Module 5

Public works

A • Stresses on big structures

Before looking at big buildings we have to have a quick look at forces and their action. Several forces (called stresses) act on big structures like bridges, skyscrapers, etc., in many ways.

Compression (Squeezing)
Compression is a force that squeezes a material together. When a material is in compression, it tends to become shorter.

Tension (Stretching)
Tension is a force that stretches a material apart. When a material is in tension, it tends to become longer.

Bending (Flexure)
When a straight material becomes curved, one side squeezes together and the other side stretches apart. This action is called bending. It is a combination of compression and tension.

Shear (Sliding)
Shear is a force that causes parts of a material to slide past one another in opposite directions.

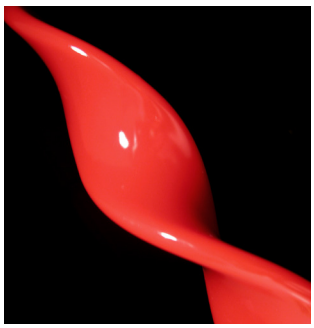
Torsion (Twisting)
Torsion is an action that twists a material.

1 *Match each picture to one of the forces described above.*

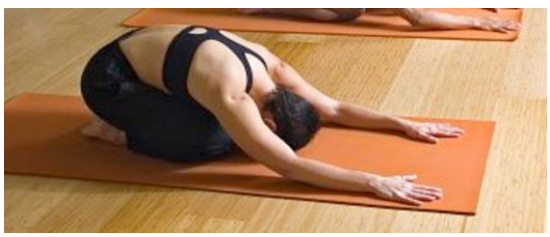
a. .....

b. .....

c. .....



d. .....



e. .....

B • Bridges

You rely on bridges every day to cross obstacles like streams, valleys, and railroad tracks. But do you know how they work? Why are some bridges curved while others are straight? Engineers must consider many things – like the distance to be covered and the types of materials available – before determining the size, shape and overall look of a bridge. Since ancient times, engineers have designed three major types of bridges to withstand all forces of nature.

- **The beam bridge** consists of a horizontal **beam** supported at each end by piers. The weight of the beam pushes straight down on the piers. The farther apart its piers, the weaker the beam becomes. This is why beam bridges rarely span more than 250 feet.

Beam bridge

- **The truss bridge** consists of an assembly of triangles. Truss bridges are commonly made from a series of straight, steel bars. The Firth of Forth Bridge in Scotland is a cantilever bridge, a complex version of the truss bridge. Rigid arms extend from both sides of two piers. Diagonal steel tubes, projecting from the top and bottom of each pier, hold the arms in place. The arms that project toward the middle are only supported on one side, like really strong diving boards. These "diving boards", called cantilever arms, support a third, central **span**.

Cantilever bridge: Firth of Forth

- **The arch bridge** has great natural strength. Thousands of years ago, Romans built arches out of stone. Today, most arch bridges are made of steel or concrete and they can **span** up to 800 feet.

Ancient Roman aqueduct

- **The suspension bridge** can span 2,000 to 7,000 feet – way farther than any other type of bridge! Most suspension bridges have a truss system beneath the roadway to resist bending and twisting.

Suspension bridge: Golden Gate Bridge

2 *What type of bridge is it?*

a. .....

b. .....

c. .....

d. .....

3 *Answer the following questions.*

1. What are the factors determining the features of a bridge?
2. Why is it unlikely to see a beam bridge 500 m. long?
3. What do basic truss bridges consist of?
4. What type of bridge was the most common among the Romans?
5. Which type of bridge do you think may better withstand an earthquake? Why?