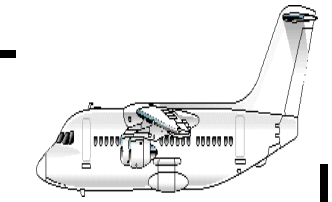
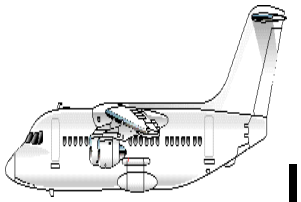


# Aircraft Classifications

Dr. Antonio A. Trani
Associate Professor
Department of Civil Engineering

Virginia Tech

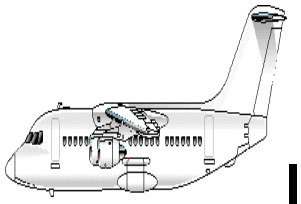
# FAA Airport Design Group Classification



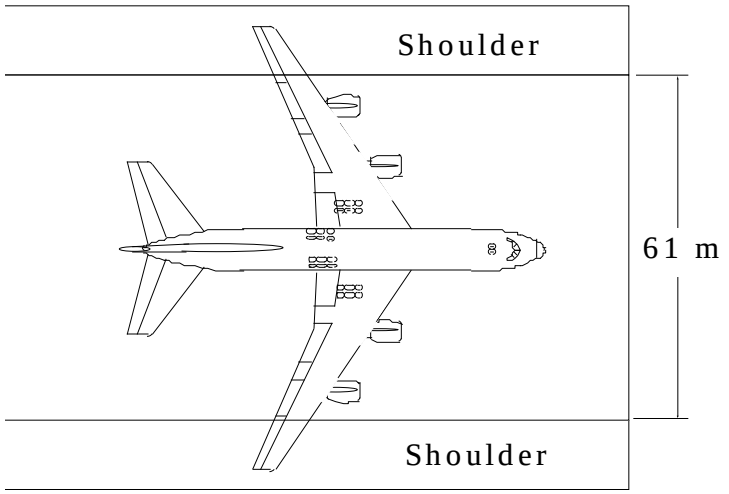
**FAA Aircraft Design Group Classification Used in Airport Geometric Design.**

| Design Group | Wingspan (ft) | Example Aircraft |
|---|---|---|
| I | < 49 | Cessna 152-210, Beechcraft A36 |
| II | 49 - 78 | Saab 2000, EMB-120, Saab 340, Canadair RJ-100 |
| III | 79 - 117 | Boeing 737, MD-80, Airbus A-320 |
| IV | 118 - 170 | Boeing 757, Boeing 767, Airbus A-300 |
| V | 171 - 213 | Boeing 747, Boeing 777, MD-11, Airbus A-340 |
| VI | 214 - 262 | A3XX-200 or VLCA (planned) |

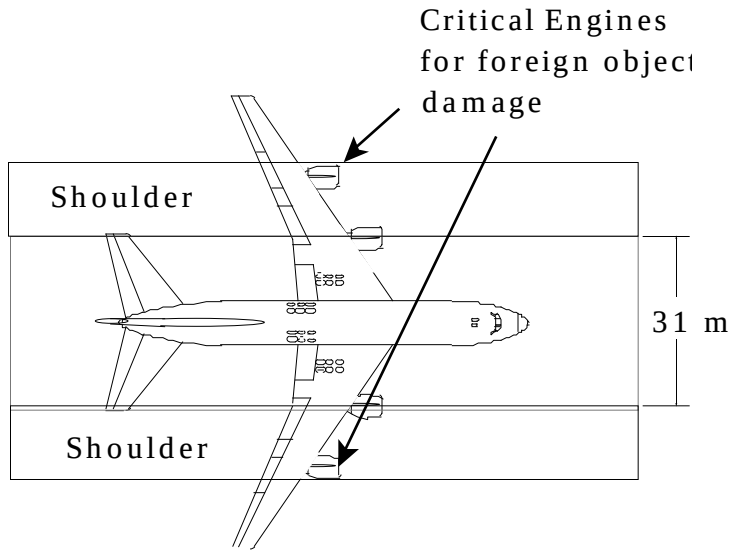
# Sample Use of FAA Design Criteria



FAA design group criteria is useful to size runways, taxiways, apron areas, and protection areas around the landing area.

