

# INTRODUCTION TO AIRCRAFT STRUCTURES

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# INTRODUCTION TO AIRCRAFT STRUCTURES : WING STRUCTURES TYPICAL CONSTRUCTION

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Or 'So we need some structure to carry those loads we just worked out'

# WING STRUCTURES

- Wing Skins
- Fabricated skin with riveted/bolted stringers





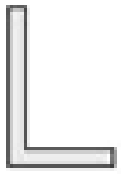
# WING STRUCTURES

- Wing Skins
- Integrally machined stringer

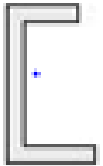


# WING STRUCTURES

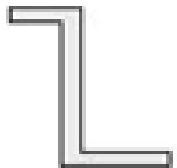
- Typical Wing Stringer Sections



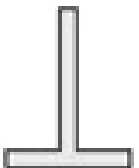
L Section



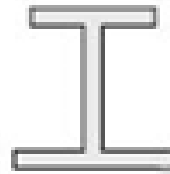
C Section



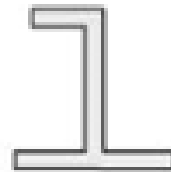
Z Section



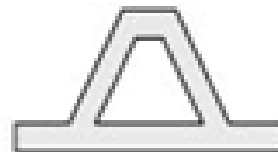
T or 'Blade' Section



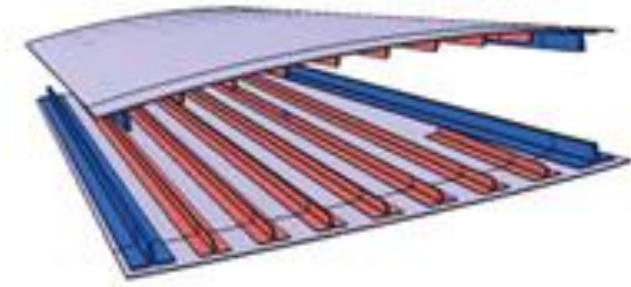
I Section



J Section



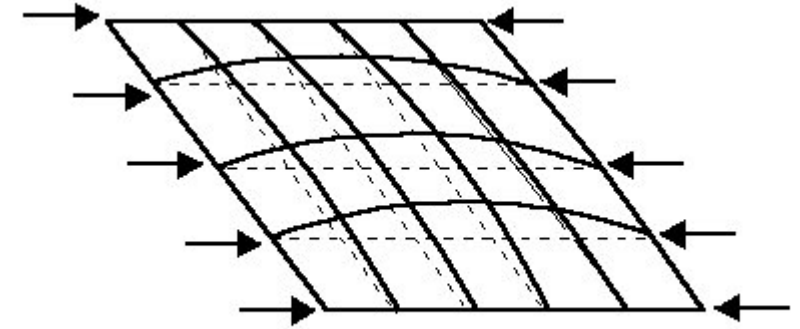
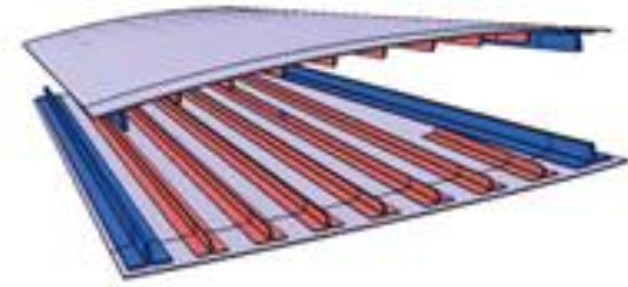
Omega Section



