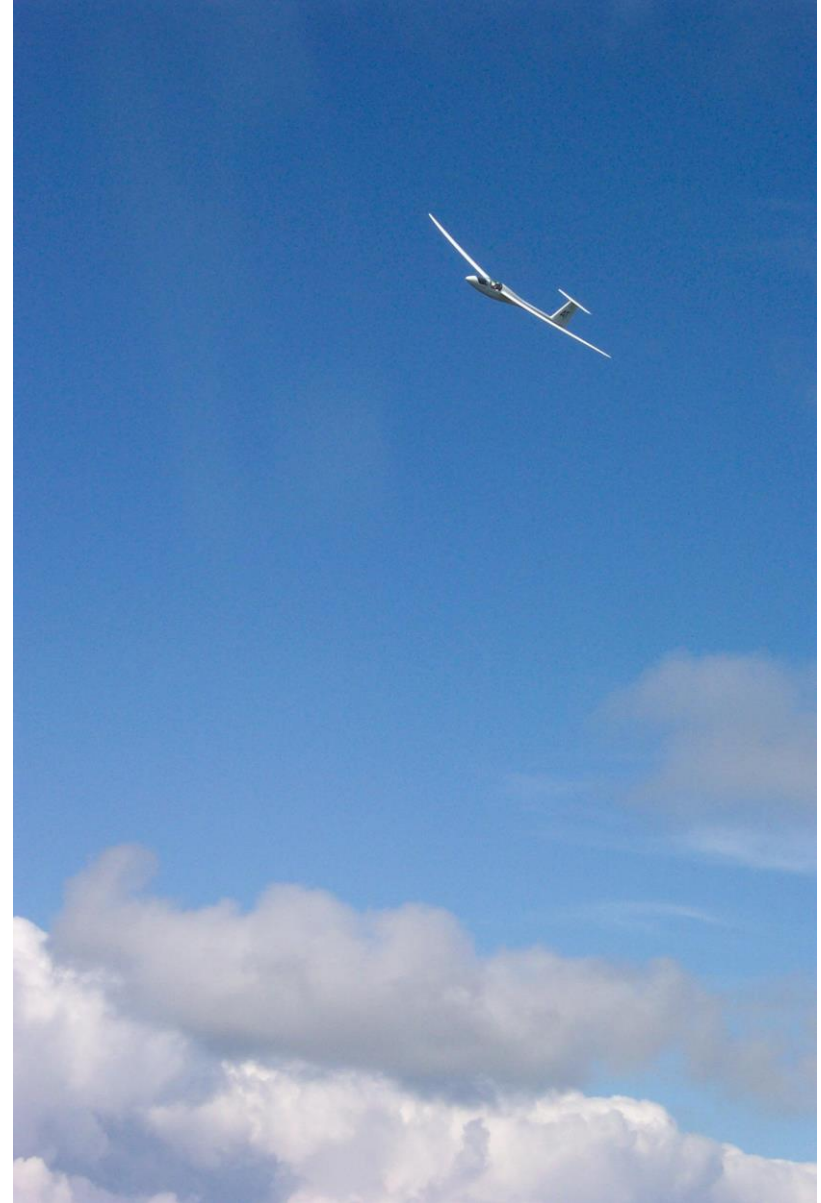


# 2026 GGC/RVSS Glider Pilot Ground School

## AGENDA – Part 2 (Airframes)

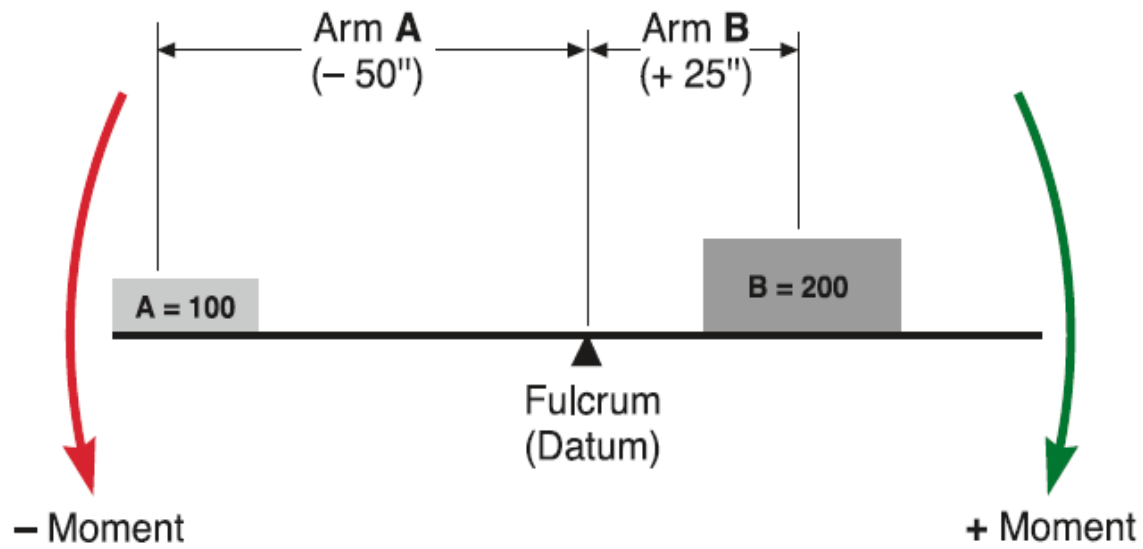
- Introduction
- Weight & Balance
- Airframes & Systems
  - Types of Construction
  - Landing Gear & Wheel Brake
  - Flaps Spoilers & Dive Brakes
  - Configuration
  - Construction Techniques
- **SUMMARY**



# Weight & Balance

TP 876 – Section 7

## A Simple Balance About a Datum



Item	Weight (lb)	Arm (in)	Moment (lb-in)
Weight A	100	-50	-5,000
Weight B	200	+25	+5,000
	300		0

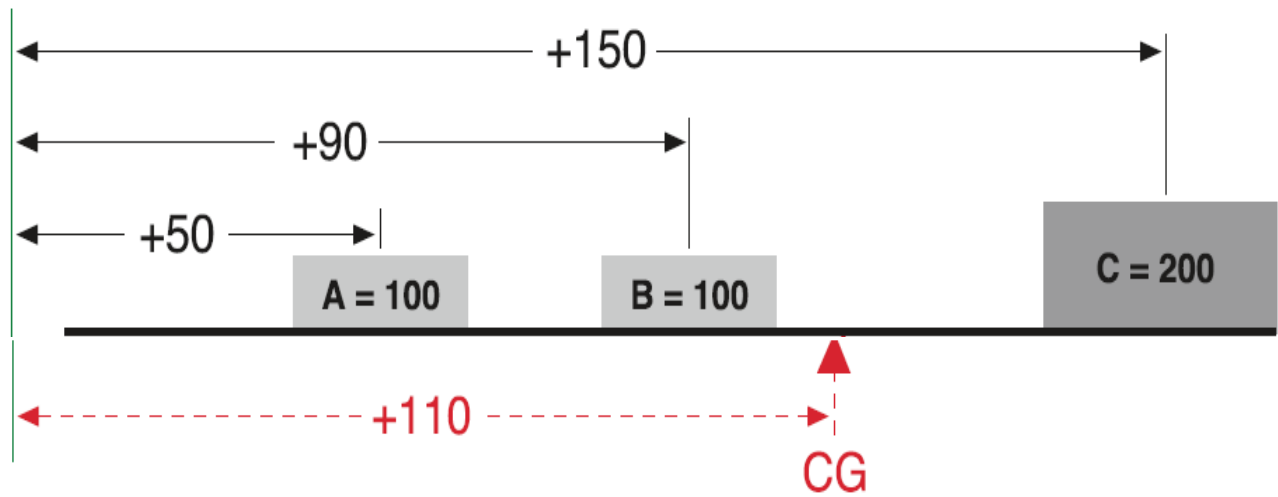
The lever is balanced when the algebraic sum of the moments about the fulcrum (datum) are zero.

