CNLC®

Wind load resistance structural calculation report

ISO9001 / 14001 UL Certificate CE Certificate FCC Certificate RoHS

Calculation of the Structure of a Single-Sided LED

Chapter 1 Load Calculation

1.2 Wind Load Calculation

GB 50009-2012 Code for Design of Building Structures

Wind pressure recurrence period: wind-period:= "50 years"

Wind speed: $v_w := 20.8\frac{m}{s}$

fundamental wind pressure ： $w_o := \left[\frac{\left(\frac{v_w}{\frac{m}{s}}\right)^2 kPa}{1600}\right] = 0.27 \cdot kPa$

Building calculation height: $z := 10\ m$

Surface roughness category: roughness := "C"

Wind pressure height variation coefficient: $\mu_z = 0.65$

gustiness factor ： $\beta_{gz} = 2.05$

Local body coefficient: $\mu_{sl} := 1.0$

Standard value of wind load: $WS := \beta_{gz} \cdot \mu_{sl} \cdot \mu_z \cdot w_o = 0.36.kPa$

Table 8.2.1 Wind pressure height variation coefficient μ

Ground Level Height (m)	Ground Roughness Category			
	A	B	C	D
5	1.09	1.00	0.65	0.51
10	1.28	1.00	0.65	0.51
15	1.42	1.13	0.65	0.51
20	1.52	1.23	0.74	0.51
30	1.67	1.39	0.88	0.51
40	1.79	1.52	1.00	0.60
50	1.89	1.62	1.10	0.69
60	1.97	1.71	1.20	0.77
70	2.05	1.79	1.28	0.84
80	2.12	1.87	1.36	0.91
90	2.18	1.93	1.43	0.98
100	2.23	2.00	1.50	1.04

Continued from Table 8.2.1

Height above ground or sea level (m)	Ground Roughness Category			
	A	B	C	D
150	2.46	2.25	1.79	1.33
200	2.64	2.46	2.03	1.58
250	2.78	2.63	2.24	1.81
300	2.91	2.77	2.43	2.02
350	2.91	2.91	2.60	2.22
400	2.91	2.91	2.76	2.40
450	2.91	2.91	2.91	2.58
500	2.91	2.91	2.91	2.74
≥550	2.91	2.91	2.91	2.91

Table 8.6.1 Gust Coefficient β_μ

Height above ground (m)	Ground Roughness Category			
	A	B	C	D
5	1.65	1.70	2.05	2.40
10	1.60	1.70	2.05	2.40
15	1.57	1.66	2.05	2.40
20	1.55	1.63	1.99	2.40
30	1.53	1.59	1.90	2.40
40	1.51	1.57	1.85	2.29
50	1.49	1.55	1.81	2.20
60	1.48	1.54	1.78	2.14
70	1.48	1.52	1.75	2.09
80	1.47	1.51	1.73	2.04
90	1.46	1.50	1.71	2.01

Continued from Table 8.6.1

Height above ground (m)	Ground Roughness Category			
	A	B	C	D
100	1.46	1.50	1.69	1.98
150	1.43	1.47	1.63	1.87
200	1.42	1.45	1.59	1.79
250	1.41	1.43	1.57	1.74
300	1.40	1.42	1.54	1.70
350	1.40	1.41	1.53	1.67
400	1.40	1.41	1.51	1.64
450	1.40	1.41	1.50	1.62
500	1.40	1.41	1.50	1.60
550	1.40	1.41	1.50	1.59

1.3 Self Weight Load Calculation

Average surface load on panels and components: $q_{dk} := 0.5kPa$

1.4 Earthquake Load Calculation

<GB50011-2010 Code for Seismic Design of Buildings>

Seismic fortification intensity(degree): seismic_intensity := 7

Base seismic acceleration(g): acceleration := 0.10.g

Maximum horizontal seismic influence coefficient: $\alpha_{max} := 0.08$

dynamic magnification factor $\beta_e := 5$

Horizontal seismic action standard value: $qek := \beta_e \alpha_{max} \cdot q_{dk} = 0.2. kPa$

1.5 Loading Combinations

Load Combination 1 (Strength Verification): 1.3D+1.5W+0.7E

Load perpendicular to the curtain wall surface: $q'_y := 1.5qwk + 0.65qek = 3.97. kPa$

