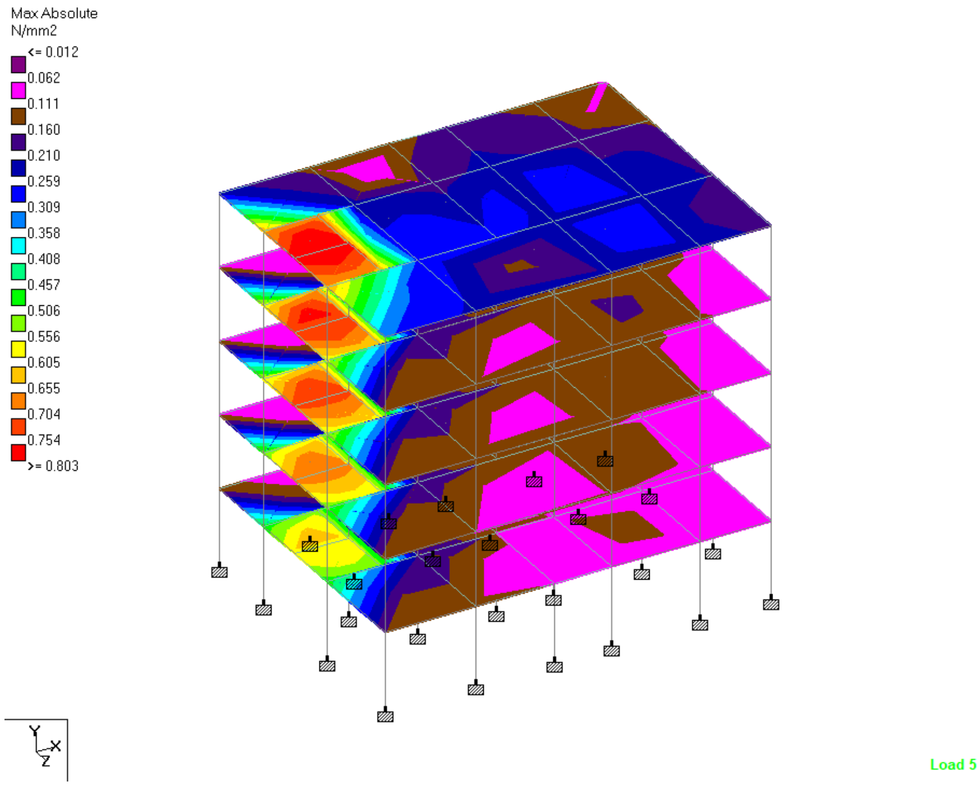
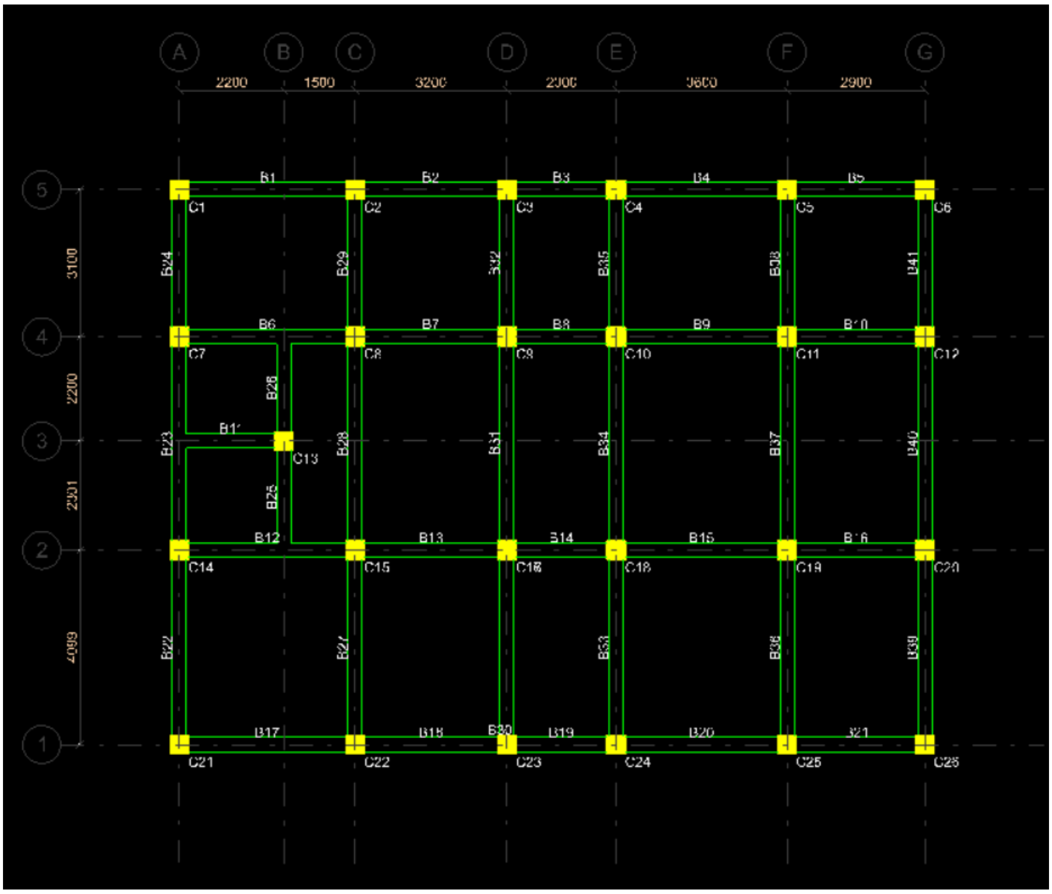


Plate contour of slabs

4. DESIGN AND DETAILING

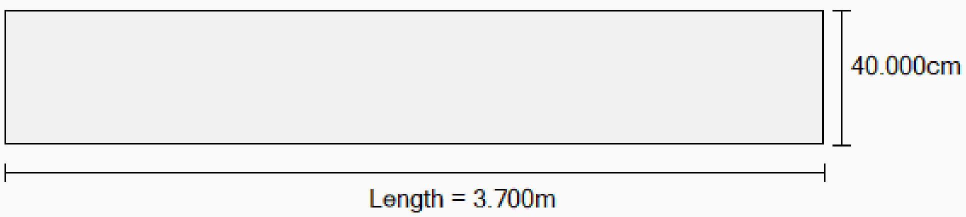
We applied the loadings and analysed the structure. Now we will use RCDC to design the beam, column, footing and slab.

4.1 Beams

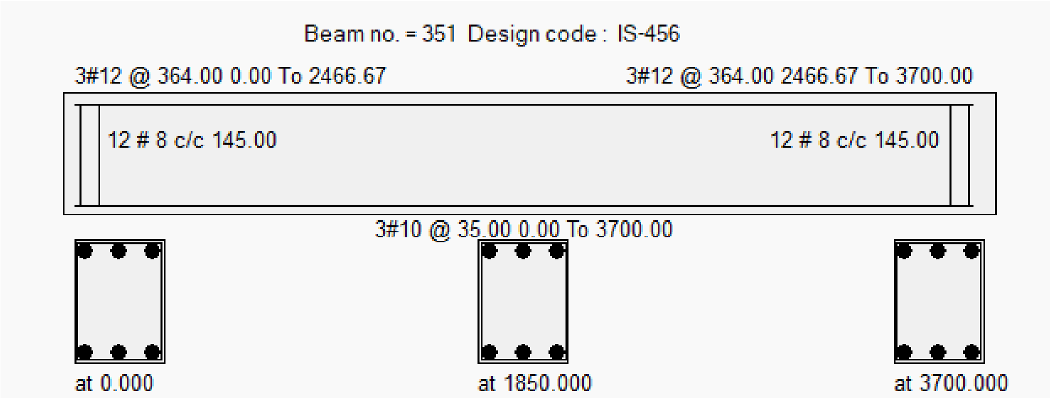


Analysis and Design of Beam:- B_1

Beam no. = 351. Section: Rect 0.40x0.30



Node	X-Coord(m)	Y-Coord(m)	Z-Coord(m)
146	0.000	15.000	0.000
147	3.700	15.000	0.000

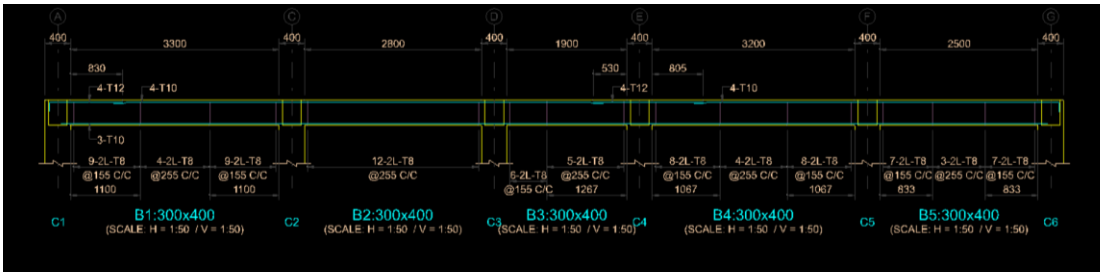


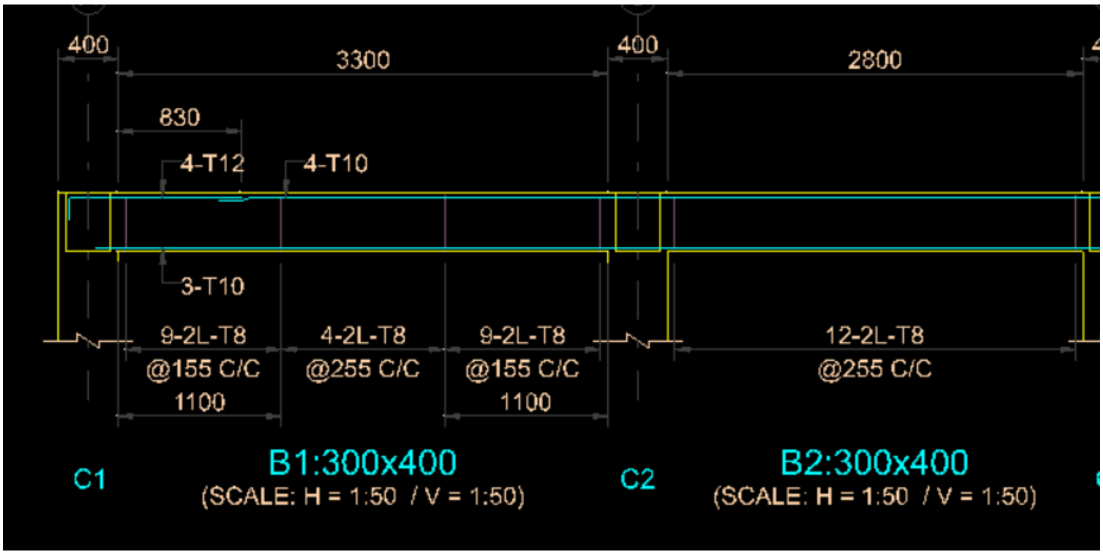
Design Load

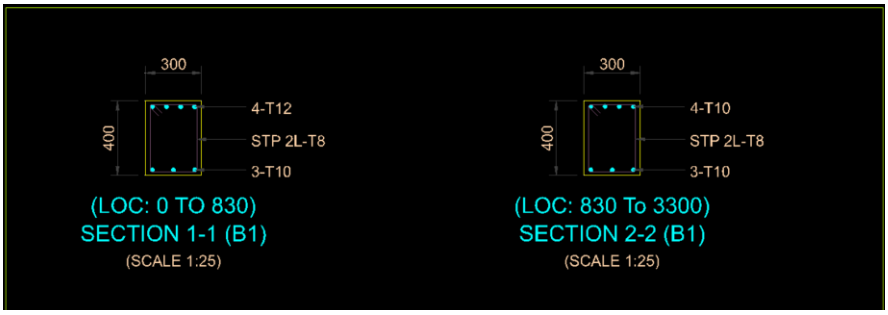
Mz Kn Met	Dist. Met	Load
31.53	1.9	9
-47.76	0	27
-41.97	3.7	26