Typical Skin / Stringer Section

# WING STRUCTURES

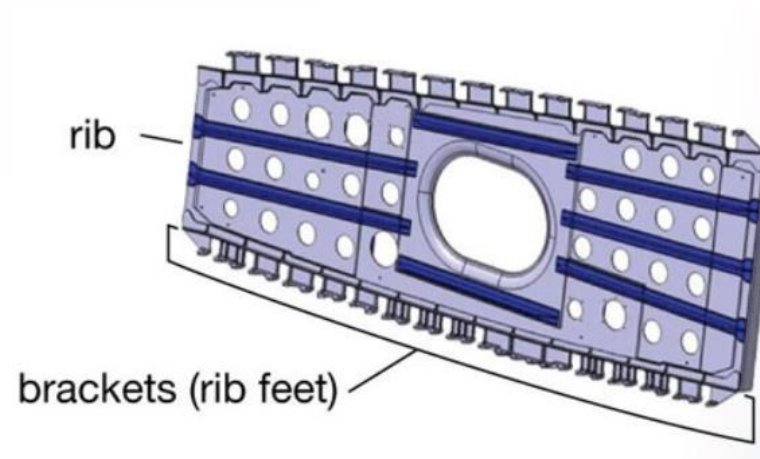
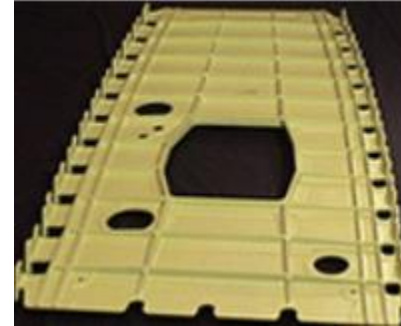
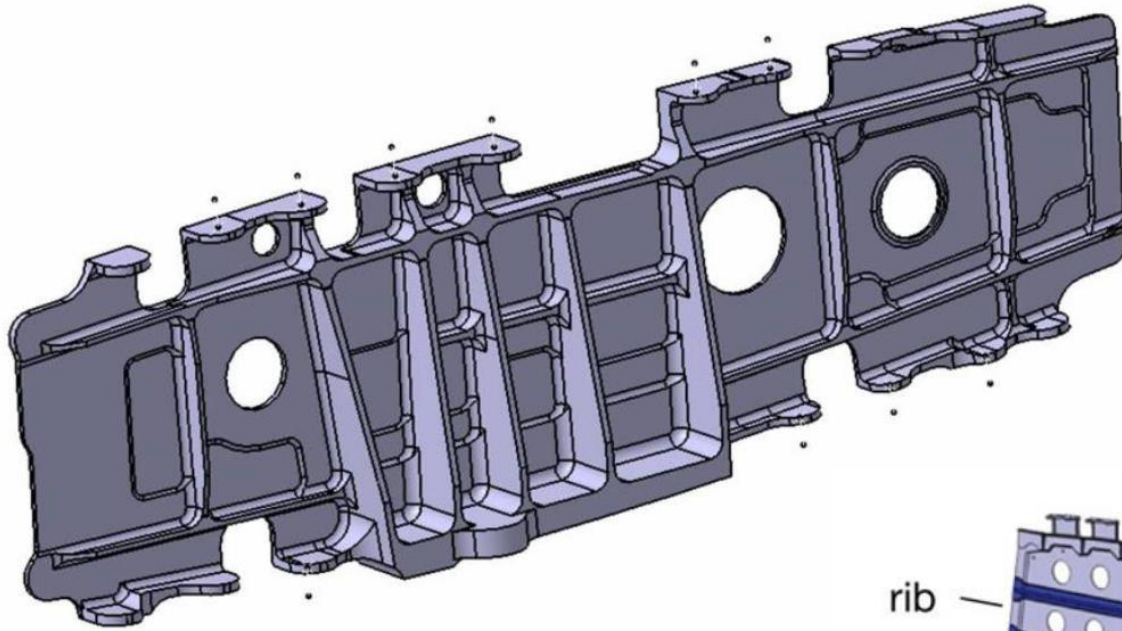
- **Stiffened panel stability in Compression**
- Critical design case for wing upper covers
- Wing up-bend puts upper cover in compression
