Frame Analysis Report

Analyzed File:	MecanumFrame2.iam
Version:	2018 (Build 220112000, 112)
Creation Date:	5/12/2017, 1:22 PM
Simulation Author:	P136265
Summary:	

Project Info (iProperties)

Summary

Author	Bryce Richards

Project

Part Number	MecanumFrame2
Designer	Bryce Richards
Cost	$0.00
Date Created	18/10/2017

Status

Design Status	WorkInProgress

Physical

Mass	15.104 kg
Area	24299.036 mm^2
Volume	1924.043 mm^3
Center of Gravity	x=1.408 mm y=0.000 mm z=66.257 mm

Simulation:1

General objective and settings:

Simulation Type	Static Analysis
Last Modification Date	5/12/2017, 1:20 PM

Material(s)

Name	Steel, Mild	
General	Mass Density	7.850 g/cm^3
	Yield Strength	207.000 MPa
	Ultimate Tensile Strength	345.000 MPa
Stress	Young's Modulus	220.000 GPa
	Poisson's Ratio	0.275 ul
Part Name(s)	AS C350L0 35x35x1.6 SHS 00000033.ipt AS C350L0 35x35x1.6 SHS 00000037.ipt AS C350L0 35x35x1.6 SHS 00000036.ipt AS C350L0 35x35x1.6 SHS 00000038.ipt AS C350L0 35x35x1.6 SHS 00000023.ipt AS C350L0 35x35x1.6 SHS 00000026.ipt AS C350L0 35x35x1.6 SHS 00000027.ipt AS C350L0 35x35x1.6 SHS 00000028.ipt AS C350L0 35x35x1.6 SHS 00000031.ipt AS C350L0 35x35x1.6 SHS 00000032.ipt AS C350L0 35x35x1.6 SHS 00000029.ipt AS C350L0 35x35x1.6 SHS 00000030.ipt AS C350L0 35x35x1.6 SHS 00000024.ipt AS C350L0 35x35x1.6 SHS 00000025.ipt AS C350L0 35x35x1.6 SHS 00000039.ipt AS C350L0 35x35x1.6 SHS 00000040.ipt AS C350L0 35x35x1.6 SHS 00000041.ipt AS C350L0 35x35x1.6 SHS 00000042.ipt	

Cross Section(s)

Geometry Properties	Section Area (A)	207.167 mm^2

	Section Width	35.000 mm
	Section Height	35.000 mm
	Section Centroid (x)	17.500 mm
	Section Centroid (y)	17.500 mm
Mechanical Properties	Moment of Inertia (I_x)	37886.231 mm^4
	Moment of Inertia (I_y)	37886.231 mm^4
	Torsional Rigidity Modulus (J)	56773.490 mm^4
	Section Modulus (W_x)	2164.927 mm^3
	Section Modulus (W_y)	2164.927 mm^3
	Torsional Section Modulus (W_z)	3250.771 mm^3
	Reduced Shear Area (A_x)	94.494 mm^2
	Reduced Shear Area (A_y)	94.494 mm^2
Part Name(s)	AS C350L0 35x35x1.6 SHS 00000033.ipt AS C350L0 35x35x1.6 SHS 00000037.ipt AS C350L0 35x35x1.6 SHS 00000036.ipt AS C350L0 35x35x1.6 SHS 00000038.ipt AS C350L0 35x35x1.6 SHS 00000023.ipt AS C350L0 35x35x1.6 SHS 00000026.ipt AS C350L0 35x35x1.6 SHS 00000027.ipt AS C350L0 35x35x1.6 SHS 00000028.ipt AS C350L0 35x35x1.6 SHS 00000031.ipt AS C350L0 35x35x1.6 SHS 00000032.ipt AS C350L0 35x35x1.6 SHS 00000029.ipt AS C350L0 35x35x1.6 SHS 00000030.ipt AS C350L0 35x35x1.6 SHS 00000024.ipt AS C350L0 35x35x1.6 SHS 00000025.ipt AS C350L0 35x35x1.6 SHS 00000039.ipt AS C350L0 35x35x1.6 SHS 00000040.ipt AS C350L0 35x35x1.6 SHS 00000041.ipt AS C350L0 35x35x1.6 SHS 00000042.ipt	

Beam Model

Nodes	38
Beams	18
- Square/Rectangular Tubes	18

Rigid Links

Name	Displacement			Rotation			Parent Node	Child Node(s)
	X - axis	Y - axis	Z - axis	X - axis	Y - axis	Z - axis		
Rigid Link:1	fixed	fixed	fixed	fixed	fixed	fixed	Node:1	Node:18, Node:8
Rigid Link:2	fixed	fixed	fixed	fixed	fixed	fixed	Node:2	Node:19, Node:3
Rigid Link:4	fixed	fixed	fixed	fixed	fixed	fixed	Node:6	Node:23, Node:7
Rigid Link:5	fixed	fixed	fixed	fixed	fixed	fixed	Node:9	Node:17, Node:16
Rigid Link:6	fixed	fixed	fixed	fixed	fixed	fixed	Node:10	Node:20, Node:13
Rigid Link:7	fixed	fixed	fixed	fixed	fixed	fixed	Node:11	Node:21, Node:14
Rigid Link:8	fixed	fixed	fixed	fixed	fixed	fixed	Node:12	Node:24, Node:15
Rigid Link:3	fixed	fixed	fixed	fixed	fixed	fixed	Node:4	Node:22, Node:5
Rigid Link:9	fixed	fixed	fixed	fixed	fixed	fixed	Node:29	Node:37
Rigid Link:10	fixed	fixed	fixed	fixed	fixed	fixed	Node:30	Node:38

Operating conditions

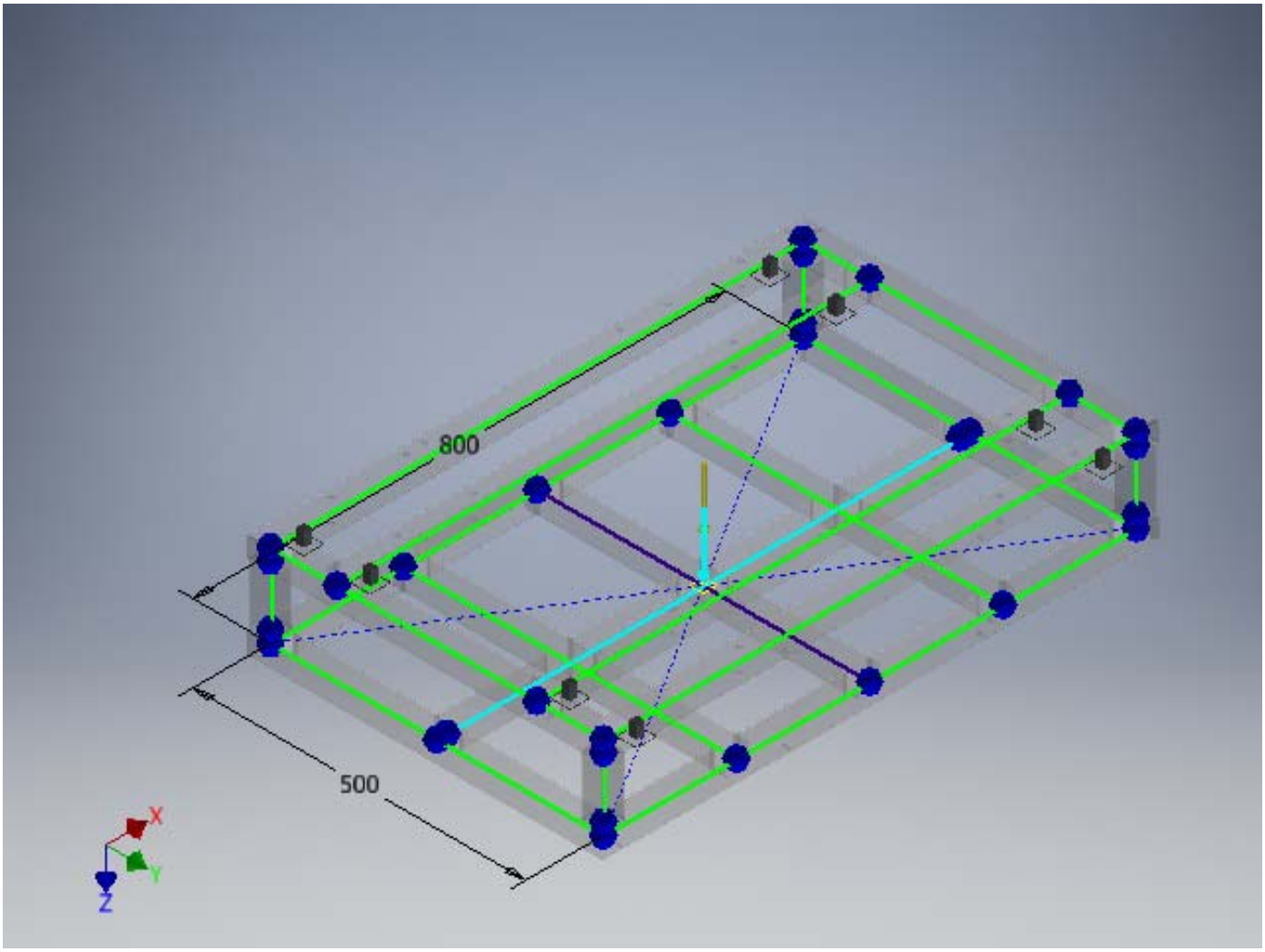
Gravity

Load Type	Gravity
Magnitude	9810.000 mm/s^2
Direction	Z+

Force:2

Load Type	Force
Magnitude	9810.000 N
Beam Coordinate System	No
Angle of Plane	0.00 deg
Angle in Plane	0.00 deg
Fx	0.000 N
Fy	0.000 N
Fz	9810.000 N
Offset	385.000 mm

Selected Reference(s)


800
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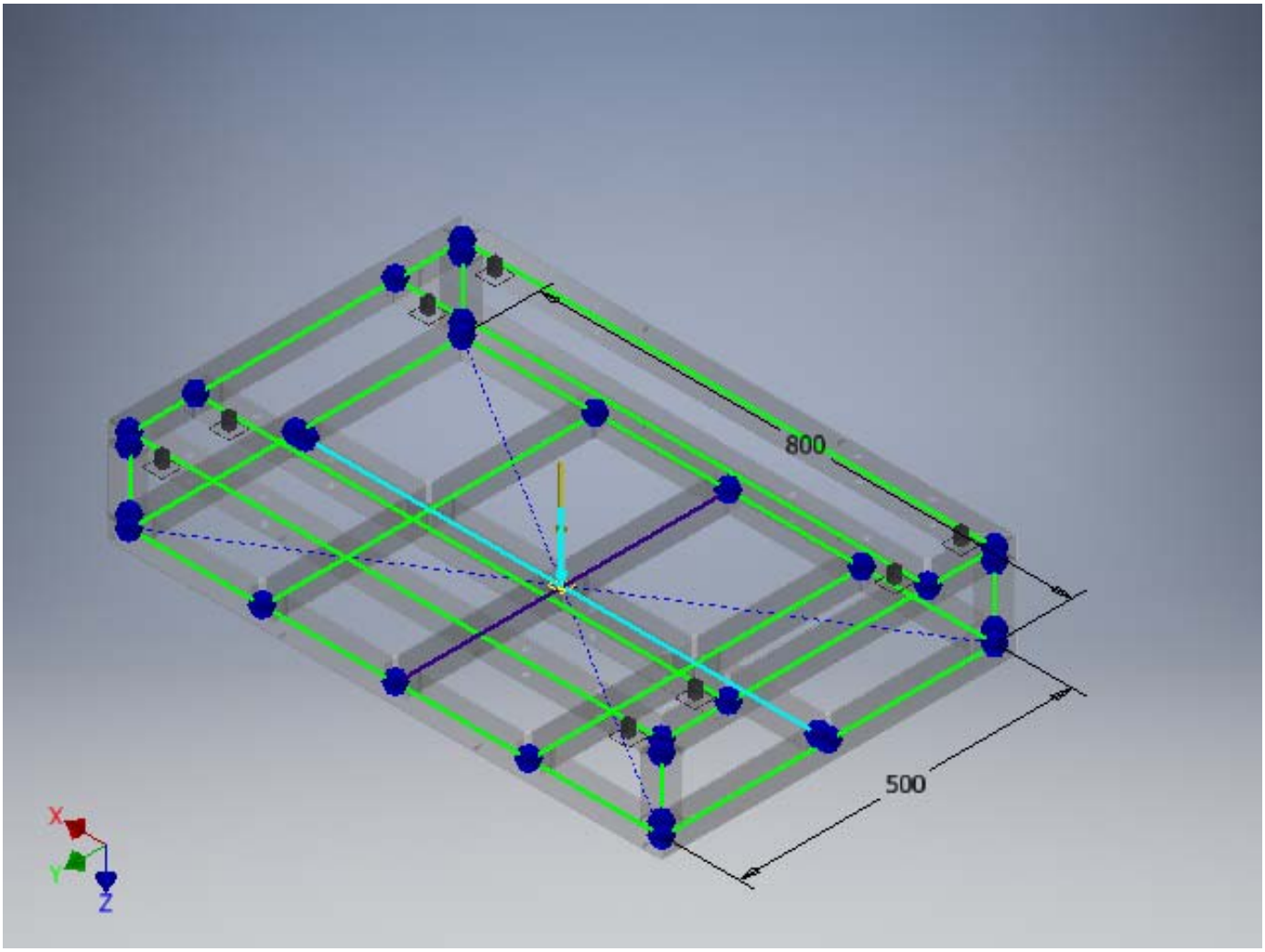
X
Y
Z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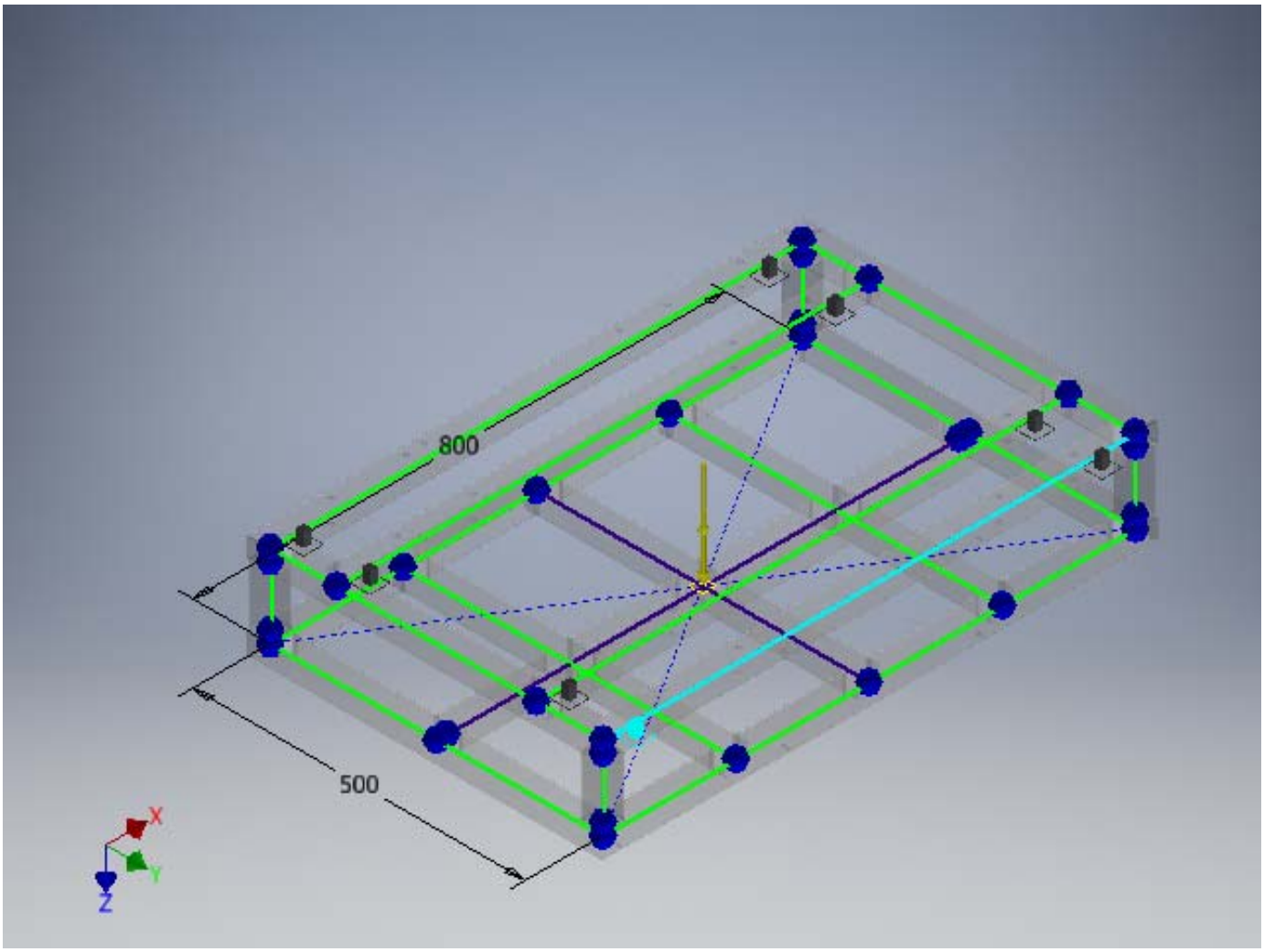
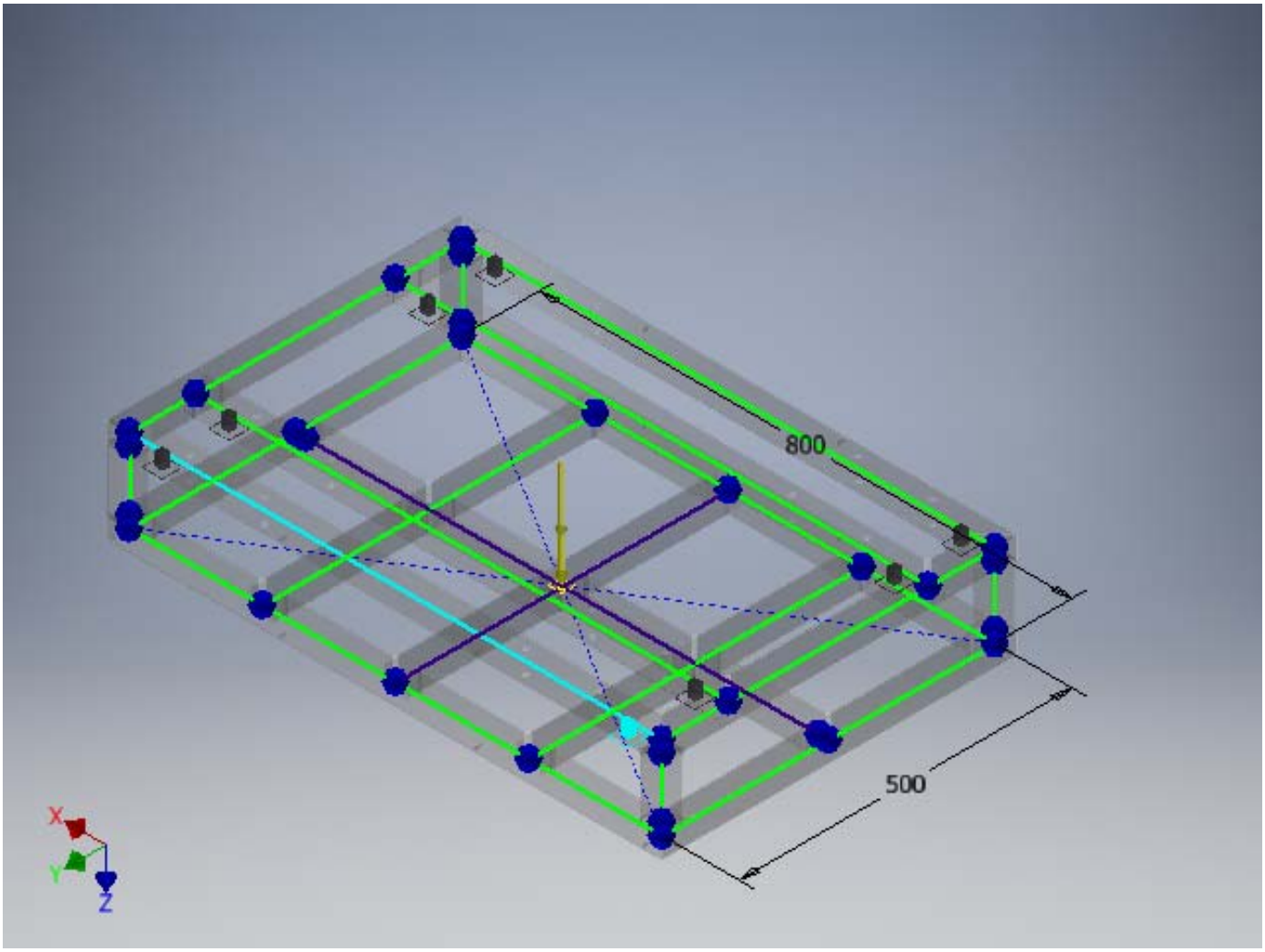
Z

⊟ Fixed Constraint:1

Constraint Type	Fixed
Offset	50.000 mm

⊟ Selected Reference(s)