Design Parameter

Fy(Mpa)	500
Fc(Mpa)	30
Depth(m)	0.400
Width(m)	0.300
Length(m)	3.700







```
=============================================================================
              IS-456   L I M I T   S T A T E   D E S I G N
              B E A M  N O.   351  D E S I G N  R E S U L T S

      M30                  Fe500 (Main)               Fe500 (Sec.)

    LENGTH:  3700.0 mm      SIZE:   300.0 mm X  400.0 mm   COVER: 30.0 mm

                      SUMMARY OF REINF. AREA (Sq.mm)
-----------------------------------------------------------------------------
SECTION       0.0 mm      925.0 mm     1850.0 mm     2775.0 mm     3700.0 mm
-----------------------------------------------------------------------------
 TOP          320.23        186.15        186.15        186.15        280.97
REINF.       (Sq. mm)      (Sq. mm)      (Sq. mm)      (Sq. mm)      (Sq. mm)

BOTTOM        186.15        186.15        210.34        186.15        186.15
REINF.       (Sq. mm)      (Sq. mm)      (Sq. mm)      (Sq. mm)      (Sq. mm)
-----------------------------------------------------------------------------


                      SUMMARY OF PROVIDED REINF. AREA
-----------------------------------------------------------------------------
SECTION       0.0 mm      925.0 mm     1850.0 mm     2775.0 mm     3700.0 mm
-----------------------------------------------------------------------------
 TOP        3-12d         3-12d         3-12d         3-12d         3-12d
REINF.    1 layer(s)    1 layer(s)    1 layer(s)    1 layer(s)    1 layer(s)

BOTTOM      3-10d         3-10d         3-10d         3-10d         3-10d
REINF.    1 layer(s)    1 layer(s)    1 layer(s)    1 layer(s)    1 layer(s)


SHEAR   2 legged  8d  2 legged  8d  2 legged  8d  2 legged  8d  2 legged  8d
REINF.  @ 145 mm c/c  @ 145 mm c/c  @ 145 mm c/c  @ 145 mm c/c  @ 145 mm c/c
-----------------------------------------------------------------------------


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

SHEAR DESIGN RESULTS AT   564.0 mm AWAY FROM START SUPPORT
  VY =     56.58 MX =     -0.57 LD=     9
  Provide 2 Legged  8d  @ 145 mm c/c

SHEAR DESIGN RESULTS AT   564.0 mm AWAY FROM END SUPPORT
  VY =    -54.06 MX =     -0.57 LD=     9
  Provide 2 Legged  8d  @ 145 mm c/c

=============================================================================
```

BEAM DESIGN SUMMARY

Project Name	:	15 m Beam House PLan
Client Name	:	Shivam
Engineer Name	:	Shivam
Design File	:	D:\Bentley\Models by Shivam\House PLan\House Plan-Beam-1-15 m.R2.rcdx
Analysis File	:	D:\Bentley\Models by Shivam\House PLan\House Plan.STD
Analysis Last Modified	:	10-04-2023 16:06:14
Level Designed	:	15 m

Beam No		:	**B_1**	
Group No		:	**G_1**	
Analysis Reference(Member)	15 m	:	351	
Breadth		:	300	mm
Depth		:	400	mm
Concrete Grade		:	M30	N/sqmm
Grade Of Steel (Main)		:	Fe500	N/sqmm
Grade Of Steel (Shear)		:	Fe500	N/sqmm
Cover		:	25	mm
Design Code		:	IS 456 : 2000 + IS 13920 : 2016	
Beam Type		:	Regular Beam	

Flexure Design

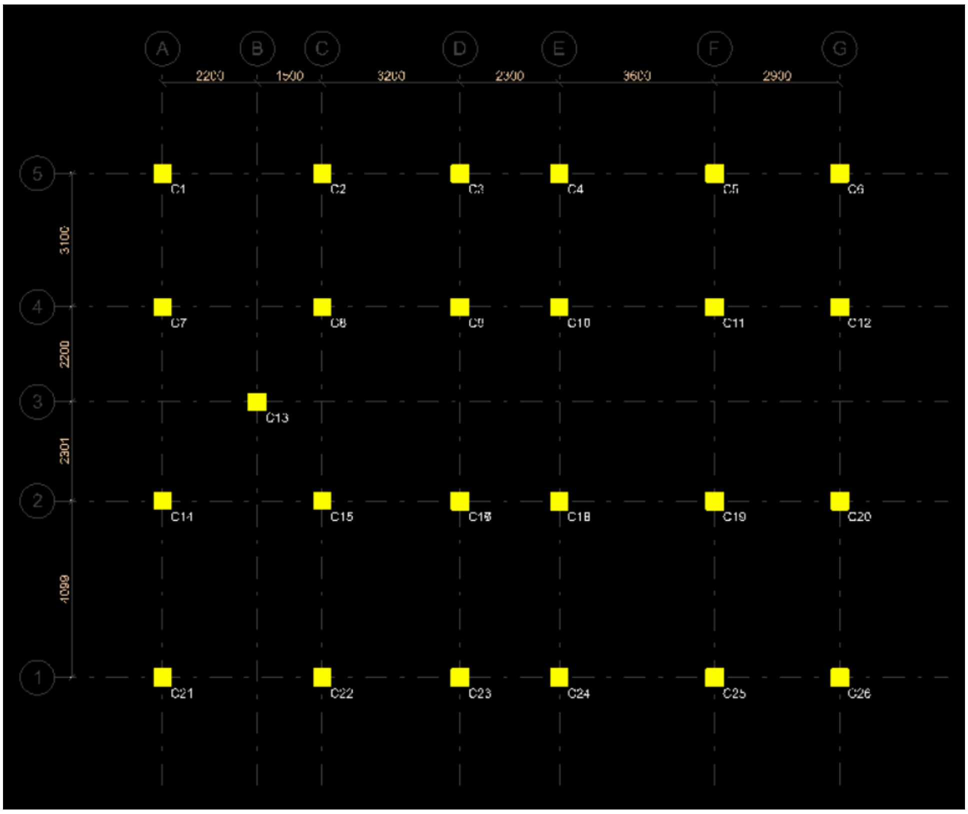
	Beam Bottom			**Beam Top**		
	Left	**Mid**	**Right**	**Left**	**Mid**	**Right**
Mud (kNm)	4.9	32.31	4.06	48.2	0.78	42.56
PtClc (%)	0.2	0.216	0.2	0.328	0.2	0.288
Ast Calc (sqmm)	207	223.37	207	339.83	207	297.93
Ast Prv (sqmm)	235.62	235.62	235.62	452.4	314.16	314.16
Reinforcement	3-T10	3-T10	3-T10	4-T12	4-T10	4-T10

Shear Design

	Left	**Mid**	**Right**
Vut (kN)	77.61	33.38	75.34
Asv Torsion (sqmm/m)	264.02	118.18	254.92
Asv Reqd (sqmm/m)	332.36	332.36	332.36
Asv Prv (sqmm/m)	648.65	394.27	648.65
Reinforcement	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155

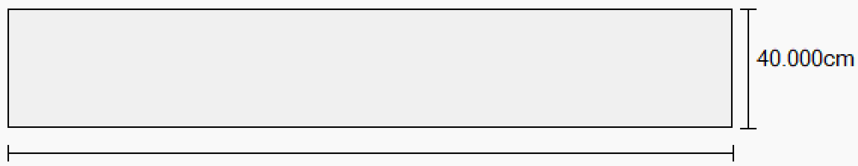
GRP	Beam	Type	Size mm	Material	Bottom Left	Bottom Mid	Bottom Right	Top Left	Top Mid	Top Right	Shear Left	Shear Mid	Shear Right	SFR	Diagonal
G1	B1	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T12	4-T10	4-T10	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
	B2	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T10	4-T10	4-T10	2L-T8 @ 255	2L-T8 @ 255	2L-T8 @ 255	-	-
	B3	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T10	4-T10	4-T12	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 255	-	-
	B4	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T12	4-T10	4-T10	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
	B5	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T10	4-T10	4-T10	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
G2	B6	Reg	300 x 400	M30:Fe500	4-T10	4-T10	4-T10	4-T12	3-T12	4-T12	2L-T8 @ 255	2L-T8 @ 255	2L-T8 @ 255	-	-
	B7	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T12	3-T12	4-T12	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
	B8	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T12	3-T12	4-T12	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
	B9	Reg	300 x 400	M30:Fe500	4-T10	4-T10	4-T10	4-T12	3-T12	4-T12	2L-T8 @ 255	2L-T8 @ 255	2L-T8 @ 255	-	-
	B10	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T12	4-T10	4-T10	2L-T8 @ 155	2L-T8 @ 155	2L-T8 @ 155	-	-
G3	B11	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T10	4-T10	4-T12	2L-T8 @ 255	2L-T8 @ 155	2L-T8 @ 155	-	-
G4	B12	Reg	300 x 400	M30:Fe500	3-T12	3-T12	3-T12	4-T12	3-T12	4-T12	2L-T8 @ 255	2L-T8 @ 255	2L-T8 @ 255	-	-
	B13	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T12	3-T12	4-T12	2L-T8 @ 255	2L-T8 @ 155	2L-T8 @ 155	-	-
	B14	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T12	3-T12	4-T12	2L-T8 @ 155	2L-T8 @ 155	2L-T8 @ 155	-	-
	B15	Reg	300 x 400	M30:Fe500	4-T10	4-T10	4-T10	4-T12	3-T12	4-T12	2L-T8 @ 155	2L-T8 @ 155	2L-T8 @ 155	-	-
	B16	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T12	4-T10	4-T10	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
G5	B17	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	3-T16	3-T12	3-T12	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
	B18	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	3-T12	3-T12	3-T16	2L-T8 @ 155	2L-T8 @ 155	2L-T8 @ 155	-	-
	B19	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	3-T16	3-T12	3-T12	2L-T8 @ 155	2L-T8 @ 155	2L-T8 @ 155	-	-
	B20	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	3-T12	3-T12	3-T16	2L-T8 @ 155	2L-T8 @ 155	2L-T8 @ 155	-	-
	B21	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	3-T16	3-T12	3-T12	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
G6	B22	Reg	300 x 400	M30:Fe500	4-T10	4-T10	4-T10	3-T16	3-T10	3-T16	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
	B23	Reg	300 x 400	M30:Fe500	3-T12	3-T12	3-T12	3-T16	3-T10	3-T16	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
	B24	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	3-T16	3-T12	3-T12	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
G7	B25	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	3-T10	3-T16	3-T20	2L-T8 @ 155	2L-T8 @ 155	2L-T8 @ 155	-	-
	B26	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	3-T20	3-T16	3-T10	2L-T8 @ 155	2L-T8 @ 155	2L-T8 @ 155	-	-
G8	B27	Reg	300 x 400	M30:Fe500	4-T12	4-T12	4-T12	4-T16	4-T10	4-T16	2L-T8 @ 155	2L-T8 @ 155	2L-T8 @ 155	-	-
	B28	Reg	300 x 400	M30:Fe500	4-T12	4-T12	4-T12	4-T16	4-T10	4-T16	2L-T8 @ 155	2L-T8 @ 155	2L-T8 @ 155	-	-
	B29	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T16	4-T10	4-T10	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
G9	B30	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T10	4-T10	4-T16	2L-T8 @ 255	2L-T8 @ 255	2L-T8 @ 255	-	-
	B31	Reg	300 x 400	M30:Fe500	4-T12	4-T12	4-T12	4-T16	4-T10	4-T16	2L-T8 @ 155	2L-T8 @ 155	2L-T8 @ 155	-	-
	B32	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T16	4-T10	4-T10	2L-T8 @ 255	2L-T8 @ 255	2L-T8 @ 255	-	-
G10	B33	Reg	300 x 400	M30:Fe500	3-T12	3-T12	3-T12	4-T16	4-T10	4-T16	2L-T8 @ 155	2L-T8 @ 155	2L-T8 @ 155	-	-
	B34	Reg	300 x 400	M30:Fe500	4-T12	4-T12	4-T12	4-T16	4-T10	4-T16	2L-T8 @ 155	2L-T8 @ 155	2L-T8 @ 155	-	-
	B35	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T16	4-T10	4-T10	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
G11	B36	Reg	300 x 400	M30:Fe500	4-T12	4-T12	4-T12	4-T16	4-T10	4-T16	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
	B37	Reg	300 x 400	M30:Fe500	4-T12	4-T12	4-T12	4-T16	4-T10	4-T16	2L-T8 @ 155	2L-T8 @ 155	2L-T8 @ 155	-	-
	B38	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	4-T16	4-T10	4-T10	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
G12	B39	Reg	300 x 400	M30:Fe500	4-T10	4-T10	4-T10	3-T16	3-T10	3-T16	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
	B40	Reg	300 x 400	M30:Fe500	4-T10	4-T10	4-T10	3-T16	3-T10	3-T16	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-
	B41	Reg	300 x 400	M30:Fe500	3-T10	3-T10	3-T10	3-T16	3-T12	3-T12	2L-T8 @ 155	2L-T8 @ 255	2L-T8 @ 155	-	-

