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FE Static Analysis Report -

Strap : Iteration II

(All components considered as 1020 Low Carbon Steel)

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1. Introduction

This Report consists of Results for FE Structural Analysis of Strap to check design adequecy under given load configuration.

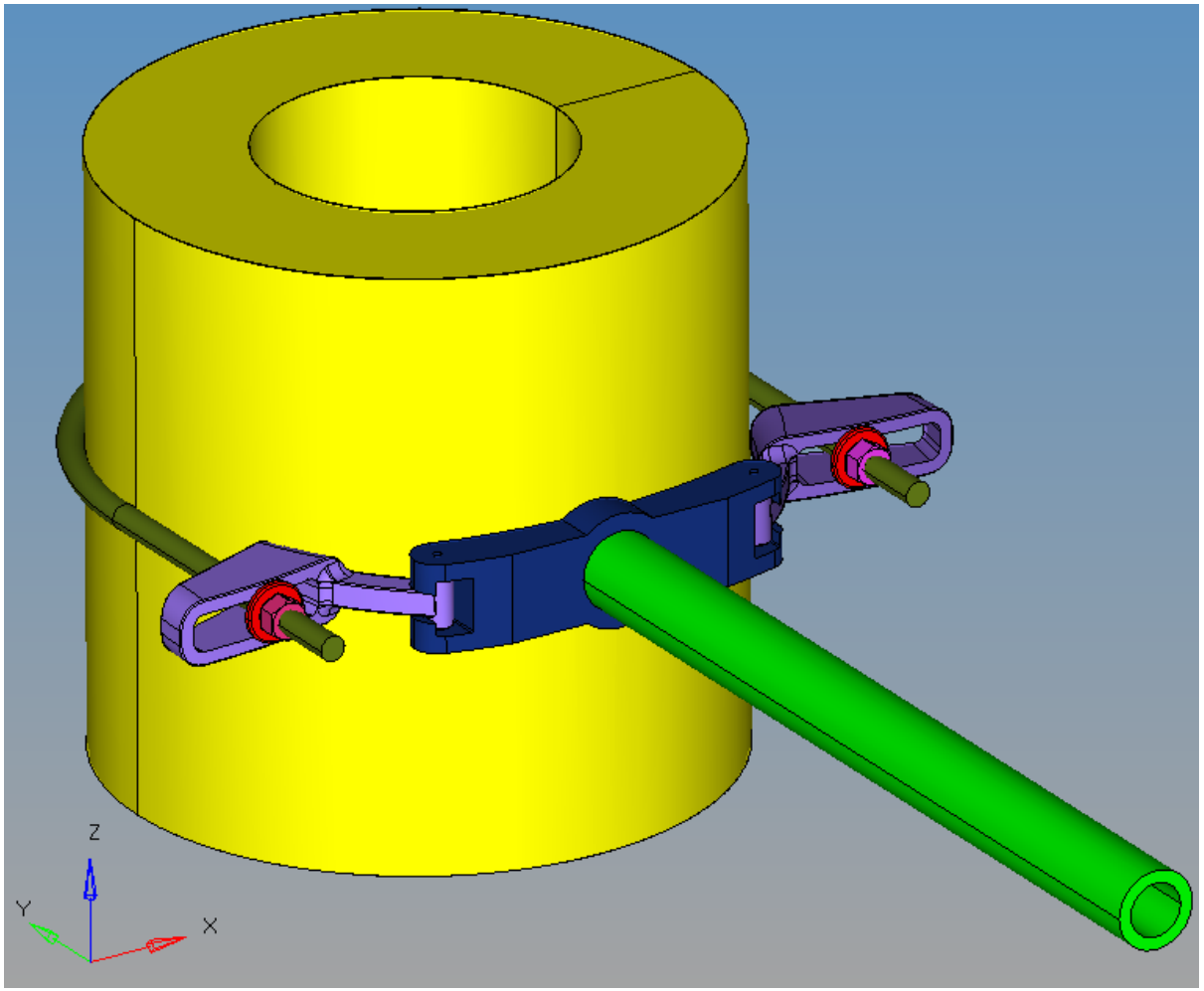
2. Objective

Objective of FE analysis is to evaluate deflection, stress and determine the Von Mises Factor of Safety of the strap.