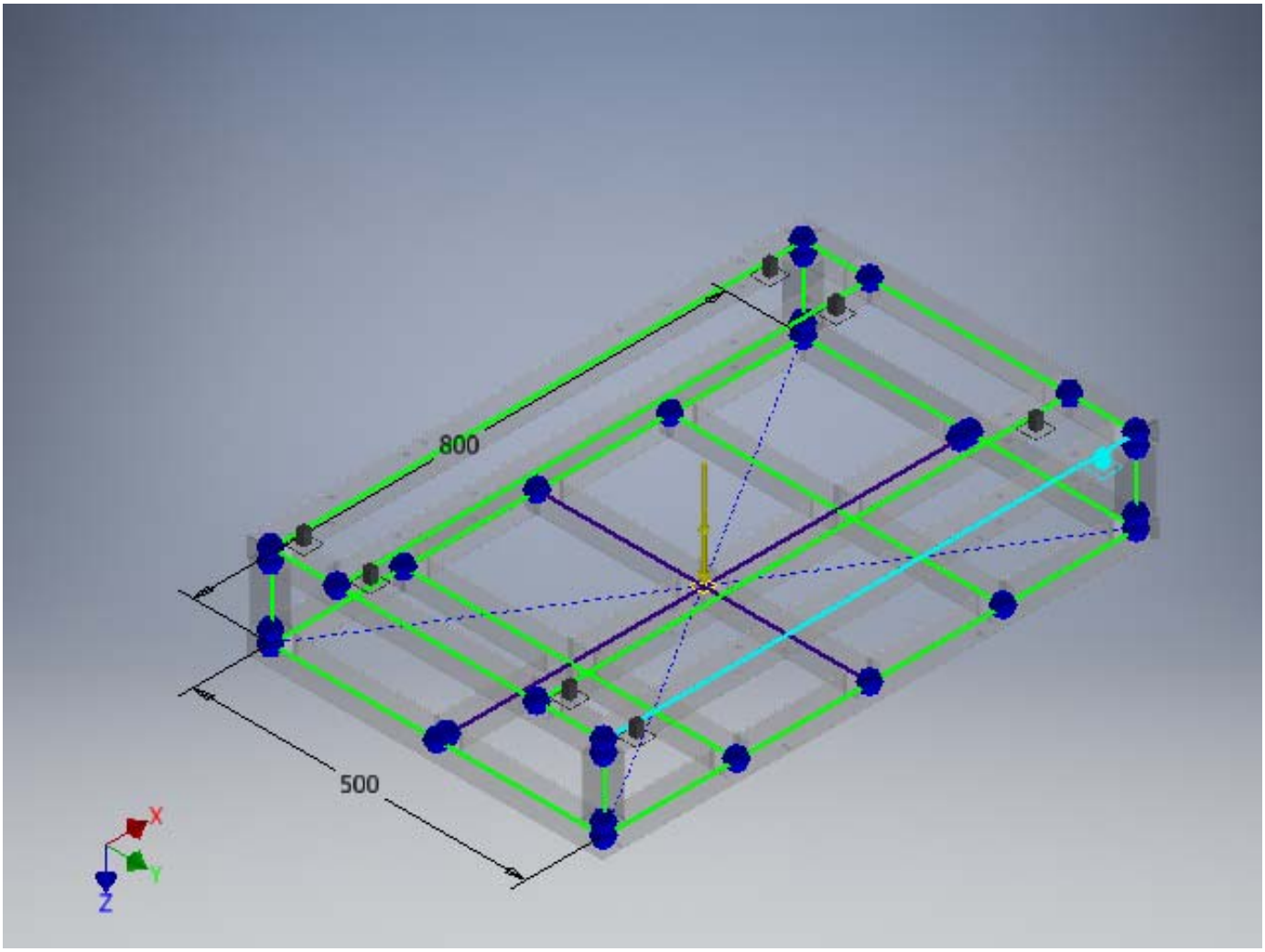




⊟ Fixed Constraint:2

Constraint Type	Fixed
Offset	750.000 mm

⊟ Selected Reference(s)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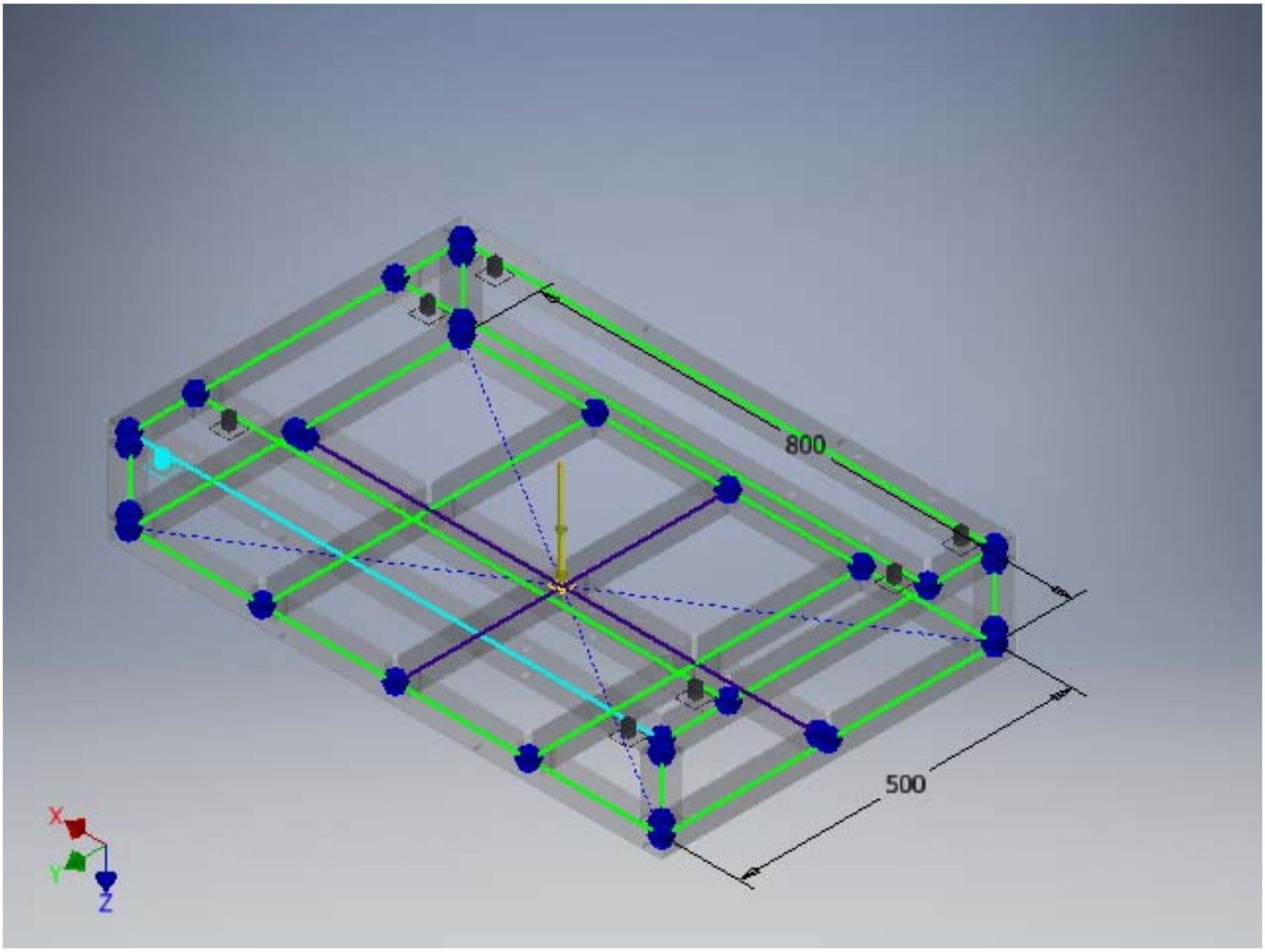
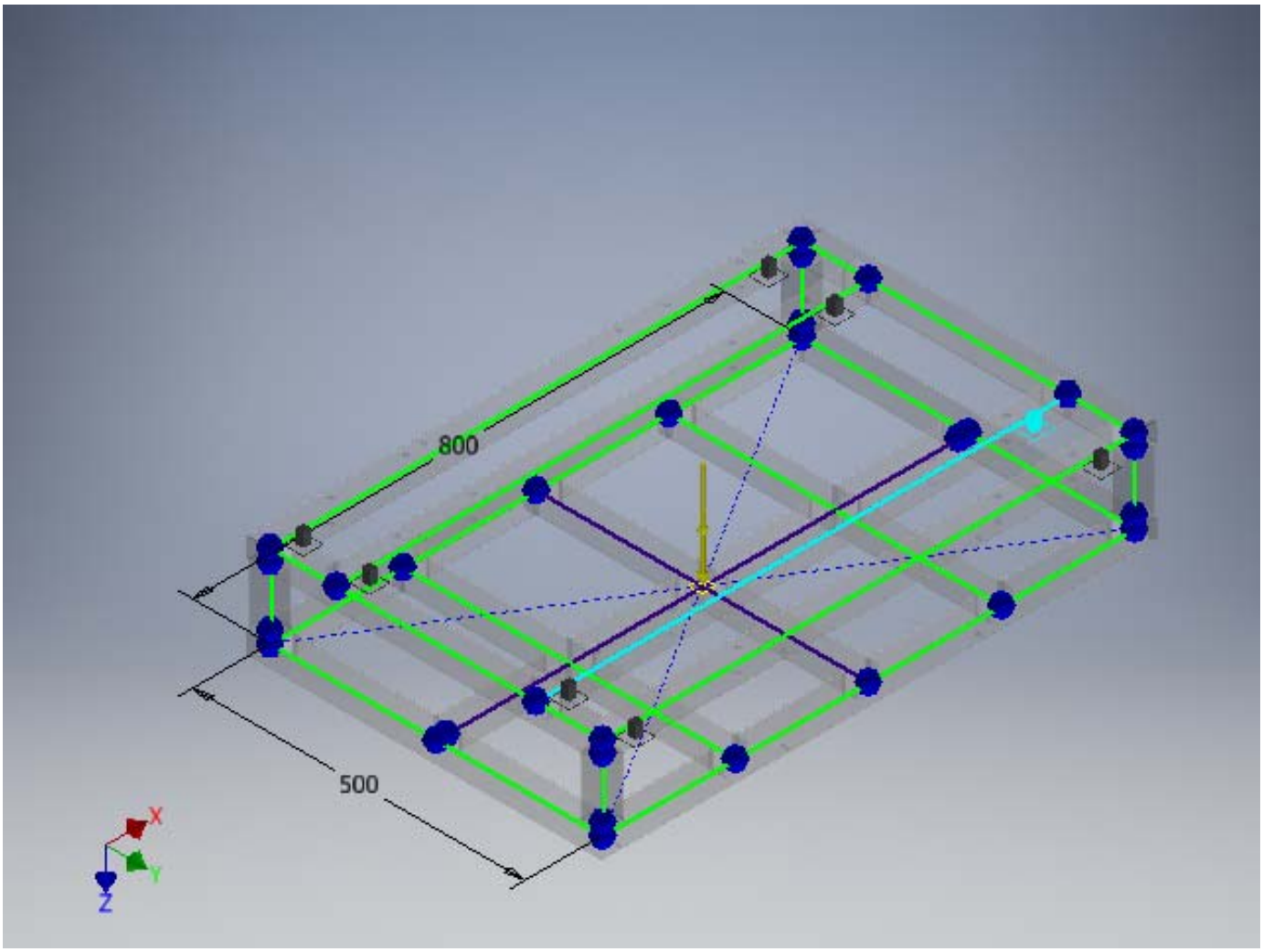
X
Y
Z

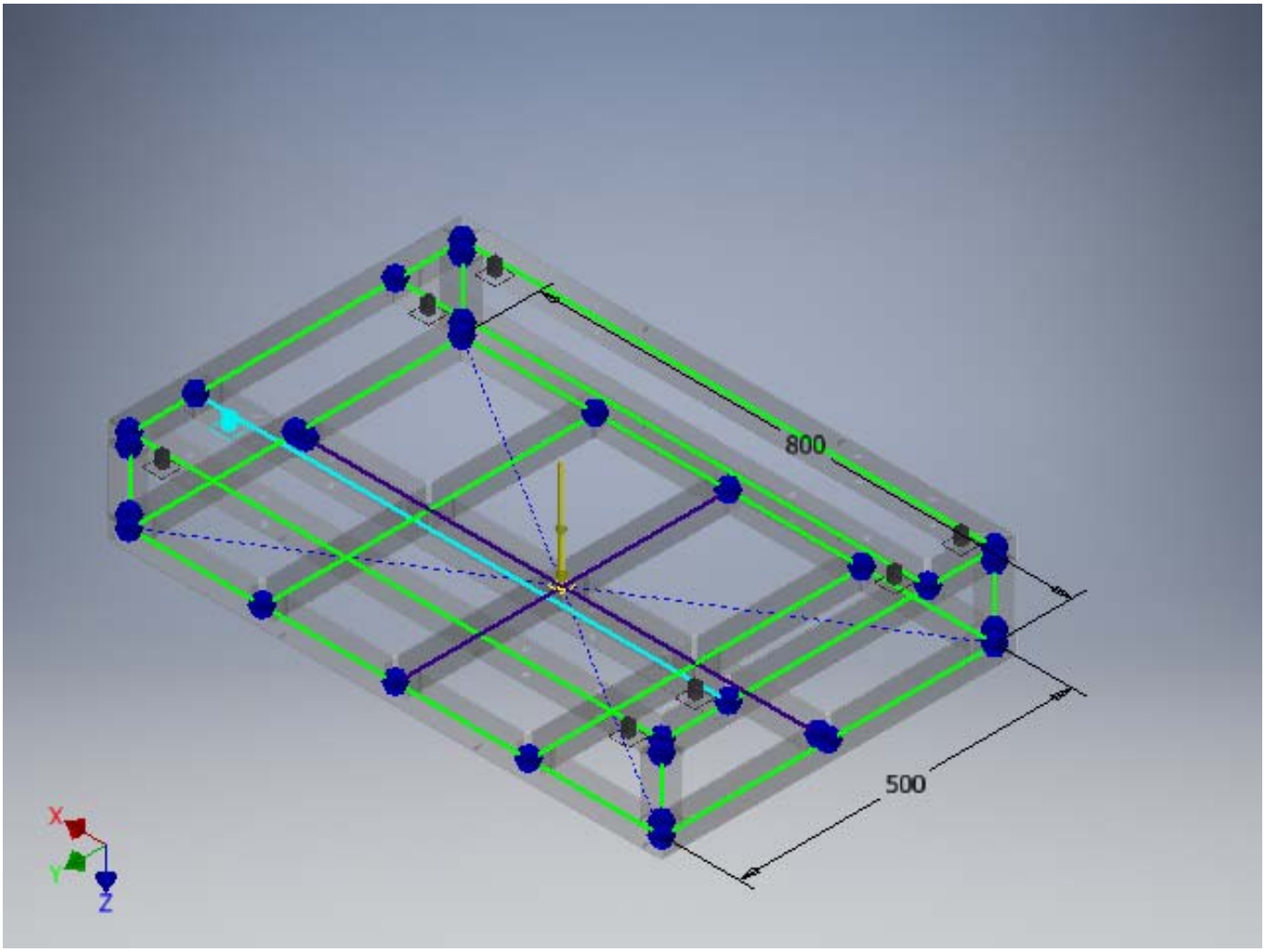

800
500
X
Y
Z

⊟ Fixed Constraint:3

Constraint Type	Fixed
Offset	50.000 mm

⊟ Selected Reference(s)

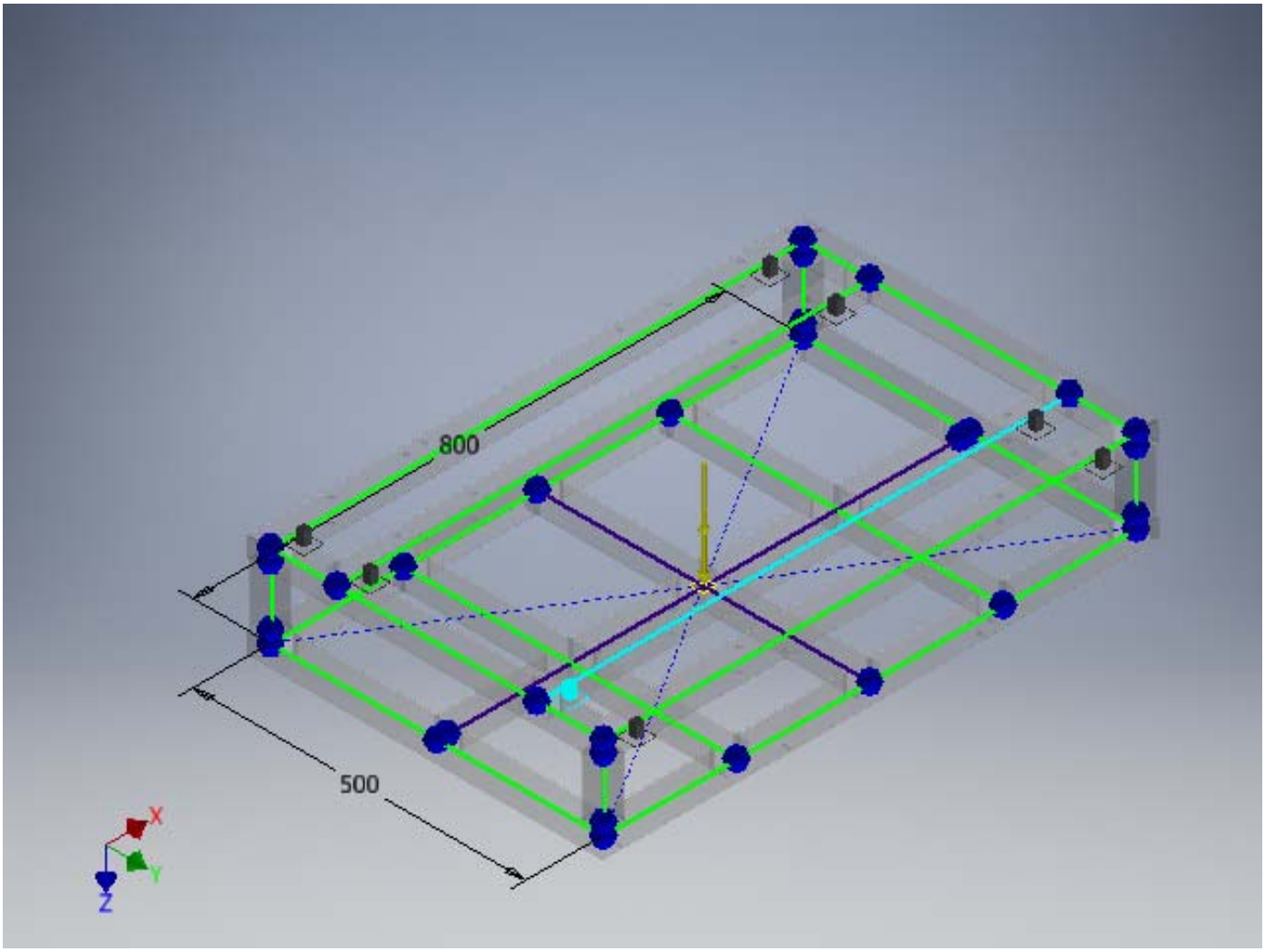


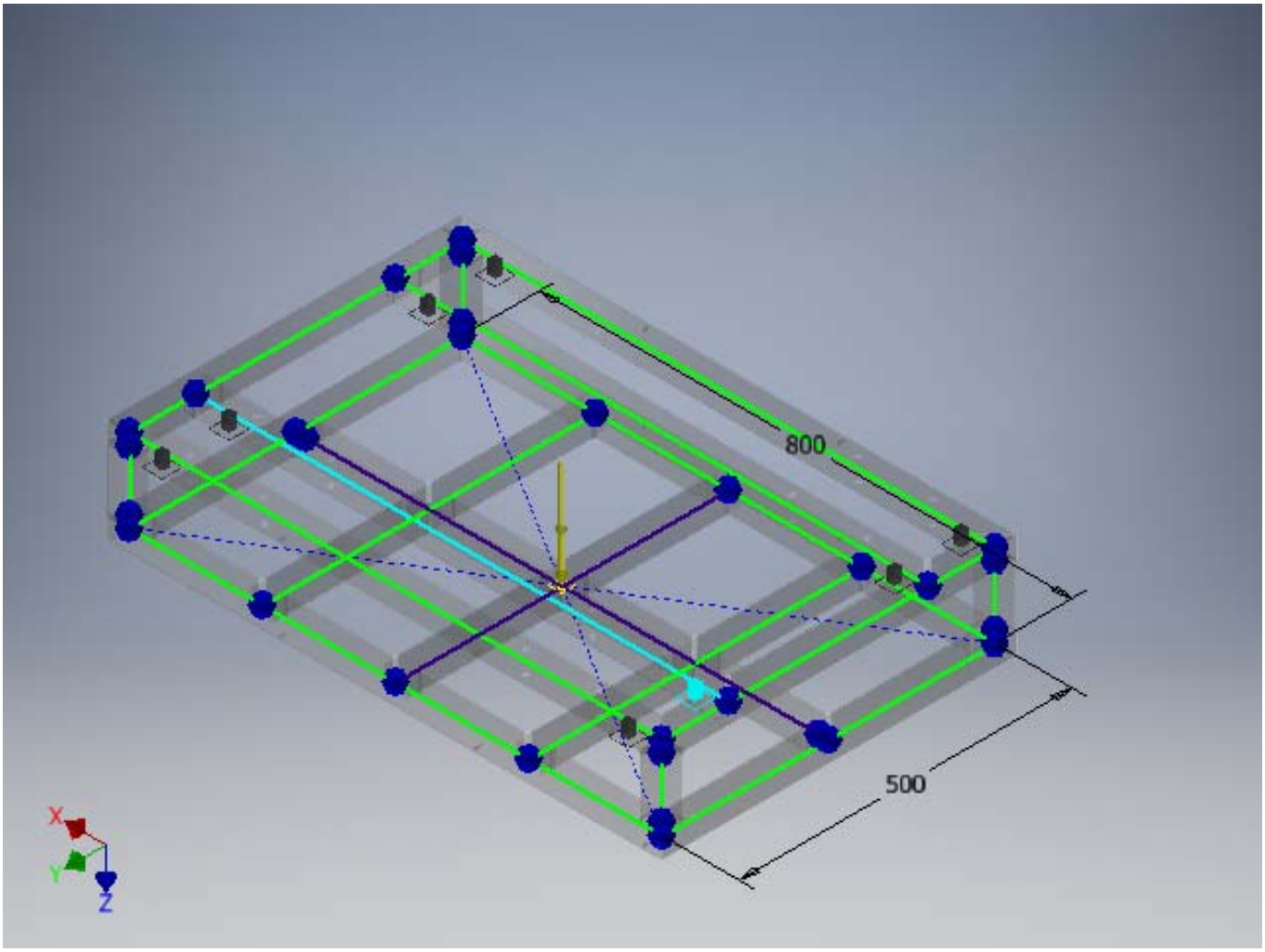


⊟ Fixed Constraint:4

Constraint Type	Fixed
Offset	750.000 mm

⊟ Selected Reference(s)

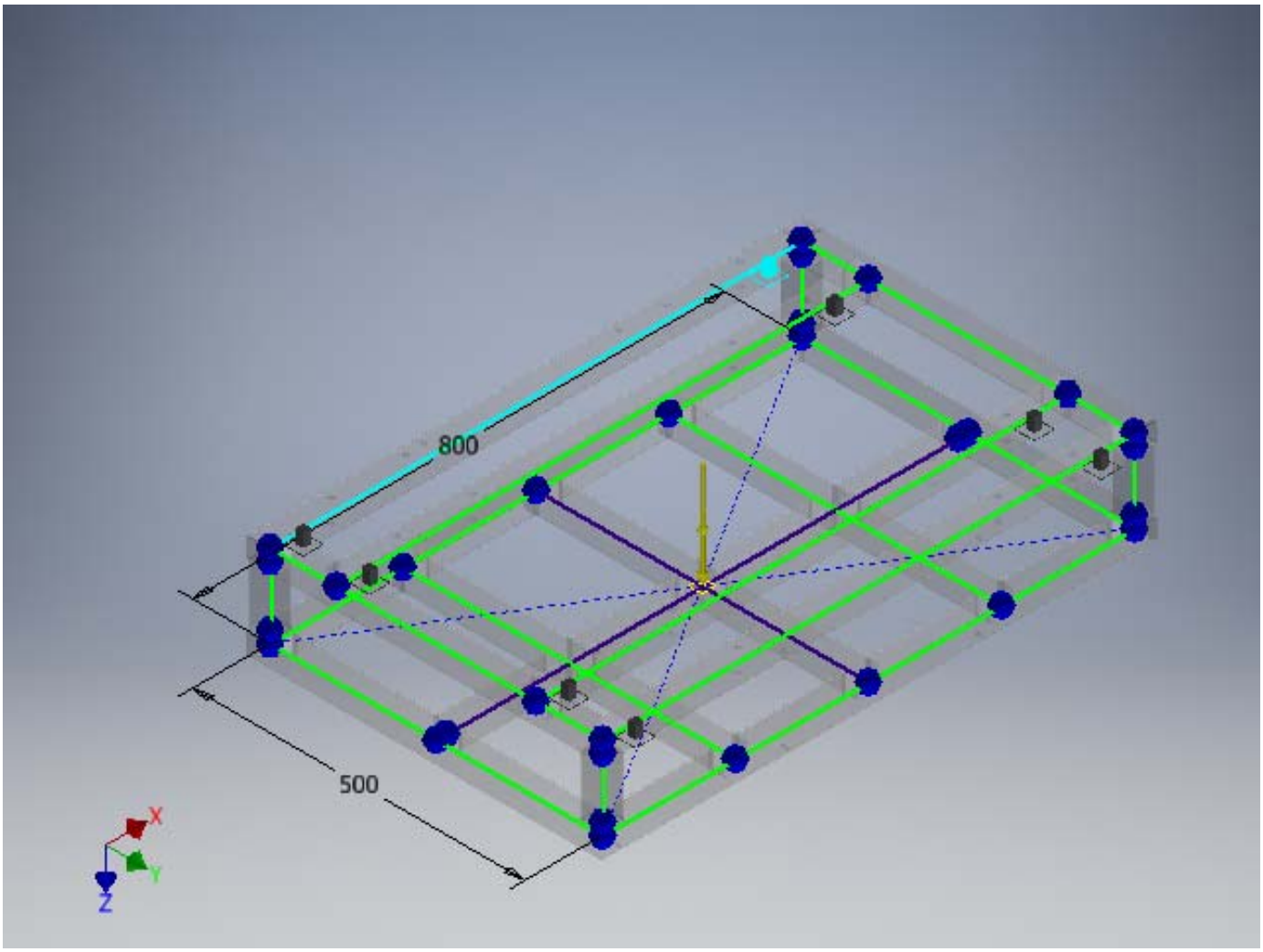

800
500
X
Y
Z

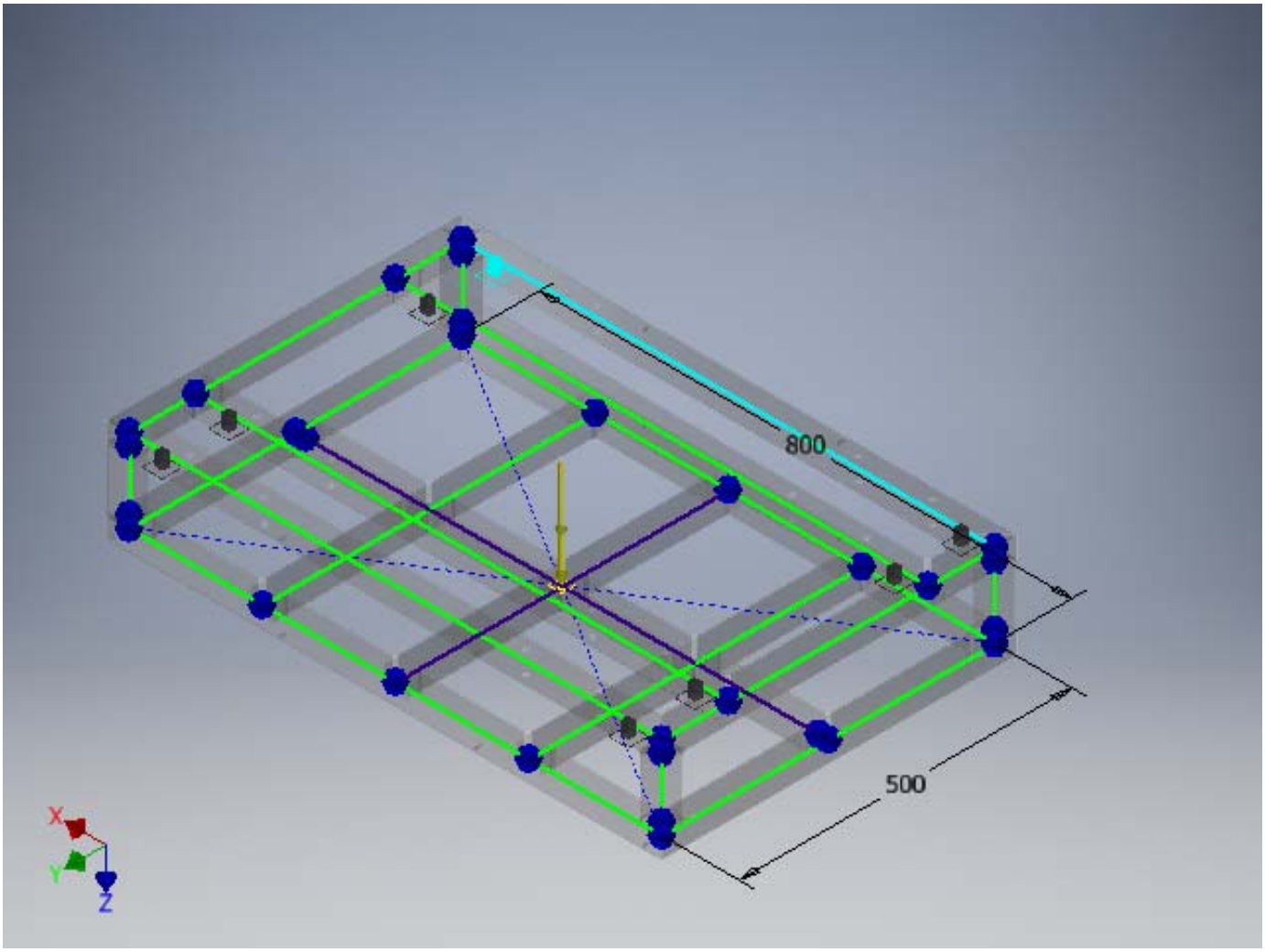

800
500
X
Y
Z

⊟ Fixed Constraint:5

Constraint Type	Fixed
Offset	50.000 mm

⊟ Selected Reference(s)