4.2 Column



Analysis and Design of Column:- C1

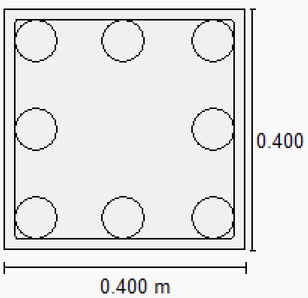
Beam no. = 42. Section: Rect 0.40x0.40



Length = 3.000m

Node	X-Coord(m)	Y-Coord(m)	Z-Coord(m)
1	0.000	0.000	0.000
30	0.000	3.000	0.000

Beam no. = 42 Design code : IS-456

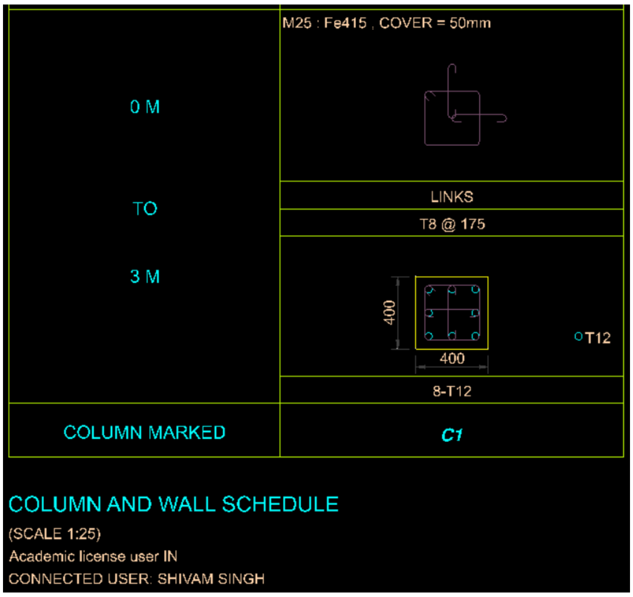


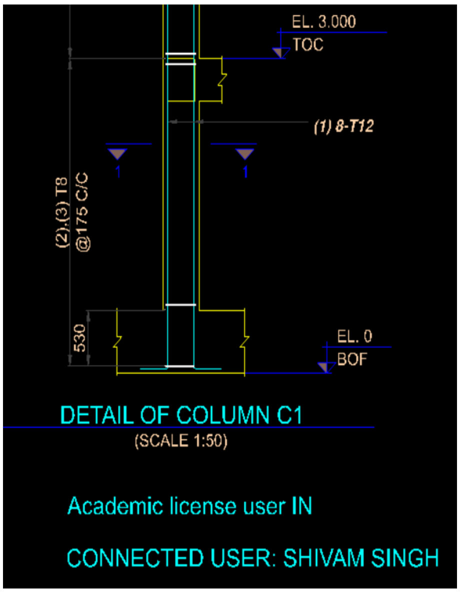
Design Load

Load	3
Location	End 1
Pu(Kns)	-83.74
Mz(Kns-Mt)	0.79
My(Kns-Mt)	31.25

Design Parameter

Fy(Mpa)	500
Fc(Mpa)	30
As Reqd(mm²)	622
As (%)	0.565
Bar Size	12
Bar No	8



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===========================================================================
             IS-456    L I M I T    S T A T E    D E S I G N
         C O L U M N    N O.    42  D E S I G N    R E S U L T S

      M30                      Fe500 (Main)                Fe500 (Sec.)

LENGTH:  3000.0 mm   CROSS SECTION:  400.0 mm X  400.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:    3 END JOINT:     1  TENSION COLUMN


REQD. STEEL AREA    :      621.57 Sq.mm.
REQD. CONCRETE AREA:    77696.56 Sq.mm.
MAIN REINFORCEMENT : Provide   8 - 12 dia. (0.57%,    904.78 Sq.mm.)
                     (Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 190 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
----------------------------------------------------------
Puz :   2384.70   Muz1 :     33.43   Muy1 :     33.43

INTERACTION RATIO: 0.98 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
----------------------------------------------------------
WORST LOAD CASE:     3
END JOINT:    30 Puz :    393.58   Muz :      0.00   Muy :      0.00   IR: 0.21
===========================================================================

  DXF IMPORT OF FLOOR PLAN FOR STAAD                        -- PAGE NO.  506
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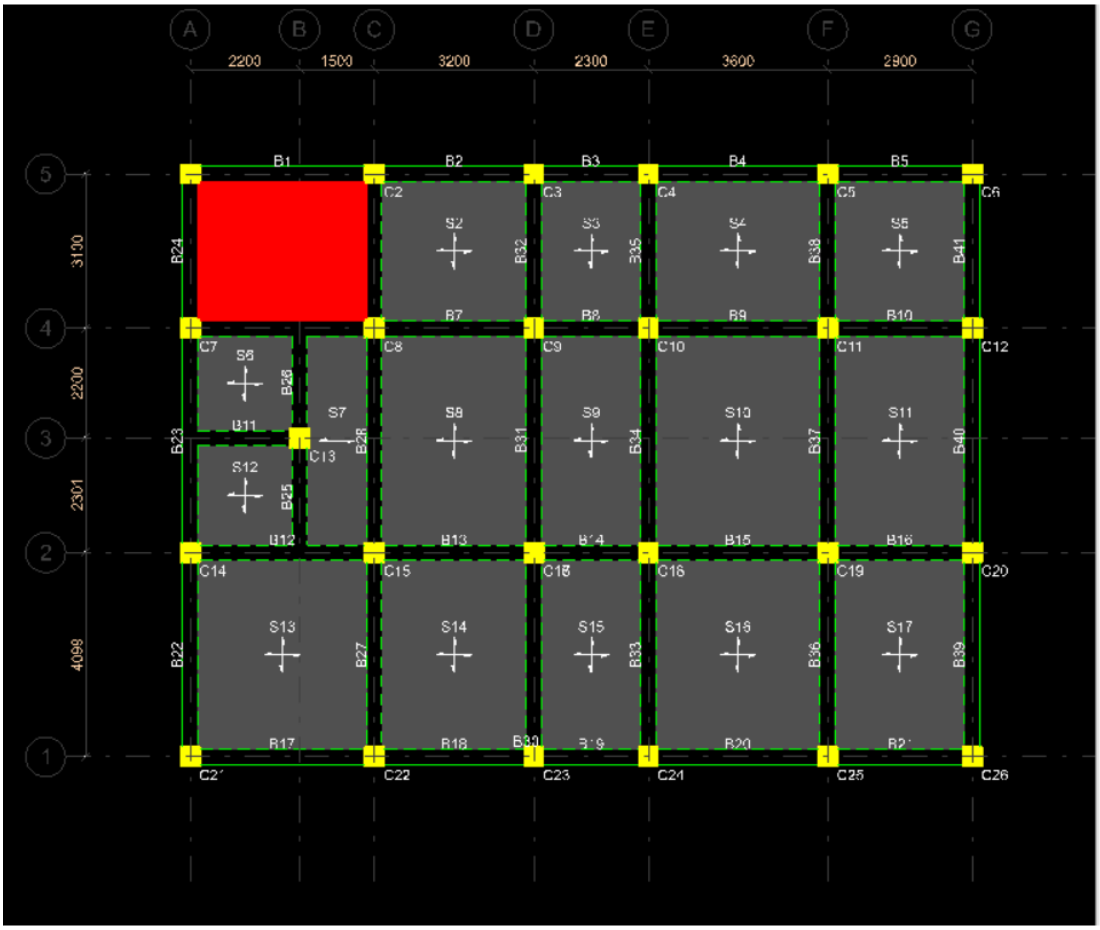
Column/Wall : **C1**
FrameType : **Non-Ductile**

Level	Size (mm)	Material	LC	P (kN)	Mx (kNm)	My (kNm)	Pt (%)	Interaction Ratio	Main Reinforcement	Links
1 TO 2	400 X 400	M25 : Fe415 : Fe415	20	907.18	-9.21	-51.25	0.57	0.5	8-T12	T8 @ 175
2 TO 3	400 X 400	M25 : Fe415 : Fe415	20	708.55	25.64	45.83	0.57	0.5	8-T12	T8 @ 175
3 TO 4	400 X 400	M25 : Fe415 : Fe415	20	518.19	27.21	46.92	0.57	0.54	8-T12	T8 @ 175
4 TO 5	400 X 400	M25 : Fe415 : Fe415	20	328.86	25.68	43.5	0.57	0.56	8-T12	T8 @ 175
5 TO 6	400 X 400	M25 : Fe415 : Fe415	15	142.2	52.09	29.88	0.57	0.82	8-T12	T8 @ 175