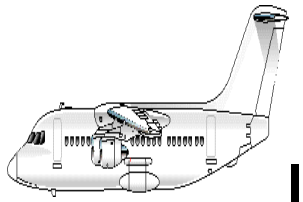



VLCA on Design Group VI Runway



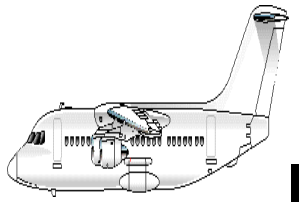

VLCA on Design Group VI Taxiway

# ICAO Airport Design Group Classification



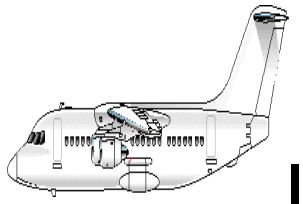
| Design Group | Wingspan (m) | Gear Width (m) | Example Aircraft |
|---|---|---|---|
| A | < 15 | < 4.5 | All single engine aircraft, Some business jets |
| B | 15 to < 24 | 4.5 to < 6 | Commuter aircraft, Large Business jets<br>(EMB-120, Saab 2000, Saab 340, etc.) |
| C | 24 to < 36 | 6 to < 9 | Medium range transports<br>(B727, B737, MD-80, A320) |
| D | 36 to < 52 | 9 to < 14 | Heavy transports<br>(B757, B767, A300) |
| E | 52 to < 65 | 9 to < 14 | Heavy transport aircraft<br>(Boeing 747, L-1011, MD-11, DC-10) |

# ATC Approach Speed Classification



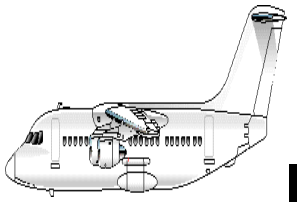
| Group | Approach Speed (knots) | Example Aircraft |
|---|---|---|
| A | < 91 | All single engine aircraft, Beech-craft Baron 58, |
| B | 91-120 | Business jets and commuter aircraft (Beech 1900, Saab 2000, Saab 340, Embraer 120) |
| C | 121-140 | Med. and Short Range Transports (Boeing 727, B737, MD-80, A320, F100, B757, etc.) |
| D | 141-165 | Heavy transports (Boeing 747, L-1011, MD-11, DC-10, A340, A300) |
| E | > 166 | BAC Concorde and military aircraft |

# Aircraft Wake Vortex Classification

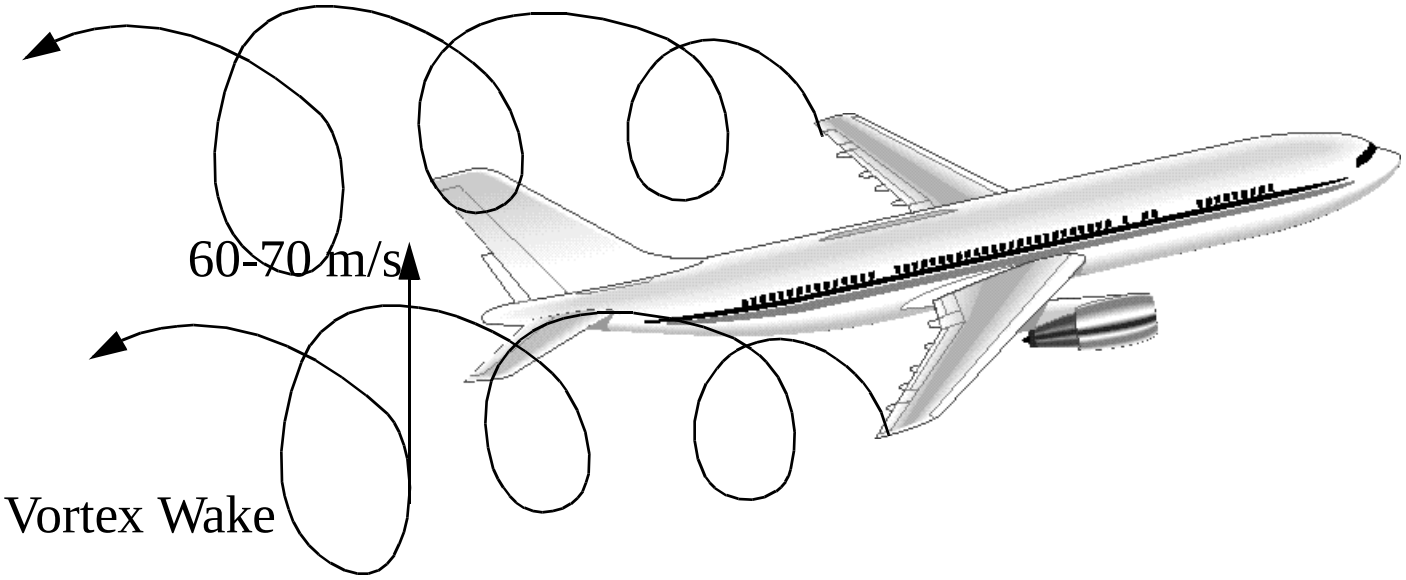


| Group | Takeoff Gross Weight (lb) | Example Aircraft |
|---|---|---|
| Small | < 41,000 | All single engine aircraft, light twins, most business jets and commuter aircraft |
| Large | 41,000-255,000 | Large turboprop commuters, short and medium range transport aircraft (MD-80, B737, B727, A320, F100, etc.) |
| Heavy | > 255,000 | Boeing 757, Boeing 747, Douglas DC-10, MD-11, Airbus A-300, Airbus A-340, Lockheed L-1011 |

