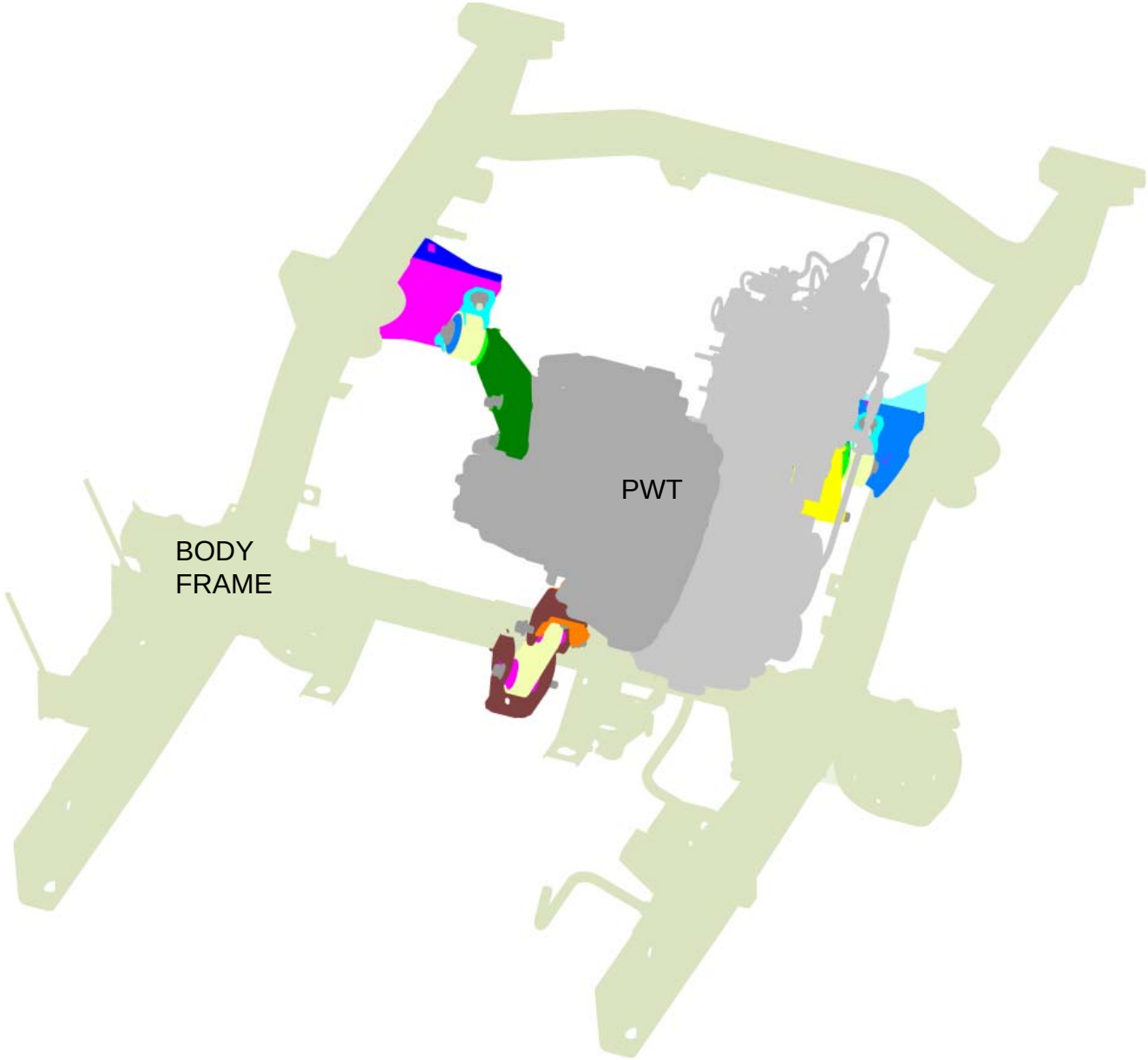
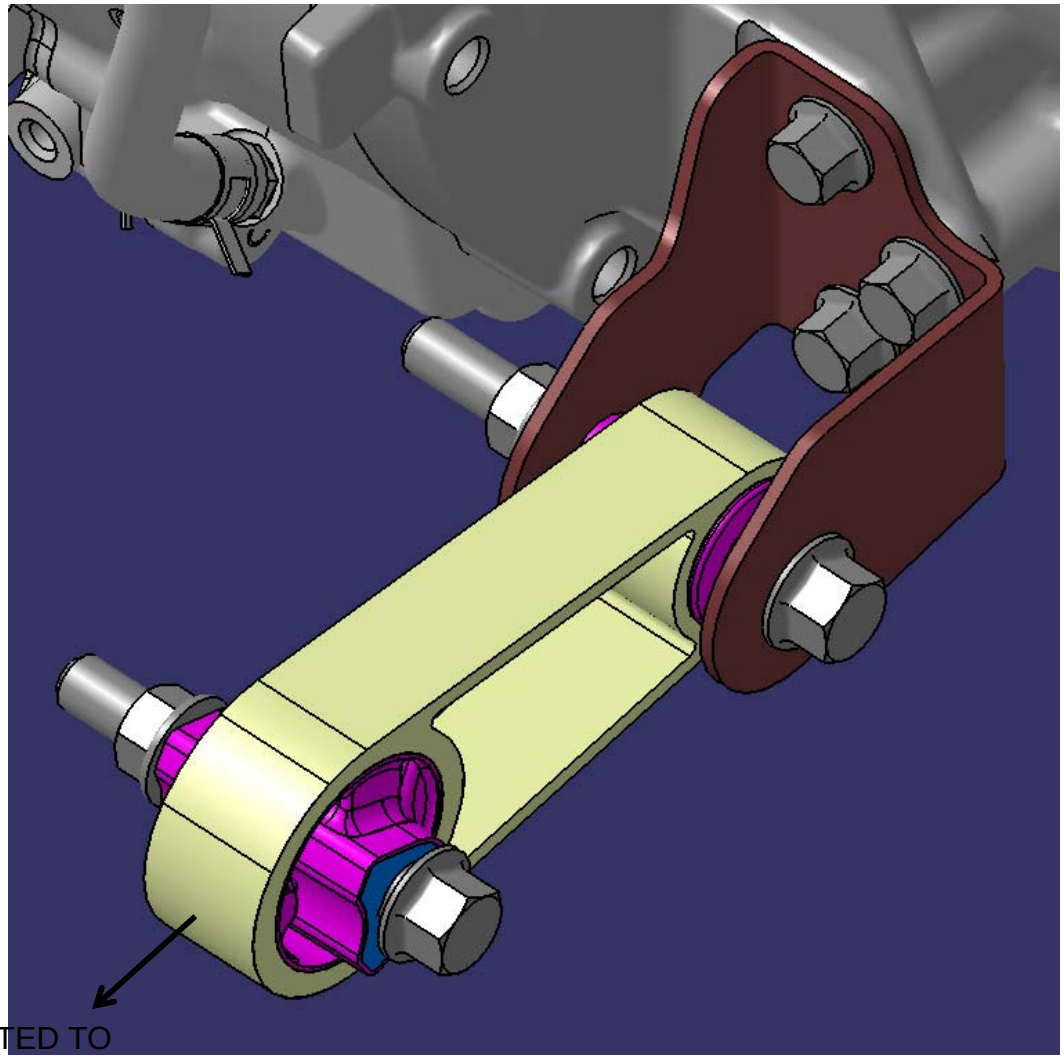
Structural Durability Analysis of a Powertrain mounting bracket

