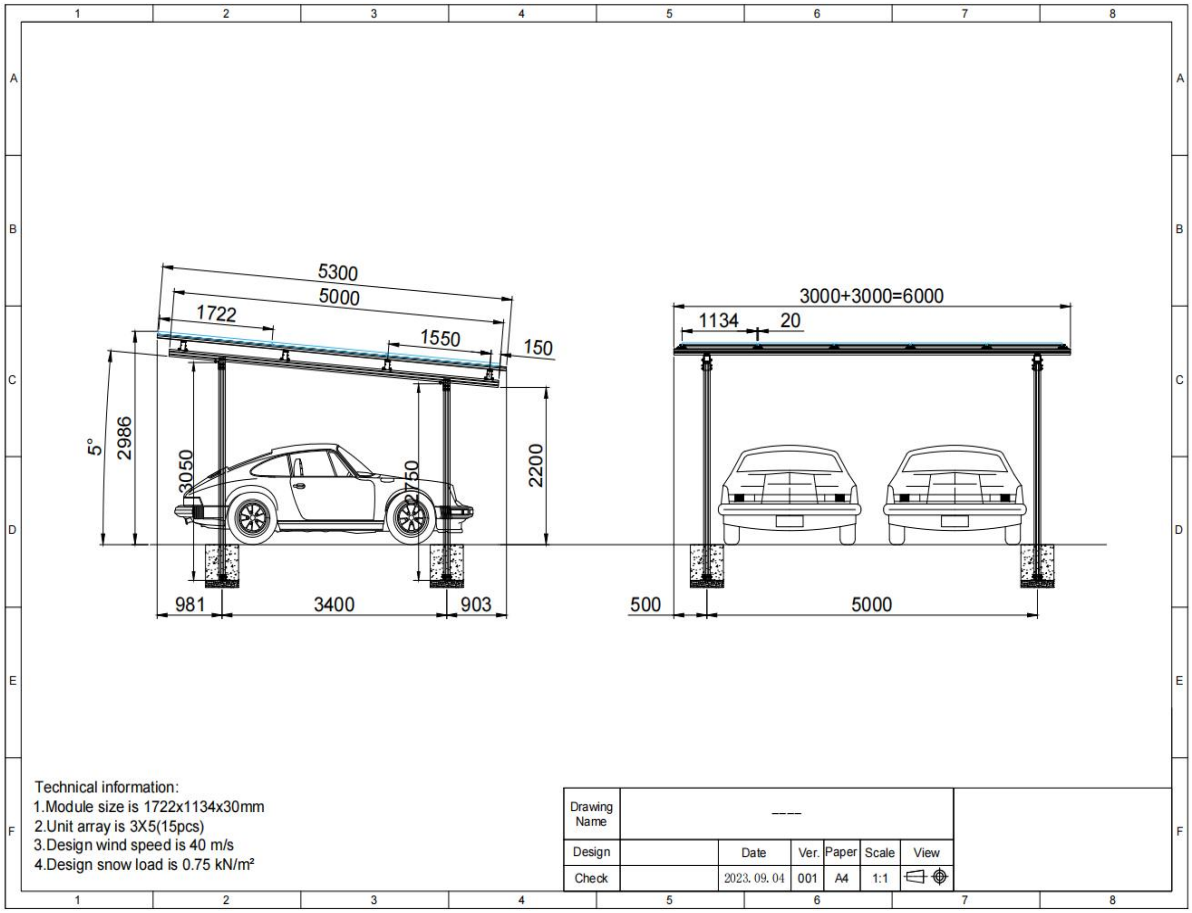
Load Calculation



1. Parameters

▲Panel Specification:	1722mm * 1134mm * 30mm		
▲Panel layout:	3 x 5 =	15	
▲Panel Array:	Portrait		
▲Weight of panel:	23	kg/pcs	
▲Tilt angle:	5	°	
▲Wind load:	1.00	kN/m^2	(V0=40m/s)
▲Snow load:	0.75	kN/m^2	
▲Technical standard:	EN 1991-1-4:2005		
▲Terrain category:	III		
▲Maximum height:	2.986	m	
▲ Spacing(rail):	5000	mm	
▲ Spacing(Beam):	3400	mm	

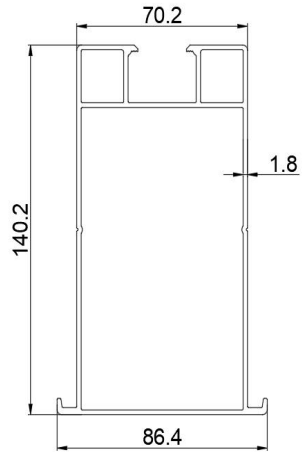
2. Load Bearing Conditions

Load condition	Loading combination
Permanent load, wind load ,snow load combination(following wind)	G*1.35+W1*1.5*0.6+S*1.5
Permanent load, wind load ,snow load combination (following wind)	G*1.35+W1*1.5+S*1.5*0.5
Permanent load, wind load combination (dead wind)	G*1.0+W2*1.5