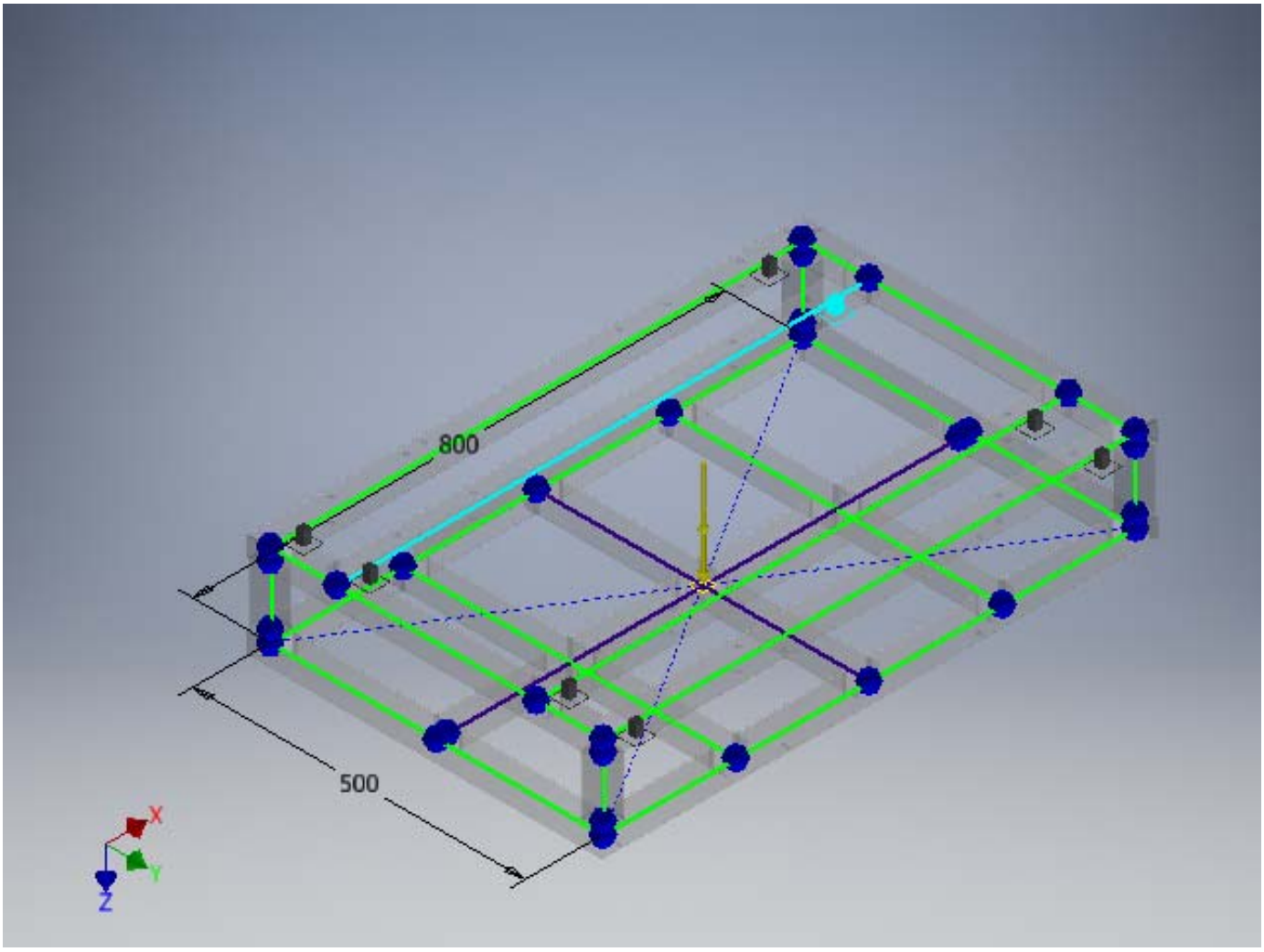


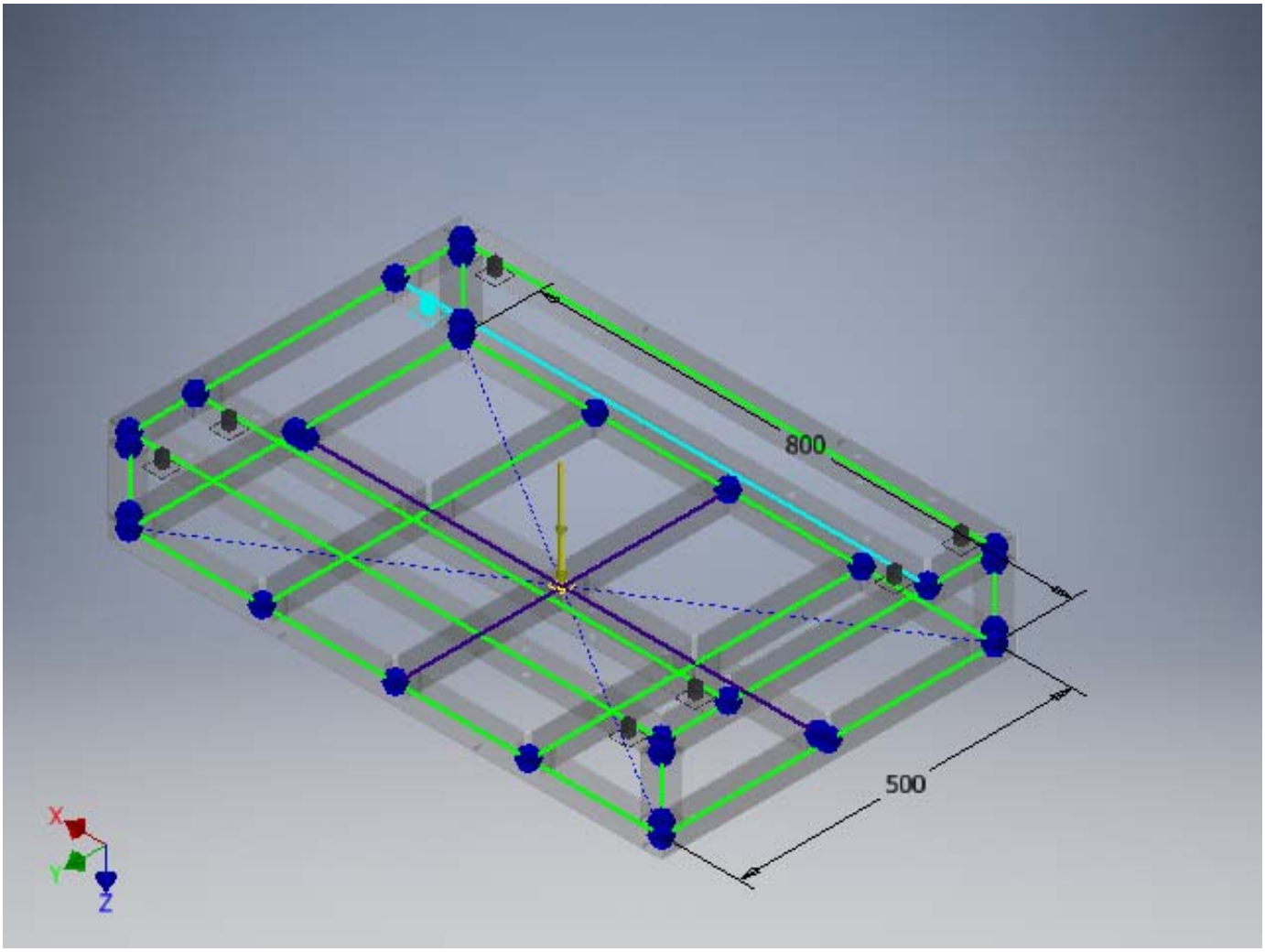


⊟ Fixed Constraint:6

Constraint Type	Fixed
Offset	750.000 mm

⊟ Selected Reference(s)

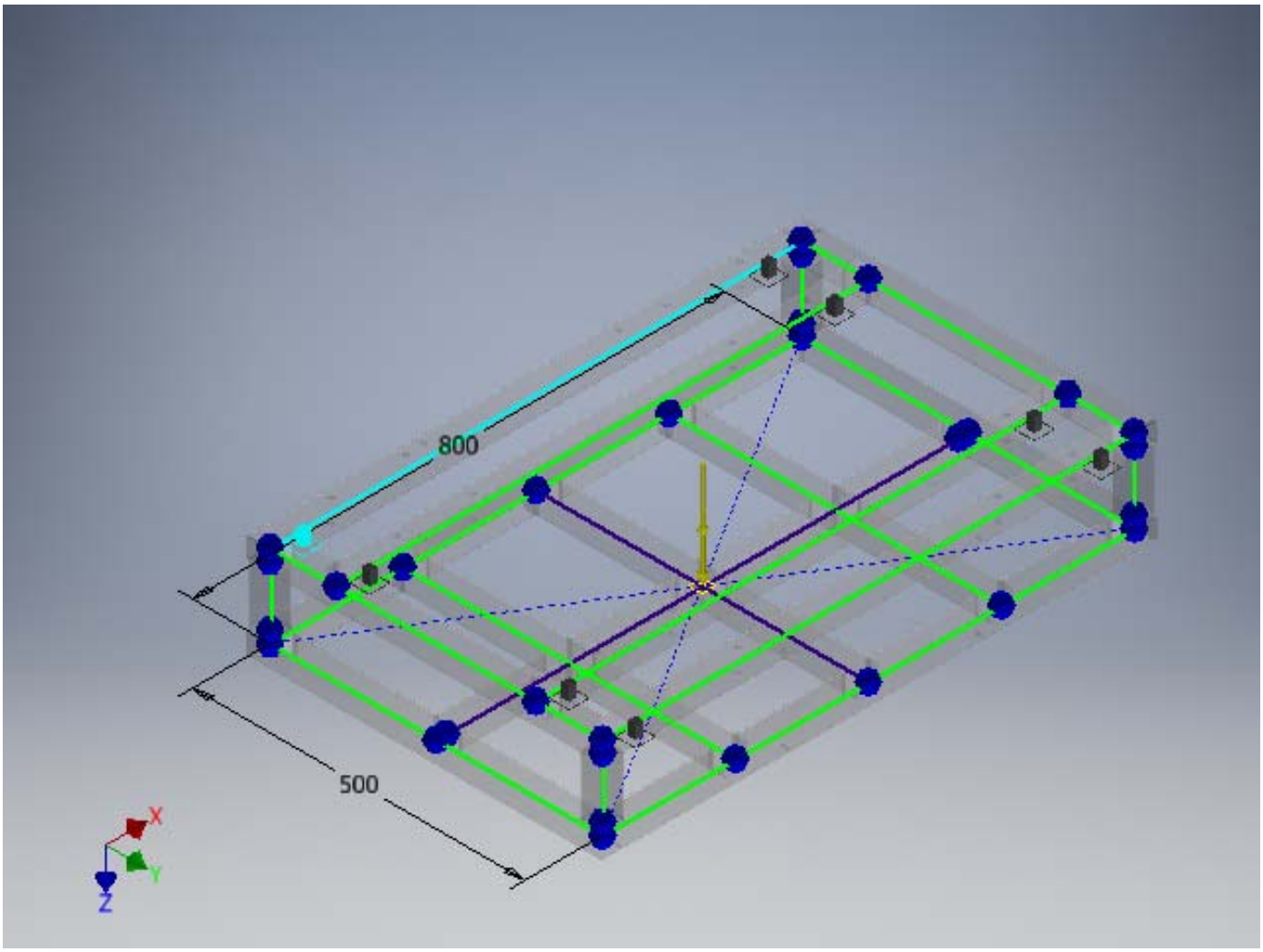

800
500
X
Y
Z

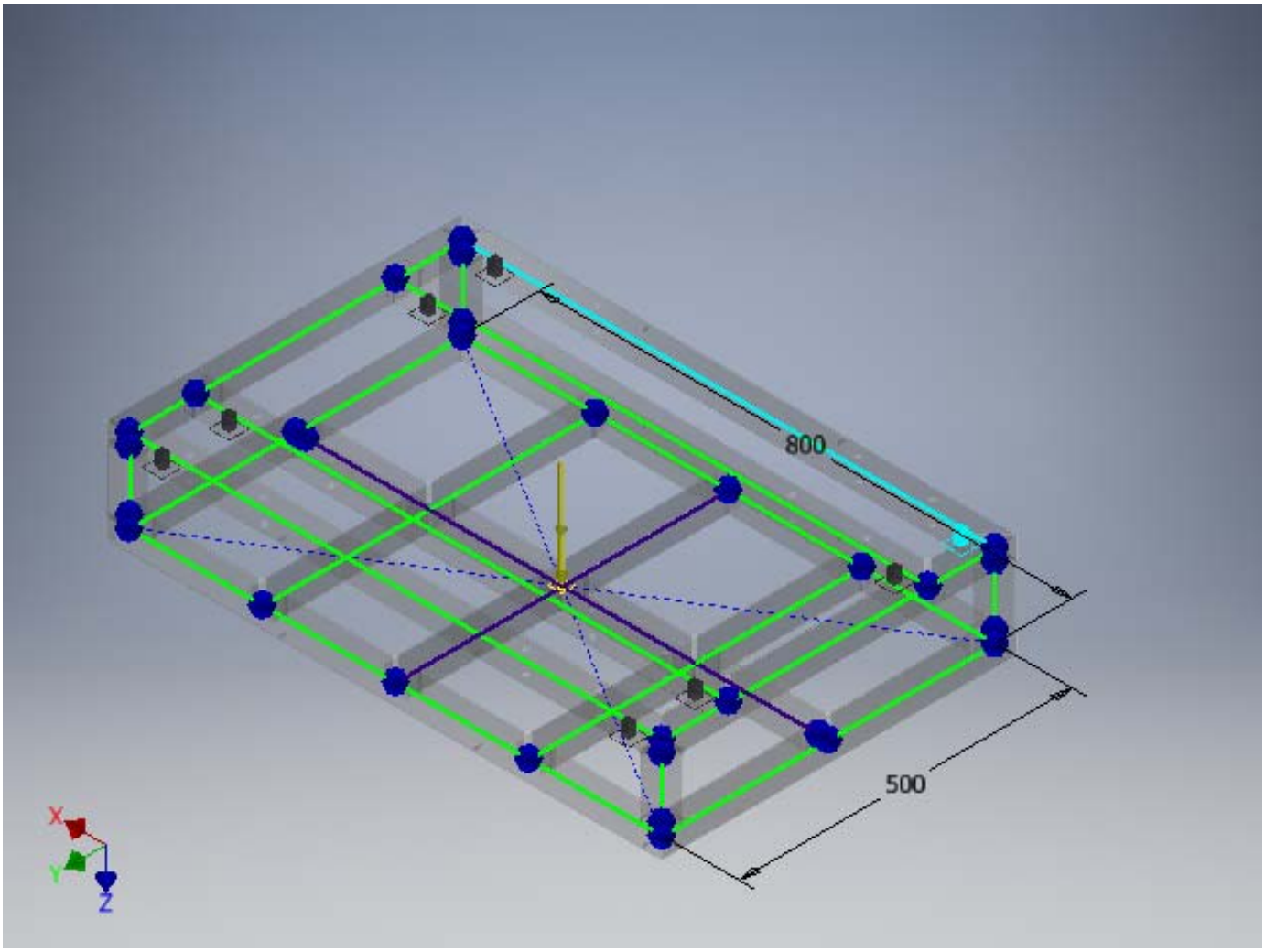

800
500
X
Y
Z

⊟ Fixed Constraint:7

Constraint Type	Fixed
Offset	750.000 mm

⊟ Selected Reference(s)

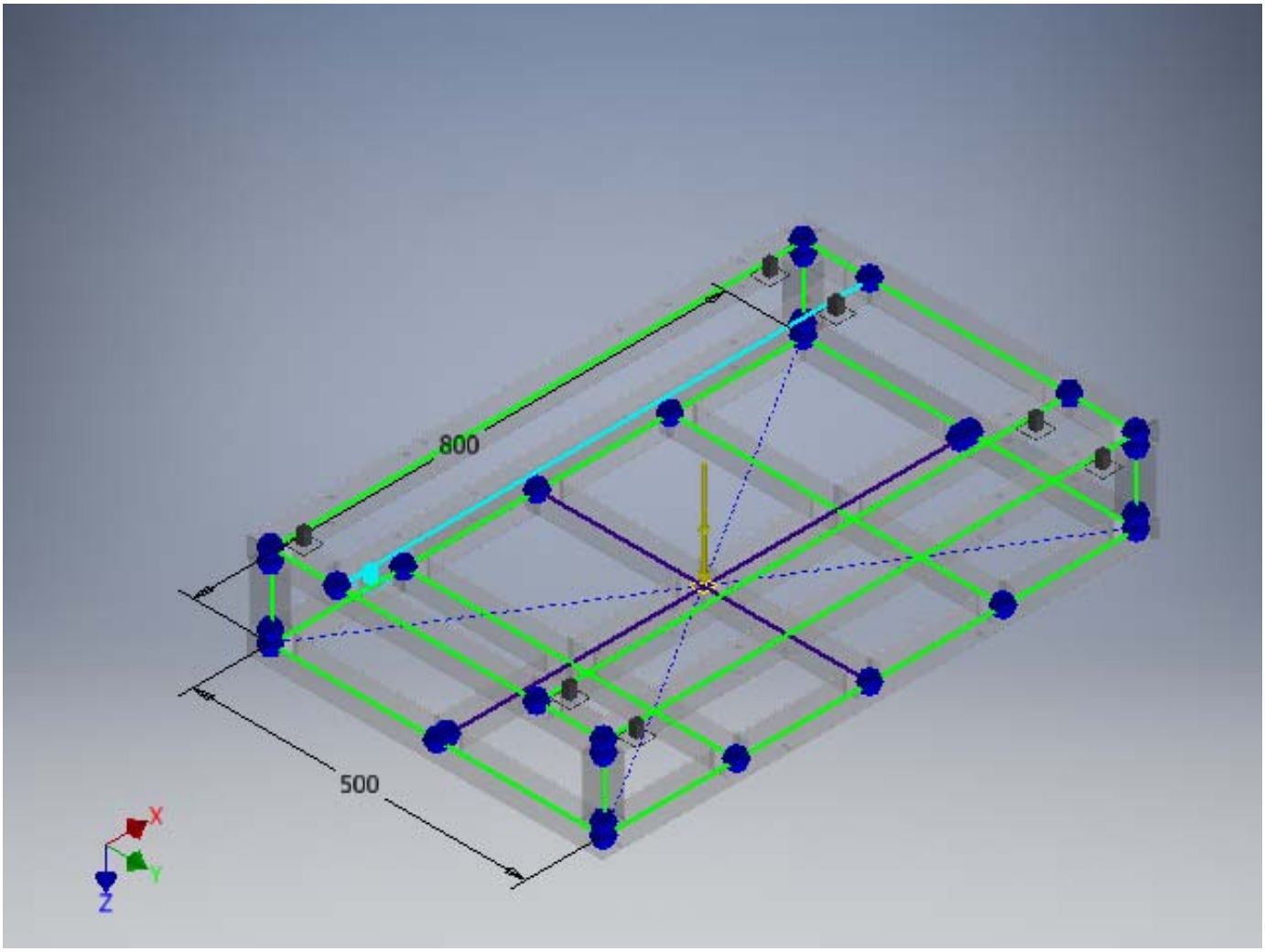


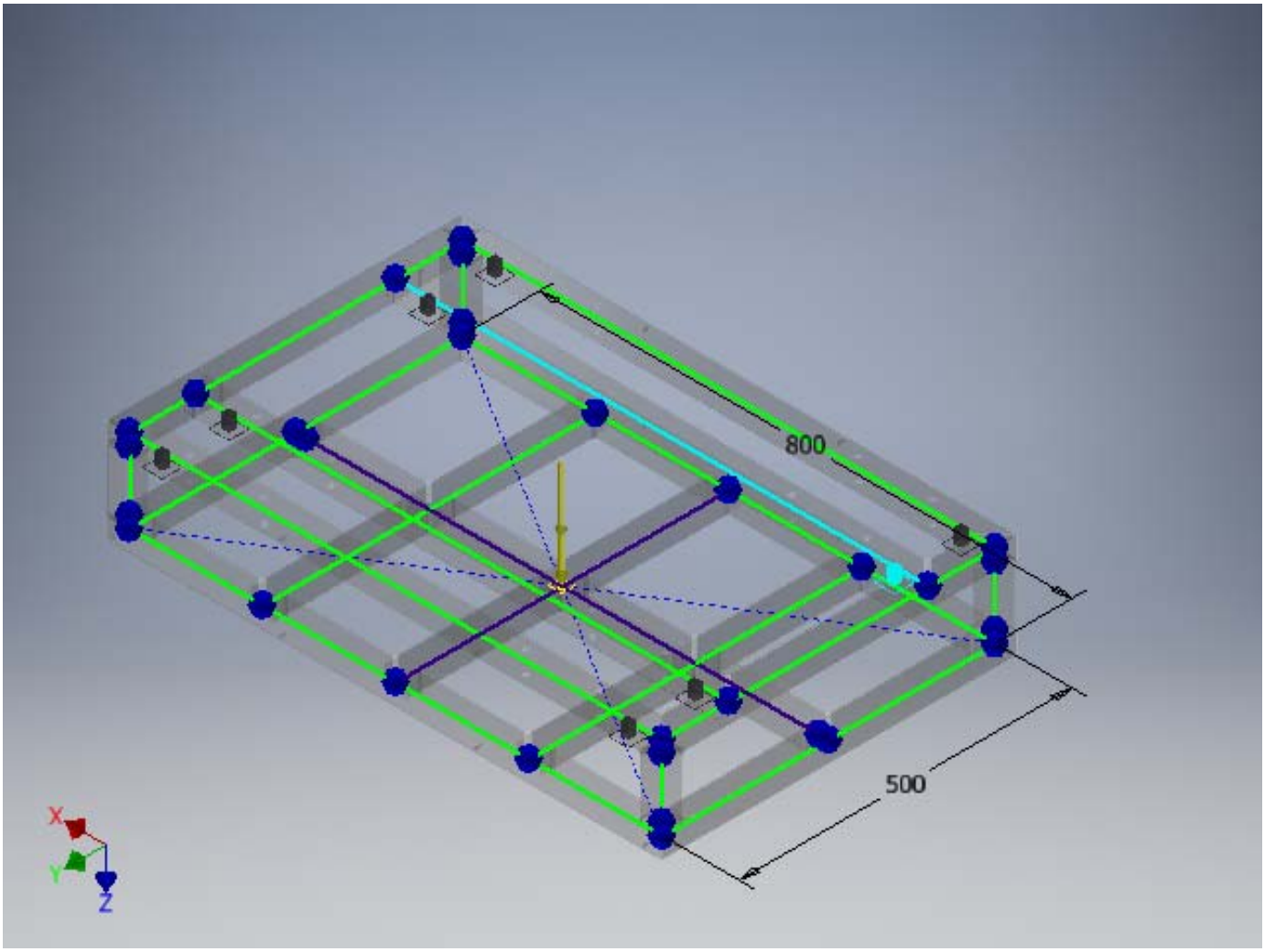


⊟ Fixed Constraint:8

Constraint Type	Fixed
Offset	50.000 mm

⊟ Selected Reference(s)


800
500
X
Y
Z


800
500
X
Y
Z

Results

Reaction Force and Moment on Constraints

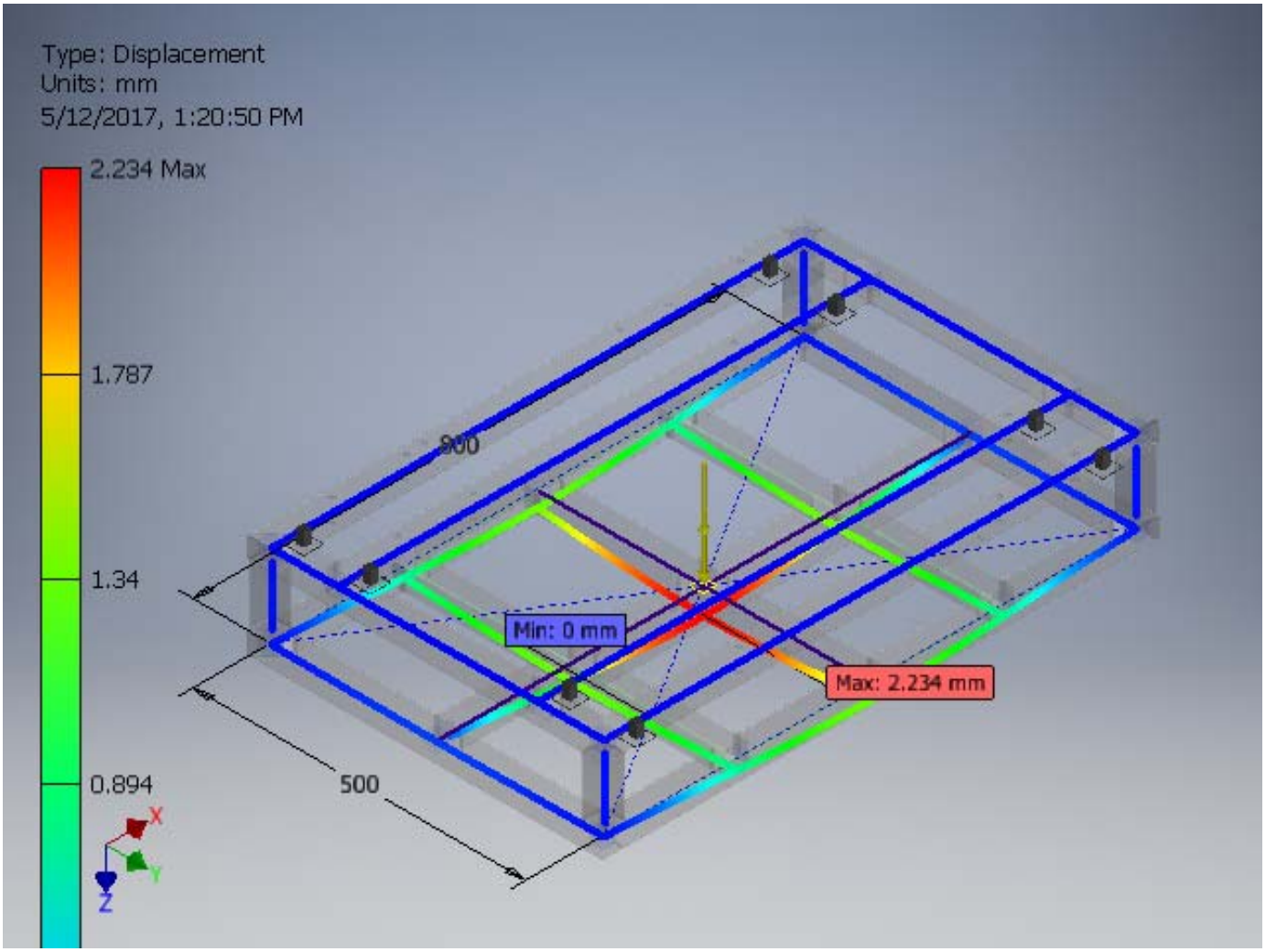
Constraint Name	Reaction Force		Reaction Moment	
	Magnitude	Components (Fx,Fy,Fz)	Magnitude	Components (Mx,My,Mz)
Fixed Constraint:1	4139.730 N	-3334.022 N	144728.396 N mm	-14821.158 N mm
		624.374 N		-142981.217 N mm
		-2373.145 N		-16823.006 N mm
Fixed Constraint:2	4146.483 N	3333.050 N	144806.508 N mm	-14871.551 N mm
		628.683 N		143038.605 N mm
		-2385.132 N		16962.289 N mm
Fixed Constraint:3	490.325 N	294.247 N	25153.721 N mm	-7265.628 N mm
		376.478 N		23083.655 N mm
		-110.009 N		6860.407 N mm
Fixed Constraint:4	488.724 N	-293.275 N	25274.558 N mm	-7287.975 N mm
		374.578 N		-23224.587 N mm
		-111.947 N		-6804.947 N mm
Fixed Constraint:5	4146.483 N	3333.050 N	144806.508 N mm	14871.551 N mm
		-628.683 N		143038.605 N mm
		-2385.132 N		-16962.289 N mm
Fixed Constraint:6	490.325 N	294.247 N	25153.721 N mm	7265.628 N mm
		-376.478 N		23083.655 N mm
		-110.009 N		-6860.407 N mm
Fixed Constraint:7	4139.730 N	-3334.022 N	144728.396 N mm	14821.158 N mm
		-624.374 N		-142981.217 N mm
		-2373.145 N		16823.006 N mm
Fixed Constraint:8	488.724 N	-293.275 N	25274.558 N mm	7287.975 N mm
		-374.578 N		-23224.587 N mm
		-111.947 N		6804.947 N mm

