Xiamen Enerack Technology Co., Ltd.

Ground Mounting Structure Report

Catalogue

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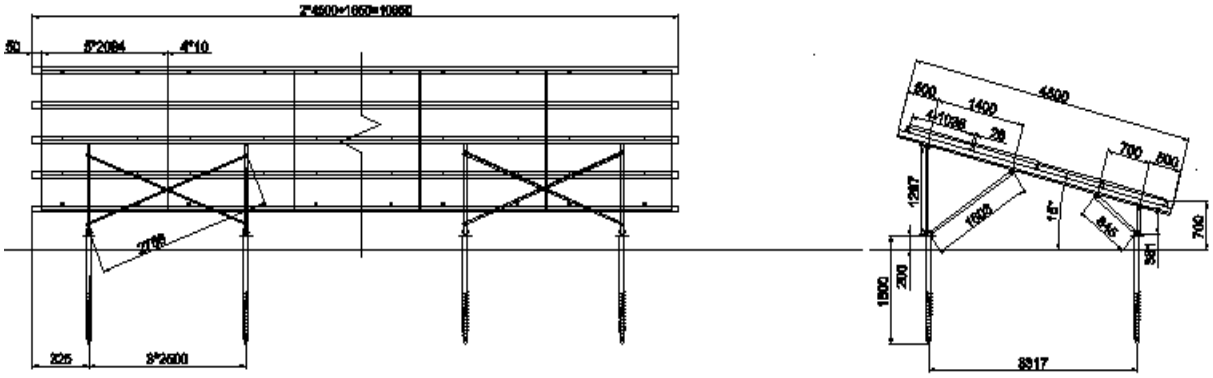
1.Project Information

1.PANEL Dimension	2094	×	1038	×	35	mm
2.Array	4	×	5			
3.PANEL WEIGHT	24	Kg				
4.Tilted Angle	15	°				
5.WIND SPEED	25	m/s				
6.Snow Depth	65	cm	normal area			
7.FLOOR ROUGHNESS GRADE	3					
8.Ground Clearance	0.5	m				
9.DESIGN DRAWING						



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2.Load analyst

2.1.DEAD LOAD

	WEIGHT	LENGTH	QTY.	G.W.(N)
PANEL	24	1	20	4704.0
MID/END CLAMP	0.05	1	50	24.5
RAIL	1.2	10.65	5	626.2
RAIL CLAMP	0.05	1	40	19.6
BEAM	1.23	4.5	4	217.0
POLE01	0.79	0.381	4	11.8
POLE02	0.79	0.845	4	26.2
POLE03	0.79	1.603	4	49.6
POLE04	0.79	1.287	4	39.9
Small H	0.21	1	16	32.9
BASE02	0.59	1	8	46.3

2.2.WIND LOAD

Wp=Cw*Qp*Aw

Cw——wind factor

Following wind， C1=0.65+0.009* 15 = 0.785

Against the wind，C2=0.71+0.016* 15 = 0.95

Qp——designed wind load(N/m^2)

Qp=0.6*Vo^2*E*I

Vo—— wind speed， 25 m/s

I——usage coefficient as 1.0

E——environmental coefficient，E=Er^2*Gf

Er——height coefficient，,Er=1.7*(Zb/Zg)^a as 0.69

Gf——gustiness factor, as 2.5

Chart 2-1 Form1 Gust factor

Ground surface roughness class	average ground clearance of array(m)		
	(1)	(2)	(3)
	<10	10 < X < 40	>40
I	2.0	data calculated in linear interpolation with data in (1) and (3)	1.8
II	2.2		2.0
III	2.5		2.1
IV	3.1		2.3

Chart 2-2 Form2 Height coefficient

Ground surface roughness class		Zb (m)	ZG (m)	a
I	The areas with flat ground and without obstructions, which specific clarified by the administrative department, and outside urban planning area	5	250	0.10
II	The areas locate outside the urban planning area and do not belong to the areas with ground roughness class I (excluding the area with array ground clearance above 13m.) ; or located in urban planning areas which do not belong to the ground roughness class IV, near to the coast or the lake shoreline (distance to the other side less in 1500m.) within 500m (excluding the array ground clearance less than 13m, or distance to the coast/lake shoreline above 200m and the arry ground clearance less in 31m)	5	350	0.15
III	area not classified in class I ,II,IV	5	450	0.20
IV	planning area specifically clarify by the administrative department,with obvious signs of urban development,	10	550	0.27
Annotation	provenance:construction paper no. 1454（31th,May,2000）			

