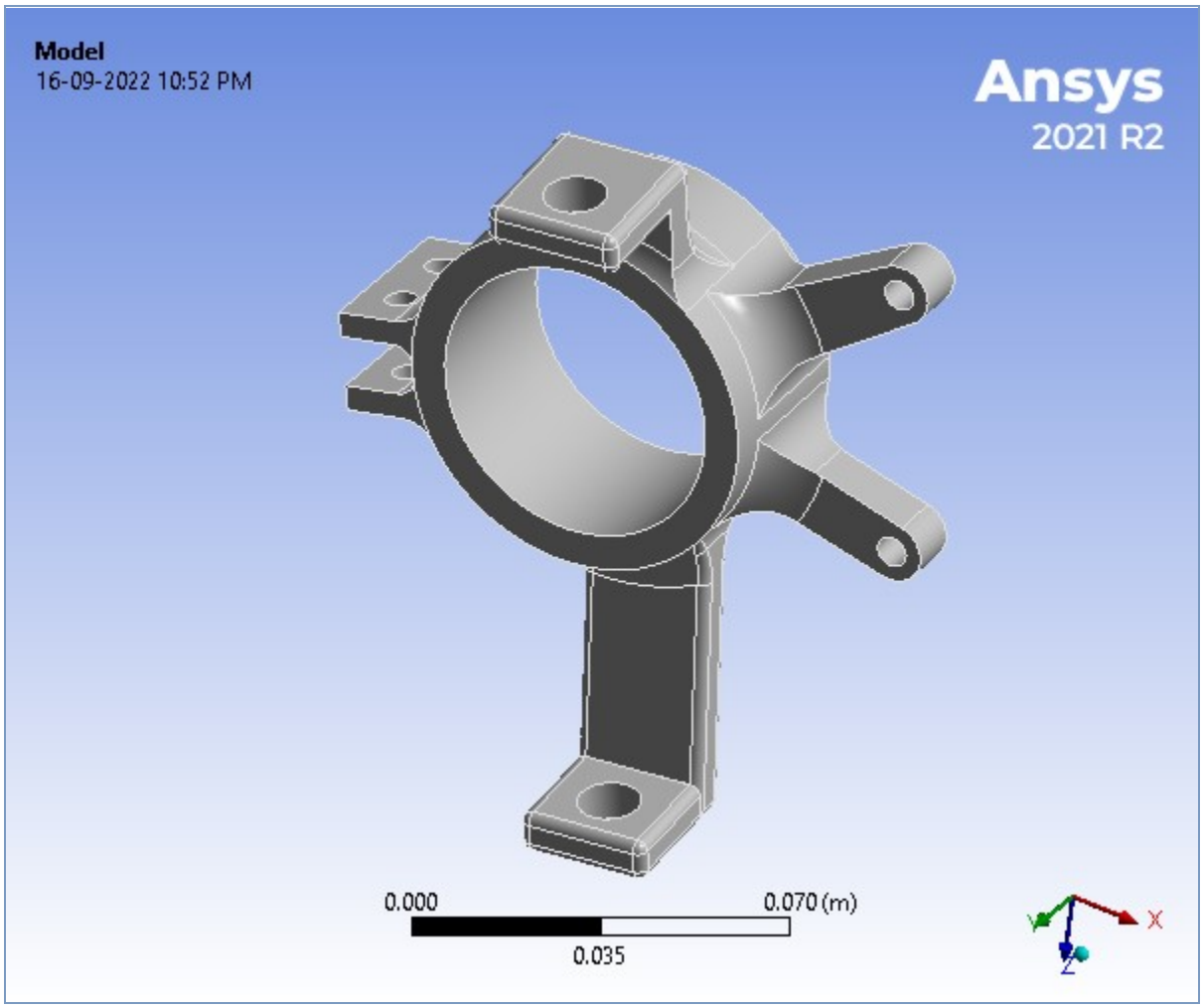
Project*

First Saved	Tuesday, September 13, 2022
Last Saved	Tuesday, September 13, 2022
Product Version	2021 R2
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 (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	D:\hyderabad.bits-pilani.ac.in\Vulcan 2022-23 - Suspension and Steering\Simulations\Sims\knuckle sims\knuckle simulation_files\dp0 \SYS\DM\SYS.scdoc
Type	SpaceClaim
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	0.11634 m
Length Y	5.9947e-002 m

Length Z	0.14745 m
Properties	
Volume	8.8343e-005 m³
Mass	0.23967 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	17041
Elements	10305
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
Import Facet Quality	Source
Clean Bodies On Import	No
Stitch Surfaces On Import	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*SYS\Solid1*
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, wrought, 6061, T6
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	0.11634 m
Length Y	5.9947e-002 m
Length Z	0.14745 m
Properties	
Volume	8.8343e-005 m³
Mass	0.23967 kg
Centroid X	5.2564e-003 m
Centroid Y	1.4696e-003 m
Centroid Z	7.3423e-003 m
Moment of Inertia Ip1	3.4255e-004 kg·m²
Moment of Inertia Ip2	4.5785e-004 kg·m²
Moment of Inertia Ip3	1.7204e-004 kg·m²
Statistics	
Nodes	17041
Elements	10305
Mesh Metric	None
CAD Attributes	
PartTolerance:	0.00000001
Color:143.149.175	

FIGURE 1
Model (A4) > Geometry > Figure

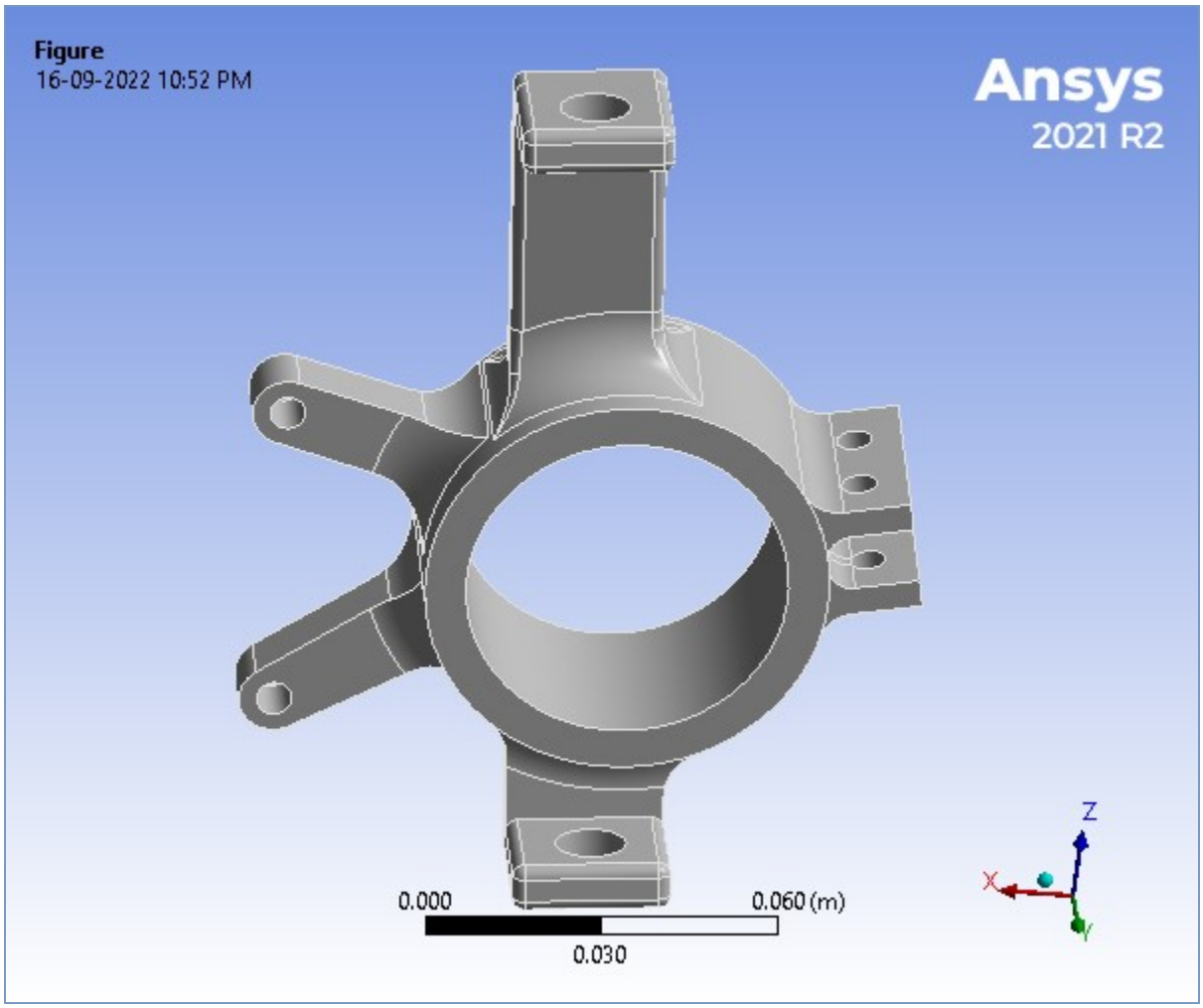


TABLE 4
Model (A4) > Materials

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

Coordinate Systems

TABLE 5
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. 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.]