Load parallel to the curtain wall surface: $q'z := 1.3q_{dk} = 0.65. kPa$

Load Combination 2 (Deflection Verification): 1.0D+1.0W

Load perpendicular to the curtain wall surface: $q'_y := 1.0qwk = 2.56. kPa$

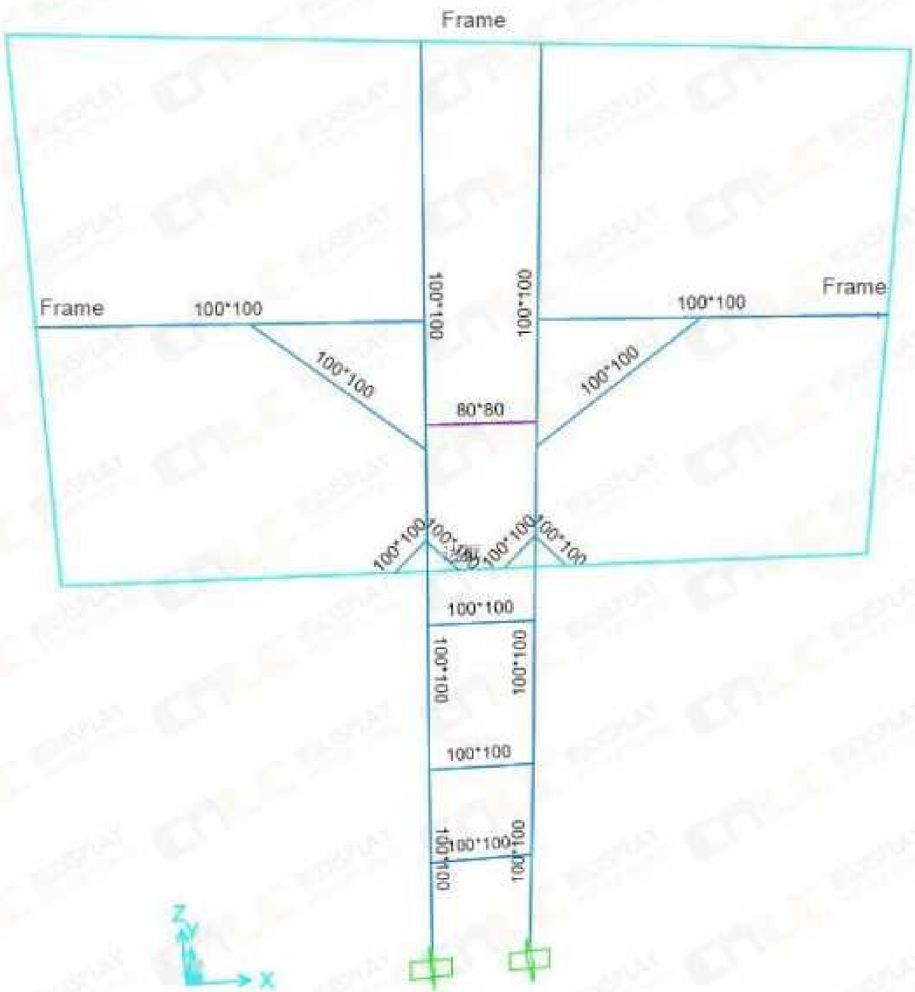
Load parallel to the curtain wall surface: $q'_z := 1.0q_{dk} = 0.5. kPa$

Chapter 2: Verification of the Keel

I. Calculation Explanation

The self-weight of steel structure keel is automatically loaded by SAP2000 software.
The structure model is as follows: specify the keel

The blue dragon bone features a 100×100×8 square tube section, while the purple variant uses an 80×80 square tube. The cyan frame measures 300×120, with the material selected as Q235B.



