## STRESS ANALYSIS OF xxxxxxx

**Structure:** xxxxxxx

***Prepared By,***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
| 0 |  | First issue |  |  |  |
| **Rev.** | **Date** | **Revision Details** | **Prepared by** | **Checked by** | **Approved by** |

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###### Introduction:

To perform Finite Element Analysis for TATA EMVEE 35 mm Solar Panel frame under Wind and snow load.

To evaluate the failure status of Aluminium frame, Coulomb – Mohr theory for brittle material failure is used; which states that fracture occurs when the maximum and minimum principal stresses combine for a condition which satisfies the following :

Where, and represent the ultimate tensile and compressive strengths, and and are maximum and minimum principal stresses; which means if the left hand side, i.e, Coulomb – Mohr factor (CMF) >1, the component fails.

###### Assumptions:

The analysis has been carried out with following assumptions.

1. Live loads (L), Self-restraining loads (T) and any other loads are not applicable.
2. Structural members are homogenous and do not contain defects.
3. Member connections are infinitely rigid.
4. Model is made quarter symmetric, for ease in analysis.

###### Analysis Details:

Table Analysis Details

|  |  |
| --- | --- |
| Software | NASTRAN |
| Analysis type | Static structural, Nonlinear Elastic - plastic |
| Element type | SOLID3D (CHEXA, CTETRA, CPENTA, CPYRAM) |
| Unit System | SI system |

