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PLANNING AND DESIGN OF MULTI STAR HOTEL

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ABSTRACT

The business and tourist sector flourishing in Hyderabad city, we planned and designed the construction of the main building of a multi star caravansary of approved Indian standards to fulfill the needs of the current situation.

In our project, Park Hyatt, Banjara Hills, we have aimed to satisfy the basic requirements of a multi star caravansary. Allocating the available space for different functions the entire structure was developed. The structure was then analyzed and designed in STAAD PRO. Park Hyatt, Banjara Hills, A luxury hotel that combines business with pleasure, style with substance, form with function. Centrally located in the upscale Banjara Hills, our 5-star luxury hotel offers personalized services and unforgettable experiences to business travelers and discerning local guests. With 209 spaciously appointed rooms, three award winning restaurants, technology friendly meeting spaces and a Nizami themed Spa, luxury at its best awaits to create seamless experiences for you. Park Hyatt Hyderabad offers free onsite parking facilities for up to 500 vehicles.

Built across on an area of 32,256 square metres (347,200 sq ft) the construction of the hotel started in 2006. Owned by Gayatri Hi-tech Hotels and managed by Hyatt, the hotel was inaugurated on 29 April 2012 costing Rs 7 billion approximately.

The Hotel has 185 rooms, 24 suites on the first six floors and 42 furnished service apartments called The Residence on the two upmost floors. Each of the hotel's guestrooms are among the largest in Hyderabad, measuring at least 463 square feet. The lobby is designed with sparkling water feature and plants that surround a 35-foot tall white abstract sculpture. Park Hyatt Hyderabad is the first hotel in India to feature Hyatt's residential-style meeting concept named The Manor.

The total meetings and events facilities measure more than 1,600 square metres (17,000 sq ft). Accommodating a range of dining the hotel has a Lobby Lounge – The Living Room, The Dining Room – All Day Dining Restaurant, Tre-Forni Bar & Restaurant - Northern Italian Cuisine, Oriental Bar & Kitchen – South East Asian Cuisine. The Hotel is also equipped with Spa & Fitness Facilities.

I INTRODUCTION

Hyderabad City progressing at a very quick pace within the commercial sector, major comes are undertaken to quench the forth returning wants. Technology soaring heights, its impact is clearly visible during this tiny, beautiful city.

Hyderabad City, a blend of beauty and technology, has become a major attraction for both tourists and business entrepreneurs. Though, towards the core, that is heavily charged with which means and activity, the suburbs of this city are within the progress of clinging to the standards. With the functioning of the Rajiv Gandhi International airport at shamshabad, India's second largest, the requirement for hotels of approved standards and hospitality arose in its proximity. Since accessibility is that the key for not only practical but also psychological reasons, the choice of site should suite the acceptable wants.

Our project, the planning and design of the main building of a 5 star hotel, has aimed toward filling this void. The project was developed so as to include the analysis and design a part of civil engineering. Our project is that the accomplishment of the structural design of the main building of the hotel, Park Hyatt, Banjara Hills.

Structural Analysis

LOAD CALCULATIONS

The different loads on the structure are taken based on the relevant Indian Standard Specifications BIS 1987. The following loads were considered for the design.

LIVE LOAD

- Banquet hall $5\frac{KN}{mm^2}$
- Other areas $3\frac{KN}{mm^2}$

DEAD LOAD

- Dead load for concrete $25\frac{KN}{m^3}$
- Dead load for brick wall $22\frac{KN}{m^3}$

STRUCTURAL DESIGN

The design of the structural members is done using the limit state method of design. This method is selected for doing the design, mainly due to the fact that it considers a factor of safety for the design with which the members are designed. The design of members by this method is commonly practiced now-a-days mainly due to its reliability over the working stress method. All designs are done according to the provisions of the Bureau of Indian Standards.

