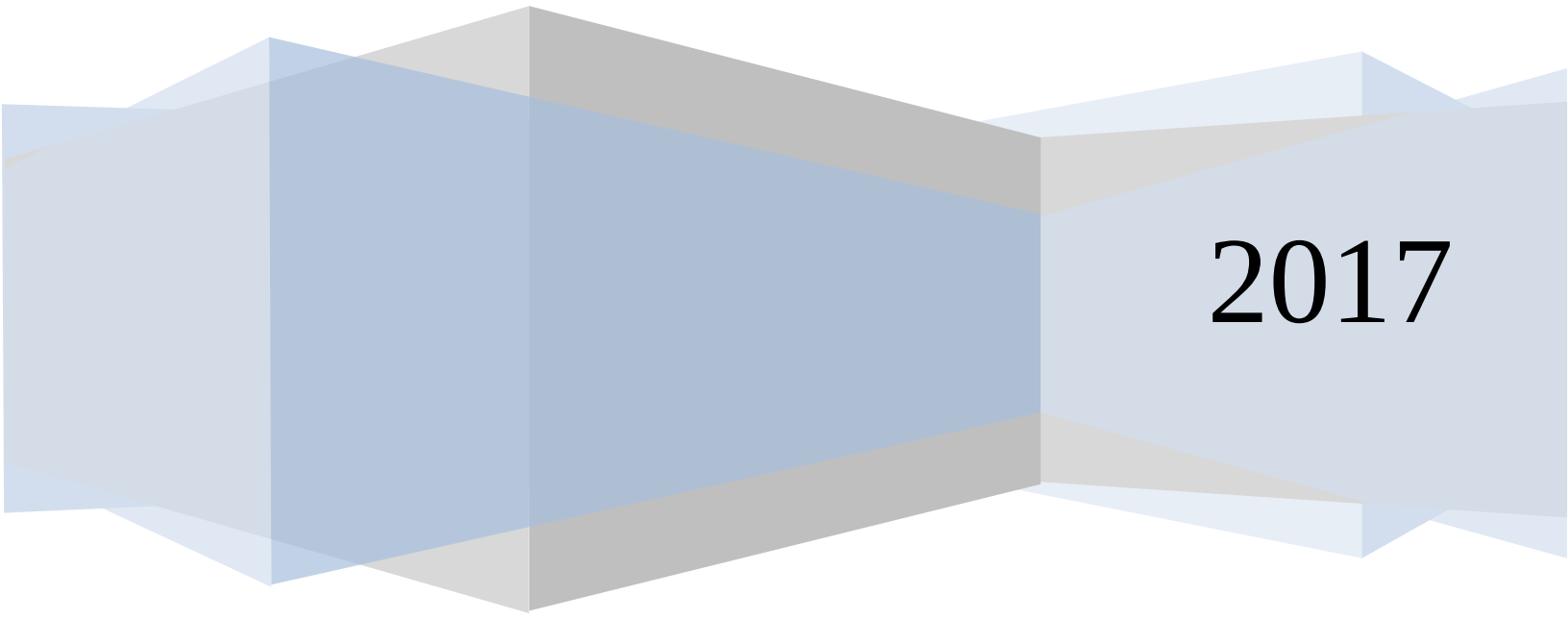
STUDY:
ENG. SHUMBUSHO MARCEL

STEEL DESING OF THE PETROL STATION ROOF

OWNER: MUSABYEMUNGU ANNE MARIE

Plot N^{o} 1594



2017

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STEEL STRUCTURE DESIGN

1.0 INTRODUCTION

Out of various sloping roofing systems, we have taken a steel roof trusses. A steel roof trusses is one of cheapest and the most convenient roofing system. A roof truss is basically a framed a framed structure formed by a connecting various members at their ends to form a system of triangles, arranged in pre-decided pattern depending upon the span, type of loading and functional requirements. The axes of the members meeting at one joint intersect at common point. The members are jointed through welds. The members carry direct forces (i.e. either tension or compression) only. The bending moment is zero. The members carrying COMPRESSION forces are called struts while those carrying tensile forces are called ties.

In order to cover our area (LXB), trusses are placed in shorter dimension so that span of truss is the least.

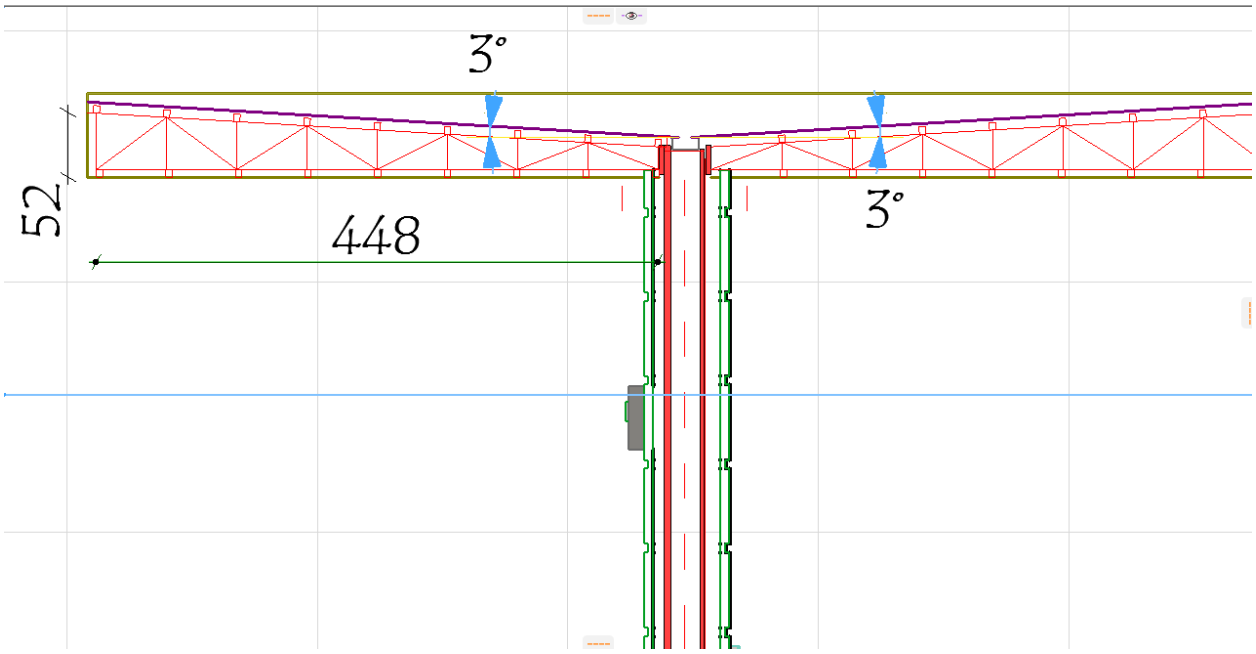
This new petrol station will have 18.6m x9.5m and will be constructed in reliable materials. Columns and the substructure will be in STEEL, and the filling with masonry wall,and the superstructure namely trusses roof and cover will be in steel.

