Ansys Tutorials for Optimum Design Course

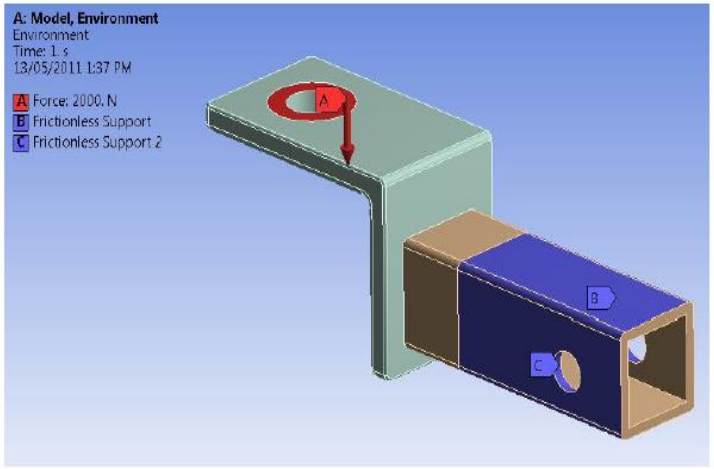
Tutorials Summary

	Ansys Optimization workshops		Description
1	Bracket Design	Mechanical	Certain parameter values
2	Cantilever Beam	Mechanical APDL	Parameter Correlation
3	Link	Mechanical	Design of Experiment
4	Cantilever L Beam	Mechanical	Response Surface Optimization
5	Cylindrical Support	Mechanical	Response Surface Optimization
6	Support Bracket	Mechanical	Response Surface Optimization
7	Airfoil	CFD - CFX	Optimization
8	Mix Tank	Heat _ Fluent	Optimization

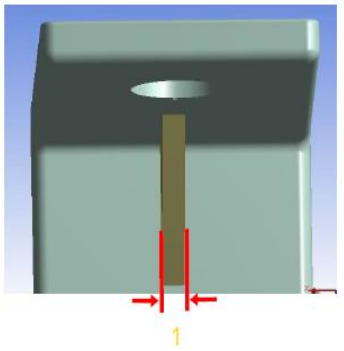
Tutorial 1 – Bracket Design

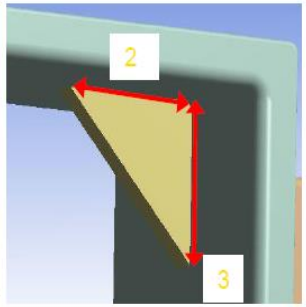
- **Goal**
  - Using Parameter Manager to investigate the behavior of stress, mass, and deformation in the hitch receiver shown here as geometry parameters are changed during vertical loading

[note: This workshop uses functionality inherent to WB.
A DX license is not required to complete this workshop]



- **Model Description**
  - The model is composed of a multibody part (3 bodies) created in DesignModeler. Constraints and loads are shown in the top figure
  - The dimensions labeled 1, 2, and 3 in the bottom figures will be promoted to input parameters

