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DESIGN AND ANALYSIS OF SOLAR PANEL SUPPORTING STRUCTURE IN WIND EFFECT

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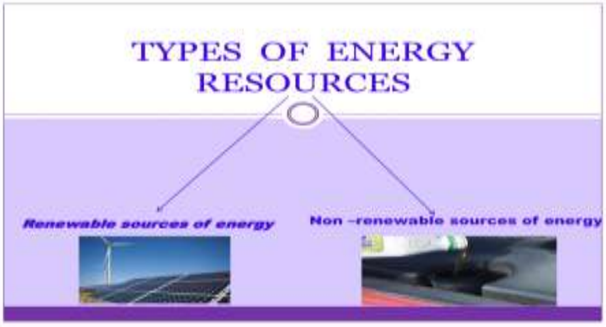
ABSTRACT

The use of renewable energy resources is increasing rapidly. Following this trend, the implementation of large area solar arrays is considered to be a essential. Many design approaches of the supporting structures have been presented in order to achieve the maximum efficiency. They are loaded mainly by aerodynamic pressures. International governence as well as the competition between industries define that they must withstand the enormous loads that result from large air acceleration. Moreover, they must have a life assurance of more than 20 yrs. Optimization plays very key role in product design and prevent un-necessary inventory satisfying the functional needs. But optimization with apt design helps to built efficient products in the everyday competing market. Stress analysis plays important role in optimizing the design. Due to the advance in computer based finite element software's design process is made simple by easier simulation methods fast replacing prototype built up and testing. In the current work, a solar panel aiding structure is designed to take rotational loads for 90^0 for safe operation. So the design should consider the loads coming on the structure for 90^0 rotation along with inertia effect of the rotating members. The mechanism should withstand the aerodynamic loads, inertia loads and rotation loads along with frictional loads. The model should look at aerodynamic circumstances for load calculations and design should satisfy all the functional requirements.

I. INTRODUCTION AND LITERATURE SURVEY

Power is a property of objects, interchangeable among them via fundamental interactions, which can be convertedinto different forms but not created or destroyed.

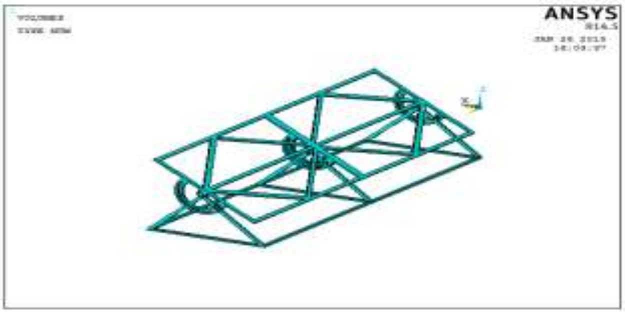


Renewable energy is a source that comes from resources which are naturally replenished on a human timescale such as sunlight, wind, rain, waves and geothermal heat.

Renewable energy takeover the conventional fuels in four distinct areas: electricity generation, hot water/space heating, motor fuels, and rural (off-grid) energy services.

