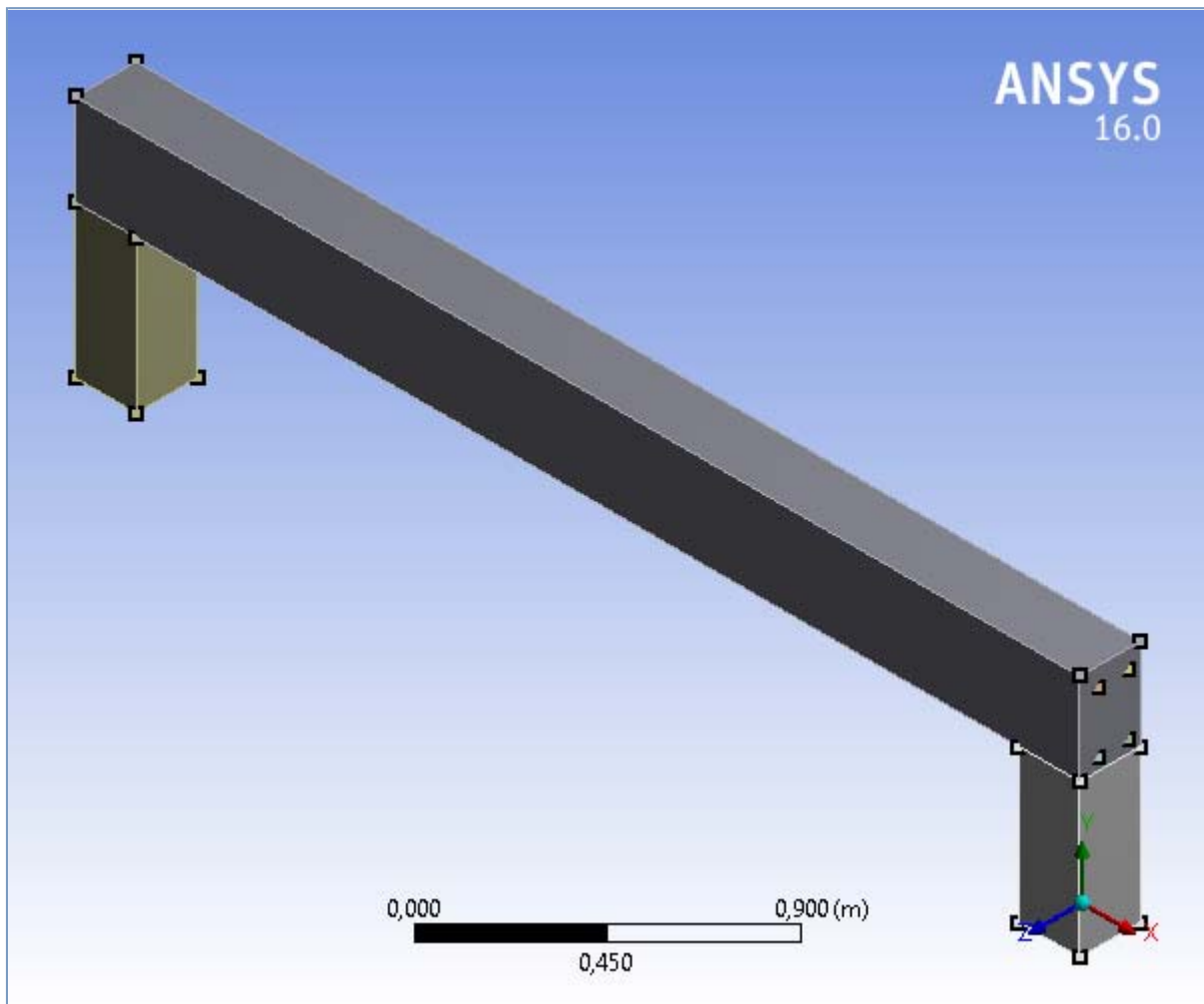# Project

First Saved	Friday, November 6, 2015
Last Saved	Friday, November 6, 2015
Product Version	16.0 Release
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)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\Raphael\Desktop\ANSYS Test\Trabalho MEF no Ansys\Trabalho_files\dp0\SYS\DM\SYS.agdb
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color

