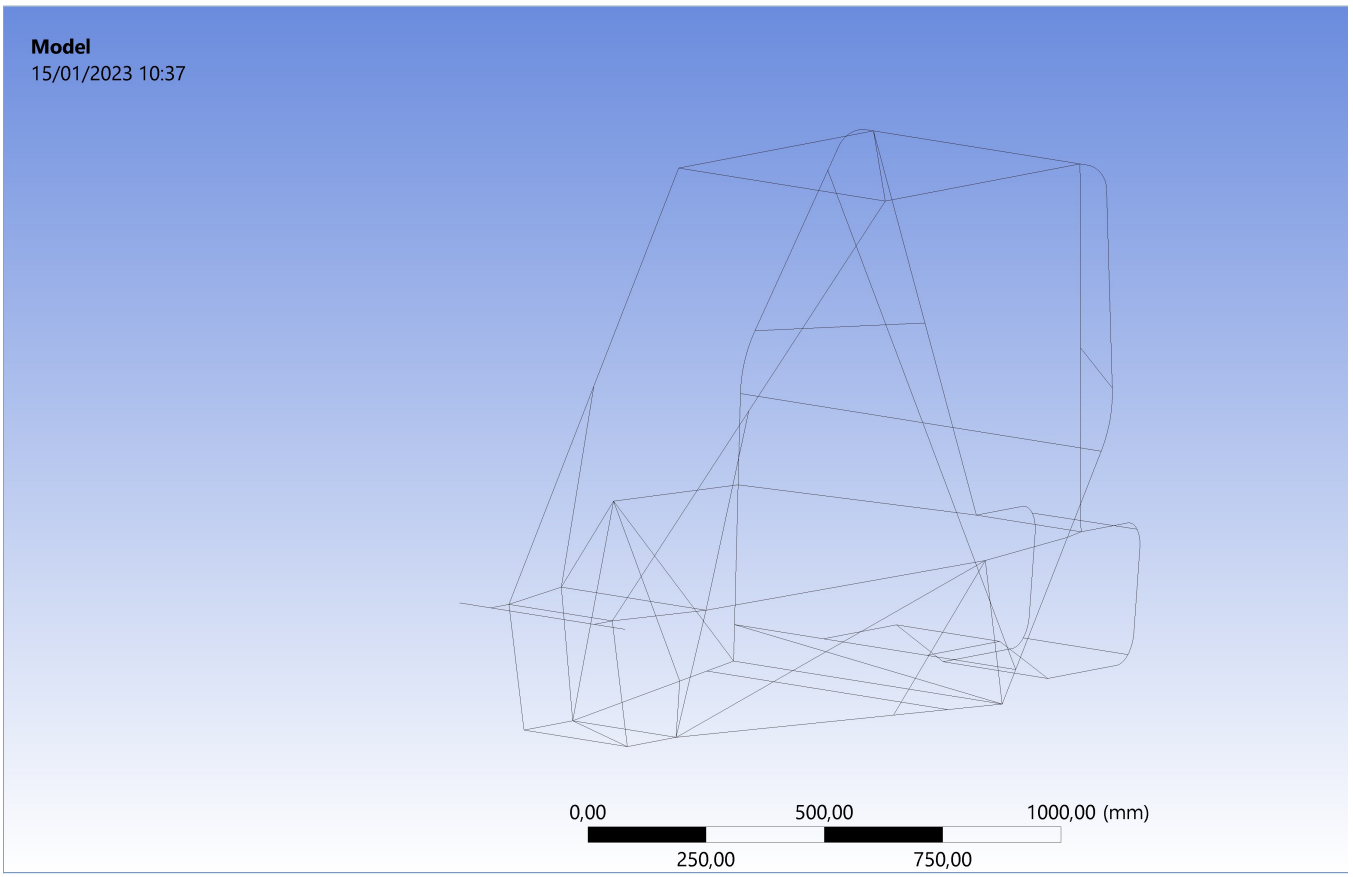
Project AGAMAS HAUQALAH BAJA steel 4140*

First Saved	Friday, December 23, 2022
Last Saved	Saturday, January 14, 2023
Product Version	2022 R2
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 (7 Systems)

TABLE 2
Model (7 Systems) > Geometry Imports

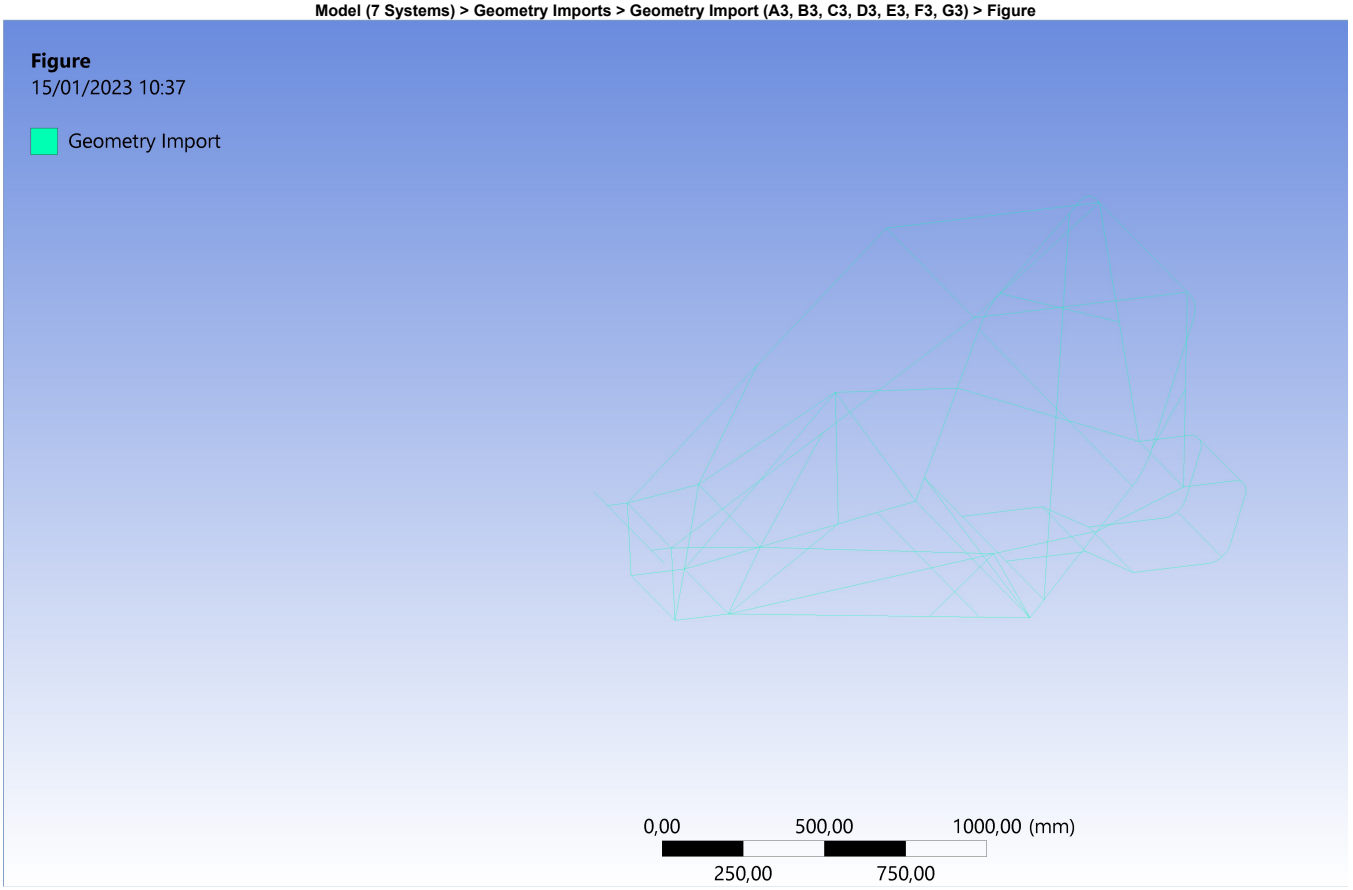
Object Name	*Geometry Imports*
State	Solved

TABLE 3
Model (7 Systems) > Geometry Imports > Geometry Import (A3, B3, C3, D3, E3, F3, G3)

Object Name	*Geometry Import (A3, B3, C3, D3, E3, F3, G3)*
State	Solved
Definition	
Source	C:\Users\ansys-AIC-user\Documents\baja\Baja_Chassis_Analysis_Geometry full test23_files\dp0\SYS\DM\SYS.scdoc
Type	SpaceClaim
Basic Geometry Options	
Parameters	Independent

Parameter Key	
Advanced Geometry Options	
Compare Parts On Update	No
Analysis Type	3-D

FIGURE 1
Model (7 Systems) > Geometry Imports > Geometry Import (A3, B3, C3, D3, E3, F3, G3) > Figure



Geometry

TABLE 4
Model (7 Systems) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\ansys-AIC-user\Documents\baja\Baja_Chassis_Analysis_Geometry full test23_files\dp0\SYS\DM\SYS.scdoc
Type	SpaceClaim
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	913,8 mm
Length Y	1143, mm
Length Z	2280,7 mm
Properties	
Volume	5,4817e+006 mm³
Mass	43,032 kg
Scale Factor Value	1,
Statistics	
Bodies	1
Active Bodies	1
Nodes	3518
Elements	1779
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	Yes
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
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 (7 Systems) > Geometry > Parts

Object Name	*Beam (Circular Tube)*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Model Type	Beam
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Cross Section	Circular Tube
Offset Mode	Refresh on Update
Offset Type	Centroid
Treatment	None
Material	
Assignment	Low alloy steel, 4140, normalized
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	913,8 mm
Length Y	1143, mm
Length Z	2280,7 mm
Properties	
Volume	5,4817e+006 mm³
Mass	43,032 kg
Length	34726 mm
Cross Section Area	157,86 mm²
Cross Section IYY	22187 mm²·mm²
Cross Section IZZ	22187 mm²·mm²
Statistics	
Nodes	3518
Elements	1779
Mesh Metric	None
CAD Attributes	
PartTolerance:	0,00000001
Color:143.175.143	

FIGURE 2
Model (7 Systems) > Geometry > Beam (Circular Tube) > Isometrik

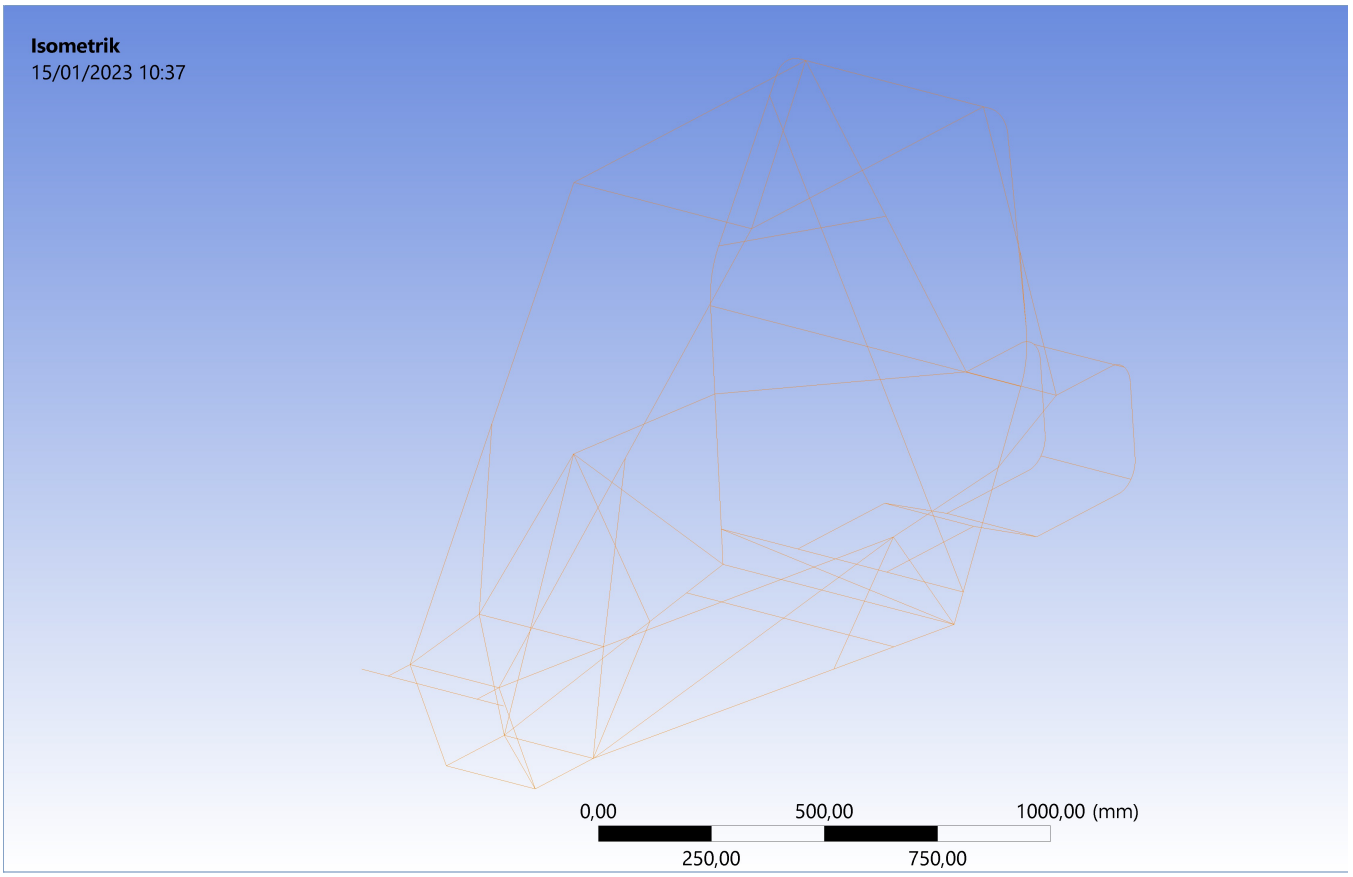


TABLE 6
Model (7 Systems) > Materials

Object Name	*Materials*
State	Fully Defined
Statistics	
Materials	7
Material Assignments	0

TABLE 7
Model (7 Systems) > Cross Sections

Object Name	*Cross Sections*
State	Fully Defined
Statistics	
Cross Sections	1

TABLE 8
Model (7 Systems) > Cross Sections > Circular Tube

Object Name	*Circular Tube*
State	Fully Defined
Definition	
Type	CTUBE
Import Type	Imported
Dimensions	
Ri	16, mm
Ro	17,5 mm
Physical Properties	
Beam Section	Circular Tube
A	157,86 mm²
Iyy	22187 mm²·mm²
Izz	22187 mm²·mm²

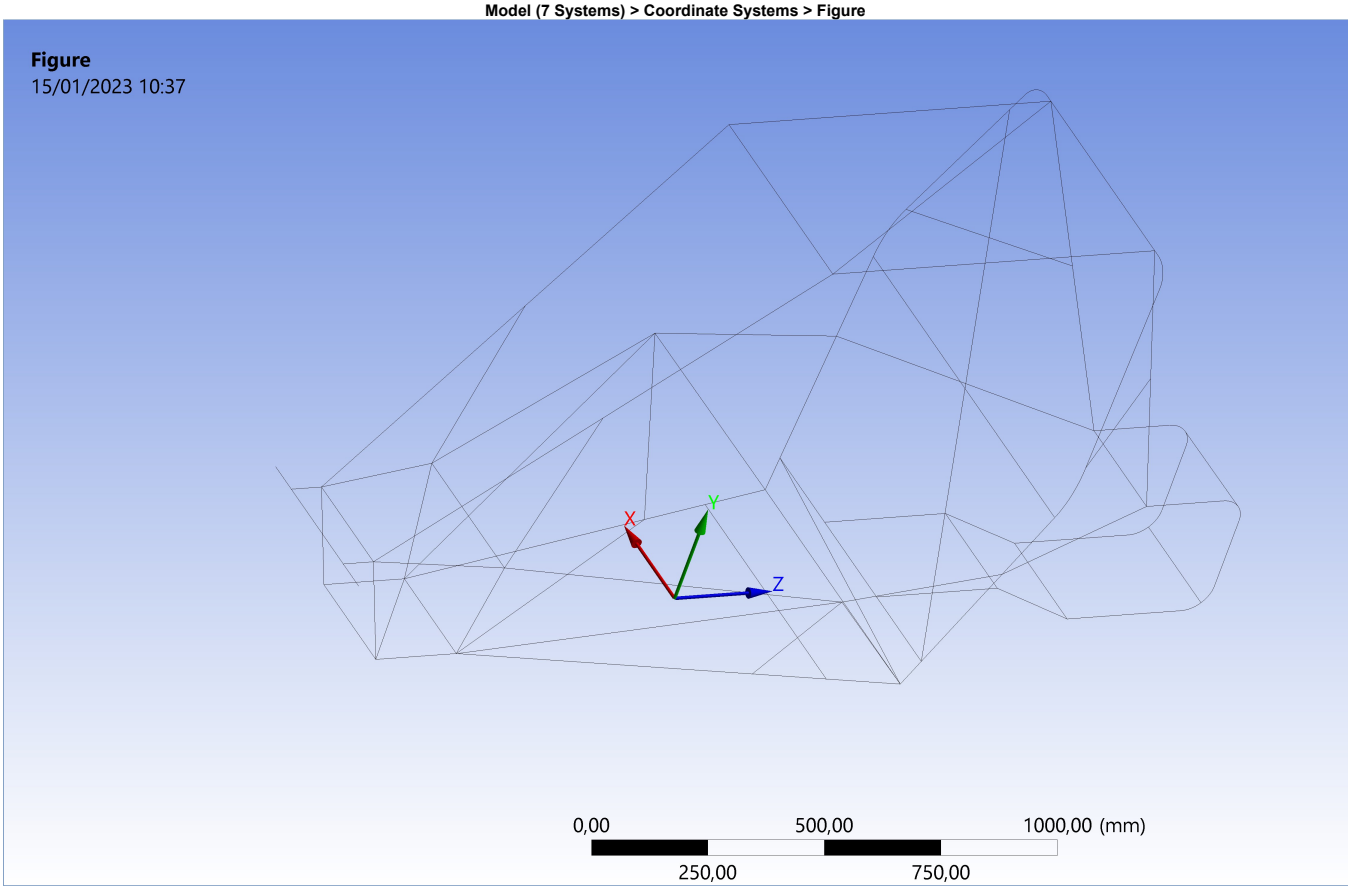
Coordinate Systems

TABLE 9
Model (7 Systems) > 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,]

FIGURE 3
Model (7 Systems) > Coordinate Systems > Figure



Mesh

TABLE 10
Model (7 Systems) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
Element Size	20, mm
Sizing	
Use Adaptive Sizing	Yes
Resolution	5
Mesh Defeaturing	Yes
Defeature Size	Default
Transition	Fast
Span Angle Center	Medium
Initial Size Seed	Assembly
Bounding Box Diagonal	2709,8 mm
Average Surface Area	0, mm²
Minimum Edge Length	1,3247 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
Batch Connections	
Mesh Based Connection	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	3518
Elements	1779

Front Impact test (A5)

TABLE 11
Model (7 Systems) > Analysis

Object Name	*Front Impact test (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 12
Model (7 Systems) > Front Impact test (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\ansys-AIC-user\Documents\baja\Baja_Chassis_Analysis_Geometry full test23_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

