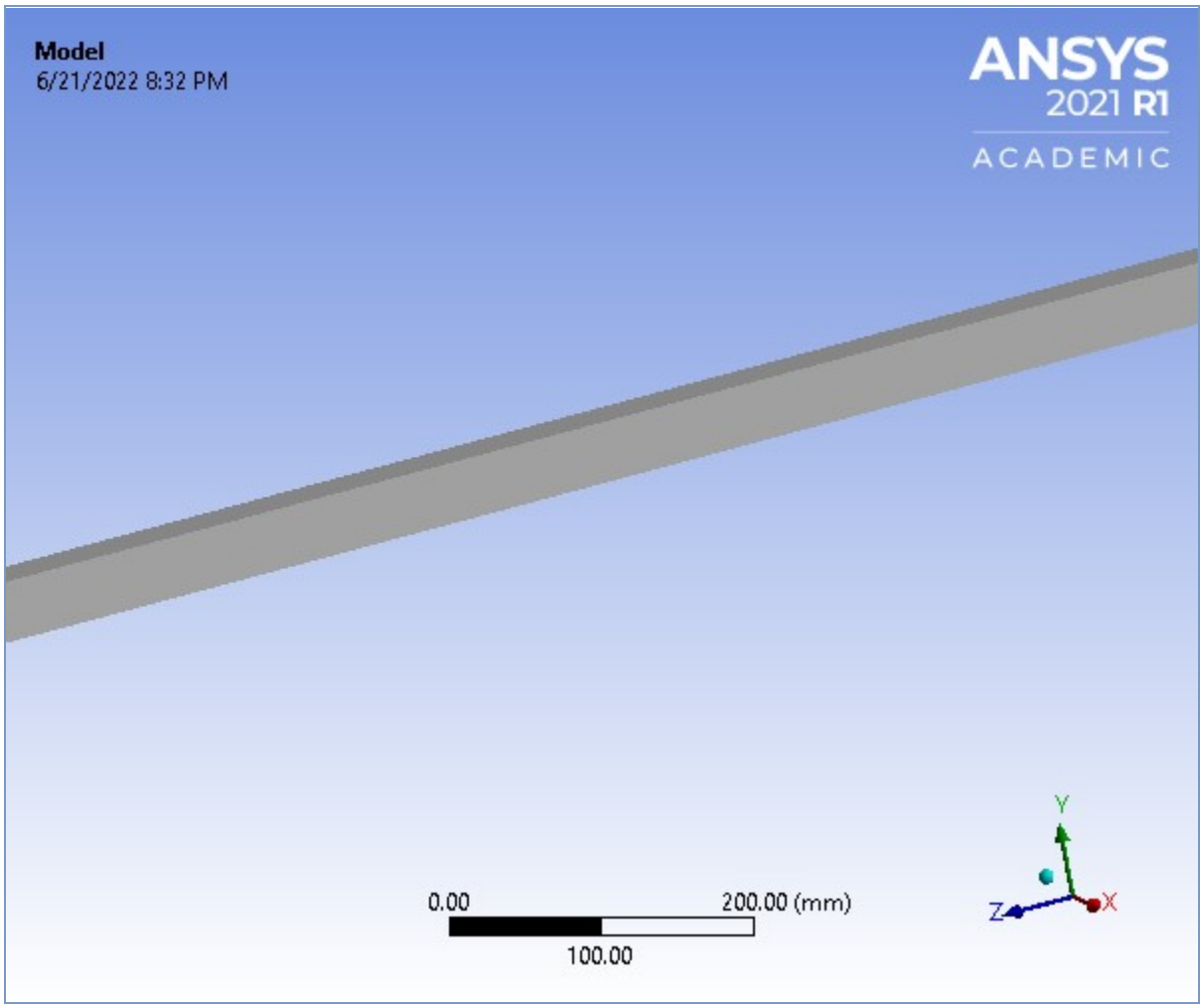
Project*

First Saved	Tuesday, June 14, 2022
Last Saved	Friday, June 17, 2022
Product Version	2021 R1
Save Project Before Solution	No
Save Project After Solution	No



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)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\janga\OneDrive - IIT Kanpur\TA-Prashamsa\ansys\beam_files\dp0 \SYS\DM\SYS.agdb
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	40. mm
Length Y	40. mm

Length Z	1000. mm
Properties	
Volume	1.6e+006 mm³
Mass	12.56 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	1521
Elements	200
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
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
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	*Solid*
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	Structural Steel

Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	40. mm
Length Y	40. mm
Length Z	1000. mm
Properties	
Volume	1.6e+006 mm³
Mass	12.56 kg
Centroid X	-1.7647e-016 mm
Centroid Y	1.7647e-016 mm
Centroid Z	500. mm
Moment of Inertia Ip1	1.0483e+006 kg·mm²
Moment of Inertia Ip2	1.0483e+006 kg·mm²
Moment of Inertia Ip3	3349.3 kg·mm²
Statistics	
Nodes	1521
Elements	200
Mesh Metric	None

FIGURE 1
Model (A4) > Geometry > beam

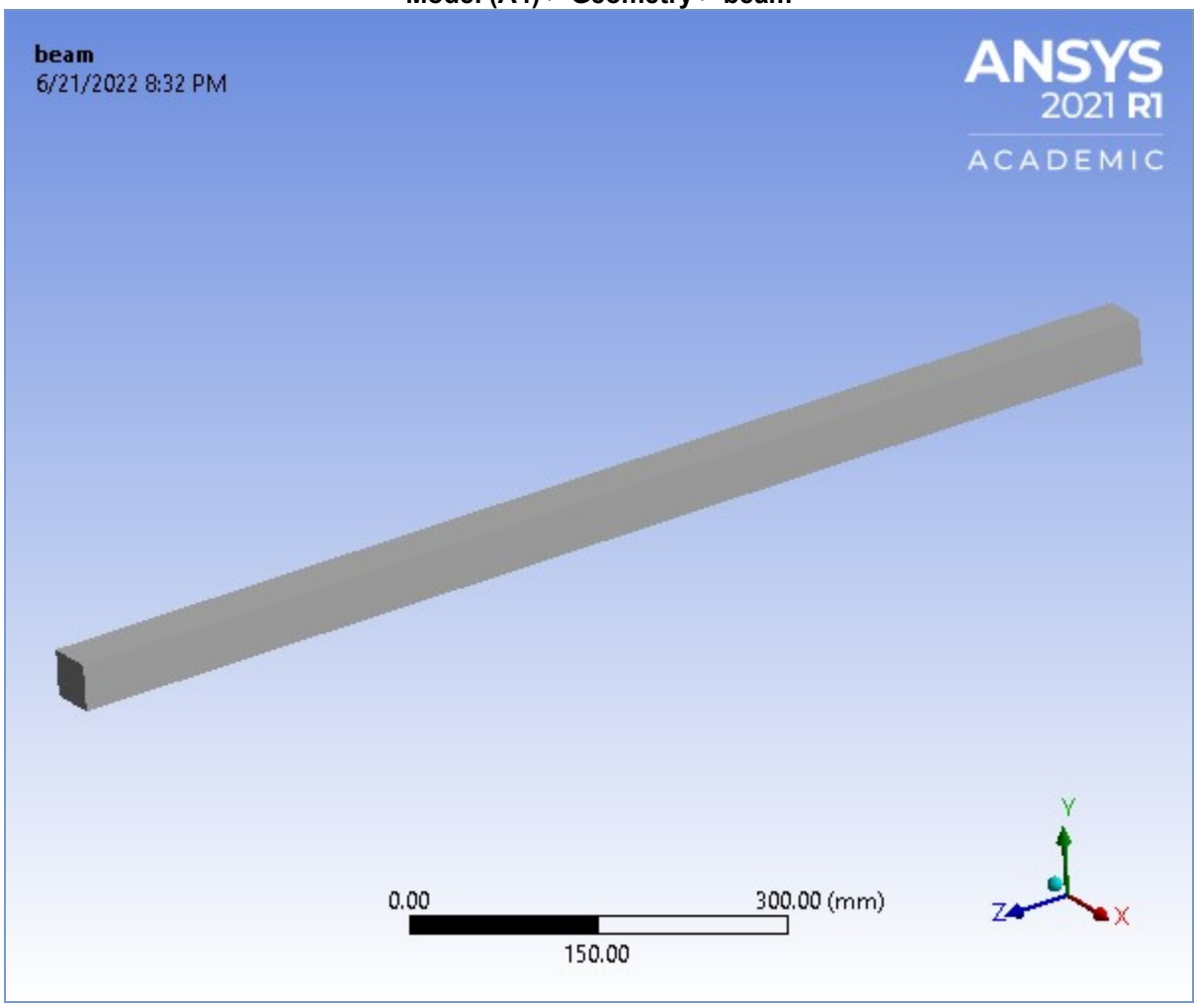


TABLE 4
Model (A4) > Materials

Object Name	*Materials*
State	Fully Defined
Statistics	
Materials	1
Material Assignments	0

TABLE 5
Model (A4) > Construction Geometry

Object Name	*Construction Geometry*
State	Fully Defined
Display	
Show Mesh	No

TABLE 6
Model (A4) > Construction Geometry > Paths

Object Name	*Path*	*Path 2*
State	Fully Defined	
Definition		
Path Type	Two Points	
Path Coordinate System	Global Coordinate System	
Number of Sampling Points	47.	
Suppressed	No	
Start		
Coordinate System	Global Coordinate System	
Start X Coordinate	0. mm	
Start Y Coordinate	20. mm	0. mm
Start Z Coordinate	1000. mm	
Location	Defined	
End		
Coordinate System	Global Coordinate System	
End X Coordinate	0. mm	
End Y Coordinate	20. mm	0. mm
End Z Coordinate	0. mm	
Location	Defined	

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.]

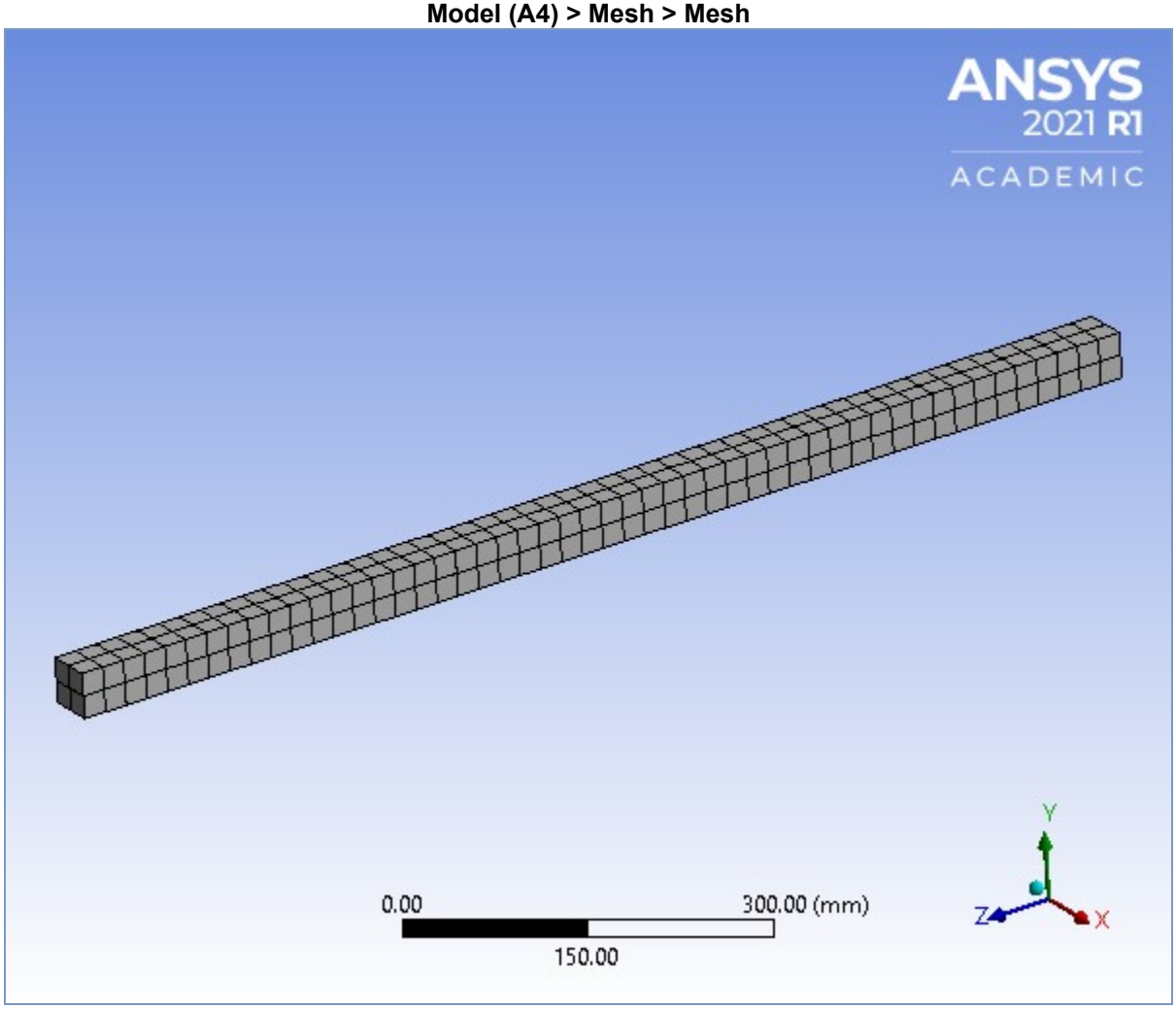
Mesh

TABLE 8
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	20.0 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	1001.6 mm
Average Surface Area	27200 mm²
Minimum Edge Length	40.0 mm
Quality	
Check Mesh Quality	Yes, Errors
Error Limits	Aggressive 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	1521
Elements	200