Bounding Box	
Length X	3,3 m
Length Y	0,8 m
Length Z	0,2 m
Properties	
Volume	0,24272 m³
Mass	584,43 kg
Scale Factor Value	1,
Statistics	
Bodies	17
Active Bodies	17
Nodes	3072
Elements	1900
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	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	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\Raphael\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Body Groups

Object Name	*EstribosDeLinhasEmCrossSection*	*ArmadurasLongitudinaisEmCrossSection*
State	Meshed	
Graphics Properties		
Visible	Yes	
Definition		
Suppressed	No	
Assignment	Structural Steel	
Coordinate System	Default Coordinate System	
Bounding Box		
Length X	2,7 m	3,3 m
Length Y	0,24 m	0,2 m
Length Z	0,14 m	0,1 m
Properties		
Volume	5,6991e-004 m³	4,1467e-003 m³
Mass	4,4738 kg	32,552 kg
Statistics		
Nodes	360	324
Elements	180	160
Mesh Metric	None	

TABLE 4
Model (A4) > Geometry > EstribosDeLinhasEmCrossSection > Parts

Object Name	Line Body	Line Body	Line Body	Line Body	Line Body	Line Body	Line Body	Line Body	Line Body	Line Body
State	Meshed									
Graphics Properties										
Visible	Yes									
Transparency	1									
Definition										
Suppressed	No									
Coordinate System	Default Coordinate System									
Reference Temperature	By Environment									
Offset Mode	Refresh on Update									
Offset Type	Centroid									
Model Type	Beam									
Reference Frame	Lagrangian									
Material										
Assignment	Structural Steel									
Nonlinear Effects	Yes									
Thermal Strain Effects	Yes									
Bounding Box										
Length X	0, m									
Length Y	0,24 m									
Length Z	0,14 m									
Properties										
Volume	5,6991e-005 m³									
Mass	0,44738 kg									
Length	0,72566 m									
Cross Section	EspessuraDoEstribo									
Cross Section Area	7,8536e-005 m²									
Cross Section IYY	4,9081e-010 m²·m²									
Cross Section IZZ	4,9081e-010 m²·m²									
Statistics										
Nodes	36									
Elements	18									
Mesh Metric	None									

TABLE 5
Model (A4) > Geometry > ArmadurasLongitudinaisEmCrossSection > Parts

Object Name	Line Body	Line Body	Line Body	Line Body
State	Meshed			
Graphics Properties				
Visible	Yes			
Transparency	1			
Definition				
Suppressed	No			
Coordinate System	Default Coordinate System			
Reference Temperature	By Environment			
Offset Mode	Refresh on Update			
Offset Type	Centroid			
Model Type	Beam			
Reference Frame	Lagrangian			

Material	
Assignment	Structural Steel
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	3,3 m
Length Y	0, m
Length Z	0, m
Properties	
Volume	1,0367e-003 m³
Mass	8,1379 kg
Length	3,3 m
Cross Section	EspessuraDaArmaduraLongitudinal
Cross Section Area	3,1414e-004 m²
Cross Section IYY	7,8529e-009 m²·m²
Cross Section IZZ	7,8529e-009 m²·m²
Statistics	
Nodes	81
Elements	40
Mesh Metric	None

TABLE 6
Model (A4) > Geometry > Parts

Object Name	Concreto	Pilar1	Pilar2
State	Meshed		
Graphics Properties			
Visible	Yes		
Transparency	1		
Definition			
Suppressed	No		
Stiffness Behavior	Flexible		
Coordinate System	Default Coordinate System		
Reference Temperature	By Environment		
Reference Frame	Lagrangian		
Material			
Assignment	Concrete		
Nonlinear Effects	Yes		
Thermal Strain Effects	Yes		
Bounding Box			
Length X	3,3 m	0,2 m	
Length Y	0,3 m	0,5 m	
Length Z	0,2 m		
Properties			
Volume	0,198 m³	2,e-002 m³	
Mass	455,4 kg	46, kg	
Centroid X	1,35 m	-0,2 m	2,9 m
Centroid Y	0,15 m	-0,25 m	
Centroid Z	0,1 m		
Moment of Inertia Ip1	4,9335 kg·m²	1,1117 kg·m²	
Moment of Inertia Ip2	414,79 kg·m²	0,30667 kg·m²	
Moment of Inertia Ip3	416,69 kg·m²	1,1117 kg·m²	
Statistics			
Nodes	820	784	
Elements	480	540	
Mesh Metric	None		