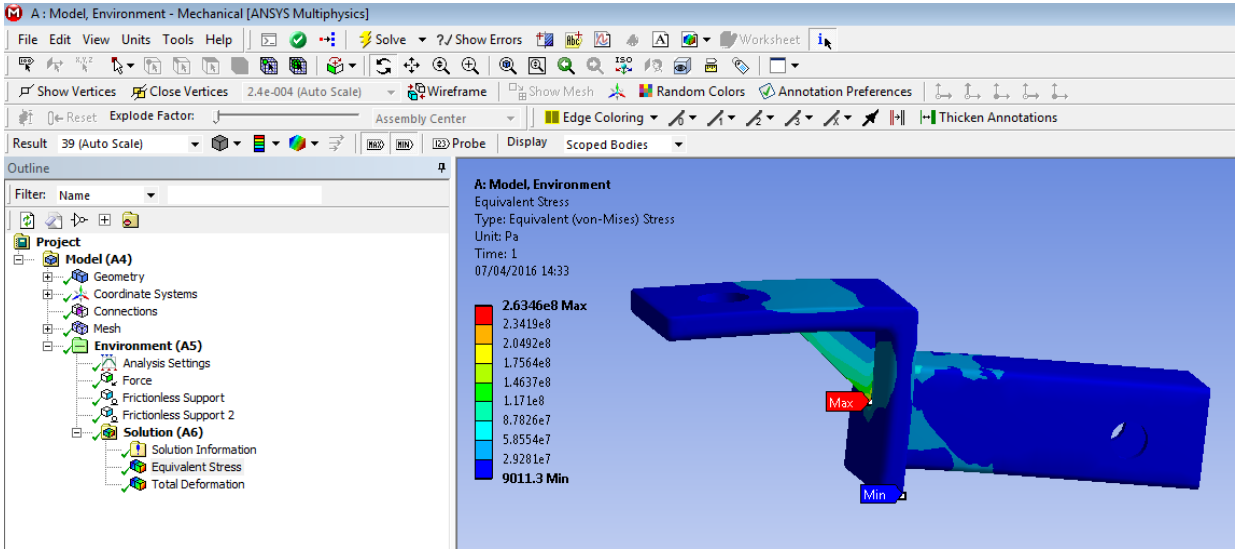




Tutorial 1 – Bracket Design

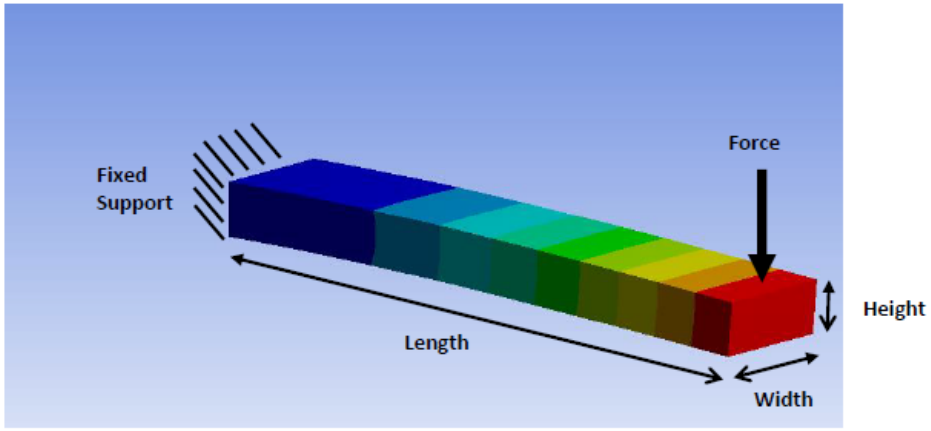
Solution for the current design point

1	Name	P1 - thick_ds	P2 - horiz_ds	P3 - vert_ds	P4 - Geometry Mass	P5 - Equivalent Stress Maximum	P6 - Total Deformation Maximum	Retain	Retained Data
2	Units	mm	mm	mm	kg	Pa	m		
3	DP 0 (Current)	2.75	33	30	1.296	2.6346E+08	0.00031454	☑	✓

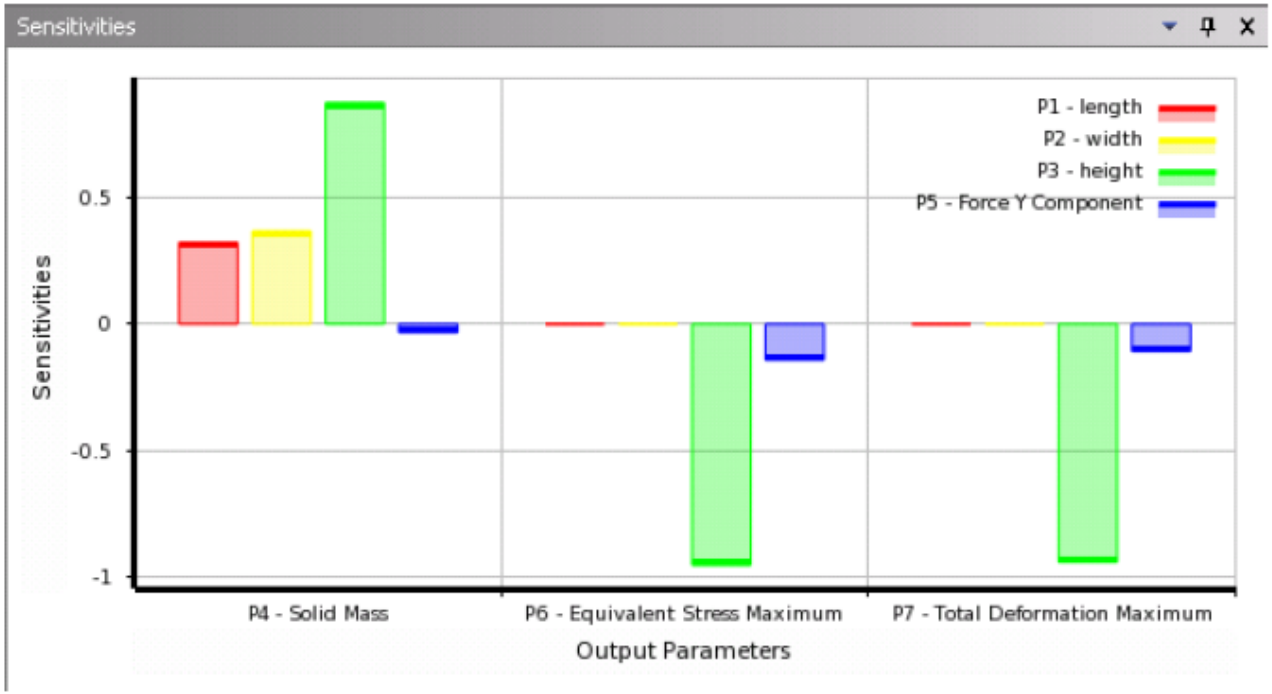


Tutorial 2 – Cantilever Beam

- This workshop looks deeper into the options available in the Parameter Set and Parameter Correlation, as well as exposes you to creating parameters in DesignModeler and Mechanical
- The problem to be analyzed is a simple beam, fixed on one side, and with an applied force on the other. Below is a list of the parameters included in this analysis:
- Input
  - Height
  - Width
  - Length
  - Force
- Output
  - Mass
  - Equivalent Stress
  - Deformation



