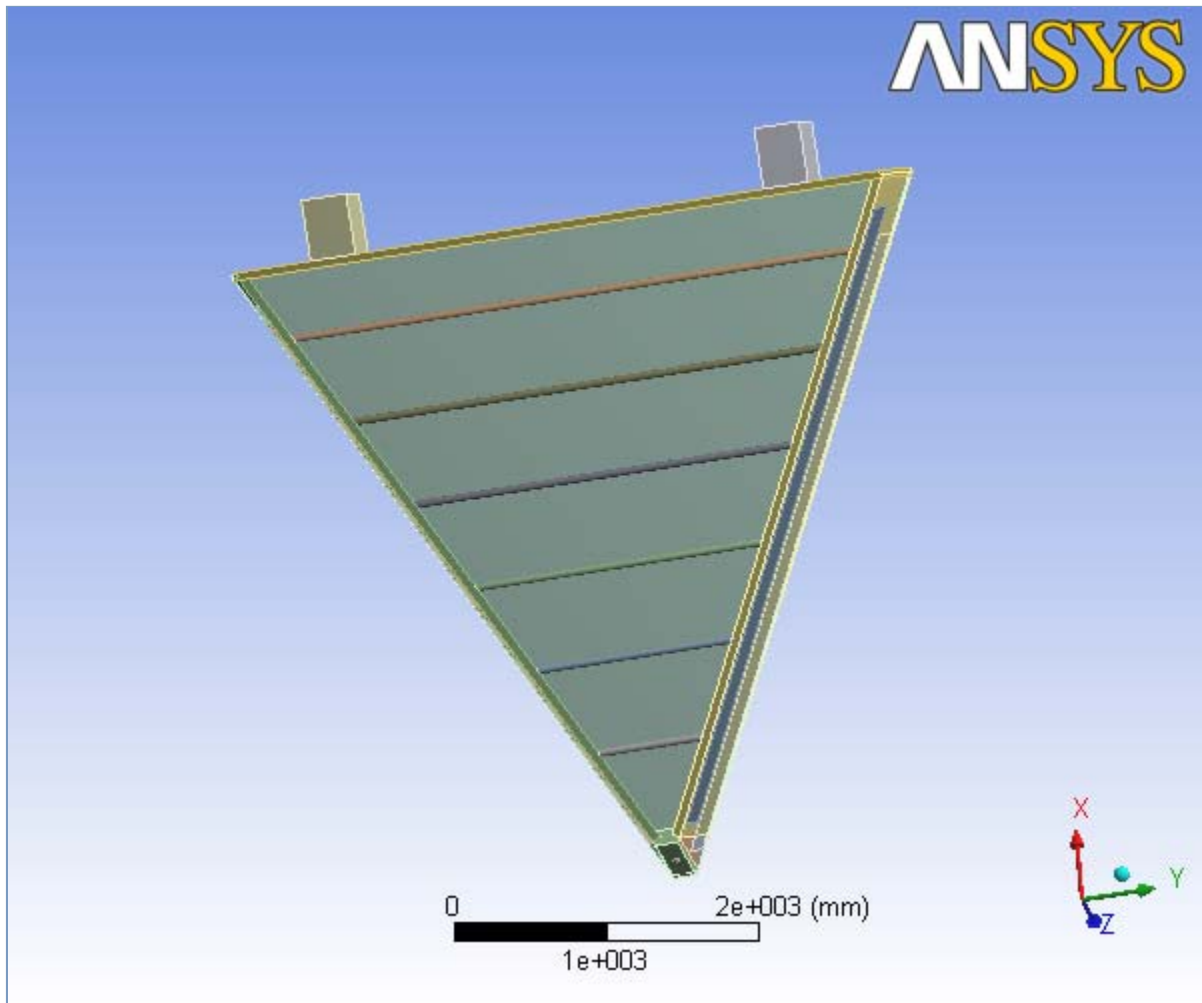




## Project

<i>First Saved</i>	<i>Tuesday, February 19, 2008</i>
<i>Last Saved</i>	<i>Friday, March 14, 2008</i>
<i>Product Version</i>	<i>11.0 Release</i>



## Contents

- **Hexcel with deflection**
  - [Geometry](#)
    - [Parts](#)
  - [Connections](#)
    - [Contact Regions](#)
  - [Mesh](#)
    - [Patch Independent](#)
  - [Named Selections](#)
  - **Static Structural**
    - [Analysis Settings](#)
    - [Acceleration](#)
    - [Loads](#)
    - [Solution](#)
      - [Solution Information](#)
      - [Results](#)
- **Material Data**
  - [Polyurethane](#)
  - [Carbon Fiber](#)
  - [Hexcel sheet](#)
  - [Structural Steel](#)

## Units

**TABLE 1**

Unit System	Metric (mm, kg, N, °C, s, mV, mA)
Angle	Degrees
Rotational Velocity	rad/s

## Hexcel with deflection

### Geometry

**TABLE 2**  
**Hexcel with deflection > Geometry**

Object Name	<i>Geometry</i>
State	Fully Defined
<b>Definition</b>	
Source	C:\Documents and Settings\Jinnuri\Desktop\wb\all axis\allaxis.agdb
Type	DesignModeler
Length Unit	Millimeters
Element Control	Program Controlled
Display Style	Part Color
<b>Bounding Box</b>	
Length X	4241.3 mm
Length Y	4560.2 mm
Length Z	2675. mm
<b>Properties</b>	

Volume	9.3496e+008 mm <sup>3</sup>
Mass	140.56 kg
<b>Statistics</b>	
Bodies	23
Active Bodies	22
Nodes	137910
Elements	169958
<b>Preferences</b>	
Import Solid Bodies	Yes
Import Surface Bodies	Yes
Import Line Bodies	Yes
Parameter Processing	Yes
Personal Parameter Key	DS
CAD Attribute Transfer	No
Named Selection Processing	No
Material Properties Transfer	No
CAD Associativity	Yes
Import Coordinate Systems	No
Reader Save Part File	No
Import Using Instances	Yes
Do Smart Update	No
Attach File Via Temp File	No
Analysis Type	3-D
Mixed Import Resolution	None
Enclosure and Symmetry Processing	Yes

**TABLE 3**  
**Hexcel with deflection > Geometry > Parts**

Object Name	<i>nose plate</i>	<i>end plate (1) 1 of 3</i>	<i>endplate(2)1 of 2</i>	<i>endplate(1) 2 of 3</i>	<i>endplate (1)3 of 3</i>
State	Meshed				
<b>Graphics Properties</b>					
Visible	Yes				
Transparency	1				
<b>Definition</b>					
Suppressed	No				
Material	Polyurethane				
Stiffness Behavior	Flexible				
Nonlinear Material Effects	Yes				
<b>Bounding Box</b>					
Length X	102.03 mm	221.42 mm	3819.7 mm	184.3 mm	
Length Y	180.6 mm	160.89 mm	2238.4 mm	139.46 mm	
Length Z	581.2 mm		2414.9 mm	233.38 mm	
<b>Properties</b>					
Volume	7.6673e+006 mm <sup>3</sup>	2.4963e+006 mm <sup>3</sup>	3.7036e+006 mm <sup>3</sup>	3.6841e+007 mm <sup>3</sup>	1.2073e+006 mm <sup>3</sup>
Mass	1.8401 kg	0.59912 kg	0.88887 kg	8.8418 kg	0.28975 kg
Centroid X	46.019 mm	91.538 mm	108.97 mm	2247.1 mm	145.03 mm
Centroid Y	8.0978e-016 mm	92.546 mm	-102.61 mm	1337.1 mm	123.43 mm

Centroid Z	288.77 mm	346.17 mm	352.87 mm	-890.99 mm	366.72 mm
Moment of Inertia Ip1	54197 kg·mm <sup>2</sup>	13573 kg·mm <sup>2</sup>	14824 kg·mm <sup>2</sup>	3.3883e+005 kg·mm <sup>2</sup>	1152.9 kg·mm <sup>2</sup>
Moment of Inertia Ip2	52807 kg·mm <sup>2</sup>	14538 kg·mm <sup>2</sup>	16681 kg·mm <sup>2</sup>	2.0698e+007 kg·mm <sup>2</sup>	1315.2 kg·mm <sup>2</sup>
Moment of Inertia Ip3	4657.9 kg·mm <sup>2</sup>	1293. kg·mm <sup>2</sup>	2342.5 kg·mm <sup>2</sup>	2.0364e+007 kg·mm <sup>2</sup>	320.6 kg·mm <sup>2</sup>
<b>Statistics</b>					
Nodes	372	151	125	5769	93
Elements	1346	407	352	17423	253

