STRUCTURAL CALCULATION & ANALYSIS
EG4® BRIGHTMOUNT ADJUSTABLE GROUND MOUNT SYSTEM

Design Standard: ASCE 7
Design Information

The following example analysis shows provisions for design wind loads complying with the ASCE 7 standard for ground mounted solar arrays. Calculations may vary depending on certain criteria influenced by the area of location where the array will be mounted, check specifications pertaining to your area using a wind hazard map when referencing this information.
Parameters in this analysis are determined with 105mph (47m/s) wind speed rating for this ground mounted solar array.
Test data uses compression-tension testing and simulations on structural members (TGI, SAP2000).
This information is not by any means to be used in substitution of a Professional Engineer certification, yet to supplement for better understanding of the analysis for design wind loads on ground mounted solar arrays.

Installation Site Information

Design Condition and Technical Parameters:

Solar Panel Size	230 x 110 x 3.5cm (90.6 x 43.3 x 1.4in.)
Solar Panel Power	550W
Solar Panel Weight	30 kg (66.1 lbs.)
Basic Wind Speed	47m/s
PV Area	2.53m^2
Span	1.3m

Calculations

Category I = 1.0 ---------- Importance Factor, refer to ASCE 7-16, Table 1.5-1

Velocity Pressure due to Wind, q_z:

$q_z = 0.613\ K_z\ K_{zt}\ K_d\ K_e\ V^2$ -------- Velocity Pressure due to Wind, refer to Table 27.3-1, ASCE 7-16
$K_z = 1.0$ ---------- Velocity Pressure Exposure Coef. (for structures < 4.57m high, Exposure C)
$K_{zt} = 1.0$ ---------- Topographic Factor, refer to Figure 26.8-1, ASCE 7-16
$K_d = 0.85$ ---------- Directionality Factor
$K_e = 1.0$ ---------- Ground Elevation Factor
V = 47 m/s ---------- Basic Wind Speed
$q_z = 1150\ N/m^2$

Design Wind Pressure, p:

$p = q_z\ G\ C_n$ ---------- Design Wind Pressure, adjust Cn for windward and leeward pressure
G = 0.8 ---------- Gust Effect Factor, assume rigid, Section 6.5.8, ASCE 7-05
$C_n = -1.8$ ---------- Net Pressure Coef. determined from Fig. 6-18A, ASCE 7-05
$p = 1760\ N/m^2$

Snow Load, p_f:

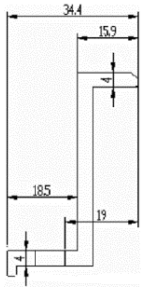
$p_f = 0.7\ C_e\ C_t\ I_s\ p_g$ ---------- Snow Load, flat surface, refer to Ch. 7, ASCE 7-16
$C_e = 0.9$ ---------- Exposure Factor
$C_t = 1.2$ ---------- Thermal Factor, refer to Table 7.3-2, ASCE 7-16
$I_s = 0.8$ ---------- Importance Factor, refer to Table 1.5-2, ASCE 7-16
$p_g = 478.81\ N/m^2$ ---------- Ground Snow Load, Figure 7.2-1, ASCE 7-16
$p_f = 289.59\ N/m^2$
$p_s = C_s p_f + p_r$ ---------- Sloped Snow Load
$C_s = 0.72$ ---------- Slope Factor, Figure 7.4-1, ASCE 7-16
$p_r = 0.0$ ---------- Rain-on-Snow Surcharge Load
$p_s = 210.53\ N/m^2$
$W_c = 27.61m$ ---------- Hypotenuse from Eave to Ridge
$W = 25.03m$ ---------- Horizontal Distance from Eave to Ridge
$W/50 = 1.64$ deg---------- if $p_g \leq 20$ psf, $p_g \neq 0$, tilt angle > W/50, $p_r = 0.0$, for rainy areas, $p_r = 5$ psf

Stress Analysis

Compression Tension Simulation (TGI Series, SAP2000)

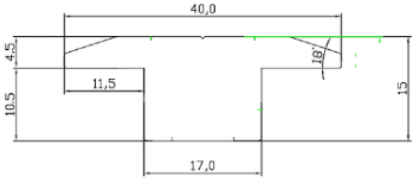
Component: End Clamp

$F_t = \frac{PA}{N_c}$ ---------- Shear Force by Wind Suction
$P = 1760\ N/m^2$ ---------- Design Wind Pressure
$A = 2.53m^2$ ---------- PV Area
$N_c = 4$ ---------- Number of clamps per module
$F_t = 1113.2$ N
$F_{max} = 5972$ N ---------- F_t does not exceed F_{max}
(refer to test report No. TGI-TS-002)