DESIGN OF SLABS

DATA: Two way slab Suitable span: 12.2m Limiting criterion: Deflection Rebar: 2.94Kg/m^2

PT; 3.87Kg/m^2

MATERIAL PROPERTIES:
Concrete:

Fc_{28} = Compressive strength on concrete 28 days

F_{cd} = Design value for compressive strength on concrete

= $0.6\times Fc_{28}$ = 21N/mm^2

Pre-stressing steel:

A_p = cross sectional area of pj steel 146mm^2 F_{py} = yield strength of PT steel 1570N/mm^2

F_{pu} = characteristics strength of PT steel 1770N/mm^2 Pre-tensioning steel:

E_p = modulus of elasticity of pre stressing steel 1.95×10^5N/mm^2 (Very low relaxation 3%)

Admissible stressing 0.75 f_{pu} Reinforcing

steel:

F_{sy} = yield strength of reinforcing steel is 460N/mm^2 Long-term losses (assumed to be 10%)

DESIGN:

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Determination of slab thickness:

Assumption l/h = 35

Self weight of slab g = yc×h L = length of slab 8.4

h = 0.24m

Yc = volumetric weight of concrete = 2.5KN/m^3 g = 6 KN/m^3

q = 5 KN/m^3

(g+q)/g = 6+5/6 =1.83

(l/h as a function (g+q)/g)

For value of 1.83 on y-axis l/h is coming to 36

0.233 Which is approximately 0.24 Determination of pre-stress:

µ = it is transfer component from pre stressing/ unit length (g+q)/g =1.83 based on previous calculation Pre stress in longitudinal direction:

For 1.83 the u/g value is 1.3 u = 8.34KN/m^2

K = woober's coefficient = (0.24×10^3) / (8.4^2×25) = 0.136 h = 0.274

Length of slab =8.4
yc = 25

εc = concrete tensile stress = 1000 Pre tensioning force:

$$P = 4 \times {l^2}/_8 \times h_p$$

Sag of tendon parabola

$$h_p = 0.178m \ (p = 8.34 \times {8.4^2}/_8 \times 0.178$$

P = 413KN/m

P = 7.8×413 for a width of 78mts P = 3221 KN/strand

PI= pre tensioning force per strand PI =A_p × f_{pu}×0.7×10^{-3}

A_p = 416mm^2

F_{pu} = 1770N/mm^2 PI = 181KN STRANDS:

No. of strands = p/pi = 413/pi = 17.8 (say 18) 18 strands of dia 15mm on 78mt width

For 7.4mt width = 7.4/7.8×17.8 = 16.88

17 mono strands of dia 15mm of 7.4mt width On 6.6mt width = 6.6/7.8×17.8 = 15.1

16 mono strands of dia 15mm of 6.6mt width For 2.4mt width = 2.4/7.8×17.8 = 5.5

6 mono strand of dia of 15mm on 2.4mt width Transverse direction:

g+q/g = 1.83

K =0.24×1000/7.8^2×25 K = 0.158

On design chart 2 for k value of 0.158 and (g+q/g) value of 1.83 the value of u/g is found be 1.41 u = 8.46KN/m^2

$$P = u \times {l^2}/_8 \times h_p$$

$$= 8.46 \times {7.8^2}/_8 \times 0.167$$

P = 3.85KN/m

On 8.4mt width p =8.4×385 P = 32334KN
P_c = 181KN

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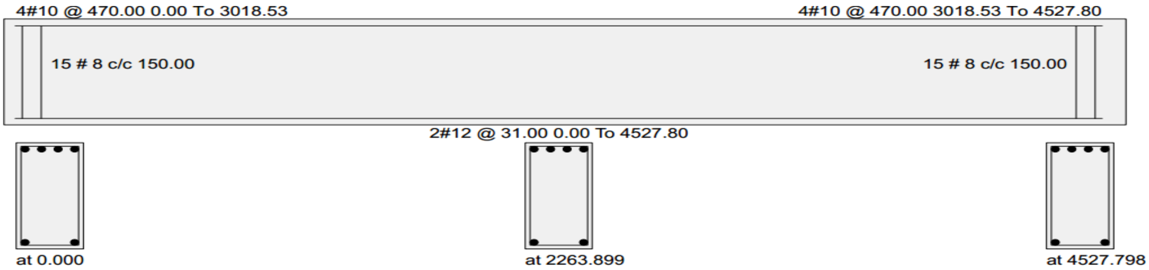
No. of strands N_p = p/pi = 3234/181 =17.9
18 mono strands of dia 15mm on 8.4mt width On 7.2mt width np =7.2/8.4×7.9 = 15.3
16 mono strands of dia 15mm on 7.2mt width



