

UNIT 4 STRUCTURES

4.1.- Structures

Definition: a structure is the part of a body, or an object, which keeps its shape, and resists the effects of the forces that act on it.

Loads: these are the forces that act on a structure. They can be fixed or permanent loads, which don't change over time, and variables which change with time and are even occasional.

Natural and artificial structures: Nature is the first maker of structures, you can see them in snail shells, trees, nests, etc. Then we learned how to make structures for supporting our objects: camping tents, a ball pen, a dam, etc

4.2.- Stresses

Stresses are the internal tensions or forces that a structure must resist when it is supporting a load.

Types of stresses: there are five of them:

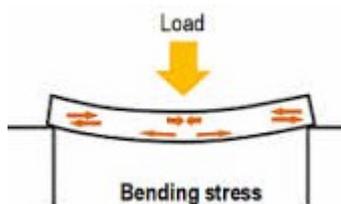
Tension: forces try to stretch the object they are acting upon, and the object tends to become longer. Examples are trailer hooks, springs, elevator wires, etc.



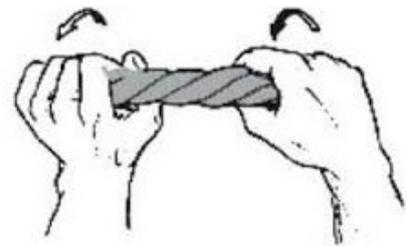
Compression: forces try to compress or flatten the body, and it tends to become compressed. Examples are the legs of a chair, columns of a building, person's legs, etc.



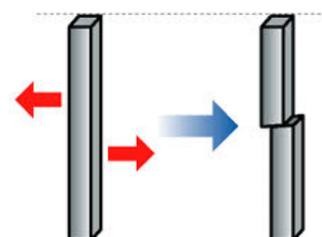
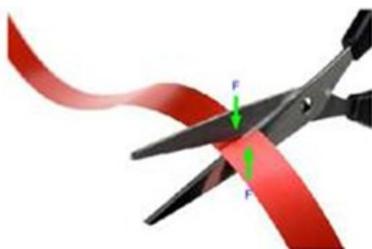
Bending: forces try to bend the body. They act perpendicular to the bar or beam. Examples are horizontal beams, a mattress, a springboard, etc.



Torsion: a pair of forces try to twist the body. Examples are a screwdriver, a key, the shaft of a wheel, etc.



Shear or cutting: a pair of forces which are very close together but act in opposite direction, like two scissor blades. Examples are: when we cut a paper, a hook for hanging a painting, etc.



4.3.- Structural conditions

Conditions for a structure to match its function:

- Rigidity: it must not deform when a load is applied.
- Resistance: it must resist loads without breaking or deforming.
- Stability: it must remain upright under a force and not turn over.

4.3.1.- Rigidity: we can reinforce and make a bar structure rigid if its bars are arranged making triangles. Sometimes it is possible to substitute a bar in a structure by a wire or a rope, if it is under a tension stress. This occurs in camping tents or suspended bridges.

4.3.2.- Resistance: the structure must support tensions and loads without breaking. It depends on the material of the structure and also in its shape.

4.3.3.- Stability: the structure must remain upright without tipping over. This depends on these three items:

- the position of the center of gravity, the closer to the ground it is, the more stable is the structure.
- the size of its base, the bigger the base is, the more stable the structure will be.

4.4.- Types of structures

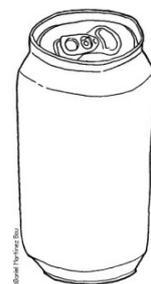
Mass or massive structures are made of solid material, filling the body completely and making it very thick and heavy. Examples: dams, pyramids,...



Frame structures: composed of long elements (bars, tubes,...) joined to each other at the ends. These elements are made of strong materials. Example: columns and beams of a building, electrical towers, cranes, etc..

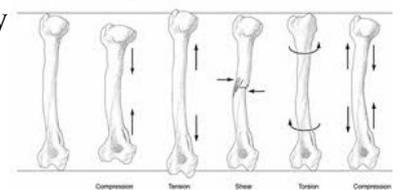


Plate or shell structures: are made of a thin outer layer of material that surrounds a volume. That volume can be empty or filled with something. Example: an egg, an airplane, a car, a can,...



4.5.- Reinforced Concrete

Reinforced concrete is a composite material, made with concrete and steel bars. The reason why we use this material is because concrete is very good supporting compression stresses, but bad when supporting tension stresses. Steel is the opposite, very good supporting tension stresses, but bad for compression. If we put some steel bars inside a concrete beam, then we have a material that is good for tension and compression at the same time. That's the reason why nowadays nearly every building structure is made using reinforced concrete.



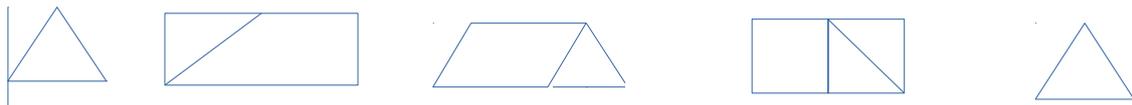
Unit 4 Activities.

- 1.- Write 5 natural structures and 5 artificial structures.
- 2.- Identify permanent and variable loads which are supporting:
 - a) an electrical power line tower
 - b) a suspension bridge
- 3.- Identify the structure of these elements:
 - a) Pen
 - b) Photograph camera
 - c) A table of your class
- 4.- Which type of effort are supporting next natural structures?
 - a) A spider net
 - b) An elephant leg
 - c) A swallow nest in its joint with the wall
 - d) A femur bone
- 5.- Which type of effort are supporting next artificial structures?
 - a) A column
 - b) A blind's belt
 - c) A wardrobe's bar
 - d) A pencil sharpener
 - e) A horizontal beam.

6.- Complete the table with the type of effort:

EFFORT	ELEMENT 1	ELEMENT 2
TENSION		
COMPRESSION		
BENDING		
TORSION		
SHEAR		

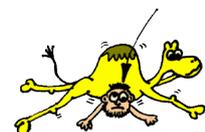
7.- Add bars to these structures to make them more resistant:



8.- Draw these structures and analyze the effort of each part:

- a) Gymnastics bar
- b) Swing
- c) Chair

9.- See the drawings and identify the efforts:



VOCABULARY UNIT 8

STRUCTURE: estructura
FORCE: fuerza
EFFORT: esfuerzo
LOAD: carga
TO SUPPORT: soportar
BEAM: viga
COLUMN: columna
TENSION: tracción
COMPRESSION: compresión
BENDING: flexión
TORSION: torsión
SHEAR: cortadura o cizalladura
STABILITY: estabilidad
RESISTANCE: resistencia
RIGIDITY: rigidez
FOUNDATIONS: cimientos
TO TRIANGULATE: triangular
BAR: barra
TIE: tirante
TO WELD: soldar
SOLID: macizo
TO FILL: rellenar
MASS: masa
SUSPENSION: en suspensión, colgante.
FRAME STRUCTURE: estructura entramada
SHELL: caparazón, escudo o coraza.