Tutorial 2 – Cantilever Beam



Tutorial 3 - Link

Overview

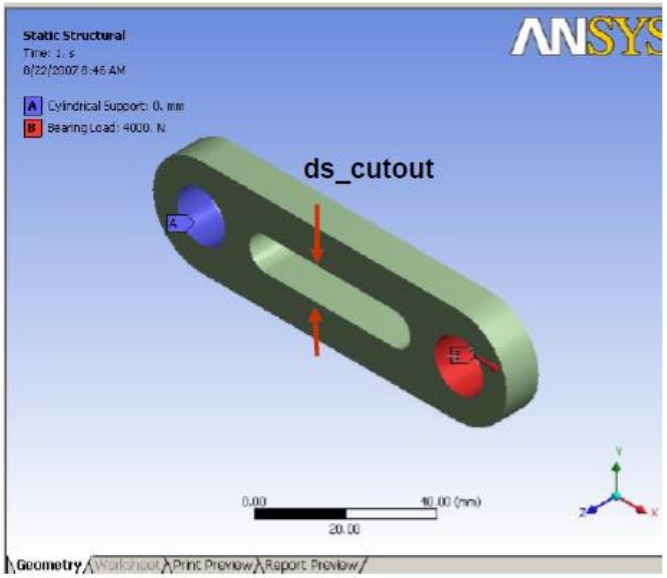
- Goal
  - Showing Design Exploration DOE scenario, and creating response charts
- Model Description
  - The boundary conditions have been applied as shown here

Input parameters

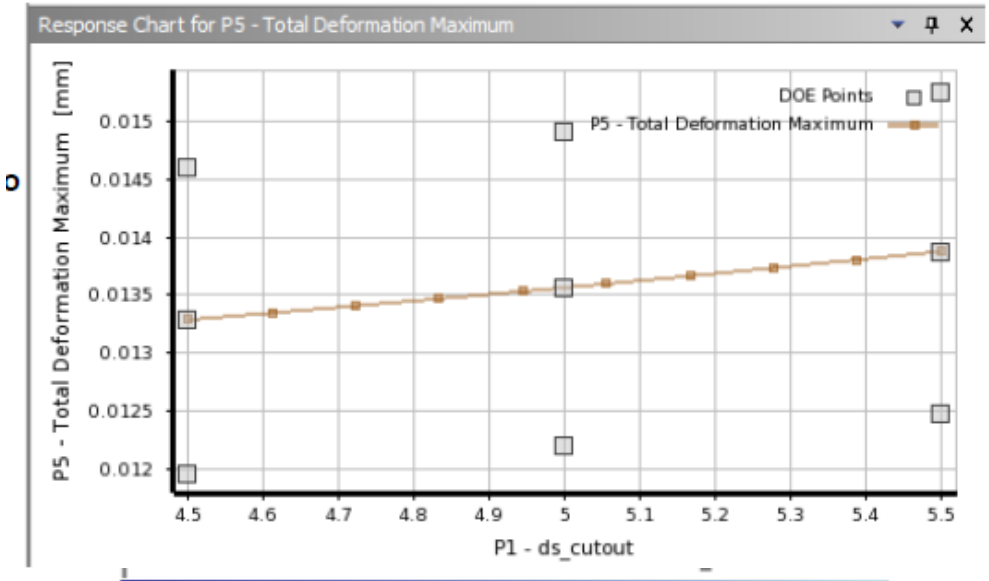
- ds_cutout – geometry parameter
- Bearing load

