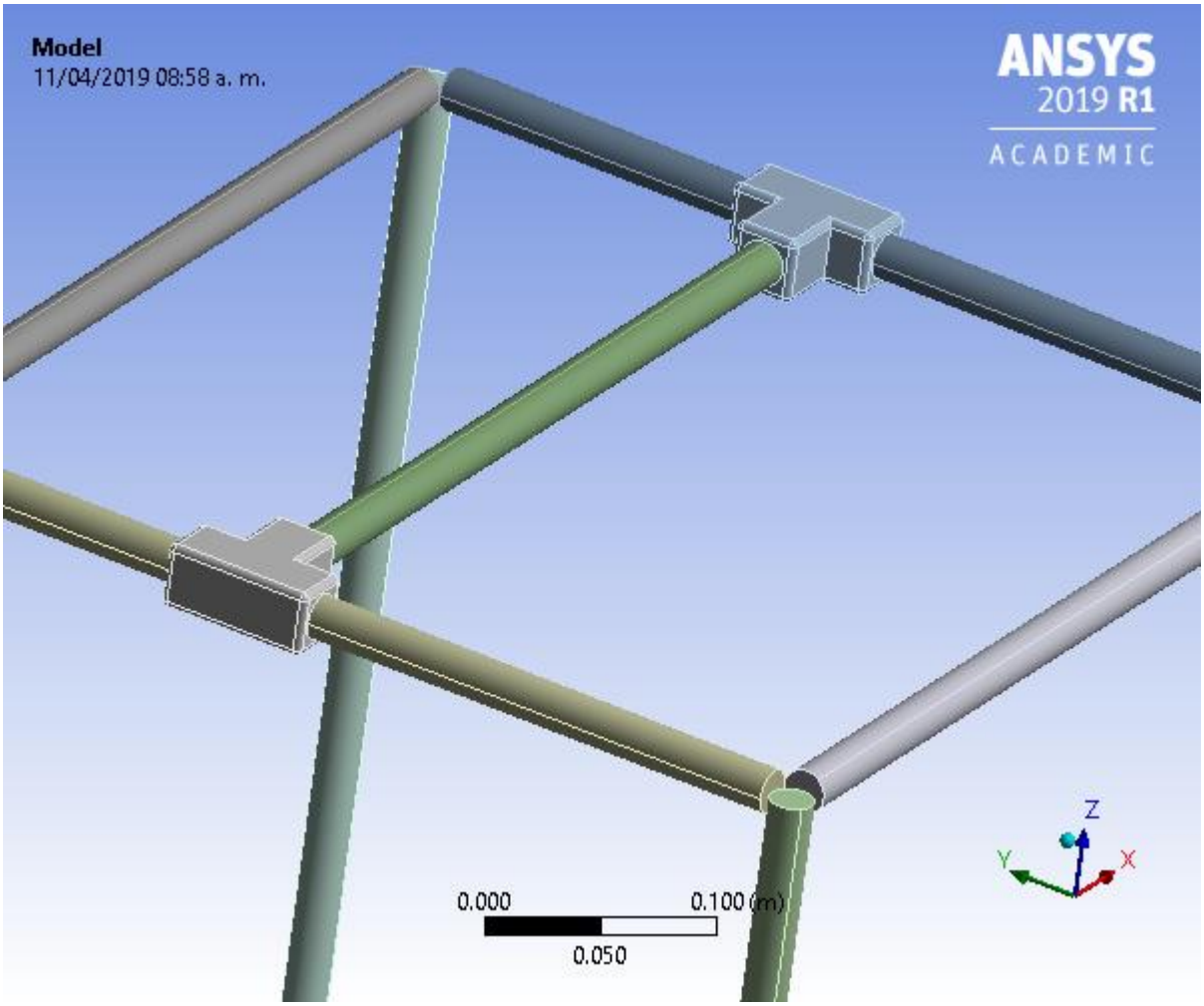
Project*

First Saved	Tuesday, April 2, 2019
Last Saved	Tuesday, April 2, 2019
Product Version	2019 R1
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (m, kg, N, s, V, A) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (B4)

Geometry

TABLE 2
Model (B4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\Miguel\Documents\Miguel\2019\Universidad Politécnica\maq_files\dp0\Geom\DM\Geom.scdoc
Type	SpaceClaim
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	0.50172 m

