FEM with Solid Edge

Types of calculus

-Linear static

-Normal Modes

-Linear Buckling

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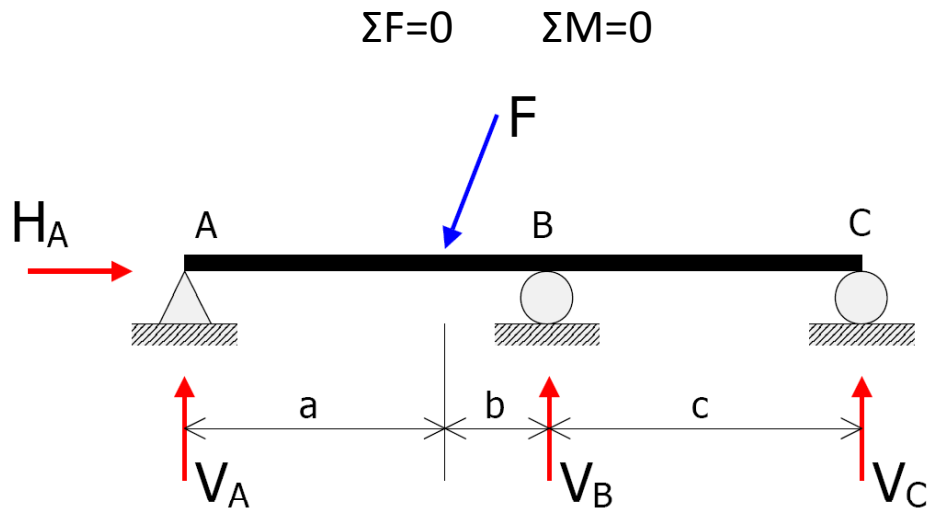
Linear static

Statics is the branch of mechanics that is concerned with the analysis of loads (force and torque, or "moment") on physical systems in static equilibrium, that is, in a state where the relative positions of subsystems do not vary over time, or where components and structures are at a constant velocity. When in static equilibrium, the system is either at rest, or its center of mass moves at constant velocity.



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Normal Modes

A **normal mode** of an oscillating system is a pattern of motion in which all parts of the system move sinusoidally with the same frequency and with a fixed phase relation. The motion described by the normal modes is called resonance. The frequencies of the normal modes of a system are known as its natural frequencies or resonant frequencies. A physical object, such as a building, bridge or molecule, has a set of normal modes that depend on its structure, materials and boundary conditions.

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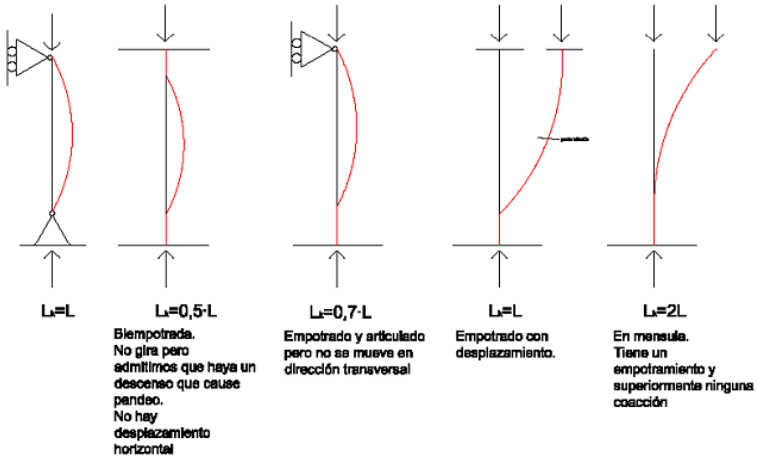
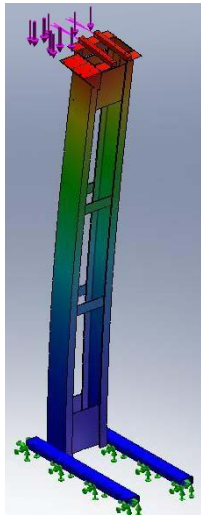
Linear Buckling

In practice, buckling is characterized by a sudden failure of a structural member subjected to high compressive stress, where the actual compressive stress at the point of failure is less than the ultimate compressive stresses that the material is capable of withstanding. For example, during earthquakes, reinforced concrete members may experience lateral deformation of the longitudinal reinforcing bars. This mode of failure is also described as failure due to elastic instability.





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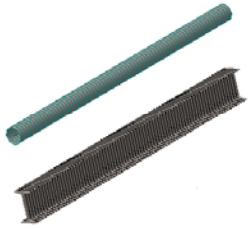
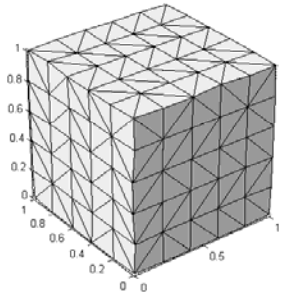
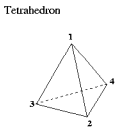
Four types of mesh

-Beam type

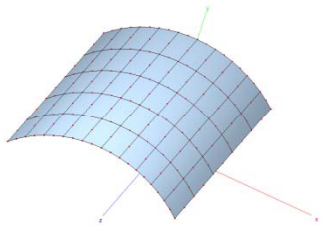


-Tetrahedral type

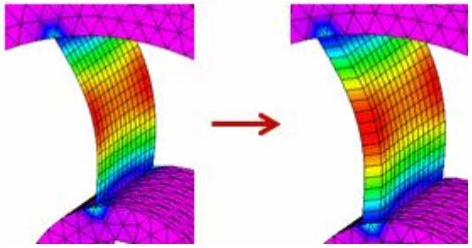




-Shell type



-Hibrid type, shell and tetrahedral



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Steps to follow in a FEM calculus

1.- Design Material

2.- Geometry validation

3.- Apply Loads

4.- Apply constraints

5.- Define mesh

6.- Calculus

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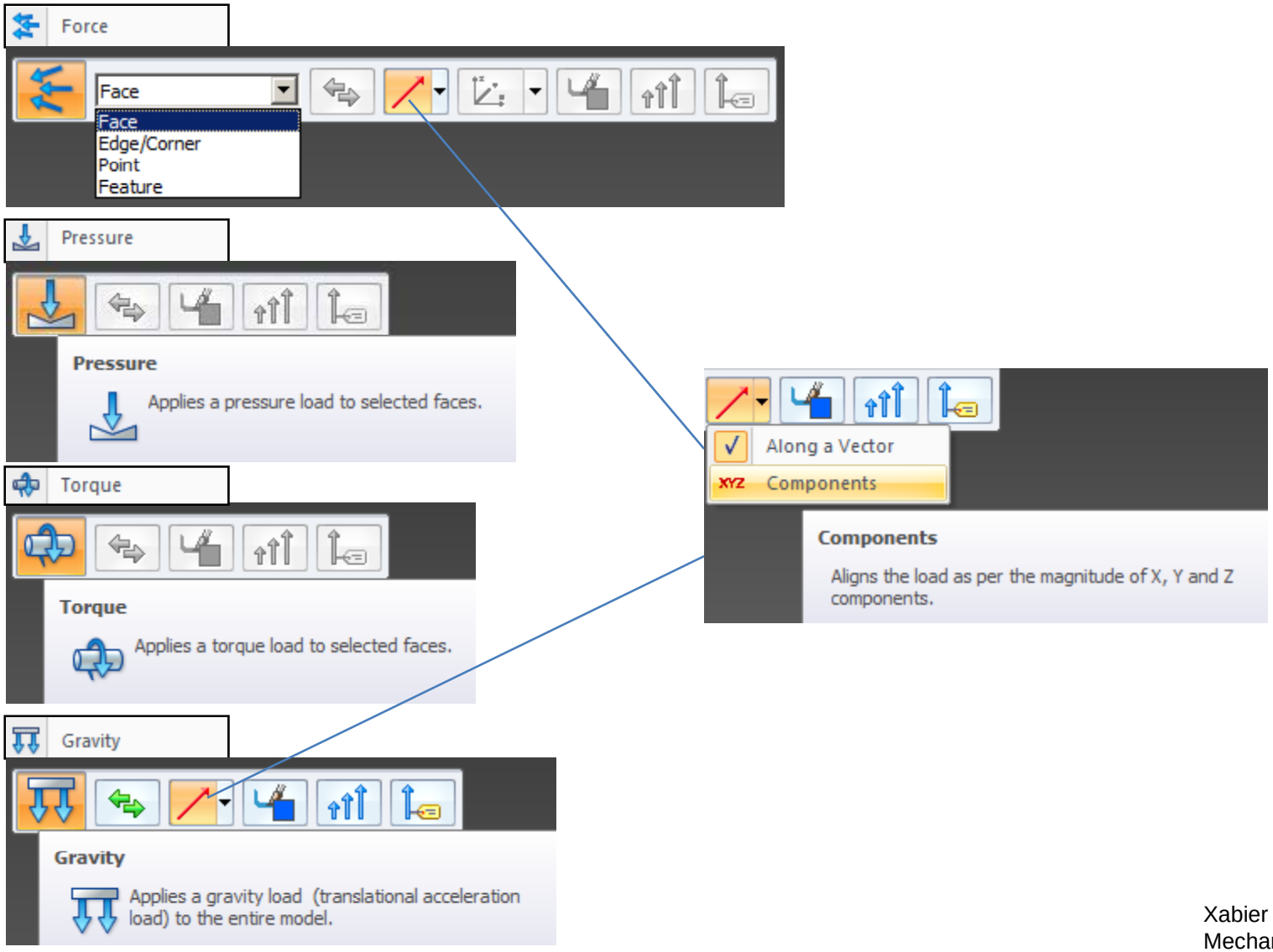
Apply loads



