By Dr. Nitika Kundan

Saathi

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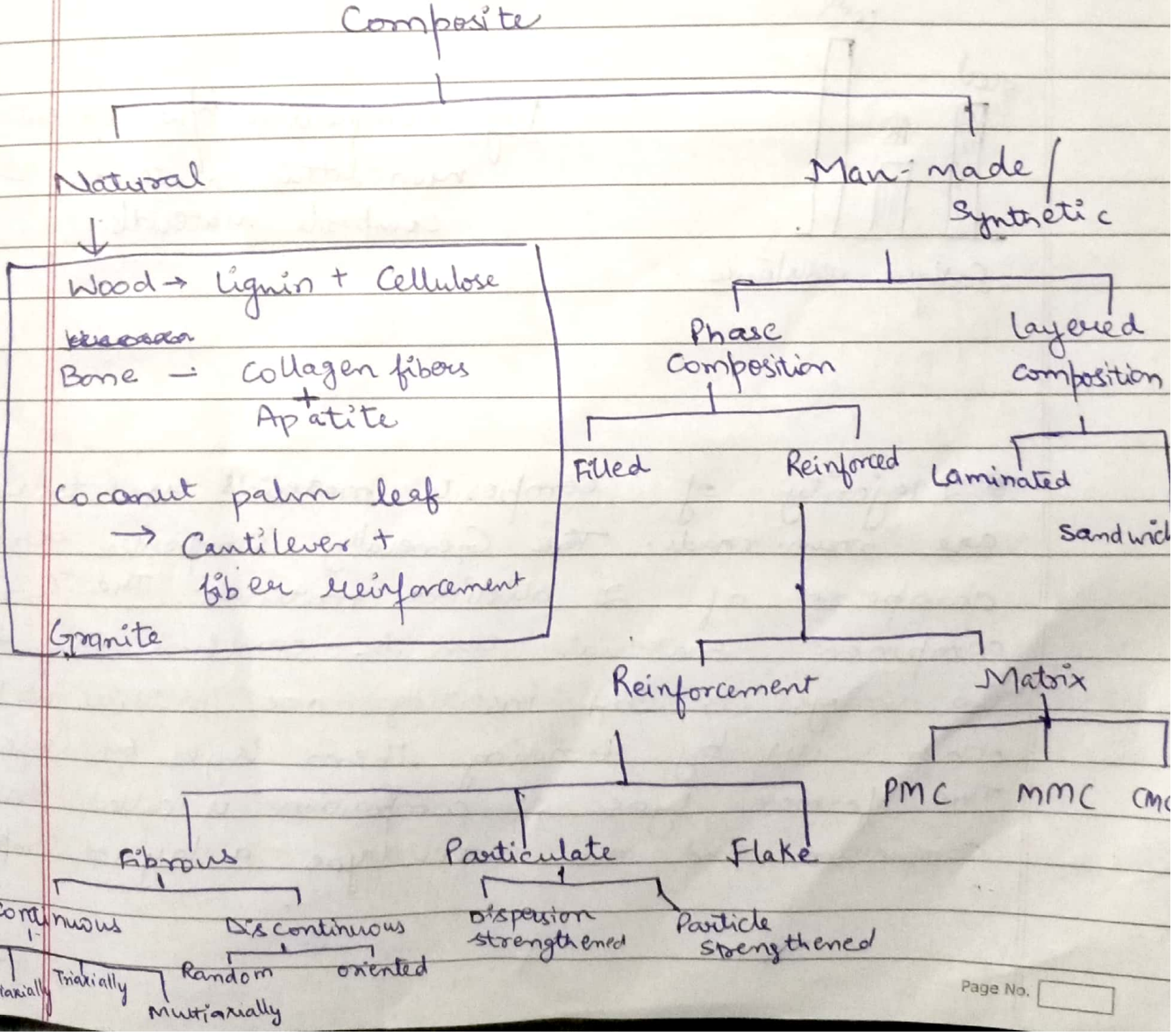
Composite Materials

Chapter 1: Introduction

Definition

A composite can be defined as a combination of two or more dissimilar materials having a distinct interface between them such that the properties of the resulting material are superior to the individual constituting components.