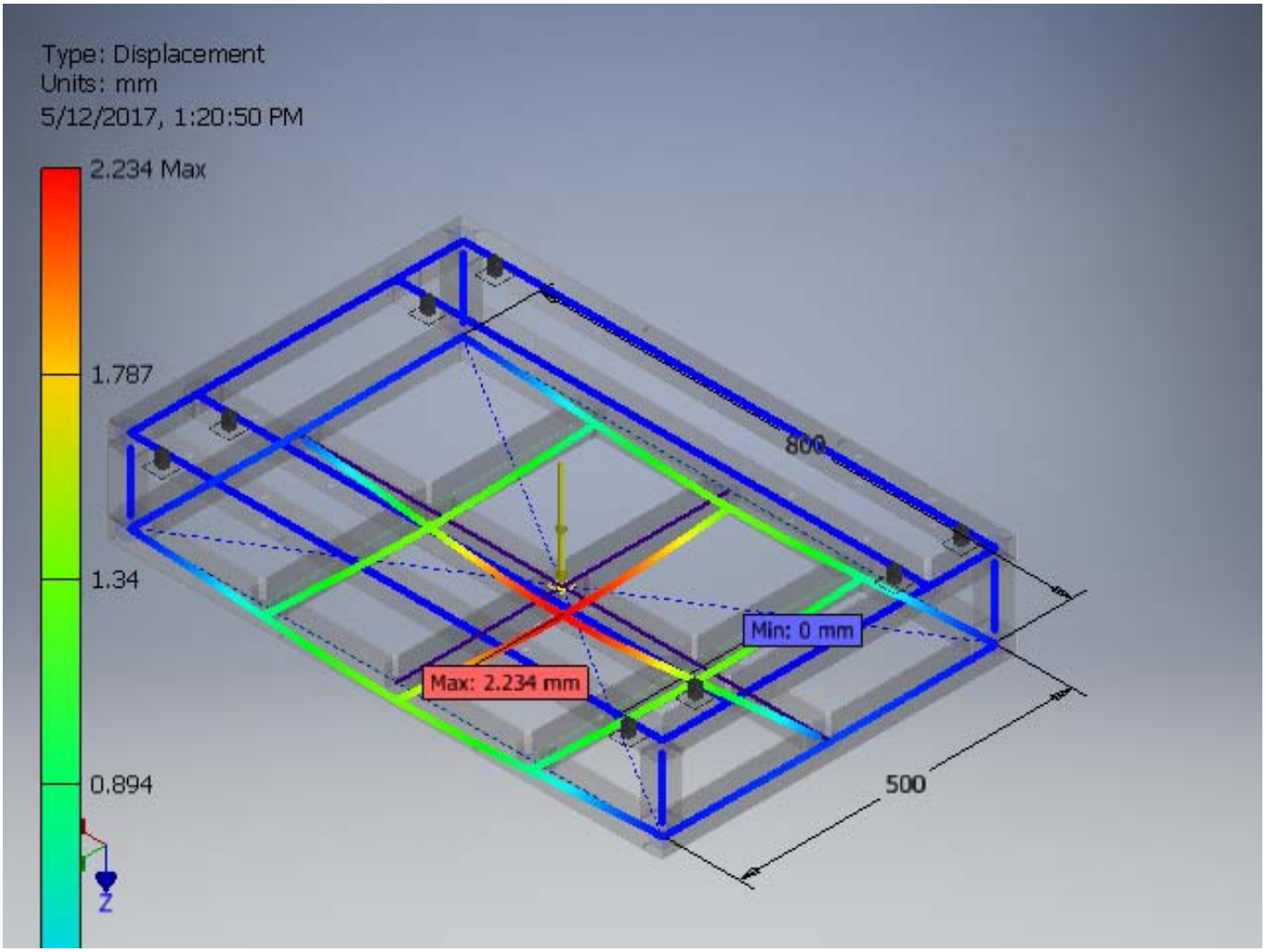
Static Result Summary

Name		Minimum	Maximum
Displacement		0.000 mm	2.234 mm
Forces	Fx	-3021.311 N	6791.643 N
	Fy	-3627.297 N	3627.297 N
	Fz	-3490.474 N	3334.022 N
Moments	Mx	-346668.069 N mm	395722.707 N mm
	My	-291178.347 N mm	563522.224 N mm
	Mz	-74304.091 N mm	74304.091 N mm
Normal Stresses	Smax	0.009 MPa	262.416 MPa
	Smin	-258.176 MPa	8.419 MPa
	Smax(Mx)	-0.000 MPa	182.788 MPa
	Smin(Mx)	-182.788 MPa	0.000 MPa
	Smax(My)	0.000 MPa	260.296 MPa
	Smin(My)	-260.296 MPa	-0.000 MPa
	Saxial	-16.093 MPa	16.849 MPa
Shear Stresses	Tx	-71.874 MPa	31.974 MPa
	Ty	-38.387 MPa	38.387 MPa
Torsional Stresses	T	-22.857 MPa	22.857 MPa

Figures

Displacement


Type: Displacement
Units: mm
5/12/2017, 1:20:50 PM
2.234 Max
1.787
1.34
0.894
800
500
Min: 0 mm
Max: 2.234 mm
X
Y
Z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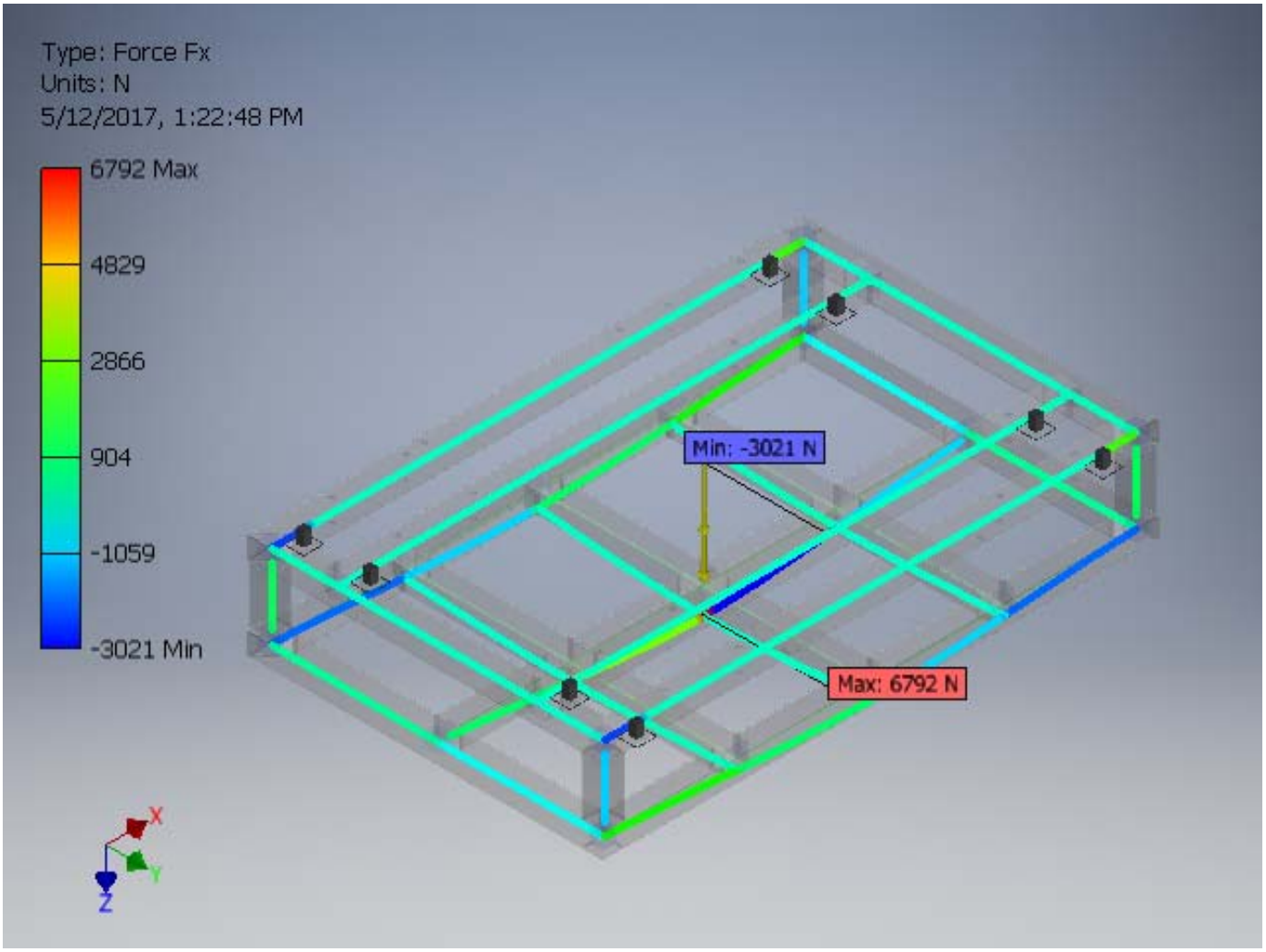
2.234 Max
1.787
1.34
0.894
800
500
Min: 0 mm
Max: 2.234 mm
Z

Fx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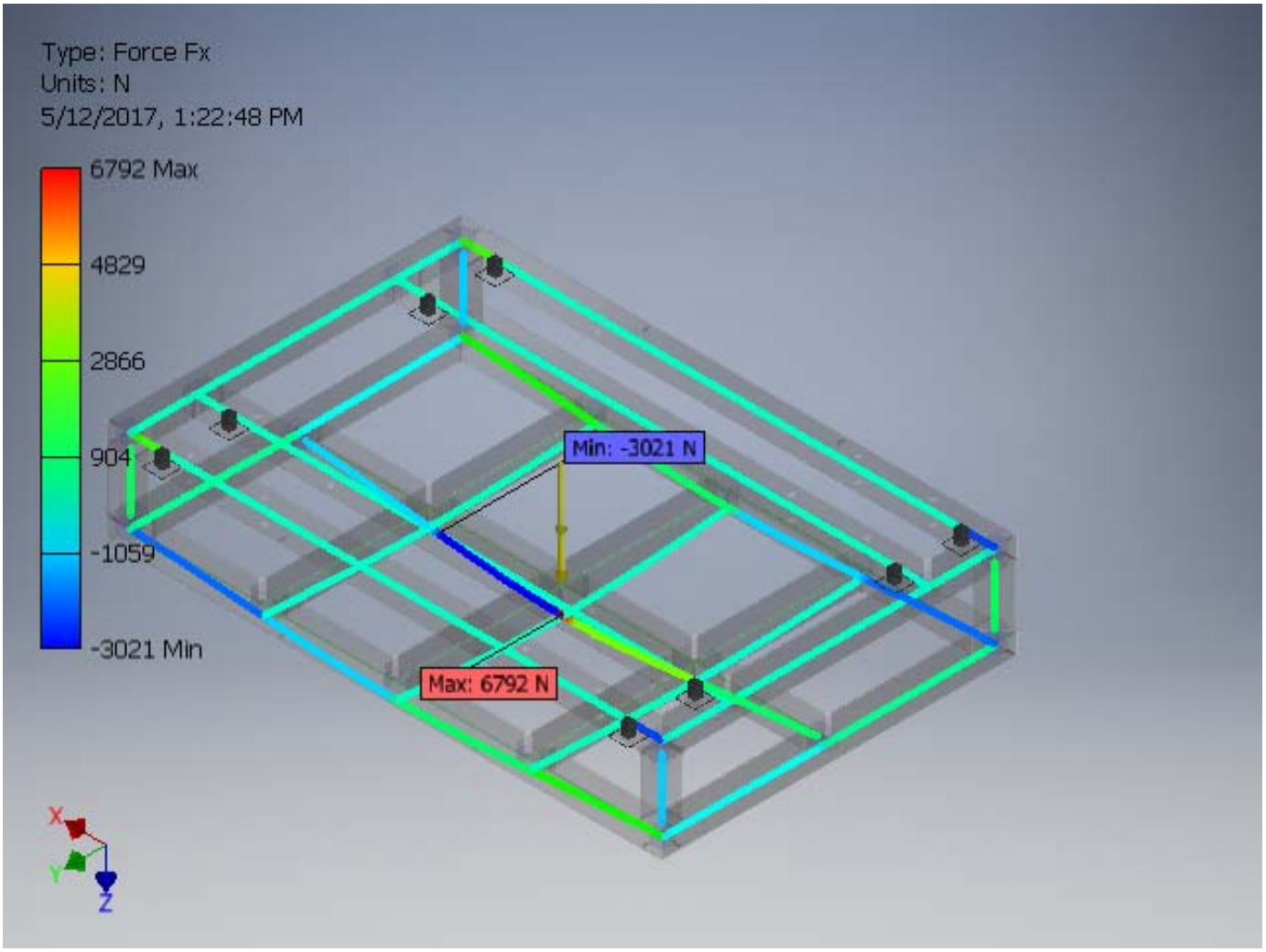
6792 Max
4829
2866
904
-1059
-3021 Min
Min: -3021 N
Max: 6792 N
X
Y
Z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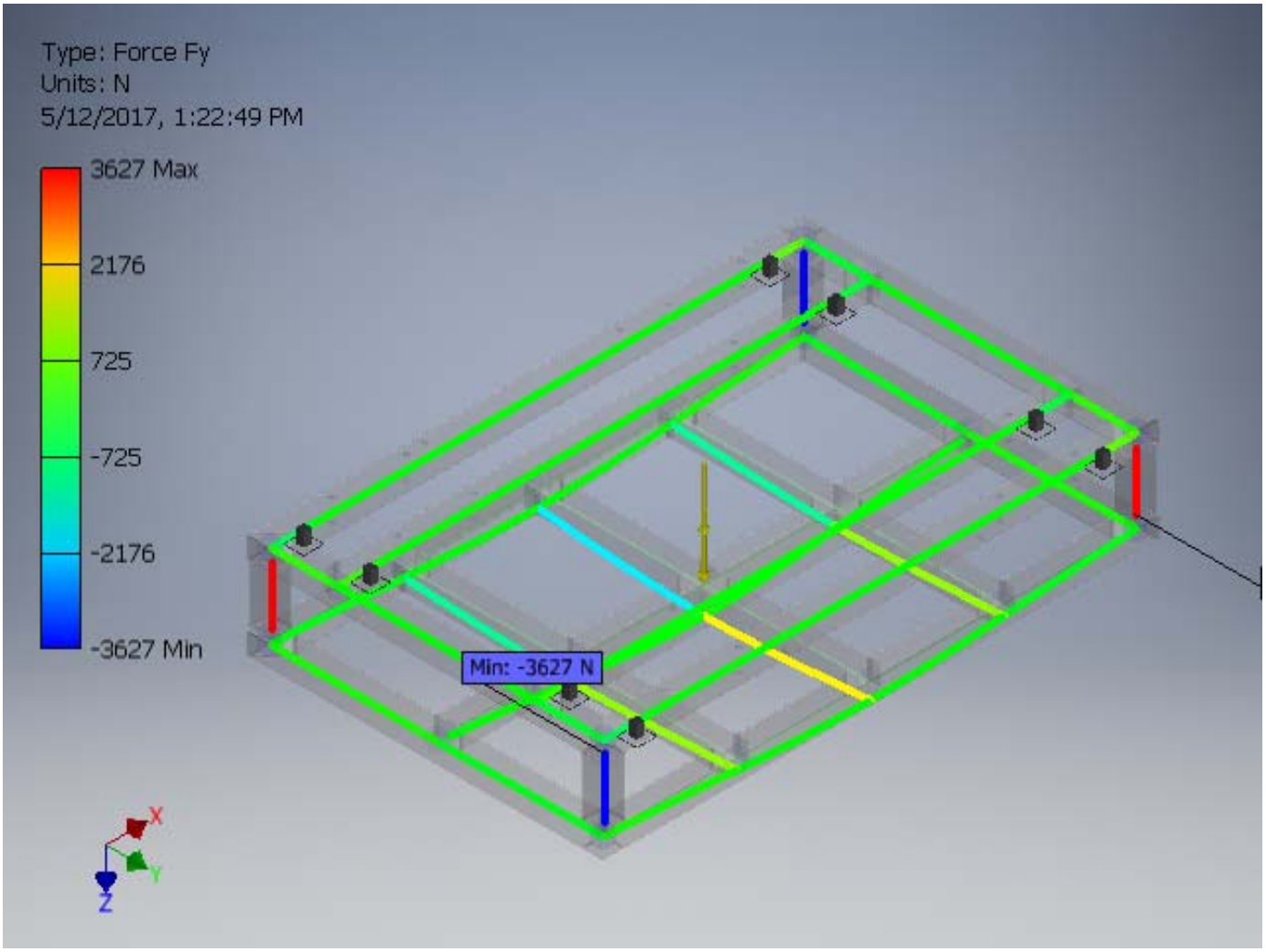
6792 Max
4829
2866
904
-1059
-3021 Min
Min: -3021 N
Max: 6792 N
X
Y
Z

Fy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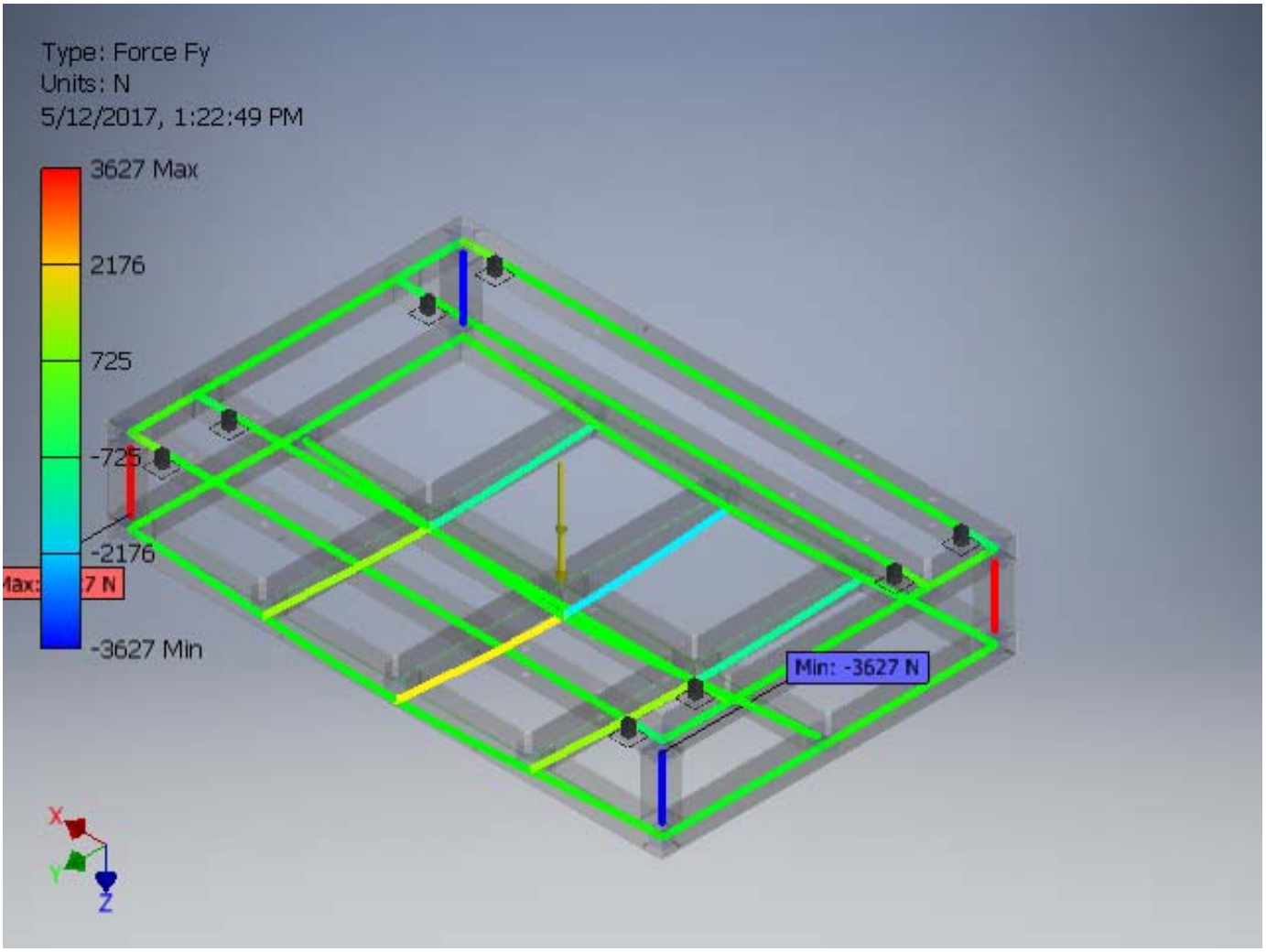
3627 Max
2176
725
-725
-2176
-3627 Min
Min: -3627 N
X
Y
Z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-3627 Min
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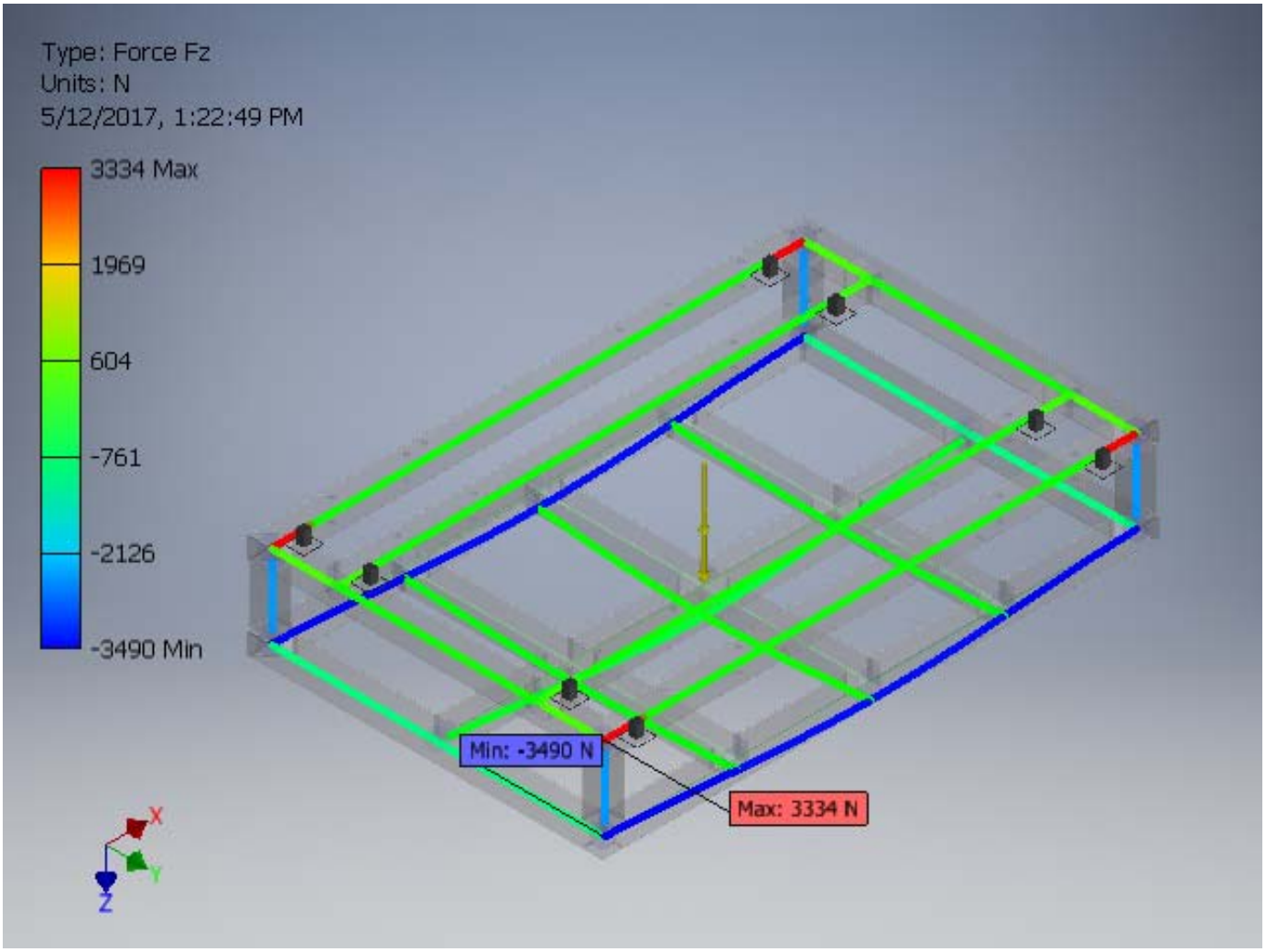
X
Y
Z