DESIGN OF BEAMS

Fig.8.2a Design Load

Table.8.2a Design Parameter Table.8.2b Bending along Z in EQX

Fig.8.2b Bending along Z in EQX

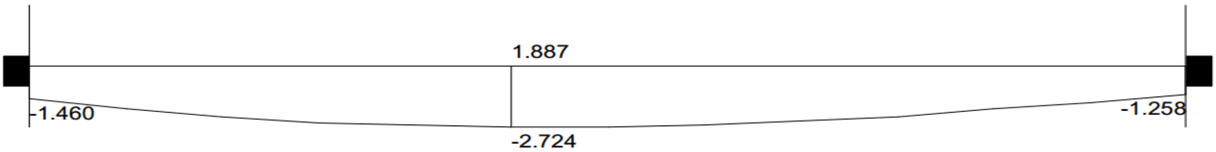


Fig.8.2c Shear along Z in EQX

Table.8.2c Shear along Z in EQX

Dist.m	Fz(kN)	My(kNm)
0.000000	-1.4587	-9.0752
0.377317	-1.4587	-8.5248
0.754633	-1.4587	-7.9745
1.131950	-1.4587	-7.4241
1.509267	-1.4587	-6.8737
1.886583	-1.4587	-6.3233
2.263900	-1.4587	-5.7729
2.641216	-1.4587	-5.2226
3.018533	-1.4587	-4.6722
3.395850	-1.4587	-4.1218
3.773166	-1.4587	-3.5714
4.150483	-1.4587	-3.0211
4.527800	-1.4587	-2.4707

Table.8.2c Shear along Z in EQX

Dist.m	Fy(kN)	Mz(kNm)
0.000000	-6.4309	-15.0630
0.377317	-6.4309	-12.6365
0.754633	-6.4309	-10.2100
1.131950	-6.4309	-7.7835
1.509267	-6.4309	-5.3571
1.886583	-6.4309	-2.9306
2.263900	-6.4309	-0.5041
2.641216	-6.4309	1.9224
3.018533	-6.4309	4.3489
3.395850	-6.4309	6.7754
3.773166	-6.4309	9.2018
4.150483	-6.4309	11.6283
4.527800	-6.4309	14.0548

Table8.2d Deflection along Z in EQX

Dist.m	X(mm)	Y(mm)	Z(mm)
0.000000	22.3242	-0.4279	-1.4604
0.377317	22.3242	-0.4609	-1.9193
0.754633	22.3242	-0.4594	-2.2680
1.131950	22.3242	-0.4299	-2.5135
1.509267	22.3242	-0.3792	-2.6631
1.886583	22.3242	-0.3138	-2.7238
2.263900	22.3242	-0.2403	-2.7027
2.641216	22.3242	-0.1655	-2.6069
3.018533	22.3242	-0.0959	-2.4436
3.395850	22.3242	-0.0383	-2.2199
3.773166	22.3242	0.0008	-1.9430
4.150483	22.3242	0.0148	-1.6198
4.527800	22.3242	-0.0031	-1.2575

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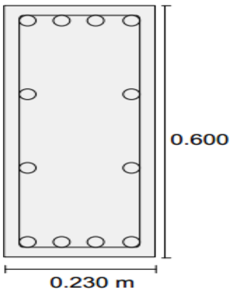
DESIGN OF COLUMNS



Load	5
Location	End 1
Pu(Kns)	-0.130000
Mz(Kns-Mt)	0.250000
My(Kns-Mt)	0.090000

Fy(Mpa)	415
Fc(Mpa)	25
As Reqd(mm²)	1104.000000
As (%)	0.983000
Bar Size	12
Bar No	12

