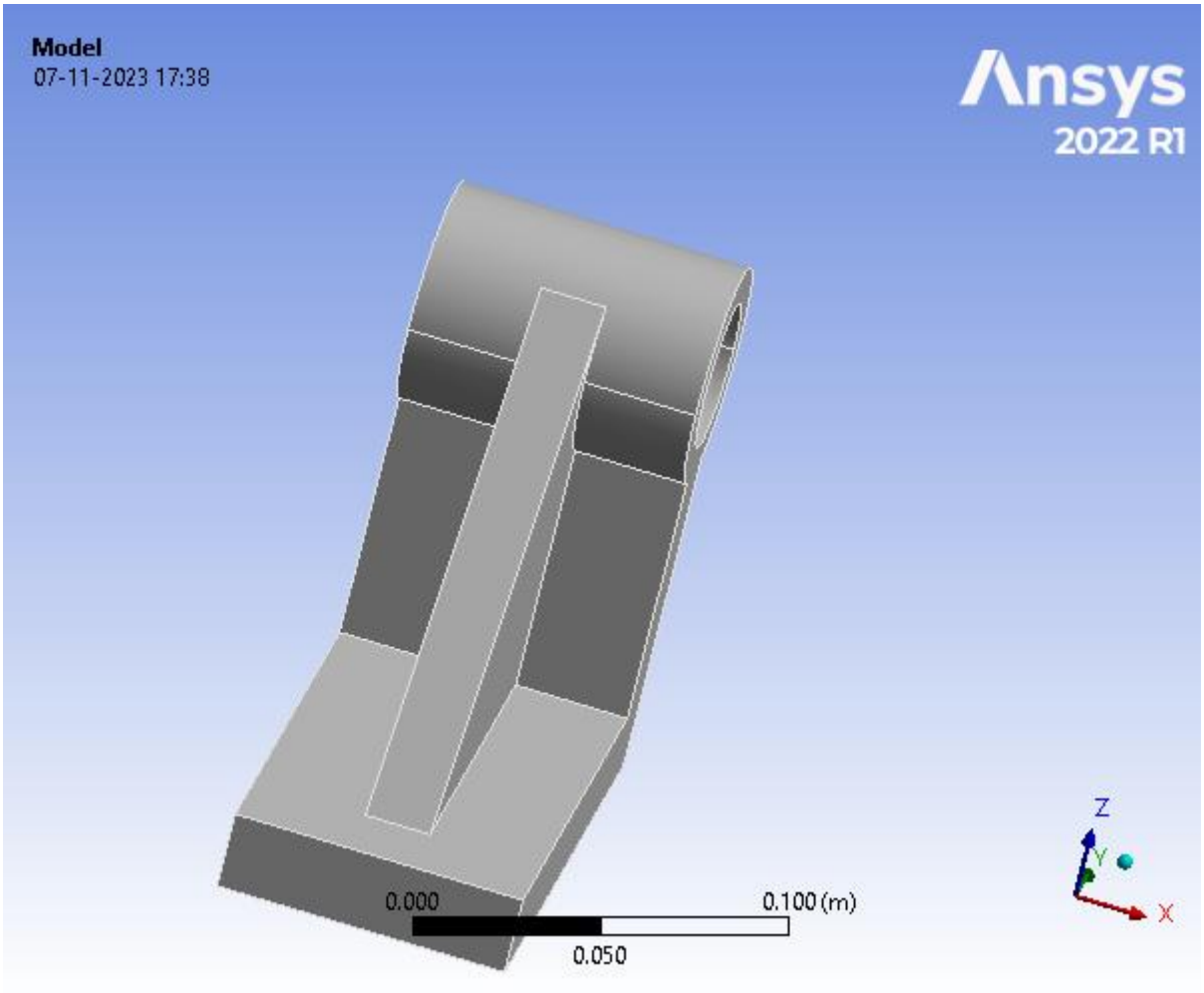
Project*

First Saved	Tuesday, November 7, 2023
Last Saved	Tuesday, November 7, 2023
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	D:\ansys stractral optimaisation.stp
Type	Step
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	D:\ansys stractral optimaisation.stp
Type	Step
Length Unit	Millimeters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	8.e-002 m
Length Y	0.17697 m
Length Z	0.14946 m
Properties	
Volume	6.2331e-004 m³
Mass	4.893 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	3701
Elements	1905

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	*ansys stractral optimaisation-FreeParts|PartBody*
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	8.e-002 m
Length Y	0.17697 m
Length Z	0.14946 m
Properties	
Volume	6.2331e-004 m^3
Mass	4.893 kg
Centroid X	1.2451e-018 m

