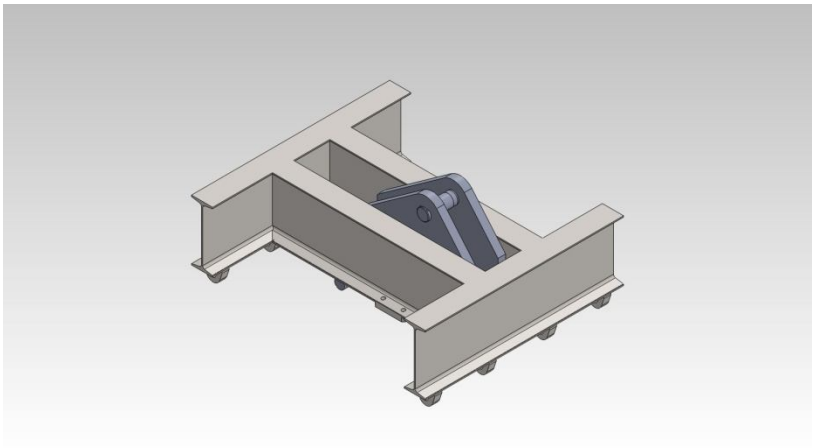


Simulation of Universal Beam

Date: 18 November 2011
Designer: Solidworks
Study name: Study 1
Analysis type: Static

Table of Contents

Description

1. Type: Universal Beam
2 Optimize the structure of lifting beam and the plate thickness.
3. use Indian standard sections instead of composite structure of plates.
4. Criterion for Optimization:
The optimized beam should be suitable to hold the load with F.O.S. more than 4 on UTS.

