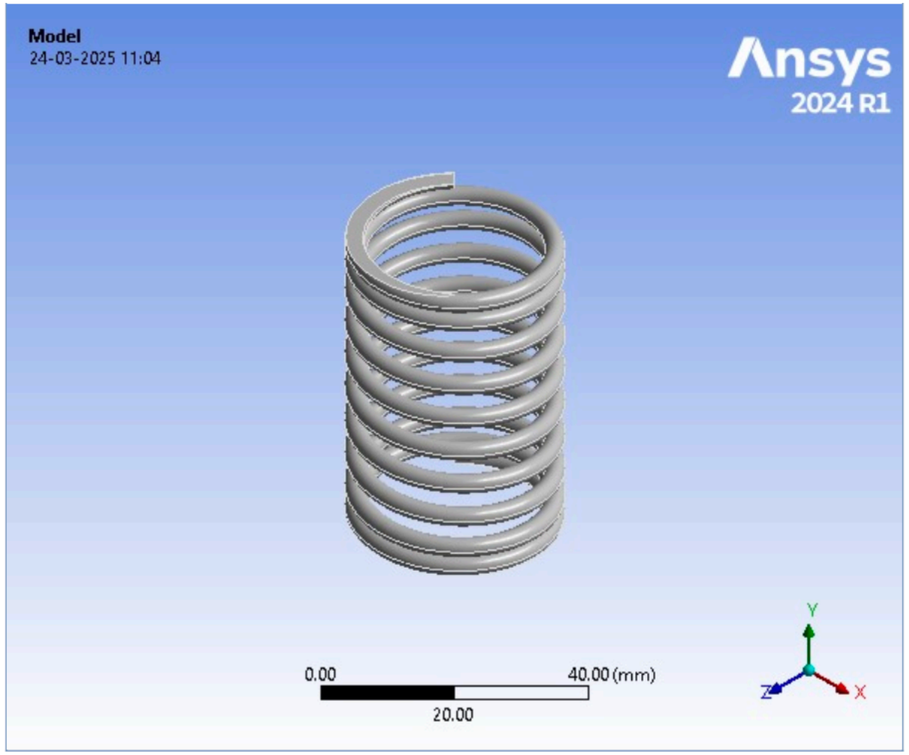


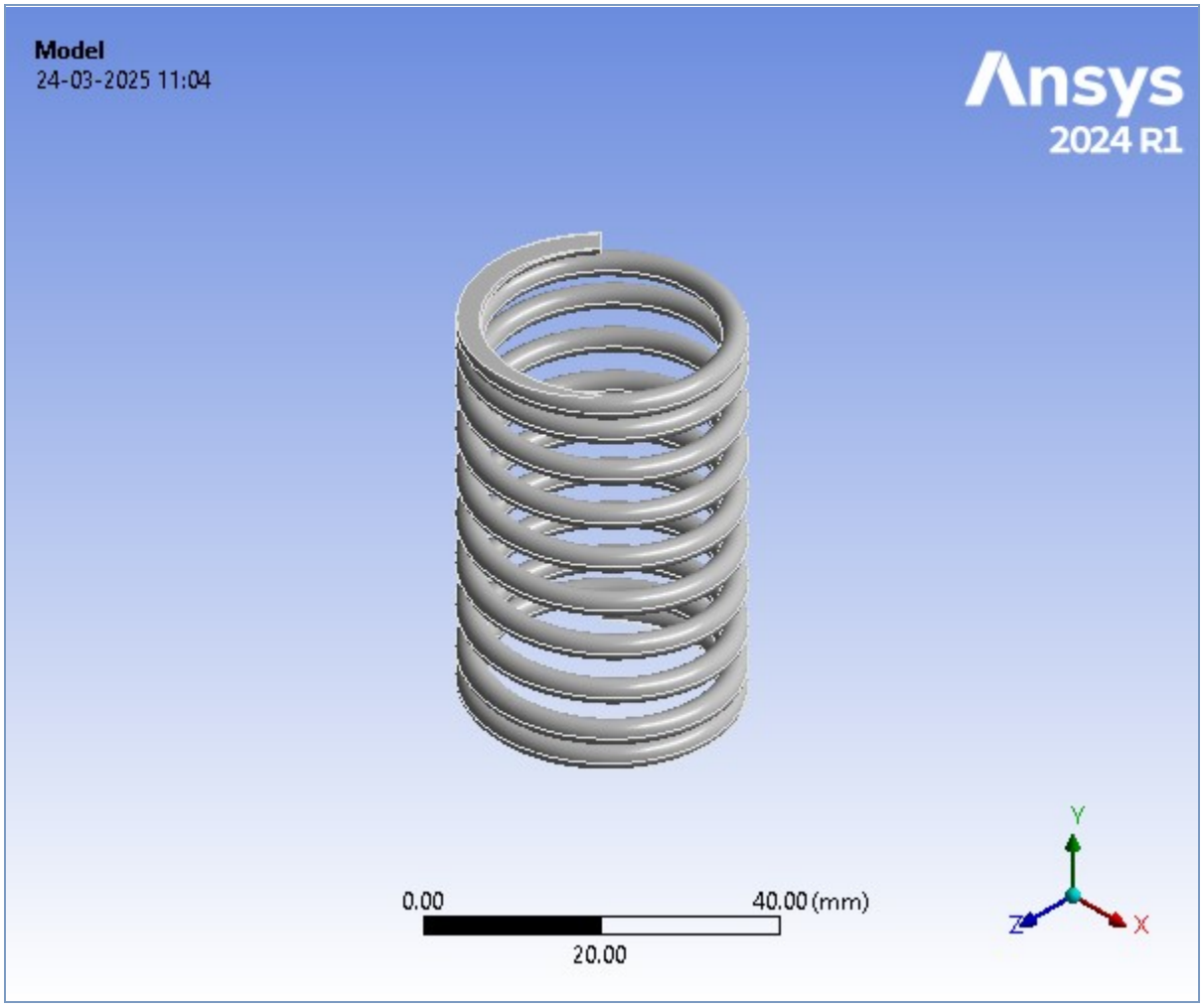
Buckling Analysis on Spring

CADD INTERNATIONAL

Drawn By	A Krishnaraj	**Project: Buckling Analysis on Spring**
Guided By	Saurav Sangeeth	
Software	ANSYS	Date: 26/03/2025

Project*

First Saved	Monday, March 24, 2025
Last Saved	Monday, March 24, 2025
Product Version	2024 R1
Save Project Before Solution	No
Save Project After Solution	No



Contents

Report Not Finalized

Not all objects described below are in a finalized state. As a result, data may be incomplete, obsolete or in error. View first state problem. To finalize this report, edit objects as needed and solve the analyses.

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, B4)

TABLE 2
Model (A4, B4) > Geometry Imports

Object Name	*Geometry Imports*
State	Solved

TABLE 3
Model (A4, B4) > Geometry Imports > Geometry Import (A3, B3)

Object Name	*Geometry Import (A3, B3)*
State	Solved
Definition	
Source	C:\Users\VS VAITHESH\OneDrive\Desktop\Krishnaraj\solidworks\Spring\Spring.IGS
Type	Iges
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	Program Tolerance
Stitch Tolerance	0.0000001
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

Geometry

TABLE 4
Model (A4, B4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\VS VAITHESH\OneDrive\Desktop\Krishnaraj\solidworks\Spring\Spring.IGS
Type	Iges
Length Unit	Millimeters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	33.35 mm
Length Y	57.03 mm
Length Z	33.331 mm

Properties	
Volume	6418.5 mm³
Mass	5.0385e-002 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	7093
Elements	2704
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	Program Tolerance
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 5
Model (A4, B4) > Geometry > Parts