- Stiffness relationship between stringer area and Skin area is a key 'trade' in structural sizing
- Choice of stringer section type is made after study of which gives the most weight and cost efficient design





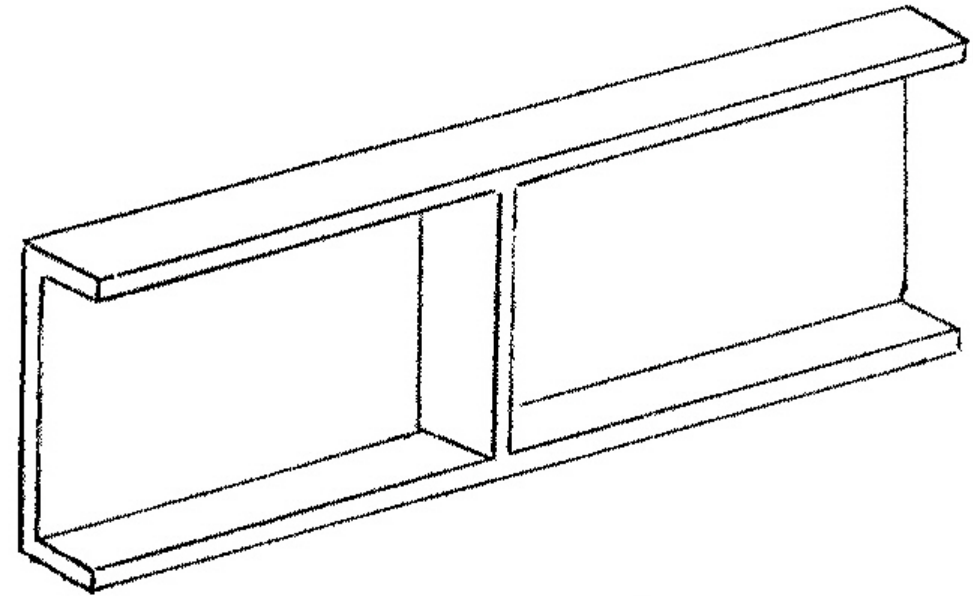
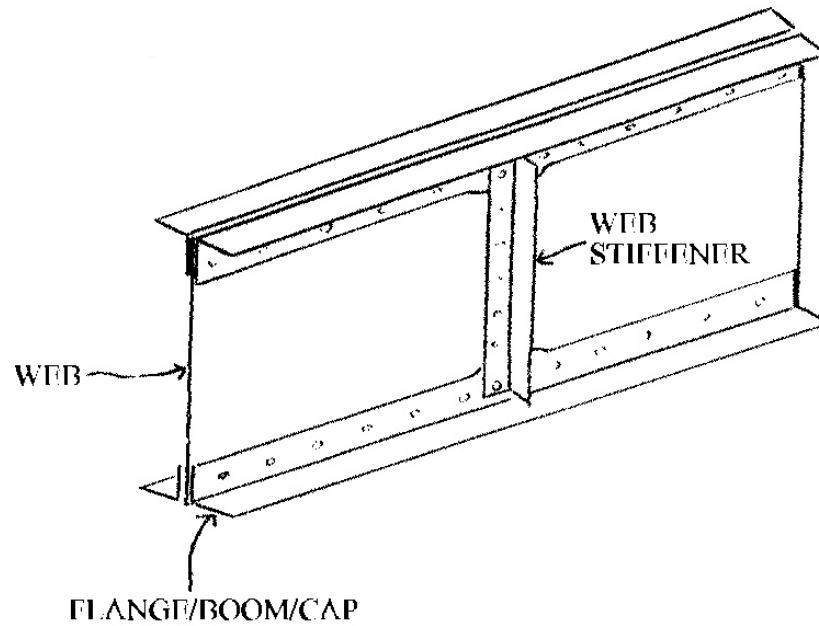
# WING STRUCTURES

