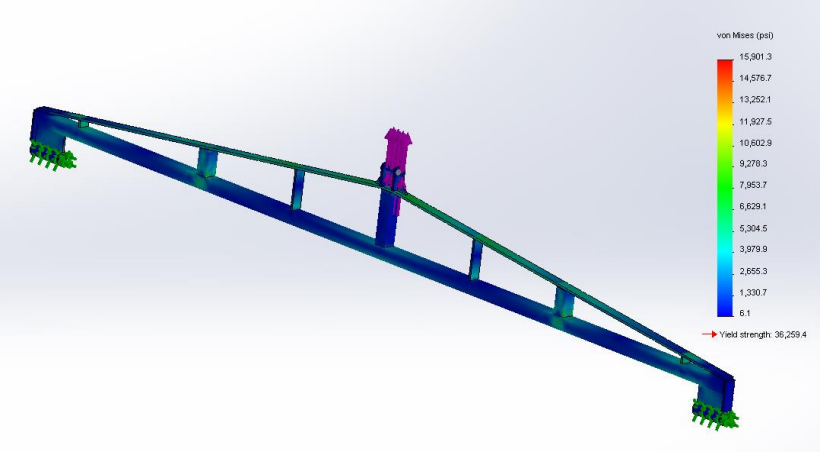
HCC, inc.
1501 1st Avenue
Mendota, IL 61342
Phone: 815-539-9371 Ext 262



Simulation of REAR ASSEMBLY LIFTING HOIST

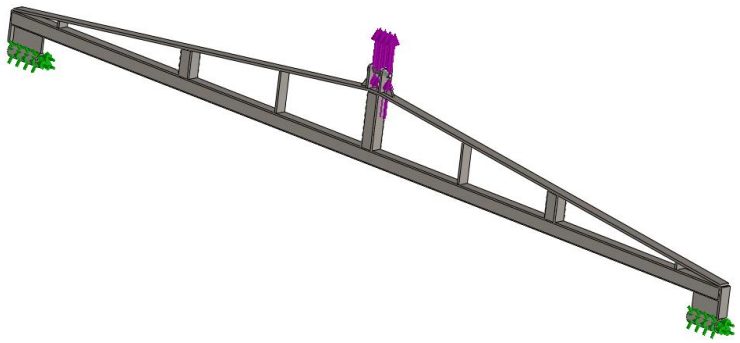
Date: Monday, April 15, 2013
Designer: John Bartoli
Study name: Study 4
Analysis type: Static

Table of Contents

Description

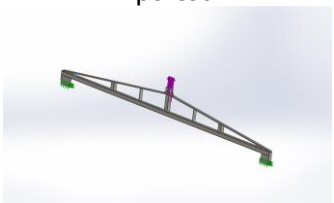
REAR ASSEMBLY LIFTING HOIST (95-1109) is used at Triple C as a lifting device for truck beds. It utilizes pin connections to securely hoist 425-lbs. In overestimation of the applied force, the truss structure shall be given a vertical upward 500-lb load.

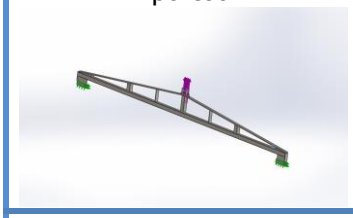
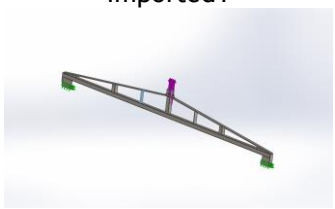
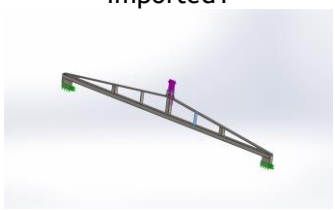
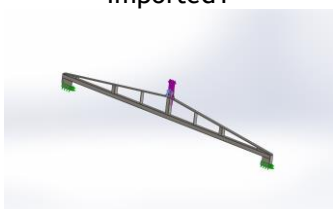
Model Information

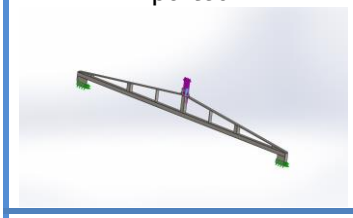
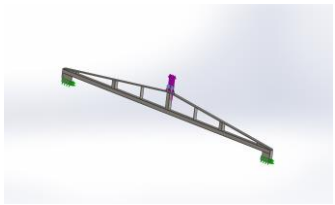
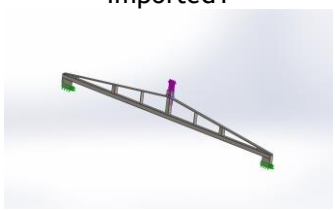
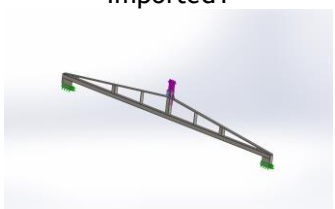