Mesh

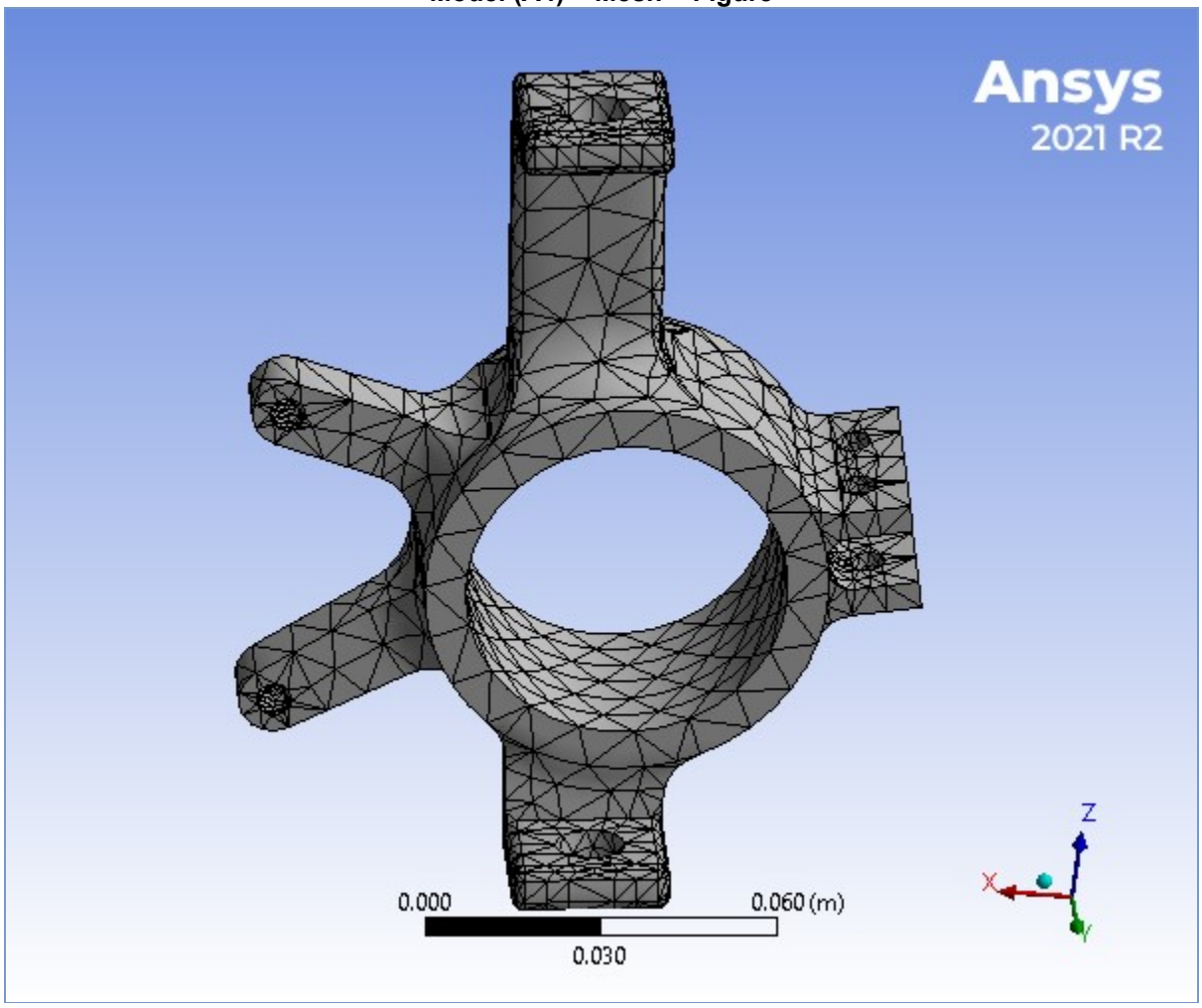
TABLE 6
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	1.e-002 m
Sizing	
Use Adaptive Sizing	Yes
Resolution	Default (2)
Mesh Defeaturing	Yes
Defeature Size	Default
Transition	Slow
Span Angle Center	Medium
Initial Size Seed	Assembly
Bounding Box Diagonal	0.19716 m
Average Surface Area	2.3191e-004 m²
Minimum Edge Length	1.4079e-004 m
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Aggressive Mechanical
Target Quality	Default (0.050000)
Smoothing	High
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	17041
Elements	10305

TABLE 7
Model (A4) > Mesh > Mesh Controls

Object Name	*Face Sizing*	*Patch Conforming Method*	*Face Sizing 2*	*Face Sizing 3*
State	Fully Defined			
Scope				
Scoping Method	Geometry Selection			
Geometry	8 Faces	1 Body	25 Faces	2 Faces
Definition				
Suppressed	No			
Type	Element Size		Element Size	
Element Size	1.e-002 m		1.e-002 m	
Method		Tetrahedrons		
Algorithm		Patch Conforming		
Element Order		Use Global Setting		
Advanced				
Defeature Size	Default		Default	
Influence Volume	No		No	
Behavior	Soft		Soft	

FIGURE 2
Model (A4) > Mesh > Figure



Static Structural (A5)

TABLE 8
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 9
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	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	Off
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)	Off
Output Controls	

Stress	Yes
Surface Stress	No
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	D:\hyderabad.bits-pilani.ac.in\Vulcan 2022-23 - Suspension and Steering\Simulations\Sims\knuckle sims\knuckle simulation_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 10
Model (A4) > Static Structural (A5) > Loads

Object Name	*Force*	*Moment*	*Fixed Support*	*Force 2*
State	Fully Defined			
Scope				
Scoping Method	Geometry Selection			
Geometry	2 Faces	4 Faces	1 Face	4 Faces
Definition				
Type	Force	Moment	Fixed Support	Force
Define By	Components			Components
Applied By	Surface Effect			Surface Effect
Coordinate System	Global Coordinate System			Global Coordinate System
X Component	0. N (ramped)	0. N·m (ramped)		0. N (ramped)
Y Component	0. N (ramped)	200. N·m (ramped)		60. N (ramped)
Z Component	2828. N (ramped)	0. N·m (ramped)		0. N (ramped)
Suppressed	No			
Behavior		Deformable		
Advanced				
Pinball Region		All		