**TABLE 4**  
**Hexcel with deflection > Geometry > Parts**

Object Name	<i>end plate 1 hole area non target end</i>	<i>end plate 1 hole area target end 1</i>	<i>end plate 1 hole area target end2</i>	<i>endplate(2) 2 of 2</i>	<i>end plate 2 hole area target end</i>
State	Meshed				
<b>Graphics Properties</b>					
Visible	Yes				
Transparency	1				
<b>Definition</b>					
Suppressed	No				
Material	Polyurethane				
Stiffness Behavior	Flexible				
Nonlinear Material Effects	Yes				
<b>Bounding Box</b>					
Length X	3363.1 mm	184.3 mm	3441.6 mm	3819.7 mm	3441.6 mm
Length Y	1974.7 mm	139.46 mm	2020. mm	2238.4 mm	2020. mm
Length Z	1945. mm	233.38 mm	1987.3 mm	2414.9 mm	1987.3 mm
<b>Properties</b>					
Volume	5.0102e+007 mm <sup>3</sup>	1.2073e+006 mm <sup>3</sup>	5.131e+007 mm <sup>3</sup>	3.4426e+007 mm <sup>3</sup>	5.131e+007 mm <sup>3</sup>
Mass	12.025 kg	0.28975 kg	12.314 kg	8.2623 kg	12.314 kg
Centroid X	1812.9 mm	137.19 mm	1844.3 mm	2274.8 mm	1765.8 mm
Centroid Y	1086.4 mm	118.9 mm	1104.5 mm	-1353. mm	-1059.2 mm
Centroid Z	-531.35 mm	110.68 mm	-808.51 mm	-914.74 mm	-766.25 mm
Moment of Inertia Ip1	47846 kg·mm <sup>2</sup>	1152.9 kg·mm <sup>2</sup>	48999 kg·mm <sup>2</sup>	3.3023e+005 kg·mm <sup>2</sup>	48999 kg·mm <sup>2</sup>
Moment of Inertia Ip2	1.7302e+007 kg·mm <sup>2</sup>	1315.2 kg·mm <sup>2</sup>	1.8581e+007 kg·mm <sup>2</sup>	1.8e+007 kg·mm <sup>2</sup>	1.8581e+007 kg·mm <sup>2</sup>
Moment of Inertia Ip3	1.7261e+007 kg·mm <sup>2</sup>	320.6 kg·mm <sup>2</sup>	1.8539e+007 kg·mm <sup>2</sup>	1.7674e+007 kg·mm <sup>2</sup>	1.8539e+007 kg·mm <sup>2</sup>
<b>Statistics</b>					
Nodes	868	275	904	5852	897
Elements	2330	36	2426	17655	2413

**TABLE 5**  
**Hexcel with deflection > Geometry > Parts**

Object Name	<i>endplate 2 hole area non target end</i>	<i>back plate</i>	<i>rod4</i>	<i>rod5</i>	<i>rod1</i>
State	Meshed				

Graphics Properties					
Visible	Yes				
Transparency	1				
Definition					
Suppressed	No				
Material	Polyurethane		Carbon Fiber		
Stiffness Behavior	Flexible				
Nonlinear Material Effects	Yes				
Bounding Box					
Length X	3520.1 mm	238.63 mm	50.8 mm		
Length Y	2065.4 mm	4557.2 mm	2558. mm	3167.6 mm	729.16 mm
Length Z	2029.5 mm	493.29 mm	50.8 mm		
Properties					
Volume	5.2517e+007 mm <sup>3</sup>	1.1556e+008 mm <sup>3</sup>	4.9963e+005 mm <sup>3</sup>	6.2009e+005 mm <sup>3</sup>	1.3828e+005 mm <sup>3</sup>
Mass	12.604 kg	27.734 kg	0.28979 kg	0.35965 kg	8.0201e-002 kg
Centroid X	1891.4 mm	3726.9 mm	2178.5 mm	2706.4 mm	595.07 mm
Centroid Y	-1131.7 mm	0.19075 mm	-6.2893e-010 mm	9.3264e-009 mm	1.3118e-010 mm
Centroid Z	-573.61 mm	-1695.4 mm	-1126.3 mm	-1411.4 mm	-271.02 mm
Moment of Inertia Ip1	50152 kg·mm <sup>2</sup>	4.6347e+007 kg·mm <sup>2</sup>	1.5274e+005 kg·mm <sup>2</sup>	2.919e+005 kg·mm <sup>2</sup>	3267.4 kg·mm <sup>2</sup>
Moment of Inertia Ip2	1.9922e+007 kg·mm <sup>2</sup>	6.1048e+005 kg·mm <sup>2</sup>	173.72 kg·mm <sup>2</sup>	215.61 kg·mm <sup>2</sup>	48.061 kg·mm <sup>2</sup>
Moment of Inertia Ip3	1.9879e+007 kg·mm <sup>2</sup>	4.5748e+007 kg·mm <sup>2</sup>	1.5274e+005 kg·mm <sup>2</sup>	2.919e+005 kg·mm <sup>2</sup>	3267.5 kg·mm <sup>2</sup>
Statistics					
Nodes	853	7676	15096	13070	17902
Elements	2231	31191	2148	1860	2626

**TABLE 6**  
Hexcel with deflection > Geometry > Parts

Object Name	<i>rod2</i>	<i>rod3</i>	<i>rod6</i>	<i>hexcel</i>	<i>mylar</i>
State	Meshed				Suppressed
Graphics Properties					
Visible	Yes				No
Transparency	1				
Definition					
Suppressed	No				Yes
Material	Carbon Fiber		Hexcel sheet		Structural Steel
Stiffness Behavior	Flexible				
Nonlinear Material Effects	Yes				
Bounding Box					
Length X	50.8 mm		3831.1 mm		3549.1 mm
Length Y	1338.8 mm	1948.4 mm	3777.2 mm	4559.1 mm	4202.6 mm
Length Z	50.8 mm		2084.1 mm		1916.6 mm
Properties					
Volume	2.5873e+005 mm <sup>3</sup>	3.7918e+005 mm <sup>3</sup>	7.4054e+005 mm <sup>3</sup>	4.0121e+008 mm <sup>3</sup>	2.2063e+005 mm <sup>3</sup>

Mass	0.15006 kg	0.21993 kg	0.42951 kg	11.568 kg	1.7319 kg
Centroid X	1122.8 mm	1650.6 mm	3234.3 mm	2514.6 mm	2415.9 mm
Centroid Y	-4.3959e-010 mm	-2.412e-009 mm	1.355e-008 mm	-0.90675 mm	8.2964e-009 mm
Centroid Z	-556.12 mm	-841.22 mm	-1696.5 mm	-776.52 mm	-1225.1 mm
Moment of Inertia Ip1	21253 kg·mm <sup>2</sup>	66800 kg·mm <sup>2</sup>	4.971e+005 kg·mm <sup>2</sup>	1.0036e+007 kg·mm <sup>2</sup>	1.2718e+006 kg·mm <sup>2</sup>
Moment of Inertia Ip2	89.952 kg·mm <sup>2</sup>	131.84 kg·mm <sup>2</sup>	257.48 kg·mm <sup>2</sup>	1.2923e+007 kg·mm <sup>2</sup>	1.6364e+006 kg·mm <sup>2</sup>
Moment of Inertia Ip3	21253 kg·mm <sup>2</sup>	66800 kg·mm <sup>2</sup>	4.971e+005 kg·mm <sup>2</sup>	2.2956e+007 kg·mm <sup>2</sup>	2.9081e+006 kg·mm <sup>2</sup>
<b>Statistics</b>					
Nodes	13856	15554	15590	22570	0
Elements	1968	2212	2220	77604	0

**TABLE 7**  
**Hexcel with deflection > Geometry > Parts**

Object Name	<i>top hinge area1</i>	<i>top hinge area2</i>	<i>ball joint</i>
State	Meshed		
<b>Graphics Properties</b>			
Visible	Yes		
Transparency	1		
<b>Definition</b>			
Suppressed	No		
Material	Polyurethane		
Stiffness Behavior	Flexible		
Nonlinear Material Effects	Yes		
<b>Bounding Box</b>			
Length X	562.43 mm	25. mm	
Length Y	300. mm	39.658 mm	
Length Z	624.05 mm	39.658 mm	
<b>Properties</b>			
Volume	6.1378e+007 mm <sup>3</sup>	11971 mm <sup>3</sup>	
Mass	14.731 kg	2.8731e-003 kg	
Centroid X	3935.1 mm		
Centroid Y	1519.7 mm	-1517.9 mm	1.7419e-015 mm
Centroid Z	-1781.8 mm		
Moment of Inertia Ip1	4.3163e+005 kg·mm <sup>2</sup>		0.33261 kg·mm <sup>2</sup>
Moment of Inertia Ip2	5.1756e+005 kg·mm <sup>2</sup>		0.25283 kg·mm <sup>2</sup>
Moment of Inertia Ip3	3.0689e+005 kg·mm <sup>2</sup>		0.25283 kg·mm <sup>2</sup>
<b>Statistics</b>			
Nodes	163	162	112
Elements	626	619	12

## Connections

**TABLE 8**  
**Hexcel with deflection > Connections**

Object Name	<i>Connections</i>
State	Fully Defined
<b>Auto Detection</b>	

Generate Contact On Update	Yes
Tolerance Type	Slider
Tolerance Slider	0.
Tolerance Value	16.945 mm
Face/Face	Yes
Face/Edge	Yes
Edge/Edge	Yes
Priority	Include All
Same Body Grouping	Yes
Revolute Joints	Yes
Fixed Joints	Yes
<b>Transparency</b>	
Enabled	Yes

**TABLE 9**  
Hexcel with deflection > Connections > Contact Regions

Object Name	<i>Bonded - nose plate To ball joint</i>	<i>Bonded - nose plate To end plate (1)</i>	<i>Bonded - nose plate To endplate(2)1 of</i>	<i>Bonded - end plate (1) 1of3 To end plate 1 hole area target end</i>	<i>Bonded - end plate (1) 1of3 To endplate (1)3 of</i>
State	Fully Defined				
<b>Scope</b>					
Scoping Method	Geometry Selection				
Contact	1 Face				
Target	1 Face				
Contact Bodies	nose plate			end plate (1) 1of3	
Target Bodies	ball joint	end plate (1) 1of3	endplate(2)1 of 2	end plate 1 hole area target end 1	endplate (1)3 of 3
<b>Definition</b>					
Type	Bonded				
Scope Mode	Manual				
Behavior	Symmetric				
Suppressed	No				
<b>Advanced</b>					
Formulation	Pure Penalty				
Normal Stiffness	Program Controlled				
Update Stiffness	Never				
Thermal Conductance	Program Controlled				
Pinball Region	Program Controlled				