- Upper Roof

Fabricated tube beam to shape.

- Roof Sheets

Metal sheet (Gauge 28 B.G blue color).



Length of the span L=4.8m

Spacing of trusses=3m

Section of the building figure 1.2

2.0 LOADS ON ROOF TRUSSES

1 Dead load

2 Imposed load

3 Wind load

2.1 Dead load

Dead loads on roof trusses consist of (i) weight of roof covering (ii) weight of purlins , weight of bracings and (iv)self weight of trusses.

The weight of coverings:

the type covering 28 gauge CGI sheet (weight per m^2 of plan area)112 N/m^2

$Wc=112N/m^2*5.1m=571.2N/m$

The weight of purlins per square meter of plan area, for G.I. sheeting is 90 N

Wp =90N*4=360N/m

Weight of bracings: the load due to the weight of bracings is 15N/m^2

Wb =15N/m^2 *5m=75N/m

weight of trusses: the exact weight of the trusses can be determined only when the section of various members of the truss are known.

So W=150 N/m^{2*}5m=750N/m

2.2 Imposed load or live load

that roofs with slope of 15^o is 750 N/m^2

For our case the surface cover is 16m^2

IMPOSED LOAD =5mX750N/m^2 =3750N/m

2.3 Wind load

P_Z =0.6 *V_Z^2

P_Z =0.6 *$(32m/s)^2$ =0.8 KN/m^2

Total loads =Dead load +imposed load

T_L =448N/m+360N/m+60N/m+600 N/m+3000N/m=4.4KN/m

3.0 DESIGN

3.1 DESIGN OF PURLIN

As the length of our purlin is equal to L=2.65m

σ_{bc}=316.6N/mm2

Total load= 0.99kN/m^2 Hence the total UDL: W= 7.92kN/m

i. Effective span= 0.7*l=0.7*2.65m=1.855m
ii. B.M= (W*L^2)/12= (7.92*1.85^2)/12= 2725.3Nm
iii. Section modulus required Z=M/σ_{bc}= (2725.3/316.6)cm3= 8.603cm

From the steel design tables, we can use tubes of the following dimensions:

Width of purlins = 50mm Depth of the purlins= 60mm thickness =3.65mm

3.1 DESIGN OF TRUSS

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========== P l a n e - F r a m e A n a l y s i s - P R O K O N ==========
Ver W1.7.06 - 29 Mar 2001

TITLE :

Data file : D:\DOCUMEuser\LOCALSTemp\lastpf.a01
Created on: 9/15/2010

========== NODAL POINT COORDINATES ==========

Node no.	X-coord m	Y-coord m	Node no.	X-coord m	Y-coord m
1	0.000	0.000	2	0.000	1.000
3	0.000	2.000	4	0.000	3.000
5	0.000	4.000	6	0.000	5.000
7	0.000	6.000	8	1.500	6.000
9	1.500	6.402	10	3.000	6.000
11	3.000	6.804	12	4.500	6.000
13	4.500	7.206	14	6.000	6.000
15	6.000	7.608	16	7.500	6.000
17	7.500	8.010	18	9.000	6.000
19	9.000	8.412	20	10.500	6.000
21	10.500	8.814	22	12.000	6.000
23	12.000	9.216	24	13.500	6.000
25	13.500	9.618	26	15.000	6.000
27	15.000	10.020	28	16.500	6.000
29	16.500	9.618	30	18.000	6.000
31	18.000	9.216	32	19.500	6.000
33	19.500	8.814	34	21.000	6.000
35	21.000	8.412	36	22.500	6.000
37	22.500	8.010	38	24.000	6.000
39	24.000	7.608	40	25.500	6.000
41	25.500	7.206	42	27.000	6.000
43	27.000	6.804	44	28.500	6.000
45	28.500	6.402	46	30.000	0.000
47	30.000	1.000	48	30.000	2.000
49	30.000	3.000	50	30.000	4.000
51	30.000	5.000	52	30.000	6.000

========== ELEMENT DATA ==========

Beam	Secn. type	Fixity	Length m
1-2	COL	00	1.000
2-3	COL	00	1.000
3-4	COL	00	1.000
4-5	COL	00	1.000
5-6	COL	00	1.000
6-7	COL	00	1.000
46-47	COL	00	1.000
47-48	COL	00	1.000
48-49	COL	00	1.000
49-50	COL	00	1.000
50-51	COL	00	1.000
51-52	COL	00	1.000

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7-9	TCHORD	00	1.553
9-11	TCHORD	00	1.553
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15-17	TCHORD	00	1.553
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21-23	TCHORD	00	1.553
23-25	TCHORD	00	1.553
25-27	TCHORD	00	1.553
27-29	TCHORD	00	1.553
29-31	TCHORD	00	1.553
31-33	TCHORD	00	1.553
33-35	TCHORD	00	1.553
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14-15	VERTCL	00	1.608
16-17	VERTCL	00	2.010
18-19	VERTCL	00	2.412
20-21	VERTCL	00	2.814
22-23	VERTCL	00	3.216
24-25	VERTCL	00	3.618
26-27	VERTCL	00	4.020
28-29	VERTCL	00	3.618
30-31	VERTCL	00	3.216
32-33	VERTCL	00	2.814
34-35	VERTCL	00	2.412
36-37	VERTCL	00	2.010
38-39	VERTCL	00	1.608
40-41	VERTCL	00	1.206
42-43	VERTCL	00	0.804
44-45	VERTCL	00	0.402
9-10	DIAGNL	00	1.553
11-12	DIAGNL	00	1.702
13-14	DIAGNL	00	1.925
15-16	DIAGNL	00	2.199
17-18	DIAGNL	00	2.508
19-20	DIAGNL	00	2.840
21-22	DIAGNL	00	3.189
23-24	DIAGNL	00	3.549
25-26	DIAGNL	00	3.917
26-29	DIAGNL	00	3.917
28-31	DIAGNL	00	3.549
30-33	DIAGNL	00	3.189
32-35	DIAGNL	00	2.840
34-37	DIAGNL	00	2.508
36-39	DIAGNL	00	2.199
38-41	DIAGNL	00	1.925
40-43	DIAGNL	00	1.702
42-45	DIAGNL	00	1.553

```
   m^2       m^4

 893.0E-6   866E-9   Steel:300W

 Section : VERTCL Section designation: 80x80x3.6      S1
----------------
    A        Ixx       Material
   m^2       m^4

 1.060E-3  1.00E-6   Steel:300W

 Section : DIAGNL Section designation: 80x80x3.6      S1
----------------
    A        Ixx       Material
   m^2       m^4

 1.060E-3  1.00E-6   Steel:300W


 ================================== MATERIALS ==================================

 Designation              E       poisson    Density    Exp. coeff.
                         kPa                 kN/m^3
 Steel:300W            206.0E6   0.30       77.00       11.70E-6


 ================================ SUPPORT DATA =================================

                                        Prescribed displacements
 Node   Fixity       X          Y          Z-Rot
                     m          m           rad.

 1       XYz        0.00       0.00       0.00
 46      XY         0.00       0.00       0.00
 18       Y         0.00       0.00       0.00
 32       Y         0.00       0.00       0.00

                                        Spring constants
 Node   Fixity       X          Y          Z-Rot
                    kN/m       kN/m       kNm/rad


 ================================== LOADS ======================================

 Load Case  Description

 DEAD_L     Dead Load
 LIVE_L     Live Load
 WIND_L     Wind Load

 Add own weight to load case : DEAD_L

 ============================ LOAD CASE DEAD_L =================================
 Dead Load

 *** POINT LOADS ***
```