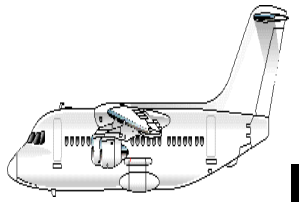
# The Wake Vortex Phenomena



- Resulting from the generation of lift around a three dimensional wing
- Wake vortex tangential speeds can reach up to 70 m/s (beyond the FAR Part 25 certification criteria of commercial aircraft)

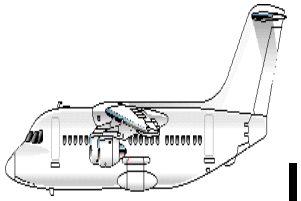


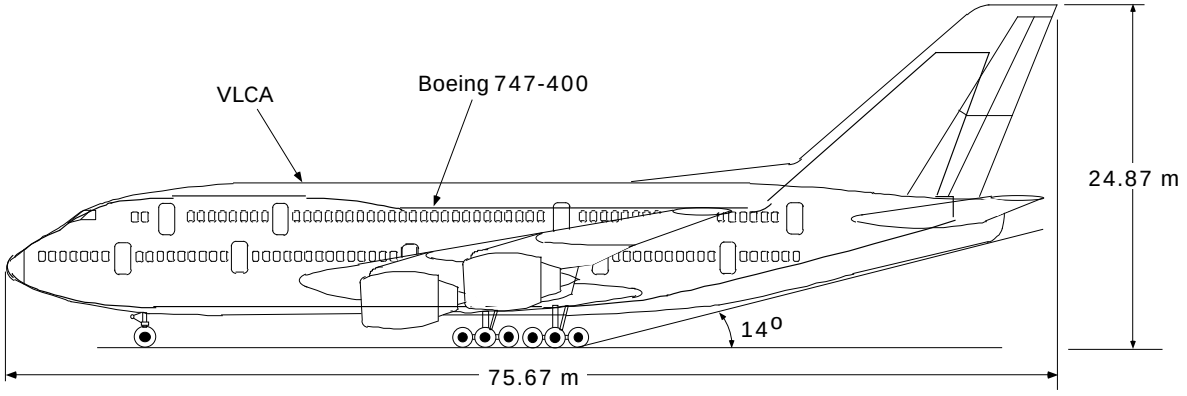
# Typical VLCA Aircraft Specifications



| Parameter | Remarks |
|---|---|
| Passenger Capacity | 650 passengers in a three-class layout plus crew |
| Desired Range | 13,000 Kilometers with 1.50 hour reserve |
| Speed | Mach 0.85 at 11.0 km |
| Runway Length | Use of conventional runways (i.e., 3,300 m at MTOW and Sea Level ISA) |

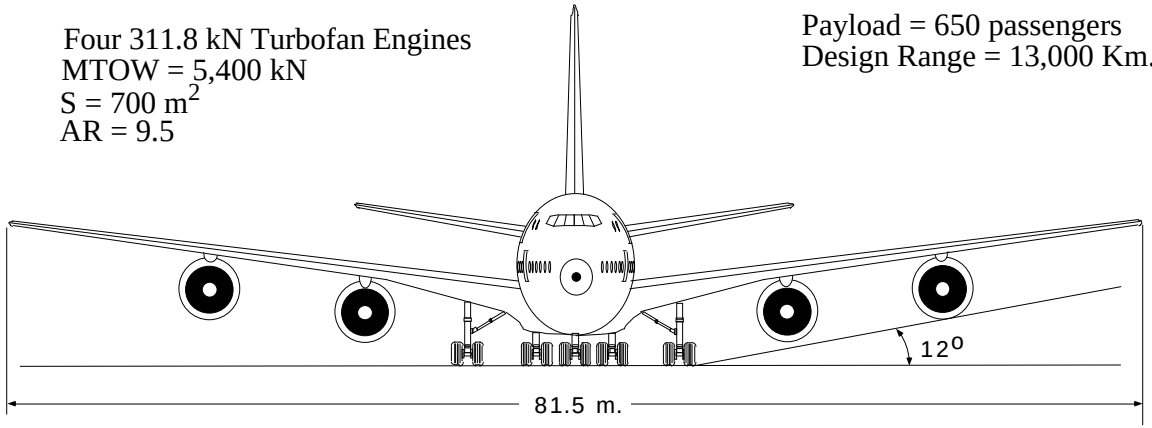
# VLCA Aircraft



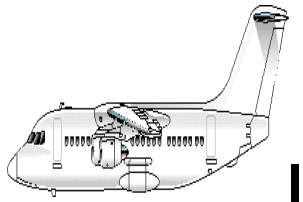



Four 311.8 kN Turbofan Engines
MTOW = 5,400 kN
S = 700 $m^2$
AR = 9.5

Payload = 650 passengers
Design Range = 13,000 Km.