Length Y	0.5 m
Length Z	0.515 m
Properties	
Volume	1.1386e-002 m³
Mass	89.383 kg
Scale Factor Value	1.
Statistics	
Bodies	12
Active Bodies	12
Nodes	18199
Elements	5877
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	Yes
Parameters	Independent
Parameter Key	
Attributes	Yes
Attribute Key	
Named Selections	Yes
Named Selection Key	
Material Properties	Yes
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	Yes
Coordinate System Key	
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	Yes
Compare Parts On Update	No
Analysis Type	3-D
Mixed Import Resolution	None
Clean Bodies On Import	No
Stitch Surfaces On Import	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (B4) > Geometry > Parts

ct Name	*pieza T\Solid1*	*pieza T\Solid1*	*Tubo\Solid1*	*Tubo\Solid1*	*Tubo\Solid1*	*Tubo\Solid1*	*tubo.2\Solid1*	*tubo.2\Solid1*	*tubo.2\Solid1*	*tubo.2\Solid1*
State	Meshed									
Graphics Properties										
Visible	Yes									
sparency	1									
Definition										
ppressed	No									
Behavior	Flexible									
oordinate System	Default Coordinate System									
eference perature	By Environment									
Behavior	None									
Material										
signment	Structural Steel									
r Effects	Yes									
al Strain Effects	Yes									
Bounding Box										
Length X	6.e-002 m		2.7716e-002 m	2.7403e-002 m	2.4428e-002 m	2.e-002 m	0.45 m	2.e-002 m	0.45 m	2.e-002 m
Length Y	7.e-002 m		2.7716e-002 m	2.7403e-002 m	2.4428e-002 m	2.e-002 m	2.8033e-002 m	0.45 m	2.e-002 m	0.45 m
Length Z	3.e-002 m		0.5 m				2.8033e-002 m	2.e-002 m		
Properties										
Volume	5.7518e-005 m³		1.5714e-004 m³				1.4142e-004 m³			
Mass	0.45151 kg		1.2335 kg				1.1102 kg			
entroid X	-0.25055 m	0.20196 m	-0.26015 m	0.21157 m	0.21156 m	-0.26015 m	-2.5052e-002 m	-0.26015 m	-2.353e-002 m	0.21156 m
entroid Y	3.0303e-002 m	3.0309e-002 m	-0.24462 m	-0.24461 m	0.22538 m	0.22539 m	-0.24461 m	-9.5181e-003 m	0.22539 m	-9.7123e-003 m
entroid Z	0.98 m		0.72989 m				0.98 m			
of Inertia Ip1	1.7694e-004 kg·m²		2.5634e-002 kg·m²				1.8693e-002 kg·m²			
of Inertia Ip2	2.5465e-004 kg·m²		2.5634e-002 kg·m²				1.8693e-002 kg·m²			
of Inertia Ip3	1.6668e-004 kg·m²		6.1266e-005 kg·m²				5.514e-005 kg·m²			
Statistics										
Nodes	2853		1171				1101			
Elements	1446		224				210			

sh Metric	None
CAD Attributes	
olerance:	0.00000001
149.175	

TABLE 4
Model (B4) > Geometry > Parts

Object Name	*Geom\Solid*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Behavior	None
Material	
Assignment	Structural Steel
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	0.5 m
Length Y	0.5 m
Length Z	4.e-002 m
Properties	
Volume	9.9446e-003 m³
Mass	78.065 kg
Centroid X	-2.4291e-002 m
Centroid Y	-9.6147e-003 m
Centroid Z	0.5 m
Moment of Inertia Ip1	1.6219 kg·m²
Moment of Inertia Ip2	1.6217 kg·m²
Moment of Inertia Ip3	3.2227 kg·m²
Statistics	
Nodes	2374
Elements	1053
Mesh Metric	None
CAD Attributes	
PartTolerance:	0.00000001
Color:143.149.175	

Coordinate Systems

TABLE 5
Model (B4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined

Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. m
Origin Y	0. m
Origin Z	0. m
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

Connections

TABLE 6
Model (B4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

TABLE 7
Model (B4) > Connections > Contacts

Object Name	*Contacts*
State	Fully Defined
Definition	
Connection Type	Contact
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Auto Detection	
Tolerance Type	Slider
Tolerance Slider	0.
Tolerance Value	2.1894e-003 m
Use Range	No
Face/Face	Yes
Face-Face Angle Tolerance	75. °
Face Overlap Tolerance	Off
Cylindrical Faces	Include
Face/Edge	No
Edge/Edge	No
Priority	Include All
Group By	Bodies
Search Across	Bodies
Statistics	
Connections	16
Active Connections	16

TABLE 8
Model (B4) > Connections > Contacts > Contact Regions

Object Name	*Contact Region*	*Contact Region 2*	*Contact Region 3*	*Contact Region 4*	*Contact Region 5*	*Contact Region 6*	*Contact Region 7*	*Contact Region 8*	*Contact Region 9*	*Contact Region 10*	*Contact Region 11*
State	Fully Defined										
Scope											
Scoping Method	Geometry Selection										
Contact	2 Faces	3 Faces	2 Faces	3 Faces	1 Face		2 Faces	1 Face		2 Faces	1 Face
Target	2 Faces	3 Faces	2 Faces	3 Faces	1 Face		2 Faces	1 Face		2 Faces	1 Face
Contact Bodies	pieza T\Solid1				Tubo\Solid1						
Target Bodies	tubo.2\Solid1	tubo 3\Solid1	tubo.2\Solid1	tubo 3\Solid1	tubo.2\Solid1		Geom\Solid	tubo.2\Solid1		Geom\Solid	tubo.2\Solid1
Protected	No										
Definition											
Type	Bonded										
Scope Mode	Automatic										
Behavior	Program Controlled										
Trim Contact	Program Controlled										
Trim Tolerance	2.1894e-003 m										
Suppressed	No										
Advanced											
Formulation	Program Controlled										
Small Sliding	Program Controlled										
Detection Method	Program Controlled										
Penetration Tolerance	Program Controlled										
Elastic Slip Tolerance	Program Controlled										
Normal Stiffness	Program Controlled										
Update Stiffness	Program Controlled										
Pinball Region	Program Controlled										
Geometric Modification											
Contact Geometry Correction	None										
Target Geometry Correction	None										

