

4.1 Influence of Dynamic Pressure

- ☐ If the static pressure on one side of a body is reduced more than the other side, a pressure differential will exist.
- ☐ Increased dynamic pressure (IAS) increases this pressure differential between the upper and lower surfaces of the wing, which increases the upward acting force (lift).

4.2 Influence of Angle of Attack (AOA)

- ☐ At a constant dynamic pressure (IAS), increasing the AOA (up to the critical angle, approx. 16°) increases the pressure differential and thus increases lift.
- ☐ The greatest positive (high) pressure occurs at the stagnation point, where the relative flow velocity is zero. As AOA increases, this point moves from the upper surface down around the leading edge to the lower surface.
- ☐ The greatest contribution to overall lift comes from the negative (low) pressure on the upper surface.

4.3 Centre of Pressure (CP) Movement

- ☐ As the AOA increases from 0° towards the stall, the point of lowest pressure on the upper surface moves forward.
- ☐ Consequently, the point where the total lift is effectively concentrated, the CP, also moves forward.
- ☐ The CP is at its most forward location just before the stall.

4.4 The Lift Formula and its Variables

- The total lift generated by a wing depends on several combined variables. The formula for lift is:

- $L = C_L \times \frac{1}{2}\rho v^2 \times S$
- Where:
- L = Lift force
- C_L = Coefficient of Lift (determined by AOA and aerofoil shape)
- $\frac{1}{2}\rho v^2$ = Dynamic Pressure (where ρ is air density and v is True Air Speed)
- S = Wing surface area
- To maintain constant lift (e.g., in level flight where Lift = Weight):
- $\square$ As altitude increases, air density (ρ) decreases. To keep lift constant, True Air Speed (v) must be increased. For example, at 40,000 ft, air density is about one-quarter of its sea level value, so TAS must be doubled to maintain the same lift.
- $\square$ As speed (v) is changed, the Angle of Attack (C_L) must be adjusted. If IAS is doubled, dynamic pressure increases by a factor of four. The AOA must be decreased so that C_L reduces to one-quarter of its initial value to keep lift constant.

4.5 The Lift Curve

- $\square$ A lift curve is a graph that plots the Coefficient of Lift (C_L) against the Angle of Attack (α).
- $\square$ C_L increases linearly with AOA up to a maximum value, known as $C_{L_{max}}$.
- $\square$ The AOA at which $C_{L_{max}}$ occurs is the critical or stalling angle of attack (around 16° for a typical aerofoil).
- $\square$ Beyond the critical angle, the airflow separates from the wing, C_L decreases rapidly, and the wing stalls.

4.6 The Lift/Drag Ratio (L/D Ratio)

- $\square$ The L/D ratio is a measure of the aerodynamic efficiency of the wing. A higher ratio means more efficient lift production.
- $\square$ The L/D ratio increases with AOA up to a maximum at the optimum angle of attack (about 4 degrees).

- ☐ Beyond this optimum AOA, the L/D ratio decreases.
- ☐ Flying at the AOA for L/D max provides the greatest gliding distance and maximum endurance. This AOA does not change with aircraft weight, but the IAS required to achieve it will. 97979797

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