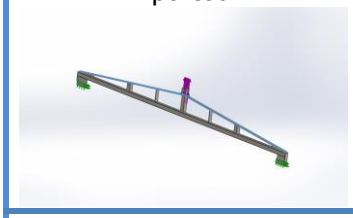
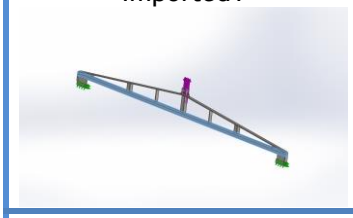
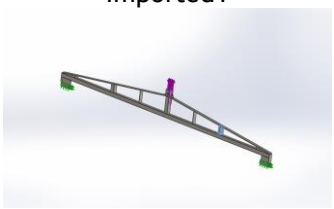
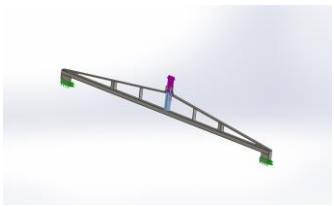
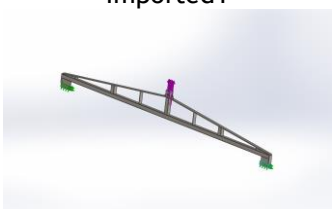
Model name: R&D REAR ASM HOIST_1-4
Current Configuration: Default

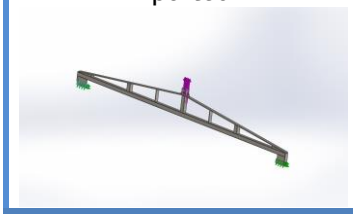
Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Imported1 	Solid Body	**Mass:0.0664686 lb** **Volume:0.234375 in^3** **Density:0.283599 lb/in^3** **Weight:0.0664235 lbf**	**G:\TripleC-Forklift Boom\FI .25 X 1.25 L .75_1.sldprt** Apr 01 16:49:22 2013

Imported1 	Solid Body	**Mass:0.0664686 lb** **Volume:0.234375 in^3** **Density:0.283599 lb/in^3** **Weight:0.0664235 lbf**	**G:\TripleC-Forklift Boom\FI .25 X 1.25 L .75_1.sldprt** Apr 01 16:49:22 2013
Imported1 	Solid Body	**Mass:0.299109 lb** **Volume:1.05469 in^3** **Density:0.283599 lb/in^3** **Weight:0.298906 lbf**	**G:\TripleC-Forklift Boom\FI .25 X 1.25 L 3.375_3.sldprt** Apr 01 16:49:22 2013
Imported1 	Solid Body	**Mass:0.299109 lb** **Volume:1.05469 in^3** **Density:0.283599 lb/in^3** **Weight:0.298906 lbf**	**G:\TripleC-Forklift Boom\FI .25 X 1.25 L 3.375_3.sldprt** Apr 01 16:49:22 2013
Imported1 	Solid Body	**Mass:0.398811 lb** **Volume:1.40625 in^3** **Density:0.283599 lb/in^3** **Weight:0.398541 lbf**	**G:\TripleC-Forklift Boom\FI .25 X 1.25 L 4.5_1.sldprt** Apr 01 16:49:22 2013
Imported1 	Solid Body	**Mass:0.398811 lb** **Volume:1.40625 in^3** **Density:0.283599 lb/in^3** **Weight:0.398541 lbf**	**G:\TripleC-Forklift Boom\FI .25 X 1.25 L 4.5_1.sldprt** Apr 01 16:49:22 2013
Imported1 	Solid Body	**Mass:0.248254 lb** **Volume:0.875368 in^3** **Density:0.283599 lb/in^3** **Weight:0.248085 lbf**	**G:\TripleC-Forklift Boom\FI .25 X 1.5 L 2.5 with hole_1.sldprt** Apr 01 16:49:21 2013

Imported1 	Solid Body	**Mass:0.248254 lb Volume:0.875368 in^3 Density:0.283599 lb/in^3 Weight:0.248085 lbf**	**G:\TripleC-Forklift Boom\FI .25 X 1.5 L 2.5 with hole_1.sldprt** Apr 01 16:49:21 2013
Imported1 	Solid Body	**Mass:0.567198 lb Volume:2 in^3 Density:0.283599 lb/in^3 Weight:0.566814 lbf**	**G:\TripleC-Forklift Boom\FI .25 X 2 L 4_3.sldprt** Apr 01 16:49:22 2013
Imported1 	Solid Body	**Mass:0.567198 lb Volume:2 in^3 Density:0.283599 lb/in^3 Weight:0.566814 lbf**	**G:\TripleC-Forklift Boom\FI .25 X 2 L 4_3.sldprt** Apr 01 16:49:22 2013
HeadChamfer 	Solid Body	**Mass:0.207263 lb Volume:0.73083 in^3 Density:0.283599 lb/in^3 Weight:0.207122 lbf**	**G:\TripleC-Forklift Boom\HHBOLT 0.5000-20x2.5x1-N.sldprt** Apr 01 16:09:57 2013
Imported1 	Solid Body	**Mass:0.0641704 lb Volume:0.226271 in^3 Density:0.283599 lb/in^3 Weight:0.0641268 lbf**	**G:\TripleC-Forklift Boom\R&D top stringer gusset_1.sldprt** Apr 01 16:49:21 2013
Imported1 	Solid Body	**Mass:0.0641704 lb Volume:0.226271 in^3 Density:0.283599 lb/in^3 Weight:0.0641268 lbf**	**G:\TripleC-Forklift Boom\R&D top stringer gusset_1.sldprt** Apr 01 16:49:21 2013