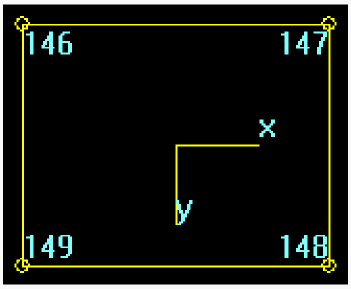
Column/Wall	Level	Size	Material	Frame Type	Designed As	Capacity Ratio Axial	Capacity Ratio Flexure	Pt Prv (%)	Main Reinforcement	Links	Ductile Links
C1	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.492	0.496	0.57	8-T12	T8 @ 175	—
C1	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.394	0.497	0.57	8-T12	T8 @ 175	—
C1	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.29	0.54	0.57	8-T12	T8 @ 175	—
C1	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.188	0.561	0.57	8-T12	T8 @ 175	—
C1	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.09	0.821	0.57	8-T12	T8 @ 175	—
C2	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.703	0.656	0.57	8-T12	T8 @ 175	—
C2	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.558	0.536	0.57	8-T12	T8 @ 175	—
C2	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.416	0.502	0.57	8-T12	T8 @ 175	—
C2	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.277	0.483	0.57	8-T12	T8 @ 175	—
C2	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.137	0.596	0.57	8-T12	T8 @ 175	—
C3	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.621	0.579	0.57	8-T12	T8 @ 175	—
C3	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.498	0.502	0.57	8-T12	T8 @ 175	—
C3	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.369	0.5	0.57	8-T12	T8 @ 175	—
C3	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.246	0.5	0.57	8-T12	T8 @ 175	—
C3	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.118	0.639	0.57	8-T12	T8 @ 175	—
C4	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.645	0.6	0.57	8-T12	T8 @ 175	—
C4	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.514	0.524	0.57	8-T12	T8 @ 175	—
C4	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.382	0.548	0.57	8-T12	T8 @ 175	—
C4	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.255	0.551	0.57	8-T12	T8 @ 175	—
C4	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.124	0.697	0.57	8-T12	T8 @ 175	—
C5	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.671	0.625	0.57	8-T12	T8 @ 175	—
C5	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.532	0.523	0.57	8-T12	T8 @ 175	—
C5	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.395	0.523	0.57	8-T12	T8 @ 175	—
C5	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.263	0.526	0.57	8-T12	T8 @ 175	—
C5	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.13	0.653	0.57	8-T12	T8 @ 175	—
C6	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.445	0.484	0.57	8-T12	T8 @ 175	—
C6	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.357	0.448	0.57	8-T12	T8 @ 175	—
C6	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.263	0.502	0.57	8-T12	T8 @ 175	—
C6	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.17	0.541	0.57	8-T12	T8 @ 175	—
C6	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.08	0.732	0.57	8-T12	T8 @ 175	—
C7	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.803	0.79	0.57	8-T12	T8 @ 175	—
C7	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.64	0.715	0.57	8-T12	T8 @ 175	—
C7	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.479	0.667	0.57	8-T12	T8 @ 175	—
C7	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.319	0.631	0.57	8-T12	T8 @ 175	—
C7	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.16	0.875	0.57	8-T12	T8 @ 175	—
C8	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.924	0.72	1.51	12-T16	T8 @ 250	—
C8	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.885	0.954	0.57	8-T12	T8 @ 175	—
C8	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.656	0.698	0.57	8-T12	T8 @ 175	—
C8	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.436	0.578	0.57	8-T12	T8 @ 175	—
C8	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.222	0.581	0.57	8-T12	T8 @ 175	—
C9	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.975	0.884	0.79	4-T16 + 4-T12	T8 @ 175	—
C9	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.818	0.842	0.57	8-T12	T8 @ 175	—
C9	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.613	0.677	0.57	8-T12	T8 @ 175	—
C9	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.409	0.579	0.57	8-T12	T8 @ 175	—
C9	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.207	0.623	0.57	8-T12	T8 @ 175	—
C10	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.953	0.793	1.07	4-T16 + 8-T12	T8 @ 175	—
C10	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.846	0.87	0.57	8-T12	T8 @ 175	—
C10	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.633	0.69	0.57	8-T12	T8 @ 175	—
C10	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.423	0.591	0.57	8-T12	T8 @ 175	—
C10	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.216	0.681	0.57	8-T12	T8 @ 175	—
C11	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.984	0.89	1.07	4-T16 + 8-T12	T8 @ 175	—
C11	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.868	0.903	0.57	8-T12	T8 @ 175	—
C11	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.646	0.709	0.57	8-T12	T8 @ 175	—
C11	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.431	0.614	0.57	8-T12	T8 @ 175	—
C11	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.222	0.703	0.57	8-T12	T8 @ 175	—
C12	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.736	0.664	0.57	8-T12	T8 @ 175	—
C12	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.591	0.605	0.57	8-T12	T8 @ 175	—
C12	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.445	0.608	0.57	8-T12	T8 @ 175	—
C12	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.297	0.612	0.57	8-T12	T8 @ 175	—
C12	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.147	0.785	0.57	8-T12	T8 @ 175	—
C13	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.692	0.612	0.57	8-T12	T8 @ 175	—
C13	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.568	0.542	0.57	8-T12	T8 @ 175	—
C13	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.435	0.477	0.57	8-T12	T8 @ 175	—
C13	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.295	0.44	0.57	8-T12	T8 @ 175	—
C13	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.15	0.689	0.57	8-T12	T8 @ 175	—
C14	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.855	0.838	0.79	4-T16 + 4-T12	T8 @ 175	—
C14	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.717	0.71	0.57	8-T12	T8 @ 175	—
C14	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.537	0.61	0.57	8-T12	T8 @ 175	—
C14	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.358	0.571	0.57	8-T12	T8 @ 175	—
C14	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.18	0.788	0.57	8-T12	T8 @ 175	—
C15	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.967	0.778	1.51	12-T16	T8 @ 250	—
C15	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.927	0.988	0.57	8-T12	T8 @ 175	—
C15	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.688	0.665	0.57	8-T12	T8 @ 175	—
C15	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.457	0.545	0.57	8-T12	T8 @ 175	—
C15	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.232	0.61	0.57	8-T12	T8 @ 175	—
C16	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.846	0.763	0.57	8-T12	T8 @ 175	—
C16	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.691	0.707	0.57	8-T12	T8 @ 175	—
C16	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.524	0.636	0.57	8-T12	T8 @ 175	—
C16	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.351	0.611	0.57	8-T12	T8 @ 175	—
C16	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.171	0.927	0.57	8-T12	T8 @ 175	—
C17	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.224	0.642	0.57	8-T12	T8 @ 175	—
C17	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.183	0.44	0.57	8-T12	T8 @ 175	—
C17	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.136	0.527	0.57	8-T12	T8 @ 175	—
C17	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.088	0.547	0.57	8-T12	T8 @ 175	—
C17	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.041	0.768	0.57	8-T12	T8 @ 175	—
C18	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.956	0.759	1.51	12-T16	T8 @ 250	—
C18	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.87	0.87	0.79	4-T16 + 4-T12	T8 @ 175	—
C18	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.678	0.798	0.57	8-T12	T8 @ 175	—
C18	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.451	0.718	0.57	8-T12	T8 @ 175	—
C18	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.232	0.827	0.57	8-T12	T8 @ 175	—
C19	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.955	0.689	1.79	4-T20 + 8-T16	T8 @ 250	—
C19	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.923	0.85	0.79	4-T16 + 4-T12	T8 @ 175	—
C19	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.724	0.685	0.57	8-T12	T8 @ 175	—
C19	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.483	0.545	0.57	8-T12	T8 @ 175	—
C19	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.249	0.565	0.57	8-T12	T8 @ 175	—
C20	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.826	0.822	0.57	8-T12	T8 @ 175	—
C20	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.665	0.59	0.57	8-T12	T8 @ 175	—
C20	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.501	0.525	0.57	8-T12	T8 @ 175	—
C20	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.334	0.525	0.57	8-T12	T8 @ 175	—
C20	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.166	0.66	0.57	8-T12	T8 @ 175	—
C21	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.548	0.548	0.57	8-T12	T8 @ 175	—
C21	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.444	0.566	0.57	8-T12	T8 @ 175	—
C21	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.334	0.6	0.57	8-T12	T8 @ 175	—
C21	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.223	0.628	0.57	8-T12	T8 @ 175	—
C21	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.108	0.998	0.57	8-T12	T8 @ 175	—
C22	0 m TO 3 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.81	0.806	0.57	8-T12	T8 @ 175	—
C22	3 m TO 6 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.646	0.667	0.57	8-T12	T8 @ 175	—
C22	6 m TO 9 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.483	0.584	0.57	8-T12	T8 @ 175	—
C22	9 m TO 12 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.32	0.559	0.57	8-T12	T8 @ 175	—
C22	12 m TO 15 m	400 X 400	M25 : Fe415	Non-Ductile	COL - E	0.159	0.791	0.57	8-T12	T8 @ 175	—

4.3 Slab



Analysis of Slab:- S_1

Plate No : 392



Node	X m	Y m	Z m
146(A)	0	15	0
147(B)	3.7	15	0
148(C)	3.7	15	3.1
149(D)	0	15	3.1

Edge Lengths & Area

	AB	BC	CD	DA
Length (m)	3.7000000476	3.0999999046	3.7000000476	3.0999999046
Area (cm2)	114700.012207			

Plate No : 392

Load List : 6:LL

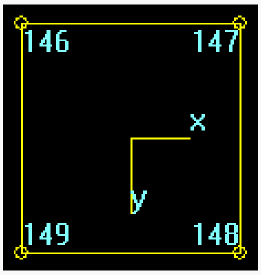
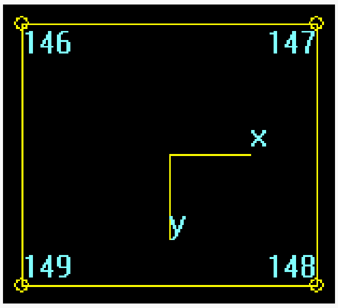