# Wake Vortex Equations



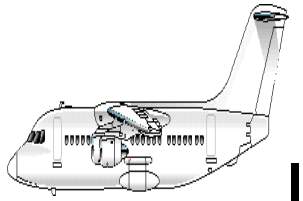
$$\Gamma = \frac{4mg}{\pi \rho V b}$$

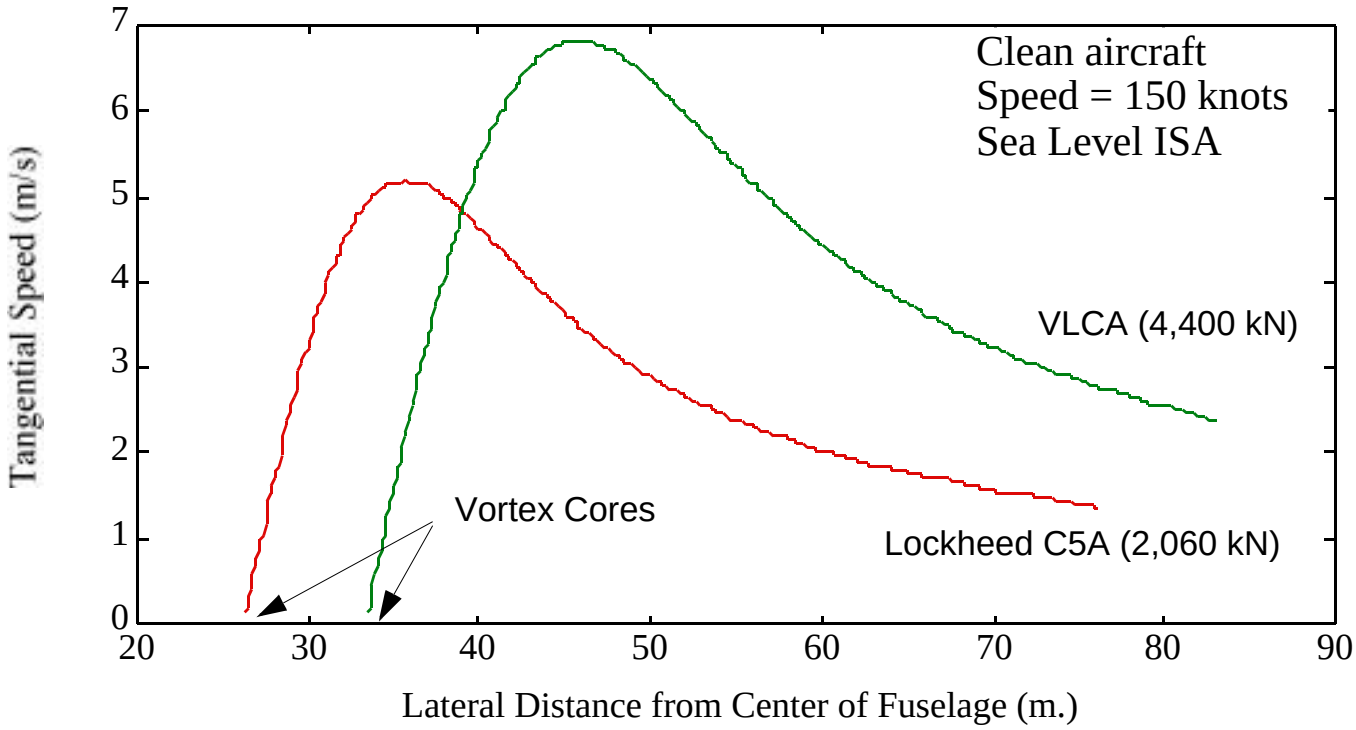
where, $\Gamma$ is the vortex circulation (in $m^2/s$), $mg$ is the gross weight of the wake generating aircraft (N.), $\rho$ is the air density ($kg/m^3$), $V$ is the true airspeed (m/s), and $b$ is the aircraft wingspan (m).

$$V_t = \frac{\Gamma}{2\pi y}\left[1 - e^{\frac{-y^2}{4\varepsilon t}}\right]$$

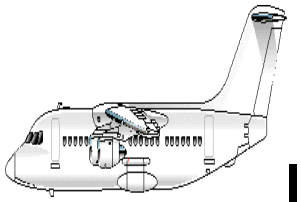
where, $V_t$ is the tangential velocity right or left from vortex core (m./sec.), $y$ is the spanwise coordinate measured from the vortex core location, $\varepsilon$ is the vortex decay value which has been found to be dependent upon the strength of the circulation, and $t$ is the time behind the wake generating aircraft (in seconds).