Node label

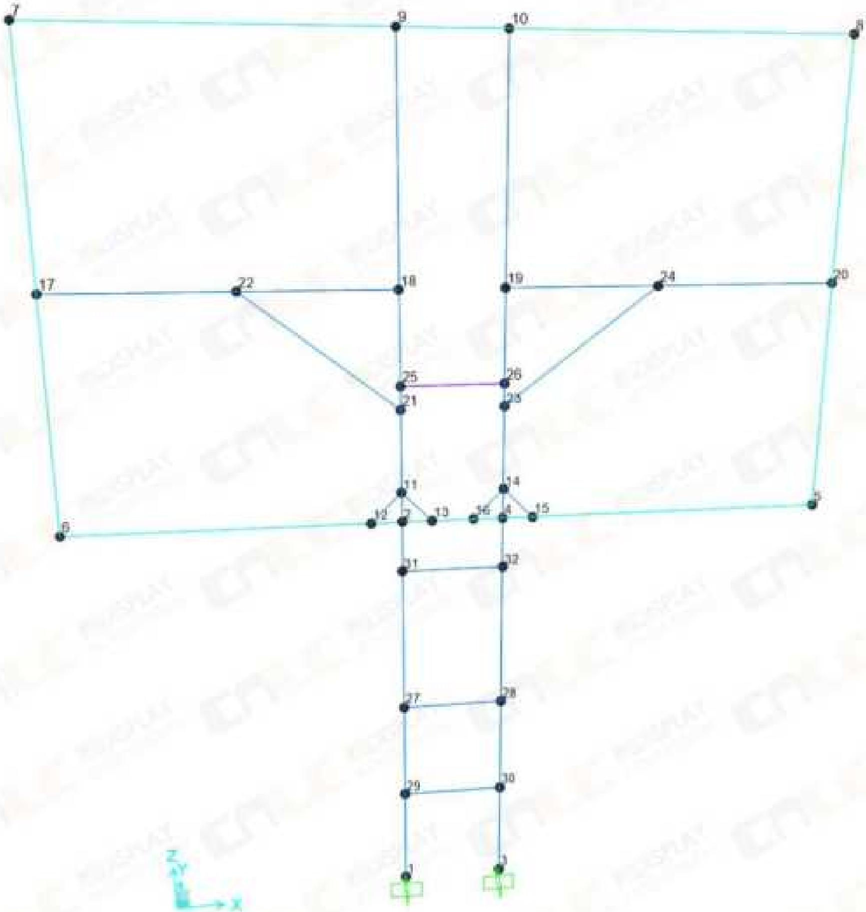


TABLE: Objects And Elements - Joints			
JointElem	GlobalX	GlobalY	GlobalZ
Text	m	m	m
1	1.62	0.15	0.00
2	1.62	0.15	2.70
3	2.30	0.15	0.00
4	2.30	0.15	2.70
5	4.49	0.15	2.70
6	-0.56	0.15	2.70
7	-0.56	0.15	5.76
8	4.49	0.15	5.76
9	1.62	0.15	5.76
10	2.30	0.15	5.76
11	1.62	0.15	2.90
12	1.42	0.15	2.70
13	1.82	0.15	2.70
14	2.30	0.15	2.90
15	2.50	0.15	2.70
16	2.10	0.15	2.70
17	-0.56	0.15	4.23
18	1.62	0.15	4.23

19	2.30	0.15	4.23
20	4.49	0.15	4.23
21	1.62	0.15	3.47
22	0.62	0.15	4.23
23	2.30	0.15	3.47
24	3.30	0.15	4.23
25	1.62	0.15	3.62
26	2.30	0.15	3.62
27	1.62	0.15	1.35
28	2.30	0.15	1.35
29	1.62	0.15	0.68
30	2.30	0.15	0.68
31	1.62	0.15	2.35
32	2.30	0.15	2.35