FIGURE 4
Model (7 Systems) > Front Impact test (A5) > Figure

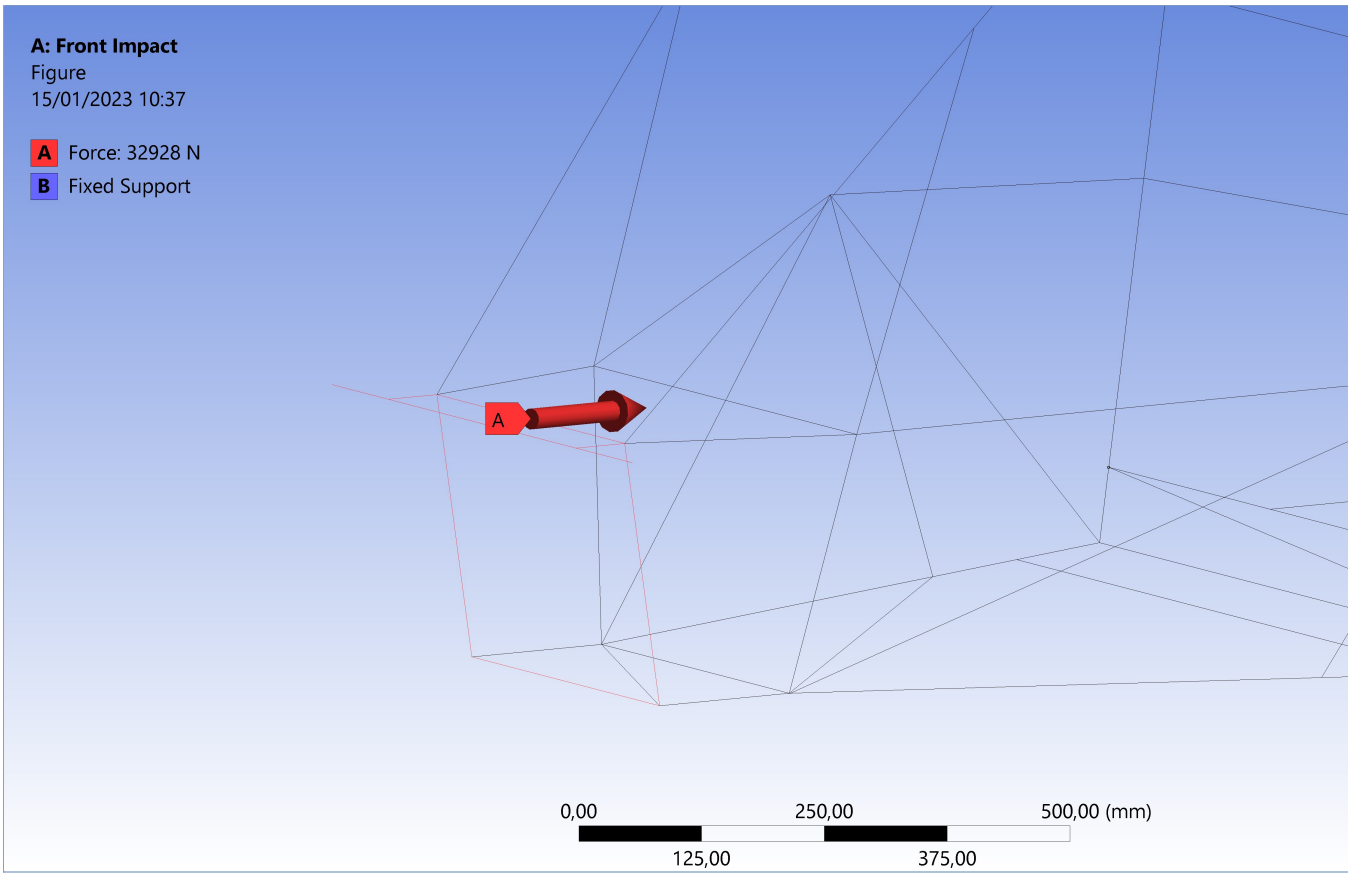


FIGURE 5
Model (7 Systems) > Front Impact test (A5) > Front Impact

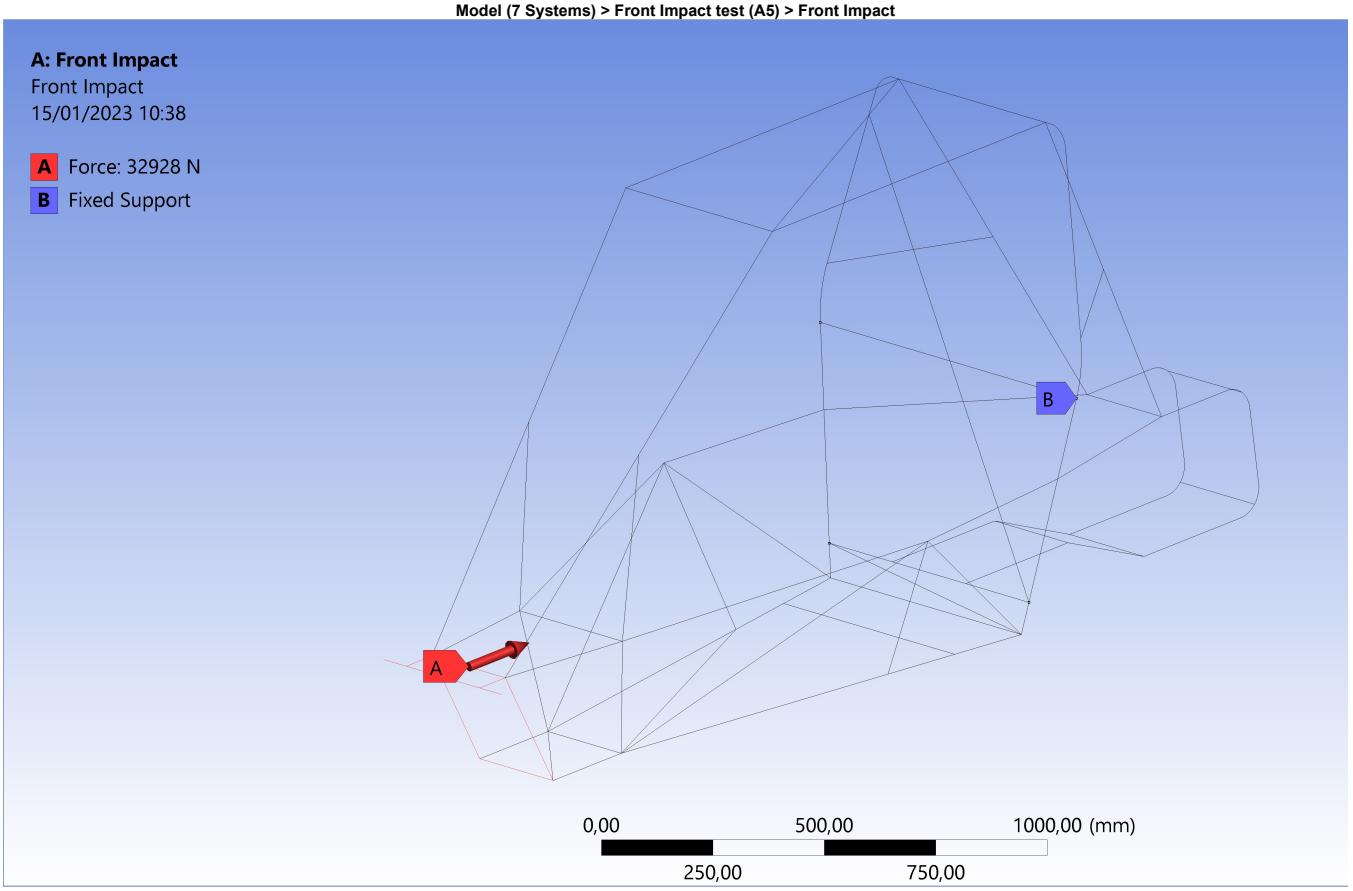


TABLE 13
Model (7 Systems) > Front Impact test (A5) > Loads

Object Name	*Force*	*Fixed Support*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	9 Edges	4 Vertices
Definition		
Type	Force	Fixed Support
Define By	Components	
Applied By	Surface Effect	
Coordinate System	Global Coordinate System	
X Component	0, N (ramped)	
Y Component	0, N (ramped)	
Z Component	32928 N (ramped)	
Suppressed	No	

FIGURE 6
Model (7 Systems) > Front Impact test (A5) > Force

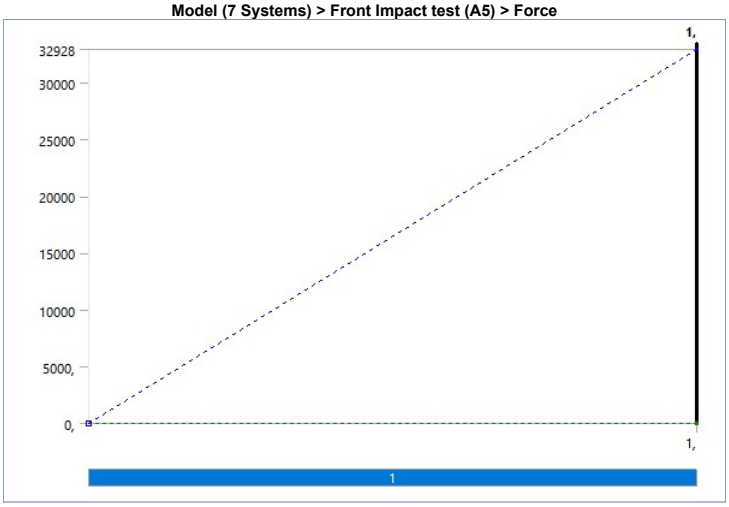


FIGURE 7
Model (7 Systems) > Front Impact test (A5) > Force > Force

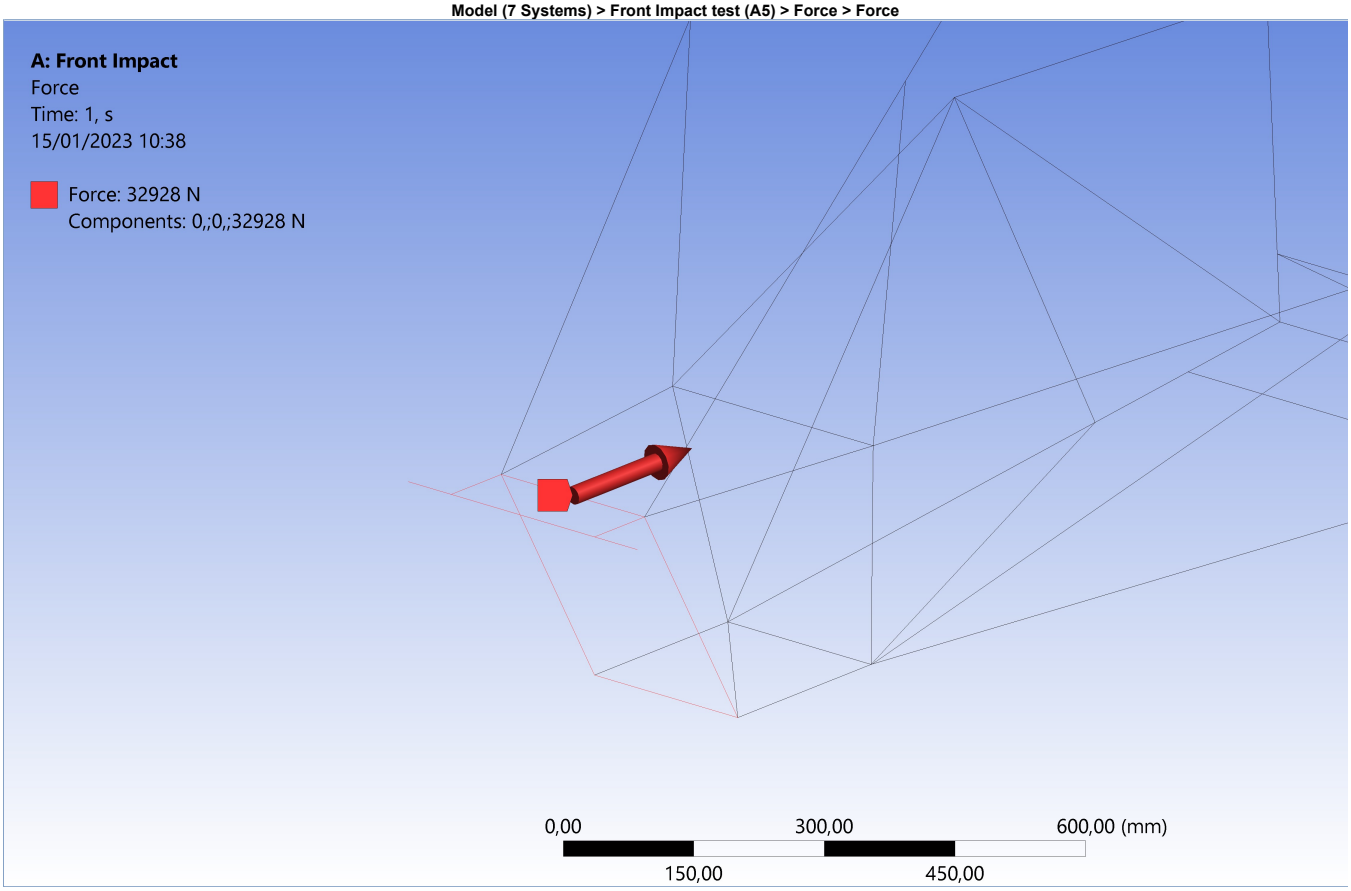
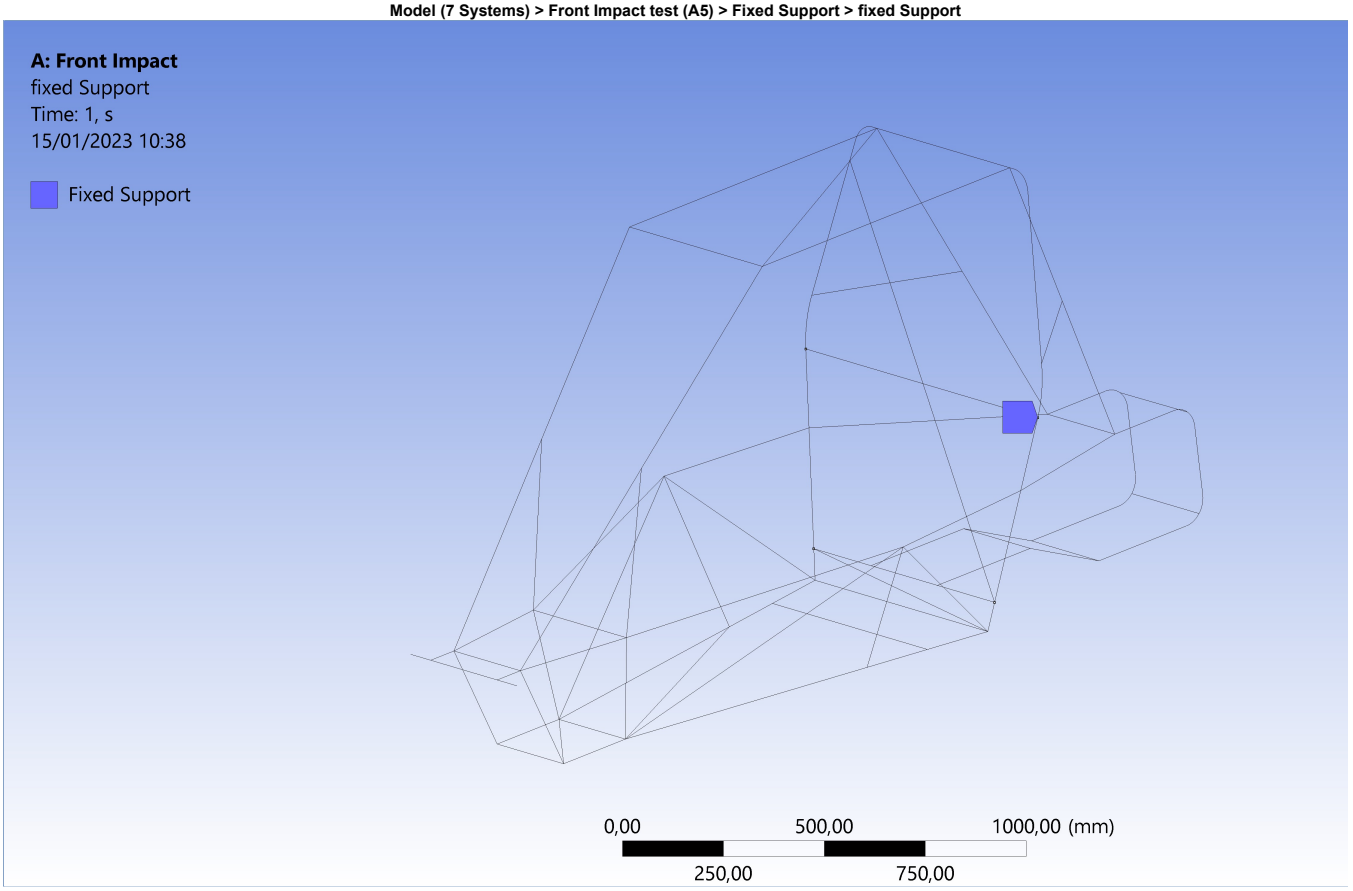


FIGURE 8
Model (7 Systems) > Front Impact test (A5) > Fixed Support > fixed Support



Solution (A6)

TABLE 14
Model (7 Systems) > Front Impact test (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	8, s
MAPDL Memory Used	531, MB
MAPDL Result File Size	4,125 MB
Post Processing	
Beam Section Results	Yes
On Demand Stress/Strain	No

TABLE 15
Model (7 Systems) > Front Impact test (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 16
Model (7 Systems) > Front Impact test (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	First
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Results		
Minimum	0, mm	9,5512e-011 MPa
Maximum	5,6936 mm	390,65 MPa
Average	2,4742 mm	31,603 MPa
Minimum Occurs On	Beam (Circular Tube)	
Maximum Occurs On	Beam (Circular Tube)	
Information		
Time	1, s	
Load Step	1	
Substep	1	
Iteration Number	1	
Integration Point Results		
Display Option		Averaged
Average Across Bodies		No

FIGURE 9
Model (7 Systems) > Front Impact test (A5) > Solution (A6) > Total Deformation

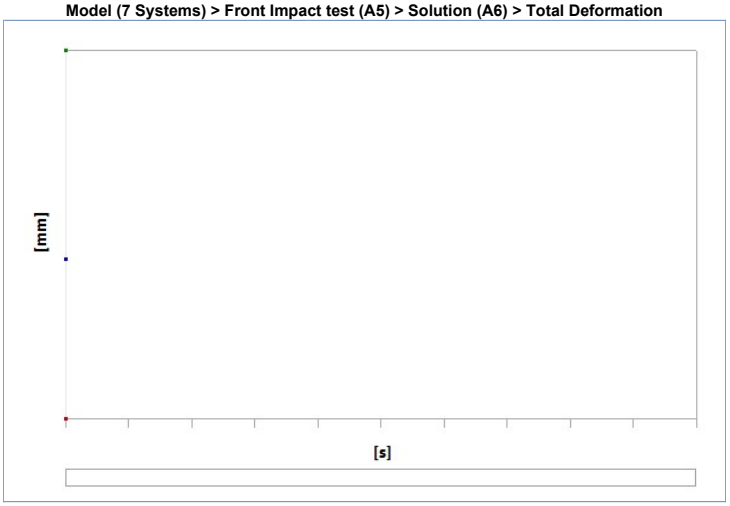


TABLE 17
Model (7 Systems) > Front Impact test (A5) > Solution (A6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
1,	0,	5,6936	2,4742

FIGURE 10
Model (7 Systems) > Front Impact test (A5) > Solution (A6) > Total Deformation > Figure