Centroid Y	-3.9439e-002 m
Centroid Z	-6.9878e-002 m
Moment of Inertia Ip1	1.9509e-002 kg·m²
Moment of Inertia Ip2	6.4663e-003 kg·m²
Moment of Inertia Ip3	1.7314e-002 kg·m²
Statistics	
Nodes	3701
Elements	1905
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. 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	1.e-002 m
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	0.24506 m
Average Surface Area	5.0495e-003 m²
Minimum Edge Length	1.8e-002 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	3701
Elements	1905

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
Step Controls	

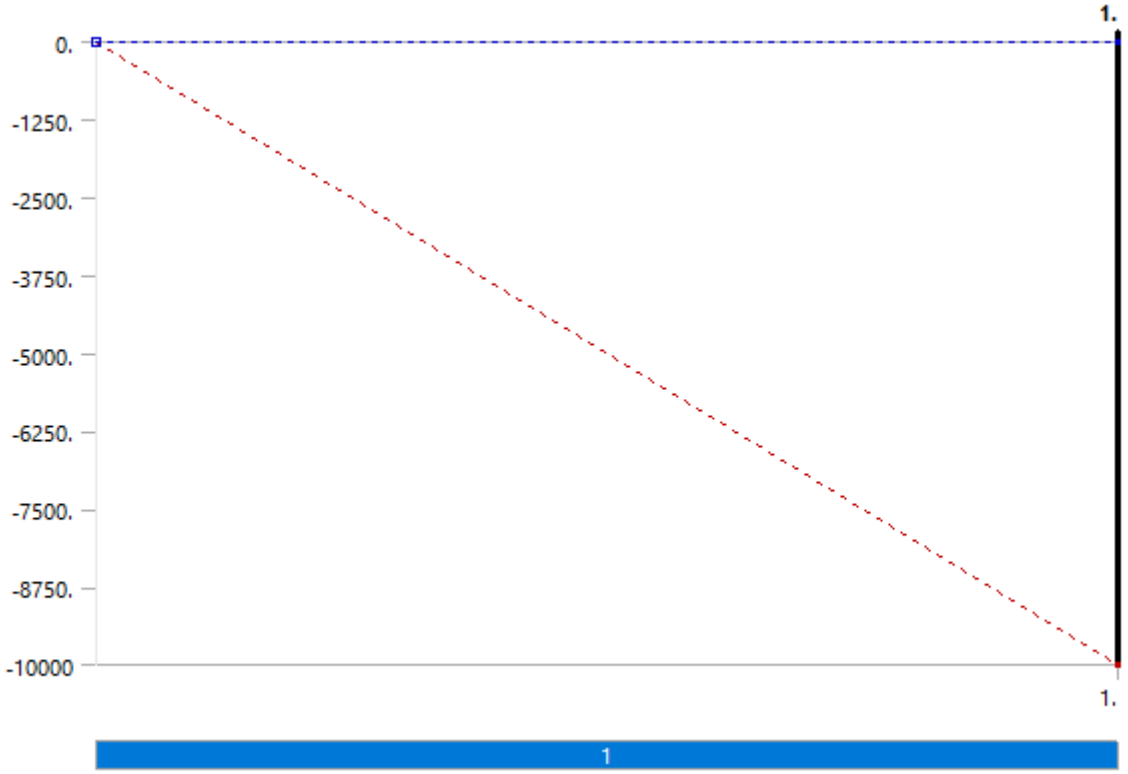
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Off
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Quasi-Static Solution	Off
Rotordynamics Controls	
Coriolis 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	Yes
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\ADMIN\AppData\Local\Temp\WB_ADMIN_18336_2\wbnew_files\dp0\SYS\MECH\
Future Analysis	Structural Optimization
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 11
Model (A4, B4) > Static Structural (A5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	2 Faces	1 Face
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components
Applied By		Surface Effect
Coordinate System		Global Coordinate System
X Component		-10000 N (ramped)
Y Component		0. N (ramped)
Z Component		0. N (ramped)

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	3. s
MAPDL Memory Used	269. MB
MAPDL Result File Size	2.5 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

Structural Optimization (B5)

TABLE 14
Model (A4, B4) > Analysis

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

TABLE 15
Model (A4, B4) > Structural Optimization (B5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Reload Volume Analysis	
Reload Volume Fraction	Off
Definition	
Maximum Number Of Iterations	500.
Minimum Normalized Density	1.e-003
Convergence Accuracy	0.1 %
Initial Volume Fraction	Program Controlled
Penalty Factor (Stiffness)	3.
Region of Manufacturing Constraint	Include Exclusions
Region of Min Member Size	Exclude Exclusions
Region of AM Overhang Constraint	Exclude Exclusions
Filter	Program Controlled
Output Controls	
Export Design Properties	No