Loading Conditions

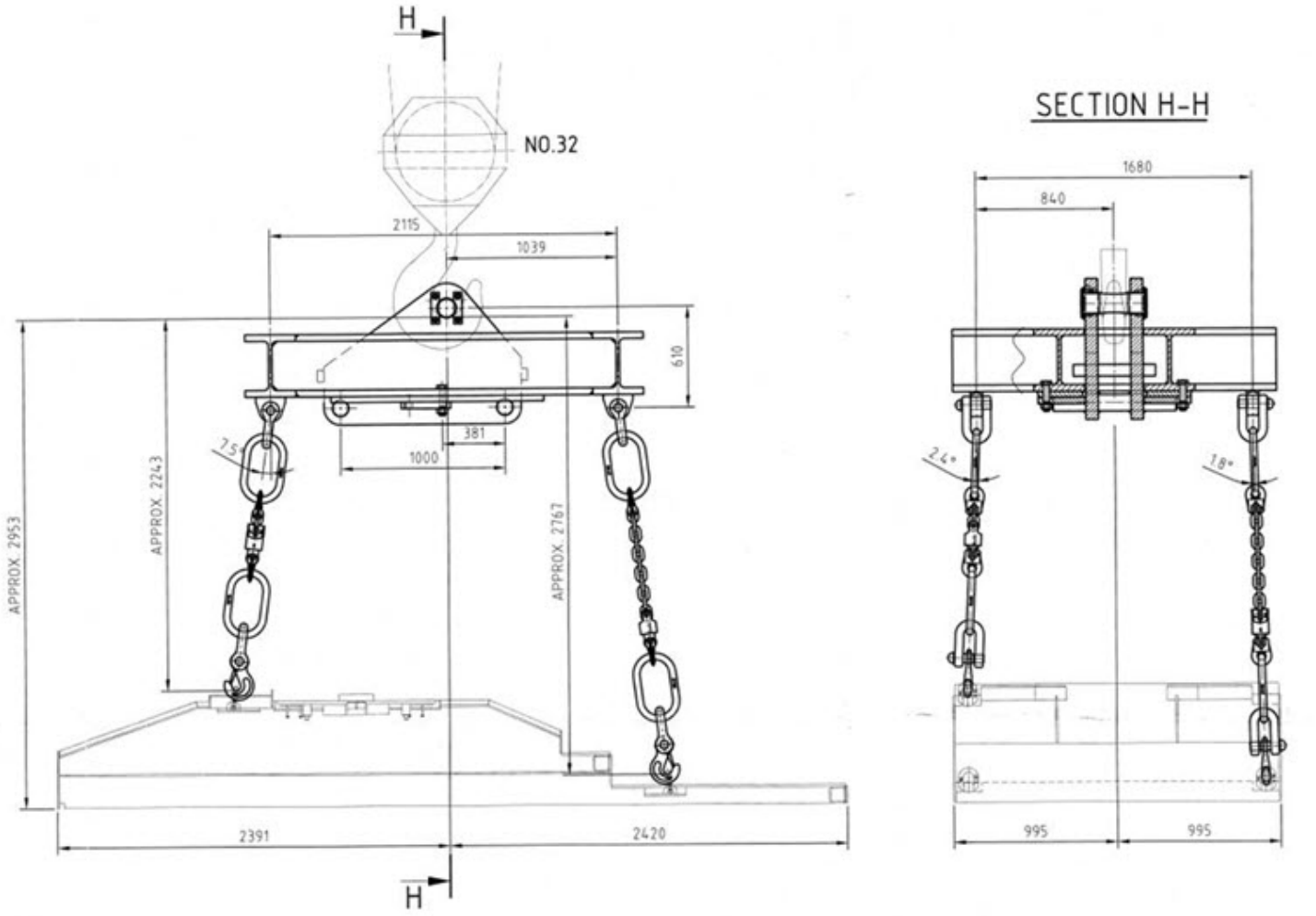
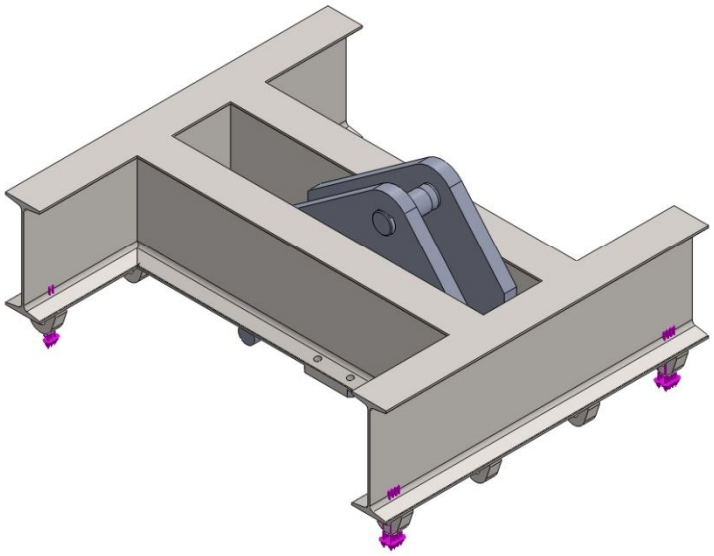


Image-6

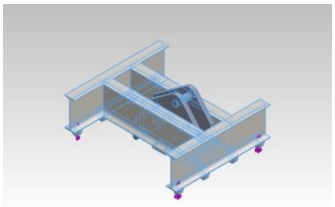
Comments:
Load = 40T

Model Information



Model name: Universal Beam_3
Current Configuration: Default

Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties	Document Path
Cut-Extrude1 	Solid Body	Mass:5384.05 lb Volume:19106.4 in^3 Density:0.281793 lb/in^3 Weight:5380.4 lbf	M:\Downloads\Rud\Final\3d universal beam\Universal Beam_3.SLDPRT

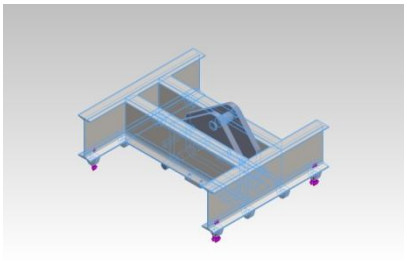
Study Properties

Study name	Study 1
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
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	M:\Downloads\Rud\Final\3d universal beam)

