

Composites

Lesson 2

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

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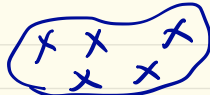
**Composites:** combination of two or more materials on a **macroscopic** scale to form a useful third material we have Composites.

→ the components can be identified by the naked eye.

metal alloys are made by combination of several materials

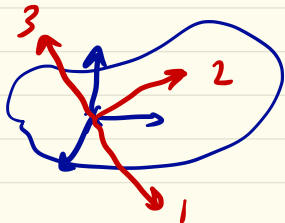
on a microscopic scale and the resulting material is macroscopically homogeneous

**Homogeneous body:** A homogeneous body has uniform properties throughout, i.e., the

properties are independent of position in the body. 

**Isotropic body:** It has material properties that are the same in every direction at a point in the body, i.e., the properties are independent of orientation at a point in the body.

**Anisotropic body:** The properties are different in different directions in a point.



# Composites based on the shape of the fiber

## 1- Fibrous composites.

- Long Fibers
- Short Fibers (chopped fibers)
- Fibers Tow
- woven fibers

## 2- Sandwich composites

## 3- Particulate composites

## Matrices:

1. PMC (Polymer matrix Composites) → { Thermoset  
Thermoplastic

- Low operating temperatures
- High CTE (coefficient of Thermal Expansion)  
and CME ( - - Moisture - )
- Low elastic properties in certain direction

2. MMC (Metal matrix Composites)

- Higher specific strength and modulus over metals
- Lower CTE than metals

- maintenance of high strength properties at high temperature.

### 3\_CMC (Ceramic matrix Composites)

- High strength, hardness and service temperatures
- Chemical inertness
- Low density

### 4\_CCC (Carbon-carbon Composites)

- Gradual failure
- withstand high temperatures
- Low creep at high temperatures
- Low density
- High Thermal and electrical conductivity
- Low CTE

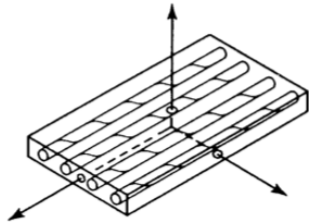
- High modulus
- Good thermal shock and abrasion resistance and fracture toughness
- Good Corrosion resistance

## Constituents of Fibers:

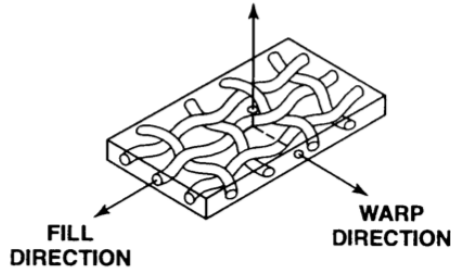
filament

1. Filament: The smallest constituent of fiber is
2. By gathering 3000-4000 filament together we have
  - strand (not twisted filaments)
  - yarn (twisted filaments)
3. Twisted strands (50-60) is Roving.
4. Weaved Roving is woven.
5. Weaved strand is cloth.

**Laminae:** The basic block of a laminate is a lamina which is a flat (sometimes curved as in shell) arrangement of unidirectional fibers or woven fibers in a matrix



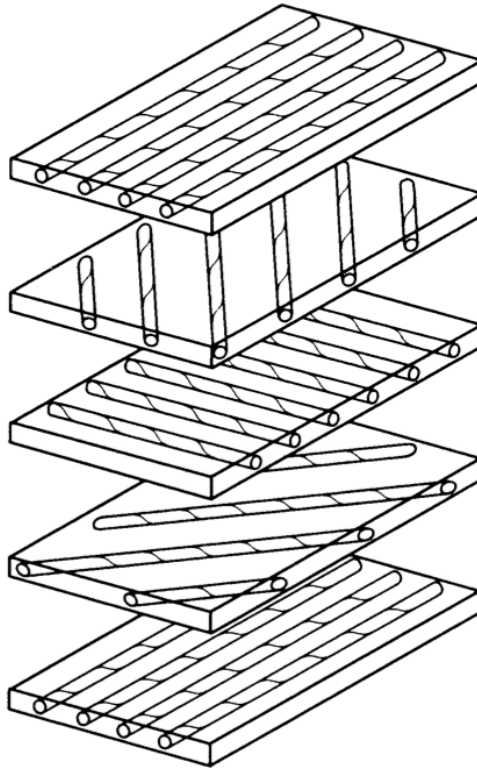
**LAMINA WITH  
UNIDIRECTIONAL FIBERS**



**LAMINA WITH  
WOVEN FIBERS**



**Laminates:** A laminate is a bonded stack of laminae with various orientations of principal material directions in the laminae.



**micromechanics:** Micromechanics is the study of composite material behavior wherein the interaction of the constituent materials is examined on a microscopic scale to determine their effect on the properties of the composite material.

**macromechanics:** Macromechanics is the study of composite material behaviour wherein the material is presumed homogeneous and the effects of the constituent materials are detected only as averaged apparent macroscopic properties of the composite material.