# Weight & Balance

TP 876 – Section 7

## Calculating Center of Gravity from an Off-Board Datum

Datum



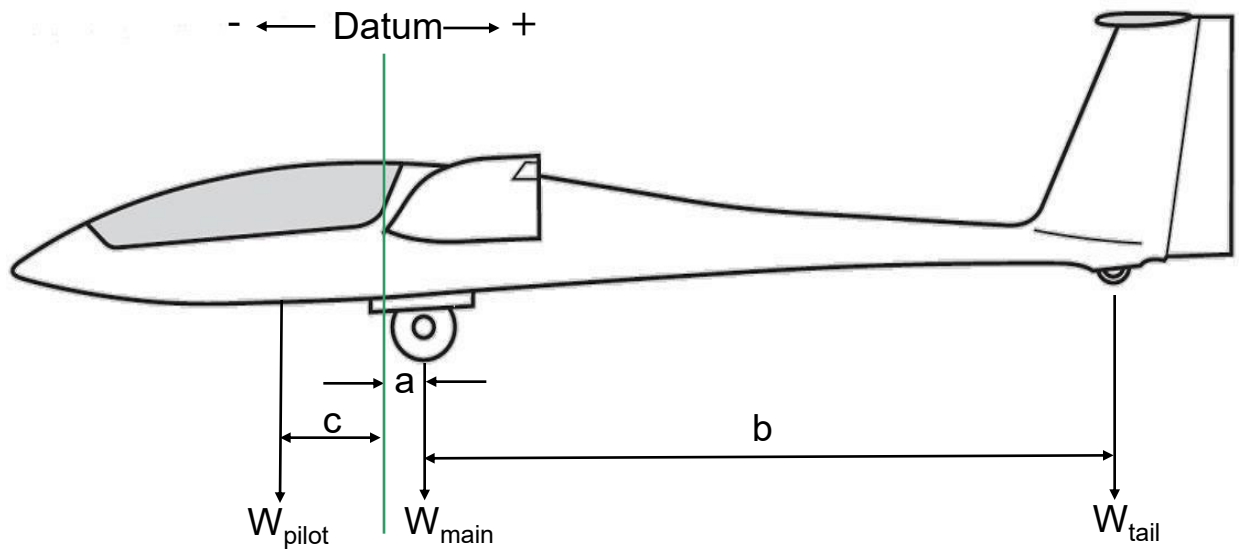
Item	Weight	Arm	Moment	CG
Weight A	100	50	5,000	
Weight B	100	90	9,000	
Weight C	200	150	30,000	
	<b>400</b>		<b>44,000</b>	<b>110</b>

The Center of Gravity (CG) is calculated by dividing the sum of the moments about a datum by the sum of the weights.

# Weight & Balance

TP 876 – Section 7

## Calculate CG Position for Glider C-FCYF (SZD-55)



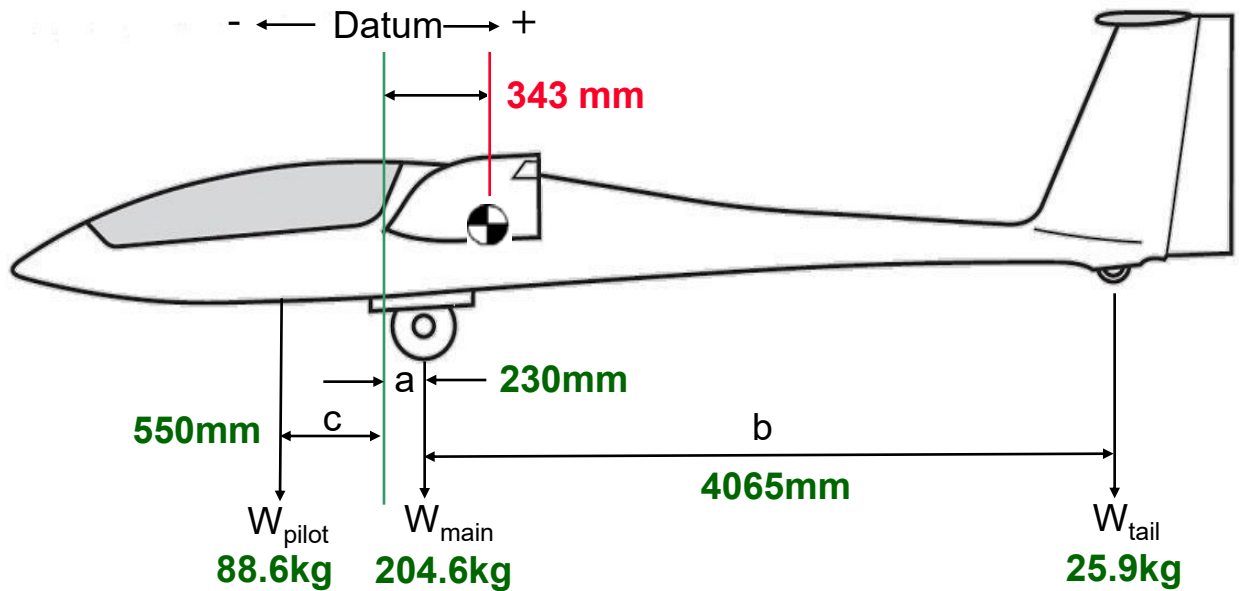
Item	Weight	Arm	Moment	CG
Pilot Weight	$W_{pilot}$	-c	$W_{pilot} * (-c)$	
Main Wheel Weight	$W_{main}$	a	$W_{main} * a$	
Tail Wheel Weight	$W_{tail}$	a + b	$W_{tail} * (a+b)$	
<b>TOTAL</b>	<b><math>W_T</math></b>		<b><math>M_T</math></b>	<b><math>M_T/W_T</math></b>

The Center of Gravity (CG) is calculated by dividing the sum of the moments about a datum by the sum of the weights.

# Weight & Balance

TP 876 – Section 7

## Calculate CG Position for Glider C-FCYF (SZD-55)



Item	Weight	Arm	Moment	CG
Pilot Weight	88.6	-550	- 48730	
Main Wheel Weight	204.6	230	47058	
Tail Wheel Weight	25.9	4295	111241	
<b>TOTAL</b>	<b>319.1</b>		<b>109569</b>	<b>343 mm</b>