**TABLE 10**  
Hexcel with deflection > Connections > Contact Regions

Object Name	<i>Bonded - end plate (1) 1of3 To endplate(1) 2 of</i>	<i>Bonded - end plate (1) 1of3 To endplate(1) 2 of 2</i>	<i>Bonded - end plate 1 hole area target end 1 To end plate 1 hole area target end2</i>	<i>Bonded - endplate (1)3 of 3 To end plate 1 hole area non target end</i>	<i>Bonded - endplate (1) 2 of 3 To end plate 1 hole area target end2</i>
State	Fully Defined				
<b>Scope</b>					
Scoping					

Method	Geometry Selection				
Contact	2 Faces	1 Edge	1 Face		
Target	2 Faces	1 Edge	1 Face		
Contact Bodies	end plate (1) 1of3		end plate 1 hole area target end 1	endplate (1)3 of 3	endplate(1) 2 of 3
Target Bodies	endplate(1) 2 of 3		end plate 1 hole area target end2	end plate 1 hole area non target end	end plate 1 hole area target end2
<b>Definition</b>					
Type	Bonded				
Scope Mode	Manual				
Behavior	Symmetric		Symmetric		
Suppressed	No				
<b>Advanced</b>					
Formulation	Pure Penalty				
Normal Stiffness	Program Controlled				
Update Stiffness	Never				
Thermal Conductance	Program Controlled				
Pinball Region	Program Controlled				

**TABLE 11**  
**Hexcel with deflection > Connections > Contact Regions**

Object Name	<i>Bonded - endplate (1) 2 of 3 To end plate 1 hole area target end2 2</i>	<i>Bonded - endplate (1) 2 of 3 To end plate 1 hole area non target end</i>	<i>Bonded - endplate (1) 2 of 3 To end plate 1 hole area non target end 2</i>	<i>Bonded - endplate(1) 2 of 3 To back plate</i>	<i>Bonded - endplate(1) 2 of 3 To back plate 2</i>
State	Fully Defined				
<b>Scope</b>					
Scoping Method	Geometry Selection				
Contact	1 Face				1 Edge
Target	1 Face				1 Edge
Contact Bodies	endplate(1) 2 of 3				
Target Bodies	end plate 1 hole area target end2	end plate 1 hole area non target end		back plate	
<b>Definition</b>					
Type	Bonded				
Scope Mode	Manual				
Behavior	Symmetric				
Suppressed	No				
<b>Advanced</b>					
Formulation	Pure Penalty				
Normal Stiffness	Program Controlled				
Update Stiffness	Never				
Thermal Conductance	Program Controlled				
Pinball Region	Program Controlled			Radius	



Pinball Radius	40. mm
----------------	--------

**TABLE 12**  
**Hexcel with deflection > Connections > Contact Regions**

Object Name	<i>Bonded - endplate (1) 2 of 3 To rod4-rod5-rod1-rod2-rod3-rod6</i>	<i>Bonded - end plate 1 hole area target end2 To rod4-rod5-rod1-rod2-rod3-rod6</i>	<i>Bonded - endplate(2)1 of 2 To endplate (2) 2 of 2</i>	<i>Bonded - endplate(2)1 of 2 To endplate (2) 2 of 2</i>	<i>Bonded - endplate (2) 2 of 2 To endplate 2 hole area non target end</i>
State	Fully Defined				
<b>Scope</b>					
Scoping Method	Geometry Selection				
Contact	1 Face			1 Edge	1 Face
Target	6 Faces		3 Faces	1 Edge	1 Face
Contact Bodies	endplate(1) 2 of 3	end plate 1 hole area target end2	endplate(2)1 of 2		endplate(2) 2 of 2
Target Bodies	rod4-rod5-rod1-rod2-rod3-rod6		endplate(2) 2 of 2		endplate 2 hole area non target end
<b>Definition</b>					
Type	Bonded				
Scope Mode	Manual				
Behavior	Symmetric				Symmetric
Suppressed	No				
<b>Advanced</b>					
Formulation	Pure Penalty				
Normal Stiffness	Program Controlled				
Update Stiffness	Never				
Thermal Conductance	Program Controlled				
Pinball Region	Program Controlled				

**TABLE 13**  
**Hexcel with deflection > Connections > Contact Regions**

Object Name	<i>Bonded - endplate (2) 2 of 2 To endplate 2 hole area non target end 2</i>	<i>Bonded - endplate (2) 2 of 2 To end plate 2 hole area target end</i>	<i>Bonded - endplate (2) 2 of 2 To end plate 2 hole area target end 2</i>	<i>Bonded - endplate(2) 2 of 2 To back plate</i>	<i>Bonded - endplate(2) 2 of 2 To back plate 2</i>
State	Fully Defined				
<b>Scope</b>					
Scoping Method	Geometry Selection				
Contact	1 Face				1 Edge
Target	1 Face				1 Edge
Contact Bodies	endplate(2) 2 of 2				
Target Bodies	endplate 2 hole area non target end	end plate 2 hole area target end		back plate	
<b>Definition</b>					
Type	Bonded				
Scope Mode	Manual				
Behavior	Symmetric				

Suppressed	No	
<b>Advanced</b>		
Formulation	Pure Penalty	
Normal Stiffness	Program Controlled	
Update Stiffness	Never	
Thermal Conductance	Program Controlled	
Pinball Region	Program Controlled	Radius
Pinball Radius		50. mm

**TABLE 14**  
**Hexcel with deflection > Connections > Contact Regions**

Object Name	<i>Bonded - endplate(2) 2 of 2 To rod4-rod5-rod1-rod2-rod3-rod6</i>	<i>Bonded - end plate 2 hole area target end To rod4-rod5-rod1-rod2-rod3-rod6</i>	<i>Bonded - hexcel To nose plate</i>	<i>Bonded - hexcel To back plate</i>	<i>Bonded - hexcel To endplate(2) 2 of 2</i>
State	Fully Defined				
<b>Scope</b>					
Scoping Method	Geometry Selection				
Contact	1 Face				1 Edge
Target	6 Faces		1 Face		1 Edge
Contact Bodies	endplate(2) 2 of 2	end plate 2 hole area target end	hexcel		
Target Bodies	rod4-rod5-rod1-rod2-rod3-rod6		nose plate	back plate	endplate(2) 2 of 2
<b>Definition</b>					
Type	Bonded				
Scope Mode	Manual				
Behavior	Symmetric				
Suppressed	No				
<b>Advanced</b>					
Formulation	Pure Penalty				
Normal Stiffness	Program Controlled				
Update Stiffness	Never				
Thermal Conductance	Program Controlled				
Pinball Region	Program Controlled		Radius		
Pinball Radius			30. mm		

**TABLE 15**  
**Hexcel with deflection > Connections > Contact Regions**

Object Name	<i>Bonded - hexcel To endplate(1) 2 of 2</i>	<i>Bonded - hexcel To back plate 2</i>	<i>Bonded - back plate To top hinge area1</i>	<i>Bonded - back plate To top hinge area2</i>
State	Fully Defined			
<b>Scope</b>				
Scoping Method	Geometry Selection			
Contact	1 Edge		1 Face	
Target	1 Edge		1 Face	

Contact Bodies	hexcel		back plate	
Target Bodies	endplate(1) 2 of 3	back plate	top hinge area1	top hinge area2
<b>Definition</b>				
Type	Bonded			
Scope Mode	Manual			
Suppressed	No			
Behavior	Symmetric			
<b>Advanced</b>				
Formulation	Pure Penalty			
Normal Stiffness	Program Controlled			
Update Stiffness	Never			
Thermal Conductance	Program Controlled			
Pinball Region	Radius		Program Controlled	
Pinball Radius	30. mm			

## Mesh

**TABLE 16**  
Hexcel with deflection > Mesh

Object Name	<i>Mesh</i>
State	Solved
<b>Defaults</b>	
Physics Preference	Mechanical
Relevance	0
<b>Advanced</b>	
Relevance Center	Coarse
Element Size	Default
Shape Checking	Standard Mechanical
Solid Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Initial Size Seed	Active Assembly
Smoothing	Low
Transition	Fast
<b>Statistics</b>	
Nodes	137910
Elements	169958

**TABLE 17**  
Hexcel with deflection > Mesh > Mesh Controls

Object Name	<i>Patch Independent</i>
State	Fully Defined
<b>Scope</b>	
Scoping Method	Geometry Selection
Geometry	14 Bodies
<b>Definition</b>	
Suppressed	No
Method	Tetrahedrons
Algorithm	Patch Independent
Element Midside Nodes	Dropped
Defined By	Max Element Size

Max Element Size	Default
Define Defeaturing Tolerance	Yes
Defeaturing Tolerance	1. mm
Curvature and Proximity Refinement	Yes
Min Size Limit	5. mm
Num Cells Across Gap	Default
Span Angle	Coarse
Minimum Edge Length	7.7856e-003 mm

## Named Selections

**TABLE 18**  
Hexcel with deflection > Named Selections > Named Selections

Object Name	<i>Problematic Geometry</i>	<i>Problematic Geometry 2</i>
State	Fully Defined	
<b>Scope</b>		
Geometry	1 Edge	
<b>Statistics</b>		
Type	Manual	
Total Selection	1 Edge	
Suppressed	0	
Hidden	0	