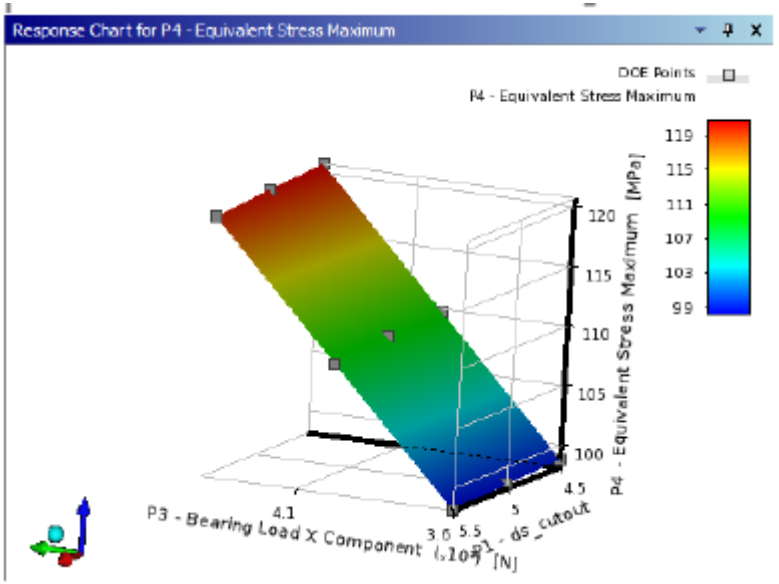
Output parameters

- Mass
- Equivalent stress
- Total deformation



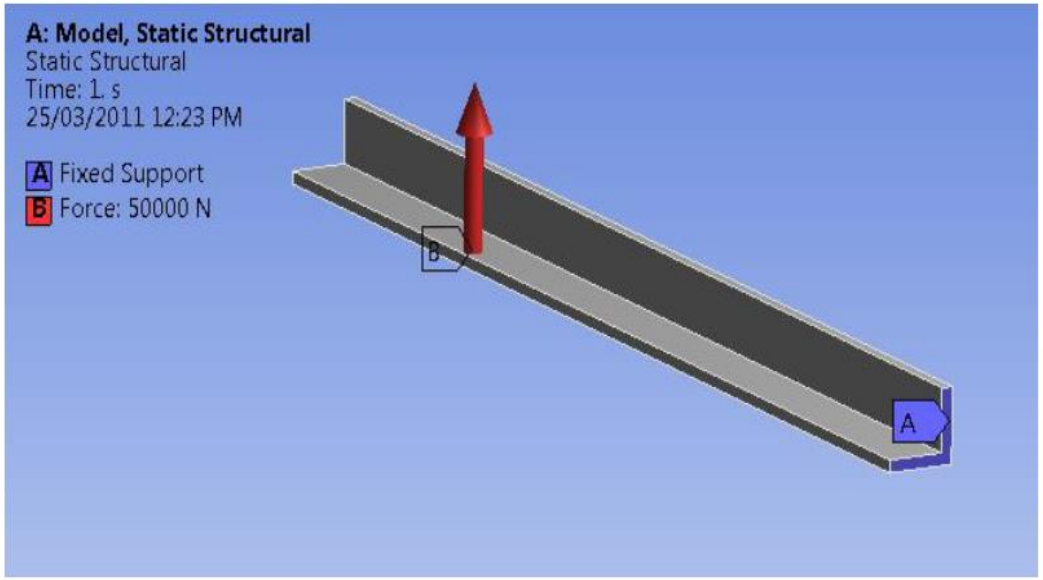
Tutorial 3 - Link





Tutorial 4 – Cantilever L Beam

- Goal
  - To use the Sparse Grid Method to create a response surface where the gradients with respect to one input parameter is much greater than that with respect to another
- Model Description
  - The boundary conditions have been applied as shown here