Imported1 	Solid Body	**Mass:9.00666 lb** **Volume:31.7584 in^3** **Density:0.283599 lb/in^3** **Weight:9.00055 lbf**	**G:\TripleC-Forklift Boom\R&D top stringer_1.sldprt** Apr 01 16:49:22 2013
Imported1 	Solid Body	**Mass:18.5899 lb** **Volume:65.5499 in^3** **Density:0.283599 lb/in^3** **Weight:18.5773 lbf**	**G:\TripleC-Forklift Boom\ST 1.5 x .120 L 101_Default_As Machined__1.sldprt** Apr 01 16:49:23 2013
Imported1 	Solid Body	**Mass:0.537652 lb** **Volume:1.89582 in^3** **Density:0.283599 lb/in^3** **Weight:0.537287 lbf**	**G:\TripleC-Forklift Boom\ST 1.5 x .120 L 3_Default_As Machined__1.sldprt** Apr 01 16:49:23 2013
Imported1 	Solid Body	**Mass:0.537652 lb** **Volume:1.89582 in^3** **Density:0.283599 lb/in^3** **Weight:0.537287 lbf**	**G:\TripleC-Forklift Boom\ST 1.5 x .120 L 3_Default_As Machined__1.sldprt** Apr 01 16:49:23 2013
Fillet1 	Solid Body	**Mass:1.10381 lb** **Volume:3.89215 in^3** **Density:0.283599 lb/in^3** **Weight:1.10306 lbf**	**G:\TripleC-Forklift Boom\ST 1.5 x .120 L 6_Default_As Machined__1.sldprt** Apr 01 16:49:23 2013
Imported1 	Solid Body	**Mass:1.05576 lb** **Volume:3.72271 in^3** **Density:0.283599 lb/in^3** **Weight:1.05504 lbf**	**G:\TripleC-Forklift Boom\ST-MT 1.500x1.032 L 4_3.sldprt** Apr 01 16:49:21 2013

Imported1 	Solid Body	**Mass:1.05576 lb** **Volume:3.72271 in^3** **Density:0.283599 lb/in^3** **Weight:1.05504 lbf**	**G:\TripleC-Forklift Boom\ST-MT 1.500x1.032 L 4_3.sldprt** Apr 01 16:49:21 2013

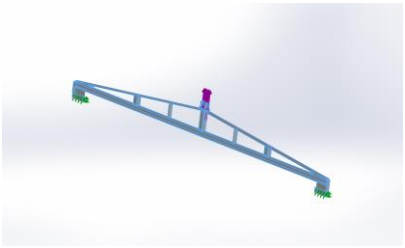
Study Properties

Study name	Study 4
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	77 Fahrenheit
Include fluid pressure effects from SolidWorks Flow Simulation	Off
Solver type	FFEPlus
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SolidWorks document (c:\users\jbartoli\appdata\local\temp)

Units

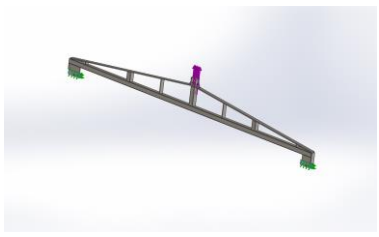
Unit system:	English (IPS)
Length/Displacement	in
Temperature	Fahrenheit
Angular velocity	Hertz
Pressure/Stress	psi

Material Properties

Model Reference	Properties	Components
	**Name:** ASTM A36 Steel **Model type:** Linear Elastic Isotropic **Default failure criterion:** Max von Mises Stress **Yield strength:** 36259.4 psi **Tensile strength:** 58015.1 psi **Elastic modulus:** 2.90075e+007 psi **Poisson's ratio:** 0.26 **Mass density:** 0.283599 lb/in^3 **Shear modulus:** 1.15015e+007 psi	SolidBody 1(Imported1)(Fl .25 X 1.25 L .75_1-1), SolidBody 1(Imported1)(Fl .25 X 1.25 L .75_1-2), SolidBody 1(Imported1)(Fl .25 X 1.25 L 3.375_3-1), SolidBody 1(Imported1)(Fl .25 X 1.25 L 3.375_3-2), SolidBody 1(Imported1)(Fl .25 X 1.25 L 4.5_1-1), SolidBody 1(Imported1)(Fl .25 X 1.25 L 4.5_1-2), SolidBody 1(Imported1)(Fl .25 X 1.5 L 2.5 with hole_1-1), SolidBody 1(Imported1)(Fl .25 X 1.5 L 2.5 with hole_1-2), SolidBody 1(Imported1)(Fl .25 X 2 L 4_3-1), SolidBody 1(Imported1)(Fl .25 X 2 L 4_3-2), SolidBody 1(HeadChamfer)(HHBOLT 0.5000-20x2.5x1-N-1), SolidBody 1(Imported1)(R&D top stringer gusset_1-1), SolidBody 1(Imported1)(R&D top stringer gusset_1-2), SolidBody 1(Imported1)(R&D top stringer_1-1), SolidBody 1(Imported1)(ST 1.5 x .120 L 101_Default_As Machined__1-1), SolidBody 1(Imported1)(ST 1.5 x .120 L 3_Default_As Machined__1-1), SolidBody 1(Imported1)(ST 1.5 x .120 L 3_Default_As Machined__1-2), SolidBody 1(Fillet1)(ST 1.5 x .120 L 6_Default_As Machined__1-1), SolidBody 1(Imported1)(ST-