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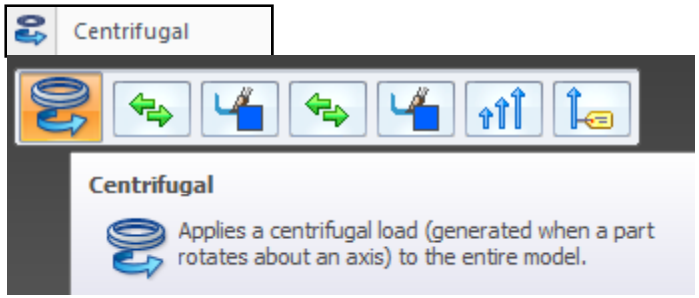
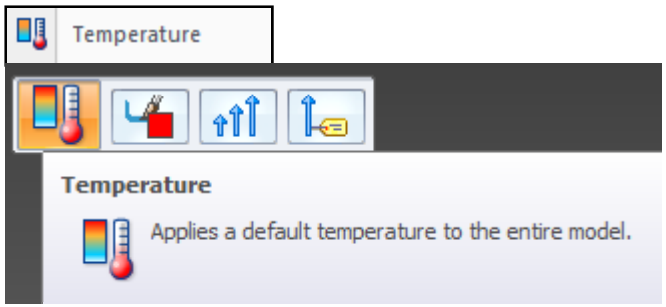
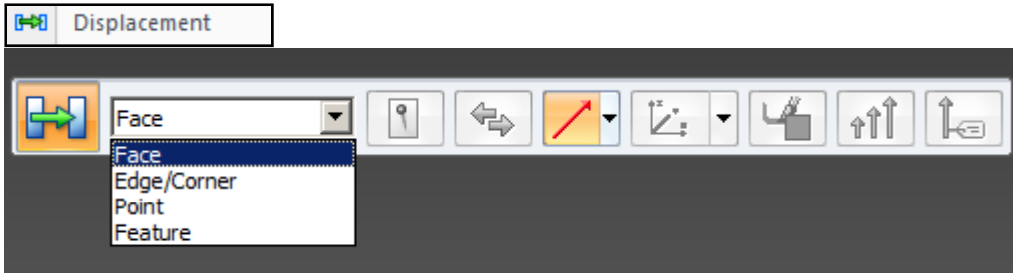
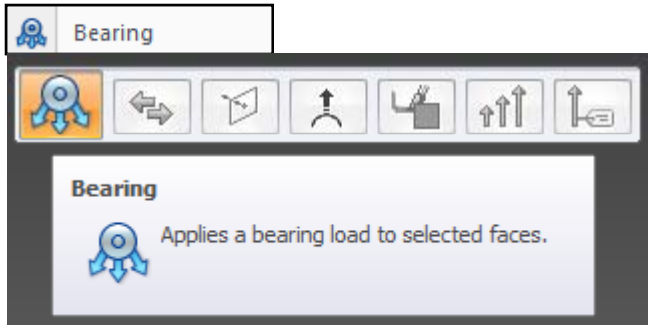
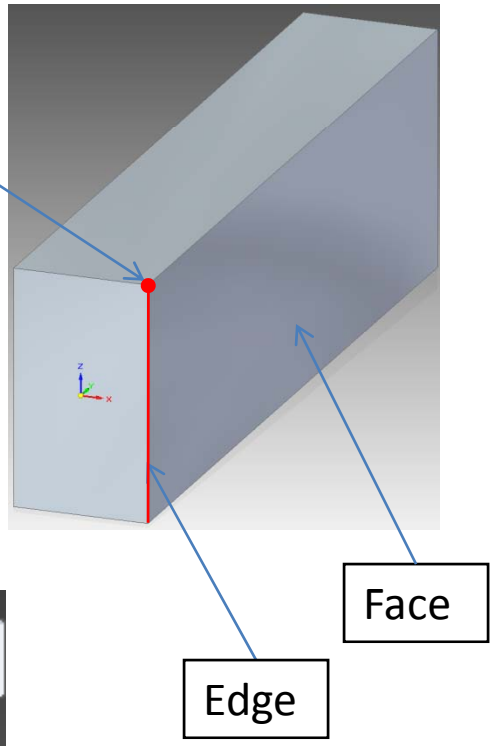
Apply loads











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Apply constraints

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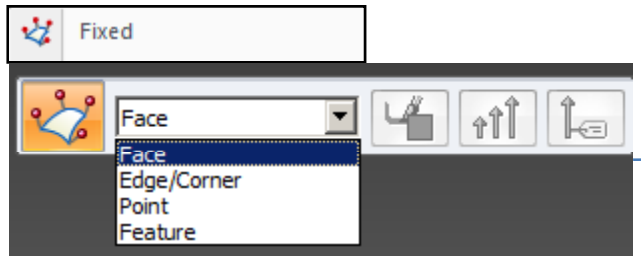
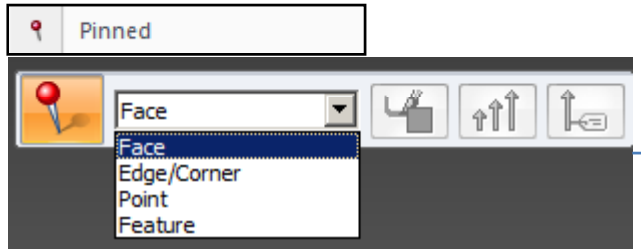


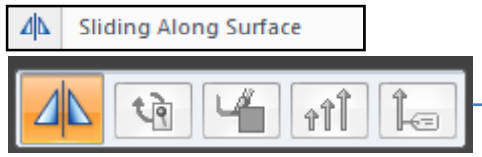
Fixed

Fixes all six degrees of freedom.



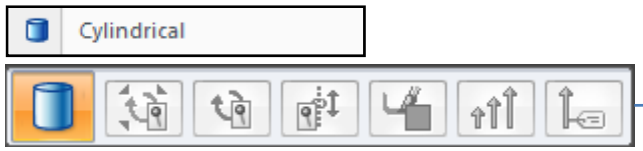
Pinned

Fixes the three translational degrees of freedom while rotational degrees of freedom remain free.



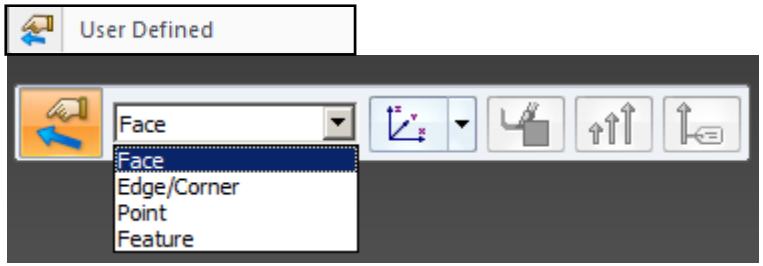
Sliding Along Surface

Creates sliding-along-surface condition on a planar face. Also used on parts containing symmetric support and loading conditions.



