INTRODUCTION TO AIRCRAFT STRUCTURES

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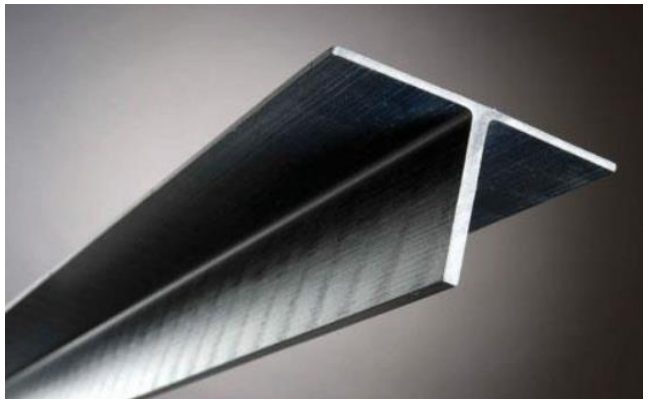
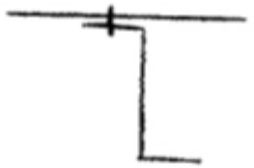
INTRODUCTION TO AIRCRAFT STRUCTURES : FUSELAGE STRUCTURES – TYPICAL CONSTRUCTION

Or ‘Building a structure to carry the fuselage loading’

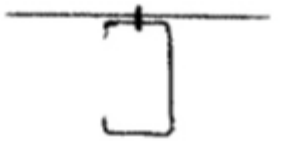
FUSELAGE STRUCTURES

- **Typical Stringer Configurations**
- **Axial & bending load carrying sections**

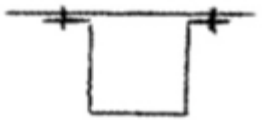




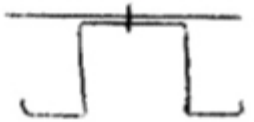
Z Section



Channel Section



‘Top Hat’ or ‘Omega’ Section



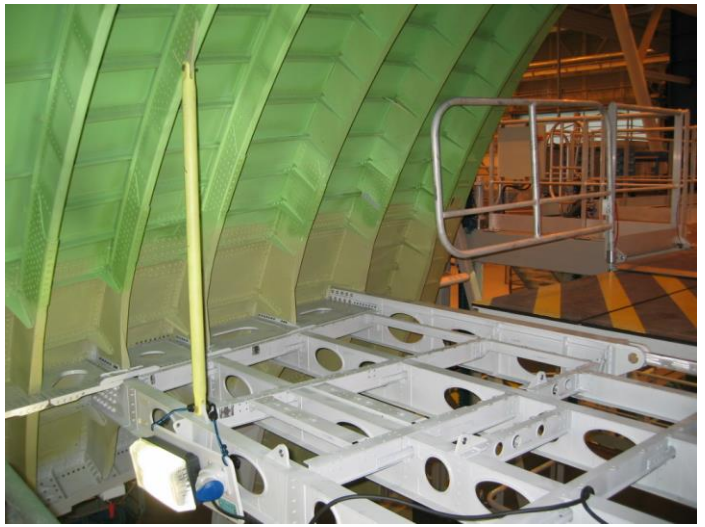
‘Inverted Top Hat’ Section

FUSELAGE STRUCTURES

- **Factors Affecting Selection of Stringer Sections**
- Need high second moment of area for buckling resistance
- Avoid localised buckling of individual walls – maintain reasonable l/t ratio
- Open sections very poor for carrying torsional loads – need a closed section
- Closed section more susceptible to corrosion, and harder to inspect

FUSELAGE STRUCTURES

- **Typical Frame Configurations**
- Frames are referred to as ‘Light’ or ‘Heavy’ depending on the load level they carry