II. STRUCTURAL ANALYSIS OF SOLAR STAND STEEL IN 23KMPH

Imported Model from Pro/Engineer



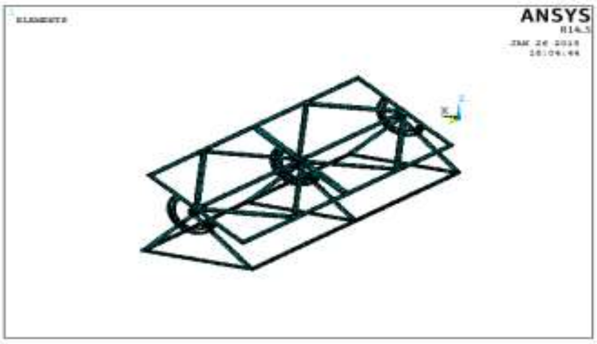
Element Type: solid 20 nodes 186

Material Properties: Youngs Modulus (EX) : 205000N/mm^2

Poissons Ratio (PRXY): 0.29

Density : 0.00000785 kg/mm^3

Meshed Model



Loads

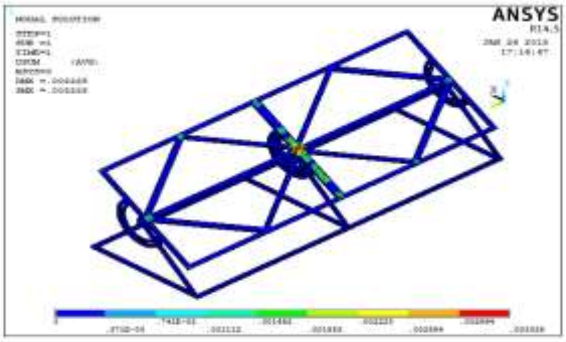
Pressure values –25N/mm2

Solution

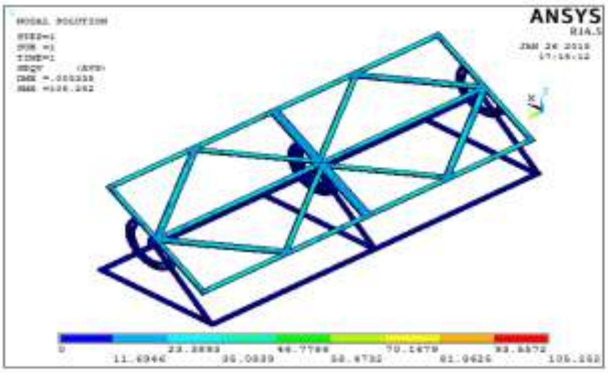
Solution – Solve – Current LS – ok

Post Processor

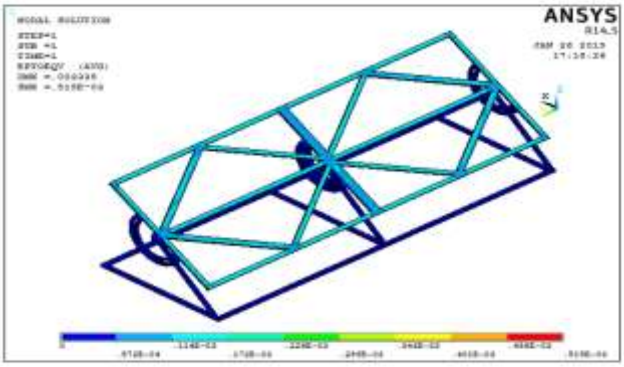
General Post Processor – Plot Results – Contour Plot - Nodal Solution – DOF Solution – Displacement Vector Sum



General Post Processor – Plot Results – Contour Plot – Nodal Solution – Stress – Von Mises Stress

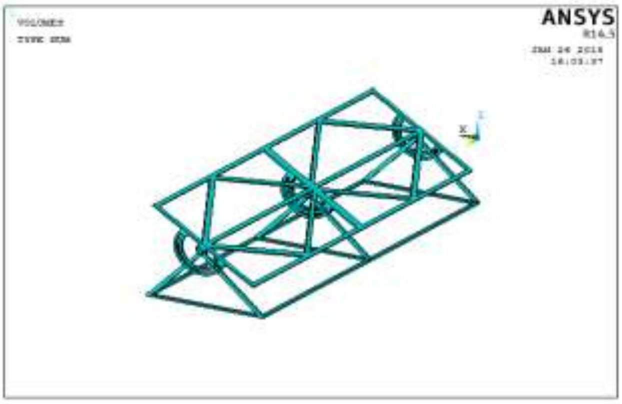


General Post Processor – Plot Results – Contour Plot – Nodal Solution – Strain – Total mechanical Strain



