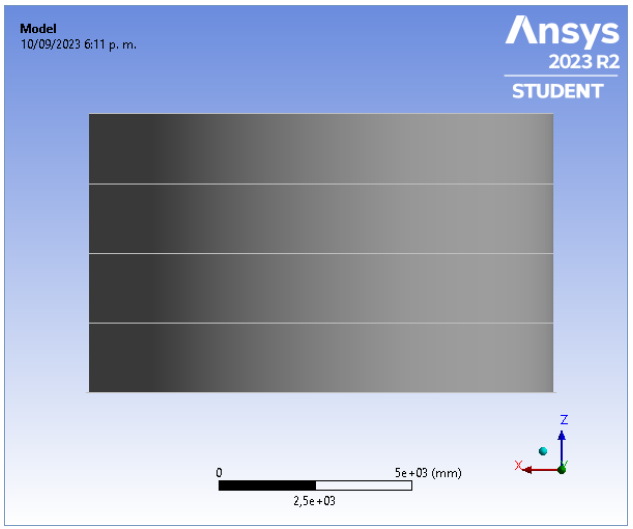
Project*

First Saved	Friday, September 1, 2023
Last Saved	Sunday, September 3, 2023
Product Version	2023 R2
Save Project Before Solution	No
Save Project After Solution	No



Contents

- Units
- Model (A4)
  - Geometry Imports
    - Geometry Import (A3)
  - Geometry
    - Parts
  - Materials
    - ASTM A283 Grade C Assignment
  - Coordinate Systems
  - Connections
    - Contacts
      - Contact Regions
  - Mesh
    - Mesh Controls
  - Static Structural (A5)
    - Analysis Settings
    - Standard Earth Gravity
    - Loads
    - Solution (A6)
      - Solution Information
      - Results
      - Stress Tool
        - Safety Factor
- Material Data
  - ASTM A283 Grade C

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\Jeisson\Desktop\Report nastran\Tk\TK1.sat
Type	ACIS
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\Jeisson\Desktop\Report nastran\Tk\TK1.sat
Type	ACIS
Length Unit	Millimeters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	12152 mm
Length Y	12152 mm
Length Z	7210,5 mm
Properties	
Volume	2,7147e+009 mm³
Mass	21311 kg
Scale Factor Value	1,
Statistics	
Bodies	5
Active Bodies	5
Nodes	126126
Elements	60524
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
Enclosure and Symmetry Processing	Yes

TABLE 5
Model (A4) > Geometry > Parts

Object Name	*Part 1*	*Part 2*	*Part 3*	*Part 4*	*Part 5*
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	ASTM A283 Grade C				
Nonlinear Effects	Yes				
Thermal Strain Effects	Yes				
Bounding Box					
Length X	12000 mm	11997 mm	12152 mm	12000 mm	11997 mm
Length Y	12000 mm	11997 mm	12152 mm	12000 mm	11997 mm
Length Z	1800, mm		10,525 mm	1800, mm	
Properties					
Volume	4,2906e+008 mm³	3,2175e+008 mm³	1,2131e+009 mm³	4,2906e+008 mm³	3,2175e+008 mm³
Mass	3368,1 kg	2525,7 kg	9522,9 kg	3368,1 kg	2525,7 kg
Centroid X	-1,8894e-010 mm	7,2539e-011 mm	-1,6724e-014 mm	8,8454e-011 mm	-1,1629e-010 mm
Centroid Y	-1,2124e-010 mm	1,1993e-010 mm	1,3377e-013 mm	-1,9069e-011 mm	1,6047e-010 mm
Centroid Z	901, mm	4501, mm	-4,2747 mm	2701, mm	6301, mm
Moment of Inertia Ip1	6,1246e+010 kg·mm²	4,5916e+010 kg·mm²	8,7351e+010 kg·mm²	6,1246e+010 kg·mm²	4,5916e+010 kg·mm²
Moment of Inertia Ip2	6,1246e+010 kg·mm²	4,5917e+010 kg·mm²	8,7351e+010 kg·mm²	6,1246e+010 kg·mm²	4,5917e+010 kg·mm²
Moment of Inertia Ip3	1,2067e+011 kg·mm²	9,047e+010 kg·mm²	1,747e+011 kg·mm²	1,2067e+011 kg·mm²	9,047e+010 kg·mm²
Statistics					
Nodes	81089	9101	15370	11465	9101
Elements	39510	4214	7240	5339	4221
Mesh Metric	None				