Input parameters

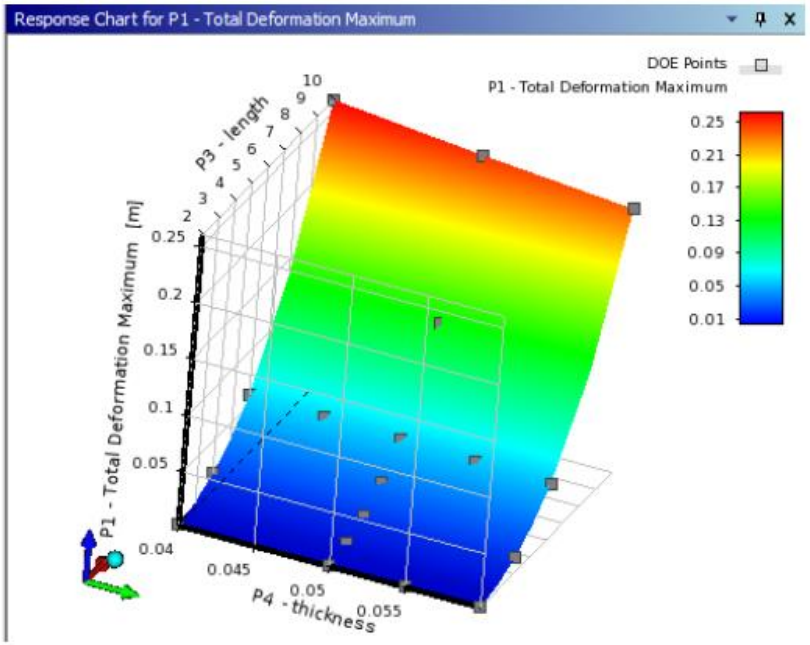
- Beam length
- Beam thickness

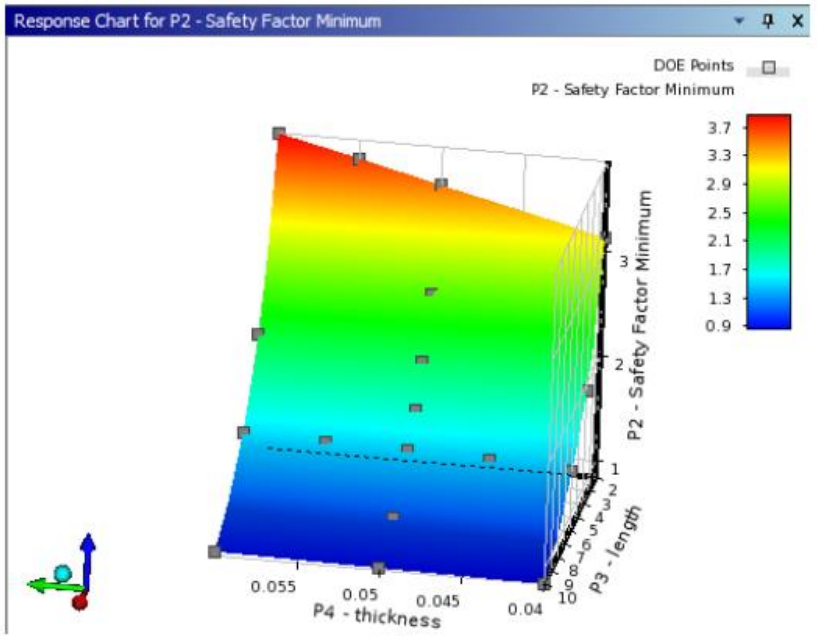
Output parameters

- Total Deformation
- Safety Factor Minimum

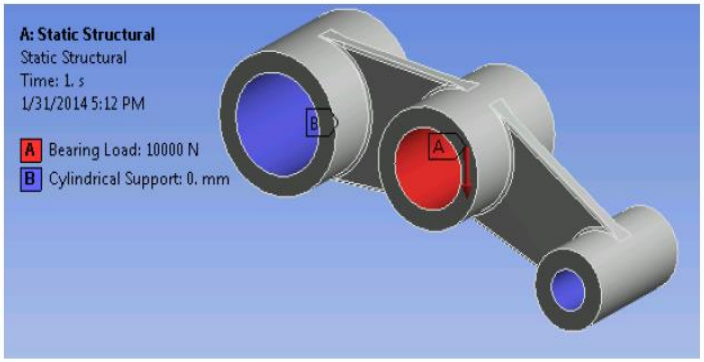
Tutorial 4 – Cantilever L Beam

Response Surface Results

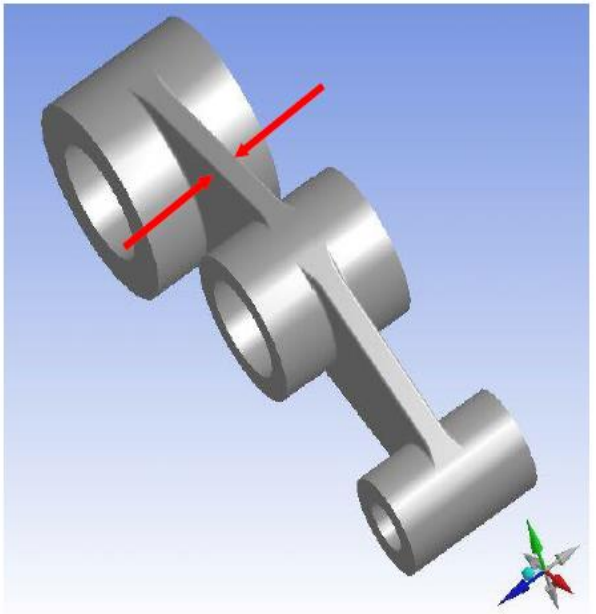




Tutorial 5 - Cylindrical Support



- **Goal**
  - Attempt to minimize the mass of the part while keeping the equivalent stress maximum below 32 MPa
- **Model Description**
  - The boundary conditions have been applied as shown here
  - The 2 cylindrical supports are configured as:
    - Radial = Fixed
    - Axial = Fixed
    - Tangential = Free
  - The model is set up to parametrically vary the web thickness (see figure at right)