III. STRUCTURAL ANALYSIS OF SOLAR STAND STEEL AT 40KMPH

Imported Model from Pro/Engineer



Element Type: solid 20 nodes 186

Material Properties: Youngs Modulus (EX) : 205000N/mm^2

Poissons Ratio (PRXY): 0.29

Density : 0.00000785 kg/mm^3

Meshed Model

Loads

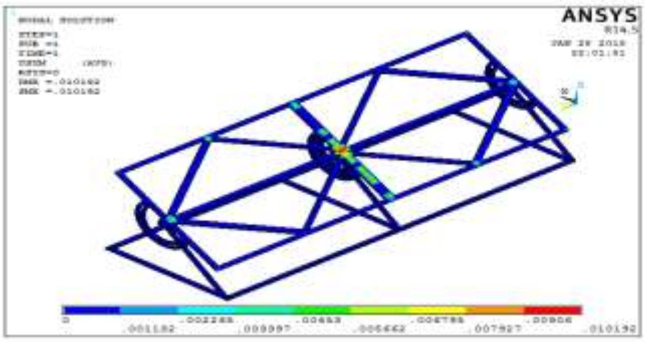
Pressure values –75N/mm2

Solution

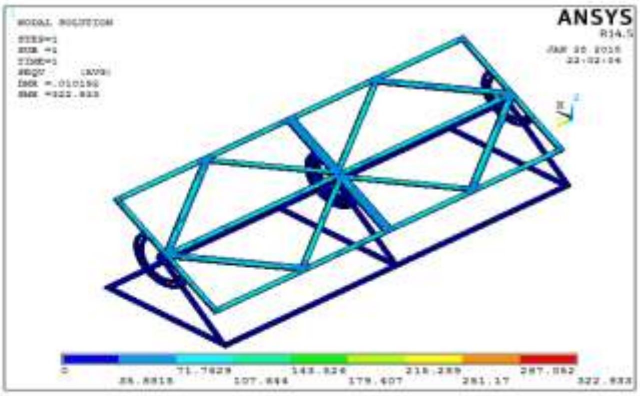
Solution – Solve – Current LS – ok

Post Processor

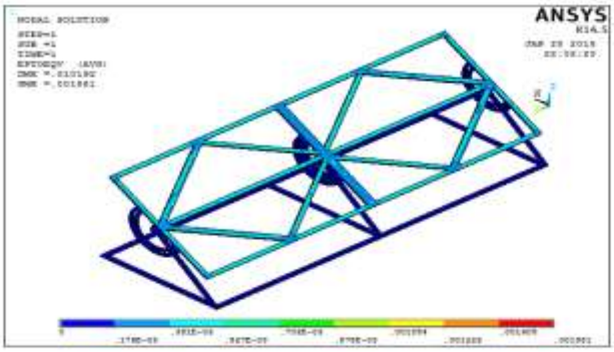
General Post Processor – Plot Results – Contour Plot - Nodal Solution – DOF Solution – Displacement Vector Sum



General Post Processor – Plot Results – Contour Plot – Nodal Solution – Stress – Von Mises Stress

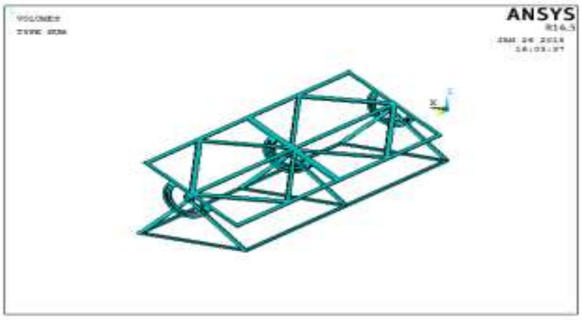


General Post Processor – Plot Results – Contour Plot – Nodal Solution – Strain – Total mechanical Strain