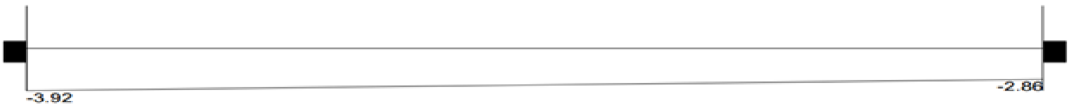


Fig.8.3b Bending along Z in EQX

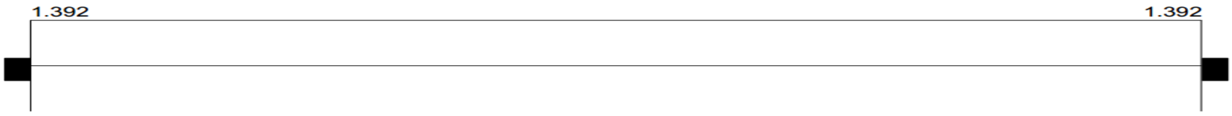


Fig.8.3c Shear along Z in EQX

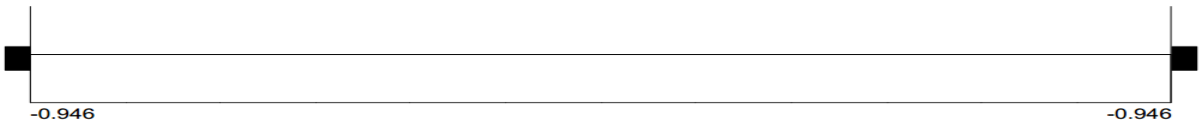
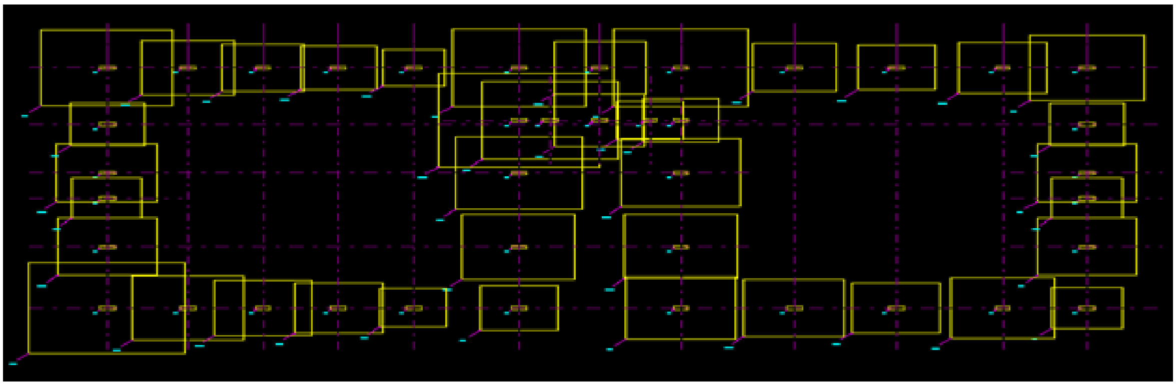


Table.8.3b Bending along Z in EQX Table..8.3c Shear along Z in EQX Table.8.3d Deflection along Z in EQX

Dist.m	Fy(kN)	Mz(kNm)
0.000000	-0.3210	-3.9159
0.275000	-0.3210	-3.8276
0.550000	-0.3210	-3.7393
0.825000	-0.3210	-3.6511
1.100000	-0.3210	-3.5628
1.375000	-0.3210	-3.4745
1.650000	-0.3210	-3.3862
1.925000	-0.3210	-3.2980
2.199999	-0.3210	-3.2097
2.474999	-0.3210	-3.1214
2.749999	-0.3210	-3.0332
3.024999	-0.3210	-2.9449
3.299999	-0.3210	-2.8566

Dist.m	X(mm)	Y(mm)	Z(mm)
0.000000	29.9703	-0.9457	0.0884
0.275000	30.1052	-0.9457	0.1081
0.550000	30.2369	-0.9457	0.1177
0.825000	30.3655	-0.9457	0.1192
1.100000	30.4910	-0.9457	0.1149
1.375000	30.6135	-0.9457	0.1069
1.650000	30.7331	-0.9457	0.0975
1.925000	30.8499	-0.9457	0.0888
2.199999	30.9638	-0.9457	0.0831
2.474999	31.0751	-0.9457	0.0825
2.749999	31.1837	-0.9457	0.0892
3.024999	31.2898	-0.9457	0.1054
3.299999	31.3934	-0.9457	0.1333