Store Results At	All Iterations
Solver Controls	
Solver Type	Program Controlled
Analysis Data Management	
Solver Files Directory	C:\Users\ADMIN\AppData\Local\Temp\WB_ADMIN_18336_2\wbnew_files\dp0\SYS-1\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Solver Units	Active System
Solver Unit System	mks
Max Num Of Intermediate Files	All Iterations

TABLE 16
Model (A4, B4) > Structural Optimization (B5) > Optimization Region

Object Name	*Optimization Region*
State	Fully Defined
Design Region	
Scoping Method	Geometry Selection
Geometry	All Bodies
Exclusion Region	
Define By	Boundary Condition
Boundary Condition	All Boundary Conditions
Definition	
Suppressed	No
Optimization Option	
Optimization Type	Topology Optimization - Density Based

TABLE 17
Model (A4, B4) > Structural Optimization (B5) > Objective

Object Name	*Objective*
State	Fully Defined
Definition	
Suppressed	No
Normalized Sum	No

Model (A4, B4) > Structural Optimization (B5) > Objective

Response Type	Goal	Criterion	Formulation	Environment Name	Weight	Multiple Sets	Start Step	End Step	Step	Start Mode	End Mode	Mode
Compliance	Minimize	N/A	Program Controlled	Static Structural	N/A	Enabled	1	1	1	N/A	N/A	N/A

TABLE 18
Model (A4, B4) > Structural Optimization (B5) > Response Constraint 2

Object Name	*Response Constraint 2*
State	Fully Defined
Scope	
Scoping Method	Optimization Region
Optimization Region Selection	Optimization Region
Definition	
Type	Response Constraint
Response	Mass
Define By	Constant
Percent to Retain	80 %
Suppressed	No

Solution (B6)

TABLE 19
Model (A4, B4) > Structural Optimization (B5) > Solution

Object Name	*Solution (B6)*
State	Solved
Information	
Status	Done
MAPDL Elapsed Time	9. s
MAPDL Memory Used	269. MB
MAPDL Result File Size	101.01 KB
Post Processing	
Export Optimal Shape	Only Geometry
-- Topology Result	Topology Density
Definition	
Environment Selection List	A5

TABLE 20
Model (A4, B4) > Structural Optimization (B5) > Solution (B6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Optimization Output
Update Interval	2.5 s
Display Points	All

TABLE 21
Model (A4, B4) > Structural Optimization (B5) > Solution (B6) > Solution Information > Results

Object Name	*Topology Density Tracker*
State	Solved
Scope	
Scoping Method	Optimization Region
Optimization Region	Optimization Region
Definition	
Type	Topology Density Tracker
By	Iteration
Iteration	Last
Retained Threshold	0.5
Suppressed	No
Results	

Minimum	1.e-003
Maximum	1.
Average	0.62966
Visibility	
Show Optimized Region	Retained Region
Information	
Iteration Number	9

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

Object Name	*Topology Density*
State	Solved
Scope	
Scoping Method	Optimization Region
Optimization Region	Optimization Region
Definition	
Type	Topology Density
By	Iteration
Iteration	Last
Retained Threshold	0.5
Exclusions Participation	Yes
Calculate Time History	Yes
Suppressed	No
Results	
Minimum	1.e-003
Maximum	1.
Average	0.62966
Original Volume	6.2402e-004 m³
Final Volume	4.6685e-004 m³
Percent Volume of Original	74.814
Original Mass	4.8985 kg
Final Mass	3.6648 kg
Percent Mass of Original	74.814
Visibility	
Show Optimized Region	Retained Region
Information	
Iteration Number	9

FIGURE 2
Model (A4, B4) > Structural Optimization (B5) > Solution (B6) > Topology Density

