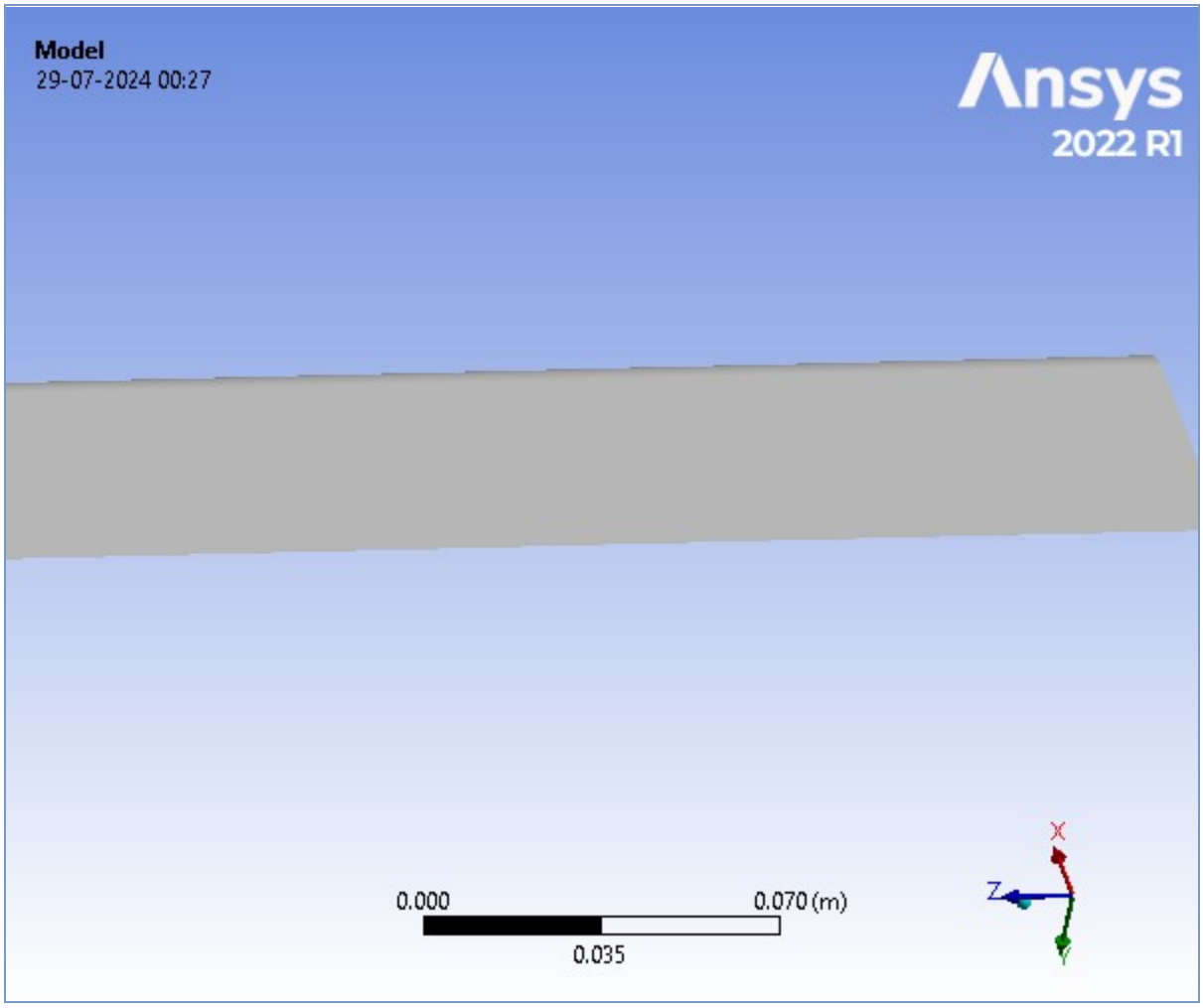
Project

First Saved	Sunday, July 28, 2024
Last Saved	Sunday, July 28, 2024
Product Version	2022 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 (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\jatin\Documents\Downloads\wing.IGS
Type	Iges

Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	No
Parameters	Independent
Parameter Key	ANS;DS
Attributes	No
Attribute Key	SDFEA;DDM
Named Selections	No
Named Selection Key	NS
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Coordinate System Key	
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	Yes
Compare Parts On Update	No
Compare Parts Tolerance	Tight
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\jatin\Documents\Downloads\wing.IGS
Type	Iges
Length Unit	Millimeters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	6.3158e-002 m
Length Y	1.4986e-002 m
Length Z	0.25402 m
Properties	
Volume	9.8251e-005 m³
Mass	0.45392 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1

Nodes	1312
Elements	540
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	*wing-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	Titanium Alloy
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	6.3158e-002 m
Length Y	1.4986e-002 m
Length Z	0.25402 m
Properties	
Volume	9.8251e-005 m³

Mass	0.45392 kg
Centroid X	3.6901e-002 m
Centroid Y	4.4424e-003 m
Centroid Z	0.127 m
Moment of Inertia Ip1	2.4436e-003 kg·m²
Moment of Inertia Ip2	2.5191e-003 kg·m²
Moment of Inertia Ip3	8.1849e-005 kg·m²
Statistics	
Nodes	1312
Elements	540
Mesh Metric	None

TABLE 6
Model (A4, B4) > Materials

Object Name	*Materials*
State	Fully Defined
Statistics	
Materials	4
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. 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 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	Fine
Initial Size Seed	Assembly
Bounding Box Diagonal	0.26218 m
Average Surface Area	6.4121e-003 m²
Minimum Edge Length	9.013e-004 m
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
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	1312
Elements	540

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*

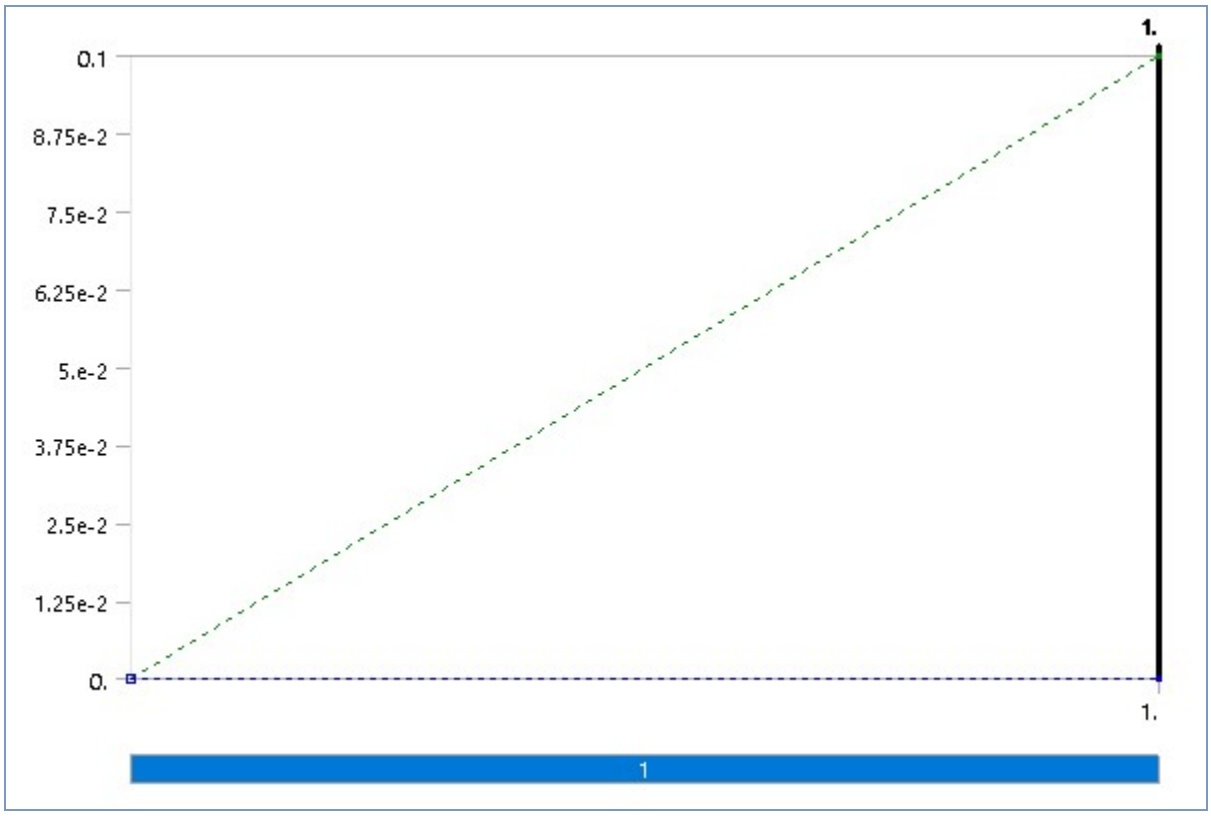
State	Fully Defined
Restart Analysis	
Restart Type	Program Controlled
Status	Done
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	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	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)	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	Program Controlled