- Ribs



# WING STRUCTURES

- Spars – Fabricated and machined





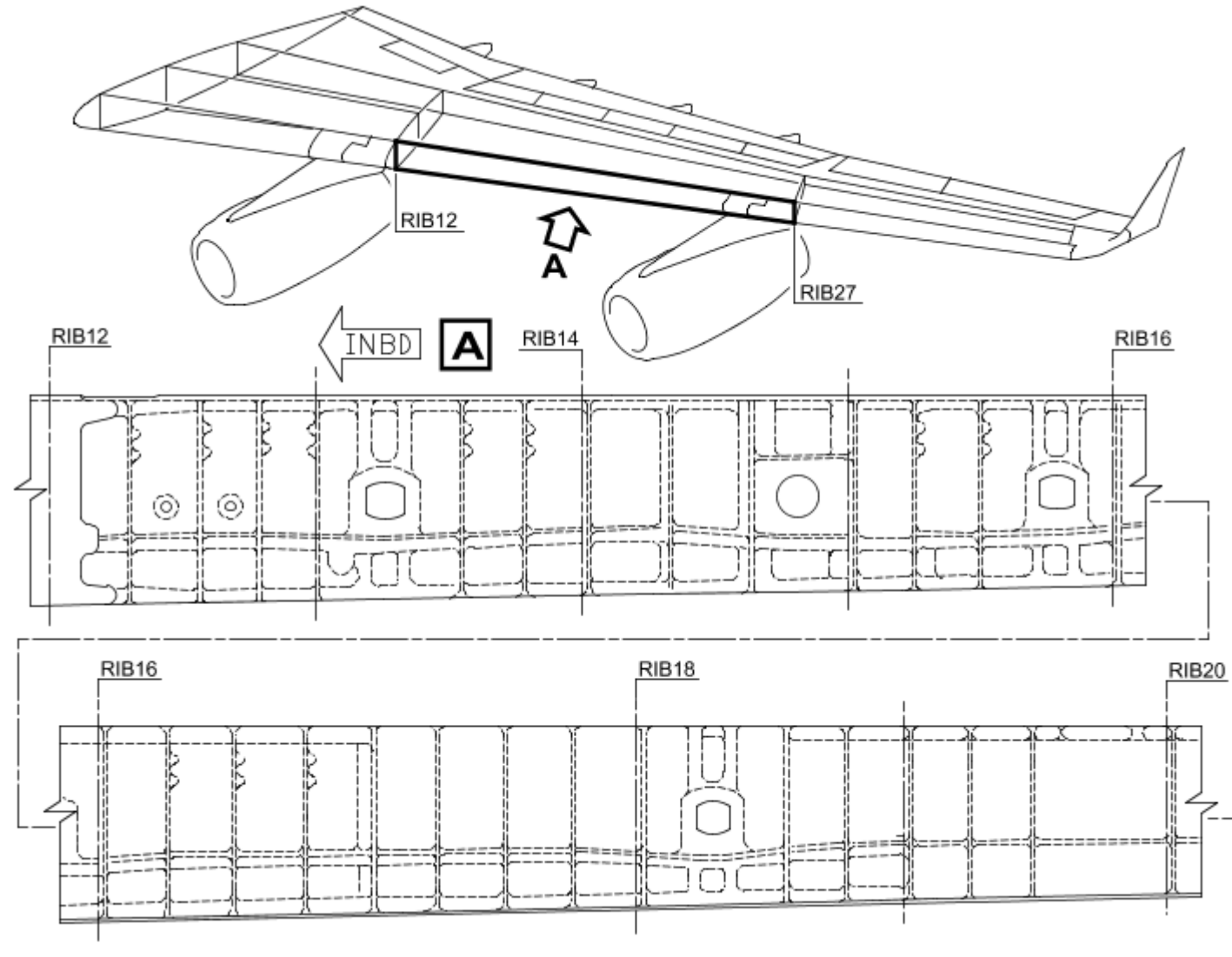
# WING STRUCTURES

- Spars – machined



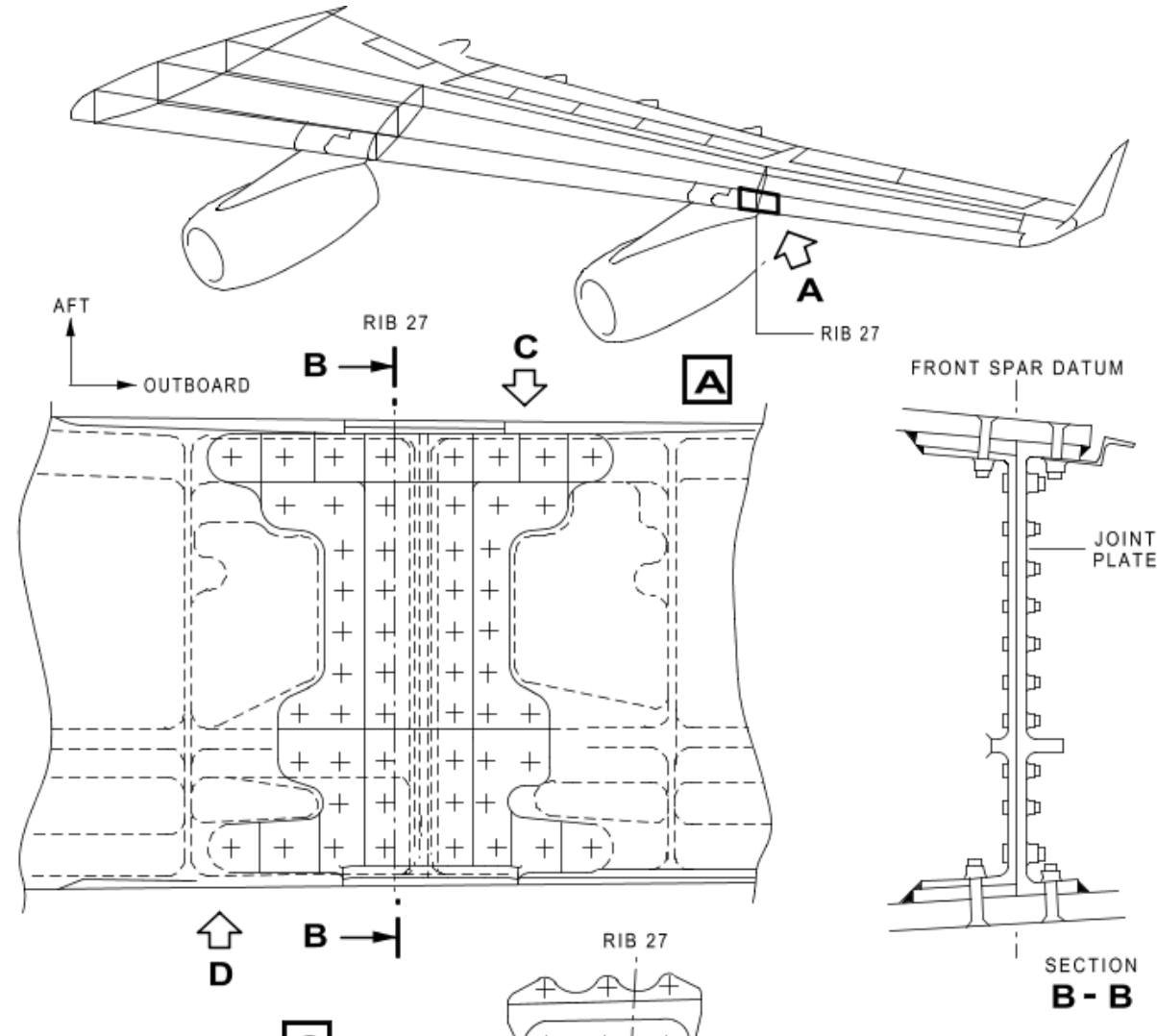
# WING STRUCTURES

- Spar



# WING STRUCTURES

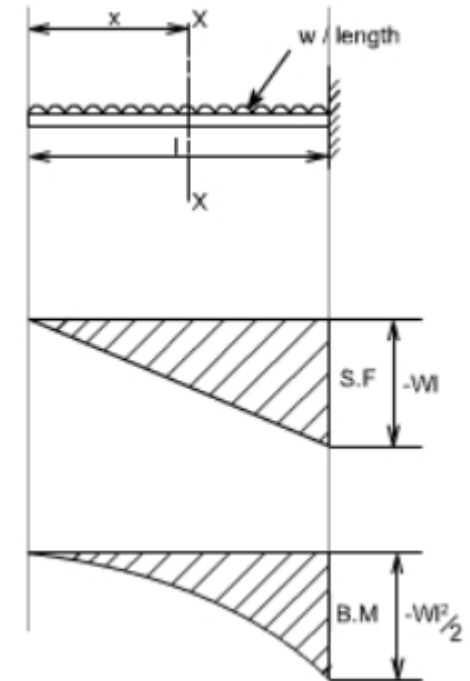
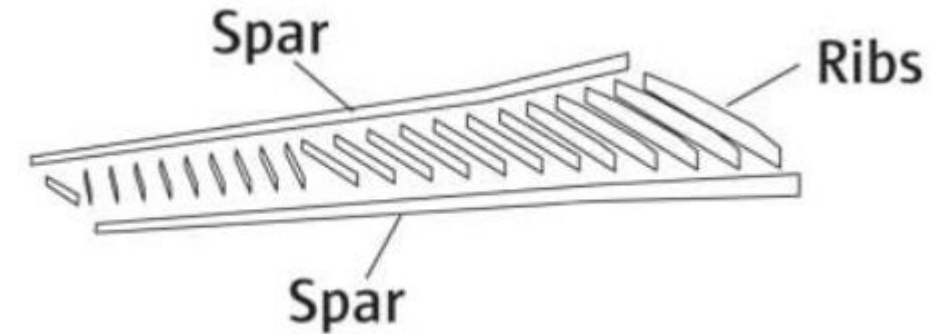
- Spar Joint



# WING STRUCTURES

- **STRUCTURAL FUNCTIONS OF SPARS**

- Webs carry large proportion of shear due to bending
- Form closed box with skins to carry torsion
- Spar booms carry end load, contributing to bending strength
- Support wing skins against buckling