Rod Label

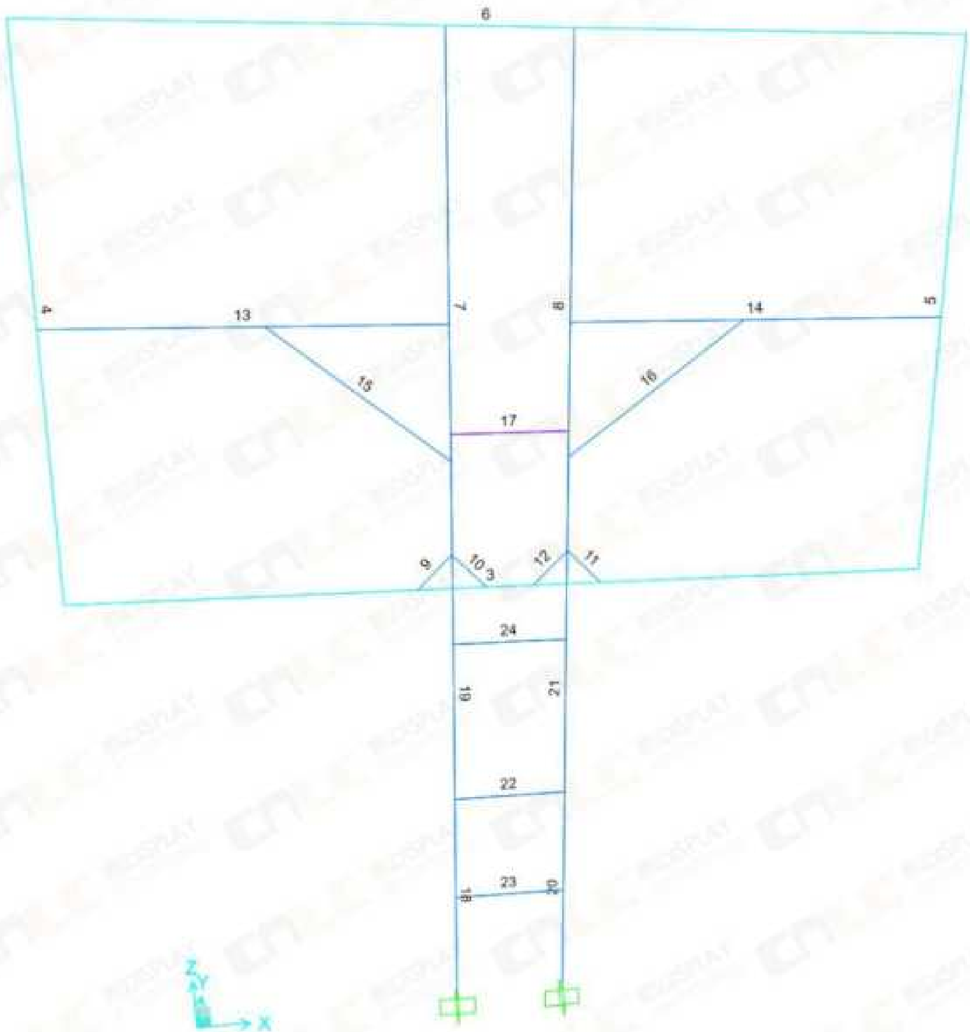


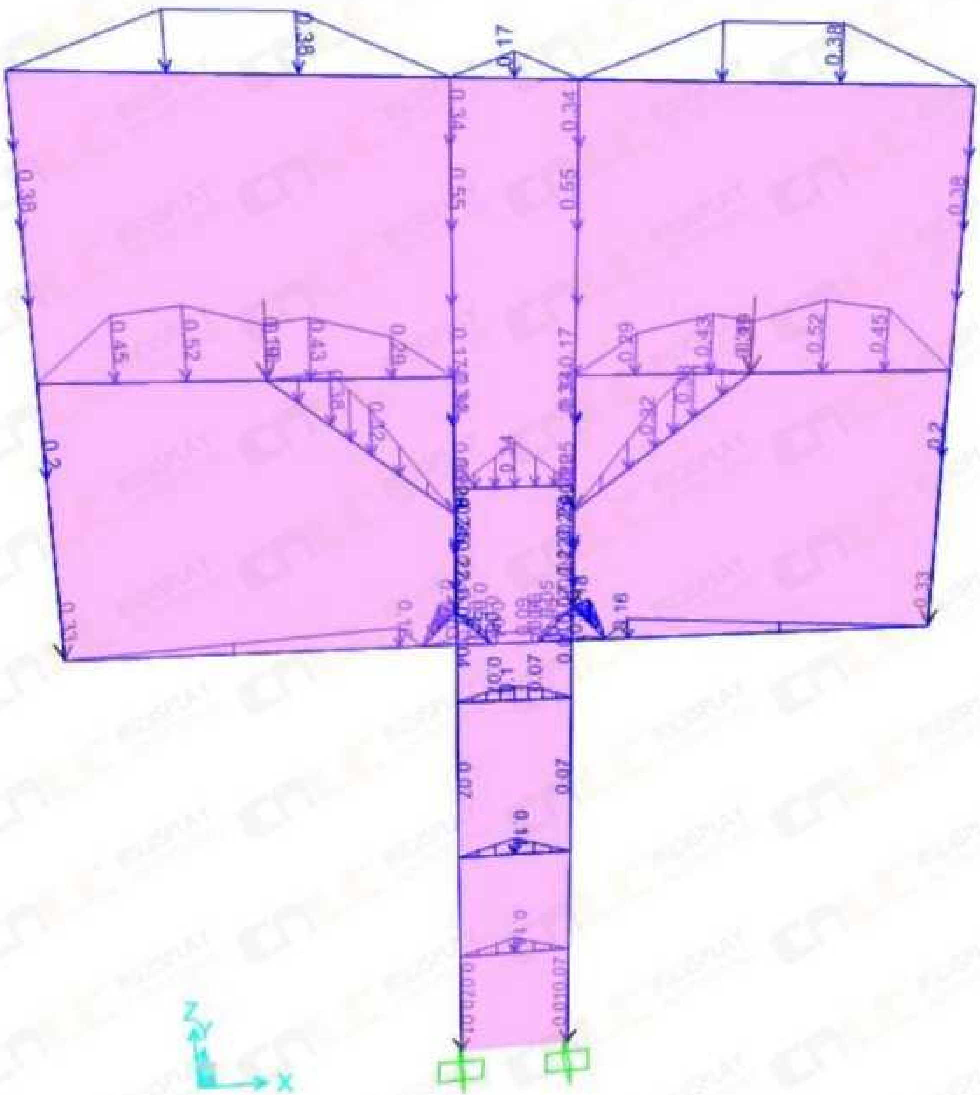
TABLE: Frame Section Assignments			
Frame	SectionType	AnalSect	DesignSect
Text	Text	Text	Text
3	Channel	Frame	Frame
4	Channel	Frame	Frame
5	Channel	Frame	Frame
6	Channel	Frame	Frame
7	Box/Tube	100*100	100*100
8	Box/Tube	100*100	100*100
9	Box/Tube	100*100	100*100
10	Box/Tube	100*100	100*100
11	Box/Tube	100*100	100*100
12	Box/Tube	100*100	100*100