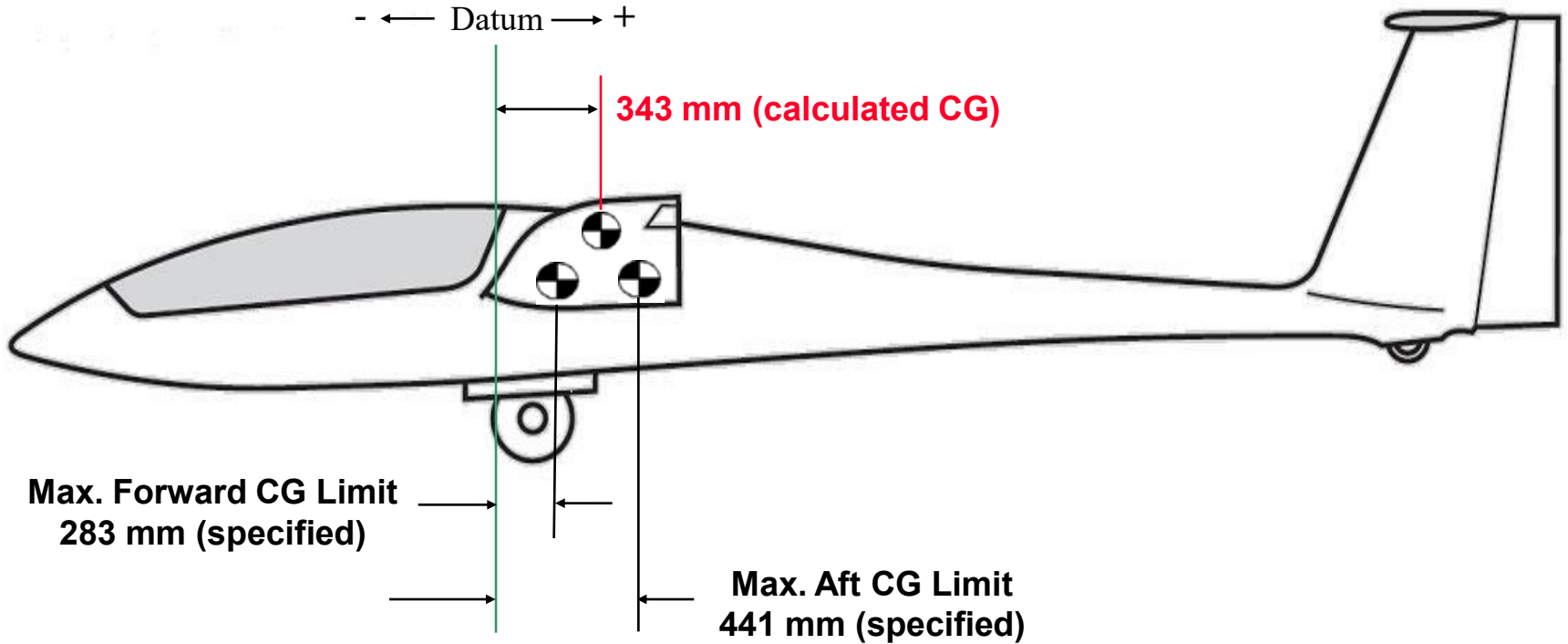
The Center of Gravity (CG) has been calculated to be 343 mm aft of the Datum.

**But What Does This Mean???**

# Weight & Balance

TP 876 – Section 7

## Calculate CG Position for Glider C-FCYF (SZD-55)



The calculated Center of Gravity (CG) is within the forward and aft limits of the manufacturer specified limits.

**Therefore SZD 55-1 C-FCYF is safe to fly by a pilot weighing 88.6 kg**

# ***Gliders - Then & Now***

Early Primary Gliders (1920s)



# ***Gliders - Then & Now***

Frame and Canvas Gliders (1900 - 1960)

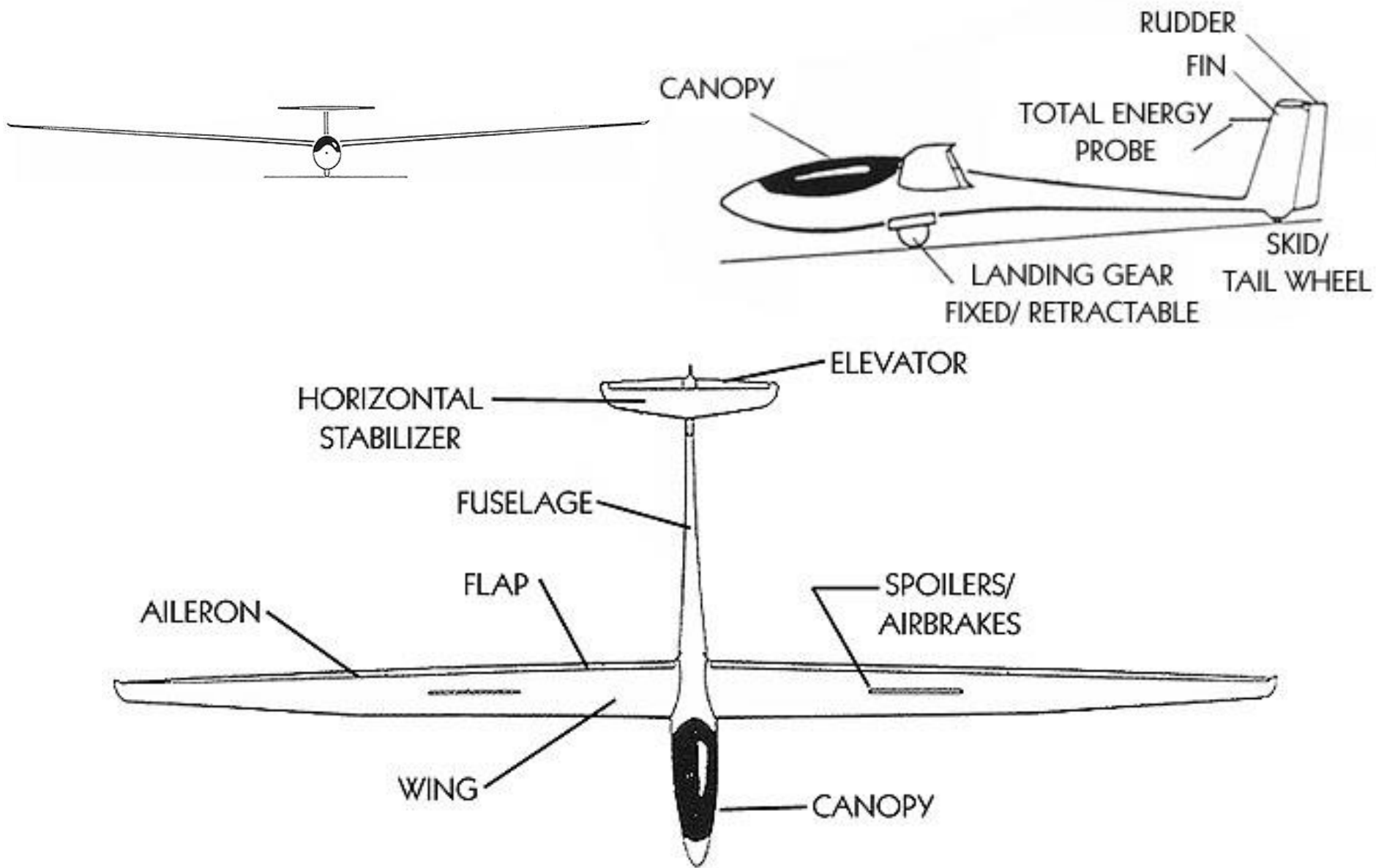


# Gliders - Then & Now

Modern Fiberglass Gliders (1960 to present)