IV. STRUCTURAL ANALYSIS OF SOLAR STAND STEEL AT 55KMPH

Imported Model from Pro/Engineer



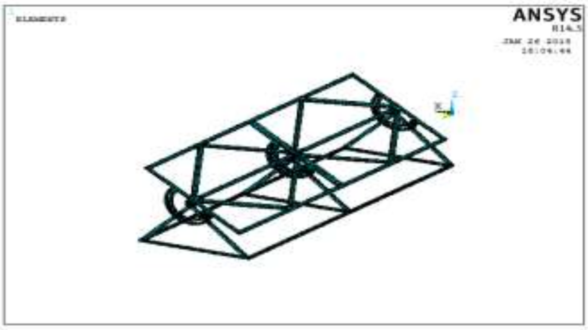
Element Type: solid 20 nodes 186

Material Properties: Youngs Modulus (EX) : 205000N/mm^2

Poissons Ratio (PRXY): 0.29

Density : 0.00000785 kg/mm^3

Meshed Model



Loads

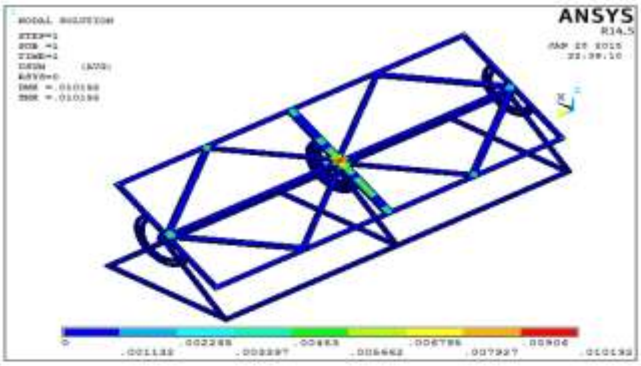
Pressure values –150N/mm2

Solution

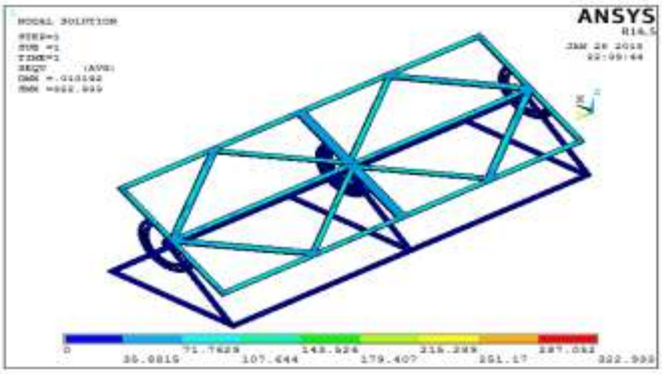
Solution – Solve – Current LS – ok

Post Processor

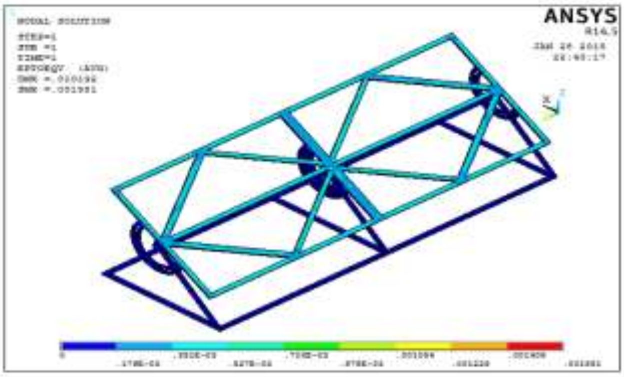
General Post Processor – Plot Results – Contour Plot - Nodal Solution – DOF Solution – Displacement Vector Sum



General Post Processor – Plot Results – Contour Plot – Nodal Solution – Stress – Von Mises Stress

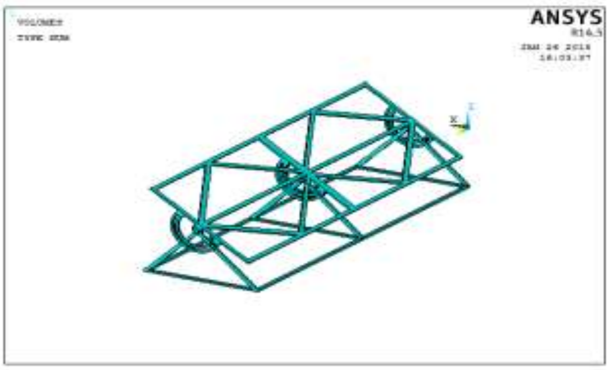


General Post Processor – Plot Results – Contour Plot – Nodal Solution – Strain – Total mechanical Strain