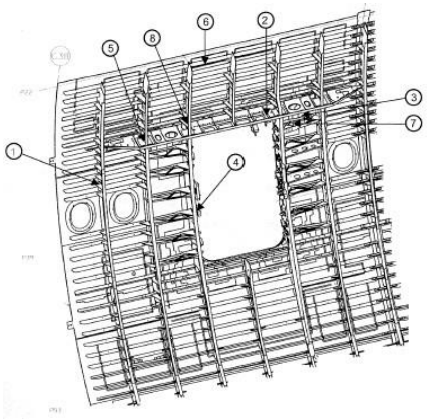


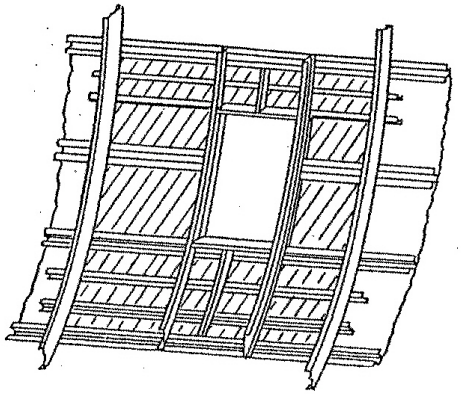
FUSELAGE STRUCTURES

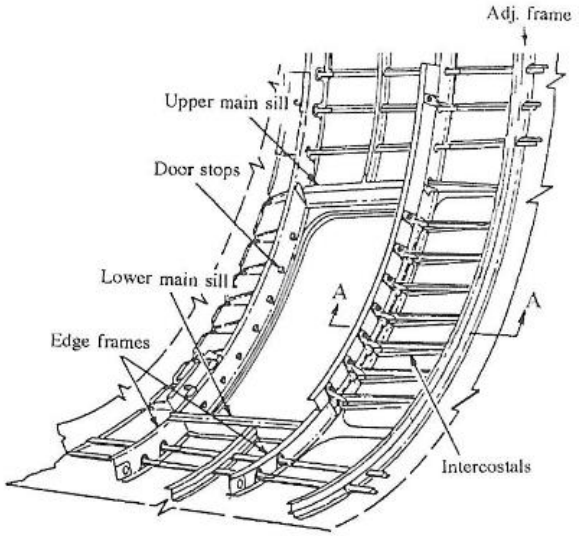
- **Frame Design Considerations**
- Light fabricated frames can be used where loads are low
- Heavy machined or forged frames required at major load introduction points e.g. wing, engine or undercarriage attachment
- Normally desirable to have continuous stringers, but large cut-outs weaken frames
- Floating frames (not directly attached to skin) allow continuous stringers without introducing notches in frames
- Frames carrying significant shear may need web stiffeners to resist shear buckling
- Flanged lightening holes improve shear buckling resistance and reduce weight

FUSELAGE STRUCTURES

- **Cutouts**
- Need to provide:
  - Frame structure around cutout to carry pressure loads
  - Alternative load paths for interrupted stringers
  - Reinforcement to carry redistributed skin loads