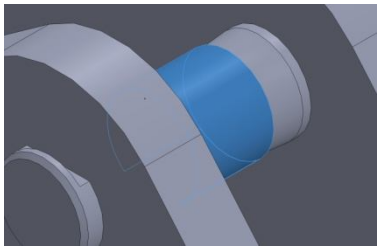
Units

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

Material Properties

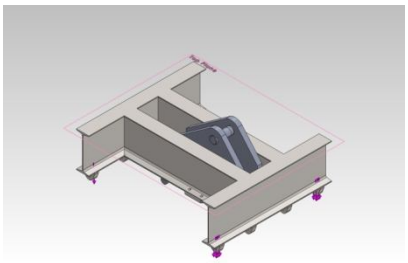
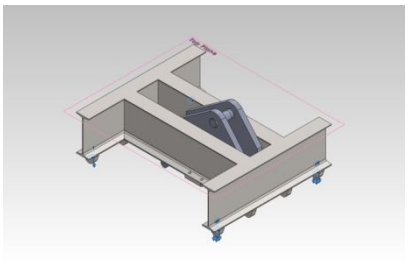
Model Reference	Properties		Components
	Name: Model type: Default failure criterion: Yield strength: Tensile strength: Elastic modulus: Poisson's ratio: Mass density: Shear modulus: Thermal expansion coefficient:	Plain Carbon Steel Linear Elastic Isotropic Max von Mises Stress 2.20594e+008 N/m^2 3.99826e+008 N/m^2 2.1e+011 N/m^2 0.28 7800 kg/m^3 7.9e+010 N/m^2 1.3e-005 /Kelvin	SolidBody 1(Cut-Extrude1)(Universal Beam_3)
Curve Data:N/A			

Loads and Fixtures

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

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	0	0	0	1e-033
Reaction Moment(N-m)	0	0	0	0

Load name	Load Image	Load Details
Gravity-1		**Reference:** Top Plane **Values:** 0 0 -9.81 **Units:** SI
Force-1		**Entities:** 4 face(s), 1 plane(s) **Reference:** Top Plane **Type:** Apply force **Values:** ---, ---, -400000 N

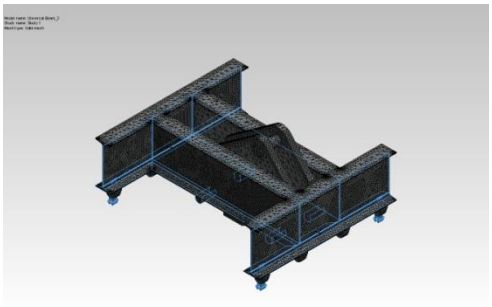
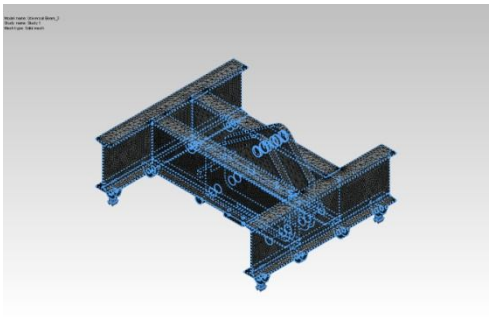
Mesh Information

Mesh type	Solid Mesh
Mesher Used:	Curvature based mesh
Jacobian points	4 Points
Maximum element size	91.972 mm
Minimum element size	18.3944 mm
Mesh Quality	High

Mesh Information - Details

Total Nodes	324275
Total Elements	179368
Maximum Aspect Ratio	155.8
% of elements with Aspect Ratio < 3	83
% of elements with Aspect Ratio > 10	3.79
% of distorted elements(Jacobian)	0
Time to complete mesh(hh;mm;ss):	00:01:14
Computer name:	▫"

Mesh Control Information:

Mesh Control Name	Mesh Control Image	Mesh Control Details
Control-1		**Entities:** 26 face(s) **Units:** mm **Size:** 22.993 **Ratio:** 1.5
Control-2		**Entities:** 544 edge(s) **Units:** mm **Size:** 25 **Ratio:** 1.5