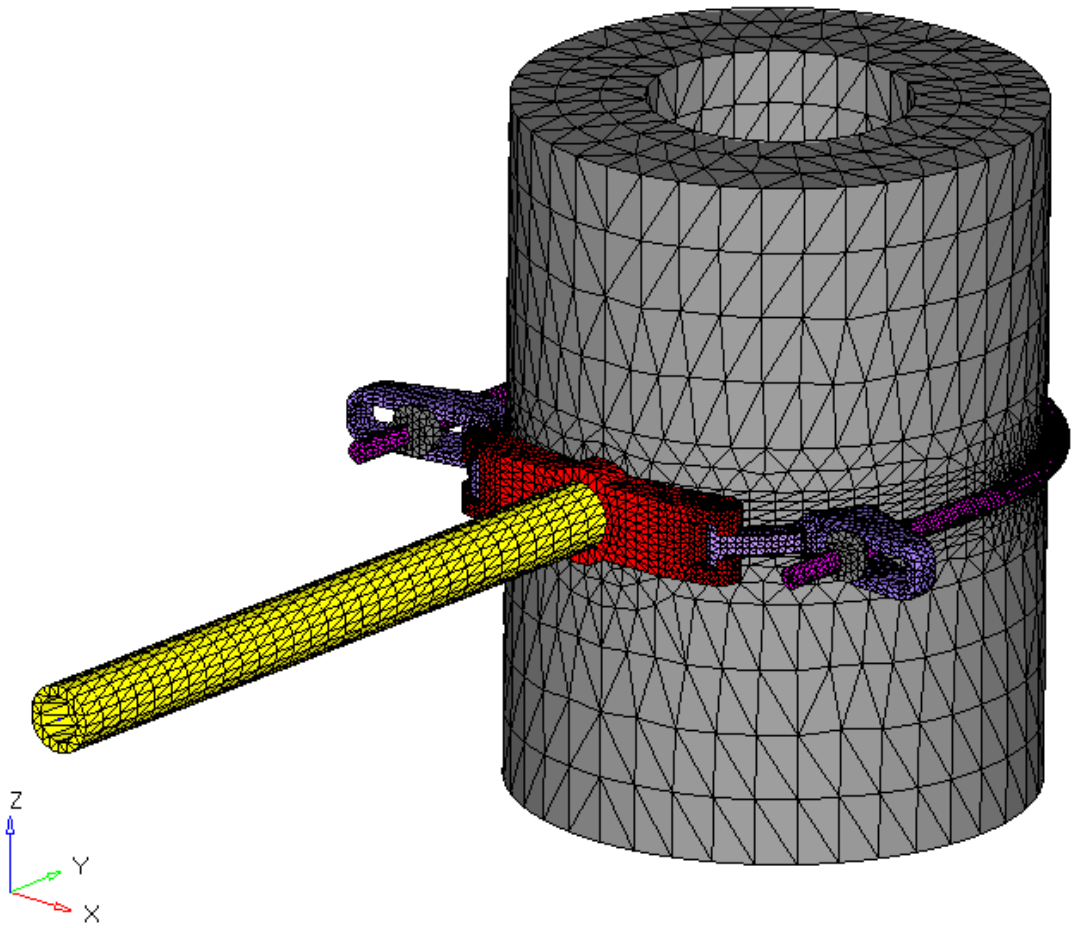
3. Assumptions

1. Non-Linear material properties have taken for analysis.
2. Inertia effects are not considered.

4. CAD Model :Model considered for FEA



5. Meshed Model :Model considered for FEA



6. FE Model Information :

The Strap model has been meshed by 2nd order Shell elements.

No. of Nodes in the Model = 109499
No. of Elements in the Model = 69956

The quality of elements is qualifying following criteria:-

From all the components in the FE Model Assembly, 99% of elements Qualify for :-

	Achieved
Warpage	< 5 (0% failed)
Aspect Ratio	< 7 (0% failed)
Jacobian	> 0.5 (0% failed)
Min. Angle Tria Faces	> 12 (0%failed)
Max. Angle Tria Faces	< 120 (0%failed)
Min. Angle Quad Faces	> 35 (0%failed)
Max. Angle Quad Faces	< 140 (0%failed)

7. Material Properties:

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Baseline

Component	Material	Young's Modulus (psi)	Poisson's Ratio	Yield Strength (psi)
Strap	340 Brass	1.523e7	0.346	19580
Ear, U-Bolt, Pipe	Steel	3.04e7	0.3	36260

Tangent Modulus for Steel = 3.04e6 psi
Tangent Modulus for Brass = 1.523e6 psi

Iteration II

Component	Material	Young's Modulus (psi)	Poisson's Ratio	Yield Strength (psi)
Strap, Ear, U-Bolt, Pipe	1020 Low Carbon Steel	2.9e7	0.29	42748

Tangent Modulus for 1020 Low Carbon Steel = 2.9e6 psi

Calculations:

U- bolt clamping force :-

For U-bolt of dia. 1/2" the pretension torque is 65 ft.lbs

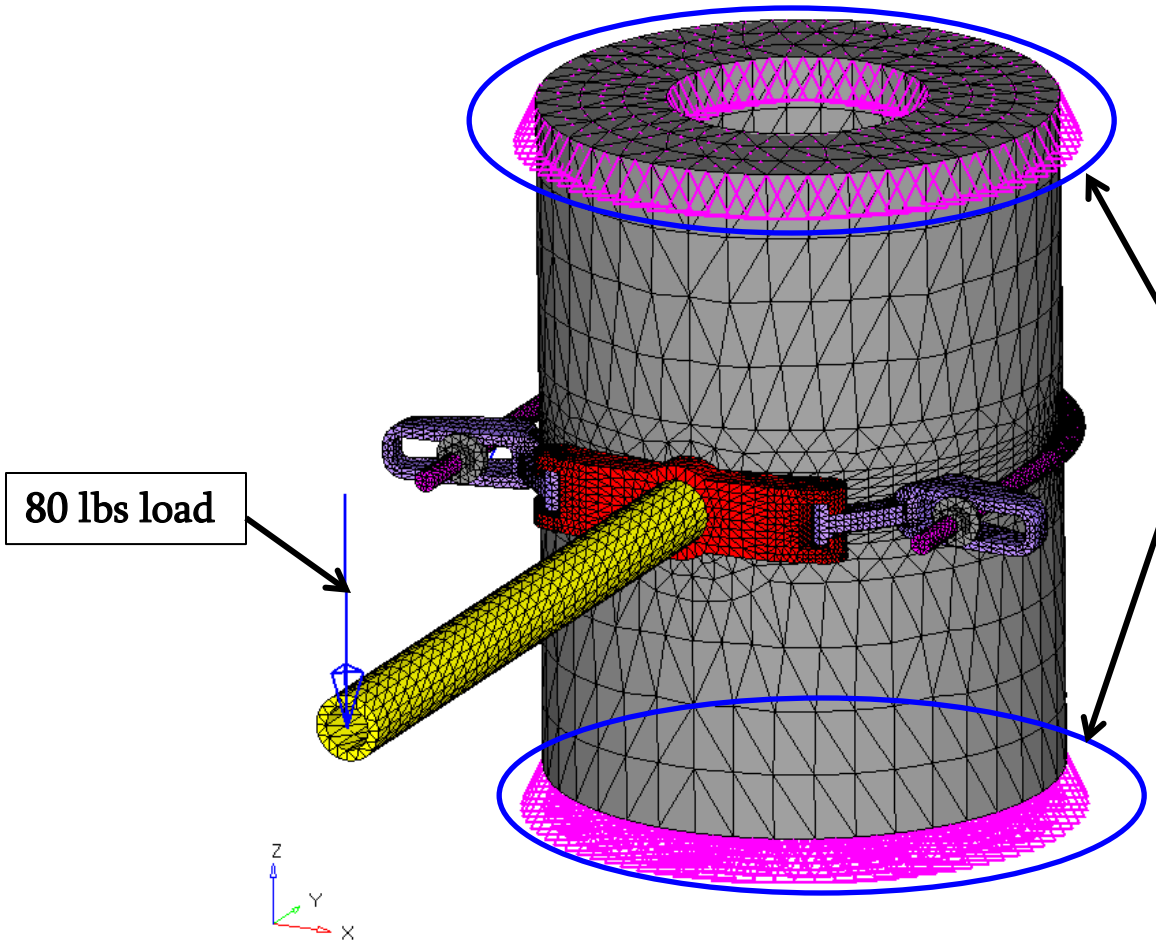
$$\text{Clamping force 'P'} = \frac{Torque}{K * Diameter}$$

K = 0.2 (For new U-bolt and nut with lubricated threads.)

$$P = \frac{65 * 12}{0.2 * 0.5}$$

P =7800 lbs

8. Loads and Boundary Conditions:



80 lbs load

Constrain in X,Y,Z direction.

Pretension load for U-bolt= 7800 lbs

9. Procedure:

- The models are imported into Hyper Mesh Software, 2nd order Shell Elements are generated.
- These elements were imported to ANSYS Software and assigned with the material properties to each component as per specified input.
- The boundary conditions are applied as per Section-8 in this report.
- Models are solved for given loads mentioned in the inputs and same is shown in the Introduction section in this report.