Object Name	*Spring-FreeParts*
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	33.35 mm
Length Y	57.03 mm
Length Z	33.331 mm
Properties	
Volume	6418.5 mm³
Mass	5.0385e-002 kg
Centroid X	0.11657 mm
Centroid Y	25.515 mm
Centroid Z	0.11658 mm
Moment of Inertia Ip1	18.639 kg·mm²
Moment of Inertia Ip2	11.387 kg·mm²
Moment of Inertia Ip3	18.633 kg·mm²
Statistics	
Nodes	7093
Elements	2704
Mesh Metric	None

TABLE 6
Model (A4, B4) > Materials

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

Coordinate Systems

TABLE 7
Model (A4, B4) > 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

Mesh

TABLE 8
Model (A4, 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	73.997 mm
Average Surface Area	1466.1 mm²
Minimum Edge Length	4.0517e-002 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
Statistics	
Nodes	7093
Elements	2704
Show Detailed Statistics	No

Static Structural (A5)

TABLE 9

Model (A4, B4) > 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, B4) > Static Structural (A5) > Analysis Settings

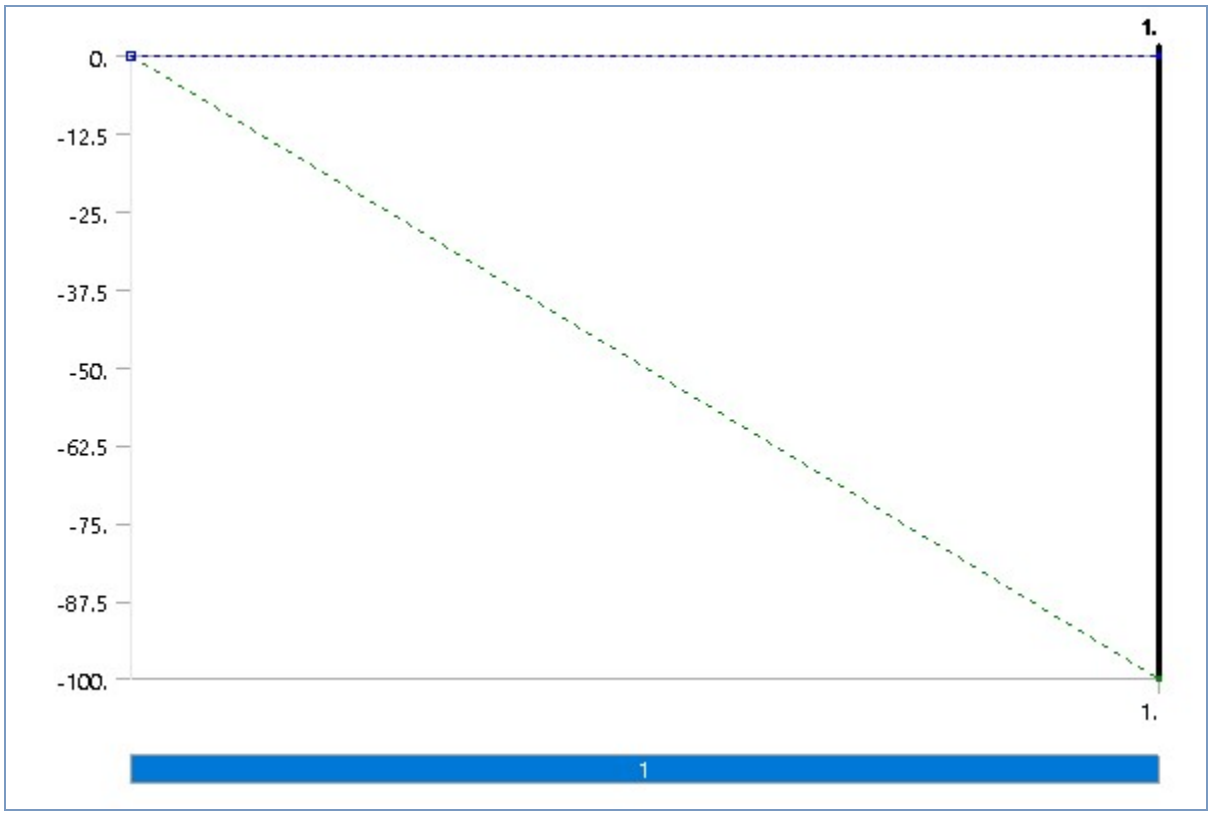
Object Name	*Analysis Settings*
State	Fully Defined
Restart Analysis	
Restart Type	Program Controlled
Status	Done
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot 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	Yes
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	
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\VS VAITHESH\OneDrive\Desktop\Krishnaraj\Ansys\spring static_files\dp0 \SYS\MECH\
Future Analysis	Prestressed analysis
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, B4) > Static Structural (A5) > Loads

