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DESIGN OF MOUNTING STRUCTURE FOR PORTABLE SOLAR GENERATOR

Akash Bhujbal[#1], Annirudha Kasar[*2], Piyush Kulkarni[#3], Akash Kalaskar[#4]

[#] *Department of Mechanical Engineering, Savitribai Phule Pune University, Pune, Maharashtra*

Abstract

The mounting structure is the supporting structure that holds the solar panels or arrays of solar panels to the ground. Mounting structures made of steel or G.I support the panels on the ground, and also tilt them at an optimal angle to receive maximum sunlight. In this project we have designed the supporting structure for mounting of the solar panel of portable solar generator. This mounting structure can survive harsh weather conditions due to its strength and proper designing of a structure. Also, this mounting structure is economically affordable. The system has low maintenance. The materials used to develop the solar generator can be easily obtained from local markets, thus reducing the cost of developing the system and making it suitable for commercial application. The increase in demand of energy, stimulated by developing countries and decrease of power sources, is leading to an unsustainable future. Thus, renewable and clean energies are necessary to be used, particularly solar energy. The main concepts of portable solar generator are to reduce installation cost and to introduce a compact design of an optimal energy sizing system.

Keywords*: Solar panel, Mounting Structure, Portable Solar Generator, Solar Container.*

MATERIAL SELECTION:

Density (kg/m^3)	**7971.81**	**7850**	**2712.63**	**1356.3**
Young's modulus(psi)	**28.5*10^6**	**204*10^6**	**10.1*10^6**	**0.38*10^6**
Shear modulus(psi)	**11.2*10^6**	**78*10^6**	**3.9*10^6**	**0.13*10^6**
Yield strength(ksi)	**87.4**	**79.77**	**16.5**	**6.03**
Compressive strength(ksi)	**87.4**	**72.6**	**19.5**	**5.9**
Tensile strength(ksi)	**87.35**	**230**	**19.5**	**6.02**
Durabilty(Water)	**Excellent**	**Excellent**	**Acceptable**	**Excellent**
Durability(UV radiation)	**Excellent**	**Excellent**	**Excellent**	**Excellent**

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Table 1 : Material Characteristics

Galvanised Iron was the most suitable material followed closely by Stainless Steel AISI

CALCULATIONS:

Step 1: The first step is to determine the risk factor of the single solar mounting system structure, see Table 3. Based on Table 3, the risk category for the single solar panel ground mounting system structure is determined to be Risk Category III to ensure that the design is conservative.

Step 2: The second step it to determine the basic wind speed, V, for the Risk Category III using the map in Appendix C, Method II. Based on the map, the highest wind speed in the India would be (V= 89 m/s).

Step 3: The third step it to determine the wind load parameter:

Wind directionality factor Kd,for the purpose of this calculation, the structure type is assumed to be an open sign and lattice framework. Given this assumption, the wind directionality factor is (Kd=0.85).

Determine exposure category B, C or D

Based on the nature of this design project, exposure category B is the most probable.

Topographic factor, Kzt, can be assumed to be equal to 1.0 (Kzt=1.0)

Gust Effect Factor, G, for a rigid building or other structure is permitted to be taken as 0.85 (G=0.85) [15]

Step 4: The fourth step is to determine the velocity pressure exposure coefficient, Kz. The velocity pressure exposure coefficient Kz is determined from the following equation: For height above ground level, z, where z < 4.6 m

$$\mathbf{Kz = 2.01\ (4.6/z_g)^{2/\alpha}}$$

For exposure category B, as determined in Step 3, the values for α and zg are the following: α=7.0, z_g=365.76 m. Now using above equation, Kz can be calculated as,

$$Kz = 2.01\ (4.6/zg)^{2/\alpha} = 0.576$$

Step 5: The fifth step is to determine the velocity pressure, qz, using the following equation:

qz=0.613 Kz Kzt Kd V2, (V in m/s)

Inputs for Equation:

Kz=0.576

Kzt=1.0

Kd=0.85

V=89 m/s

Using the given inputs in Equation yields the following:

$$qz = 0.613\ Kz\ Kzt\ Kd\ V2 = 2.376 \times 10^3$$

Step 6: The sixth step is to determine the force coefficient, Cḟ , using reference (ASCE/SEI 7-10 pg.311) , Cḟ is assumed to be 1.95

Step 7: The seventh step it to calculate the wind force, F, using Equation 4 (ASCE/SEI 7-10 pg. 308) bellow:

F = qz G Cḟ As (N)

Where:

qz = the velocity pressure

G = gust-effect factor

Cḟ = net force coefficient

As = the gross area of the solid freestanding solid sign (m2)

Inputs for Equation:

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$$qz = 2.376 \times 103$$
$$G = 0.85$$
$$C\dot{f} = 1.95$$
$$As = 1.942\ m2 \text{ (Solar panel dimensions 1956 mm x 993 mm)}$$

Solving Equation yields the following:

$$F = qz\ G\ C\dot{f}\ \ As = 7.4227 \times 103\ N$$

Hence**, F=7,422 N**

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