# BEACON Newsletter – January 2025

## Calculating Centre of Pressure in 3DEXPERIENCE Platform - FMK

In aerodynamics, understanding the forces acting on a body as it moves through a fluid is crucial for designing efficient and stable structures. One key metric in this analysis is the center of pressure (CoP), the point where the total sum of aerodynamic pressure forces acts on a body. This point is essential in determining the stability and control of vehicles such as aircraft, rockets, and even automobiles.

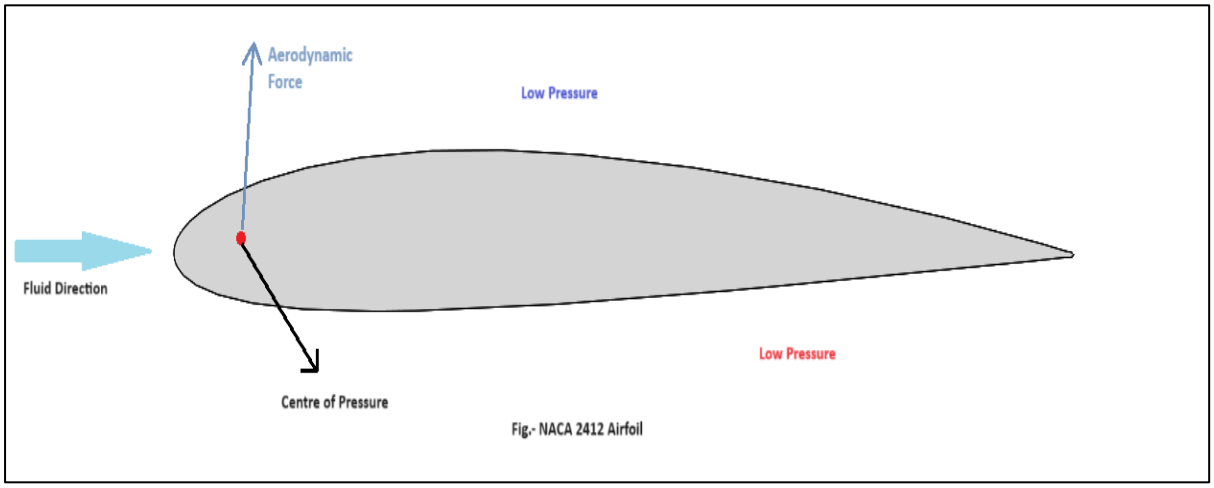


Fig.- NACA 2412 Airfoil

As an object moves through a fluid, the fluid's velocity changes along the object's surface, leading to variations in pressure at different points. These pressure differences generate an aerodynamic force on the object when integrated over the surface area. This force can be considered to act through the average location of these pressure variations, known as the Center of Pressure, like how the center of gravity represents the average location of an object's weight. The aerodynamic force can then be divided into lift and drag components, both of which act through the center of pressure during flight.

Determining the center of pressure is crucial for any flying object. To trim an airplane or ensure the stability of a model rocket or kite, it's essential to know the exact location of the center of pressure for the entire aircraft. But how do engineers identify the center of pressure when designing an aircraft?

In general, finding the center of pressure (cp) is a complex task because the pressure varies across the object. This process involves calculus and an understanding of the pressure distribution along the object's surface. The pressure variation can be

represented as a function p(x), where pressure depends on the distance x from a reference line, typically the leading edge of the object. Once the form of this function is known, engineers can use calculus integration methods to calculate the center of pressure.

