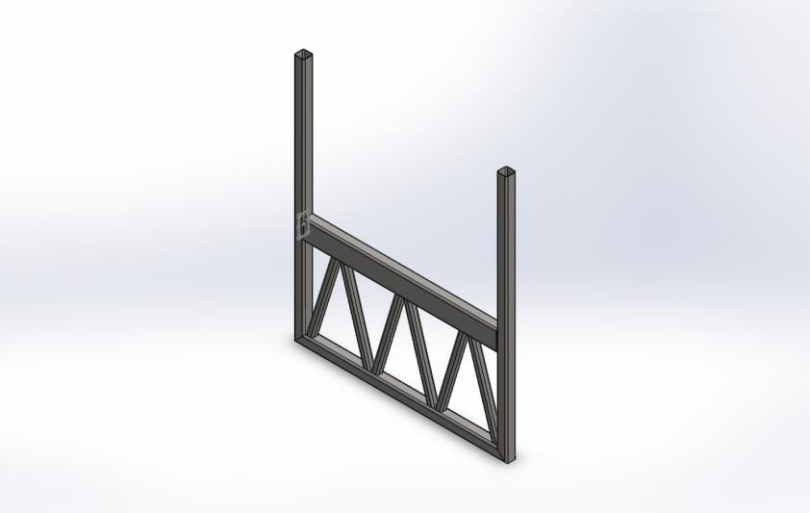
Vermont technical College
Company Address Line 2]



Simulation of Main Frame

Date: Wednesday, January 22, 2014
Designer: Carter Mealey, Ben Holleran
Study name: Bridge
Analysis type: Static

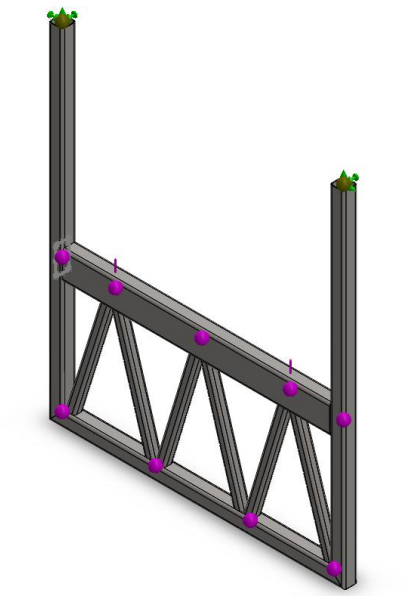
Table of Contents

Description

No Data

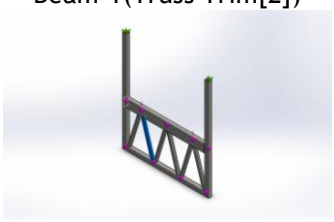
Assumptions

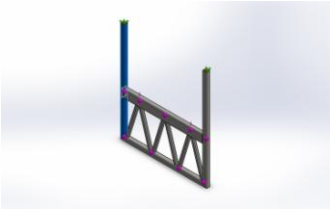
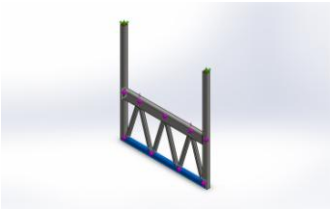
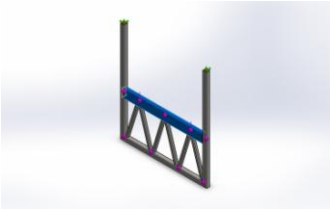
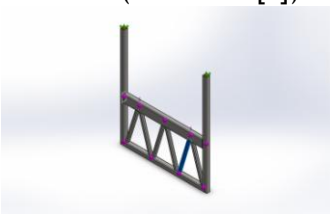
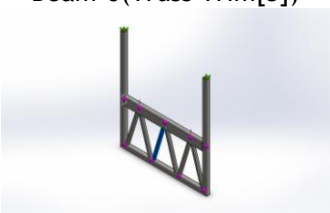
Model Information

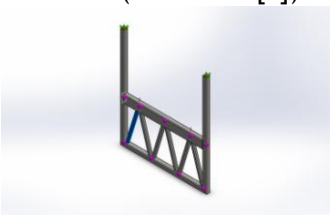
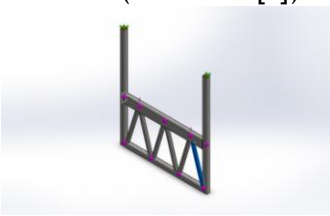
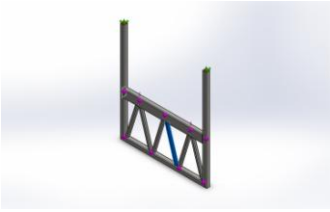
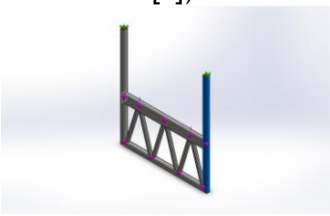