TABLE 9
Model (B4) > Connections > Contacts > Contact Regions

Object Name	*Contact Region 12*	*Contact Region 13*	*Contact Region 14*	*Contact Region 15*	*Contact Region 16*
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Contact	1 Face	2 Faces	1 Face	2 Faces	
Target	1 Face	2 Faces	1 Face		2 Faces
Contact Bodies	Tubo\Solid1				
Target Bodies	tubo.2\Solid1	Geom\Solid	tubo.2\Solid1		Geom\Solid
Protected	No				
Definition					
Type	Bonded				
Scope Mode	Automatic				
Behavior	Program Controlled				
Trim Contact	Program Controlled				
Trim Tolerance	2.1894e-003 m				
Suppressed	No				
Advanced					
Formulation	Program Controlled				
Small Sliding	Program Controlled				
Detection Method	Program Controlled				
Penetration Tolerance	Program Controlled				
Elastic Slip Tolerance	Program Controlled				
Normal Stiffness	Program Controlled				
Update Stiffness	Program Controlled				
Pinball Region	Program Controlled				
Geometric Modification					
Contact Geometry Correction	None				
Target Geometry Correction	None				

Mesh

TABLE 10
Model (B4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	Default
Sizing	
Use Adaptive Sizing	Yes
Resolution	Default (2)

Mesh Defeaturing	Yes
Defeature Size	Default
Transition	Fast
Span Angle Center	Coarse
Initial Size Seed	Assembly
Bounding Box Diagonal	0.87575 m
Average Surface Area	6.0452e-003 m²
Minimum Edge Length	5.9278e-004 m
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Standard Mechanical
Target Quality	Default (0.050000)
Smoothing	Medium
Mesh Metric	None
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Straight Sided Elements	No
Rigid Body Behavior	Dimensionally Reduced
Triangle Surface Mesher	Program Controlled
Topology Checking	Yes
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Statistics	
Nodes	18199
Elements	5877

Static Structural (B5)

TABLE 11
Model (B4) > Analysis

Object Name	*Static Structural (B5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 12
Model (B4) > Static Structural (B5) > Analysis Settings

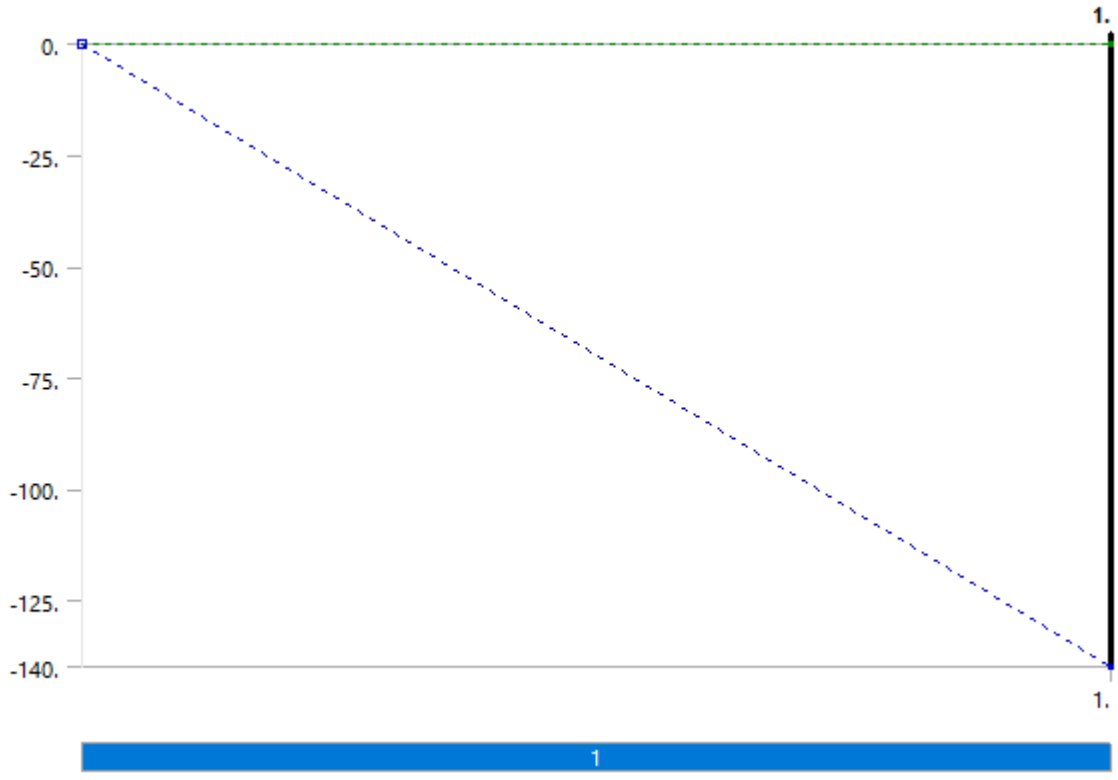
Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Rotordynamics Controls	
Coriolis Effect	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Combine Restart Files	Program Controlled
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\Miguel\Documents\Miguel\2019\Universidad Politécnica\maq_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Contact Summary	Program Controlled

Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	mks

TABLE 13
Model (B4) > Static Structural (B5) > Loads

Object Name	*Fixed Support*	*Pressure*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	2 Faces
Definition		
Type	Fixed Support	Pressure
Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. Pa (ramped)
Y Component		0. Pa (ramped)
Z Component		-140. Pa (ramped)

FIGURE 1
Model (B4) > Static Structural (B5) > Pressure



Solution (B6)

TABLE 14
Model (B4) > Static Structural (B5) > Solution

Object Name	*Solution (B6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
MAPDL Elapsed Time	12. s
MAPDL Memory Used	136. MB
MAPDL Result File Size	6.9375 MB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 15
Model (B4) > Static Structural (B5) > Solution (B6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Identify Element Violations	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 16
Model (B4) > Static Structural (B5) > Solution (B6) > Results

Object Name	*Total Deformation*	*Equivalent Stress*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Total Deformation	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
By	Time		
Display Time	Last		
Calculate Time History	Yes		

Identifier			
Suppressed	No		
Results			
Minimum	0. m	6.7953e-002 Pa	4.1725e-013 m/m
Maximum	2.4106e-006 m	4.7286e+005 Pa	2.3691e-006 m/m
Average	4.8931e-007 m	21484 Pa	1.3072e-007 m/m
Minimum Occurs On	Geom\Solid		
Maximum Occurs On	tubo 3\Solid1	tubo.2\Solid1	
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

FIGURE 2
Model (B4) > Static Structural (B5) > Solution (B6) > Total Deformation

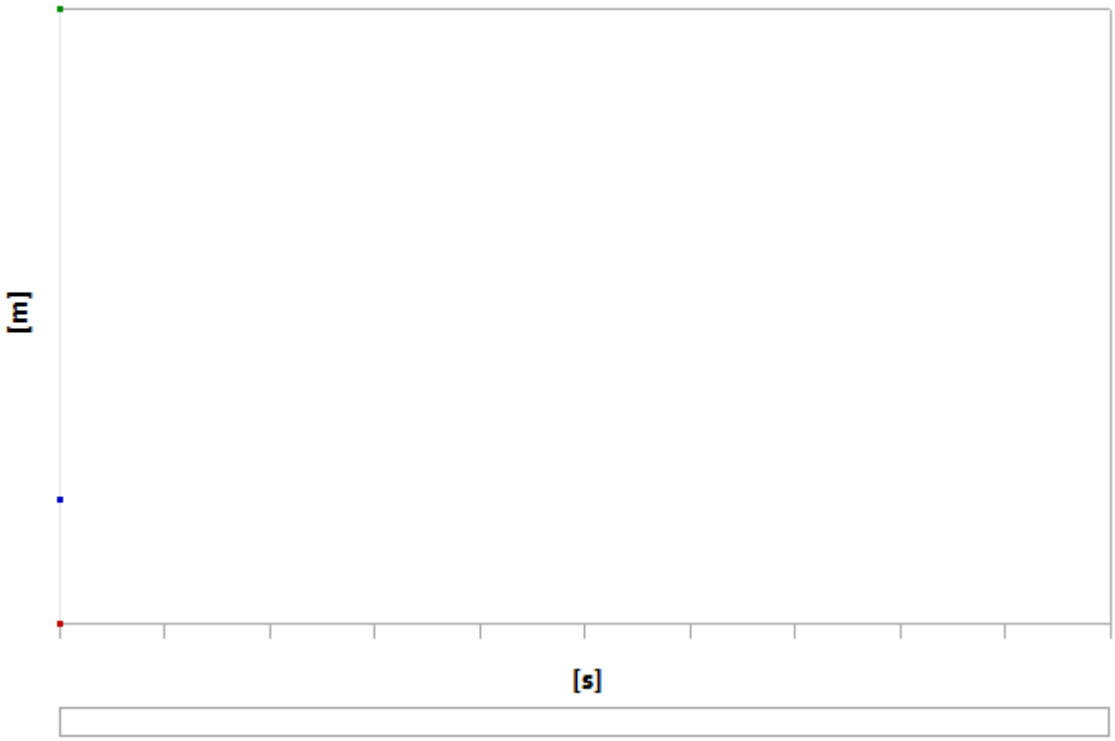


TABLE 17
Model (B4) > Static Structural (B5) > Solution (B6) > Total Deformation

Time [s]	Minimum [m]	Maximum [m]	Average [m]
1.	0.	2.4106e-006	4.8931e-007

FIGURE 3
Model (B4) > Static Structural (B5) > Solution (B6) > Total Deformation > Figure

