New Boeing 787 & Airbus 380 aircraft
Throughout history, people watched birds in flight and dreamed of joining them. Inventions such as hot-air balloons and gliders were a start. But powered, controlled flight was just a dream until 1903, when Orville and Wilbur Wright made their first successful flight. Since then, dreamers like the Wrights have created and flown aircraft that have revolutionized the way people live, work, and learn.

**Flying Machines**

**Dreamers Who Made a Difference**

**To Learn More**
Introduction

• The History of Boeing & Airbus Companies
• Analyze Boeing and Airbus structures
• Describe the types of Boeing & Airbus aircraft
• Description and analysis of aircraft material and corrosion treatment
• Boeing aircraft accident investigation
• Discussion and analysis of Boeing 787 and Airbus 380 trend from aluminum to composite structures
The History of Boeing

The first Boeing Company established by William E. Boeing in 1916

- In 1916 William Boeing & Navy Lt. Conrad Westervelt designed the B & W Seaplane

- The headquarters of Boeing Company at Seattle in USA

- The Boeing production lines are at Seattle
  - Sub Contract (eg: China / Japan)
In war years: 1939-45

- B17 Flying Fortress
- XPBB-1 Sea Ranger
- B-29 Superfortress
- Streaman Kaydet
- XFBB-1 Fighter-Bomber
Boeing DC-3 (C47 model)

The DC-3 is one of Douglas’s oldest aircraft in 1936.

- Wingspan: 95.6 ft
- Length: 63.5 ft
- Height: 17 ft
- Service ceiling: 24,000 ft
- Normal range: 3,800 miles / Max range: 3,800 miles
- Weight: 31,000 pounds
- Speed: 160 mph
- Two 1,200 horsepower for DC3 engines
- 3 crews / 6,000 pounds of cargo for military aircraft
DC3 Aircraft
DC3 cockpit
Boeing & Airbus
Aircraft
Structure
Boeing & Airbus types of aircraft

Boeing types of aircraft models include as:
• DC3-6, B707 > B717 > B727 > B737 > B747 > B757 > B767 > B777
  MD11 > B787

Airbus types of aircraft models include as:
• A300 > A320 > A321 > A330 > A340 > A350 > A380
Aircraft Zones

There are many different zones on Boeing & Airbus aircraft. It are divided into 6 areas.

- Cabin & Upper Deck
- Fwd & Aft & Bulk Cargo Compartment
- Wing
- Nose & Main Landing Gears
- Pylon & engine
- Tail Area (include Fin & Rudder)
Aircraft Zones

- Lower Shell Centre Wing
- Rear pressure bulkhead
- Inner flap lower skin
- Fuselage skin
- HTP & VTP leading edges
- Main L/G roof
- Bulk cargo floor panels & liners
- Main L/G bulkheads
- Nose L/G roof
- Belly fairing
- Slats
- Engine nacelle
- Cargo hold
- Wing fixed leading edge
- Winglet skin
- Lower wing skin
- Pressurised cockpit floor
Aircraft Structure

- Longitudinal Splice Joint
- Circumferential Joint
- Shear Clip End to Skin Attachment
- Aft Pressure Dome
- Pressure Bulkhead Attachment
- Fuselage Frames
- Stringer to Frame Attachment
- Over Wing Fuselage Attachment
Boeing 747 lower skin & wing center section replacement
Boeing Commercial Airplanes designed and built a full-scale twin-aisle fuselage section, which it will subject to a full set of fatigue loads such as body bending and shear, floor loading and pressure in the months ahead.
Aircraft Structure on Body Skin
Aircraft Material

- Aluminum 75% uses on fuselage skin & aircraft structures
- Composite 10% uses on fuselage fairings, wing L/E fairings & panel
- Steel 9% uses on aircraft components
- Titanium 5% uses on pylon & engines
- Miscellaneous 1% uses on minor areas
Aircraft Corrosion
Corrosion Cause

Current diagram illustrates the process of corrosion, focusing on the reaction between aluminum and its surrounding environment. The diagram highlights the role of potential difference (ΔE), the interaction between aluminum and nonmetallic substances, and the presence of water, sodium hydroxide (NaOH), chloride ions (Cl⁻), and hydrogen ions (H⁺). The process involves the transfer of electrons (e⁻) through the metal, leading to corrosion.