Composites consists of two phases, 'the matrix' which is continuous and surround the discontinuous phase, the reinforcement.



Man-made composites

→ carbon black in rubber
→ portland cement
→ asphalt + sand
→ plywood
→ Fibre glass

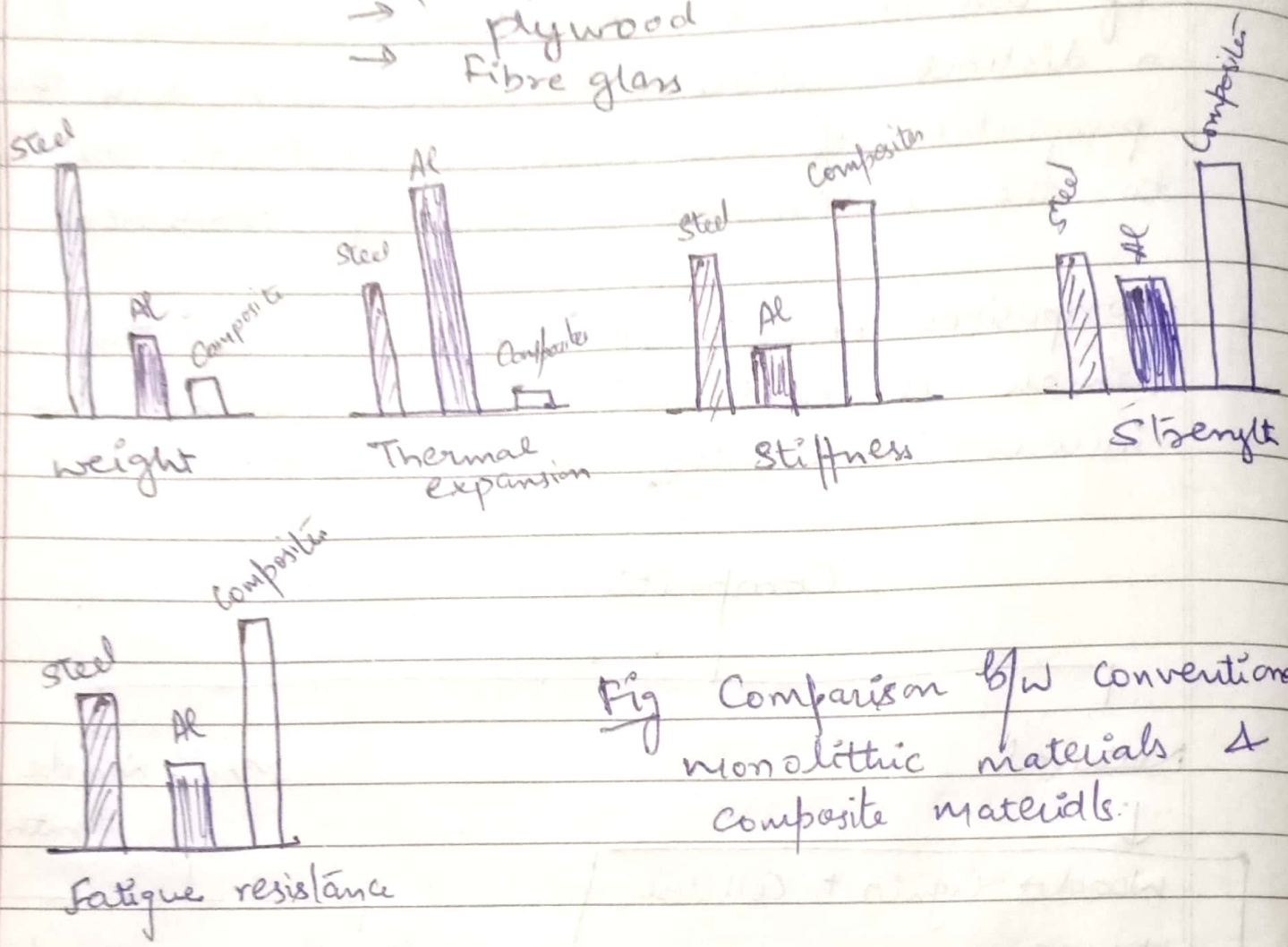
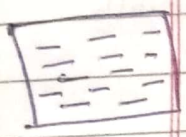
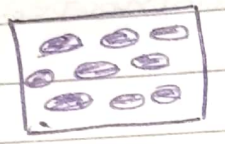
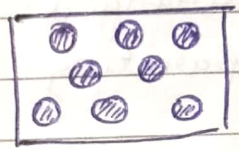
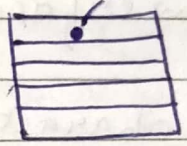
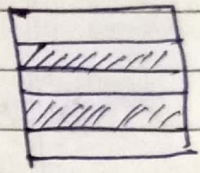
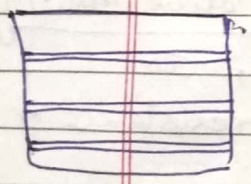
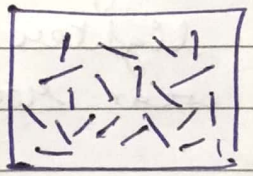
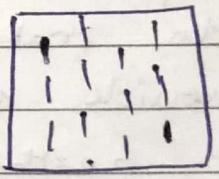