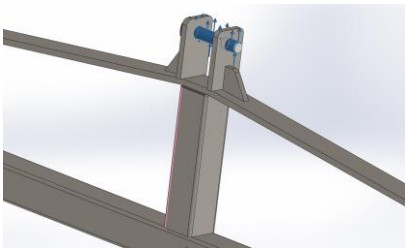
		MT 1.500x1.032 L 4_3-1), SolidBody 1(Imported1)(ST-MT 1.500x1.032 L 4_3-2)
Curve Data:N/A		

Loads and Fixtures

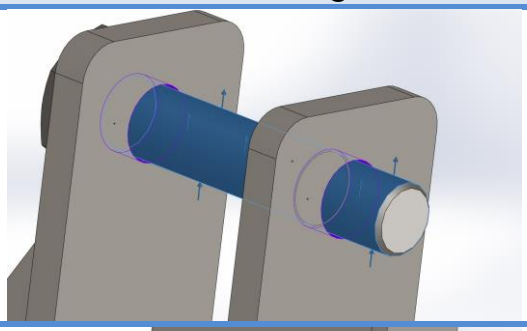
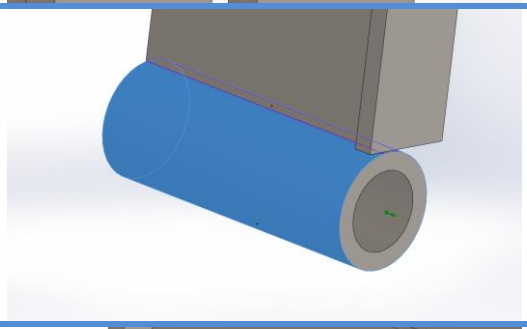
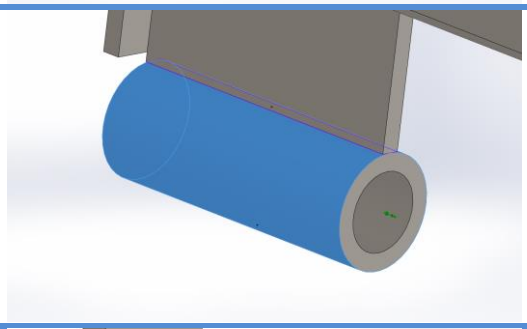
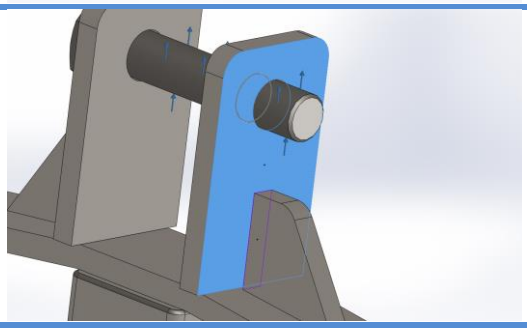
Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** 2 face(s) **Type:** Fixed Hinge

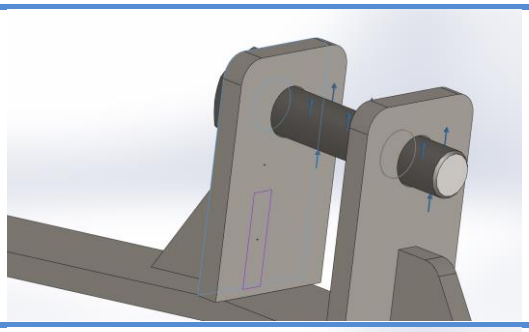
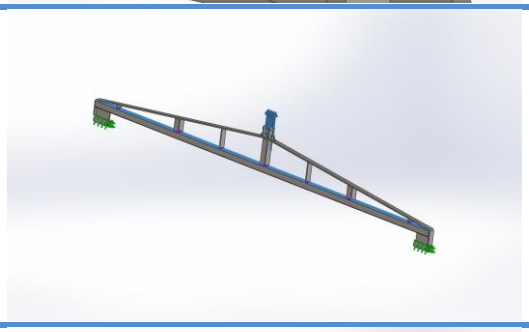
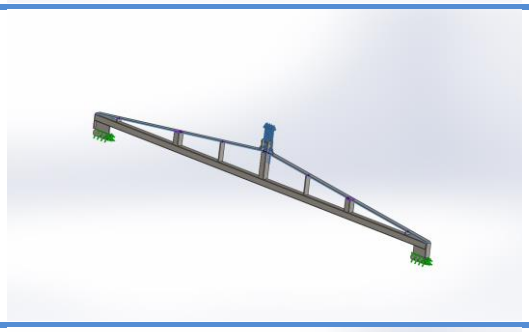
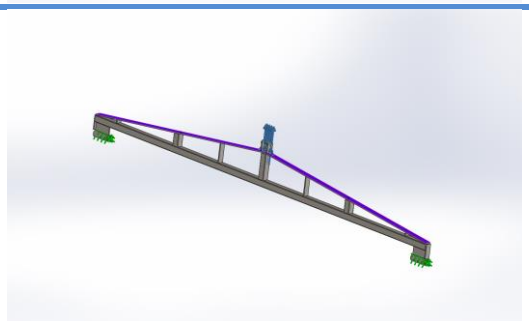
Resultant Forces

