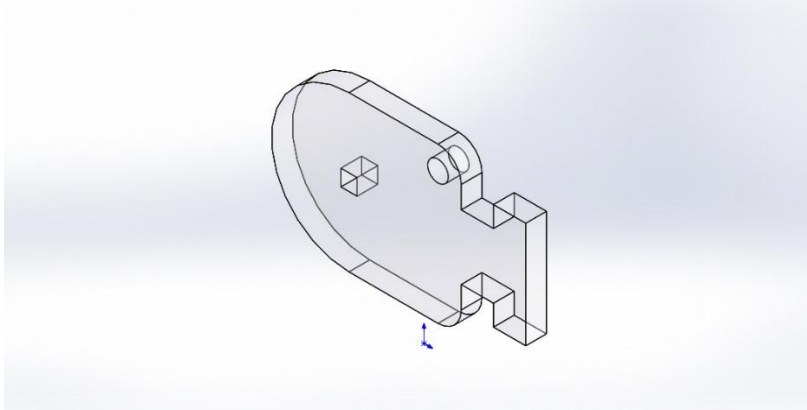


Simulation of A45-009989

Date: Saturday, May 31, 2014
Designer: Estiven Sierra
Study name: Dumbbell Load
Analysis type: Static

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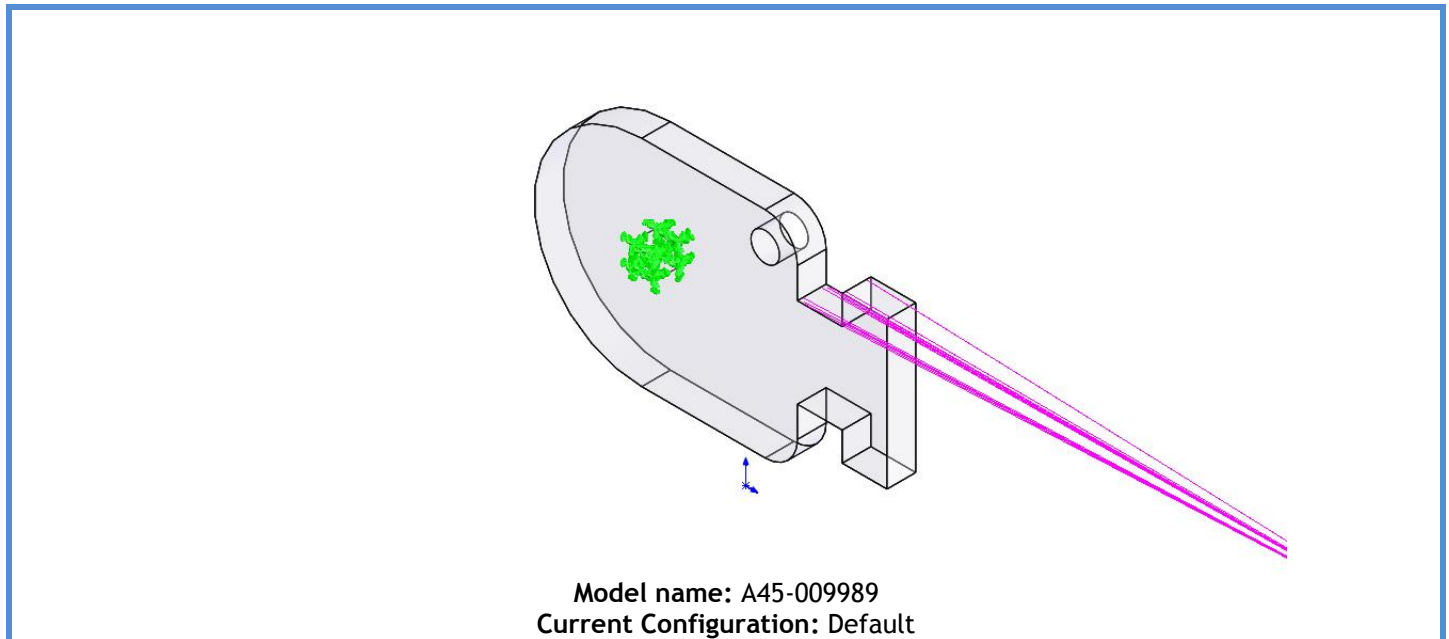
Description

This study looks into the stresses actuating in the wrist of the Sierra Arm while holding a 0.1 N load.