## Static Structural

**TABLE 19**  
Hexcel with deflection > Analysis

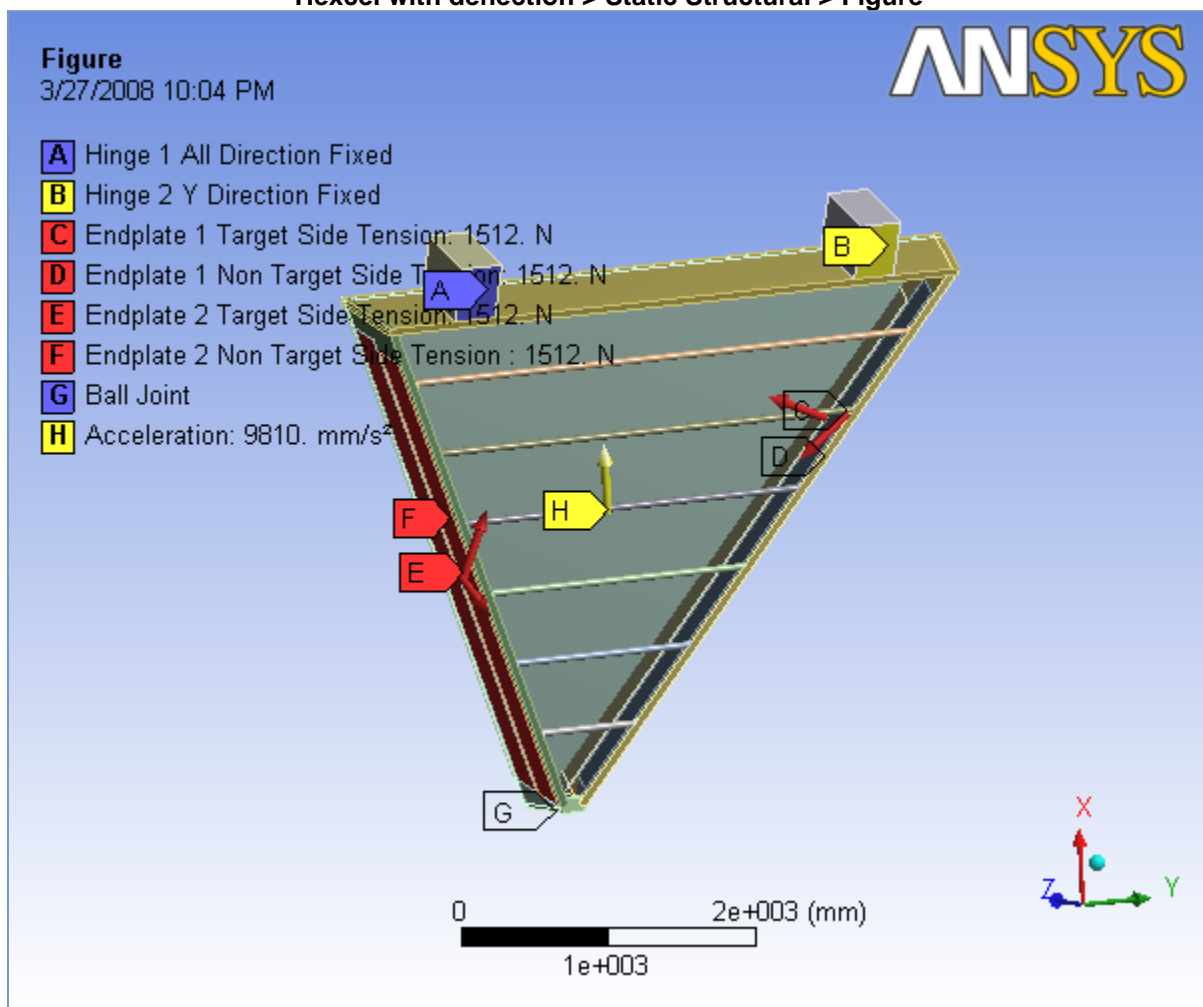
Object Name	<i>Static Structural</i>
State	Fully Defined
<b>Definition</b>	
Physics Type	Structural
Analysis Type	Static Structural
<b>Options</b>	
Reference Temp	22. °C

**TABLE 20**  
Hexcel with deflection > Static Structural > Analysis Settings

Object Name	<i>Analysis Settings</i>
State	Fully Defined
<b>Step Controls</b>	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
<b>Solver Controls</b>	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Large Deflection	Off
Inertia Relief	Off
<b>Nonlinear Controls</b>	

Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
<b>Output Controls</b>	
Calculate Stress	Yes
Calculate Strain	Yes
Calculate Results At	All Time Points
<b>Analysis Data Management</b>	
Solver Files Directory	C:\Documents and Settings\Jinnuri\Desktop\wb\all axis\allaxis Simulation Files\Static Structural (4)\
Future Analysis	None
Save ANSYS db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No

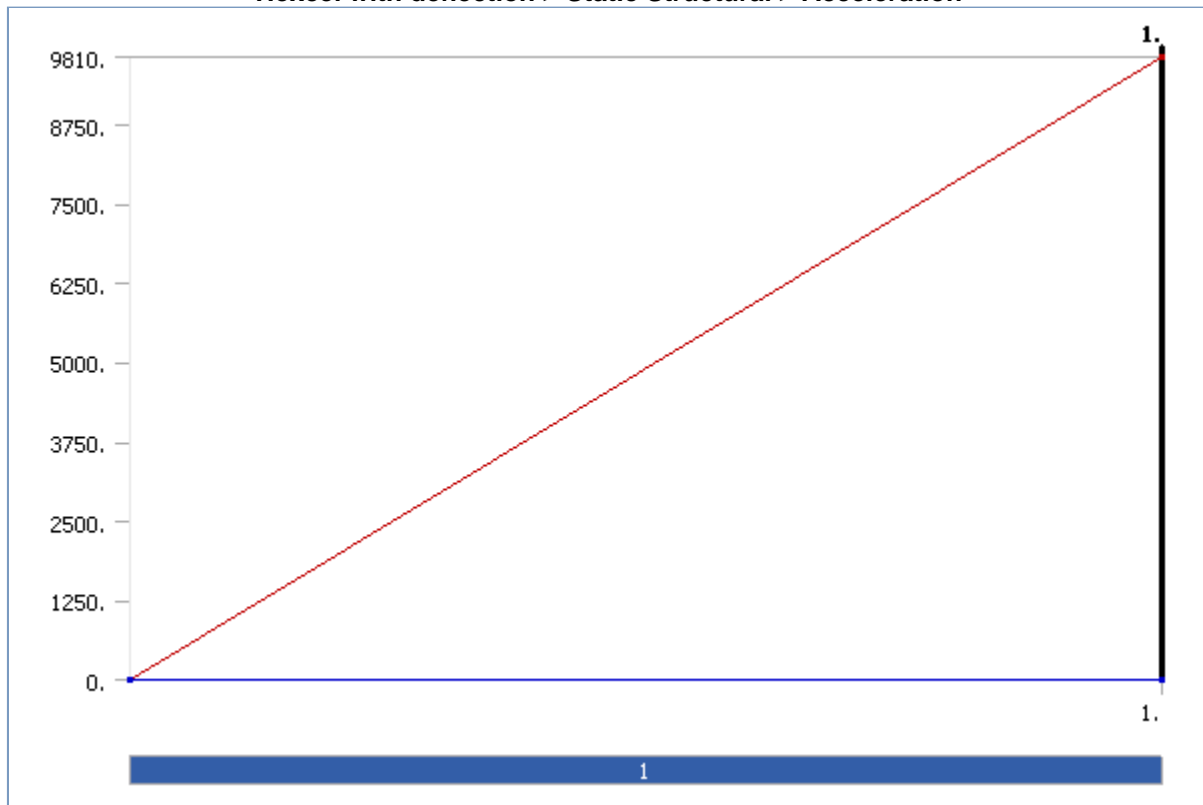
**FIGURE 1**  
Hexcel with deflection > Static Structural > Figure



**TABLE 21**  
Hexcel with deflection > Static Structural > Accelerations

Object Name	<i>Acceleration</i>
State	Fully Defined
<b>Scope</b>	
Geometry	All Bodies
<b>Definition</b>	
Define By	Components
X Component	9810. mm/s <sup>2</sup> (ramped)
Y Component	0. mm/s <sup>2</sup> (ramped)
Z Component	0. mm/s <sup>2</sup> (ramped)
Suppressed	No