Coordinate Systems

TABLE 7
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, 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,]

Connections

TABLE 8
Model (A4) > Connections

Object Name	Connections
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

TABLE 9
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	8,5037e-003 m
Use Range	No
Face/Face	Yes
Face/Edge	No
Edge/Edge	No
Priority	Include All
Group By	Bodies
Search Across	Bodies
Statistics	
Connections	2
Active Connections	2

TABLE 10
Model (A4) > Connections > Contacts > Contact Regions

Object Name	Contact Region	Contact Region 2

State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Contact	1 Face	
Target	1 Face	
Contact Bodies	Concreto	
Target Bodies	Pilar1	Pilar2
Definition		
Type	Bonded	
Scope Mode	Automatic	
Behavior	Program Controlled	
Trim Contact	Program Controlled	
Trim Tolerance	8,5037e-003 m	
Maximum Offset	1,e-007 m	
Breakable	No	
Suppressed	No	
Advanced		
Formulation	Program Controlled	
Detection Method	Program Controlled	
Elastic Slip Tolerance	Program Controlled	
Normal Stiffness	Program Controlled	
Update Stiffness	Program Controlled	
Thermal Conductance	Program Controlled	
Electric Conductance	Program Controlled	
Pinball Region	Program Controlled	
Restitution Factor	1	

TABLE 11
Model (A4) > Connections > Body Interactions

Object Name	*Body Interactions*
State	Fully Defined
Advanced	
Contact Detection	Trajectory
Formulation	Penalty
Body Self Contact	Program Controlled
Element Self Contact	Program Controlled
Tolerance	0,2

TABLE 12
Model (A4) > Connections > Body Interactions > Body Interaction

Object Name	*Body Interaction*	*Body Interaction 2*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Frictionless	Reinforcement
Suppressed	No	

Mesh

TABLE 13
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	

Display Style	Body Color
Defaults	
Physics Preference	Explicit
Relevance	0
Sizing	
Use Advanced Size Function	Off
Relevance Center	Medium
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	High
Transition	Slow
Span Angle Center	Coarse
Minimum Edge Length	3,1416e-002 m
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
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Explicit
Element Midside Nodes	Dropped
Straight Sided Elements	
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Full Mesh
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	3072
Elements	1900
Mesh Metric	None

Explicit Dynamics (A5)

TABLE 14
Model (A4) > Analysis

Object Name	*Explicit Dynamics (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Explicit Dynamics
Solver Target	AUTODYN
Options	
Environment Temperature	22, °C

Generate Input Only	No

TABLE 15
Model (A4) > Explicit Dynamics (A5) > Initial Conditions

Object Name	Initial Conditions
State	Fully Defined

TABLE 16
Model (A4) > Explicit Dynamics (A5) > Initial Conditions > Initial Condition

Object Name	Pre-Stress (None)
State	Fully Defined
Definition	
Pre-Stress Environment	None
Pressure Initialization	From Deformed State

TABLE 17
Model (A4) > Explicit Dynamics (A5) > Analysis Settings

Object Name	Analysis Settings
State	Fully Defined
Analysis Settings Preference	
Type	Program Controlled
Step Controls	
Resume From Cycle	0
Maximum Number of Cycles	1e+07
End Time	5,e-003 s
Maximum Energy Error	0,1
Reference Energy Cycle	0
Initial Time Step	Program Controlled
Minimum Time Step	Program Controlled
Maximum Time Step	Program Controlled
Time Step Safety Factor	0,9
Characteristic Dimension	Diagonals
Automatic Mass Scaling	No
Solver Controls	
Solve Units	mm, mg, ms
Beam Solution Type	Bending
Beam Time Step Safety Factor	0,5
Hex Integration Type	Exact
Shell Sublayers	3
Shell Shear Correction Factor	0,8333
Shell BWC Warp Correction	Yes
Shell Thickness Update	Nodal
Tet Integration	Average Nodal Pressure
Shell Inertia Update	Recompute
Density Update	Program Controlled
Minimum Velocity	1,e-006 m s^-1
Maximum Velocity	1,e+010 m s^-1
Radius Cutoff	1,e-003
Minimum Strain Rate Cutoff	1,e-010
Euler Domain Controls	
Domain Size Definition	Program Controlled
Display Euler Domain	Yes

