Project 1

Contents

Units

TABLE 1

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

Model (A4)

TABLE 2
Model (A4) > Geometry Imports

Object Name	Geometry Imports
State	Solved

TABLE 3
Model (A4) > Geometry Imports > Geometry Import (A3)

Object Name	Geometry Import (A3)
State	Solved
Definition	
Source	C:\Users\awado\Desktop\Ansys\Downlaods\HowToNavigateTheAnsysMechanicalUI\Geometry - NavigateMechanicalUI.x_t

Type	Parasolid
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	No
Parameters	Independent
Parameter Key	ANS;DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
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
Import Facet Quality	Source
Clean Bodies On Import	No
Stitch Surfaces On Import	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

Geometry

TABLE 4
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\awado\Desktop\Ansys\Downlaods\HowToNavigateTheAnsysMechanicalUI\Geometry - NavigateMechanicalUI.x_t
Type	Parasolid
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	533.4 mm
Length Y	499.66 mm
Length Z	109.98 mm
Properties	
Volume	1.3499e+006 mm³
Mass	3.7392 kg
Scale Factor Value	1.
Statistics	
Bodies	4

Active Bodies	4
Nodes	21618
Elements	8268
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	No
Parameters	Independent
Parameter Key	ANS;DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
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
Import Facet Quality	Source
Clean Bodies On Import	No
Stitch Surfaces On Import	None
Decompose Disjoint Geometry	Yes
ID_GeometryPrefProcessPhysicsDefinition	No
Enclosure and Symmetry Processing	Yes

TABLE 5
Model (A4) > Geometry > Parts

Object Name	Component1;Bell Crank	Component2;Mount	Component3;Bolt	Component4;Nut
State	Meshed			
Graphics Properties				
Visible	Yes			
Transparency	1			
Definition				
Suppressed	No			
Stiffness Behavior	Flexible			
Coordinate System	Default Coordinate System			
Reference Temperature	By Environment			
Treatment	None			
Material				
Assignment	Aluminum Alloy			
Nonlinear Effects	Yes			

Thermal Strain Effects	Yes			
Bounding Box				
Length X	323.85 mm	304.8 mm	54.697 mm	38.1 mm
Length Y	467.91 mm	127. mm	54.697 mm	38.1 mm
Length Z	71.12 mm	12.7 mm	109.98 mm	10.16 mm
Properties				
Volume	7.9993e+005 mm³	4.7786e+005 mm³	64675 mm³	7413.3 mm³
Mass	2.2158 kg	1.3237 kg	0.17915 kg	2.0535e-002 kg
Centroid X	64.871 mm	-76.571 mm	12.7 mm	
Centroid Y	127.36 mm	12.7 mm		
Centroid Z	12.692 mm	-29.21 mm	23.094 mm	-40.64 mm
Moment of Inertia Ip1	48955 kg·mm²	1803.1 kg·mm²	217.14 kg·mm²	2.6692 kg·mm²
Moment of Inertia Ip2	12758 kg·mm²	10198 kg·mm²	217.13 kg·mm²	2.6692 kg·mm²
Moment of Inertia Ip3	61145 kg·mm²	11965 kg·mm²	26.636 kg·mm²	4.9876 kg·mm²
Statistics				
Nodes	10853	7850	2659	256
Elements	5579	1316	1341	32
Mesh Metric	None			

TABLE 6
Model (A4) > Materials

Object Name	*Materials*
State	Fully Defined
Statistics	
Materials	2
Material Assignments	0

Coordinate Systems

TABLE 7
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]
Transfer Properties	
Source	
Read Only	No

Connections

TABLE 8
Model (A4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes
Statistics	
Contacts	5
Active Contacts	5
Joints	0
Active Joints	0
Beams	0
Active Beams	0
Bearings	0
Active Bearings	0
Springs	0
Active Springs	0
Body Interactions	0
Active Body Interactions	0

TABLE 9
Model (A4) > 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	1.8478 mm
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	5

