

Introduction to aeronautics

Part 3. The era of the mature, propeller driven airplanes

3.6 The high lift devices

- **As the maximum speed of aircraft increased, there was the demand for high lift devices**

For efficient high speed flight, smaller wing area is preferred

To improve take off and landing performance, high lift is requested



High lift devices, i.e FLAP

To improve aerial combat performance, high lift is desired

3.6 The high lift devices

- As the maximum speed of aircraft increased, there was the demand for high lift devices

The principle of FLAP

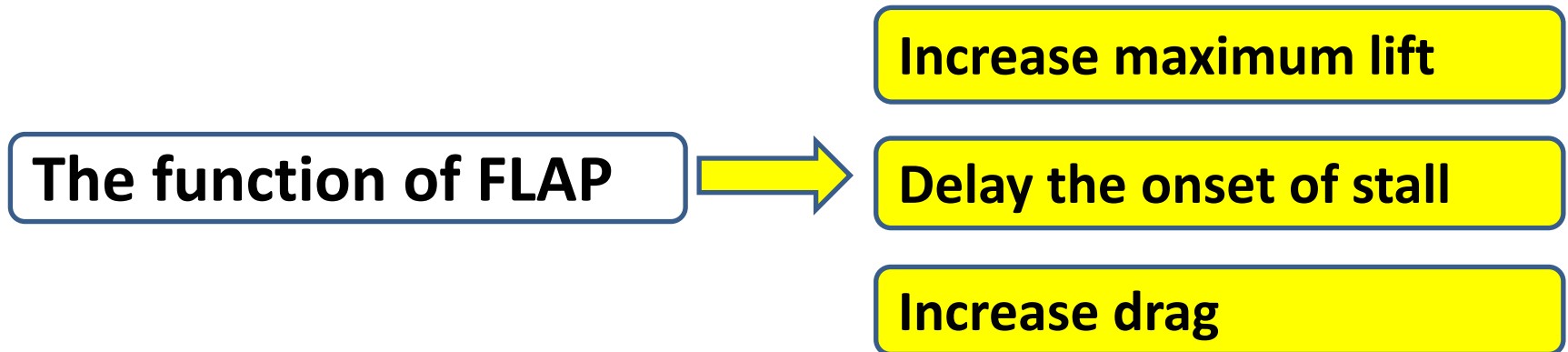


Increase the camber of wing

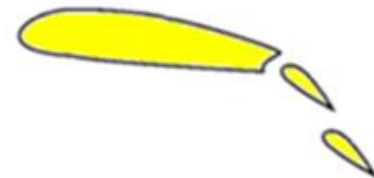
Increase the wing area

3.6 The high lift devices

- As the maximum speed of aircraft increased, there was the demand for high lift devices



3.6 The high lift devices



Double sloted flap



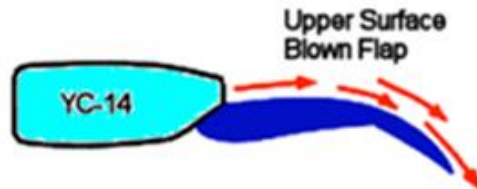
Slotted leading edge flap



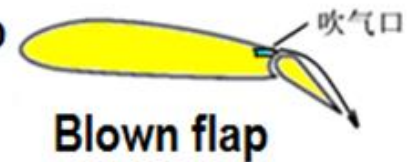
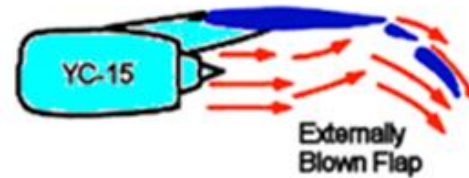
Leading edge flap