FIGURE 2

Model (A4) > Mesh > Mesh



Static Structural (A5)

TABLE 9
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 10
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	C:\Users\janga\OneDrive - IIT Kanpur\TA-Prashamsa\ansys\beam_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	nmm

TABLE 11
Model (A4) > Static Structural (A5) > Loads

Object Name	*Fixed Support*	*Displacement*	*Force*
State	Fully Defined		
Scope			
Scoping Method	Geometry Selection		
Geometry	1 Edge		1 Face
Definition			
Type	Fixed Support	Displacement	Force
Suppressed	No		
Define By		Components	Vector
Coordinate System		Global Coordinate System	
X Component		0. mm (ramped)	
Y Component		0. mm (ramped)	
Z Component		Free	
Applied By			Surface Effect
Magnitude			5000. N (ramped)
Direction			Defined

FIGURE 3
Model (A4) > Static Structural (A5) > Fixed Support > Fixed support

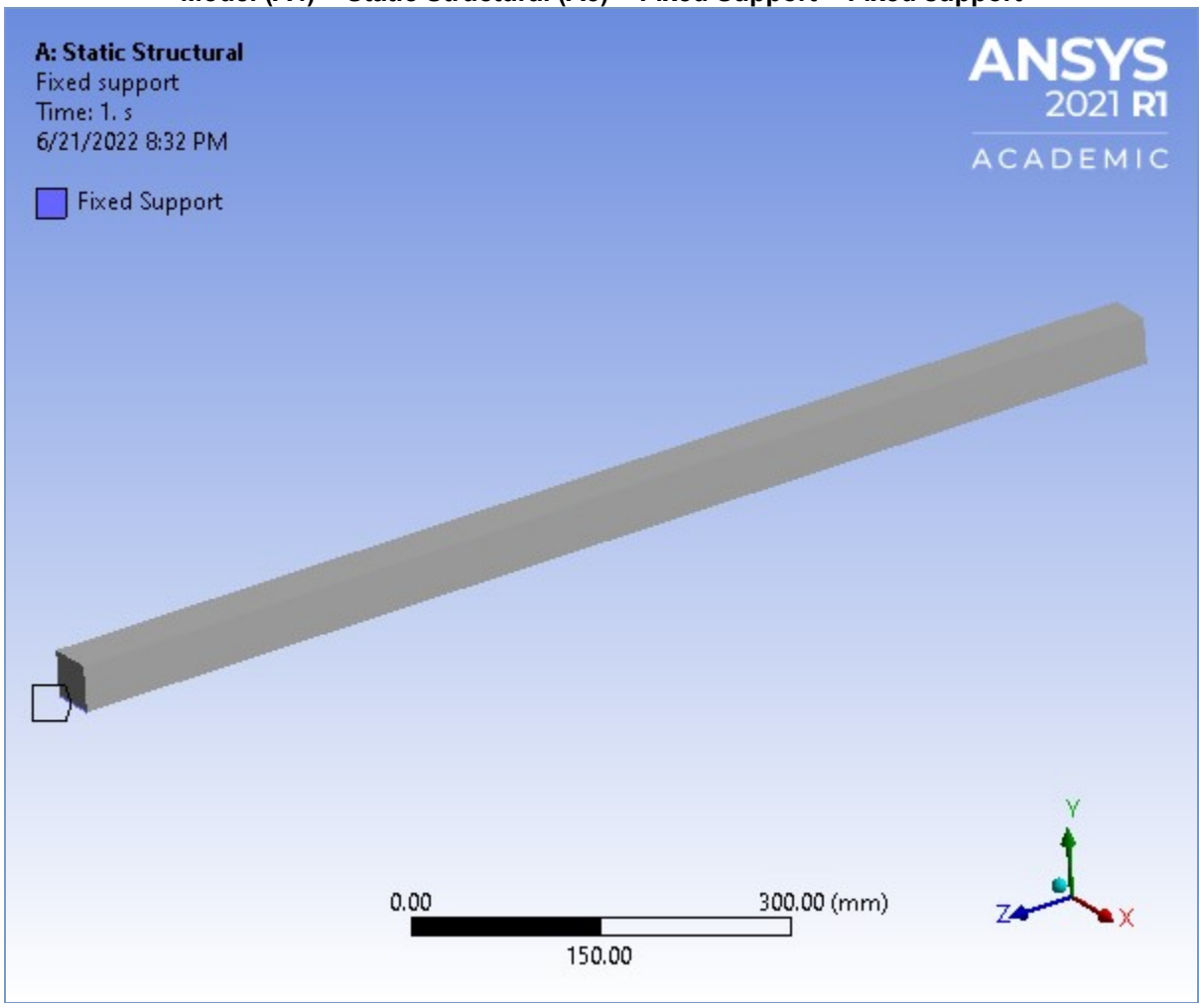


FIGURE 4
Model (A4) > Static Structural (A5) > Displacement

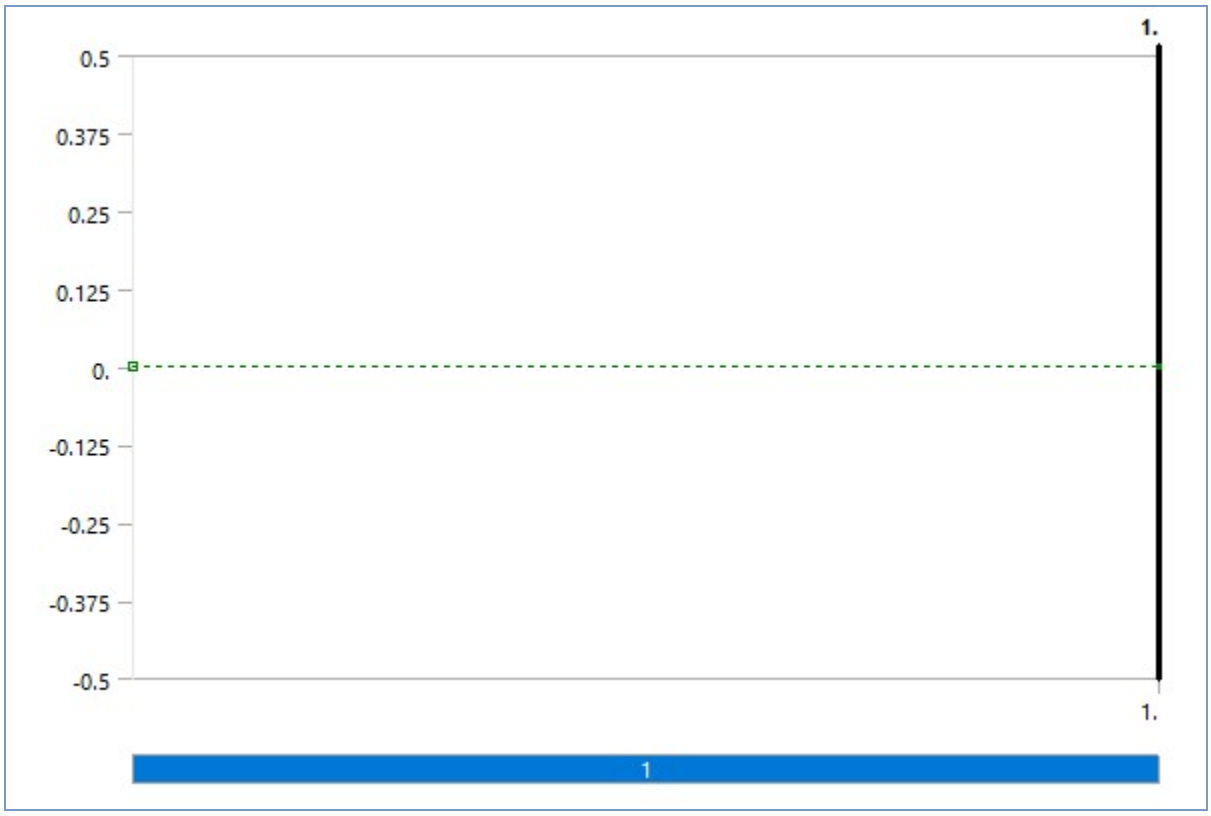


FIGURE 5
Model (A4) > Static Structural (A5) > Displacement > Displacement support