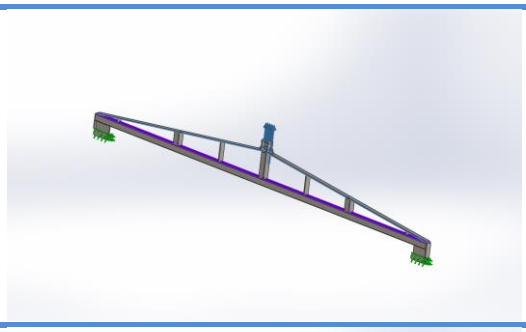
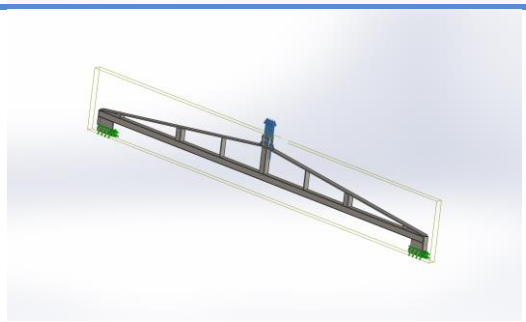
Components	X	Y	Z	Resultant
Reaction force(lbf)	500.011	-0.0198238	-0.00989988	500.011
Reaction Moment(lbf-in)	0	0	0	0

Load name	Load Image	Load Details
Force-1		**Entities:** 1 face(s) **Reference:** Edge< 1 > **Type:** Apply force **Values:** ---, ---, 500 lbf

Contact Information

Contact	Contact Image	Contact Properties
Contact Set-1		**Type:** Bonded contact pair **Entites:** 3 face(s)
Contact Set-2		**Type:** Bonded contact pair **Entites:** 2 face(s)
Contact Set-3		**Type:** Bonded contact pair **Entites:** 2 face(s)
Contact Set-4		**Type:** Bonded contact pair **Entites:** 2 face(s)

Contact Set-5		**Type:** Bonded contact pair **Entites:** 2 face(s)
Contact Set-6		**Type:** Bonded contact pair **Entites:** 8 face(s)
Contact Set-7		**Type:** Bonded contact pair **Entites:** 12 face(s)
Contact Set-8		**Type:** Bonded contact pair **Entites:** 4 face(s)

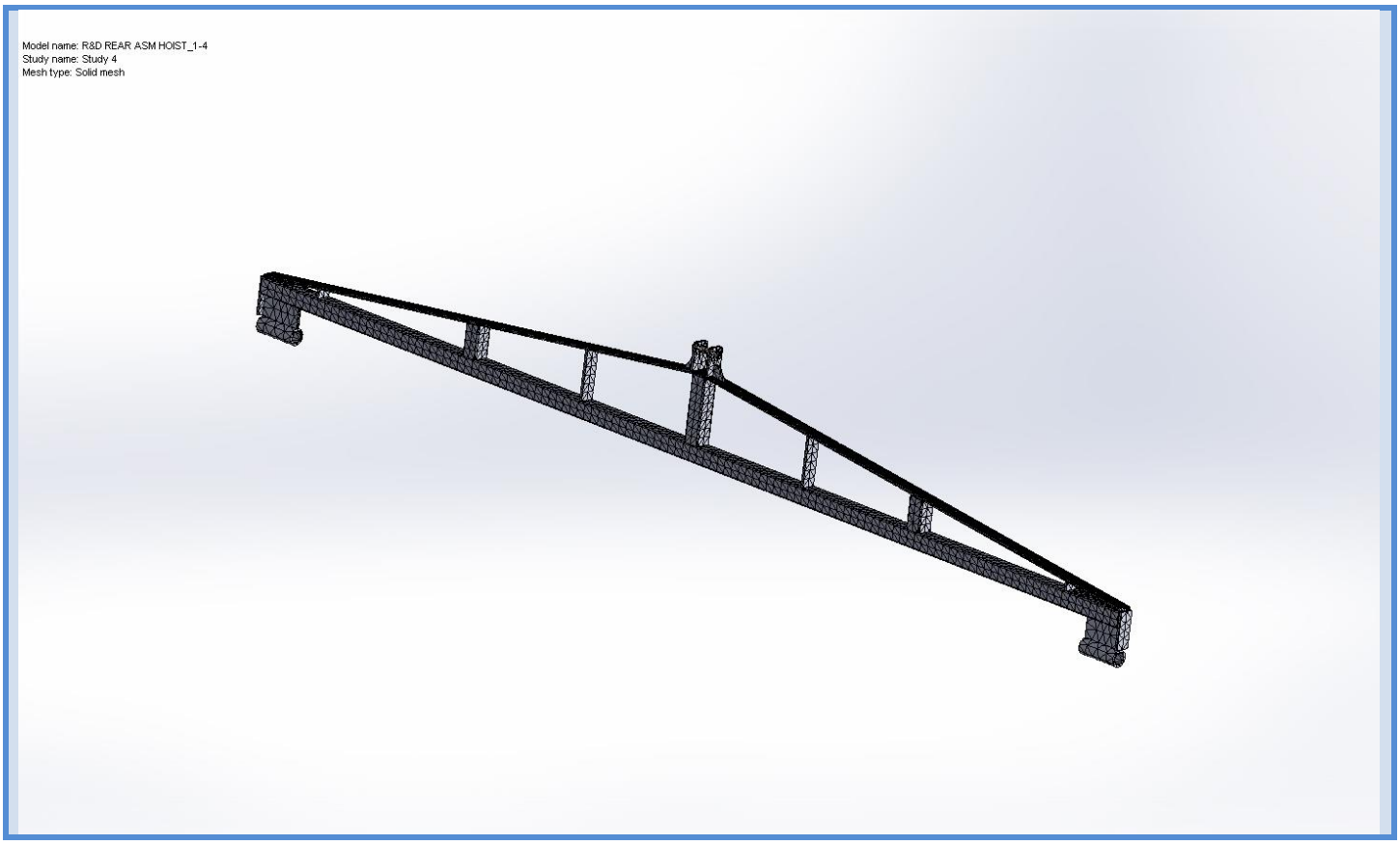
Contact Set-9		**Type:** Bonded contact pair **Entites:** 3 face(s)
Global Contact		**Type:** Bonded **Components:** 1 component(s) **Options:** Compatible mesh