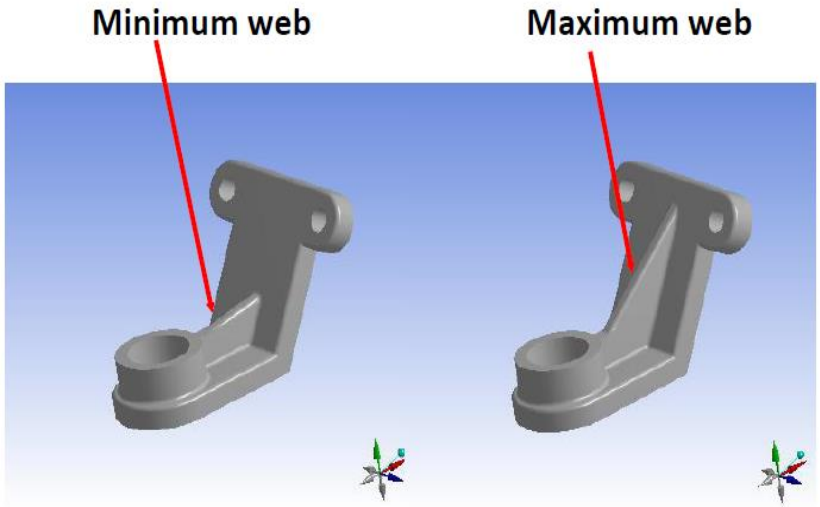


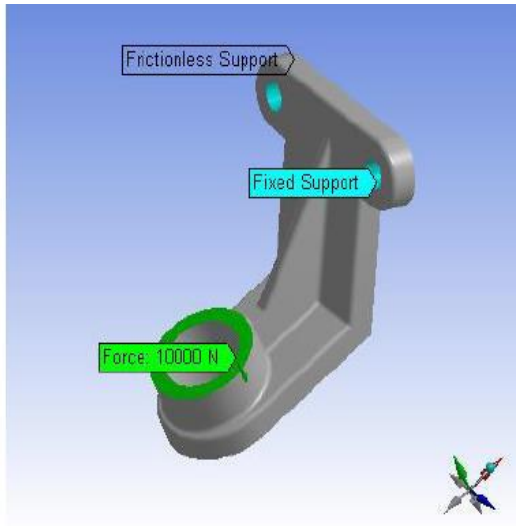
Tutorial 5 - Cylindrical Support

Candidate Points			
	Candidate Point 1	Candidate Point 2	Candidate Point 3
P2 - ds_web	13.035	13.735	14.435
P3 - Solid Mass (kg)	24.22	24.334	24.448
P5 - Equivalent Stress Maximum (MPa)	31.986	30.916	29.958

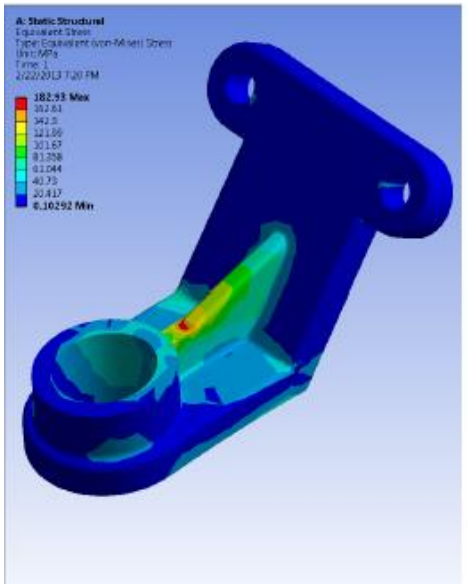
Tutorial 6 – Support Bracket

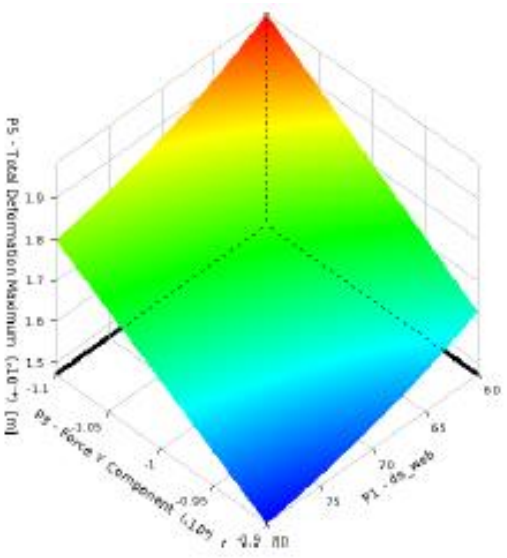
- Goal
  - Investigate the deflection and mass for model shown here as the load and the geometry are varied
  - The goal is to minimize mass and deflection with mass as the most important consideration
- Model Description
  - Constraints and Load are shown on the picture





