

Structures

Definition of Structures

- Made of different members (parts)
- joined together
- perform certain functions

Structures are classified according to origin (man-made or natural) and by their type/design

Types

Shell Structure

- Hollow structure
- Function: Contain/protect or to enclose, support a load, span a gap
- Every part of structure supports load - gives it strength
- egg, nest, car, box

Frame Structure

- made of different members joined together
- gaps in between
- Function: Enclose, protect, span a gap, support a load
- Supports from inside
- bicycle wheel, skeleton, roof trusses

Solid Structure

- Solid, not hollow
- made of one material
- no gaps
- Function: support a load, enclose or protect, span a gap
- relies on own mass to resist forces
- stone wall, concrete paving, tiles, rocks

Functions

Supporting a load

- all structures support own weight
- load - person, object, animal, force
- skeleton, pillars, bookshelf

Spanning a gap

- crossing or filling a gap
- natural: spider web, man-made: bridge

Enclosing people, animals or objects

- structures made to enclose people, animals, plants, objects
- some enclose to protect - egg
- some enclose to contain - prison

Forces

Compressive (pushing)

structural member under compression - **strut**

Tensile (pulling)

structural member under tension - **tie**

These forces can:
Bend
Separate (shear)
Twist (torsion)

Properties Frame Structures

Strength

- Should not break or collapse
- Made stronger - folding/tubing

Rigid/stiff

- Will not bend, buckle/ change shape
- Triangulation** - using triangles to make structure more rigid

Stability

- Will not fall over, be stable
- Make structure **LEVEL**
- use **SUPPORTing members**
 - guys** (steel cables)
 - buttresses** (wood poles or stone supports)
 - struts**
 - stays**



Structures - Terminology

Term/phrase	Definition
Structure	A structure is something that is made up of different members (parts) joined together that can perform certain functions.
Functions of Structures	Supporting a load Spanning a gap Enclosing or protecting someone or something
Types of Structures	Shell structure Frame structure Solid structure
Shell structure	A shell structure is a hollow structure that contains or protects something, e.g. egg, bicycle helmet, car. A shell structure spreads the forces throughout the structure, meaning every part supports and gives strength.
Frame structure	A frame structure is made of stiff parts, with members joined together to provide a strong support that cannot easily collapse or fall over. A frame structure have gaps or spaces between the columns and beams and consist of a framework, e.g. bicycle, trusses, skeleton, pylons, etc. A frame structure supports from inside.
Solid structure	A solid structure is solid and is not hollow or with any gaps. Usually a solid structure is made of one material, e.g. stone wall, paving, rocks, etc. Solid structures rely on their own mass to resist forces.
Compressive Forces	Pushing force acting in on a structure. A structural member under a compressive force is a strut.
Tensile Force	Pulling force acting in on a structure. A structural member under a tensile force is a tie.
Properties of structures	Strength, Rigidity, Stability
Corrugated	Means folded. For example corrugated cardboard is used to strengthen cardboard boxes.
Folding or Tubing	Used to make frame structures stronger.
Triangulation	Using triangles to make a structure more rigid.
Guys	Supporting members, usually steel cables or ropes used to make a structure more stable, e.g. cables that keep a flagpole stable or ropes that are used to keep a tent stable.
Buttresses	A structure of stone or brick that are built against a wall or another structure to make it more stable, e.g. in nature a big tree has its roots acting as buttresses, castles were made more stable with stone buttresses in Medieval times.
Columns	Vertical members of a structure
Beams	Horizontal members of a structure - spread a load across columns
Truss	A structure made up of triangles
Struts & Ties	Strut - member under a compressive force Tie - member under a tensile force



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