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GOOD PRACTICE EXAMPLE: DESIGNING 100KN DELTA EYE PLATE

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Abstract: *This article is presenting the steps carried for the design process of a 100KN delta eye plate, which is a simple but important element used in different setups for offshore installation, by using CAD/CAE methods applied on ANSYS 12.1 Workbench.*

Keywords: *CAD/CAE, shear stress, distortion.*

A general single towing arrangements consists in:

- A short pennant – the connection from tug to delta eye plate
- One delta eye plate
- Two bridles (from delta eye plate to the vessel sides)
- Two chafing chains from the bridles to the tow connections

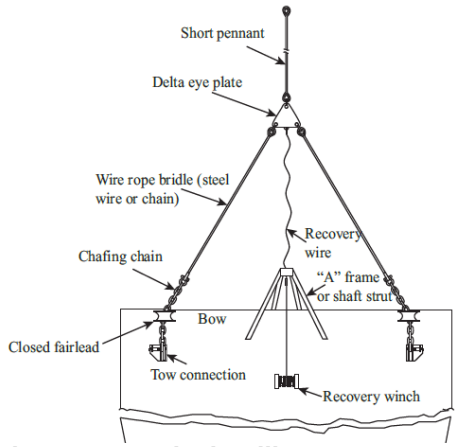

Figure 1 A typical pulling arrangements (Referinta)

One of the key points of the tugging arrangements, is the delta eye plate.
In this plate it is concentrated the tug force and it is distributed on the vessel sides.
In this paperwork we will present the designing steps for a 100KN delta eye plate, using CAD/CAE methods on ANSYS 12.1 Software.
First of all, it is necessary to create the geometric model of the plate.
In a 221mm equilateral triangle we are drawing another 100mm equilateral triangle. The big triangle represents the delta eye plate and the small triangle corners represent the center of 3x40mm holes.
The delta eye plate have 40mm thickness.
The 221mm triangle corners are blended at a 35mm radius.
The delta eye plate looks like in figure:

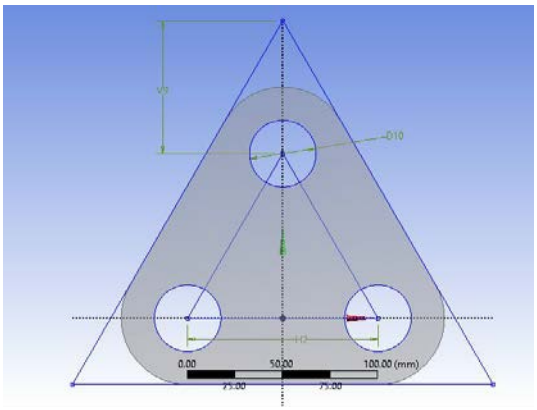

Figure 2 Side view of the 100 KN delta eye plate

Isometric view of the delta eye plate:

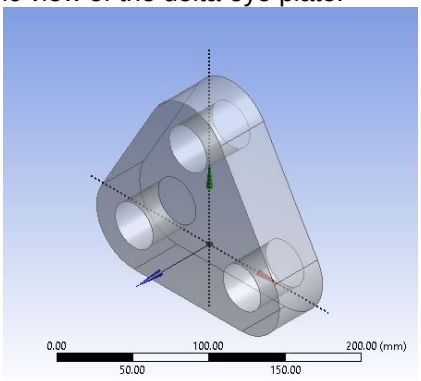

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Figure 3 Isometric view of the 100 KN delta eye plate

In practice, the delta eye plate must be realized at it was described, using AH36 structural steel plate.

For the structural analysis during towing, there were added 40mm pins in the holes.

The entire ensemble looks like below:

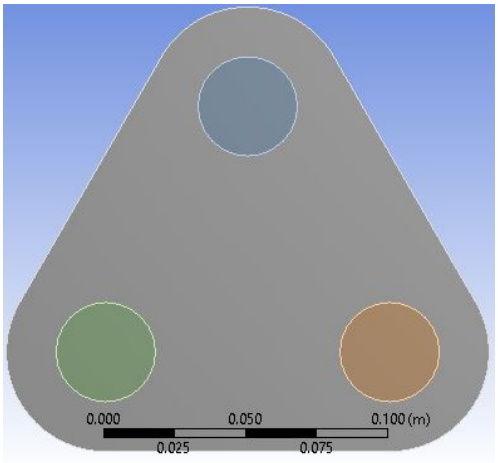

Figure 4 Side view of the towing arrangements

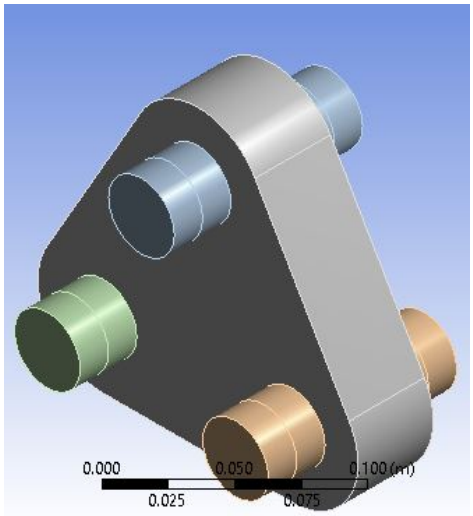

Figure 5 Isometric view of the towing arrangements

The next step in designing the plate is meshing. Mesh characteristics are presented below:

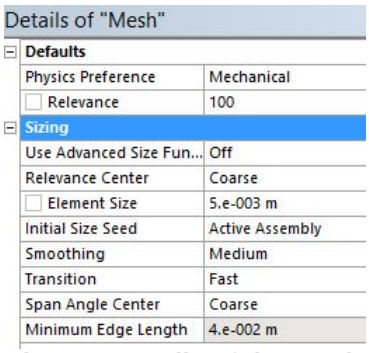

Figure 6 Details of the mesh

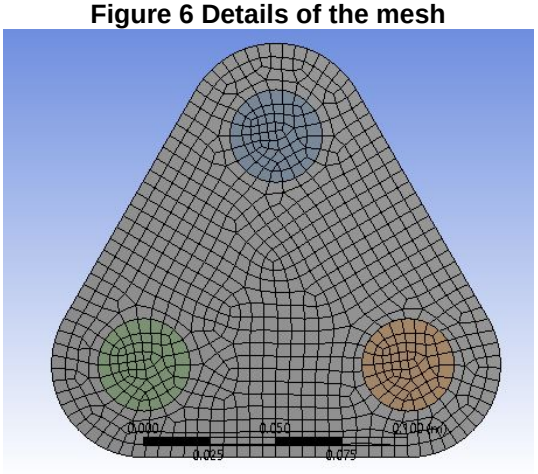

Figure 7 Side view of the mesh structure

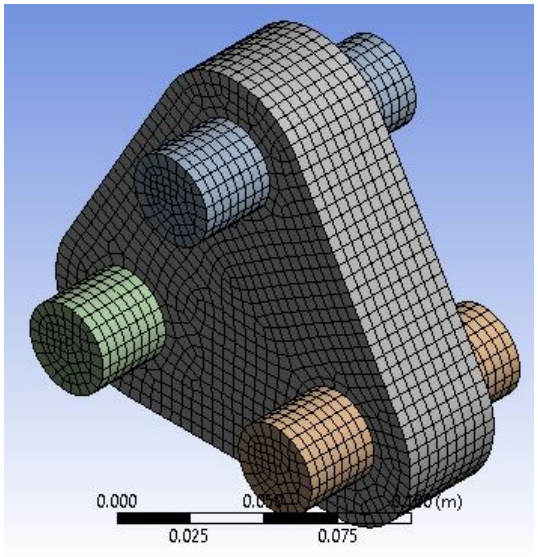

Figure 8 Isometric view of the mesh structure

The mesh consists in 52192 nodes and 11160 elements.

After meshing, the next step consists in setting up the boundary conditions which are:

- Earth gravity is active,
- The 100KN force acts on one of the bolts, on the OY direction
- The other are two bolts are fixed.

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Boundary conditions are presented in following picture:

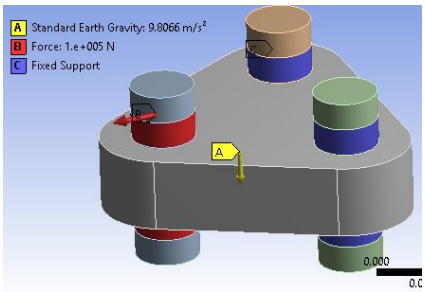

Figure 9 Boundary conditions

Last step is the structural check.