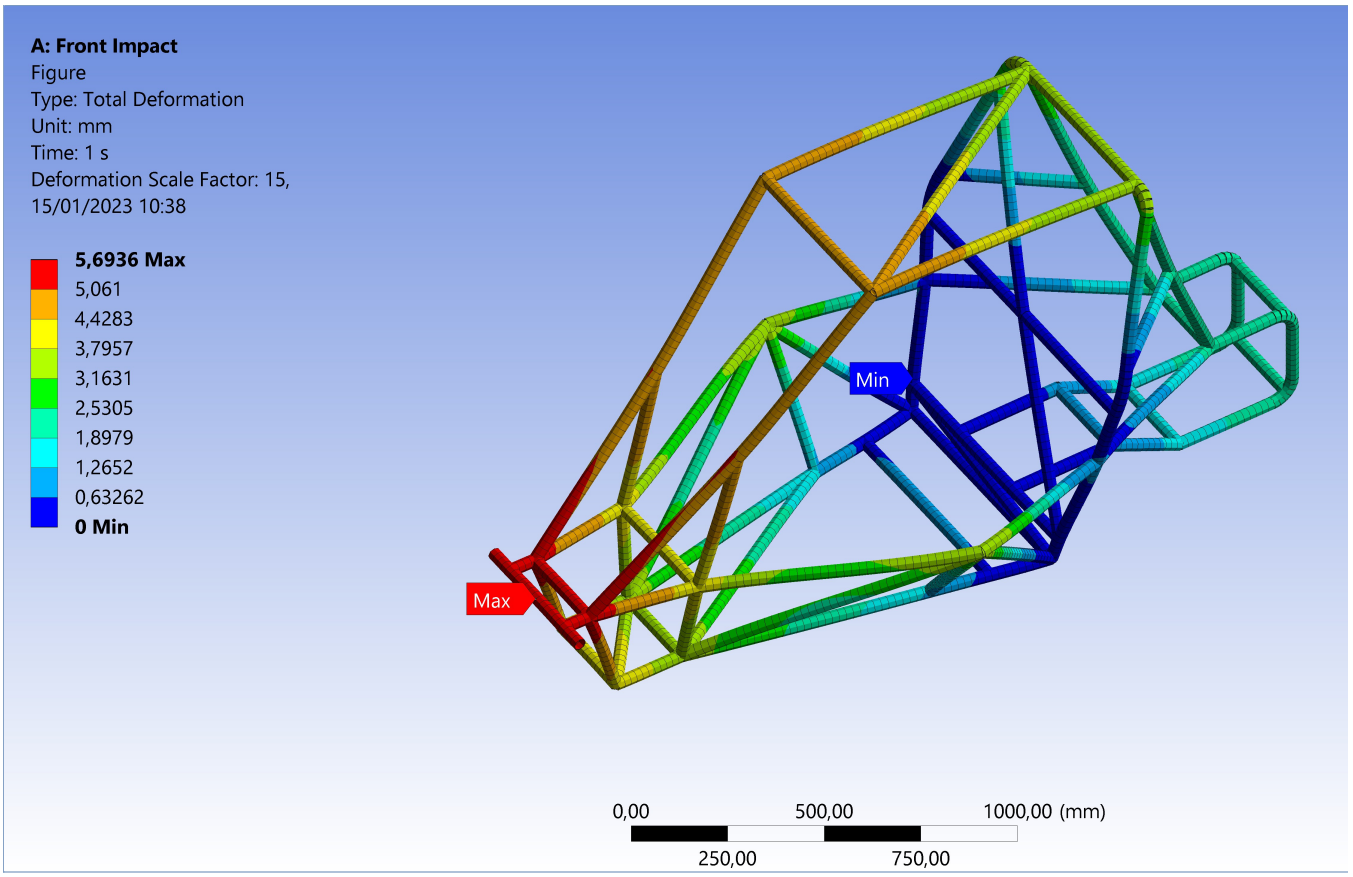


FIGURE 11
Model (7 Systems) > Front Impact test (A5) > Solution (A6) > Total Deformation > Figure 2

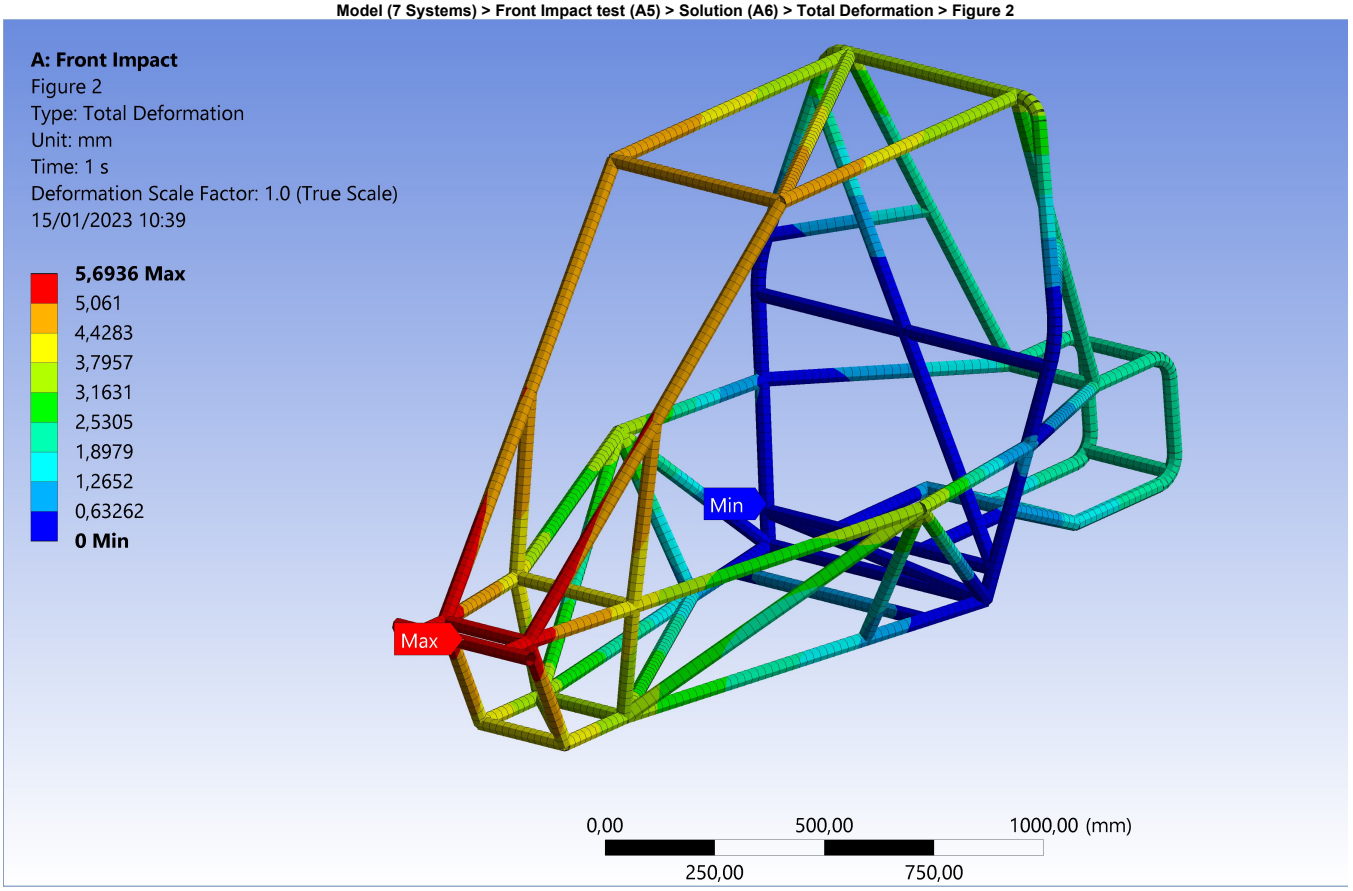


FIGURE 12
Model (7 Systems) > Front Impact test (A5) > Solution (A6) > Equivalent Stress

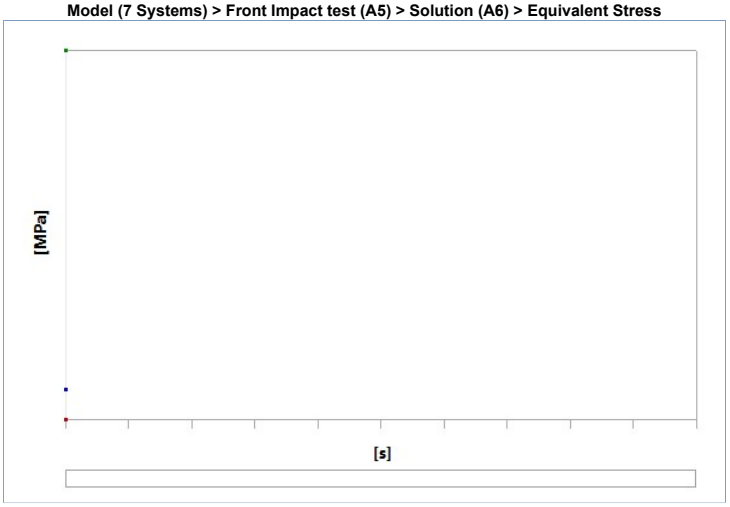
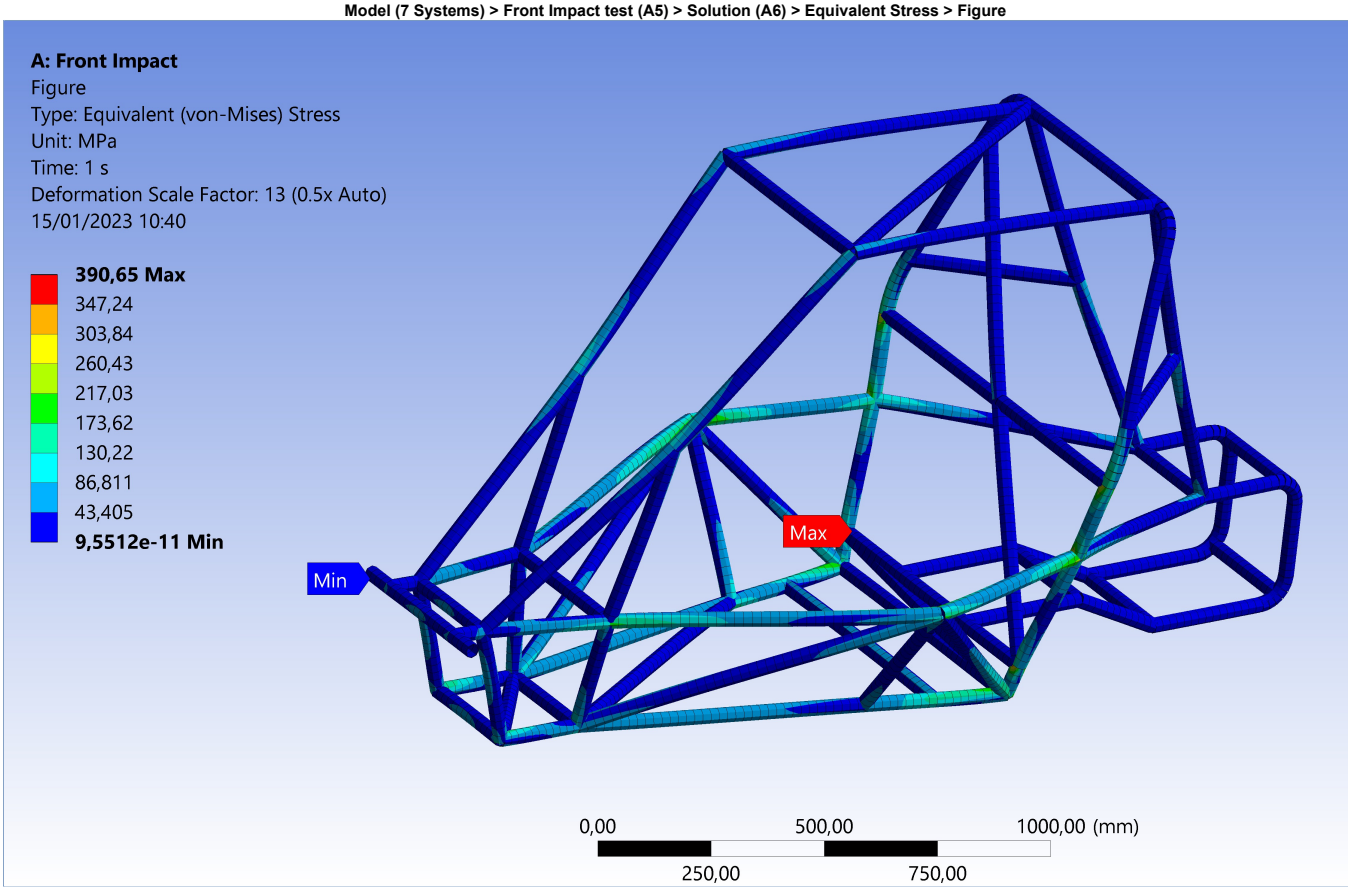


TABLE 18
Model (7 Systems) > Front Impact test (A5) > Solution (A6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
1,	9,5512e-011	390,65	31,603

FIGURE 13
Model (7 Systems) > Front Impact test (A5) > Solution (A6) > Equivalent Stress > Figure



side impact right (B5)

TABLE 19
Model (7 Systems) > Analysis

Object Name	*side impact right (B5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	

Environment Temperature	22, °C
Generate Input Only	No

TABLE 20
Model (7 Systems) > side impact right (B5) > 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	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\ansys-AIC-user\Documents\baja\Baja_Chassis_Analysis_Geometry full test23_files\dp0\SYS-1\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

FIGURE 14
Model (7 Systems) > side impact right (B5) > Side Impact(Right)

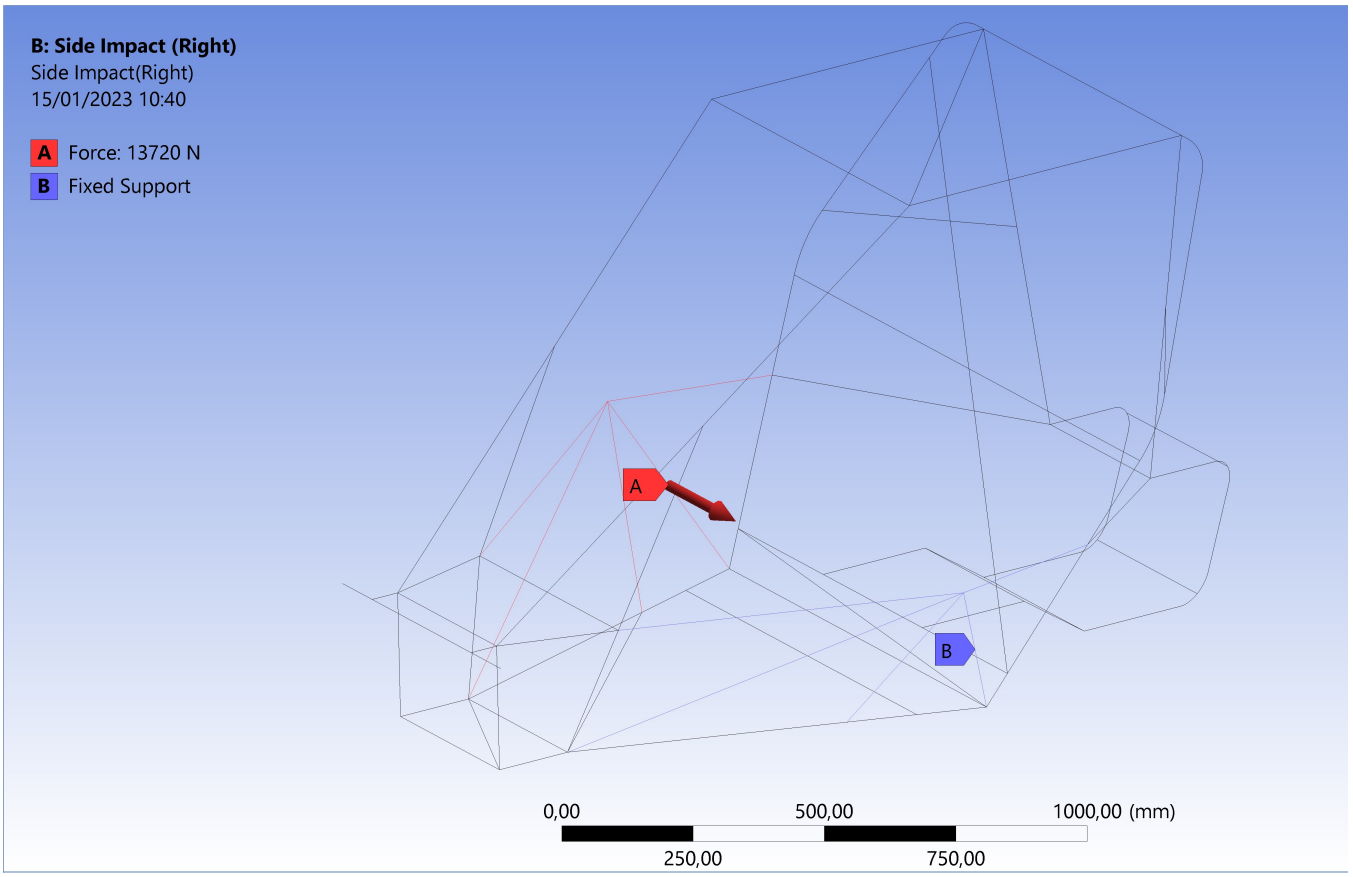
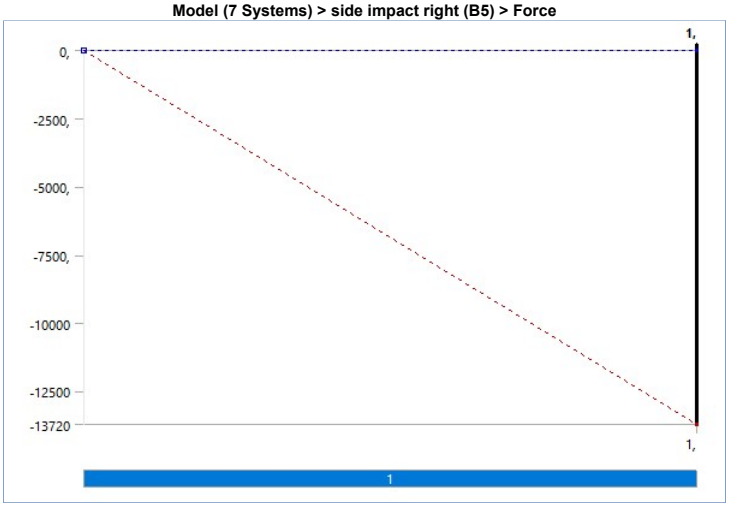


TABLE 21
Model (7 Systems) > side impact right (B5) > Loads

Object Name	*Force*	*Fixed Support*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	5 Edges	
Definition		
Type	Force	Fixed Support
Define By	Components	
Applied By	Surface Effect	
Coordinate System	Global Coordinate System	
X Component	-13720 N (ramped)	
Y Component	0, N (ramped)	
Z Component	0, N (ramped)	
Suppressed	No	

FIGURE 15
Model (7 Systems) > side impact right (B5) > Force



Solution (B6)

TABLE 22
Model (7 Systems) > side impact right (B5) > Solution

Object Name	*Solution (B6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	5, s
MAPDL Memory Used	532, MB
MAPDL Result File Size	3,875 MB
Post Processing	
Beam Section Results	Yes
On Demand Stress/Strain	No

TABLE 23
Model (7 Systems) > side impact right (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 24
Model (7 Systems) > side impact right (B5) > Solution (B6) > 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, mm	0, MPa
Maximum	8,0698 mm	434,21 MPa
Average	1,3504 mm	26,832 MPa
Minimum Occurs On	Beam (Circular Tube)	
Maximum Occurs On	Beam (Circular Tube)	
Information		
Time	1, s	
Load Step	1	
Substep	1	
Iteration Number	1	
Integration Point Results		
Display Option		Averaged
Average Across Bodies		No

FIGURE 16
Model (7 Systems) > side impact right (B5) > Solution (B6) > Total Deformation