Cylindrical

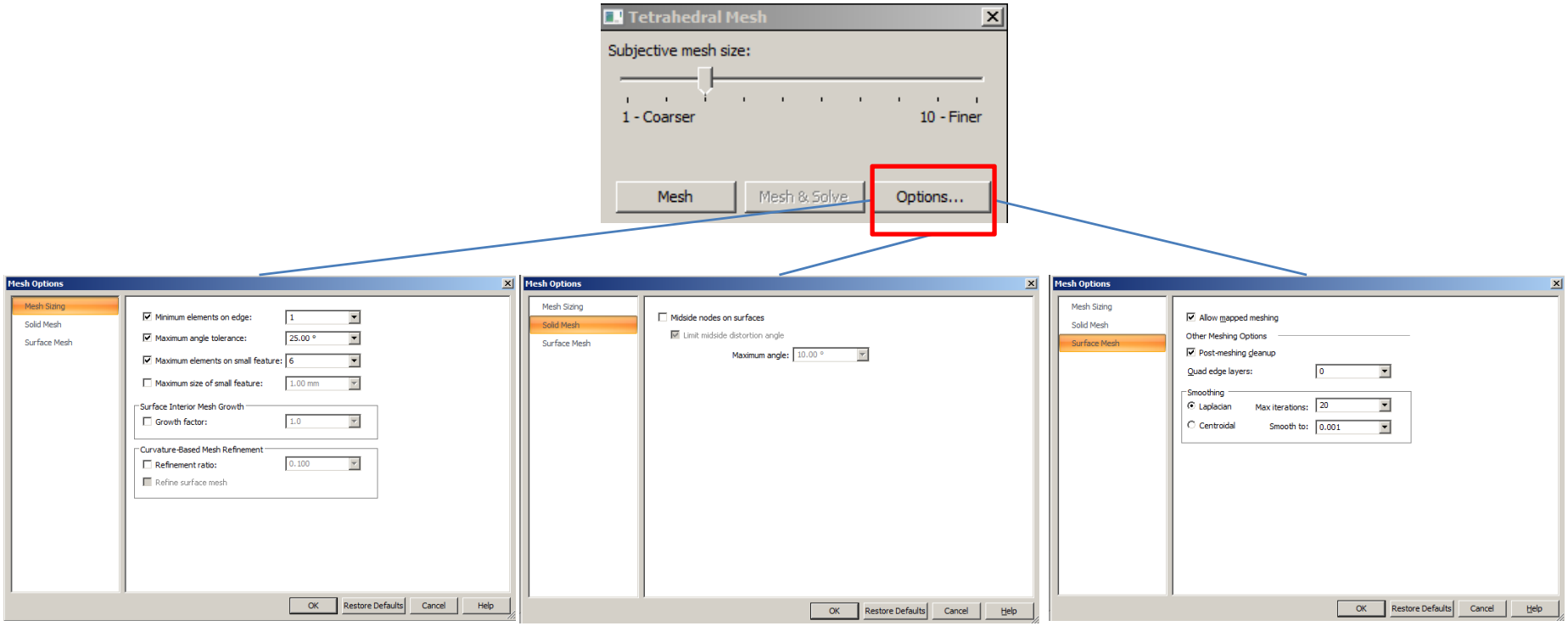
Constrains radial growth/rotation around axis or sliding along axis for cylindrical faces.

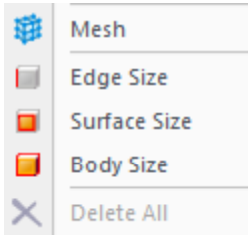


No Rotation

Fixes the three rotational degrees of freedom while the three translational degrees of freedom remain free.

Apply mesh





Specify the size of mesh for diferent options, edge, syrface or body.

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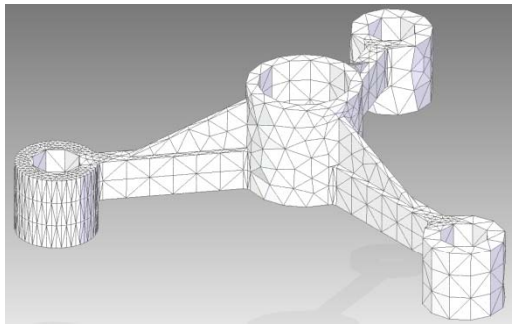
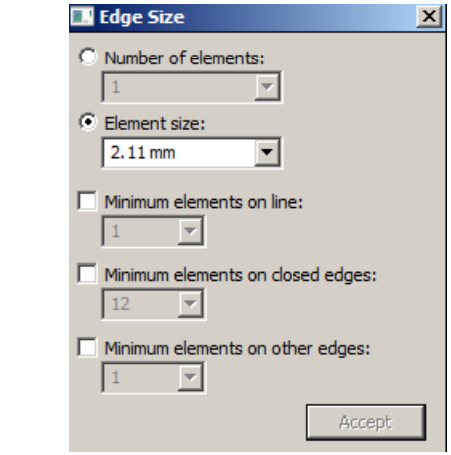
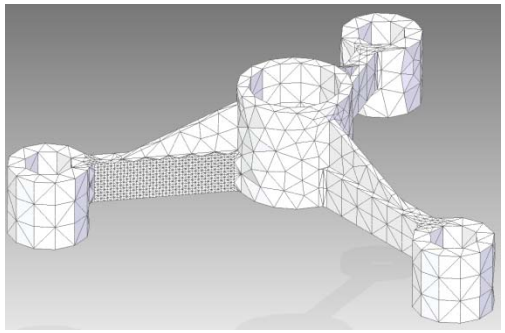
Apply mesh