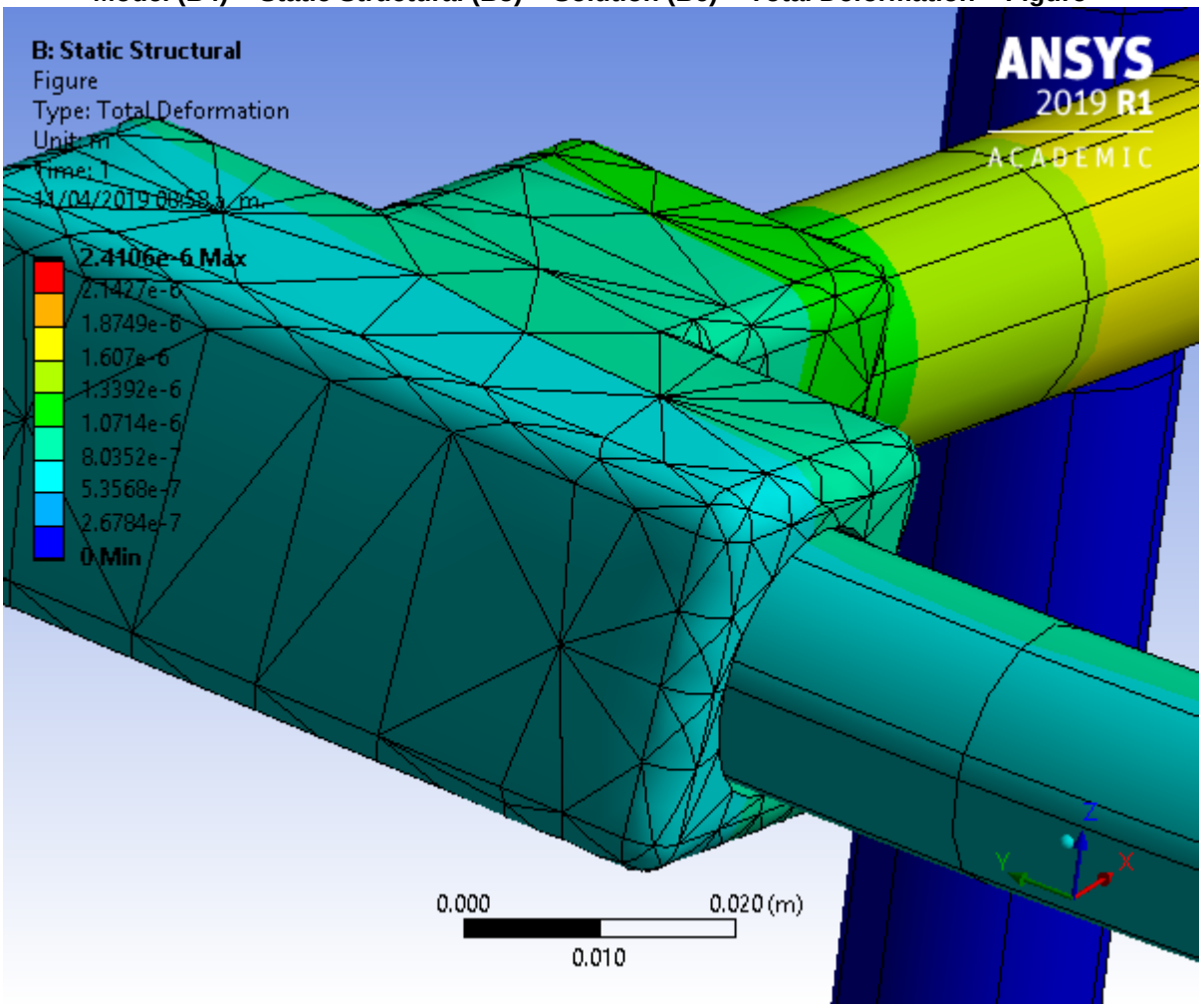


FIGURE 4
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Stress

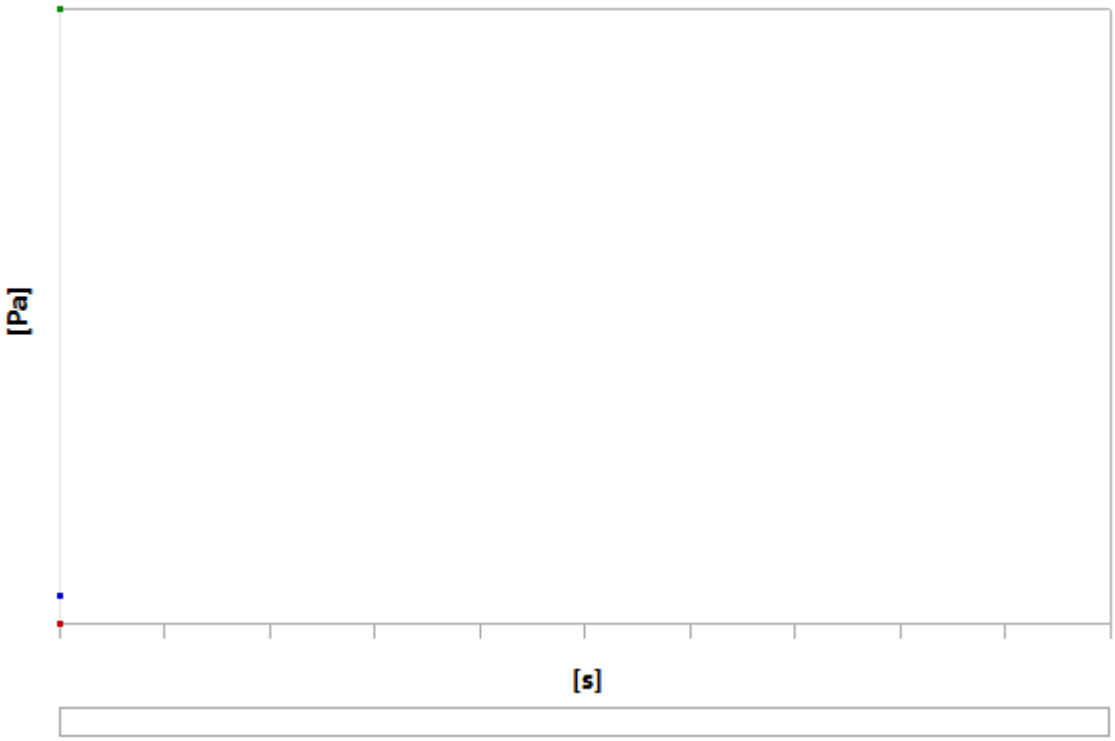


TABLE 18
