

16.2 Coordinate Systems and Definitions

Three airplane orthogonal axis systems are commonly in use. The body axis system was described in Chapter 7. The other two systems are:

Wind axis system (used for aircraft performance)

- Origin at the center of gravity
- X-axis pointing into the apparent wind
- Y-axis pointing horizontally to starboard
- Z-axis pointing down.

Stability axis system (used for stability and control analysis)

- Origin at the center of gravity
- X-axis pointing into the apparent wind in side elevation, and pointing along the aircraft axis of symmetry in plan view
- Y-axis pointing horizontally to starboard
- Z-axis pointing down.

For aerodynamic analysis, forces and moments may be referenced to the wing section quarter-chord for wing section data, or the quarter-chord of the mean aerodynamic chord (MAC) for wing data. This is usually very close to the section or wing aerodynamic center. It may also be used as the origin for airplane reference axes, because for an airplane with a conventionally-located horizontal stabilizer, the reference center of gravity is often located close to the wing quarter-chord.

In the stability axis system, the inconsistency in the way that the X-axis is defined between the horizontal and vertical planes (pointing into the apparent wind in side elevation, but attached to the airplane in plan view), results in a similar inconsistency in the sign of stable static stability derivatives. In pitch, C_{m_α} must be negative for a stable configuration, whereas in yaw C_{n_β} must be positive for stability.