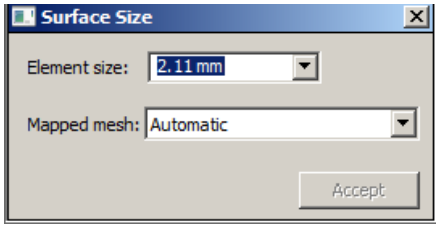
Edge Size



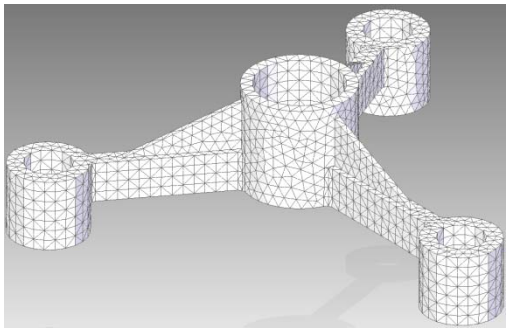


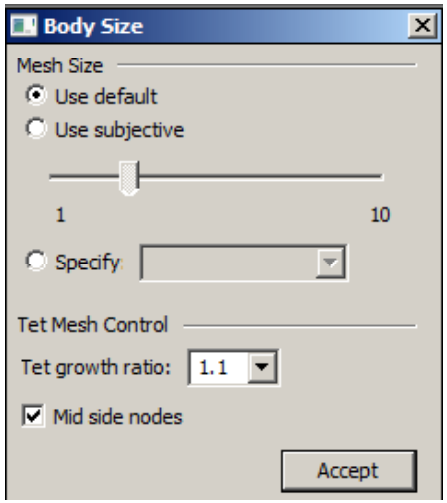
Surface Size





Body Size





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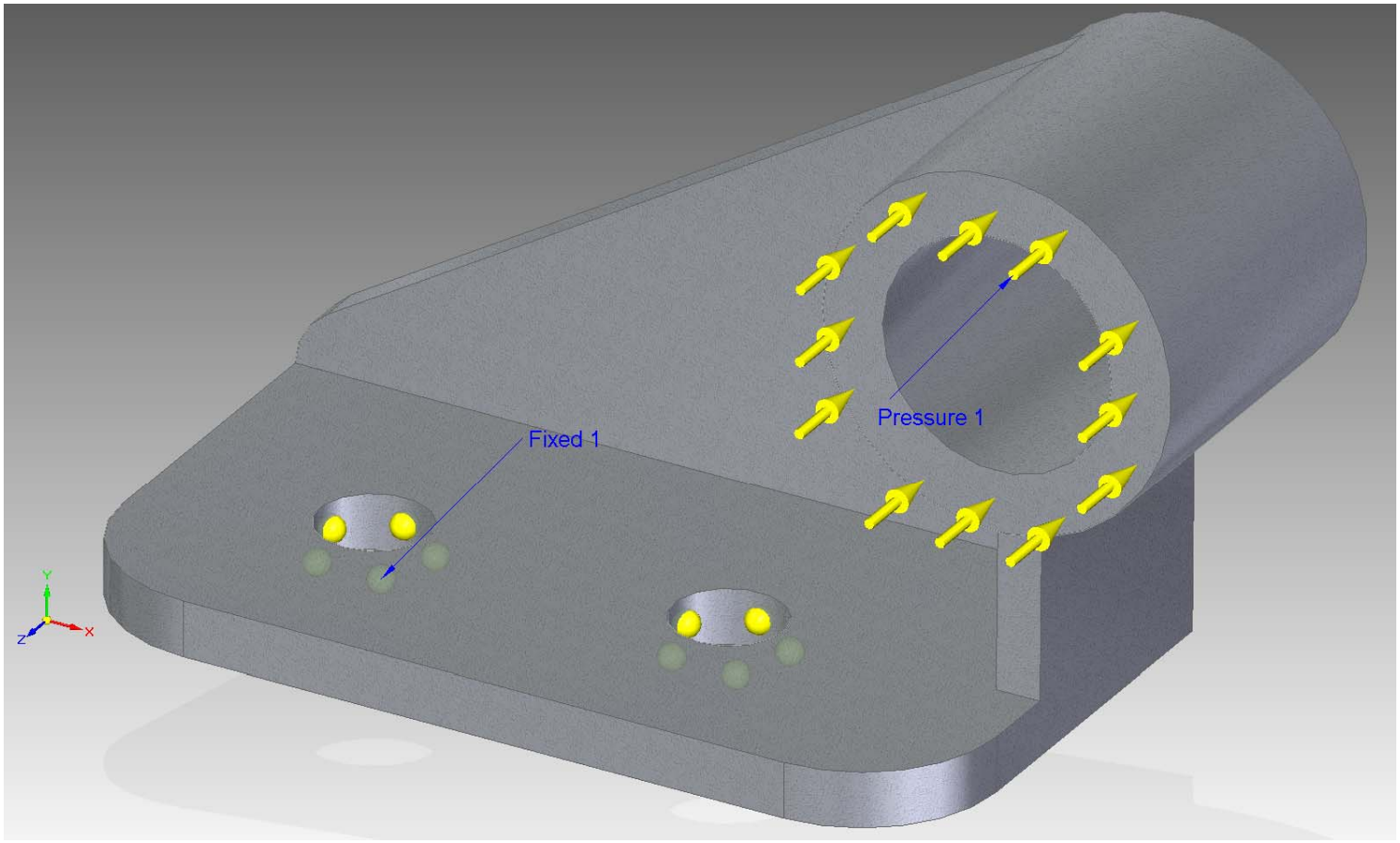
1.-Analysis of a piece

1.- Find the point of maximum Von Mises stress.
2.- Find the maximum displacement of the workpiece in the direction Z.



Pressure 1: 1000 Psi (Z Direction)
Mesh size = 8

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1.- Analysis of a piece

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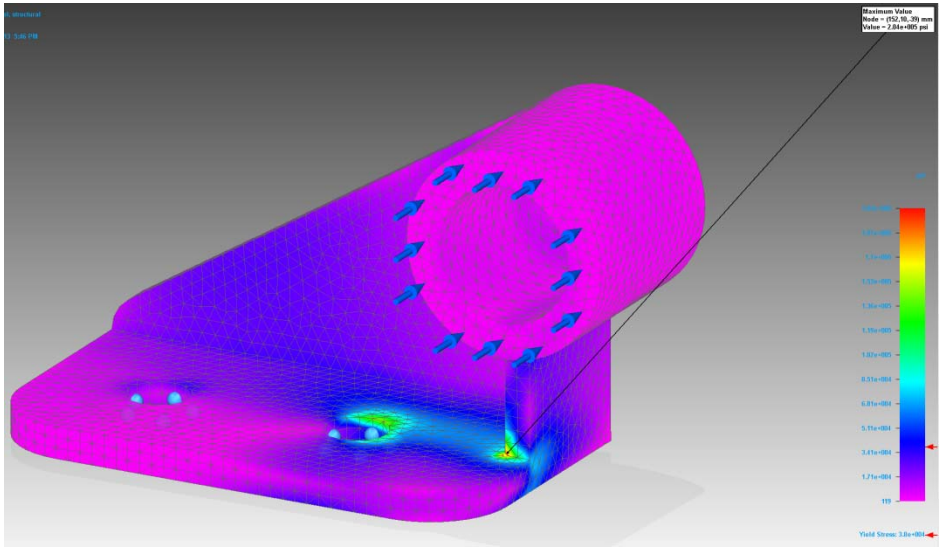
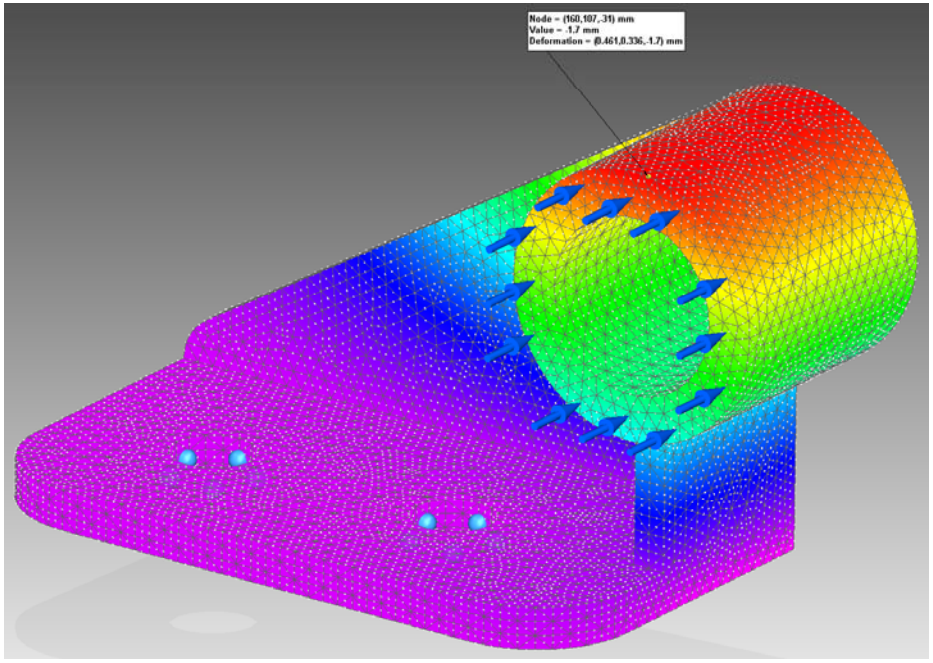