41	0.00	-3.60	0.00
43	0.00	-3.60	0.00
45	0.00	-3.60	0.00
52	0.00	-1.80	0.00

========== LOAD CASE LIVE_L ==========
Live Load

*** POINT LOADS ***

Node	Fx kN	Fy kN	Mz kNm
7	0.00	-1.35	0.00
9	0.00	-2.70	0.00
11	0.00	-2.70	0.00
13	0.00	-2.70	0.00
15	0.00	-2.70	0.00
17	0.00	-2.70	0.00
19	0.00	-2.70	0.00
21	0.00	-2.70	0.00
23	0.00	-2.70	0.00
25	0.00	-2.70	0.00
27	0.00	-2.70	0.00
29	0.00	-2.70	0.00
31	0.00	-2.70	0.00
33	0.00	-2.70	0.00
35	0.00	-2.70	0.00
37	0.00	-2.70	0.00
39	0.00	-2.70	0.00
41	0.00	-2.70	0.00
43	0.00	-2.70	0.00
45	0.00	-2.70	0.00
52	0.00	-1.35	0.00

========== LOAD CASE WIND_L ==========
Wind Load

*** POINT LOADS ***

Node	Fx kN	Fy kN	Mz kNm
7	-0.24	0.91	0.00
9	-0.49	1.83	0.00
11	-0.49	1.83	0.00
13	-0.49	1.83	0.00
15	-0.49	1.83	0.00
17	-0.49	1.83	0.00
19	-0.49	1.83	0.00
21	-0.49	1.83	0.00
23	-0.49	1.83	0.00
25	-0.49	1.83	0.00
27	-0.16	1.26	0.00
29	0.16	0.63	0.00

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========== OUTPUT: LINEAR ANALYSIS ==========

========== NODAL POINT DISPLACEMENTS at SLS ==========

Node	Lcase	X-disp. mm	Y-disp. mm	Z-rot. radian
1	DEAD_L	0.00	0.00	0.0000
	LIVE_L	0.00	0.00	0.0000
	WIND_L	0.00	0.00	0.0000
2	DEAD_L	-0.14	-0.03	0.0002
	LIVE_L	-0.09	-0.02	0.0002
	WIND_L	127.73	0.02	-0.2297
3	DEAD_L	-0.42	-0.05	0.0003
	LIVE_L	-0.28	-0.03	0.0002
	WIND_L	413.77	0.04	-0.3224
4	DEAD_L	-0.62	-0.08	0.0001
	LIVE_L	-0.41	-0.05	0.0001
	WIND_L	738.47	0.06	-0.3128
5	DEAD_L	-0.55	-0.11	-0.0003
	LIVE_L	-0.36	-0.07	-0.0002
	WIND_L	1016.98	0.08	-0.2358
6	DEAD_L	0.00	-0.13	-0.0009
	LIVE_L	0.01	-0.09	-0.0006
	WIND_L	1199.24	0.10	-0.1262
7	DEAD_L	1.26	-0.16	-0.0017
	LIVE_L	0.85	-0.10	-0.0011
	WIND_L	1269.99	0.12	-0.0186
8	DEAD_L	1.41	-2.25	-0.0006
	LIVE_L	0.95	-1.53	-0.0004
	WIND_L	1270.14	-1.16	0.0013
9	DEAD_L	1.63	-2.25	-0.0005
	LIVE_L	1.10	-1.53	-0.0003
	WIND_L	1270.13	-1.15	0.0003
10	DEAD_L	1.57	-2.33	0.0001
	LIVE_L	1.06	-1.58	0.0001
	WIND_L	1270.19	-0.58	0.0002
11	DEAD_L	1.53	-2.32	0.0001
	LIVE_L	1.03	-1.57	0.0001
	WIND_L	1269.99	-0.57	0.0003
12	DEAD_L	1.67	-1.91	0.0003
	LIVE_L	1.13	-1.29	0.0002
	WIND_L	1270.15	-0.26	0.0002
13	DEAD_L	1.36	-1.89	0.0003
	LIVE_L	0.91	-1.28	0.0002
	WIND_L	1269.94	-0.25	0.0002
14	DEAD_L	1.72	-1.31	0.0004
	LIVE_L	1.16	-0.88	0.0003
	WIND_L	1270.10	-0.08	0.0001
15	DEAD_L	1.20	-1.26	0.0003
	LIVE_L	0.81	-0.85	0.0002
	WIND_L	1269.92	-0.08	0.0001
16	DEAD_L	1.70	-0.64	0.0004
	LIVE_L	1.15	-0.43	0.0003
	WIND_L	1270.05	-0.00	0.0000
17	DEAD_L	1.11	-0.57	0.0003