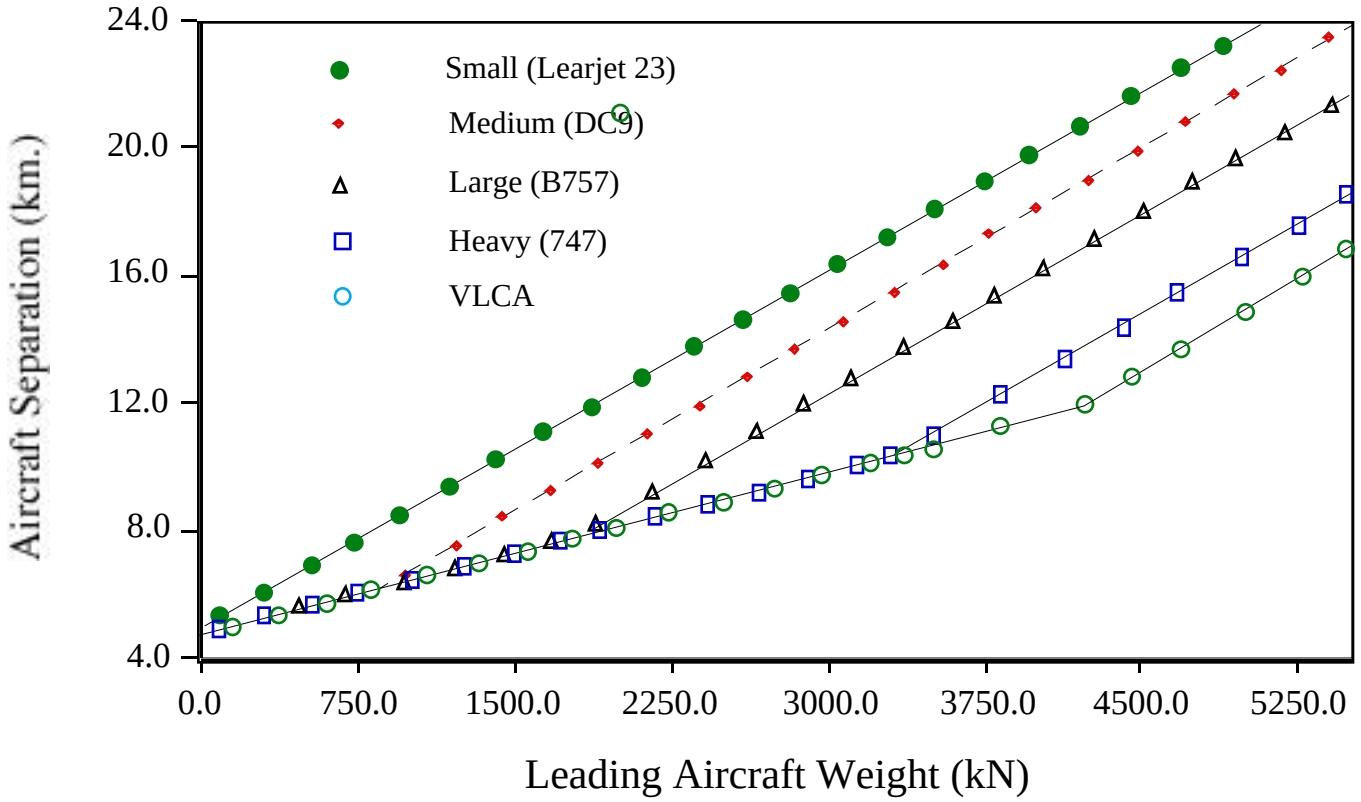
# Tangential Velocity Profiles



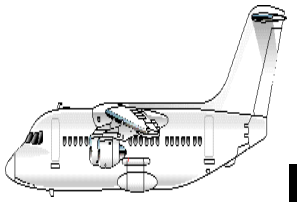


# Projected Separation Criteria

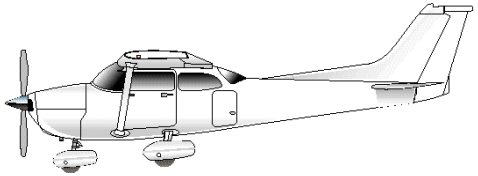




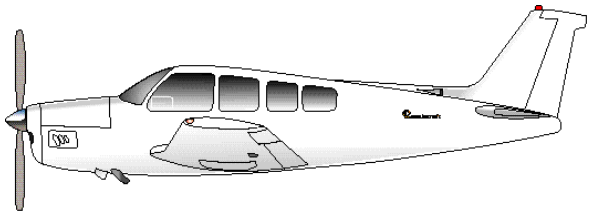
# Small Aircraft



**Single-Engine GA**

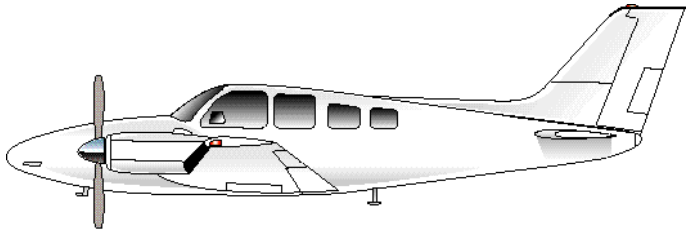


Cessna 172 (Skyhawk)