Leading edge slot



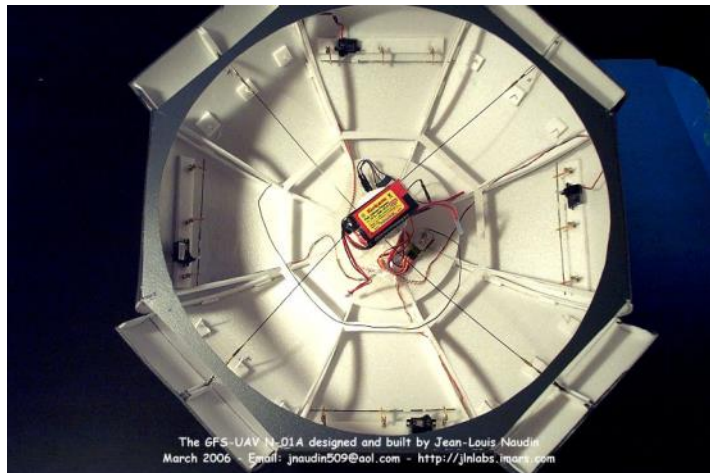
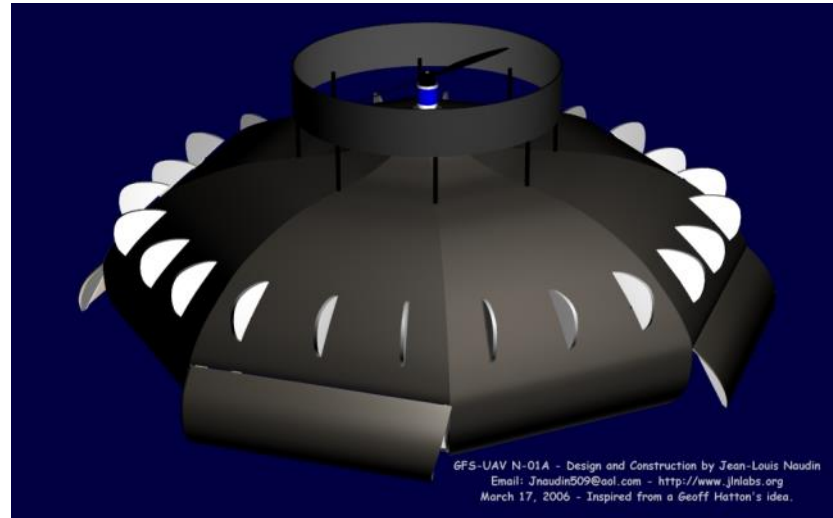
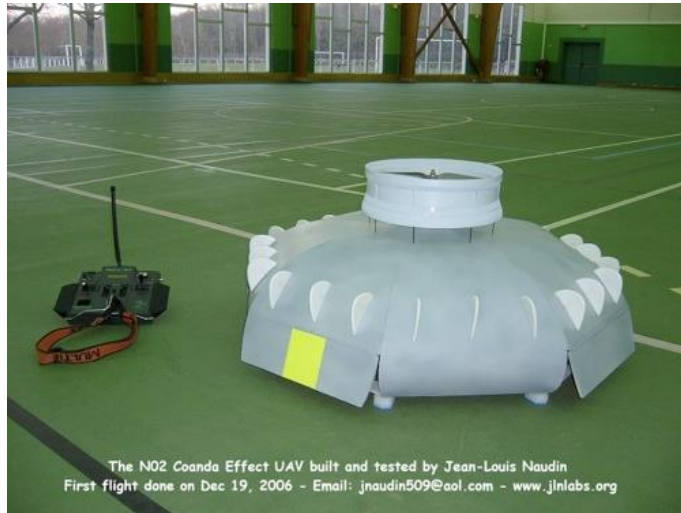
Junker flap



Coanda Effect

3.6 The high lift devices

- The flying soccer using Coanda effect



3.6 The high lift devices



3.6 How to slow down the aircraft

- Spoilers (also known as “Air brake”)
 - Slow down the aircraft with drag force



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3.6 How to slow down the aircraft

- Brake parachute/Drag parachute



3.6 How to slow down the aircraft

- Propeller reversing



3.6 How to slow down the aircraft

- Arresting cable



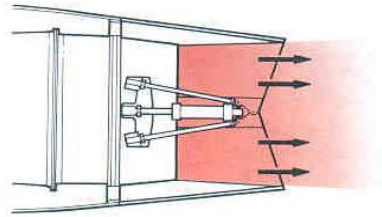
3.6 How to slow down the aircraft

- Arresting barrier

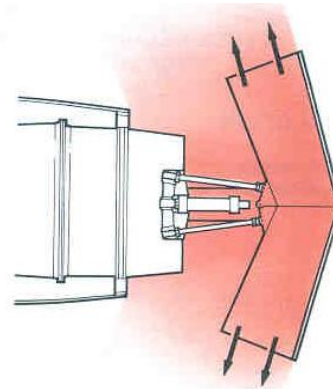


3.6 How to slow down the aircraft

- Thrust reverser (for jet engines)