Object Name	*Force*	*Fixed Support*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Force	Fixed Support
Define By	Components	
Applied By	Surface Effect	
Coordinate System	Global Coordinate System	
X Component	0. N (ramped)	
Y Component	-100. N (ramped)	
Z Component	0. N (ramped)	
Suppressed	No	

FIGURE 1
Model (A4, B4) > Static Structural (A5) > Force



Solution (A6)

TABLE 12
Model (A4, B4) > 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	4. s
MAPDL Memory Used	549. MB
MAPDL Result File Size	2.125 MB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 13
Model (A4, B4) > 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, B4) > 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	
Separate Data by Entity	No	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Results		
Minimum	0. mm	6.4523e-010 MPa
Maximum	67.068 mm	1566. MPa
Average	22.65 mm	412.66 MPa
Minimum Occurs On	Spring-FreeParts	
Maximum Occurs On	Spring-FreeParts	
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 (A4, B4) > Static Structural (A5) > Solution (A6) > Total Deformation

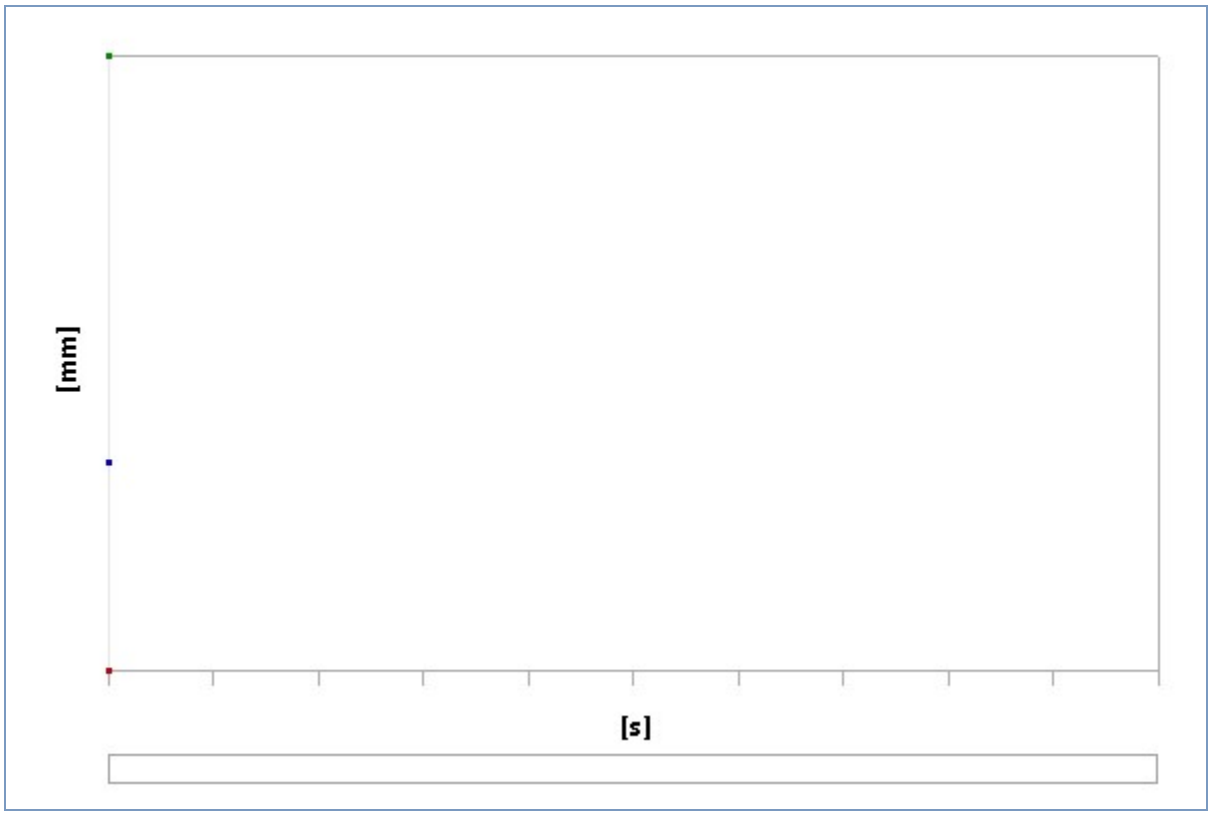


TABLE 15
Model (A4, B4) > Static Structural (A5) > Solution (A6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
1.	0.	67.068	22.65

FIGURE 3
Model (A4, B4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

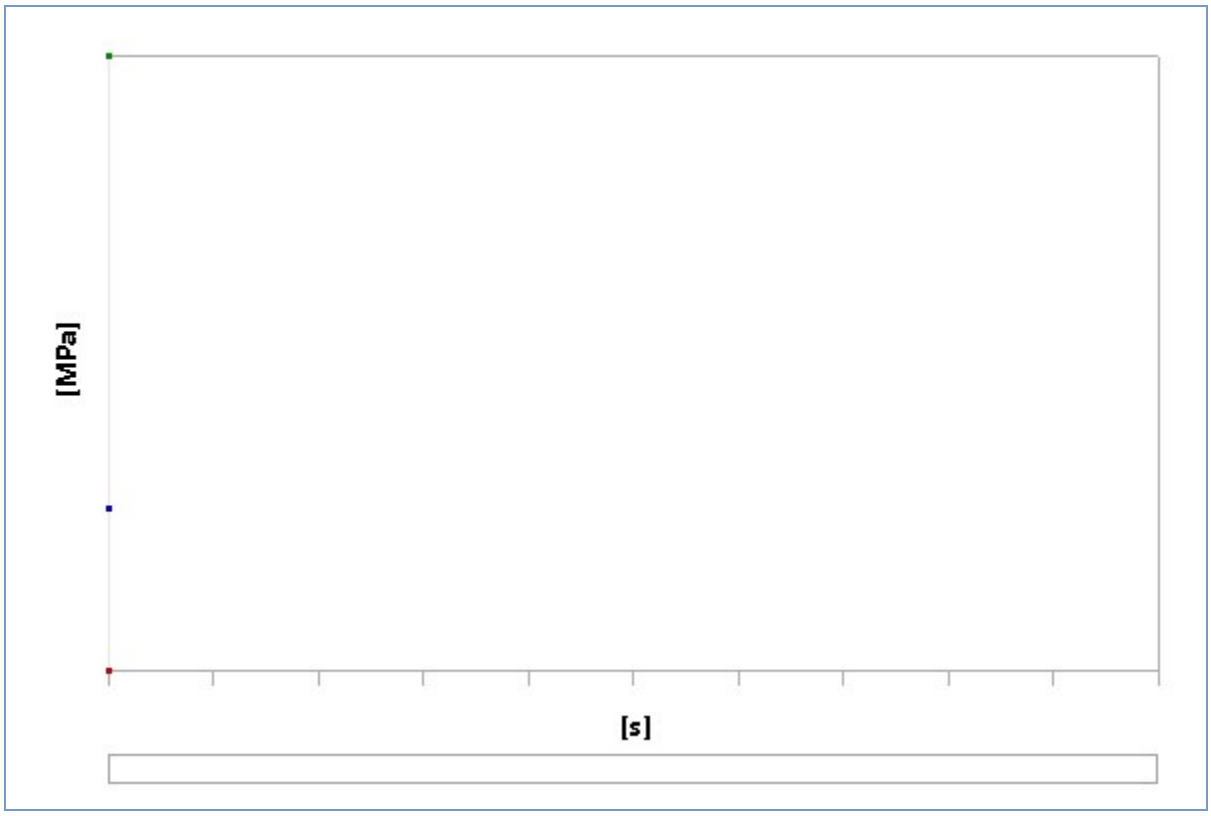


TABLE 16
Model (A4, B4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
1.	6.4523e-010	1566.	412.66