**FIGURE 2**  
Hexcel with deflection > Static Structural > Acceleration

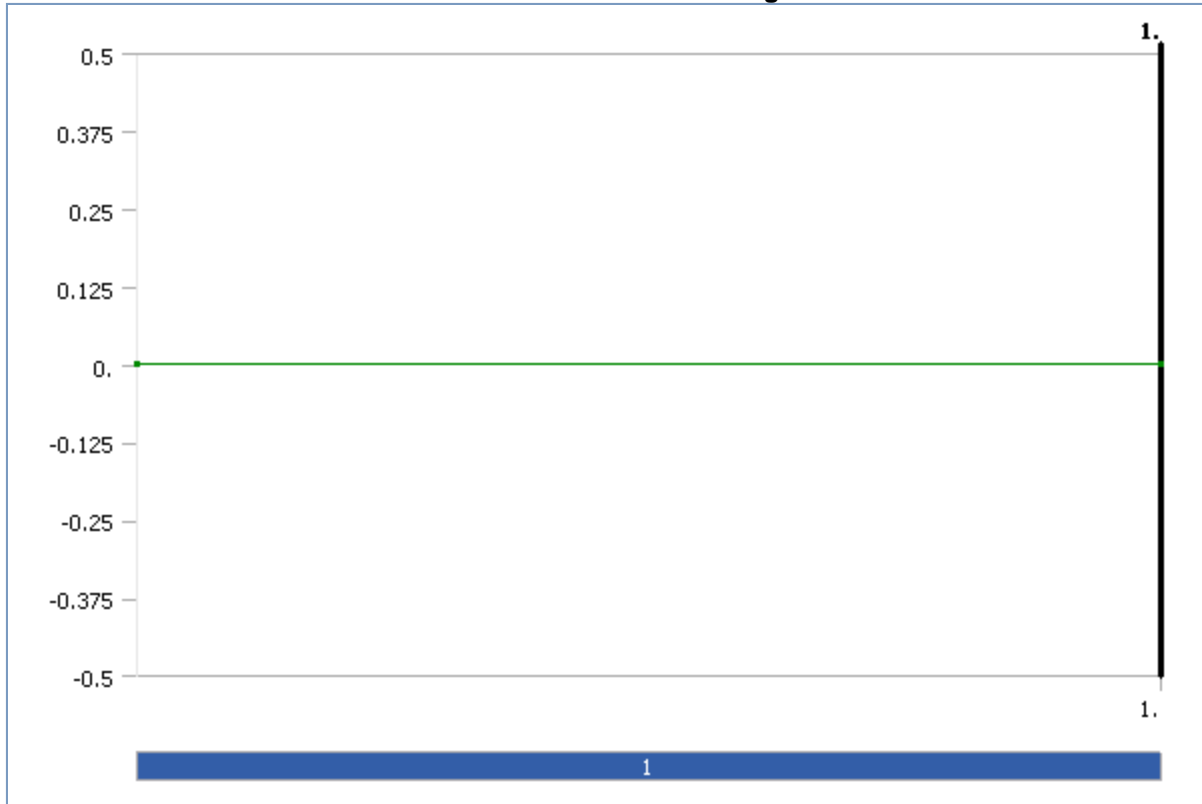


**TABLE 22**  
Hexcel with deflection > Static Structural > Loads

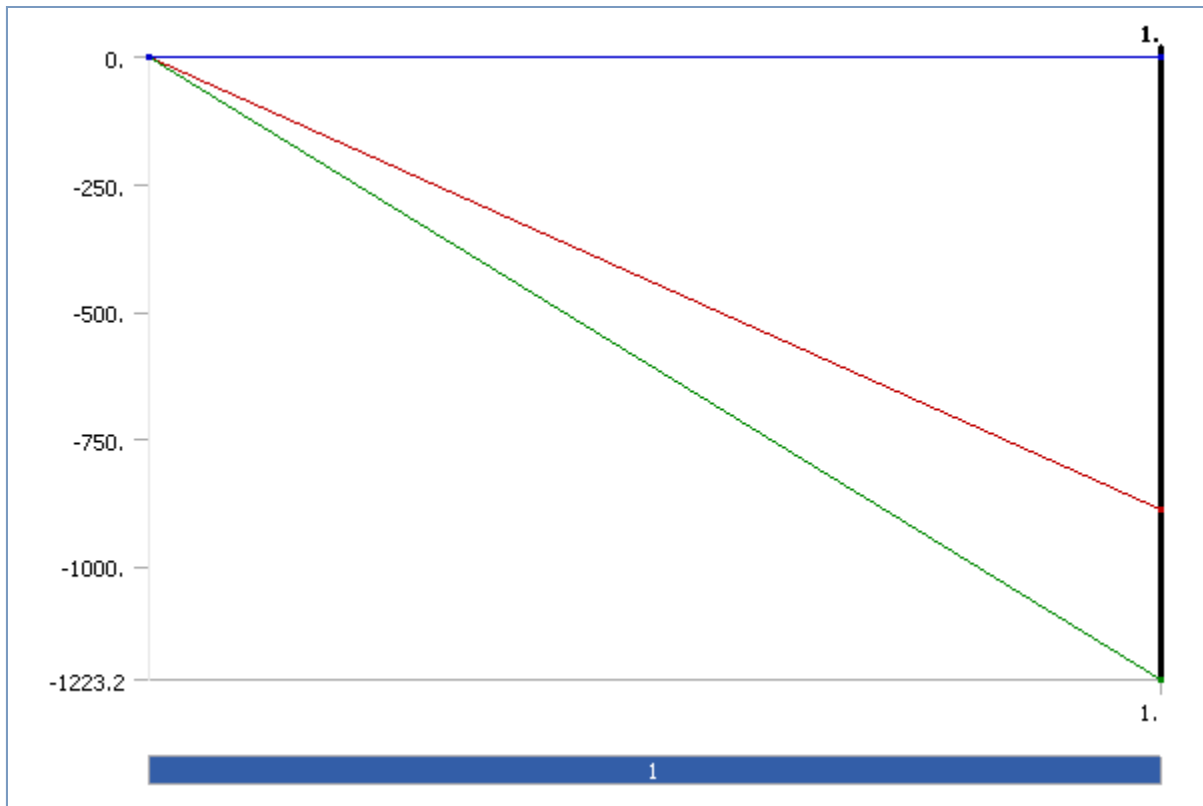
Object Name	<i>Hinge 1 All Direction Fixed</i>	<i>Hinge 2 Y Direction Fixed</i>	<i>Endplate 1 Target Side Tension</i>	<i>Endplate 1 Non Target Side Tension</i>	<i>Endplate 2 Target Side Tension</i>
State	Fully Defined				
<b>Scope</b>					
Scoping Method	Geometry Selection				
Geometry	1 Face				
<b>Definition</b>					
Type	Fixed Support	Displacement	Force		
Suppressed	No				
Define By	Components				
X Component		0. mm (ramped)	-888.73 N (ramped)	614.98 N (ramped)	1381.3 N (ramped)

Y Component	Free	-1223.2 N (ramped)	-1381.3 N (ramped)	614.98 N (ramped)
Z Component	0. mm (ramped)	0. N (ramped)		