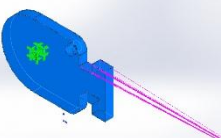
Assumptions

Part material maintain similar physical and mechanical properties along all axes (isotropic).

Model Information



Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Cut-Extrude4 	Solid Body	Mass:0.00594591 kg Volume:4.95492e-006 m ³ Density:1200 kg/m ³ Weight:0.0582699 N	C:\Users\esierra\Documents\SW_projects\VexRobot V4\A45-009989.SLDPRT May 31 19:22:56 2014

Study Properties

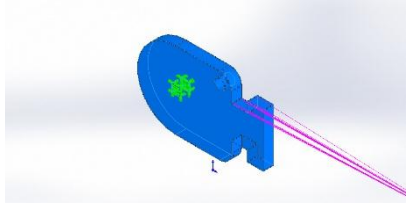
Study name	Dumbbell Load
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SolidWorks Flow Simulation	Off
Solver type	FFEPlus
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SolidWorks document (C:\Users\esierra\Documents\SW_projects\VexRobotV4)

Units

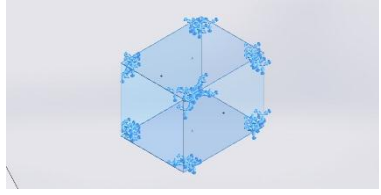
Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m ²

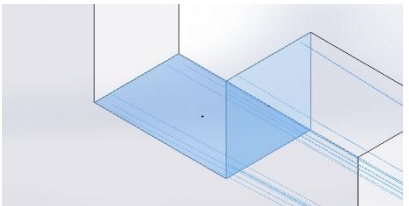


Material Properties

Model Reference	Properties	Components
	<p>Name: Acrylic (Medium-high impact)</p> <p>Model type: Linear Elastic Isotropic</p> <p>Default failure criterion: Max von Mises Stress</p> <p>Yield strength: 4.5e+007 N/m²</p> <p>Tensile strength: 7.3e+007 N/m²</p> <p>Elastic modulus: 3e+009 N/m²</p> <p>Poisson's ratio: 0.35</p> <p>Mass density: 1200 kg/m³</p> <p>Shear modulus: 8.9e+008 N/m²</p> <p>Thermal expansion coefficient: 5.2e-005 /Kelvin</p>	<p>SolidBody 1(Cut-Extrude4)(A45-009989)</p>
Curve Data:N/A		

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details		
Fixed-1		Entities: 4 face(s) Type: Fixed Geometry		
Resultant Forces				
Components	X	Y	Z	Resultant
Reaction force(N)	5.61029e-006	0.10023	2.59089e-005	0.10023
Reaction Moment(N.m)	0	0	0	0

Load name	Load Image	Load Details
Remote Load (Direct transfer)-1		Entities: 2 face(s) Type: Load (Direct transfer) Coordinate System: Coordinate System1 Force Values: ---, -0.1, --- N Moment Values: ---, ---, --- N.m Reference coordinates: 70.5 10.4 -6.6 mm Components transferred: Force