Scope	All Bodies
X Scale factor	1,2
Y Scale factor	1,2
Z Scale factor	1,2
Domain Resolution Definition	Total Cells
Total Cells	2,5e+05
Lower X Face	Flow Out
Lower Y Face	Flow Out
Lower Z Face	Flow Out
Upper X Face	Flow Out
Upper Y Face	Flow Out
Upper Z Face	Flow Out
Euler Tracking	By Body
Damping Controls	
Linear Artificial Viscosity	0,2
Quadratic Artificial Viscosity	1,
Linear Viscosity in Expansion	No
Artificial Viscosity For Shells	Yes
Hourglass Damping	AUTODYN Standard
Viscous Coefficient	0,1
Static Damping	0,
Erosion Controls	
On Geometric Strain Limit	Yes
Geometric Strain Limit	1,5
On Material Failure	No
On Minimum Element Time Step	No
Retain Inertia of Eroded Material	Yes
Output Controls	
Save Results on	Equally Spaced Points
Result Number Of Points	20
Save Restart Files on	Equally Spaced Points
Restart Number Of Points	5
Save Result Tracker Data on	Cycles
Tracker Cycles	1
Output Contact Forces	Off
Analysis Data Management	
Solver Files Directory	C:\Users\Raphael\Desktop\ANSYS Test\Trabalho MEF no Ansys\Trabalho_files\dp0\SYS\MECH\
Scratch Solver Files Directory	

TABLE 18
Model (A4) > Explicit Dynamics (A5) > Loads

Object Name	*Force*	*Fixed Support*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	2 Faces
Definition		
Type	Force	Fixed Support
Define By	Vector	

Magnitude	-7,e+006 N (step applied)	
Direction	Defined	
Suppressed	No	

FIGURE 1
Model (A4) > Explicit Dynamics (A5) > Force
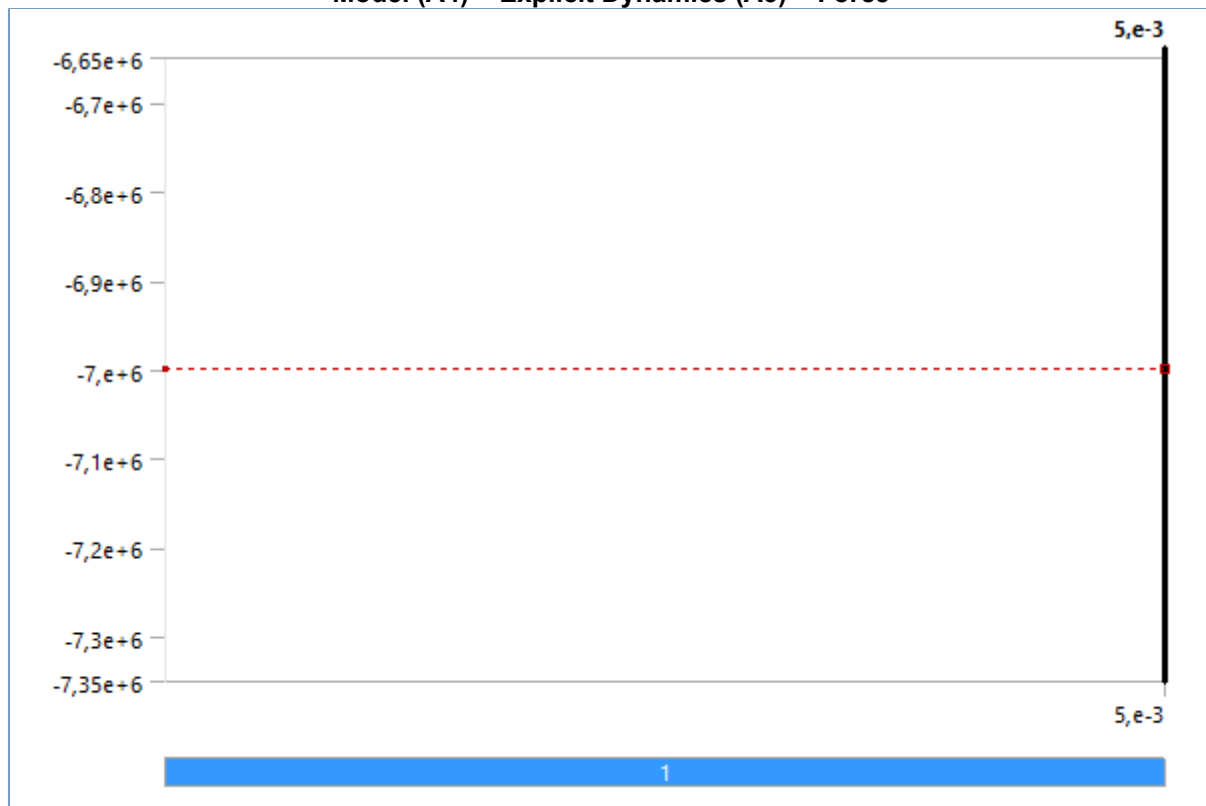
Solution (A6)