Mesh Information

Mesh type	Solid Mesh
Mesher Used:	Curvature based mesh
Jacobian points	4 Points
Maximum element size	0 mm
Minimum element size	0 mm
Mesh Quality	High
Remesh failed parts with incompatible mesh	Off

Mesh Information - Details

Total Nodes	81604
Total Elements	44691
Maximum Aspect Ratio	160.77
% of elements with Aspect Ratio < 3	76.8
% of elements with Aspect Ratio > 10	1.36
% of distorted elements(Jacobian)	0
Time to complete mesh(hh;mm;ss):	00:00:24
Computer name:	JBARTOLI1



Mesh Control Information:

Mesh Control Name	Mesh Control Image	Mesh Control Details
Control-1		**Entities:** 1 Solid Body (s) **Units:** mm **Size:** 5.25532 **Ratio:** 1.5

Resultant Forces

Reaction Forces

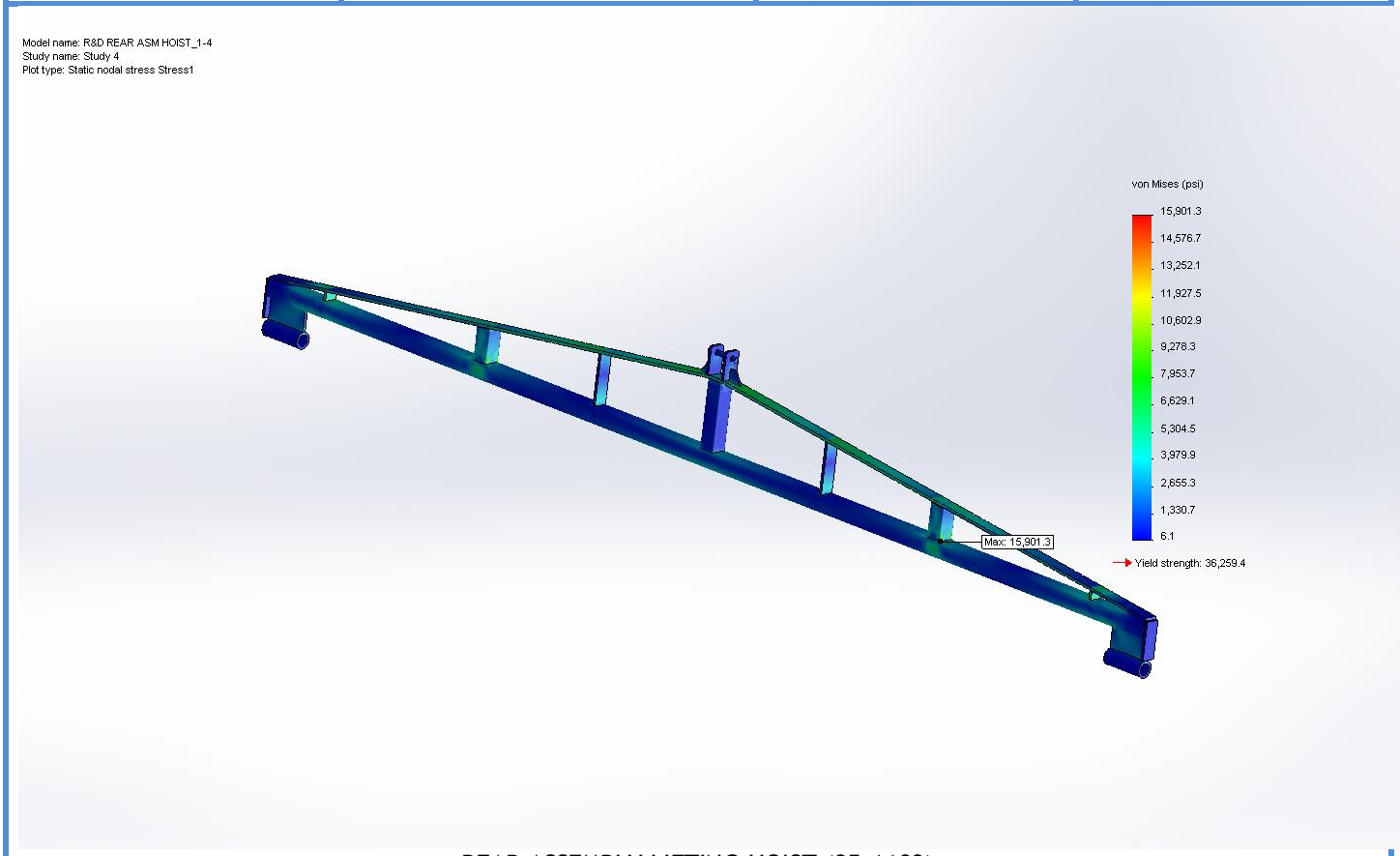
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	lbf	500.011	-0.0198238	-0.00989988	500.011