# Parts of a Glider



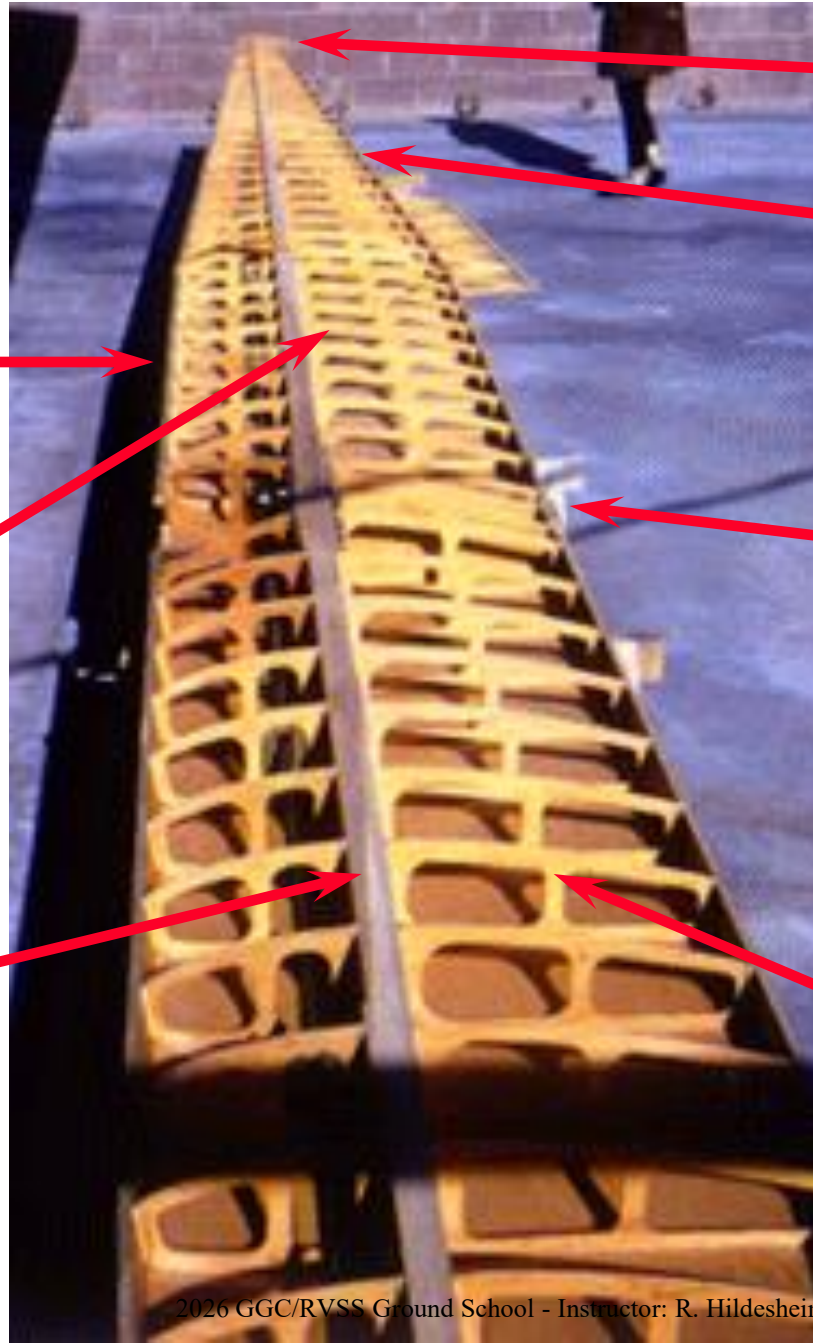
- Normal Category
  - maximum gross weight operation is permitted but maneuvers such as spins are not permitted
  - load factors +3.8 to -1.52
  
- Utility Category
  - maneuvers such as spins permitted but at reduced weight and airspeed
  - load factors +4.4 to -1.76
  
- Aerobatic Category
  - wide variety of maneuvers allowed
  - typical load factors +6.0 to -5.0

# The Wing

## Definitions

- Angle of Incidence
  - the angle at which the wing is permanently inclined (attached) to the longitudinal axis of the aircraft.
- Angle of Attack
  - the angle at which the airfoil meets the relative airflow
- Chord Line
  - the line between the furthest forward part of the airfoil and the trailing edge
- Aspect Ratio
  - relationship between the length (span) of the wing and it's width or chord
  - it is calculated buy dividing the span by the average chord (Mean Aerodynamic Chord MAC)

***THE WING***



Tip

Ailerons

Leading Edge

Trailing Edge

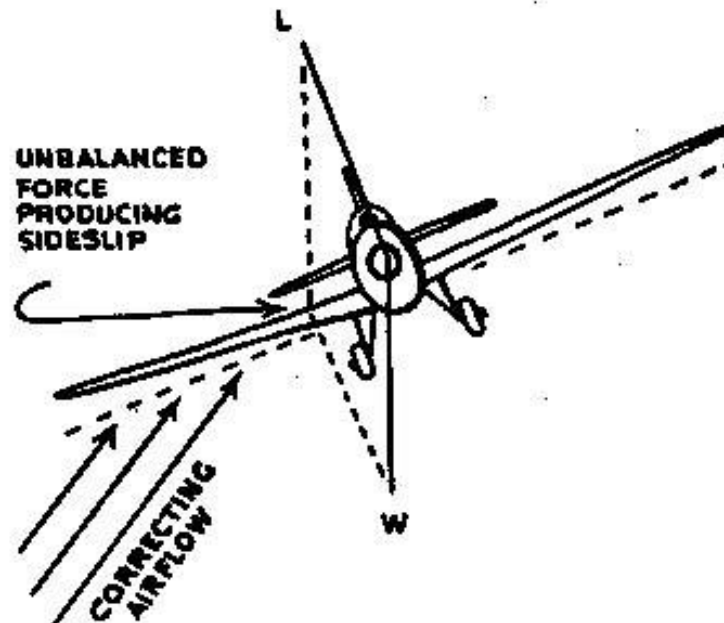
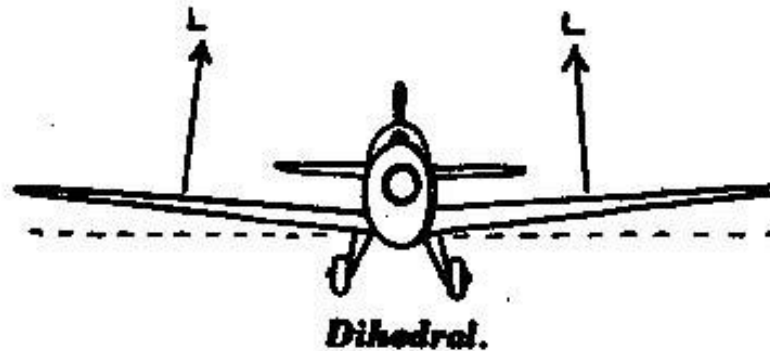
Spoilers

Main Spar

Ribs

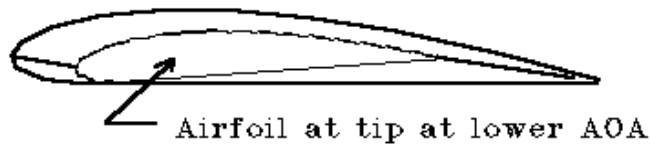
# DIHEDRAL

- the angle that each wing makes with the horizontal
- used to enhance the lateral stability of the aircraft