3. Structure Material

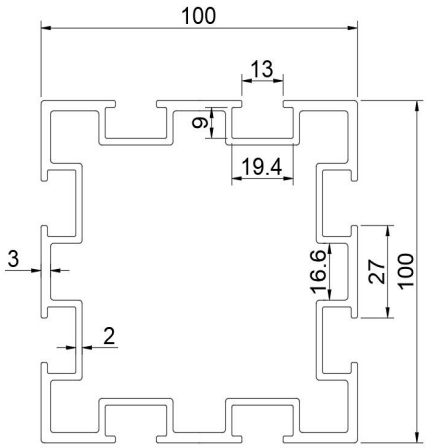
a) Rail **R035**

Material :	AL6005-T5	σs=	240 N/mm^2	E=	79000 N/mm^2	L=	6000 mm
weight=	2.614 kg/m	Wx=	34693 mm^3	Wy=	19113 mm^3	A=	961 mm^2



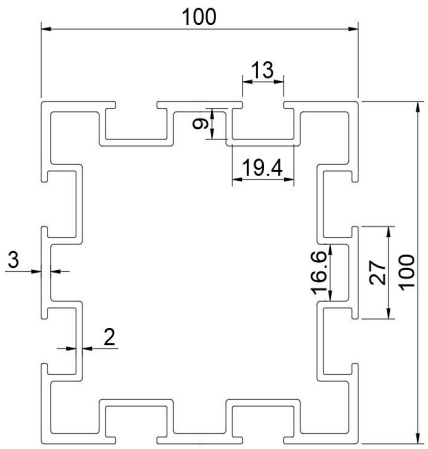
b) Beam **L051**

Material :	AL6005-T5	σs=	240 N/mm^2	E=	79000 N/mm^2	L=	5300 mm
weight=	3.893 kg/m	Wx=	39670.8 mm^3	Wy=	39670.81 mm^3	A=	1431.1994 mm^2



c) Pillar **L051**

Material :	AL6005-T5	σs=	240 N/mm^2	E=	79000 N/mm^2	L=	3050 mm
weight=	3.893 kg/m	Wx=	39670.8 mm^3	Wy=	39670.81 mm^3	A=	1431.1994 mm^2



4. Fixed Load

Module weight:	G1=	15	x	23	x		9.8 =	3381 N
Rail weight:	G2=	2.614	x	6	x	4 x	9.8 =	614.81 N
Beam weight:	G3=	3.893	x	5.3	x	2 x	9.8 =	404.40 N
Fix load on Rail:	G4=	G1+G2 =			3996	N		
Fix load on Beam:	G5=	G4+G3 =			4400	N		

5. Wind Load

$W_e = q_p(Z_e)*C_{pe}$

$q_p(z) = c_e(z)*q_b$

$c_e(z)$= 1.281 III (Exposure coefficient)

$q_p(z)$= 1.281 * V0^2 / 1600 = 1.281 * 40 ^ 2 / 1600 = 1.28 kN/m^2

C_{pe}= 0.40 （following wind）

C_{pe}= -0.70 （dead wind）

Are_f= 1.722 * 1.134 * 3 * 5 = 29.29 m^2 (Benchmark area)

Wind load of following wind（front）:

$W_{following}$ (w1)= 0.4 * 1.28 * 29.29 = 15.009 kN

Wind load of dead wind（back）:

$W_{against\ (W2)}$ = -0.7 * 1.28 * 29.29 = -26.265 kN

(The minus sign meaning the wind force from the opposite direction)

6. Snow Load

S= Ui*Sk*Aref

ui: Shape factor	0.8	
sk: Characteristic value of snow load	0.75	kN/m^2
S= 0.8 * 0.75 * 29.29122 * COS(5°)	17.508	kN

7. Uniformly distributed load (Rail)

Permanent load G(Normal):	3996 / 4 / 6 =	166.49	N/m
1.35*G:	=	224.76	N/m
W1:	15009 / 4 / 6 =	625.37	N/m
1.5*0.6*W1:	=	562.83	N/m
1.5*W1:	=	938.05	
W2:	-26265 / 4 / 6 =	-1094.39	N/m
1.5*W2:	=	-1641.59	N/m
S:	17508 / 4 / 6 =	729.49	N/m
1.5*S:	=	1094.24	N/m
1.5*0.5*S:	=	547.12	N/m

8. Load combination(Rail)

	Strong axis	Weak axis
G*1.35+W1*1.5*0.6+S*1.5	1876.82 N/m	114.96 N/m
G*1.35+W1*1.5+S*1.5*0.5	1707.00 N/m	67.27 N/m
G*1.0+W2*1.5	-1475.73 N/m	14.51 N/m