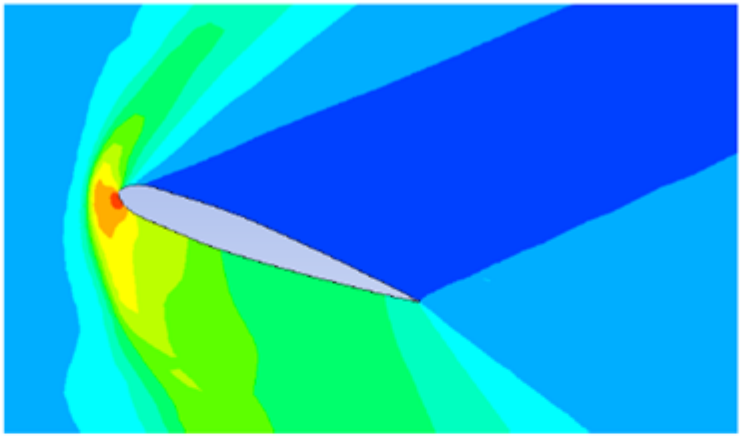
Tutorial 6 – Support Bracket





8	Candidate Points				
9		Candidate Point 1	Candidate Point 1 (verified)	Candidate Point 2	Candidate Point 3
10	P1 - ds_web	60		60.15	60.07
11	P3 - Force Y Component (N)	-9000		-9249	-9499
12	P2 - Geometry Mass (kg)	2.6112	2.6112	2.6115	2.6113
13	P5 - Total Deformation Maximum (m)	0.00016239	0.00016239	0.00016669	0.0001713

Tutorial 7 - Airfoil



Objective:

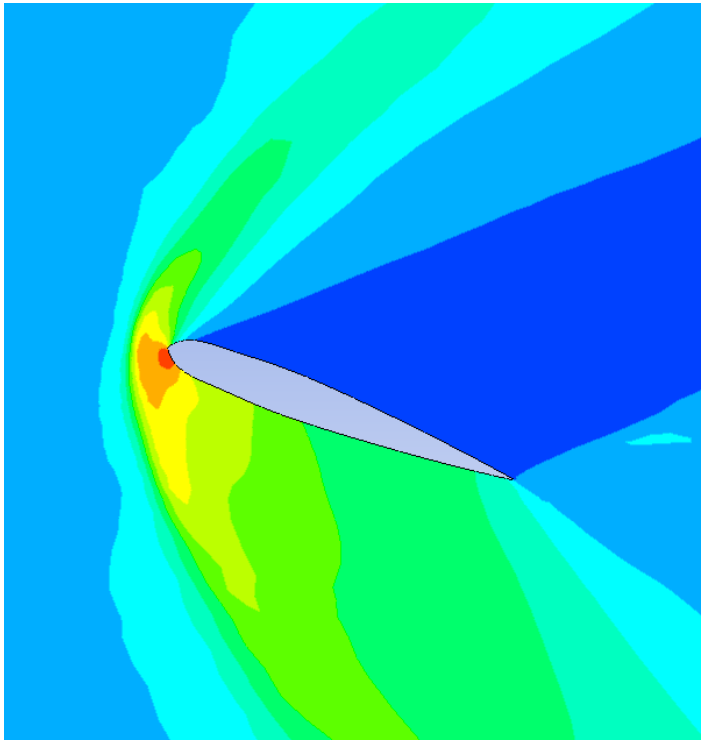
Optimize the angle of attack of a NACA 0012 airfoil to maximize lift while minimizing drag. Supersonic air flow at 600 m/s will be used with the SST turbulence model

Approach:

We will model a 2D slice of the airfoil only 1 element thick in order to capture the flow as it passes over the airfoil. We will then run a Response Surface Optimization on lift and drag by varying the angle of attack

Tutorial 7 - Airfoil

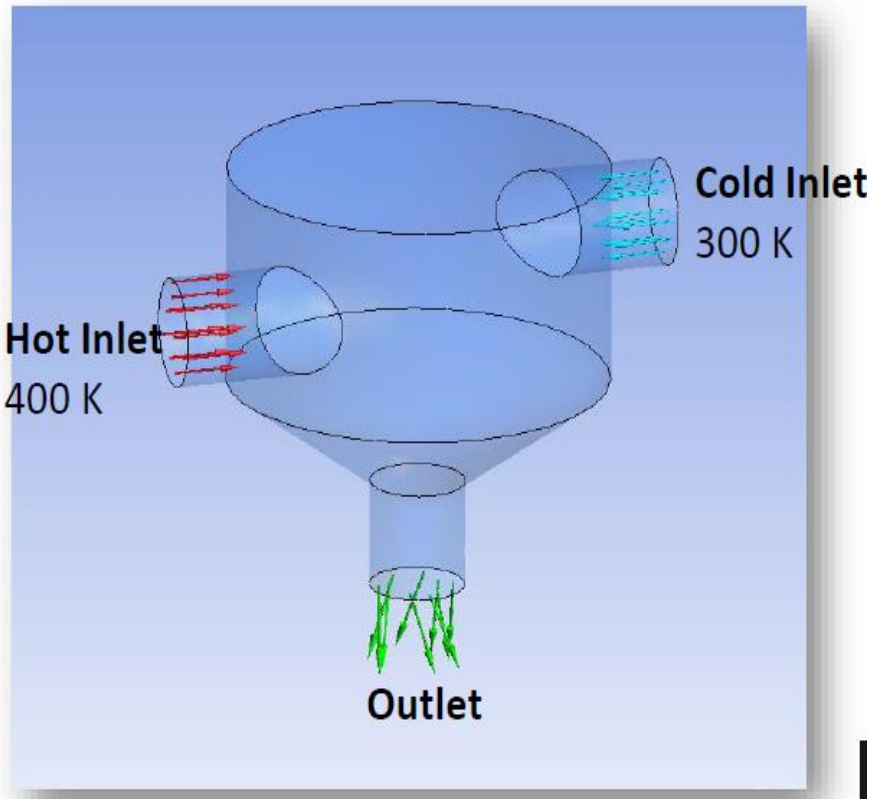
8	Candidate Points				
9		Candidate Point 1	Candidate Point 2	Candidate Point 2 (verified) DP 1	Candidate Point 3
10	P1 - AngleOfAttack	21.443	23.828		26.213
11	P2 - Drag (N)	★ 19373	★ 22600	★ 22380	25830
12	P3 - Lift (N)	★★ 38930	★★ 42346	★★ 42829	★★ 45253