Plate Corner Displacements

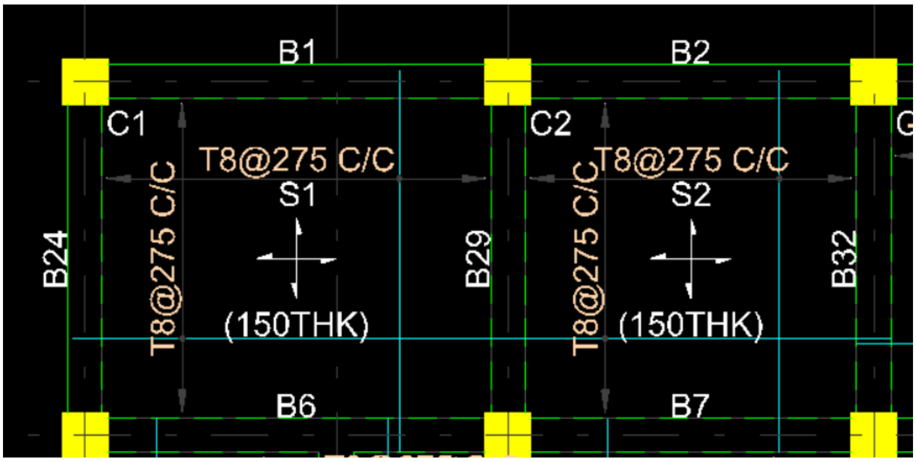
Node	X mm	Y mm	Z mm
146	-0.013	-0.119	0.117
147	-0.014	-0.211	0.105
148	-0.004	-0.436	0.105
149	-0.003	-0.250	0.117

Plate No : 392



Physical Properties

Node	Thickness m
146(A)	0.1500000059
147(B)	0.1500000059
148(C)	0.1500000059
149(D)	0.1500000059



Slab No. : **S1**

Ly = 3.7 m | Lx = 3.1 m

Live Load = 3 kN/sqm | Imposed Load = 3.75 kN/sqm

Thickness = 150 mm | Span Type = 2-Way | Panel Type = 4

Design Code = IS 456 : 2000 + IS 13920 : 2016 | Grade of Concrete = M30 | Grade of Steel = Fe500

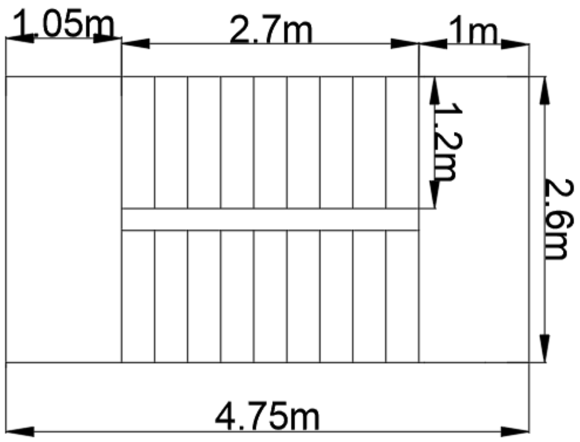
Bottom SS	Bottom LS	Top SS	Top LS	Distribution
T8 @ 275	T8 @ 275	T8 @ 275	T8 @ 275	T8 @ 300

No	Slab	Thickness (mm)	Conc Grade	Steel Grade	Bottom @ Lx	Bottom @ Ly	Top @ Lx (Cont)	Top @ Lx (End)	Top @ Ly (Cont)	Top @ Ly (End)	Dist. Steel
1	S1	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 275	T8 @ 300	T8 @ 275	T8 @ 300	T8 @ 300
2	S2	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 275	T8 @ 300	T8 @ 275	T8 @ 300	T8 @ 300
3	S3	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 275	---	T8 @ 275	T8 @ 300	T8 @ 300
4	S4	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 275	T8 @ 300	T8 @ 275	T8 @ 300	T8 @ 300
5	S5	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 275	T8 @ 300	T8 @ 275	T8 @ 300	T8 @ 300
6	S6	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 275	T8 @ 300	T8 @ 275	T8 @ 300	T8 @ 300
7	S7	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 275	---	---	T8 @ 300	T8 @ 300
8	S8	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 275	---	T8 @ 275	---	T8 @ 300
9	S9	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 275	---	T8 @ 275	---	T8 @ 300
10	S10	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 275	---	T8 @ 275	---	T8 @ 300
11	S11	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 265	T8 @ 300	T8 @ 275	T8 @ 300	T8 @ 300
12	S12	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 275	T8 @ 300	T8 @ 275	T8 @ 300	T8 @ 300
13	S13	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 215	T8 @ 300	T8 @ 245	T8 @ 300	T8 @ 300
14	S14	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 275	---	T8 @ 275	T8 @ 300	T8 @ 300
15	S15	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 275	---	T8 @ 275	T8 @ 300	T8 @ 300
16	S16	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 275	---	T8 @ 275	T8 @ 300	T8 @ 300
17	S17	150	M30	Fe500	T8 @ 275	T8 @ 275	T8 @ 270	T8 @ 300	T8 @ 275	T8 @ 300	T8 @ 300

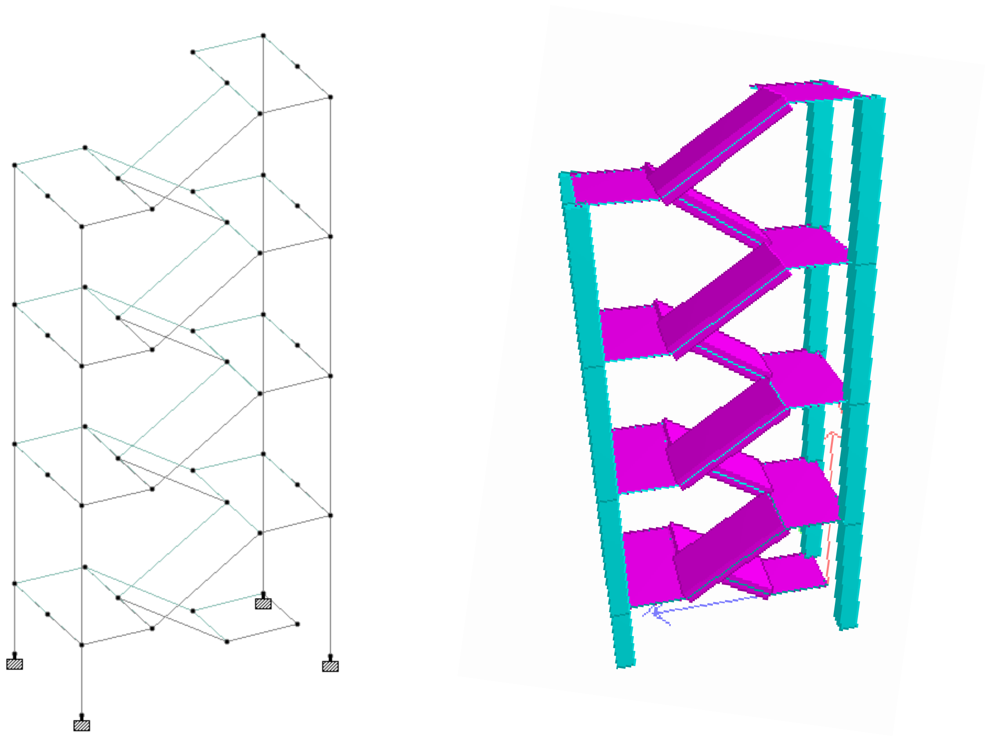
4.4 Staircase

Dimensions:

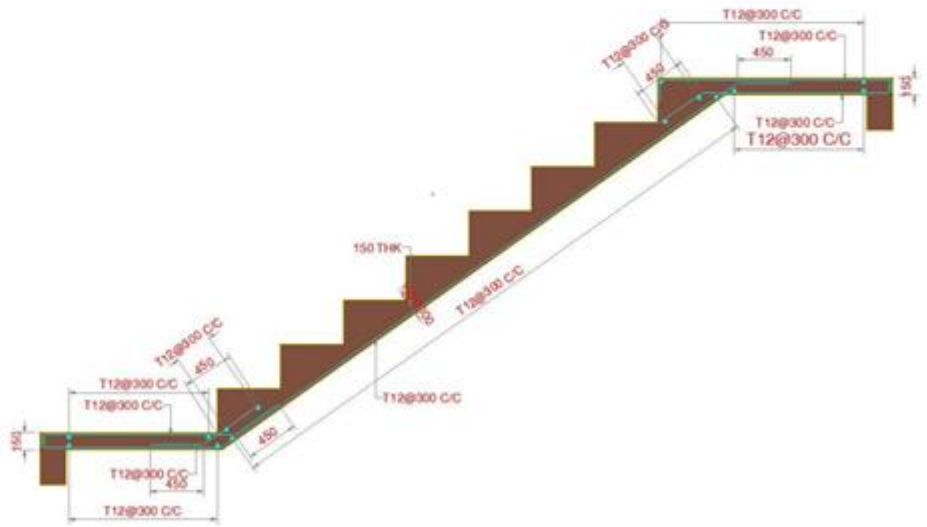
- f_{ck} : M30
- fy : Fe500
- Width : 1.2 m
- Tread : 30 cm
- Riser : 15 cm