ACTUATOR EXTENDED AND BUCKET DOORS IN FORWARD THRUST POSITION



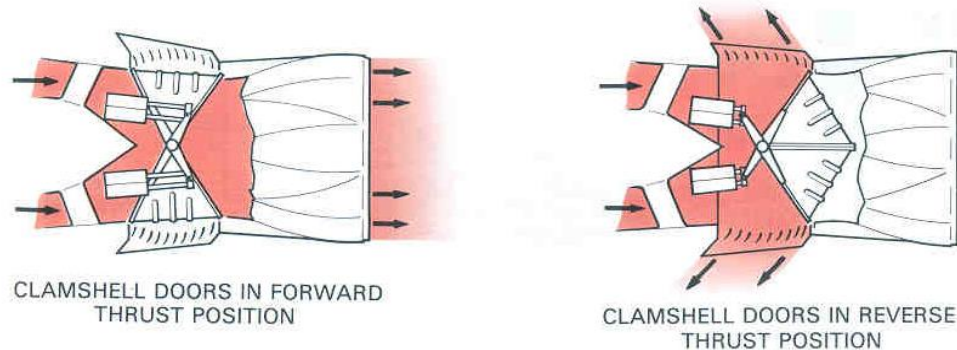
ACTUATOR AND BUCKET DOORS IN REVERSE THRUST POSITION



Clamshell-type thrust reverser

3.6 How to slow down the aircraft

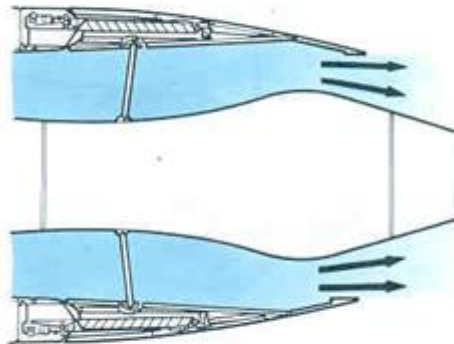
- Thrust reverser (for jet engines)



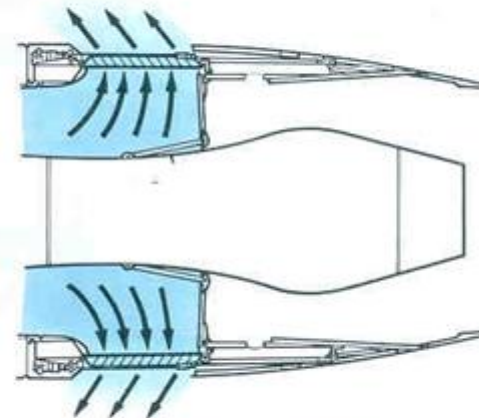
Clamshell-type thrust reverser

3.6 How to slow down the aircraft

- Thrust reverser (for jet engines)



COLD STREAM REVERSER IN FORWARD THRUST POSITION



COLD STREAM REVERSER IN REVERSE THRUST POSITION

Cascade-type thrust reverser

3.6 How to slow down the aircraft

- Thrust reverser (for jet engines)