Resultant Forces

Reaction Forces

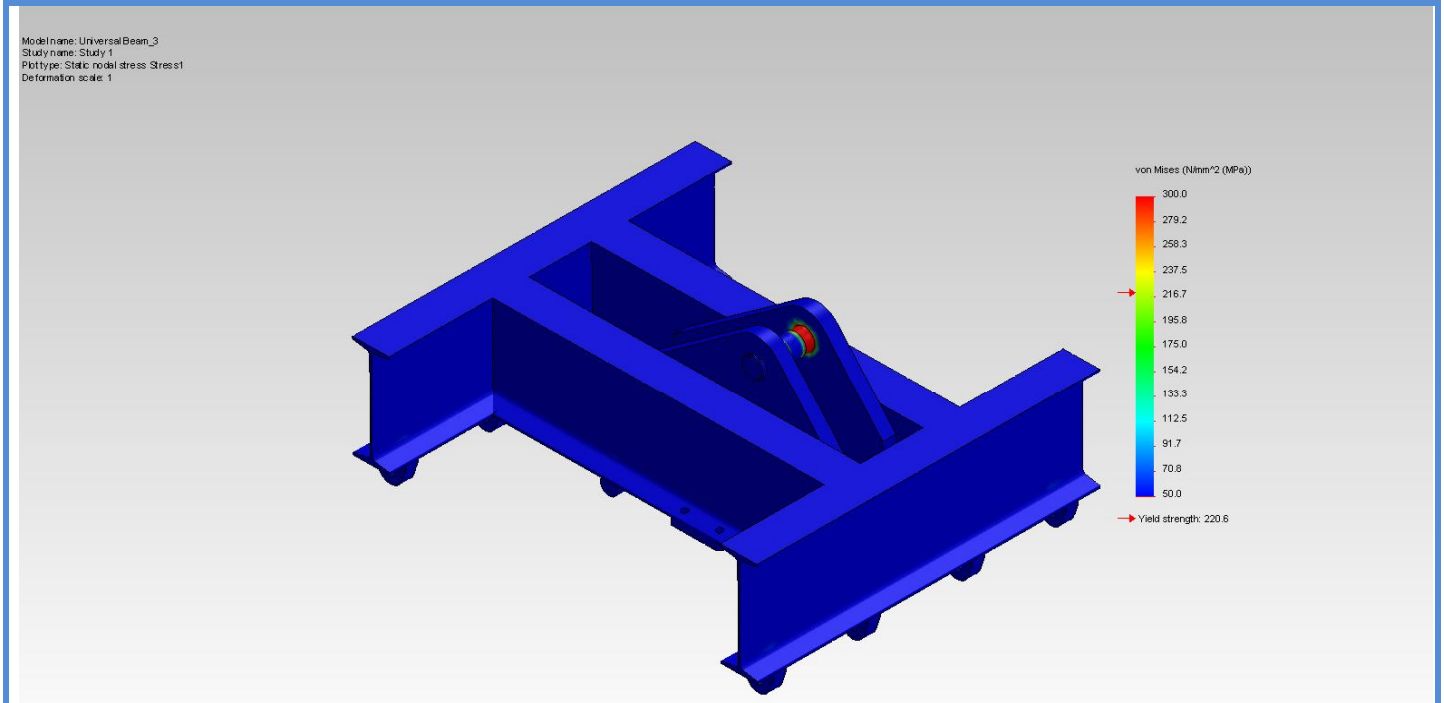
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	-1349.35	424061	707.131	424063