###### 3D Geometric Model:

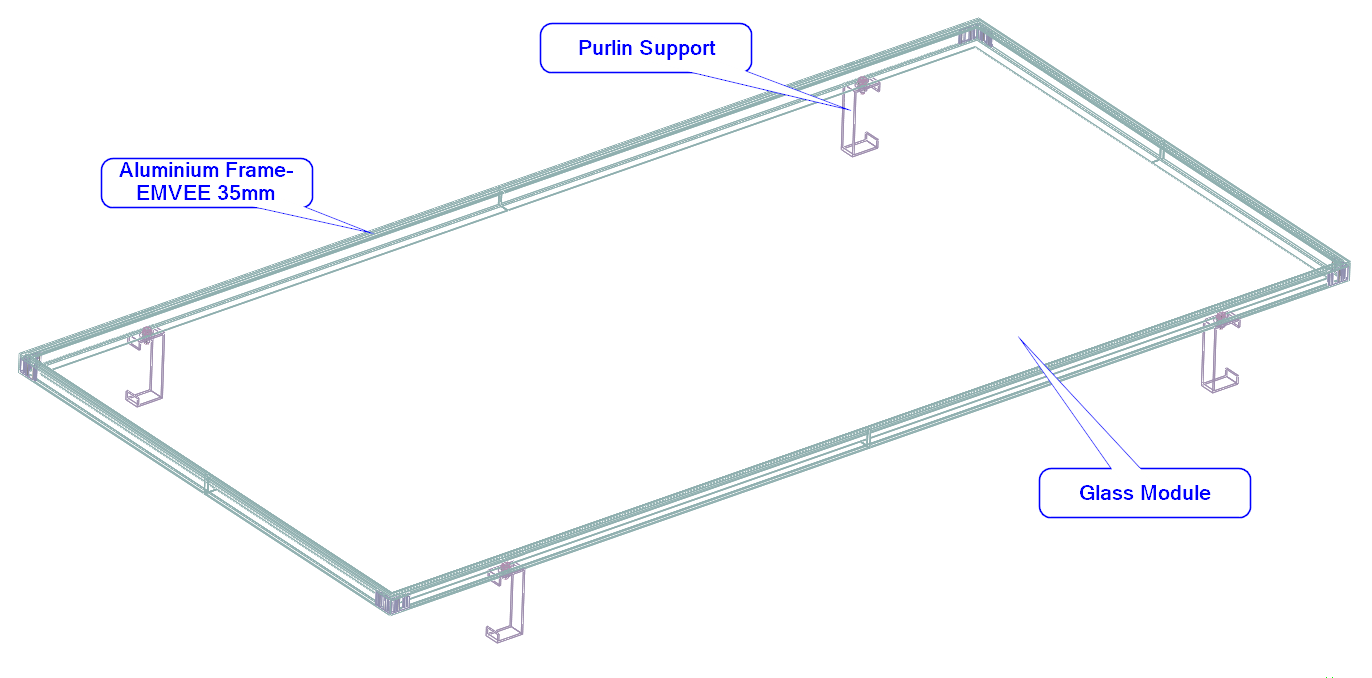


Figure 3D Geometrical Model

###### Element Plot:

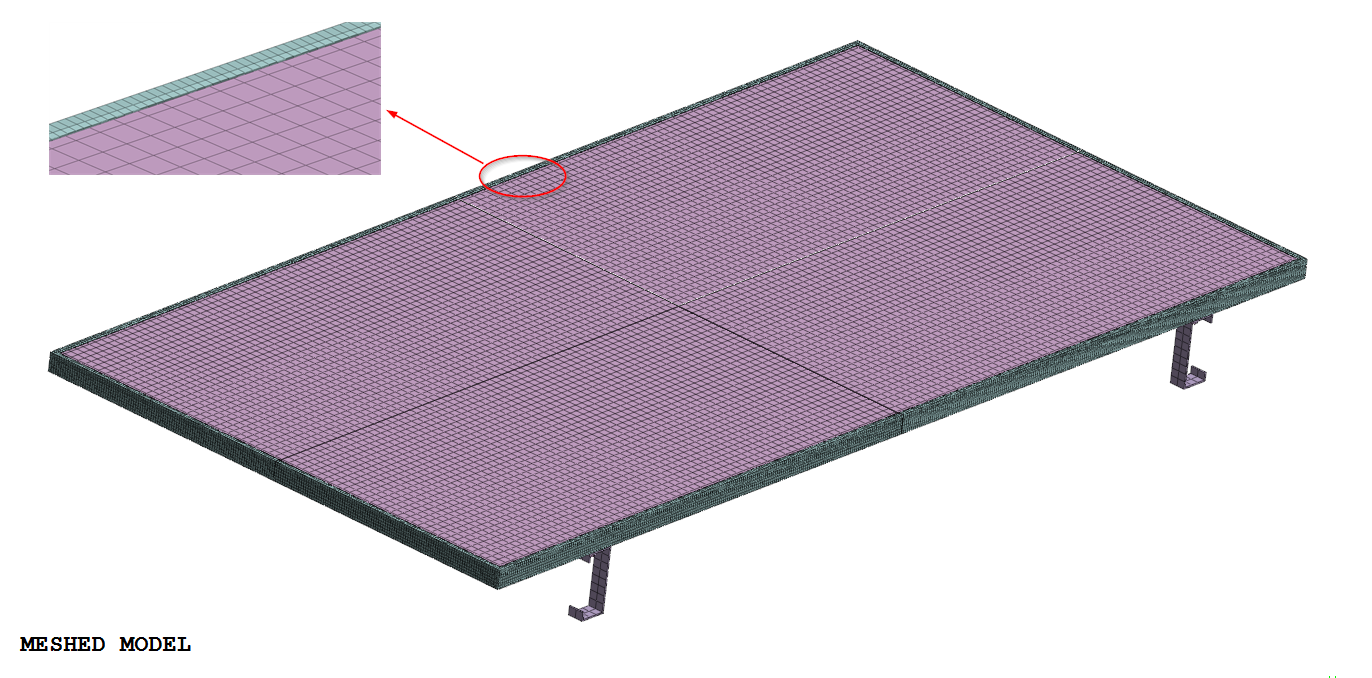
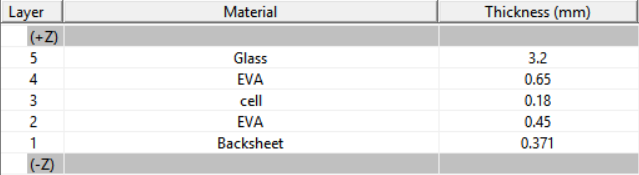


Figure Finite Element Model

###### Material Data:

**Material property for Aluminum Alloy (AL-6063-T5) :**

Table Laminate Thicknesses



Layer 1 is on the bottom. Subsequent layers are added to the top, increasing in the +Z normal direction.

Table Laminate Material Data

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr. No.** | **Material** | **Properties** | |
| **E (MPa)** | **P.R.** |
| 1 | Aluminum Alloy (AL-6063-T5) | 68900 | 0.33 |
| 2 | Backsheet | 2138 | 0.35 |
| 3 | Silicon cell | 1.625 ×105 | 0.3 |
| 4 | EVA sheet | 394 | 0.29 |
| 5 | Glass | 73000 | 0.2 |

E- Modulus of Elasticity, P.R.- Poisson’s Ratio

###### Loads:

The analysis aims to provide the verification of structural stability considering wind and snow loads for the solar panel frame by means of the Finite-Element-Method (FEM).

Following Pressure magnitude is applied on Panel face.

Wind load- 2400 Pa.

Snow load – 5400 Pa

###### Load Cases:

1. LC1 – Wind load
2. LC2 – Snow Load

###### Boundary conditions and loads:

* 1. Purlin is constrained in all directions.
  2. Frame is constrained at bolting locations.
  3. Wind and snow pressure is applied normal to Panel face.