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	lbf-in	0	0	0	0

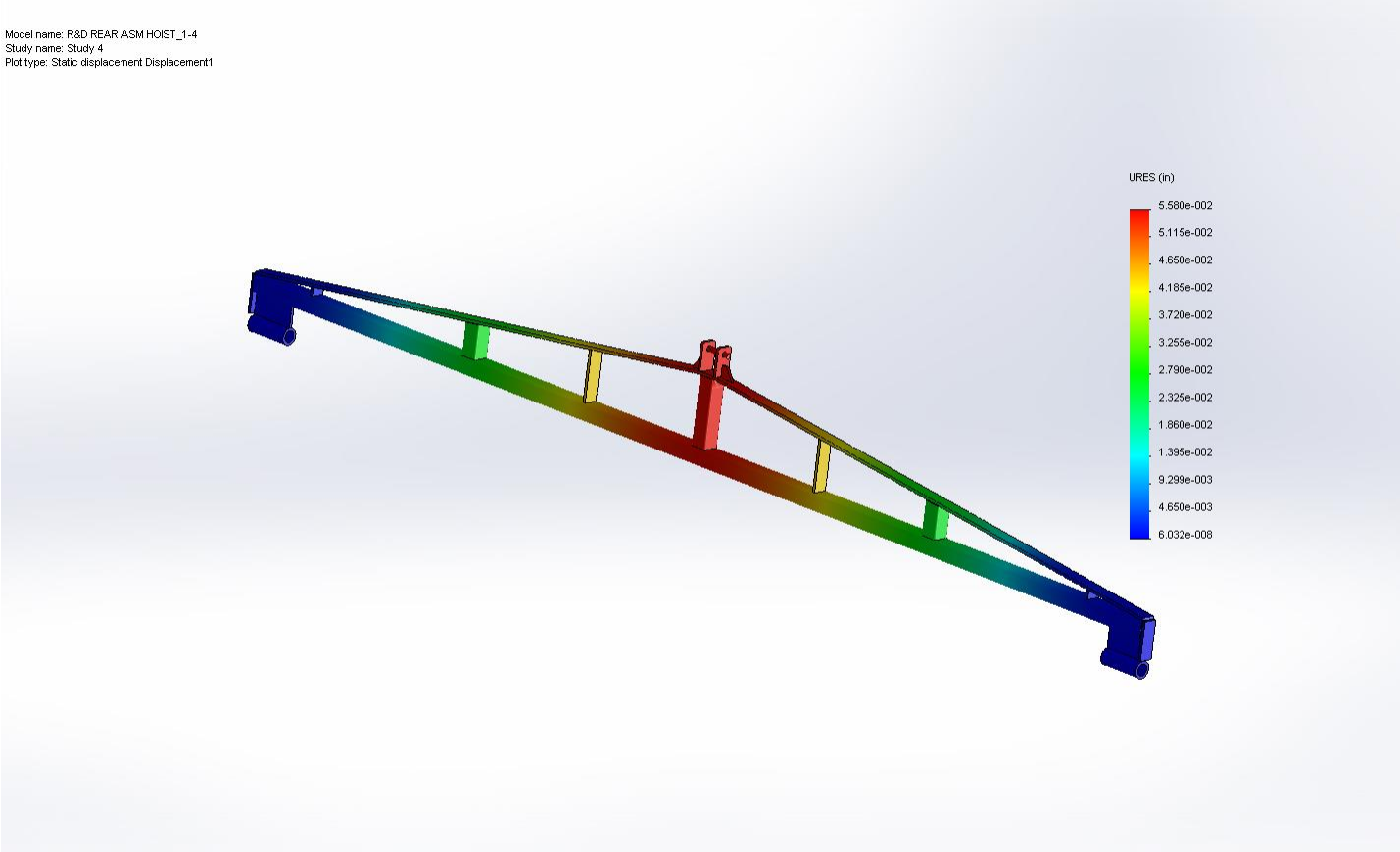
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	6.11819 psi Node: 5416	15901.3 psi Node: 78913



