V_{LOF}: Lift off speed

- Short runways **higher flaps** to take-off faster **lower V_{LOF}** but lowers **climb performance**
- Distant obstacles **lower flaps** higher **V_{LOF},** higher **ground roll distance**
- **Higher with increased mass**

V_{MCG}:

- Min control speed on the ground
- **No nose-wheel steering & no crosswind** used for determination
- Determined by **engine thrust & rudder deflection**
- Determined by **primary aerodynamic control only**
- $V_{MCG} < V_{EF} < V_1$

V_1:

- Pilot decides to **abort take-off AT** V_1 (At the last resort)
- Limited by $V_{MCG,}$ V_R & V_{MBE}
- Min value V_{MCG}, max value V_R
- Must not be exceeded by V_{MBE}
- **Can** be **higher** than V_{MU}
- Value exceeds correct V_1 value = ASD will exceed the ASDA
- V_1 increase but V_R the same = Increased **ASD**
- Higher value used with constant mass: TODR decrease & ASDR increase
- Reduced by **inoperative anti-skid** (Because you are braking manually you need a lower decision speed)
- OEI obstacle clearance reduces because of **contaminated runway**, but **climb performance remains constant**
- **Increased with mass (Because higher mass requires more lift = more speed)**
- **Down slope <u>decreases V_1</u>**

V_R:

- Speed at which **pilot should start** to **rotate** the aeroplane
- If aircraft rotates earlier: Stabilizer trim setting miscalculated, centre of gravity too far aft (Miscalculated V_R does **not cause** early rotation, it is just a calculated value)
- Speed to which rotation to the lift off angle is initiated
- Must not be less than $1.05V_{MCA}$ or V_1

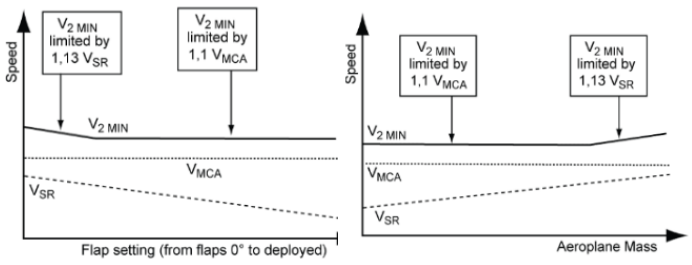
V_{EF}: 2 seconds are for **recognition**

V_{MBE} (Max brake energy):

- Must not be exceeded by V_1
- If TOM is V_{MBE} limited on **uphill** requires less brake energy thus allows an **increased mass** (A good thing)

V_2:

- Take-off safety speed/**take off climb speed** or **speed at 35ft**
- May not be less than **1.13 V_{SR}** for **turbojets**
- May not be less than **1.08 V_{SR}** for **turboprops**
- May not be less than **1.10 V_{MCA}**
- **Limited by V_{MCA}**: Large flap angles, high air pressure & low aircraft weight (What is good for thrust also increases adverse yaw OEI)
- **Decreases with higher flaps**
- **Increased V_2 procedure(Improved take-off climb/climb performance procedure):**
  - Only possible when **an excess field length** is available **(ASD is not limiting)**
  - Further screen height along runway
  - Increases **TODR & climb gradient** for a given TOM
- V_{2MIN}:
  - Decrease with higher flaps if not limited by V_{MCA}
  - Uses V_{SR} & V_{MCA}



V speeds affected by:

- Mass: Lower mass, lower speeds
- Density altitude: Density altitude increase, thrust decrease, lower V_{MCA} to counteract yaw OEI
- Low field elevation = lower speeds
- Flap settings: Higher flaps = decreased stall speed