Dist.m	Fz(kN)	My(kNm)
0.000000	1.3925	2.1682
0.275000	1.3925	1.7852
0.550000	1.3925	1.4023
0.825000	1.3925	1.0194
1.100000	1.3925	0.6365
1.375000	1.3925	0.2535
1.650000	1.3925	-0.1294
1.925000	1.3925	-0.5123
2.199999	1.3925	-0.8952
2.474999	1.3925	-1.2782
2.749999	1.3925	-1.6611
3.024999	1.3925	-2.0440
3.299999	1.3925	-2.4269



DESIGN OF FOOOTINGS

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
41	1	5.250 m	5.250 m	0.305 m
42	2	5.350 m	5.350 m	0.355 m
43	3	5.400 m	5.400 m	0.356 m
44	4	4.550 m	4.550 m	0.355 m
45	5	4.000 m	4.000 m	0.606 m
46	6	3.950 m	3.950 m	0.656 m
47	7	2.850 m	2.850 m	0.505 m
48	8	4.350 m	4.350 m	0.506 m
49	9	3.100 m	3.100 m	0.655 m
50	10	6.250 m	6.250 m	0.355 m
51	11	3.950 m	3.950 m	0.656 m
52	12	4.000 m	4.000 m	0.656 m
53	13	5.050 m	5.050 m	0.657 m
54	14	4.500 m	4.500 m	0.756 m
55	15	4.700 m	4.700 m	0.757 m
56	16	4.450 m	4.450 m	0.756 m
57	17	6.450 m	6.450 m	0.356 m
58	18	3.000 m	3.000 m	0.555 m
59	19	3.750 m	3.750 m	0.305 m
60	20	3.300 m	3.300 m	0.305 m
61	21	3.050 m	3.050 m	0.305 m
62	22	2.500 m	2.500 m	0.455 m
63	23	3.650 m	3.650 m	0.305 m
64	24	5.400 m	5.400 m	0.305 m
65	25	3.600 m	3.600 m	0.305 m
66	26	2.650 m	2.650 m	0.455 m
67	27	2.950 m	2.950 m	0.505 m
68	28	2.950 m	2.950 m	0.505 m
69	29	2.800 m	2.800 m	0.555 m
70	30	2.800 m	2.800 m	0.555 m
71	31	3.350 m	3.350 m	0.355 m

72	32	3.100 m	3.100 m	0.405 m
73	33	3.550 m	3.550 m	0.355 m
74	34	4.450 m	4.450 m	0.305 m
75	35	3.850 m	3.850 m	0.305 m
76	36	3.500 m	3.500 m	0.305 m
77	37	2.650 m	2.650 m	0.455 m
78	38	4.000 m	4.000 m	0.355 m
79	39	3.500 m	3.500 m	0.355 m
80	40	4.150 m	4.150 m	0.355 m

Isolated Footing 41

Fig.8.7 Isolated Footing

Input Values

Footing Geometry

Design Type: Calculate Dimension Footing

Thickness (Ft): 305.000 mm

Footing Length - X (Fl): 1000.000 mm

Footing Width - Z (Fw): 1000.000 mm

Eccentricity along X (Oxd): 0.000 mm

Eccentricity along Z (Ozd): 0.000 mm

Column Dimensions

Column Shape: Rectangular

Column Length - X (Pl): 0.600 m

Column Width - Z (Pw): 0.230 m

Pedestal

Include Pedestal? No

Pedestal Shape: N/A

Pedestal Height (Ph): N/A

Pedestal Length - X (Pl): N/A

Pedestal Width - Z (Pw): N/A

Design Parameters

Concrete and Rebar Properties

Unit Weight of Concrete: 30.000 KN/m^3 Strength of Concrete: 30.000 N/mm^2 Yield Strength of Steel: 415.000 N/mm^2 Minimum Bar Size: Ø8

Maximum Bar Size: Ø16 Minimum Bar Spacing: 50.000 mm

Maximum Bar Spacing: 300.000 mm Pedestal Clear Cover (P, CL): 50.000 mm Footing Clear Cover (F, CL): 50.000 mm **Soil Properties**

