Solar floating photovoltaic power station unit Structural simulation analysis

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Abstract. In this paper, Xihe solar floating photovoltaic power station unit. Simulation analysis is carried out for the structure, strength analysis is carried out for a single solar structure support, analysis is carried out for photovoltaic array structure, and analysis is carried out for rectangular and square structures with different wind directions.

1. Introduction

For a single PV panel bracket, through simulation analysis, the stress nephogram and numerical value of the bracket under four different working conditions are obtained, and the strength of the bracket is checked [1].

For the photovoltaic panel array, the reaction force of the anchor chain constraint position is obtained through the analysis, that is, the drag force. In the analysis process, the surface tension of the floating body is not considered. Because the anchor chain only produces tension and no pressure, when it is stressed in the X direction, one side of the anchor chain of the array structure will not be stressed, and the X direction constraint of this end will be released in the analysis. Through calculation, the drag force of the anchor chain constraint position can be obtained [2,3].

2. Analysis modelling

Geometric finishing, face meshing, body meshing, mesh quality detection, and modification of poor-quality mesh are carried out on the model, so that all mesh quality meets the standard requirements of finite element analysis. The mesh is divided into hexagonal and pent sided meshes, with a base size of 0.5mm and a float with a base size of 12mm. The number of units is995767, as shown in Figures 1:

Figure 1. Grid Model schematic

3. Calculate the result

As shown in Figures 2, the stress cloud map and stress maximum distribution positions for all brackets on the left and right are distributed, under which the brackets are in a state of overall pressure.

The overall stress cloud map of the left bracket, as shown in Figures 2:
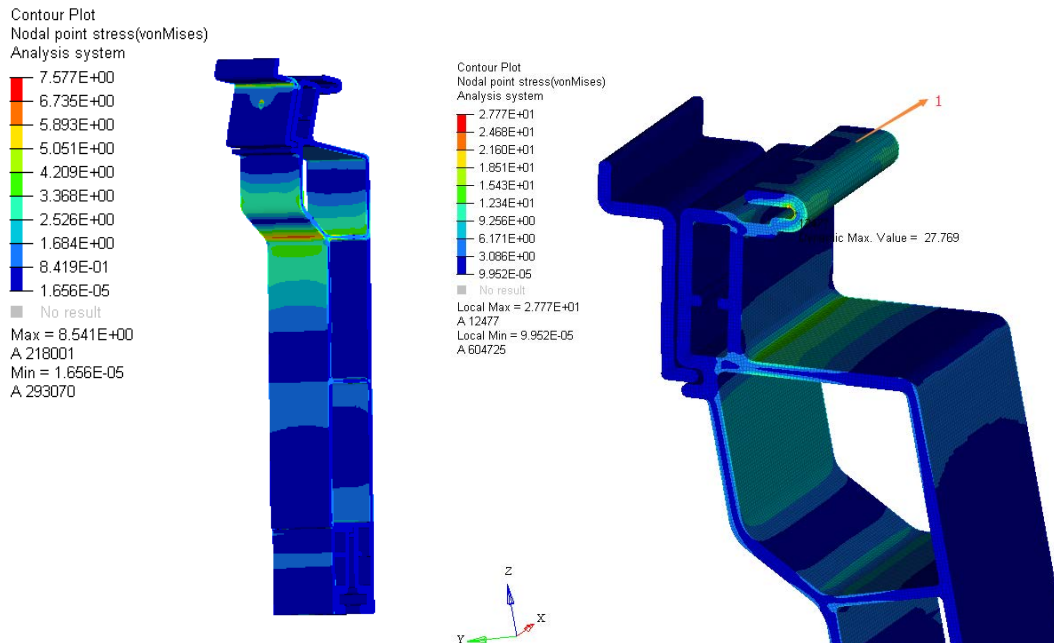

Figure 2. Overall stress cloud map of the bracket on the left   **Figure 3.** Left Bracket Local Stress Cloud Map

3.1. Operating conditions 1- North-South wind analysis results.

The stress cloud map and the maximum stress distribution position for all brackets on the left and right. The bracket is in a pulled state under this condition. The local stress cloud map of the left bracket, 1 with the greatest stress at this arc due to the upward pressure of the solar panel due to the upward pressure of the solar panel in position 1, is 27.777MPa. By calculation, the maximum stress value of the left bracket is 7.577MPa and the maximum stress of the right bracket is 8.494MPa.