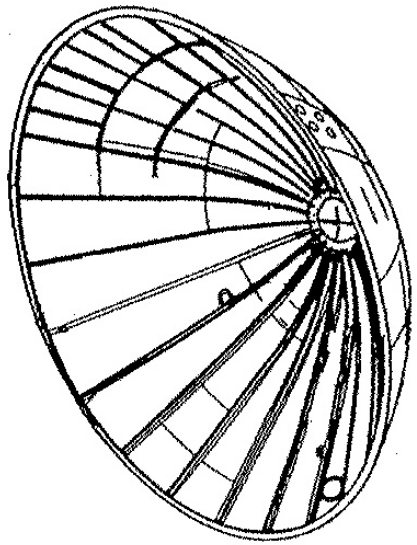




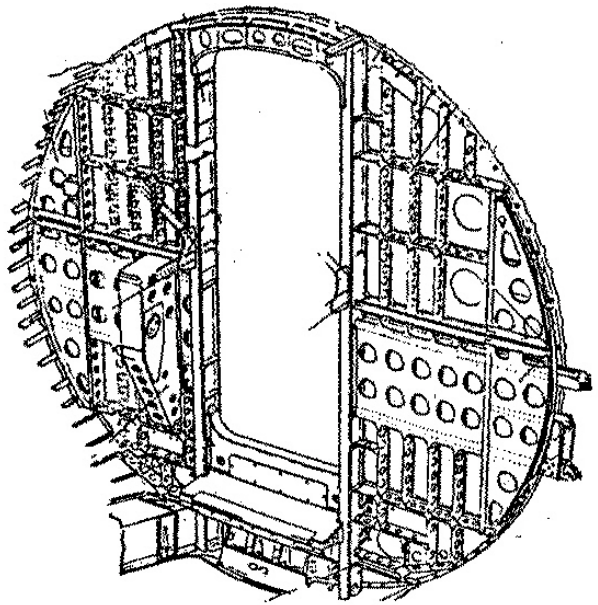


FUSELAGE STRUCTURES

- **Pressure Bulkheads**



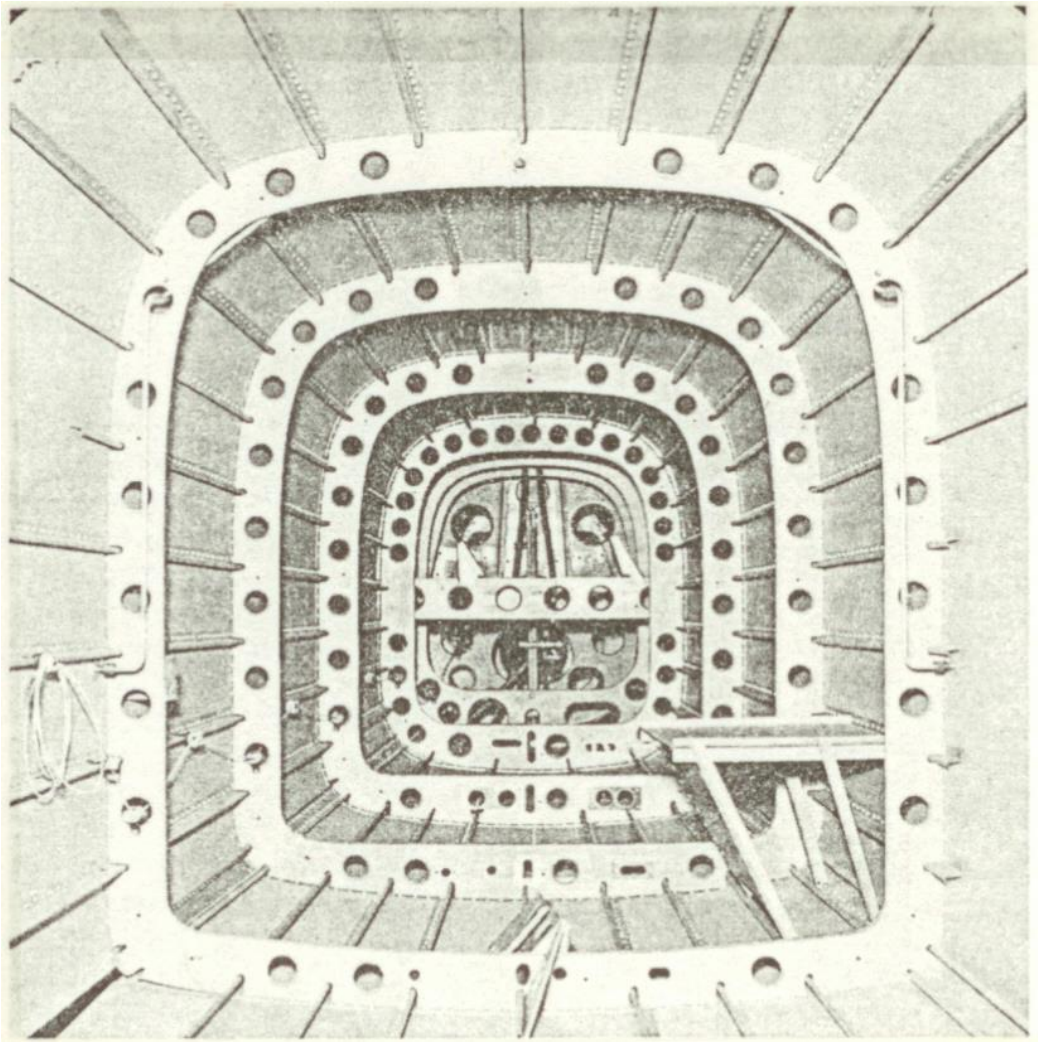
Domed



Flat

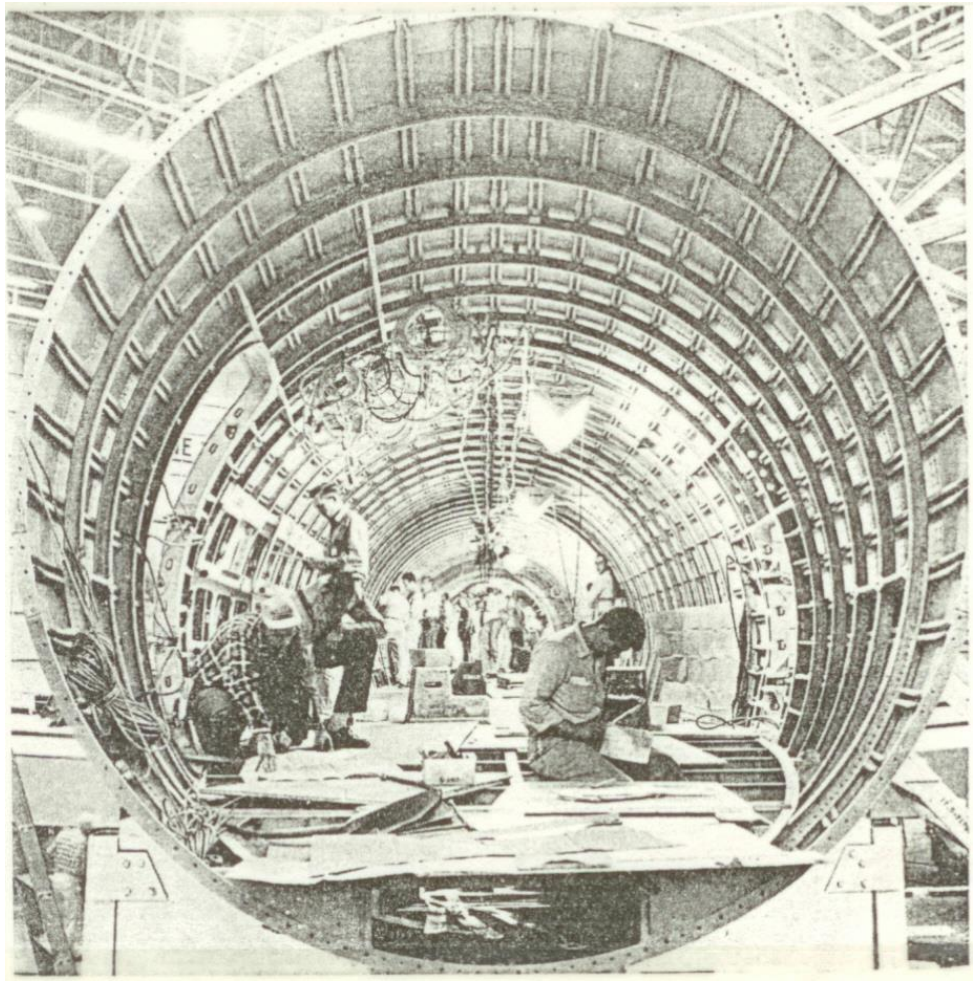
FUSELAGE STRUCTURES

- **Classical Fuselage Structures**
- **Beechcraft Twin-Bonanza – 1950's**