Results of the structural check are presented bellow:

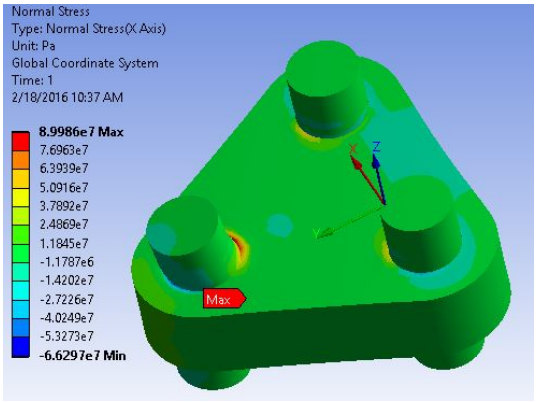

Figure 10 Normal Stres on X axis

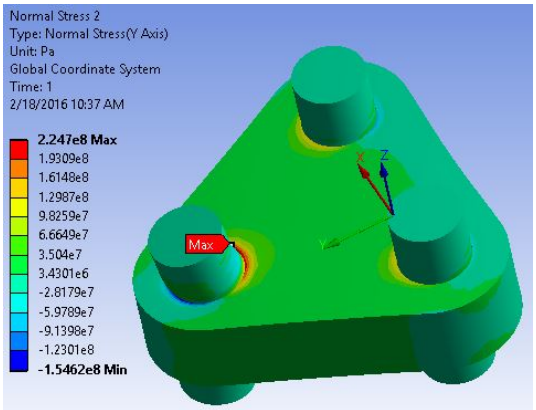

Figure 11 Normal Stres on Y axis

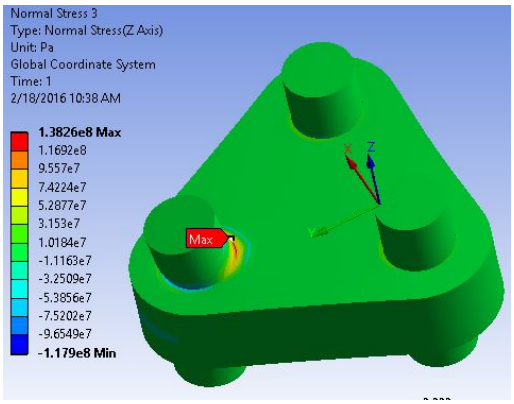

Figure 12 Normal Stres on Z axis

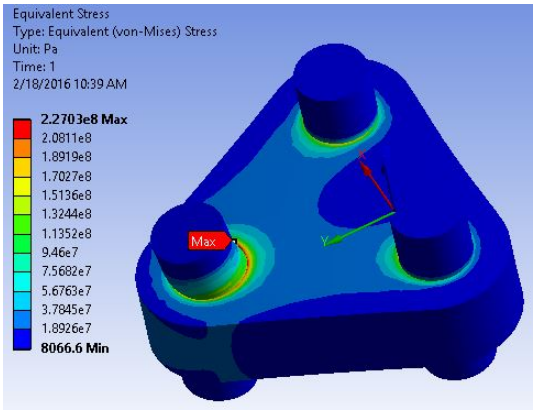

Figure 13 Equivalent Stres

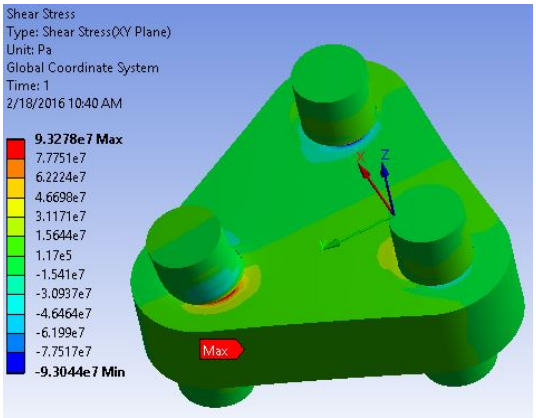

Figure 14 Shear Stress (XY Plane)

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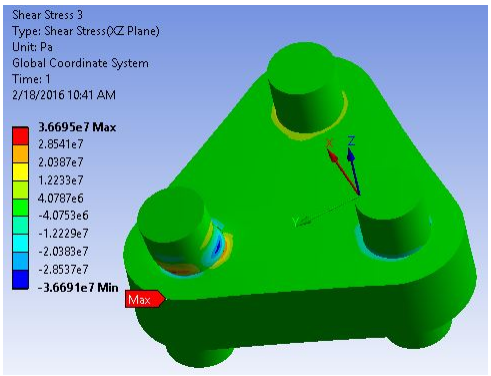