TABLE 19
Model (A4) > Explicit Dynamics (A5) > Solution

Object Name	Solution (A6)
State	Solved
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 20
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Solution Information

Object Name	Solution Information
State	Solved
Solution Information	
Solution Output	Solver Output
Update Interval	2,5 s
Display Points	All
Display Filter During Solve	Yes

TABLE 21
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Results

Object Name	Total Deformation	Vector Principal Stress	Directional Deformation
State		Solved	
Scope			

Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Total Deformation	Vector Principal Stress	Directional Deformation
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Orientation			X Axis
Coordinate System			Global Coordinate System
Results			
Minimum	0, m		-2,4321e-002 m
Maximum	9,1304e-016 m		2,4321e-002 m
Minimum Occurs On	Line Body		Concreto
Maximum Occurs On	Line Body		Concreto
Minimum Value Over Time			
Minimum	0, m		-2,4321e-002 m
Maximum	0, m		-9,0949e-016 m
Maximum Value Over Time			
Minimum	9,1304e-016 m		9,0949e-016 m
Maximum	0,13352 m		2,4321e-002 m
Information			
Time	1,1755e-038 s	5,0001e-003 s	
Set	1	21	
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

FIGURE 2
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Total Deformation
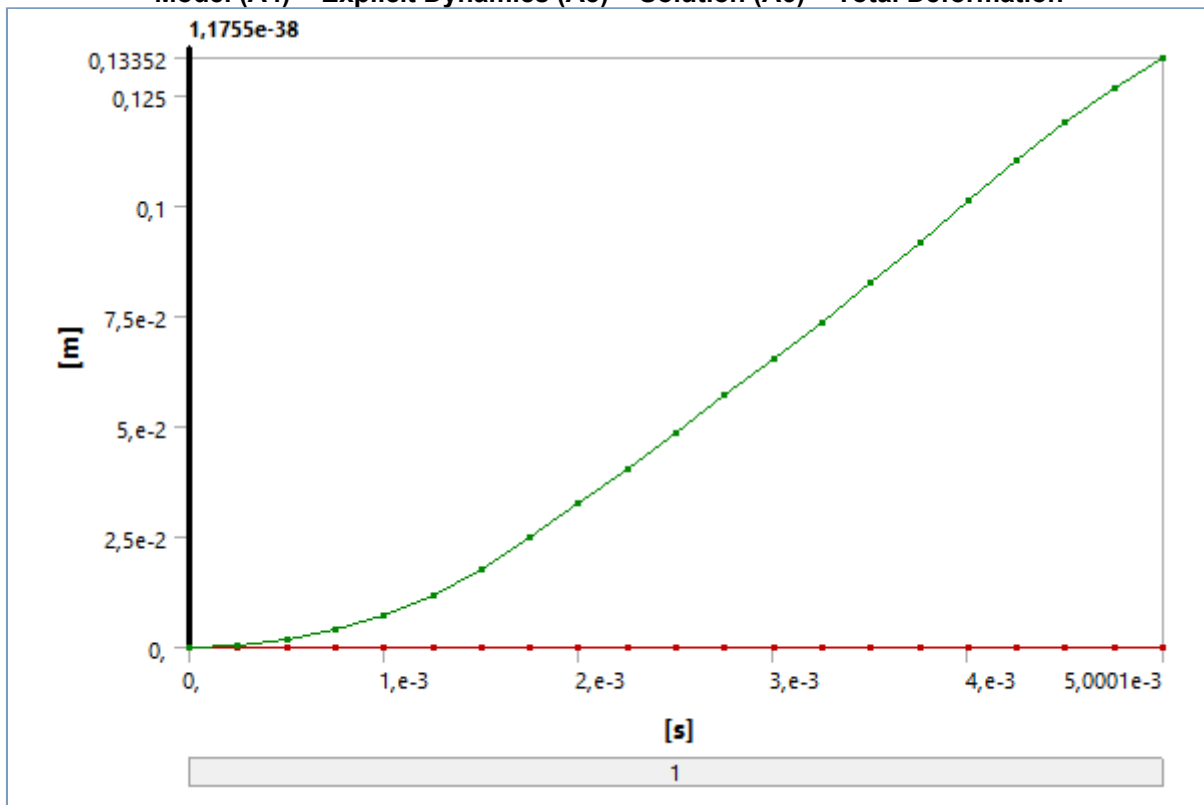
TABLE 22

Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Total Deformation

Time [s]	Minimum [m]	Maximum [m]
1,1755e-038		9,1304e-016
2,5041e-004		6,1559e-004
5,0071e-004		1,822e-003
7,5101e-004		4,1166e-003
1,0003e-003		7,4112e-003
1,2506e-003		1,1727e-002
1,5009e-003		1,7887e-002
1,7501e-003		2,4979e-002
2,0002e-003		3,2521e-002
2,2503e-003		4,0356e-002
2,5002e-003	0,	4,8651e-002
2,75e-003		5,7102e-002
3,0008e-003		6,5376e-002
3,2504e-003		7,37e-002
3,5001e-003		8,2569e-002
3,7505e-003		9,1947e-002
4,0008e-003		0,10136
4,2509e-003		0,1104
4,5008e-003		0,11881
4,7505e-003		0,1265
5,0001e-003		0,13352

FIGURE 3
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Directional Deformation
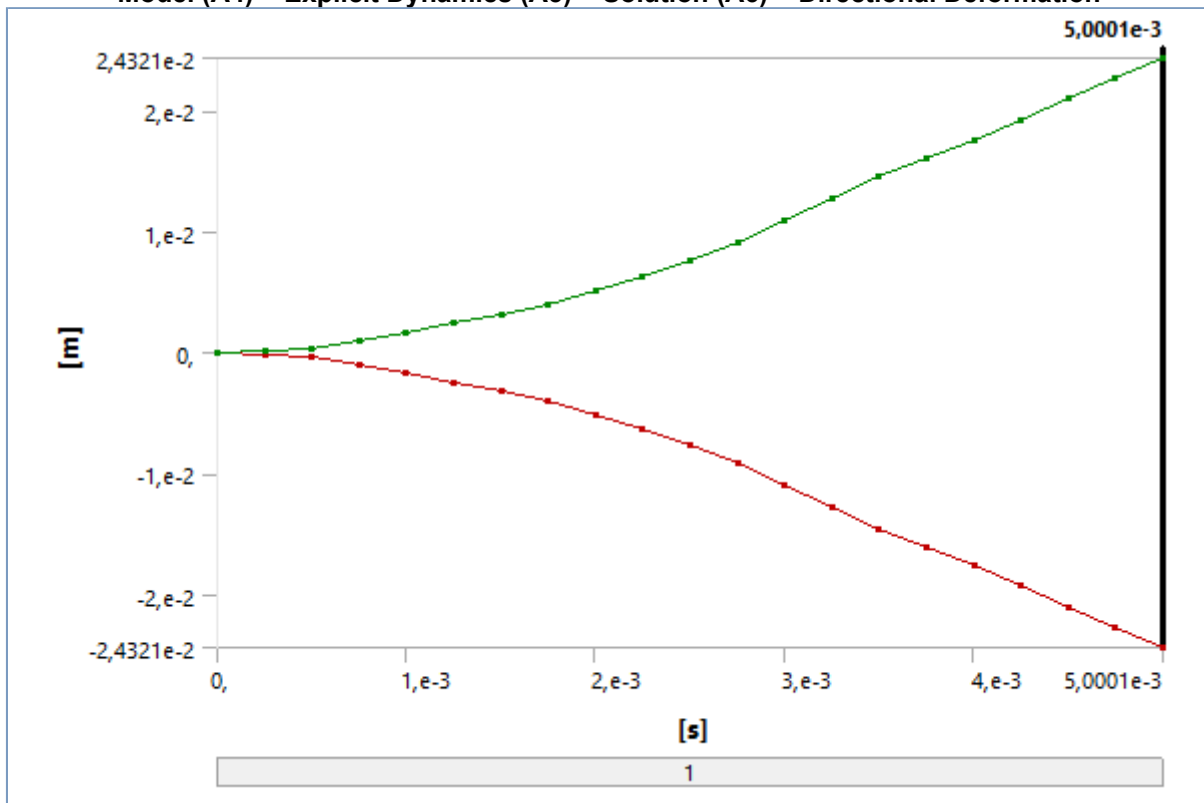
TABLE 23
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Directional Deformation