Compression	
Analysis Data Management	
Solver Files Directory	C:\Users\jatin\Documents\Downloads\NACA0012 aircraf wing project\aircraft wing structural analysis_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	Yes
Solver Units	Active System
Solver Unit System	mks

TABLE 11
Model (A4, B4) > Static Structural (A5) > Loads

Object Name	*Fixed Support*	*Pressure*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Pressure
Suppressed	No	
Define By		Components
Applied By		Surface Effect
Loaded Area		Deformed
Coordinate System		Global Coordinate System
X Component		0. Pa (ramped)
Y Component		0.1 Pa (ramped)
Z Component		0. Pa (ramped)

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



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	87. MB
MAPDL Result File Size	704. KB
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	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Results		
Minimum	0. m	1.9061e-003 Pa
Maximum	1.0048e-008 m	333.67 Pa
Average	4.4777e-009 m	60.749 Pa
Minimum Occurs On	wing-FreeParts	
Maximum Occurs On	wing-FreeParts	
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	2	
Integration Point Results		
Display Option		Averaged
Average Across Bodies		No

FIGURE 2
Model (A4, B4) > Static Structural (A5) > Solution (A6) > Total Deformation

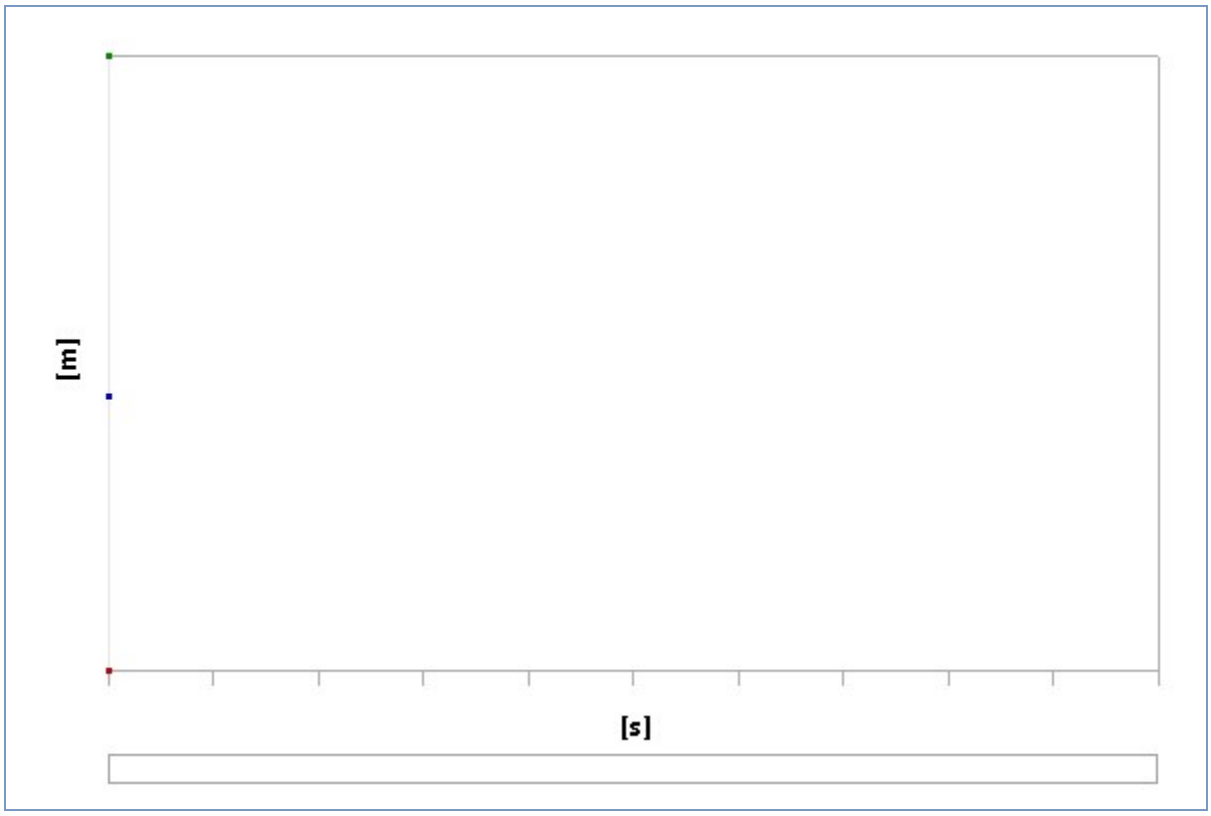


TABLE 15
Model (A4, B4) > Static Structural (A5) > Solution (A6) > Total Deformation

Time [s]	Minimum [m]	Maximum [m]	Average [m]
1.	0.	1.0048e-008	4.4777e-009

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

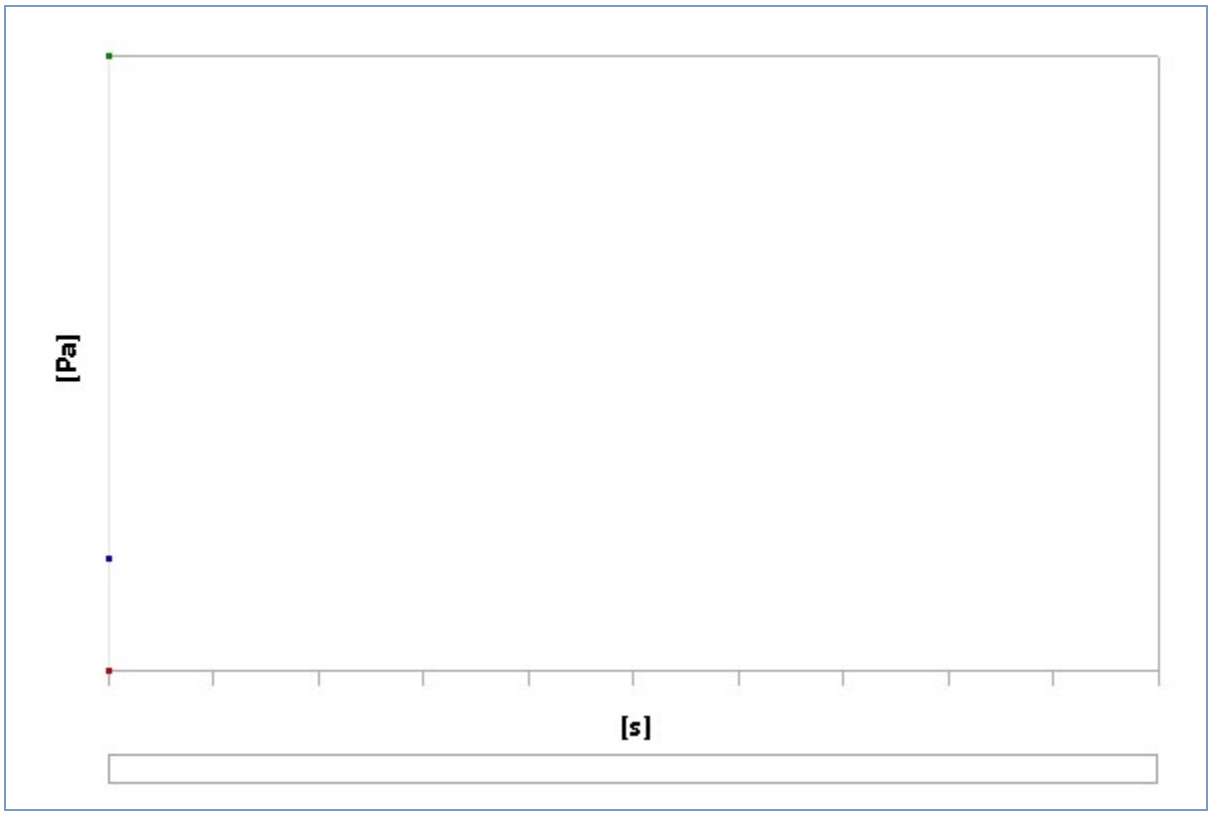


TABLE 16
Model (A4, B4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

Time [s]	Minimum [Pa]	Maximum [Pa]	Average [Pa]
1.	1.9061e-003	333.67	60.749

Modal (B5)