Maximun Value
Node=(152,10,-39)mm
Value=2.04e+05 psi



Node=(160,107,-31)mm
Value=-1.7 mm (T3)
Deformation=(0.461,0.336,-1.7)mm

2.-Analysis of assembly

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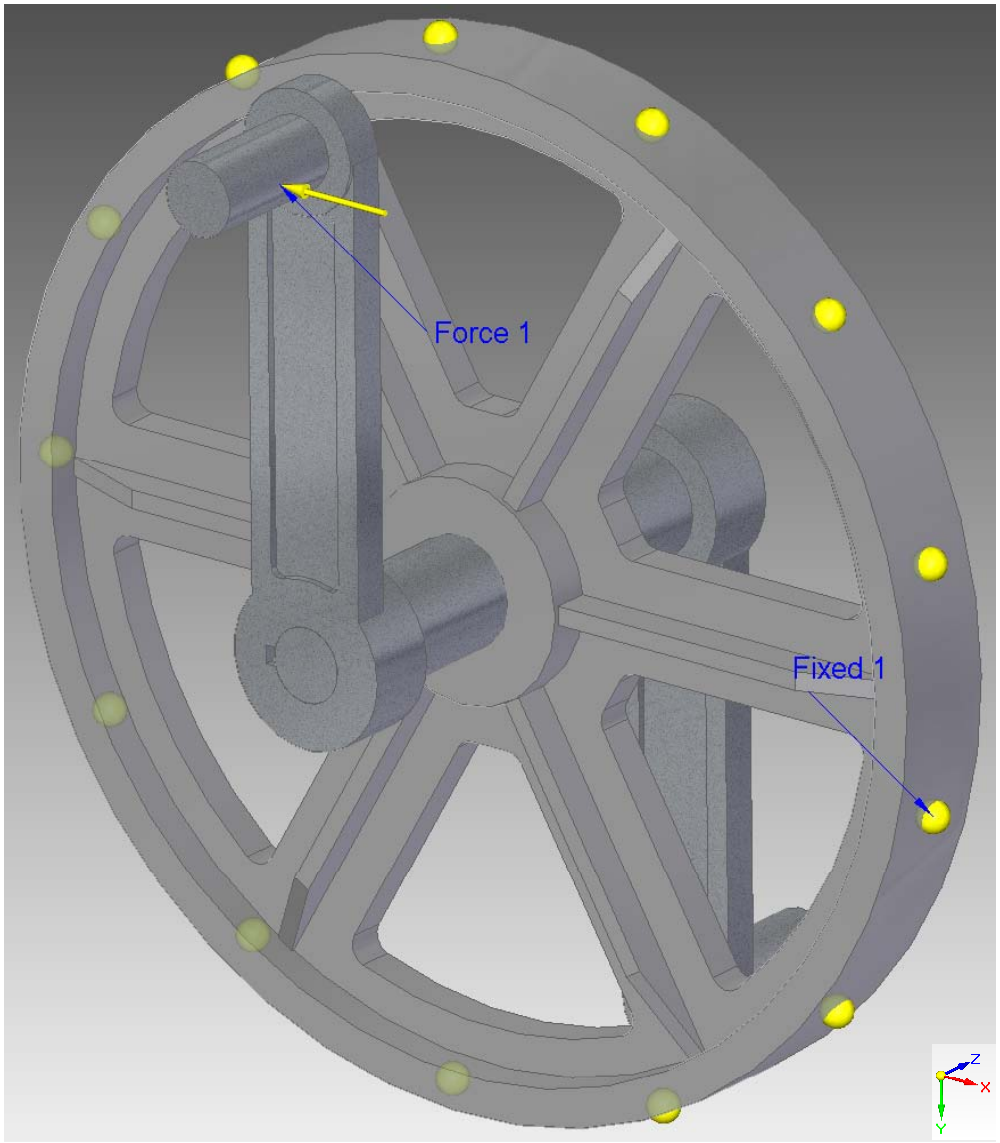
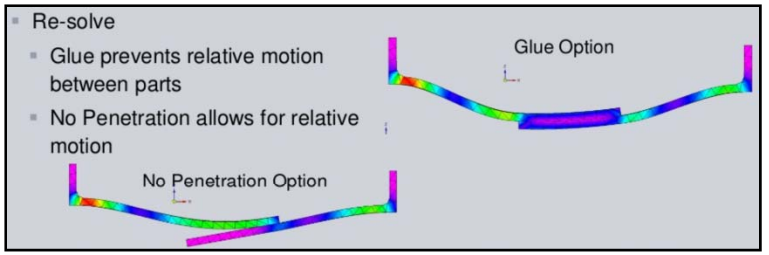


1.- Find the point of maximum Von Mises stress.
2.- Find the maximum displacement of the workpiece in the direction Z.

Force 1: 200 lbf (X Direction)
Mesh size = 6
Connector = Glue



2.- Analysis of assembly

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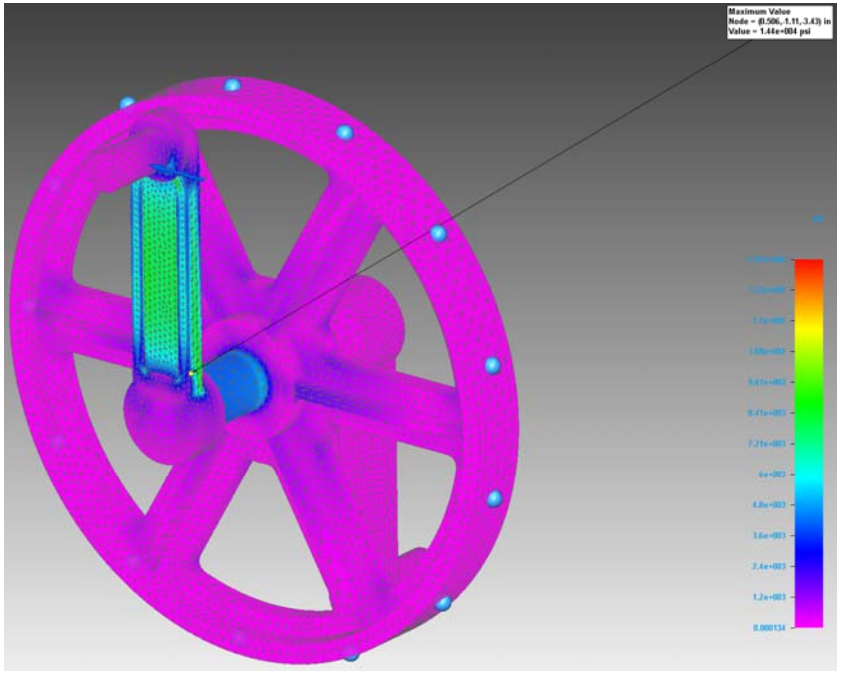
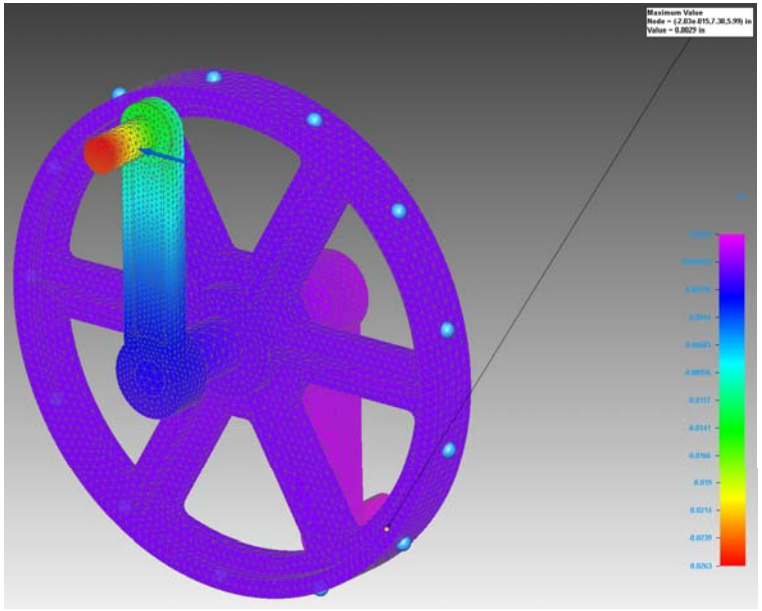
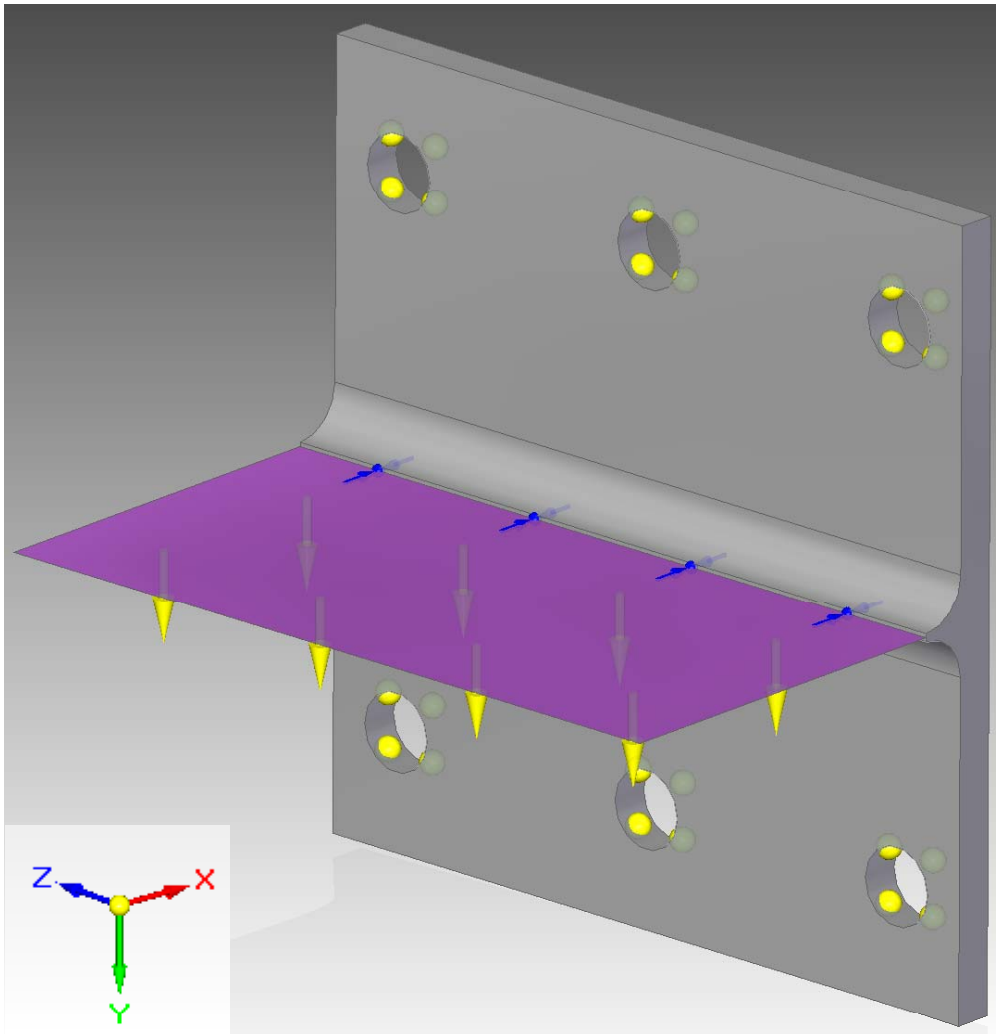