Qp = 0.6*Vo^2*Er^2*Gf*I = 448N/m^2

Aw——wind area

Aw = 1.038 *2.09 *4 *5= 43.47 m^2

from above format

follwing wind：

W1=C1*Qp*Aw= 0.79 *448 *43.47 = 15284.31 N

against the wind：

W2=C2*Qp*Aw= 0.95 *448 *43.47 = 18496.93 N

2.3.Snow load calculation

Sk=Cs*P*Zs*As

Cs——slope rating

$$Cs = \sqrt[2]{\cos(1.5 \times \theta)}$$

θ——snow surface inclination

Cs= 0.96

P——average unit snow loadN/(m^2*cm）

Equal to snow load with the area of 1 square meter and 1cm thickness.20N in this case

P = 20

Zs——snowpack 65 cm

refer to the vertical snow thickness as

As——snow area, namely the array of horizontal projection area

As = Aw* cos(15°)= 42.0 m^2

In conclusion

Sk=Cs*P*Zs*As	52468.52	N

2.4.Earthquake load calculation

In normal area:

Kp=k_p*G

Kp——design earthquake horizontal rate 1

G——stardard load

earthquake load of rail

Kp1 = 1*G = 5797.94 N

2.5.Load combination

Form2-3 condition combination of load

Load condition		DIV	
		nomal area	snowy area
long term	normal	G	G
	snow covered		G+0.75S
short term	snow covered	G+S	G+S
	storming		G+W
			G+0.35S+W

as above data:

design wind load

following the wind W1 = 15284.31 N against, W1 = 18496.93 N

desgin snow load:

Sk = 52468.52 N

design earthquake load:

Kp1 = 5797.94 N

design area as normal area load as below：

Form 2-4 Part's load

	Long term load		Short term load			
	normally	snowy	snowing	Tail wind	Dead wind	earthquake
Rail	5354.72	5354.72	57823.24	20639.03	-13142.2	/
Beam	5591.29	5591.29	58059.81	20875.60	-12905.6	-
Strengthen pipe	-	-	-	-	-	11389.23

Mark：

1.Supporting arm only calculated earthquake rate

2."-" means load upward

3.Rail strength calculation

3.1 Load analyst

From Form 2-4, rail load as below

normally F1 = 5354.72 N

snowy F2 = 5354.72 N

short term load

snowy F3 = 57823.24 N

follow the wind F4 = 20639.03 N

against the wind F5= 13142.21 N

3.2 strength ability

Material：aluminum alloy AL6005-T5

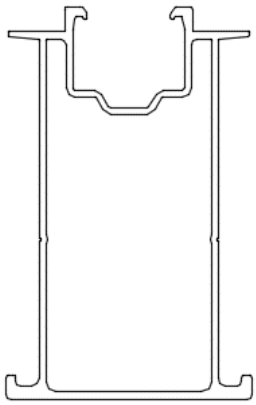
according the allowable stress calculation of JIS C 8955-2011 8.2 , below as the result.

Form 3-1 Al6005-T5 allowable stress

Allowable stress(long term)			
σ B	260.00	MAX	outcome
σ0.2	240.00		
Tensile stress intensity	160.00	144.44	144.44
Shear stress intensity	92.38	83.40	83.40
compressive stress intensity	160.00	144.44	144.44
The bending stress intensity	160.00	144.44	144.44
Support the buckling stress intensity	218.18	196.97	196.97
Allowable stress(short term, 1.5 times of long term)			
Tensile stress intensity	240.00	216.67	216.67
Shear stress intensity	138.56	125.09	125.09
compressive stress intensity	240.00	216.67	216.67
The bending stress intensity	240.00	216.67	216.67
Support the buckling stress intensity	327.27	295.45	295.45

3.3 Strength calculation

Rail section photo as below

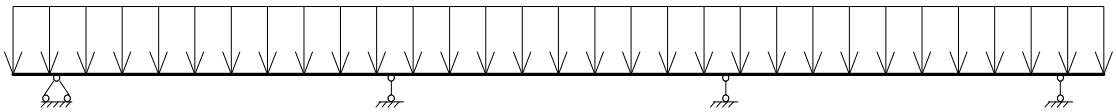


A	440.5	Ip	485331.91
Ix	372396.63	Iy	112935.28
ix	29.08	iy	16.01
Wx(above)	8974.26	Wy(left)	4517.41
Wx(below)	9671.65	Wy(right)	4517.41

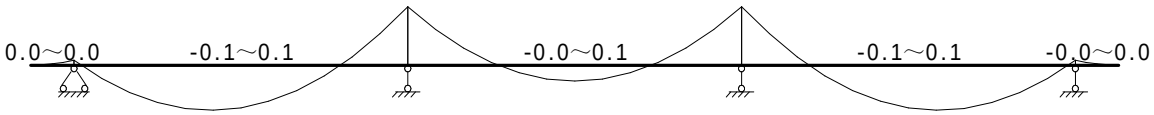
rail length 10.7 m

3.3.1 in long term, rail average load as

q1 = 125.70 N/m



Bending moment as below:



P3-2 rail's bending moment in long term

Maximum bending moment 0.1 KN*m

Maximum stress

$$\sigma = \frac{M_{max}}{W_x} = 11.14 \text{ MPa}$$

From Form 3-1, maximum stress is

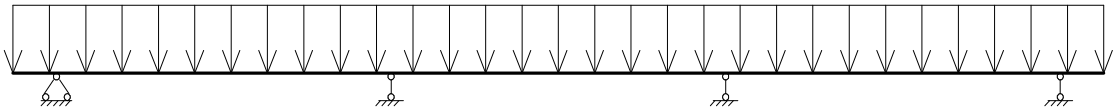
σ1 = 144.44 MPa

11.14 < 144.44

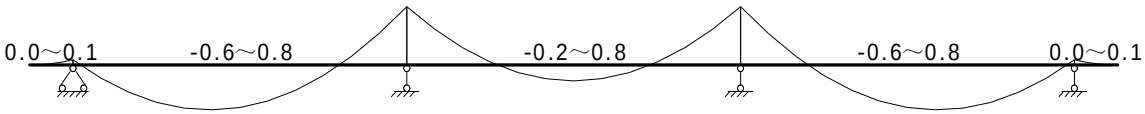
in conclusion, the rail is qualify in this case

3.3.3 In short term, rail average load is

q1 = 1357.3531 N/m



Bending moment as below:



P3-3 rail's bending moment in short term

Maximum bending moment 0.8 KN*m

Maximum stress

$$\sigma = \frac{M_{max}}{W_x} = 89.14 \text{ MPa}$$

From Form 3-1, maximum stress is

σ1 = 216.67 MPa

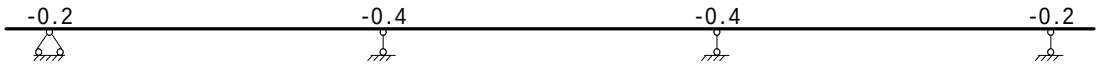
89.14 < 216.67

in conclusion, the rail is qualify in this case

4.Beam strength calculation

4.1 load analyst

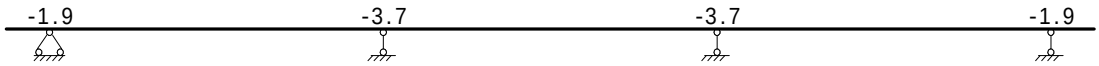
4.1.1 according 3.3.1, the loading point on the beam in long term is as below:



in long term, the maximum load on the beam is

F6 = 0.40 KN

4.1.2 according 3.3.1, the loading point on the beam in short term is as below:



in short term, the maximum load on the beam is

F7 = 3.70 KN

4.2 allowable stress calculation

(same as above 3.2)

4.3 beam strength calculation

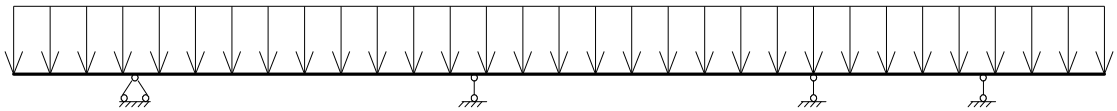
sectional photo of beam as below:

A	443.92	Ip	656530.3
Ix	514707.77	Iy	141822.53
ix	34.05	iy	17.87
Wx(above)	11115.02	Wy(left)	6303.22
Wx(below)	10570.56	Wy(right)	6303.22

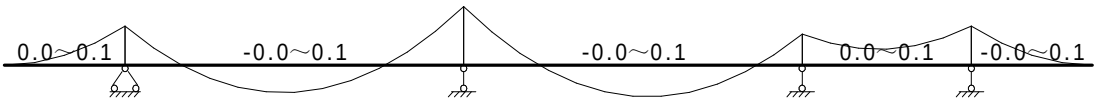
beam length 4.5 m

4.3.1 beam's loading data as below in long term

q1 = 450 N/m



bending moment as below:



P 4-1 bending moment of the beam in long term

maximum bending moment 0.1 KN*m

maximum stress is

$$\sigma = \frac{M_{max}}{W_x} = 9.46 \text{ MPa}$$

According 4-1, the allowable stress of the beam is

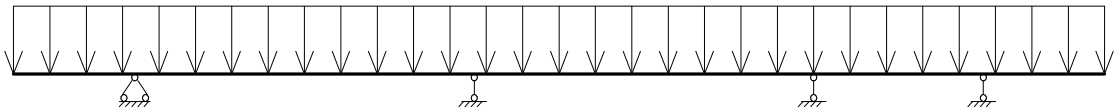
σ1 = 144.44 MPa

9.46 < 144.44

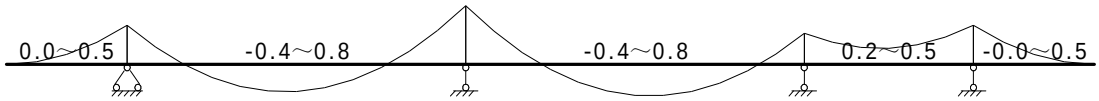
in conclution, the beam is qualify in this case in long term