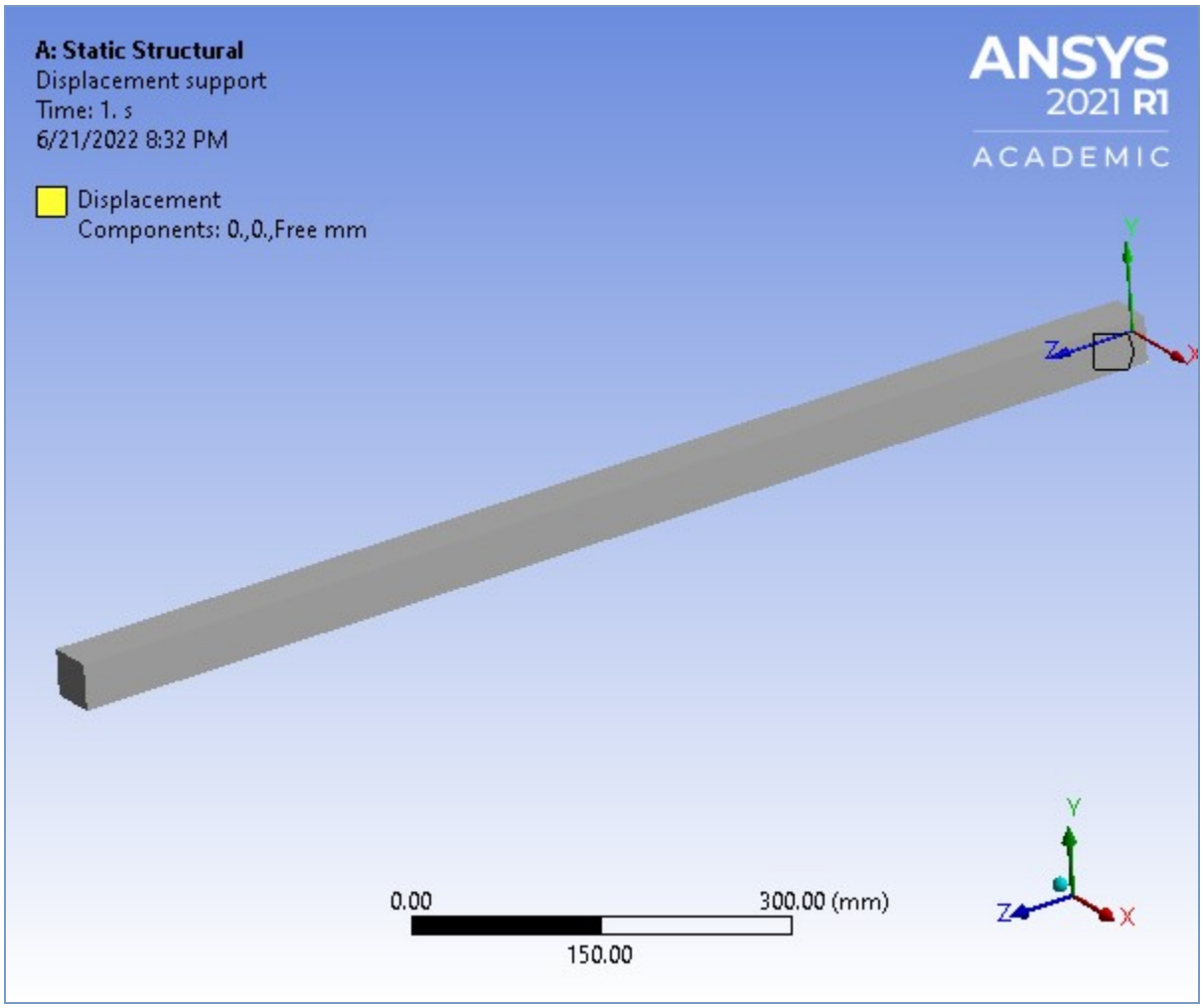


FIGURE 6
Model (A4) > Static Structural (A5) > Force

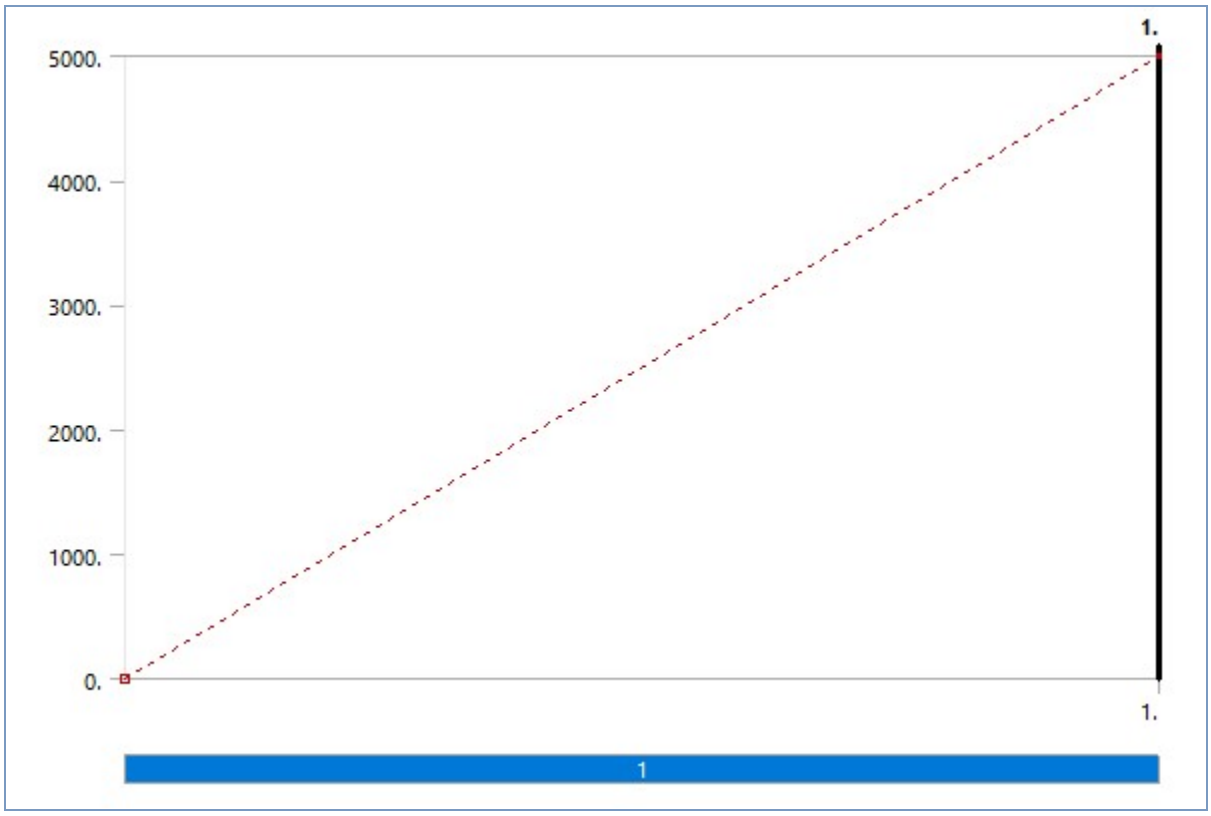
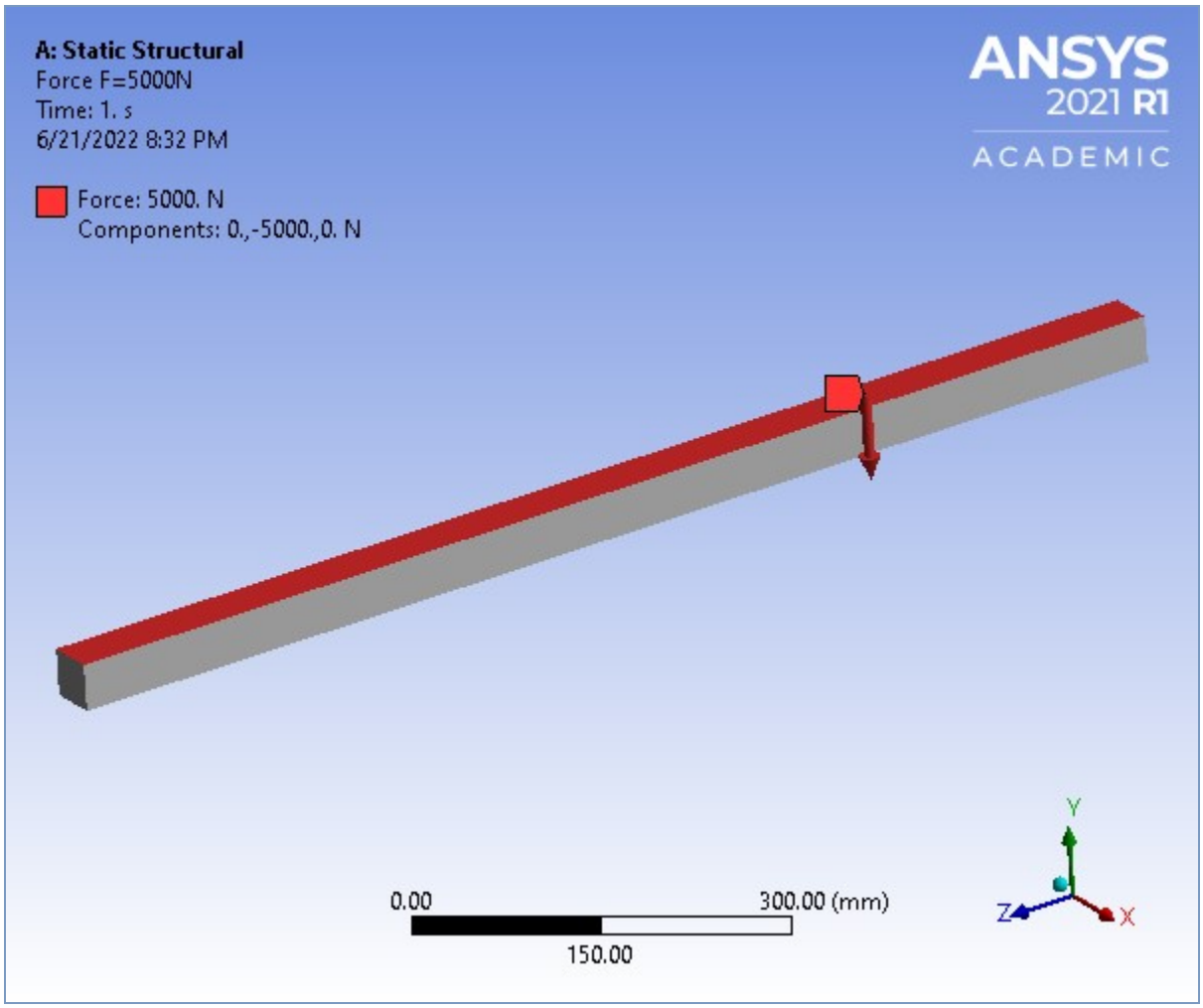


FIGURE 7
Model (A4) > Static Structural (A5) > Force > Force F=5000N



Solution (A6)

TABLE 12
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	3.
Refinement Depth	2.
Information	
Status	Done
MAPDL Elapsed Time	3. s
MAPDL Memory Used	63. MB
MAPDL Result File Size	2.875 MB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 13
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 14
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Directional Deformation*	*Equivalent Stress*	*Directional Deformation 2*	*Normal Stress*	*Equivalent Stress 2*	*Equivalent Stress 3*
State	Solved					
Scope						
Scoping Method	Geometry Selection		Path	Geometry Selection	Path	
Geometry	All Bodies					
Path			Path		Path	Path 2
Definition						
Type	Directional Deformation	Equivalent (von-Mises) Stress	Directional Deformation	Normal Stress	Equivalent (von-Mises) Stress	
Orientation	Y Axis		Y Axis	Z Axis		
By	Time					
Display Time	Last					
Coordinate System	Global Coordinate System		Global Coordinate System			
Calculate Time History	Yes					
Identifier						
Suppressed	No					
Results						
Minimum	-1.4603 mm	6.5879e-002 MPa	-1.4586 mm	-58.619 MPa	0.51253 MPa	5.5314e-002 MPa
Maximum	0. mm	58.622 MPa	-1.6127e-003 mm	58.627 MPa	58.541 MPa	5.3644 MPa
Average	-0.97192 mm	27.889 MPa	-0.91476 mm	-9.9525e-002 MPa	38.161 MPa	1.9051 MPa
Minimum Occurs On	Solid					
Maximum Occurs On	Solid					
Information						
Time	1. s					
Load Step	1					
Substep	1					
Iteration	1					

Number				
Integration Point Results				
Display Option		Averaged		Averaged
Average Across Bodies		No		No
Graph Controls				
X-Axis		S		S

FIGURE 8
Model (A4) > Static Structural (A5) > Solution (A6) > Directional Deformation

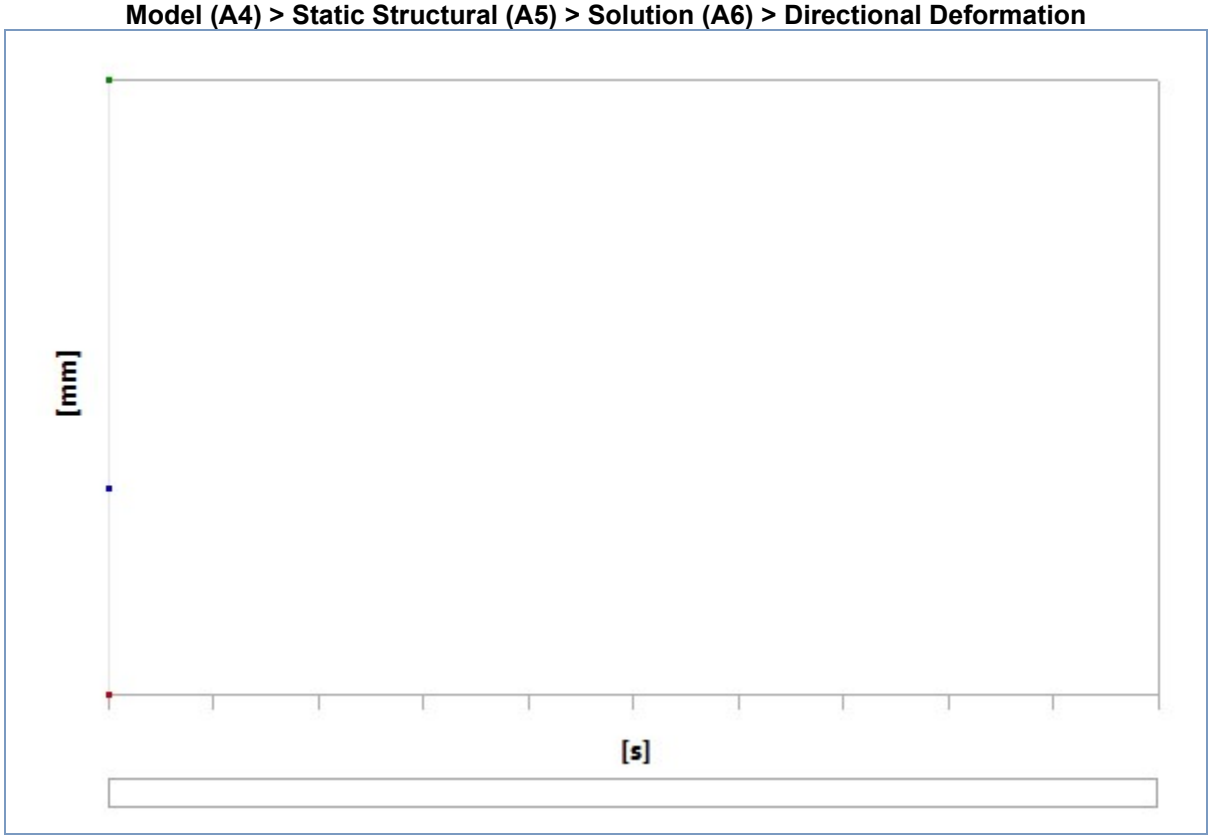


TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Directional Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
1.	-1.4603	0.	-0.97192

FIGURE 9
Model (A4) > Static Structural (A5) > Solution (A6) > Directional Deformation > Directional Deformation

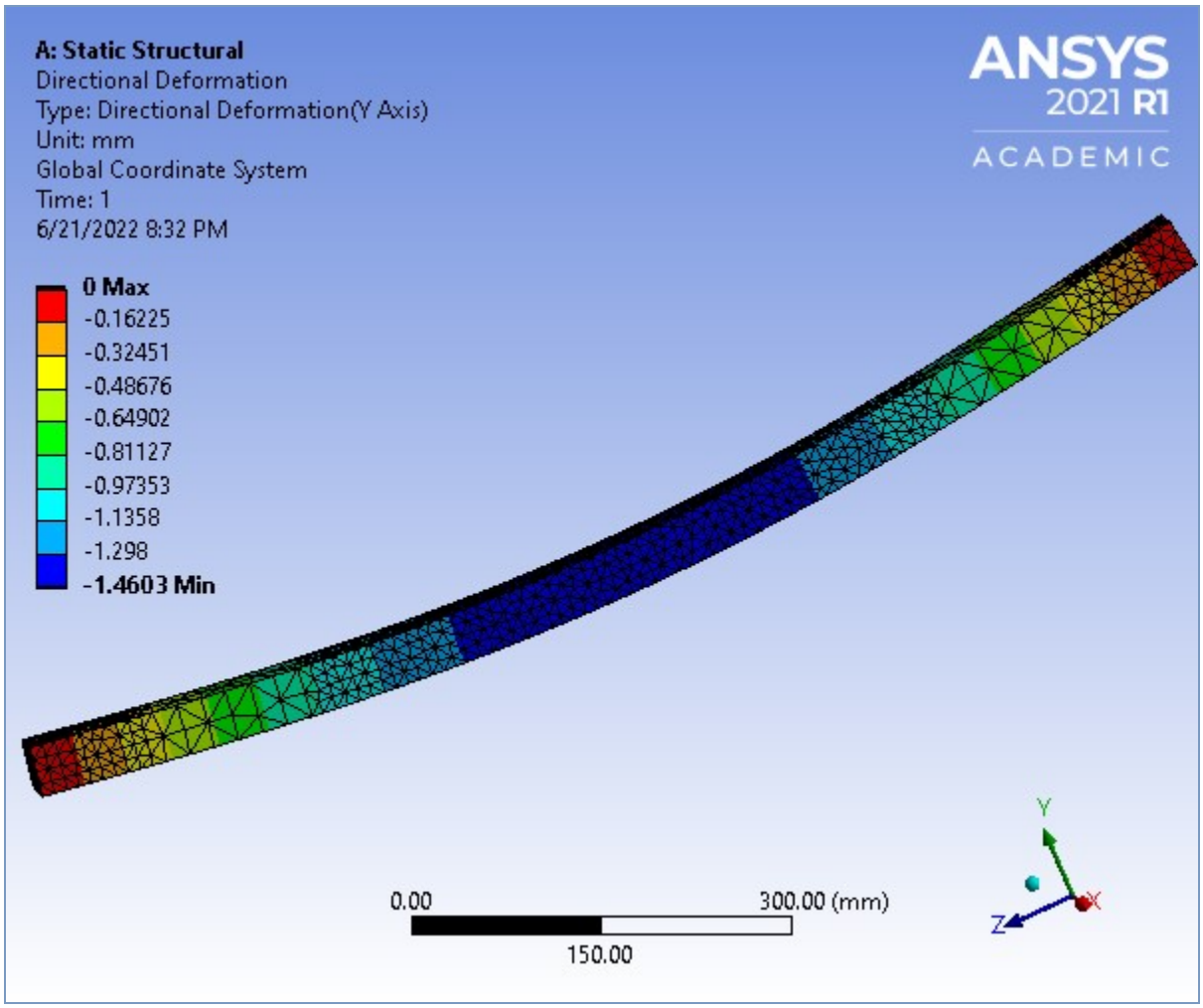


FIGURE 10
Model (A4) > Static Structural (A5) > Solution (A6) > Directional Deformation > Figure