Cascade-type thrust reverser

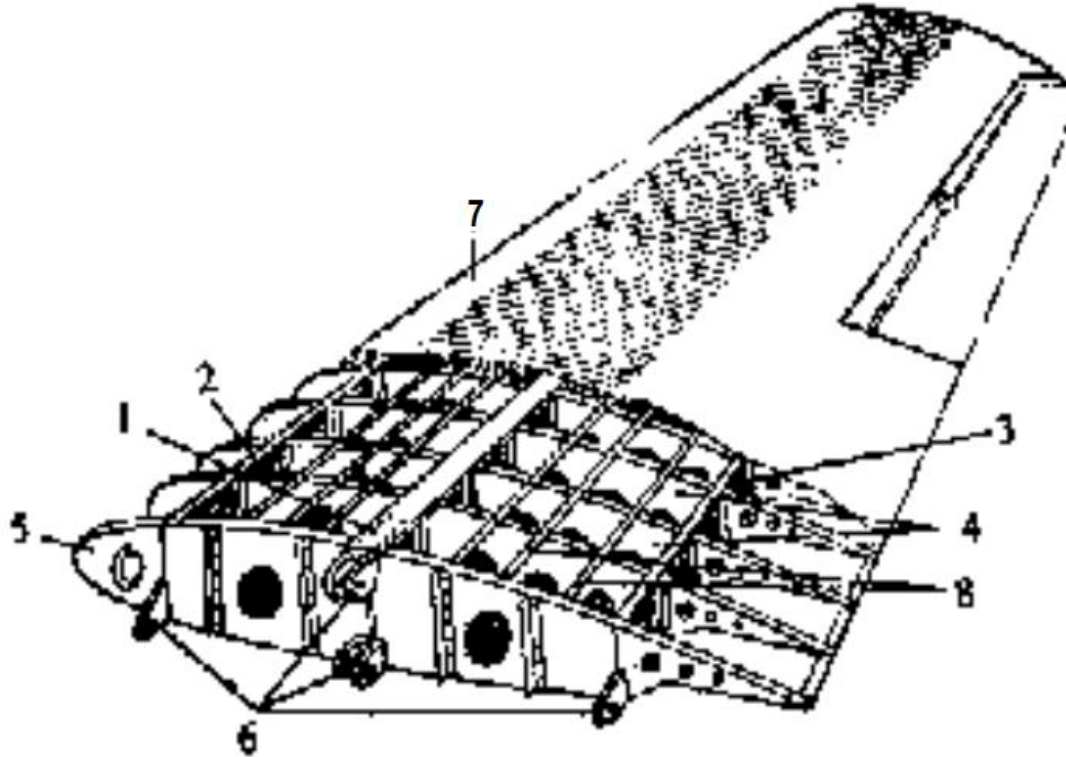
3.6 How to slow down the aircraft

The braking system:

- As the landing speed of aircraft increased, it is more difficult to slow down the aircraft
- ABS (Anti-lock braking system) can avoid wheels sliding on the runway