Fz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Units: N
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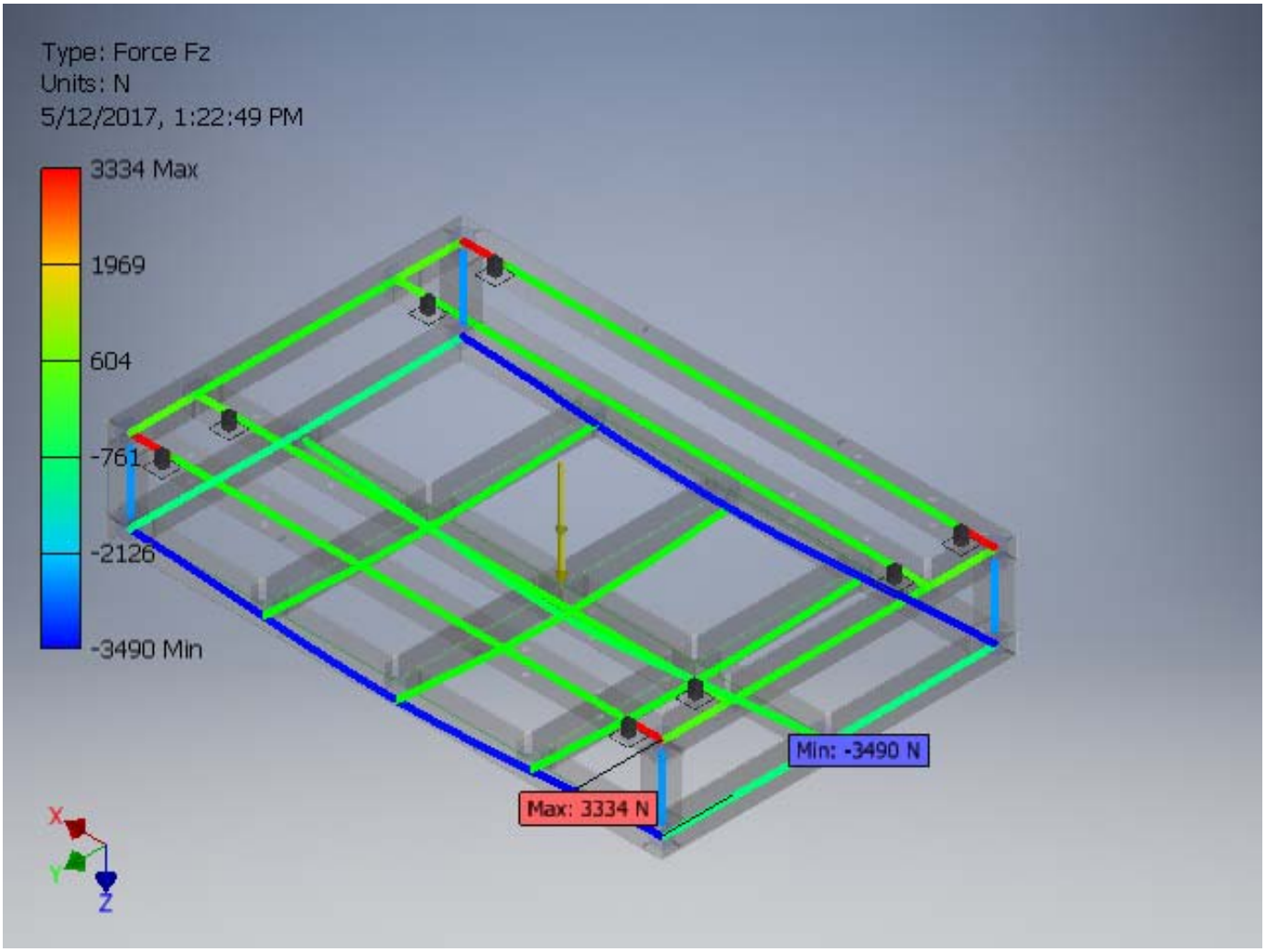
3334 Max
1969
604
-761
-2126
-3490 Min
Min: -3490 N
Max: 3334 N
X
Y
Z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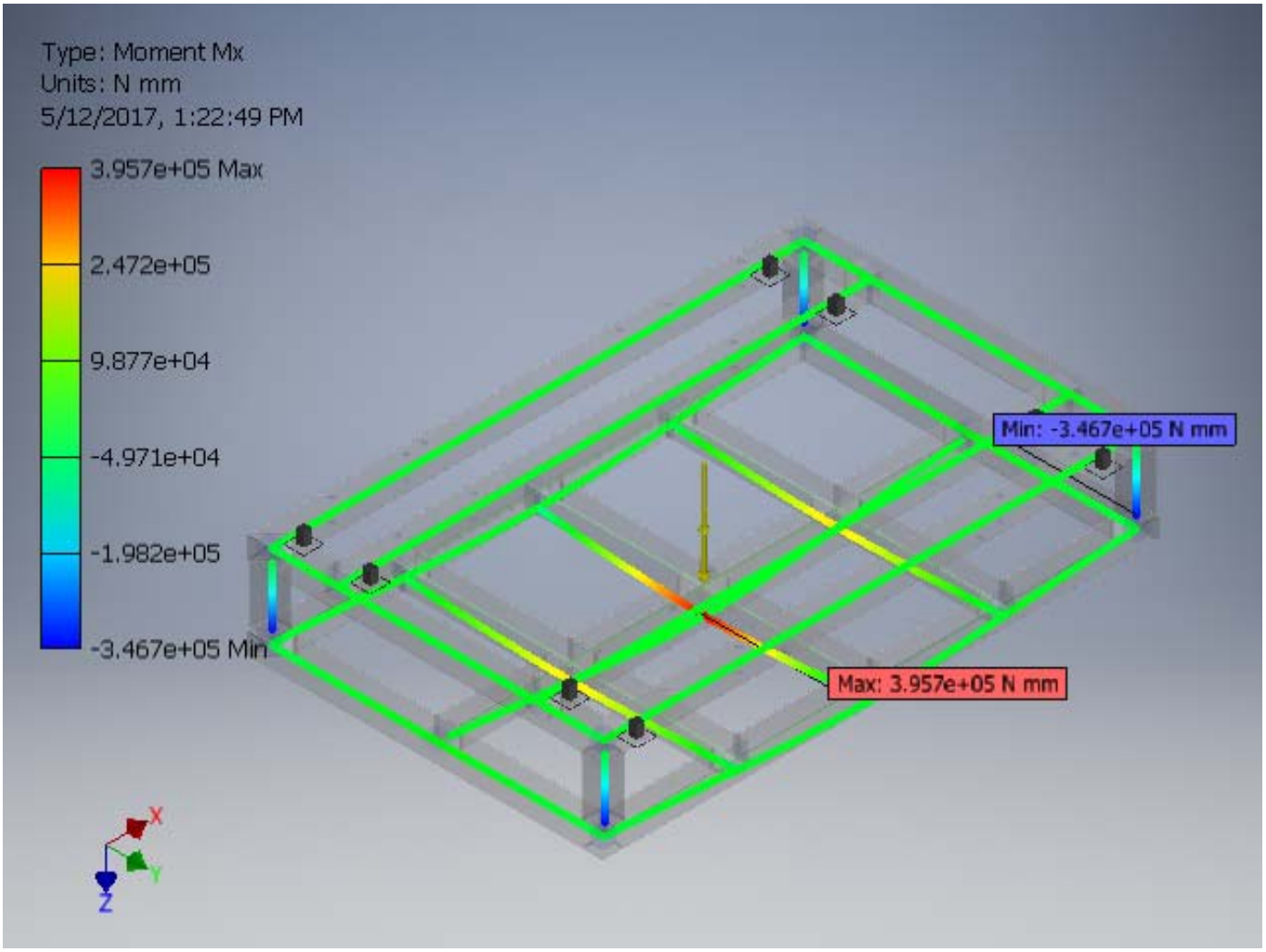
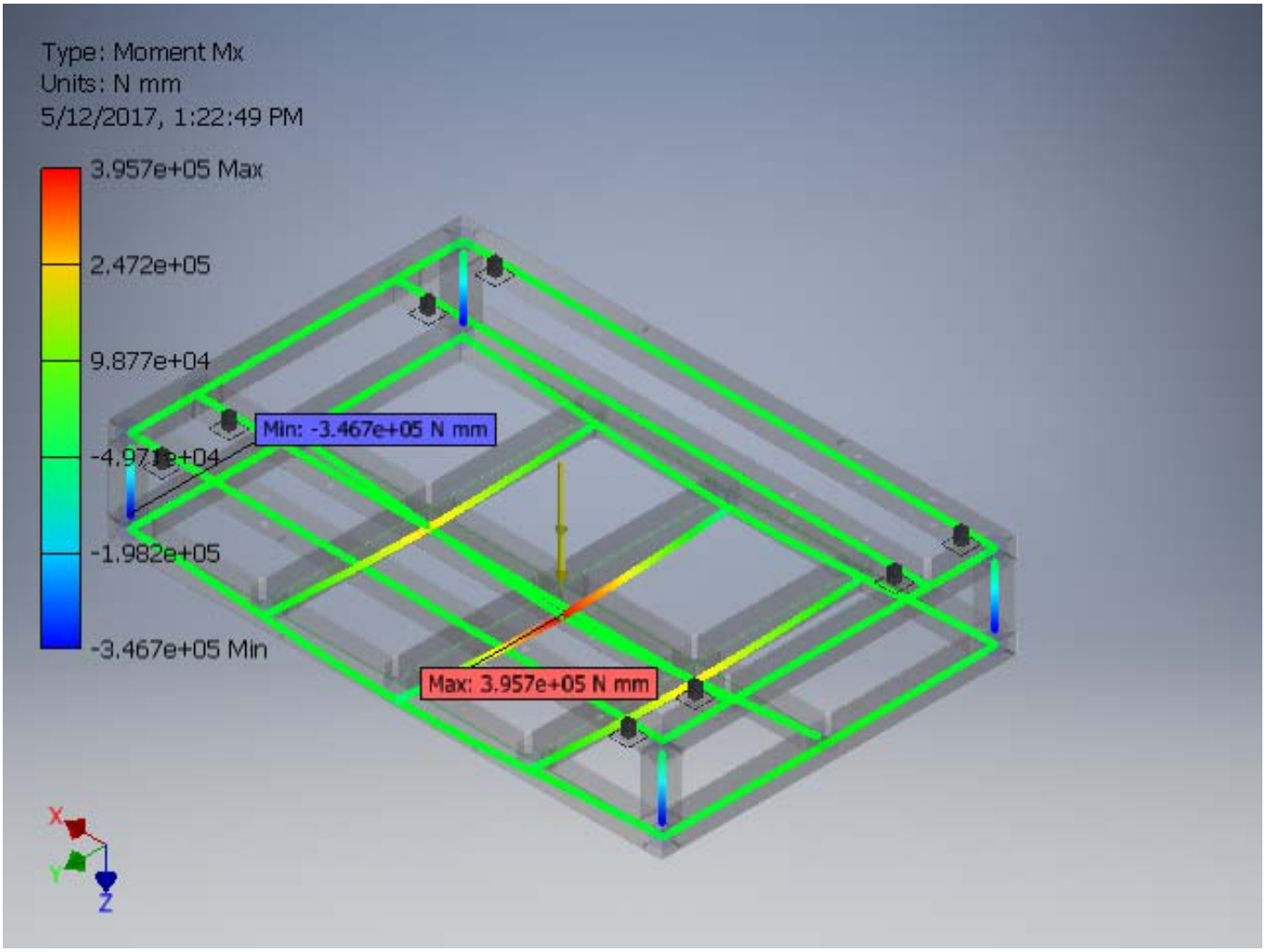
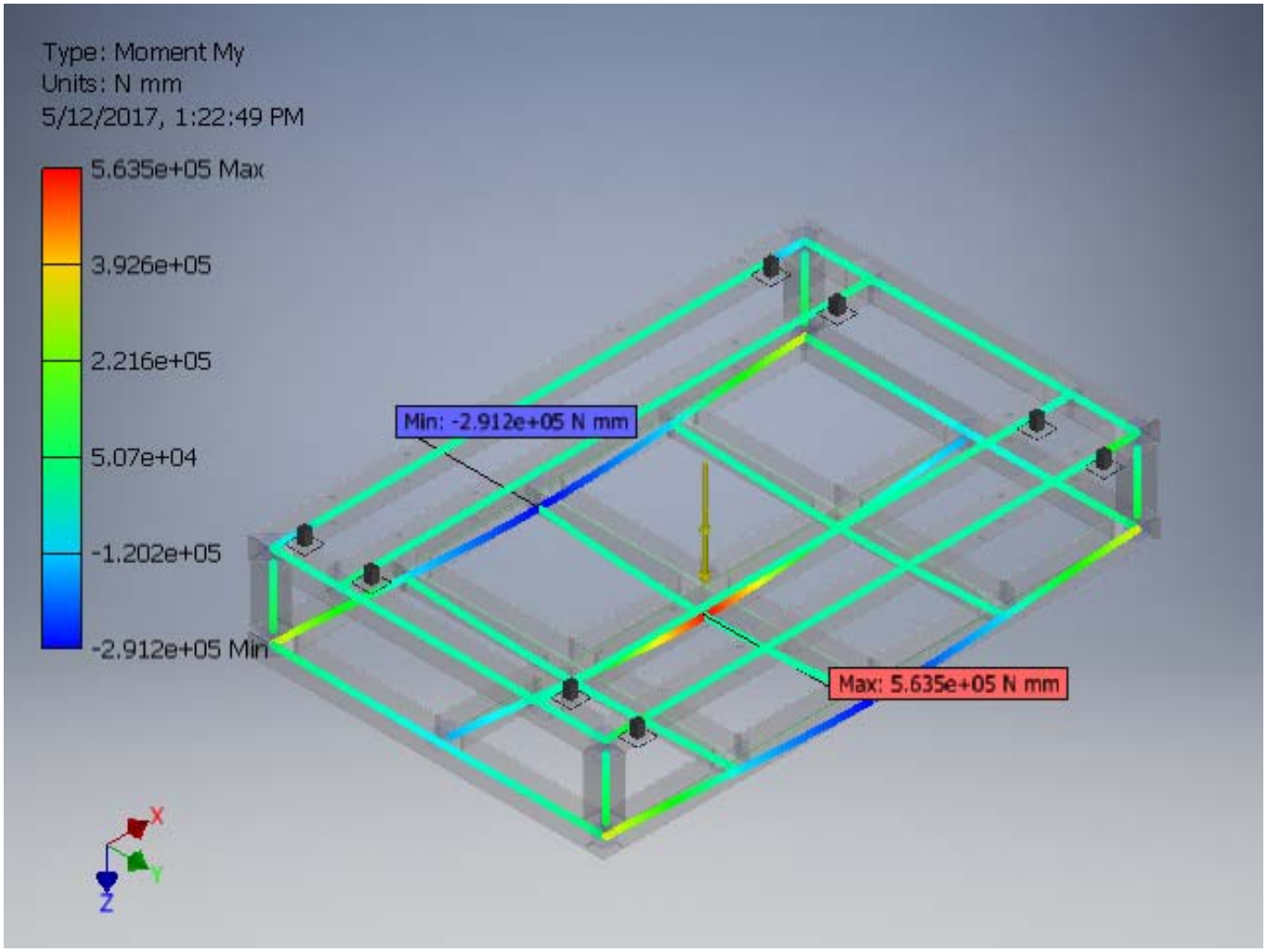
5/12/2017, 1:22:49 PM
3334 Max
1969
604
-761
-2126
-3490 Min
Min: -3490 N
Max: 3334 N
X
Y
Z

Mx


Type: Moment Mx
Units: N mm
5/12/2017, 1:22:49 PM
3.957e+05 Max
2.472e+05
9.877e+04
-4.971e+04
-1.982e+05
-3.467e+05 Min
Min: -3.467e+05 N mm
Max: 3.957e+05 N mm
X
Y
Z


Type: Moment Mx
Units: N mm
5/12/2017, 1:22:49 PM
3.957e+05 Max
2.472e+05
9.877e+04
-4.971e+04
-1.982e+05
-3.467e+05 Min
Min: -3.467e+05 N mm
Max: 3.957e+05 N mm
X
Y
Z

My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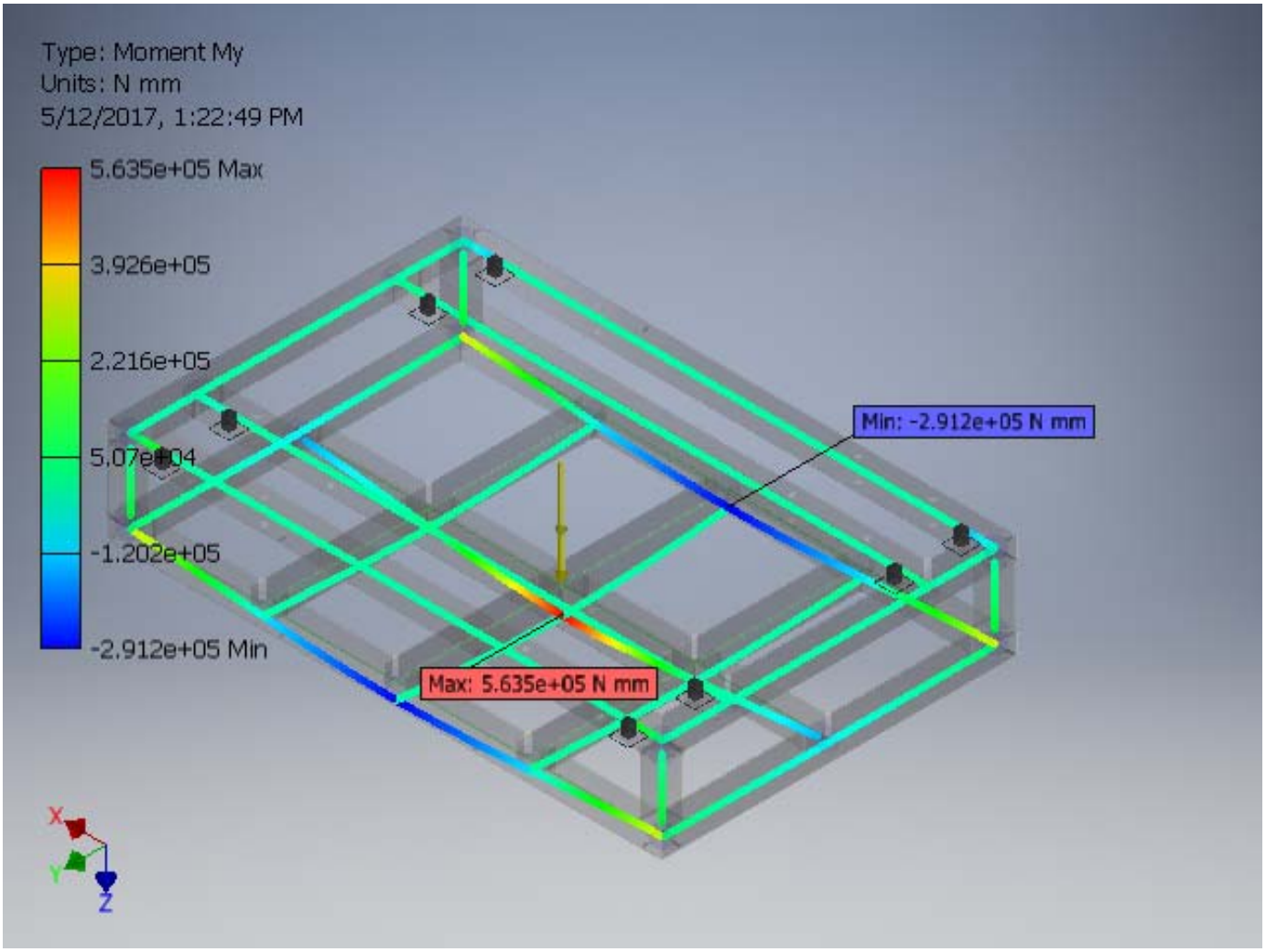
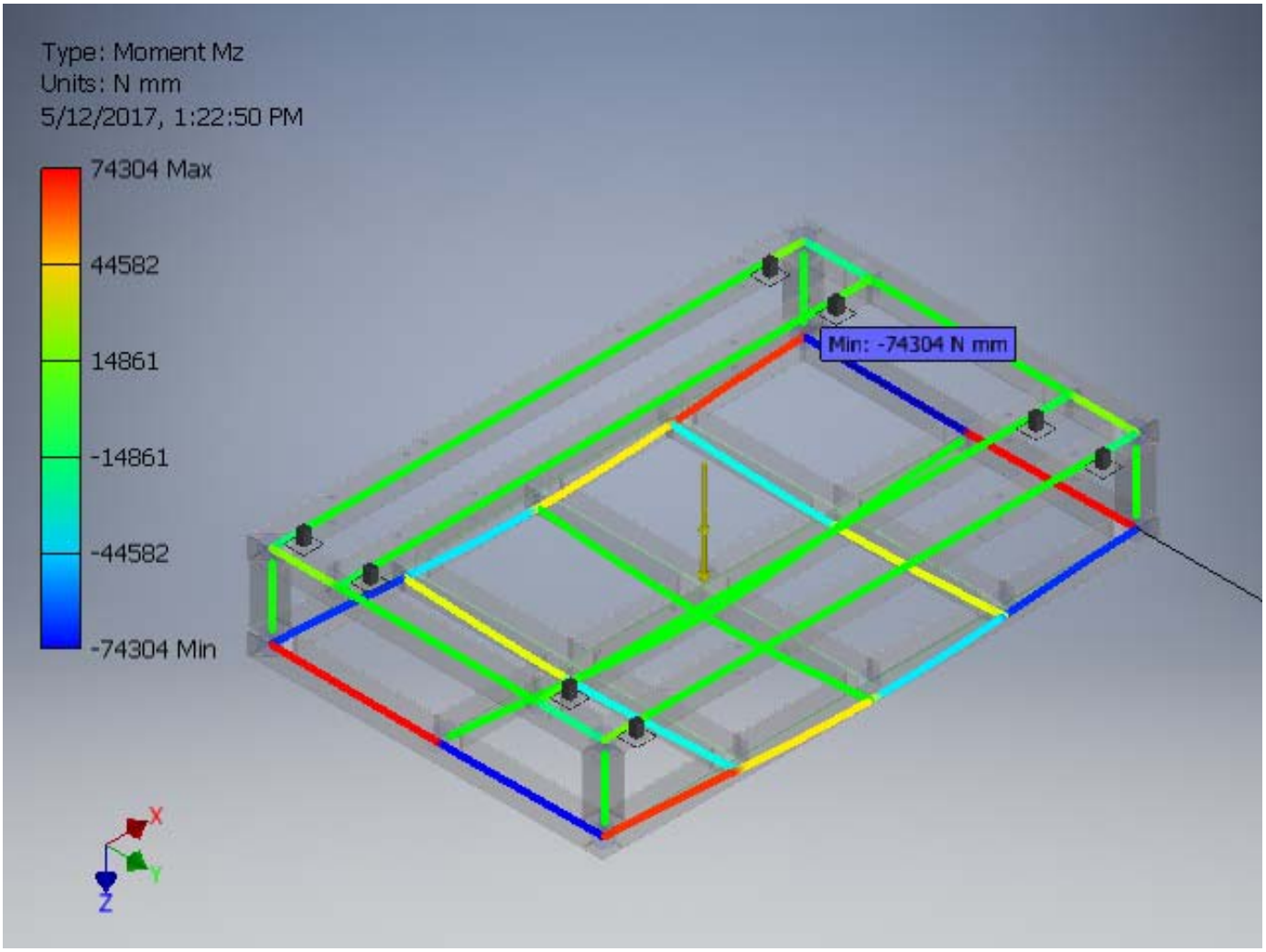
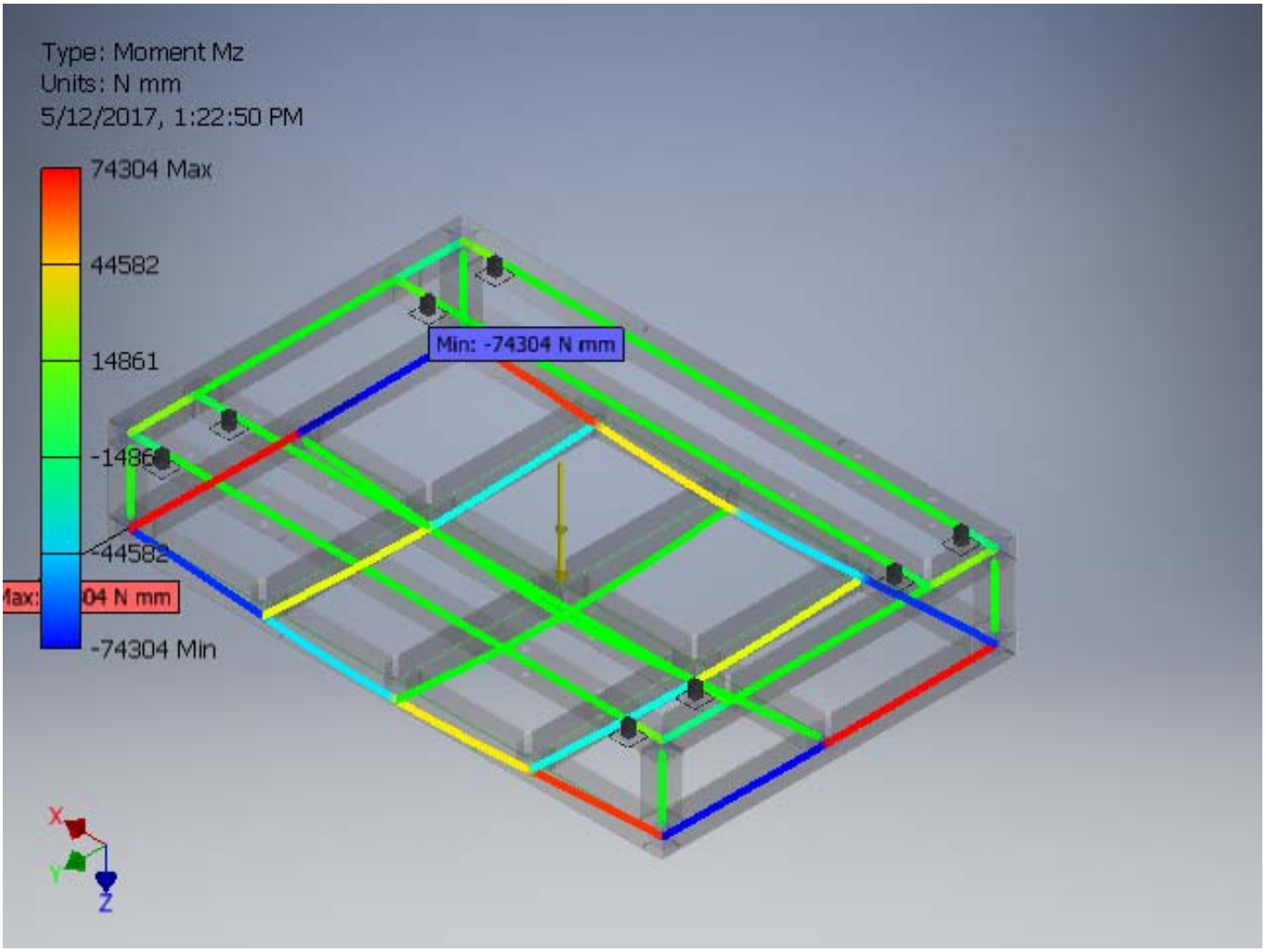
3.926e+05
2.216e+05
5.07e+04
-1.202e+05
-2.912e+05 Min
Min: -2.912e+05 N mm
Max: 5.635e+05 N mm
X
Y
Z

