Pressure Coefficient *(Cp)* Plot along NACA0012 at 2° Angle of Attack

Description: An XY-plot of *Cp* along the chord line length of the NACA0012 airfoil

Keywords: *Aerodynamics, CFD, Fluent, ANSYS, Cp, Airfoil*

In fluid dynamics, the **pressure coefficient** is a dimensionless number which describes the relative pressures throughout a flow field. The pressure coefficient is used in aerodynamics and hydrodynamics. Every point in a fluid flow field has its own unique pressure coefficient, C_p.

In many situations in aerodynamics and hydrodynamics, the pressure coefficient at a point near a body is independent of body size. Consequently, an engineering model can be tested in a wind tunnel or water tunnel, pressure coefficients can be determined at critical locations around the model, and these pressure coefficients can be used with confidence to predict the fluid pressure at those critical locations around a full-size aircraft or boat.

Definition [edit]

The pressure coefficient is a parameter for studying both incompressible/compressible fluids such as water and air. The relationship between the dimensionless coefficient and the dimensional numbers is [1][2]

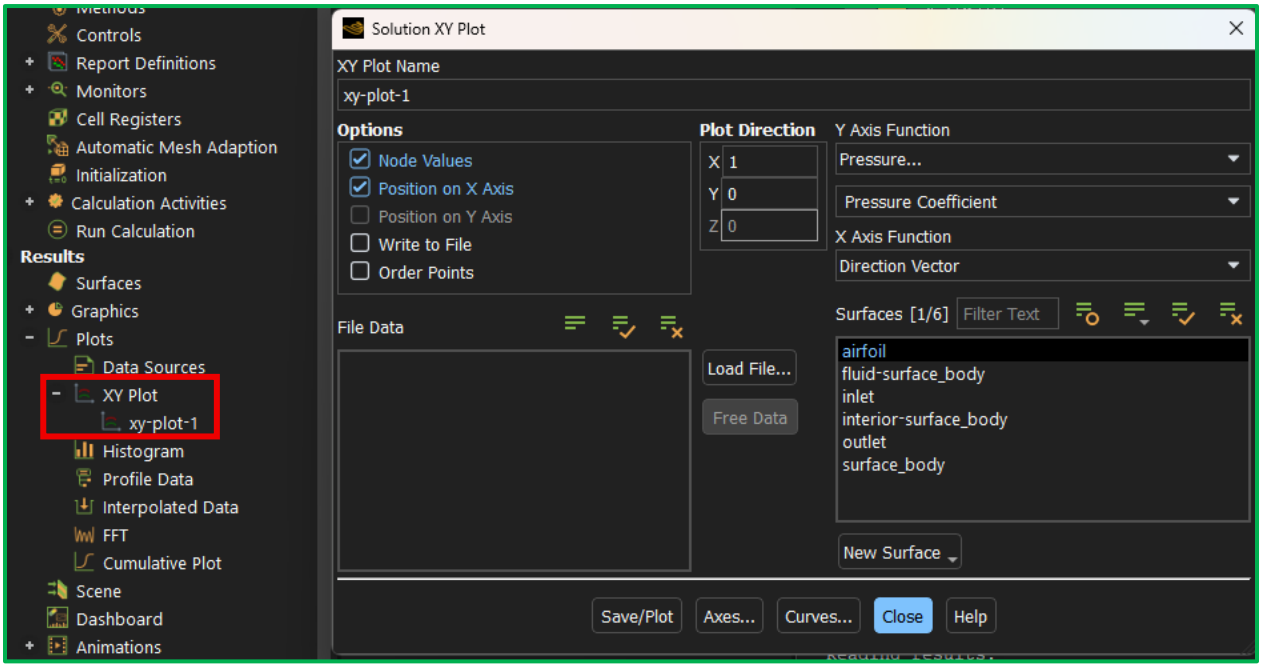
$$C_p = \frac{p - p_\infty}{\frac{1}{2}\rho_\infty V_\infty^2}$$

where:

- p is the static pressure at the point at which pressure coefficient is being evaluated
- p_∞ is the static pressure in the freestream (i.e. remote from any disturbance)
- ρ_∞ is the freestream fluid density (Air at sea level and 15 °C is 1.225 $\mathrm{kg/m^3}$)
- V_∞ is the freestream velocity of the fluid, or the velocity of the body through the fluid

Setup of the Pressure Coefficient Curve

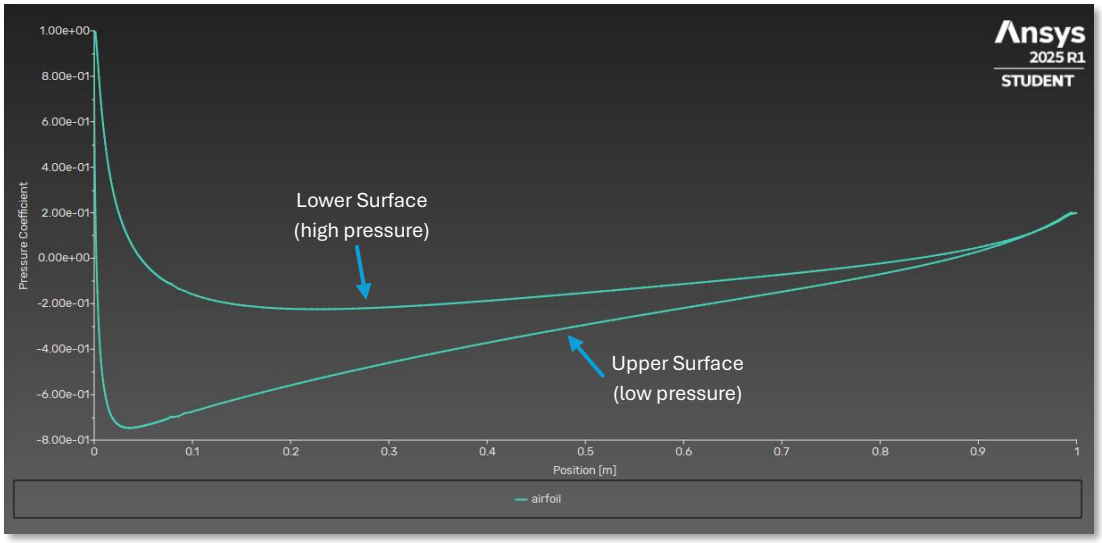
Once the simulation is done, stay in the same module and look for the following settings –



Right-click XY Plot, click New and set up the plot accordingly.

- Y-axis – Pressure Coefficient
- X-Axis – Chord length (m)
- Surface – Airfoil

Interpretation of the Pressure Coefficient Curve



Cp is equal (or almost) to 1 at position = 0 m

- The flow meets the airfoil head on, stagnation point

Cp recovering 0 towards downstream

- Pressure is being recovered at the trailing edge

Asymmetric Curves

- Lift is generated

Slope difference for top and bottom surface

- The higher the gap, the more lift will be generated

Pro tip – Separate top and bottom airfoil surface for a cleaner, robust plot. To do that, slice the airfoil in meshing (advanced)

Omar Saif
CFD Enthusiast
July 13, 2025