Maximun Value
Node=(0.506,-1.11,-3.42)in
Value=1.44e+04 psi



Maximun Value
Node=(-2.03e-015,7.38,5.99)in
Value=0.0029 in

3.-Analysis of a shell and part



1.- Find the point of maximum Von Mises stress.
2.- Find the maximum displacement of the workpiece in the direction Y.

Pressure 1: 3 psi (Y Direction)
Mesh size = 5
Connector = Glue

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3.- Analysis of a shell and part

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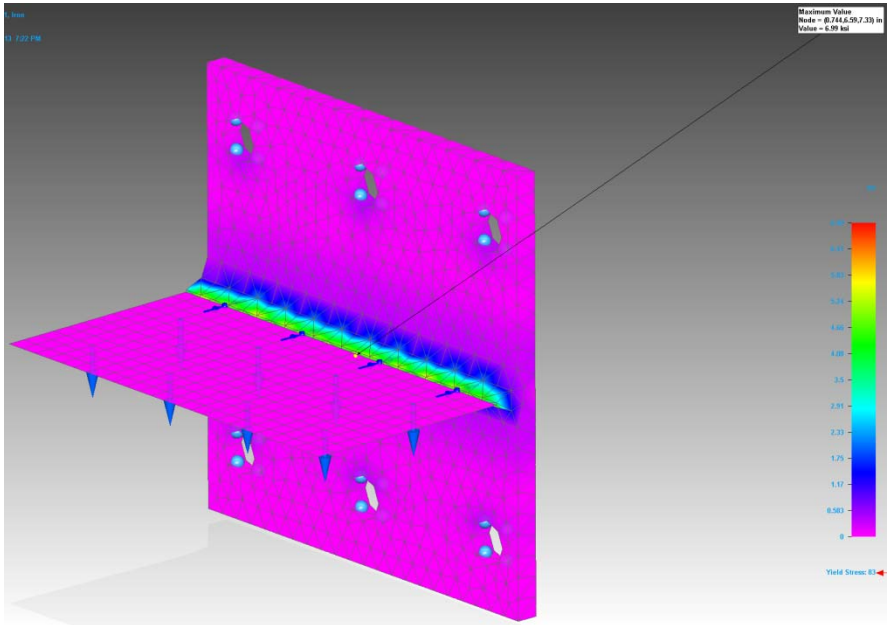
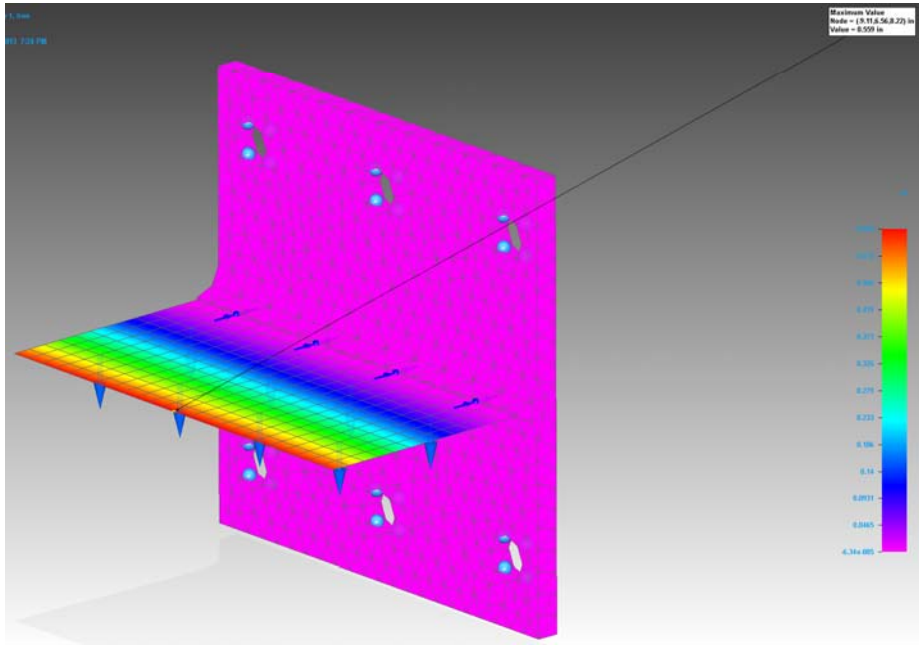
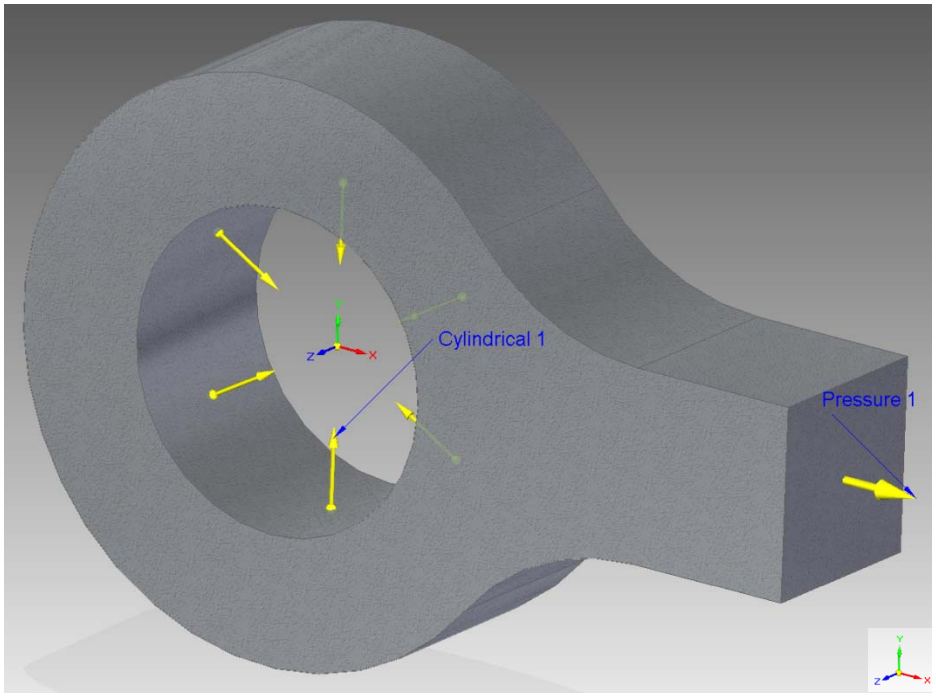


Maximun Value
Node=(0.744,6.59,7.33)in
Value=6.99 ksi

Maximun Value
Node=(-9.11,6.56,8.22)in
Value=0.559 in



4.-Analysis of a piece



1.- Find the point of maximum σx stress.
2.- Find the maximum displacement of the workpiece in the direction X.