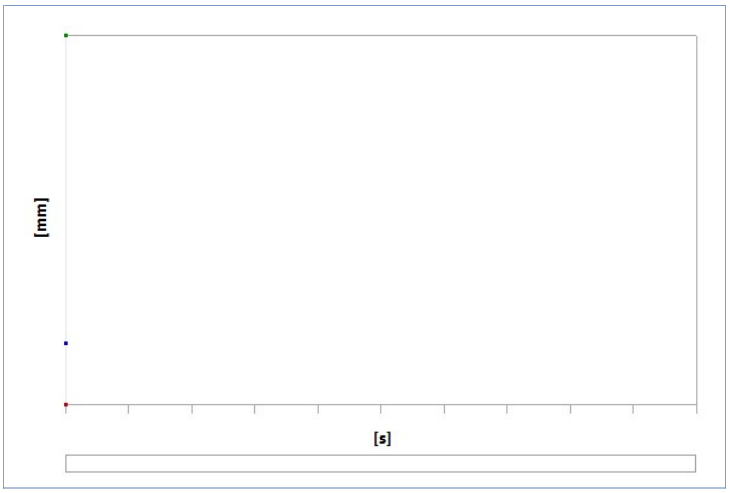


TABLE 25
Model (7 Systems) > side impact right (B5) > Solution (B6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
1,	0,	8,0698	1,3504

FIGURE 17
Model (7 Systems) > side impact right (B5) > Solution (B6) > Total Deformation > Figure

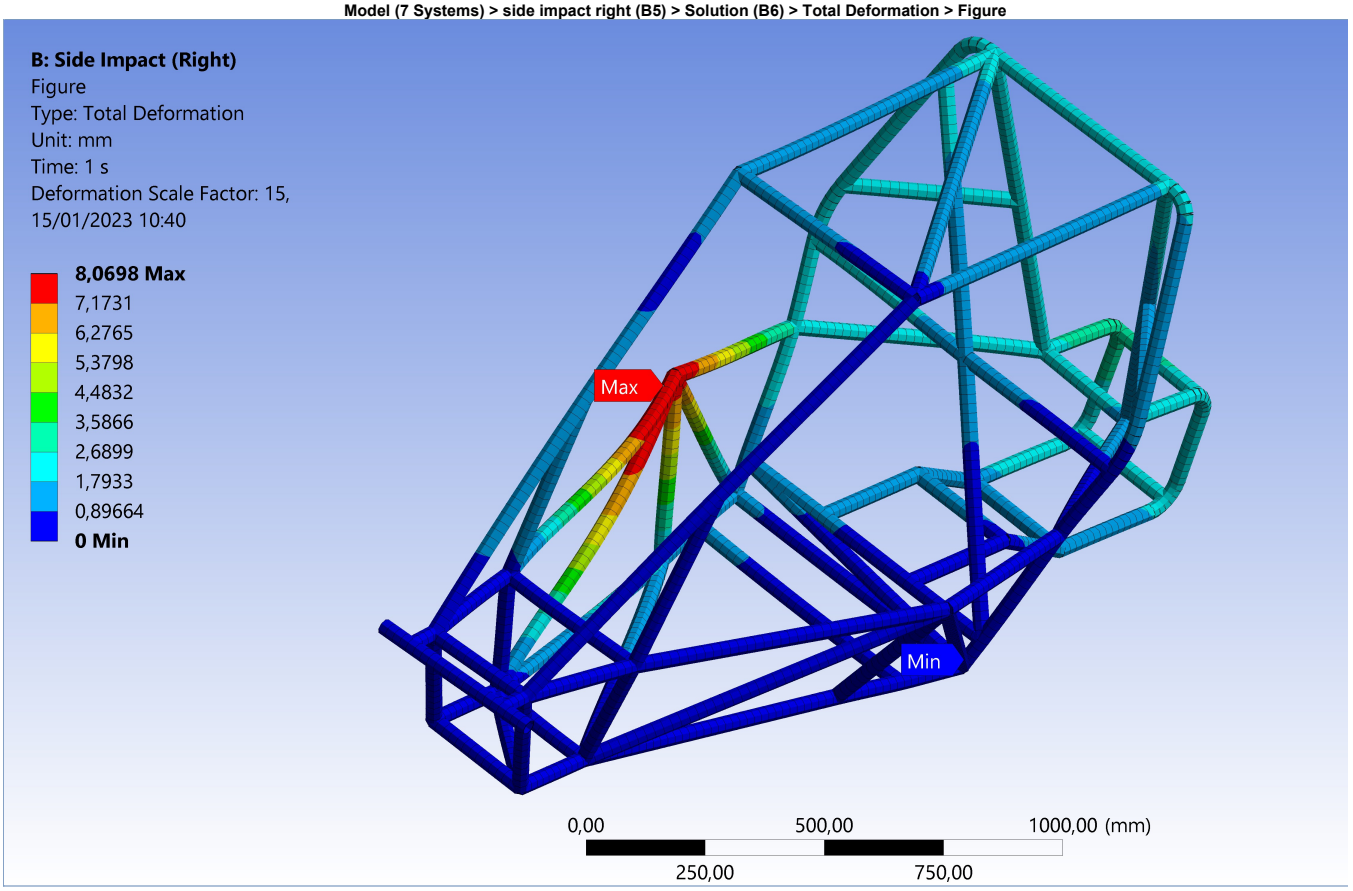


FIGURE 18
Model (7 Systems) > side impact right (B5) > Solution (B6) > Equivalent Stress

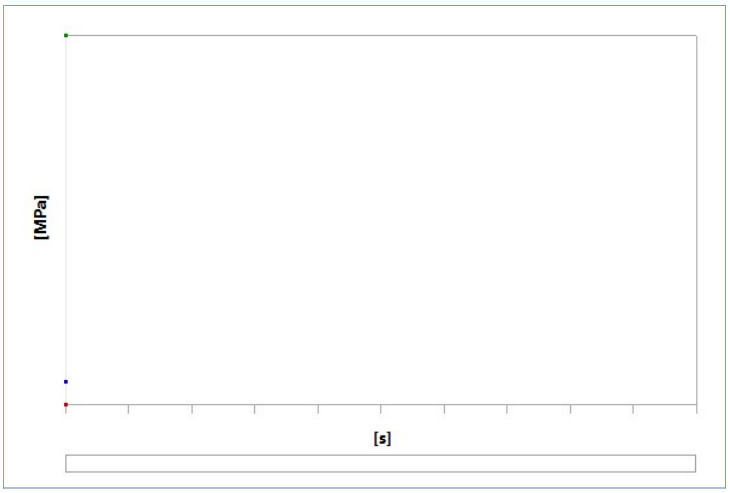
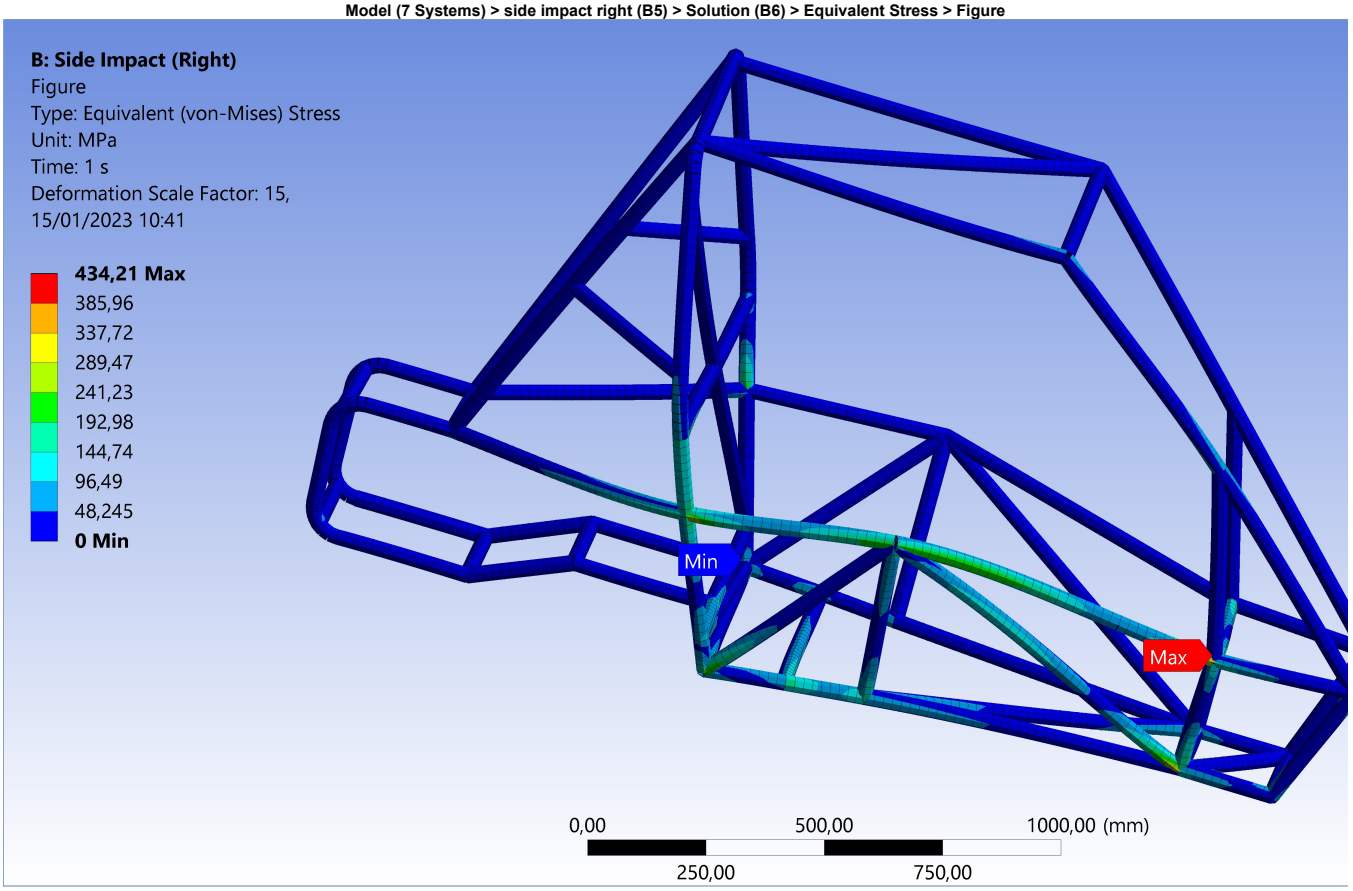


TABLE 26
Model (7 Systems) > side impact right (B5) > Solution (B6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
1,	0,	434,21	26,832

FIGURE 19
Model (7 Systems) > side impact right (B5) > Solution (B6) > Equivalent Stress > Figure



side impact left (G5)

TABLE 27
Model (7 Systems) > Analysis

Object Name	*side impact left (G5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 28
Model (7 Systems) > side impact left (G5) > 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\ansys-AIC-user\Documents\baja\Baja_Chassis_Analysis_Geometry full test23_files\dp0\SYS-2\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

FIGURE 20
Model (7 Systems) > side impact left (G5) > Figure

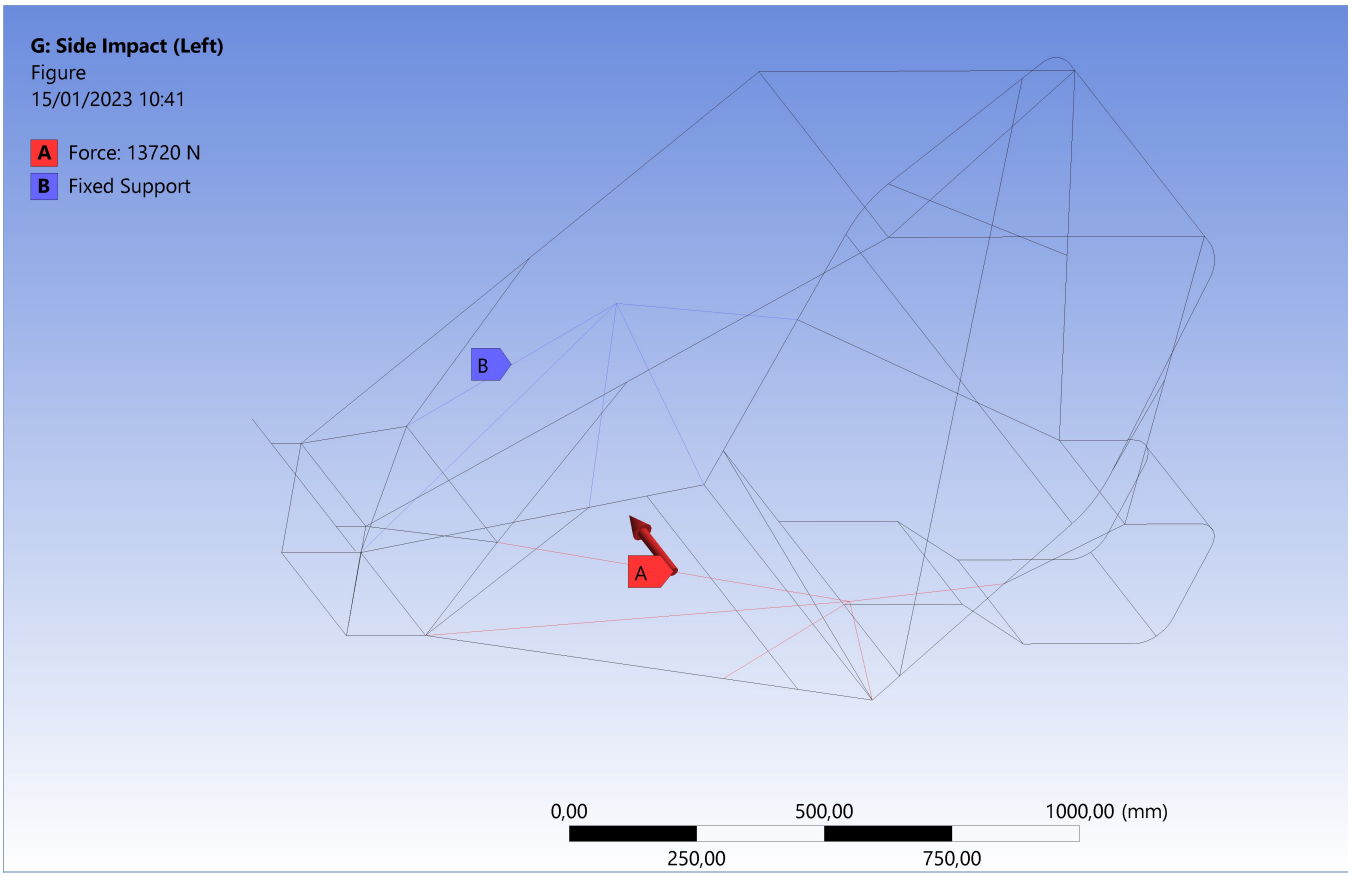
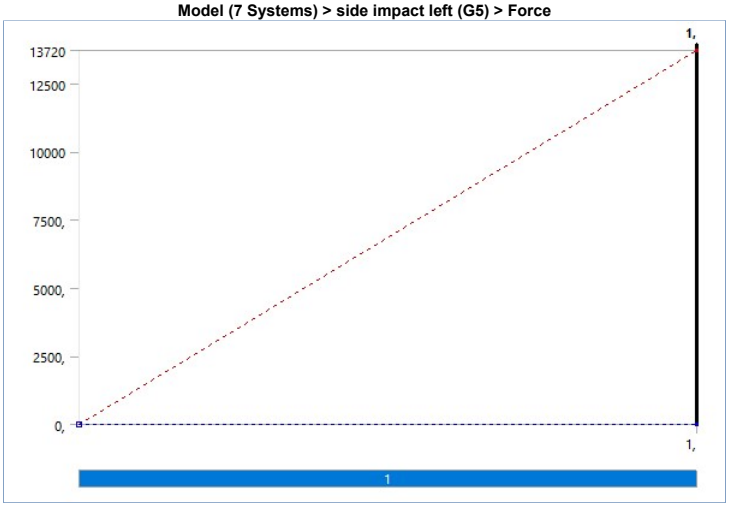


TABLE 29
Model (7 Systems) > side impact left (G5) > Loads

Object Name	*Force*	*Fixed Support*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	5 Edges	
Definition		
Type	Force	Fixed Support
Define By	Components	
Applied By	Surface Effect	
Coordinate System	Global Coordinate System	
X Component	13720 N (ramped)	
Y Component	0, N (ramped)	
Z Component	0, N (ramped)	
Suppressed	No	

FIGURE 21
Model (7 Systems) > side impact left (G5) > Force



Solution (G6)

TABLE 30
Model (7 Systems) > side impact left (G5) > Solution

Object Name	*Solution (G6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	7, s
MAPDL Memory Used	532, MB
MAPDL Result File Size	3,8125 MB
Post Processing	
Beam Section Results	Yes
On Demand Stress/Strain	No

TABLE 31
Model (7 Systems) > side impact left (G5) > Solution (G6) > 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 32
Model (7 Systems) > side impact left (G5) > Solution (G6) > 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, mm	0, MPa
Maximum	8,0941 mm	452,68 MPa
Average	1,3434 mm	26,777 MPa
Minimum Occurs On	Beam (Circular Tube)	
Maximum Occurs On	Beam (Circular Tube)	
Information		
Time	1, s	
Load Step	1	
Substep	1	
Iteration Number	1	
Integration Point Results		
Display Option		Averaged
Average Across Bodies		No

FIGURE 22
Model (7 Systems) > side impact left (G5) > Solution (G6) > Total Deformation

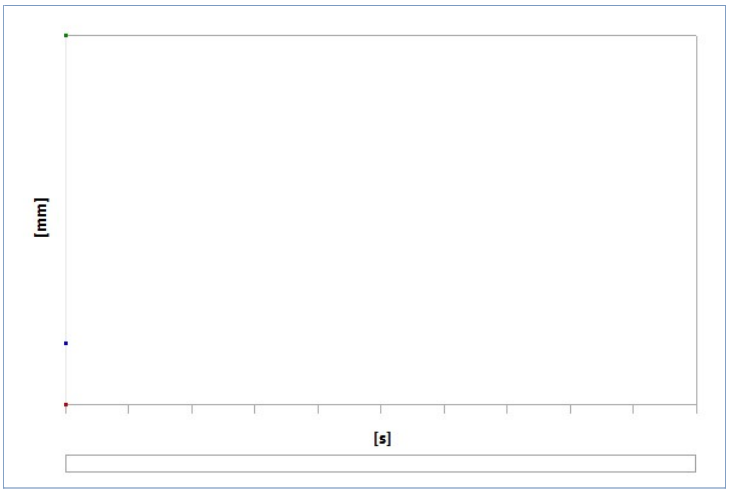


TABLE 33
Model (7 Systems) > side impact left (G5) > Solution (G6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
1,	0,	8,0941	1,3434

FIGURE 23
Model (7 Systems) > side impact left (G5) > Solution (G6) > Total Deformation > Figure