3.2. Operating conditions 2- North-South leeward analysis results

The local stress cloud map of the left bracket, 1 with the greatest stress at this arc due to the upward pressure of the solar panel due to the upward pressure of the solar panel in position 1, is 27.777MPa.

By calculating, the maximum stress value of the left bracket is 27.777MPa, the maximum stress of the right bracket is 53.4MPa, and the safety factor is very high because the yield limit of aluminium alloy material exceeds 200MPa, as shown in figure 3.

3.3. Operating conditions 3-East-West wind analysis results

The stress cloud map and the maximum stress distribution position for all brackets on the left and right. The bracket is in a pressurized state under this condition. By calculation, the maximum stress on the left bracket is 20.53MPaand the maximum stress on the right bracket is 18.65MPa, as shown in Figure 5.

3.4. Operating conditions 4-East-West leeward analysis results

The stress cloud map and the stress maximum distribution position for all brackets on the left and right. The bracket is in a pulled state under this condition. The local stress cloud map of the left bracket, due to the upward pressure on the solar panel at position1, has a small stiffness and the greatest stress at this arc, with a value of 62.38MPa. By calculation, the maximum stress value of the left bracket is 62 38MPa, the maximum stress on the right bracket is 87.64MPa, because the yield limit of aluminium alloy

material exceeds 200MPa, the maximum stress value is less than aluminium in the four operating conditions calculated, as shown in Figure 6.
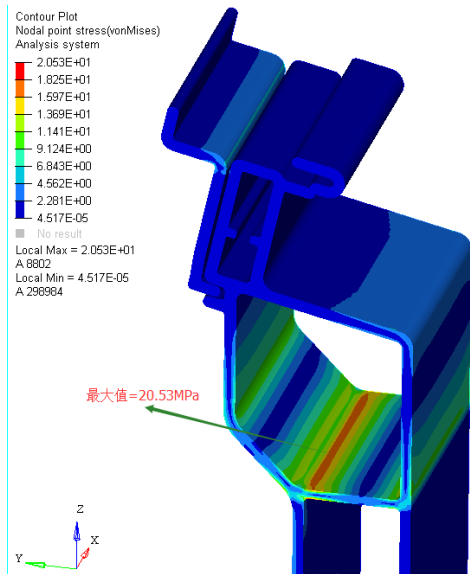

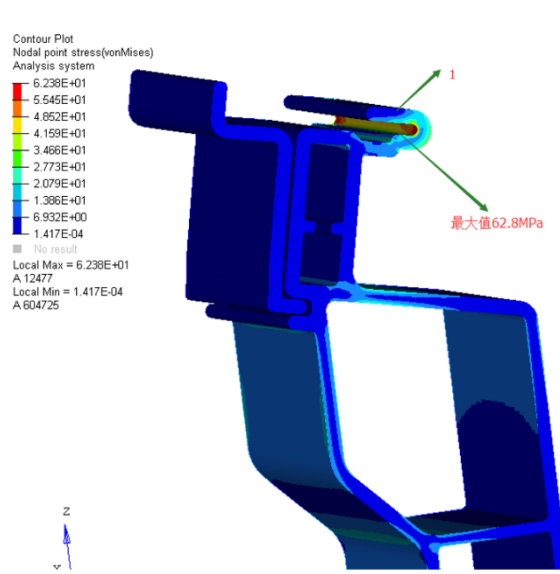**Figure 4.** Left Bracket Local Stress Cloud Map   **Figure 5.** Left Bracket Local Stress Cloud Map

The yield limit of the alloy material. Therefore, this bracket design meets the strength requirements, the safety factor is relatively high.