Component: Mid Clamp

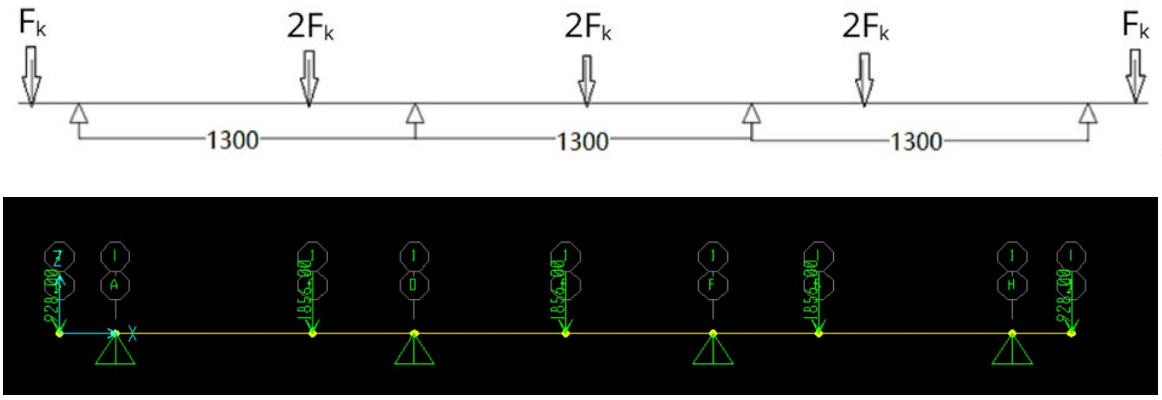
$F_t = \frac{PA}{N_c}$ ---------- Shear Force by Wind Suction
$P = 1760\ N/m^2$ ---------- Design Wind Pressure
$A = 2.53m^2$ ---------- PV Area
$N_c = 4$ - ---------- Number of clamps per module
$F_t = 1113.2$ N
$F_{max} = 16098$ N ---------- Ft does not exceed F_{max}
(refer to test report No. TGI-TS-001)



Component: Rail

6005-T5 ---------- Material Property
σ = 240 MPa ---------- Design Strength
V = 205 MPa ---------- Design Shear
I_y = 88790 mm^4 ---------- Second Moment of Inertia
W_y = 3288 mm^3 ---------- Elastic Modulus
A = 292 mm^2 ---------- Sectional Area
L_d = 1300 mm ---------- Span

Free Body Diagram:



$F_k = \frac{PA}{N_c}$ ---------- Shear Force by Wind Suction

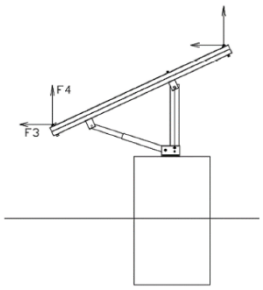
F_k = 1113 N

M_{max} = 310936 Nm---------- Max Moment

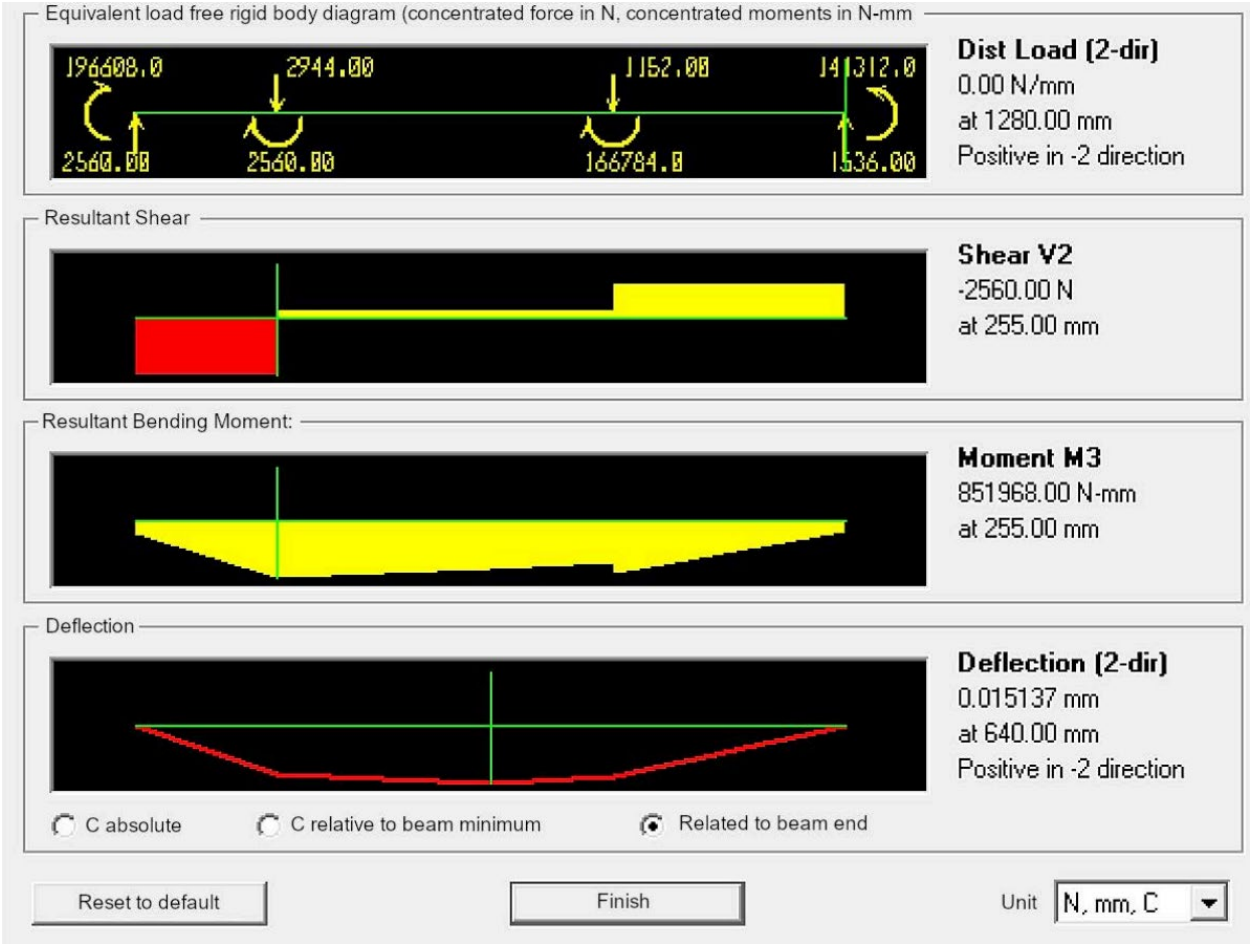
$\sigma_{max} = \frac{M_{max}}{W_y}$---------- Max Stress

σ_{max} = 240 MPa---------- Does not exceed max load capacity

Component: Main Beam

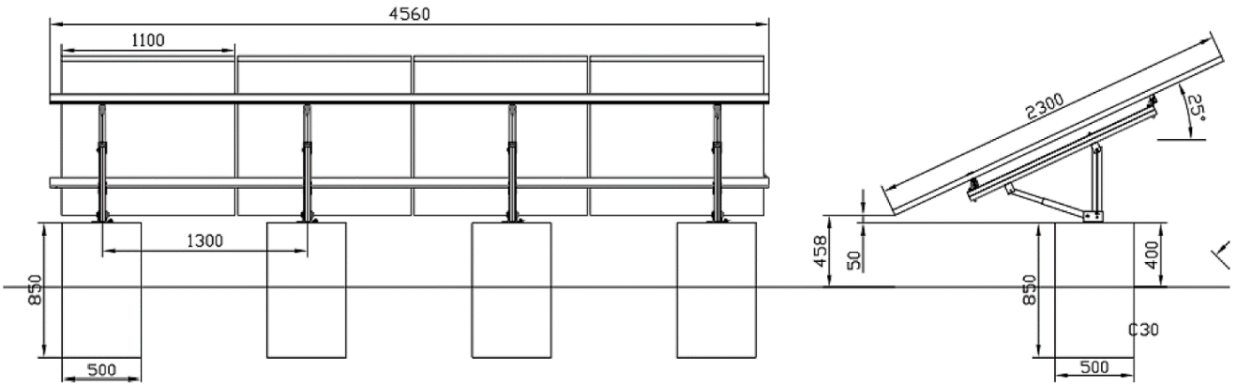


$F_3 = \frac{PA4\sin\theta}{8}$ ---------- Force in x-direction
P = 1760 N/m^2 ---------- Design Wind Pressure
A = 2.53m^2 ---------- PV Area
θ = 45 deg ---------- Angle w.r.t. PV
F_3 = 1574 N
W_{y1} = 7505 m^3 ---------- Elastic Modulus



M_{max} = 851968 Nm---------- Max Moment
$\sigma_{max} = \frac{M_{max}}{W_{y1}}$ ---------- Max Stress
σ_{max} = 240 MPa---------- Does not exceed max load capacity

Component: Cement Base



$F_5 = \frac{PA4\cos\theta}{8}$ ---------- Force in x-direction
P = 1760 N/m^2 ---------- Design Wind Pressure
A = 2.53m^2 ---------- PV Area
θ = 25 deg ---------- Angle w.r.t. PV
F_5 = 16137 N
W_p = 300 N ---------- Weight of PV
W_c = 5100 N ---------- Weight of cement base
$F_5 < 4W_p + 4W_c$
F_5 < 21600 N ---------- Does not exceed max load capacity