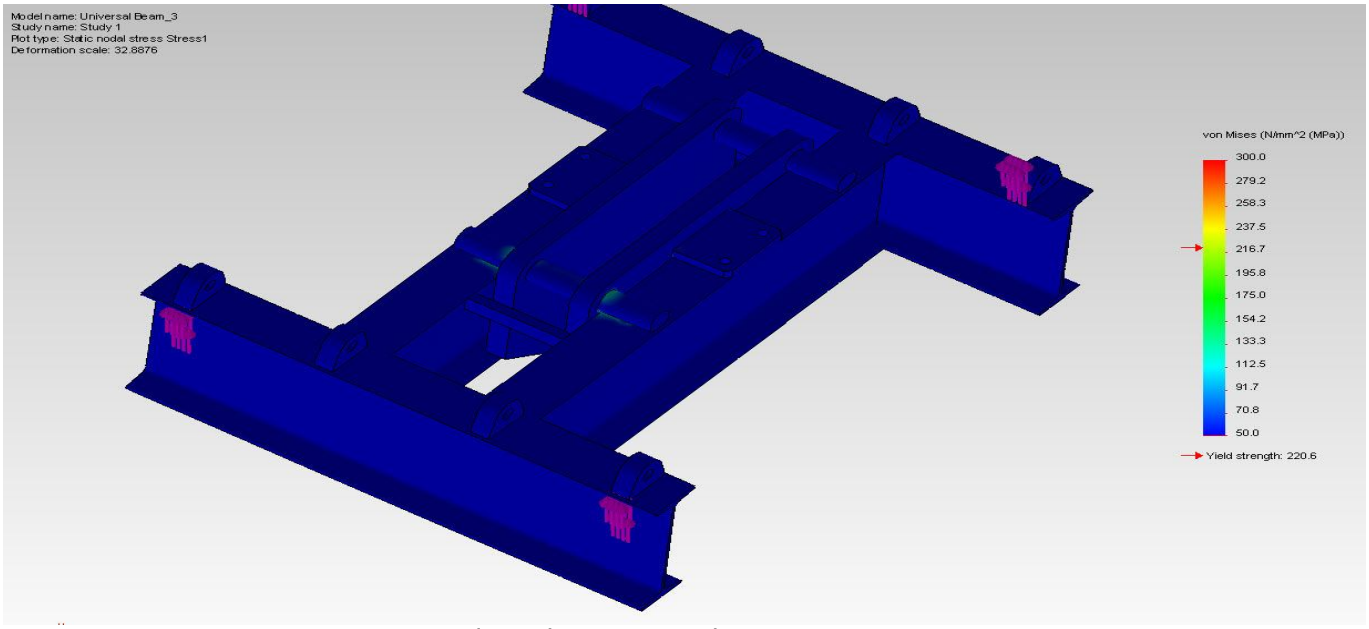
Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N-m	0	0	0	0

Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	0.00184366 N/mm^2 (MPa) Node: 136825	3226.7 N/mm^2 (MPa) Node: 51842