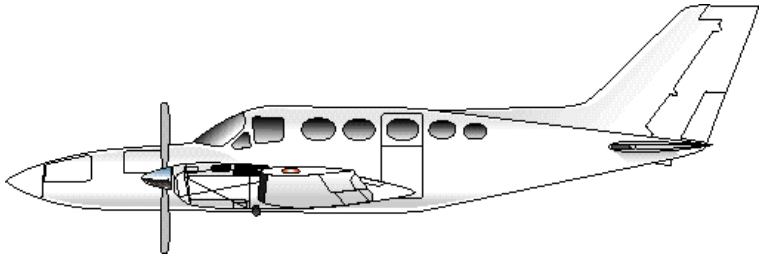


Beechcraft A36 (Bonanza)

**Twin-Engine GA**



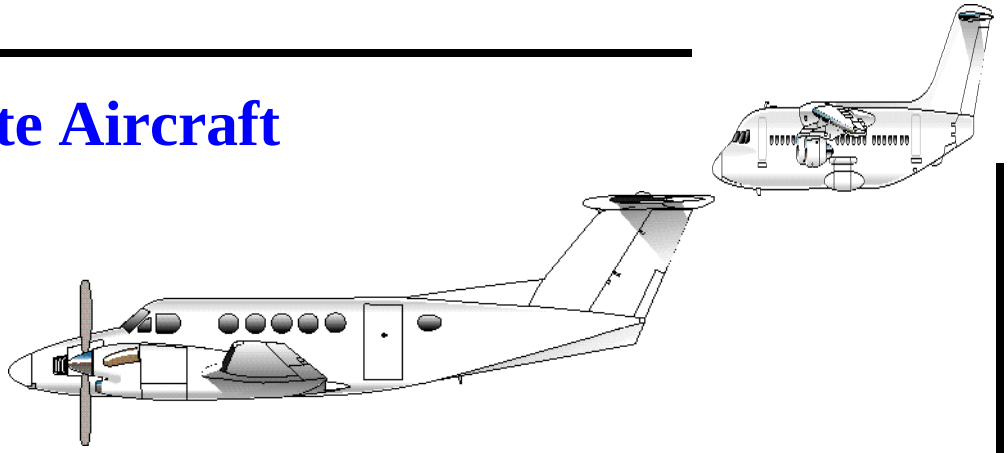
Beechcraft 58TC (Baron)

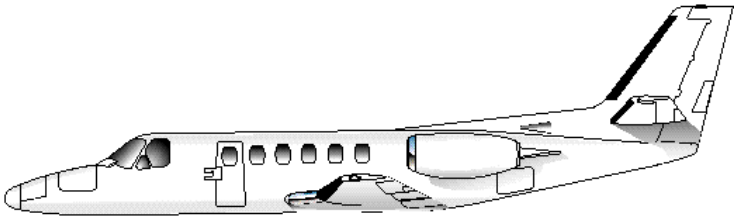


Cessna 421C (Golden Eagle)