- Carry fuel pressure loads
- Provide attachment points, transmit discrete loads into structure



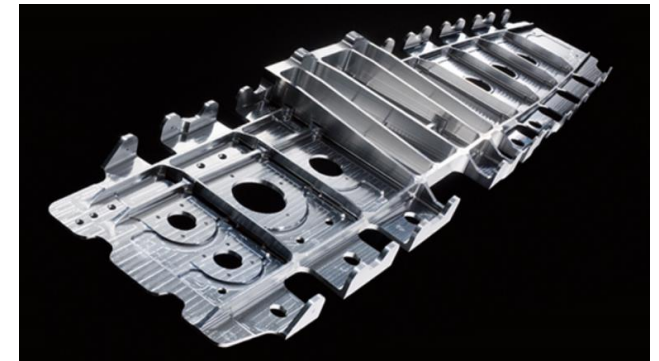


# WING STRUCTURES

- COMPARISON OF MACHINED AND FABRICATED STRUCTURAL MEMBERS

- **Advantages of Machined Construction**

- Part thickness can be varied
- Flexible geometry - integral stiffeners or fittings easily accommodated
- Weight & cost saving due to reduced bolt/rivet requirement
- More scope for weight saving and structural optimisation
- Less stress concentrations due to bolts/rivets
- Consistent, high quality parts from numerical controlled (NC) machines