FIGURE 3
Model (A4) > Static Structural (A5) > Force

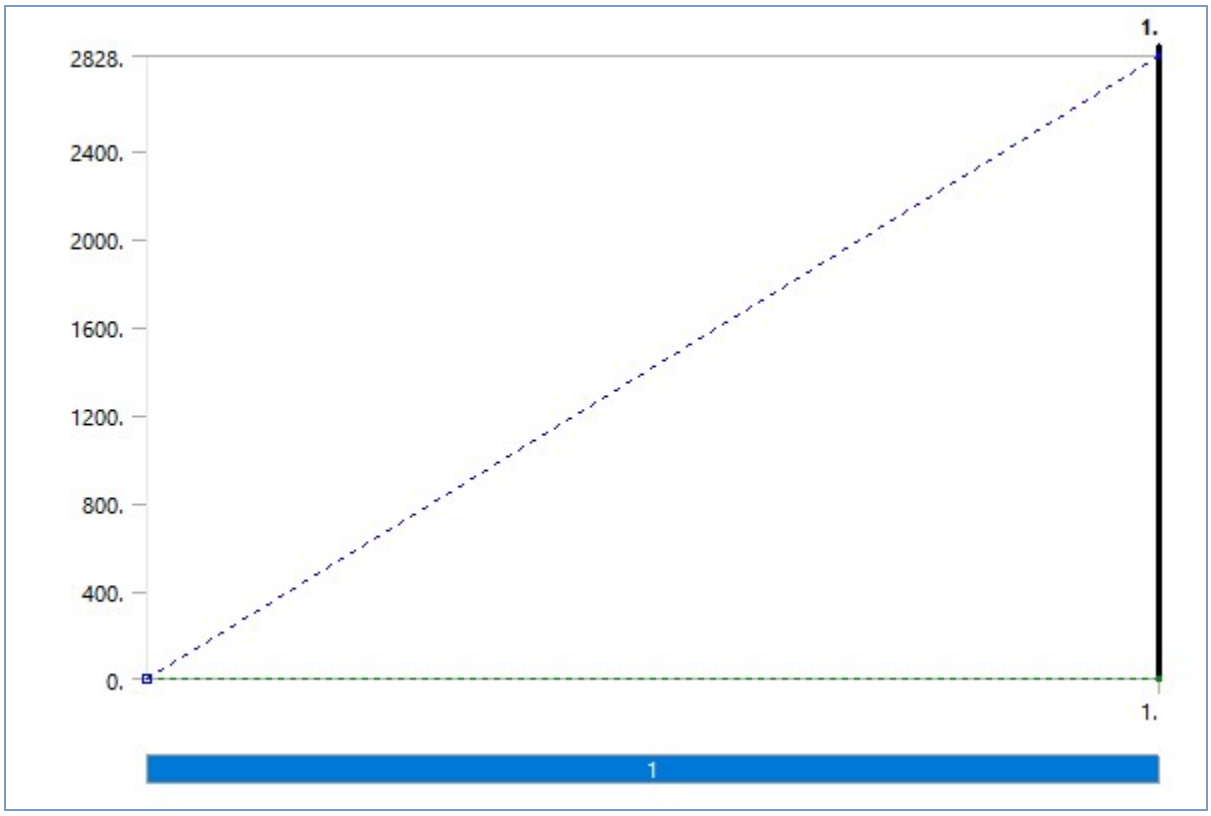


FIGURE 4
Model (A4) > Static Structural (A5) > Force > Figure

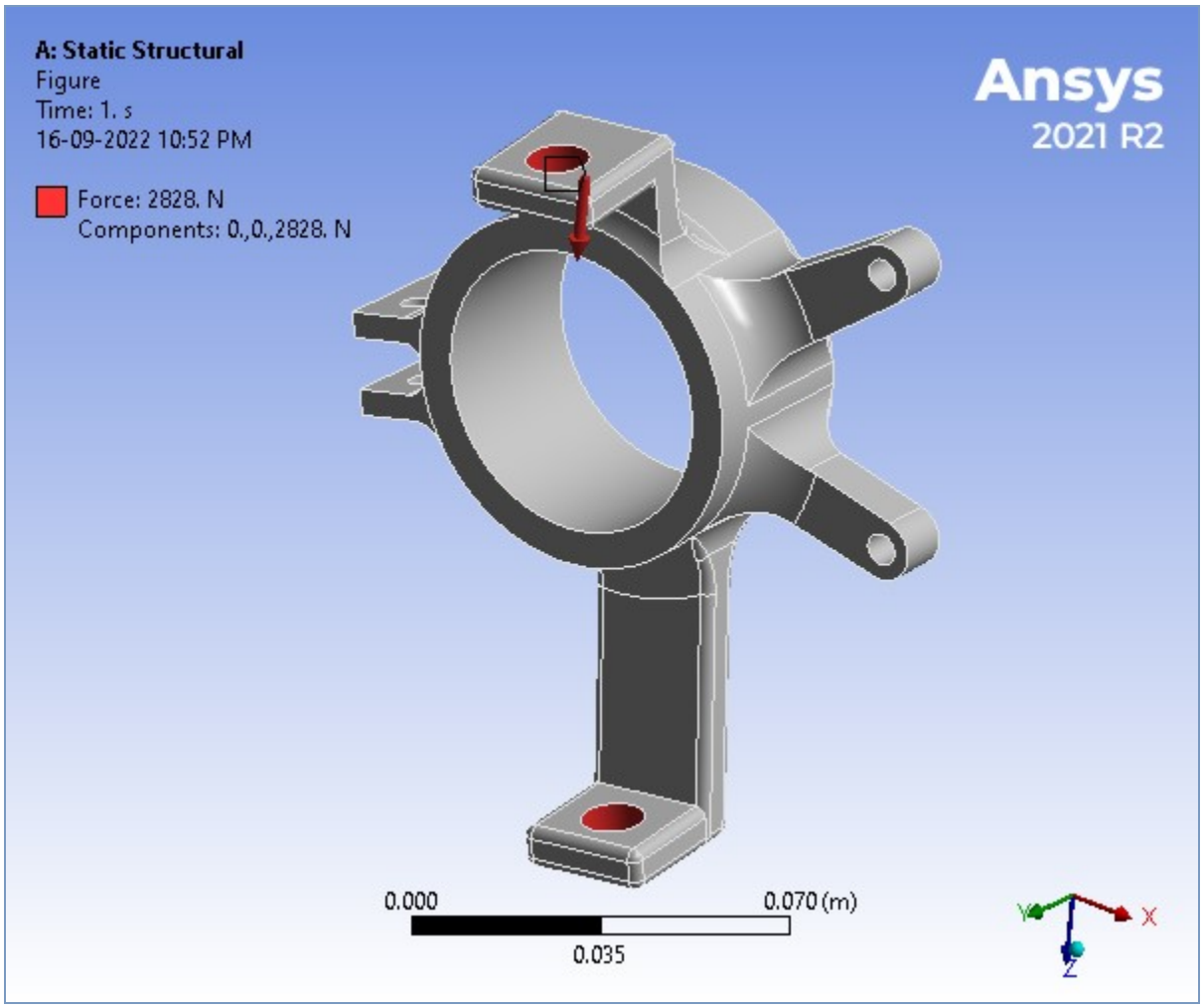


FIGURE 5