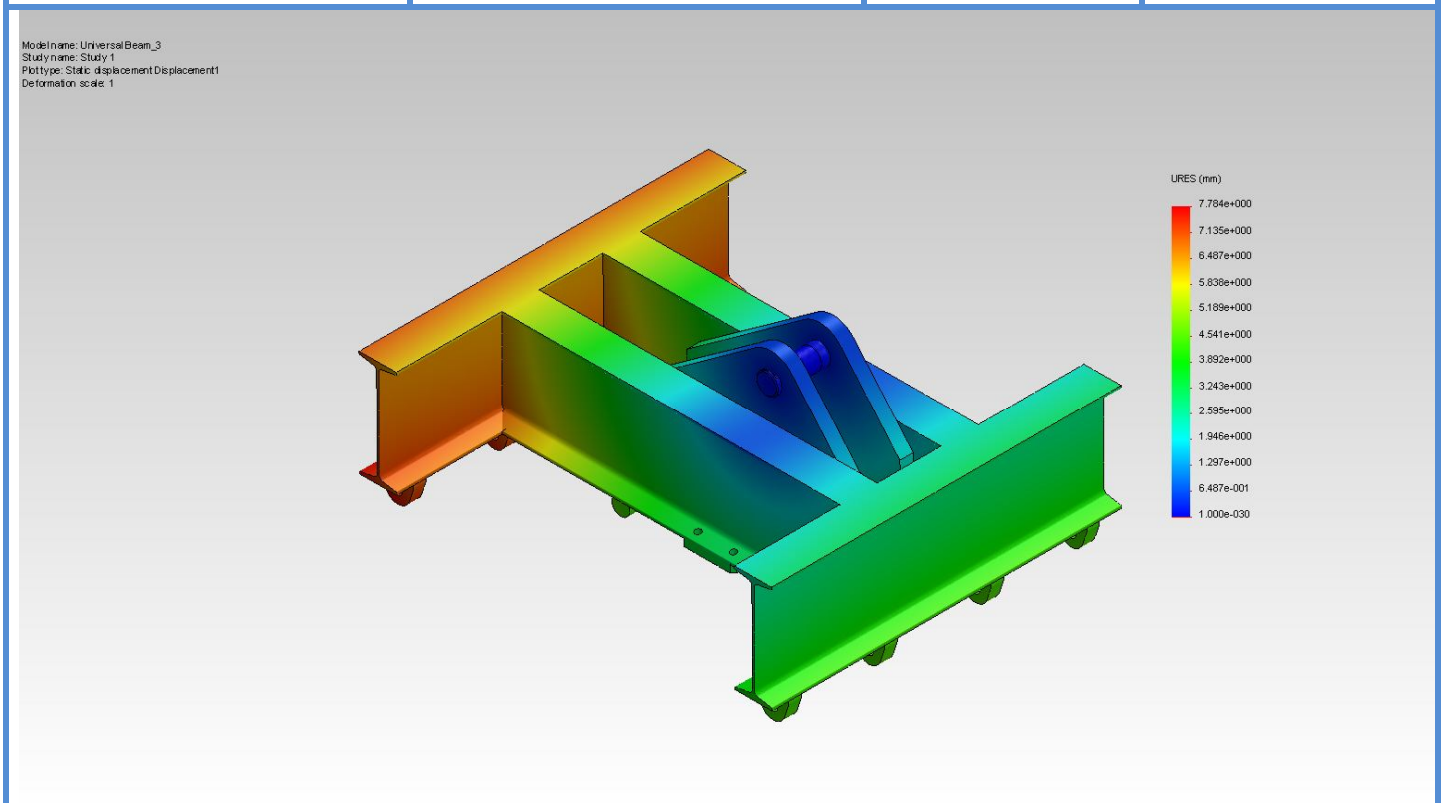




Universal Beam_3-Study 1-Stress-Stress1

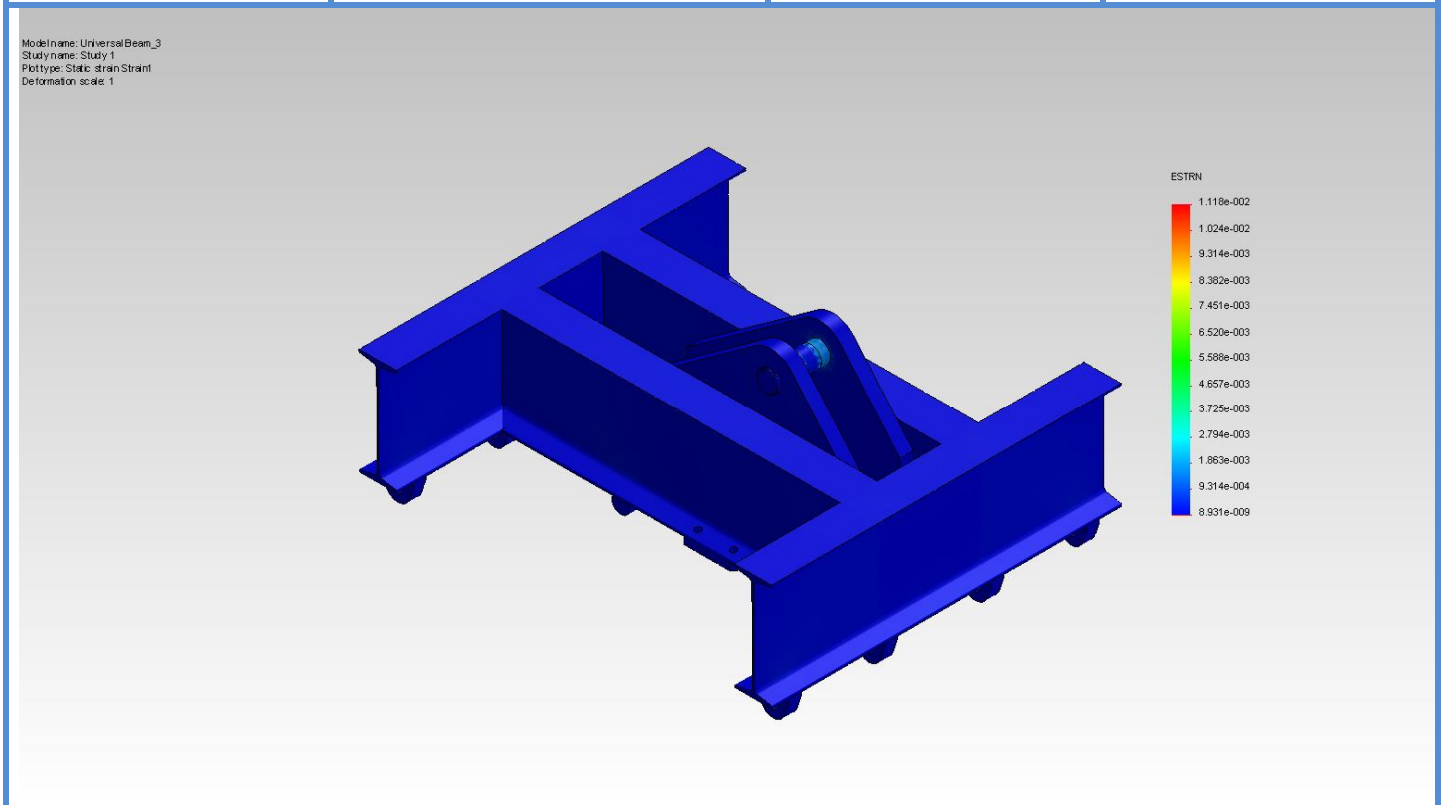
Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0 mm	7.78383 mm