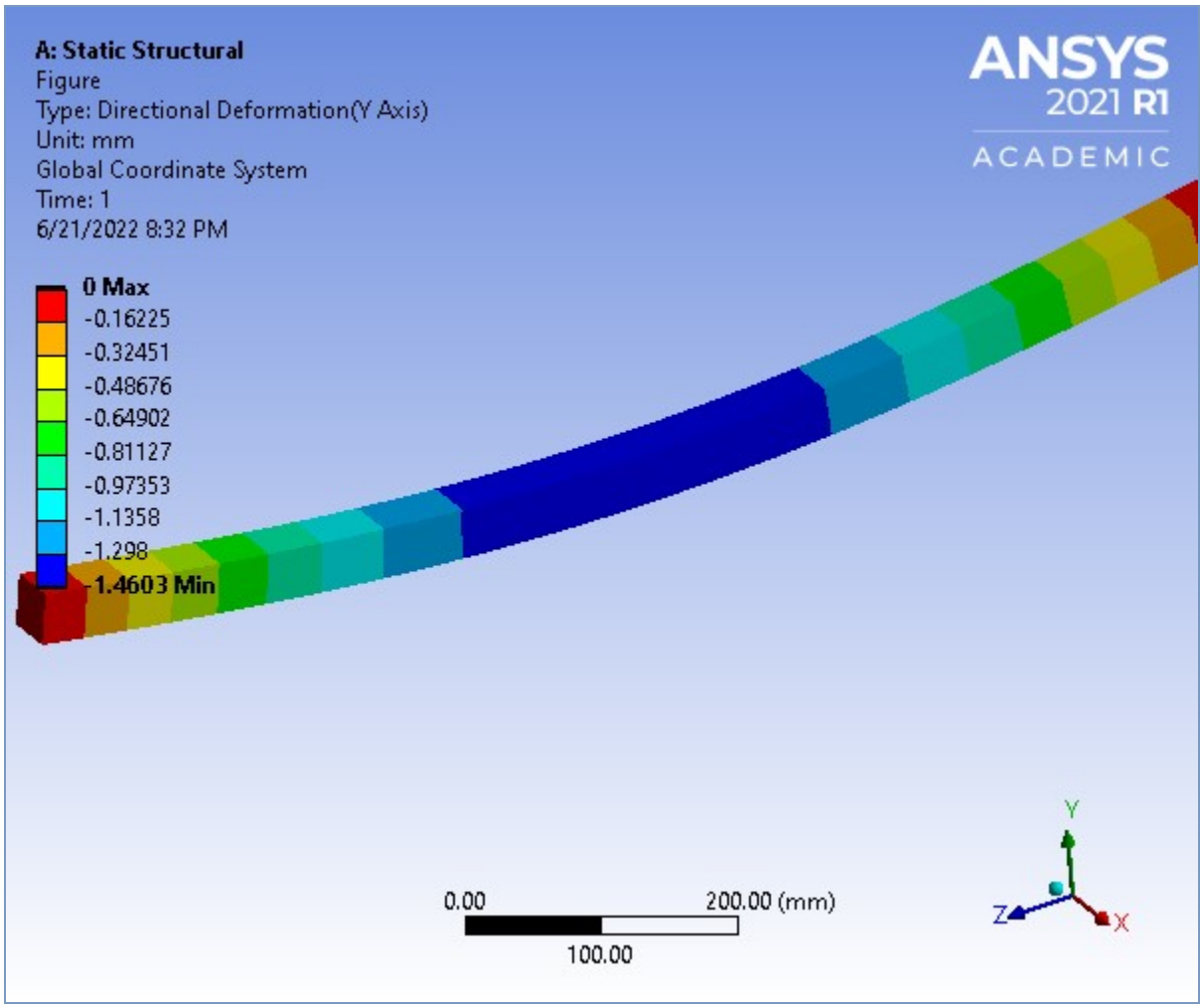


FIGURE 11
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

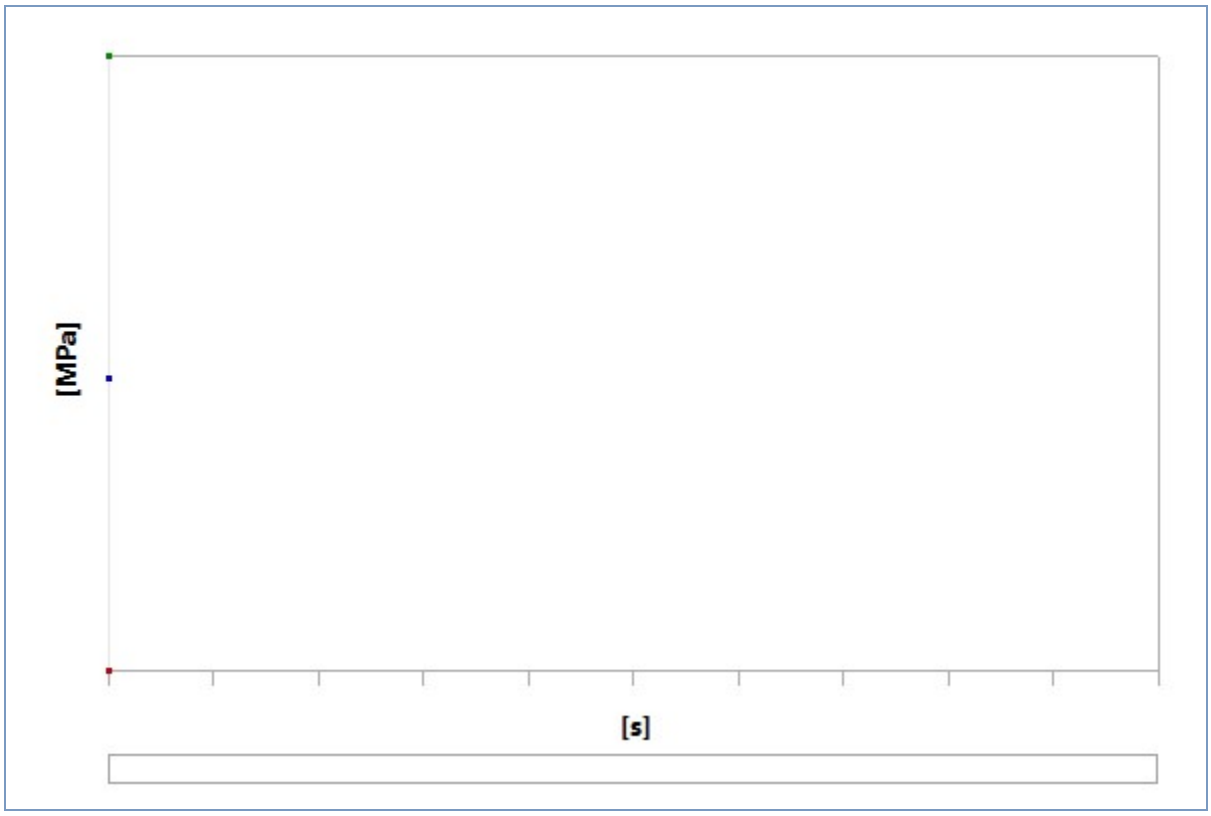


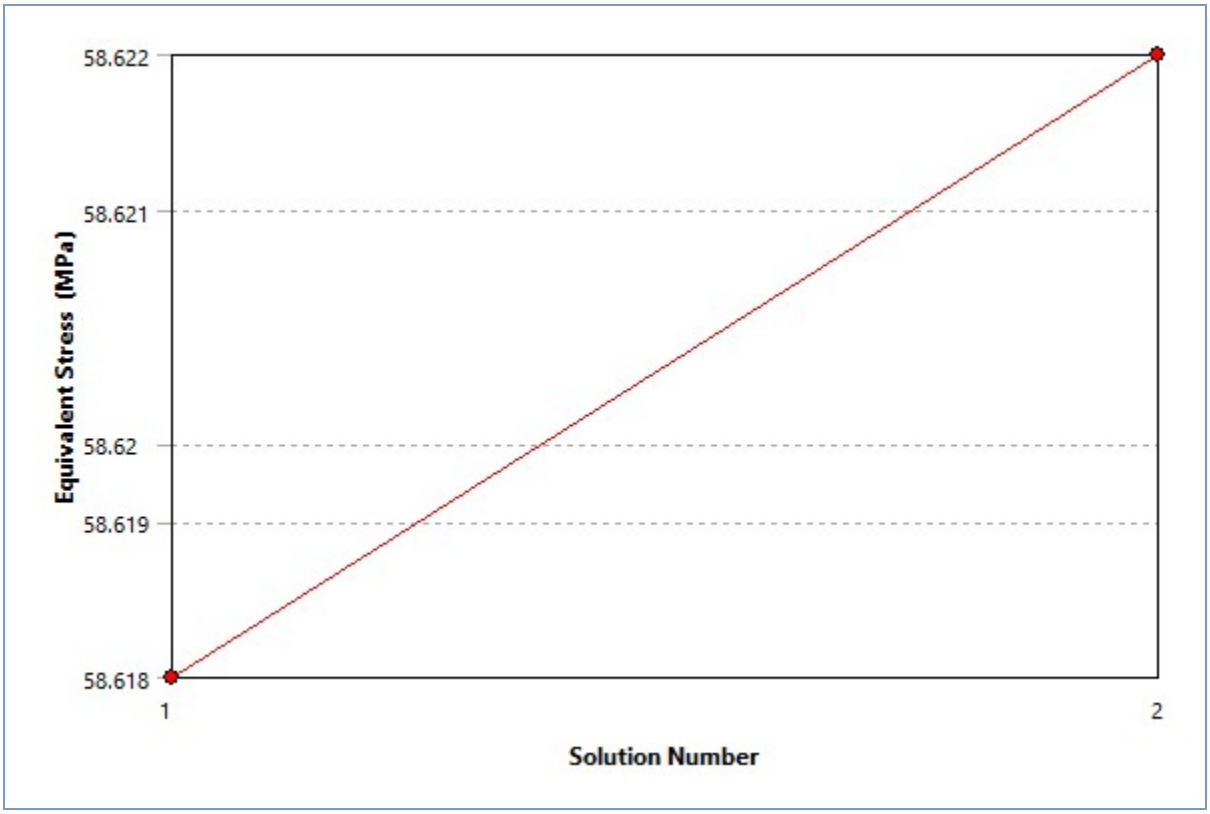
TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
1.	6.5879e-002	58.622	27.889

TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress > Convergences

Object Name	*Convergence*
State	Solved
Definition	
Type	Maximum
Allowable Change	1. %
Results	
Last Change	5.337e-003 %
Converged	Yes

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



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

	Equivalent Stress (MPa)	Change (%)	Nodes	Elements
1	58.618		1521	200
2	58.622	5.337e-003	7982	3795