TABLE 6
Model (A4) > Materials

Object Name	*Materials*
State	Fully Defined
Statistics	
Materials	2
Material Assignments	1

TABLE 7
Model (A4) > Materials > ASTM A283 Grade C Assignment

Object Name	*ASTM A283 Grade C Assignment*
State	Fully Defined
General	
Scoping Method	Geometry Selection
Geometry	5 Bodies
Definition	
Material Name	ASTM A283 Grade C
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Reference Temperature	By Environment
Suppressed	No

Coordinate Systems

TABLE 8
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,]

Connections

TABLE 9
Model (A4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes
Statistics	
Contacts	4
Active Contacts	4
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 10
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	46,594 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	4
Active Connections	4

TABLE 11
Model (A4) > Connections > Contacts > Contact Regions

Object Name	*Contact Region*	*Contact Region 2*	*Contact Region 3*	*Contact Region 4*
State	Fully Defined			
Scope				
Scoping Method	Geometry Selection			
Contact	1 Face			
Target	1 Face			
Contact Bodies	Part 1		Part 2	
Target Bodies	Part 3	Part 4		Part 5
Protected	No			
Definition				
Type	Bonded			
Scope Mode	Automatic			
Behavior	Program Controlled			
Trim Contact	Program Controlled			
Trim Tolerance	46,594 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 12
Model (A4) > 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	18637 mm
Average Surface Area	3,6915e+007 mm²
Minimum Edge Length	37659 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
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	126126
Elements	60524
Show Detailed Statistics	No

TABLE 13
Model (A4) > Mesh > Mesh Controls

Object Name	*Patch Conforming Method*	*Body Sizing*	*Body Sizing 2*	*Body Sizing 3*
State	Fully Defined			
Scope				
Scoping Method	Geometry Selection			
Geometry	5 Bodies	3 Bodies	1 Body	
Definition				
Suppressed	No			
Method	Tetrahedrons			
Algorithm	Patch Conforming			
Element Order	Use Global Setting			
Type		Element Size		
Element Size		345, mm	109, mm	300, mm
Advanced				
Defeature Size		Default		
Behavior		Soft		

Static Structural (A5)

TABLE 14
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 15
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)	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\Jeisson\OneDrive\Proyecto Gr70\Simulate\Ansys_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 16
Model (A4) > Static Structural (A5) > Accelerations

Object Name	*Standard Earth Gravity*
State	Fully Defined
Scope	
Geometry	All Bodies
Definition	
Coordinate System	Global Coordinate System
X Component	0, mm/s² (ramped)
Y Component	0, mm/s² (ramped)
Z Component	-9806,6 mm/s² (ramped)
Suppressed	No
Direction	-Z Direction

FIGURE 1
Model (A4) > Static Structural (A5) > Standard Earth Gravity

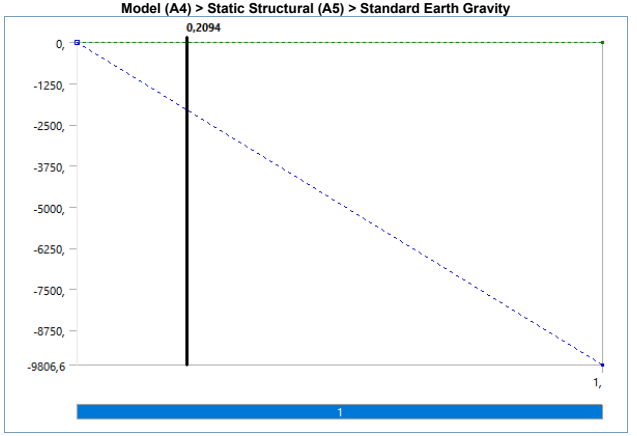


TABLE 17
Model (A4) > Static Structural (A5) > Loads

Object Name	*Hydrostatic Pressure*	*Fixed Support*	*Pressure*
State	Fully Defined		Suppressed
Scope			
Scoping Method	Geometry Selection		
Geometry	5 Faces	1 Face	
Definition			
Type	Hydrostatic Pressure	Fixed Support	Pressure
Applied By	Surface Effect		Surface Effect
Coordinate System	Global Coordinate System		