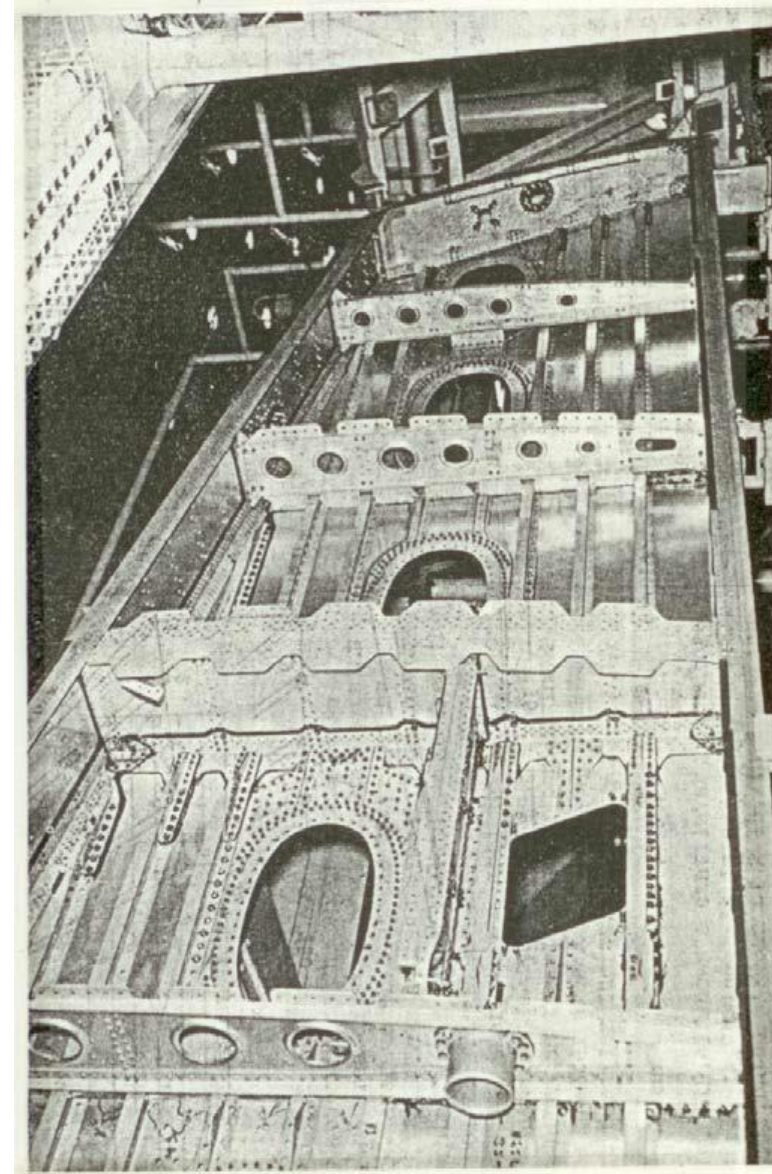
# WING STRUCTURES

- COMPARISON OF MACHINED AND FABRICATED STRUCTURAL MEMBERS
- **Disadvantages of machined construction**
  - Require expensive machine tools
  - May not be economic if the number of Aircraft to be made is small
  - Large amount of material wasted – but nearly all can be recycled
  - More difficult to repair
  - More vulnerable to crack propagation on poor designs



# WING STRUCTURES

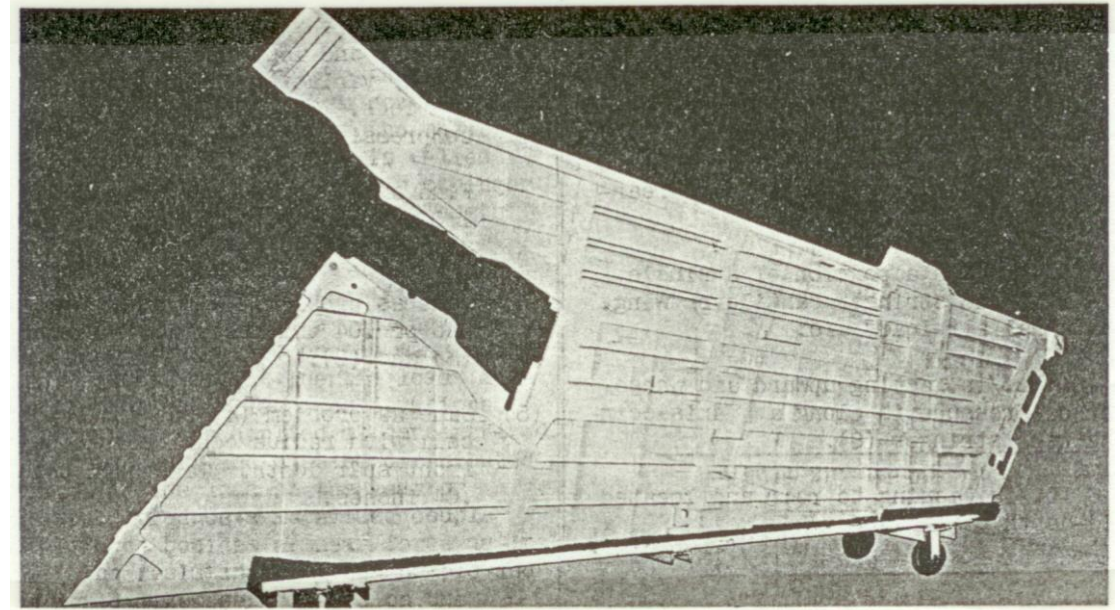
- DC-8 lower part of outer wing





# WING STRUCTURES

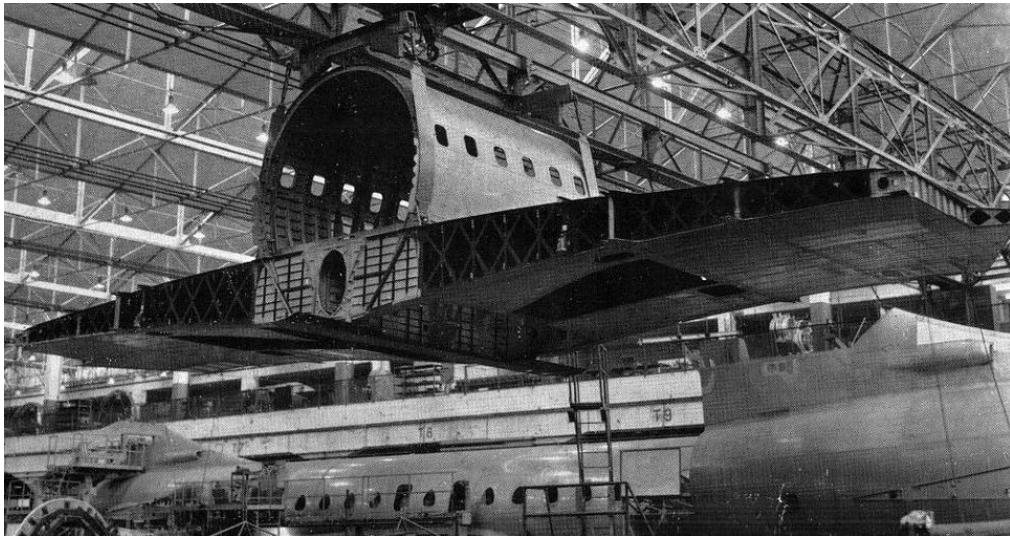
- North American FJ-3 integrally machined lower wing skin