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

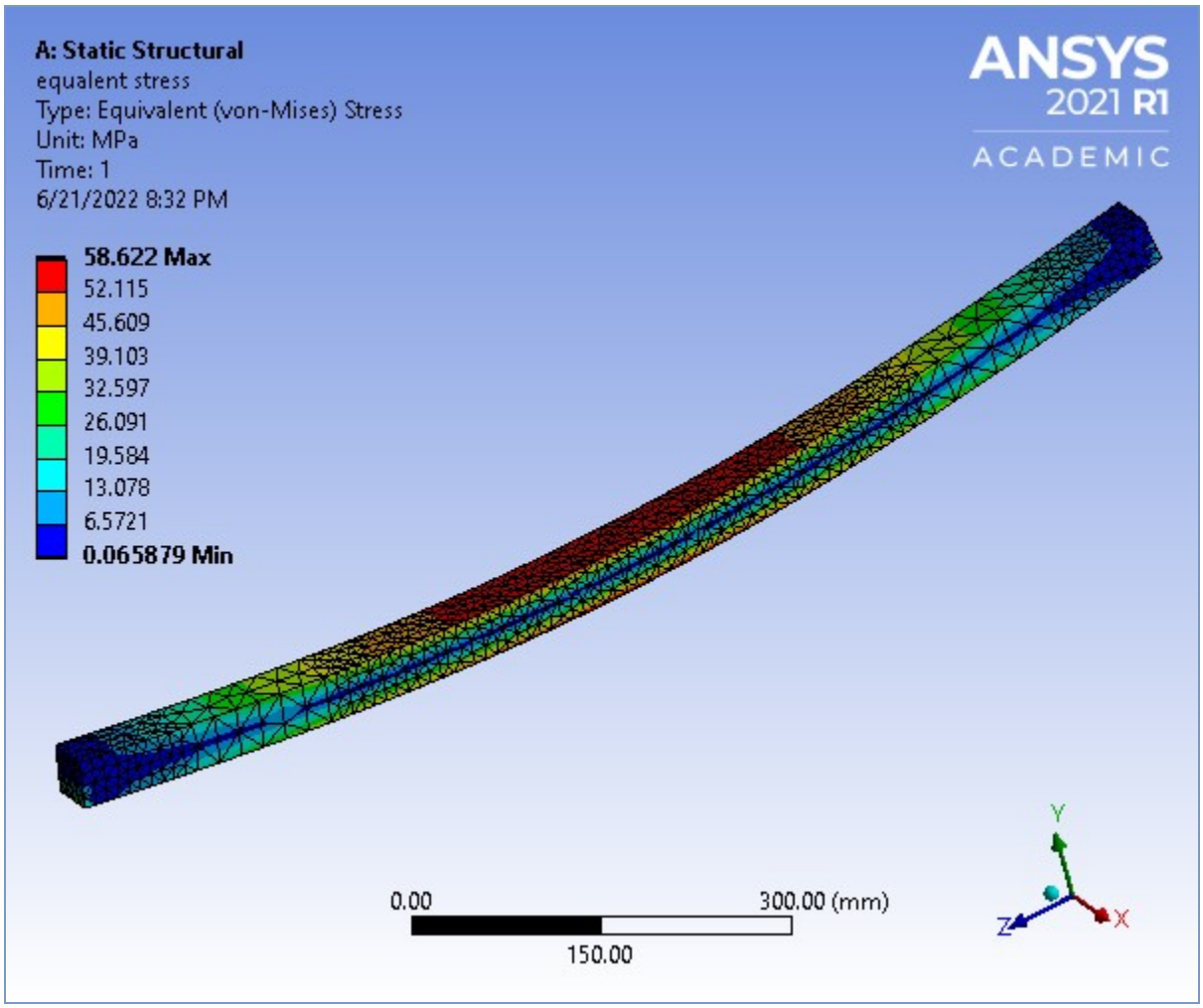


FIGURE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress > Figure

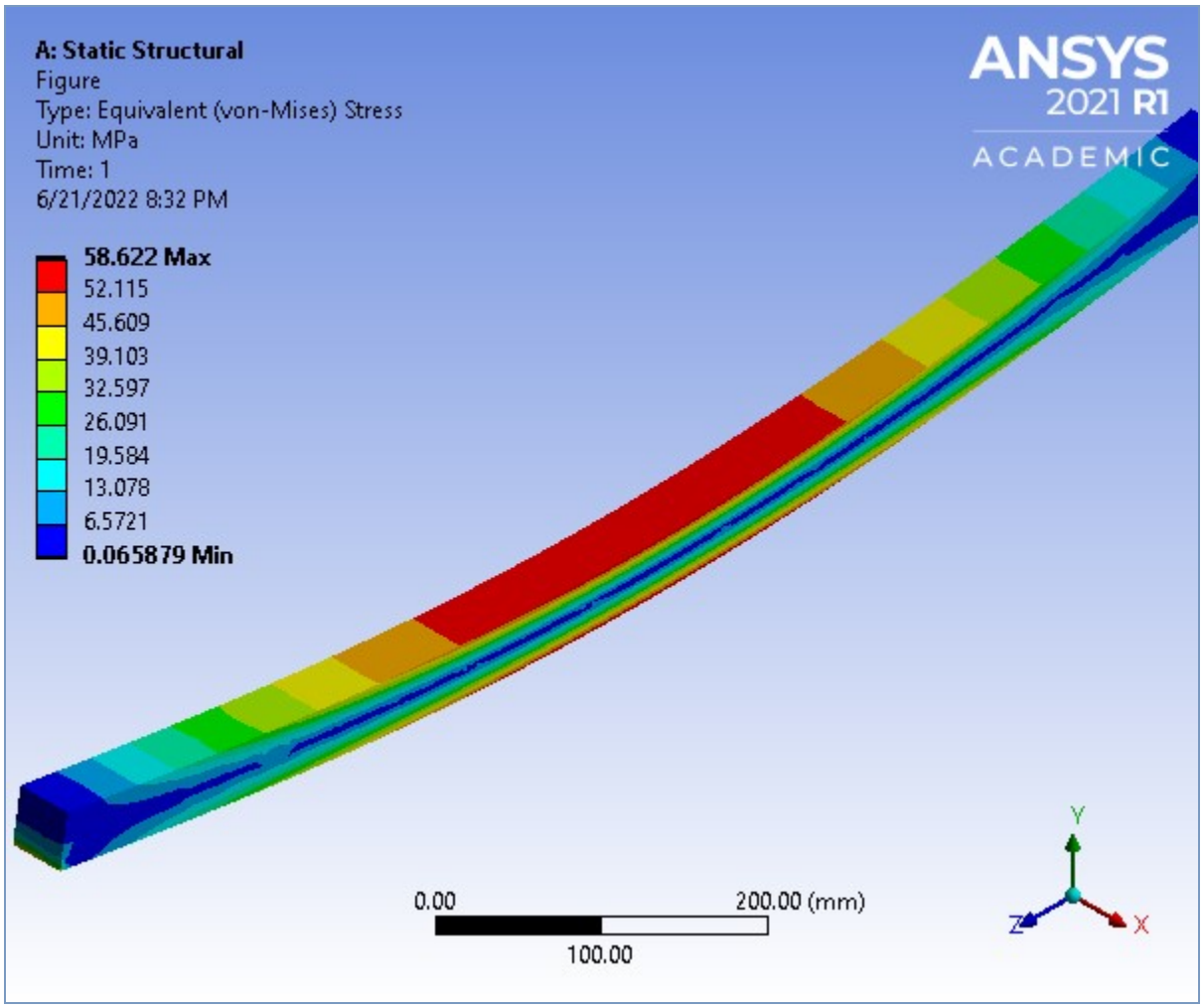


FIGURE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress > Figure 2

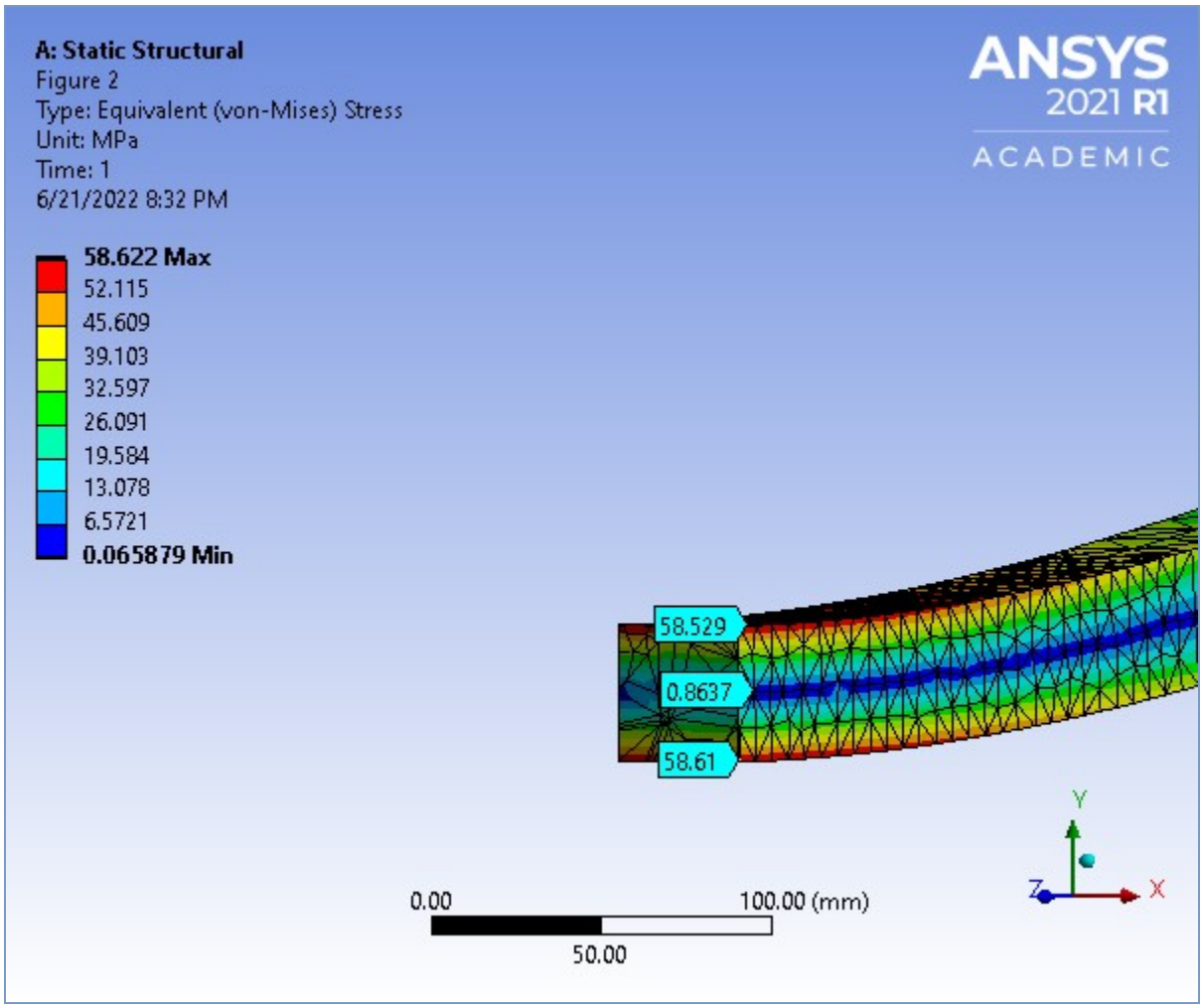


FIGURE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Directional Deformation 2

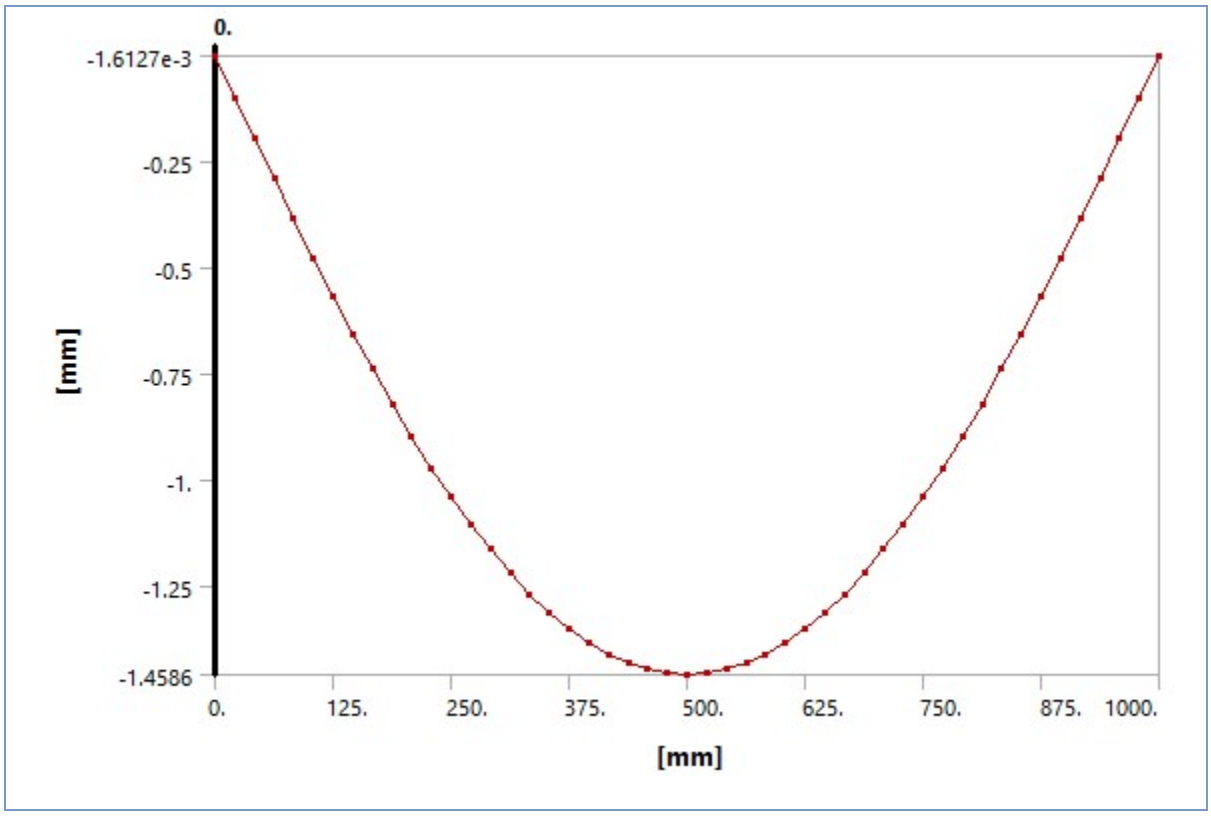


TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Directional Deformation 2

Length [mm]	Value [mm]
0.	-1.6127e-003
20.833	-9.8489e-002
41.667	-0.19512
62.5	-0.29077
83.333	-0.38499
104.17	-0.47733
125.	-0.5674
145.83	-0.6548
166.67	-0.73918
187.5	-0.82018
208.33	-0.89748
229.17	-0.97078
250.	-1.0398
270.83	-1.1042
291.67	-1.1639
312.5	-1.2186
333.33	-1.268
354.17	-1.312
375.	-1.3505
395.83	-1.3833
416.67	-1.4103
437.5	-1.4314
458.33	-1.4465
479.17	-1.4556
500.	-1.4586

520.83	-1.4556
541.67	-1.4465
562.5	-1.4314
583.33	-1.4103
604.17	-1.3833
625.	-1.3505
645.83	-1.312
666.67	-1.268
687.5	-1.2186
708.33	-1.1639
729.17	-1.1043
750.	-1.0398
770.83	-0.97079
791.67	-0.89749
812.5	-0.82021
833.33	-0.73919
854.17	-0.65483
875.	-0.56742
895.83	-0.47735
916.67	-0.38499
937.5	-0.29078
958.33	-0.19513
979.17	-9.8504e-002
1000.	-1.619e-003