V. STRUCTURAL ANALYSIS OF SOLAR STAND ALUMINIUM ALLOY 24345 AT 23 KMPH

Imported Model from Pro/Engineer



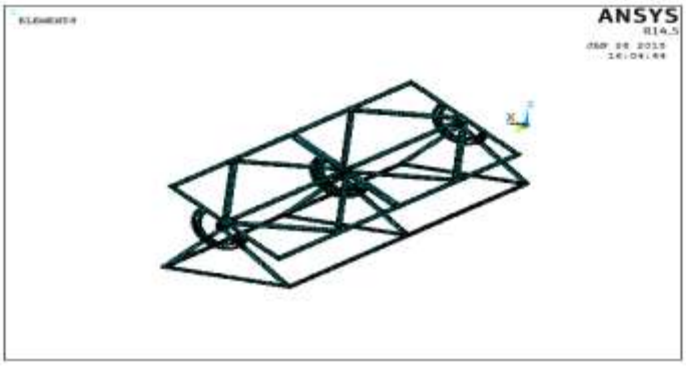
Element Type: solid 20 nodes 186

Material Properties: Youngs Modulus (EX) : 70000N/mm^2

Poissons Ratio (PRXY): 0.33

Density : 0.0000028kg/mm^3

Meshed Model



Loads

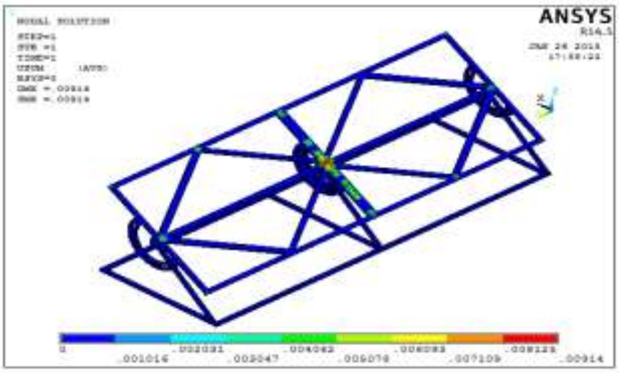
Pressure values –25N/mm2

Solution

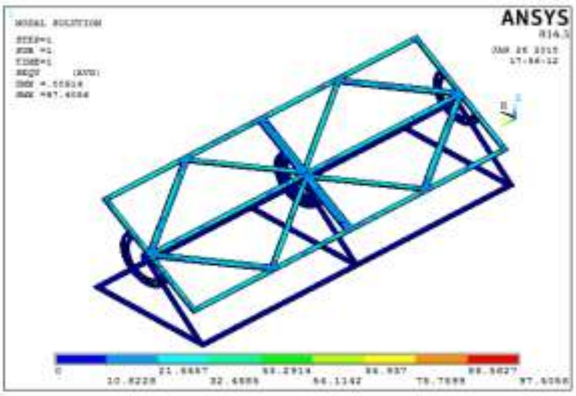
Solution – Solve – Current LS – ok

Post Processor

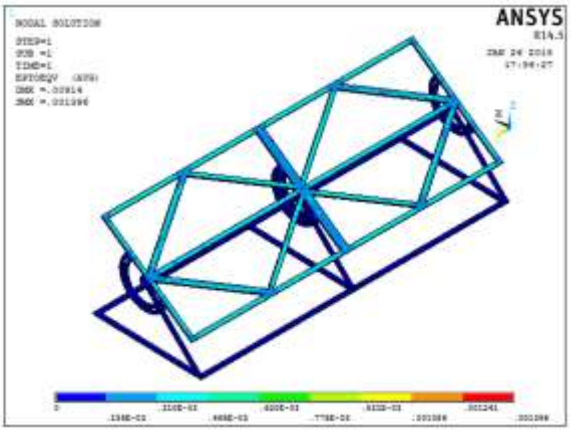
General Post Processor – Plot Results – Contour Plot - Nodal Solution – DOF Solution – Displacement Vector Sum



General Post Processor – Plot Results – Contour Plot – Nodal Solution – Stress – Von Mises Stress