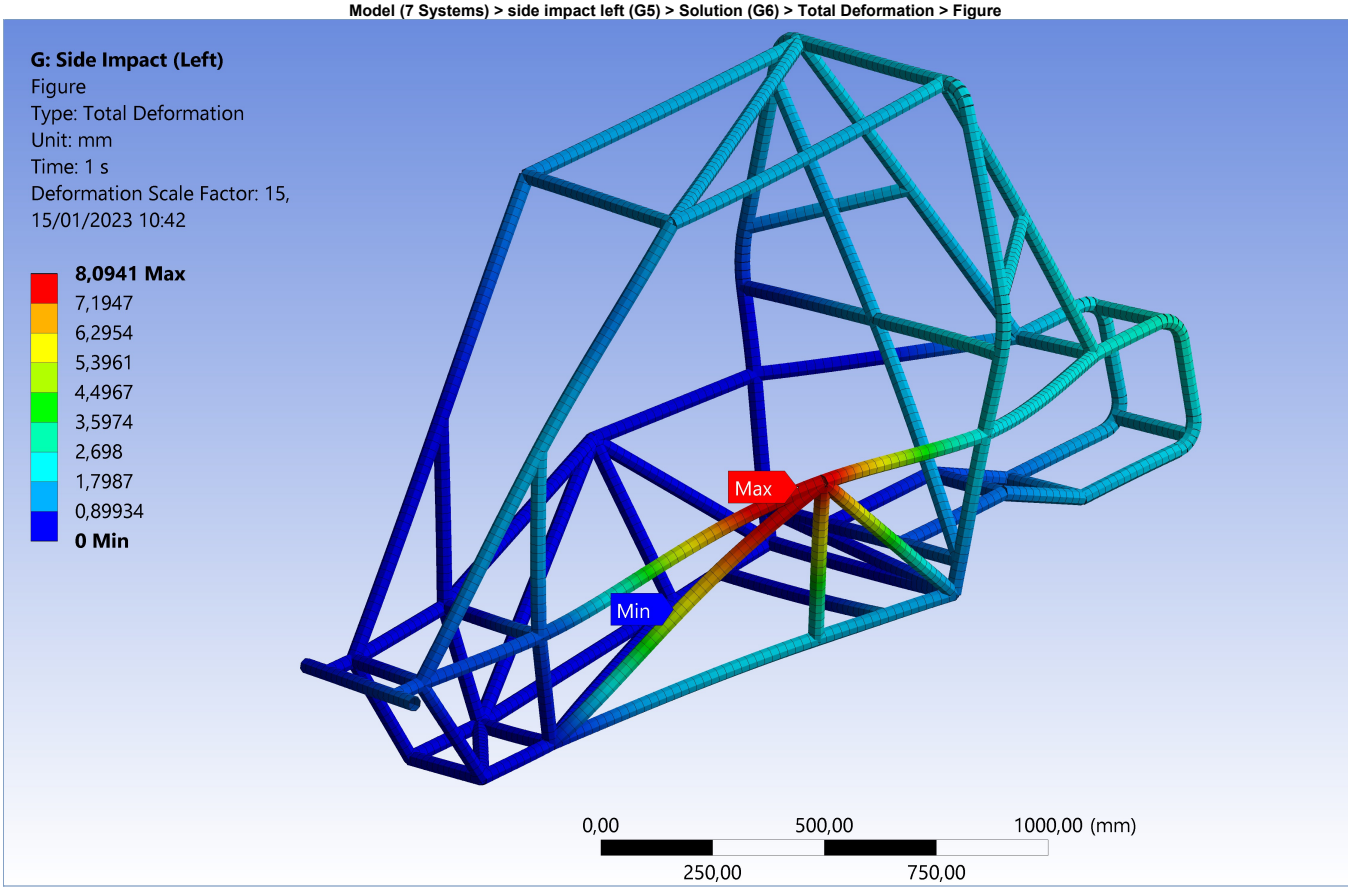


FIGURE 24
Model (7 Systems) > side impact left (G5) > Solution (G6) > Equivalent Stress

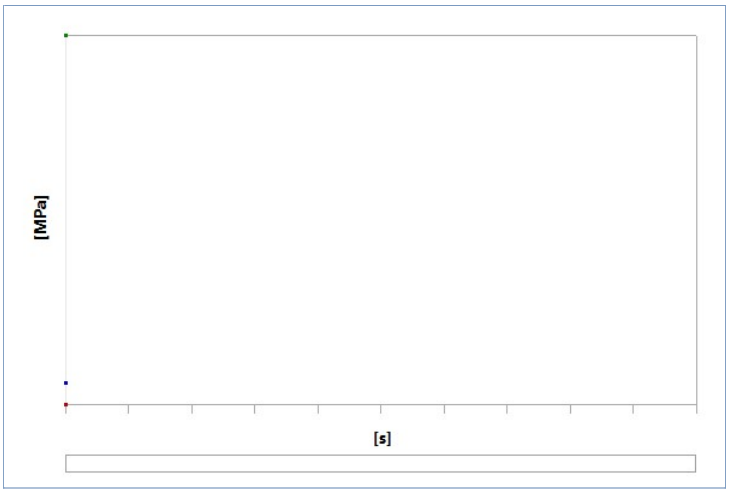
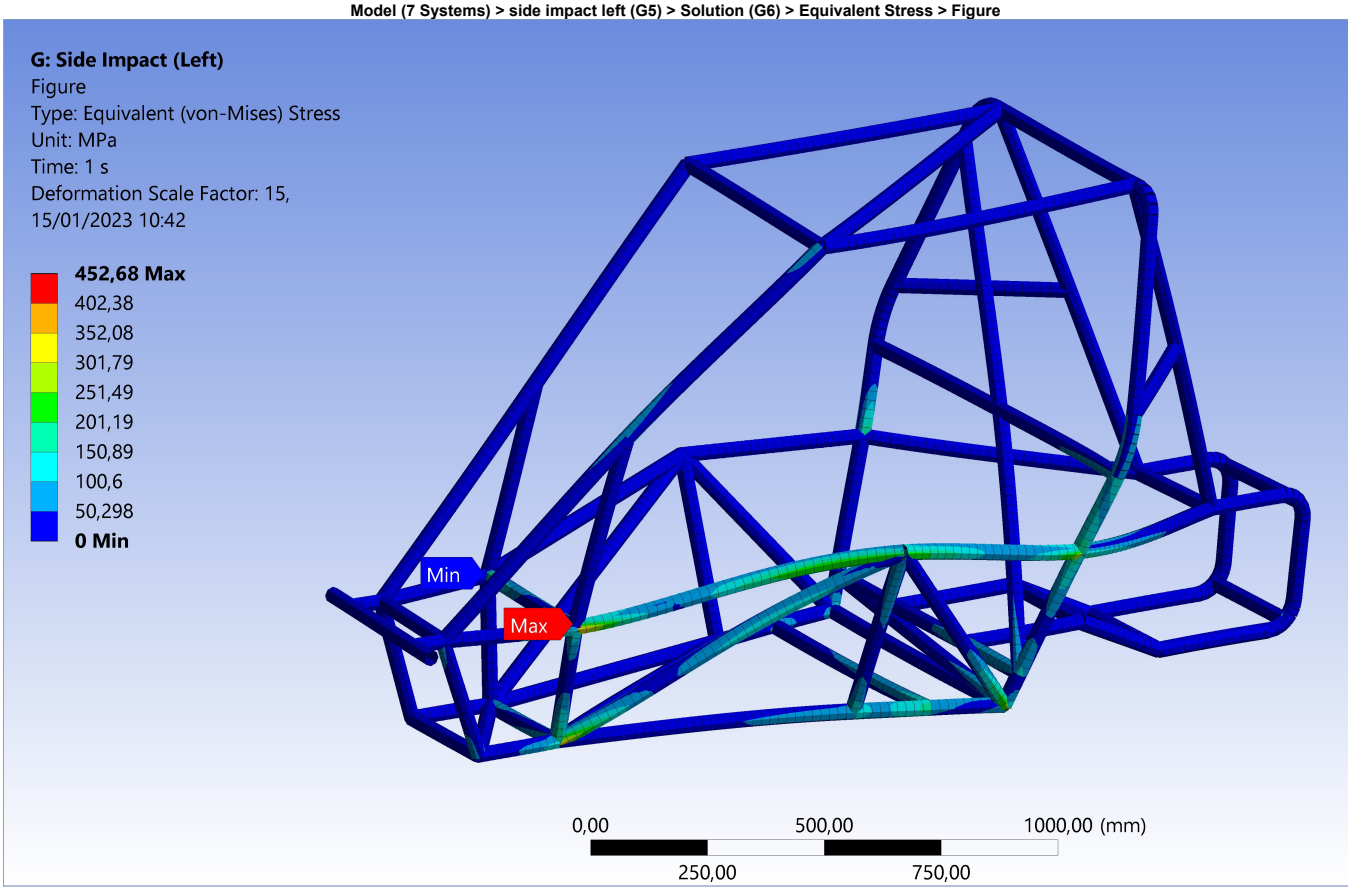


TABLE 34
Model (7 Systems) > side impact left (G5) > Solution (G6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
1,	0,	452,68	26,777

FIGURE 25
Model (7 Systems) > side impact left (G5) > Solution (G6) > Equivalent Stress > Figure



roll test (C5)

TABLE 35
Model (7 Systems) > Analysis

Object Name	*roll test (C5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 36
Model (7 Systems) > roll test (C5) > 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\ansys-AIC-user\Documents\baja\Baja_Chassis_Analysis_Geometry full test23_files\dp0\SYS-3\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

FIGURE 26
Model (7 Systems) > roll test (C5) > Figure

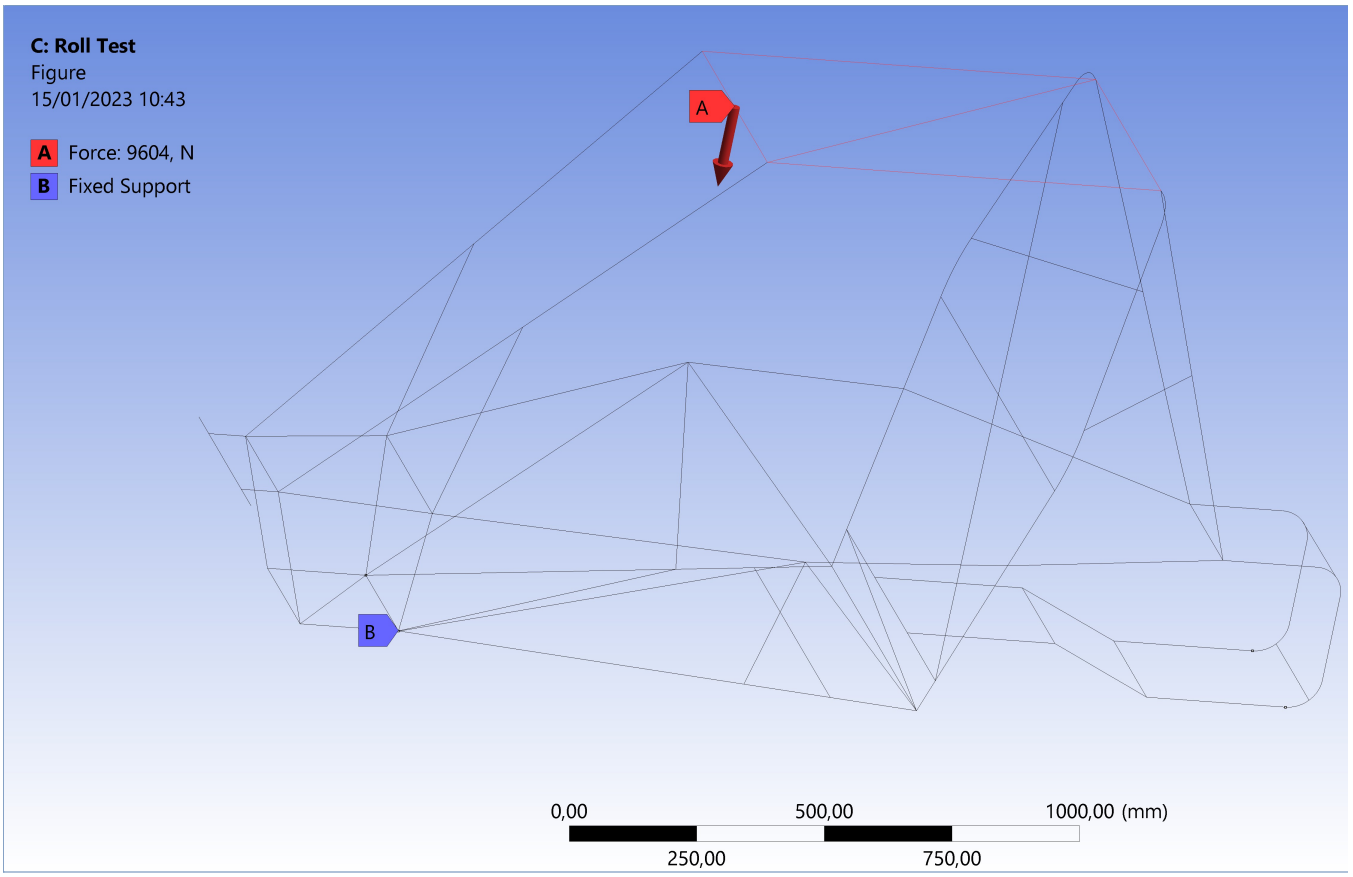
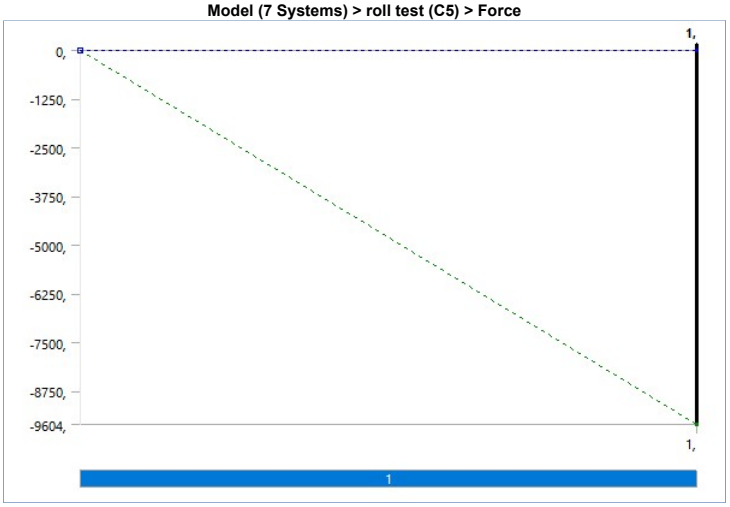


TABLE 37
Model (7 Systems) > roll test (C5) > Loads

Object Name	*Force*	*Fixed Support*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	5 Edges	4 Vertices
Definition		
Type	Force	Fixed Support
Define By	Components	
Applied By	Surface Effect	
Coordinate System	Global Coordinate System	
X Component	0, N (ramped)	
Y Component	-9604, N (ramped)	
Z Component	0, N (ramped)	
Suppressed	No	

FIGURE 27
Model (7 Systems) > roll test (C5) > Force



Solution (C6)

TABLE 38
Model (7 Systems) > roll test (C5) > Solution

Object Name	*Solution (C6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	6, s
MAPDL Memory Used	532, MB
MAPDL Result File Size	4,125 MB
Post Processing	
Beam Section Results	Yes
On Demand Stress/Strain	No

TABLE 39
Model (7 Systems) > roll test (C5) > Solution (C6) > 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 40
Model (7 Systems) > roll test (C5) > Solution (C6) > 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, mm	0, MPa
Maximum	5,3489 mm	239,66 MPa
Average	0,93839 mm	19,548 MPa
Minimum Occurs On	Beam (Circular Tube)	
Maximum Occurs On	Beam (Circular Tube)	
Information		
Time	1, s	
Load Step	1	
Substep	1	
Iteration Number	1	
Integration Point Results		
Display Option		Averaged
Average Across Bodies		No

FIGURE 28
Model (7 Systems) > roll test (C5) > Solution (C6) > Total Deformation

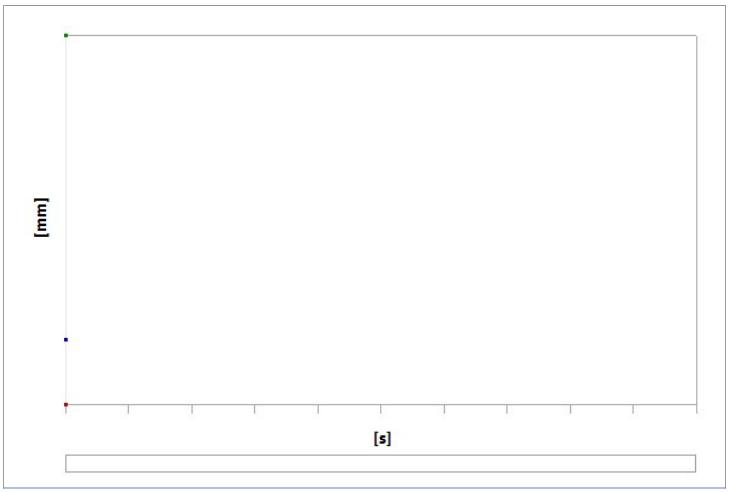


TABLE 41
Model (7 Systems) > roll test (C5) > Solution (C6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
1,	0,	5,3489	0,93839

FIGURE 29
Model (7 Systems) > roll test (C5) > Solution (C6) > Total Deformation > Figure