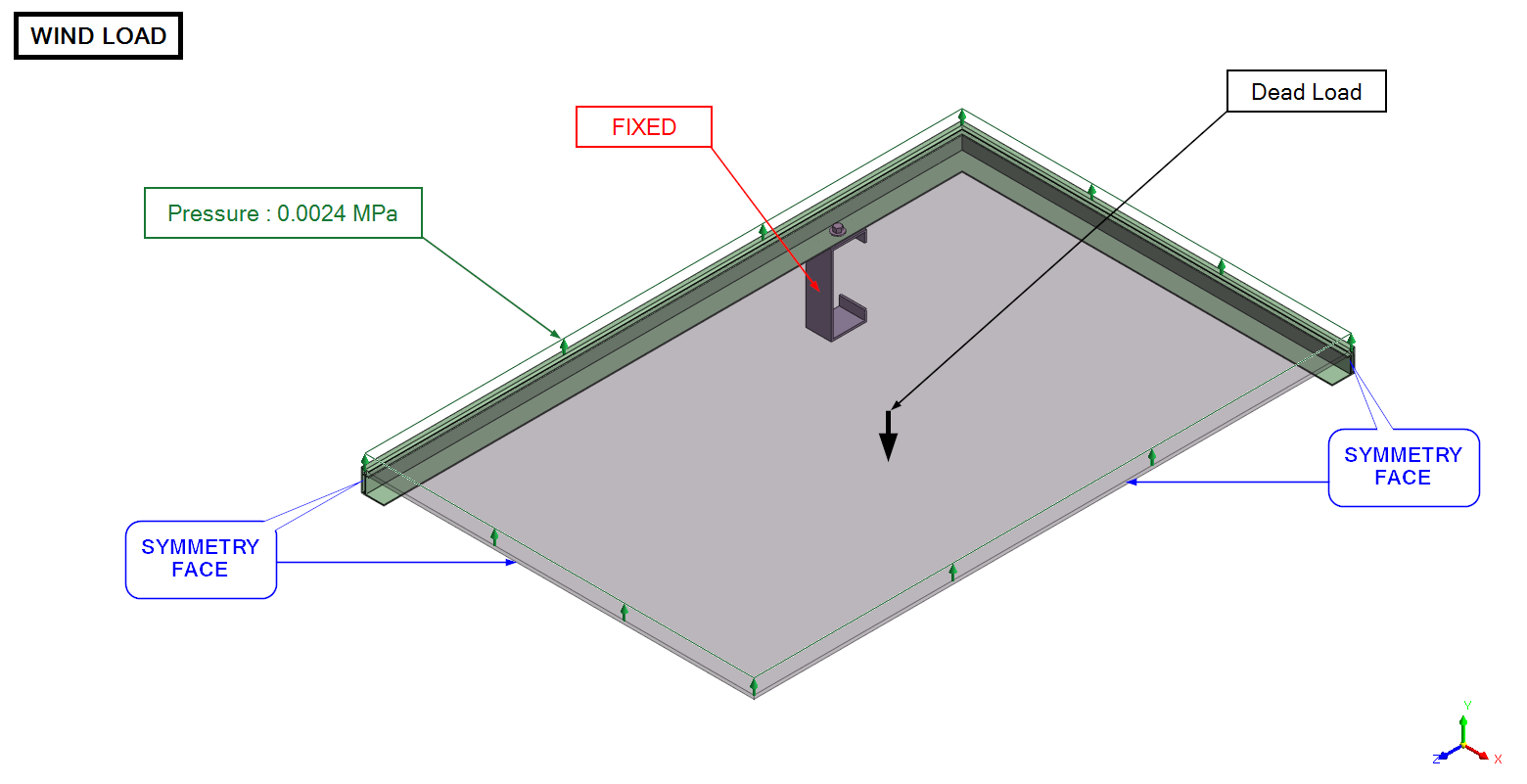


Figure : Loading condition LC-1

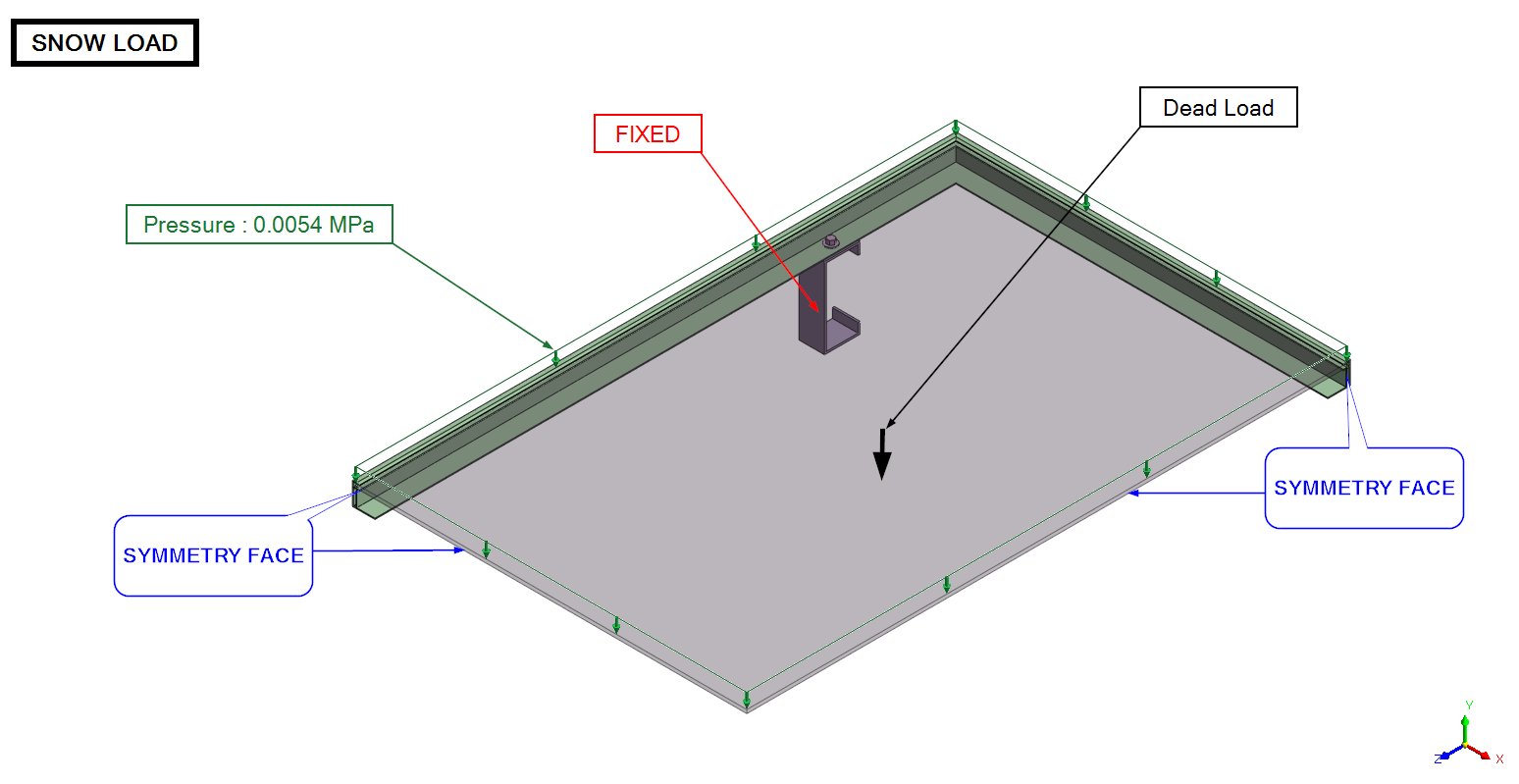