13	Box/Tube	100*100	100*100
14	Box/Tube	100*100	100*100
15	Box/Tube	100*100	100*100
16	Box/Tube	100*100	100*100
17	Box/Tube	80*80	80*80
18	Box/Tube	100*100	100*100
19	Box/Tube	100*100	100*100
20	Box/Tube	100*100	100*100
21	Box/Tube	100*100	100*100
22	Box/Tube	100*100	100*100
23	Box/Tube	100*100	100*100
24	Box/Tube	100*100	100*100

II. Definition of Load

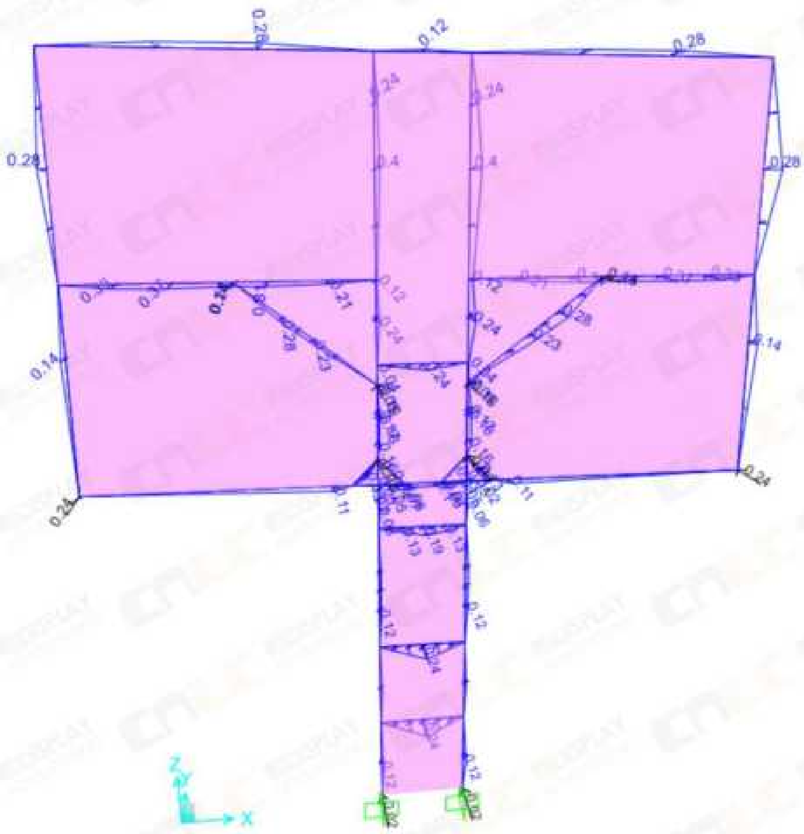
Self-weight load D	G=0.5kPa
Wind load W	q=0.36kPa