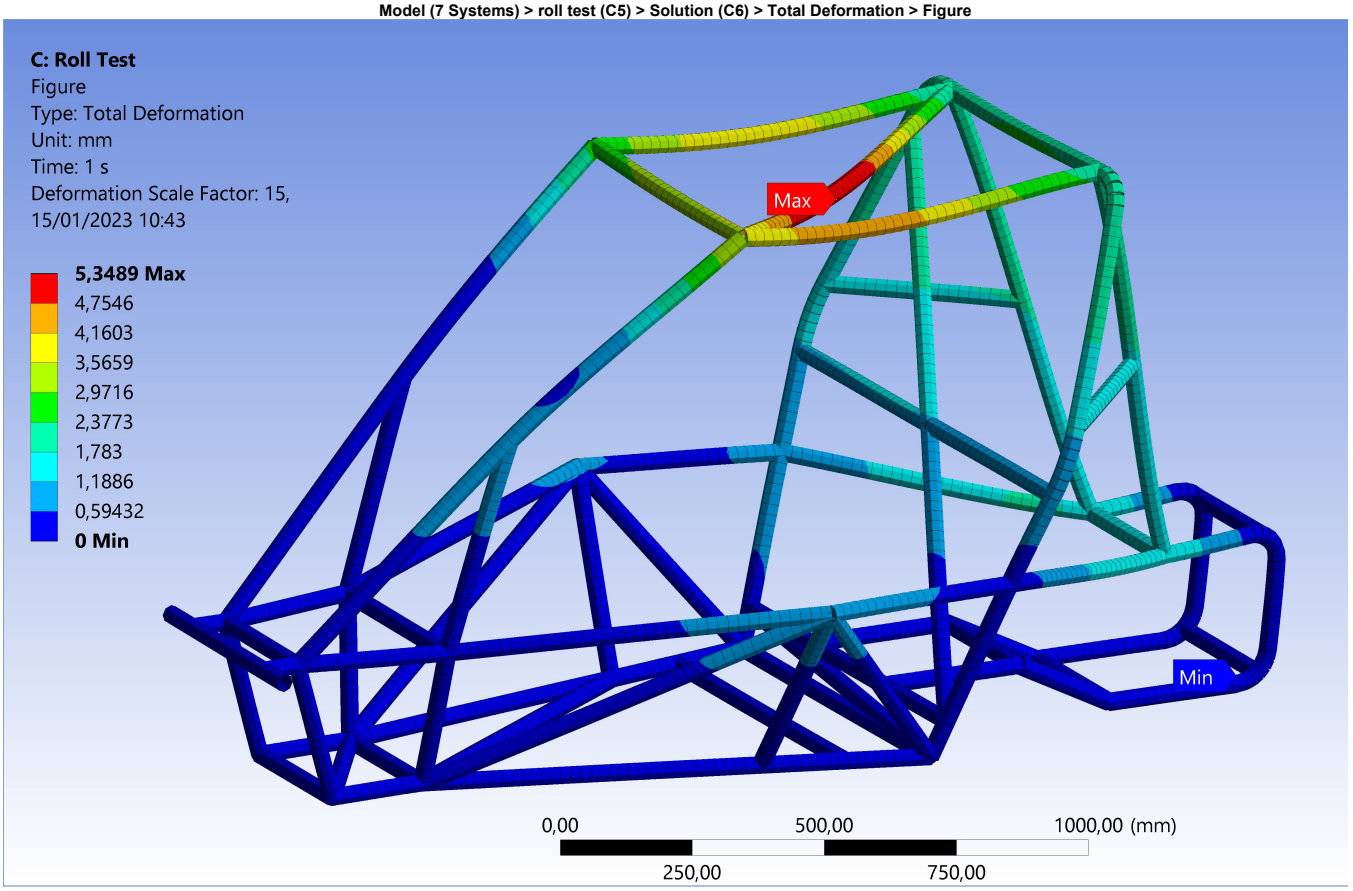


FIGURE 30
Model (7 Systems) > roll test (C5) > Solution (C6) > Equivalent Stress

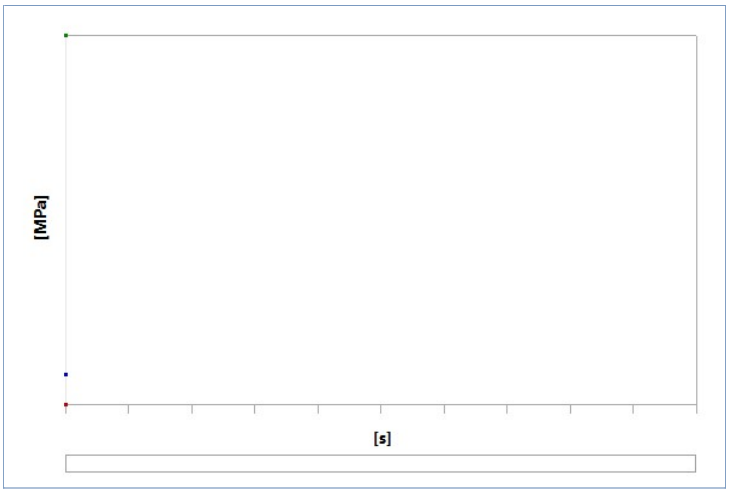
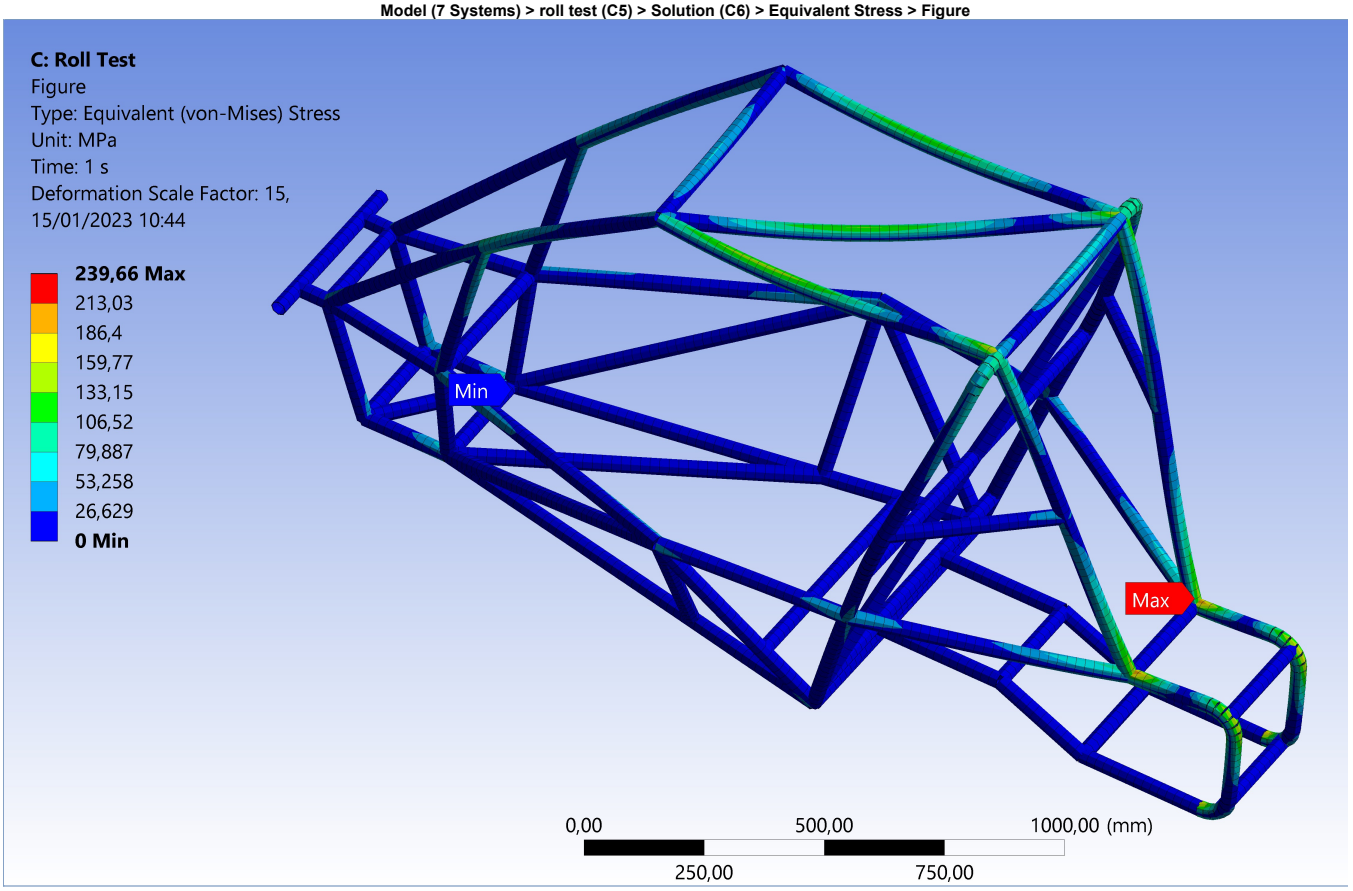


TABLE 42
Model (7 Systems) > roll test (C5) > Solution (C6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
1,	0,	239,66	19,548

FIGURE 31
Model (7 Systems) > roll test (C5) > Solution (C6) > Equivalent Stress > Figure



rear end (D5)

TABLE 43
Model (7 Systems) > Analysis

Object Name	*rear end (D5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 44
Model (7 Systems) > rear end (D5) > 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\ansys-AIC-user\Documents\baja\Baja_Chassis_Analysis_Geometry full test23_files\dp0\SYS-4\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

FIGURE 32
Model (7 Systems) > rear end (D5) > Figure

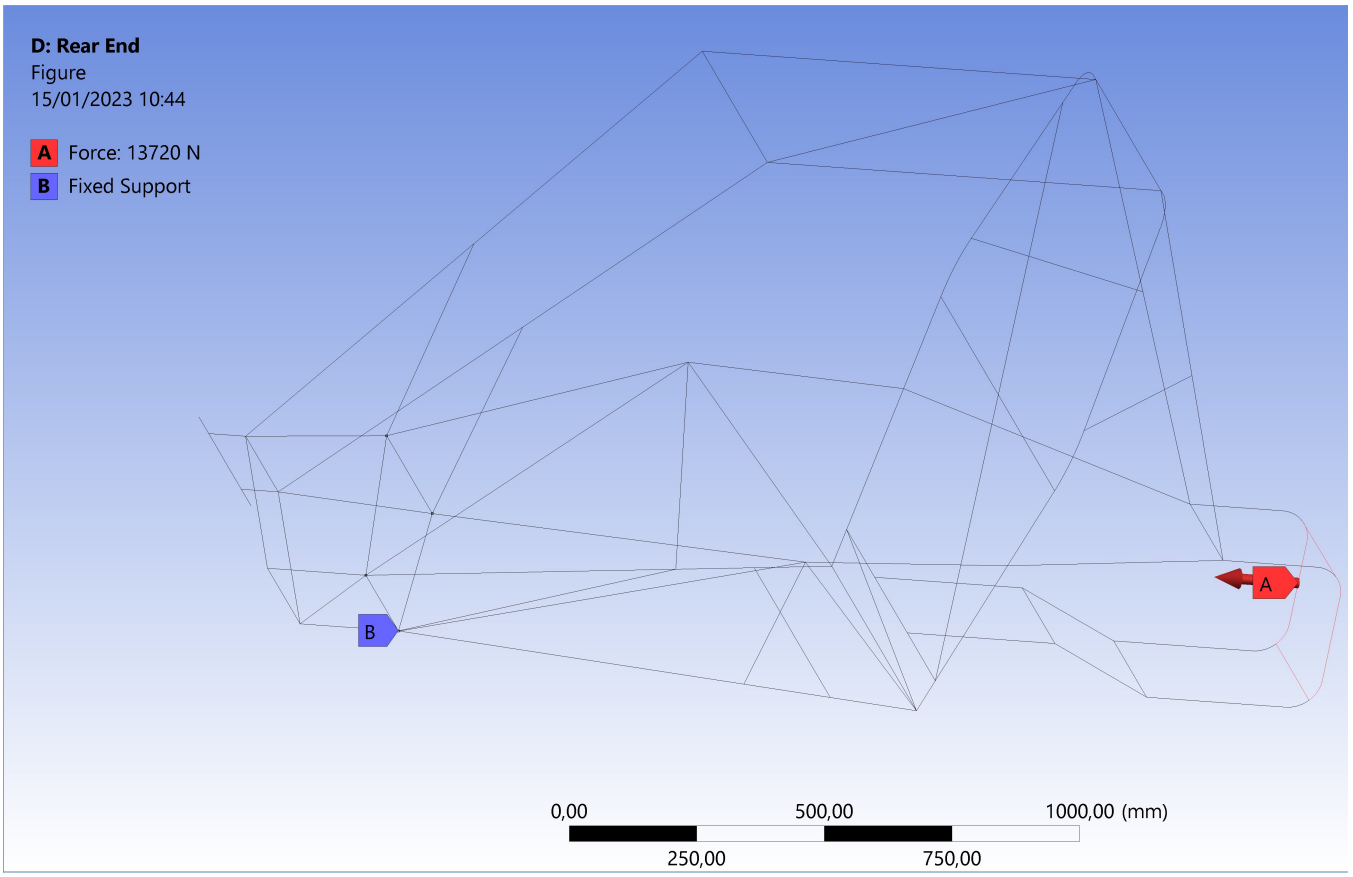
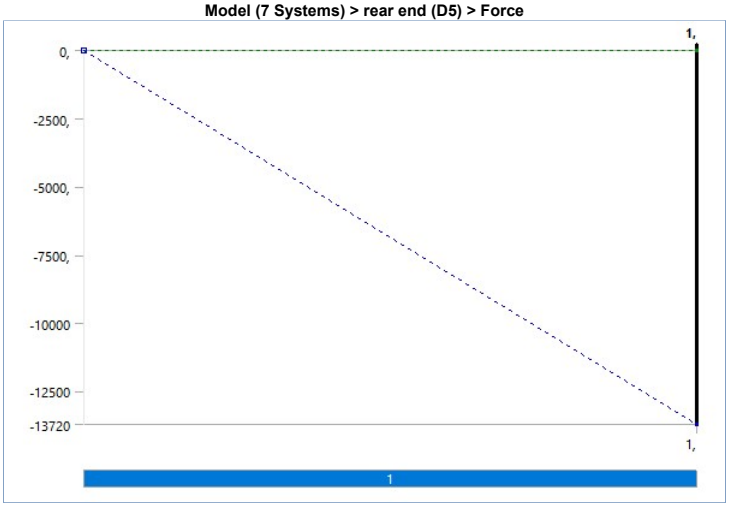


TABLE 45
Model (7 Systems) > rear end (D5) > Loads

Object Name	*Force*	*Fixed Support*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	8 Edges	4 Vertices
Definition		
Type	Force	Fixed Support
Define By	Components	
Applied By	Surface Effect	
Coordinate System	Global Coordinate System	
X Component	0, N (ramped)	
Y Component	0, N (ramped)	
Z Component	-13720 N (ramped)	
Suppressed	No	

FIGURE 33
Model (7 Systems) > rear end (D5) > Force



Solution (D6)

TABLE 46
Model (7 Systems) > rear end (D5) > Solution

Object Name	*Solution (D6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	6, s
MAPDL Memory Used	531, MB
MAPDL Result File Size	4, MB
Post Processing	
Beam Section Results	Yes
On Demand Stress/Strain	No

TABLE 47
Model (7 Systems) > rear end (D5) > Solution (D6) > 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 48
Model (7 Systems) > rear end (D5) > Solution (D6) > 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, mm	0, MPa
Maximum	3,6632 mm	335,16 MPa
Average	1,254 mm	24,348 MPa
Minimum Occurs On	Beam (Circular Tube)	
Maximum Occurs On	Beam (Circular Tube)	
Information		
Time	1, s	
Load Step	1	
Substep	1	
Iteration Number	1	
Integration Point Results		
Display Option		Averaged
Average Across Bodies		No

FIGURE 34
Model (7 Systems) > rear end (D5) > Solution (D6) > Total Deformation

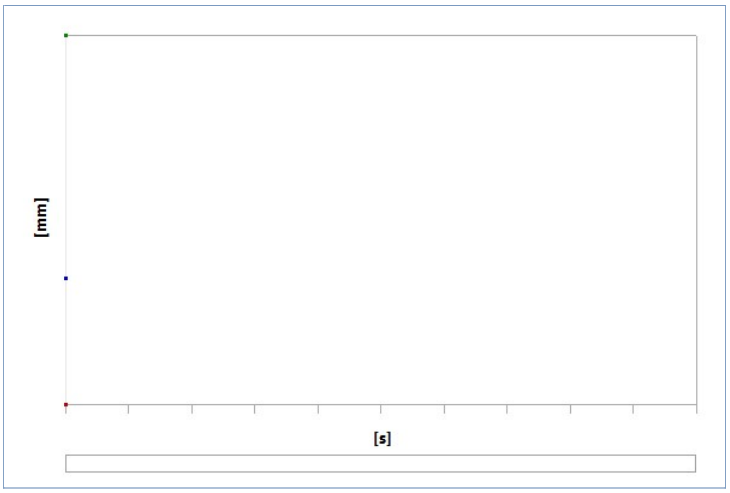


TABLE 49
Model (7 Systems) > rear end (D5) > Solution (D6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
1,	0,	3,6632	1,254

FIGURE 35
Model (7 Systems) > rear end (D5) > Solution (D6) > Total Deformation > Figure

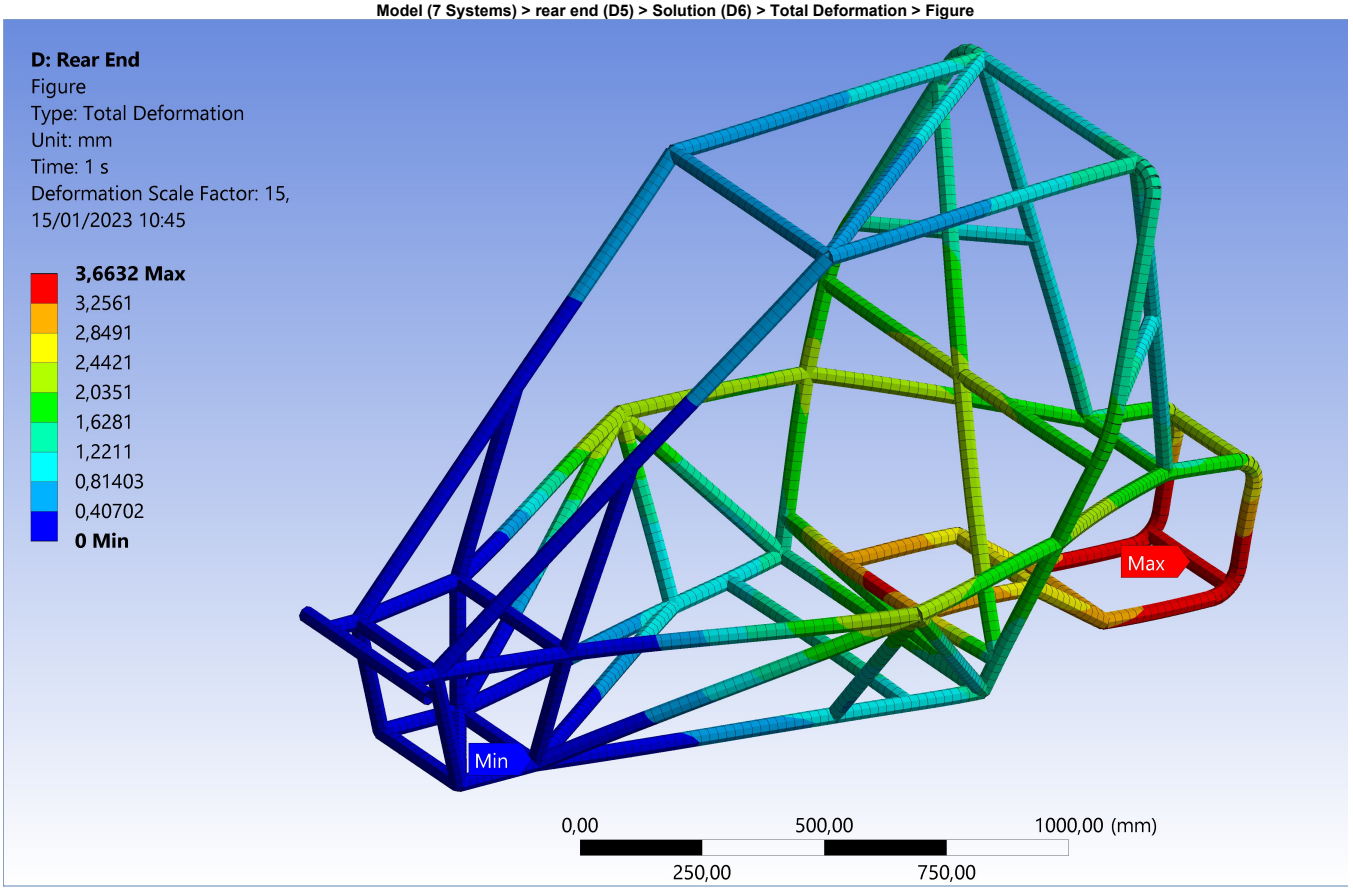


FIGURE 36
Model (7 Systems) > rear end (D5) > Solution (D6) > Equivalent Stress

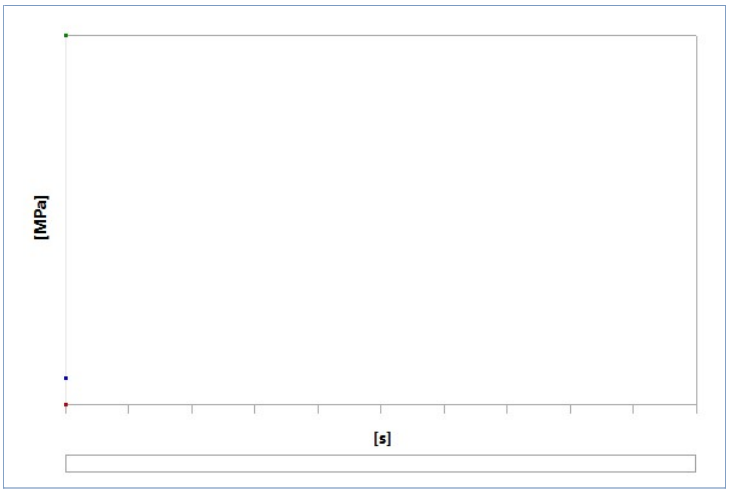
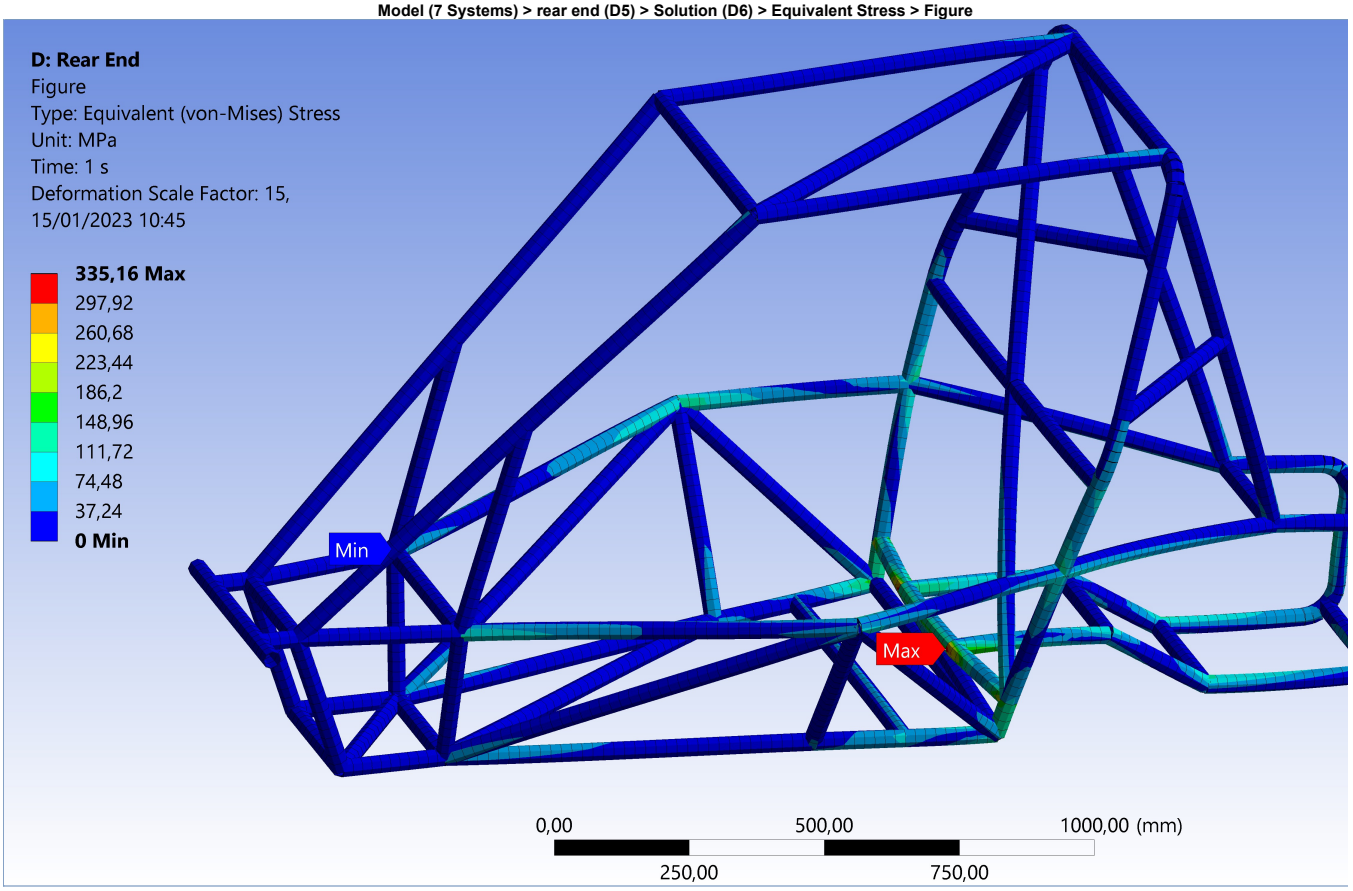