4. Two photovoltaic array structural analysis

There are 2 types of solar panel array models, one rectangular and the other square, with load applied in the middle of the model, and the anchor chain is replaced by a beam unit to secure the anchor chain endpoint position, as shown in Figures 6 and 7:
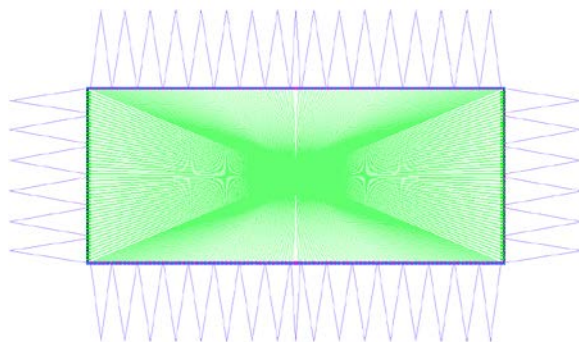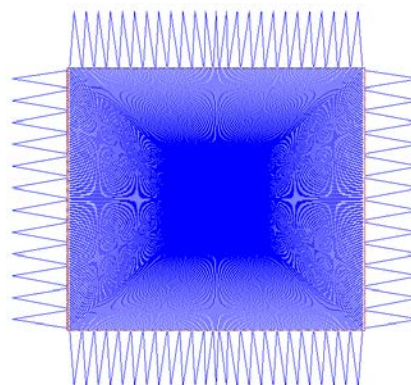

Figure 6. Rectangular Array Model Diagram   **Figure 7.** Square Array Model Diagram

There are four analytical conditions, each applying a load in two directions.

Table 1. Analytical conditions

conditions	North and south are windy	South wind and leeward	Things are blowing in the wind	East-west leeward
x-way load (N).	112	-163	176	-260

Figures 8 to 9 are a diagram of north-south and Windward Schematic distributions:
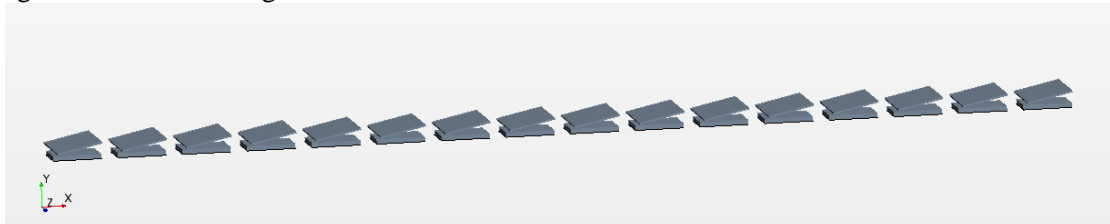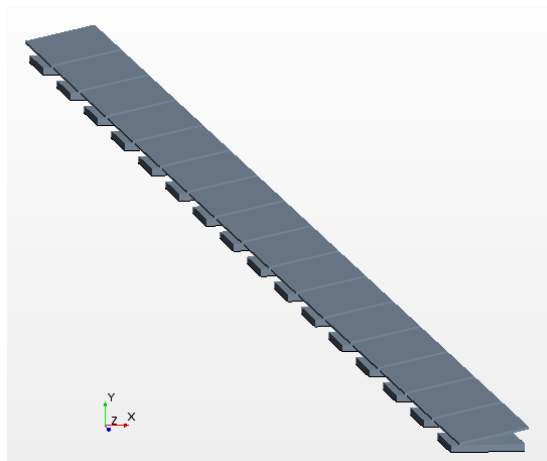

Figure 8. North-South wind map

Figure 9. Windward Schematic

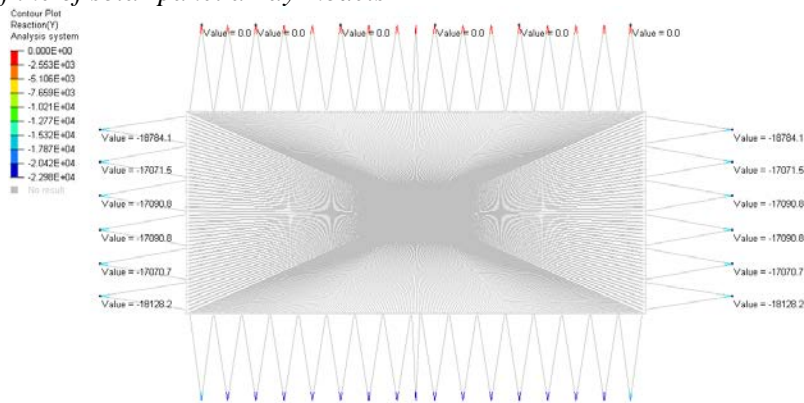*4.1. First type of the of solar panel array models*