Active Connections	5

TABLE 10
Model (A4) > Connections > Contacts > Contact Regions

Object Name	Contact Region	Contact Region 2	Contact Region 3	Contact Region 4	Contact Region 5
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Contact	1 Face	2 Faces	1 Face		
Target	1 Face	2 Faces	1 Face		
Contact Bodies	Component1;Bell Crank		Component2;Mount		Component3;Bolt
Target Bodies	Component2;Mount	Component3;Bolt		Component4;Nut	
Protected	No				
Definition					
Type	Bonded				
Scope Mode	Automatic				
Behavior	Program Controlled				
Trim Contact	Program Controlled				
Trim Tolerance	1.8478 mm				
Contact APDL Name					
Target APDL Name					
Suppressed	No				
Display					
Element Normals	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 11
Model (A4) > Mesh

Object Name	Mesh
State	Solved
Display	

Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	8.0 mm
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	739.1 mm
Average Surface Area	2847.2 mm²
Minimum Edge Length	6.3345 mm
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Aggressive Mechanical
Target Element Quality	Default (5.e-002)
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
Inflation Element Type	Wedges
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
Auto-Map Fillets	No
Automatic Methods	
Sheet Body Method	Prime Quad Dominant
Sweepable Body Method	Sweep
Statistics	
Nodes	21618
Elements	8268
Show Detailed Statistics	No

Static Structural (A5)

TABLE 12
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No
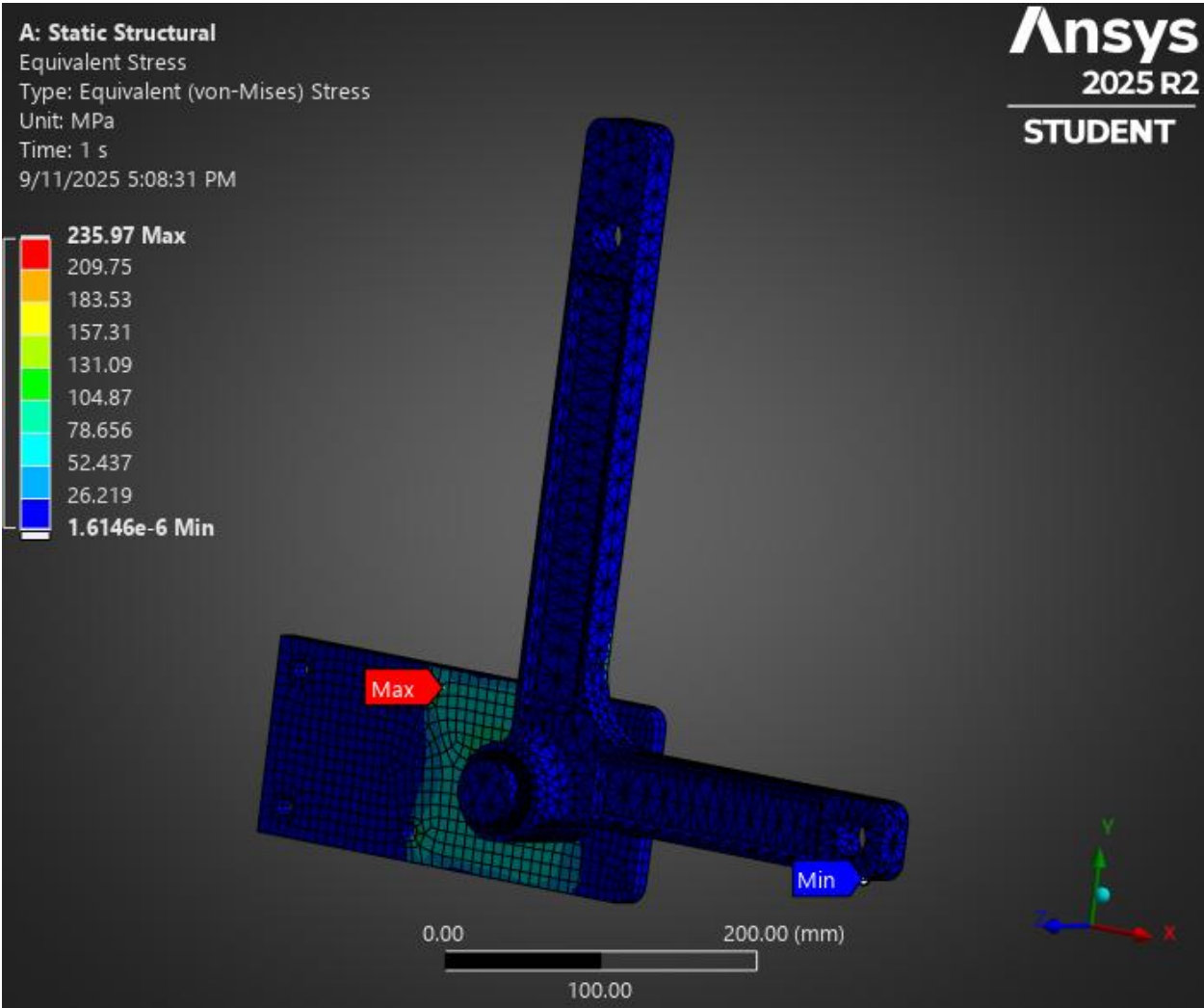
TABLE 13
Model (A4) > Static Structural (A5) > Analysis Settings