10.1 Stress Analysis Results :

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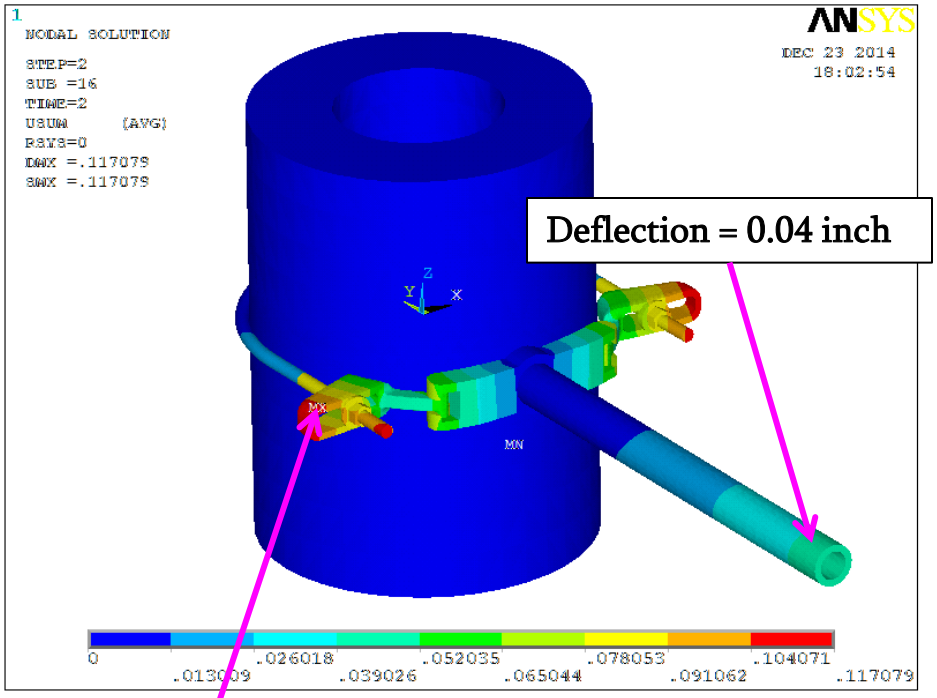
Deflection Plot (inch):