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24	DEAD_L	1.39	-0.75	-0.0000
	LIVE_L	0.94	-0.45	-0.0000
	WIND_L	1269.99	0.32	0.0000
25	DEAD_L	1.47	-0.81	-0.0001
	LIVE_L	0.98	-0.49	-0.0000
	WIND_L	1269.83	0.30	0.0000
26	DEAD_L	1.38	-0.83	0.0000
	LIVE_L	0.93	-0.50	0.0000
	WIND_L	1269.99	0.29	-0.0000
27	DEAD_L	1.52	-0.92	-0.0000
	LIVE_L	1.02	-0.57	-0.0000
	WIND_L	1269.82	0.32	0.0000
28	DEAD_L	1.34	-0.60	0.0001
	LIVE_L	0.90	-0.36	0.0001
	WIND_L	1270.01	0.17	-0.0000
29	DEAD_L	1.57	-0.78	0.0001
	LIVE_L	1.06	-0.48	0.0000
	WIND_L	1269.81	0.27	0.0000
30	DEAD_L	1.26	-0.30	0.0001
	LIVE_L	0.84	-0.18	0.0001
	WIND_L	1270.05	0.06	-0.0000
31	DEAD_L	1.68	-0.54	0.0001
	LIVE_L	1.14	-0.33	0.0000
	WIND_L	1269.76	0.17	0.0000
32	DEAD_L	1.10	0.00	-0.0003
	LIVE_L	0.74	0.00	-0.0002
	WIND_L	1270.12	0.00	0.0001
33	DEAD_L	1.84	-0.30	-0.0001
	LIVE_L	1.24	-0.19	-0.0001
	WIND_L	1269.69	0.12	0.0001
34	DEAD_L	1.01	-0.84	-0.0006
	LIVE_L	0.68	-0.56	-0.0004
	WIND_L	1270.18	0.37	0.0003
35	DEAD_L	1.91	-0.72	-0.0004
	LIVE_L	1.28	-0.48	-0.0003
	WIND_L	1269.67	0.34	0.0002
36	DEAD_L	0.98	-1.67	-0.0005
	LIVE_L	0.66	-1.12	-0.0003
	WIND_L	1270.23	0.80	0.0003
37	DEAD_L	1.79	-1.60	-0.0004
	LIVE_L	1.20	-1.07	-0.0003
	WIND_L	1269.71	0.78	0.0003
38	DEAD_L	1.01	-2.45	-0.0005
	LIVE_L	0.67	-1.64	-0.0003
	WIND_L	1270.25	1.28	0.0003
39	DEAD_L	1.61	-2.41	-0.0004
	LIVE_L	1.08	-1.61	-0.0003
	WIND_L	1269.79	1.26	0.0003
40	DEAD_L	1.10	-3.09	-0.0003
	LIVE_L	0.74	-2.07	-0.0002
	WIND_L	1270.24	1.80	0.0003
41	DEAD_L	1.39	-3.07	-0.0003
	LIVE_L	0.94	-2.05	-0.0002
	WIND_L	1269.90	1.78	0.0003
42	DEAD_L	1.25	-3.41	-0.0000
	LIVE_L	0.84	-2.29	-0.0000
	WIND_L	1270.19	2.30	0.0002
43	DEAD_L	1.39	-3.40	-0.0000

50	DEAD_L	3.88	-0.13	0.0001
	LIVE_L	2.58	-0.08	0.0001
	WIND_L	1069.39	-0.02	-0.1745
51	DEAD_L	3.28	-0.16	0.0011
	LIVE_L	2.19	-0.10	0.0007
	WIND_L	1208.72	-0.02	-0.1021
52	DEAD_L	1.65	-0.19	0.0022
	LIVE_L	1.10	-0.12	0.0015
	WIND_L	1269.76	-0.03	-0.0182

========== REACTIONS at ULS ==========

Node	Lcase	X-force kN	Y-force kN	Z-moment kNm
1	DEAD_L	0.03	8.05	-0.04
	LIVE_L	0.02	5.10	-0.03
	WIND_L	-18.64	-6.13	37.05
46	DEAD_L	-0.03	9.54	0.00
	LIVE_L	-0.02	6.08	0.00
	WIND_L	-2.32	1.45	0.00
18	DEAD_L	0.00	30.80	0.00
	LIVE_L	0.00	19.74	0.00
	WIND_L	0.00	-7.82	0.00
32	DEAD_L	0.00	36.11	0.00
	LIVE_L	0.00	23.08	0.00
	WIND_L	0.00	-12.12	0.00

EQUILIBRIUM CHECK AT ULS:

LC APPLIED LOADS MOMENTS about (0.0,0.0,0.0)

Sum of:	Px	Py	Mz
DEAD_L	0.00	-84.50	-1267.54
LIVE_L	0.00	-54.00	-810.00
WIND_L	20.96	24.61	226.00

LC REACTIONS & REACTION MOMENTS about (0.0,0.0,0.0)

Sum of:	Rx	Ry	MRz
DEAD_L	0.00	84.50	1267.54
LIVE_L	0.00	54.00	810.00
WIND_L	-20.96	-24.61	-226.00

========== BEAM ELEMENT END FORCES IN LOCAL ELEMENT AXES at ULS ==========

Elem	Lcase	Axial kN	Y-Shear kN	M-xx kNm	Axial kN	Y-Shear kN	M-xx kNm

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	WIND_L	1.45	-2.32	0.00	-1.45	2.32	2.32
47-48	DEAD_L	9.37	-0.03	-0.03	-9.37	0.03	0.05
	LIVE_L	6.08	-0.02	-0.02	-6.08	0.02	0.03
	WIND_L	1.45	-2.11	-2.32	-1.45	2.11	4.42
48-49	DEAD_L	9.26	-0.03	-0.05	-9.26	0.03	0.08
	LIVE_L	6.08	-0.02	-0.03	-6.08	0.02	0.05
	WIND_L	1.45	-1.90	-4.42	-1.45	1.90	6.32
49-50	DEAD_L	9.15	-0.03	-0.08	-9.15	0.03	0.10
	LIVE_L	6.08	-0.02	-0.05	-6.08	0.02	0.07
	WIND_L	1.45	-1.69	-6.32	-1.45	1.69	8.01
50-51	DEAD_L	9.04	-0.03	-0.10	-9.04	0.03	0.13
	LIVE_L	6.08	-0.02	-0.07	-6.08	0.02	0.08
	WIND_L	1.45	-1.48	-8.01	-1.45	1.48	9.49
51-52	DEAD_L	8.93	-0.03	-0.13	-8.93	0.03	0.15
	LIVE_L	6.08	-0.02	-0.08	-6.08	0.02	0.10
	WIND_L	1.45	-1.27	-9.49	-1.45	1.27	10.75
7-8	DEAD_L	-19.06	0.29	0.07	19.06	-0.18	0.29
	LIVE_L	-13.00	0.17	0.05	13.00	-0.17	0.21
	WIND_L	-18.01	-7.43	-7.94	18.01	7.43	-3.21
8-10	DEAD_L	-19.06	-0.13	-0.21	19.06	0.23	-0.06
	LIVE_L	-12.99	-0.13	-0.16	12.99	0.13	-0.03
	WIND_L	-6.37	0.34	0.38	6.37	-0.34	0.13
10-12	DEAD_L	-12.88	0.01	-0.04	12.88	0.09	-0.02
	LIVE_L	-8.74	-0.03	-0.04	8.74	0.03	-0.01
	WIND_L	5.32	-0.02	-0.01	-5.32	0.02	-0.02
12-14	DEAD_L	-5.62	0.02	-0.02	5.62	0.09	-0.03
	LIVE_L	-3.81	-0.03	-0.03	3.81	0.03	-0.02
	WIND_L	6.55	0.02	0.02	-6.55	-0.02	0.00
14-16	DEAD_L	1.80	0.03	-0.01	-1.80	0.07	-0.02
	LIVE_L	1.19	-0.02	-0.02	-1.19	0.02	-0.01
	WIND_L	5.35	0.01	0.02	-5.35	-0.01	0.00
16-18	DEAD_L	9.34	-0.06	-0.04	-9.34	0.16	-0.12
	LIVE_L	6.22	-0.08	-0.04	-6.22	0.08	-0.08
	WIND_L	3.16	0.04	0.03	-3.16	-0.04	0.03
18-20	DEAD_L	16.84	0.26	0.20	-16.84	-0.15	0.10
	LIVE_L	11.17	0.12	0.12	-11.17	-0.12	0.07
	WIND_L	0.51	-0.04	-0.03	-0.51	0.04	-0.02
20-22	DEAD_L	8.18	0.13	0.06	-8.18	-0.02	0.05
	LIVE_L	5.73	0.04	0.02	-5.73	-0.04	0.03
	WIND_L	1.70	-0.00	0.00	-1.70	0.00	-0.01
22-24	DEAD_L	3.64	0.11	0.06	-3.64	-0.01	0.04
	LIVE_L	2.87	0.03	0.02	-2.87	-0.03	0.02
	WIND_L	1.69	0.00	0.01	-1.69	-0.00	-0.00
24-26	DEAD_L	1.90	0.09	0.03	-1.90	0.02	0.02
	LIVE_L	1.77	0.02	0.01	-1.77	-0.02	0.02
	WIND_L	0.87	0.02	0.02	-0.87	-0.02	0.01
26-28	DEAD_L	4.71	-0.04	-0.06	-4.71	0.15	-0.08
	LIVE_L	3.55	-0.05	-0.05	-3.55	0.05	-0.03
	WIND_L	-2.47	0.05	0.04	2.47	-0.05	0.03
28-30	DEAD_L	9.97	-0.04	-0.06	-9.97	0.14	-0.08
	LIVE_L	6.89	-0.04	-0.04	-6.89	0.04	-0.03
	WIND_L	-5.24	0.04	0.03	5.24	-0.04	0.03
30-32	DEAD_L	18.98	-0.20	-0.13	-18.98	0.30	-0.25
	LIVE_L	12.57	-0.15	-0.08	-12.57	0.15	-0.14
	WIND_L	-9.13	0.09	0.05	9.13	-0.09	0.08
32-34	DEAD_L	11.42	0.20	0.16	-11.42	-0.09	0.06
	LIVE_L	7.62	0.10	0.10	-7.62	-0.10	0.05
	WIND_L	7.28	0.05	0.05	-7.28	0.05	0.03