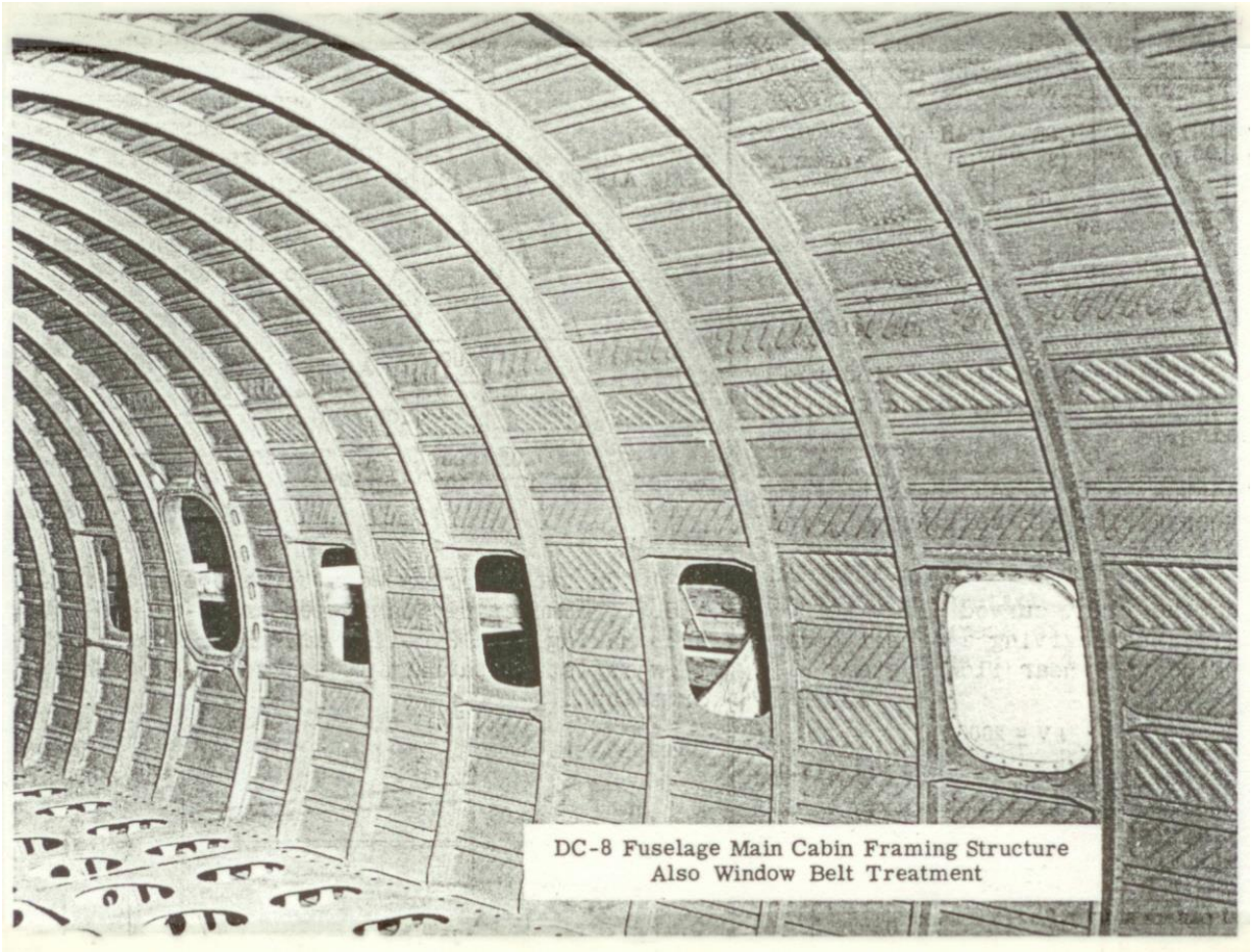
FUSELAGE STRUCTURES

- **Classical Fuselage Structures**
- **Boeing 707 – Late 1950's**



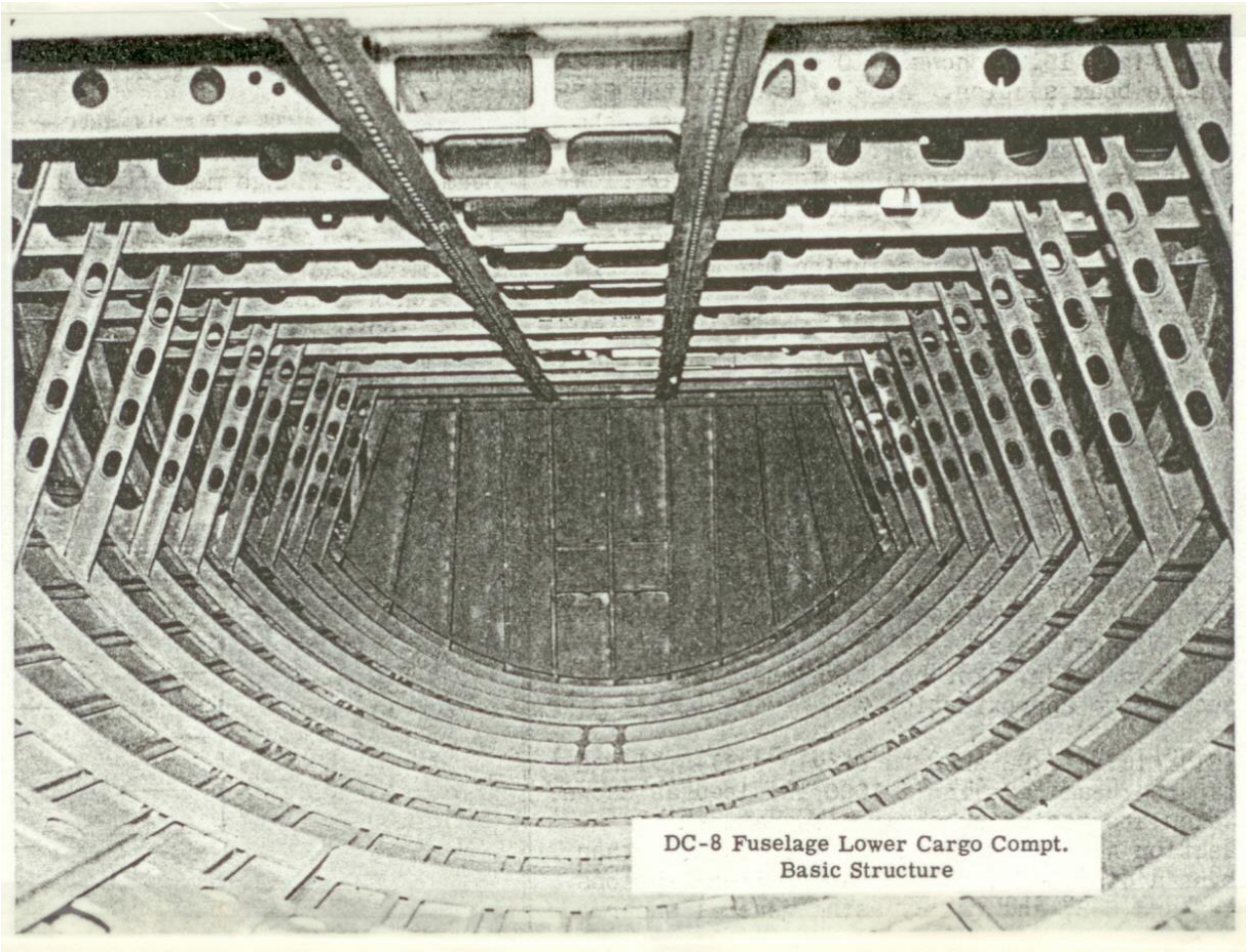
FUSELAGE STRUCTURES

- **Classical Fuselage Structures**
- **Douglas DC 8 – 1960's**


DC-8 Fuselage Main Cabin Framing Structure
Also Window Belt Treatment

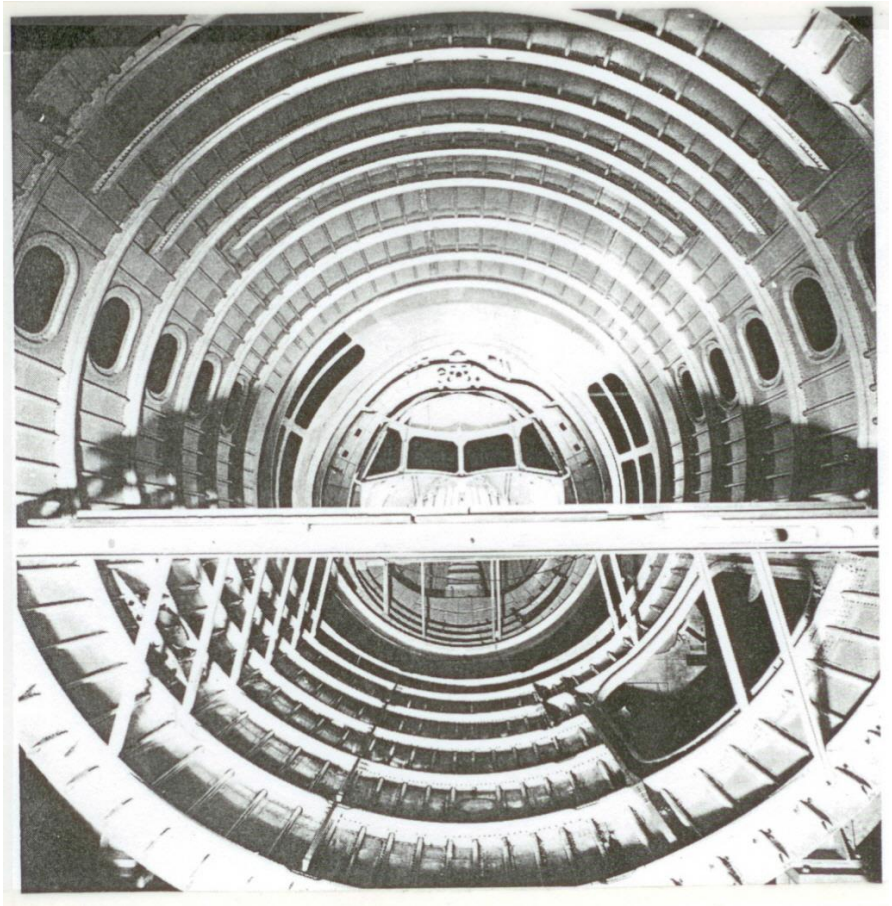
