# STRUCTURAL CALCULATION & ANALYSIS
# EG4® BRIGHTMOUNT ADJUSTABLE GROUND MOUNT SYSTEM

## Design Standard: ASCE 7
### 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$^2$

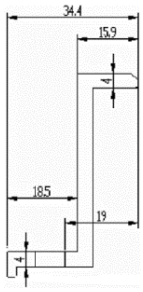
**Snow Load, $p_f$:**

$p_f = 0.7\ C_e\ C_t\ I_s\ p_g$ ---------- 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
$p_f = 289.59$ N/m$^2$
$p_g = 478.81$ N/m$^2$ ---------- Ground Snow Load, Figure 7.2-1, ASCE 7-16
$p_s = C_s p_f + p_r$ ---------- 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$^2$
$W_c = 27.61$m ---------- 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

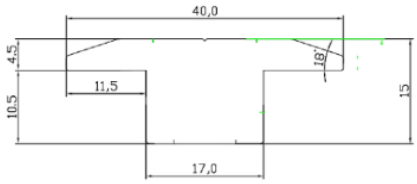
$N_c$ = 4 ---------- Number of clamps per module

$F_t$ = 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

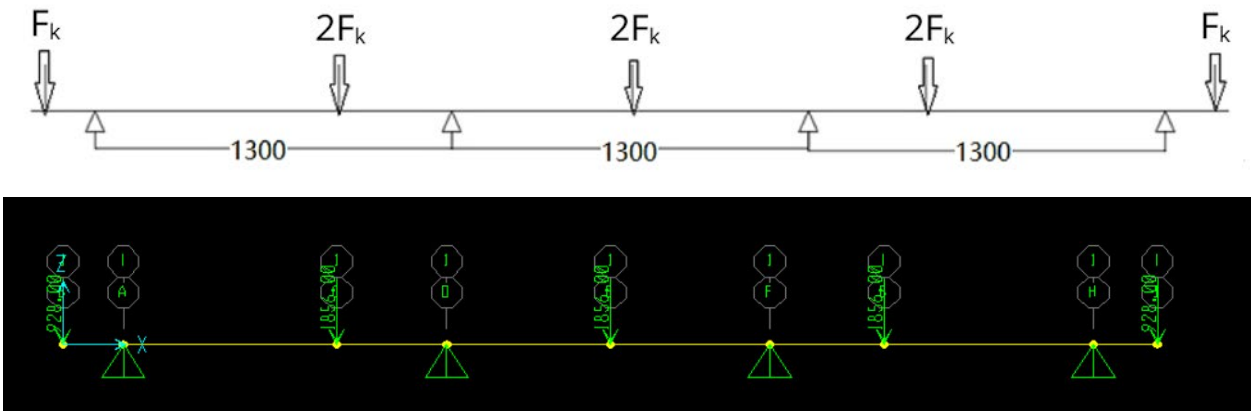
$I_y$ = 88790 mm$^4$ ---------- Second Moment of Inertia