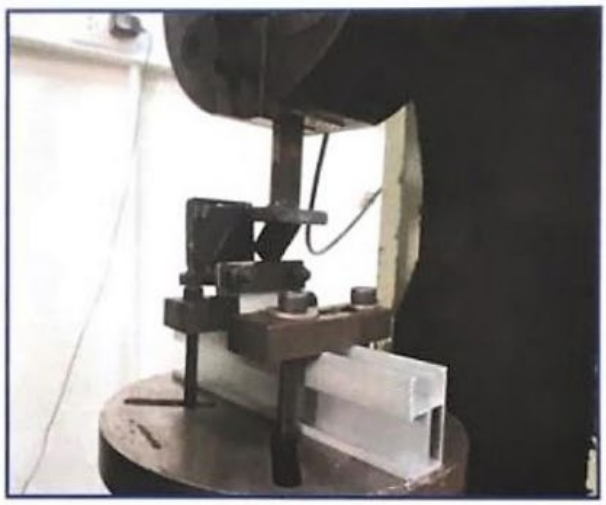
Report No. TGI-TS-002

TEST REPORT

Received No.: 62-01-083
Report No: TGI-TS-002
Rev.:00

Customer's company name : **Sunforson Power CO.,LTD**
Address : **20/27 Soi Bang Na-Trat 56 Bangna District T.Bangkaew A.Bangplee Bangkok, Thailand**

Part Name:	End Clomp	Material Characterization:	-
Part No:	-	Standard of Test:	-
Supplier:	-	Type of Test:	Tensile Testing
Material Specification:	-	Equipment / Serial No.:	Universal Testing Machine
Received Date:	24 / Jan. / 2019	Equipment's Capacity:	Tension force 10 tons
Tested Date:	07 / Feb. / 2019	Ambient Temp.:	23.5 °C,65 % RH



Result of Tensile Test

Test No.	Max Load (N)	Max Load (kgf)
1	6,150.779	626.990
2	5,971.995	608.766
3	6,178.216	629.787

Operated by: Sunapit ..... **Checked by:** ..... **Approved by:** .....

Testing Operator
Technical Team

Mr.Arun Jeangsrijaroen
Technical Manager

Mr.Arun Jeangsrijaroen
Quality Manager

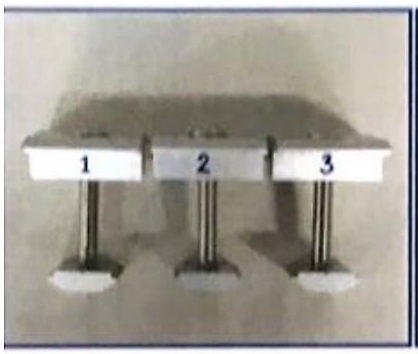
Report No. TGI-TS-001

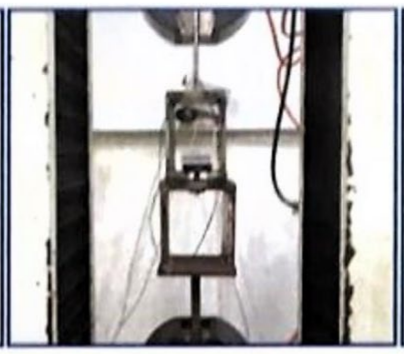
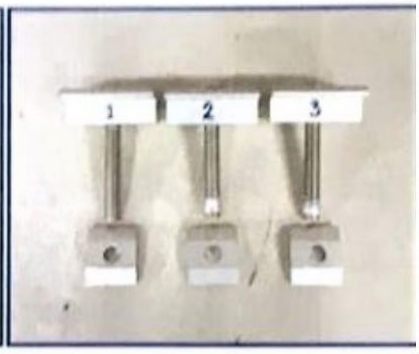
TEST REPORT

Received No.: 62-05-113
Report No: TGI-TS-001
Rev.:00

Customer's company name : **Sunforson Power CO.,LTD**
Address : **20/27 Soi Bang Na-Trat 56 Bangna District T.Bangkaew A.Bangplee Bangkok, Thailand**

Part Name:	Mid Clamp	Material Characterization:	-
Part No:	-	Standard of Test:	-
Supplier:	-	Type of Test:	Tensile Testing
Material Specification:	-	Equipment / Serial No.:	Universal Testing Machine
Received Date:	30 / May / 2019	Equipment's Capacity:	Tension force 10 tons
Tested Date:	06 / June / 2019	Ambient Temp.:	24.7 °C,62 % RH



Result of Tensile Test

Test No.	Max Load (N)	Max Load (kgf)
1	16,098.056	1,640.984
2	20,706.604	2,110.764
3	20,379.571	2,077.428