Aircraft Velocity and Runway Operations

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SYST 460
Takeoff

• Manuever from static condition to:
  – 1500 feet above field elevation
  – altitude at which transition to enroute configuration is completed
Runway Length Calculation

- Airplane must generate enough speed to produce Lift
- Acceleration takes place with limited length of runway
  - Need stopping distance if anything goes wrong
- Below V1 takeoff safely aborted
- Above V1, takeoff must continue
- Point A- B-C-H (last possible trajectory to stop on runway)
- Point A, engine failure and thrust spools down
- Point B crew recognizes problem and start stopping by retroading throttles
- Point C brakes are applied and spoilers deployed
- Point H, aircraft comes to complete stop
- Point D, no engine failures results in liftoff speed
- Point E, all engines, aircraft reaches safe speed $V_2$
- Point F, engine failure occurs beyond Point A, making it impossible to stop aircraft on remaining runway
- Point G, aircraft operating with one engine reaches safe speed $V_2$ at 35 ft.

Balanced Field Condition (BFC) : distance required to stop after engine failure = distance travelled to reach $V_2$ at 35ft.
Takeoff Speed Profile

- $V_1$ – airspeed beyond which no stopping action be initiated: Decision speed
- $V_R$ – airspeed at which rotation is initiated during takeoff to obtain $V_2$
- $V_{MU}$ – minimum unstick speed = airspeed at which aircraft can be made to lift-off and continue to perform takeoff
- $V_{LOF}$ – airspeed when aircraft becomes airborne
- $V_S$ – stall speed of airplane
- $V_2$ – target airspeed for 35 feet above runway elevation to achieve climb gradient for airborne takeoff
- $V_1 < V_R$
- $1.1 V_{MU} < V_{LOF}$
- $1.2 V_S < V_2$