COMSOL CONFERENCE BANGALORE2013

Powertrain Mounting System

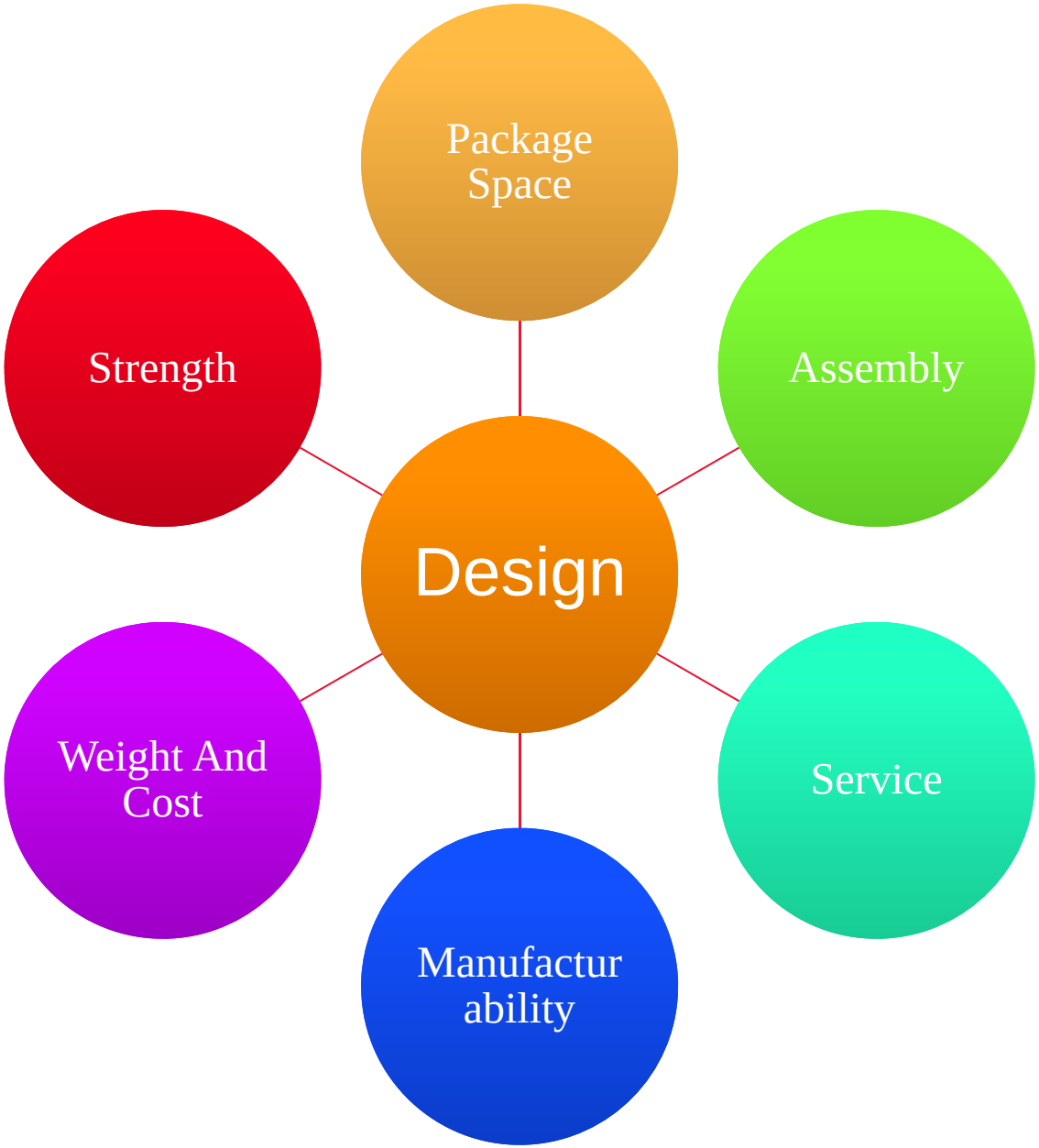


Bracket Under Consideration

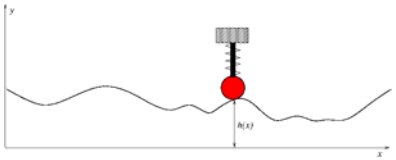


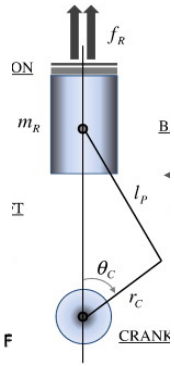
BOLTED TO
BODY FRAME

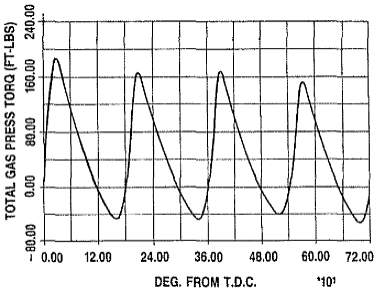
Factors affecting the design



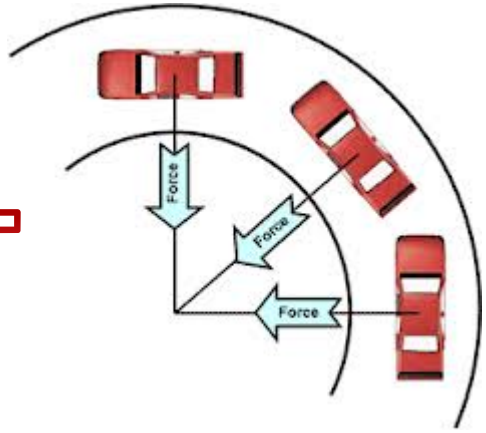
Loads exerted by/on powertrain







3-2-1g + T



Finite Element Analysis

Pre-processing

- Material specification, Meshing, Boundary conditions

Processing

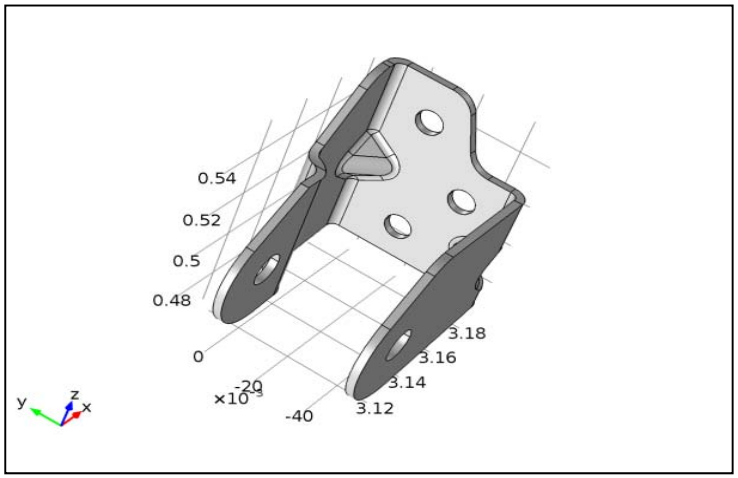
- Element matrix equations, Assembly of elements based on continuity of boundary conditions, solver.