Model (A4) > Static Structural (A5) > Moment

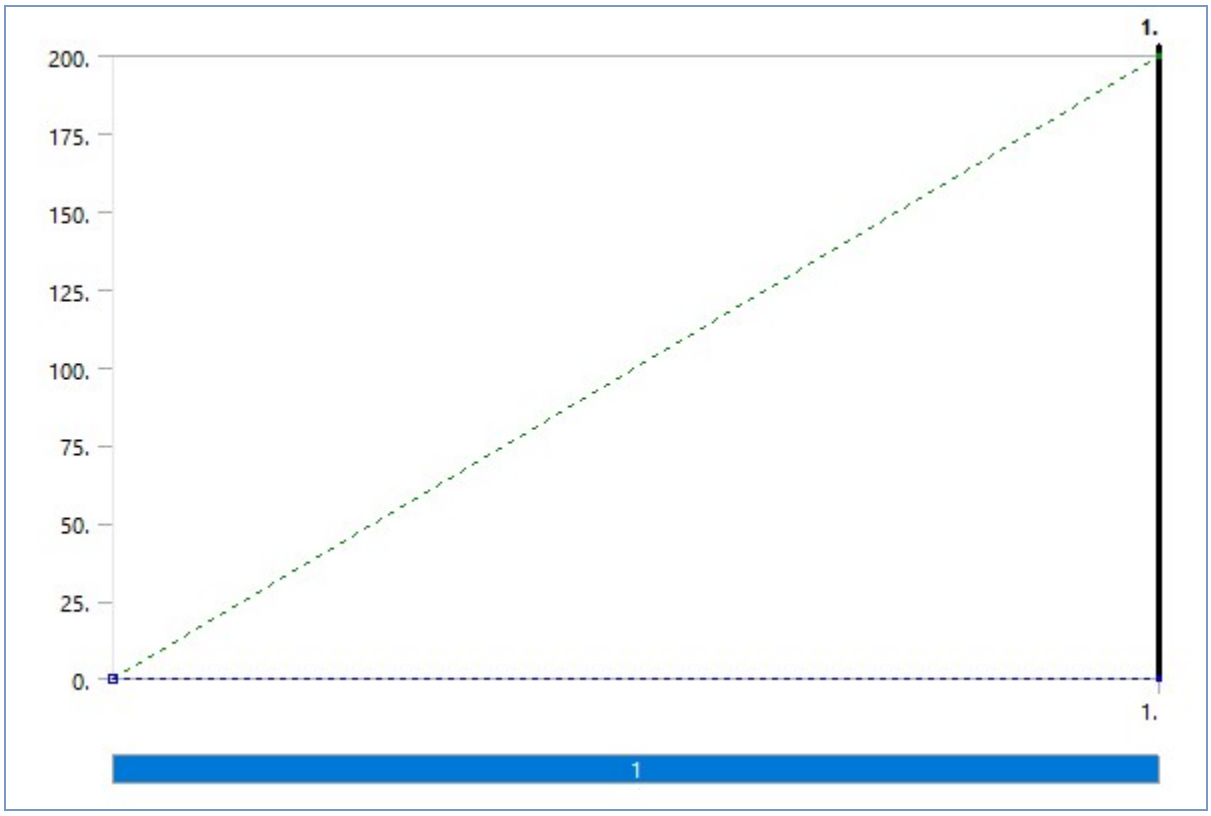


FIGURE 6
Model (A4) > Static Structural (A5) > Moment > Figure

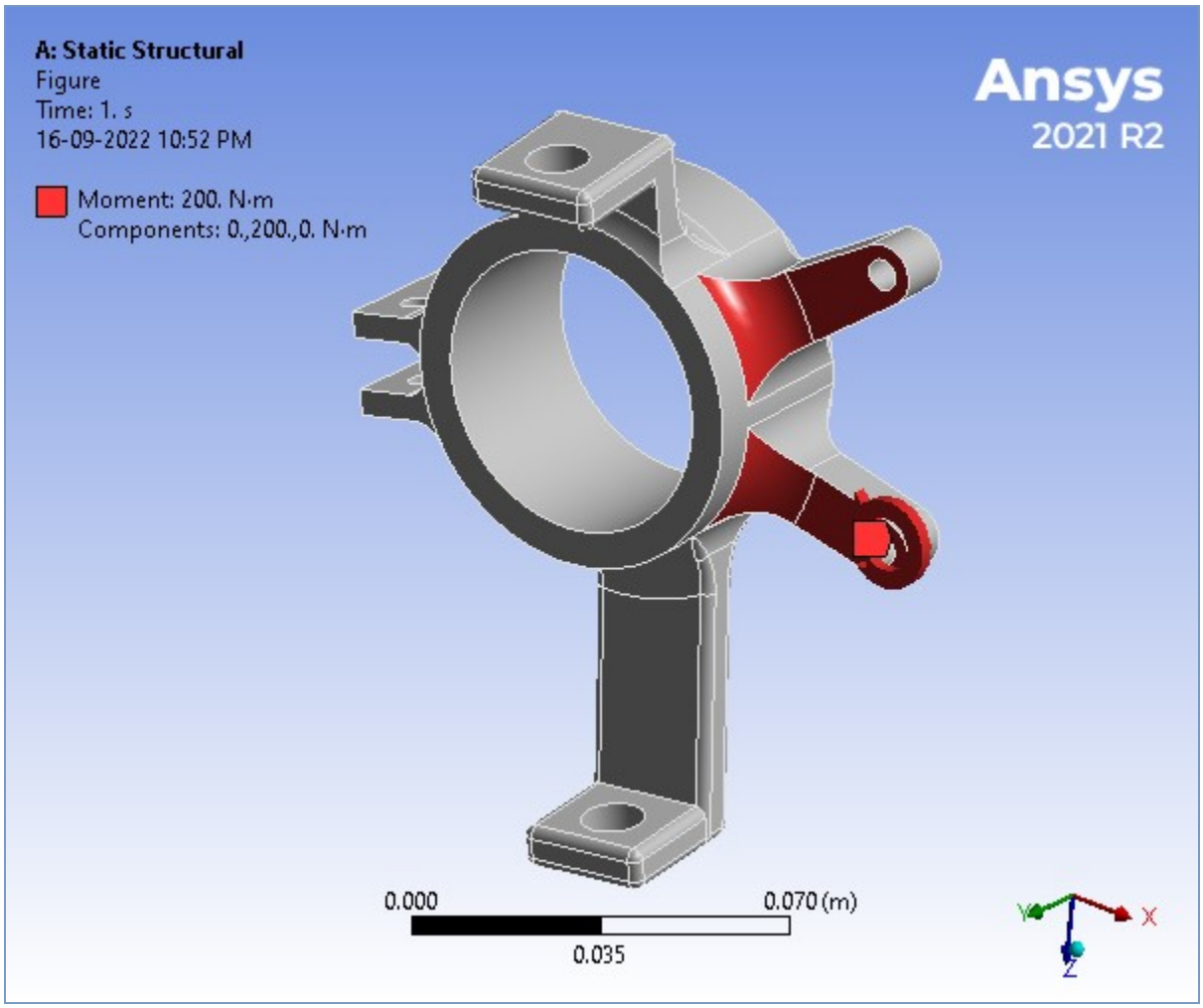


FIGURE 7