Soil Type :	Drained
Unit Weight :	22.000 kN/m^3
Soil Bearing Capacity :	200.000 kN/m^2

Sliding and Overturning

Coefficient of Friction: 0.500

Factor of Safety against Sliding: 1.500 Factor of Safety against Overturning: 1.500 **Design Calculations**

Footing Size

Initial Length (L_o) = 1.000 m Initial Width (W_o) = 1.000 m

Uplift force due to buoyancy = 0.000 KN Effect due to adhesion = 0.000 KN

Area from initial length and width, $A_o = L_o \times W_o$ = 1.000m^2

Min. area required from bearing pressure, $A_{min} = P / q_{max}$ = 3.470 m^2

Note: A_{min} is an initial estimation.

P = Critical Factored Axial Load (without self weight/buoyancy/soil).

q_{max} = Respective Factored Bearing Capacity.

Final Footing Size			
Length (L_2) =	5.250m	Governing Load Case :	# 1
Width (W_2) =	5.250m	Governing Load Case :	# 1
Depth (D_2) =	0.305m	Governing Load Case :	# 1
Area (A_2) =27.563m^2			

ANALYSIS AND DESIGN USING STAAD

DETAILS OF THE ANALYSIS SOFTWARE

STAAD for windows is comprehensive structural engineering software that addresses all aspects of engineering-model development, analysis, design, verification and visualization. Staad for windows is based on the principles of finite element analysis and is available in a “concurrent engineering” profile. It is capable of analyzing and designing structures consisting of both frames and shell elements. Following are the main options available from the concurrent graphics environment.

STAAD	Analysis and design
STAAD PRE	Graphical input generator
STAAD POST	Graphical post processing STAAD

INTDESInteractive design of structural components

STAAD uses a command language based input format which can be created through a text editor or through STAAD PRE, graphical or through CAD, based formats.

Analysis facilities available in STAAD are:

1. Stiffness Analysis-based on the matrix displacement method.
2. Second Order Analysis
   i. P-Delta Analysis-incorporates secondary loading.

ii. Non Linear Analysis-incorporates both secondary loading and geometric stiffness correction.

3. Dynamic Analysis-solution of free vibration problems response spectrum analysis and fixed vibration analysis.

SEISMIC PARAMATERS

FROM IS 1893 (PART-1)-2002

Zone Factor (Z) (Seismic Zone 3 – Table-2Clause 6.4.2)	=	0.1
Importance factor (I) (Table-6 Clause 6.4.2)	=	1.0
Response Reduction Factor (R) (Table 7 Clause 6.4.2)	=	5.0
Structural Soil (SS) (Fig 2 type 1 Rock or Hard soil)	=	1.0
Structure Type (ST) (RC Frame Building)	=	1.0
Damping Ratio (D_{mp})	=	0.05

COLLAPSE LOAD COMBINATIONS (KN/M)

1. 1.5 (DL +LL)
2. 1.5 (DL+EQ X)
3. 1.5 (DL+EQ Z)
4. 1.2 (DL+LL+EQ X)
5. 1.2 (DL+LL+EQ Z)
6. 0.9 DL+1.5 EQ X
7. 0.9 DL + 1.5 EQ Z
8. 1.0 (DL + LL)
9. 1.5(DL + WL X)
10. 1.5 (DL + WL Z)
11. 1.2 (DL + LL + WL X)
12. 1.2 (DL + LL + WL Z)
13. 0.9 DL + 1.5 WL X
14. 0.9 DL + 1.5 WLZ

SERVICEABILITY LOAD COMBINATIONS

To examine the Sway and Drift in different columns of the building by using Serviceability load combinations are as follows:

1. 1.0 (DL + EQ X)
2. 1.0 (DL – EQ X)
3. 1.0 (DL + EQ Z)
4. 1.0 (DL – EQ Z)
5. 1.0 (DL + WL X)
6. 1.0 (DL – WL X)
7. 1.0 (DL + WL Z)
8. 1.0 (DL – WL Z)
9. DL + 0.8 (LL + EQ X)
10. DL + 0.8 (LL – EQ X)
11. DL + 0.8 (LL + EQ Z)
12. DL + 0.8 (LL – EQ Z)
13. DL + 0.8 (LL + WLX)
14. DL + 0.8 (LL – WLX)
15. DL + 0.8 (LL + WLZ)
16. DL + 0.8 (LL – WLZ)