Seismic load, seismic fortification intensity is 7 degrees, ground seismic acceleration is 0.10g, steel through self-weight automatic loading

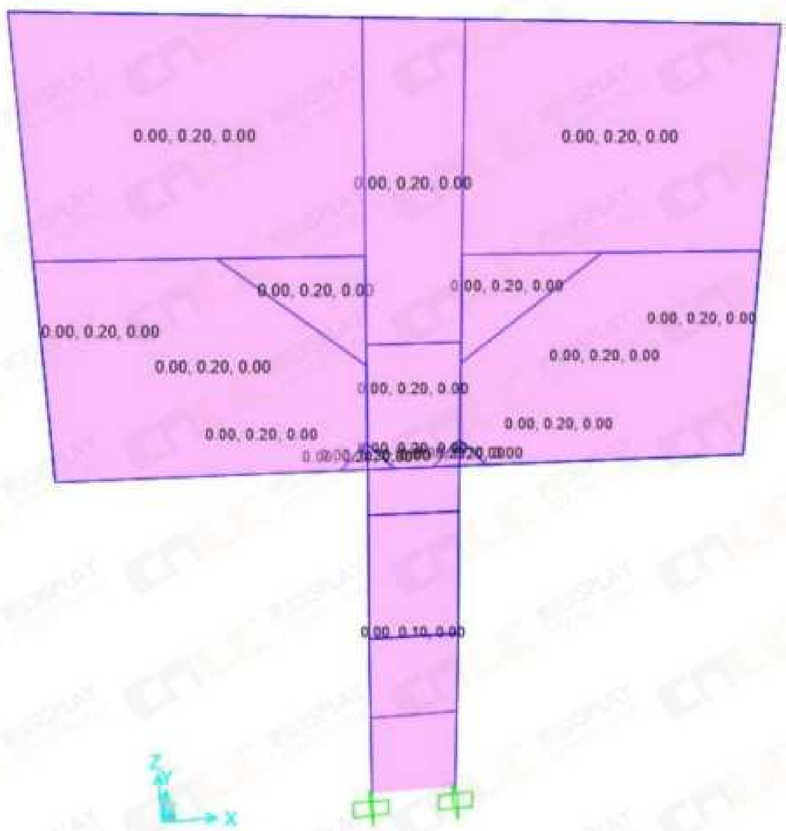
Load application: self weight load

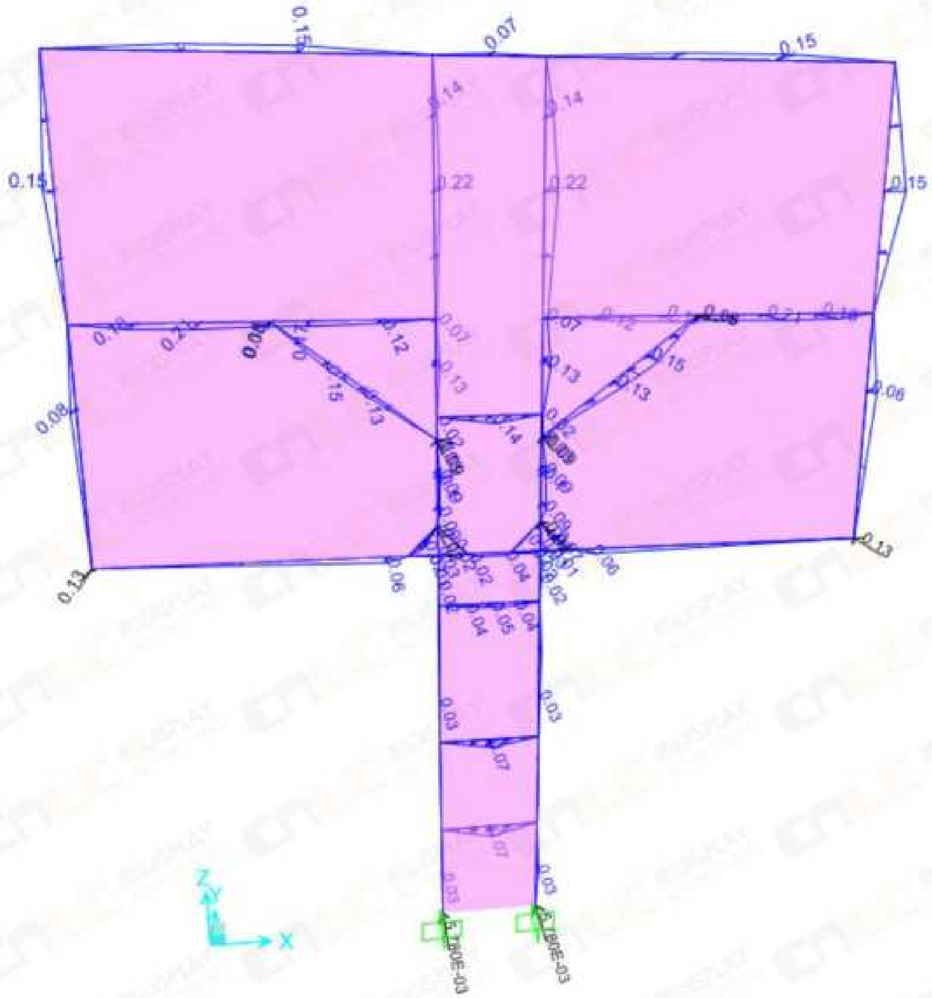


wind load