Figure 15 Shear Stress (XZ Plane)

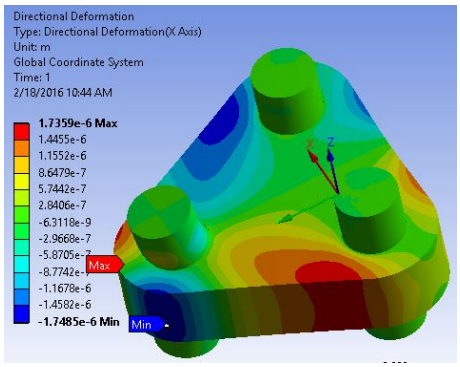

Figure 18Deformations on X Axis

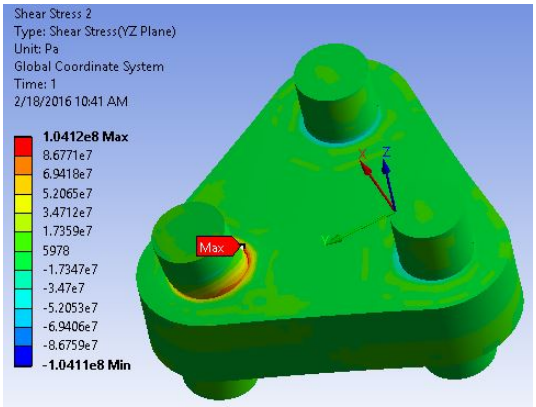

Figure 16 Shear Stress (YZ Plane)

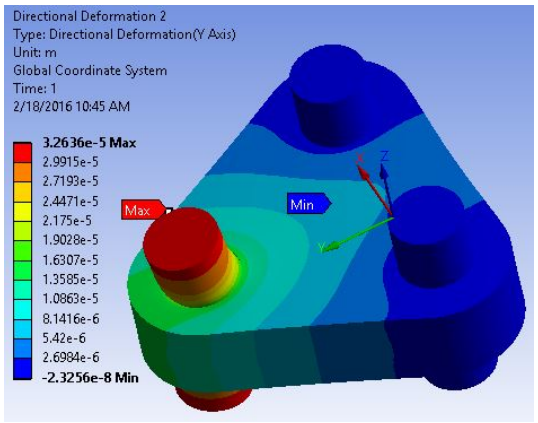

Figure 19 Deformations on Y Axis

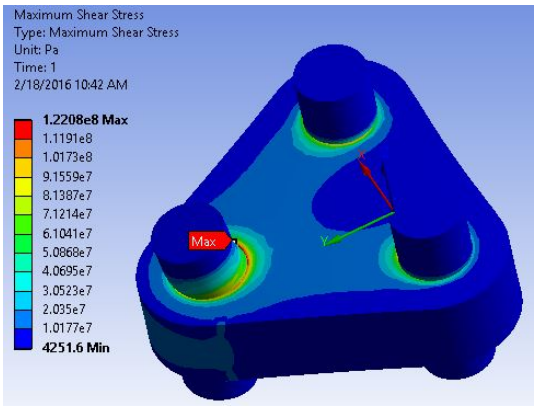

Figure 17 Shear Stress

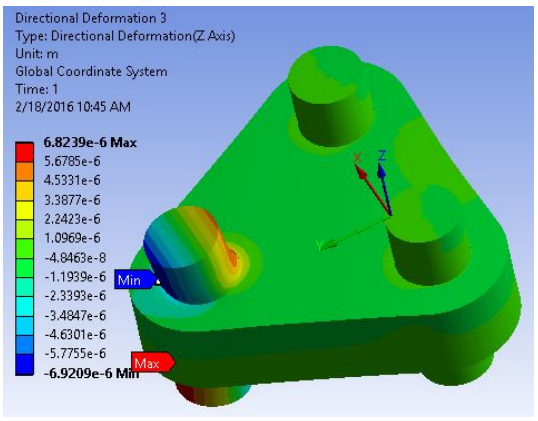

Figure 20 Deformations on Z Axis

The AH36 structural steel have the elastic limit at 355N/mm^2 (3.55E8 Pa). The maximum equivalent stress at this plate, having the design force on one bolt, is at about 63.9% of this limit, which is accepted by all the classification societies.

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