Time [s]	Minimum [m]	Maximum [m]
1,1755e-038	-9,0949e-016	9,0949e-016
2,5041e-004	-9,967e-005	9,967e-005
5,0071e-004	-2,8392e-004	2,8392e-004

7,5101e-004	-9,248e-004	9,248e-004
1,0003e-003	-1,6961e-003	1,6961e-003
1,2506e-003	-2,4087e-003	2,4087e-003
1,5009e-003	-3,1592e-003	3,1592e-003
1,7501e-003	-4,0112e-003	4,0112e-003
2,0002e-003	-5,0531e-003	5,0531e-003
2,2503e-003	-6,273e-003	6,273e-003
2,5002e-003	-7,6267e-003	7,6267e-003
2,75e-003	-9,1439e-003	9,1439e-003
3,0008e-003	-1,087e-002	1,087e-002
3,2504e-003	-1,2753e-002	1,2753e-002
3,5001e-003	-1,458e-002	1,458e-002
3,7505e-003	-1,6116e-002	1,6116e-002
4,0008e-003	-1,7523e-002	1,7523e-002
4,2509e-003	-1,9153e-002	1,9153e-002
4,5008e-003	-2,0936e-002	2,0936e-002
4,7505e-003	-2,2642e-002	2,2642e-002
5,0001e-003	-2,4321e-002	2,4321e-002

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 > Compressive Ultimate Strength

Compressive Ultimate Strength Pa
0,

TABLE 26
Structural Steel > Compressive Yield Strength

Compressive Yield Strength Pa
2,5e+008

TABLE 27
Structural Steel > Tensile Yield Strength

Tensile Yield Strength Pa
2,5e+008

TABLE 28
Structural Steel > Tensile Ultimate Strength

Tensile Ultimate Strength Pa
4,6e+008

TABLE 29
Structural Steel > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature C
22,

TABLE 30
Structural Steel > Alternating Stress Mean Stress

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 31
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 32
Structural Steel > Isotropic Elasticity

Temperature C	Young's Modulus Pa	Poisson's Ratio	Bulk Modulus Pa	Shear Modulus Pa
	2,e+011	0,3	1,6667e+011	7,6923e+010

TABLE 33
Structural Steel > Isotropic Relative Permeability

Relative Permeability
10000

Concrete

TABLE 34
Concrete > Constants

Density	2300, kg m^-3
Coefficient of Thermal Expansion	1,4e-005 C^-1
Specific Heat	780, J kg^-1 C^-1
Thermal Conductivity	0,72 W m^-1 C^-1

TABLE 35
Concrete > Compressive Ultimate Strength

Compressive Ultimate Strength Pa
4,1e+007

TABLE 36
Concrete > Compressive Yield Strength

Compressive Yield Strength Pa
0,

TABLE 37
Concrete > Tensile Yield Strength

Tensile Yield Strength Pa
0,

TABLE 38
Concrete > Tensile Ultimate Strength

Tensile Ultimate Strength Pa
5,e+006

TABLE 39
Concrete > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature C
22,

TABLE 40
Concrete > Isotropic Elasticity

Temperature C	Young's Modulus Pa	Poisson's Ratio	Bulk Modulus Pa	Shear Modulus Pa
	3,e+010	0,18	1,5625e+010	1,2712e+010