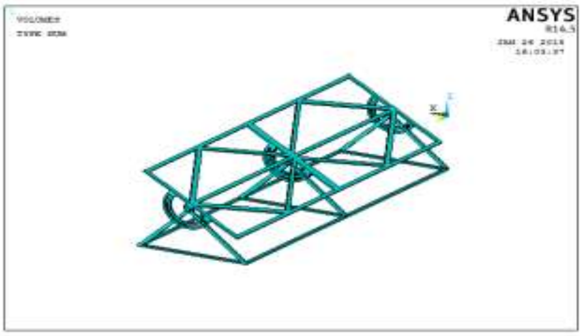


General Post Processor – Plot Results – Contour Plot – Nodal Solution – Strain – Total mechanical Strain



VI. STRUCTURAL ANALYSIS OF SOLAR STAND ALUMINIUM ALLOY 24345 AT 40 KMPH

Imported Model from Pro/Engineer



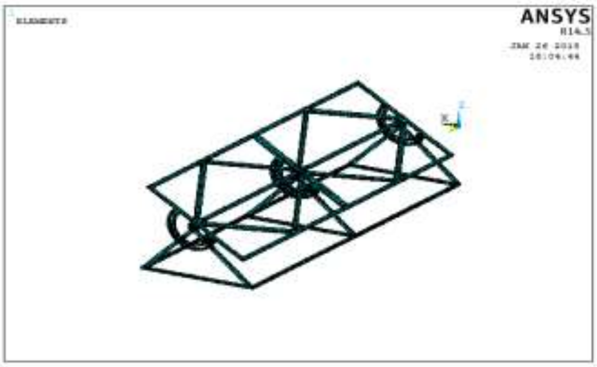
Element Type: solid 20 nodes 186

Material Properties: Youngs Modulus (EX) : 70000N/mm^2

Poissons Ratio (PRXY): 0.33

Density : 0.0000028kg/mm^3

Meshed Model



Loads

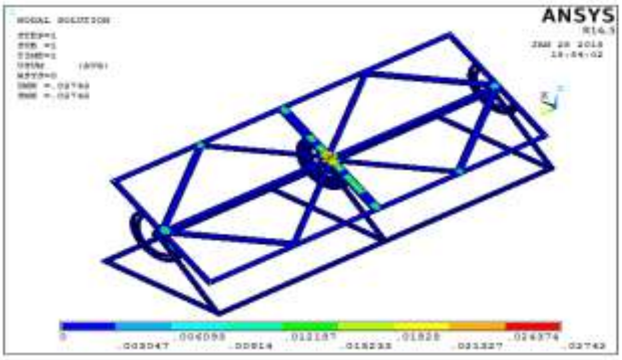
Pressure values –75N/mm2

Solution

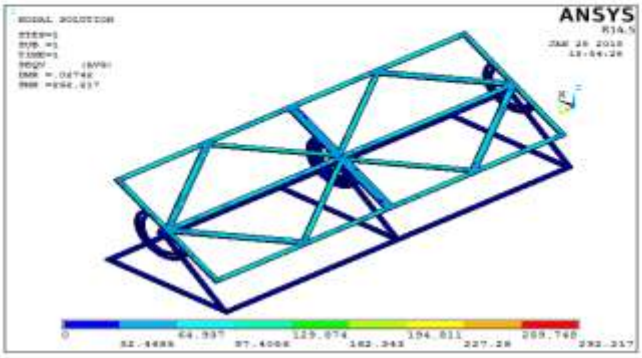
Solution – Solve – Current LS – ok

Post Processor

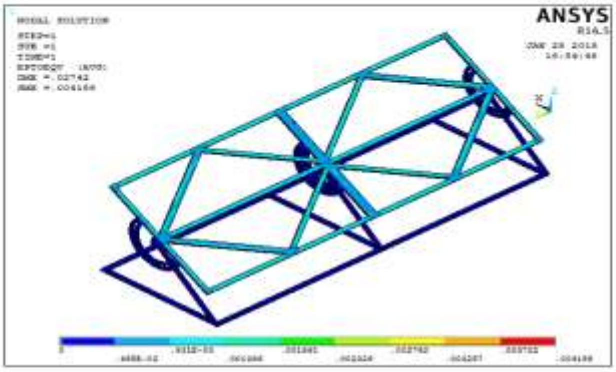
General Post Processor – Plot Results – Contour Plot - Nodal Solution – DOF Solution – Displacement Vector Sum