AutoCAD Plan

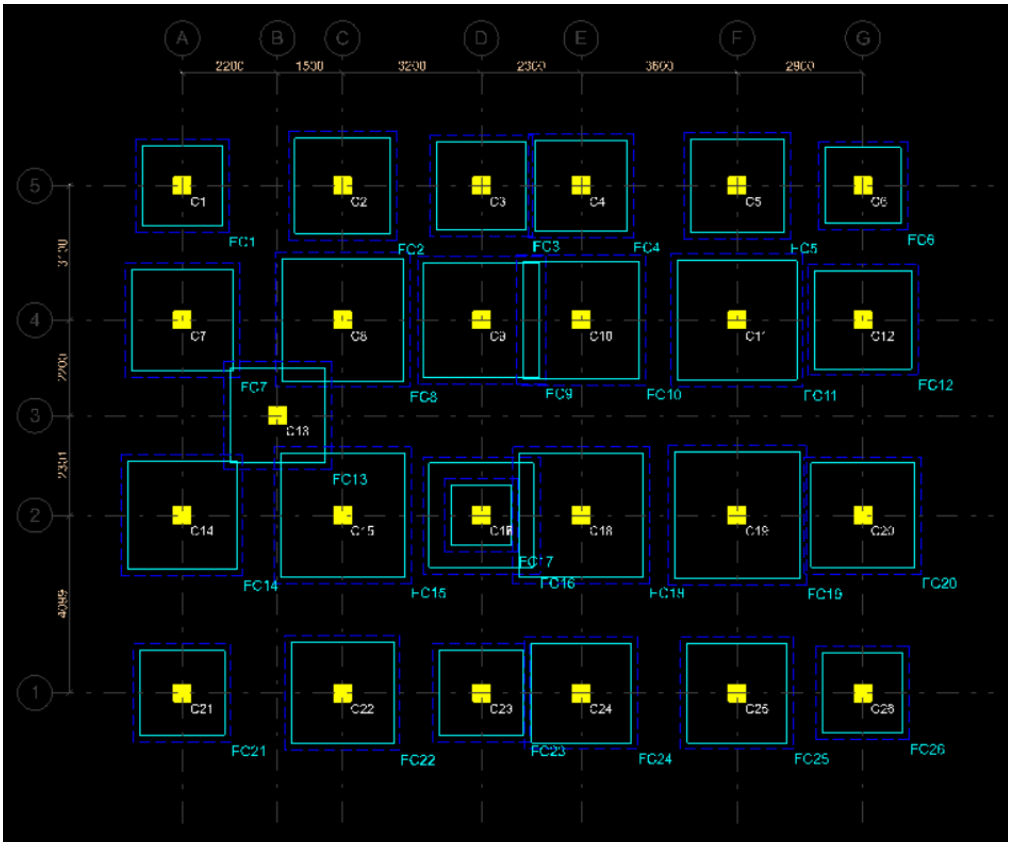


3D Model in STAAD Pro



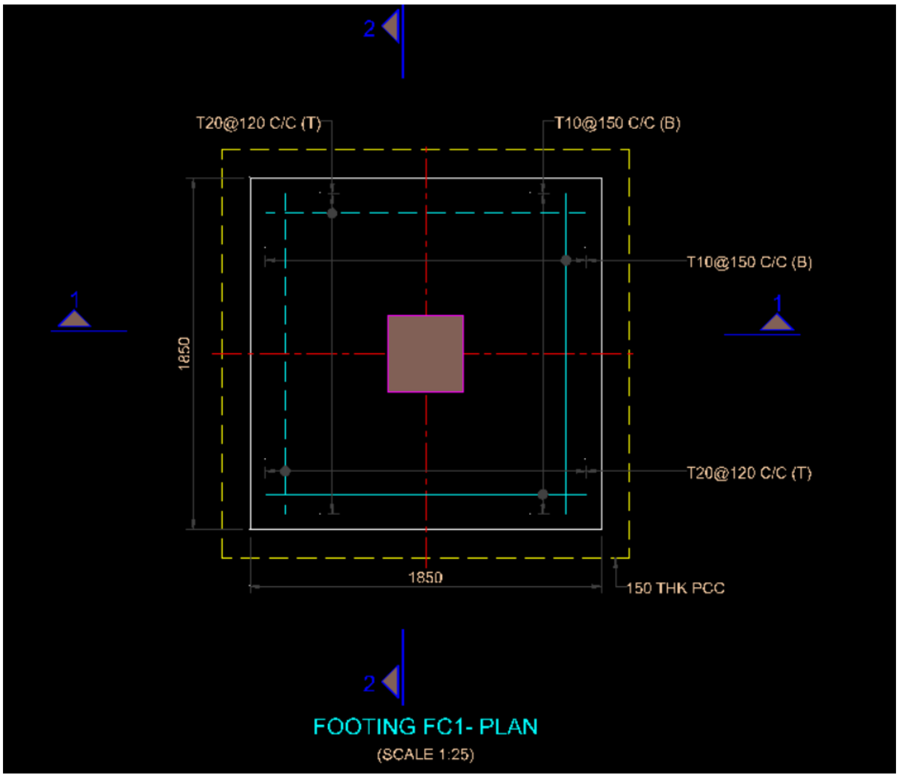
Reinforcement Detailing of Staircase

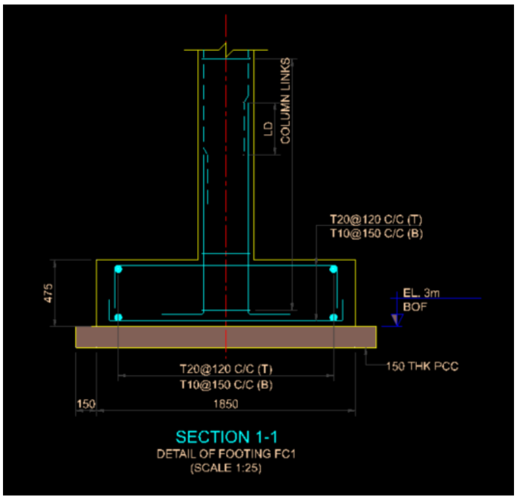
4.5 Footing

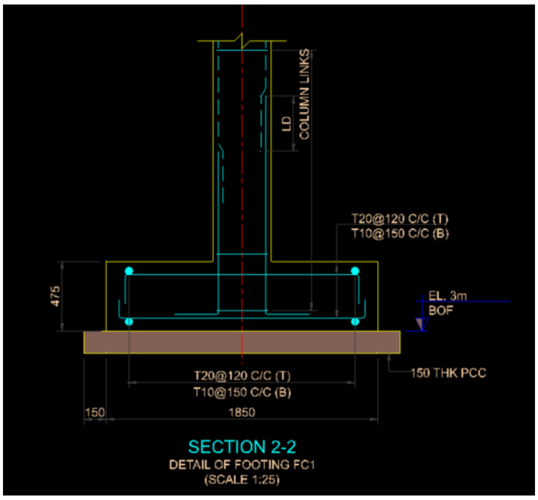


Plan of footing

Analysis of Footing:- F_1







Sectional View of footing (FC_1)

FOOTING DESIGN SUMMARY

Project Name	:	Footing House Plan
Client Name	:	Unassigned
Engineer Name	:	Unassigned
Design File	:	D:\Bentley\Models by Shivam\House PLan\House Plan-Footing-1.R2.rcdx
Analysis File	:	D:\Bentley\Models by Shivam\House PLan\House Plan.STD
Analysis Last Modified	:	10-04-2023 16:06:14

Design Code : IS 456 : 2000 + IS 13920 : 2016

Footing No: **FC1**
Column No: C1 (400 mm X 400 mm)
Footing Type: Pad
Concrete Grade: M30
Steel Grade: Fe500

Size (LxBxD)	Bot @ L	Bot @ B	Top @ L	Top @ B	Shear @ L	Shear @ B
1850x1850x475	14-T10 @ 150	14-T10 @ 150	17-T20 @ 120	17-T20 @ 120	-	-

Grp. No.	Footing Mark	Column Mark	Footing Type	Material Property	Column Size (mm)	Footing Size (LxBxD) (mm)	Loss of contact (%)	Bottom @ L	Bottom @ B	Top @ L	Top @ B
1	FC1	C1	Pad	M30 : Fe500	400 X 400	1850 x 1850 x 475	0	T10 @ 150	T10 @ 150	T20 @ 120	T20 @ 120
2	FC2	C2	Pad	M30 : Fe500	400 X 400	2200 x 2200 x 550	0	T10 @ 140	T10 @ 125	T20 @ 115	T20 @ 115
3	FC3	C3	Pad	M30 : Fe500	400 X 400	2050 x 2050 x 525	0	T10 @ 145	T10 @ 135	T20 @ 110	T20 @ 110
4	FC4	C4	Pad	M30 : Fe500	400 X 400	2100 x 2100 x 525	0	T10 @ 140	T10 @ 130	T20 @ 115	T20 @ 115
5	FC5	C5	Pad	M30 : Fe500	400 X 400	2150 x 2150 x 525	0	T10 @ 140	T10 @ 125	T20 @ 110	T20 @ 110
6	FC6	C6	Pad	M30 : Fe500	400 X 400	1750 x 1750 x 450	0	T10 @ 145	T10 @ 145	T16 @ 100	T16 @ 100
7	FC7	C7	Pad	M30 : Fe500	400 X 400	2350 x 2350 x 550	0	T10 @ 110	T10 @ 115	T20 @ 115	T20 @ 115
8	FC8	C8	Pad	M30 : Fe500	400 X 400	2800 x 2800 x 675	0	T10 @ 100	T12 @ 145	T20 @ 110	T20 @ 110
9	FC9	C9	Pad	M30 : Fe500	400 X 400	2650 x 2650 x 625	0	T10 @ 100	T10 @ 100	T20 @ 115	T20 @ 115
10	FC10	C10	Pad	M30 : Fe500	400 X 400	2700 x 2700 x 650	0	T10 @ 100	T12 @ 145	T20 @ 110	T20 @ 110
11	FC11	C11	Pad	M30 : Fe500	400 X 400	2750 x 2750 x 650	0	T12 @ 140	T12 @ 140	T20 @ 110	T20 @ 110
12	FC12	C12	Pad	M30 : Fe500	400 X 400	2250 x 2250 x 550	0	T10 @ 120	T10 @ 120	T20 @ 115	T20 @ 115
13	FC13	C13	Pad	M30 : Fe500	400 X 400	2200 x 2200 x 525	0	T10 @ 135	T10 @ 135	T20 @ 115	T20 @ 115
14	FC14	C14	Pad	M30 : Fe500	400 X 400	2500 x 2500 x 600	0	T10 @ 105	T10 @ 110	T20 @ 110	T20 @ 110
15	FC15	C15	Pad	M30 : Fe500	400 X 400	2850 x 2850 x 675	0	T12 @ 140	T12 @ 135	T20 @ 110	T20 @ 110
16	FC16	C16	Pad	M30 : Fe500	400 X 400	2400 x 2400 x 575	0	T10 @ 115	T10 @ 105	T20 @ 110	T20 @ 110
17	FC17	C17	Pad	M30 : Fe500	400 X 400	1400 x 1400 x 350	0	T10 @ 155	T10 @ 155	T16 @ 135	T16 @ 135
18	FC18	C18	Pad	M30 : Fe500	400 X 400	2850 x 2850 x 675	0	T12 @ 135	T12 @ 140	T20 @ 110	T20 @ 110
19	FC19	C19	Pad	M30 : Fe500	400 X 400	2900 x 2900 x 700	0	T12 @ 135	T12 @ 135	T20 @ 110	T20 @ 110
20	FC20	C20	Pad	M30 : Fe500	400 X 400	2400 x 2400 x 575	0	T10 @ 110	T10 @ 115	T20 @ 110	T20 @ 110
21	FC21	C21	Pad	M30 : Fe500	400 X 400	1950 x 1950 x 475	0	T10 @ 145	T10 @ 135	T20 @ 120	T20 @ 120
22	FC22	C22	Pad	M30 : Fe500	400 X 400	2350 x 2350 x 575	0	T10 @ 120	T10 @ 110	T20 @ 115	T20 @ 115
23	FC23	C23	Pad	M30 : Fe500	400 X 400	1950 x 1950 x 475	0	T10 @ 145	T10 @ 145	T20 @ 120	T20 @ 120
24	FC24	C24	Pad	M30 : Fe500	400 X 400	2300 x 2300 x 550	0	T10 @ 125	T10 @ 110	T20 @ 110	T20 @ 110
25	FC25	C25	Pad	M30 : Fe500	400 X 400	2300 x 2300 x 550	0	T10 @ 125	T10 @ 110	T20 @ 110	T20 @ 110
26	FC26	C26	Pad	M30 : Fe500	400 X 400	1850 x 1850 x 475	0	T10 @ 150	T10 @ 150	T20 @ 120	T20 @ 120

5. CONCLUSION:

STAAD PRO, STAAD RCDC, and AutoCAD are used in the building's planning, design, and analysis. This home has three bedrooms on each floor and is a BG+3 structure. Parking spaces are located in the basement. This was designed utilizing several IS codes, including BS2007, IS 456, IS 1893, and IS 875 (Parts 1, 2, and 3). For the footing's reinforcement, M30 grade concrete and FE500 steel are used, while FE500 steel is used in the staircase's slab and M30 and FE500 are used for the design of the beam and column. Buildings are built to withstand wind, earthquake, seismic, and dead loads. It is intended for the Bhubaneswar region.