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	WIND_L	22.04	-3.61	-3.87	-22.04	3.61	-1.75
9-11	DEAD_L	13.64	-0.02	-0.07	-13.61	0.12	-0.03
	LIVE_L	9.25	-0.05	-0.06	-9.25	0.05	-0.01
	WIND_L	-1.69	-0.04	-0.03	1.69	0.04	-0.03
11-13	DEAD_L	5.94	0.01	-0.03	-5.92	0.09	-0.03
	LIVE_L	4.02	-0.02	-0.03	-4.02	0.02	-0.01
	WIND_L	-3.44	0.00	0.01	3.44	-0.00	-0.00
13-15	DEAD_L	-1.78	0.01	-0.02	1.81	0.09	-0.04
	LIVE_L	-1.18	-0.02	-0.02	1.18	0.02	-0.02
	WIND_L	-2.71	0.01	0.01	2.71	-0.01	0.00
15-17	DEAD_L	-9.60	-0.01	-0.03	9.63	0.10	-0.06
	LIVE_L	-6.39	-0.03	-0.02	6.39	0.03	-0.02
	WIND_L	-0.95	0.01	0.01	0.95	-0.01	0.01
17-19	DEAD_L	-17.42	0.04	0.02	17.44	0.06	-0.03
	LIVE_L	-11.56	0.00	0.01	11.56	-0.00	-0.01
	WIND_L	1.30	0.00	0.00	-1.30	-0.00	0.00
19-21	DEAD_L	-8.46	0.12	0.08	8.49	-0.02	0.03
	LIVE_L	-5.93	0.05	0.05	5.93	-0.05	0.04
	WIND_L	-0.43	-0.01	-0.01	0.43	0.01	-0.01
21-23	DEAD_L	-3.74	0.08	0.04	3.77	0.02	0.01
	LIVE_L	-2.96	0.03	0.02	2.96	-0.03	0.02
	WIND_L	-0.93	-0.00	0.00	0.93	0.00	-0.00
23-25	DEAD_L	-1.94	0.05	0.01	1.97	0.05	-0.02
	LIVE_L	-1.82	0.01	0.01	1.82	-0.01	0.01
	WIND_L	-0.59	0.01	0.01	0.59	-0.01	0.01
25-27	DEAD_L	-2.20	0.06	0.01	2.22	0.04	0.00
	LIVE_L	-1.95	0.01	0.01	1.95	-0.01	0.01
	WIND_L	0.34	0.00	0.00	-0.34	-0.00	0.00
27-29	DEAD_L	-2.23	0.02	-0.01	2.20	0.07	-0.03
	LIVE_L	-1.96	-0.02	-0.02	1.96	0.02	-0.02
	WIND_L	0.17	0.02	0.01	-0.17	-0.02	0.01
29-31	DEAD_L	-4.88	0.01	-0.02	4.85	0.09	-0.05
	LIVE_L	-3.67	-0.04	-0.03	3.67	0.04	-0.03
	WIND_L	2.37	0.03	0.03	-2.37	-0.03	0.03
31-33	DEAD_L	-10.34	-0.04	-0.05	10.32	0.14	-0.09
	LIVE_L	-7.13	-0.07	-0.05	7.13	0.07	-0.06
	WIND_L	5.40	0.04	0.03	-5.40	-0.04	0.04
33-35	DEAD_L	-19.66	0.05	0.03	19.63	0.05	-0.02
	LIVE_L	-13.01	-0.01	0.01	13.01	0.01	-0.01
	WIND_L	9.60	0.01	0.00	-9.60	-0.01	0.01
35-37	DEAD_L	-11.78	0.12	0.07	11.76	-0.02	0.04
	LIVE_L	-7.85	0.04	0.03	7.85	-0.04	0.03
	WIND_L	7.83	-0.02	-0.02	-7.83	0.02	-0.01
37-39	DEAD_L	-3.89	0.10	0.05	3.86	-0.00	0.03
	LIVE_L	-2.64	0.03	0.02	2.64	-0.03	0.02
	WIND_L	5.77	-0.01	-0.01	-5.77	0.01	-0.01
39-41	DEAD_L	3.91	0.09	0.04	-3.93	0.01	0.03
	LIVE_L	2.56	0.02	0.01	-2.56	-0.02	0.02
	WIND_L	3.25	-0.02	-0.01	-3.25	0.02	-0.01
41-43	DEAD_L	11.62	0.09	0.03	-11.64	0.01	0.04
	LIVE_L	7.75	0.02	0.01	-7.75	-0.02	0.03
	WIND_L	-0.22	-0.02	-0.02	0.22	0.02	-0.02
43-45	DEAD_L	19.29	0.12	0.03	-19.31	-0.03	0.09
	LIVE_L	12.96	0.05	0.01	-12.96	-0.05	0.07
	WIND_L	-6.00	-0.09	-0.05	6.00	0.09	-0.09
45-52	DEAD_L	25.10	-0.12	-0.20	-25.12	0.21	-0.06
	LIVE_L	16.98	-0.12	-0.15	-16.98	0.12	-0.04
	WIND_L	30.93	3.22	1.49	-30.93	-3.22	3.52