TABLE 17
Model (A4, B4) > Analysis

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

TABLE 18
Model (A4, B4) > Modal (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
Newton-Raphson Option	Program Controlled

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

Object Name	*Analysis Settings*
State	Fully Defined
Options	
Max Modes to Find	5
Limit Search to Range	No
On Demand Expansion	No
Spin Softening	Program Controlled
Solver Controls	
Damped	No
Solver Type	Program Controlled
Rotordynamics Controls	
Coriolis Effect	Off
Campbell Diagram	Off
Output Controls	
Stress	Yes
Surface Stress	No
Back Stress	No
Strain	Yes
Contact Data	No
Nodal Forces	No
Volume and Energy	No
Euler Angles	No
Calculate Reactions	No
Store Modal Results	Program Controlled
General Miscellaneous	No
Result File Compression	Program Controlled
Analysis Data Management	
Solver Files Directory	C:\Users\jatin\Documents\Downloads\NACA0012 aircraf wing project\aircraft wing structural analysis_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	mks

Solution (B6)

TABLE 20
Model (A4, B4) > Modal (B5) > Solution

Object Name	*Solution (B6)*

State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
MAPDL Elapsed Time	4. s
MAPDL Memory Used	89. MB
MAPDL Result File Size	1.4375 MB
Post Processing	
Beam Section Results	No

The following bar chart indicates the frequency at each calculated mode.