Fluid Density	1,e-006 kg/mm³	
Suppressed	No	Yes
Define By		Normal To
Loaded Area		Deformed
Magnitude		3,5e-004 MPa (ramped)
Hydrostatic Acceleration		
Define By	Components	
X Component	0, mm/s² (ramped)	
Y Component	0, mm/s² (ramped)	
Z Component	9810, mm/s² (ramped)	
Free Surface Location		
X Coordinate	0, mm	
Y Coordinate	0, mm	
Z Coordinate	7200, mm	
Location	Defined	

FIGURE 2
Model (A4) > Static Structural (A5) > Hydrostatic Pressure

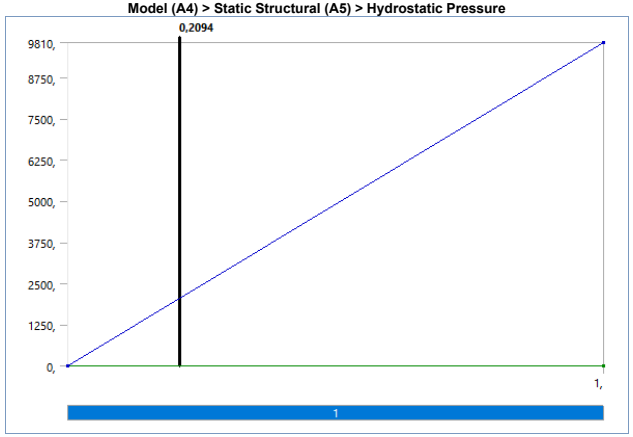
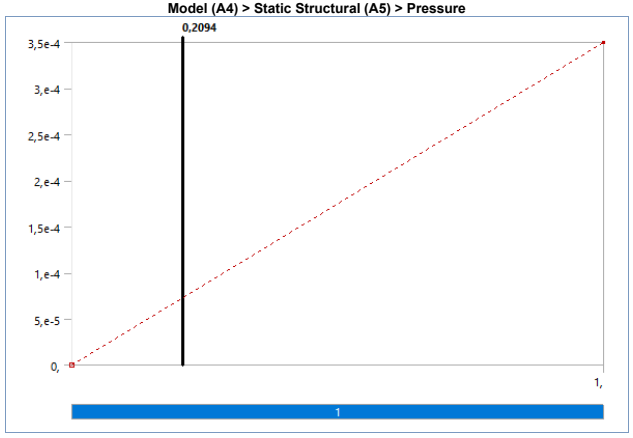


FIGURE 3
Model (A4) > Static Structural (A5) > Pressure



Solution (A6)

TABLE 18
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	17, s
MAPDL Memory Used	2,251 GB
MAPDL Result File Size	46,875 MB
Post Processing	
Beam Section Results	No
On Demand Stress/Strain	No

TABLE 19
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 20
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Equivalent Stress*	*Total Deformation*	*Maximum Principal Stress*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Equivalent (von-Mises) Stress	Total Deformation	Maximum Principal Stress
By	Time		
Display Time	Last	First	Last
Separate Data by Entity	No		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Integration Point Results			
Display Option	Averaged		Averaged
Average Across Bodies	No		No
Results			
Minimum	1,1824e-003 MPa	0, mm	-0,86874 MPa
Maximum	69,055 MPa	1,9719 mm	70,428 MPa
Average	41,629 MPa	1,2232 mm	40,558 MPa
Minimum Occurs On	Part 3		Part 1
Maximum Occurs On	Part 1		
Information			
Time	1, s		
Load Step	1		
Substep	1		
Iteration Number	1		

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

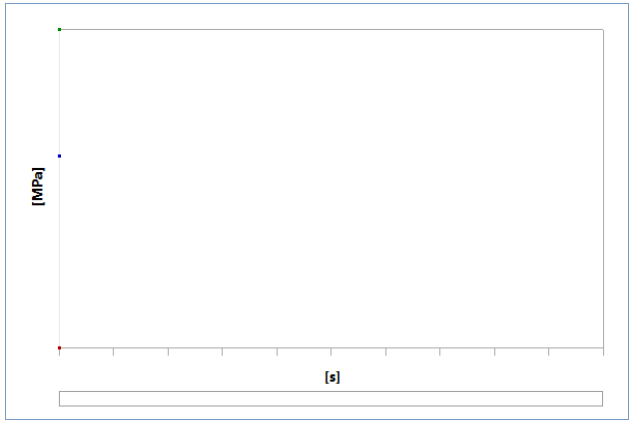


TABLE 21
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
1,	1,1824e-003	69,055	41,629