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	On
Define By	Substeps
Initial Substeps	25.
Minimum Substeps	10.
Maximum Substeps	100.
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	On
Inertia Relief	Off
Quasi-Static Solution	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	Program Controlled
Advanced	
Inverse Option	No
Contact Split (DMP)	Program Controlled
Output Controls	
Output Selection	None
Stress	Yes
Back Stress	No
Strain	Yes
Contact Data	Yes
Nonlinear Data	No
Nodal Forces	No
Volume and Energy	Yes
Euler Angles	Yes
General Miscellaneous	No
Contact Miscellaneous	No

Store Results At	All Time Points
Result File Compression	Program Controlled
Analysis Data Management	
Solver Files Directory	C:\Users\awado\AppData\Local\Temp\WB_Abdul Wadood Fathah_23888_2\wbnew_files\dp0\SYS-1\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Contact Summary	Program Controlled
Delete Unneeded Files	Yes
Nonlinear Solution	Yes
Solver Units	Active System
Solver Unit System	nmm

TABLE 14
Model (A4) > Static Structural (A5) > Loads

Object Name	*Force*	*Fixed Support*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	4 Faces
Definition		
Type	Force	Fixed Support
Define By	Components	
Applied By	Surface Effect	
Coordinate System	Global Coordinate System	
X Component	0. N (ramped)	
Y Component	10000 N (ramped)	
Z Component	0. N (ramped)	
Suppressed	No	