Connector Definitions

No Data

Contact Information

No Data

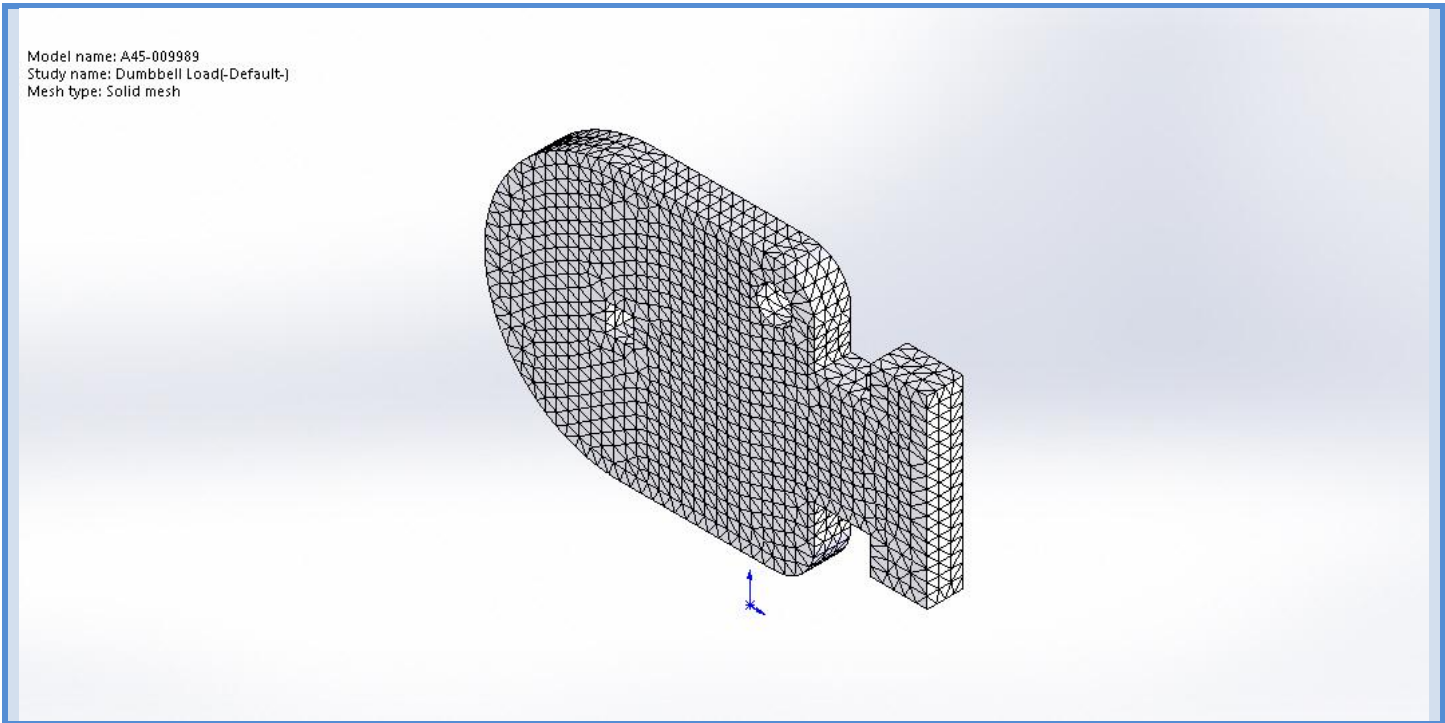
Mesh Information

Mesh type	Solid Mesh
Mesher Used:	Curvature based mesh
Jacobian points	4 Points
Maximum element size	0 mm
Minimum element size	0 mm
Mesh Quality	High

Mesh Information - Details

Total Nodes	23142
Total Elements	14439
Maximum Aspect Ratio	3.7619
% of elements with Aspect Ratio < 3	99.9
% of elements with Aspect Ratio > 10	0
% of distorted elements(Jacobian)	0
Time to complete mesh(hh:mm:ss):	00:00:01
Computer name:	ESIERRA-PC





Sensor Details

No Data

Resultant Forces

Reaction Forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	5.61029e-006	0.10023	2.59089e-005	0.10023