4.3.2 beam's loading data as below in short term

q1 = 4200 N/m



bending moment as below:



P 4-2 bending moment of the beam in short term

maximum bending moment 0.8 KN*m

maximum stress is

$$\sigma = \frac{M_{max}}{W_x} = 75.68 \text{ MPa}$$

According 4-1, the allowable stress of the beam is

σ1 = 216.67 MPa

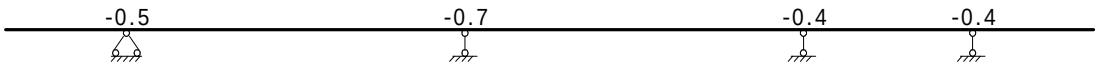
75.68 < 216.67

in conclution, the beam is qualify in this case in short term

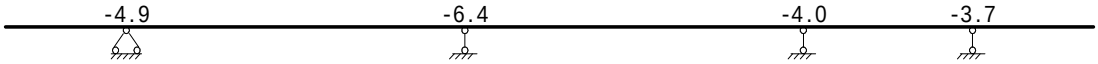
5.Post strength calculation

5.1 load analyst

5.1.1 post loading data as below in long term



5.1.2 post loading data as below in long term



load in long term

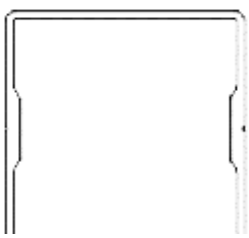
F1= 0.5 KN F2 = 0.7 KN F3 = 0.4 KN F4 = 0.4 KN

load in short term

F1= 4.9 KN F2 = 6.4 KN F3 = 4 KN F4 = 3.7 KN

5.2 Mechanical performance of the post

sectional photo of the post as below:



A	290.66	Ip	175907.54
Ix	81372.88	Iy	94534.66
ix	16.74	iy	18.04
Wx(above)	3616.58	Wy(left)	4201.54

Wx(below)	3616.58	Wy(right)	4201.54

5.3 post strength calculation

Material slenderness ratio $\lambda_1 = \sqrt{\frac{\pi^2 E}{\sigma_p}}$ = 53.27

a)post01 strength calculation

length 1287 mm

post 01 slenderness ratio $\lambda_2 = \mu \frac{L}{i_{min}}$ = 76.9

76.9 > 53.27

allowable stress in long term $\sigma_{cr} = \frac{\pi^2 E I}{ul^2 A} =$ 115.1 MPa

stress in long term $\sigma = \frac{F}{A} =$ 1.72 MPa

1.7 < 115.10 (according form 3-1)

stress in short term $\sigma = \frac{F}{A} =$ 16.86 MPa

16.86 < 115.10 (according form 3-1)

post01 is qualify

b)post02 strength calculation

length 1603 mm

post 02 slenderness ratio $\lambda_2 = \mu \frac{L}{i_{min}}$ = 95.8

95.8 > 53.27

allowable stress in long term $\sigma_{cr} = \frac{\pi^2 E I}{ul^2 A} =$ 74.195 MPa

stress in long term $\sigma = \frac{F}{A} =$ 2.41 MPa

2.4 < 74.20 (according form 3-1)

stress in short term $\sigma = \frac{F}{A} =$ 22.02 MPa

22.02 < 74.20 (according form 3-1)

post02 is qualify

c)post03 strength calculation

length 845 mm

post 03 slenderness ratio $\lambda_2 = \mu \frac{L}{i_{min}}$ = 50.5

50.5 < 53.27

stress in long term $\sigma = \frac{F}{A} =$ 1.38 MPa

1.4 < 196.97 (according form 3-1)

stress in short term $\sigma = \frac{F}{A} =$ 13.76 MPa

13.76 < 295.45 (according form 3-1)

post03 is qualify

d)post04 strength calculation

length 381 mm

post 04 slenderness ratio $\lambda_2 = \mu \frac{L}{i_{min}}$ = 22.8

22.8 < 53.27

stress in long term $\sigma = \frac{F}{A} =$ 1.38 MPa

1.4 < 144.44 (according form 3-1)

stress in short term $\sigma = \frac{F}{A} =$ 12.73 MPa

12.73 < 216.67 (according form 3-1)

post04 is qualify