FIGURE 1
Model (A4) > Static Structural (A5) > Force
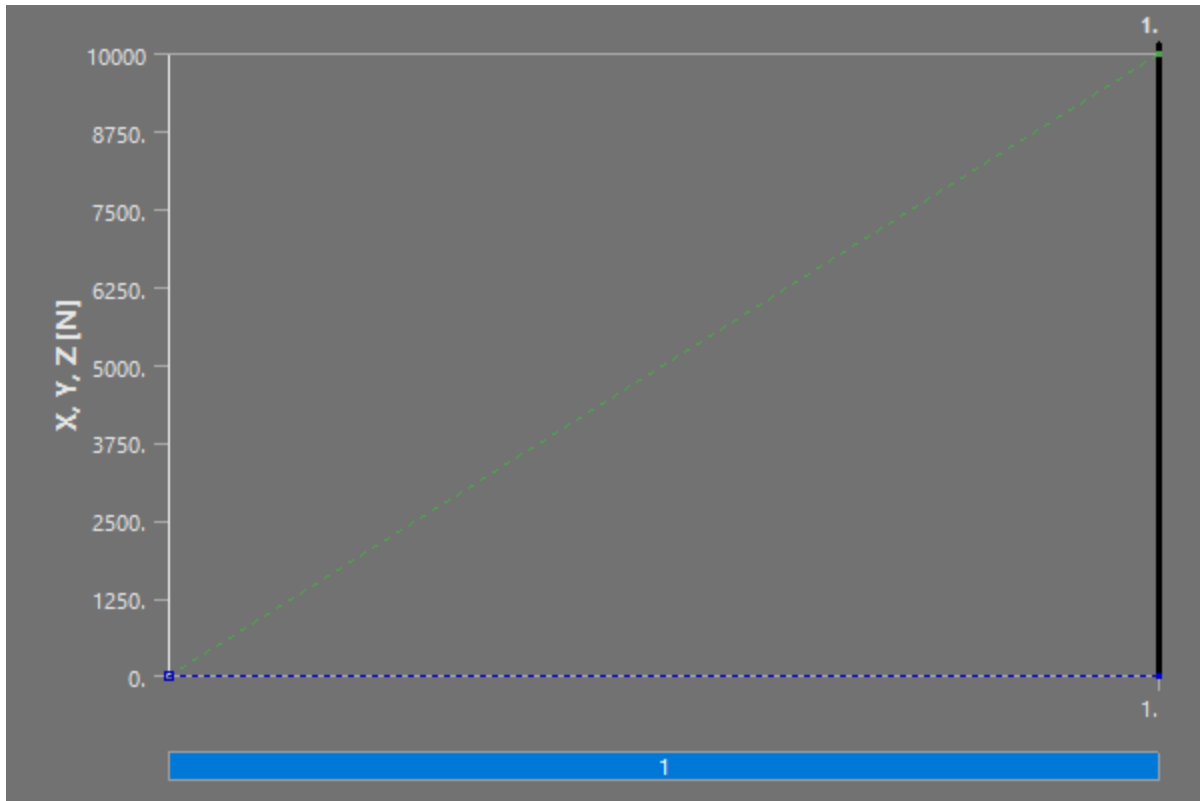
Solution (A6)

TABLE 15
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
MAPDL Elapsed Time	48. s
MAPDL Memory Used	505. MB
MAPDL Result File Size	53.938 MB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Force Convergence
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