**FIGURE 3**  
**Hexcel with deflection > Static Structural > Hinge 2 Y Direction Fixed**



**FIGURE 4**  
**Hexcel with deflection > Static Structural > Endplate 1 Target Side Tension**

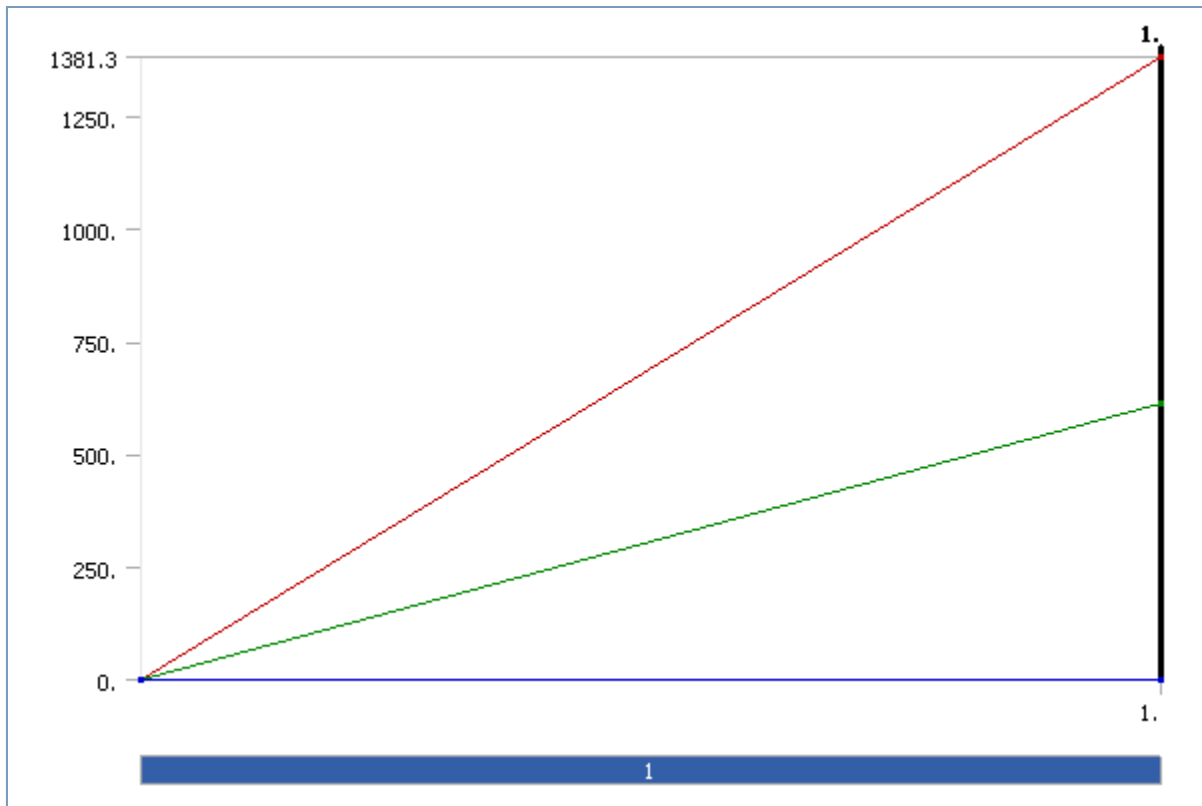


**FIGURE 5**  
Hexcel with deflection > Static Structural > Endplate 1 Non Target Side Tension



**FIGURE 6**  
Hexcel with deflection > Static Structural > Endplate 2 Target Side Tension

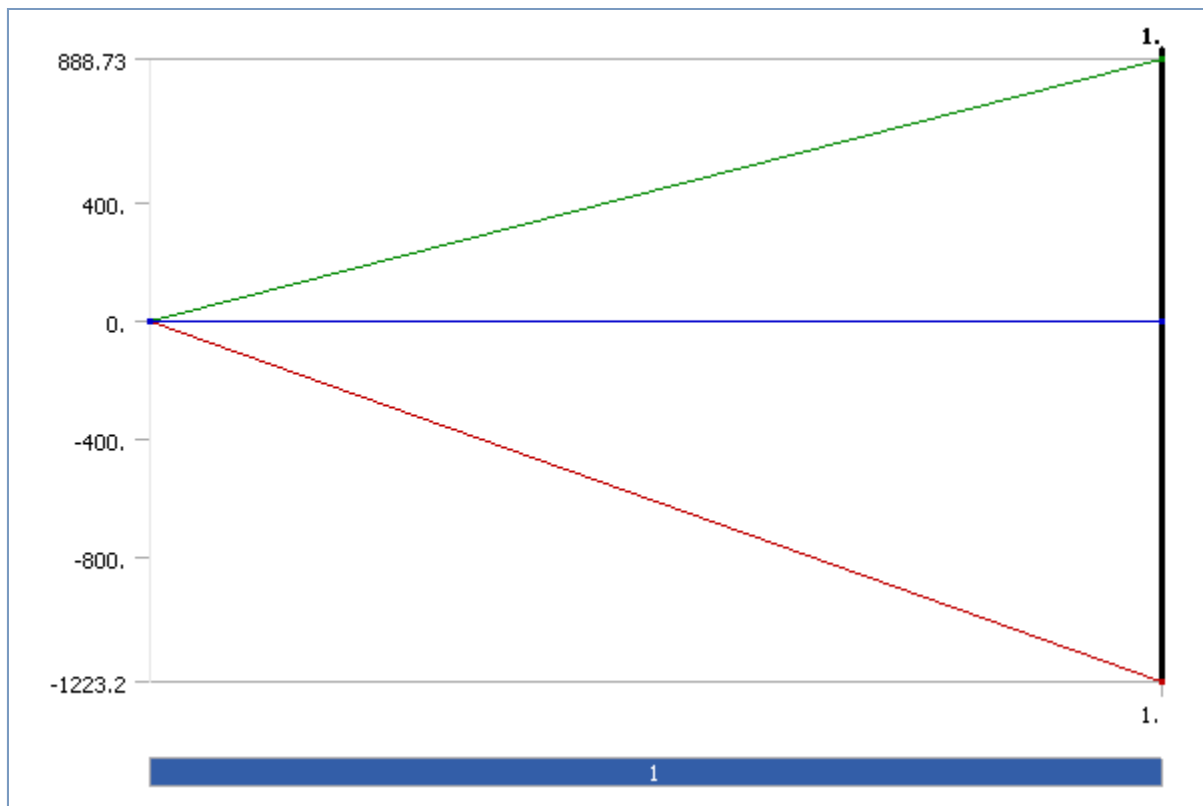




**TABLE 23**  
**Hexcel with deflection > Static Structural > Loads**

Object Name	<i>Endplate 2 Non Target Side Tension</i>	<i>Ball Joint</i>
State	Fully Defined	
<b>Scope</b>		
Scoping Method	Geometry Selection	
Geometry	1 Face	
<b>Definition</b>		
Define By	Components	
Type	Force	Fixed Support
X Component	-1223.2 N (ramped)	
Y Component	888.73 N (ramped)	
Z Component	0. N (ramped)	
Suppressed	No	

**FIGURE 7**  
**Hexcel with deflection > Static Structural > Endplate 2 Non Target Side Tension**



## Solution

**TABLE 24**  
Hexcel with deflection > Static Structural > Solution

Object Name	<i>Solution</i>
State	Solved
<b>Adaptive Mesh Refinement</b>	
Max Refinement Loops	1.
Refinement Depth	2.

**TABLE 25**  
Hexcel with deflection > Static Structural > Solution > Solution Information

Object Name	<i>Solution Information</i>
State	Solved
<b>Solution Information</b>	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All

**TABLE 26**  
Hexcel with deflection > Static Structural > Solution > Results

Object Name	<i>Total Deformation</i>	<i>x Directional Deformation</i>	<i>y Directional Deformation</i>	<i>z Directional Deformation</i>
State	Solved			
<b>Scope</b>				
Geometry	All Bodies			
<b>Definition</b>				

Type	Total Deformation	Directional Deformation		
Display Time	0.40293 s	End Time		
Orientation		X Axis	Y Axis	Z Axis
Results				
Minimum	0. mm	-6.0651e-002 mm	-9.9818e-003 mm	-2.5785e-002 mm
Maximum	6.5459e-002 mm	8.4139e-003 mm	1.1103e-002 mm	1.4604e-002 mm
Minimum Occurs On	top hinge area2	rod6	endplate(1) 2 of 3	rod5
Maximum Occurs On	rod6	endplate(2) 2 of 2		back plate
Information				
Time	1. s			
Load Step	1			
Substep	1			
Iteration Number	1			

FIGURE 8

Hexcel with deflection &gt; Static Structural &gt; Solution &gt; Total Deformation &gt; Figure

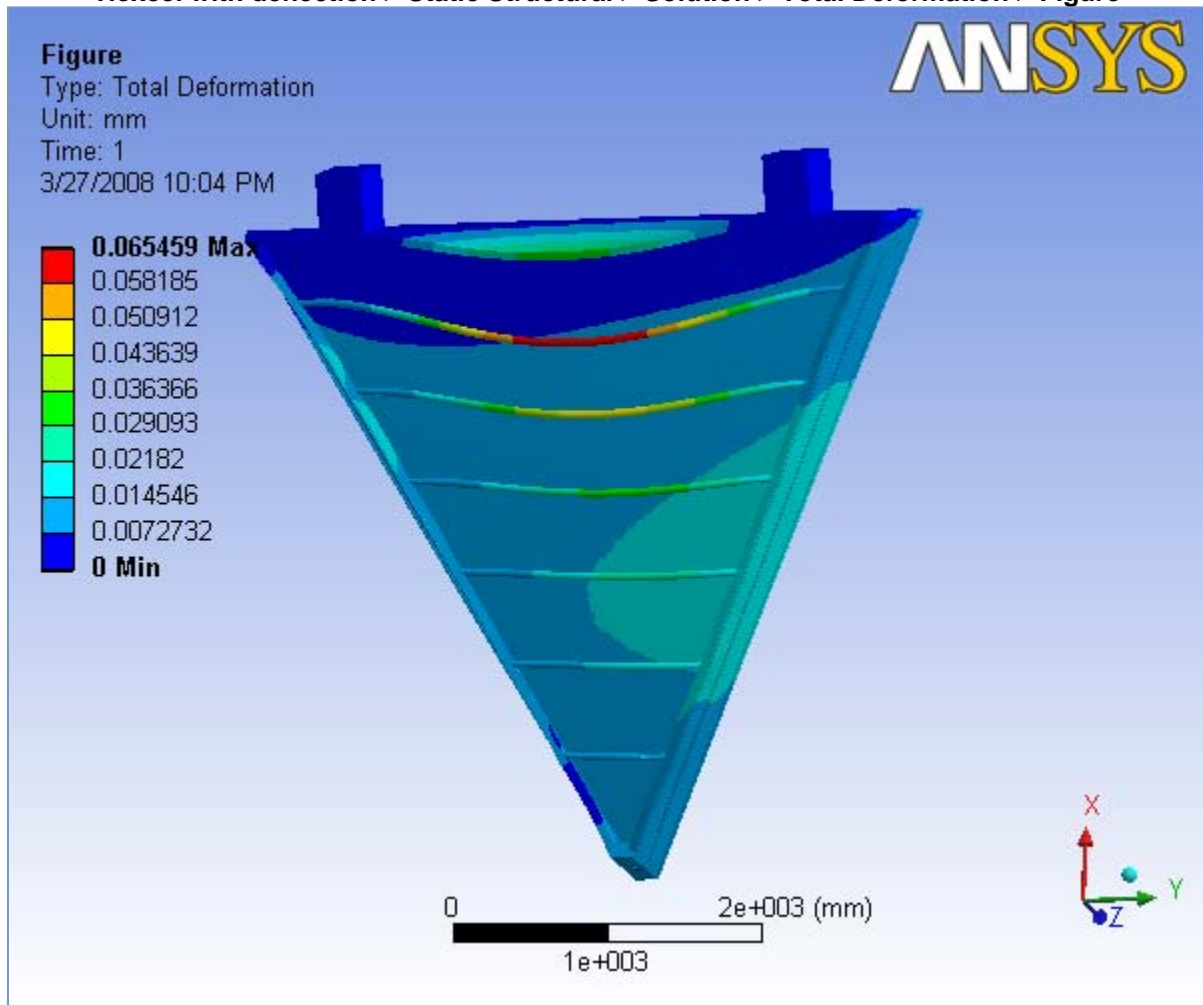
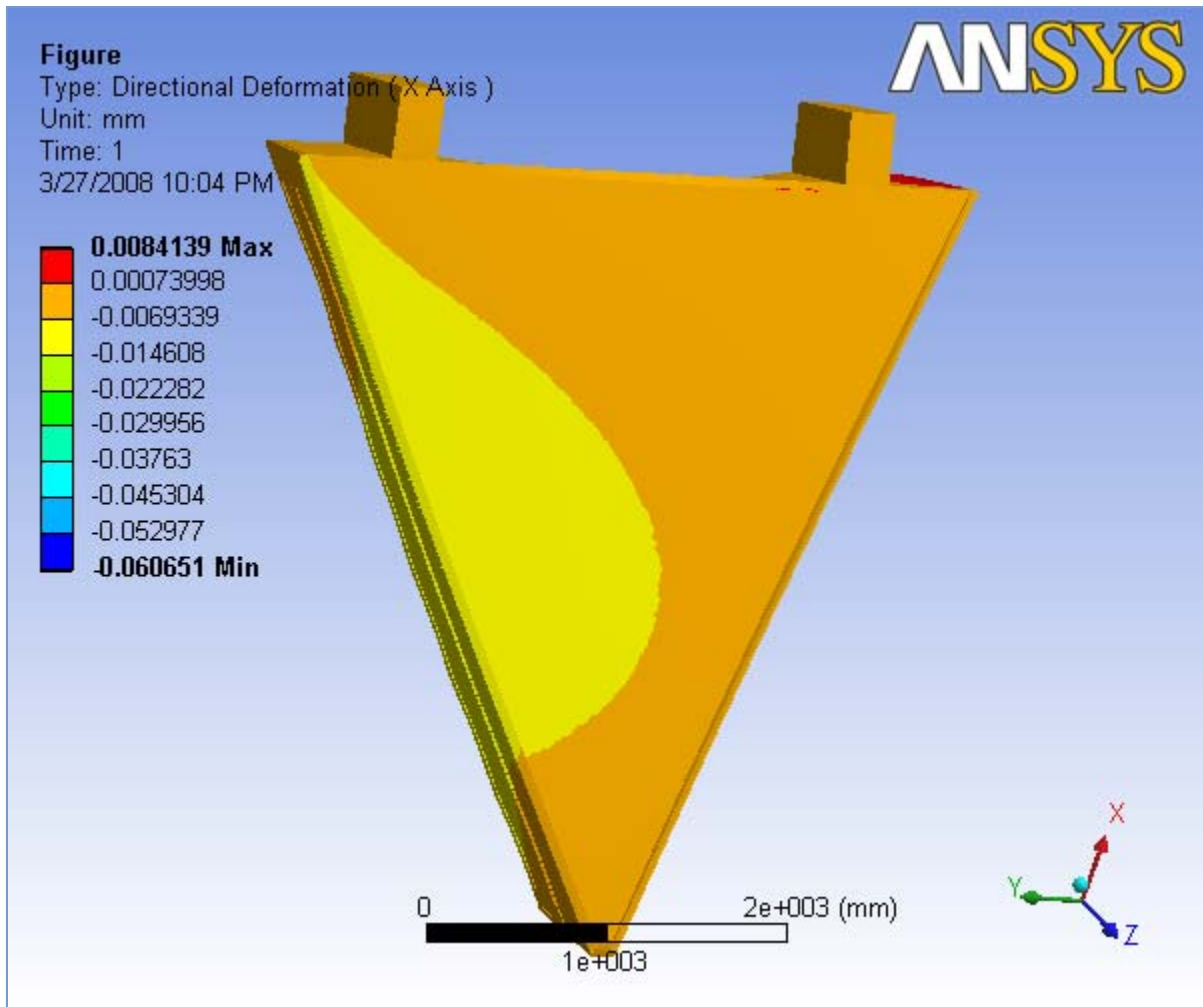
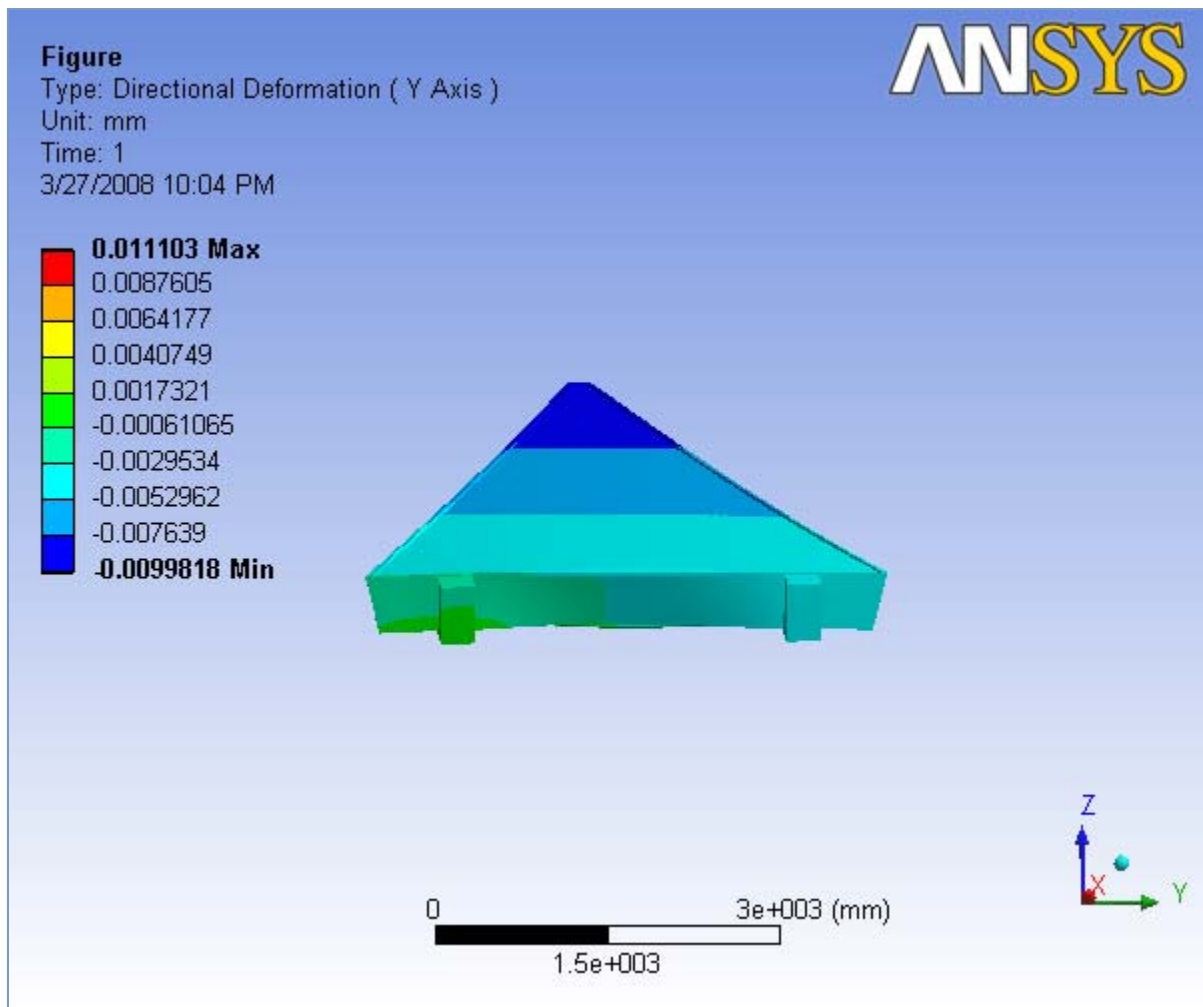