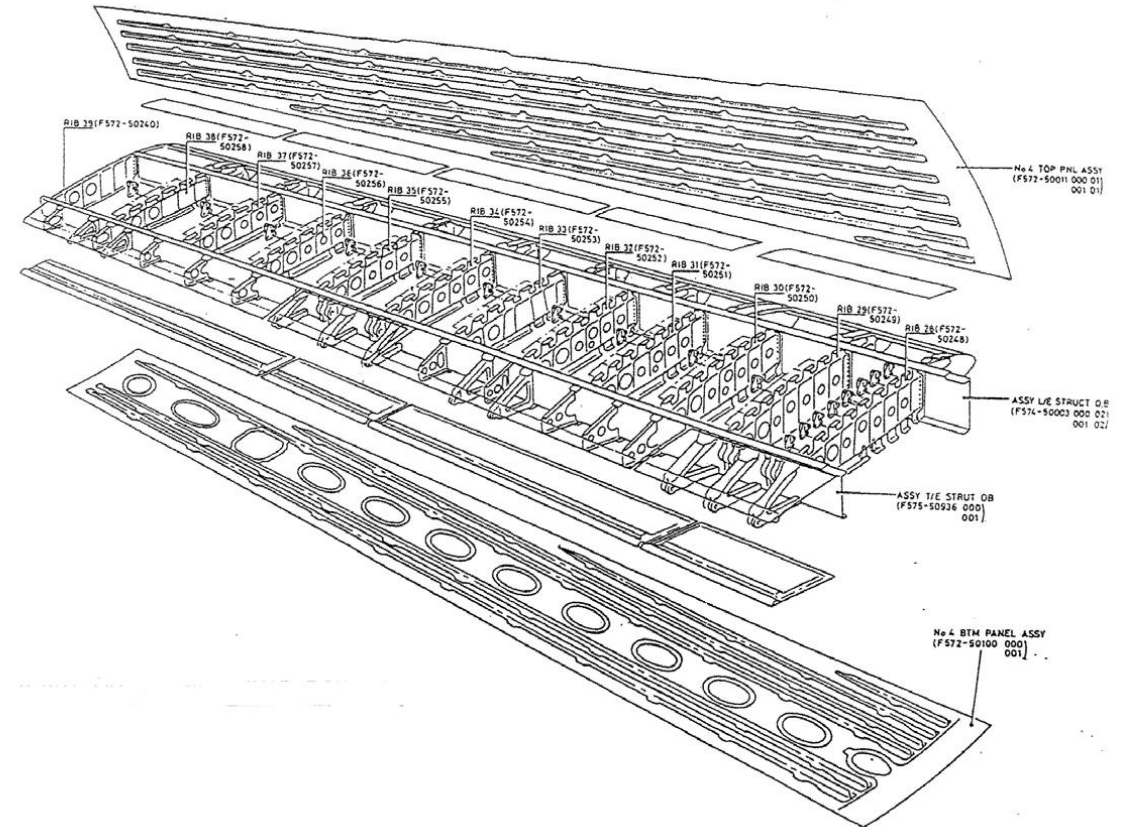
# WING STRUCTURES

- Concorde and A380 centre wing boxes



# WING STRUCTURES

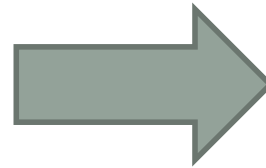
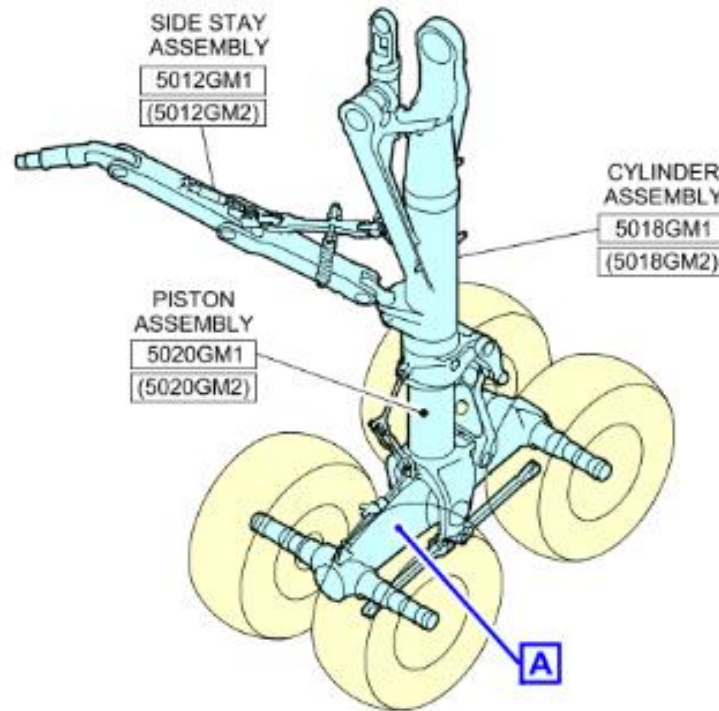
- A340 Outboard Wing Box Assembly