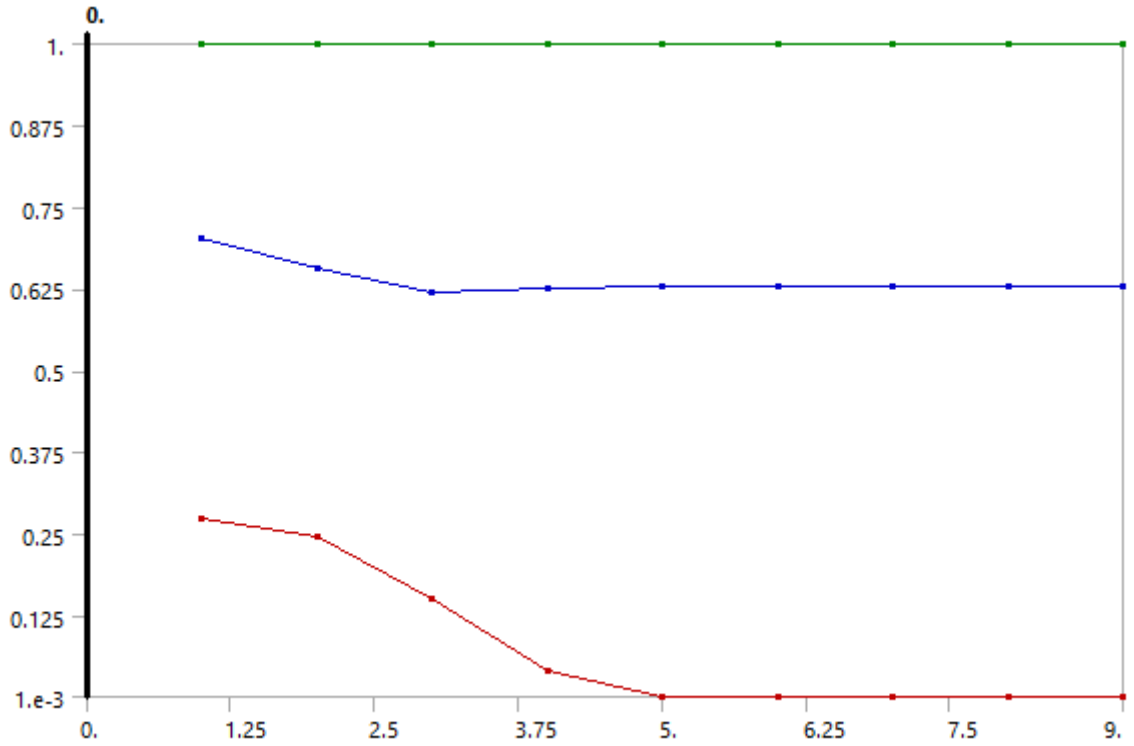


TABLE 23
Model (A4, B4) > Structural Optimization (B5) > Solution (B6) > Topology Density

Iteration	Minimum	Maximum	Average
1.	0.2725	1.	0.70286
2.	0.24489		0.65669
3.	0.15006		0.61938
4.	4.1589e-002		0.62584
5.	1.e-003		0.62993
6.			0.62989
7.			0.62975
8.			0.62969
9.			0.62966

Material Data

Structural Steel

TABLE 24
Structural Steel > Constants

Density	7850 kg m^-3
Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat	434 J kg^-1 C^-1
Thermal Conductivity	60.5 W m^-1 C^-1
Resistivity	1.7e-007 ohm m

TABLE 25
Structural Steel > Color

Red	Green	Blue

132	139	179

TABLE 26
Structural Steel > Compressive Ultimate Strength

Compressive Ultimate Strength Pa
0

TABLE 27
Structural Steel > Compressive Yield Strength

Compressive Yield Strength Pa
2.5e+008

TABLE 28
Structural Steel > Tensile Yield Strength

Tensile Yield Strength Pa
2.5e+008

TABLE 29
Structural Steel > Tensile Ultimate Strength

Tensile Ultimate Strength Pa
4.6e+008

TABLE 30
Structural Steel > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
22

TABLE 31
Structural Steel > S-N Curve

Alternating Stress Pa	Cycles	Mean Stress Pa
3.999e+009	10	0
2.827e+009	20	0
1.896e+009	50	0
1.413e+009	100	0
1.069e+009	200	0
4.41e+008	2000	0
2.62e+008	10000	0
2.14e+008	20000	0
1.38e+008	1.e+005	0
1.14e+008	2.e+005	0
8.62e+007	1.e+006	0

TABLE 32
Structural Steel > Strain-Life Parameters

Strength Coefficient Pa	Strength Exponent	Ductility Coefficient	Ductility Exponent	Cyclic Strength Coefficient Pa	Cyclic Strain Hardening Exponent
9.2e+008	-0.106	0.213	-0.47	1.e+009	0.2

TABLE 33
Structural Steel > Isotropic Elasticity

Young's Modulus Pa	Poisson's Ratio	Bulk Modulus Pa	Shear Modulus Pa	Temperature C
2.e+011	0.3	1.6667e+011	7.6923e+010	

TABLE 34
Structural Steel > Isotropic Relative Permeability

Relative Permeability
10000