Model name: Main Frame
Current Configuration: Default<As Machined>

Beam Bodies:

Document Name and Reference	Formulation	Properties	Document Path/Date Modified
Beam-1(Truss Trim[2]) 	Beam - Uniform C/S	**Section Standard- Section Area: 544.265in^2 Length:636.35mm Volume:0.000346335m^3 Mass Density:7800kg/m^3 Mass:2.70141kg Weight:26.4738N**	**\\vtcfiles\shared\ELM\ELM 4701\Bridge Tester\Design\Solidworks Models\Frame Optimization REV 2\Main Frame.SLDPRT** Jan 22 00:54:07 2014

Beam-2(Bottom miter 2[2]) 	Beam - Uniform C/S	**Section Standard-ansi inch/square tube/3 x 3 x 0.25** **Section Area: 866.845in^2** **Length:1828.8mm** **Volume:0.00158529m^3** **Mass Density:7800kg/m^3** **Mass:12.3652kg** **Weight:121.179N**	**\\vtcfiles\shared\ELM\ELM 4701\Bridge Tester\Design\Solidworks Models\Frame Optimization REV 2\Main Frame.SLDPRT** Jan 22 00:54:07 2014
Beam-3(Bottom miter 2[1]) 	Beam - Uniform C/S	**Section Standard-ansi inch/square tube/3 x 3 x 0.25** **Section Area: 1670.35in^2** **Length:1524mm** **Volume:0.00254566m^3** **Mass Density:7800kg/m^3** **Mass:19.8561kg** **Weight:194.59N**	**\\vtcfiles\shared\ELM\ELM 4701\Bridge Tester\Design\Solidworks Models\Frame Optimization REV 2\Main Frame.SLDPRT** Jan 22 00:54:07 2014
Beam-4(Deck trim) 	Beam - Uniform C/S	**Section Standard-ansi inch/rectangular tube/3 x 2 x 0.25** **Section Area: 1350.71in^2** **Length:1447.8mm** **Volume:0.00195556m^3** **Mass Density:7800kg/m^3** **Mass:15.2534kg** **Weight:149.483N**	**\\vtcfiles\shared\ELM\ELM 4701\Bridge Tester\Design\Solidworks Models\Frame Optimization REV 2\Main Frame.SLDPRT** Jan 22 00:54:07 2014
Beam-5(Truss Trim[5]) 	Beam - Uniform C/S	**Section Standard-** **Section Area: 544.265in^2** **Length:636.35mm** **Volume:0.000346335m^3** **Mass Density:7800kg/m^3** **Mass:2.70141kg** **Weight:26.4738N**	**\\vtcfiles\shared\ELM\ELM 4701\Bridge Tester\Design\Solidworks Models\Frame Optimization REV 2\Main Frame.SLDPRT** Jan 22 00:54:07 2014
Beam-6(Truss Trim[3]) 	Beam - Uniform C/S	**Section Standard-** **Section Area: 544.265in^2** **Length:636.35mm** **Volume:0.000346335m^3** **Mass Density:7800kg/m^3** **Mass:2.70141kg** **Weight:26.4738N**	**\\vtcfiles\shared\ELM\ELM 4701\Bridge Tester\Design\Solidworks Models\Frame Optimization REV 2\Main Frame.SLDPRT** Jan 22 00:54:07 2014