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Stress

Time [s]	Minimum [Pa]	Maximum [Pa]	Average [Pa]
1.	6.7953e-002	4.7286e+005	21484

FIGURE 5
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Stress > Figure

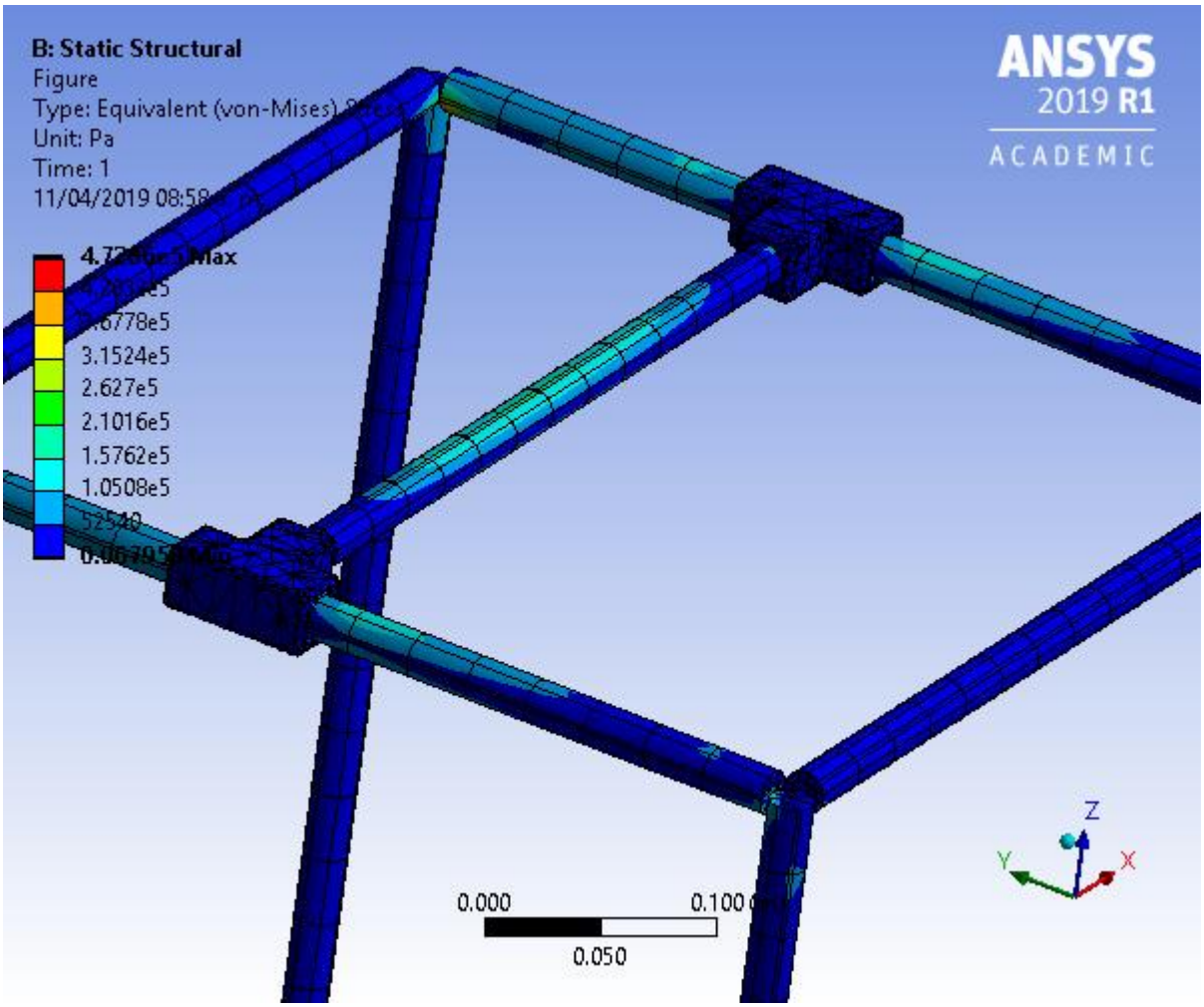


FIGURE 6
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain

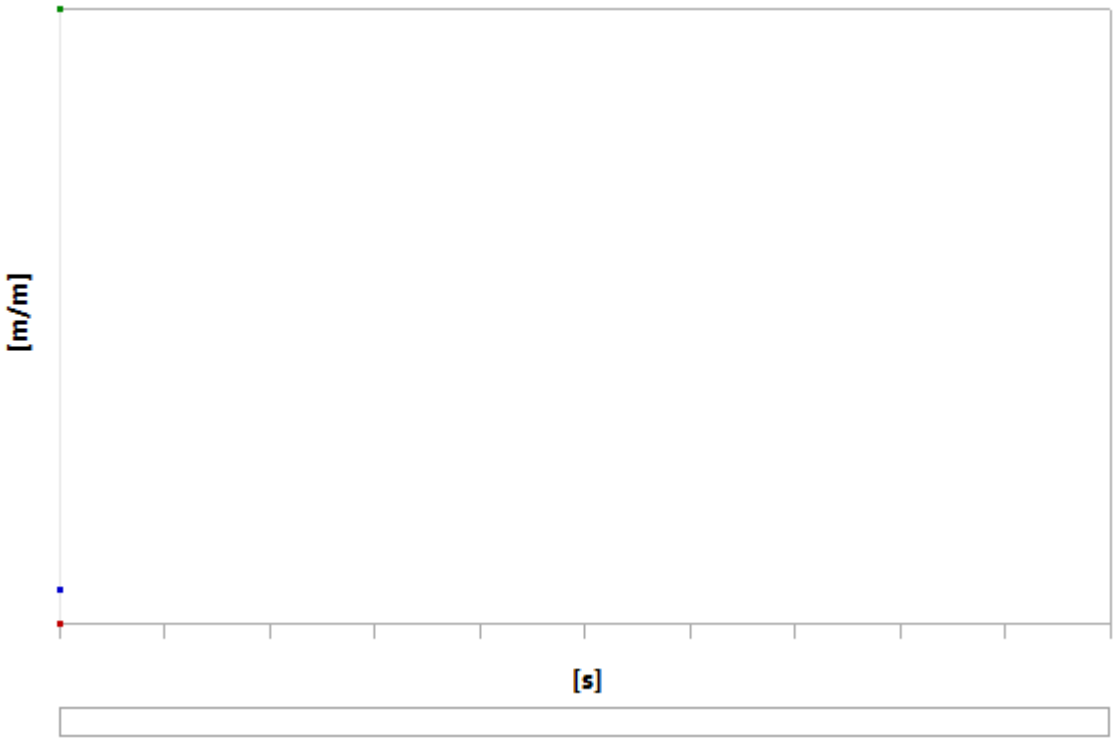
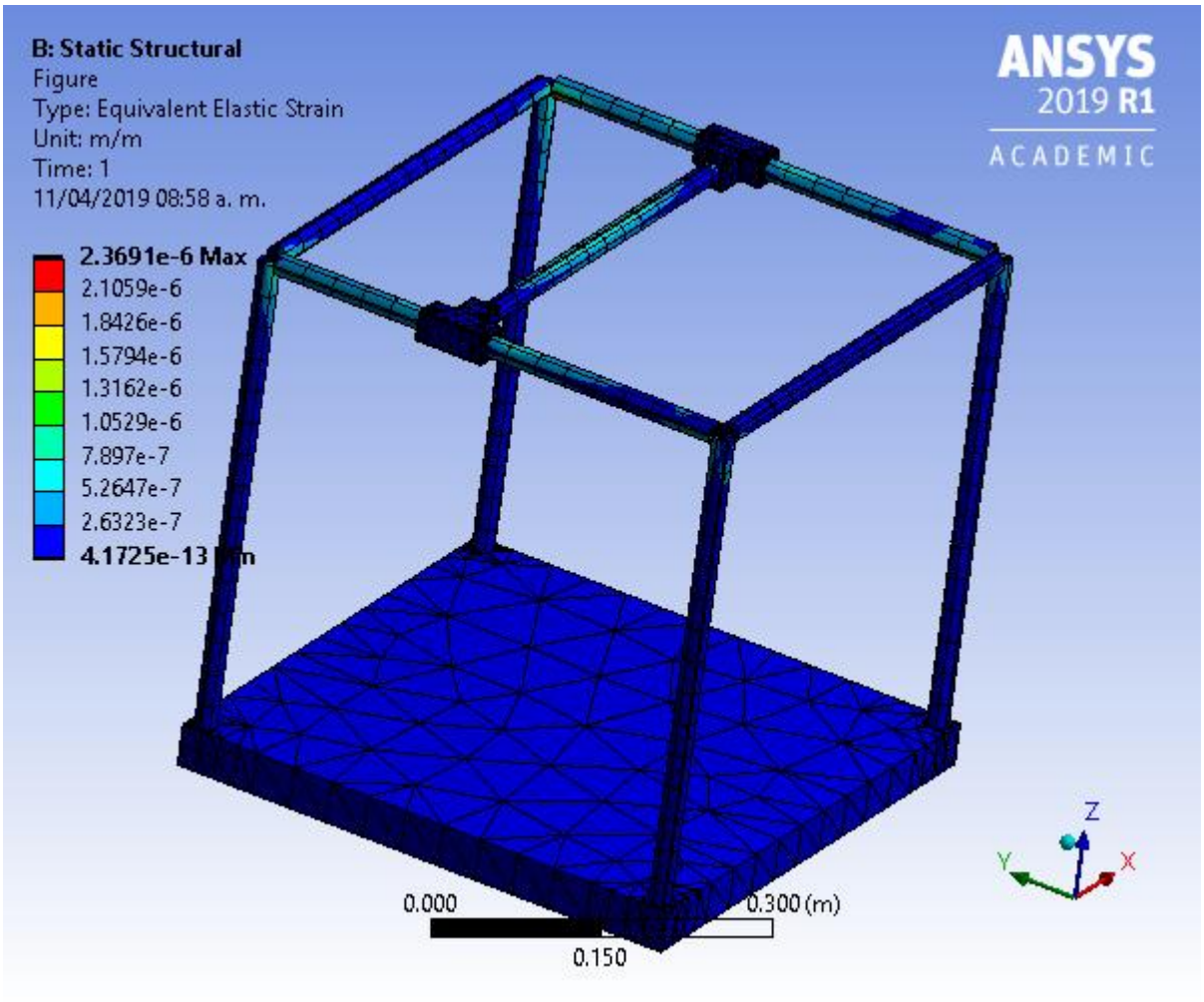