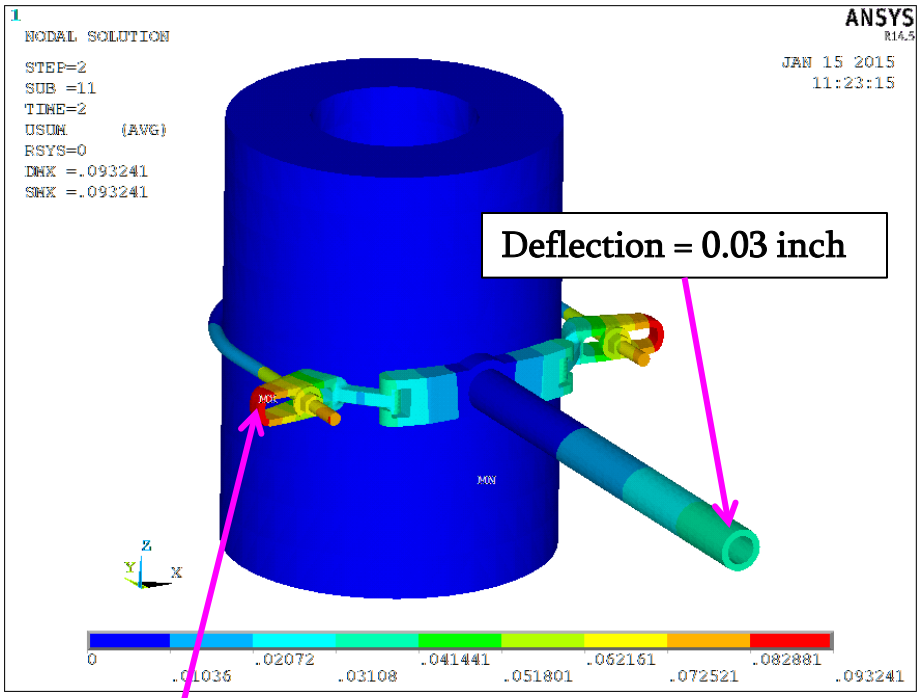
Baseline



Deflection = 0.04 inch

Max. Deflection = 0.11 inch

Iteration II



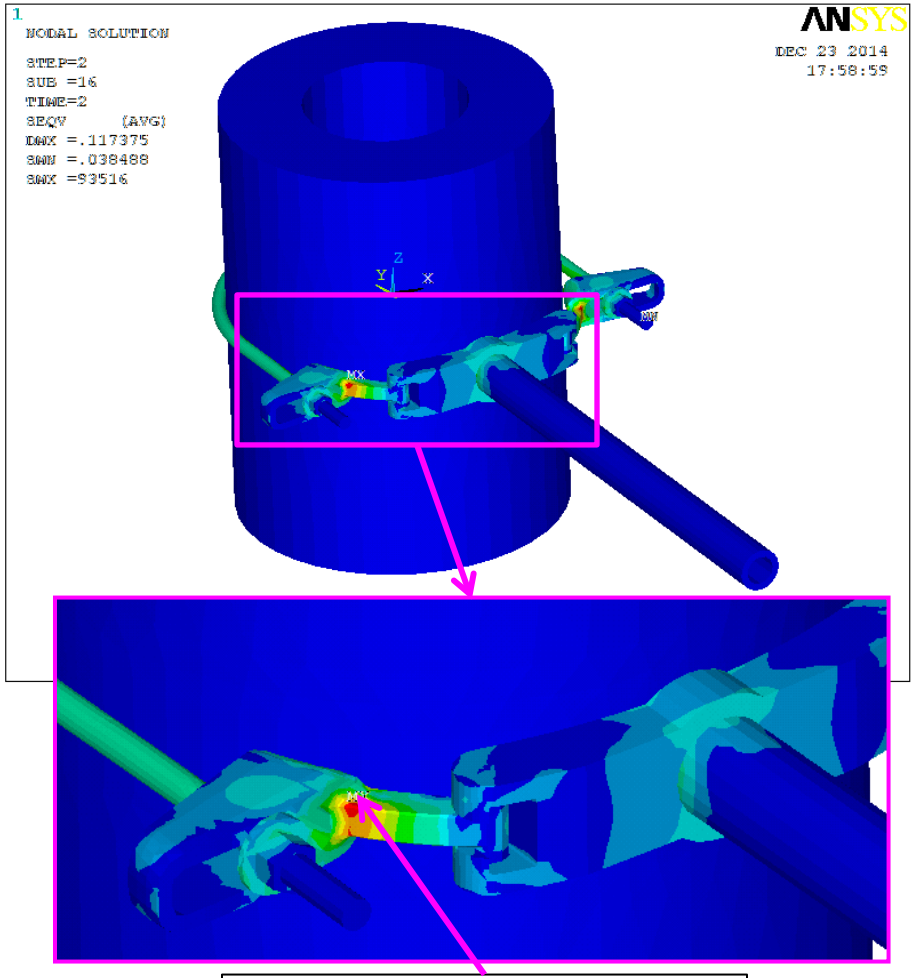
Deflection = 0.03 inch

Max. Deflection = 0.09 inch

10.2 Stress Analysis Results :Assembly

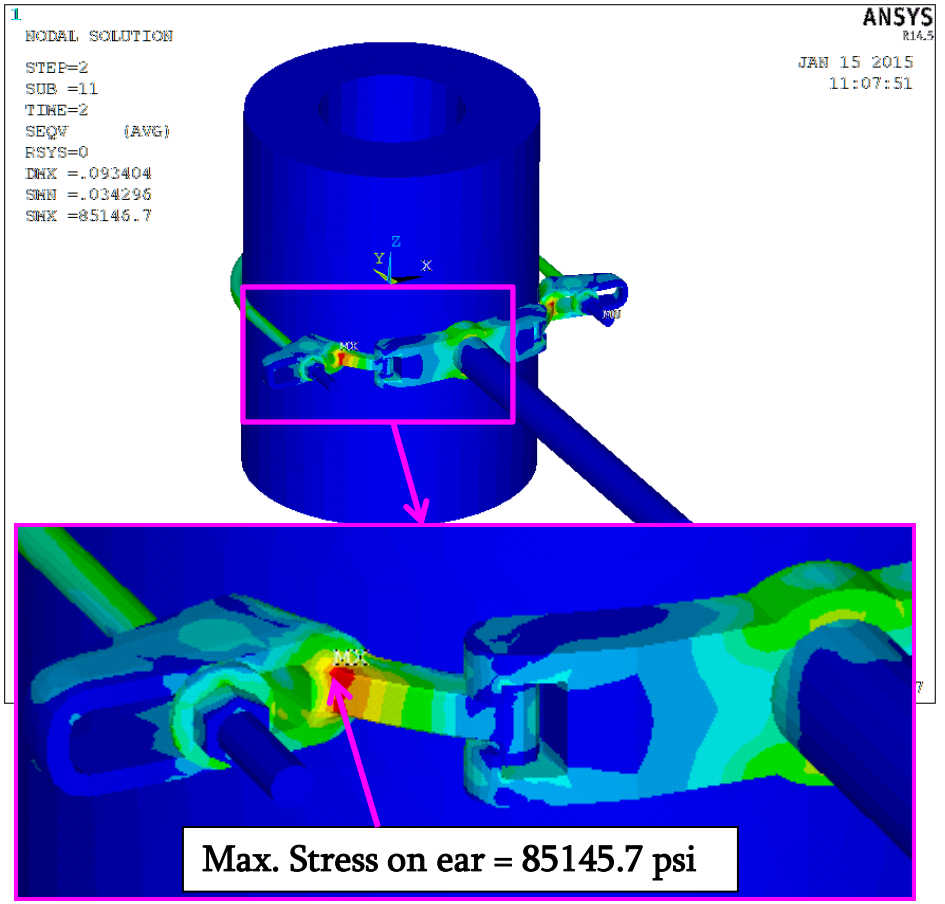
Von-Mises Stress Plot(psi) :

Baseline



Max. Stress on ear = 93516 psi

Iteration II



Max. Stress on ear = 85145.7 psi

Von-mises safety factor for ear = $\frac{42748}{85145.7}$ = 0.5 which is less than 1