TABLE 50
Model (7 Systems) > rear end (D5) > Solution (D6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
1,	0,	335,16	24,348

FIGURE 37
Model (7 Systems) > rear end (D5) > Solution (D6) > Equivalent Stress > Figure



torsional test left up ,right down (E5)

TABLE 51
Model (7 Systems) > Analysis

Object Name	*torsional test left up ,right down (E5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 52
Model (7 Systems) > torsional test left up ,right down (E5) > 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\ansys-AIC-user\Documents\baja\Baja_Chassis_Analysis_Geometry full test23_files\dp0\SYS-5\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

FIGURE 38
Model (7 Systems) > torsional test left up ,right down (E5) > Figure

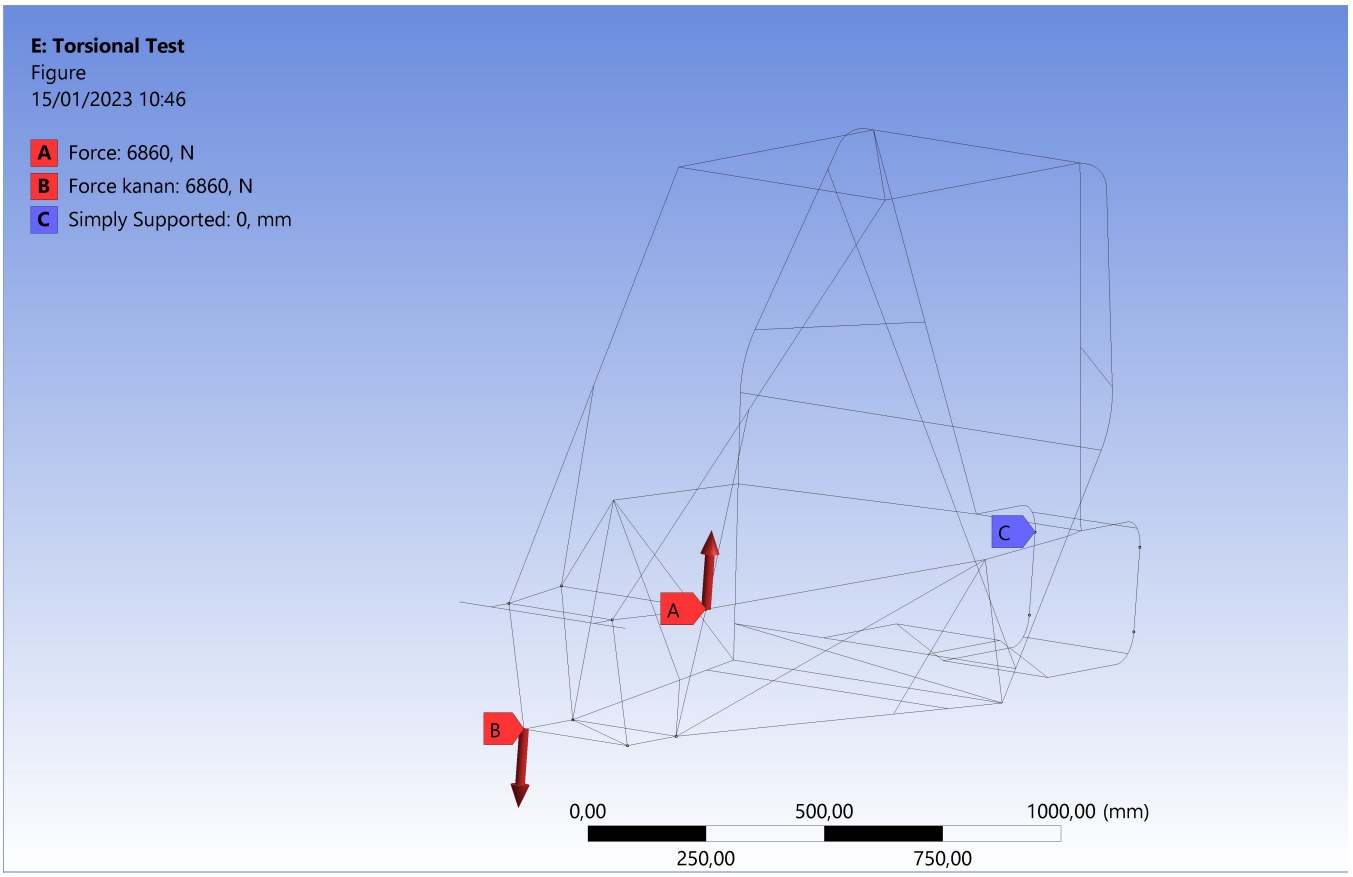


TABLE 53
Model (7 Systems) > torsional test left up ,right down (E5) > Loads

Object Name	*Force*	*Force kanan*	*Simply Supported*
State	Fully Defined		
Scope			
Scoping Method	Geometry Selection		
Geometry	4 Vertices		
Definition			
Type	Force		Simply Supported
Define By	Components		
Coordinate System	Global Coordinate System		
X Component	0, N (ramped)		
Y Component	6860, N (ramped)	-6860, N (ramped)	
Z Component	0, N (ramped)		
Suppressed	No		

FIGURE 39
Model (7 Systems) > torsional test left up ,right down (E5) > Force

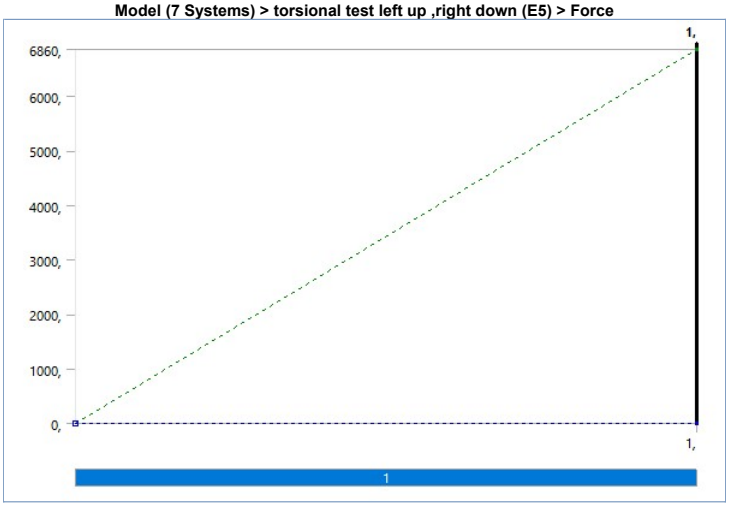


FIGURE 40
Model (7 Systems) > torsional test left up ,right down (E5) > Force kanan

Solution (E6)

TABLE 54
Model (7 Systems) > torsional test left up ,right down (E5) > Solution

Object Name	*Solution (E6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	6, s
MAPDL Memory Used	532, MB
MAPDL Result File Size	4,125 MB
Post Processing	
Beam Section Results	Yes
On Demand Stress/Strain	No

TABLE 55
Model (7 Systems) > torsional test left up ,right down (E5) > Solution (E6) > 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 56
Model (7 Systems) > torsional test left up ,right down (E5) > Solution (E6) > 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	5,8834e-003 mm	8,8772e-011 MPa
Maximum	23,529 mm	330,29 MPa
Average	9,597 mm	34,529 MPa
Minimum Occurs On	Beam (Circular Tube)	
Maximum Occurs On	Beam (Circular Tube)	
Information		
Time	1, s	
Load Step	1	
Substep	1	
Iteration Number	1	
Integration Point Results		
Display Option		Averaged

Average Across Bodies		No

FIGURE 41
Model (7 Systems) > torsional test left up ,right down (E5) > Solution (E6) > Total Deformation

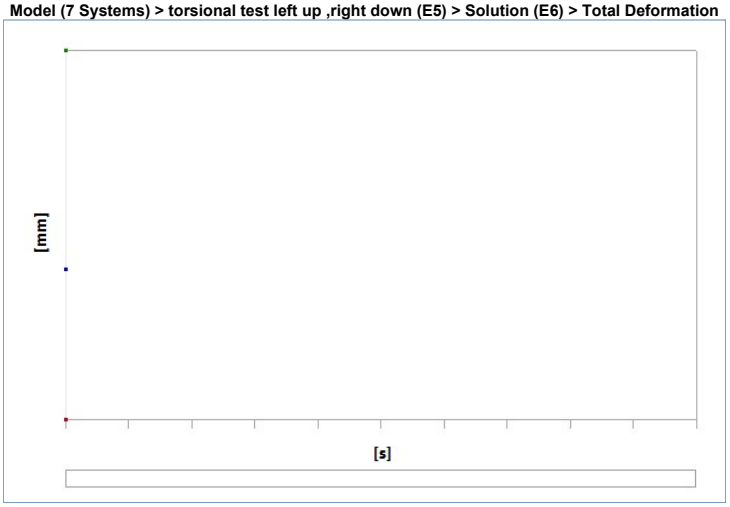


TABLE 57
Model (7 Systems) > torsional test left up ,right down (E5) > Solution (E6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
1,	5,8834e-003	23,529	9,597

FIGURE 42
Model (7 Systems) > torsional test left up ,right down (E5) > Solution (E6) > Total Deformation > Figure

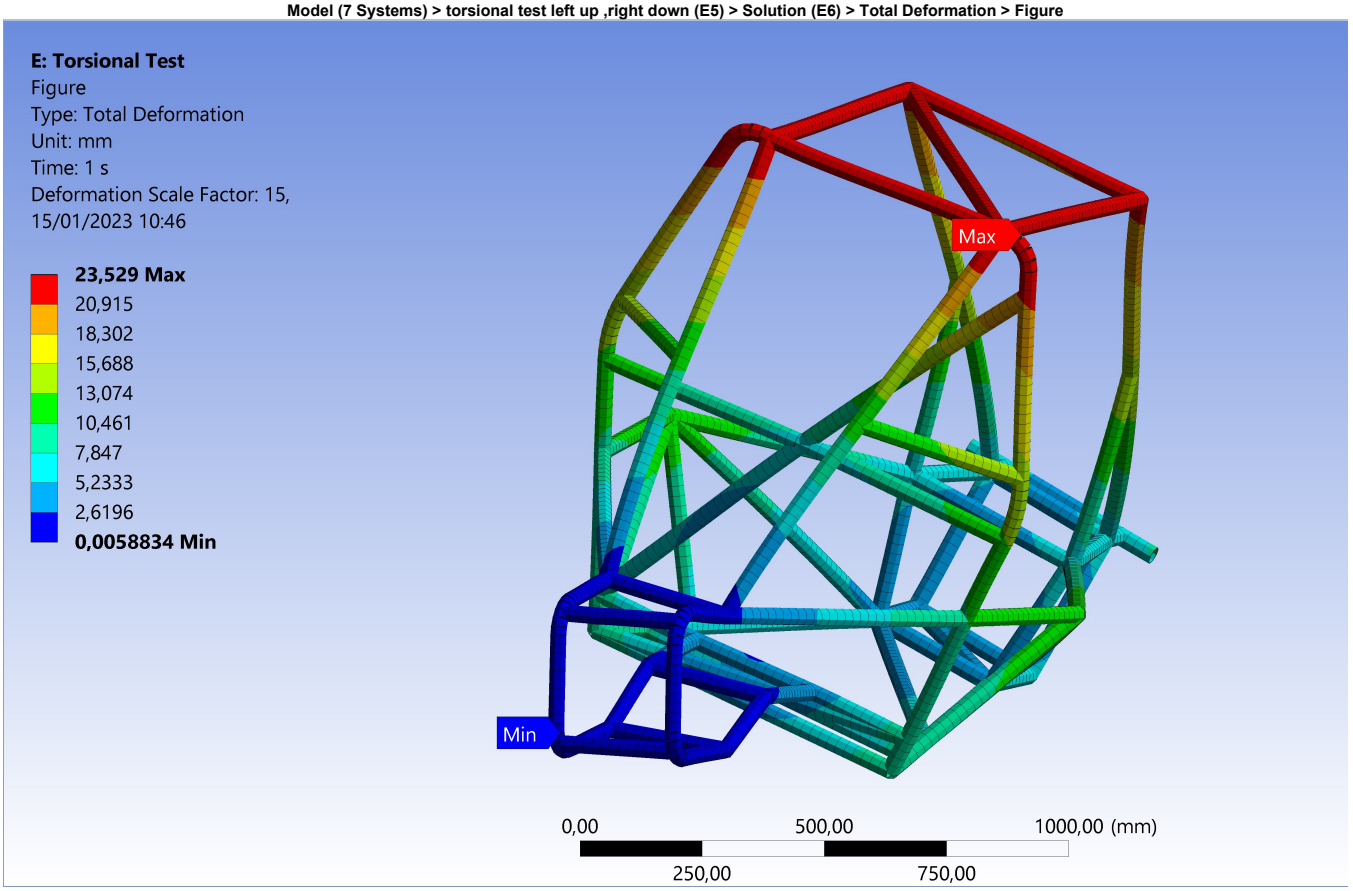


FIGURE 43
Model (7 Systems) > torsional test left up ,right down (E5) > Solution (E6) > Equivalent Stress

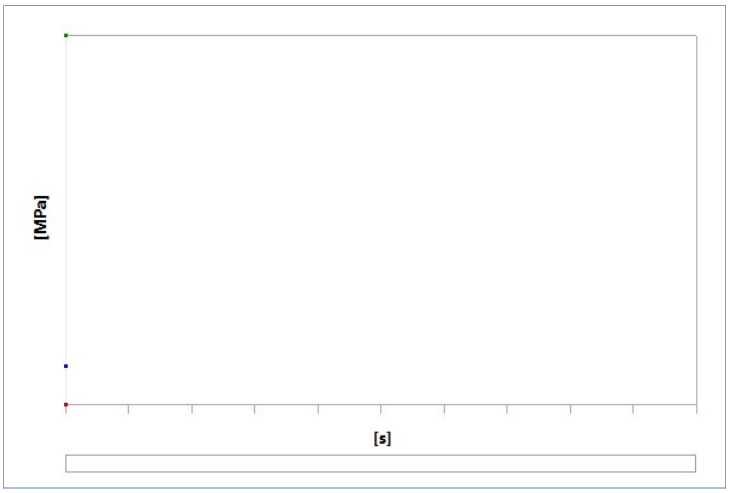
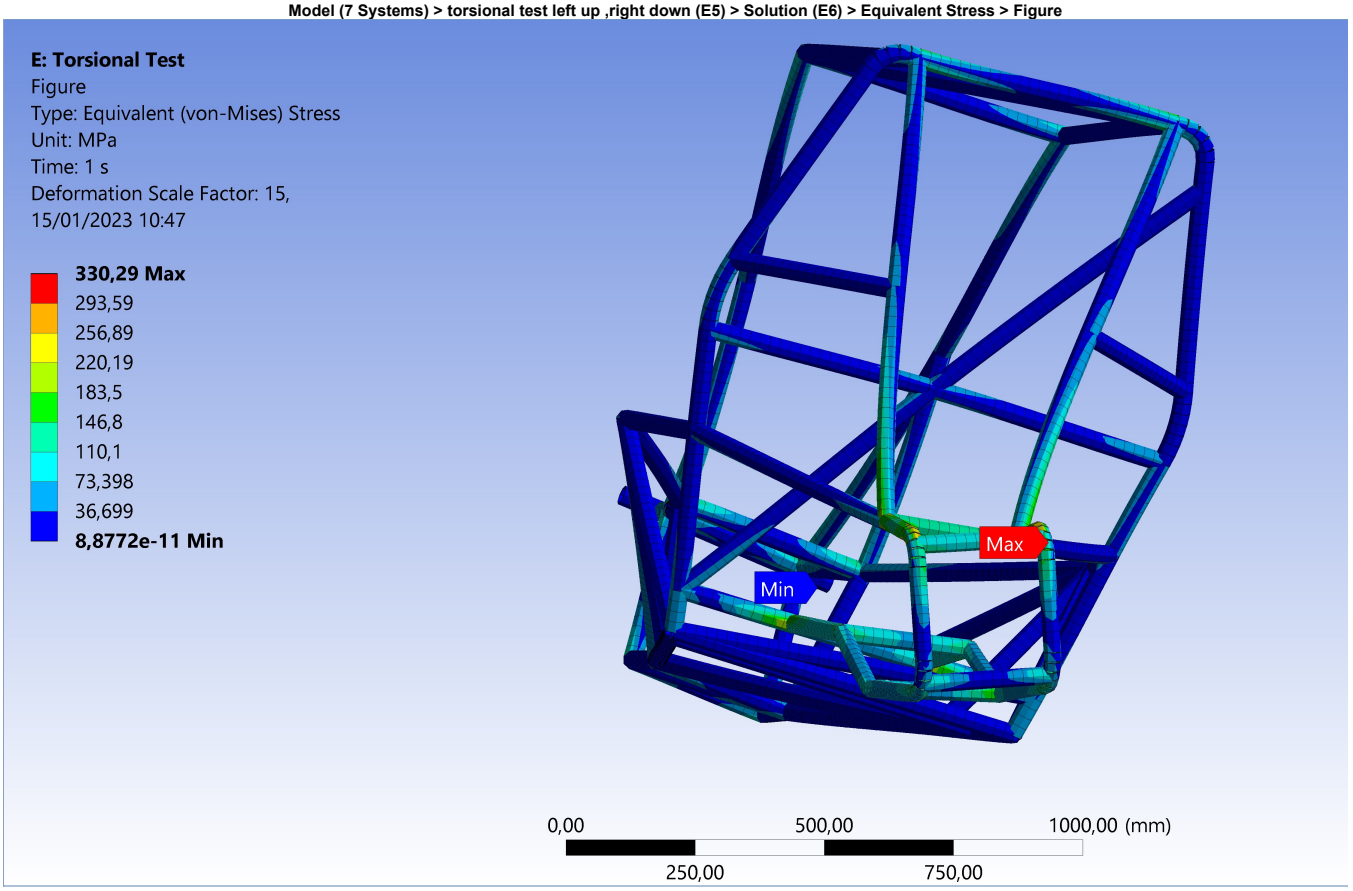