$W_y$ = 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

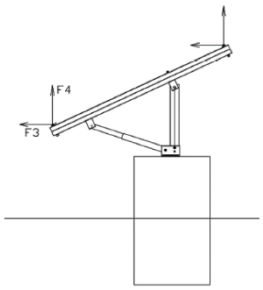
$F_k$ = 1113 N


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

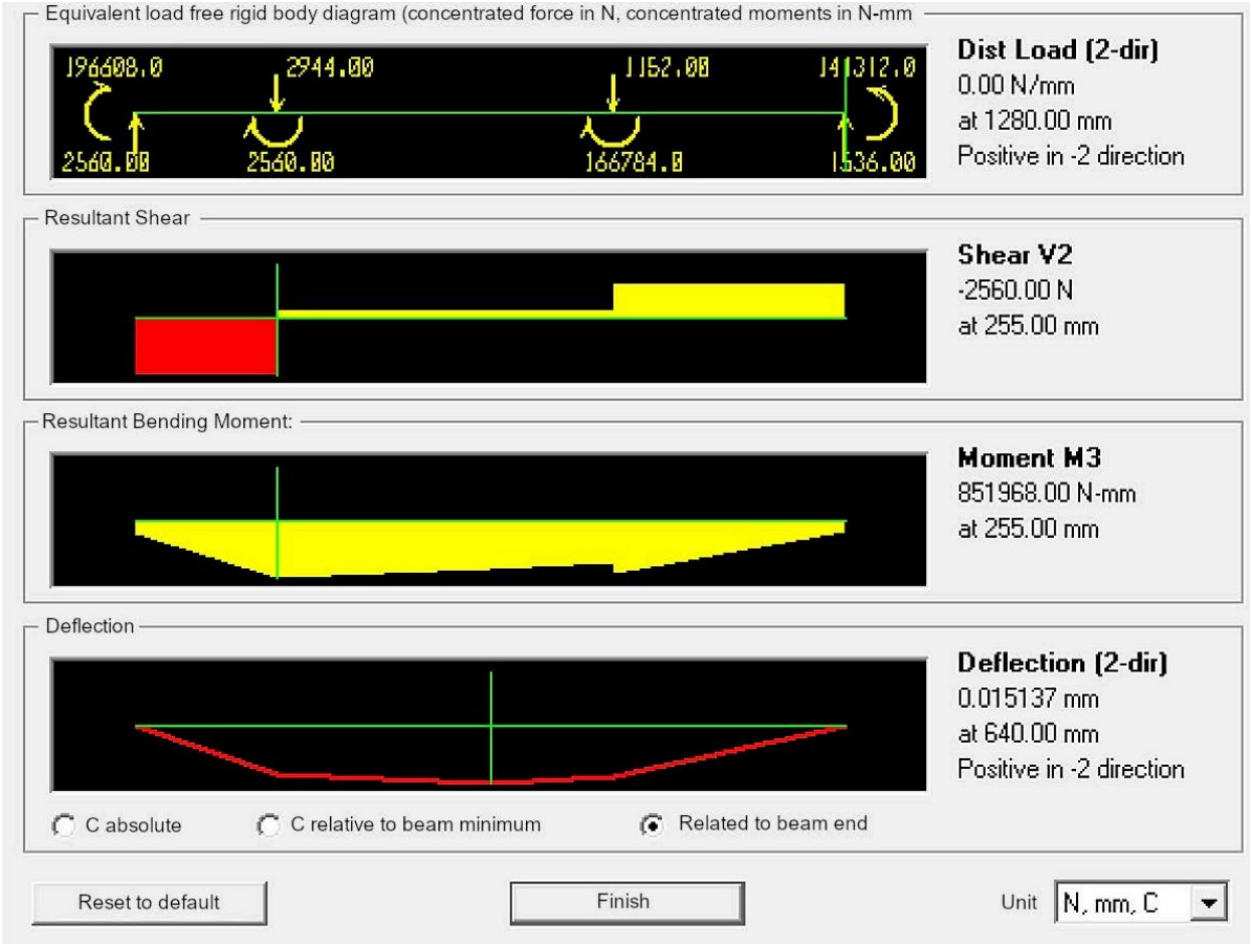
$\sigma_{max} = \frac{M_{max}}{W_y}$---------- Max Stress