		Node: 422	Node: 60448



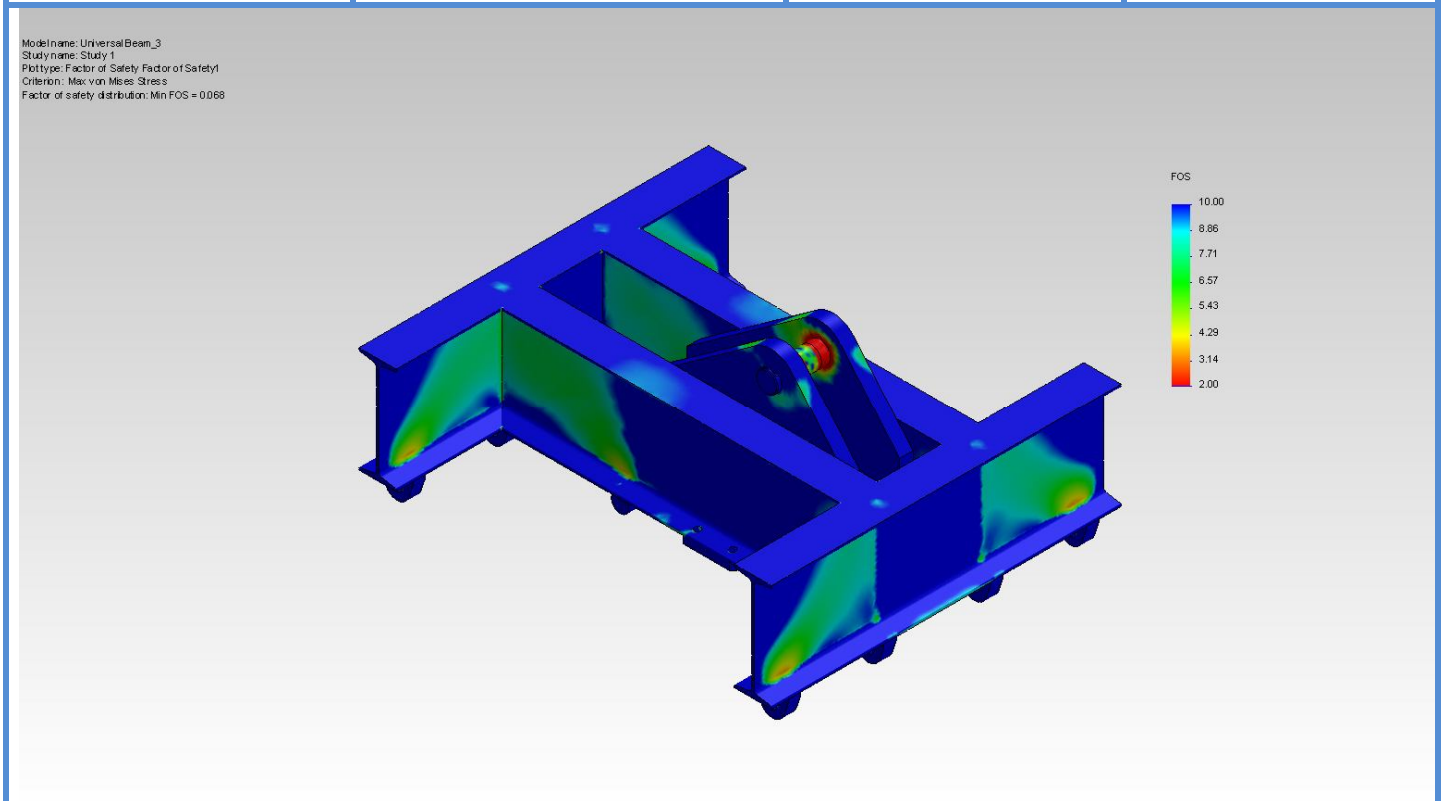
Universal Beam_3-Study 1-Displacement-Displacement1