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

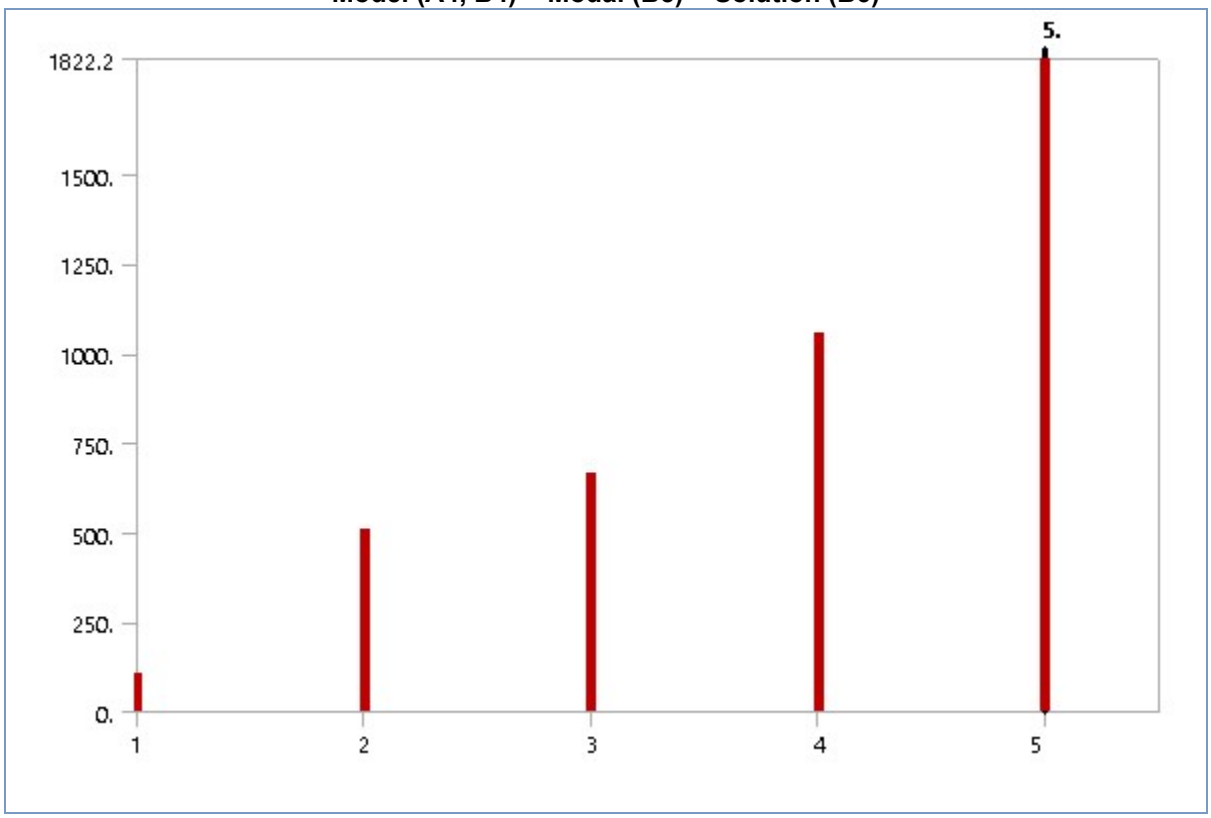


TABLE 21
Model (A4, B4) > Modal (B5) > Solution (B6)

Mode	Frequency [Hz]
1.	106.73
2.	507.36
3.	663.1
4.	1058.7
5.	1822.2

TABLE 22
Model (A4, B4) > Modal (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) > Modal (B5) > Solution (B6) > Results

Object Name	*Total Deformation*	*Total Deformation 2*	*Total Deformation 3*	*Total Deformation 4*	*Total Deformation 5*
State	Solved				
Scope					
Scoping Method	Geometry Selection				
Geometry	All Bodies				
Definition					
Type	Total Deformation				
Mode	1.	2.	3.	4.	5.
Identifier					
Suppressed	No				
Results					
Minimum	0. m				
Maximum	3.005 m	2.9936 m	3.1461 m	6.3256 m	3.2349 m
Average	1.3549 m	1.3616 m	1.3805 m	1.5125 m	1.3762 m
Minimum Occurs On	wing-FreeParts				
Maximum Occurs On	wing-FreeParts				
Information					
Frequency	106.73 Hz	507.36 Hz	663.1 Hz	1058.7 Hz	1822.2 Hz

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

Mode	Frequency [Hz]
1.	106.73
2.	507.36
3.	663.1
4.	1058.7
5.	1822.2

TABLE 25
Model (A4, B4) > Modal (B5) > Solution (B6) > Total Deformation 2

Mode	Frequency [Hz]
1.	106.73

2.	507.36
3.	663.1
4.	1058.7
5.	1822.2

TABLE 26
Model (A4, B4) > Modal (B5) > Solution (B6) > Total Deformation 3

Mode	Frequency [Hz]
1.	106.73
2.	507.36
3.	663.1
4.	1058.7
5.	1822.2

TABLE 27
Model (A4, B4) > Modal (B5) > Solution (B6) > Total Deformation 4

Mode	Frequency [Hz]
1.	106.73
2.	507.36
3.	663.1
4.	1058.7
5.	1822.2

TABLE 28
Model (A4, B4) > Modal (B5) > Solution (B6) > Total Deformation 5

Mode	Frequency [Hz]
1.	106.73
2.	507.36
3.	663.1
4.	1058.7
5.	1822.2

Material Data

Titanium Alloy

TABLE 29
Titanium Alloy > Constants

Density	4620 kg m^-3
Coefficient of Thermal Expansion	9.4e-006 C^-1
Specific Heat	522 J kg^-1 C^-1
Thermal Conductivity	21.9 W m^-1 C^-1
Resistivity	1.7e-006 ohm m

TABLE 30
Titanium Alloy > Color

Red	Green	Blue
88	72	117

TABLE 31
Titanium Alloy > Compressive Ultimate Strength

Compressive Ultimate Strength Pa

0

TABLE 32
Titanium Alloy > Compressive Yield Strength

Compressive Yield Strength Pa
9.3e+008

TABLE 33
Titanium Alloy > Tensile Yield Strength

Tensile Yield Strength Pa
9.3e+008

TABLE 34
Titanium Alloy > Tensile Ultimate Strength

Tensile Ultimate Strength Pa
1.07e+009

TABLE 35
Titanium Alloy > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
22

TABLE 36
Titanium Alloy > Isotropic Elasticity

Young's Modulus Pa	Poisson's Ratio	Bulk Modulus Pa	Shear Modulus Pa	Temperature C
9.6e+010	0.36	1.1429e+011	3.5294e+010	

TABLE 37
Titanium Alloy > Isotropic Relative Permeability

Relative Permeability
1