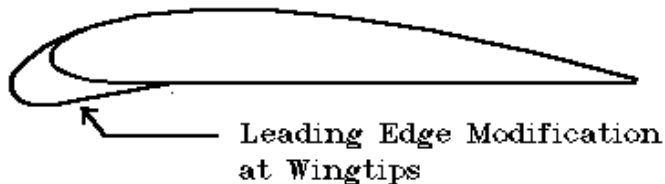
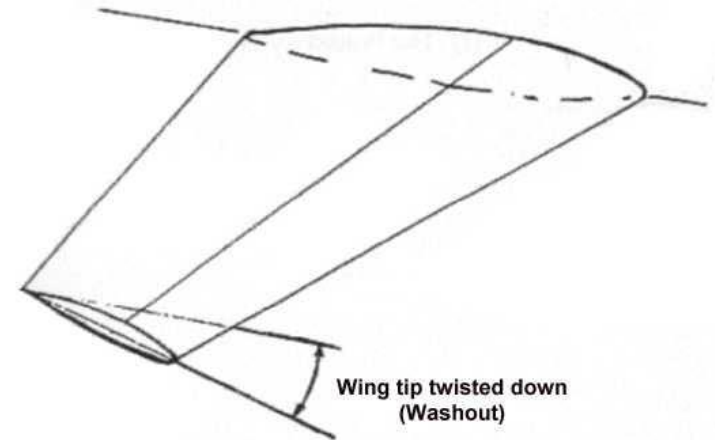


- this is where the angle of incidence of a wing is intentionally designed to be less at the wing tip than at the wing root
- this is a control enhancing feature that delays the onset of stalling at the wing tip (where the ailerons are located) thus giving the pilot better roll control, closer to the stall.

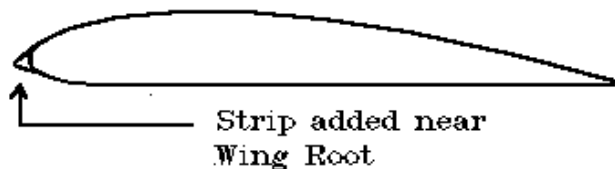
## STALL TAMERS



## Washout



## NASA Droops

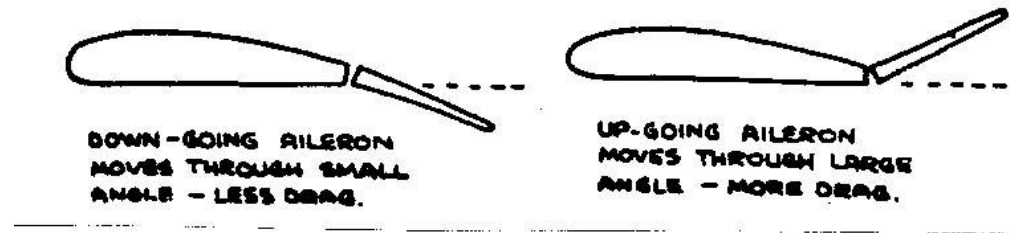


## Stall Strips

# AILERONS

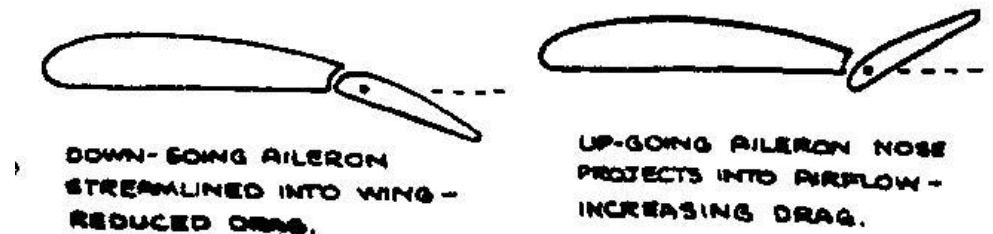
### Differential

- Downward aileron moves through a small angle, reducing drag
- Upward aileron moves through a large angle, increasing drag



### Frise

- Downward aileron streamlined into the wing, reducing drag
- Upward aileron nose projects into airflow, increasing drag