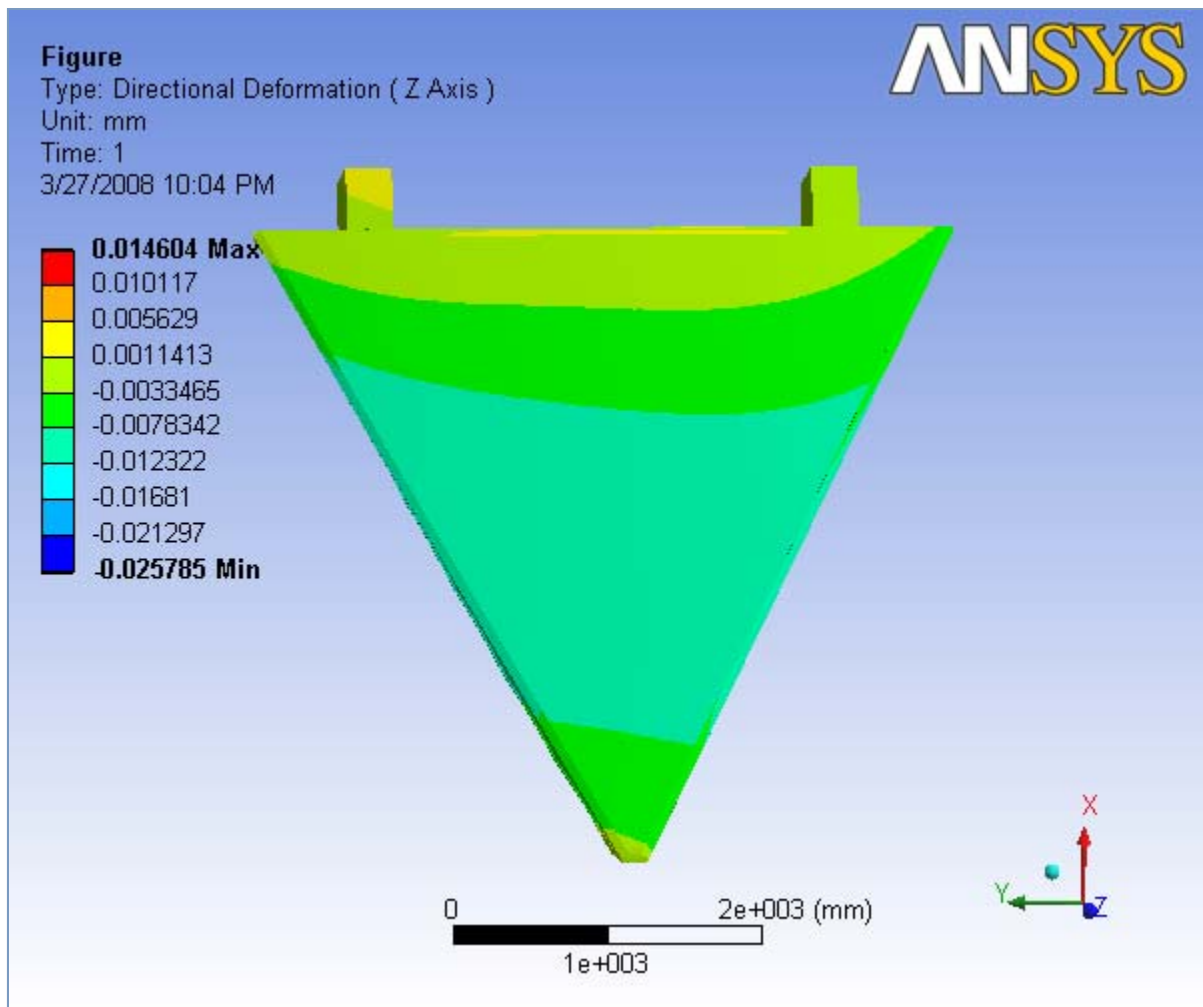
FIGURE 9

Hexcel with deflection &gt; Static Structural &gt; Solution &gt; x Directional Deformation &gt; Figure