Model (A4) > Static Structural (A5) > Fixed Support > Figure

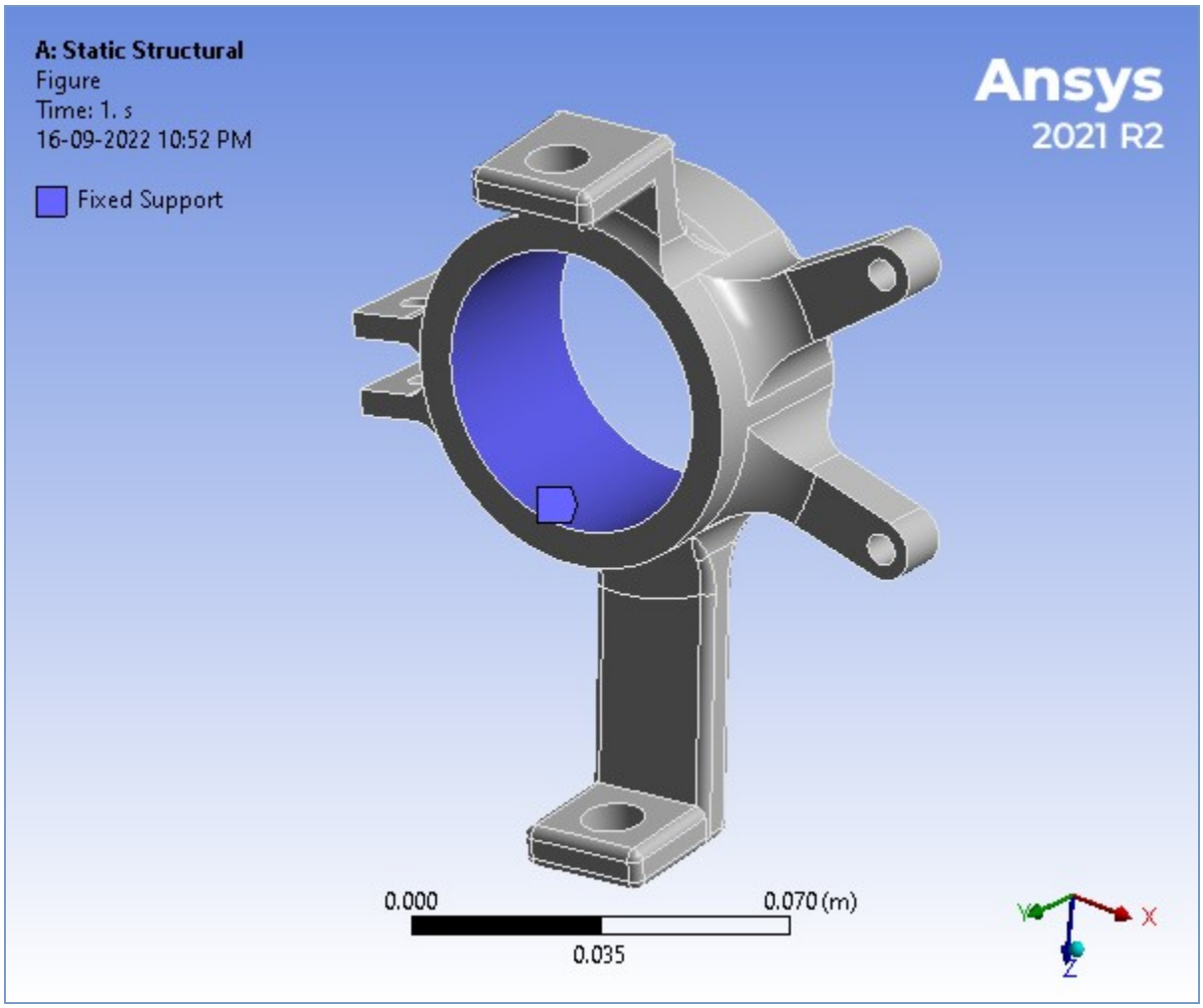


FIGURE 8
Model (A4) > Static Structural (A5) > Force 2

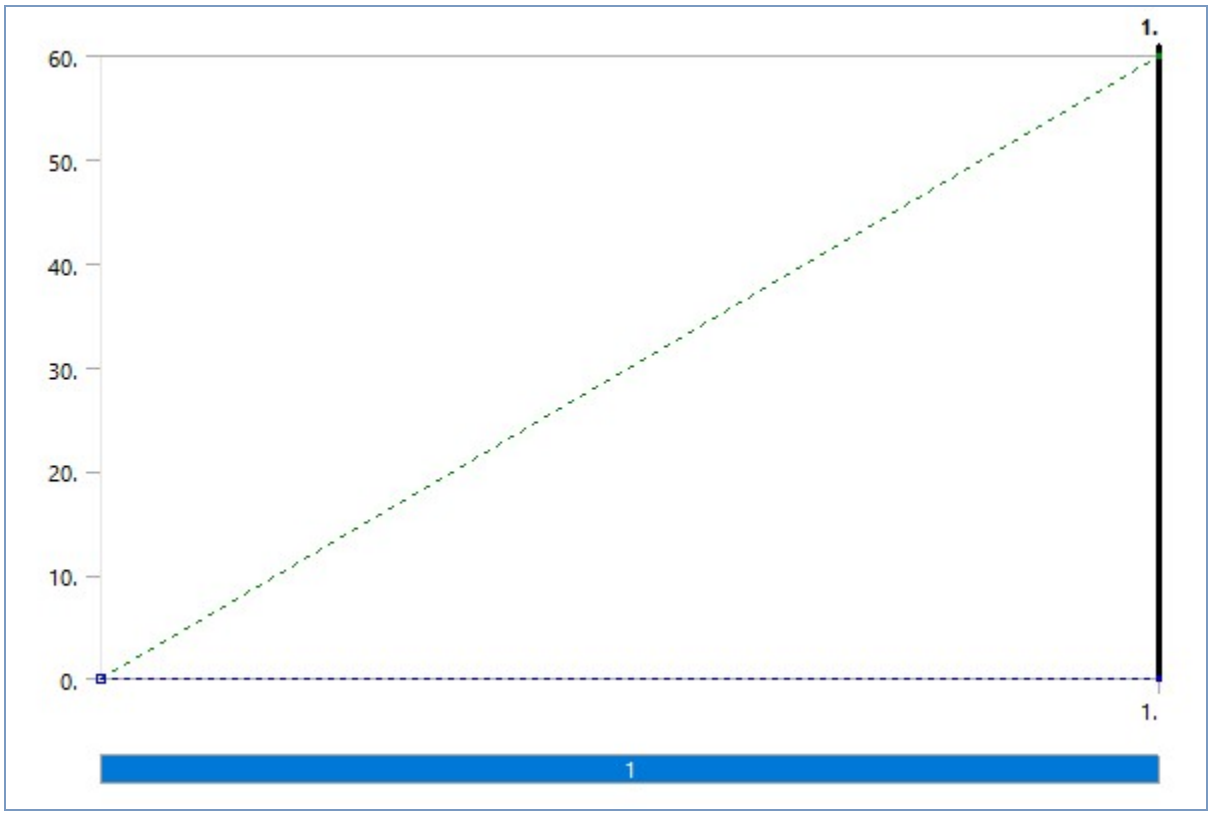
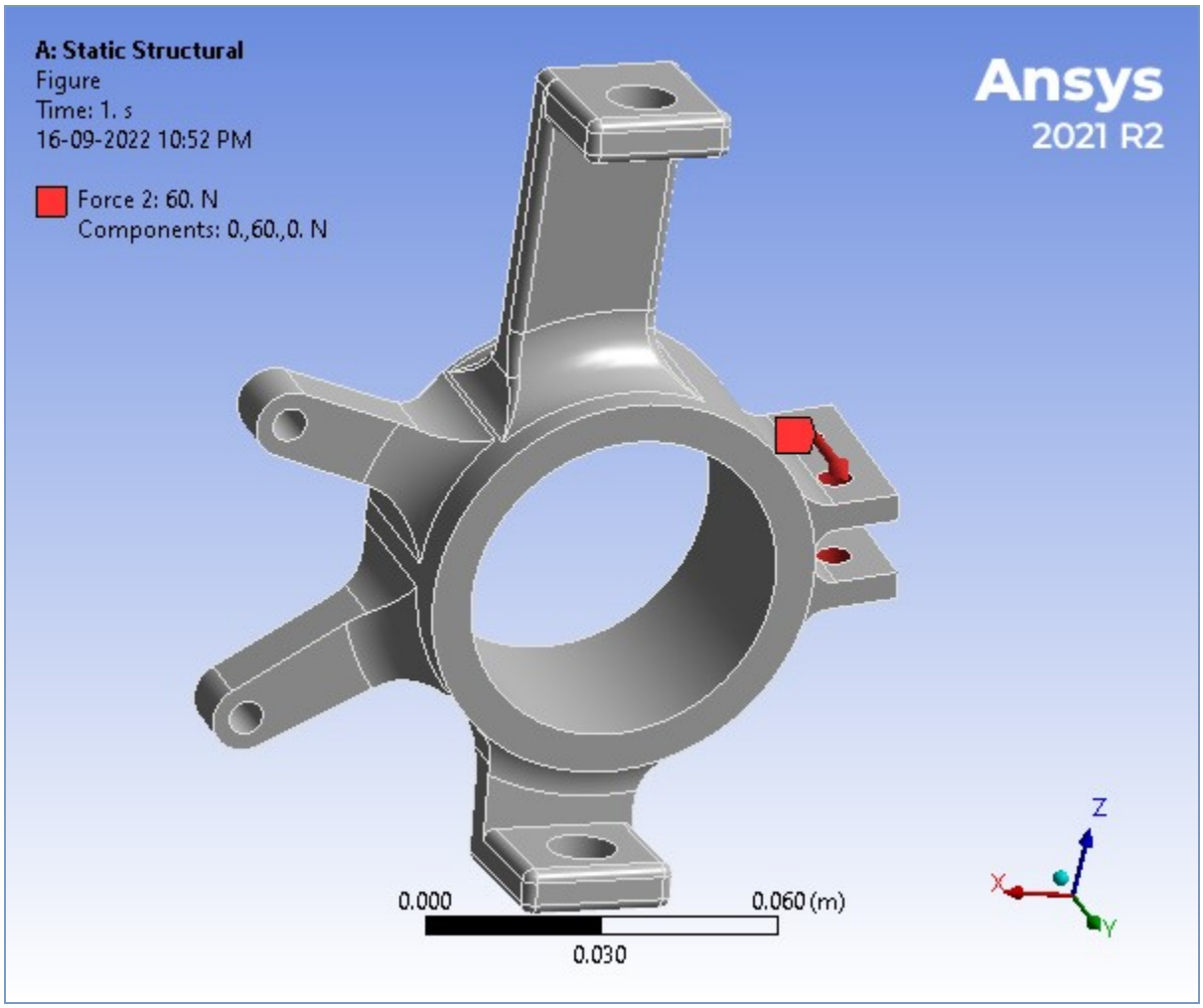