Key elements of the diagram include:
- Water
- Cathode
- Na⁺, OH⁻ (alkaline)
- Potential difference (ΔE)
- Aluminum or nonmetallic substance
- Cl⁻, Al³⁺, H⁺ (acid)
- Aluminum (corrosion)

The diagram provides a visual representation of the corrosion mechanism, emphasizing the critical factors that contribute to the corrosion process.
Exfoliation corrosion of 705T6 fuselage Stringers
Stress Corrosion Cracking of a 7079T6 Forging
General Corrosion of 2024T3 on Clad Skin
Pitting Corrosion of a 7075T73 Forging
Aluminum Material Change To CFRP
Aircraft Material

Boeing company uses many types of materials in the primary and secondary structures include as:

- 2024T3 (aluminum clad)
- 7075T6 (aluminum clad)
- AISI301 (stainless steel)
- 4130 or 4340 (steel)
- 15-5ph & 17-4 ph (steel)
- AMS4901 (titanium)
Composite Material

Composite material includes as:

- Fabric glass material uses to repair the parts including wing trailing & leading edge panel, floor panel & body fairing).
- Honey comb material uses floor panel, body fairing & wing panels and galley partition).
- Graphite reinforced plastic or carbon reinforced plastic (CFRP or CRP) uses some major structural area (eg: B777 cabin lateral floor beam structure)
Carbon Fabric Reinforced Plastic (CFRP) Improvement

- **Boeing 777** designs CFRP on cabin floor beam attaches vertical frame area
  a) Advantage:
     - strong, light, corrosion resistance & cost effective
  b) Application:
     - airplane, automotive, sailboats & bicycles
  c) Recycling
Composite Solutions Applied Throughout the 787

- Carbon laminate
- Carbon sandwich
- Fiberglass
- Aluminum
- Aluminum/steel/titanium pylons

- Steel 10%
- Titanium 15%
- Aluminum 20%
- Other 5%
- Composites 50%
Boeing 717
Boeing 737
Boeing 747
Boeing 757
Boeing 777
Boeing MD11
Boeing Accident Case
Boeing 747 accident case

Several people died in this accident.

Aircraft experts investigated the causes of the accident and found that aft bulkhead had cracks on the aluminum doublers area.
Boeing 747 Investigation

Fuselage Lower Skin @ Lap Joint (Externally Hidden Detail)

Frame Shear Tie

First Initiation (Hole 9)

Externally Visible Portion of Crack
Boeing 747 accident case
Accident case
Airbus Structure and Trend
The History of Airbus:
- Airbus established in Dec 1970.
- Place: Toulouse, France
- Employees – 52,000

Operations:
France, Germany, Spain and U.K.

Main subsidiaries:
- Airbus North America
- Airbus China
- Airbus Japan
- Airbus Transport International

Training Centers:
- Toulouse (France)
- Miami, Florida (USA)
- Beijing (PRC)
Airbus Operations

• The Manufacturing Units:

- Cabin Interiors (Germany)
- Fuselage (France)
- Wing (England)
- Pylon/ Engine (France)
- Tail (Spain)
Airbus 300

- In 1970 the first of Airbus 300 designed and manufactured in France.
Airbus Composite Structures

• The Airbus Company designs the A380, adopting carbon fabric reinforced plastic material in different zones area. It includes the primary and secondary structures areas.

• In the past, all aircrafts used the fabric glass and honey comb panels to repair in the areas. For example:
  a) Fabric glass – it uses on bond skin area such as wing trailing panel and stabilizer panels
  b) Honey comb panels – it uses to repair on floor panels, air cooling ducts and galley partitions.
Major monolithic Carbon Fiber Reinforced Plastic (CFRP) and Thermoplastics applications

- Upper Deck Floor Beams
- CFRP Vertical Tail Plane
- Tail cone
- CFRP Outer Flaps
- Un-pressurized Fuselage
- Wing ribs
- Horizontal Tail Plane
- Landing Gear Doors
- Engine Cowlings
- Center Wing Box
- Flap track panels
- Rear Pressure Bulkhead

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A380 types
Airbus Manufacturing Fields
Airbus 330
Airbus A340
Airbus A350
• Question &
• answers