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

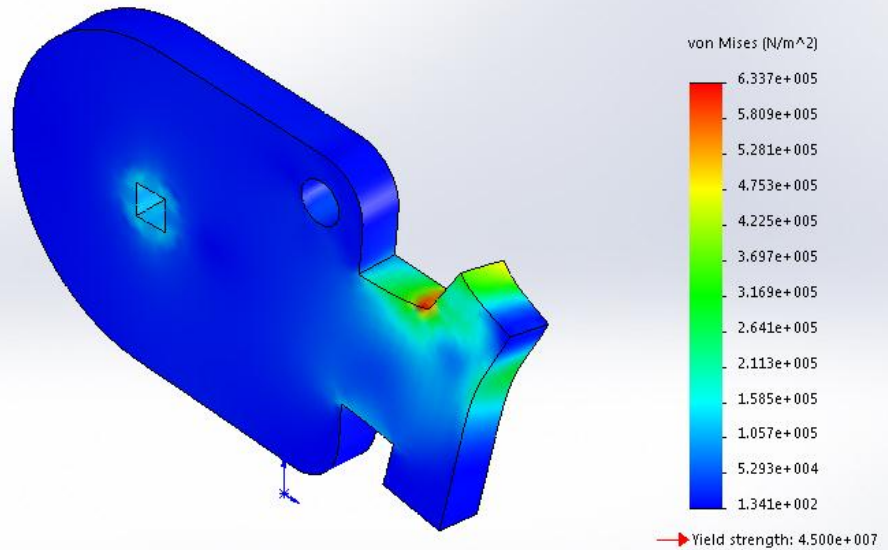
Beams
No Data



Study Results

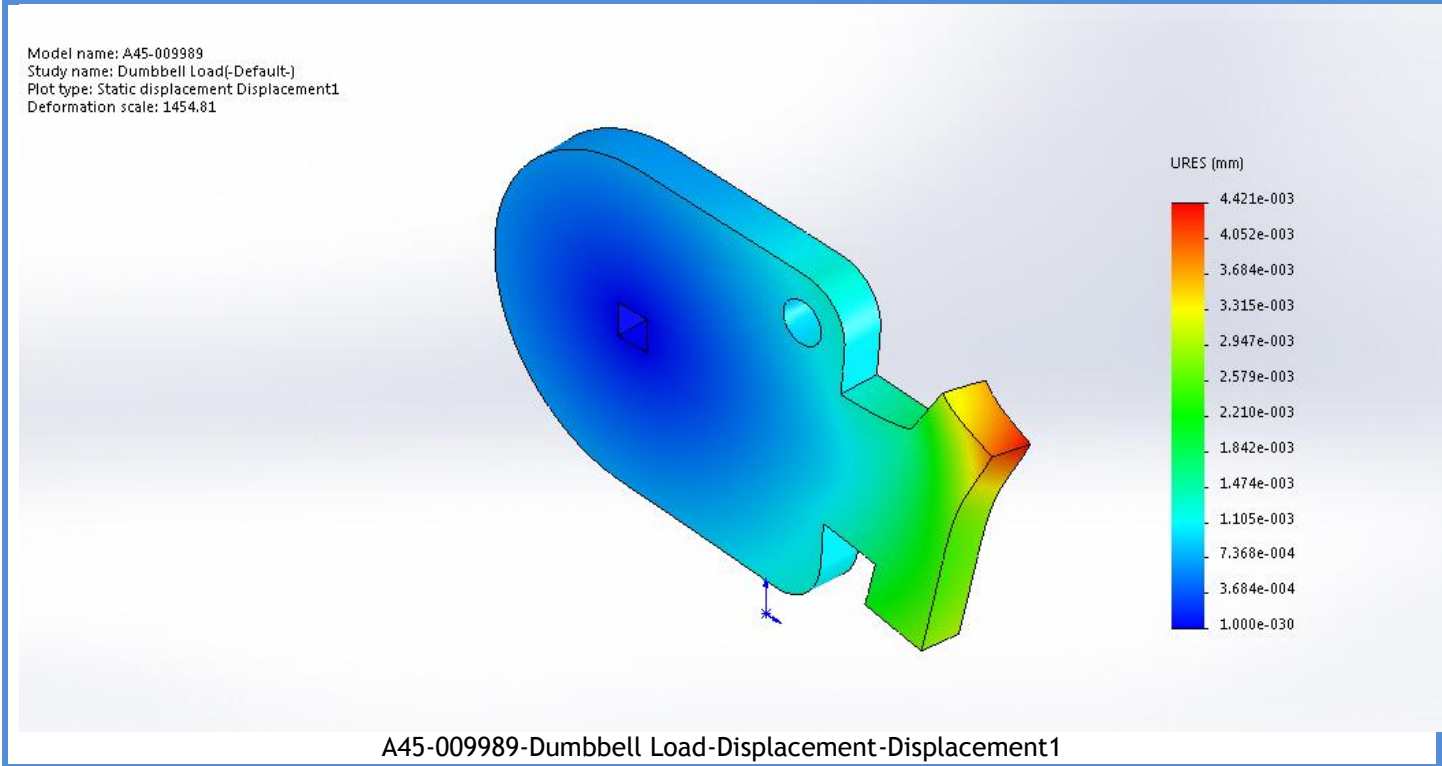
Name	Type	Min	Max
Stress1	VON: von Mises Stress	134.082 N/m ² Node: 17011	633682 N/m ² Node: 16423