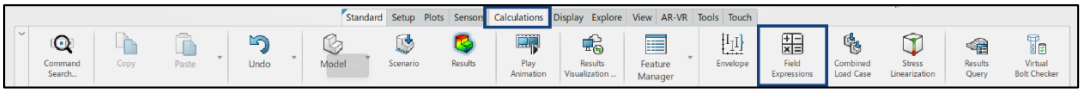
$$C_p = \frac{\int x.p(x)\,dx}{\int p(x)dx}$$

In this blog, we will guide you through the steps to calculate the center of pressure using the powerful simulation tools available on the 3DEXPERIENCE platform using Fluid Dynamics Engineer (FMK) role. Open Physics Results Explorer

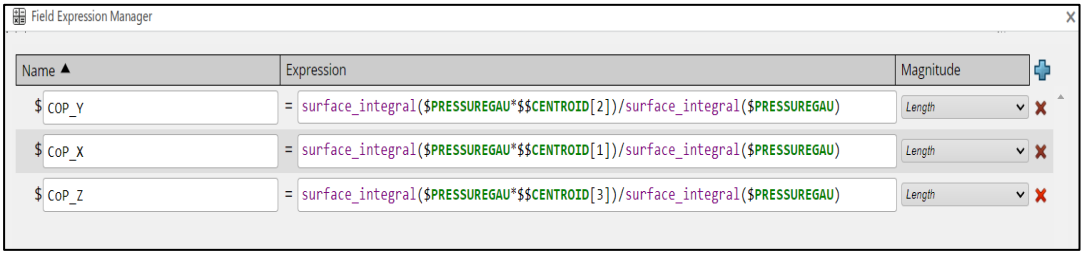
**Field Expressions**

Define each of the coordinates of Centre of Pressure in Field Expressions.

1. Load results
2. Go to **Calculations** from below task bar




3. Select **Field Expressions** and define the following parameters

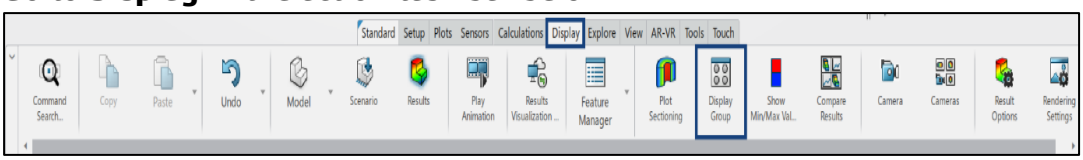



- surface_integral($PRESSUREGAU*$$CENTROID[1])/surface_integral($PRESSUREGAU)
- surface_integral($PRESSUREGAU*$$CENTROID[2])/surface_integral($PRESSUREGAU)
- surface_integral($PRESSUREGAU*$$CENTROID[3])/surface_integral($PRESSUREGAU)

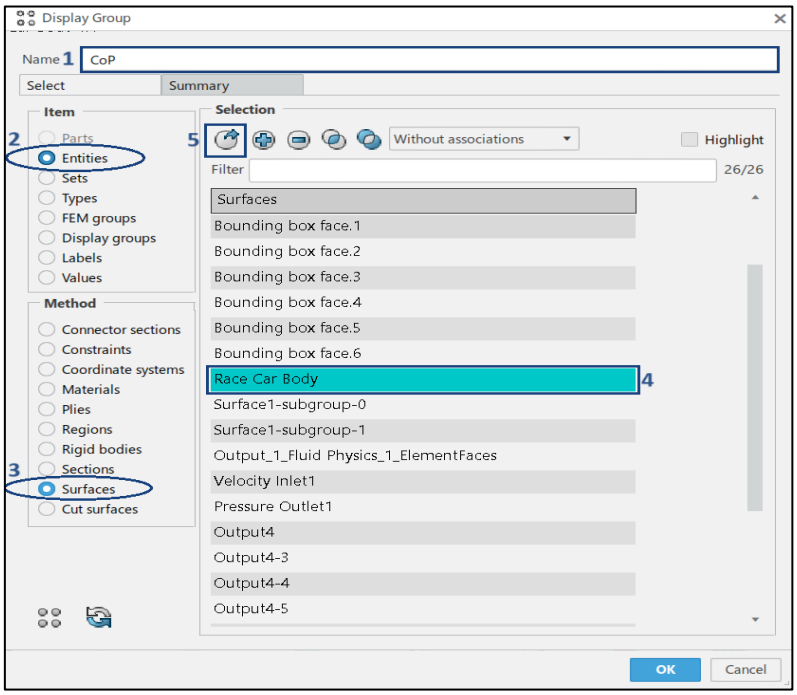
**Display group**

Create a display group containing the Race Car Surface.