Figure 10. x Drag Force Distribution Diagram

4.1.1. Operating conditions 1 - North-South wind analysis results. In the x direction of the center point, the load applied is: F-112N x 5290x592480N. Constraint releases the 1st degree of freedom of the constraint point on the x-direction side, constrains 2-5 degrees of freedom, and the rest constrains 1-6 degrees of freedom. By calculating, the x-direction drag force of the endpoint of the anchor chain is calculated, as shown in Figure 10 and 11.
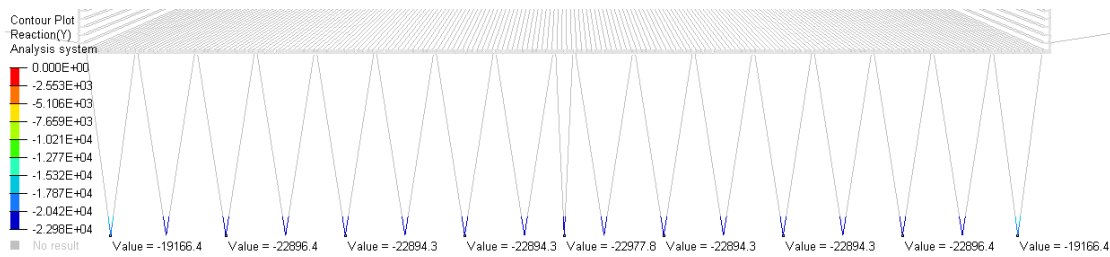
Figure 11. x Drag Force Distribution Diagram

4.1.2. Operating conditions 2-North-South Leeward Analysis results. The load appliedin the x direction of the center point is: F-163N x 5290-862270N. Constraint releases the 1st degree of freedom of the constraint point on the x-direction side, constrains 2-5 degrees of freedom, and the rest constrains 1-6 degrees of freedom. By calculating, the x-direction drag force of the anchor chain endpoint is calculated. The drag force is 0, because the anchor chain is pressurized and the x-direction constraint is released.
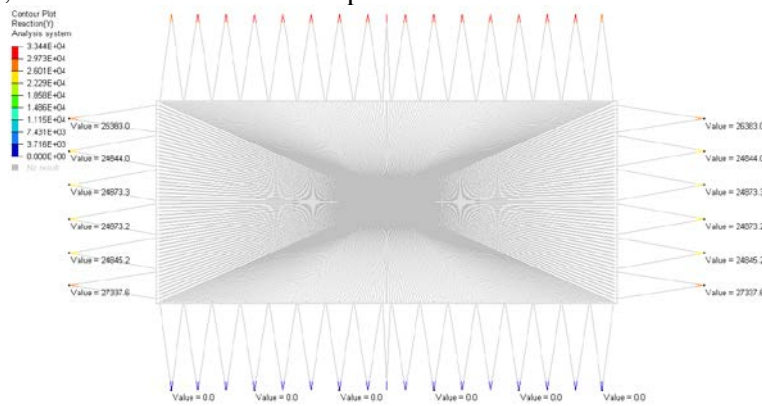

Figure 12. x Drag Force Distribution schematic

4.1.3. Operating conditions 1 - North-South wind analysis results. The load applied in the x direction of the center point is: F-176N x 5290s 9.31040000E-05 N. Constraint releases the 1st degree of freedom of the constraint point on the x-direction side, constrains 2-5 degrees of freedom, and the rest constrains 1-6 degrees of freedom. By calculating, the x-direction drag force of the anchor chain endpoint is calculated.