Post processing

- Analyzing the results, design modifications

Pre-processing

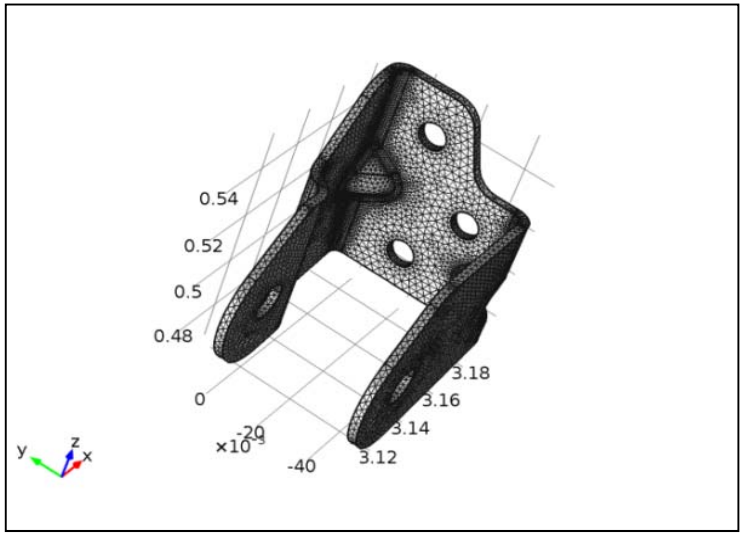
Imported CAD model



Material Specifications

Material Property	Value
Material	Structural Steel
Density	7850 kg/m3
Young's Modulus	210 GPa
Poisson's Ratio	0.29
Ultimate Tensile strength	410 MPa
Yield strength	270 MPa
Endurance strength	210 MPa

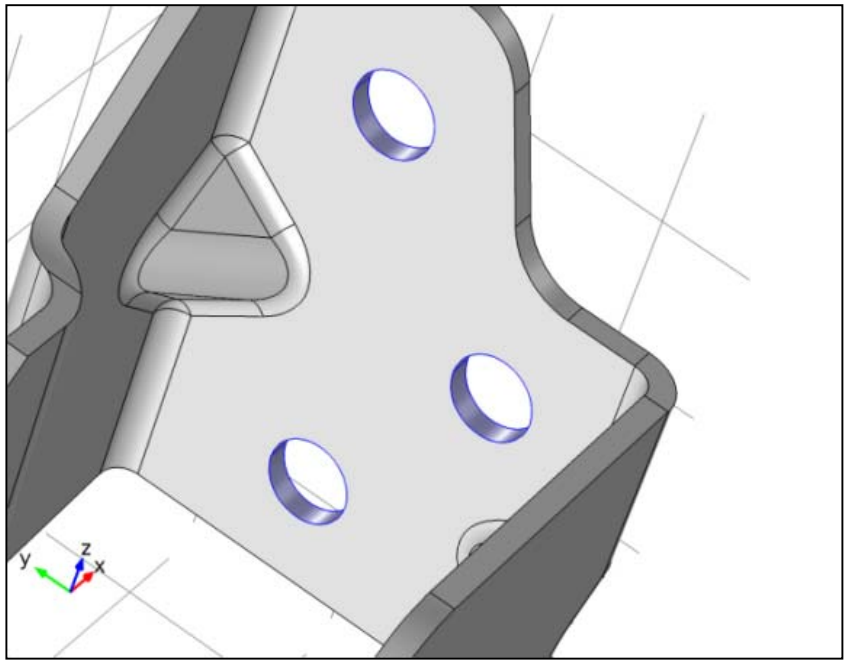
Meshing



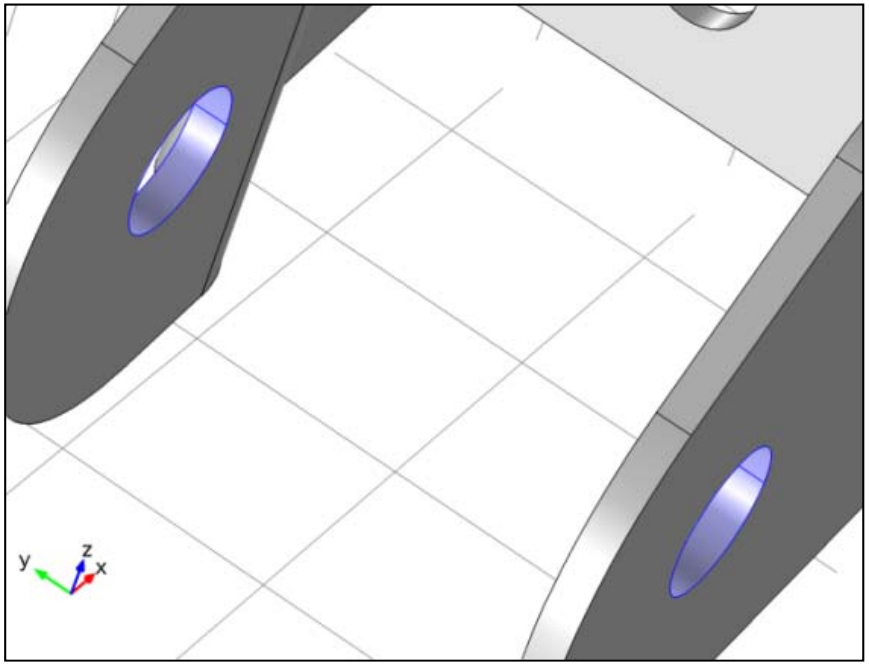
Mesh Property	Value
Meshing element	Tetrahedron
Predefined size	Extra fine