Pressure 1: 4000 kpa (X Direction)
Mesh size = 8
Constraints = Cilindrical (Radial Free)

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4.- Analysis of a piece

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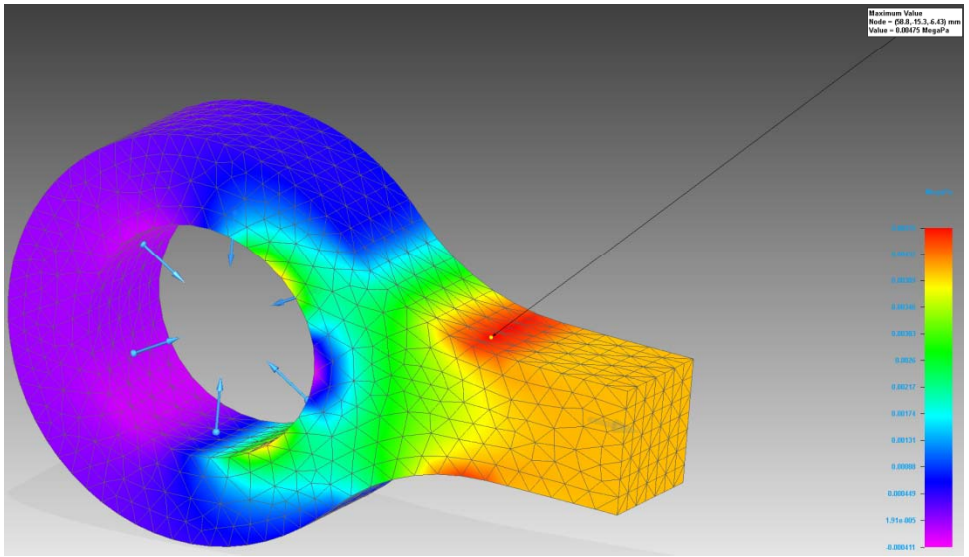
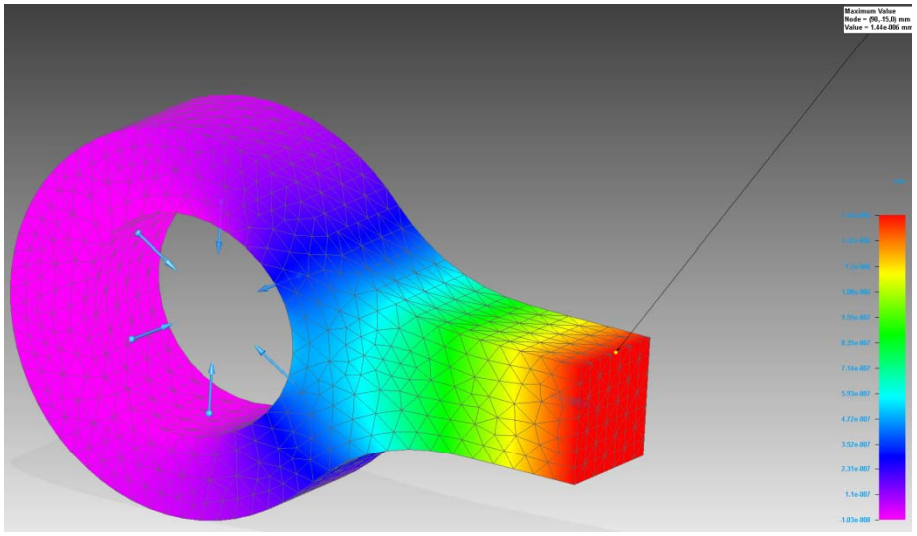
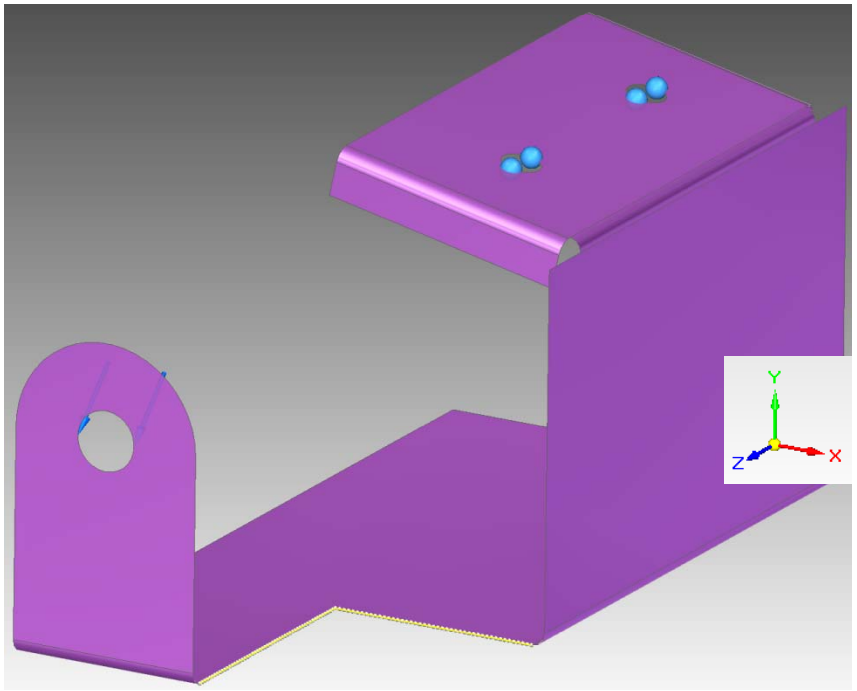


Maximun Value
Node=(58.8,-15.3,-6.43)mm
Value=0.00475 MegaPa

Maximun Value
Node=(90,-15,0)mm
Value= 1.44e-006 mm



5.-Analysis of a sheet metal



1.- Find the point of maximum Von Mises stress.
2.- Find the maximum displacement of the workpiece in the direction Z.

Force 1: 10 N dirección Z
Force 2: -10 N dirección Y
Edge size 2 in the edge shown
Mesh size = 3
Constraints = Fixed

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5.- Analysis of a sheet metal

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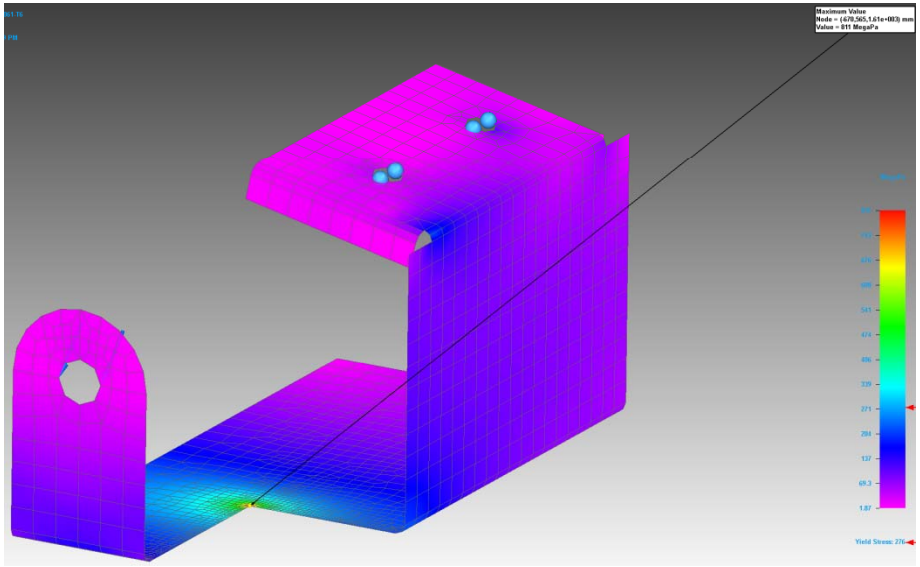
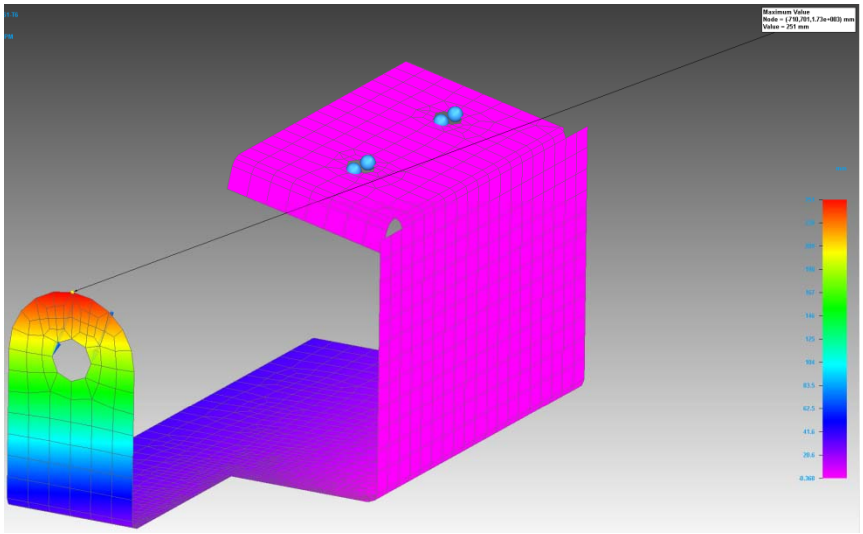
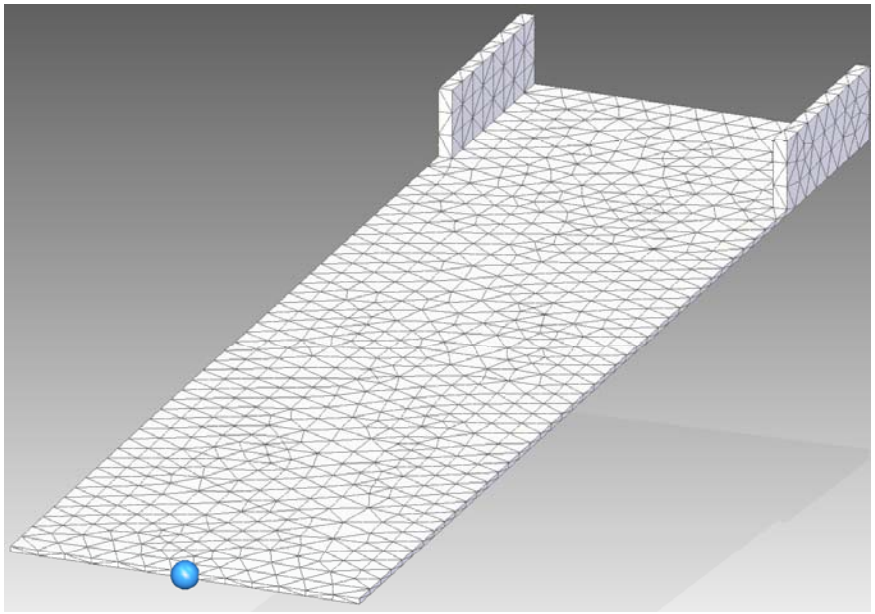