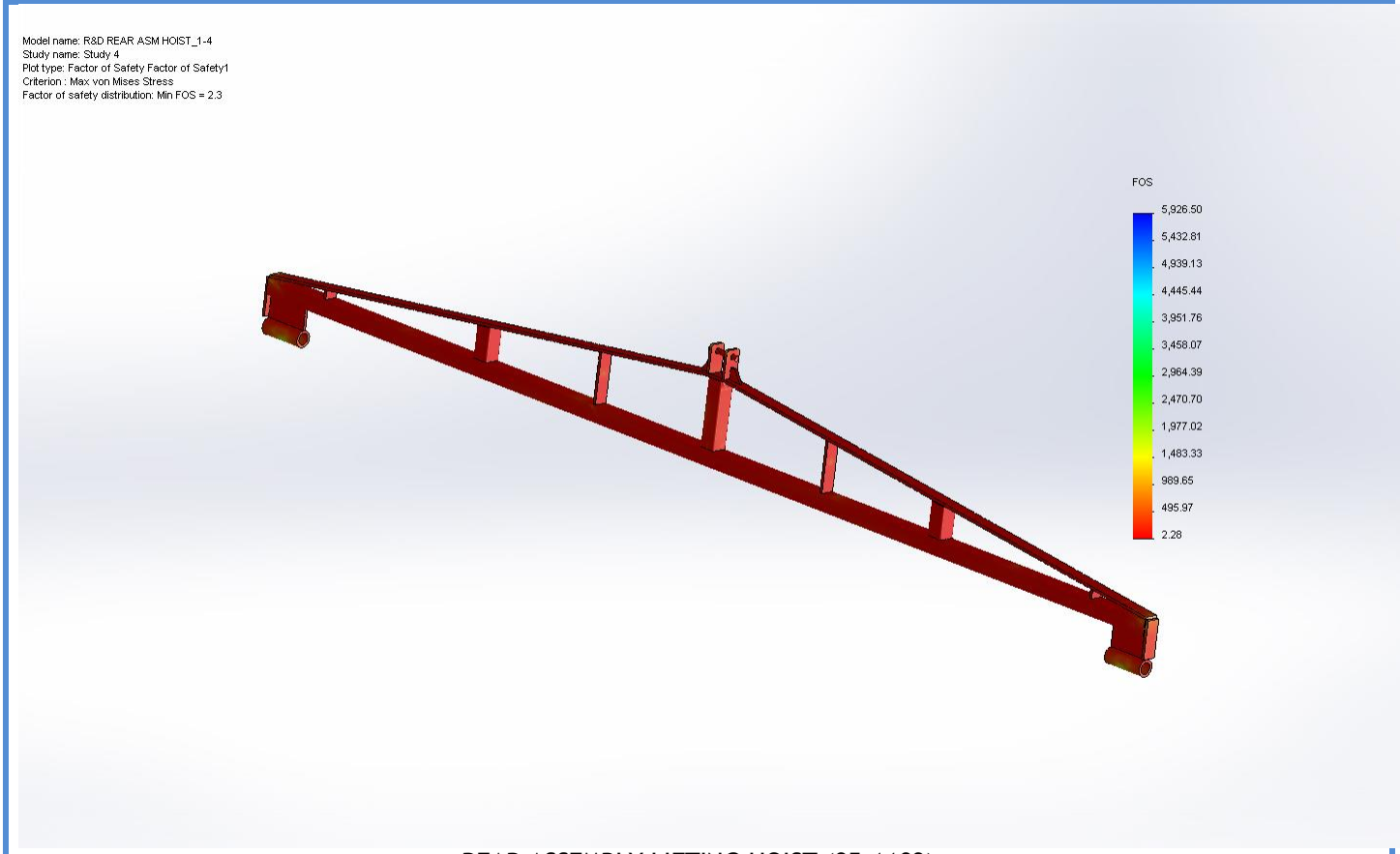
REAR ASSEMBLY LIFTING HOIST (95-1109)

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	6.032e-008 in Node: 80583	0.0557956 in Node: 19467



REAR ASSEMBLY LIFTING HOIST (95-1109)

Name	Type	Min	Max
Factor of Safety1	Max von Mises Stress	2.28028 Node: 78913	5926.5 Node: 5416



REAR ASSEMBLY LIFTING HOIST (95-1109)

Conclusion

After performing the finite element analysis on REAR ASSEMBLY LIFTING HOIST the maximum stress, maximum displacement and minimum factor of safety are 15901.3 psi, 0.0557956 inches and 2.28028, respectively. The safety factor exceeds the standard requirement of 2 and suggests that the structure is both safe and reliable under the application of a 500-lb force.