Beam-7(Truss Trim[1]) 	Beam - Uniform C/S	**Section Standard- Section Area: 544.265in^2 Length:638.672mm Volume:0.000347599m^3 Mass Density:7800kg/m^3 Mass:2.71127kg Weight:26.5704N**	**\\vtcfiles\shared\ELM\ELM 4701\Bridge Tester\Design\Solidworks Models\Frame Optimization REV 2\Main Frame.SLDPRT** Jan 22 00:54:07 2014
Beam-8(Truss Trim[6]) 	Beam - Uniform C/S	**Section Standard- Section Area: 544.265in^2 Length:638.672mm Volume:0.000347599m^3 Mass Density:7800kg/m^3 Mass:2.71127kg Weight:26.5704N**	**\\vtcfiles\shared\ELM\ELM 4701\Bridge Tester\Design\Solidworks Models\Frame Optimization REV 2\Main Frame.SLDPRT** Jan 22 00:54:07 2014
Beam-9(Truss Trim[4]) 	Beam - Uniform C/S	**Section Standard- Section Area: 544.265in^2 Length:636.35mm Volume:0.000346335m^3 Mass Density:7800kg/m^3 Mass:2.70141kg Weight:26.4738N**	**\\vtcfiles\shared\ELM\ELM 4701\Bridge Tester\Design\Solidworks Models\Frame Optimization REV 2\Main Frame.SLDPRT** Jan 22 00:54:07 2014
Beam-10(Bottom miter 1[2]) 	Beam - Uniform C/S	**Section Standard-ansi inch/square tube/3 x 3 x 0.25 Section Area: 866.845in^2 Length:1828.8mm Volume:0.00158529m^3 Mass Density:7800kg/m^3 Mass:12.3652kg Weight:121.179N**	**\\vtcfiles\shared\ELM\ELM 4701\Bridge Tester\Design\Solidworks Models\Frame Optimization REV 2\Main Frame.SLDPRT** Jan 22 00:54:07 2014

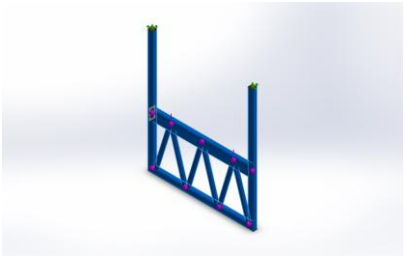
Study Properties

Study name	Bridge
Analysis type	Static
Mesh type	Beam Mesh
Solver type	Direct sparse solver
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Result folder	SolidWorks document (\\vtcfiles\shared\ELM\ELM4701\Bridge Tester\Design\Solidworks Models\Frame Optimization REV 2)

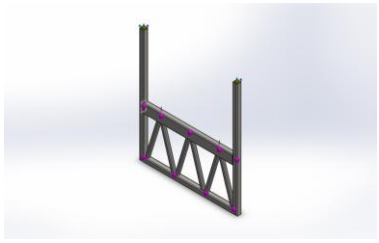
Units

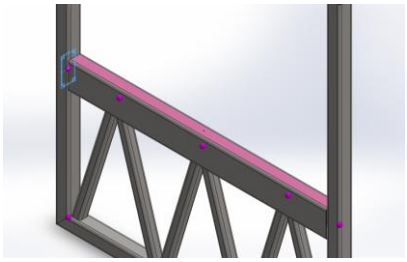
Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m^2

Material Properties

Model Reference	Properties	Components
	**Name:** Plain Carbon Steel **Model type:** Linear Elastic Isotropic **Default failure criterion:** Unknown **Yield strength:** 2.20594e+008 N/m^2 **Tensile strength:** 3.99826e+008 N/m^2 **Elastic modulus:** 2.1e+011 N/m^2 **Poisson's ratio:** 0.28 **Mass density:** 7800 kg/m^3 **Shear modulus:** 7.9e+010 N/m^2 **Thermal expansion coefficient:** 1.3e-005 /Kelvin	SolidBody 1(Truss Trim[2])(Main Frame), SolidBody 2(Bottom miter 2[2])(Main Frame), SolidBody 3(Bottom miter 2[1])(Main Frame), SolidBody 4(Deck trim)(Main Frame), SolidBody 5(Truss Trim[5])(Main Frame), SolidBody 6(Truss Trim[3])(Main Frame), SolidBody 7(Truss Trim[1])(Main Frame), SolidBody 8(Truss Trim[6])(Main Frame), SolidBody 9(Truss Trim[4])(Main Frame), SolidBody 10(Bottom miter 1[2])(Main Frame)
Curve Data:N/A		

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** 2 Joint(s) **Type:** Fixed Geometry

Load name	Load Image	Load Details
Force-1		**Entities:** 2 Joint(s) **Reference:** Face< 1 > **Type:** Apply force **Values:** ---, ---, 10000 lbf **Moments:** ---, ---, --- lbf·in