FUSELAGE STRUCTURES

- **Classical Fuselage Structures**
- **Douglas DC8 – 1960's**



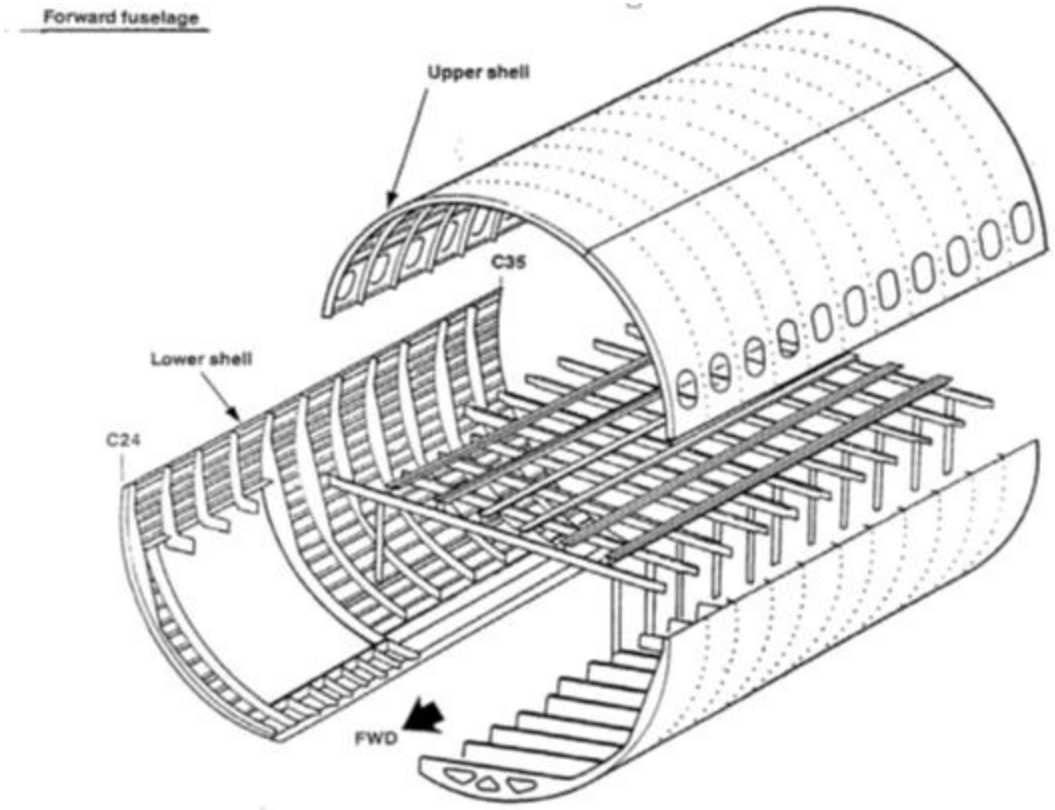
FUSELAGE STRUCTURES

- **Classical Fuselage Structures**
- **Bae 146 – 1980's**



FUSELAGE STRUCTURES

- **Typical Airbus Metallic Fuselage Construction**
- **A320 Family – 1980's**



INTRODUCTION TO AIRCRAFT STRUCTURES : A SPECIAL FUSELAGE

Or ‘Sometimes there is a need to design a very special fuselage’

LARGE AIRFRAME STRUCTURES

- **Airbus Beluga**
- **‘Super Transporter’**

LARGE AIRFRAME STRUCTURES

- **Airbus Beluga**
- **‘Super Transporter’**

LARGE AIRFRAME STRUCTURES

- **Airbus Beluga ‘Super Transporter’**

LARGE AIRFRAME STRUCTURES

- **Airbus Beluga**
- **‘Super Transporter’**

INTRODUCTION TO AIRCRAFT STRUCTURES : HELICOPTER AIRFRAME

Or ‘A different type of flight vehicle structure’

HELICOPTER STRUCTURES

- **AW101 Airframe**

HELICOPTER STRUCTURES

- **AW101 Airframe – Main Cabin**

HELICOPTER STRUCTURES

- **AW101 Airframe – Cockpit / Fwd Fuselage**