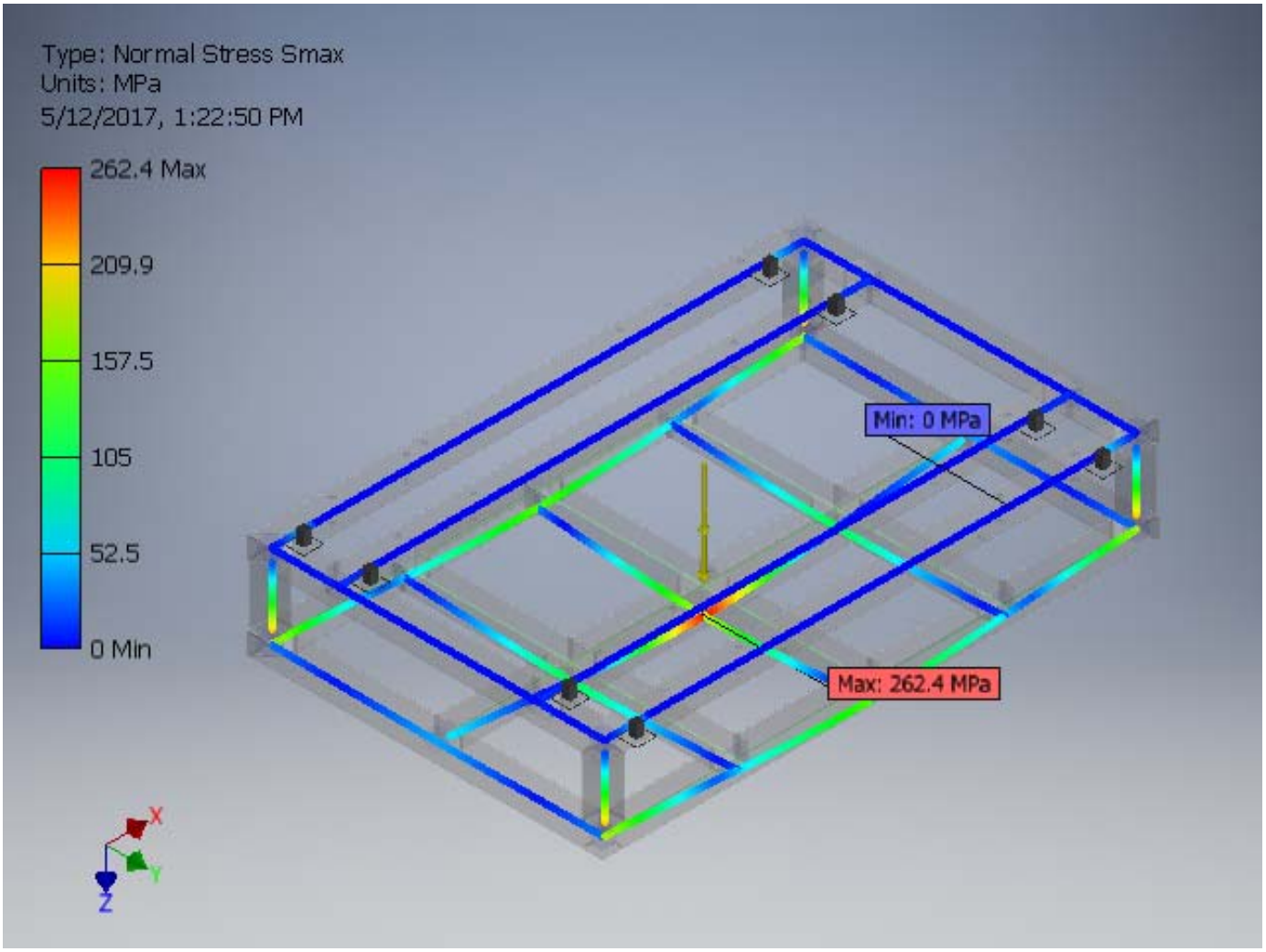

Type: Moment My
Units: N mm
5/12/2017, 1:22:49 PM
5.635e+05 Max
3.926e+05
2.216e+05
5.07e+04
-1.202e+05
-2.912e+05 Min
Min: -2.912e+05 N mm
Max: 5.635e+05 N mm
X
Y
Z

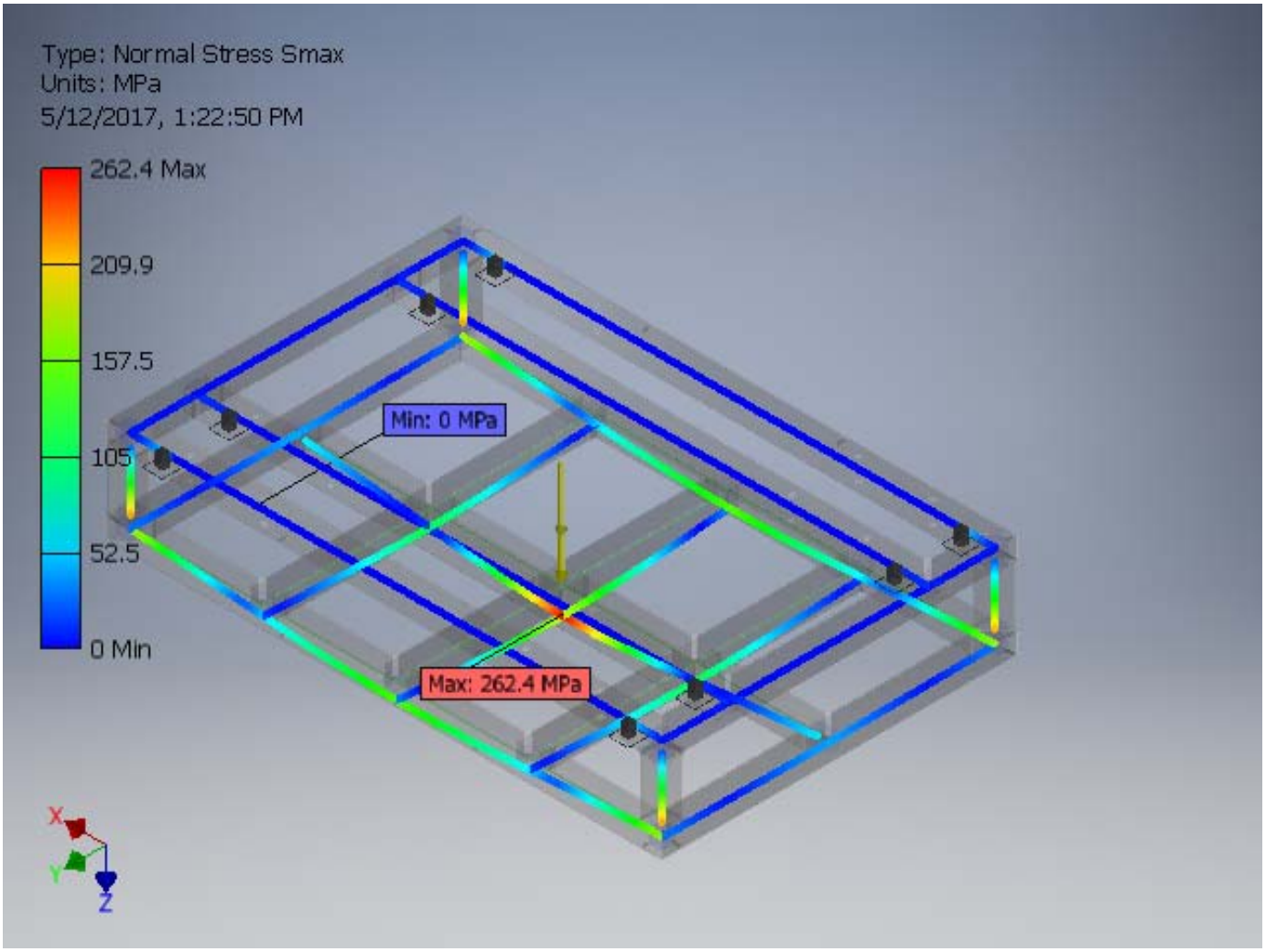
Mz


Type: Moment Mz
Units: N mm
5/12/2017, 1:22:50 PM
74304 Max
44582
14861
-14861
-44582
-74304 Min
Min: -74304 N mm
X
Y
Z

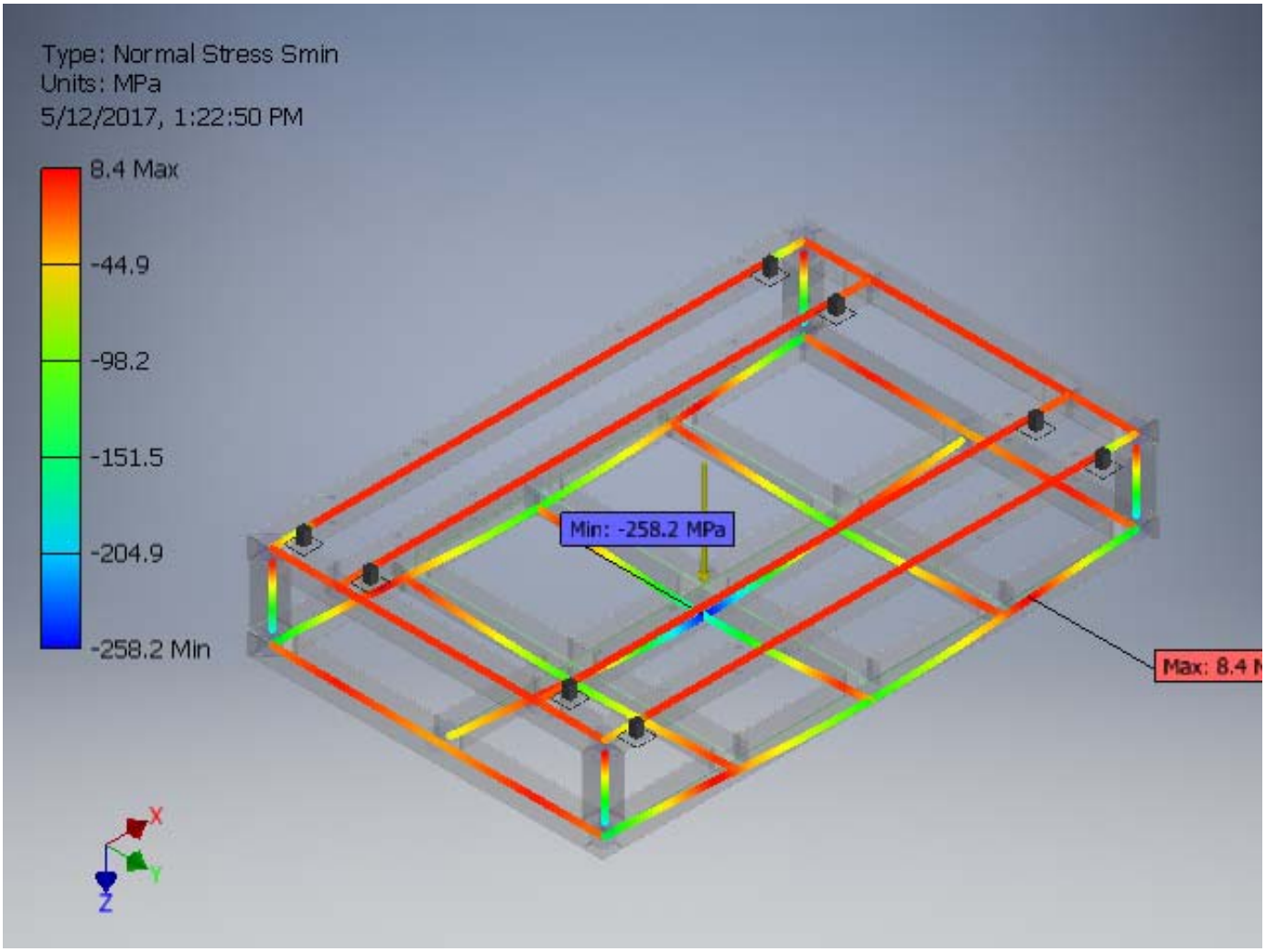

Type: Moment Mz
Units: N mm
5/12/2017, 1:22:50 PM
74304 Max
44582
14861
-44582
-74304 Min
Min: -74304 N mm
X
Y
Z

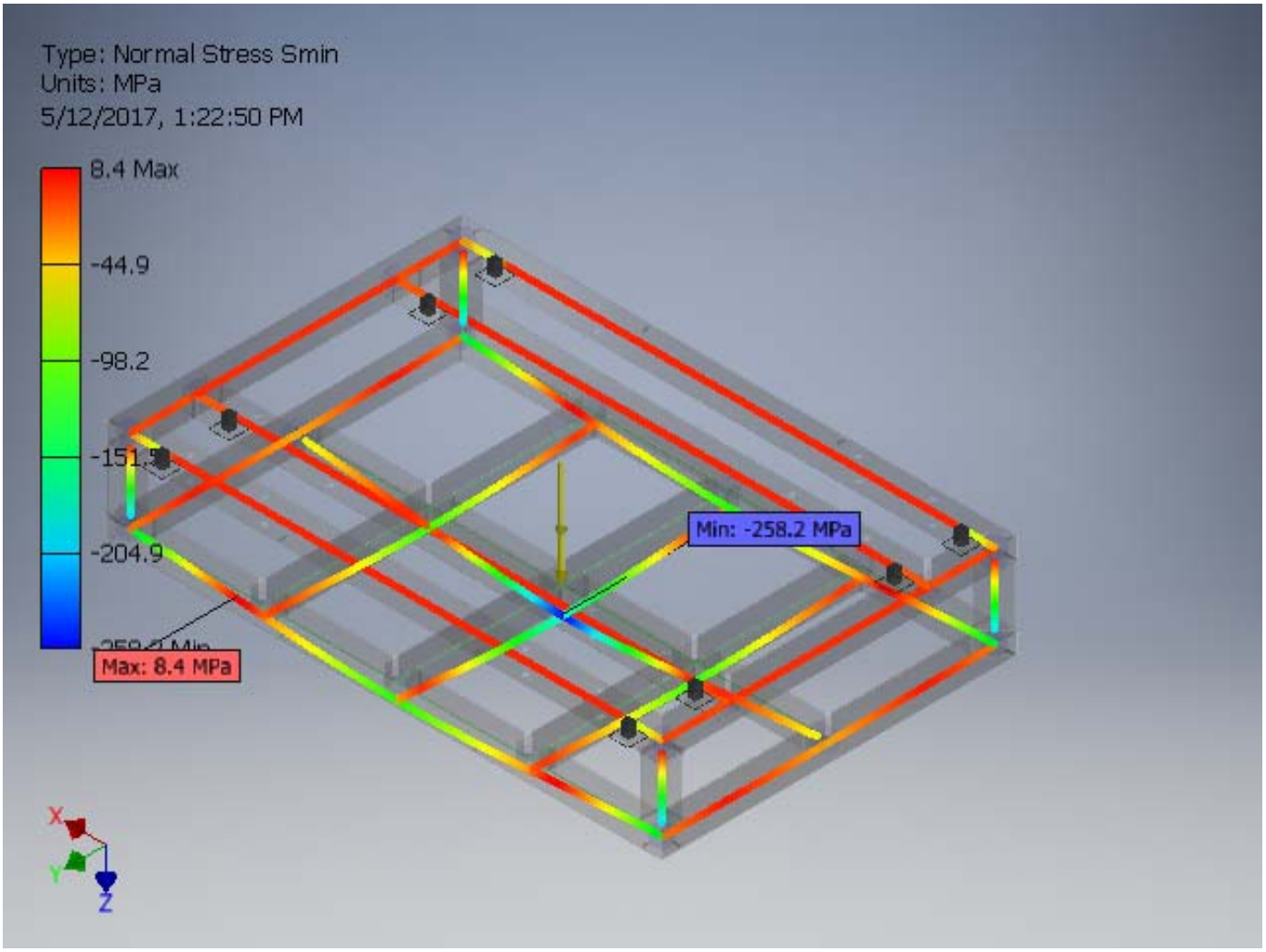
Smax


Type: Normal Stress Smax
Units: MPa
5/12/2017, 1:22:50 PM
262.4 Max
209.9
157.5
105
52.5
0 Min
Min: 0 MPa
Max: 262.4 MPa
X
Y
Z

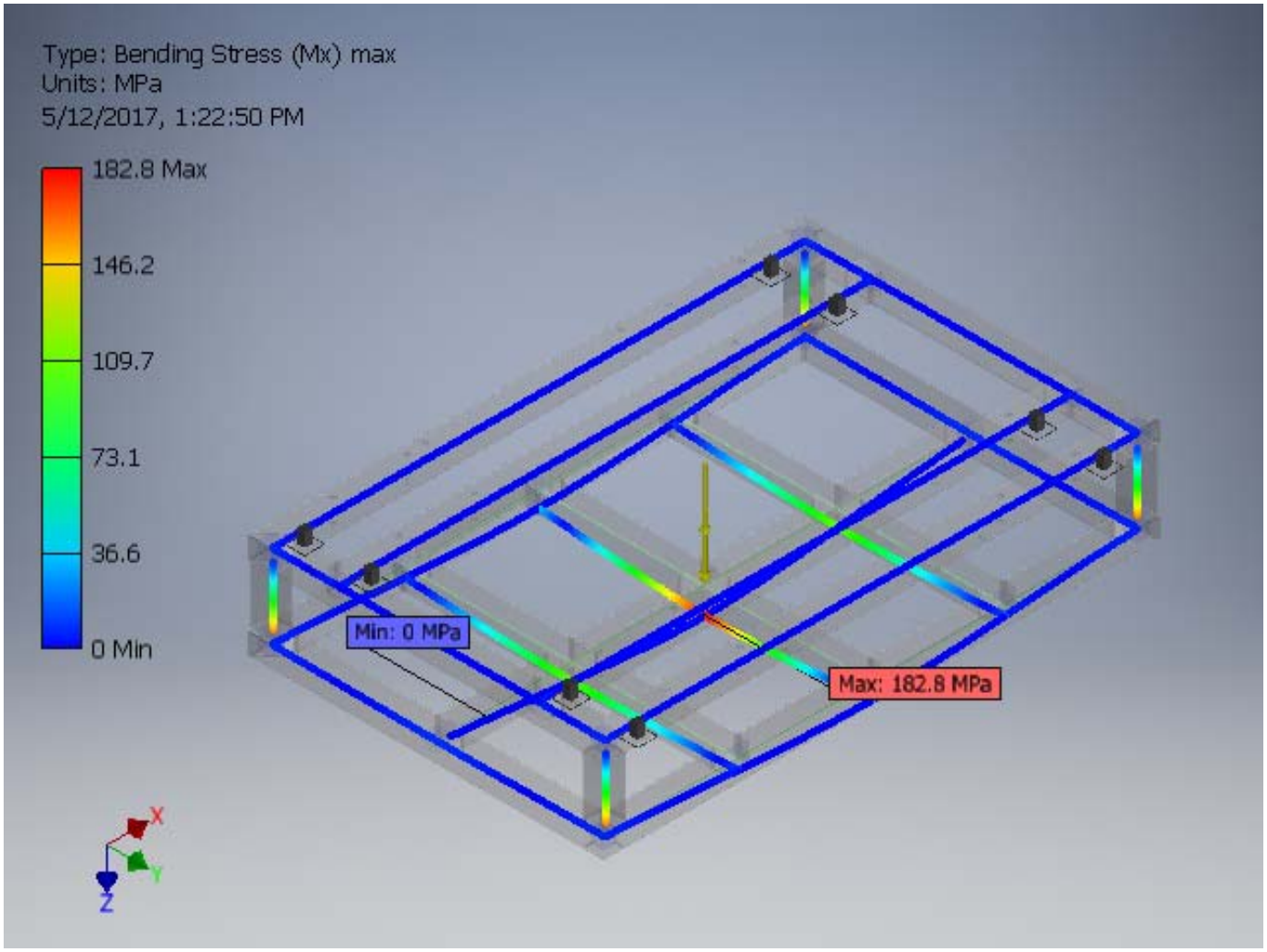

Type: Normal Stress Smax
Units: MPa
5/12/2017, 1:22:50 PM
262.4 Max
209.9
157.5
105
52.5
0 Min
Min: 0 MPa
Max: 262.4 MPa
X
Y
Z

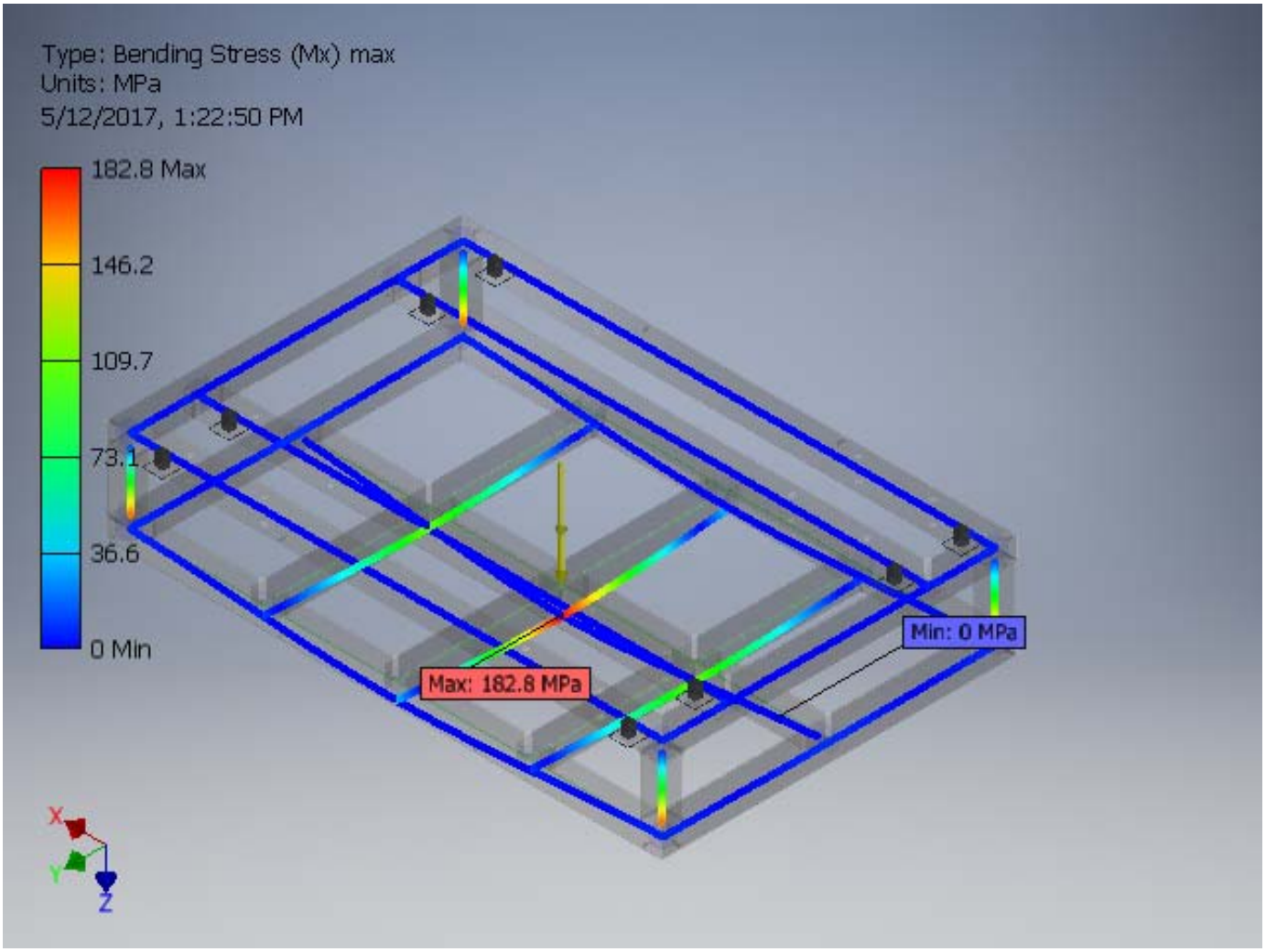
⊟ Smin


Type: Normal Stress Smin
Units: MPa
5/12/2017, 1:22:50 PM
8.4 Max
-44.9
-98.2
-151.5
-204.9
-258.2 Min
Min: -258.2 MPa
Max: 8.4 M
X
Y
Z

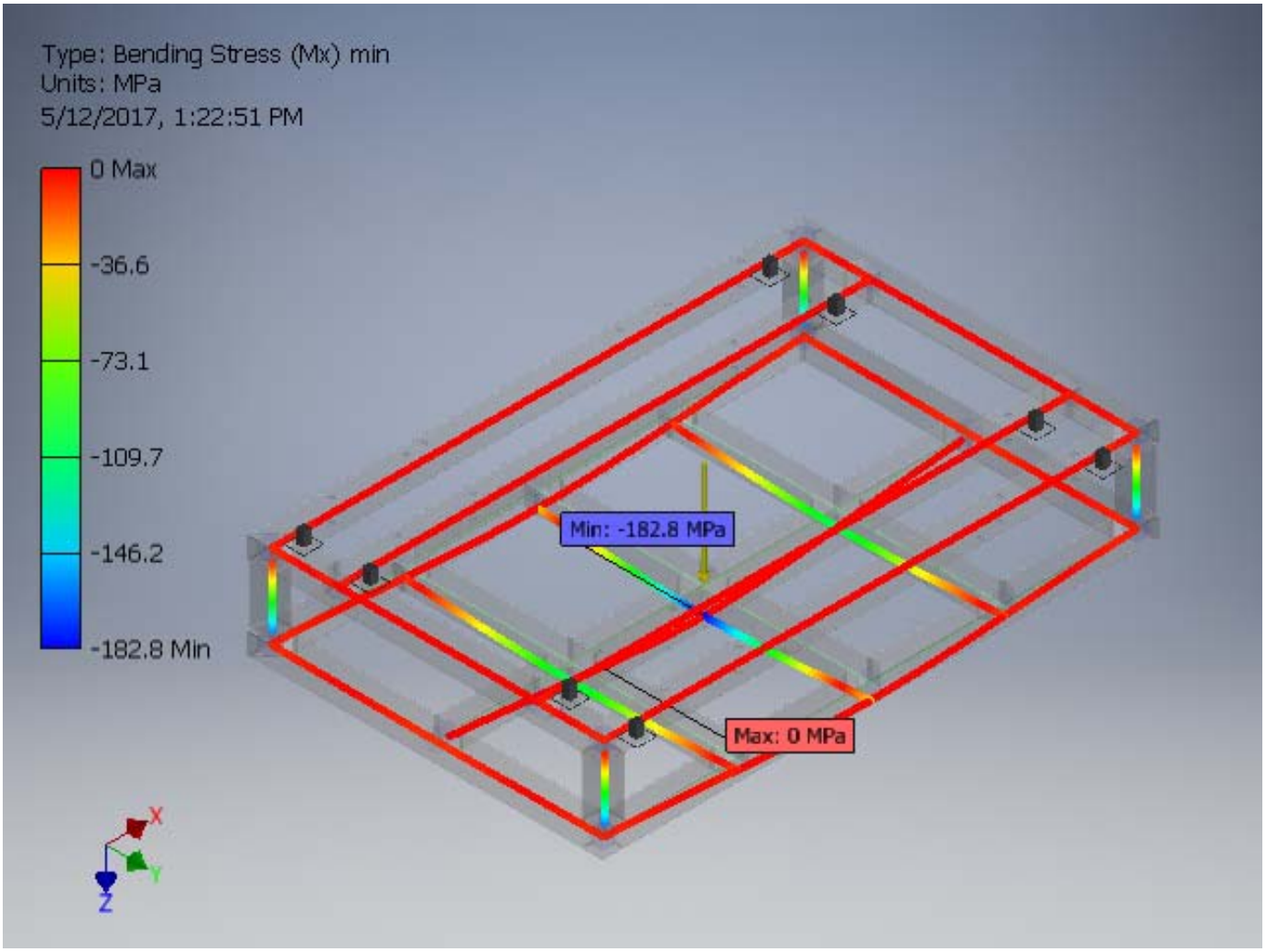

Type: Normal Stress Smin
Units: MPa
5/12/2017, 1:22:50 PM
8.4 Max
-44.9
-98.2
-151.5
-204.9
Min: -258.2 MPa
Max: 8.4 MPa
X
Y
Z