Connector Definitions

No Data

Contact Information

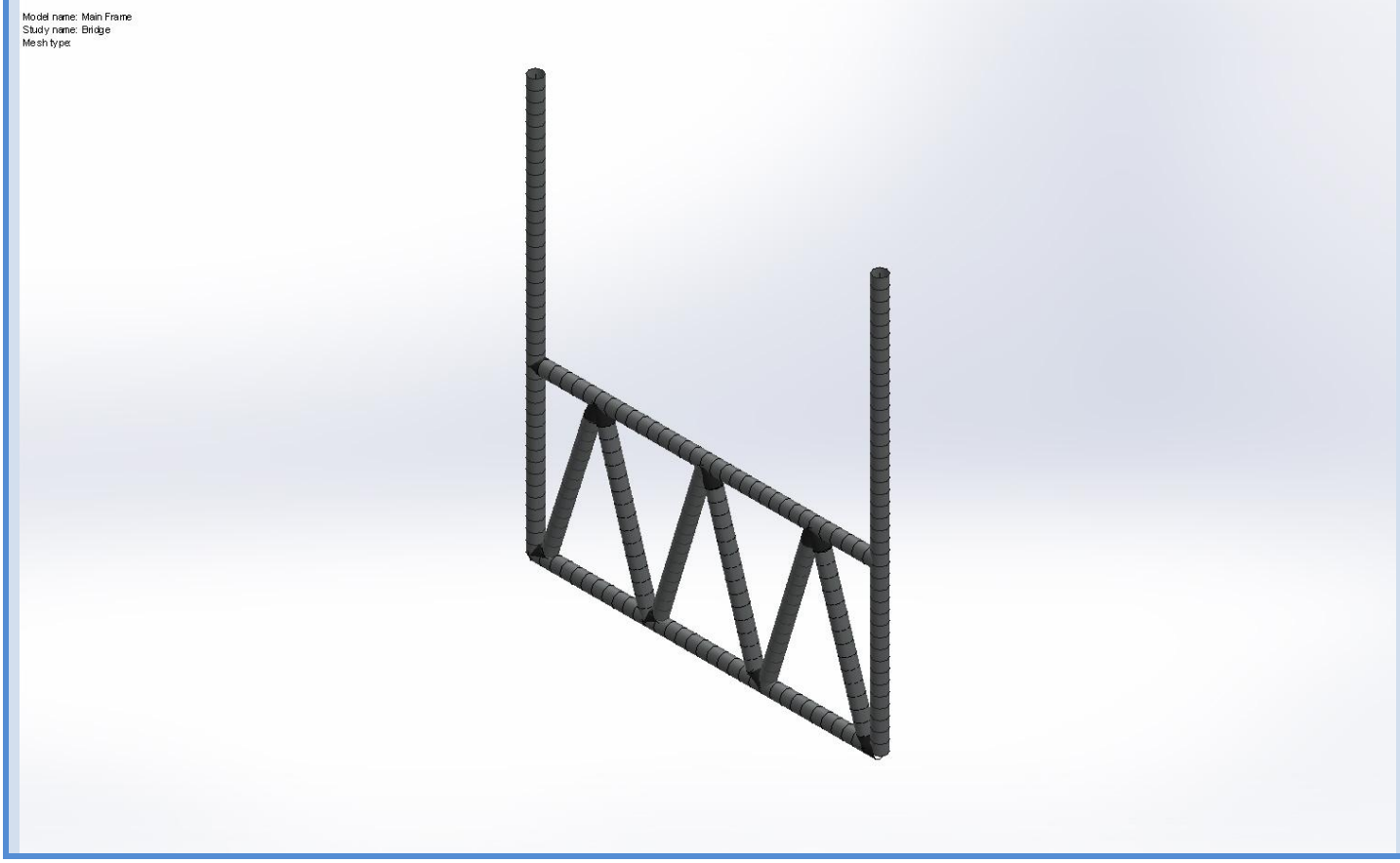
No Data

Mesh Information

Mesh type	Beam Mesh

Mesh Information - Details

Total Nodes	247
Total Elements	243
Time to complete mesh(hh;mm;ss):	00:00:02
Computer name:	DRACOLYTH



Sensor Details

No Data

Resultant Forces

Reaction Forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	0	88964.4	4.38451e-016	88964.4

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N·m	-1.54772e-013	7.4997e-012	9.06491	9.06491

