



SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)



Department of Aerospace Engineering

23AST101-Fundamentals of Aerospace Engineering

UNIT-2:
AERODYNAMICS

DRAG TYPES

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In aerodynamics, drag is the force that opposes an object's motion through a fluid (such as air). It is a critical concept in the design and performance of vehicles, aircraft, and other objects moving through air. Drag can be categorized into several types based on its source and characteristics. Here are the main types of drag:

1. Parasitic Drag

Parasitic drag is caused by the movement of an object through a fluid and is not related to lift production. It is further divided into:

a. Form Drag (Pressure Drag)

Caused by the shape of the object moving through the fluid.

Results from the pressure difference between the front (high pressure) and rear (low pressure) of the object.

Streamlined shapes reduce form drag by minimizing turbulence and pressure differences.

b. Skin Friction Drag

Caused by the friction between the fluid and the surface of the object.

Depends on the surface roughness and the viscosity of the fluid.

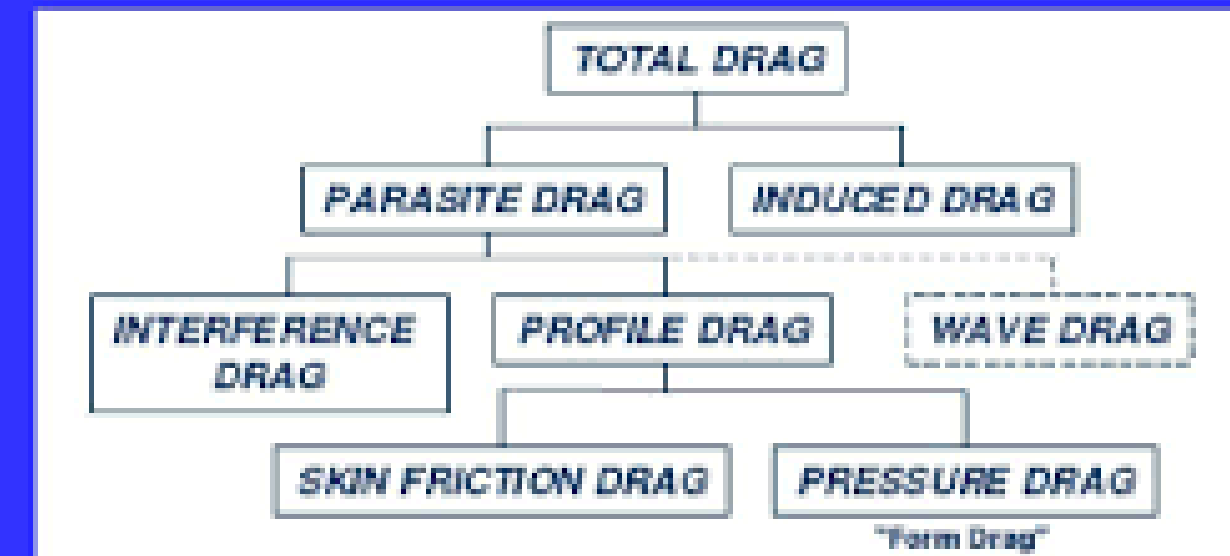
Smoother surfaces reduce skin friction drag.

c. Interference Drag

Occurs when two or more components of an object (e.g., wings and fuselage of an aircraft) interact, causing turbulent flow at their junctions.

Proper design and fairings can minimize interference drag.

TYPES OF DRAG





2. Induced Drag

- Associated with the generation of lift.
- Caused by the vortices created at the wingtips due to the pressure difference between the upper and lower surfaces of the wing.
- Increases with higher angles of attack and lower airspeeds.
- Can be reduced by using wingtip devices (e.g., winglets) or increasing the aspect ratio of the wing.

3. Wave Drag

- Occurs at transonic and supersonic speeds when shock waves form around the object.
- Caused by the energy lost in the formation of these shock waves.
- Significant in high-speed aircraft and missiles.

4. Profile Drag

- A combination of form drag and skin friction drag.
- Typically used to describe the drag of airfoils or wings in two-dimensional flow.

5. Cooling Drag

- Specific to vehicles or aircraft with internal combustion engines.
- Caused by the airflow required to cool the engine, which disrupts the streamlined flow around the object.