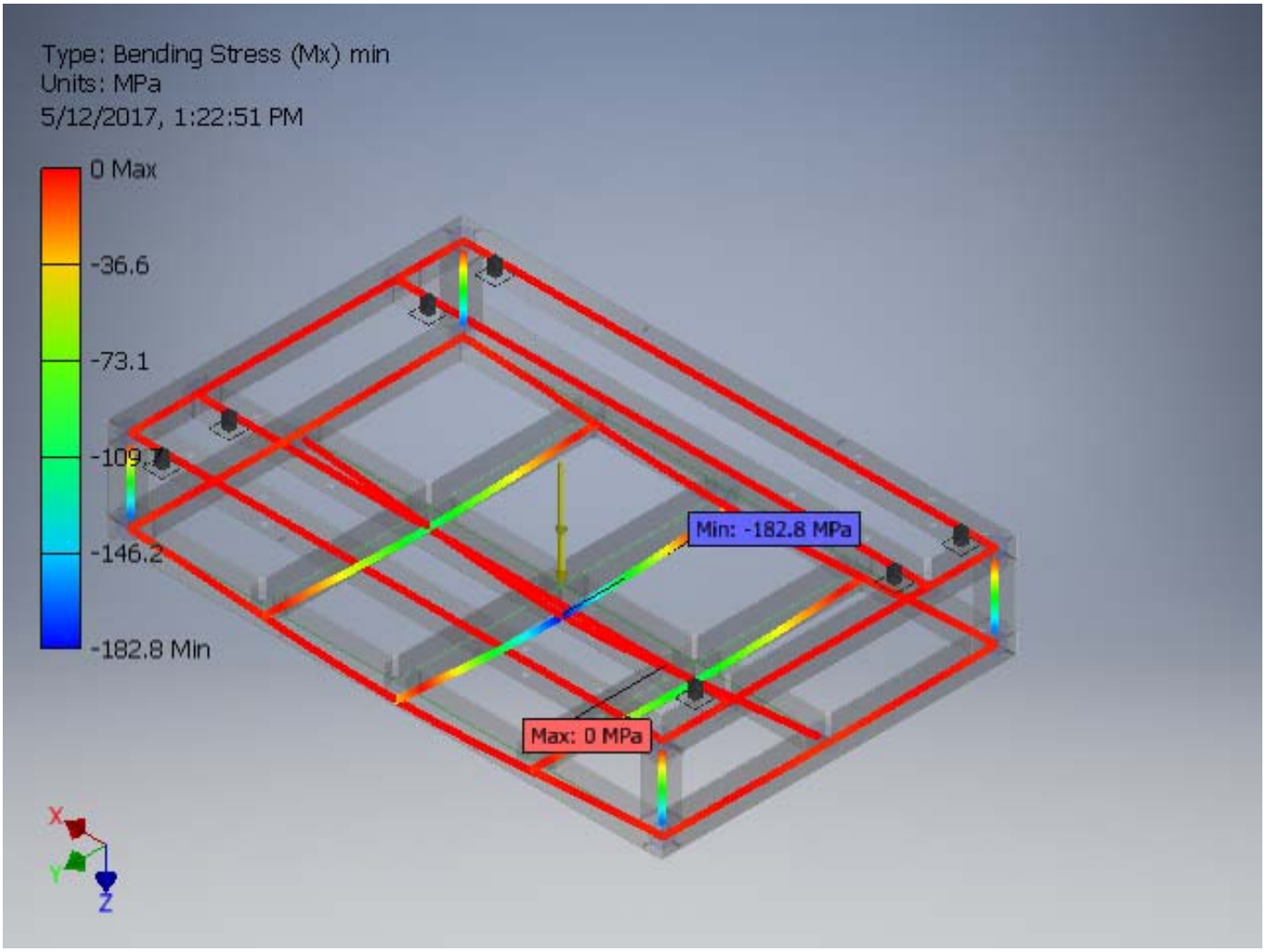
⊟ Smax(Mx)


Type: Bending Stress (Mx) max
Units: MPa
5/12/2017, 1:22:50 PM
182.8 Max
146.2
109.7
73.1
36.6
0 Min
Min: 0 MPa
Max: 182.8 MPa
X
Y
Z

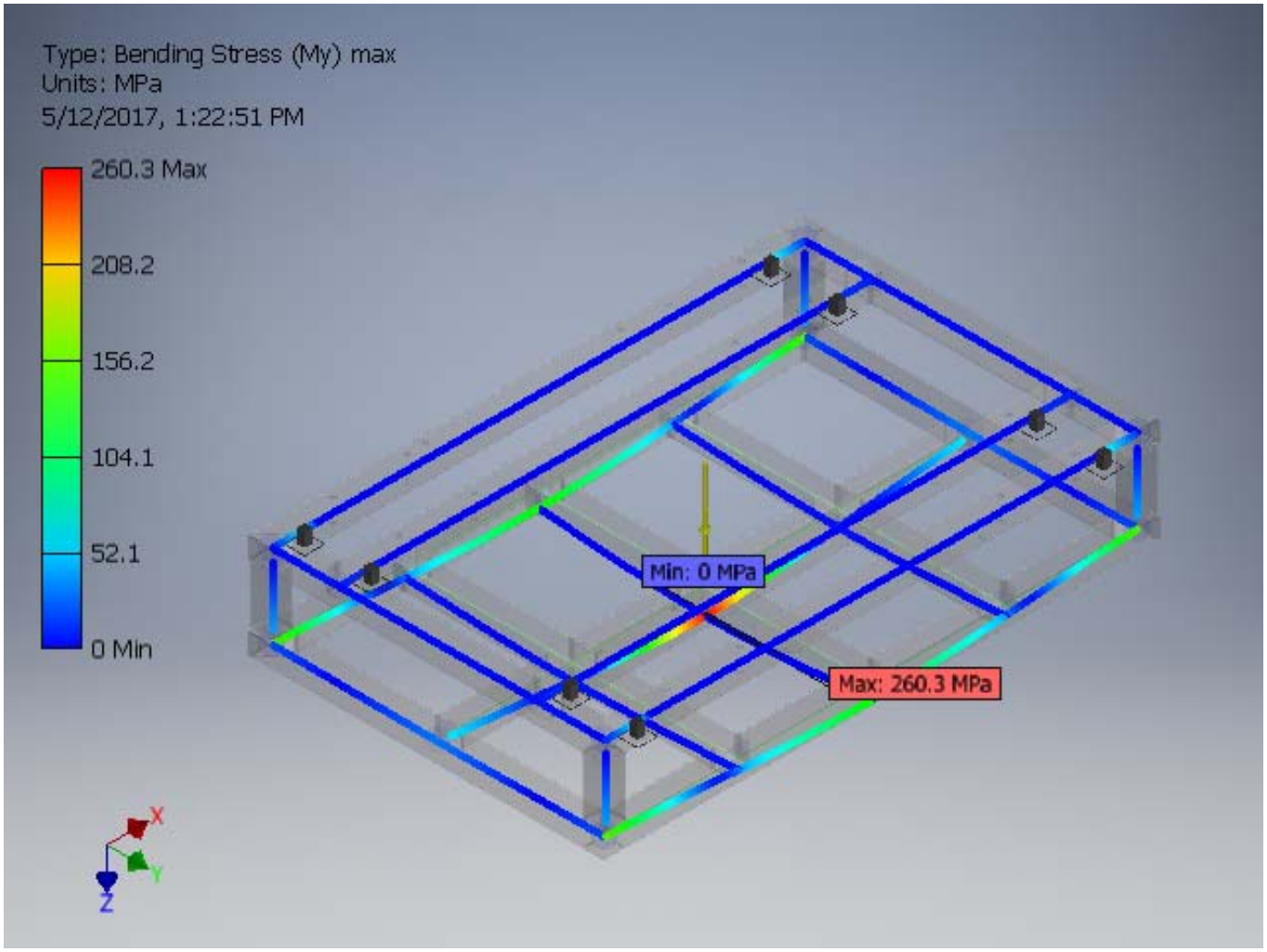

Type: Bending Stress (Mx) max
Units: MPa
5/12/2017, 1:22:50 PM
182.8 Max
146.2
109.7
73.1
36.6
0 Min
Max: 182.8 MPa
Min: 0 MPa
X
Y
Z

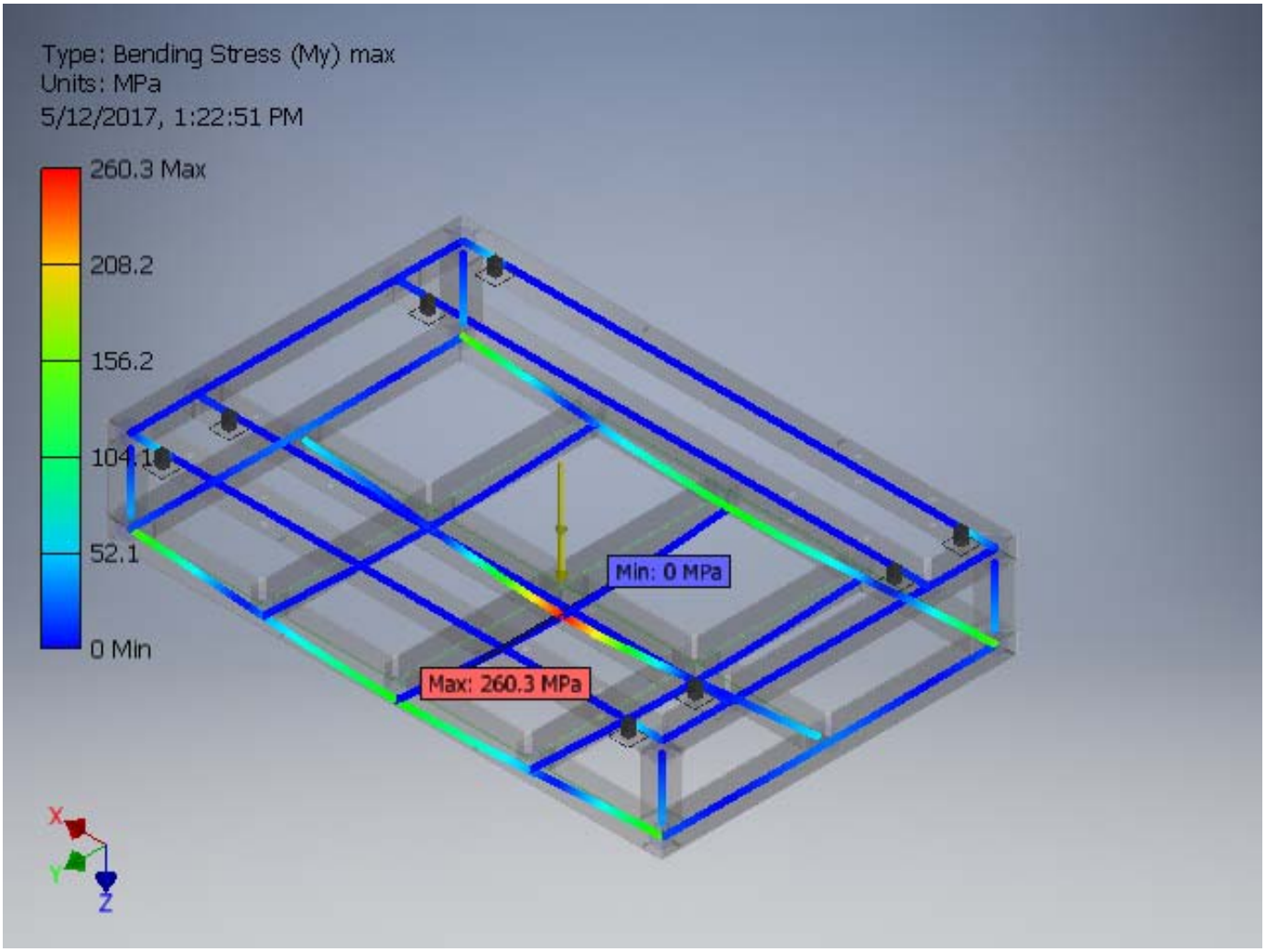
⊟ Smin(Mx)


Type: Bending Stress (Mx) min
Units: MPa
5/12/2017, 1:22:51 PM
0 Max
-36.6
-73.1
-109.7
-146.2
-182.8 Min
Min: -182.8 MPa
Max: 0 MPa
X
Y
Z

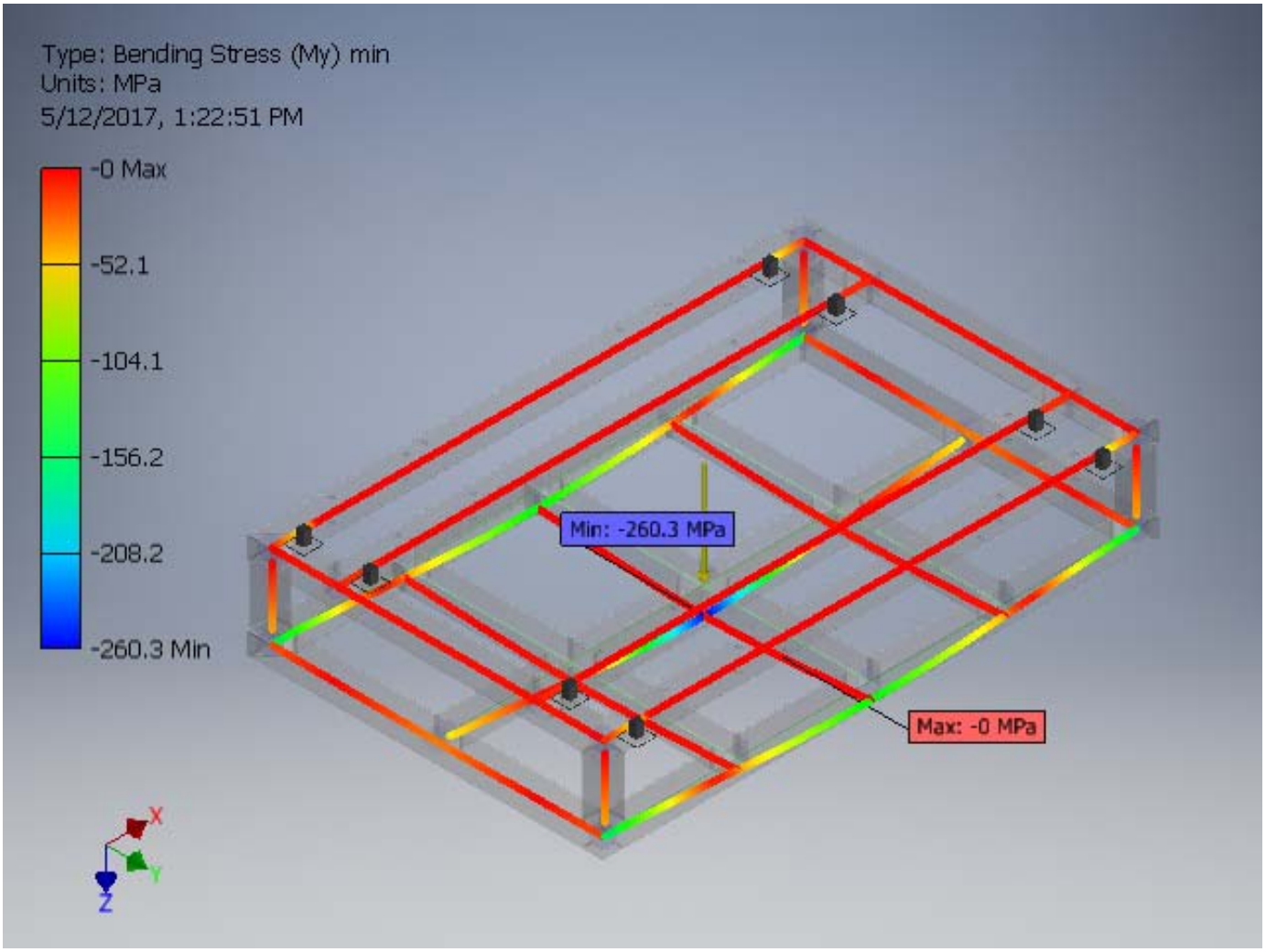

Type: Bending Stress (Mx) min
Units: MPa
5/12/2017, 1:22:51 PM
0 Max
-36.6
-73.1
-109.7
-146.2
-182.8 Min
Min: -182.8 MPa
Max: 0 MPa
X
Y
Z

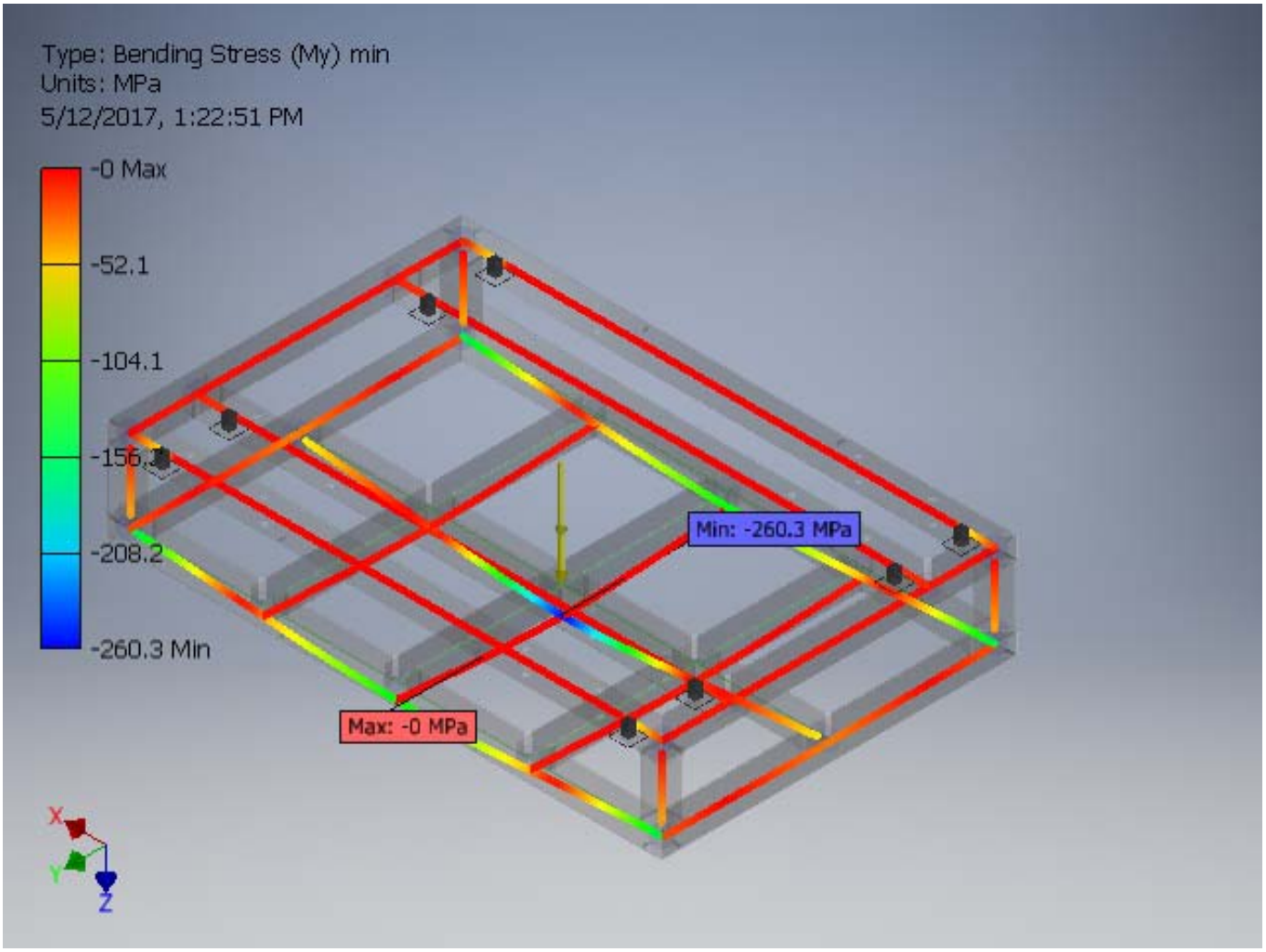
⊟ Smax(My)


Type: Bending Stress (My) max
Units: MPa
5/12/2017, 1:22:51 PM
260.3 Max
208.2
156.2
104.1
52.1
0 Min
Min: 0 MPa
Max: 260.3 MPa
X
Y
Z

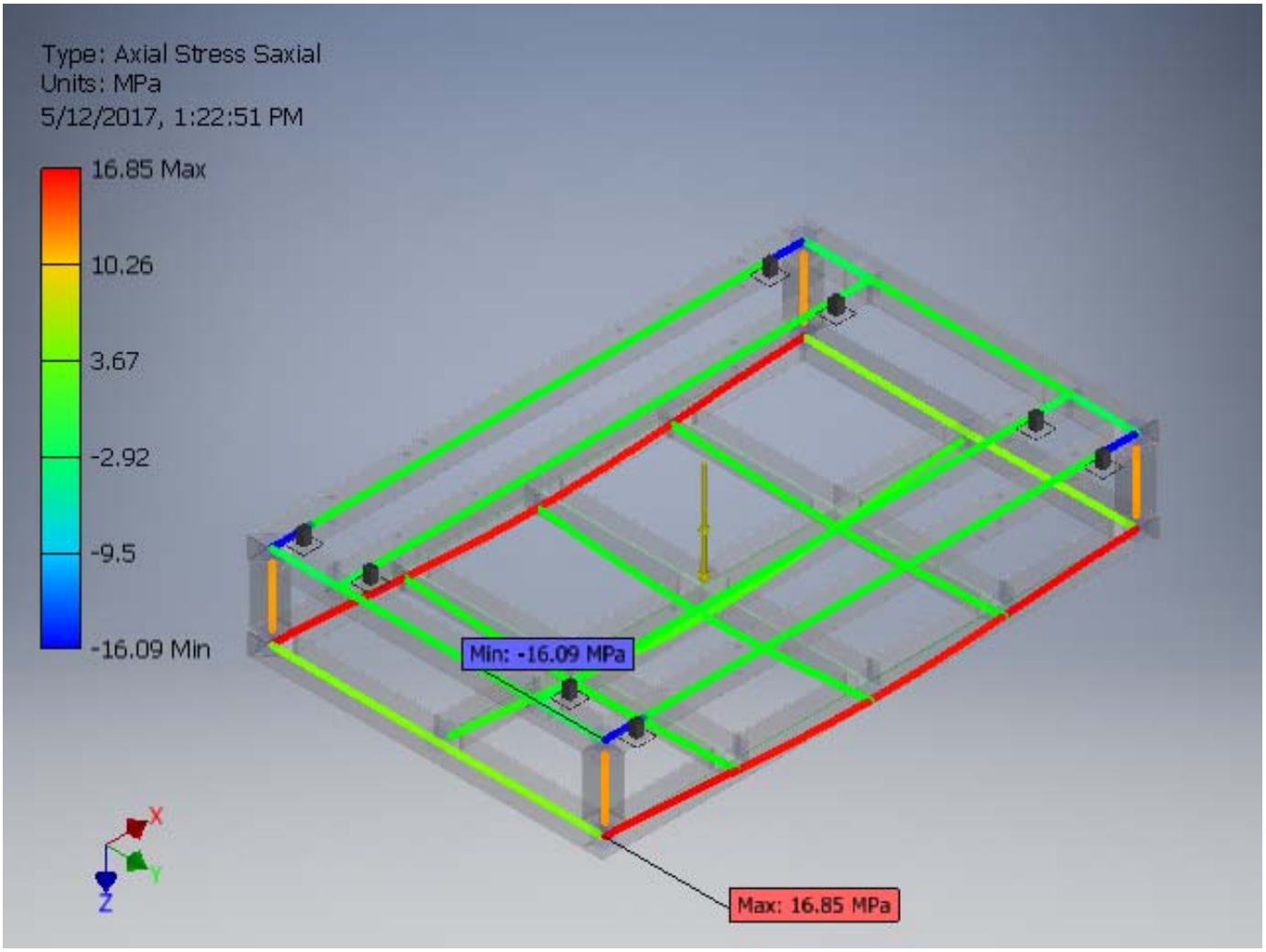

Type: Bending Stress (My) max
Units: MPa
5/12/2017, 1:22:51 PM
260.3 Max
208.2
156.2
104.1
52.1
0 Min
Min: 0 MPa
Max: 260.3 MPa
X
Y
Z

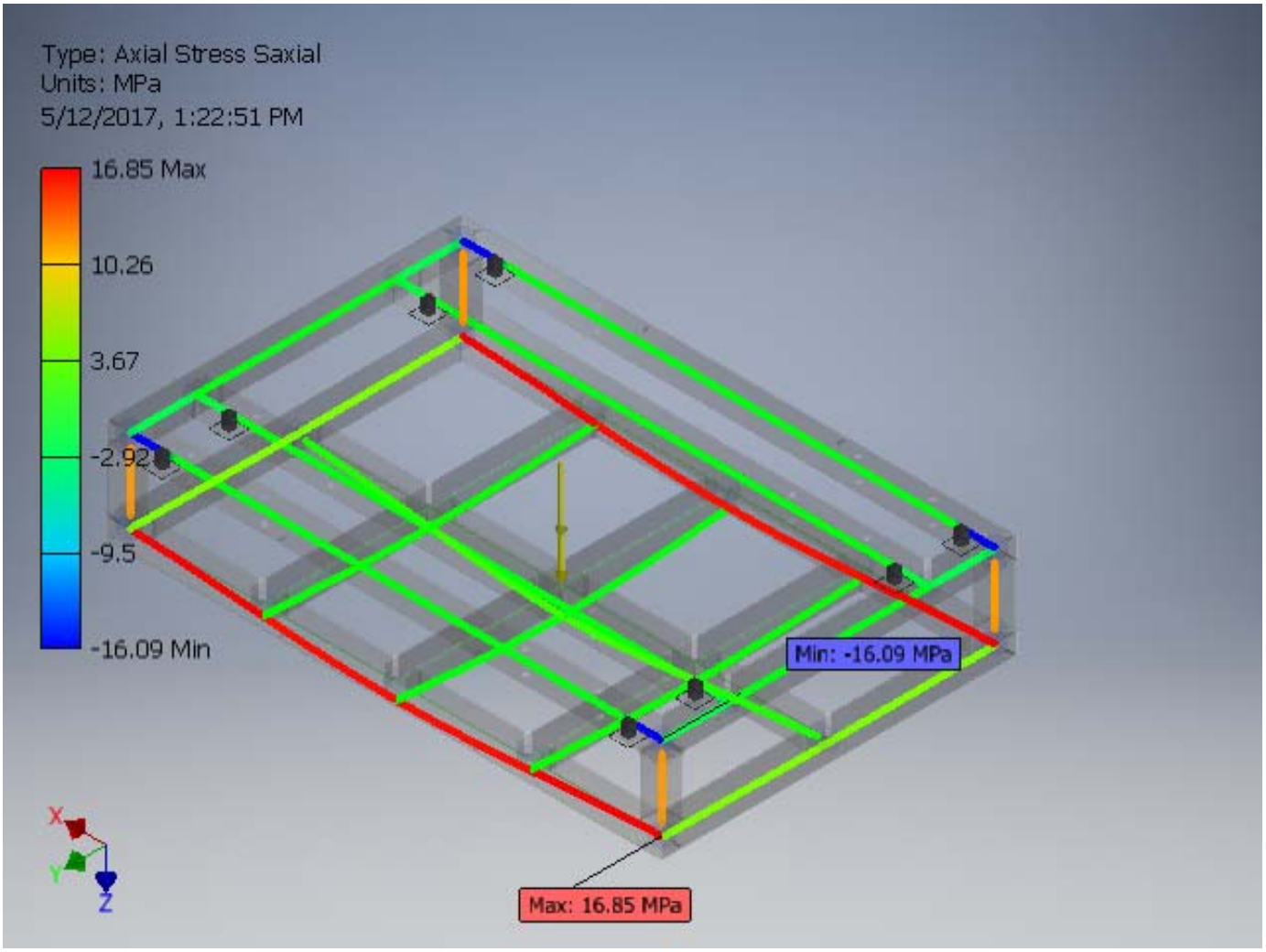
⊟ Smin(My)