Beams

Beam Forces

Beam Name	Joints	Axial(N)	Shear1(N)	Shear2(N)	Moment1(N·m)	Moment2(N·m)	Torque(N·m)
Beam-1(Truss Trim[2])	1	5504.27	0.00138841	-559.878	-160.011	-0.000396805	-1.46155e-013
	2	-5504.27	-0.000956741	559.881	-218.535	-0.00037344	1.46153e-013
Beam-2(Bottom miter 2[2])	1	44488.2	-4.91304e-012	-786.007	-284.243	3.04103e-012	3.80117e-012
	2	-28586.1	-9.50966e-013	2739.79	-933.427	-7.68225e-013	-3.02452e-014
	3	28586.1	9.50966e-013	-2739.79	-1049.9	7.9821e-014	3.02453e-014
Beam-3(Bottom miter 2[1])	1	12499.6	-230.882	-4.82211e-013	-3.8713e-013	326.435	6.70304e-013
	2	-12499.6	230.882	-8.06557e-012	-1.70118e-012	-220.413	-5.54059e-013
	3	16330.9	-22.2372	-2.2299e-013	-1.09055e-013	308.642	5.57374e-013
	4	12502.8	141.669	-1.85641e-013	6.03742e-014	282.03	1.82823e-013
Beam-4(Deck trim)	1	-1953.78	-15902	4.46363e-012	-2.35418e-012	2950.9	2.58243e-012
	2	1953.78	15902	-4.46363e-012	3.47111e-012	1028.25	-2.58243e-012
	3	-13822.2	-5278.18	4.70448e-012	2.24511e-012	2625.31	2.08829e-012
	4	-13829	5337.22	5.65953e-012	4.13361e-013	147.18	1.81326e-012
	5	-1839.42	15563.5	5.32308e-012	3.39428e-012	-1571.08	1.30878e-012
Beam-5(Truss Trim[5])	1	-5518.91	-0.00366016	544.99	-154.805	-0.00103967	1.00083e-014
	2	0	0	0	0	0	0
Beam-6(Truss Trim[3])	1	5589.51	-0.00063585	-117.228	57.8102	-0.000313564	1.39206e-013
	2	-5589.51	-0.000419664	117.23	26.1154	9.34892e-005	-1.39204e-013
Beam-7(Truss Trim[1])	1	-29975.6	-0.00194658	857.857	273.025	0.000619527	-9.09229e-014
	2	29975.6	0.000763378	-857.871	274.871	0.000244594	9.09231e-014
Beam-8(Truss Trim[6])	1	-30407.6	-1.02897e-014	846.037	271.294	1.57306e-013	-1.57159e-013
	2	30407.6	0.000182593	-846.037	269.046	5.80658e-005	1.57159e-013
Beam-9(Truss	1	-5566.14	-0.000188081	131.381	59.3665	8.49869e-005	-2.4356e-013

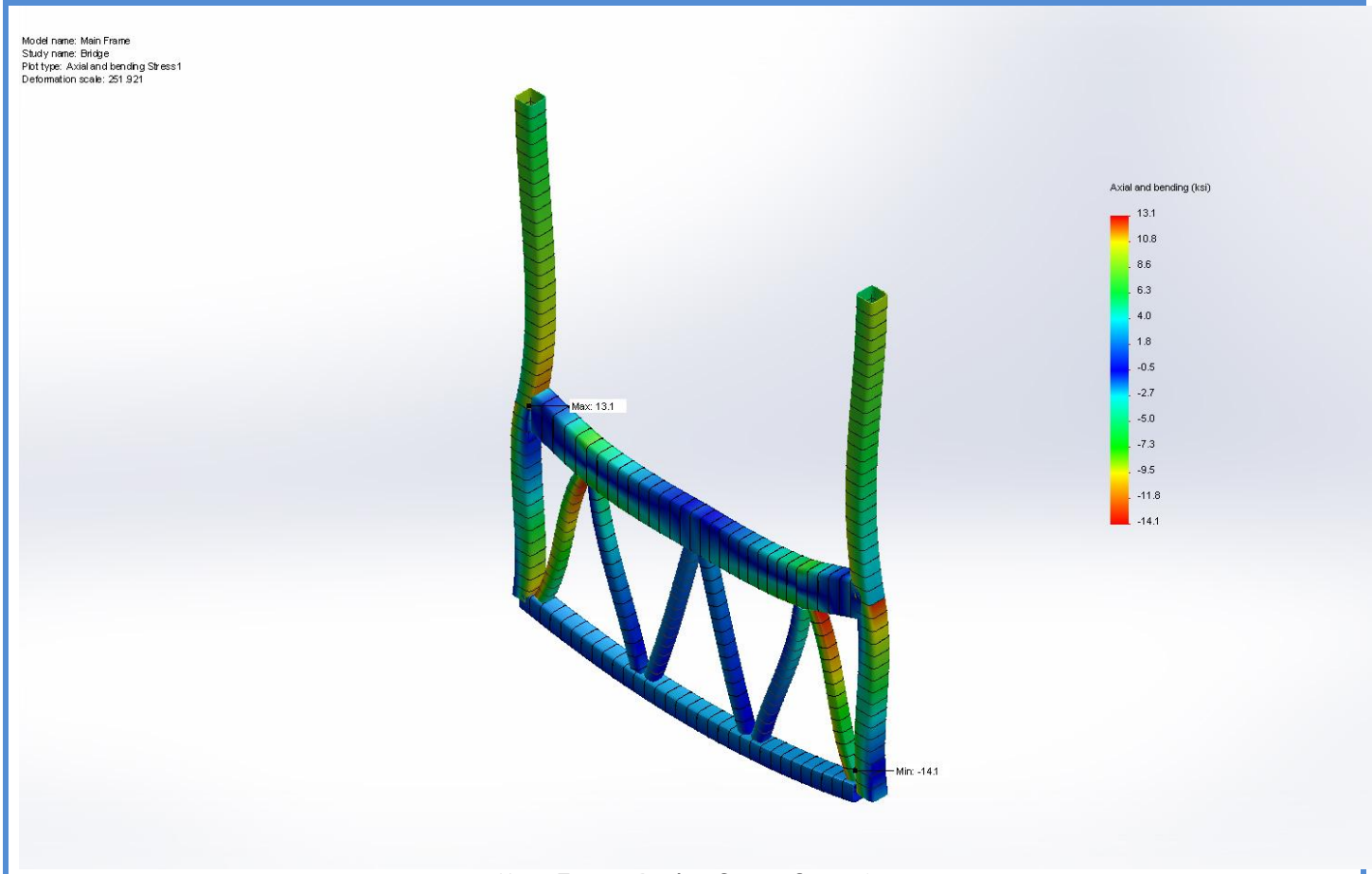
Trim[4])	2	5566.14	0.00115671	-131.388	24.2387	0.000213391	2.4356e-013
Beam-10(Bottom miter 1[2])	1	-28912.8	4.80964e-013	-2625.44	904.625	-6.34336e-013	-3.04245e-013
	2	44476.3	0.0166265	785.892	293.308	-0.00620528	3.69852e-012
	3	28912.8	-4.80964e-013	2625.44	877.148	9.60745e-013	3.04245e-013