Pre-processing

Fixed constraints (ALL DOFs)



Boundary Load



Force direction	Value
X	-3000 N
Y	100 N
Z	3000 N

Processing

- Second order governing differential equation for static solid mechanics

$$-\frac{d}{dx}\left(EA\frac{du}{dx}\right)+q=0$$

- Construction of variational formulation of the given differential equation.

- Obtain element matrix equation.

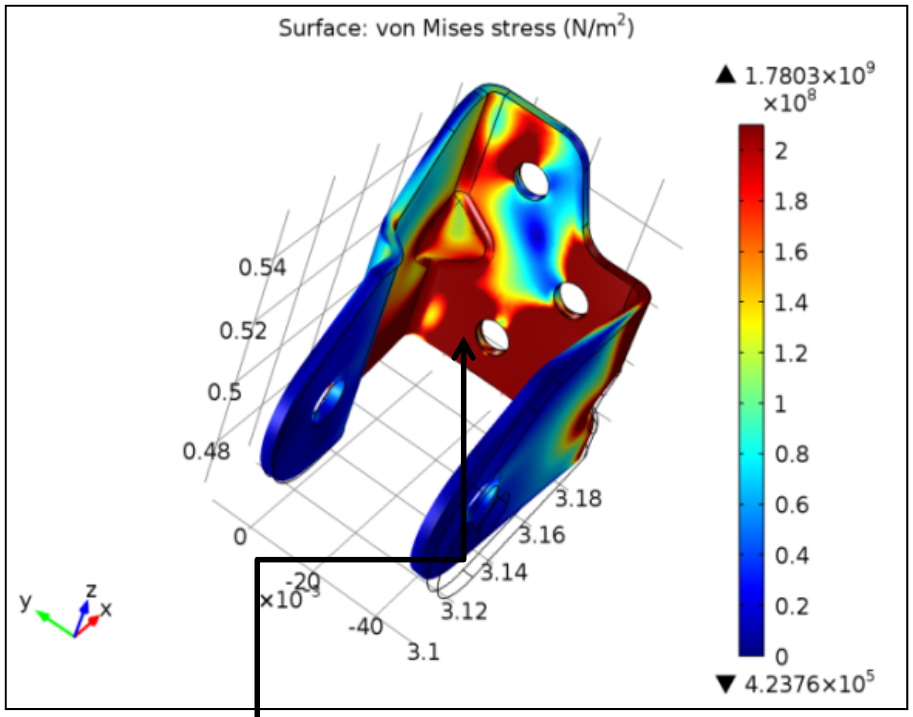
$$\left[K^{e}\right]\left\{u^{e}\right\}=\left[F^{e}\right]$$

- Assembly of elements using continuity conditions among the primary variables and equilibrium conditions among secondary variables.

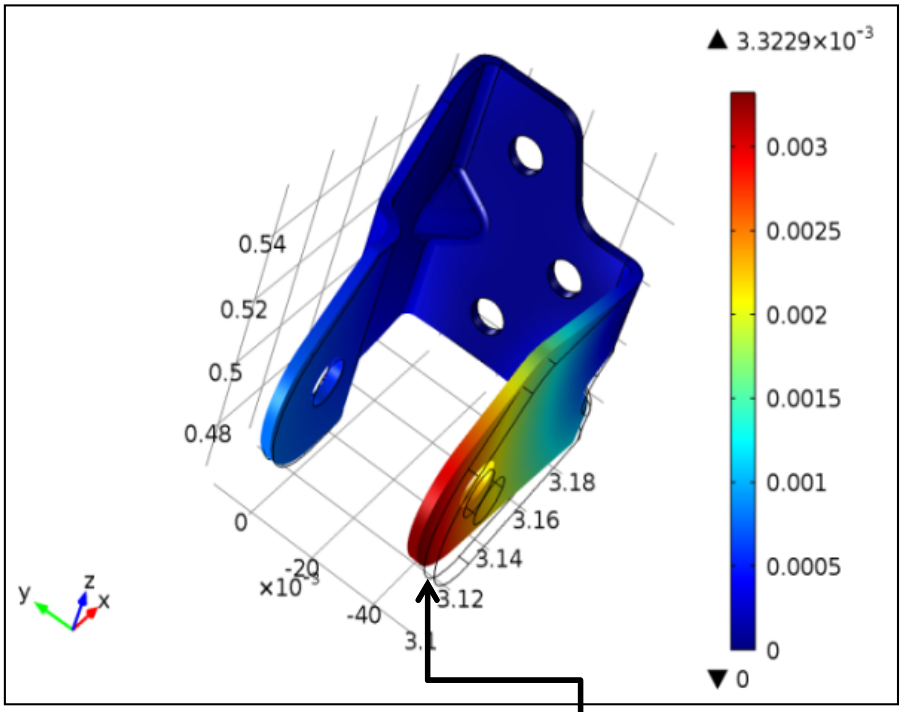
- Solution of assembled equation.