10.3 Stress Analysis Results :

Von-Mises Stress Plot(psi) : Strap

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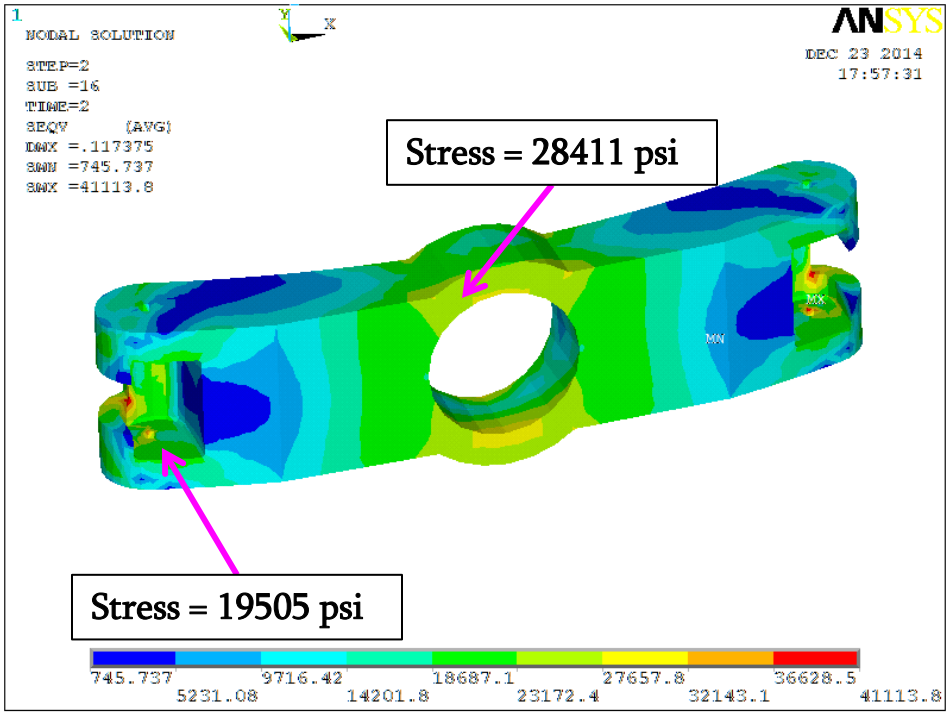
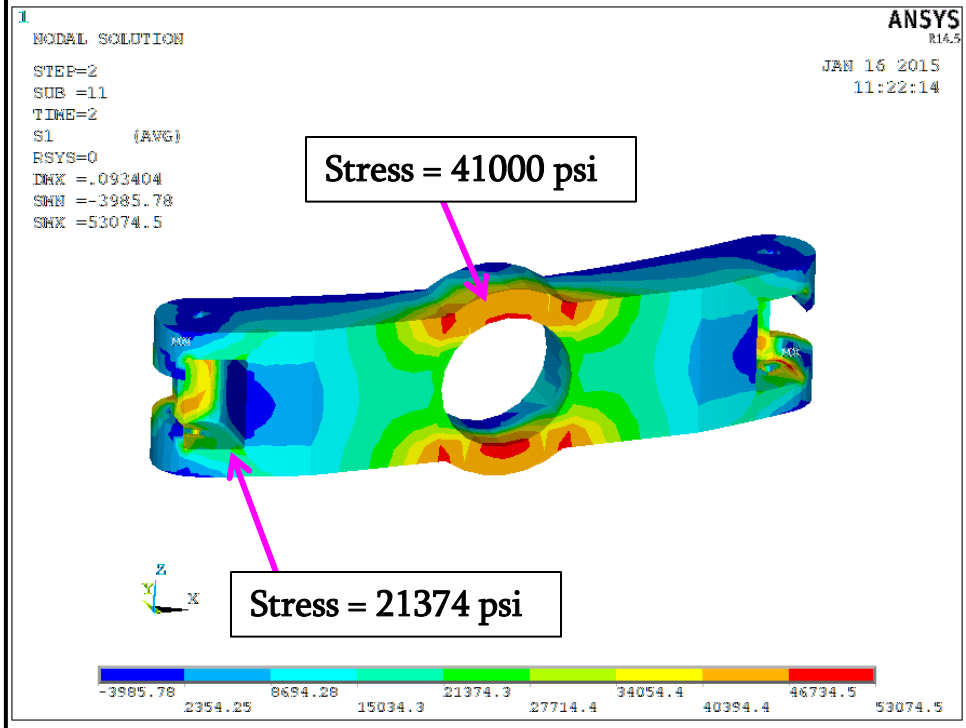
Baseline



Iteration II



Von-mises safety factor for strap = $\frac{42748}{41000}$ = 1.04 which is greater than 1.