# FLAPS

Plain



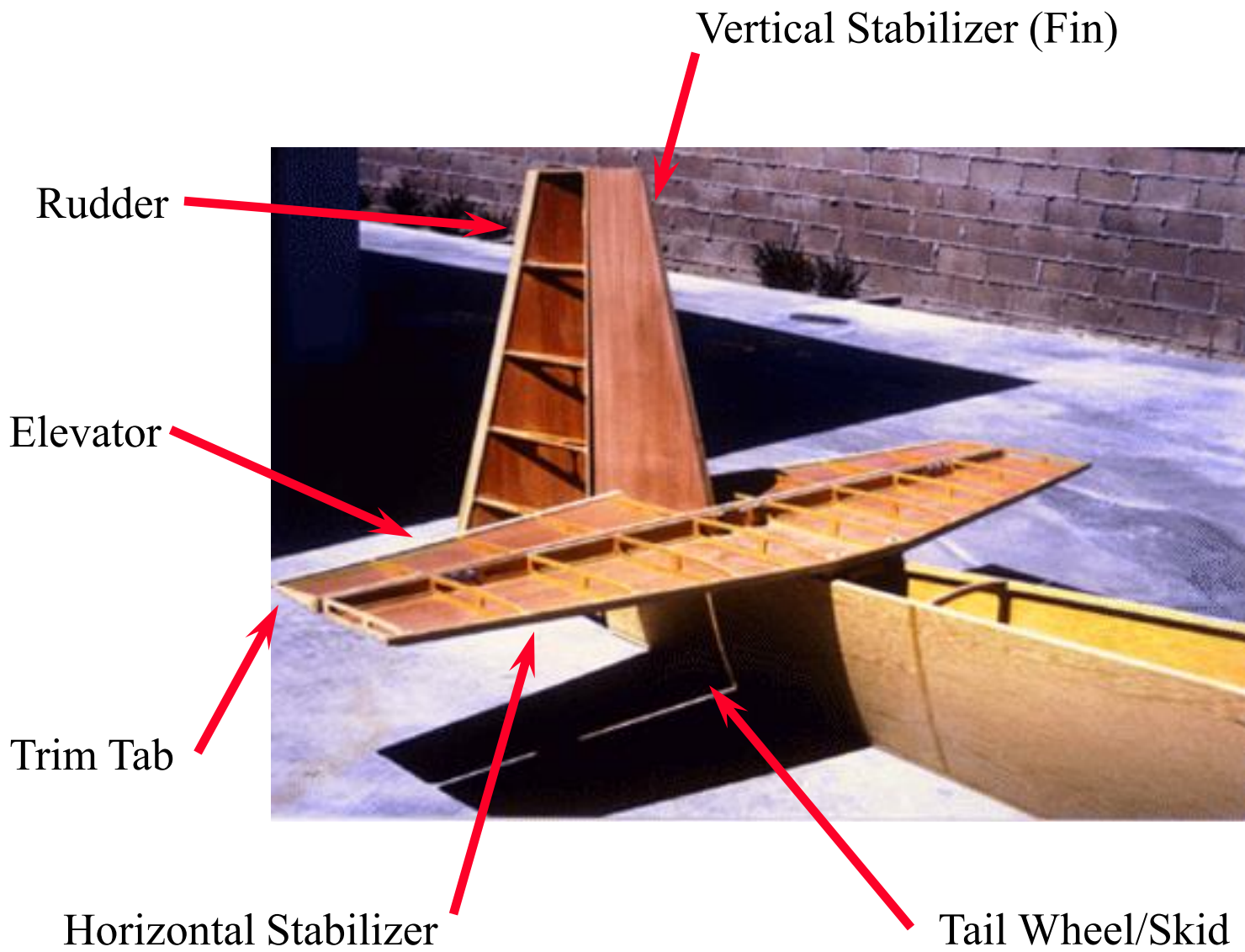
Slotted



Fowler



# EMPENNAGE (a.k.a. tail feathers)





### **Provides longitudinal (pitch) stability and control**

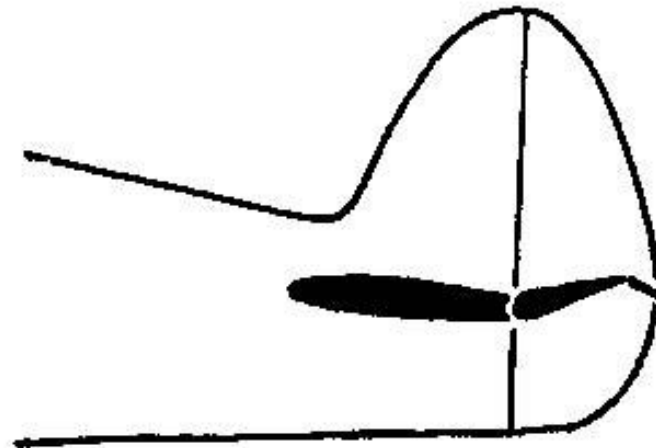
- C of G is designed to be ahead of the centre of pressure
- this creates a nose heavy condition which has to be counteracted with a tail plane (horizontal stabilizer/elevator)
- tail plane is set at a negative angle of incidence to produce negative lift which holds the tail down
- therefore in level, trimmed flight, the nose heavy tendency and negative lift of the tail plane exactly balance each other
- due to the moment arm of the fuselage, a “general rule of thumb” can be applied
  - the greater the distance between the C of G and the tail plane,
  - the smaller the size of the horizontal stabilizer/elevator

### **Two factors affect longitudinal stability**

- size and position of horizontal stabilizer
- position of centre of gravity

## TRIM

- trim tab is a control surface hinged to the elevator it is designed to move above or below the chord line of the control surface to which it is attached and thereby create an aerodynamic force that assists the pilot in holding the control in the desired position



- some trim devices use adjustable spring tension to exert pressure on the control surface to maintain the trimmed position



## Provides directional stability and control

- If the airplane yaws off course, the airflow strikes the fin from the side and forces the aircraft back to its original line of flight
- a general rule of thumb can be applied
  - the side area of the airplane aft of the CG (including fin) must be greater than the side area of the sailplane forward of the C of G.

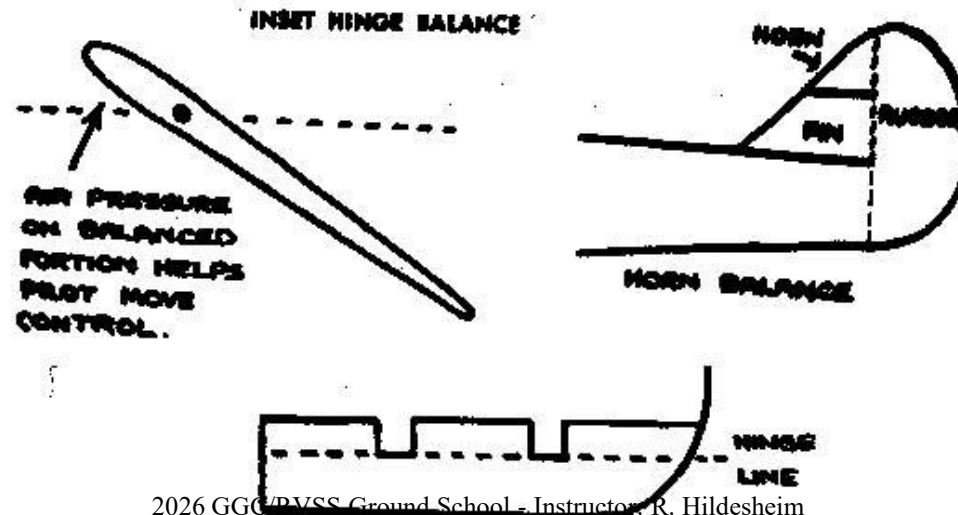
## Static Balancing

- where the control surface is balanced around its specified C of G
- this is sometimes accomplished by modifying the location of the hinge point



## Dynamic Balancing

- where the airflow is used assist with the movement of the control
- a mass balance is also sometimes attached to a control surface to protect against flutter at high speeds

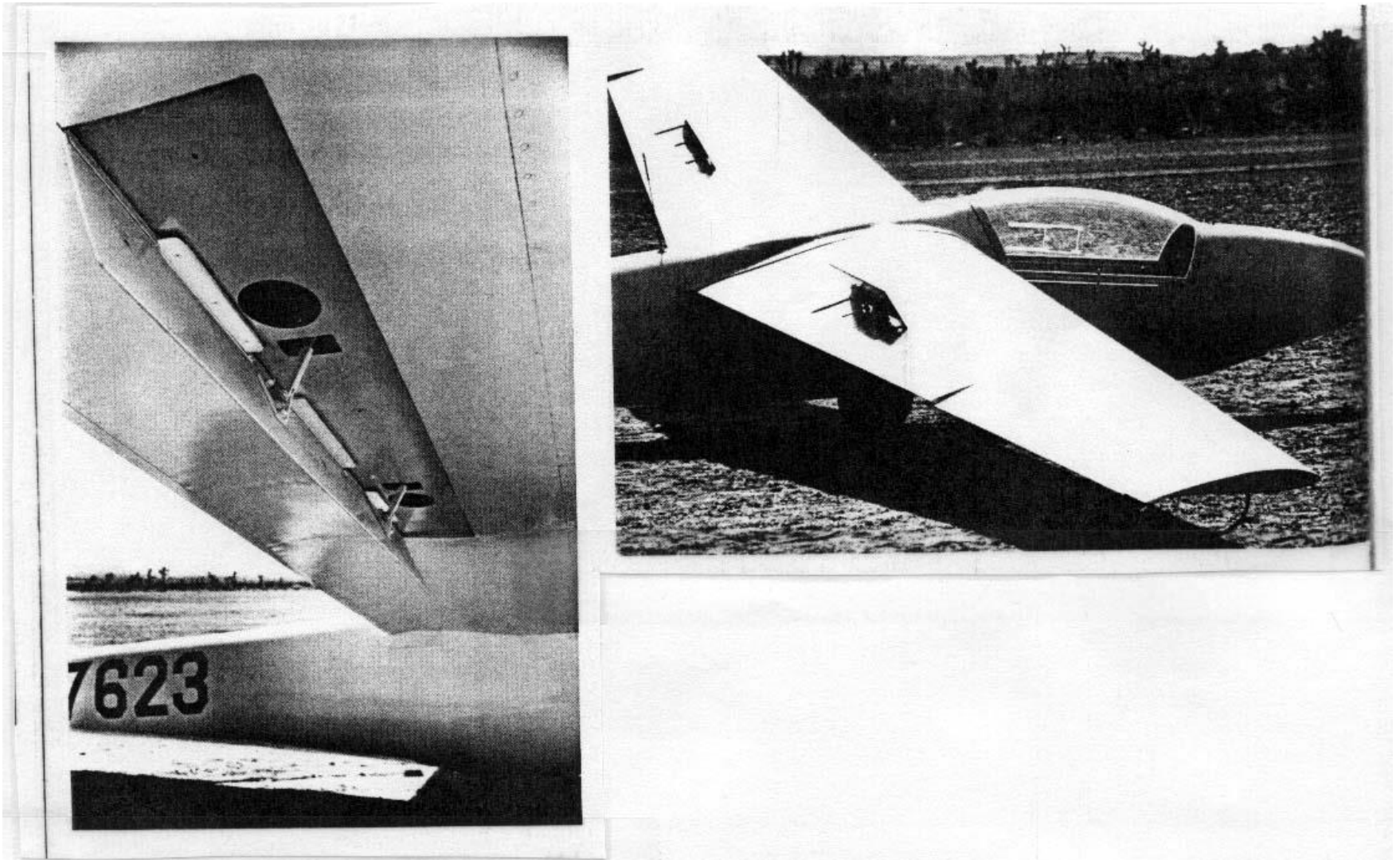


# SPOILERS

- reduces the amount of lift generated by the wing without changing attitude (speed)
- allows sailplane to land in relatively short fields
  - example - typical high performance 2 seat sailplane
    - glide angle = 36:1 (no spoilers deployed)
    - glide angle = 8:1 (full spoiler deployed)
- additional glidepath control may be provided by drag chute
  - example - ASW-12
    - no spoilers, only uses a drag chute