General Post Processor – Plot Results – Contour Plot – Nodal Solution – Stress – Von Mises Stress

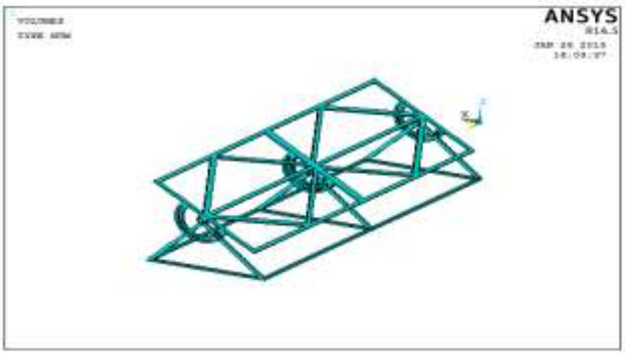


General Post Processor – Plot Results – Contour Plot – Nodal Solution – Strain – Total mechanical Strain



VII. STRUCTURAL ANALYSIS OF SOLAR STAND ALUMINIUM ALLOY 24345 AT 55 KMPH

Imported Model from Pro/Engineer



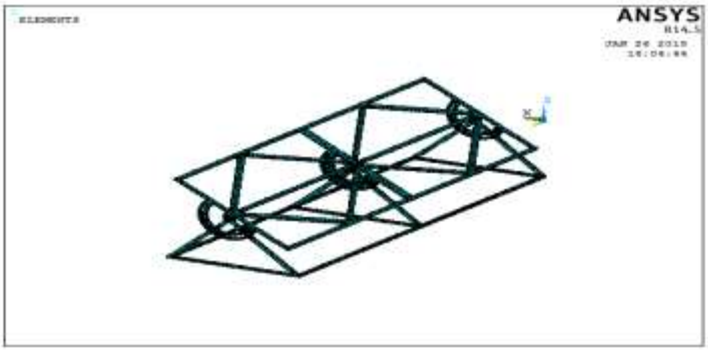
Element Type: solid 20 nodes 186

Material Properties: Youngs Modulus (EX) : 70000N/mm^2

Poissons Ratio (PRXY): 0.33

Density : 0.0000028kg/mm^3

Meshed Model



Loads

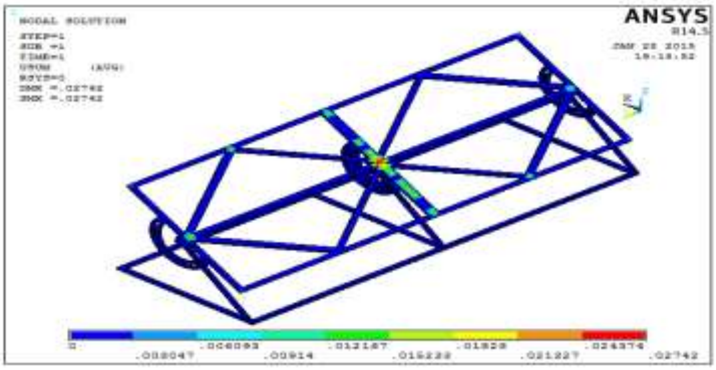
Pressure values –150N/mm2

Solution

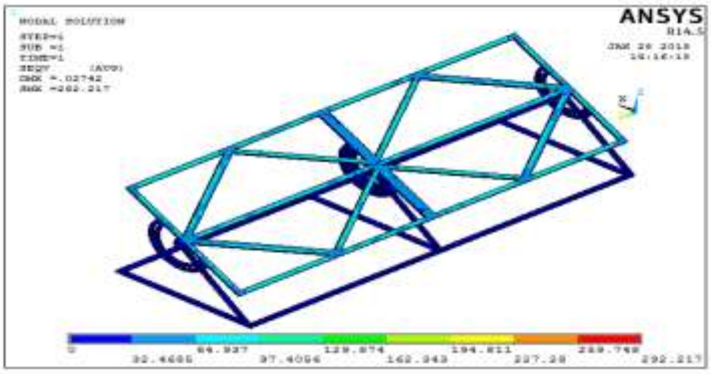
Solution – Solve – Current LS – ok

Post Processor

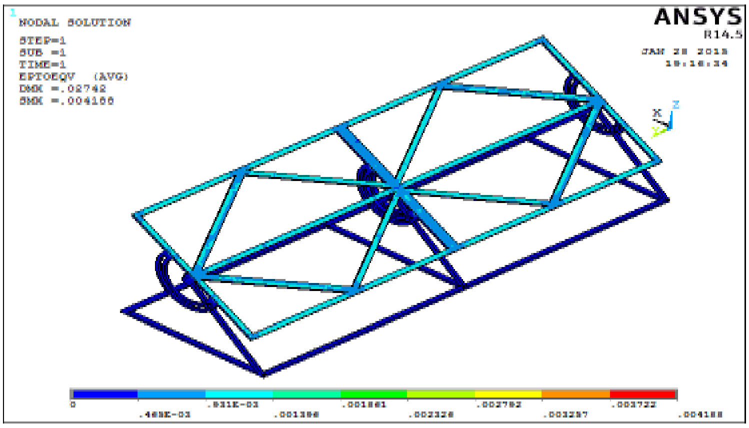
General Post Processor – Plot Results – Contour Plot - Nodal Solution – DOF Solution – Displacement Vector Sum



General Post Processor – Plot Results – Contour Plot – Nodal Solution – Stress – Von Mises Stress



General Post Processor – Plot Results – Contour Plot – Nodal Solution – Strain – Total mechanical Strain



VIII. RESULTS & DISCUSSION

Sl.No	Material	Wind Speed	Displacement		VON Mises Stress		Strain	
			Min	Max	Min	Max	Min	Max
1	STEEL	23 KMPH	0	0.003335	0	105.252	0	5.15e-04
2	STEEL	40 kMPH	0					

IX. CONCLUSION

The solar panel support structure is design optimized using computer based Finite element software ANSYS. The results summary is as follows.

- Initial wind load calculations are carried out based on the given wind speed.
- Initial calculations are carried out to find critical position of loading. Calculations are based on projected area of the problem.
- Calculations are done for structural members based on allowable stresses of the structure.