Eigenvalue Buckling (B5)

TABLE 17
Model (A4, B4) > Analysis

Object Name	*Eigenvalue Buckling (B5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Eigenvalue Buckling
Solver Target	Mechanical APDL
Options	
Generate Input Only	No

TABLE 18
Model (A4, B4) > Eigenvalue Buckling (B5) > Initial Condition

Object Name	*Pre-Stress (Static Structural)*
State	Fully Defined
Definition	
Pre-Stress Environment	Static Structural
Pre-Stress Define By	Program Controlled
Reported Loadstep	Last
Reported Substep	Last
Reported Time	End Time

Contact Status	Use True Status

TABLE 19
Model (A4, B4) > Eigenvalue Buckling (B5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Options	
Max Modes to Find	2.
Solver Controls	
Solver Type	Program Controlled
Include Negative Load Multiplier	Program Controlled
Output Controls	
Stress	No
Back Stress	No
Strain	No
Contact Data	No
Volume and Energy	No
Euler Angles	No
General Miscellaneous	No
Result File Compression	Program Controlled
Analysis Data Management	
Solver Files Directory	C:\Users\VS VAITHESH\OneDrive\Desktop\Krishnaraj\Ansys\spring static_files\dp0 \SYS-1\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Contact Summary	Program Controlled
Delete Unneeded Files	Yes
Solver Units	Active System
Solver Unit System	nmm

Solution (B6)

TABLE 20
Model (A4, B4) > Eigenvalue Buckling (B5) > Solution

Object Name	*Solution (B6)*
State	Obsolete
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Post-processing Required
MAPDL Elapsed Time	4. s
MAPDL Memory Used	577. MB
MAPDL Result File Size	1.5 MB
Post Processing	
Beam Section Results	No

FIGURE 4
Model (A4, B4) > Eigenvalue Buckling (B5) > Solution (B6)