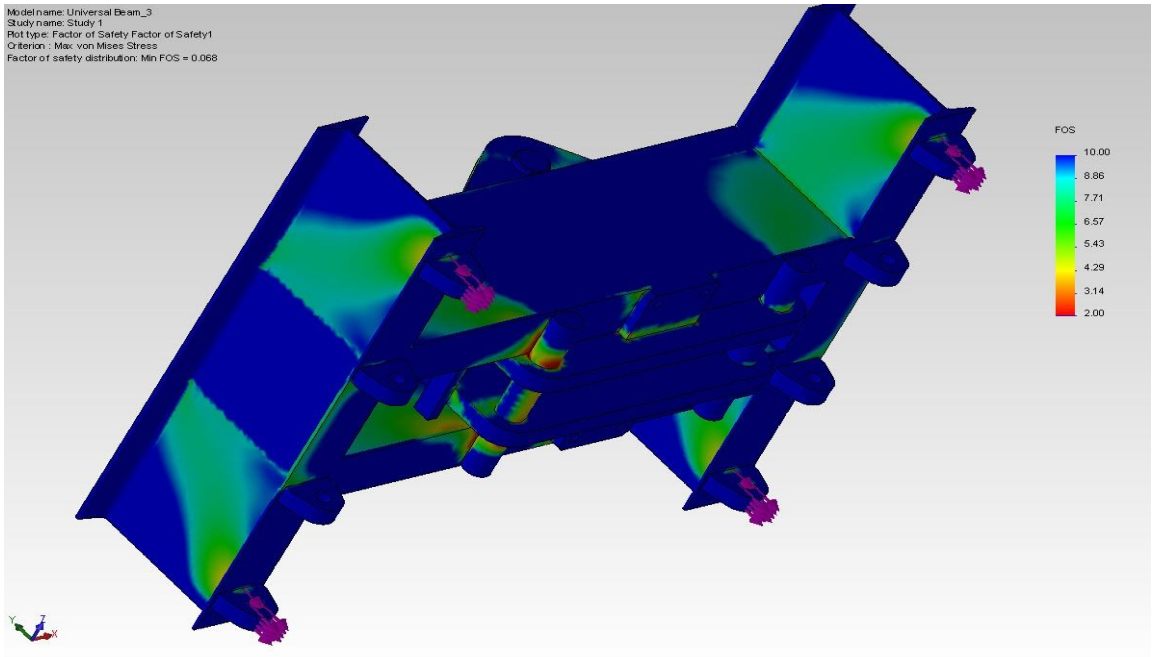
Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	8.93068e-009 Element: 12782	0.0111764 Element: 19858



Universal Beam_3-Study 1-Strain-Strain1

Name	Type	Min	Max
Factor of Safety1	Max von Mises Stress	0.0683653 Node: 51842	119650 Node: 136825





Universal Beam_3-Study 1-Factor of Safety-Factor of Safety1

FOS - Bottom View

Conclusion & Recommendations:

The Result shows that the Universal Beam can take up to 40T load and does satisfy over FOS 4.0

There are minor areas where FOS fails due to localization of load.

1) Top hinged Pin -> shows Yield Stress below 220 N/mm2.

This can be ignored since the material used is Forged and is much stronger than overall material taken for the test.

2. Certain areas showing FOS just below or nearly 4.0, can be strengthened by using 20mm stiffener plates.

3) Bottom pins on Lift assembly also showing small-localized stress areas falling below FOS 4.0.

To eliminate that, the pin diameter needs to be increased to 60mm.

4. Maximum deformation is about 7.78 mm.