Model name: A45-009989
Study name: Dumbbell Load(-Default-)
Plot type: Static nodal stress Stress1
Deformation scale: 1454.81

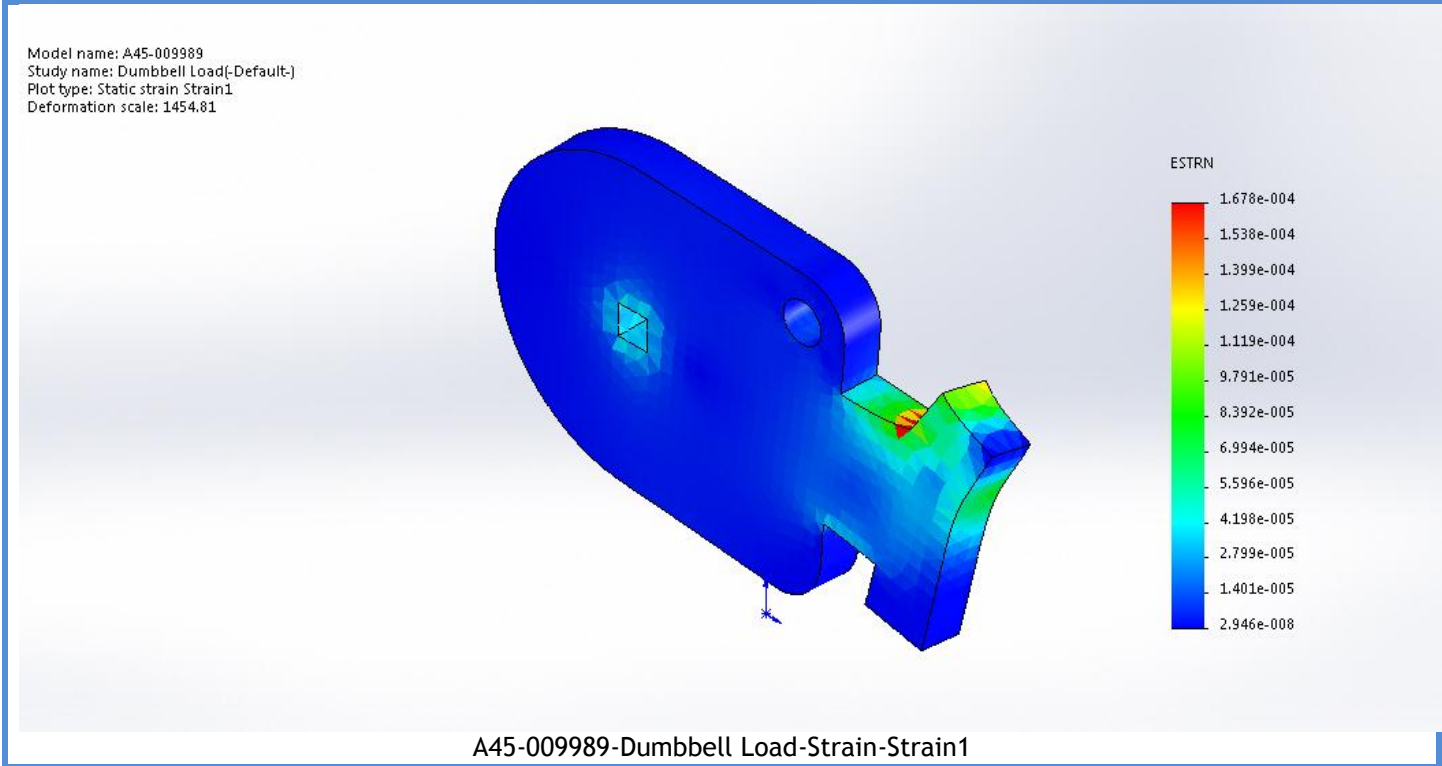


A45-009989-Dumbbell Load-Stress-Stress1

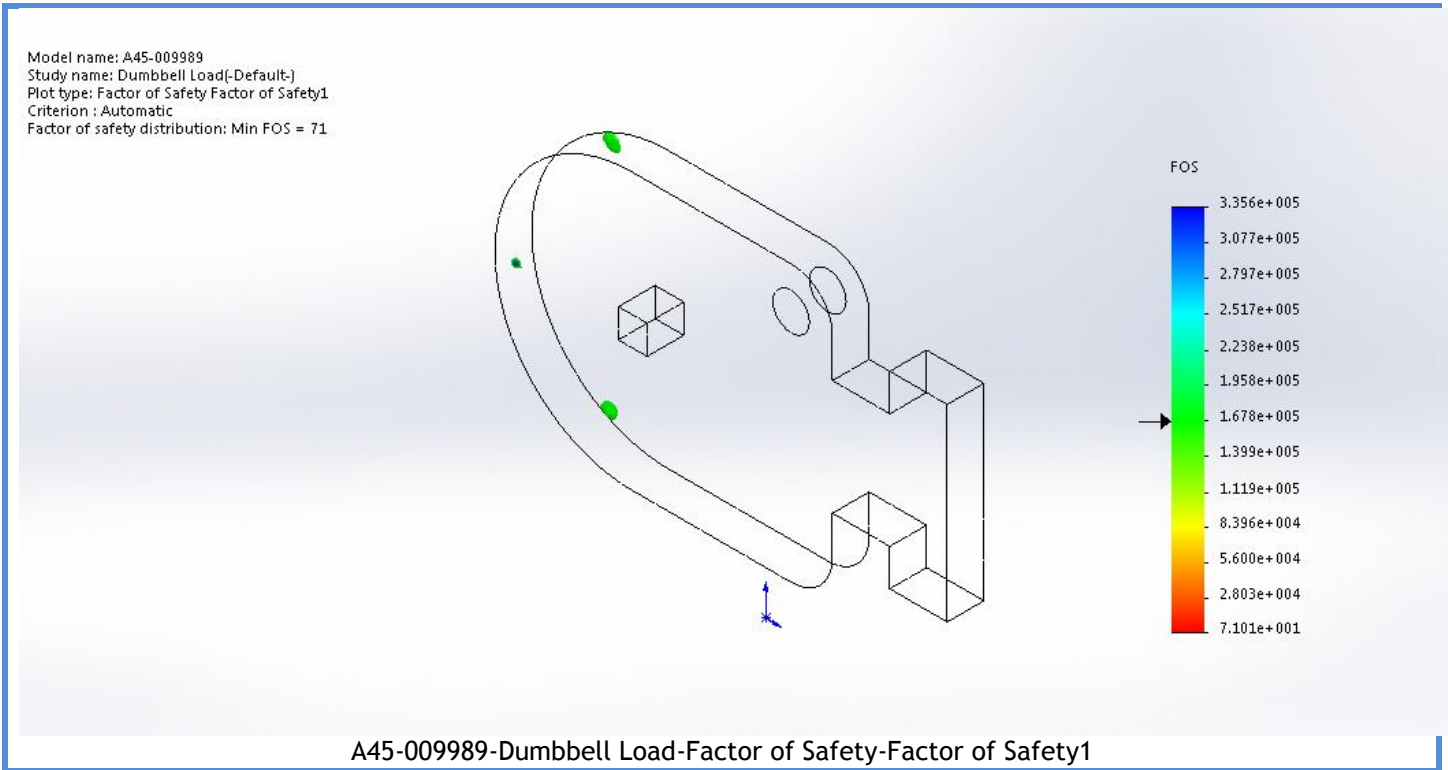
Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0 mm Node: 193	0.00442052 mm Node: 140



Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	2.94608e-008 Element: 8911	0.000167818 Element: 4277



Name	Type	Min	Max
Factor of Safety1	Automatic	71.0135 Node: 16423	335616 Node: 17011



Conclusion

The Part will easily tolerate the stresses of the load in spite of the stress points created by the sharp 90 degrees corners of the square end.