ANNEX-2

STAAD PRO Command File/ Steps:

1. STAAD SPACE DXF IMPORT OF FLOOR PLAN FOR STAAD
2. START JOB INFORMATION
3. ENGINEER DATE 09-Apr-23
4. END JOB INFORMATION
5. INPUT WIDTH 79
6. UNIT METER KN
7. JOINT COORDINATES
8. 1 0 0 0; 2 3.7 0 0; 3 3.7 0 3.1; 4 0 0 3.1; 5 6.9 0 0; 6 6.9 0 3.1; 7 9.2 0 0;
9. 8 9.2 0 3.1; 9 12.8 0 0; 10 12.8 0 3.1; 11 15.7 0 0; 12 15.7 0 3.1; 13 0 0 7.6;
10. 14 3.7 0 7.6; 15 6.9 0 7.60105; 16 9.2 0 7.60105; 17 12.8 0 7.60105;
11. 18 15.7 0 7.60105; 19 0 0 11.7; 20 3.7 0 11.7; 21 6.9 0 11.7;
12. 22 6.90134 0 7.60105; 23 9.2 0 11.7; 24 12.8 0 11.7; 25 15.7 0 11.7;
13. 26 2.2 0 5.3; 30 0 3 0; 31 3.7 3 0; 32 3.7 3 3.1; 33 0 3 3.1; 34 6.9 3 0;
14. 35 6.9 3 3.1; 36 9.2 3 0; 37 9.2 3 3.1; 38 12.8 3 0; 39 12.8 3 3.1;
15. 40 15.7 3 0; 41 15.7 3 3.1; 42 0 3 7.6; 43 3.7 3 7.6; 44 6.9 3 7.60105;
16. 45 9.2 3 7.60105; 46 12.8 3 7.60105; 47 15.7 3 7.60105; 48 0 3 11.7;
17. 49 3.7 3 11.7; 50 6.9 3 11.7; 51 6.90134 3 7.60105; 52 9.2 3 11.7;
18. 53 12.8 3 11.7; 54 15.7 3 11.7; 55 2.2 3 5.3; 56 2.2 3 3.1; 57 2.2 3 7.6;
19. 58 0 3 5.3; 59 0 6 0; 60 3.7 6 0; 61 3.7 6 3.1; 62 0 6 3.1; 63 6.9 6 0;
20. 64 6.9 6 3.1; 65 9.2 6 0; 66 9.2 6 3.1; 67 12.8 6 0; 68 12.8 6 3.1;
21. 69 15.7 6 0; 70 15.7 6 3.1; 71 0 6 7.6; 72 3.7 6 7.6; 73 6.9 6 7.60105;
22. 74 9.2 6 7.60105; 75 12.8 6 7.60105; 76 15.7 6 7.60105; 77 0 6 11.7;
23. 78 3.7 6 11.7; 79 6.9 6 11.7; 80 6.90134 6 7.60105; 81 9.2 6 11.7;
24. 82 12.8 6 11.7; 83 15.7 6 11.7; 84 2.2 6 5.3; 85 2.2 6 3.1; 86 2.2 6 7.6;
25. 87 0 6 5.3; 88 0 9 0; 89 3.7 9 0; 90 3.7 9 3.1; 91 0 9 3.1; 92 6.9 9 0;
26. 93 6.9 9 3.1; 94 9.2 9 0; 95 9.2 9 3.1; 96 12.8 9 0; 97 12.8 9 3.1;
27. 98 15.7 9 0; 99 15.7 9 3.1; 100 0 9 7.6; 101 3.7 9 7.6; 102 6.9 9 7.60105;
28. 103 9.2 9 7.60105; 104 12.8 9 7.60105; 105 15.7 9 7.60105; 106 0 9 11.7;
29. 107 3.7 9 11.7; 108 6.9 9 11.7; 109 6.90134 9 7.60105; 110 9.2 9 11.7;
30. 111 12.8 9 11.7; 112 15.7 9 11.7; 113 2.2 9 5.3; 114 2.2 9 3.1; 115 2.2 9 7.6;
31. 116 0 9 5.3; 117 0 12 0; 118 3.7 12 0; 119 3.7 12 3.1; 120 0 12 3.1;
32. 121 6.9 12 0; 122 6.9 12 3.1; 123 9.2 12 0; 124 9.2 12 3.1; 125 12.8 12 0;
33. 126 12.8 12 3.1; 127 15.7 12 0; 128 15.7 12 3.1; 129 0 12 7.6; 130 3.7 12 7.6;
34. 131 6.9 12 7.60105; 132 9.2 12 7.60105; 133 12.8 12 7.60105;
35. 134 15.7 12 7.60105; 135 0 12 11.7; 136 3.7 12 11.7; 137 6.9 12 11.7;
36. 138 6.90134 12 7.60105; 139 9.2 12 11.7; 140 12.8 12 11.7; 141 15.7 12 11.7;
37. 142 2.2 12 5.3; 143 2.2 12 3.1; 144 2.2 12 7.6; 145 0 12 5.3; 146 0 15 0;
38. 147 3.7 15 0; 148 3.7 15 3.1; 149 0 15 3.1; 150 6.9 15 0; 151 6.9 15 3.1;
39. 152 9.2 15 0; 153 9.2 15 3.1; 154 12.8 15 0; 155 12.8 15 3.1; 156 15.7 15 0;
40. 157 15.7 15 3.1; 158 0 15 7.6; 159 3.7 15 7.6; 160 6.9 15 7.60105;
41. 161 9.2 15 7.60105; 162 12.8 15 7.60105; 163 15.7 15 7.60105; 164 0 15 11.7;
42. 165 3.7 15 11.7; 166 6.9 15 11.7; 167 6.90134 15 7.60105; 168 9.2 15 11.7;
43. 169 12.8 15 11.7; 170 15.7 15 11.7; 171 2.2 15 5.3; 172 2.2 15 3.1;
44. 173 2.2 15 7.6; 174 0 15 5.3;
45. MEMBER INCIDENCES
46. 42 1 30; 43 2 31; 44 3 32; 45 4 33; 46 5 34; 47 6 35; 48 7 36; 49 8 37;
47. 50 9 38; 51 10 39; 52 11 40; 53 12 41; 54 13 42; 55 14 43; 56 15 44; 57 16 45;
48. 58 17 46; 59 18 47; 60 19 48; 61 20 49; 62 21 50; 63 22 51; 64 23 52; 65 24 53;
49. 66 25 54; 67 26 55; 71 30 31; 72 31 32; 73 32 33; 74 33 30; 75 31 34; 76 34 35;
50. 77 35 32; 78 34 36; 79 36 37; 80 37 35; 81 36 38; 82 38 39; 83 39 37; 84 38 40;
51. 85 40 41; 86 41 39; 87 33 42; 88 42 43; 89 43 32; 90 35 44; 91 44 43; 92 37 45;
52. 93 45 44; 94 39 46; 95 46 45; 96 41 47; 97 47 46; 98 42 48; 99 48 49;
53. 100 49 43; 101 49 50; 102 50 51; 103 50 52; 104 52 45; 105 52 53; 106 53 46;
54. 107 53 54; 108 54 47; 109 55 56; 110 55 57; 111 55 58; 112 30 59; 113 31 60;
55. 114 32 61; 115 33 62; 116 34 63; 117 35 64; 118 36 65; 119 37 66; 120 38 67;

121 39 68; 122 40 69; 123 41 70; 124 42 71; 125 43 72; 126 44 73; 127 45 74;
128 46 75; 129 47 76; 130 48 77; 131 49 78; 132 50 79; 133 51 80; 134 52 81;
135 53 82; 136 54 83; 137 55 84; 141 59 60; 142 60 61; 143 61 62; 144 62 59;
145 60 63; 146 63 64; 147 64 61; 148 63 65; 149 65 66; 150 66 64; 151 65 67;
152 67 68; 153 68 66; 154 67 69; 155 69 70; 156 70 68; 157 62 71; 158 71 72;
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166 70 76; 167 76 75; 168 71 77; 169 77 78; 170 78 72; 171 78 79; 172 79 80;
173 79 81; 174 81 74; 175 81 82; 176 82 75; 177 82 83; 178 83 76; 179 84 85;
180 84 86; 181 84 87; 182 59 88; 183 60 89; 184 61 90; 185 62 91; 186 63 92;
187 64 93; 188 65 94; 189 66 95; 190 67 96; 191 68 97; 192 69 98; 193 70 99;
194 71 100; 195 72 101; 196 73 102; 197 74 103; 198 75 104; 199 76 105;
200 77 106; 201 78 107; 202 79 108; 203 80 109; 204 81 110; 205 82 111;
206 83 112; 207 84 113; 211 88 89; 212 89 90; 213 90 91; 214 91 88; 215 89 92;
216 92 93; 217 93 90; 218 92 94; 219 94 95; 220 95 93; 221 94 96; 222 96 97;
223 97 95; 224 96 98; 225 98 99; 226 99 97; 227 91 100; 228 100 101;
229 101 90; 230 93 102; 231 102 101; 232 95 103; 233 103 102; 234 97 104;
235 104 103; 236 99 105; 237 105 104; 238 100 106; 239 106 107; 240 107 101;
241 107 108; 242 108 109; 243 108 110; 244 110 103; 245 110 111; 246 111 104;
247 111 112; 248 112 105; 249 113 114; 250 113 115; 251 113 116; 252 88 117;
253 89 118; 254 90 119; 255 91 120; 256 92 121; 257 93 122; 258 94 123;
259 95 124; 260 96 125; 261 97 126; 262 98 127; 263 99 128; 264 100 129;
265 101 130; 266 102 131; 267 103 132; 268 104 133; 269 105 134; 270 106 135;
271 107 136; 272 108 137; 273 109 138; 274 110 139; 275 111 140; 276 112 141;
277 113 142; 281 117 118; 282 118 119; 283 119 120; 284 120 117; 285 118 121;
286 121 122; 287 122 119; 288 121 123; 289 123 124; 290 124 122; 291 123 125;
292 125 126; 293 126 124; 294 125 127; 295 127 128; 296 128 126; 297 120 129;
298 129 130; 299 130 119; 300 122 131; 301 131 130; 302 124 132; 303 132 131;
304 126 133; 305 133 132; 306 128 134; 307 134 133; 308 129 135; 309 135 136;
310 136 130; 311 136 137; 312 137 138; 313 137 139; 314 139 132; 315 139 140;
316 140 133; 317 140 141; 318 141 134; 319 142 143; 320 142 144; 321 142 145;
322 117 146; 323 118 147; 324 119 148; 325 120 149; 326 121 150; 327 122 151;
328 123 152; 329 124 153; 330 125 154; 331 126 155; 332 127 156; 333 128 157;
334 129 158; 335 130 159; 336 131 160; 337 132 161; 338 133 162; 339 134 163;
340 135 164; 341 136 165; 342 137 166; 343 138 167; 344 139 168; 345 140 169;
346 141 170; 347 142 171; 351 146 147; 352 147 148; 353 148 149; 354 149 146;
355 147 150; 356 150 151; 357 151 148; 358 150 152; 359 152 153; 360 153 151;
361 152 154; 362 154 155; 363 155 153; 364 154 156; 365 156 157; 366 157 155;
367 149 158; 368 158 159; 369 159 148; 370 151 160; 371 160 159; 372 153 161;
373 161 160; 374 155 162; 375 162 161; 376 157 163; 377 163 162; 378 158 164;
379 164 165; 380 165 159; 381 165 166; 382 166 167; 383 166 168; 384 168 161;
385 168 169; 386 169 162; 387 169 170; 388 170 163; 389 171 172; 390 171 173;
391 171 174;
ELEMENT INCIDENCES SHELL
392 146 147 148 149; 393 147 148 151 150; 395 150 151 153 152;
396 151 148 159 160; 397 152 153 155 154; 398 153 151 160 161;
399 154 155 157 156; 400 155 153 161 162; 401 157 155 162 163;
402 158 159 165 164; 403 162 161 168 169; 404 163 162 169 170;
405 168 161 159 165; 406 149 172 171 174; 407 174 171 173 158;
408 172 148 159 173; 409 167 161 168 166; 413 117 118 119 120;
414 118 119 122 121; 415 121 122 124 123; 416 122 119 130 131;
417 123 124 126 125; 418 124 122 131 132; 419 125 126 128 127;
420 126 124 132 133; 421 128 126 133 134; 422 129 130 136 135;
423 133 132 139 140; 424 134 133 140 141; 425 139 132 130 136;
426 120 143 142 145; 427 145 142 144 129; 428 143 119 130 144;
429 138 132 139 137; 433 88 89 90 91; 434 89 90 93 92; 435 92 93 95 94;
436 93 90 101 102; 437 94 95 97 96; 438 95 93 102 103; 439 96 97 99 98;
440 97 95 103 104; 441 99 97 104 105; 442 100 101 107 106; 443 104 103 110 111;
444 105 104 111 112; 445 110 103 101 107; 446 91 114 113 116;
447 116 113 115 100; 448 114 90 101 115; 449 109 103 110 108; 453 59 60 61 62;
454 60 61 64 63; 455 63 64 66 65; 456 64 61 72 73; 457 65 66 68 67;