FIGURE 2
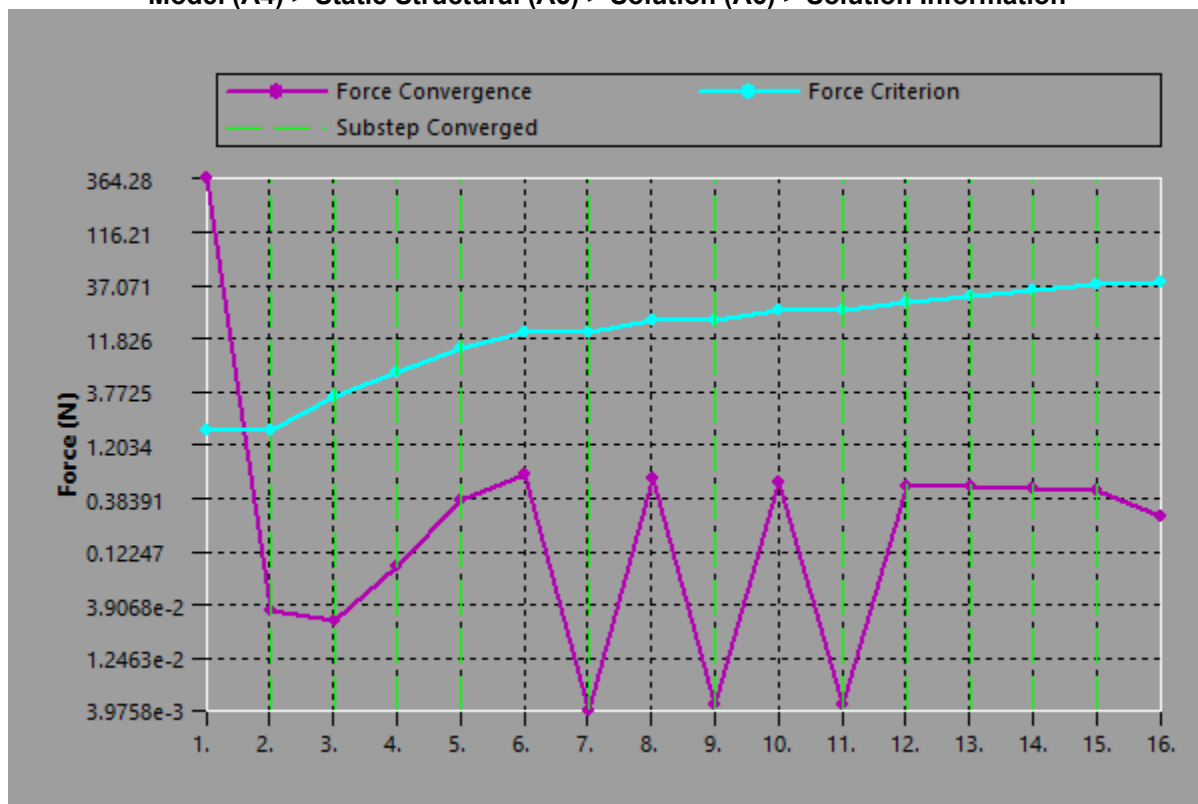**Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information**

FIGURE 3
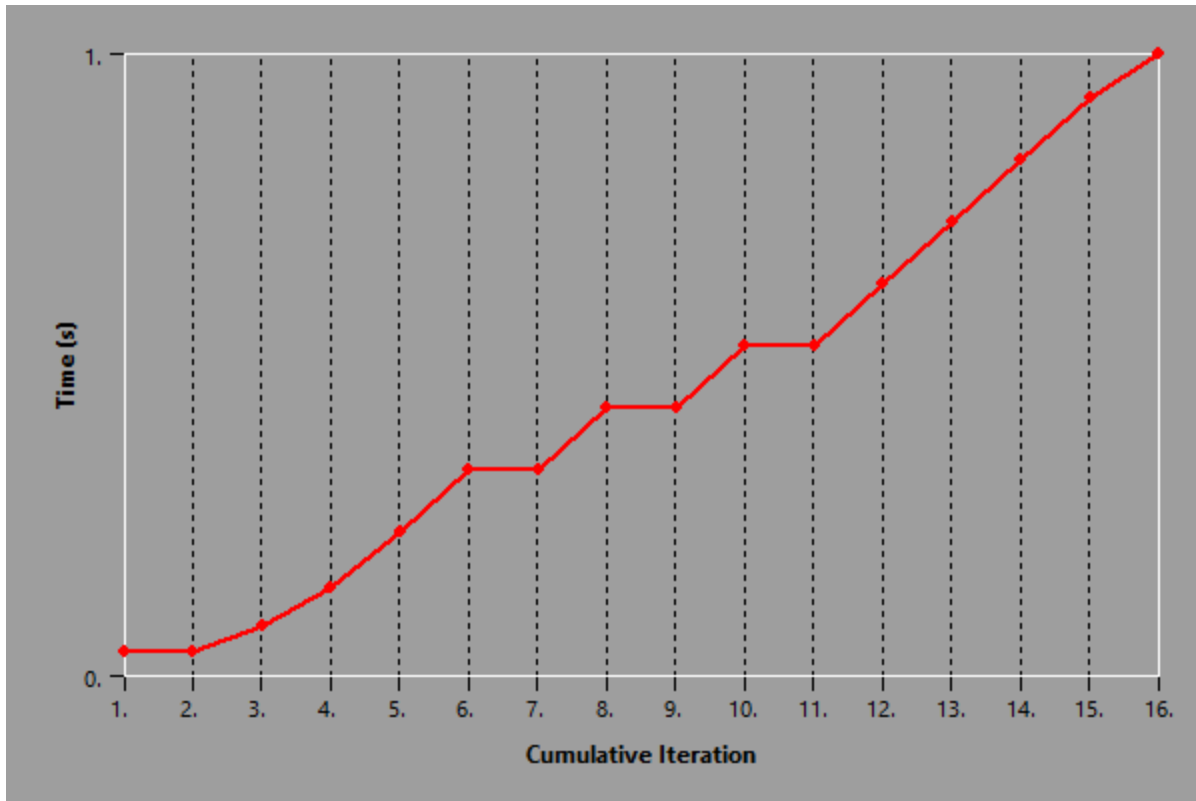**Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information**

TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Equivalent Stress*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Equivalent (von-Mises) Stress
By	Time
Display Time	Last
Separate Data by Entity	No
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	1.6146e-006 MPa
Maximum	235.97 MPa
Average	11.176 MPa
Minimum Occurs On	Component1;Bell Crank
Maximum Occurs On	Component2;Mount
Minimum Value Over Time	

Minimum	1.0275e-007 MPa
Maximum	7.0874e-006 MPa
Maximum Value Over Time	
Minimum	10.042 MPa
Maximum	235.97 MPa
Information	
Time	1. s
Load Step	1
Substep	12
Iteration Number	16

FIGURE 4
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress
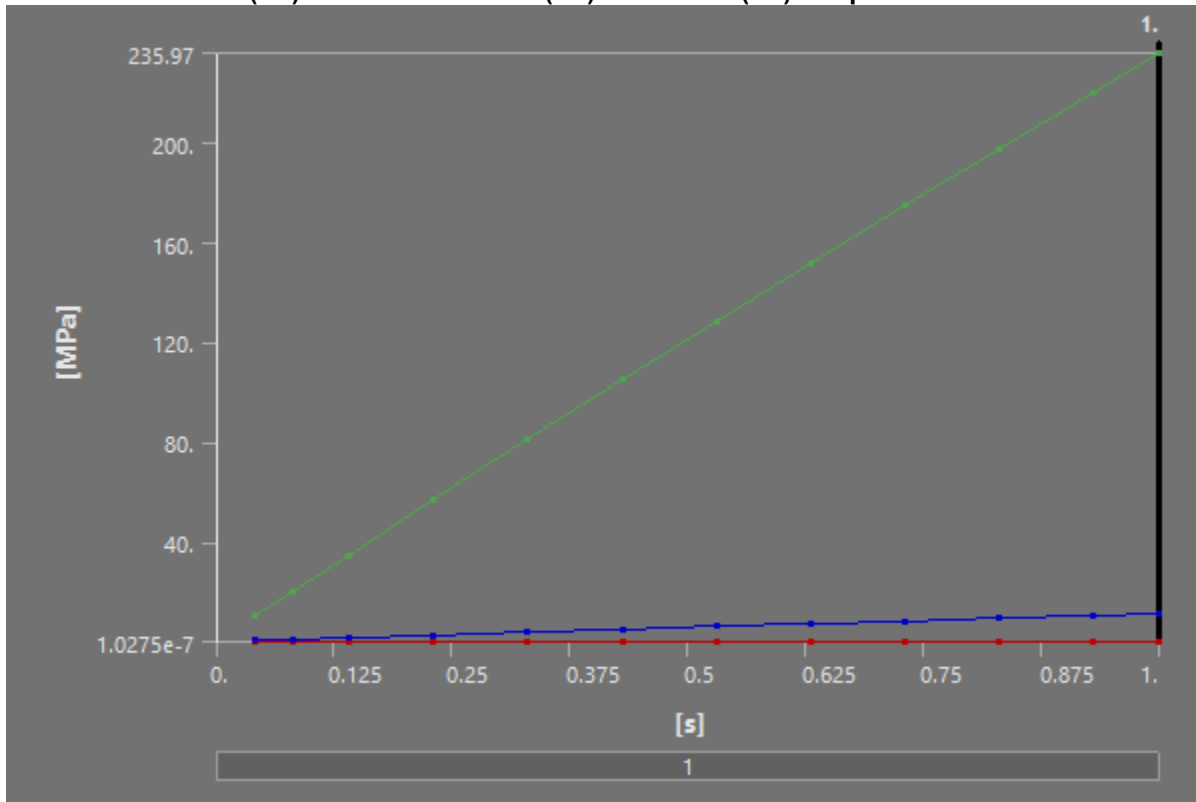

TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
4.e-002	1.6545e-006	10.042	0.47182
8.e-002	3.8375e-007	20.022	0.94089
0.14	1.2902e-006	34.877	1.6395
0.23	5.6777e-006	56.918	2.6769
0.33	1.0275e-007	81.083	3.8156
0.43	1.042e-007	104.94	4.9411
0.53	1.2025e-007	128.51	6.0545
0.63	7.0874e-006	151.81	7.1572
0.73	6.7494e-006	174.86	8.2505

0.83	5.865e-006	197.68	9.3367
0.93	5.3878e-006	220.28	10.42
1.	1.6146e-006	235.97	11.176

Material Data

Aluminum Alloy

TABLE 19
Aluminum Alloy > Constants

Density	2.77e-006 kg mm^-3
Isotropic Secant Coefficient of Thermal Expansion	2.3e-005 K^-1
Specific Heat Constant Pressure	8.75e+005 mJ kg^-1 K^-1

TABLE 20
Aluminum Alloy > Appearance

Red	Green	Blue
138	104	46

TABLE 21
Aluminum Alloy > Compressive Ultimate Strength

Compressive Ultimate Strength MPa
0

TABLE 22
Aluminum Alloy > Compressive Yield Strength

Compressive Yield Strength MPa
280

TABLE 23
Aluminum Alloy > Tensile Yield Strength

Tensile Yield Strength MPa
280

TABLE 24
Aluminum Alloy > Tensile Ultimate Strength

Tensile Ultimate Strength MPa
310

TABLE 25
Aluminum Alloy > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature K
295.15

TABLE 26
Aluminum Alloy > Isotropic Thermal Conductivity

Thermal Conductivity W mm^-1 K^-1	Temperature K
0.114	173.15
0.144	273.15

0.165	373.15
0.175	473.15

TABLE 27
Aluminum Alloy > S-N Curve

Alternating Stress MPa	Cycles	R-Ratio
275.8	1700	-1
241.3	5000	-1
206.8	34000	-1
172.4	1.4e+005	-1
137.9	8.e+005	-1
117.2	2.4e+006	-1
89.63	5.5e+007	-1
82.74	1.e+008	-1
170.6	50000	-0.5
139.6	3.5e+005	-0.5
108.6	3.7e+006	-0.5
87.91	1.4e+007	-0.5
77.57	5.e+007	-0.5
72.39	1.e+008	-0.5
144.8	50000	0
120.7	1.9e+005	0
103.4	1.3e+006	0
93.08	4.4e+006	0
86.18	1.2e+007	0
72.39	1.e+008	0
74.12	3.e+005	0.5
70.67	1.5e+006	0.5
66.36	1.2e+007	0.5
62.05	1.e+008	0.5

TABLE 28
Aluminum Alloy > Isotropic Resistivity

Resistivity ohm mm	Temperature K
2.43e-005	273.15
2.67e-005	293.15
3.63e-005	373.15

TABLE 29
Aluminum Alloy > Isotropic Elasticity

Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature K
71000	0.33	69608	26692	

TABLE 30
Aluminum Alloy > Isotropic Relative Permeability

Relative Permeability
1