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	WIND_L	-1.93	0.01	0.01	1.93	-0.01	0.01
22-23	DEAD_L	8.08	-0.02	-0.03	-8.08	0.02	-0.04
	LIVE_L	5.31	-0.01	-0.02	-5.31	0.01	-0.02
	WIND_L	0.01	-0.00	-0.00	-0.01	0.00	-0.00
24-25	DEAD_L	3.31	-0.01	-0.02	-3.31	0.01	-0.02
	LIVE_L	2.34	-0.01	-0.01	-2.34	0.01	-0.01
	WIND_L	1.73	-0.00	-0.01	-1.73	0.00	-0.01
26-27	DEAD_L	4.98	0.01	0.01	-4.98	-0.01	0.01
	LIVE_L	3.68	0.00	0.01	-3.68	-0.00	0.01
	WIND_L	-1.38	-0.01	-0.02	1.38	0.01	-0.01
28-29	DEAD_L	10.76	0.03	0.05	-10.76	-0.03	0.05
	LIVE_L	7.06	0.02	0.03	-7.06	-0.02	0.03
	WIND_L	-5.86	-0.01	-0.03	5.86	0.01	-0.02
30-31	DEAD_L	16.50	0.05	0.09	-16.50	-0.05	0.08
	LIVE_L	10.64	0.03	0.06	-10.64	-0.03	0.05
	WIND_L	-7.28	-0.02	-0.04	7.28	0.02	-0.03
32-33	DEAD_L	23.16	0.02	0.02	-23.16	-0.02	0.04
	LIVE_L	14.82	0.01	0.02	-14.82	-0.01	0.02
	WIND_L	-8.97	-0.01	-0.01	8.97	0.01	-0.02
34-35	DEAD_L	-10.29	-0.04	-0.06	10.29	0.04	-0.03
	LIVE_L	-6.60	-0.03	-0.04	6.60	0.03	-0.03
	WIND_L	2.82	0.01	0.02	-2.82	-0.01	0.01
36-37	DEAD_L	-8.29	-0.04	-0.05	8.29	0.04	-0.04
	LIVE_L	-5.34	-0.03	-0.03	5.34	0.03	-0.03
	WIND_L	2.76	0.01	0.02	-2.76	-0.01	0.01
38-39	DEAD_L	-6.17	-0.06	-0.05	6.17	0.06	-0.04
	LIVE_L	-3.98	-0.04	-0.03	3.98	0.04	-0.03
	WIND_L	2.77	0.02	0.02	-2.77	-0.02	0.02
40-41	DEAD_L	-4.08	-0.09	-0.06	4.08	0.09	-0.05
	LIVE_L	-2.62	-0.06	-0.04	2.62	0.06	-0.04
	WIND_L	3.03	0.06	0.04	-3.03	-0.06	0.03
42-43	DEAD_L	-2.00	-0.29	-0.12	2.00	0.29	-0.11
	LIVE_L	-1.24	-0.20	-0.08	1.24	0.20	-0.08
	WIND_L	3.80	0.20	0.07	-3.80	-0.20	0.09
44-45	DEAD_L	0.40	0.10	0.12	-0.40	-0.10	-0.07
	LIVE_L	0.37	0.06	0.08	-0.37	-0.06	-0.06
	WIND_L	6.82	10.78	2.56	-6.82	-10.78	1.77
9-10	DEAD_L	6.13	-0.05	-0.15	-6.16	0.17	-0.02
	LIVE_L	4.23	-0.08	-0.11	-4.23	0.08	-0.01
	WIND_L	12.16	-0.10	-0.07	-12.16	0.10	-0.09
11-12	DEAD_L	8.12	0.03	-0.04	-8.18	0.09	-0.02
	LIVE_L	5.53	-0.02	-0.03	-5.53	0.02	-0.00
	WIND_L	1.40	0.01	0.02	-1.40	-0.01	0.00
13-14	DEAD_L	9.41	0.06	0.01	-9.51	0.06	-0.01
	LIVE_L	6.36	-0.00	-0.01	-6.36	0.00	0.00
	WIND_L	-1.52	0.00	0.01	1.52	-0.00	-0.01
15-16	DEAD_L	10.91	0.08	0.03	-11.04	0.04	0.01
	LIVE_L	7.31	0.01	0.01	-7.31	-0.01	0.02
	WIND_L	-3.18	-0.00	0.00	3.18	0.00	-0.01
17-18	DEAD_L	12.51	0.04	0.01	-12.68	0.08	-0.06
	LIVE_L	8.32	-0.01	-0.01	-8.32	0.01	-0.02
	WIND_L	-4.43	0.00	0.00	4.43	-0.00	0.00
19-20	DEAD_L	-16.34	0.03	-0.01	16.14	0.10	-0.09
	LIVE_L	-10.21	-0.02	-0.02	10.21	0.02	-0.04
	WIND_L	2.23	0.00	0.00	-2.23	-0.00	0.01
21-22	DEAD_L	-9.69	0.04	-0.00	9.46	0.08	-0.07
	LIVE_L	-6.01	-0.01	-0.02	6.01	0.01	-0.02
	WIND_L	0.03	0.00	0.00	0.03	0.00	0.00

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	WIND_L	-3.57	0.01	0.01	3.57	-0.01	0.01
36-39	DEAD_L	11.01	0.05	0.00	-10.88	0.07	-0.02
	LIVE_L	7.30	-0.01	-0.01	-7.30	0.01	-0.00
	WIND_L	-3.77	0.00	0.00	3.77	-0.00	0.00
38-41	DEAD_L	9.49	0.06	0.00	-9.39	0.06	-0.00
	LIVE_L	6.35	-0.00	-0.01	-6.35	0.00	0.01
	WIND_L	-4.42	-0.00	-0.00	4.42	0.00	-0.00
40-43	DEAD_L	8.13	0.09	0.01	-8.07	0.03	0.05
	LIVE_L	5.50	0.02	-0.01	-5.50	-0.02	0.04
	WIND_L	-6.32	-0.01	-0.00	6.32	0.01	-0.02
42-45	DEAD_L	5.90	0.19	0.01	-5.87	-0.06	0.18
	LIVE_L	4.06	0.09	-0.00	-4.06	-0.09	0.13
	WIND_L	-14.83	-0.19	-0.10	14.83	0.19	-0.19

```
============================== STATISTICAL DATA ==============================

Own weight of structure = 12.50 kN

No. of real numbers in Stiffness matrix = 1194  (7164 bytes)
Time used to analyse = 0: 0:0.157 seconds
Total number of : Nodes              = 52
                  Beam Elements      = 89
                  Shell Elements     = 0
                  Supports           = 4
                  Section properties = 5
                  Load cases         = 3
                  Load combinations  = 0

============================== END OF OUTPUT ==============================
```

3.2 DESIGN OF RAFTERS

Span = 655.32mm Effective span= 0.551m

i. Total load W= 8.64kN/m
ii. B.M= (8.64kN/m)/10=262.311Nm
iii. Section modulus Z= M/ σ_{bc}=0.83cm

So the minimum width and depth of rafters required are 20mm and 26.9mm respectively.