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458 66 64 73 74; 459 67 68 70 69; 460 68 66 74 75; 461 70 68 75 76;
462 71 72 78 77; 463 75 74 81 82; 464 76 75 82 83; 465 81 74 72 78;
466 62 85 84 87; 467 87 84 86 71; 468 85 61 72 86; 469 80 74 81 79;
473 30 31 32 33; 474 31 32 35 34; 475 34 35 37 36; 476 35 32 43 44;
477 36 37 39 38; 478 37 35 44 45; 479 38 39 41 40; 480 39 37 45 46;
481 41 39 46 47; 482 42 43 49 48; 483 46 45 52 53; 484 47 46 53 54;
485 52 45 43 49; 486 33 56 55 58; 487 58 55 57 42; 488 56 32 43 57;
489 51 45 52 50;
ELEMENT PROPERTY
392 393 395 TO 409 413 TO 429 433 TO 449 453 TO 469 473 TO 489 THICKNESS 0.15
DEFINE MATERIAL START
ISOTROPIC CONCRETE
E 2.17185e+07
POISSON 0.17
DENSITY 23.5616
ALPHA 1e-05
DAMP 0.05
G 9.28139e+06
TYPE CONCRETE
STRENGTH FCU 27579
END DEFINE MATERIAL
MEMBER PROPERTY
71 TO 111 141 TO 181 211 TO 251 281 TO 321 351 TO 391 PRIS YD 0.4 ZD 0.3
42 TO 67 112 TO 137 182 TO 207 252 TO 277 322 TO 347 PRIS YD 0.4 ZD 0.4
CONSTANTS
MATERIAL CONCRETE ALL
SUPPORTS
1 TO 26 FIXED
DEFINE WIND LOAD
TYPE 1 WIND 1
<! STAAD PRO GENERATED DATA DO NOT MODIFY !!!
IS875-2015:PARAMS 0 0 0 15.000 0.000 5.000 0 BHUBANESHWAR 50.000 0 1.000 0 4 -
1.050 1.050 1.050 1.090 1.000 2 1.000 0.002 0 15.700 11.700 15.000 0 0 0 -
0 0 0.200 1.000 0 1.000 1.000 1.000
!> END GENERATED DATA BLOCK
INT 1.654 1.654 1.654 1.782 HEIG  0  5  10  15
EXP 1 JOINT 1 TO 26 30 TO 174
DEFINE IS1893 2016 LOAD
ZONE 0.16 RF 5 I 1.2 SS 2 ST 1 DM 0.05
SELFWEIGHT 1
FLOOR WEIGHT
YRANGE 0 15 FLOAD -3.75
LOAD 1 LOADTYPE Seismic-H  TITLE EQX
1893 LOAD X 1
LOAD 2 LOADTYPE Seismic-H  TITLE EQ-X
1893 LOAD X -1
LOAD 3 LOADTYPE Seismic-H  TITLE EQZ
1893 LOAD Z 1
LOAD 4 LOADTYPE Seismic-H  TITLE EQ-Z
1893 LOAD Z -1
LOAD 5 LOADTYPE Dead  TITLE DL
SELFWEIGHT Y -1
MEMBER LOAD
71 TO 90 92 TO 101 103 TO 111 141 TO 160 162 TO 171 173 TO 181 211 TO 230 -
232 TO 241 243 TO 251 281 TO 300 302 TO 311 313 TO 321 351 TO 370 -
372 TO 381 383 TO 391 UNI GY -17.1
FLOOR LOAD
YRANGE 0 15 FLOAD -3.75 GY
YRANGE 0 15 FLOAD -0.5 GY
LOAD 6 LOADTYPE Live  TITLE LL
```

```
FLOOR LOAD
YRANGE 0 15 FLOAD -3 GY
LOAD 7 LOADTYPE Wind  TITLE WLZ
WIND LOAD Z 1 TYPE 1 YR 0 15
WIND LOAD Z -1 TYPE 1 YR 0 15
LOAD 8 LOADTYPE Wind  TITLE WLX
WIND LOAD X 1 TYPE 1 YR 0 15
WIND LOAD X -1 TYPE 1 YR 0 15
LOAD COMB 9 COMB - 1.5 DEAD + 1.5 LIVE
5 1.5 6 1.5
LOAD COMB 10 COMB - 1.2 DEAD + 1.2 LIVE + 1.2 WIND (1)
5 1.2 6 1.2 7 1.2
LOAD COMB 11 COMB - 1.2 DEAD + 1.2 LIVE + 1.2 WIND (2)
5 1.2 6 1.2 8 1.2
LOAD COMB 12 COMB - 1.2 DEAD + 1.2 LIVE + -1.2 WIND (1)
5 1.2 6 1.2 7 -1.2
LOAD COMB 13 COMB - 1.2 DEAD + 1.2 LIVE + -1.2 WIND (2)
5 1.2 6 1.2 8 -1.2
LOAD COMB 14 COMB - 1.2 DEAD + 1.2 LIVE + 1.2 SEISMIC-H (1)
5 1.2 6 1.2 1 1.2
LOAD COMB 15 COMB - 1.2 DEAD + 1.2 LIVE + 1.2 SEISMIC-H (2)
5 1.2 6 1.2 2 1.2
LOAD COMB 16 COMB - 1.2 DEAD + 1.2 LIVE + 1.2 SEISMIC-H (3)
5 1.2 6 1.2 3 1.2
LOAD COMB 17 COMB - 1.2 DEAD + 1.2 LIVE + 1.2 SEISMIC-H (4)
5 1.2 6 1.2 4 1.2
LOAD COMB 18 COMB - 1.2 DEAD + 1.2 LIVE + -1.2 SEISMIC-H (1)
5 1.2 6 1.2 1 -1.2
LOAD COMB 19 COMB - 1.2 DEAD + 1.2 LIVE + -1.2 SEISMIC-H (2)
5 1.2 6 1.2 2 -1.2
LOAD COMB 20 COMB - 1.2 DEAD + 1.2 LIVE + -1.2 SEISMIC-H (3)
5 1.2 6 1.2 3 -1.2
LOAD COMB 21 COMB - 1.2 DEAD + 1.2 LIVE + -1.2 SEISMIC-H (4)
5 1.2 6 1.2 4 -1.2
LOAD COMB 22 COMB - 1.5 DEAD + 1.5 WIND (1)
5 1.5 7 1.5
LOAD COMB 23 COMB - 1.5 DEAD + 1.5 WIND (2)
5 1.5 8 1.5
LOAD COMB 24 COMB - 1.5 DEAD + -1.5 WIND (1)
5 1.5 7 -1.5
LOAD COMB 25 COMB - 1.5 DEAD + -1.5 WIND (2)
5 1.5 8 -1.5
LOAD COMB 26 COMB - 1.5 DEAD + 1.5 SEISMIC-H (1)
5 1.5 1 1.5
LOAD COMB 27 COMB - 1.5 DEAD + 1.5 SEISMIC-H (2)
5 1.5 2 1.5
LOAD COMB 28 COMB - 1.5 DEAD + 1.5 SEISMIC-H (3)
5 1.5 3 1.5
LOAD COMB 29 COMB - 1.5 DEAD + 1.5 SEISMIC-H (4)
5 1.5 4 1.5
LOAD COMB 30 COMB - 1.5 DEAD + -1.5 SEISMIC-H (1)
5 1.5 1 -1.5
LOAD COMB 31 COMB - 1.5 DEAD + -1.5 SEISMIC-H (2)
5 1.5 2 -1.5
LOAD COMB 32 COMB - 1.5 DEAD + -1.5 SEISMIC-H (3)
5 1.5 3 -1.5
LOAD COMB 33 COMB - 1.5 DEAD + -1.5 SEISMIC-H (4)
5 1.5 4 -1.5
LOAD COMB 34 COMB - 0.9 DEAD + 1.5 WIND (1)
5 0.9 7 1.5
```

```
LOAD COMB 35 COMB - 0.9 DEAD + 1.5 WIND (2)
5 0.9 8 1.5
LOAD COMB 36 COMB - 0.9 DEAD + -1.5 WIND (1)
5 0.9 7 -1.5
LOAD COMB 37 COMB - 0.9 DEAD + -1.5 WIND (2)
5 0.9 8 -1.5
LOAD COMB 38 COMB - 0.9 DEAD + 1.5 SEISMIC-H (1)
5 0.9 1 1.5
LOAD COMB 39 COMB - 0.9 DEAD + 1.5 SEISMIC-H (2)
5 0.9 2 1.5
LOAD COMB 40 COMB - 0.9 DEAD + 1.5 SEISMIC-H (3)
5 0.9 3 1.5
LOAD COMB 41 COMB - 0.9 DEAD + 1.5 SEISMIC-H (4)
5 0.9 4 1.5
LOAD COMB 42 COMB - 0.9 DEAD + -1.5 SEISMIC-H (1)
5 0.9 1 -1.5
LOAD COMB 43 COMB - 0.9 DEAD + -1.5 SEISMIC-H (2)
5 0.9 2 -1.5
LOAD COMB 44 COMB - 0.9 DEAD + -1.5 SEISMIC-H (3)
5 0.9 3 -1.5
LOAD COMB 45 COMB - 0.9 DEAD + -1.5 SEISMIC-H (4)
5 0.9 4 -1.5
PERFORM ANALYSIS PRINT ALL
PERFORM ANALYSIS
PERFORM ANALYSIS
PERFORM ANALYSIS
PERFORM ANALYSIS PRINT ALL
FINISH
```