Figure : Loading condition LC-2

###### Deformation Plot:

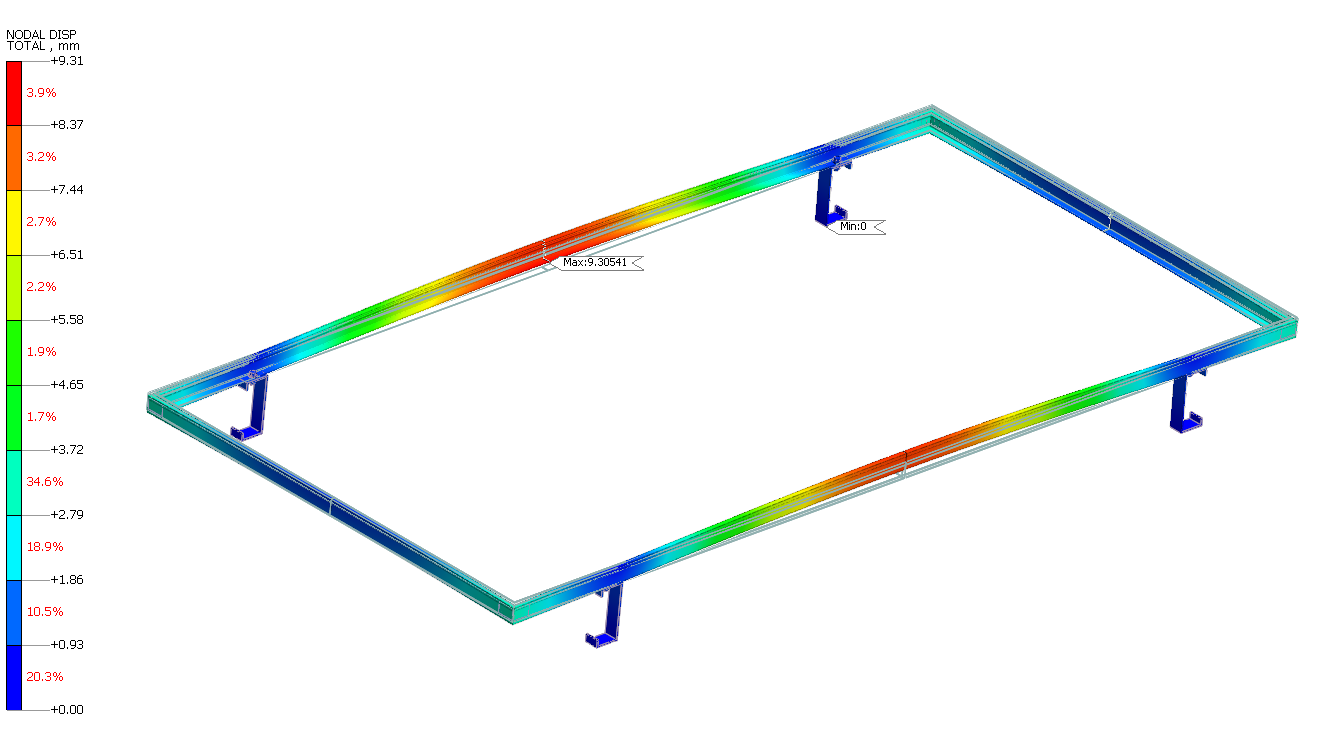


Figure Total deformation plot for load