TABLE 58
Model (7 Systems) > torsional test left up ,right down (E5) > Solution (E6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
1,	8,8772e-011	330,29	34,529

FIGURE 44
Model (7 Systems) > torsional test left up ,right down (E5) > Solution (E6) > Equivalent Stress > Figure



frontal bump test (left) (F5)

TABLE 59
Model (7 Systems) > Analysis

Object Name	*frontal bump test (left) (F5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 60
Model (7 Systems) > frontal bump test (left) (F5) > 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\ansys-AIC-user\Documents\baja\Baja_Chassis_Analysis_Geometry full test23_files\dp0\SYS-6\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

FIGURE 45
Model (7 Systems) > frontal bump test (left) (F5) > Figure

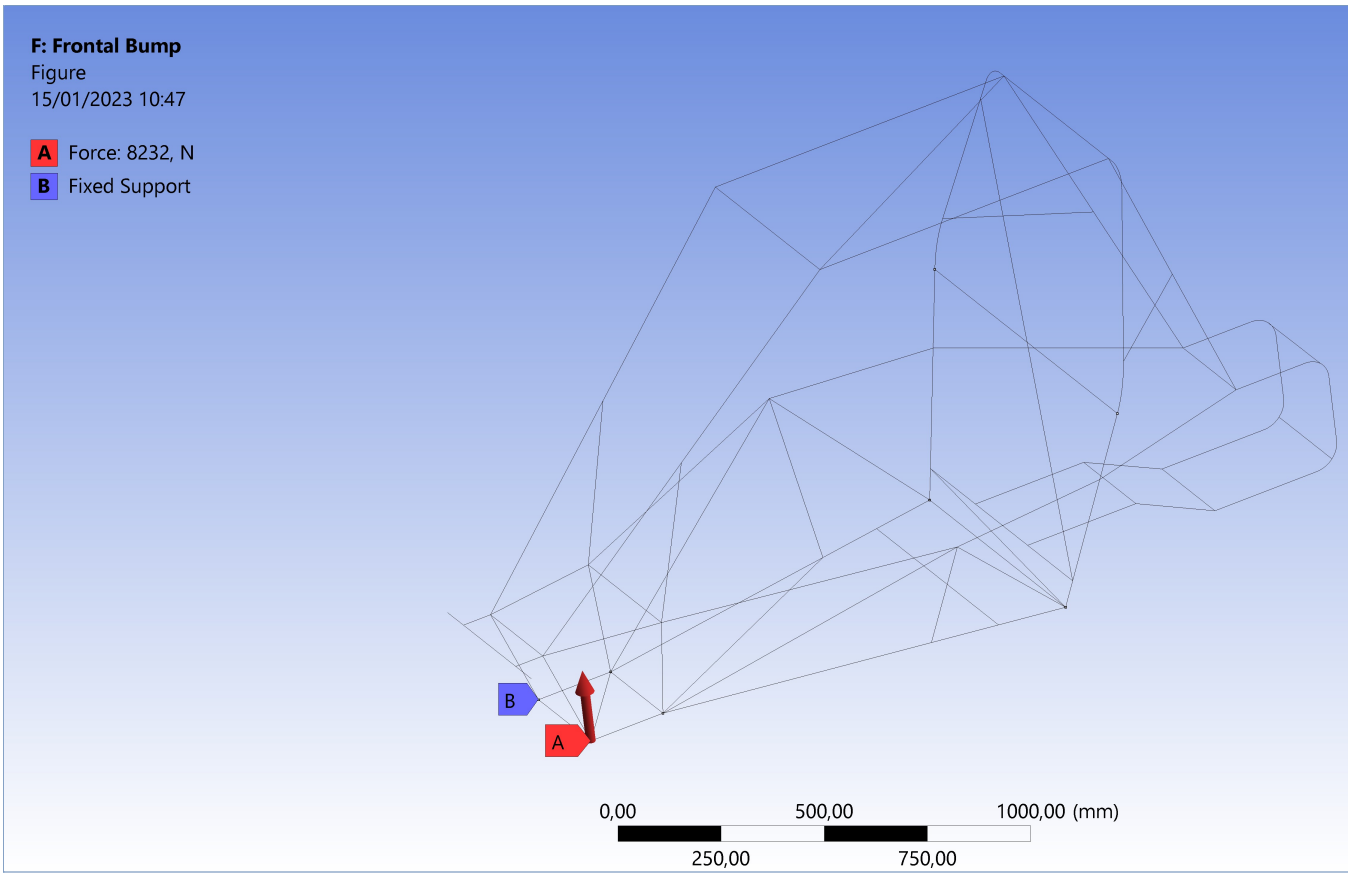
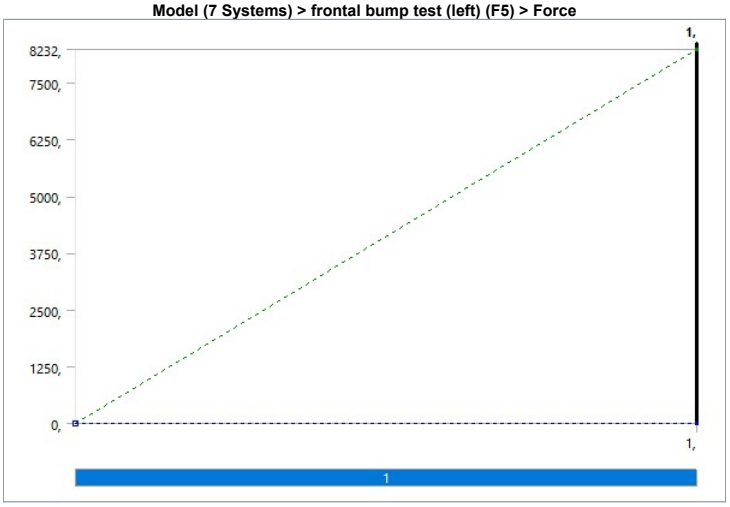


TABLE 61
Model (7 Systems) > frontal bump test (left) (F5) > Loads

Object Name	*Force*	*Fixed Support*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	2 Vertices	6 Vertices
Definition		
Type	Force	Fixed Support
Define By	Components	
Coordinate System	Global Coordinate System	
X Component	0, N (ramped)	
Y Component	8232, N (ramped)	
Z Component	0, N (ramped)	
Suppressed	No	

FIGURE 46
Model (7 Systems) > frontal bump test (left) (F5) > Force



Solution (F6)

TABLE 62

Model (7 Systems) > frontal bump test (left) (F5) > Solution

Object Name	*Solution (F6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done
MAPDL Elapsed Time	6, s
MAPDL Memory Used	532, MB
MAPDL Result File Size	4,0625 MB
Post Processing	
Beam Section Results	Yes
On Demand Stress/Strain	No

TABLE 63
Model (7 Systems) > frontal bump test (left) (F5) > Solution (F6) > 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 64
Model (7 Systems) > frontal bump test (left) (F5) > Solution (F6) > 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, mm	0, MPa
Maximum	1,7798 mm	259,83 MPa
Average	0,39347 mm	10,464 MPa
Minimum Occurs On	Beam (Circular Tube)	
Maximum Occurs On	Beam (Circular Tube)	
Information		
Time	1, s	
Load Step	1	
Substep	1	
Iteration Number	1	
Integration Point Results		
Display Option		Averaged
Average Across Bodies		No

FIGURE 47
Model (7 Systems) > frontal bump test (left) (F5) > Solution (F6) > Total Deformation

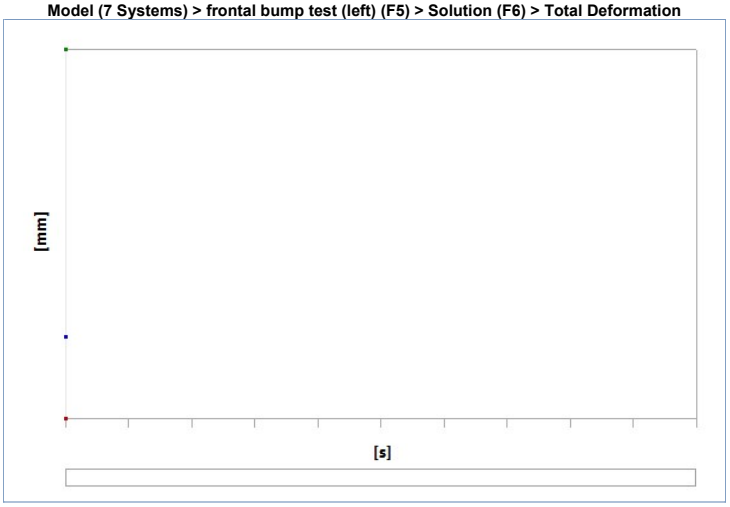


TABLE 65
Model (7 Systems) > frontal bump test (left) (F5) > Solution (F6) > Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]	Average [mm]
1,	0,	1,7798	0,39347

FIGURE 48
Model (7 Systems) > frontal bump test (left) (F5) > Solution (F6) > Total Deformation > Figure

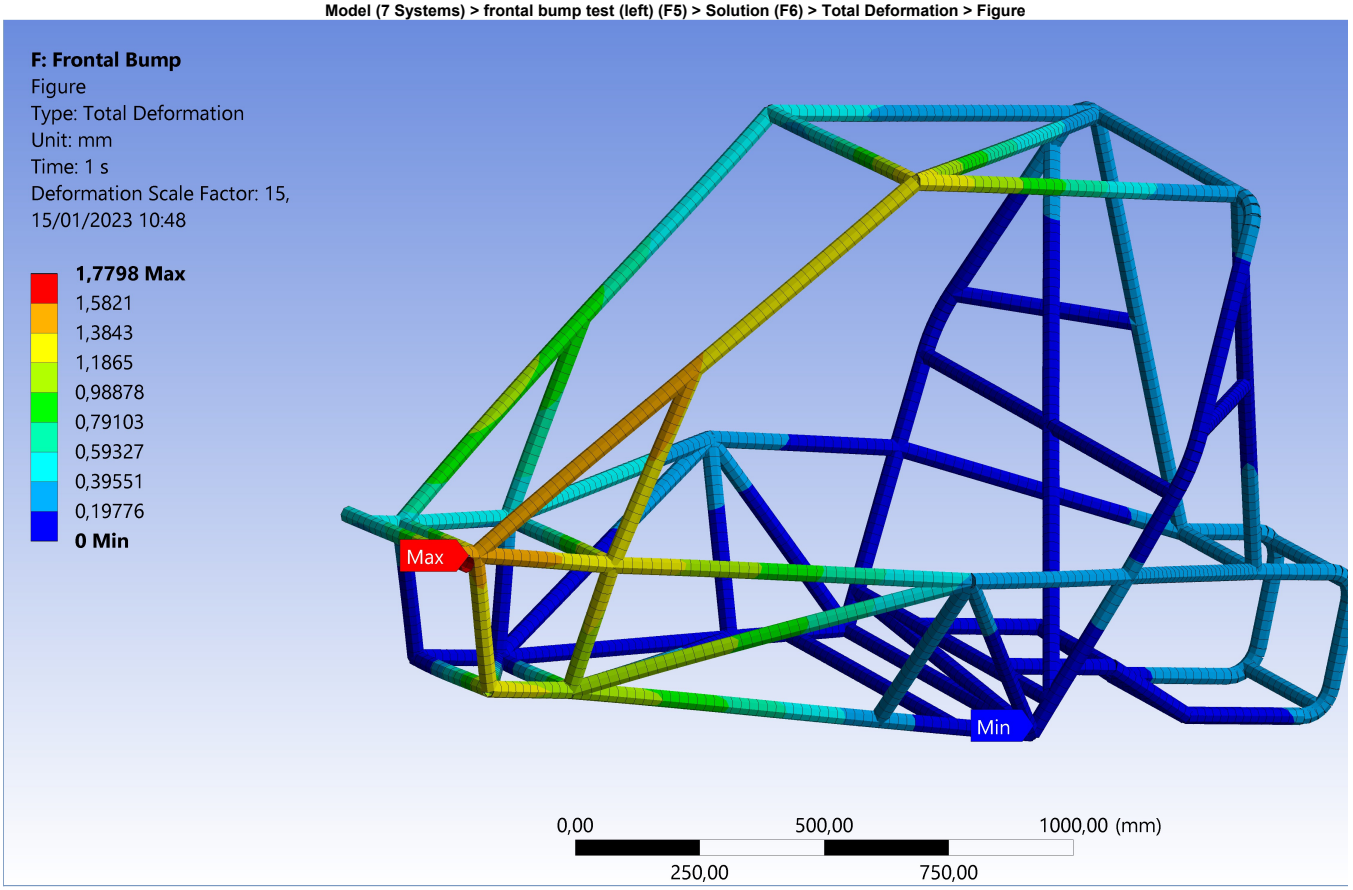


FIGURE 49
Model (7 Systems) > frontal bump test (left) (F5) > Solution (F6) > Equivalent Stress

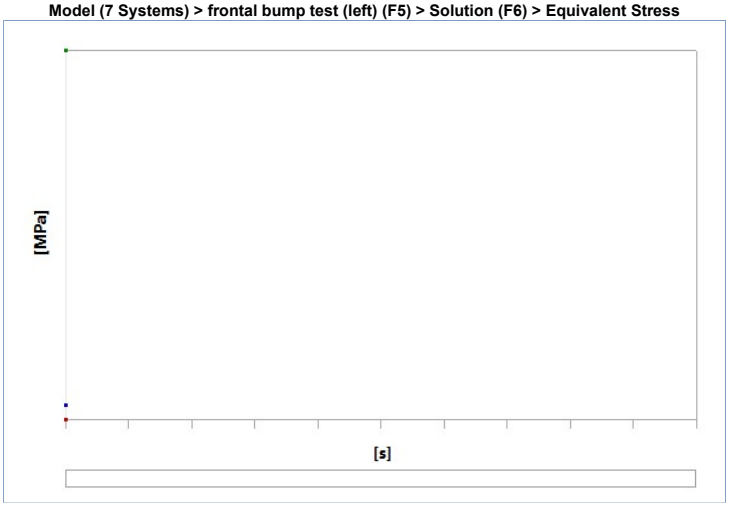
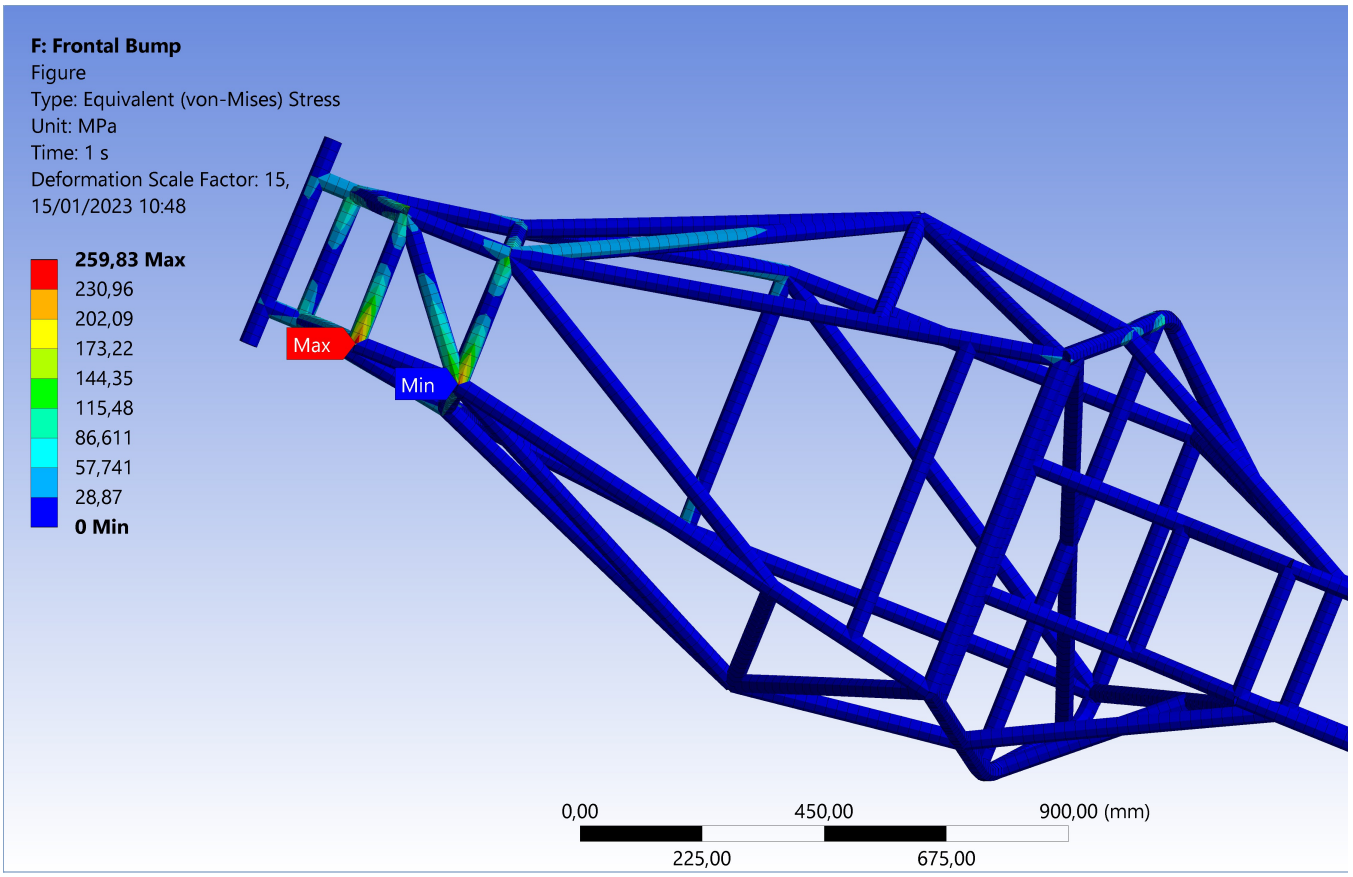


TABLE 66
Model (7 Systems) > frontal bump test (left) (F5) > Solution (F6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
1,	0,	259,83	10,464

FIGURE 50
Model (7 Systems) > frontal bump test (left) (F5) > Solution (F6) > Equivalent Stress > Figure



Material Data

Low alloy steel, 4140, normalized

TABLE 67
Low alloy steel, 4140, normalized > Constants

Density	7,85e-006 kg mm^-3
Tensile Yield Strength	652,2 MPa
Tensile Ultimate Strength	1015, MPa
Coefficient of Thermal Expansion	1,172e-005 C^-1
Thermal Conductivity	4,333e-002 W mm^-1 C^-1
Specific Heat	4,354e+005 mJ kg^-1 C^-1

TABLE 68
Low alloy steel, 4140, normalized > Opacity

Red	Green	Blue
204,	204,	204,

Opacity
1,

Metallic Finish
1,

TABLE 69
Low alloy steel, 4140, normalized > Isotropic Elasticity

Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
2,125e+005	0,29	1,6865e+005	82364	23,

TABLE 70
Low alloy steel, 4140, normalized > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
20,