Beam Stresses

Beam Name	Joints	Axial(N/m^2)	Bending Dir1(N/m^2)	Bending Dir2(N/m^2)	Torsional (N/m^2)	Worst Case(N/m^2)
Beam-1(Truss Trim[2])	1	1.01132e+007	-2.13806e+007	53.0208	-7.77954e-009	3.14939e+007
	2	1.01132e+007	2.92006e+007	-49.8988	7.77945e-009	3.93138e+007
Beam-2(Bottom miter 2[2])	1	5.1322e+007	-1.46963e+007	-1.57232e-007	8.22346e-008	6.60183e+007
	2	3.29772e+007	4.82614e+007	-3.97199e-008	-6.54326e-010	8.12386e+007
	3	3.29772e+007	-5.42837e+007	-4.12702e-009	6.54327e-010	8.72609e+007
Beam-3(Bottom miter 2[1])	1	7.48321e+006	-1.12285e-008	-9.4681e+006	1.45014e-008	1.69513e+007
	2	7.48321e+006	4.93421e-008	-6.39299e+006	-1.19865e-008	1.38762e+007
	3	9.77695e+006	-3.1631e-009	-8.95204e+006	1.20582e-008	1.8729e+007
	4	7.48514e+006	1.75113e-009	-8.18017e+006	3.95519e-009	1.56653e+007
Beam-4(Deck trim)	1	-1.44648e+006	-6.4884e-008	-5.63782e+007	3.31982e-008	5.78247e+007
	2	-1.44648e+006	-9.56679e-008	1.96452e+007	-3.31982e-008	2.10917e+007
	3	-1.02332e+007	6.1878e-008	-5.01576e+007	2.68459e-008	6.03908e+007
	4	-1.02383e+007	1.13927e-008	-2.81194e+006	2.33102e-008	1.30503e+007
	5	-1.36181e+006	9.35504e-008	3.00162e+007	1.6825e-008	3.1378e+007
Beam-5(Truss Trim[5])	1	1.01401e+007	2.06849e+007	-138.92	5.32722e-010	3.08252e+007
	2	0	0	0	0	0
Beam-6(Truss Trim[3])	1	-1.02698e+007	-7.72456e+006	-41.8982	7.40965e-009	1.79944e+007
	2	-1.02698e+007	3.48953e+006	-12.492	-7.40958e-009	1.37594e+007
Beam-7(Truss Trim[1])	1	-5.50755e+007	3.64814e+007	-82.7808	-4.83965e-009	9.1557e+007
	2	-5.50755e+007	-3.67281e+007	32.6826	4.83966e-009	9.18036e+007
Beam-8(Truss Trim[6])	1	-5.58692e+007	3.62501e+007	-2.10191e-008	-8.36525e-009	9.21193e+007
	2	-5.58692e+007	-3.59498e+007	7.75872	8.36525e-009	9.1819e+007
Beam-9(Truss Trim[4])	1	-1.02269e+007	7.93251e+006	-11.3559	-1.29643e-008	1.81594e+007
	2	-1.02269e+007	-3.23876e+006	28.5132	1.29642e-008	1.34657e+007
Beam-10(Bottom miter 1[2])	1	3.33541e+007	-4.67722e+007	-3.27974e-008	-6.58205e-009	8.01263e+007
	2	5.13082e+007	1.5165e+007	320.834	8.00139e-008	6.64736e+007
	3	3.33541e+007	4.53516e+007	-4.96739e-008	6.58205e-009	7.87057e+007