case LC1 (Scaled : 1x)

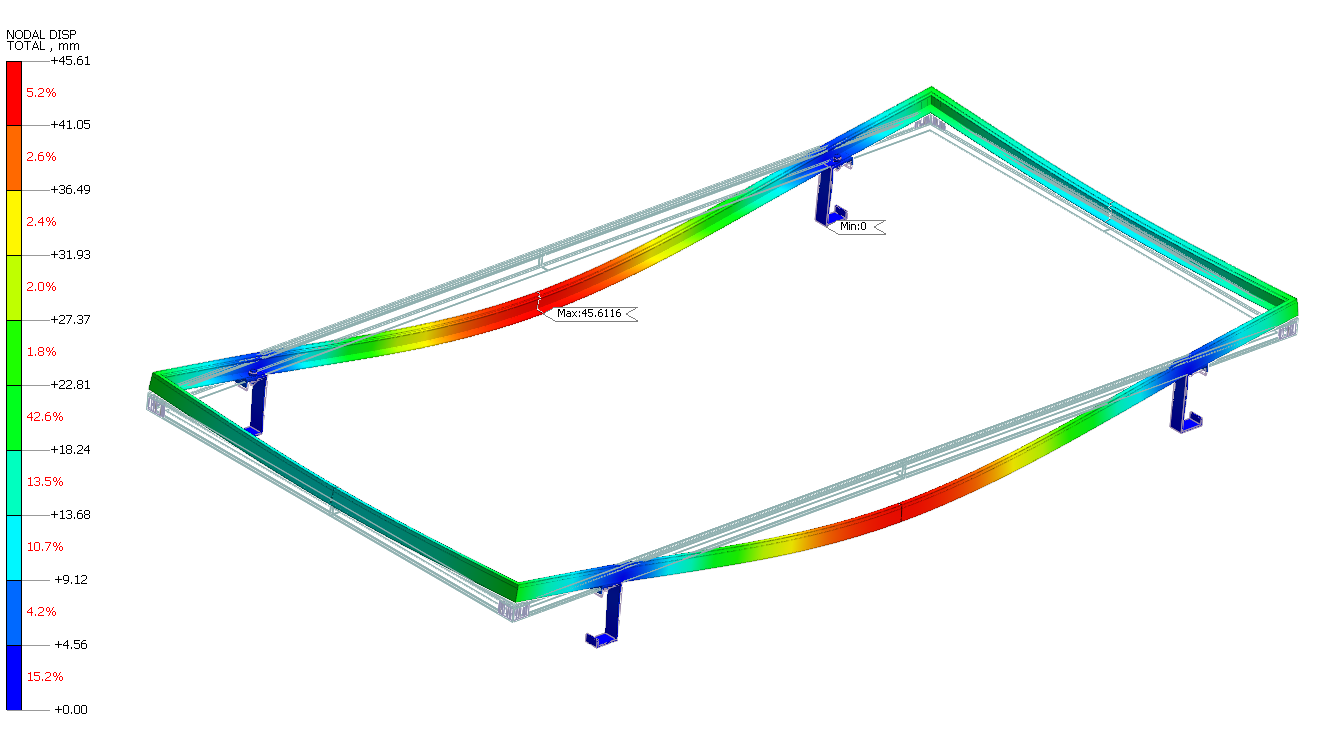


Figure Total deformation plot for load case LC2 (Scaled : 1x)