Maximun Value
Node=(-670,565,1.61e+003)mm
Value=811 MegaPa



Maximun Value
Node=(-710,701,1.73e+003)mm
Value= 251 mm

6.-Analysis of a sheet metal normal modes



Find the 6 normal modes and show which is the higher stressful for the sheet metal.

Material Aluminum 6061-T6

Fixed constraint in the face shown

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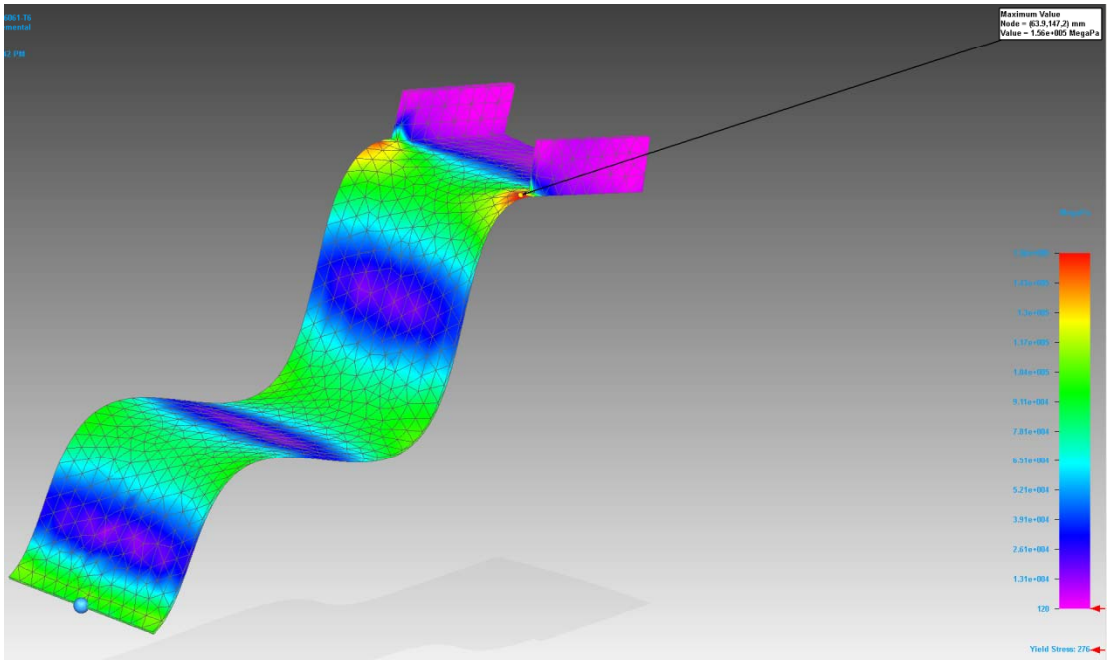
6.- Analysis of a sheet metal normal modes



Maximun Value
Node= (63.9,147,2)mm
Value= 1.56e+005 MegaPa
Modo 6
2.634e+002 Hz

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7.-Analysis of a beam in buckling

Find for four modes of buckling.

Material Aluminum 6061-T6

Fixed constrain in the face shown

Force 10 N in the face shown

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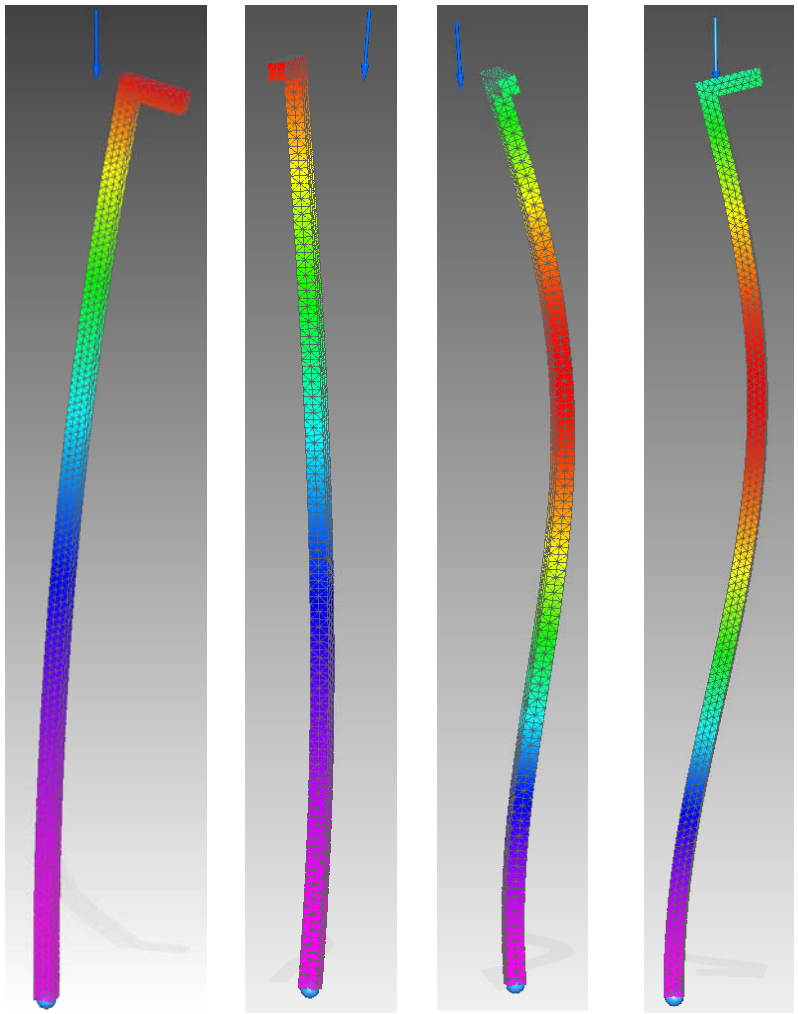
7.- Analysis of a beam in buckling



- Load Case 1
  - Displacement
  - Constraint Force
  - Stress
- Load Case 2
  - Mode 1, Eigenvalue = 5.747e+001
    - Displacement
    - Constraint Force
    - Stress
  - Mode 2, Eigenvalue = 5.758e+001
    - Displacement
    - Constraint Force
    - Stress
  - Mode 3, Eigenvalue = 4.871e+002
    - Displacement
    - Constraint Force
    - Stress
  - Mode 4, Eigenvalue = 4.948e+002
    - Displacement
    - Constraint Force
    - Stress

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