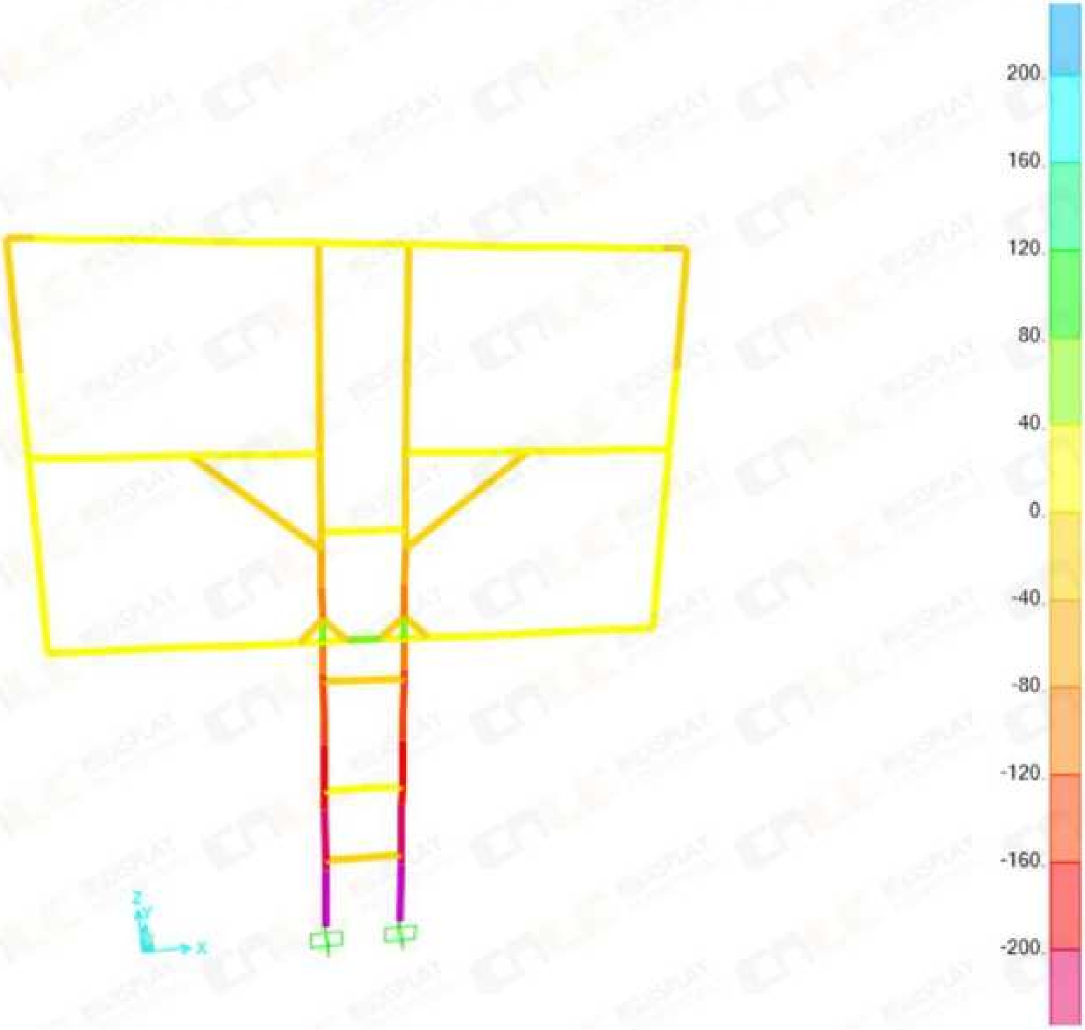
earthquake load



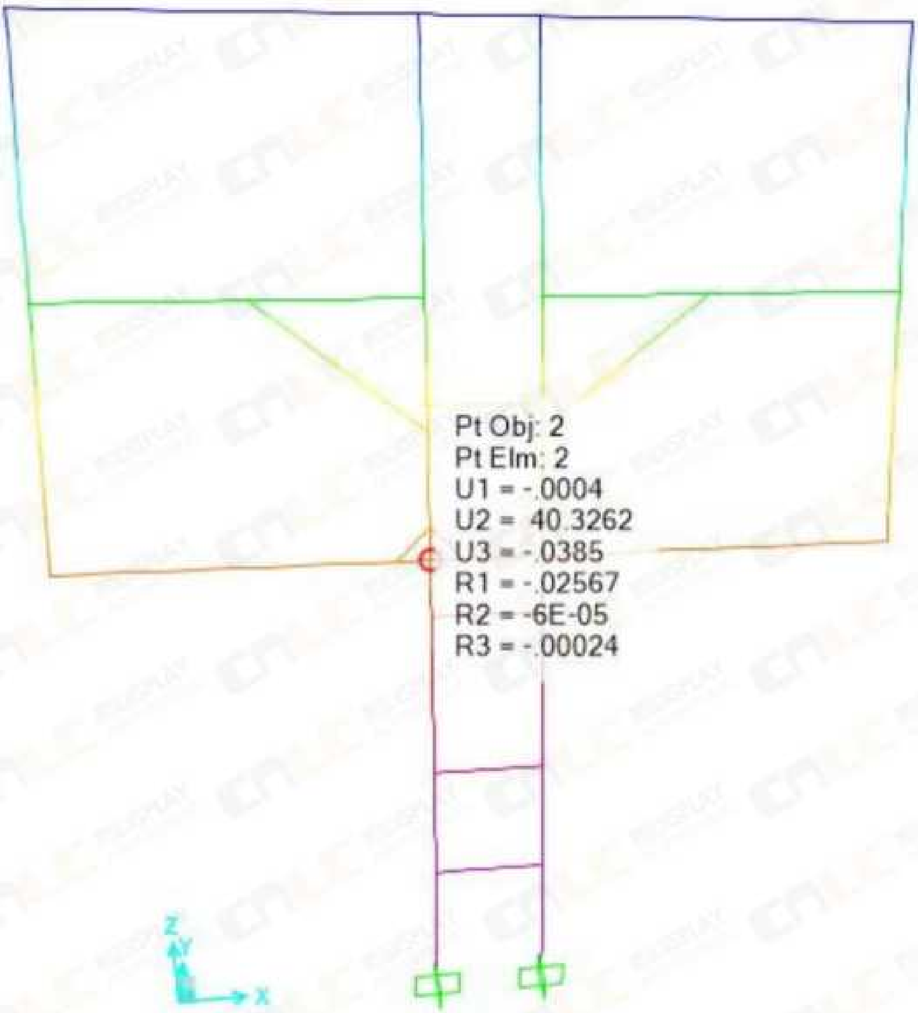


III. Load Combinations

IV. Verification of Strength and Deformation

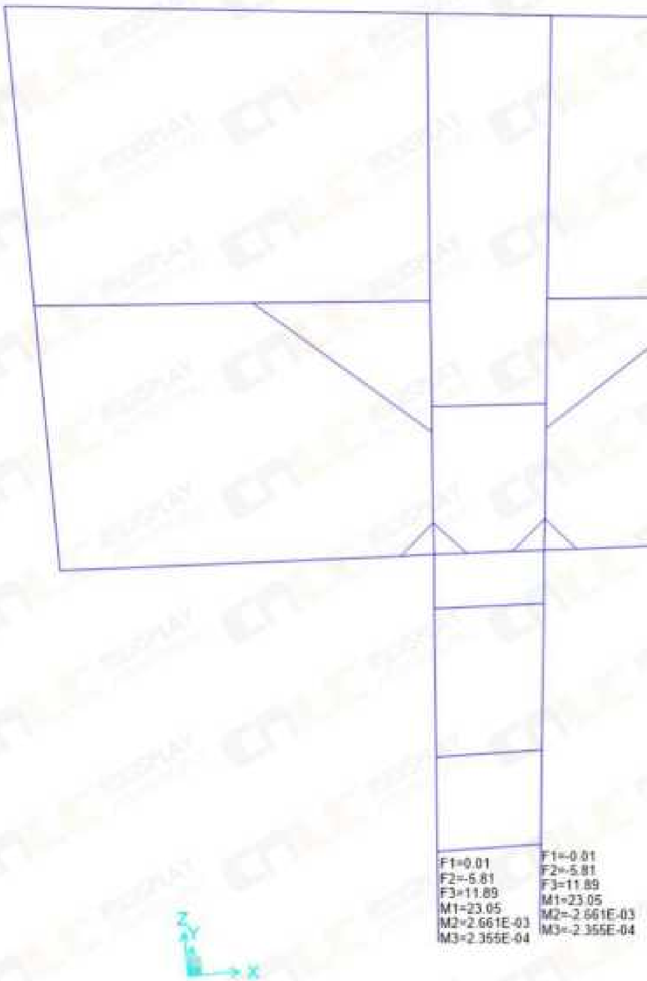


The maximum stress of the member under the heavy load condition is 200MPa<215MPa.