**FIGURE 10**  
Hexcel with deflection > Static Structural > Solution > y Directional Deformation > Figure

**FIGURE 11****Hexcel with deflection > Static Structural > Solution > z Directional Deformation > Figure**



## Material Data

### *Polyurethane*

**TABLE 27**  
**Polyurethane > Constants**

<b>Structural</b>	
Young's Modulus	9751.9 MPa
Poisson's Ratio	0.3
Density	2.4e-007 kg/mm <sup>3</sup>
Thermal Expansion	0. 1/°C
<b>Thermal</b>	
Thermal Conductivity	0. W/mm·°C
Specific Heat	0. J/kg·°C
<b>Electromagnetics</b>	
Relative Permeability	0.
Resistivity	0. Ohm-mm

### *Carbon Fiber*

**TABLE 28**

**Carbon Fiber > Constants**

<b>Structural</b>	
Young's Modulus	1.5e+005 MPa
Poisson's Ratio	0.3
Density	5.8e-007 kg/mm <sup>3</sup>
Thermal Expansion	0. 1/°C
<b>Thermal</b>	
Thermal Conductivity	0. W/mm·°C
Specific Heat	0. J/kg·°C
<b>Electromagnetics</b>	
Relative Permeability	0.
Resistivity	0. Ohm·mm

**Hexcel sheet**

**TABLE 29**  
**Hexcel sheet > Constants**

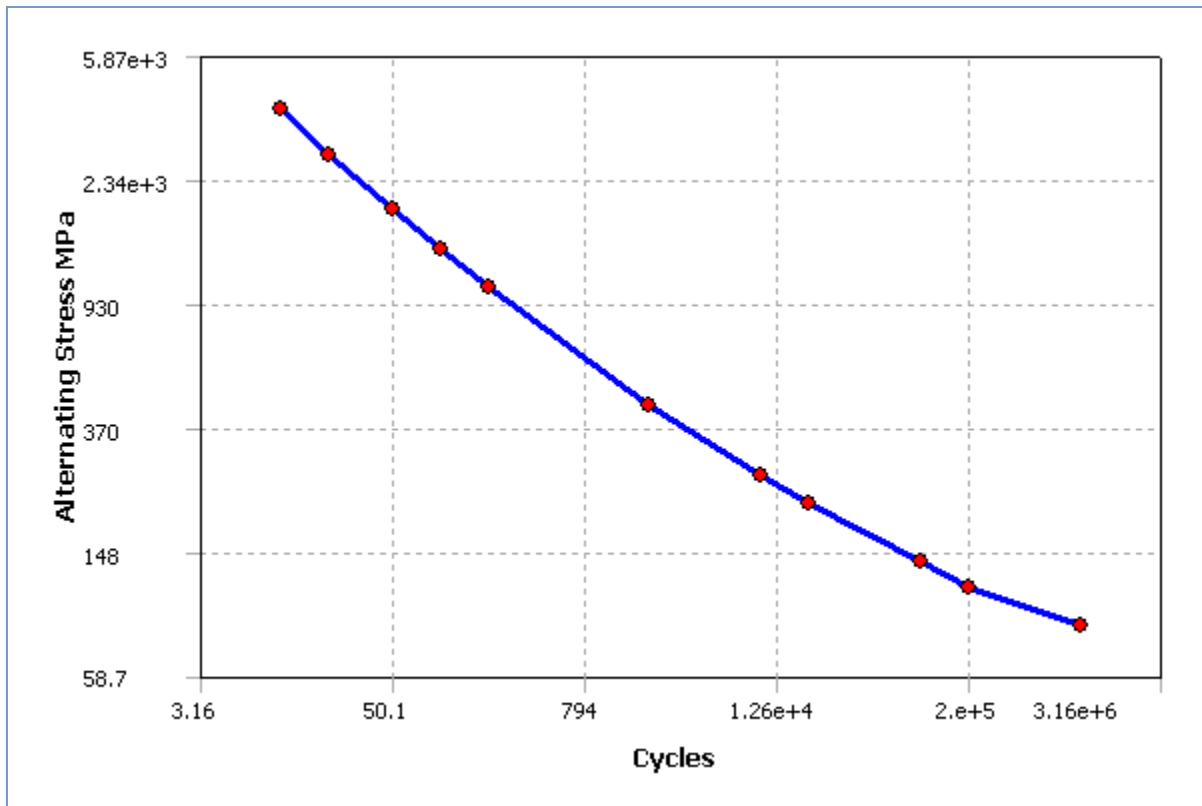
<b>Structural</b>	
Young's Modulus	1.4805e+005 MPa
Poisson's Ratio	0.3
Density	2.8833e-008 kg/mm <sup>3</sup>
Thermal Expansion	0. 1/°C
<b>Thermal</b>	
Thermal Conductivity	0. W/mm·°C
Specific Heat	0. J/kg·°C
<b>Electromagnetics</b>	
Relative Permeability	0.
Resistivity	0. Ohm·mm

**Structural Steel**

**TABLE 30**  
**Structural Steel > Constants**

<b>Structural</b>	
Young's Modulus	2.e+005 MPa
Poisson's Ratio	0.3
Density	7.85e-006 kg/mm <sup>3</sup>
Thermal Expansion	1.2e-005 1/°C
Tensile Yield Strength	250. MPa
Compressive Yield Strength	250. MPa
Tensile Ultimate Strength	460. MPa
Compressive Ultimate Strength	0. MPa
<b>Thermal</b>	
Thermal Conductivity	6.05e-002 W/mm·°C
Specific Heat	434. J/kg·°C
<b>Electromagnetics</b>	
Relative Permeability	10000
Resistivity	1.7e-004 Ohm·mm

**FIGURE 12**  
**Structural Steel > Alternating Stress**



**TABLE 31**  
Structural Steel > Alternating Stress > Property Attributes

Interpolation	Log-Log
Mean Curve Type	Mean Stress

**TABLE 32**  
Structural Steel > Alternating Stress > Alternating Stress Curve Data

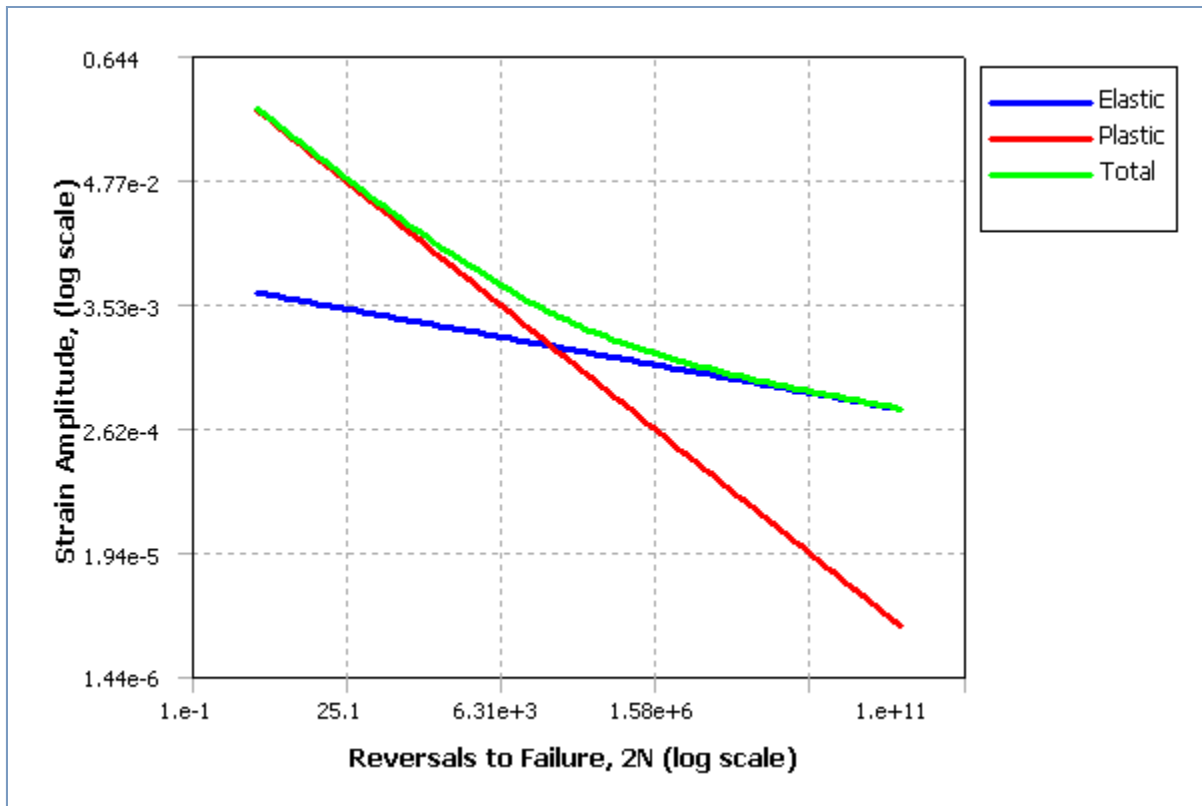
Mean Value MPa
0.

**TABLE 33**  
Structural Steel > Alternating Stress > Alternating Stress vs. Cycles

Cycles	Alternating Stress MPa
10.	3999.
20.	2827.
50.	1896.
100.	1413.
200.	1069.
2000.	441.
10000	262.
20000	214.
1.e+005	138.
2.e+005	114.
1.e+006	86.2

**FIGURE 13**  
Structural Steel > Strain-Life Parameters





**TABLE 34**  
**Structural Steel > Strain-Life Parameters > Property Attributes**  
 Display Curve Type Strain-Life

**TABLE 35**  
**Structural Steel > Strain-Life Parameters > Strain-Life Parameters**

Strength Coefficient MPa	920.
Strength Exponent	-0.106
Ductility Coefficient	0.213
Ductility Exponent	-0.47
Cyclic Strength Coefficient MPa	1000.
Cyclic Strain Hardening Exponent	0.2