10.4 Stress Analysis Results : Strap

Von-Mises Stress Plot: Stresses < Yield Strength

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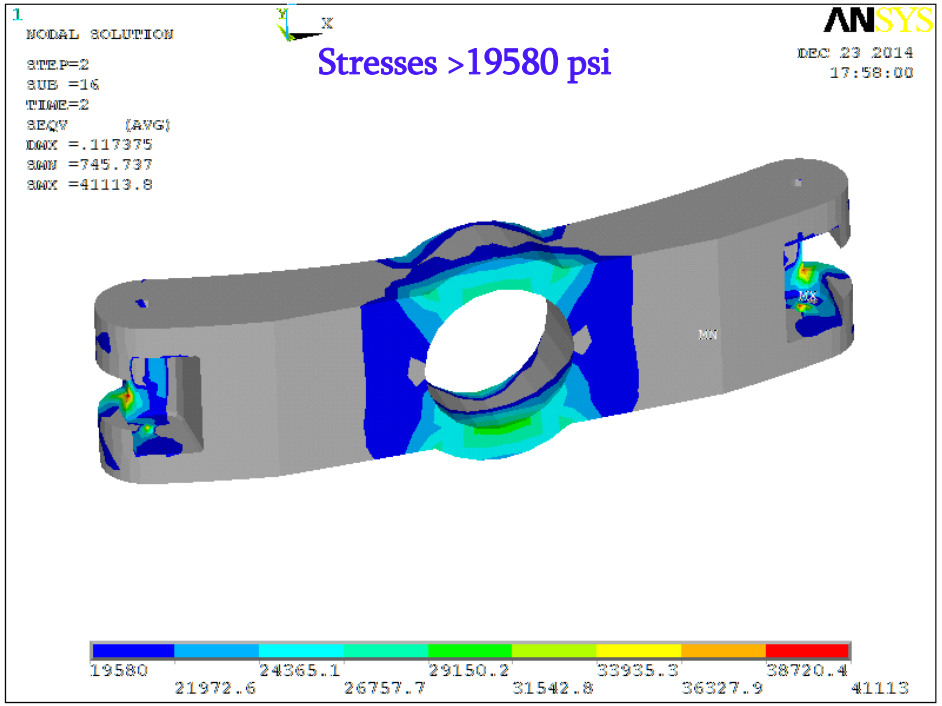
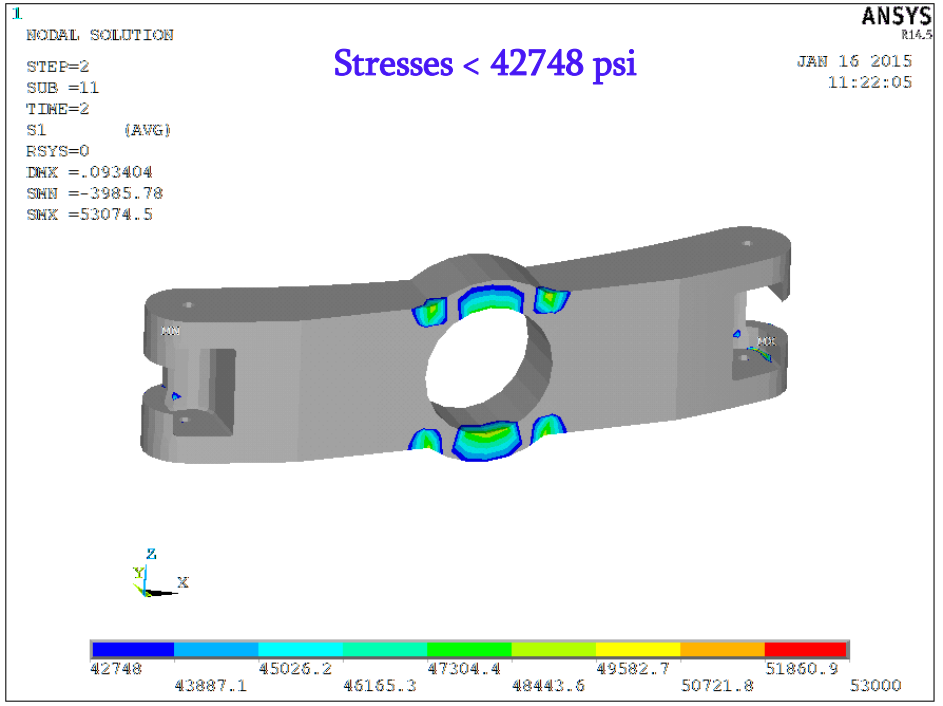
Baseline



Highlighted region shows stress exceeding yield strength of material.

