

STRUCTURE

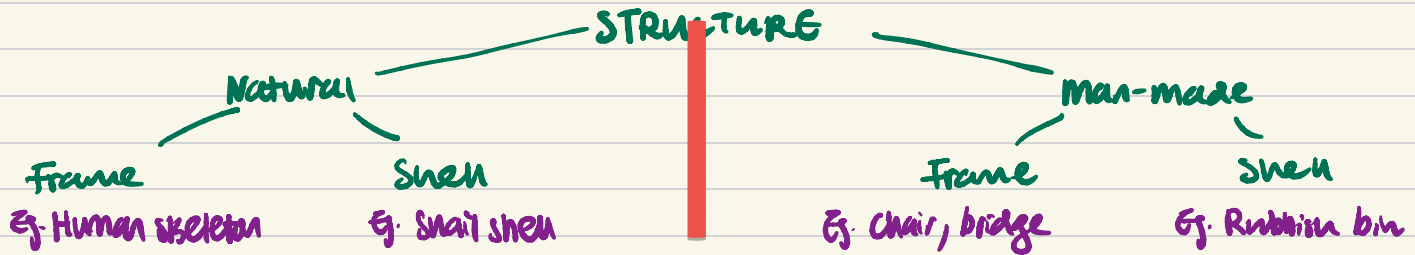
- an object that can support its self-weight & external loads without collapsing.