FIGURE 9
Model (A4) > Static Structural (A5) > Force 2 > Figure



Solution (A6)

TABLE 11
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	5. s
MAPDL Memory Used	237. MB
MAPDL Result File Size	6.9375 MB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 12
Model (A4) > Static Structural (A5) > Solution (A6) > 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 13
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Total Deformation*	*Equivalent Stress*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Total Deformation	Equivalent (von-Mises) Stress
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Results		
Minimum	0. m	10277 Pa
Maximum	6.1431e-004 m	1.4035e+008 Pa
Average	1.1838e-004 m	1.5139e+007 Pa
Minimum Occurs On	SYS\Solid1	
Maximum Occurs On	SYS\Solid1	
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	
Integration Point Results		
Display Option		Averaged
Average Across Bodies		No

FIGURE 10
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

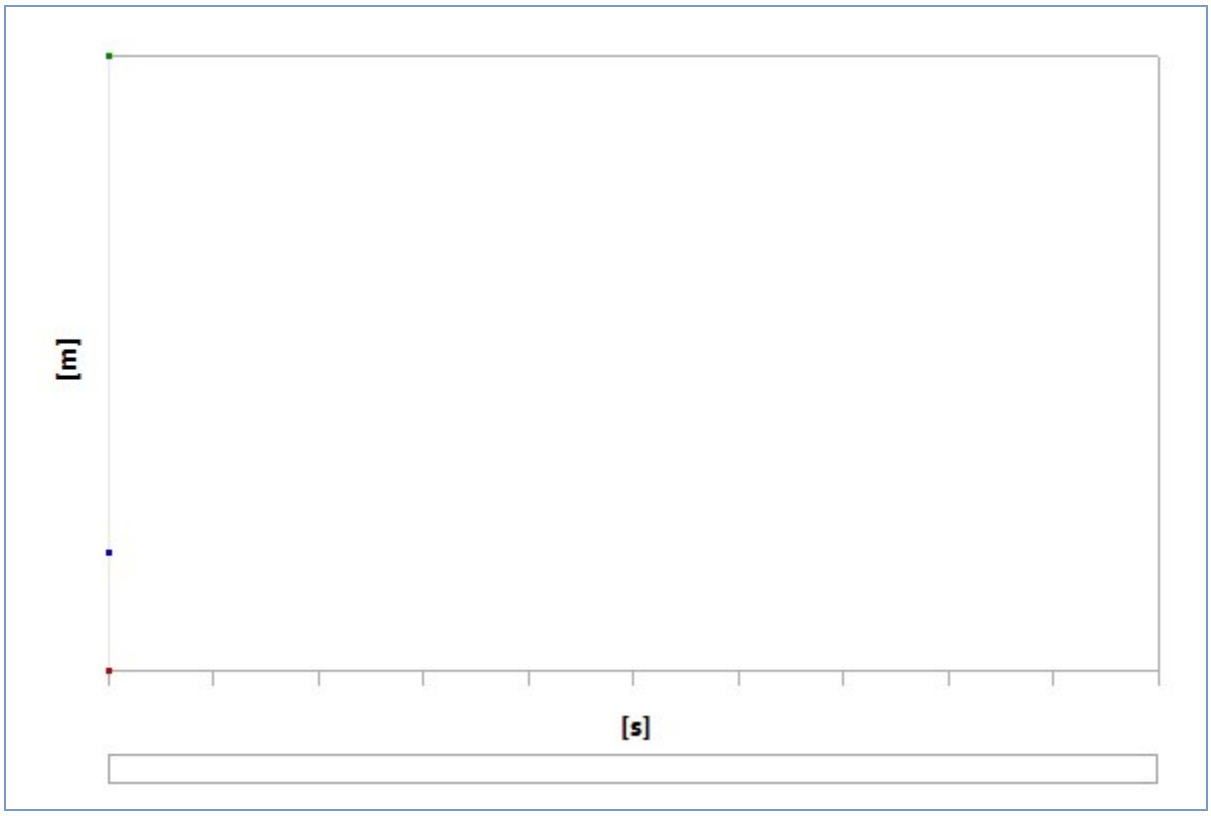


TABLE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

Time [s]	Minimum [m]	Maximum [m]	Average [m]
1.	0.	6.1431e-004	1.1838e-004

FIGURE 11
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation > Figure

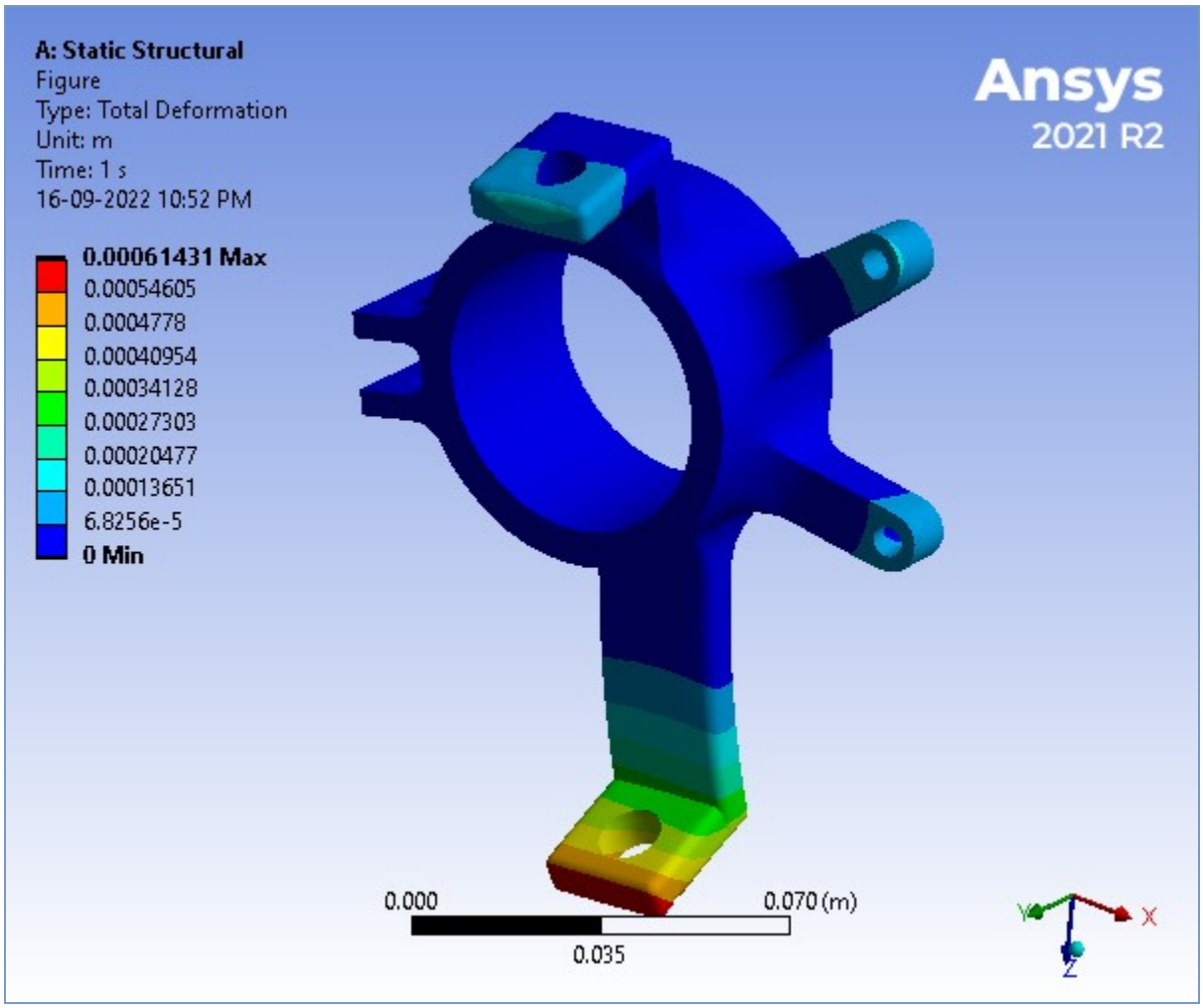


FIGURE 12
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

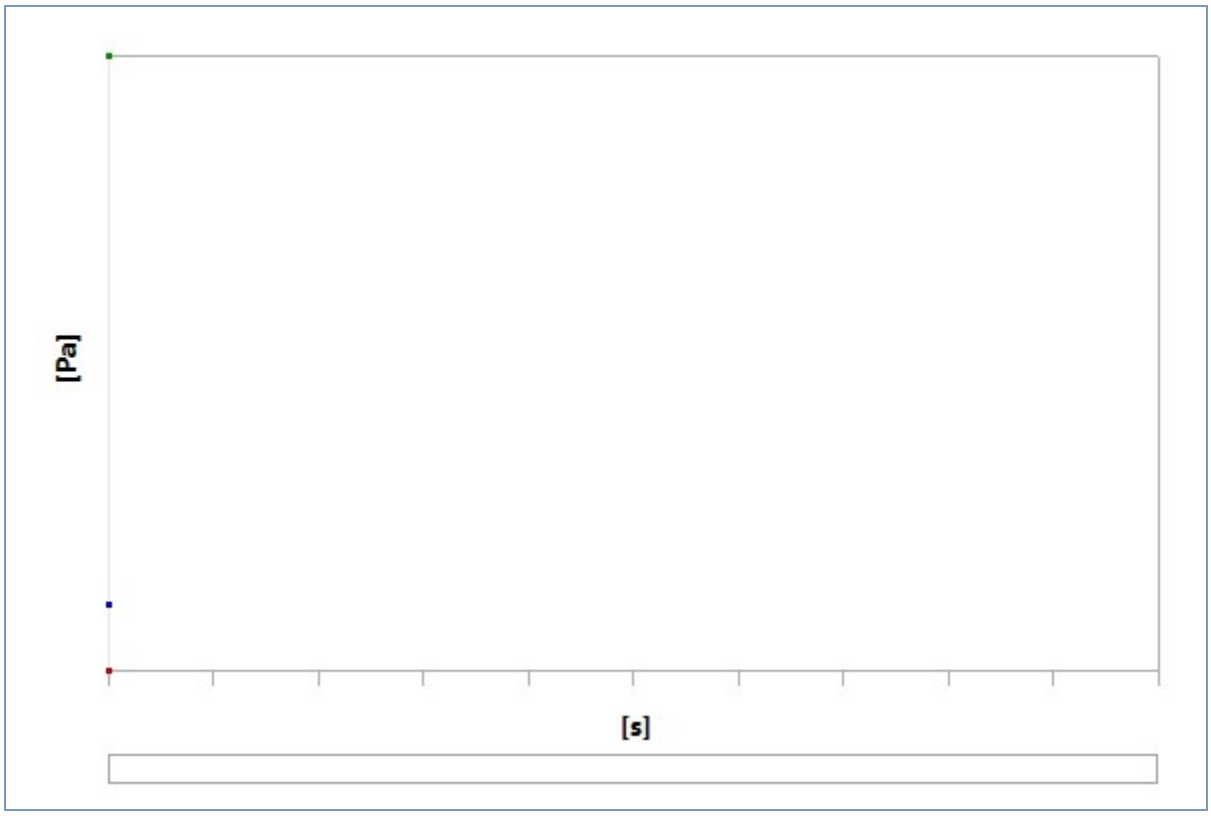


TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

Time [s]	Minimum [Pa]	Maximum [Pa]	Average [Pa]
1.	10277	1.4035e+008	1.5139e+007

FIGURE 13
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress > Figure

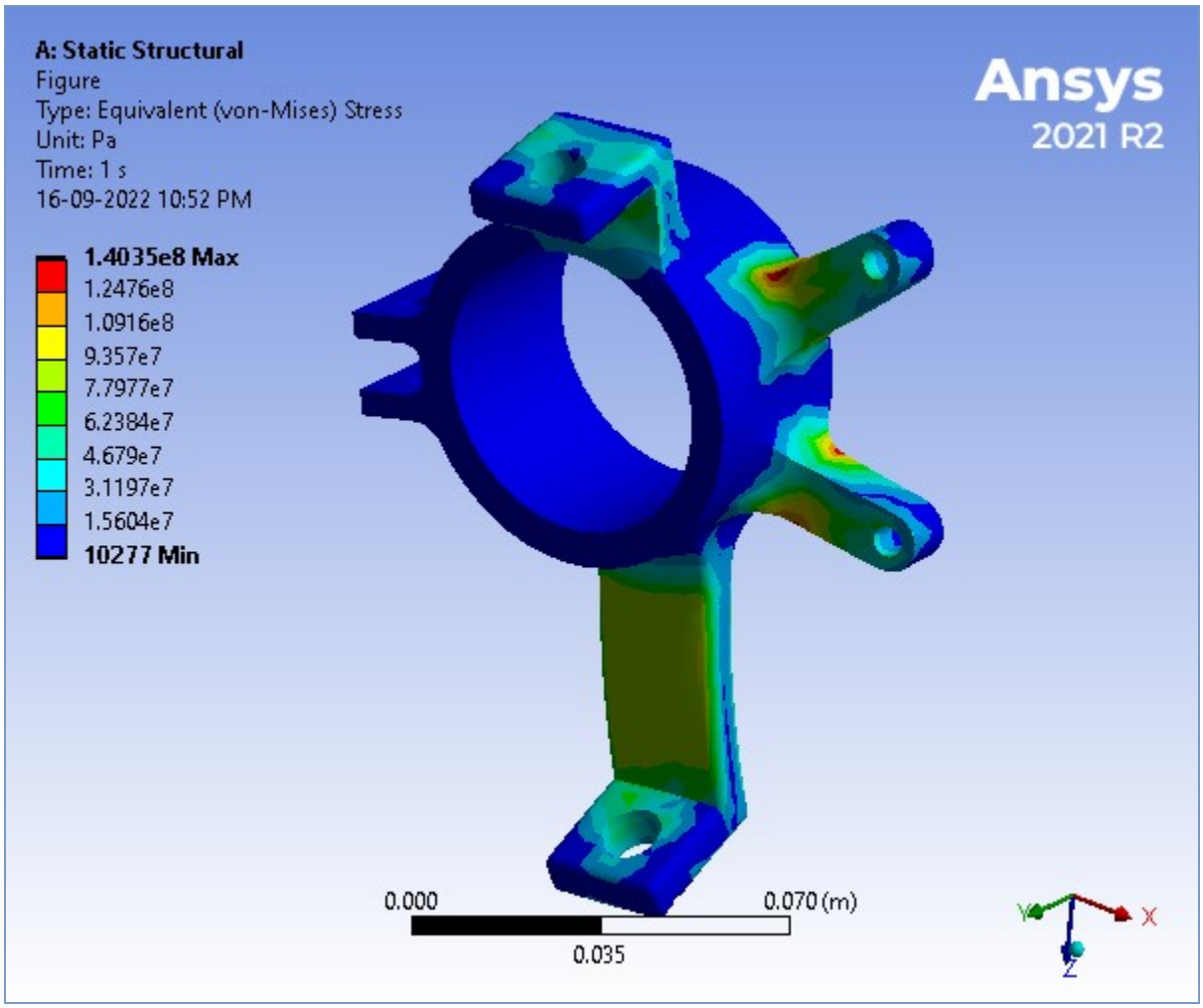


TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

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

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	

Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	1.8468
Minimum Occurs On	SYS\Solid1
Information	
Time	1. s
Load Step	1
Substep	1
Iteration Number	1

