Introduction to Composite Materials and Structures

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Lecture 1
Introduction

Overview of Lectures

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Lecture Overview

- What are “composites”?
- Importance and areas of application
- Classification
- Advantages of fiber-reinforced composites

What are “composites”?

- Composite: Two or more chemically different constituents *combined macroscopically* to yield a useful material.

- Examples of naturally occurring composites
  - Wood: Cellulose fibers bound by lignin matrix
  - Bone: Stiff mineral “fibers” in a soft organic matrix permeated with holes filled with liquids
  - Granite: Granular composite of quartz, feldspar, and mica

What are “composites”?

- Some examples of man-made composites
  - Concrete: Particulate composite of aggregates (limestone or granite), sand, cement and water
  - Plywood: Several layers of wood veneer glued together
  - Fiberglass: Plastic matrix reinforced by glass fibers
  - Cemets: Ceramic and metal composites
  - Fibrous composites: Variety of fibers (glass, kevlar, graphite, nylon, etc.) bound together by a polymeric matrix

These are not composites!

- Plastics: Even though they may have several “fillers”, their presence does not alter the physical properties significantly.
- Alloys: Here the alloy is *not macroscopically heterogeneous*, especially in terms of physical properties.
- Metals with impurities: The presence of impurities does not significantly alter physical properties of the metal.

Where are composites used?

- Automotive industry: Lighter, stronger, wear resistance, rust-free, aesthetics
  - Car body
  - Brake pads
  - Drive shafts
  - Fuel tanks
  - Hoods
  - Spoilers

Where are composites used?

- Aerospace: Lighter, stronger, temperature resistance, smart structures, wear resistance
  - Aircraft: Nose, doors, struts, trunnion, fairings, cowlings, ailerons, outboard and inboard flaps, stabilizers, elevators, rudders, fin tips, spoilers, edges
  - Rockets & missiles: Nose, body, pressure tanks, frame, fuel tanks, turbo-motor stators, etc.
  - Satellites: Antennae, frames, structural parts

Where are composites used?

- Sports: Lighter, stronger, toughness, better aesthetics, higher damping properties
  - Tennis
  - Bicycles
  - Badminton
  - Boats
  - Hockey
  - Golfing
  - Motorcycles …

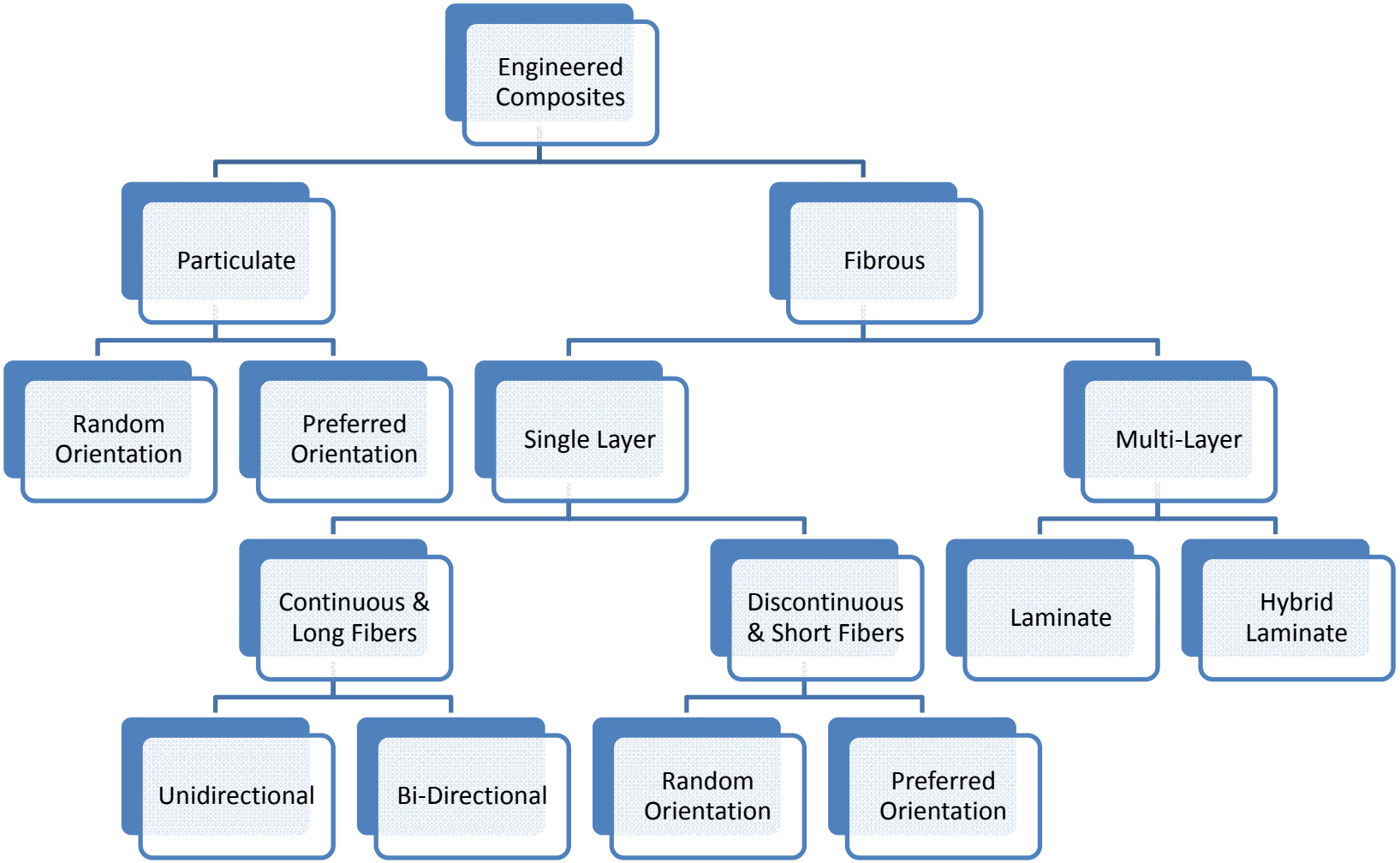
Where are composites used?

- Transportation & Infrastructure: Lighter, stronger, toughness, damping
  - Railway coaches
  - Bridges
  - Ships and boats
  - Dams
  - Truck bodies and floors
  - RV bodies

Where are composites used?

- And many more industry sectors
  - Biomedical industry
  - Consumer goods
  - Agricultural equipment
  - Heavy machinery
  - Computers
  - Healthcare

Classification of Composites



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