Purpose

- resist force
- hold different parts together
- not to collapse during usage

Functions

- Support
- Span
- contain
- protect



Frame : Framework, minimal materials used, Strong

Shell : Outer layer → strength

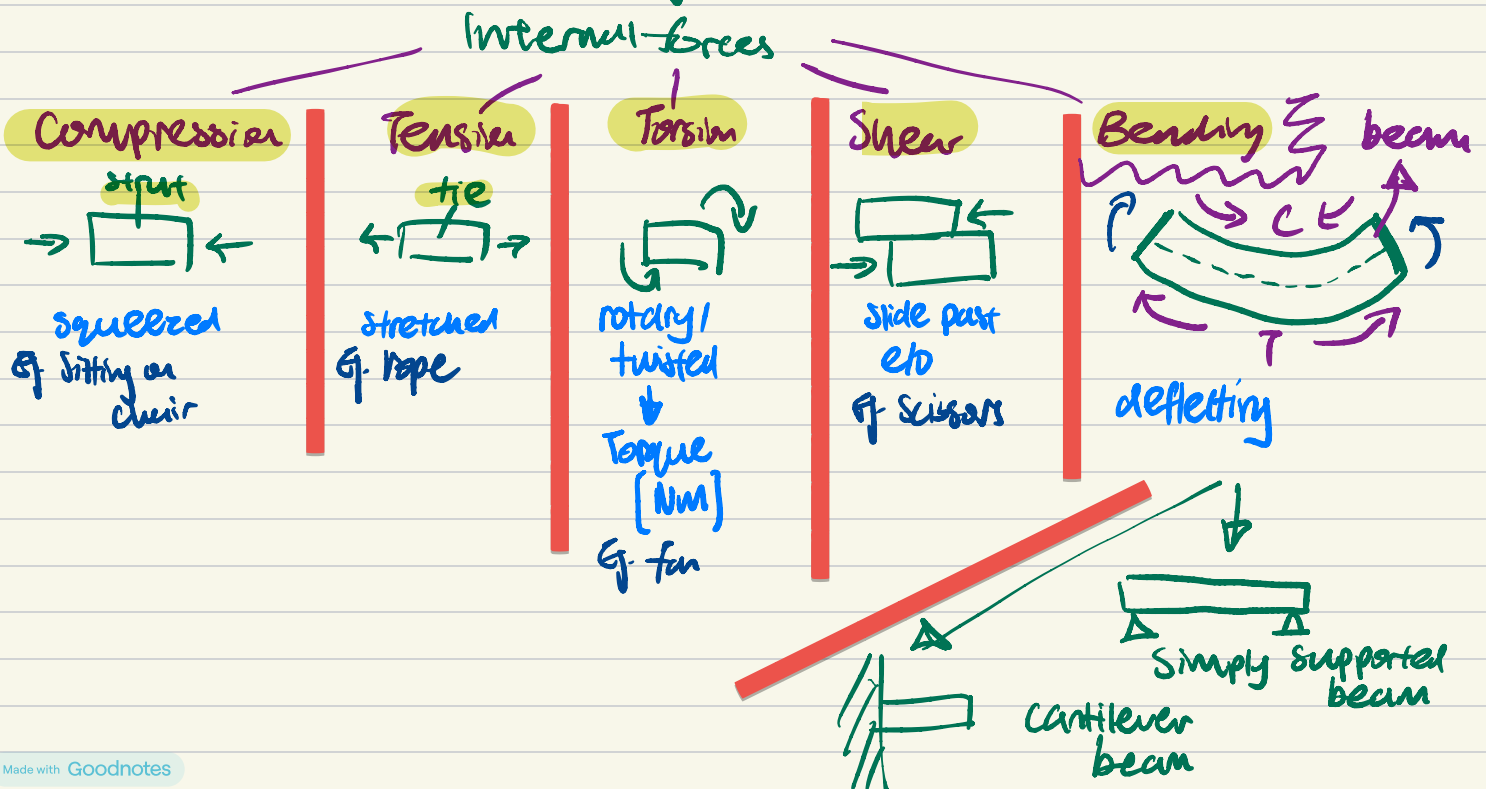
FORCES

Static
constant
size/
direction/
position

dynamic
changing
size/
direction/
position.

External
Forces act on
structure from
outside.

Internal
Forces acting within
structure → resist
external forces



STRUCTURE

Structure in Equilibrium

Total downward force

=

Total upward force

And

Total clockwise G moments

=

Total anti clockwise G moments

$\perp$: perpendicular

Moment of force

Moment = force $\times$ $\perp$ dist from fulcrum

Structural failure

- not able to resist forces acting on it
- unstable / deformed / break apart

REASONS:

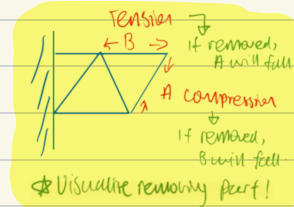
- wrong design calculation
- excessive loads
- joint failure
- defective construction : poor workmanship
- wrong choice in use of materials

Reinforcing Structures

- for rigidity $\rightarrow$ withstand deformation / bending

1. Triangulation (Strut/Tie) - Trusses

- $\Delta \rightarrow$ strongest shape $\rightarrow$ very strong/rigid $\rightarrow$ do not deform/bend easily.



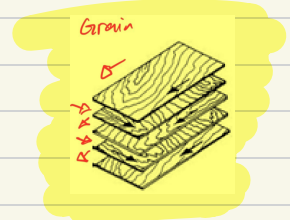
2. Stiffened folds : body

- weak thin sheets $\rightarrow$ stiffened by folds / rolls.
- Eg trays, disposable plates



3. Lamination : body

- weak thin material $\rightarrow$ placed & joined tpt in layers to strengthen
- soft material strengthened $\rightarrow$ outer hard material
- Eg Plywood, paper certificates



4. Honeycomb : body

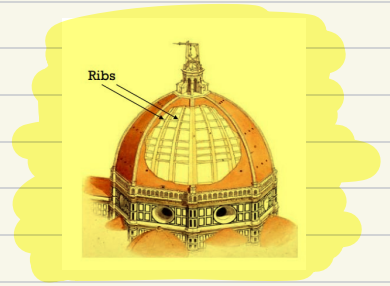
- strong compression
- very light
- air $\rightarrow$ poor heat/sound conductor
- Eg. Door, Carton boxes, racing car shell



Reinforcing Structures

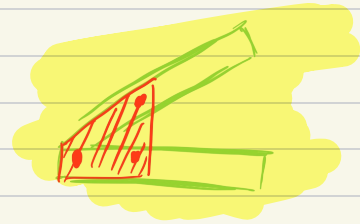
5. Ribs : body

- strong & light
- add strength to walls $\rightarrow$ prevent walls from caving in
- stiffeners
- eg. aircraft wing, sheltered walkway, bus stop shelter, roof dome



6. Gusset plates : joint

- add strength/support $\rightarrow$ joints
- $\uparrow$ contact area of joint & distribute stress more evenly
- plates secured by bolts & nuts
- eg. joints in frame structure $\rightarrow$ bridge, roof.

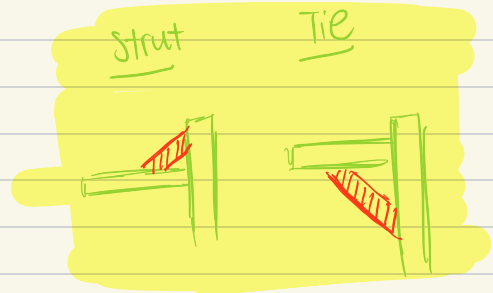


7. Braces : joint

- add strength $\rightarrow$ joint
- support $\rightarrow$ structure
- eg. wall shelves, street lamp, tripod stand legs

8. Webs : joint

- add strength $\rightarrow$ joint
- support $\rightarrow$ structure
- eg. wall shelves



Structural Properties

Strength : resist force w/o breaking.

Hardness : resist cutting / scratching / wearing off

Toughness : resist / withstand impact w/o breaking.
brittle material $\rightarrow$ breaks easily upon impact

Elasticity : return to its original length after being deformed

Ductility : pulled apart w/o breaking

Malleability : shaped / bent w/o breaking