The maximum deformation of the rod under the deflection condition is 40.3mm<5760/125=46 mm

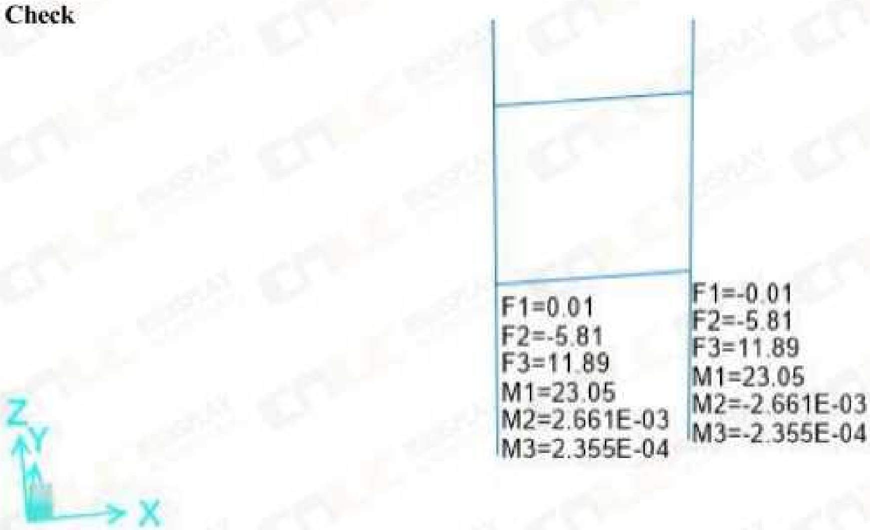
V. CONCLUSION



In conclusion, the unidirectional LED structure demonstrates compliance with design specifications for stress and deformation under a 9- level wind speed, confirming its feasibility. Note: Since the structure's load capacity has reached its limit at 9-level wind speed, the maximum wind load it can withstand is equivalent to 9-level or lower.

Chapter 3: Embedded Calculations

1. Reaction Check



The largest reaction force is selected for the connection calculation of the steel frame root:

Axial force: $N := 11.89kN$

Scissors: $V := 5.81kN$

bending moment: $M := 23.05kN.m$

2. Insert Check

The anchor bars are arranged in 3 rows and 3 columns, with a diameter of 16mm and HRB400 grade steel bars. The spacing between the anchor bars is 100mm, and the thickness of the anchor plate is 14mm.

2.1 Calculation of Anchor Area

According to Appendix C of the Technical Code for Glass Curtain Wall Engineering (JGJ102-2003), when shear force, normal tensile force, and bending moment act together, the area of the anchor bar should be calculated using the following formula and must exceed its maximum value.

Concrete Grade	Concrete grade = "C30"
Design value of the axial compressive strength of concrete	$f_c = 14.3\,MPa$
Design values for the axial tensile strength of concrete;	$f_t = 1.43\,MPa$
design values for the tensile strength of anchor y bars	fy:=300MPa
Anchor bar diameter	$d = 16\,mm$
Anchor bar thickness	$t = 14\,mm$
Effect coefficient of the number of layers of steel bars	$a_r = 0.9$
The distance from the center of the outermost anchor bar	$L_z = 200\,mm$
Shear bearing capacity coefficient of anchor bars	$a_v := \min\left[\left(4 - \frac{0.08 \cdot d}{mm}\right) \cdot \sqrt{\frac{f_c}{f_y}}, 0.7\right] = 0.594$
Reduction factor for the bending deformation of anchor plates	$a_b := 0.6 + 0.25 \cdot \frac{t}{d} = 0.819$
Calculation of the cross-sectional area of the anchor bar:	
Minimum cross-sectional area of anchor bars required for embedded parts	$A_{s1} := \frac{V}{a_r \cdot a_v \cdot f_y} + \frac{N}{0.8 \cdot a_b \cdot f_y} + \frac{M}{1.3 \cdot a_r \cdot a_b \cdot f_y \cdot L_z} = 497.78 \cdot mm^2$ $A_{s2} := \frac{N}{0.8 \cdot a_b \cdot f_y} + \frac{M}{0.4 \cdot a_r \cdot a_b \cdot f_y \cdot L_z} = 1363.873 \cdot mm^2$ $A_{m1} := \max(A_{s1}, A_{s2}) = 1363.873\,mm^2$
Total area of embedded anchor bars:	$n = 9$
Check:	$A_1 := n \cdot \frac{\pi \cdot d^2}{4} = 1809.557 \cdot mm^2$ $\frac{A_{m1}}{A_1} = 0.754$
The area of the anchor bar meets the requirement!	
2.2 Verification of 2 Anchorage Lengt	$\alpha = 0.14$
Form factor of anchor bar	
Anchorage length calculation	$l_{a0} := \alpha \cdot \frac{f_y}{f_t} \cdot d = 0.47\,m$
Anchor length correction factor	$\zeta_a := 0.6$
Verification of the actual anchoring length using the anchored correction length	$l_a := 1.1 \zeta_a \cdot l_{a0} = 310.154\,mm$
Check:	$l_{ef} = 0.32\,m$
Verified!	$ratio\left(l_a, l_{ef}\right)$ = "0.969 <1 PASS!"