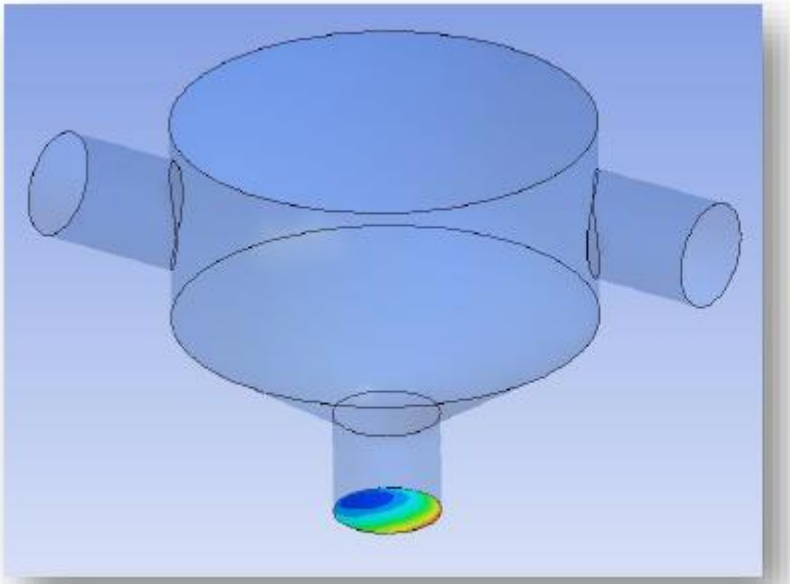
Tutorial 8 – Mixing Tank - Thermal

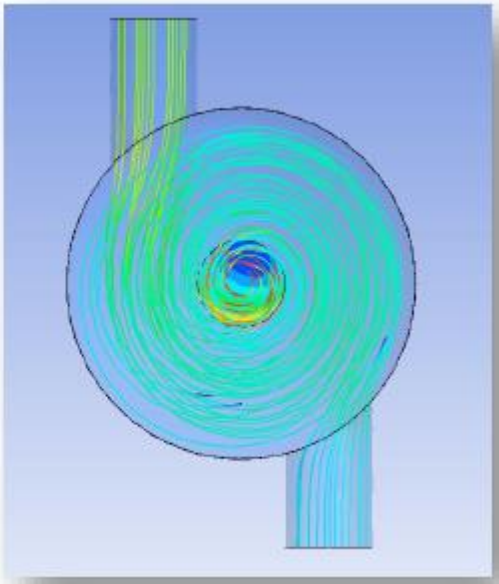
- This workshop looks deeper into the options available for DOEs, Response Surfaces and Optimization, as well as exposes you to creating parameters in FLUENT and CFD-Post
- The problem to be analyzed is a static mixer where hot and cold fluid entering at variable velocities mix. The objective of this analysis is to find inlet velocities which minimize pressure loss from the cold inlet to the outlet and minimize the temperature spread at the outlet

- **Input**
  - Hot inlet velocity
  - Cold inlet velocity
- **Output**
  - Pressure loss
  - Temperature spread



Tutorial 8 – Mixing Tank - Thermal





8	Candidate Points				
9		Candidate Point 1	Candidate Point 1 (verified)	Candidate Point 2	Candidate Point 3
10	P1 - inletcold_velocity (m s^-1)	3.538		4.05	4.434
11	P2 - inlethot_velocity (m s^-1)	1.5127		1.503	1.5498
12	P3 - PressureDrop (Pa)	★★ 37.717	★★ 36.876	★ 46.449	★ 54.392
13	P4 - TempSpread (K)	★★ 0.46453	★ 0.48686	★★ 0.41081	★★ 0.40185

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