9 Rail Verification of Calculation

Following wind+snow:
(G*1.35+W1*1.5*0.6+S*1.5):

q1=	1876.82	N/m
q2=	114.96	N/m
Lq=	5	m
Wx=	34693	mm^3
Wy=	19113	mm^3

M_x = q1 * Lq^2 / 8 = 1876.82 * 5^2 / 8 = 5865.05 N*m

σ_x = M_x / Wx = 5865.05 / 34693 * 1000 = 169.06 N/mm^2

M_y = q2 * Lq^2 / 8 = 114.96 * 5^2 / 8 = 359.25 N*m

σ_y = M_y / Wy = 359.25 / 19113 * 1000 = 18.80 N/mm^2

$\sigma=\sigma_x+\sigma_y$ = 169.06 + 18.80

= 187.85 N/mm^2 **<** 240 ***It is OK;***

Following wind+snow:
(G*1.35+W1*1.5+S*1.5*0.5):

q1=	1707.00	N/m
q2=	67.27	N/m
Lq=	5	m
Wx=	34693	mm^3
Wy=	19113	mm^3

M_x = q1 * Lq^2 / 8 = 1707 * 5^2 / 8 = 5334.37 N*m

σ_x = M_x / Wx = 5334.37 / 34693 * 1000 = 153.76 N/mm^2

M_y = q2 * Lq^2 / 8 = 67.27 * 5^2 / 8 = 210.23 N*m

σ_y = M_y / Wy = 210.23 / 19113 * 1000 = 11.00 N/mm^2

$\sigma=\sigma_x+\sigma_y$ = 153.76 + 11.00

= 164.76 N/mm^2 **<** 240 ***It is OK;***

Dead wind:
(G*1.0+W2*1.5):

q1=	-1475.73	N/m
q2=	14.51	N/m
Lq=	5	m
Wx=	34693	mm^3
Wy=	19113	mm^3

M_x = q1 * Lq^2 / 8 = -1475.73 * 5^2 / 8 = -4611.66 N*m

σ_x = M_x / Wx = -4611.66 / 34693 * 1000 = -132.93 N/mm^2

M_y = q2 * Lq^2 / 8 = 14.51 * 5^2 / 8 = 45.35 N*m

σ_y = M_y / Wy = 45.35 / 19113 * 1000 = 2.37 N/mm^2

$\sigma=\sigma_x+\sigma_y$ = 132.93 + 2.37

= 135.30 N/mm^2 **<** 240 ***It is OK;***

10 Beam&Pillar Verification of Calculation

Following wind+snow:
(G*1.35+W1*1.5*0.6+S*1.5):
Beam:

q=	45710	/	2	/	5.3	=	4312.27 N/m
Lq=	3.4	m					
Wx=	39670.8	mm^3					

M = q * Lq^2 / 8 = 45710.02 * 3.4^2 / 8 = 6231.22 N*m

σ = M / Wx = 6231.22 / 39670.8 * 1000 = 157.07 N/mm^2

σ = 157.07 N/mm^2 < 240 ***It is OK;***

Pillar:

F=	45710	/	2	/	2	=	11427.50 N
A=	1431.1994	mm^2					

σ = F / A = 11427.5 / 1431.1994 = 7.98 N/mm^2

σ = 7.98 N/mm^2 < 240 ***It is OK;***

Following wind+snow:
(G*1.35+W1*1.5+S*1.5*0.5):
Beam:

q=	41584	/	2	/	5.3	=	3923.06 N/m
Lq=	3.4	m					
Wx=	39670.8	mm^3					

M = q * Lq^2 / 8 = 41584.42 * 3.4^2 / 8 = 5668.82 N*m

σ = M / Wx = 5668.82 / 39670.8 * 1000 = 142.90 N/mm^2

σ = 142.90 N/mm^2 < 240 ***It is OK;***

Pillar:

F=	41584	/	2	/	2	=	10396.10 N
A=	1431.1994	mm^2					

σ = F / A = 10396.1 / 1431.1994 = 7.26 N/mm^2

σ = 7.26 N/mm^2 < 240 ***It is OK;***

Dead wind:
(G*1.0+W2*1.5):
Beam:

q=	-34998	/	2	/	5.3	=	-3301.69 N/m
Lq=	3.4	m					
Wx=	39670.8	mm^3					

M = q * Lq^2 / 8 = -34997.94 * 3.4^2 / 8 = -4770.95 N*m

σ = M / Wx = -4770.95 / 39670.8 * 1000 = -120.26 N/mm^2

σ = 120.26 N/mm^2 < 240 ***It is OK;***

Pillar:

F=	-34998	/	2	/	2	=	-8749.48 N
A=	1431.1994	mm^2					

σ = F / A = -8749.48 / 1431.1994 = -6.11 N/mm^2

σ = 6.11 N/mm^2 < 240 ***It is OK;***