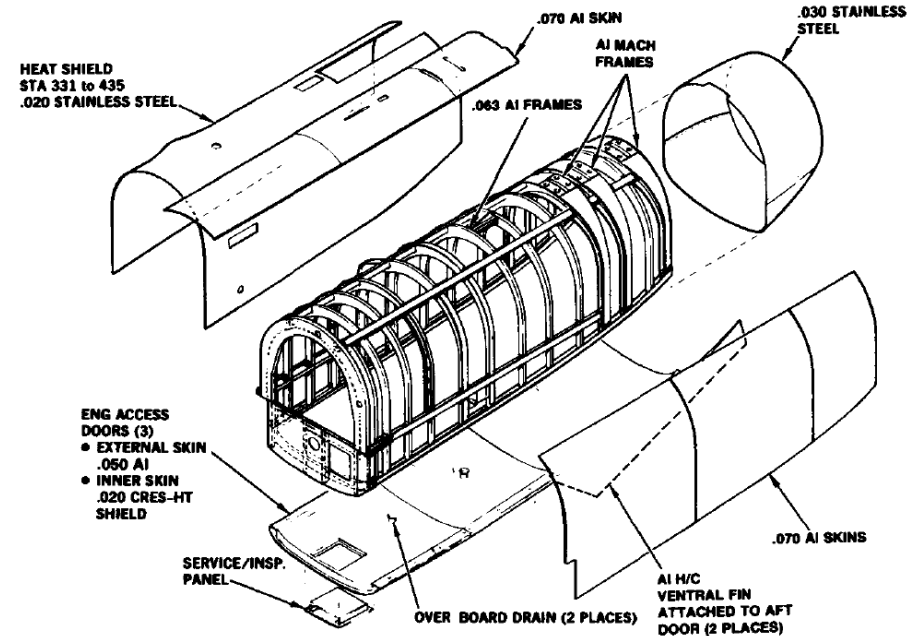
3.6 The airframe for low speed aircraft



1. Wing spar; 2. Front web; 3. Rear web; 4. Rib; 5. Reinforced rib;
6. Wing root joint; 7. Aluminum skin; 8. Stringer;

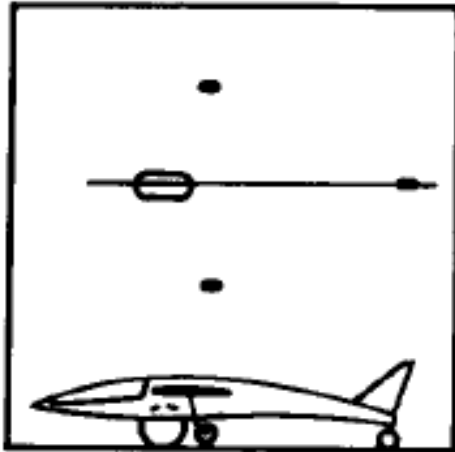
Wing structure

3.6 The airframe for low speed aircraft

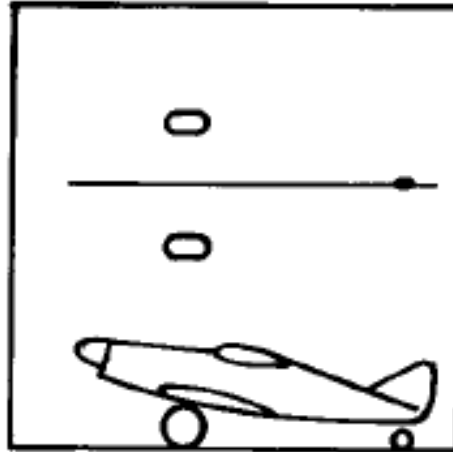


Fuselage structure

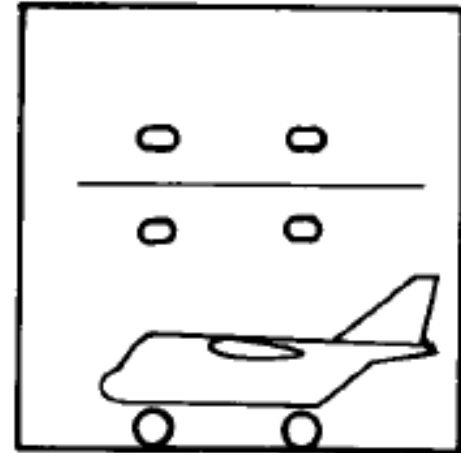
3.7 The landing gears



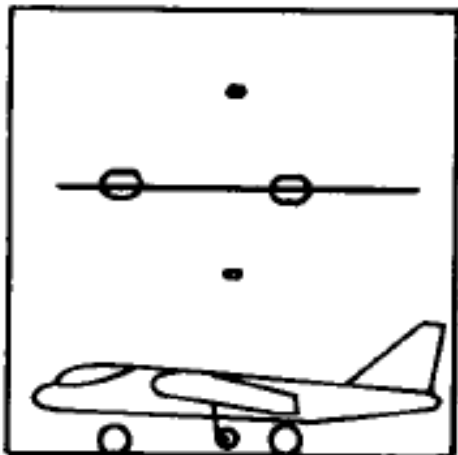
SINGLE MAIN



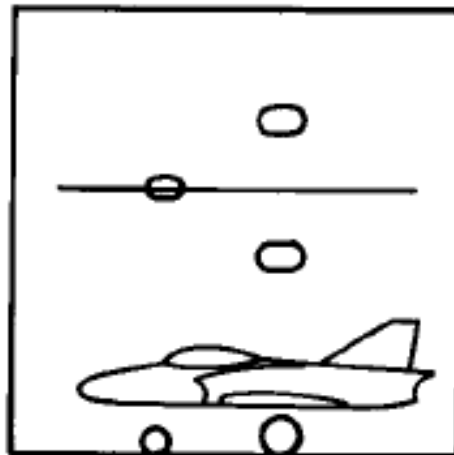
TAILDRAGGER



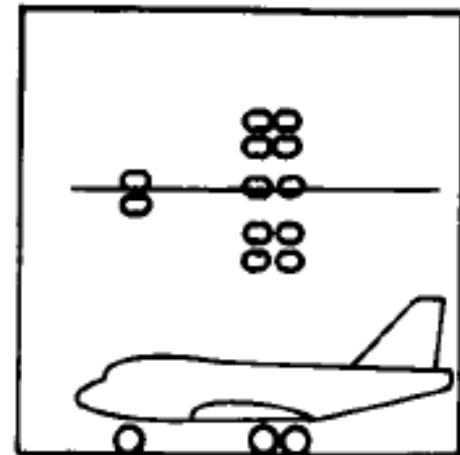
QUADRICYCLE



BICYCLE



TRICYCLE



MULTI-BOGEY

3.7 The landing gears

- **Tail dragger**
 - The main gear locates in front of C.G, offers good ground clearance for propellers
 - Simple and light weight