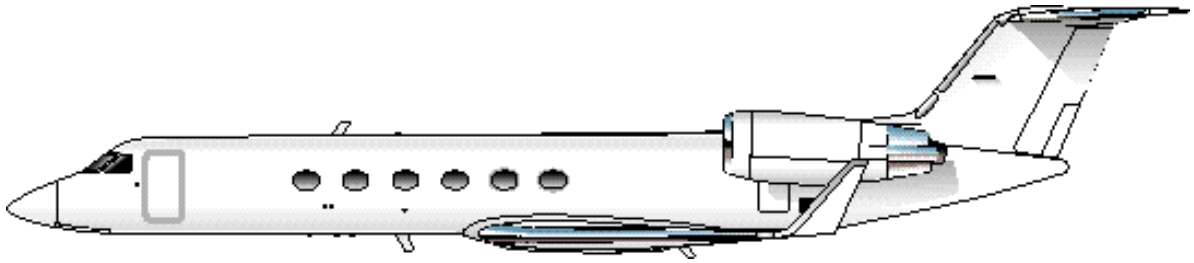
# Corporate Aircraft

Raytheon-Beechcraft King Air B300



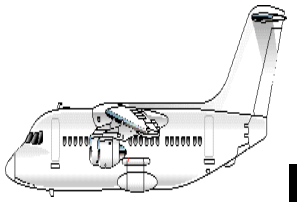


Cessna Citation II

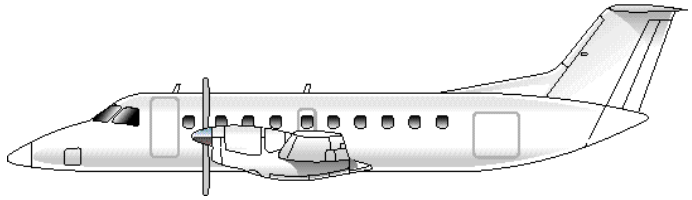


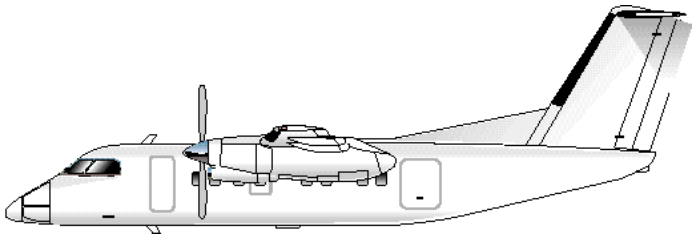
Gulfstream G V

# Commuter Aircraft



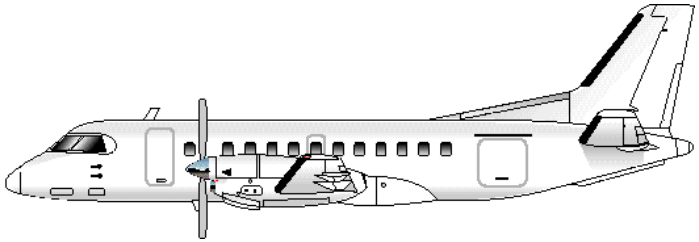
Embraer 120(Brasilia)





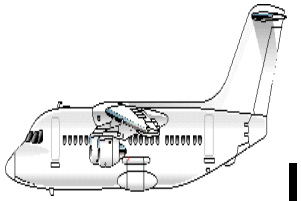
Bombardier DHC-8 (Dash 8)