Therefore, we can use tubes of the following dimensions: Depth= 50mm Width= 40mm.

3.3 COMPRESSION MEMBERS

We have taken the very loaded strut

3.3.1 DESIGN OF STRUTS

Design load P= 54.64kN Length of spans L=2.114m

i. Effective length l= 0.85L= 1.797m
ii. Assume for double angle struts λ= 100
iii. f_y=480N/mm2 Hence σ_{ac}= 99N/mm2 (from steel design tables)
iv. Gross-section area A= P/ σ_{ac}= (54640/99)mm2 =5.52cm2
v. Minimum radius of gyration r_{min}= 1.57cm
vi. Λ_{cal}=179.7/1.57= 114.46. The design is OK since 100< Λ_{cal}<120

So we can use tubes of the following dimensions: Width = 40mm and Depth= 50mm

3.4 DESIGN OF TIES

Fy= 480N/mm2 So, σ_{at}= 288 N/mm2

1. Design load P= 186.3kN
2. Net area of the section Anet= P/ σ_{at}= 186300/288mm2= 646.875mm2
3. Gross-section area Agross= 1.35*646.875mm2= 873.3mm2= 8.73cm2
   From steel design tables, we get a cross-section area of 8.74cm2
   So, we can use tubes of the following dimensions: Width= 80mm; Depth= 90mm

TABLE 7.5 PERMISSIBLE STRESS σ_{ac} (N/mm^2) IN AXIAL COMPRESSION.

λ ↓ \ f_y →	220	230	240	250	260	280	300	320	340	360	380	400	420	450	480	510	540
10	132	138	144	150	156	168	180	192	204	215	227	239	251	269	287	305	323
20	131	137	142	148	154	166	177	189	201	212	224	235	246	263	280	297	314
30	128	134	140	145	151	162	172	183	194	204	215	225	236	251	266	280	295
40	124	129	134	139	145	154	164	174	183	192	201	210	218	231	243	255	267
50	118	123	127	132	136	145	153	161	168	176	183	190	197	207	216	225	233
60	111	115	118	122	126	133	139	146	152	158	163	168	173	180	187	193	199
70	102	106	109	112	115	120	125	130	135	139	142	147	150	155	160	164	168
80	93	96	98	101	103	107	111	115	118	121	124	127	129	133	136	139	141
90	85	87	88	90	92	95	98	101	103	105	108	109	111	114	116	118	119
100	76	78	79	80	82	84	86	88	90	92	93	94	96	97	99	100	101
110	68	69	71	72	73	74	76	77	79	80	81	82	83	84	85	86	87
120	61	62	63	64	64	66	67	67	69	70	71	71	72	73	73	74	75
130	55	55	56	57	57	58	59	60	61	61	62	62	63	63	64	64	65
140	49	50	50	51	51	52	53	53	54	54	54	55	55	56	56	56	57
150	44	45	45	45	46	46	47	47	48	48	48	49	49	49	49	50	50
160	40	40	41	41	41	42	42	42	43	43	43	43	43	44	44	44	44
170	36	36	37	37	37	37	38	38	38	38	39	39	39	39	39	39	39
180	33	33	33	33	33	34	34	34	34	35	35	35	35	35	35	35	35
190	30	30	30	30	30	30	31	31	31	31	31	31	32	32	32	32	32
200	27	27	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
210	25	25	25	25	25	25	26	26	26	26	26	26	26	26	26	26	26
220	23	23	23	23	23	23	23	24	24	24	24	24	24	24	24	24	24
230	21	21	21	21	21	21	21	21	22	22	22	22	22	22	22	22	22
240	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
250	18	18	18	18	18	18	18	18	18	19	19	19	19	19	19	19	19

4. Thickness of elements

Formula: $A=P/\sigma_{ac}$ =175260N:73N/mm^2 =2400 mm^2

A=b*h for rectangular section

Let b=40mm and h=60mm

Note that the tension members have the same dimensions as compression members.

b=40mm and h=60mm

3.5 DESIGN OF STEEL COLUMN

General

The column span is 1000mm x 1000mm.

The upper and the Lower columns assume the shape of letter 'X'. The upper columns support the roof while the lower columns are fixed on the foundation cages.

L=5.50m

End conditions: Effectively held in position and restrained against rotation at both ends.

LOADING

Dead load

from roof sheeting P_1= (150N/m^2)*(64 m^2)=2400N=9.6kN

Self weight of purlins for GI sheeting: 60-90

Let's take P_2 = 90N/m^2 = 0.09kN/m^2*64 m^2=5.76 KN

Trusses load=150N/m2*64=9.6KN

P_{tot}= P_1+ P_2 = (5.76+9.6+9.6) KN=24.96KN

Live load

For θ<= 10^0: 750N/m^2

So we've: (750N/m^2)* (64 m^2)= 48000N= 48kN

Imposed load: 1N/m^2

So we've P_z= (1N/m^2)* (64 m^2)= 64kN

Total load= 48 + 64+24.96= 137KN

*Design load= Safety factor*total load= 1.15*137=157.6KN*

DESIGN STEPS

Step1: Effective length l= 0.65L

Step2: Assume suitable value of slenderness ratio: λ=90 for I-stanchions

Step4: Computation of the gross-area by the relation:

Step3: σ_{ac}- Permissible shear stress.