- The three modelling is carried out using modelling software CATIA and meshing is done using hyper mesh software. The meshed file is imported to ANSYS in „imp" file format for structural analysis.
- Initial analysis results shows stresses and deflections with in allowable range. So Optimization is carried out by identifying possible regions of optimization.
- Totally 6 design variables and 2 state variables are selected along weight as objective function; design optimization is carried out for the problem.
- The design optimization process shows 11 feasible sets satisfying the stress and deflection requirements for structural safety.
- A weight reduction of 13.9% can be observed in the problem. This reduction is also significant as the production costs, manufacturing costs and maintenance costs will reduce with less requirement of the material. Also dynamic effects in the structure also will reduce.
- The graphs are represented showing variation of weight, stress and deflection with iterations. Weight reduction with iterations can be observed along with increase in stress and deflection with reduction in thickness.

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[2] ^ Jump up to:*a b c d* REN21 (2010). Renewables 2010 Global Status Report p. 15.

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[5] Bénard, C.; Gobin, D.; Gutierrez, M. (1981). "Experimental Results of a Latent-Heat Solar-Roof, Used for Breeding Chickens". *Solar Energy* **26** (4): 347–359.Bibcode:1981SoEn...26..347B. doi:10.1016/0038-092X(81)90181-X.

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	**V. Badde Naik** working as Assistant Professor at Nalanda Institute of Engineering & Technology (NIET), siddharth Nagar, Kantepudi(V), Sattenapalli (M), Guntur (D), Andhra Pradesh , Affiliated to JNTU-KAKINADA.