FIGURE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Directional Deformation 2 > deformation along a path

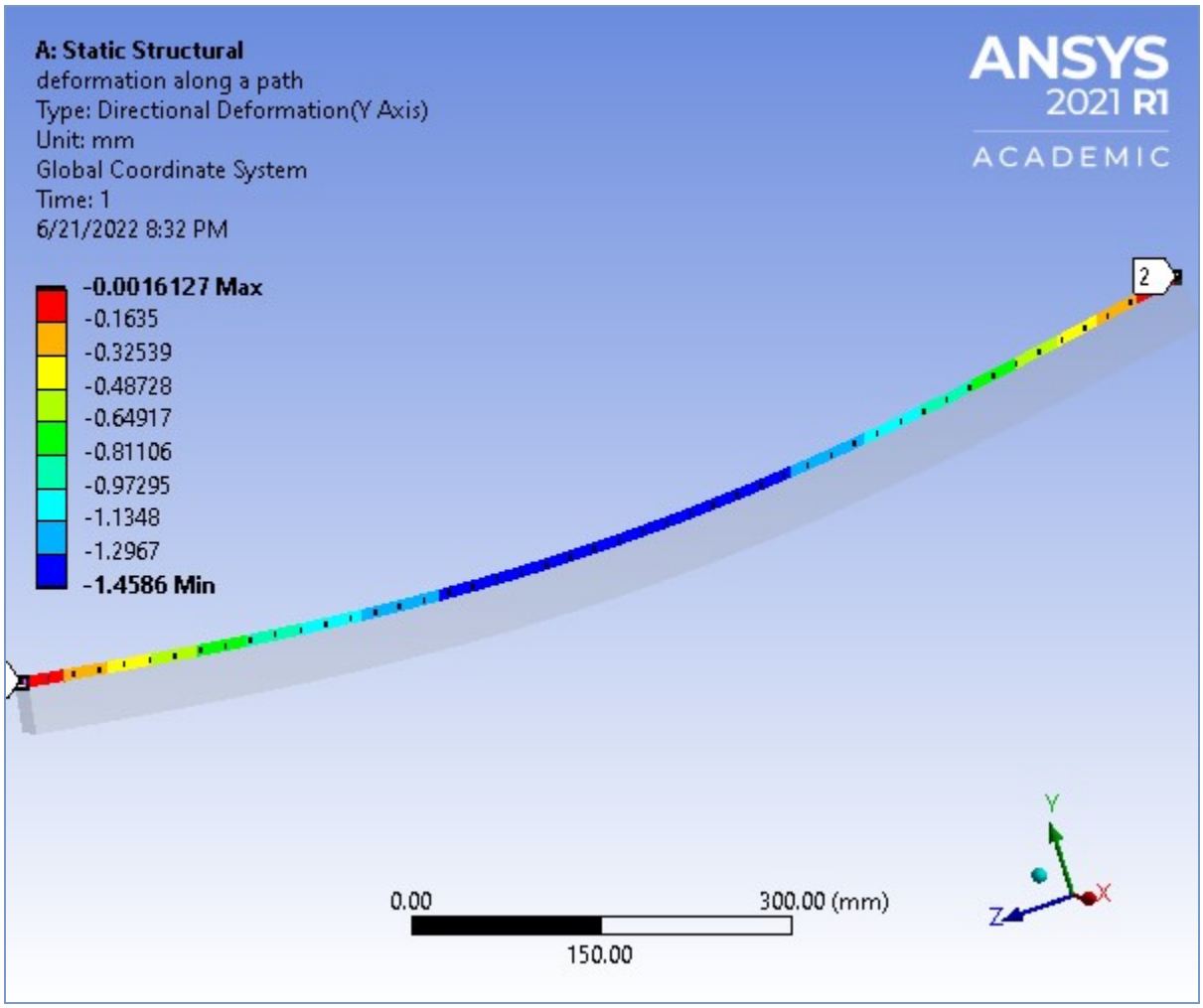


FIGURE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Normal Stress

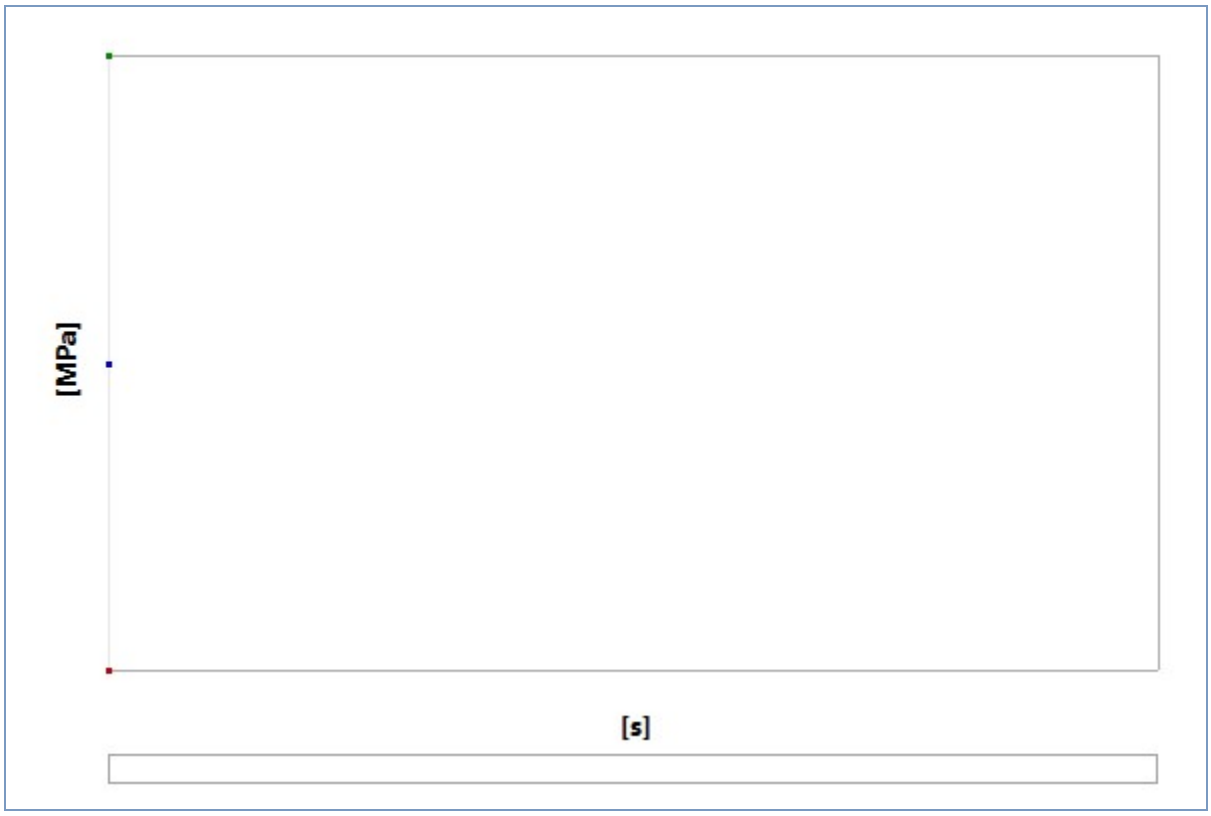


TABLE 19
Model (A4) > Static Structural (A5) > Solution (A6) > Normal Stress

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
1.	-58.619	58.627	-9.9525e-002

FIGURE 19
Model (A4) > Static Structural (A5) > Solution (A6) > Normal Stress > Normal stress

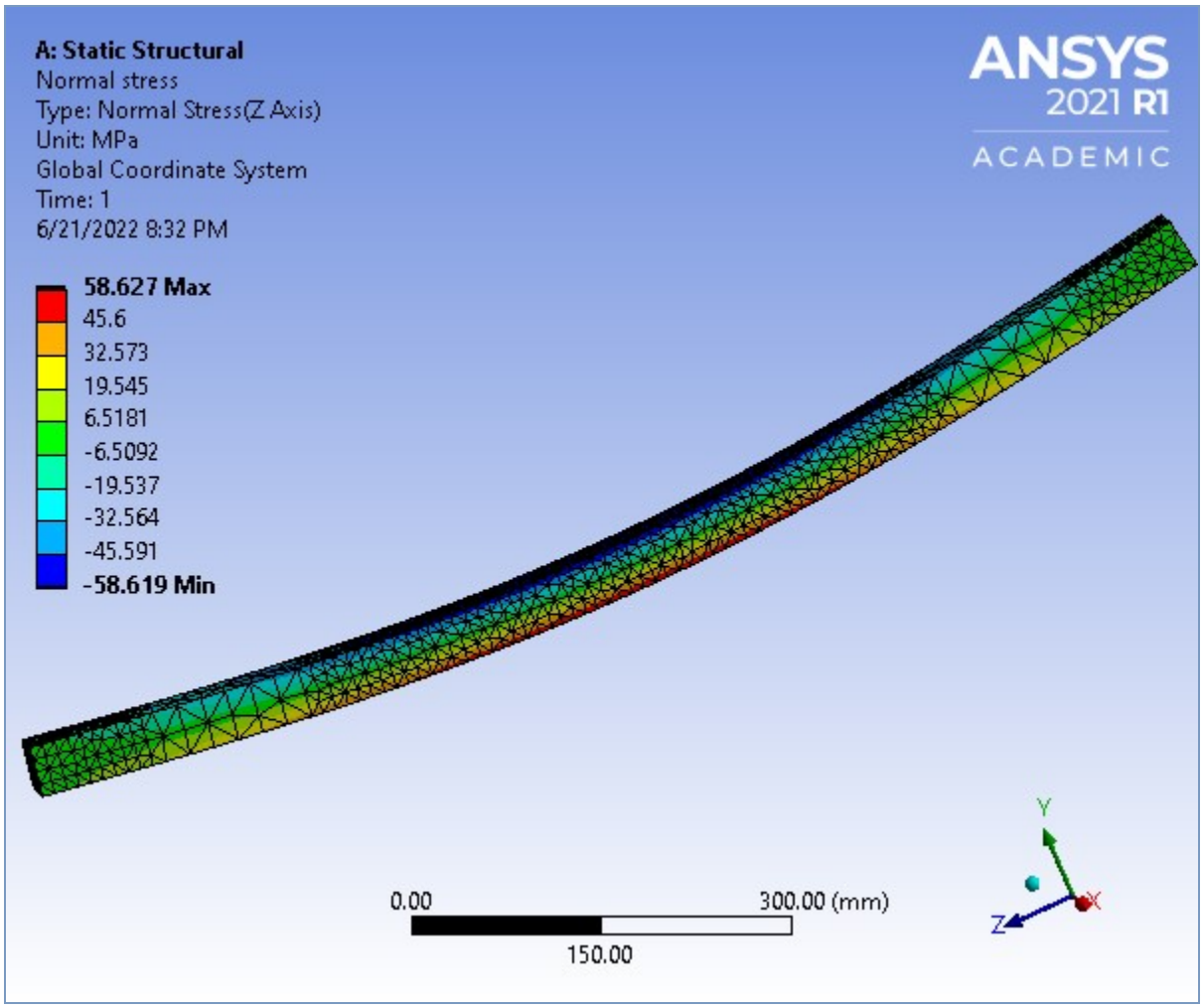


FIGURE 20
Model (A4) > Static Structural (A5) > Solution (A6) > Normal Stress > Figure

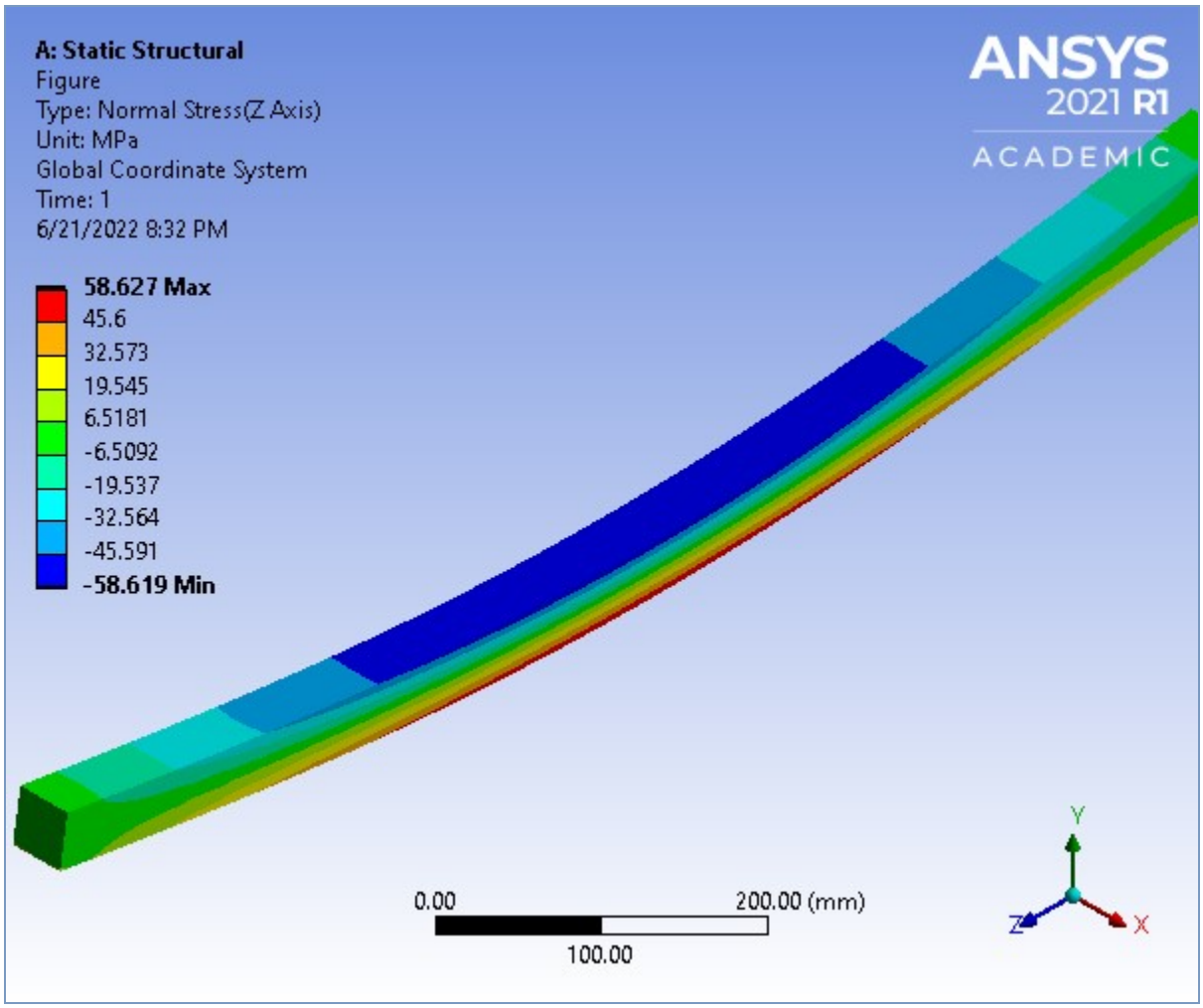


FIGURE 21
Model (A4) > Static Structural (A5) > Solution (A6) > Normal Stress > Figure 2