4.1.4. Operating conditions 1 - North-South wind analysis results. The load appliedin the x direction of the center point is: F-260N x 5290- -1.37540000E-06 N. Releases the 1st degree of freedom of the constraint point on the x-directional side, constrains 2-5 degrees of freedom, and the rest constrains 1-6 degrees of freedom. By calculating, the x-direction drag force of the anchor chain endpoint is calculated.

4.2. Second type of the of solar panel array models

4.2.1. Operating conditions 1 - North-South wind analysis results. The load appliedin the x direction of the center point is: F-112N x 10580s1.18496E-06 N. Constraint releases the 1st degree of freedom of the constraint point on the x-direction side, constrains 2-5 degrees of freedom, and the rest constrains 1-6 degrees of freedom, as shown in Figure 11:
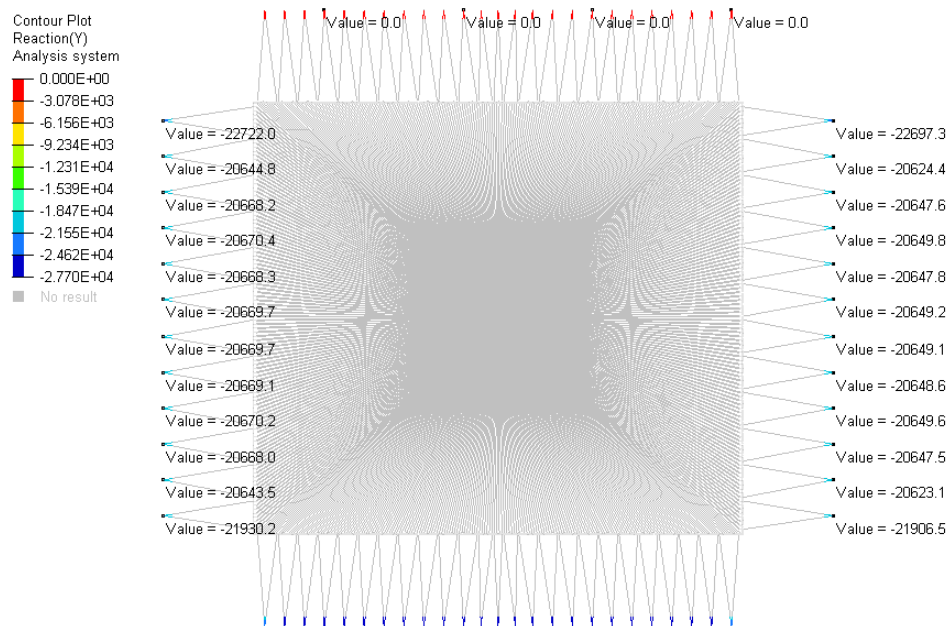
Figure 13. x Drag Force Distribution schematic

4.2.2. Operating conditions 2-North-South leeward analysis results. The load appliedin the x direction of the center point is: F-163N x 10580--1.7244E plus 06 N. Constraint releases the 1st degree of freedom of the constraint point on the x-direction side, constrains 2-5 degrees of freedom, and the rest constrains 1-6 degrees of freedom.

4.2.3. Operating conditions 1 - North-South wind analysis results. The load appliedin the x direction of the center point is: F-176N x 10580s1.86208E-06N. Constraint releases the 1st degree of freedom of the constraint point on the x-direction side, constrains 2-5 degrees of freedom, and the rest constrains 1-6 degrees of freedom.

4.2.4. Operating conditions 1 - North-South wind analysis results. The load appliedin the x direction of the center point is: F-260N x 10580--2.7508E plus 06N. Constraint releases the 1st degree of freedom of the constraint point on the x-direction side, constrains 2-5 degrees of freedom, and the rest constrains 1-6 degrees of freedom.

5. Conclusion
Through the simulation analysis, the stress of the support under four different working conditions can meet the strength requirements. The results show that the two different distribution patterns can also meet the stress requirements, and the rectangular arrangement is more uniform.

References
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