Type: Bending Stress (My) min
Units: MPa
5/12/2017, 1:22:51 PM
-0 Max
-52.1
-104.1
-156.2
-208.2
-260.3 Min
Min: -260.3 MPa
Max: -0 MPa
X
Y
Z

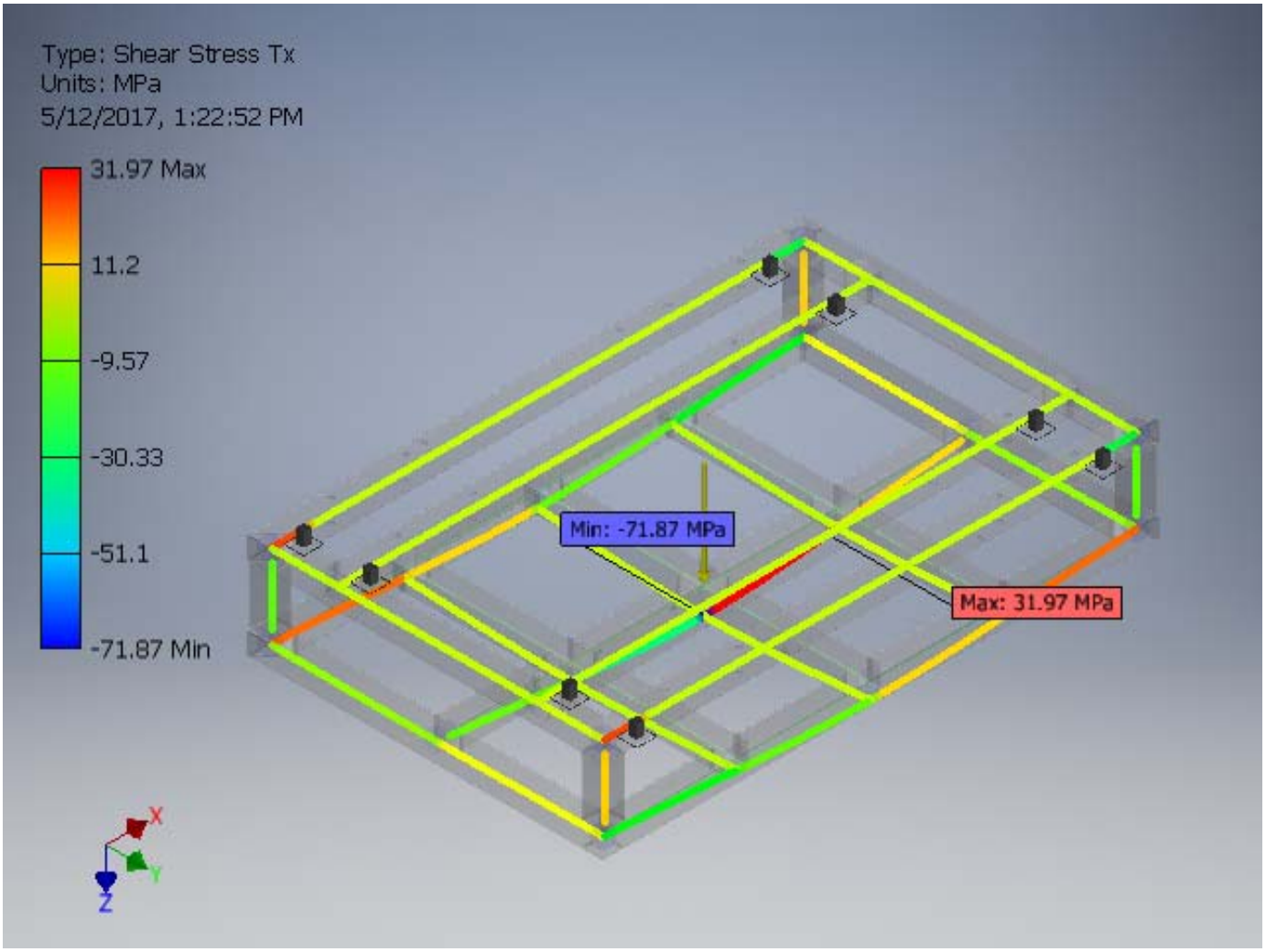

Type: Bending Stress (My) min
Units: MPa
5/12/2017, 1:22:51 PM
-0 Max
-52.1
-104.1
-156.2
-208.2
-260.3 Min
Min: -260.3 MPa
Max: -0 MPa
X
Y
Z

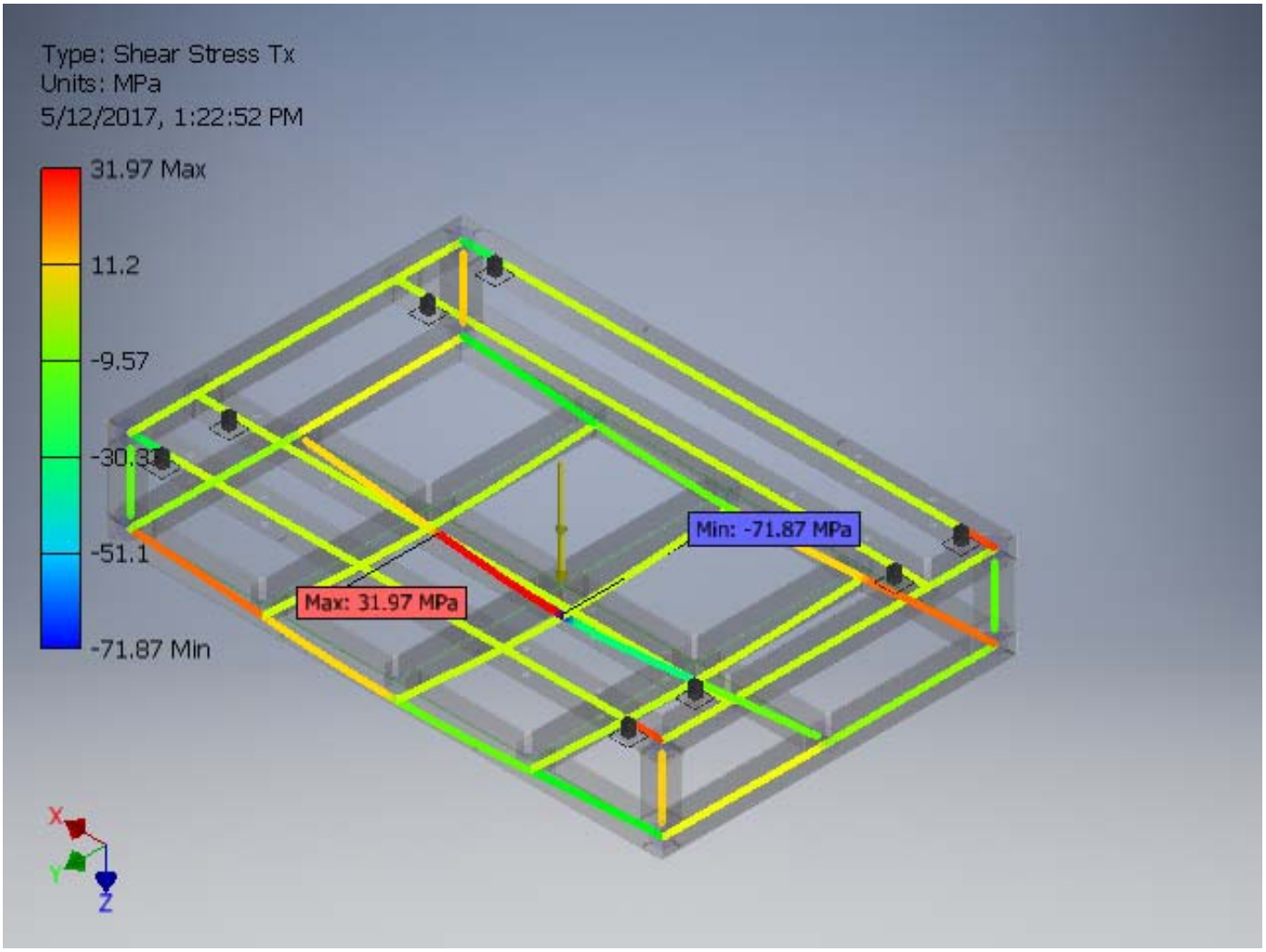
Saxial


Type: Axial Stress Saxial
Units: MPa
5/12/2017, 1:22:51 PM
16.85 Max
10.26
3.67
-2.92
-9.5
-16.09 Min
Min: -16.09 MPa
Max: 16.85 MPa
X
Y
Z

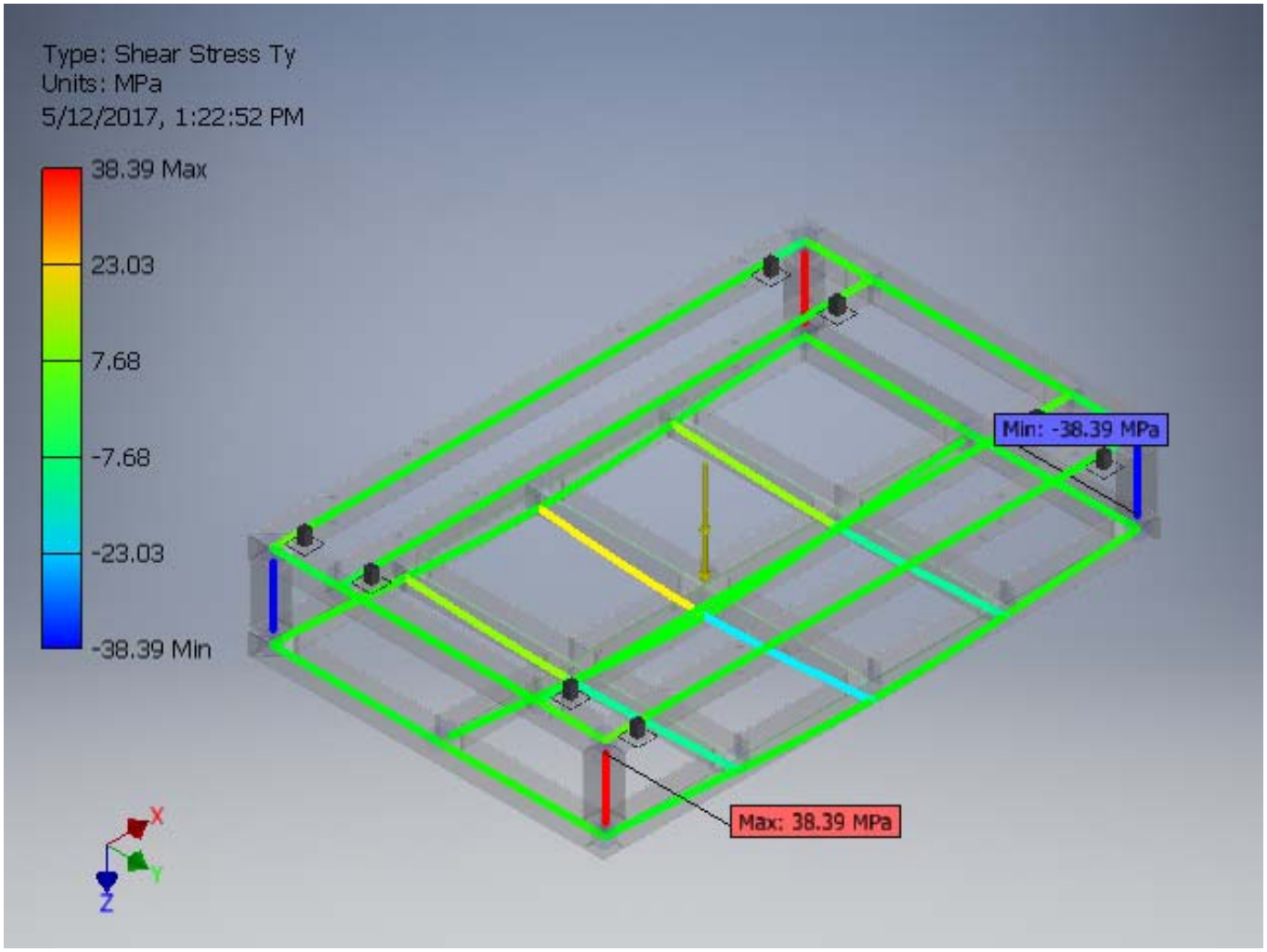

Type: Axial Stress Saxial
Units: MPa
5/12/2017, 1:22:51 PM
16.85 Max
10.26
3.67
-2.92
-9.5
-16.09 Min
Min: -16.09 MPa
Max: 16.85 MPa
X
Y
Z

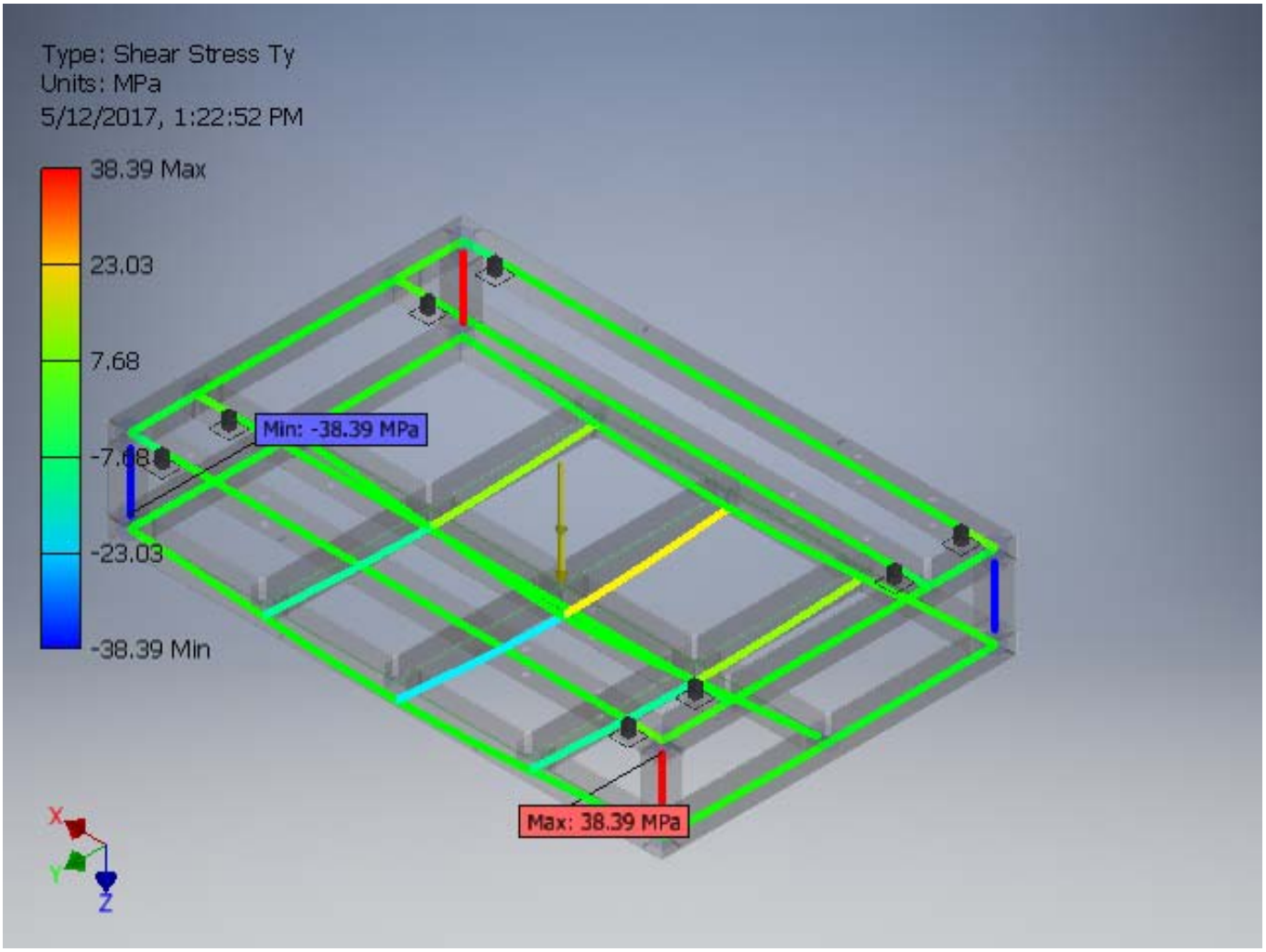
⊟ Tx


Type: Shear Stress Tx
Units: MPa
5/12/2017, 1:22:52 PM
31.97 Max
11.2
-9.57
-30.33
-51.1
-71.87 Min
Min: -71.87 MPa
Max: 31.97 MPa
X
Y
Z

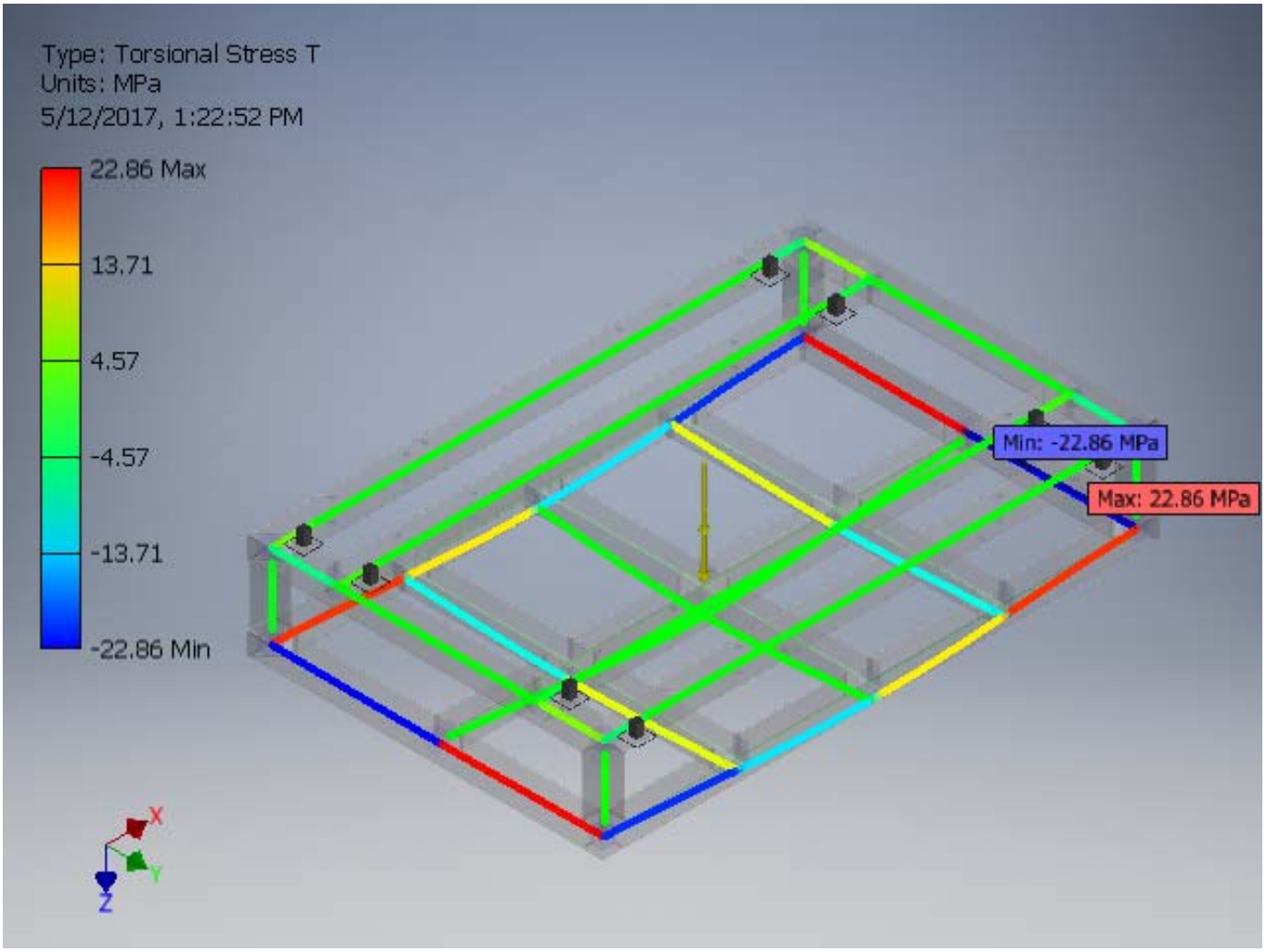

Type: Shear Stress Tx
Units: MPa
5/12/2017, 1:22:52 PM
31.97 Max
11.2
-9.57
-30.33
-51.1
-71.87 Min
Min: -71.87 MPa
Max: 31.97 MPa
X
Y
Z

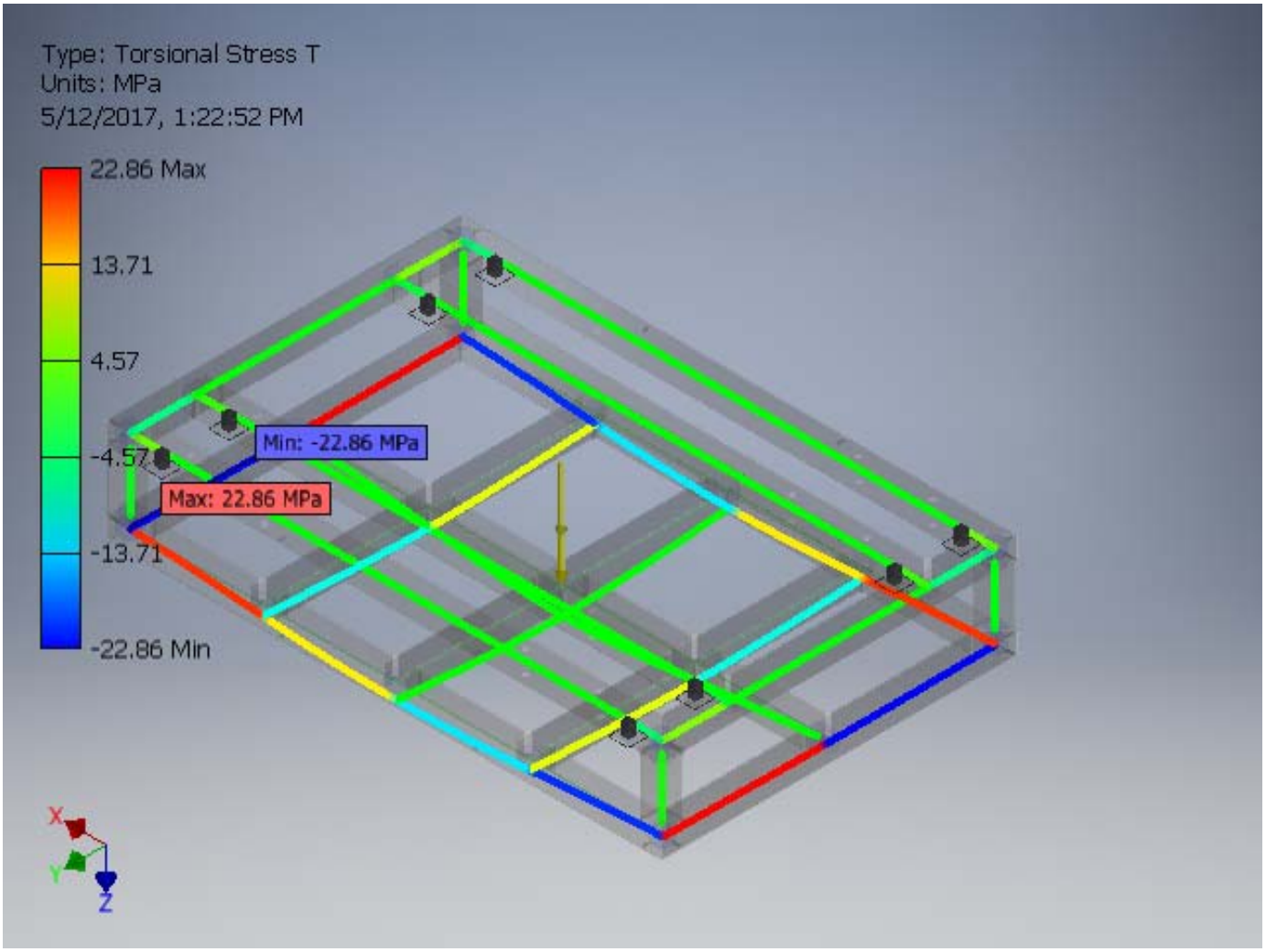
⊟ Ty


Type: Shear Stress Ty
Units: MPa
5/12/2017, 1:22:52 PM
38.39 Max
23.03
7.68
-7.68
-23.03
-38.39 Min
Min: -38.39 MPa
Max: 38.39 MPa
X
Y
Z


Type: Shear Stress Ty
Units: MPa
5/12/2017, 1:22:52 PM
38.39 Max
23.03
7.68
-7.68
-23.03
-38.39 Min
Min: -38.39 MPa
Max: 38.39 MPa
X
Y
Z

T


Type: Torsional Stress T
Units: MPa
5/12/2017, 1:22:52 PM
22.86 Max
13.71
4.57
-4.57
-13.71
-22.86 Min
Min: -22.86 MPa
Max: 22.86 MPa
X
Y
Z


Type: Torsional Stress T
Units: MPa
5/12/2017, 1:22:52 PM
22.86 Max
13.71
4.57
-4.57
-13.71
-22.86 Min
Min: -22.86 MPa
Max: 22.86 MPa
X
Y
Z

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