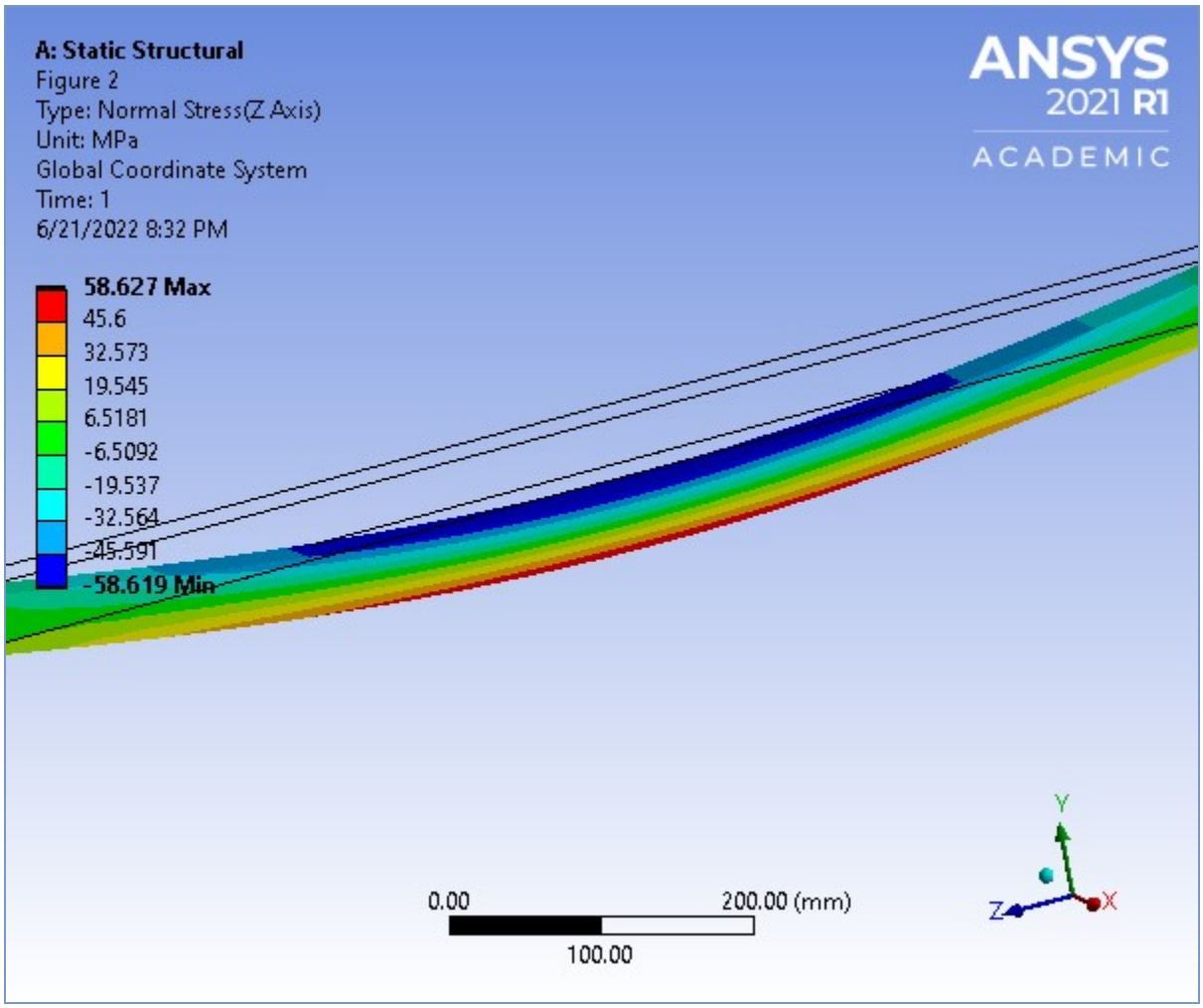


FIGURE 22
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress 2

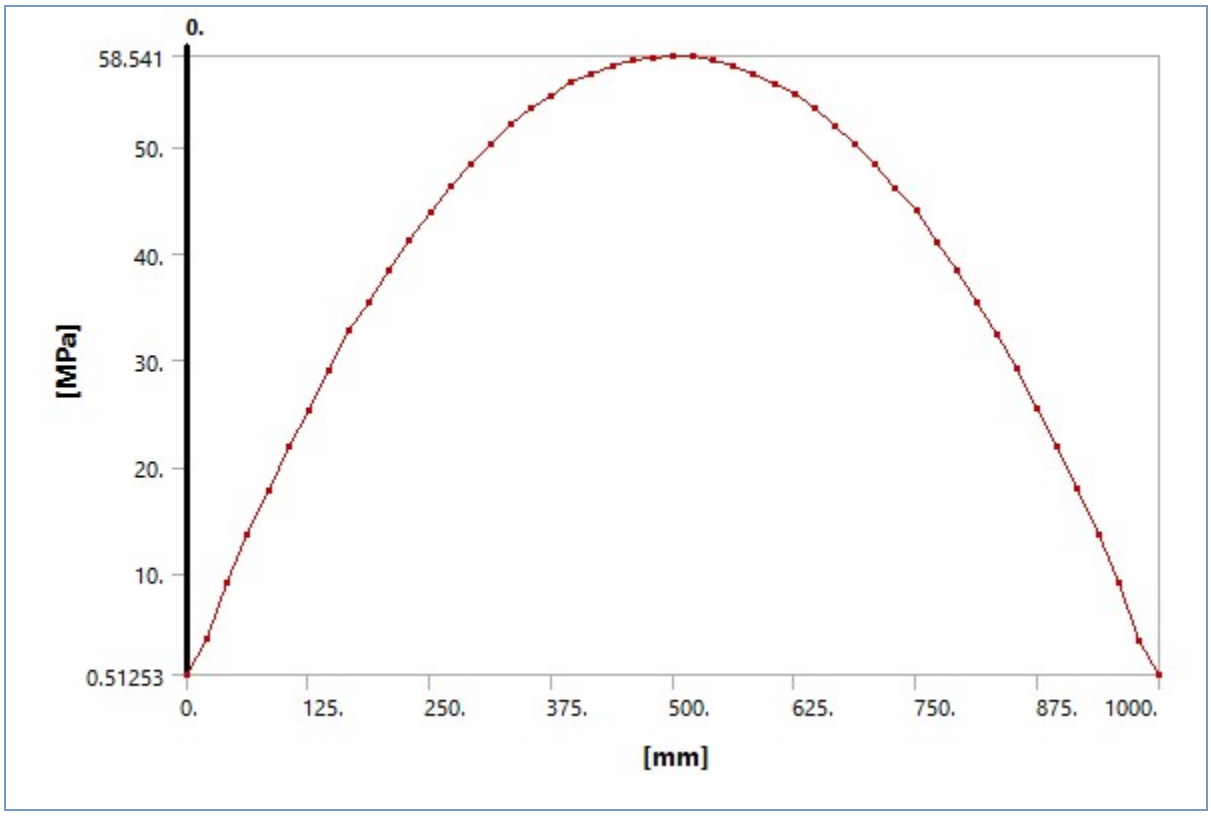


TABLE 20
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress 2

Length [mm]	Value [MPa]
0.	0.51253
20.833	3.851
41.667	9.0957
62.5	13.639
83.333	17.812
104.17	21.894
125.	25.367
145.83	28.981
166.67	32.735
187.5	35.457
208.33	38.514
229.17	41.344
250.	43.872
270.83	46.253
291.67	48.348
312.5	50.281
333.33	52.071
354.17	53.572
375.	54.878
395.83	56.014
416.67	56.932
437.5	57.633
458.33	58.139
479.17	58.436
500.	58.541

520.83	58.452
541.67	58.146
562.5	57.638
583.33	56.904
604.17	55.98
625.	54.916
645.83	53.583
666.67	51.949
687.5	50.261
708.33	48.446
729.17	46.127
750.	44.044
770.83	41.17
791.67	38.501
812.5	35.431
833.33	32.489
854.17	29.312
875.	25.507
895.83	21.836
916.67	18.026
937.5	13.67
958.33	9.1073
979.17	3.6977
1000.	0.52519