FIGURE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

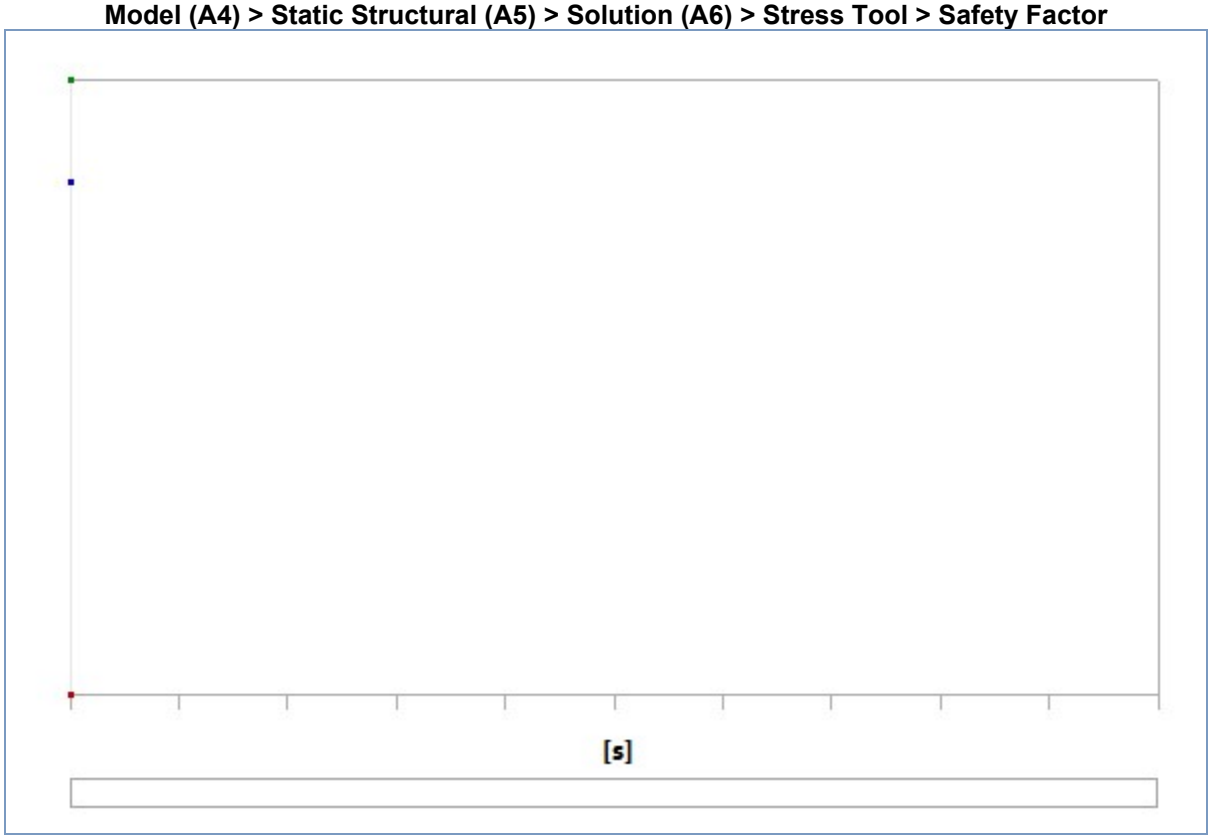
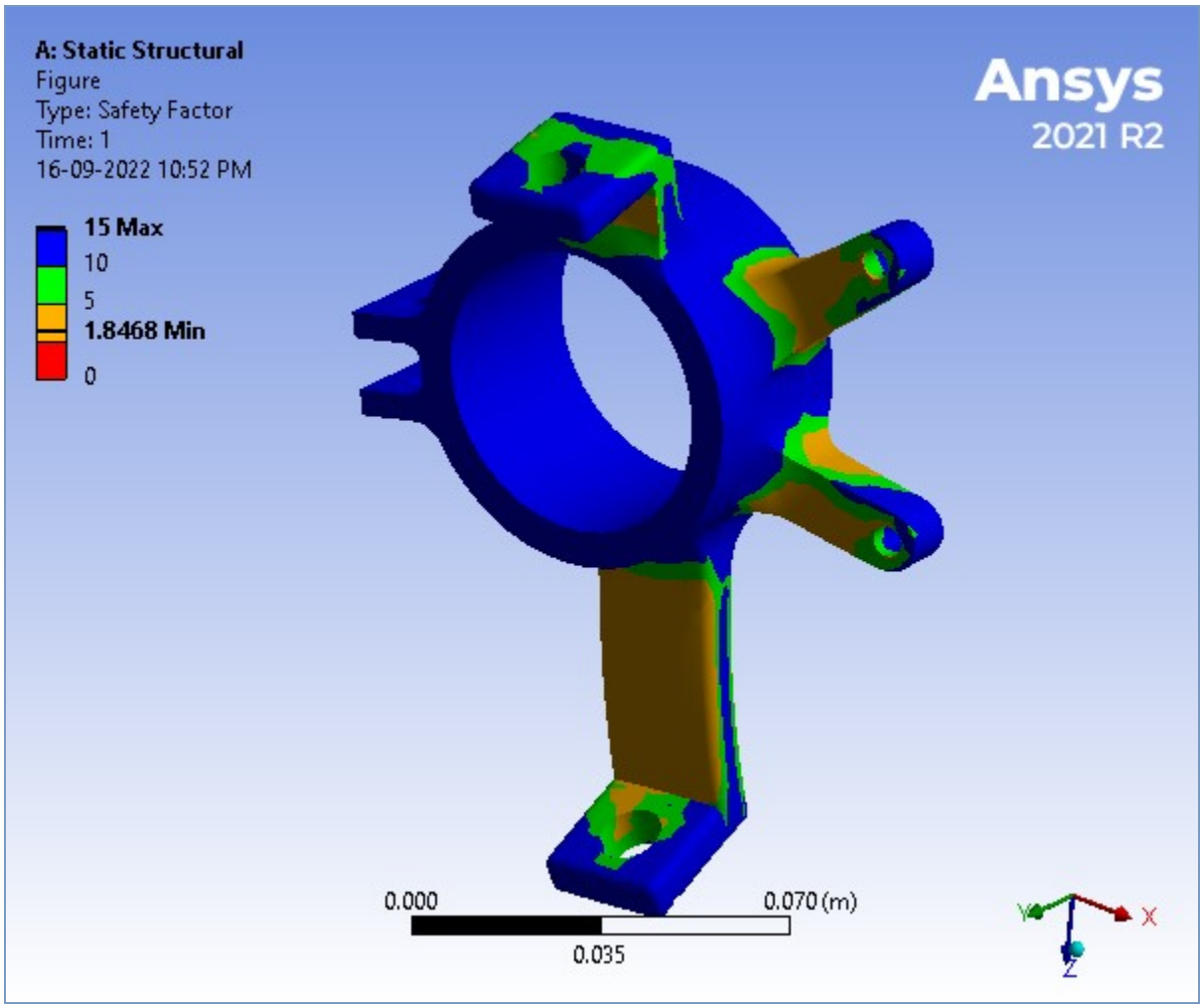


TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum	Average
1.	1.8468	15.	12.819

FIGURE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor > Figure



Material Data

Aluminum alloy, wrought, 6061, T6

TABLE 19
Aluminum alloy, wrought, 6061, T6 > Constants

Density	2713 kg m^-3
Tensile Yield Strength	2.592e+008 Pa
Tensile Ultimate Strength	3.131e+008 Pa
Coefficient of Thermal Expansion	2.278e-005 C^-1
Thermal Conductivity	155.3 W m^-1 C^-1
Specific Heat	915.7 J kg^-1 C^-1

TABLE 20
Aluminum alloy, wrought, 6061, T6 > Opacity

Red	Green	Blue
234	234	234

Opacity
1
Metallic Finish
1

TABLE 21
Aluminum alloy, wrought, 6061, T6 > Isotropic Elasticity

Young's Modulus Pa	Poisson's Ratio	Bulk Modulus Pa	Shear Modulus Pa	Temperature C
6.904e+010	0.33	6.7686e+010	2.5955e+010	23

TABLE 22
Aluminum alloy, wrought, 6061, T6 > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
20