###### Stress plots

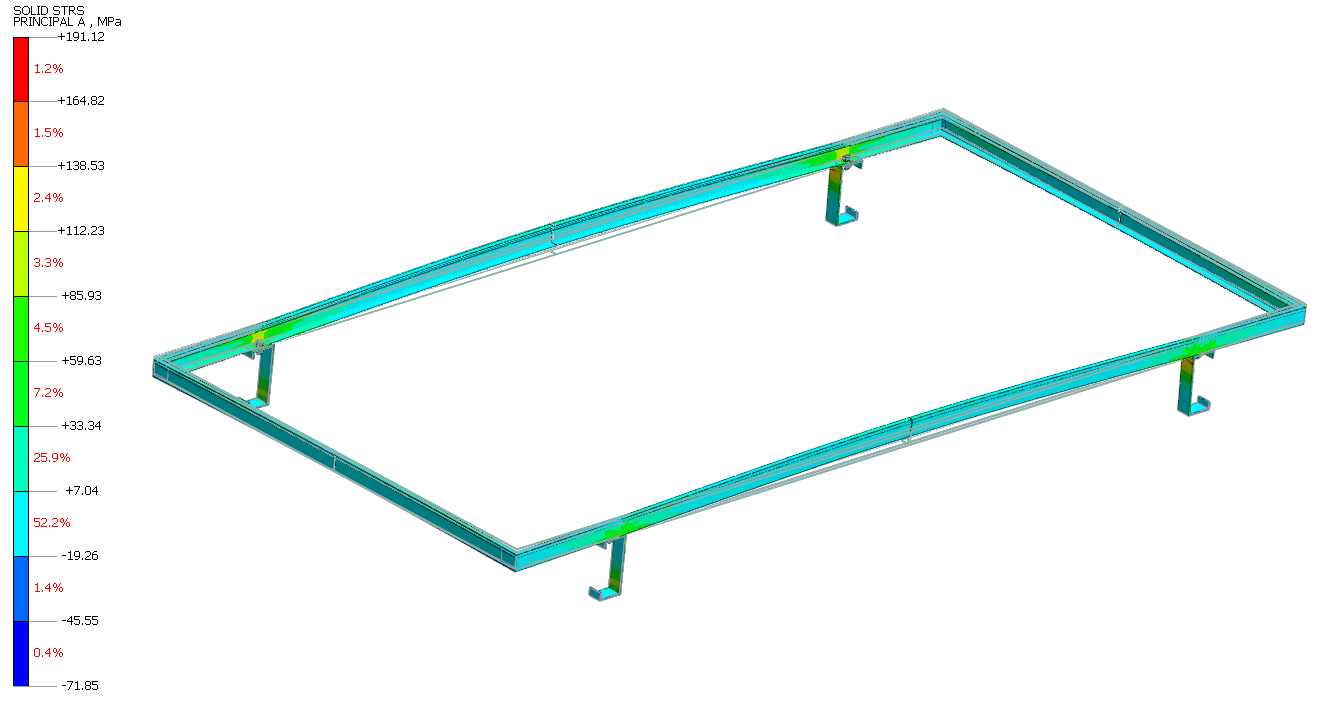


Figure Maximum Principal stress plot for load case LC-1

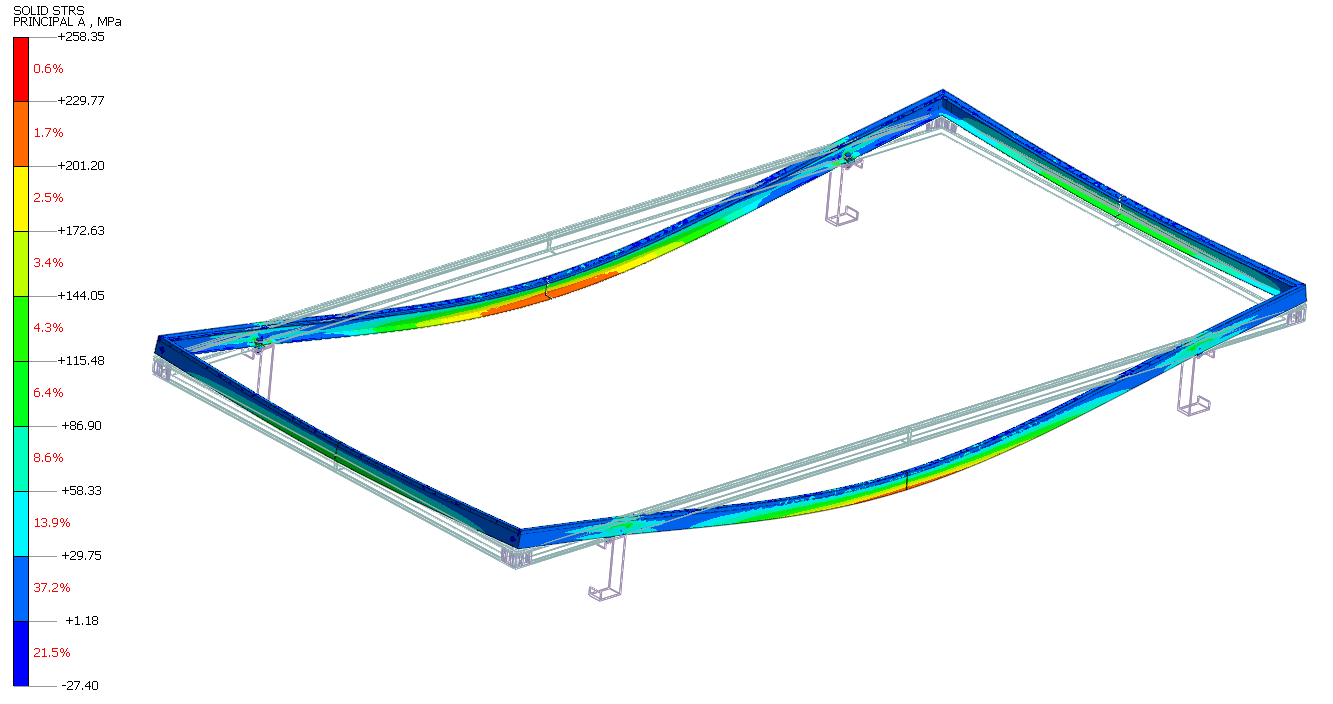


Figure Maximum Principal stress plot for load case LC-2

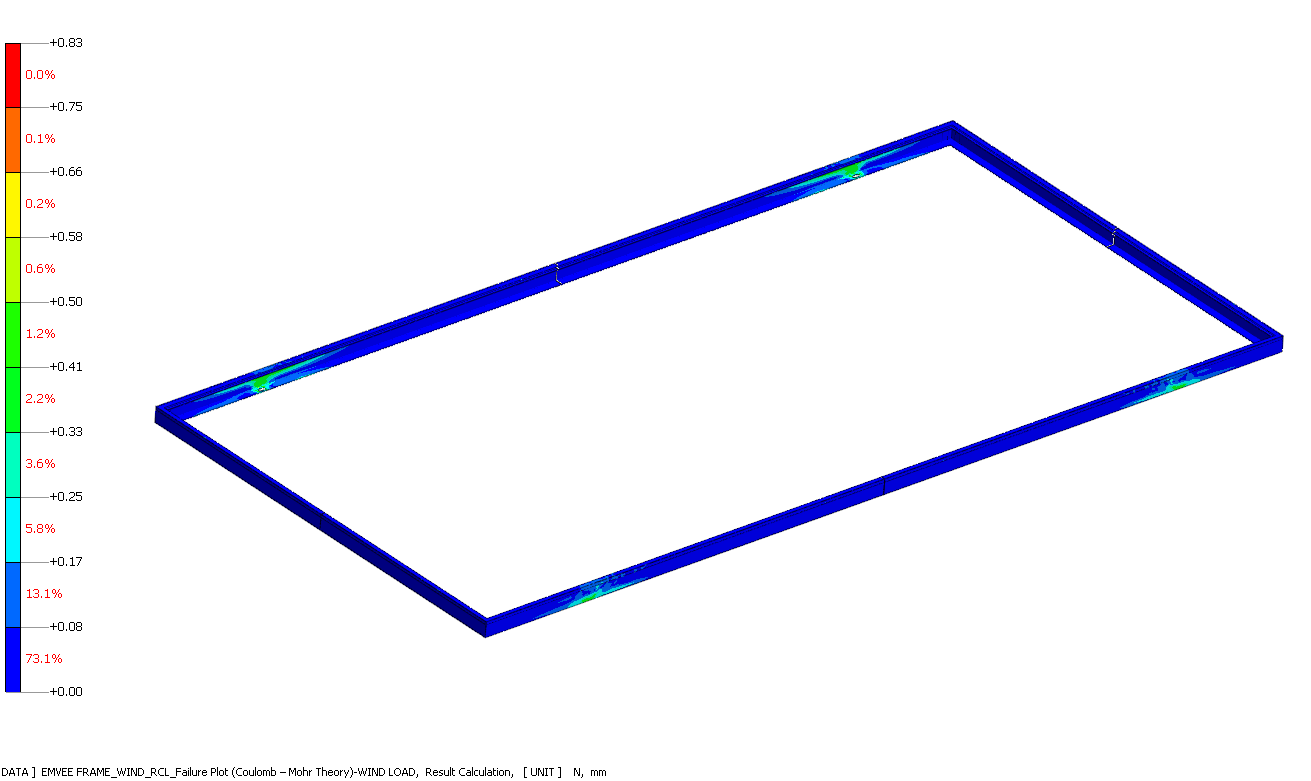


Figure Failure Plot (Coulomb – Mohr Theory) for LC1

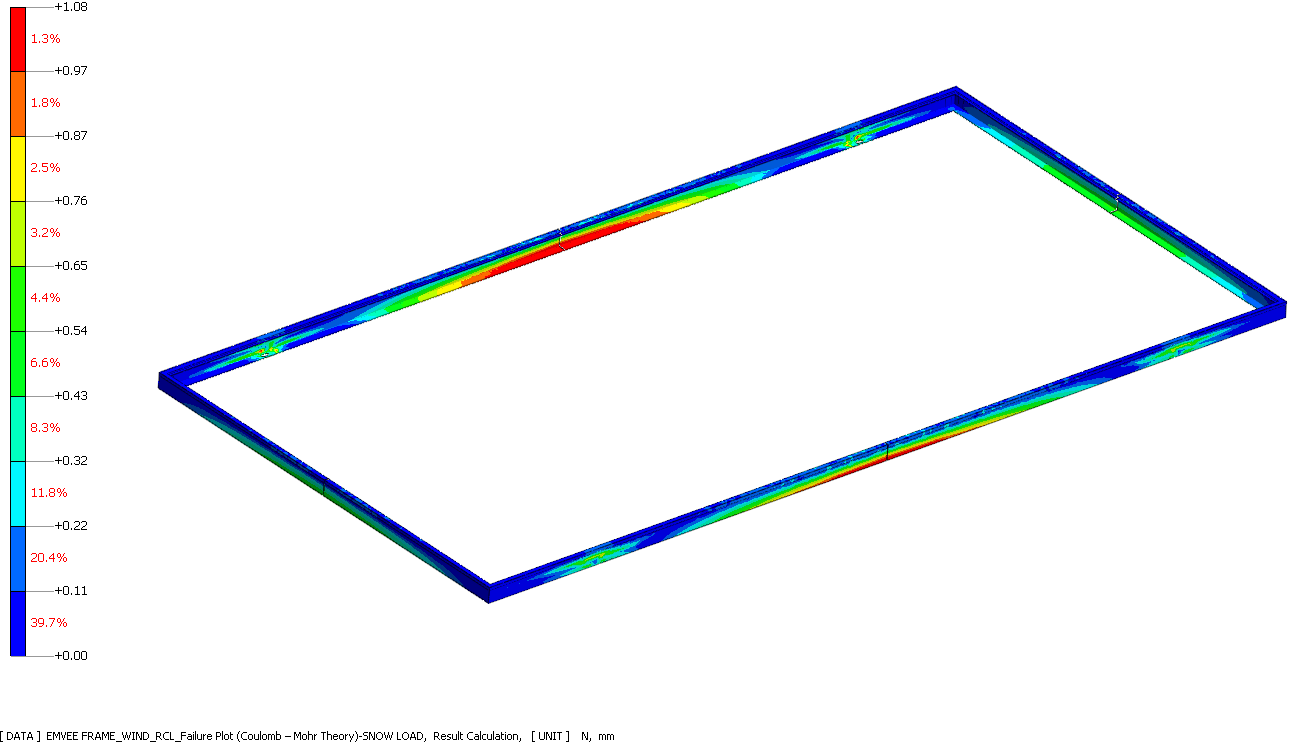


Figure Failure Plot (Coulomb – Mohr Theory) for LC2

###### Results:

Table Results summary

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Load Case** | **Induced Deflection**  **(mm)** | **Coulomb –Mohr Factor**  **(CMF)** | **Allowable Coulomb – Mohr factor (CMF)** | **Result** |
| LC1 | 9.31 | 0.83 | 1 | PASS |
| LC2 | 45.61 | 1.08 | 1 | FAIL |

**Note:**

1. Refer section 11) for result plots.

2. Refer Section 1) for Coulomb – Mohr theory for interpretation.

###### Conclusion:

*As shown in Section 12) of this report, calculated CMF is less than 1 for LC1, but greater than 1 for LC2. Hence, the design is considered as FAIL in Snow Loading Condition.*