FIGURE 23
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress 2 > Figure

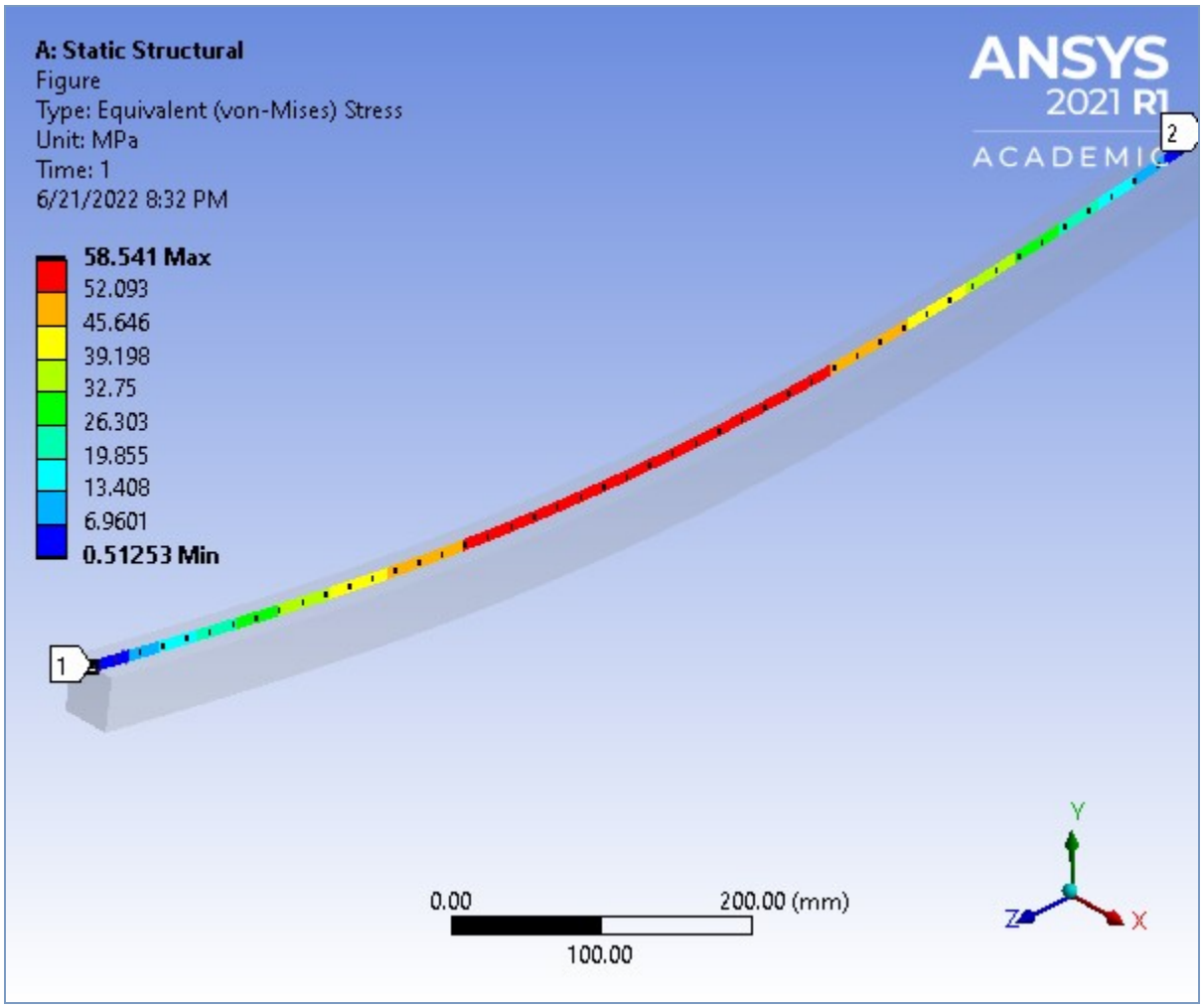


FIGURE 24
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress 3

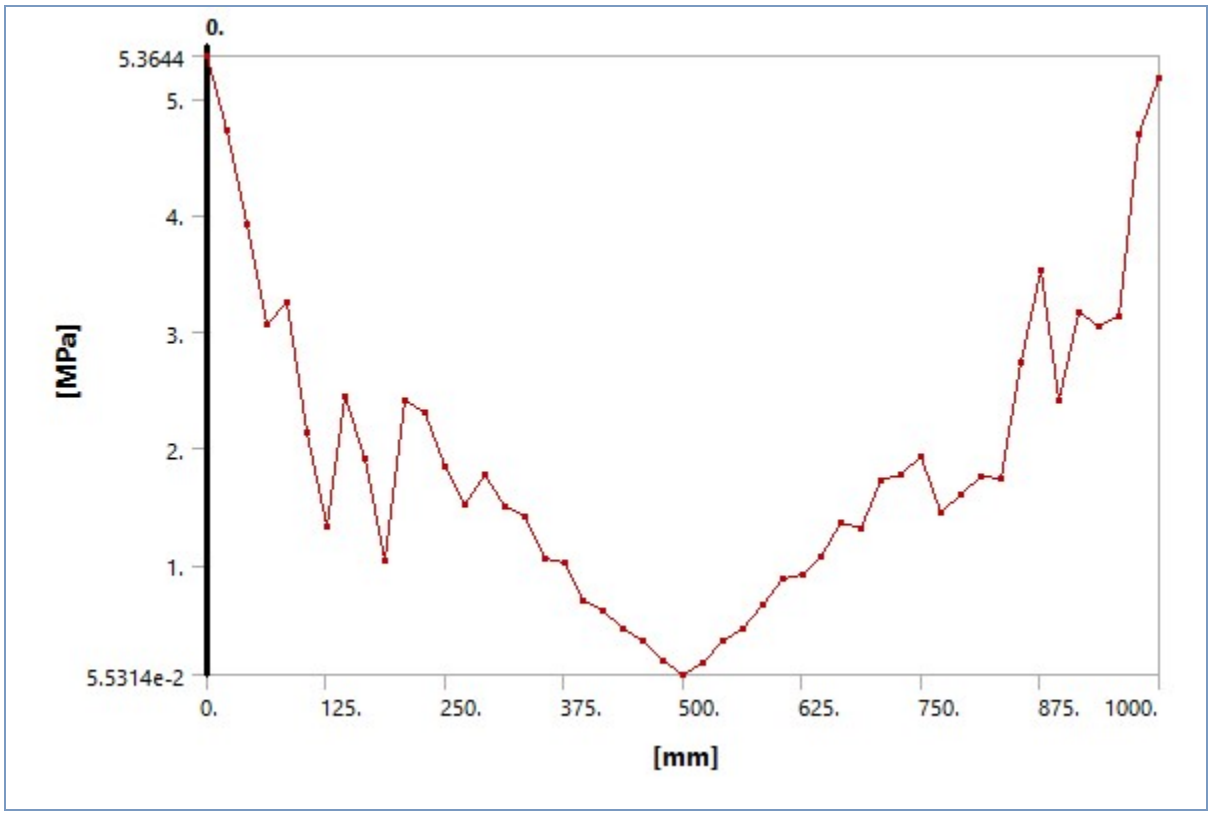
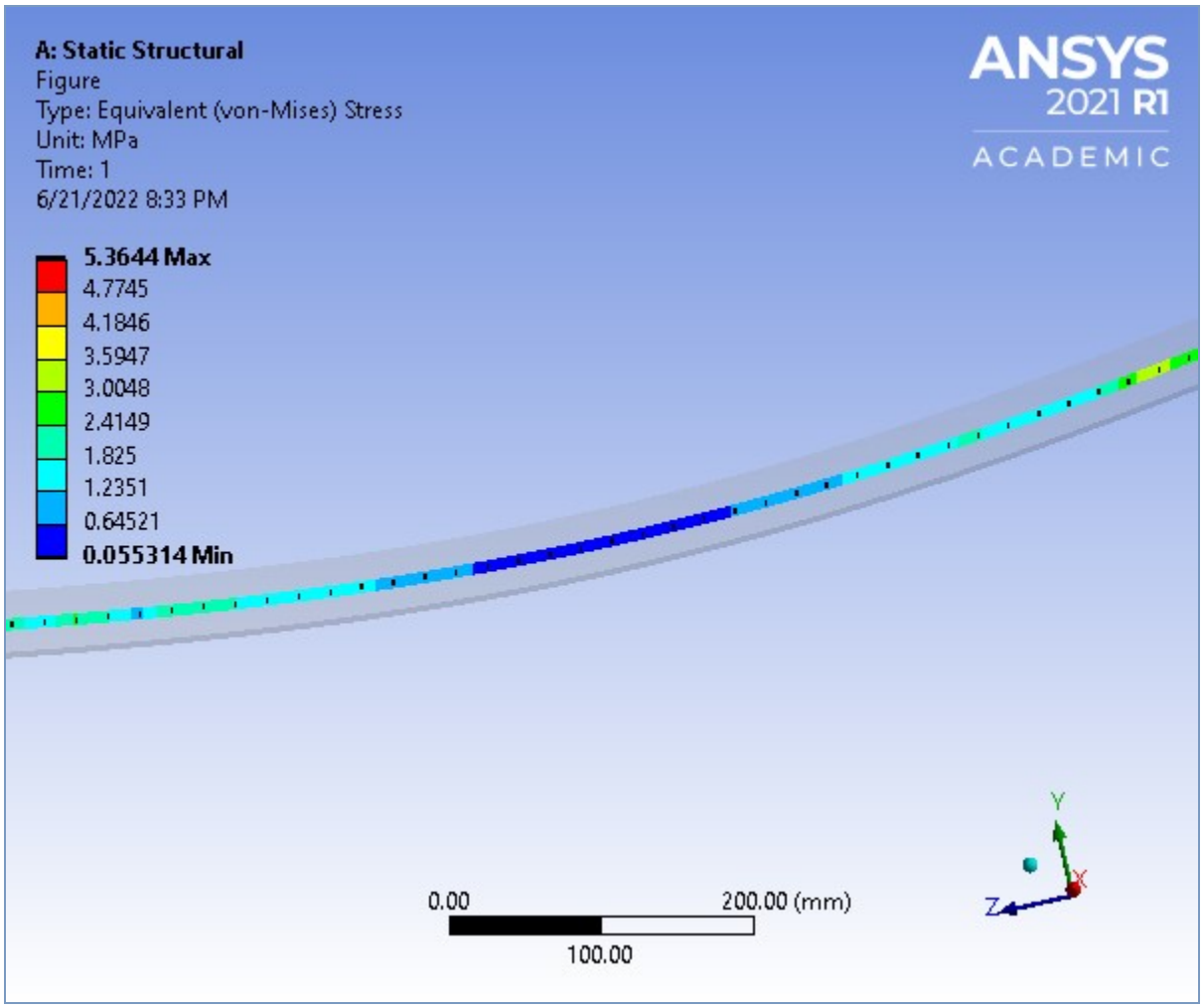


TABLE 21
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress 3

Length [mm]	Value [MPa]
0.	5.3644
20.833	4.7323
41.667	3.9225
62.5	3.062
83.333	3.2582
104.17	2.1381
125.	1.3183
145.83	2.449
166.67	1.9038
187.5	1.0354
208.33	2.4027
229.17	2.3083
250.	1.8498
270.83	1.5243
291.67	1.7714
312.5	1.5034
333.33	1.4057
354.17	1.0543
375.	1.0158
395.83	0.69862
416.67	0.60996
437.5	0.45402
458.33	0.34573
479.17	0.17075
500.	5.5314e-002

520.83	0.15149
541.67	0.35331
562.5	0.45536
583.33	0.65868
604.17	0.87985
625.	0.91328
645.83	1.0711
666.67	1.3688
687.5	1.3031
708.33	1.7285
729.17	1.7659
750.	1.9234
770.83	1.4432
791.67	1.5953
812.5	1.7526
833.33	1.737
854.17	2.7425
875.	3.5272
895.83	2.4145
916.67	3.1591
937.5	3.0431
958.33	3.1373
979.17	4.693
1000.	5.1781

FIGURE 25
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress 3 > Figure



stress to top surface

FIGURE 26
Model (A4) > stress to top surface

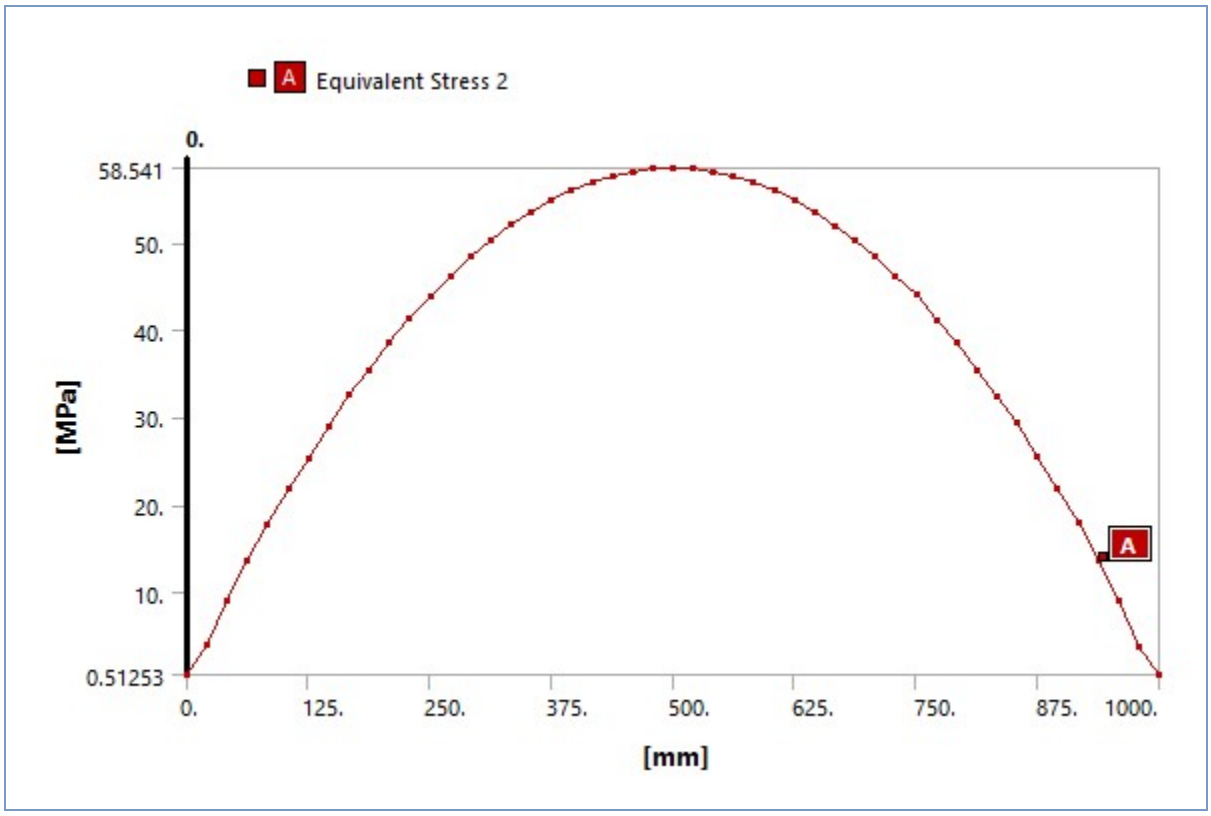


TABLE 22
Model (A4) > stress to top surface

Length [mm]	[A] Equivalent Stress 2 [MPa]
0.	0.51253
20.833	3.851
41.667	9.0957
62.5	13.639
83.333	17.812
104.17	21.894
125.	25.367
145.83	28.981
166.67	32.735
187.5	35.457
208.33	38.514
229.17	41.344
250.	43.872
270.83	46.253
291.67	48.348
312.5	50.281
333.33	52.071
354.17	53.572
375.	54.878
395.83	56.014
416.67	56.932
437.5	57.633
458.33	58.139
479.17	58.436
500.	58.541

520.83	58.452
541.67	58.146
562.5	57.638
583.33	56.904
604.17	55.98
625.	54.916
645.83	53.583
666.67	51.949
687.5	50.261
708.33	48.446
729.17	46.127
750.	44.044
770.83	41.17
791.67	38.501
812.5	35.431
833.33	32.489
854.17	29.312
875.	25.507
895.83	21.836
916.67	18.026
937.5	13.67
958.33	9.1073
979.17	3.6977
1000.	0.52519

Material Data

Structural Steel

TABLE 23
Structural Steel > Constants

Density	7.85e-006 kg mm^-3
Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat	4.34e+005 mJ kg^-1 C^-1
Thermal Conductivity	6.05e-002 W mm^-1 C^-1
Resistivity	1.7e-004 ohm mm

TABLE 24
Structural Steel > Color

Red	Green	Blue
132	139	179

TABLE 25
Structural Steel > Compressive Ultimate Strength

Compressive Ultimate Strength MPa
0

TABLE 26
Structural Steel > Compressive Yield Strength

Compressive Yield Strength MPa
250

TABLE 27
Structural Steel > Tensile Yield Strength

Tensile Yield Strength MPa
250

TABLE 28
Structural Steel > Tensile Ultimate Strength

Tensile Ultimate Strength MPa
460

TABLE 29
Structural Steel > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
22

TABLE 30
Structural Steel > S-N Curve

Alternating Stress MPa	Cycles	Mean Stress MPa
3999	10	0
2827	20	0
1896	50	0
1413	100	0
1069	200	0
441	2000	0
262	10000	0
214	20000	0
138	1.e+005	0
114	2.e+005	0
86.2	1.e+006	0

TABLE 31
Structural Steel > Strain-Life Parameters

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

TABLE 32
Structural Steel > Isotropic Elasticity

Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
2.1e+005	0.3	1.75e+005	80769	

TABLE 33
Structural Steel > Isotropic Relative Permeability

Relative Permeability
10000