# SPOILERS



## Flaps

### Positive Flap

- increases camber of airfoil
- increases lift at lower airspeeds
- decreases stalling speed
- allows for slower approach speed
- increases drag



### Negative Flap

- decreases camber of airfoil
- decreases drag at higher airspeeds
- increases stalling speed
- reduces pitch angle of aircraft at high speed (less drag)

# SAILPLANE CONFIGURATIONS

### Centre Tail



### T- Tail



### V-Tail



- Centre of Gravity (C of G) is ahead of the main wheel
- a wooden skid mounted with rubber shock absorbers is attached to the nose
- sometimes a smaller second wheel is used instead of a skid
- small skid or wheel on tail
- small skid or wheel on wingtips
- the skid offers excellent stopping ability
- wheel brake usually connected to spoilers

Nose Skid



# Taildragger Landing Gear Configuration

## Airframes & Systems

TP 876 – Section 4.2 Landing Gear & Brake

- C of G is behind the main wheel
- nose of sailplane is not designed to contact the ground
- small skid or wheel on tail
- small skid or wheel on wingtips
- a disk or drum wheel brake provides stopping ability



# Typical Wheel Brake Systems

## Typical Drum Brake Assembly



## Typical Disc Brake Assembly



**Wheel brakes are usually operated by one of four methods in gliders:**

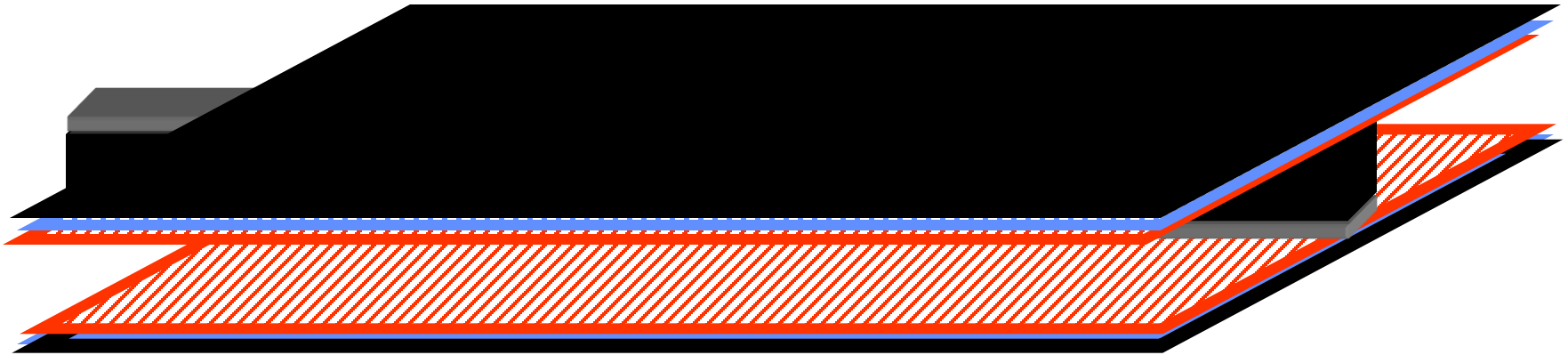
1. When spoilers are fully opened (SZD-55)
2. Using a separate handle on the control stick (ASW-20)
3. Use of a separate pull handle on the cockpit floor (Puchacz/Blanik)
4. Use of the heels (feet) on the rudder pedals (LS 4)

## Sailplane Construction

### General Types of Construction

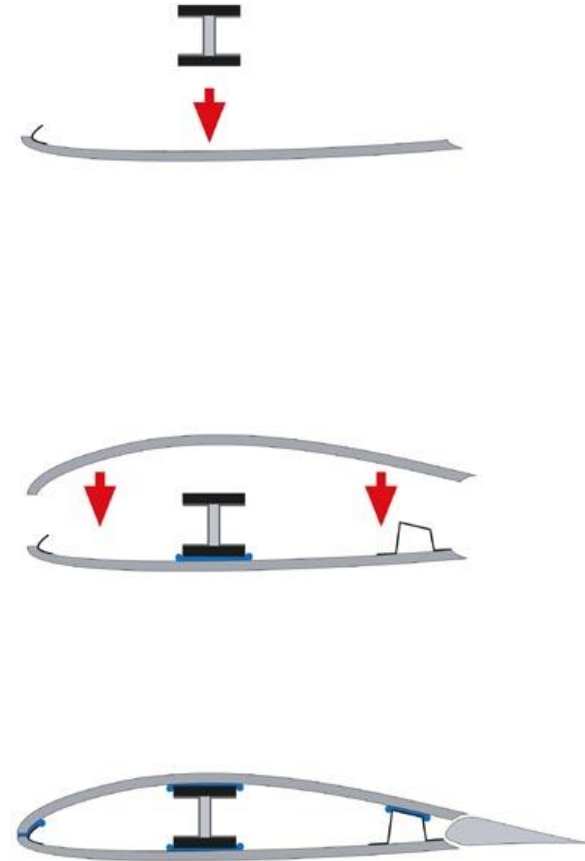
- wooden frame, plywood covered
- wooden frame, fabric covered
- metal frame, fabric covered
- metal frame, metal covered (strength in frame)
- metal frame, metal covered (strength in covering)
  - called Stressed Skin or Monocoque
- composite (fiberglass) material





- 1/ Gelcoat is sprayed into mould
- 2/ Epoxy rolled onto surface and fiberglass is applied
- 3/ Pre-fabricated spar cap is epoxied into place
- 4/ Pre-fabricated spar is epoxied onto spar cap
- 5/ Opposite half of wing fabricated in the same manner and bonded to the other half