FIGURE 5
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

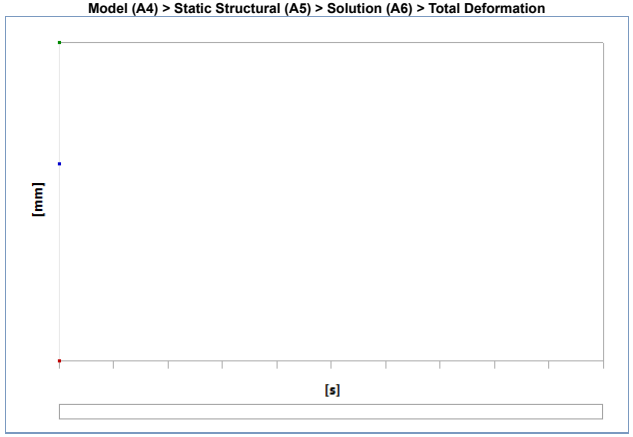


TABLE 22
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
1,	0,	1,9719	1,2232

FIGURE 6
Model (A4) > Static Structural (A5) > Solution (A6) > Maximum Principal Stress

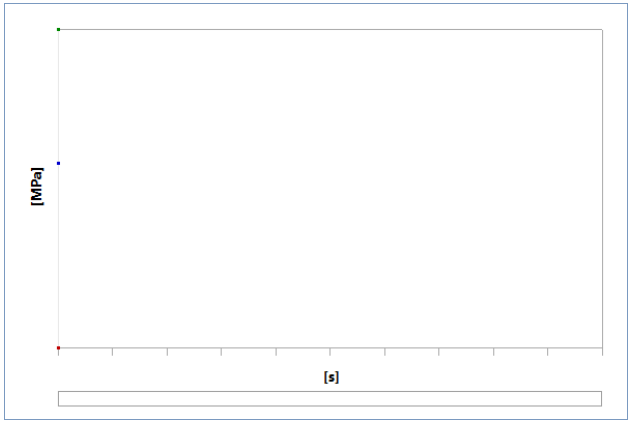


TABLE 23
Model (A4) > Static Structural (A5) > Solution (A6) > Maximum Principal Stress

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
1,	-0,86874	70,428	40,558

TABLE 24
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 25
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
Separate Data by Entity	No
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	2,9686
Minimum Occurs On	Part 1
Information	
Time	1, s
Load Step	1
Substep	1
Iteration Number	1

FIGURE 7
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

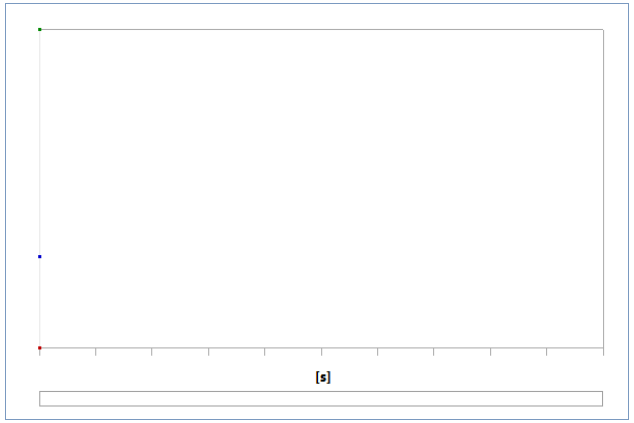


TABLE 26
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum	Average
1,	2,9686	15,	6,4123

Material Data

ASTM A283 Grade C

TABLE 27
ASTM A283 Grade C > 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 28
ASTM A283 Grade C > Color

Red	Green	Blue
132,	139,	179,

TABLE 29
ASTM A283 Grade C > Compressive Ultimate Strength

Compressive Ultimate Strength MPa
0,

TABLE 30
ASTM A283 Grade C > Compressive Yield Strength

Compressive Yield Strength MPa
250,

TABLE 31
ASTM A283 Grade C > Tensile Yield Strength

Tensile Yield Strength MPa
205,

TABLE 32
ASTM A283 Grade C > Tensile Ultimate Strength

Tensile Ultimate Strength MPa
380,

TABLE 33
ASTM A283 Grade C > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
22,

TABLE 34
ASTM A283 Grade C > 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 35
ASTM A283 Grade C > 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 36
ASTM A283 Grade C > 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 37
ASTM A283 Grade C > Isotropic Relative Permeability

Relative Permeability
10000