Post-processing

Stress Plot



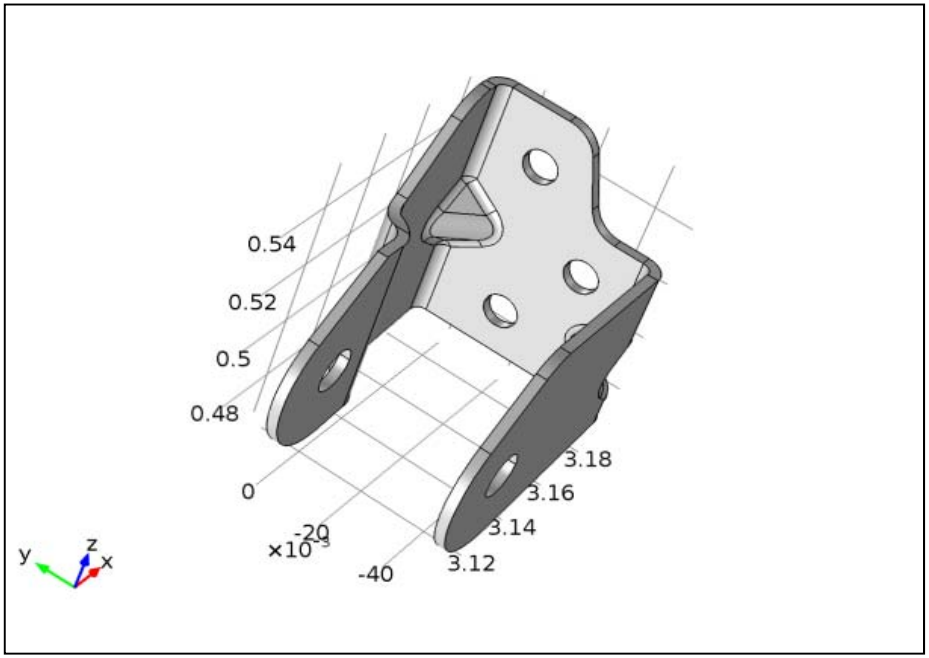
Displacement Plot



Maximum Stress = 1340 MPa

Maximum Displacement = 3.3mm

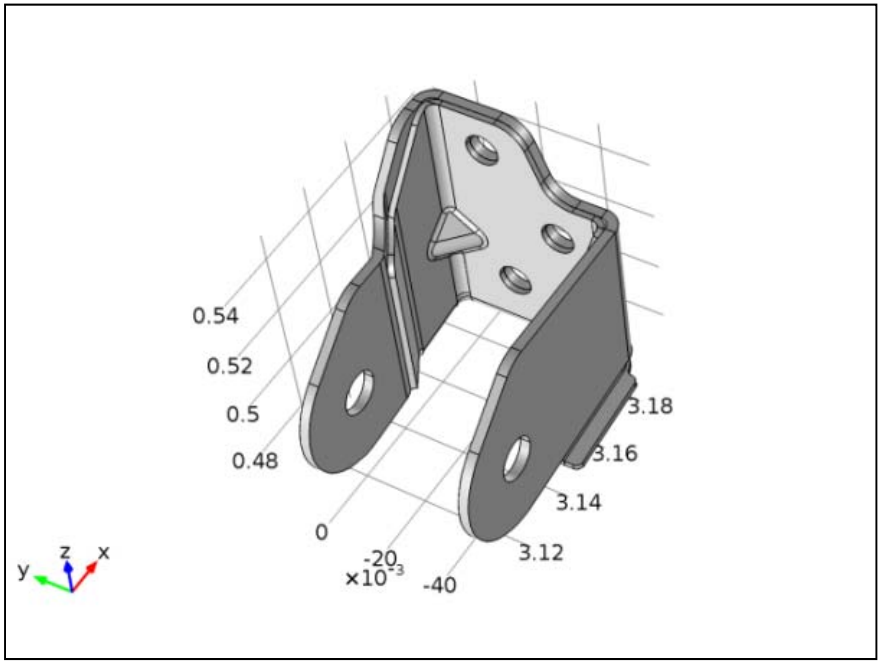
Post-processing



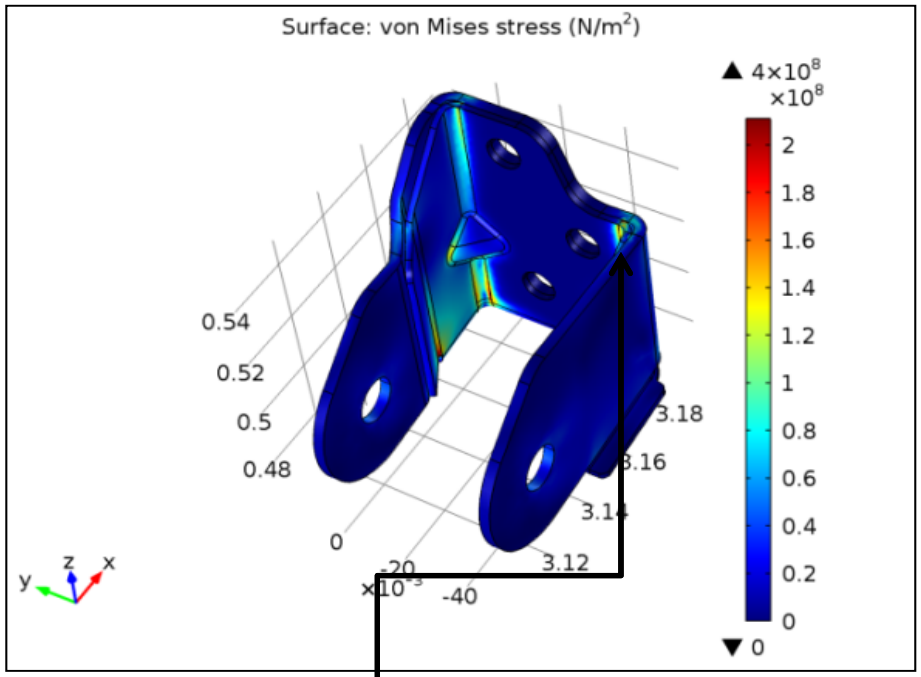
