

# Design Features

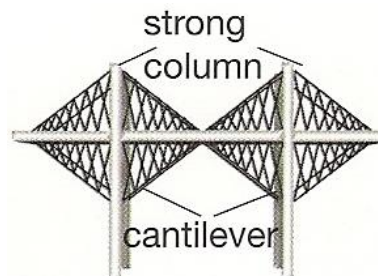
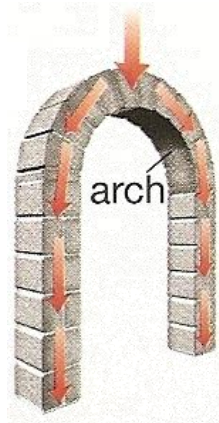
- Major Structures are designed by Engineers.
- Engineers are required to have a 4 year university degree plus 4 years experience before gaining designation as a “Professional Engineer.”
- This level of education is required to ensure a high level of safety in their designs.
- There are 4 design features engineers must consider, Function, Shape, Material and Joining Technology.
- Within these considerations are thoughts on cost, size, strength and location.

## Function

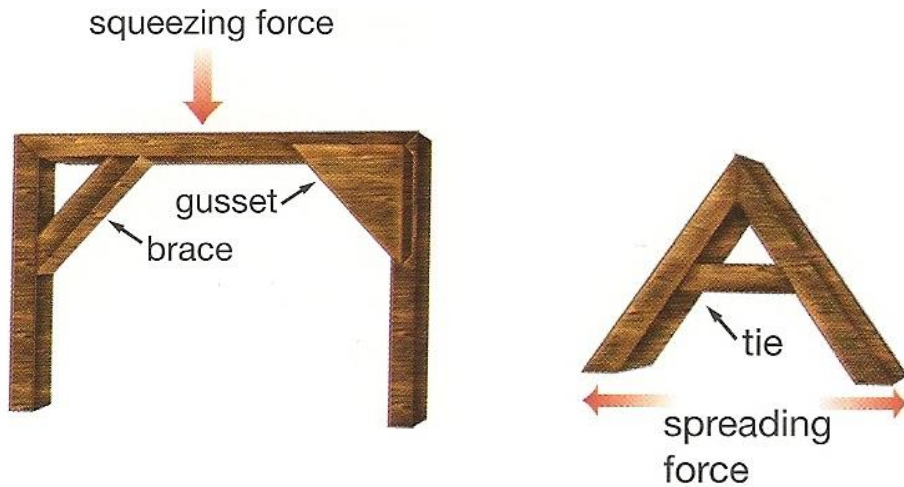
- “Function” describes what a structure is actually supposed to do.
- Example, what does a bridge do?
  - Span a gap
  - Support cars
  - Support itself
  - Stand up to wind
  - Provide smooth transport
  - Etc
- Function needs to consider the location in which the structure will be used.

## Shape

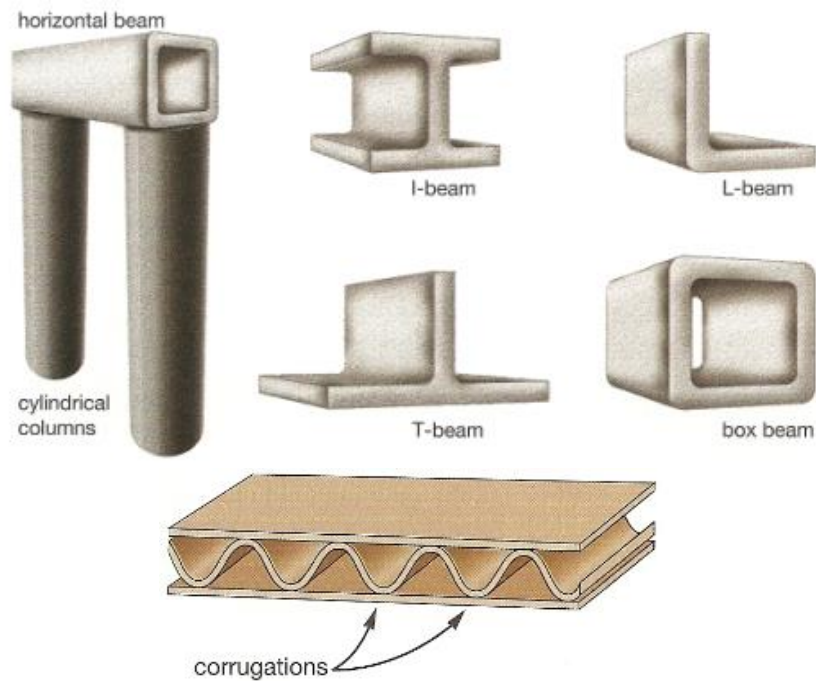
- Shape of a structure is made such that it can withstand the necessary forces.
- Shape can be used to spread forces.
  - Arch
  - Wired cantilever



- “Column” – an upright support
- “Beam” – a horizontal support
- Rectangular frames are made of two columns and a beam, however alone they are weak.
- Triangular frames are made from two diagonal columns, which are also weak.
- Need to add support for a weak structure, for example a brace, tie or a gusset.



- The shape of the material can be solid, hollow, or irregular, depending on the forces being applied.
- Corrugations may be used to increase the strength of the structure.



## Material

- Materials are chosen based on several considerations – strength needed, environment, etc.
- Composite materials use two different materials together so that the beneficial properties of both may be used.
  - Concrete and iron rods – concrete is very strong when pushed, iron rods are very strong when pulled
  - Fibreglass
- Layered materials (laminates) are used to create extra strength or to take advantage of multiple properties.
  - Juice boxes have a leak resistant inner layer
  - Windshields have a plastic layer to resist shattering
- Woven or knit materials are very flexible.
  - Newspaper (as we saw under the microscope)
  - Cloth

## Joining Technology

- A joint is any place on a structure where pieces are held together.
- Joints are important for many reasons:
  - Allow the use of multiple materials
  - Allow a structure to have different components
  - Without joints a structure would have to be carved or moulded
- “Mobile Joints” are joints that allow movement.
  - Your shoulder is a ball and socket joint
- “Rigid Joints” prevent movement.
  - Your stool has a rigid joint between the seat and legs
- Joints are normally the weakest point of a structure, therefore there is a need for a variety of types of joints to suit a variety of different situations.