Member End Forces

Units Force - KN , Length - m

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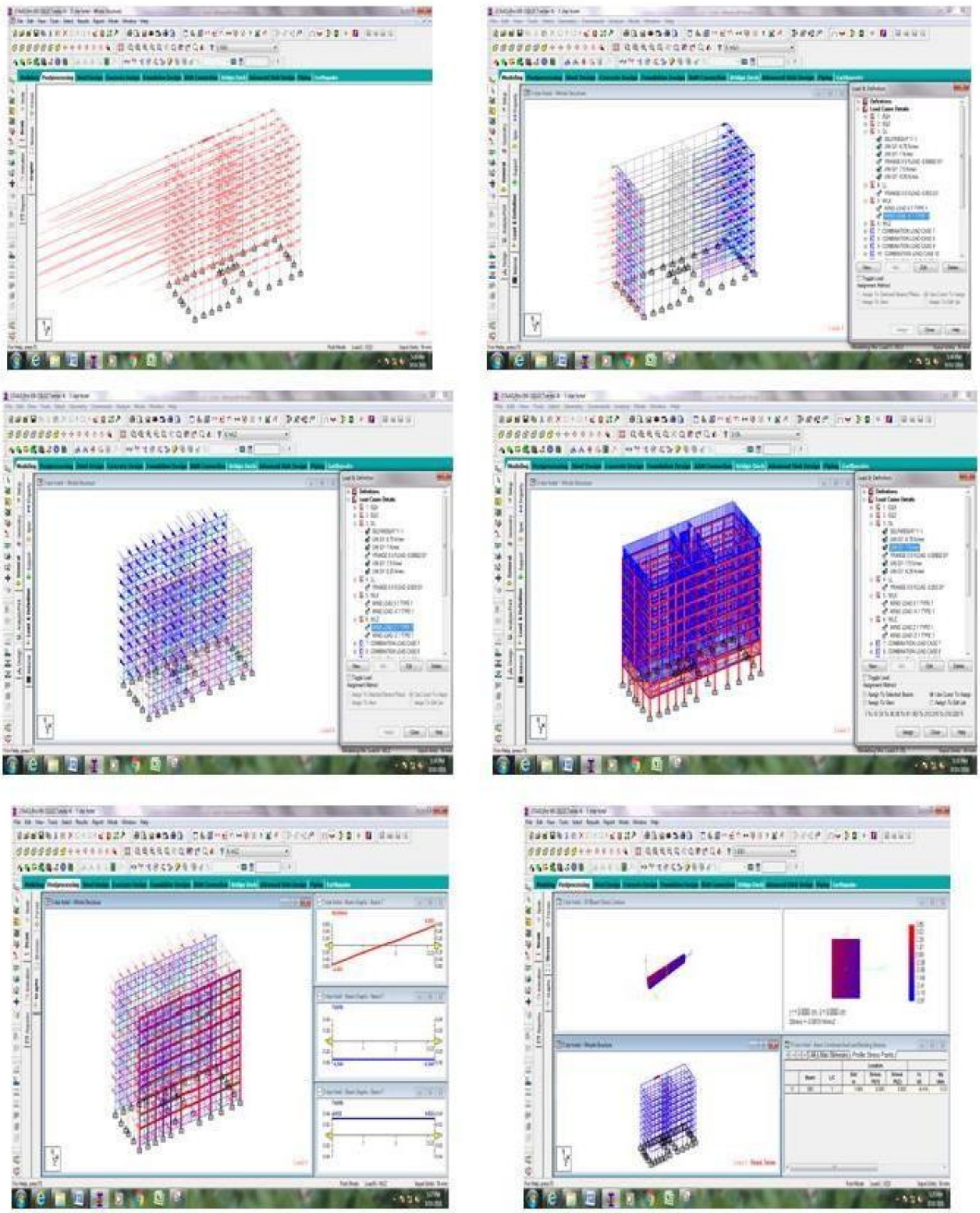
Staad output



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