# Typical Composite Wing Construction



# Typical Composite Wing Construction



# Typical Composite Wing Connection

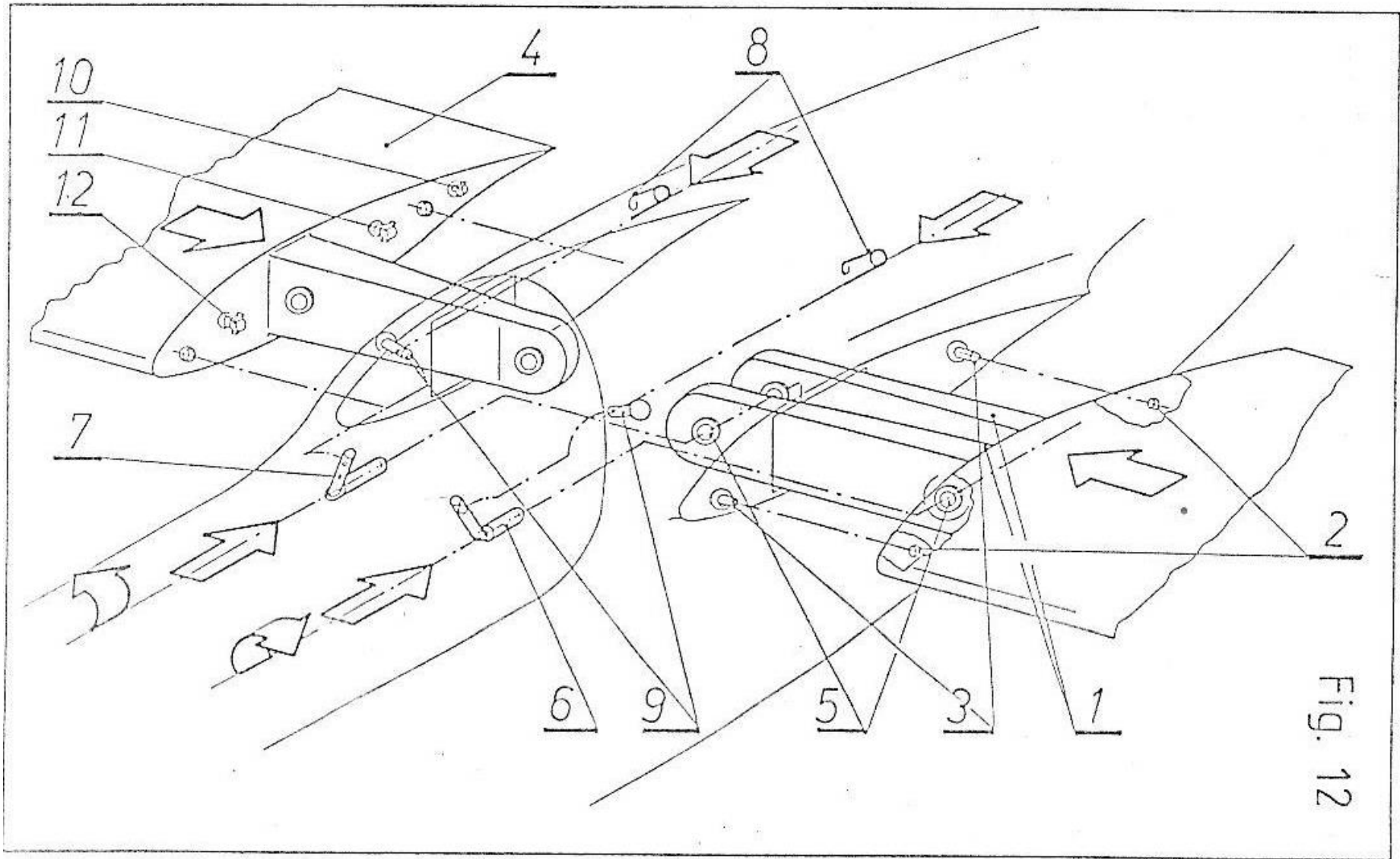
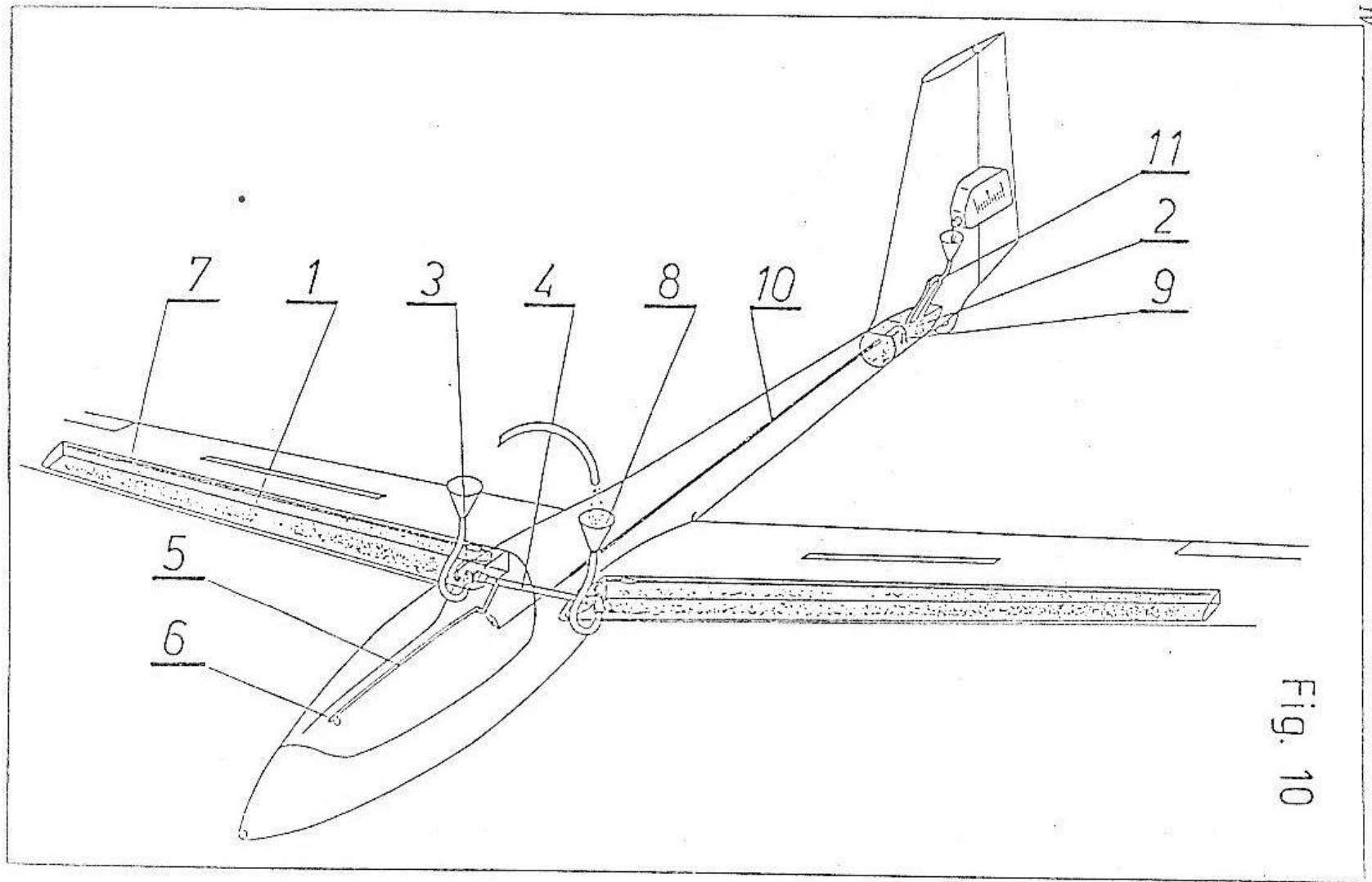


Fig. 12

# Typical Water Ballast Design



SS.11

Fig. 10

# COMPOSITE CONSTRUCTION - WING MOULD PREPARATION



# COMPOSITE CONSTRUCTION - WING CLOTH LAYOUT



# COMPOSITE CONSTRUCTION - WING CURING & HARDENING



# COMPOSITE CONSTRUCTION - FUSELAGE HALF SECTION BONDING



# COMPOSITE CONSTRUCTION - WING SPAR PIN ALIGNMENT JIG





# COMPOSITE CONSTRUCTION – FINAL ASSEMBLY