Saab 230B



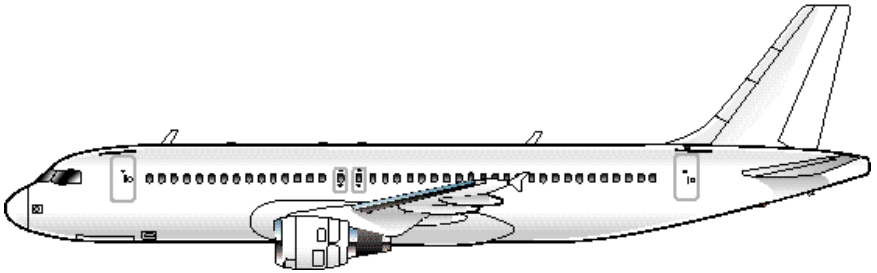
Bombardier Regional Jet

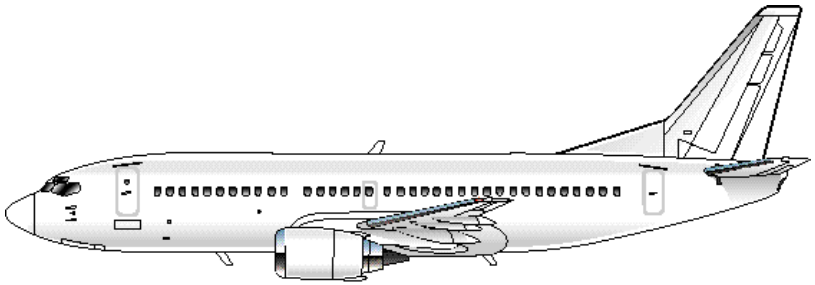
# Short-Haul Transport Aircraft



Fokker F100

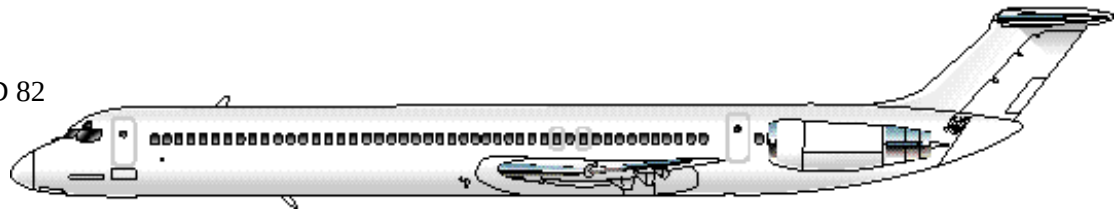
Airbus A-320



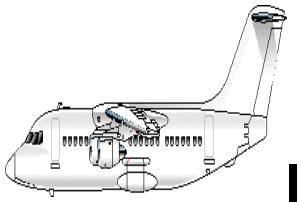


Boeing 737-300

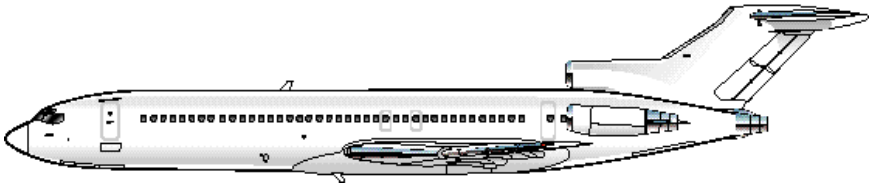
McDonnell-
Douglas MD 82

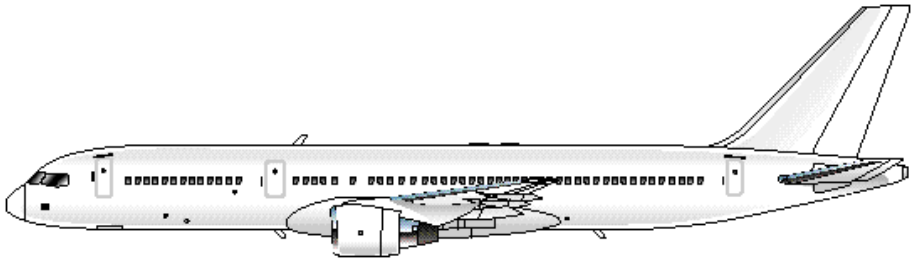


# Medium-Haul Transport Aircraft



Beoing B727-200

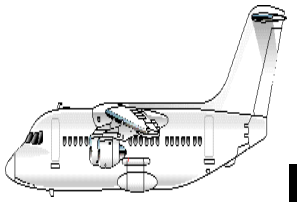




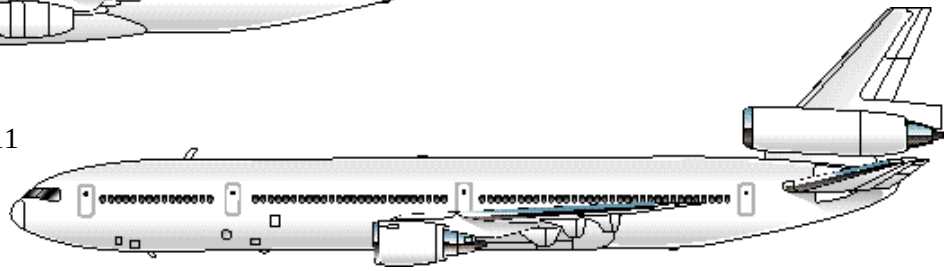
Boeing 757-200

Airbus A300-600R

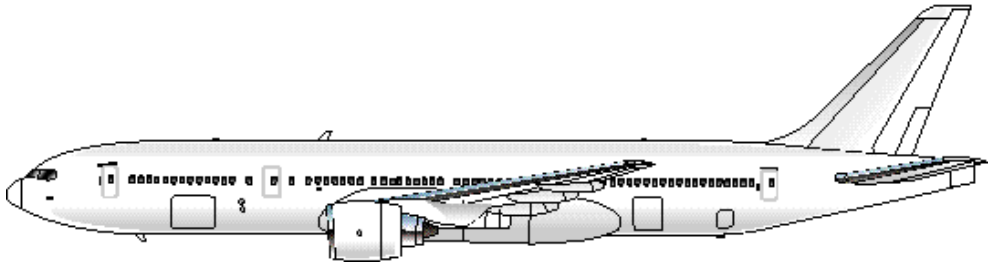
# Long-Haul Transport Aircraft



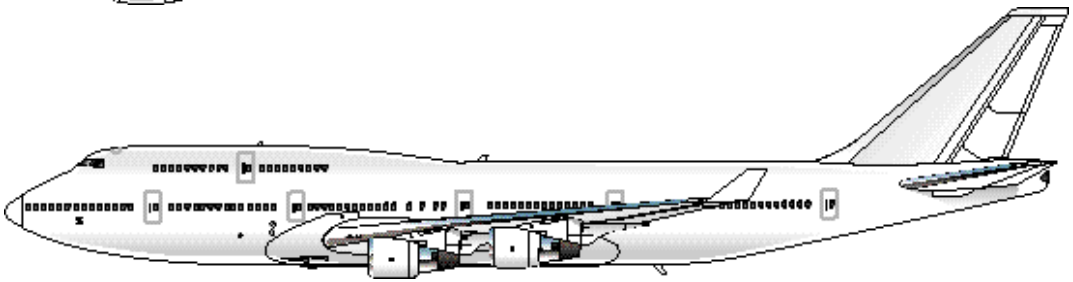
Airbus A340-200



McDonnell-Douglas MD-11



Boeing 777-200



Boeing 747-400