MATERIAL FOR AIRCRAFT STRUCTURAL APPLICATIONS

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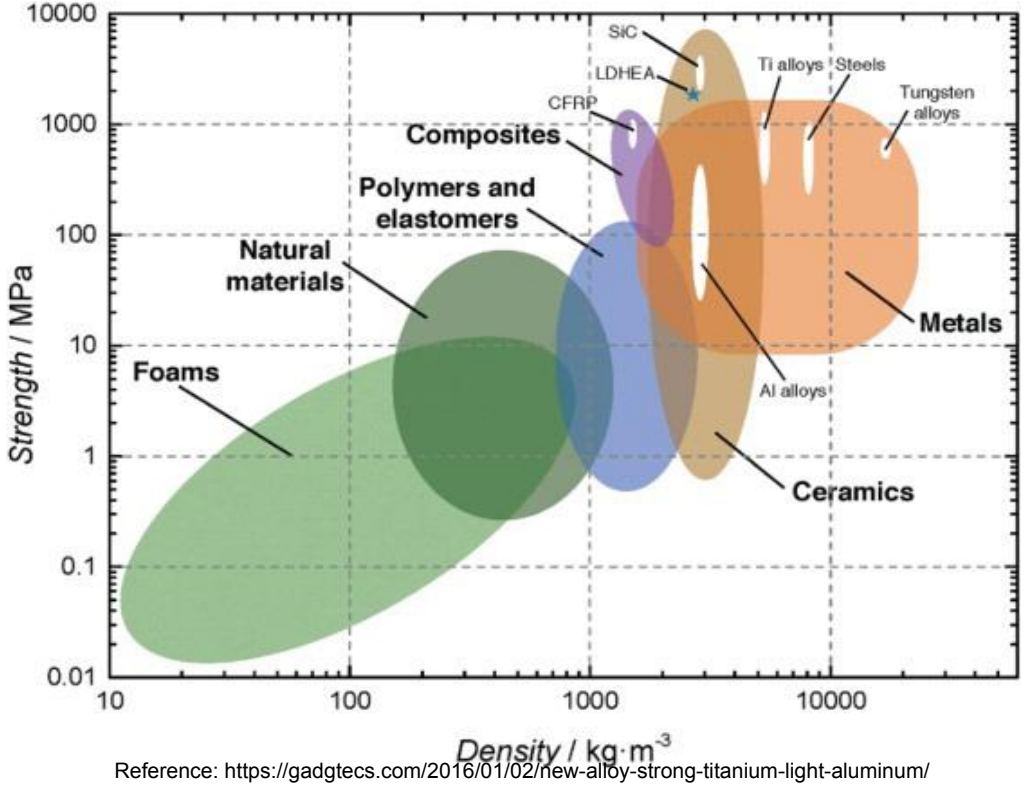
Material properties for aircraft applications

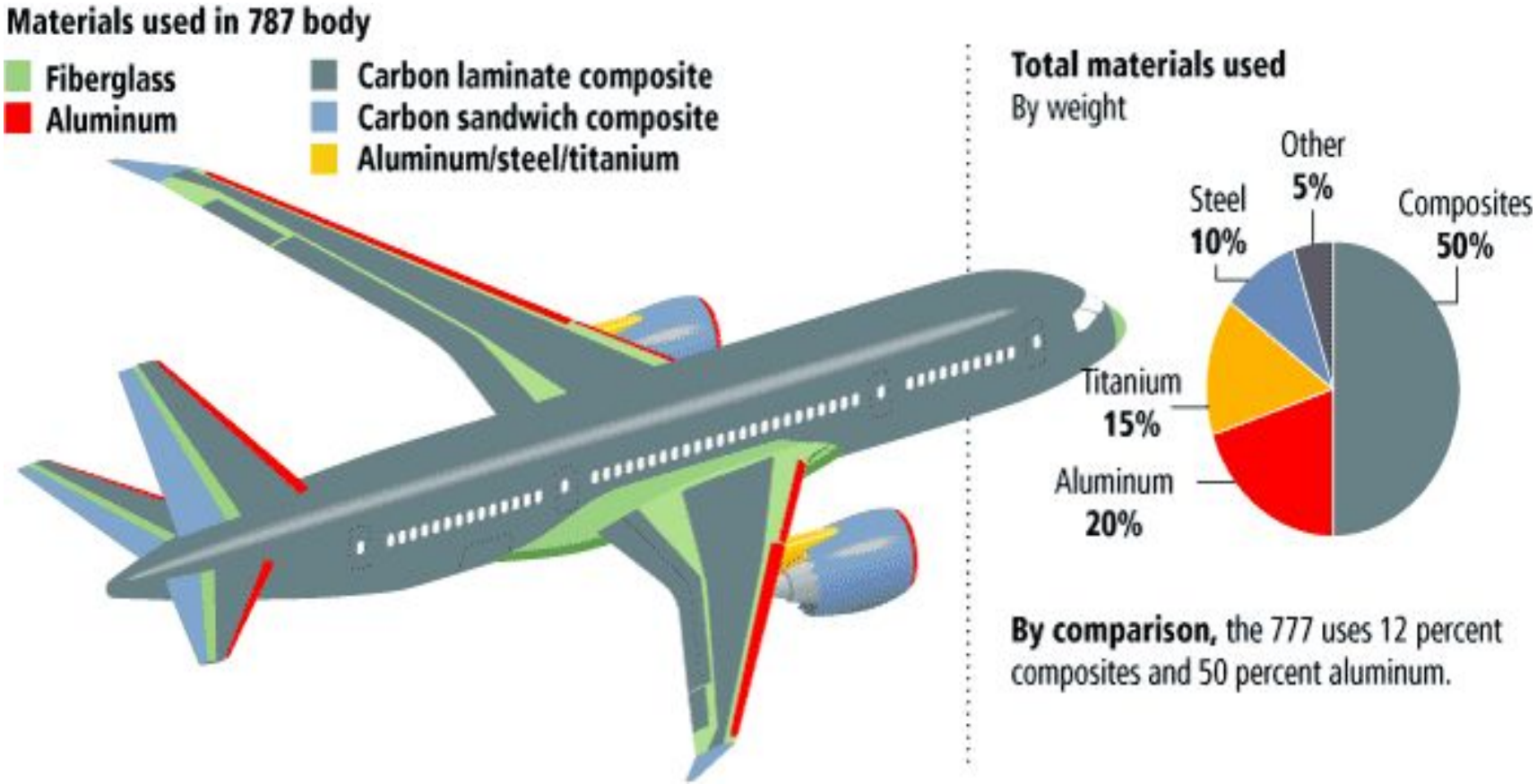
- Weight to strength ratio
- Good thermal capability
- Low coefficient of thermal expansion
- Resistance to corrosion and wear
- Crack resistance and fatigue load resistance