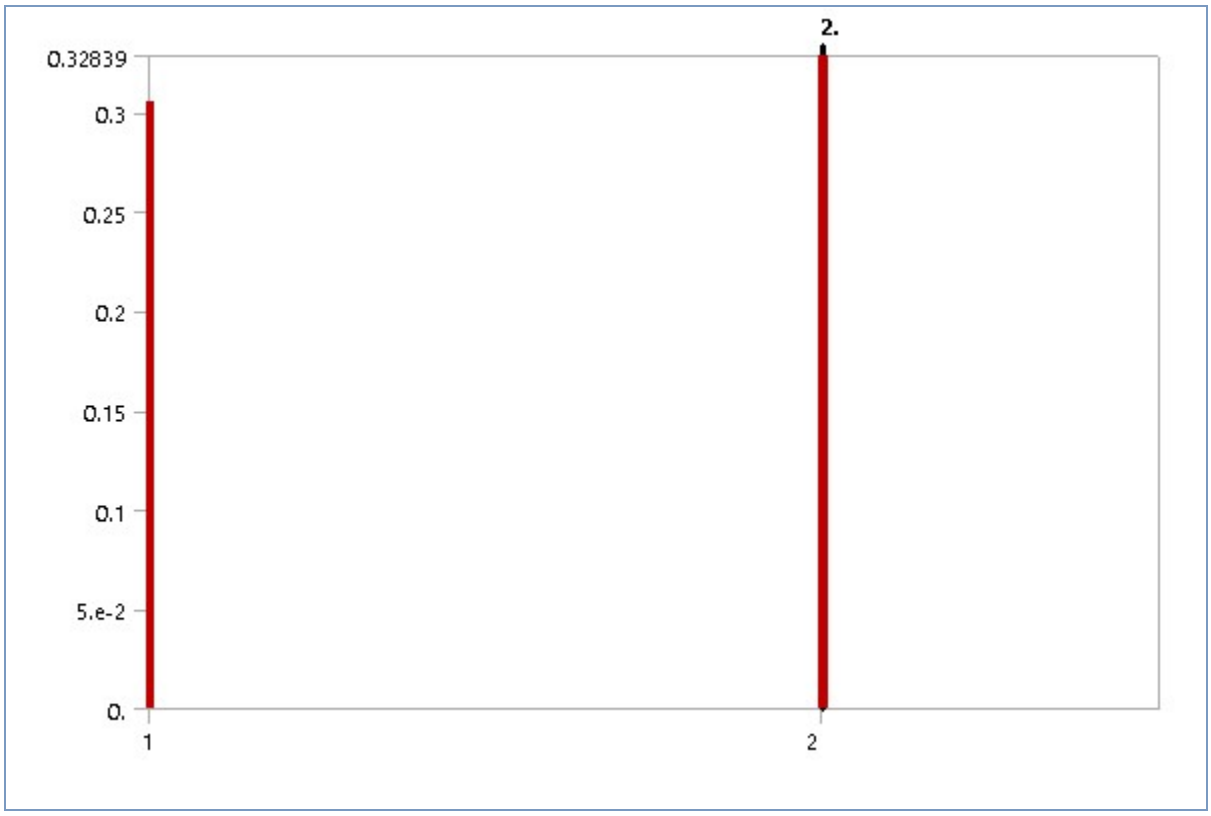


TABLE 21
Model (A4, B4) > Eigenvalue Buckling (B5) > Solution (B6)

Mode	Load Multiplier
1.	0.30565
2.	0.32839

TABLE 22
Model (A4, B4) > Eigenvalue Buckling (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 23
Model (A4, B4) > Eigenvalue Buckling (B5) > Solution (B6) > Results

Object Name	*Total Deformation*

State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Total Deformation
Mode	1.
Separate Data by Entity	No
Identifier	
Suppressed	No
Results	
Load Multiplier	0.30565
Minimum	0. mm
Maximum	1.1368 mm
Average	0.45652 mm
Minimum Occurs On	Spring-FreeParts
Maximum Occurs On	Spring-FreeParts

TABLE 24
Model (A4, B4) > Eigenvalue Buckling (B5) > Solution (B6) > Total Deformation

Mode	Load Multiplier
1.	0.30565
2.	0.32839

Total Deformation

TABLE 25
Model (A4, B4) > Eigenvalue Buckling (B5) > Solution (B6) > Total Deformation > Results

Object Name	*Total Deformation 2*	*Total Deformation 3*
State	Not Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Total Deformation	
Mode	1.	2.
Separate Data by Entity	No	
Identifier		
Suppressed	No	
Results		
Load Multiplier		
Minimum		
Maximum		
Average		
Minimum Occurs On		
Maximum Occurs On		

Material Data

Structural Steel

TABLE 26

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 27
Structural Steel > Color

Red	Green	Blue
132	139	179

TABLE 28
Structural Steel > Compressive Ultimate Strength

Compressive Ultimate Strength MPa
0

TABLE 29
Structural Steel > Compressive Yield Strength

Compressive Yield Strength MPa
250

TABLE 30
Structural Steel > Tensile Yield Strength

Tensile Yield Strength MPa
250

TABLE 31
Structural Steel > Tensile Ultimate Strength

Tensile Ultimate Strength MPa
460

TABLE 32
Structural Steel > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
22

TABLE 33
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 34
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 35
Structural Steel > Isotropic Elasticity

Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
2.e+005	0.3	1.6667e+005	76923	

TABLE 36
Structural Steel > Isotropic Relative Permeability

Relative Permeability
10000