Iteration II



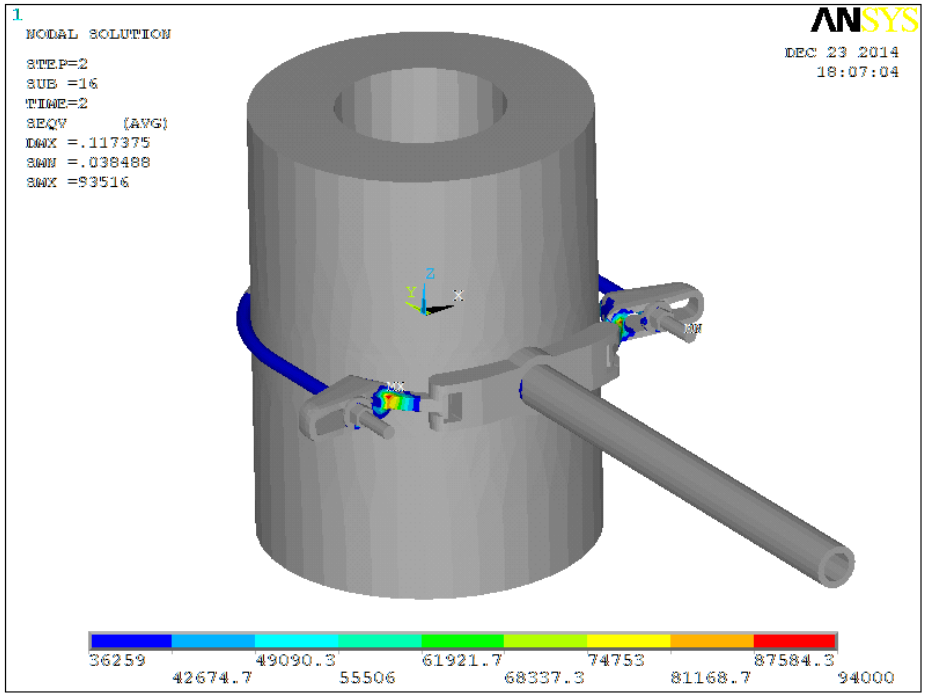
Overall stresses on strap are below the allowable limit.

10.5 Stress Analysis Results :Assembly

Von-Mises Stress Plot :Stresses > Yield Strength

Baseline

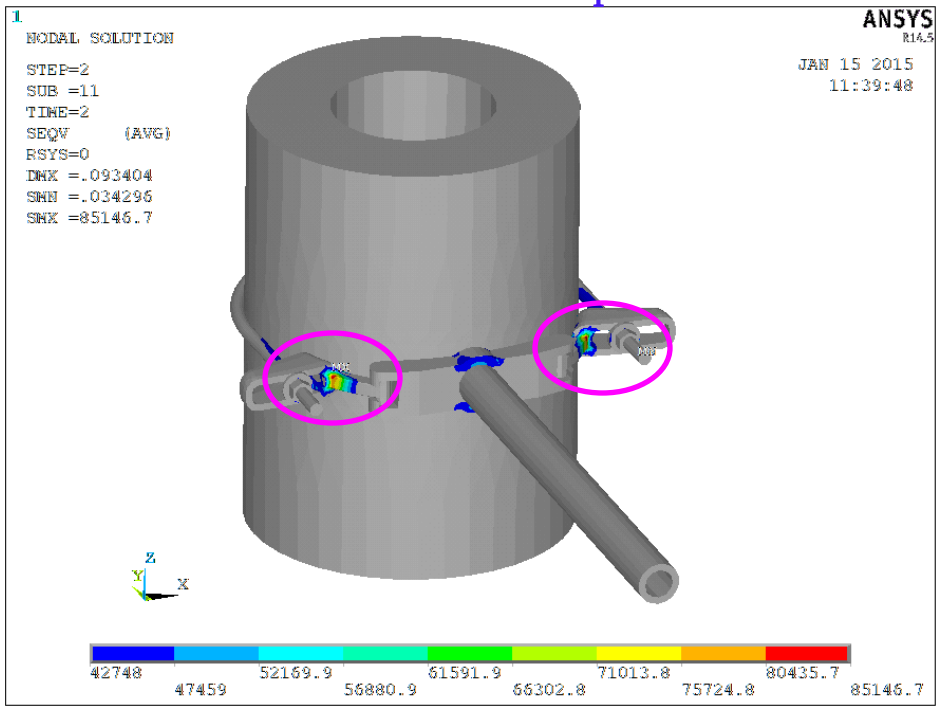
Stresses >36260 psi



Highlighted region shows stress exceeding yield strength of material.

Iteration II

Stresses >42748 psi



Stresses on strap are below the allowable limit, but in highlighted locations shows stress on ear exceeding yield strength of material.

11. Result Summary :

From FE Analysis of Strap, it is observed that :

- Max. Deflection is 0.09 inches and Max. Stress is 85145.7 psi which occurred on the ear.
- Max. Stress on Strap is 41000 psi which is below the Yield Strength of Material.
- By changing the Material from Brass to 1020 Low Carbon Steel, Deflection and Stresses observed on Strap are below the Allowable Limit.
- As Stresses on ear exceeds the Yield Strength of Material so ear design is inadequate to withstand at given load configuration.

Contact Us

Scott Raitt
Chief Executive Officer
scott@connektllc.com

15844 Norlene Way
Grass Valley, CA 95949

(530) 604-5821