PARASITE VS INDUCED DRAG

	PARASITE DRAG	INDUCED DRAG
WEIGHT	UNAFFECTED	INCREASES WITH INCREASED WEIGHT
SPEED	INCREASES WITH INCREASED SPEED	DECREASES WITH INCREASED SPEED
ALTITUDE	DECREASES WITH INCREASED ALTITUDE	INCREASES WITH INCREASED ALTITUDE
ANGLE OF ATTACK	VARIABLE WHILE PROFILE DRAG REMAINS UNAFFECTED	INCREASES WITH INCREASED ANGLE OF ATTACK



6. Base Drag

- A type of form drag that occurs at the rear of an object due to the low-pressure region created by the separation of flow.
- Common in blunt or flat-backed objects.

7. Ram Drag

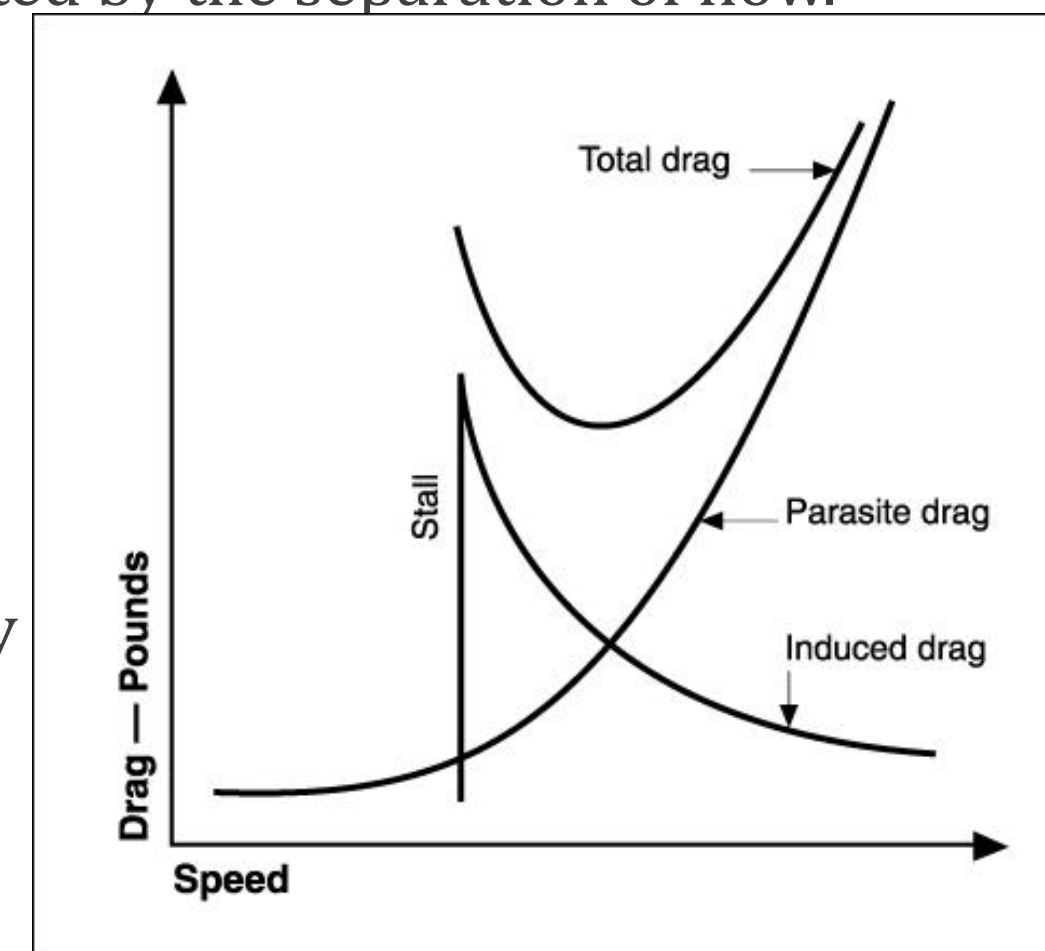
- Occurs in jet engines when incoming air is slowed down before entering the engine.
- Part of the overall thrust calculation for jet-powered aircraft.

8. Trim Drag

- Caused by the need to adjust control surfaces (e.g., elevators, rudders) to maintain stability and balance during flight.
- Increases when the aircraft is not optimally balanced.

9. Wave-Induced Drag (for Ships)

- Specific to ships and boats, caused by the formation of waves as the vessel moves through water.
- Not strictly aerodynamic but a related concept in fluid dynamics.





THANK YOU!