Fig Comparison b/w conventional monolithic materials & composite materials.

Majority of composite materials used today are man-made. Generally composites are composed of 2 distinct materials. The two component materials can be combined only by two ways (i) by inserting one material into the other (ii) by bonding them layer by layer. The former type of composition is called phase composition and the latter type a layered composite.

Composites

- Phase composites
  - Fibrous
    - Continuous fibre
      - Oriented fibre
        - Uniaxial
        - Biaxial
        - Triaxial
        - Multiaxial
    - Discontinuous fibre
      - Random fibres
      - Oriented fibres
  - Flake
  - Particulate
- Layered Composites
  - Laminated (Lamina)
  - Sandwich

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We shall call a material that satisfies the following conditions a composite material:-

1. It is manufactured (i.e. naturally occuring composites, such as wood, are excluded).

2. It consists of two or more physically and/or chemically distinct, suitably arranged or distributed phases with an interface separating them.

3. It has characteristics that are not depicted by any of the components in isolation.

Applications of Composites

- Composites are heavily used in Automotive Industry to make things lighter in weight, to provide strength, wear resistance, rust resistance or for aesthetic
  eg for car body, brake pad, drive shafts, fuel tank, hoods (bonnet), spoilers etc.

- Aerospace sector: Light
  Strong
  Temp. resistance
  Smart structures
  wear resistance

  In Aircraft → nose, doors, struts (structural member that takes lot of load), cowling, trunnion, fairings, ailerons, flaps (wings part), stabilizers, fin tips, spoilers, etc

Page No.

Date __/__/____

Saathi

In Rockets & Missiles
↓
highly ~~more~~ engineered composites are used
↓
nose, body, pressure tanks, fuel tanks etc

In satellites
↓
frame (takes all the load of satellite so it has to strong but also needs to light in weight), and other structural parts, antenna (smart material)

- computers
- very frequently in sports : Light & Strong, aesthatics, high damping → Tennis, bikes, badminton rackets, boats, hockey, golf etc.
- Transportation, Infrastructure → light, strong, tough, more damping → ships, trucks, SUVs, bridges, railway coaches, dams, etc.
- Heathcare Industry
- Biomedical Industry eg artifical legs
- Consumer goods
- Agricultural Equipment and various other areas

Page No.