1. Go to **Display** in the action task bar below



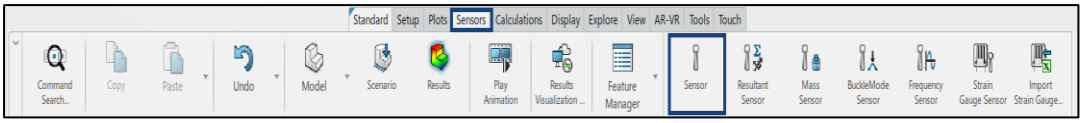
2. Click on **Display group**



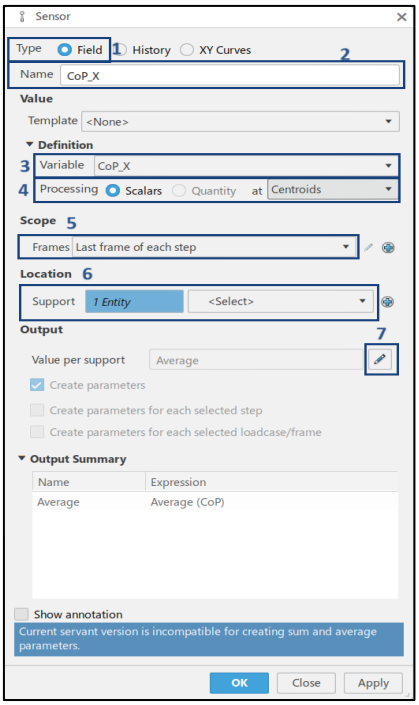

## Sensor

Create a sensor for each of the coordinates of Centre of Pressure

1. Click on **Sensors** from action bar and select **Sensor**




2. Define all the highlighted parameters and click apply





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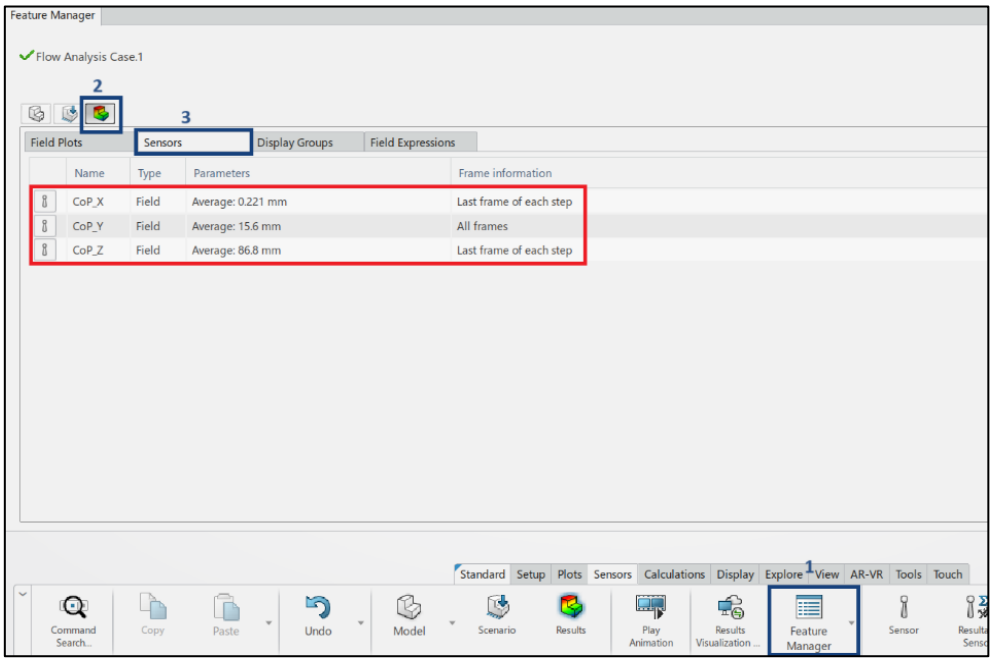
3. Click on **Feature Manager**, select **Sensors** to get plotted values

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