$\sigma_{max}$ = 240 MPa---------- Does not exceed max load capacity

## Component: Main Beam

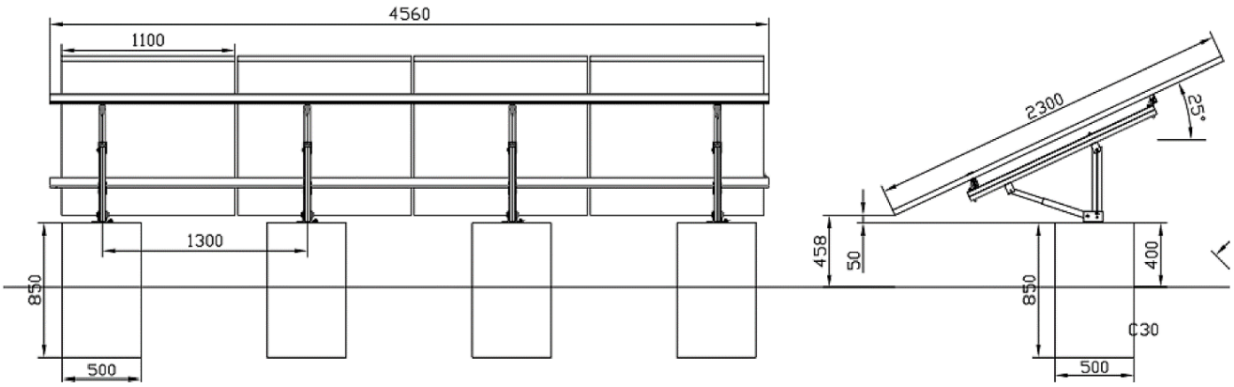



$F_3 = \frac{PA4 \sin\theta}{8}$ ---------- Force in x-direction
P = 1760 N/m$^2$ ---------- Design Wind Pressure
A = 2.53m$^2$ ---------- PV Area
θ = 45 deg ---------- Angle w.r.t. PV
$F_3$ = 1574 N
$W_{y1}$ = 7505 m$^3$ ---------- Elastic Modulus




$M_{max}$ = 851968 Nm---------- Max Moment
$\sigma_{max} = \frac{M_{max}}{W_{y1}}$ ---------- Max Stress
$\sigma_{max}$ = 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
$F_5$ < 4$W_p$ + 4$W_c$
$F_5$ < 21600 N ---------- Does not exceed max load capacity

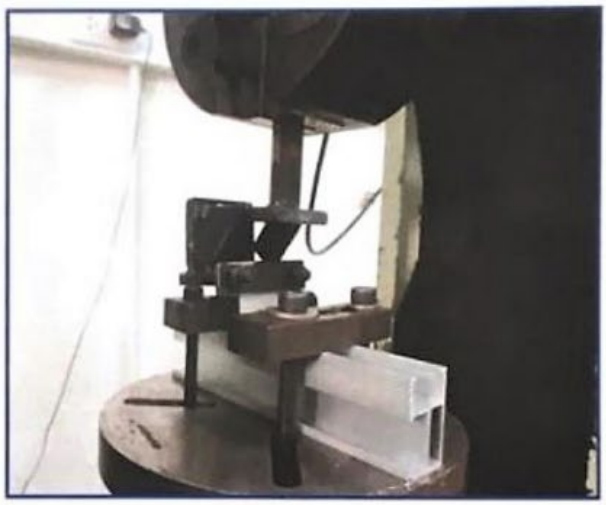
**Report No. TGI-TS-002**

# 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

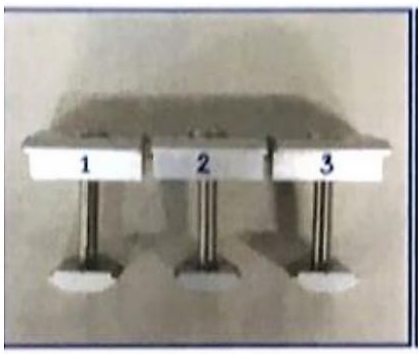
**Report No. TGI-TS-001**

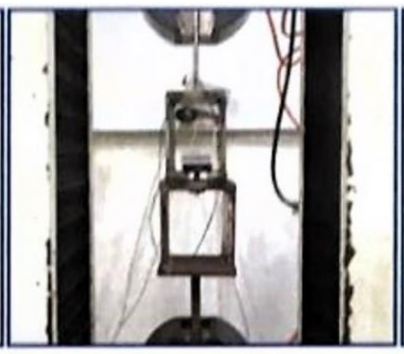
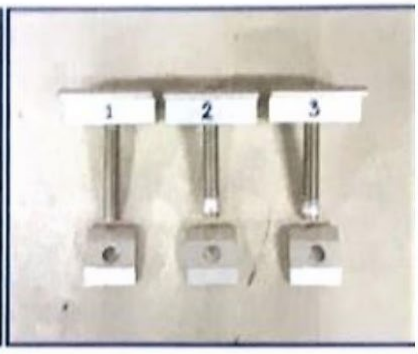
# TEST REPORT

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 |