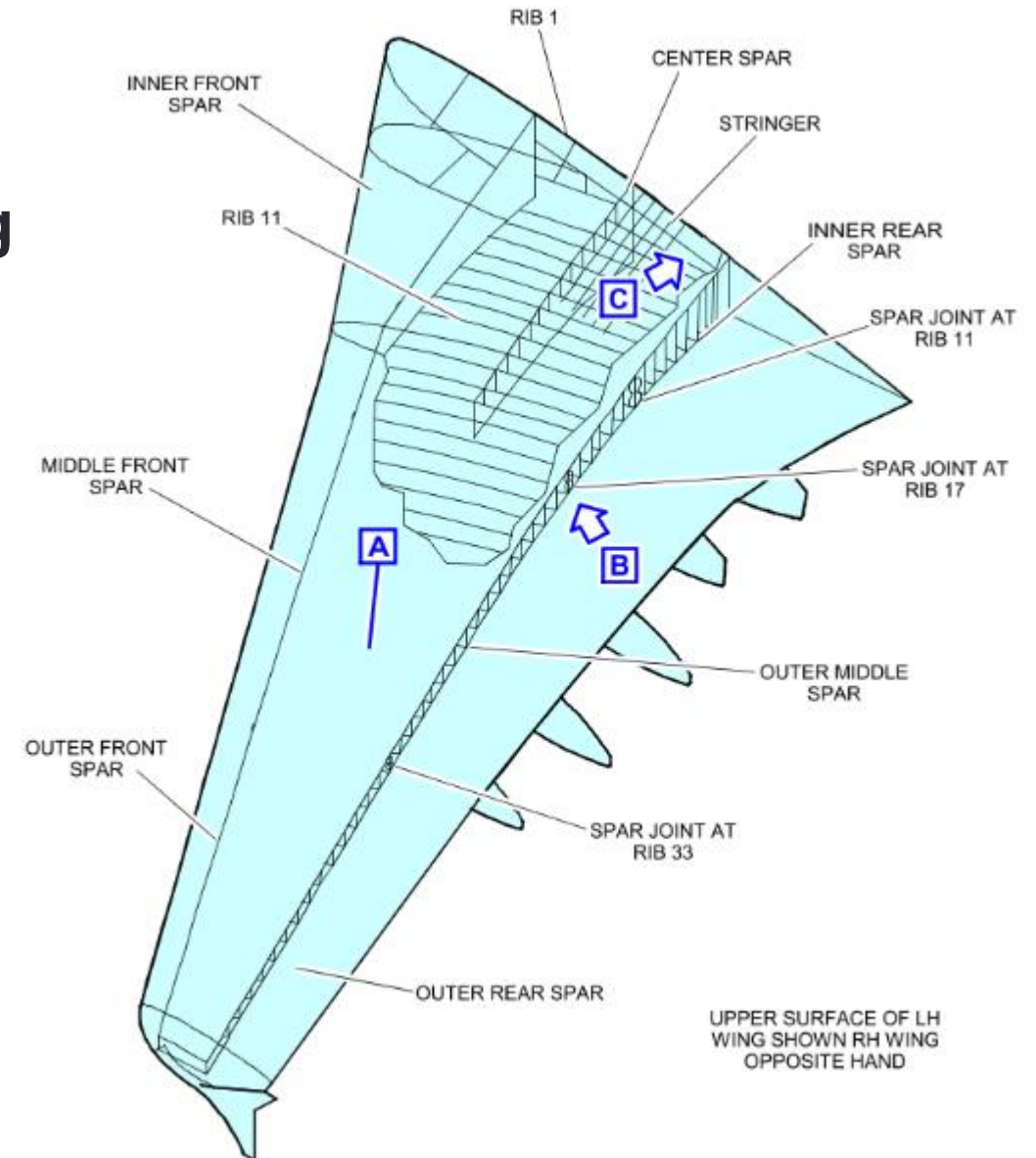


# WING STRUCTURES

- Attaching the Landing Gear to the wing



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# WING STRUCTURES

- A380 Gear support rib