3.7 The landing gears

Disadvantage of the tail draggers:

- More susceptible to Ground looping
- More subject to “Nose over” accidents
- Poor forward visibility
- During takeoff run, pilot needs to push the stick then pull the stick
- Floor is tilted, very uncomfortable for passenger plane
- Bump landing is expected if landing speed is too high

3.7 The landing gears

Disadvantage of the tail draggers:



3.7 The landing gears

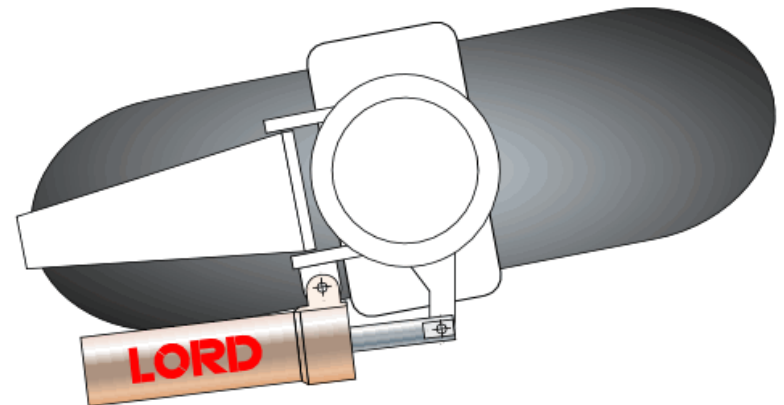
Tricycle landing gears:

- **All problems due to tail dragger are solved**
 - **No nose over accident**
 - **No ground roll**
 - **Nice forward visibility**
 - **Aircraft is level, comfort for passengers**

3.7 The landing gears

Disadvantage of the tricycle landing gear:

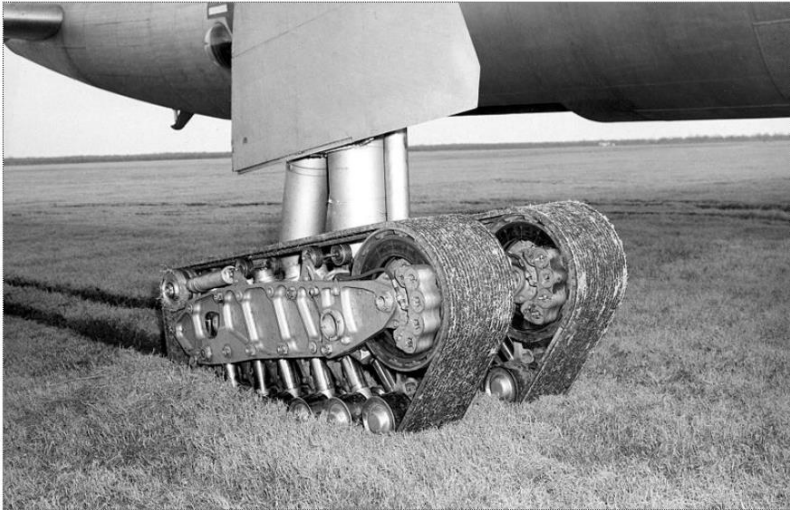
- Nose gear shimmy
- Nose wheel barrowing



3.7 The landing gears

The multi bogey landing gear:

- Used for heavy aircraft



Tracked gear is used on B-36, but NO GOOD



The solution is multi-bogey landing gear

3.7 The landing gears

The multi bogey landing gear:

- Used for heavy aircraft



3.7 The landing gears

The quadri-cycle landing gear:



3.7 The landing gears

The simple-main landing gear:



3.7 The landing gears

The bicycle landing gear:



3.7 The landing gears

The shock absorber of the landing gear:

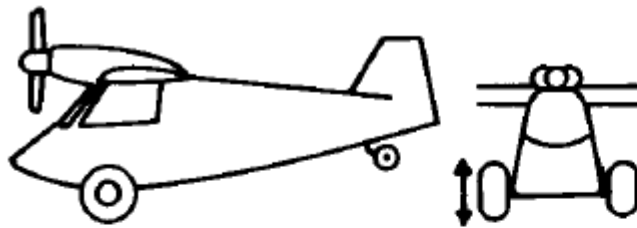
- **Used to damp shock and dissipate kinetic energy**



3.7 The landing gears

The shock absorber of the landing gear:

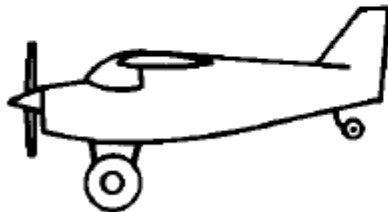
- The simplest shock absorber is spring/rubber



RIGID AXLE



SOLID SPRING



LEVERED BUNGEE

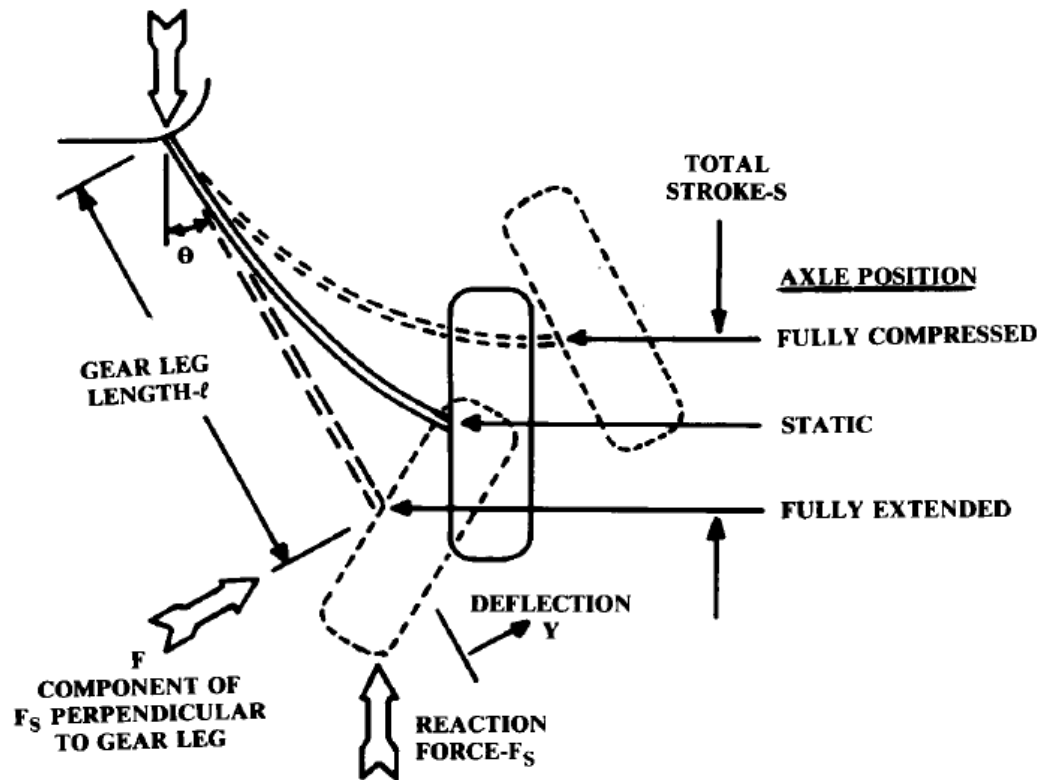


- Spring/rubber only absorbs energy
- Light weighted, but not effective

3.7 The landing gears

The shock absorber of the landing gear:

- The simplest shock absorber is spring/rubber

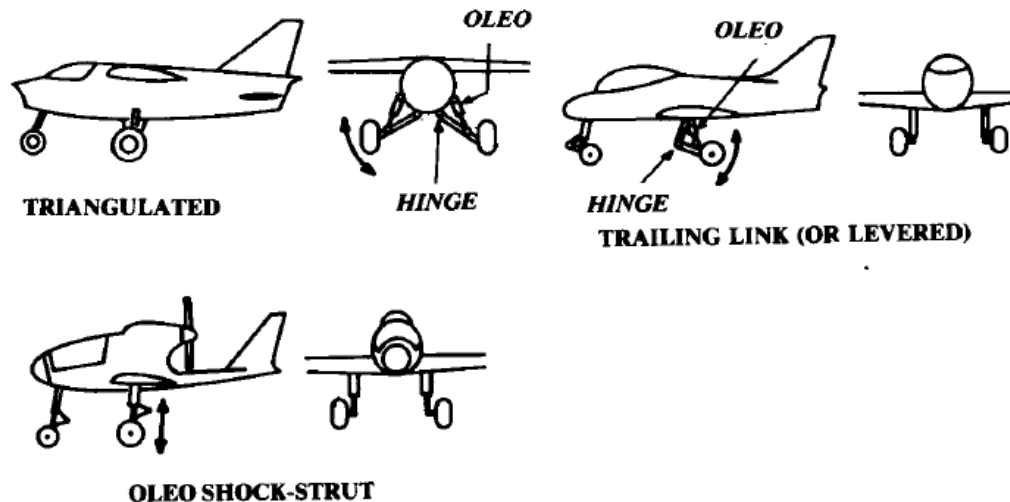


Solid spring gear deflection.

3.7 The landing gears

The shock absorber of the landing gear:

- The most common shock absorber is OLEO shock strut

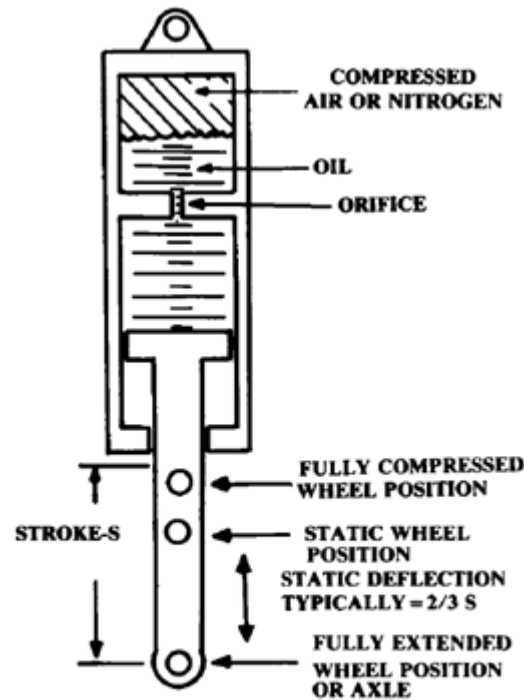


- Oil-air or OLEO shock-strut turns the mechanical energy into other form of energy
- A little complex, but very effective

3.7 The landing gears

The shock absorber of the landing gear:

- The most common shock absorber is OLEO shock strut

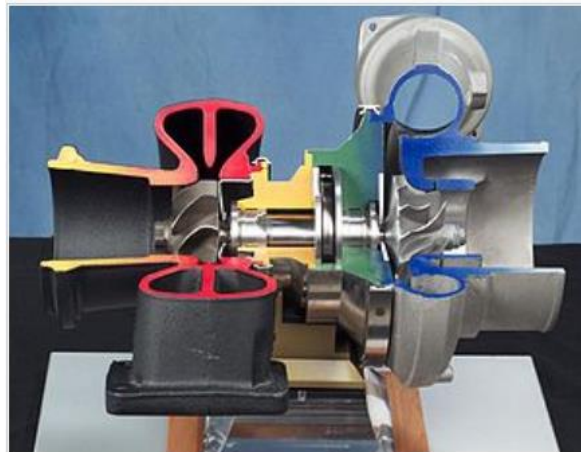


Oleo shock absorber (most simple type).

3.8 The turbo charger/super charger

The ceiling of the aircraft increased, to increase the engine output at high altitude, the turbo chargers/super chargers are applied.

- Turbo charger:
 - Driven by exhaust gas
- Supercharger:
 - Driven by engine mechanically



3.8 The turbo charger/super charger

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