Material properties for aircraft applications



Reference: https://gadgtecs.com/2016/01/02/new-alloy-strong-titanium-light-aluminum/

- Due to their high strength to weight ratio Aluminium, Ti alloys and composite materials are the major manufacturing materials for aircrafts



Reference:
http://aviation.stackexchange.com/questions/12958/what-materials-make-up-most-of-the-weight-of-an-aircraft

Timeline of aircrafts

The Wright Flyer

- Material used was spruce & ash wood with muslin covering the wings.
- Spruce wood has very favorable strength to weight ratio.

Al & Ni alloys

- Aluminum can be heated & easily molded.
- Nitinol used as vibration dampers as it is a shape memory alloy.

Use of carbon fiber

- It's incredibly light weight & strong.
- It was first used in passenger plane in 2003 by Boeing.

Nickel

- Immense strength at extremely high temperatures.
- Resistance to oxidation and corrosion.
- Low expansion at severe temperatures.
- Creep resistance under high stress conditions.

Aluminium

- The biggest advantage of Aluminium over other metals is its low density
- Lightweight and strong properties makes the aircraft fuel efficient
- It’s high resistance to corrosion ensures the safety of aircraft

Drawback

- It loses strength at high temperatures

Titanium alloy

- Lightweight yet strong, uniquely versatile metal with excellent weight-to-strength ratio resulting in fuel efficiency enhancement
- Highly resistant to corrosion
- Elevated and cryogenic temperature capabilities
- Low thermal coefficient
- Aerospace industry is the next largest user of Titanium and its alloys after chemical industry
- High cost limits its usage

Choice of Wood for Aircraft Use

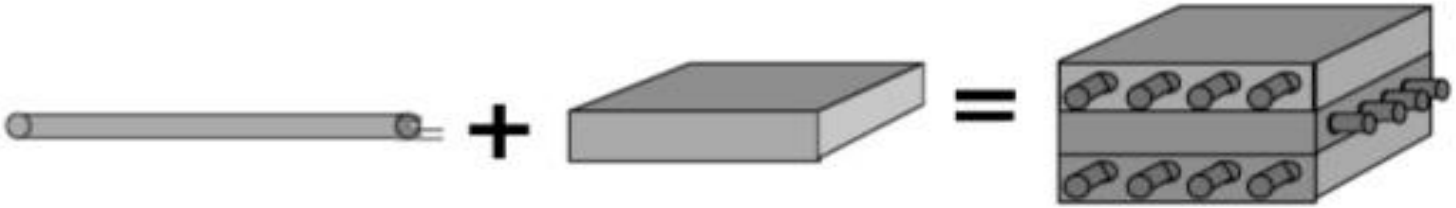
- Aircraft Structural Wood is cut from the tree in such a way that most of the grain lies at **45°** or more grains lies at **wide dimension** of the wood Plank.
- There are Certain Defects that aren't acceptable to be used such as Cross grain on the wood or using compression wood.

Types of Wood Used in Aircraft

- The Different types of wood used in aircraft includes: **Solid Wood**, **Laminated Wood** and **Plywood**.

Aircraft Totally Made of Wood (dH-98 de Havilland Mosquito)

- **dH- 98** (de Havilland Mosquito) entirely made of **Wood** and one of the fastest aircraft in 1941.
- Due to its Speed it was nicknamed as **The Wooden Wonder**.
- It was able to carry up to 1900 kg of Bombs.



Fiber/Filament Reinforcement

Matrix

Composite

- High Strength
- High Stiffness
- Low Density

- Good shear properties
- Low density

- High Strength
- High Stiffness
- Good shear properties
- Low density

Uses of composites in Aircraft Structures

- Use of composites, we are going to the new heights of safety, comfort and efficiency.
- Increasingly, the aircraft designers have been turning to composites.
- This makes the vehicles lighter, more fuel efficient and more comfortable for the passengers.
- Half of the Boeing 787 and the Airbus 350 are constructed of composite materials.
- Other manufacturers, like Bombardier, are adopting composites for many aircraft sections.

Pros of composites

- Composites offer a very high stiffness to weight ratio.
- Development of cracks in the structures can be prevented by use of composites.
- Composites do not corrode and are not subjected to fatigue.
- Increased comfort of the passengers.

Cons of using composites

- Composites make it difficult to find out the interior damages of the aircraft .
- Repairing also becomes very difficult.
- Composite structures weakens at temperatures as low as 150 degrees.
- Composite structures can be expensive.