TABLE 19
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain

Time [s]	Minimum [m/m]	Maximum [m/m]	Average [m/m]
1.	4.1725e-013	2.3691e-006	1.3072e-007

FIGURE 7
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain > Figure



Material Data

Structural Steel

TABLE 20
Structural Steel > Constants

Density	7850 kg m^-3
Isotropic Secant Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat Constant Pressure	434 J kg^-1 C^-1
Isotropic Thermal Conductivity	60.5 W m^-1 C^-1
Isotropic Resistivity	1.7e-007 ohm m

TABLE 21
Structural Steel > Color

Red	Green	Blue
132	139	179

TABLE 22
Structural Steel > Compressive Ultimate Strength

Compressive Ultimate Strength Pa
0

TABLE 23
Structural Steel > Compressive Yield Strength

Compressive Yield Strength Pa
2.5e+008

TABLE 24
Structural Steel > Tensile Yield Strength

Tensile Yield Strength Pa
2.5e+008

TABLE 25
Structural Steel > Tensile Ultimate Strength

Tensile Ultimate Strength Pa
4.6e+008

TABLE 26
Structural Steel > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
22

TABLE 27
Structural Steel > S-N Curve

Alternating Stress Pa	Cycles	Mean Stress Pa
3.999e+009	10	0
2.827e+009	20	0
1.896e+009	50	0
1.413e+009	100	0
1.069e+009	200	0
4.41e+008	2000	0
2.62e+008	10000	0
2.14e+008	20000	0
1.38e+008	1.e+005	0
1.14e+008	2.e+005	0
8.62e+007	1.e+006	0

TABLE 28
Structural Steel > Strain-Life Parameters

Strength Coefficient Pa	Strength Exponent	Ductility Coefficient	Ductility Exponent	Cyclic Strength Coefficient Pa	Cyclic Strain Hardening Exponent
9.2e+008	-0.106	0.213	-0.47	1.e+009	0.2

TABLE 29
Structural Steel > Isotropic Elasticity

Young's Modulus Pa	Poisson's Ratio	Bulk Modulus Pa	Shear Modulus Pa	Temperature C
2.e+011	0.3	1.6667e+011	7.6923e+010	

TABLE 30
Structural Steel > Isotropic Relative Permeability

Relative Permeability
10000