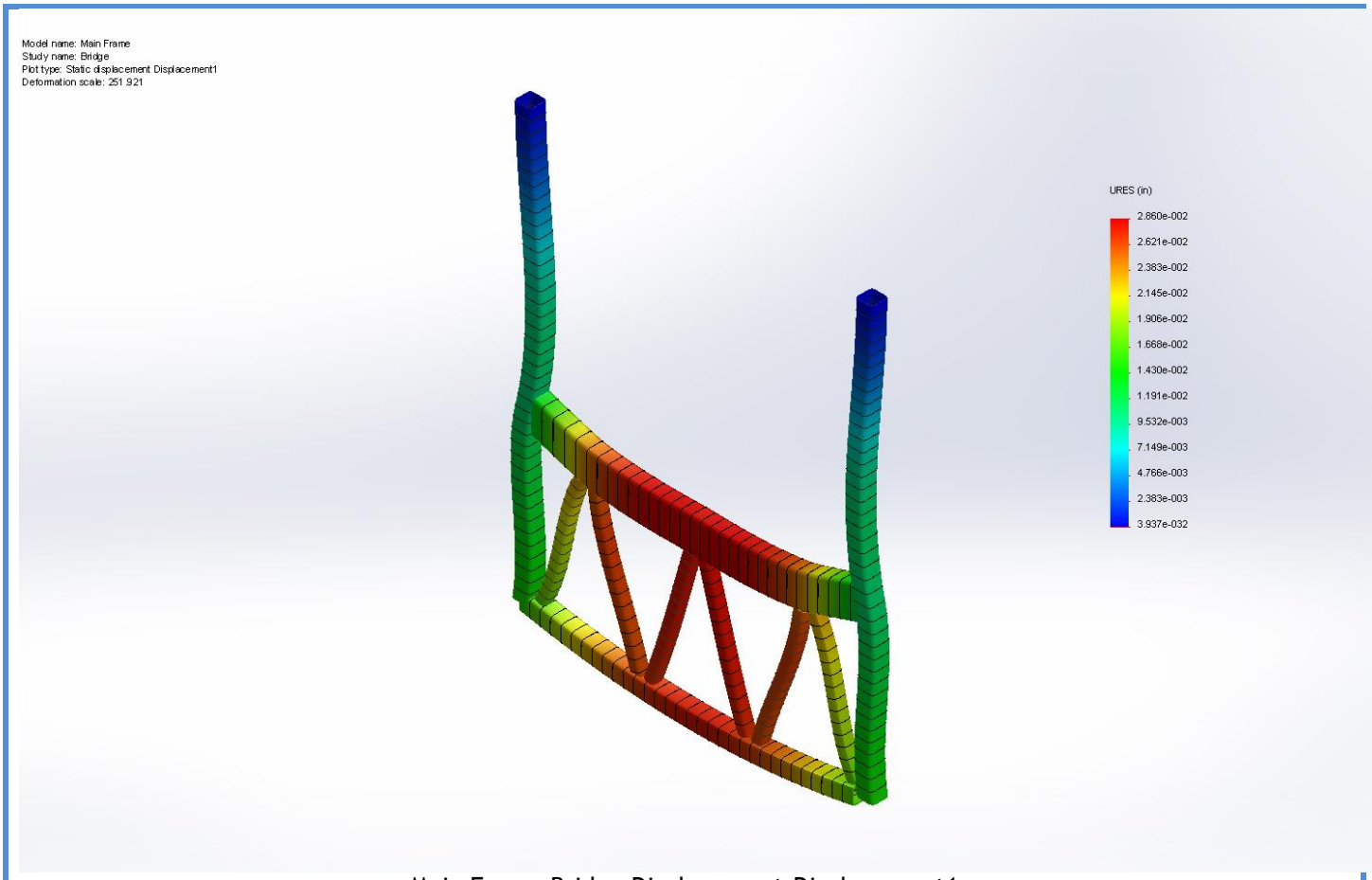
Study Results

Name	Type	Min	Max
Stress1	TXY: Shear in Y Dir. on YZ Plane	0 ksi Element: 233	13.3608 ksi Element: 178