Additional member of less thickness was inserted inside the main bracket.

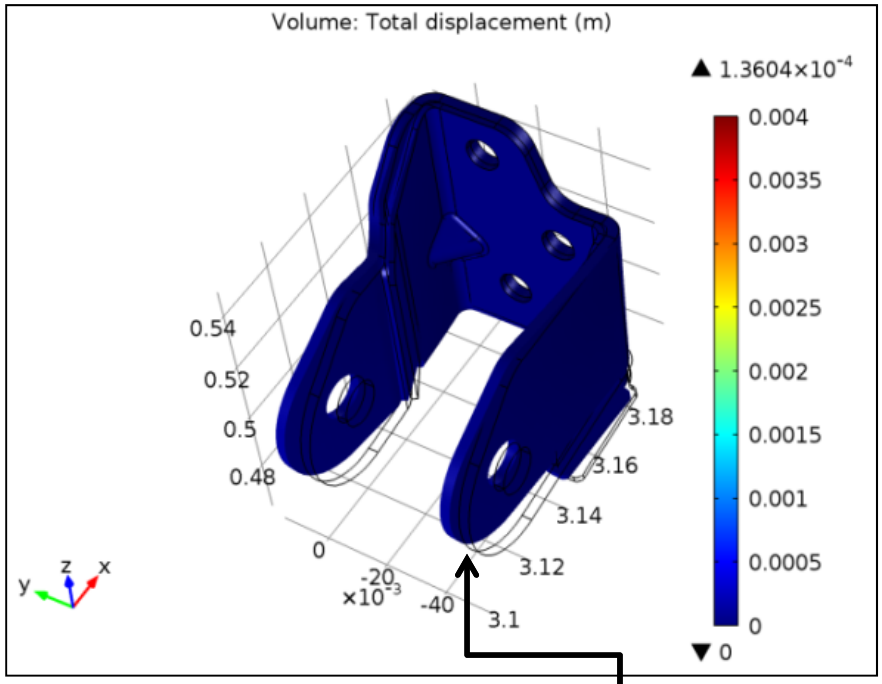
'Joint constraints' was applied at the seam welding locations.

Material, Meshing and boundary conditions were specified as before.