λ=90

f_y= 480 then σ_{ac}= 0.116kN/ mm^2

Gross –area computation

A= P/ σ_{ac} =157600:116N/ mm^2=1358mm=0.14m

Section designation

D=203mm B=203.6mm thickness web=7.2mm thickness flange=11mm

3.6 DESIGN OF THE BASE PLATE WELDED

Assume a base of say 370mm*500mm

UDL of wind=1.5KN/m^2

M=1.5*8*5.5=66KNm

A=500*270=185 000mm2

Axial load=157600+(46.1*10*5.5)=160135.5=160.14KN

Modulus Z=370*500^2/6=15416666.67

Maximum pressure, max=$\left(\frac{W}{A}\right)+\left(\frac{M}{Z}\right)=\left(\frac{160.14}{185}\right)+\left(\frac{66}{15.42}\right)$=5.166N/$mm^2$

Pmin==$\left(\frac{W}{A}\right)-\left(\frac{M}{Z}\right)=\left(\frac{160.14}{185}\right)-\left(\frac{66}{15.42}\right)$=-3.44N/$mm^2$

b) Thickness of base plate

Base pressure at x-x=$Pmin+(\left(\frac{L-x}{L}\right)*(Pmax-Pmin))$

$=-3.44+(\left(\frac{500-138.35}{500}\right)*(5.166+3.44))$=2.8N/ mm^2

T=$\sqrt{((2.5/py)w*(a^2-0.3b^2))}=\sqrt{(\left(\frac{2.5}{480}\right)2.8*(296.14^2-0.3*167^2))}$=35mm

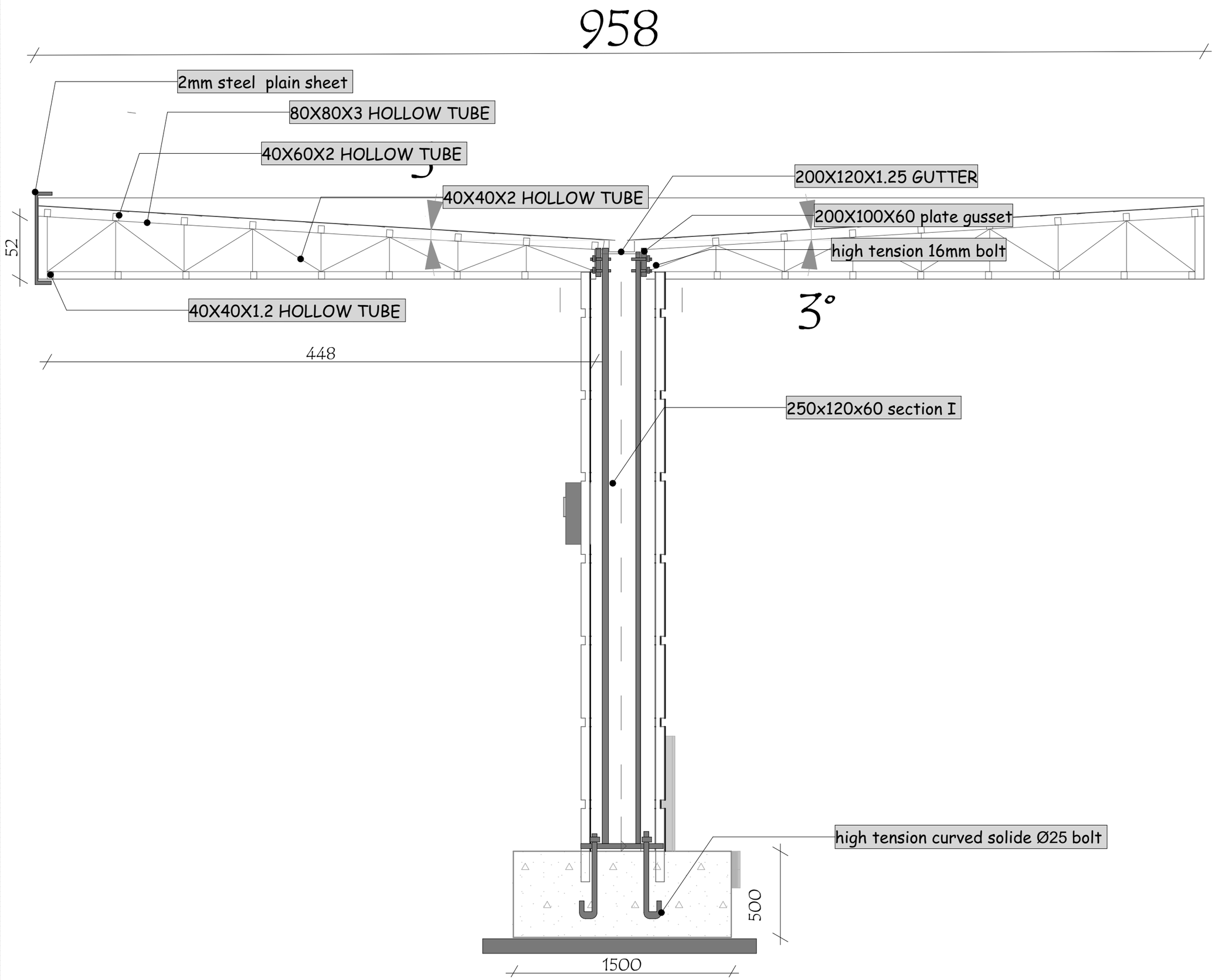
The thickness of the plate is 35 mm

A=500mm B=370mm

Done at Kigali, February /2017

Done by

ENG.SHUMBUSHO Marcel



GENERAL NOTES

1 ALL DIMENSIONS IS IN Cmm AND TO BE CHECKED ON SITE. WRITTEN DIMENSIONS RULES OVER SCALED DRAWINGS. ANY DISCREPANCY IN DIMENSIONS TO BE REPORTED TO THE ARCHITECT BEFORE PROCEEDING.

2 DEPTH AT FOUNDATION TO BE DETERMINED ON SITE, ALL FOUNDATIONS R.C. COLUMNS AND R.C. WORKS TO STRUCTURAL ENGINEERS' DETAIL.

3. HEAVY DUTY POLYTHENE SHEETING AND TERMITE TREATMENT TO BE PROVIDED UNDER GROUND FLOOR SLAB. DPC TO BE THREE PLY BITUMINOUS FELT LAID UNDER ALL WALLS.

4 P.V. DENOTES PERMANENT VENTILATION . F.L. DENOTES FANLIGHT ABOVE.

5 ALL WALLS TO BE REINFORCED WITH HOOP IRON AT EVERY ALTERNATIVE COURSE.

6 ALL SANITARY WORKS TO BE EXECUTED IN ACCORDANCE WITH M.O.H. RULES AND REGULATIONS.

7 ALL DRAINS UNDER BUILDING, DRIVEWAY , AND PARKING TO BE 150mm CAST IRON PIPE ENCASED IN 150mm CONCRETE INSPECTION CHAMBERS WITHIN BUILDING TO BE FITTED WITH HEAVY DUTY DOUBLE SEAL AIR TIGHT COVERS

REV.	DATE	DESCRIPTION	BY

Company Title

C&F INNOVATION COMPANY

Client :
MUSABYEMUNGU ANNE MARIE

Project:
PROPOSED PETROL STATION

Plot No: 1594	Road

Location : WESTERN PROVINCE RUBAVU-KANZENZE-KIREREMA	Town GISENYI

Project Manager / Architect
C&F INNOVATION COMPANY LTD

DOCUMENTS	Scale
COLUMN DETAIL ROOF DETAILS FOOTING DETAILS	

Drawing Title: **STRUCTURAL PLANS FUEL PUMP AREA**

Drawing No: 17-JAN/062	SHEET No: A3-1

Drawn By: M.C	Checked By: M.C.	Date: JAN.-2017

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