Main Frame-Bridge-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0 in Node: 57	0.0285959 in Node: 107

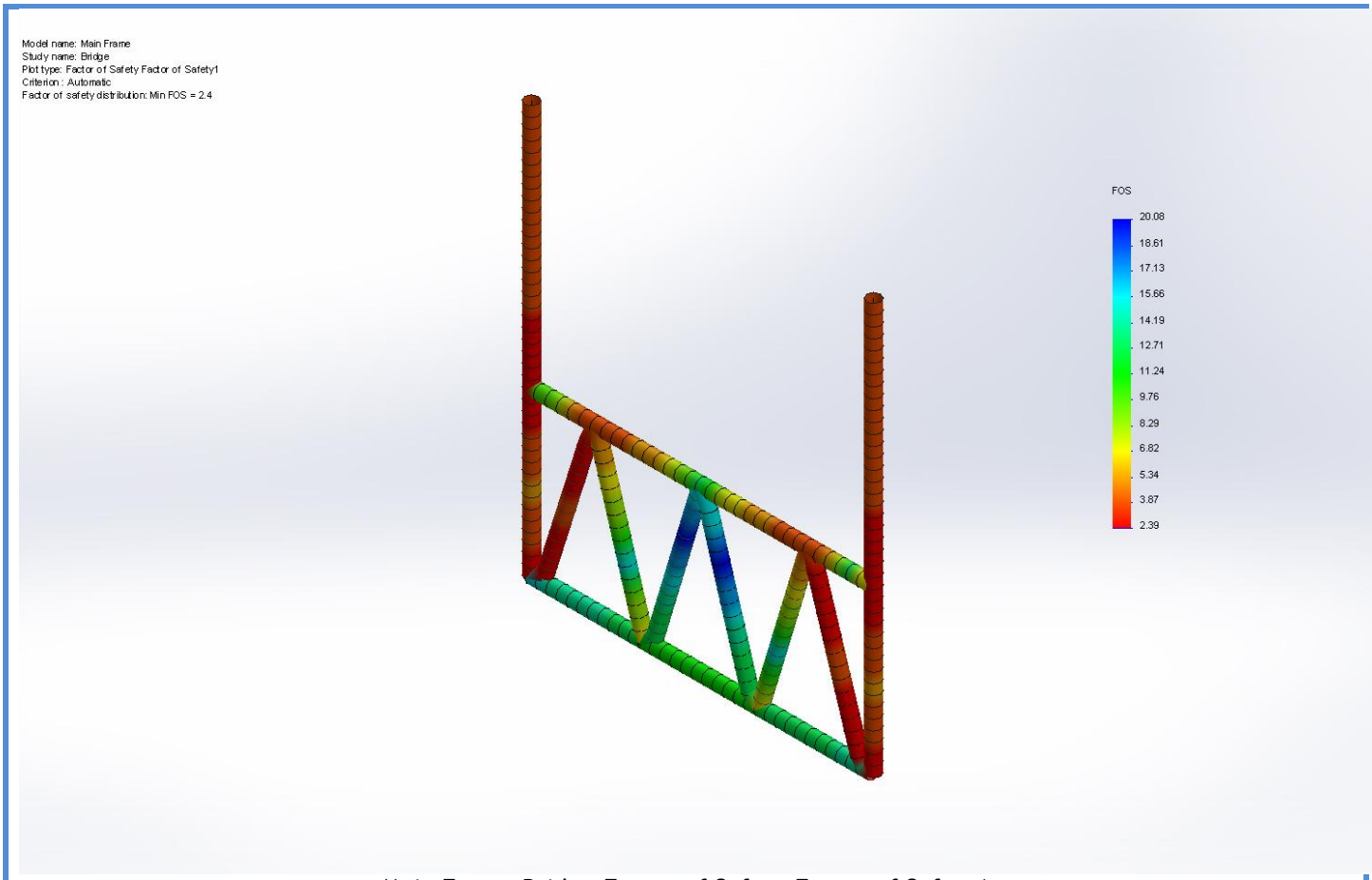


Main Frame-Bridge-Displacement-Displacement1

Name	Type
Displacement1{1}	Deformed Shape

Main Frame-Bridge-Displacement-Displacement1{1}

Name	Type	Min	Max
Factor of Safety1	Automatic	2.39465 Node: 181	20.0803 Node: 148



Main Frame-Bridge-Factor of Safety-Factor of Safety1

Conclusion