Post-processing



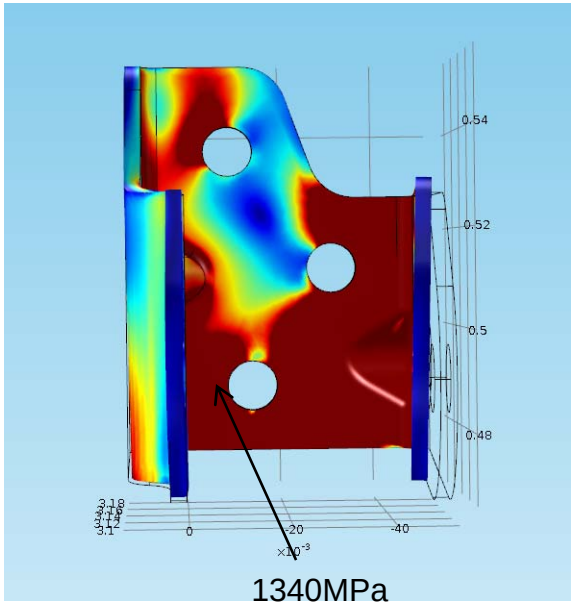


Maximum Displacement = 0.7mm

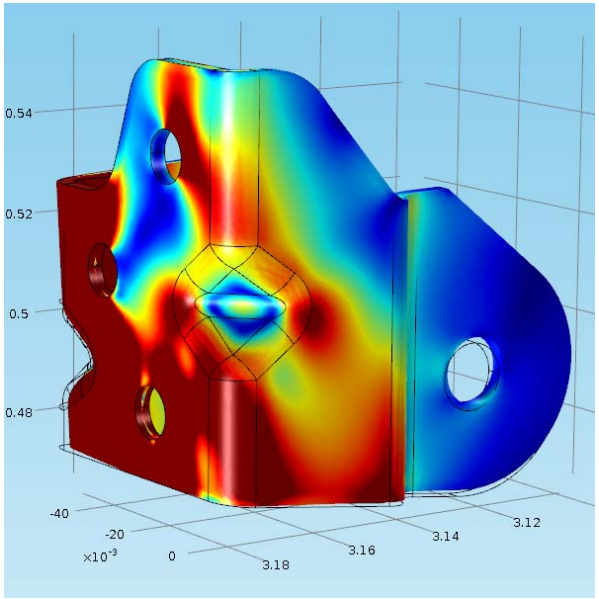
Maximum Stress = 204 MPa

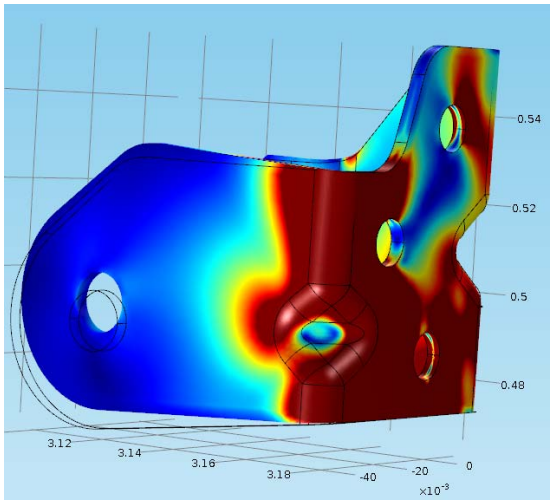
Correlation with CAE analysis results

COMSOL results

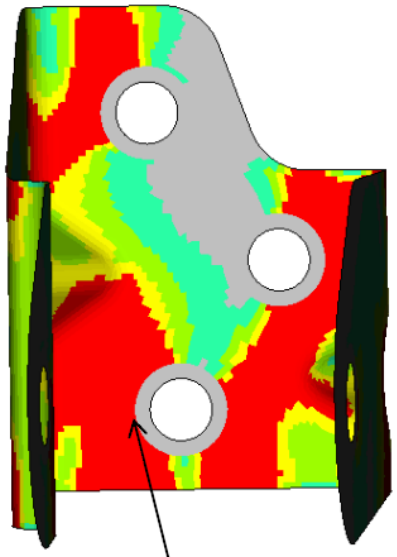


1340MPa

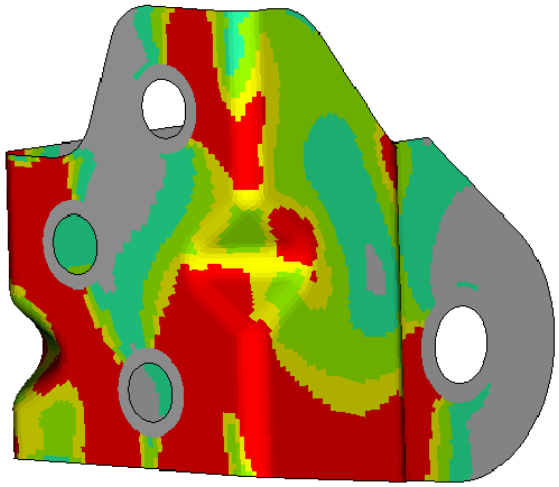


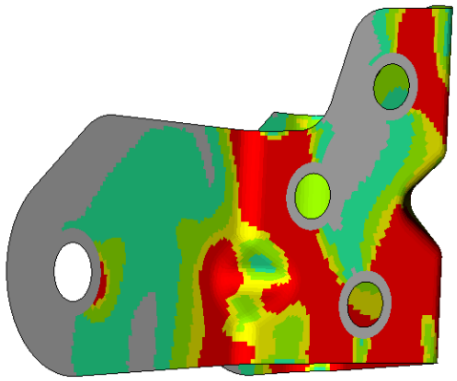


CAE durability results



1258MPa





Conclusion

- Used COMSOL multiphysics to perform the structural analysis of powertrain mounting bracket.
- Optimized the bracket design by using the obtained results thereby reducing the number of CAE iterations and thus save time.

The way forward…

- Using multiphysics to perform the thermal, frequency and fatigue life analysis for the bracket.

Thank you

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