Rochester Bridge Trust
Learning about Bridges

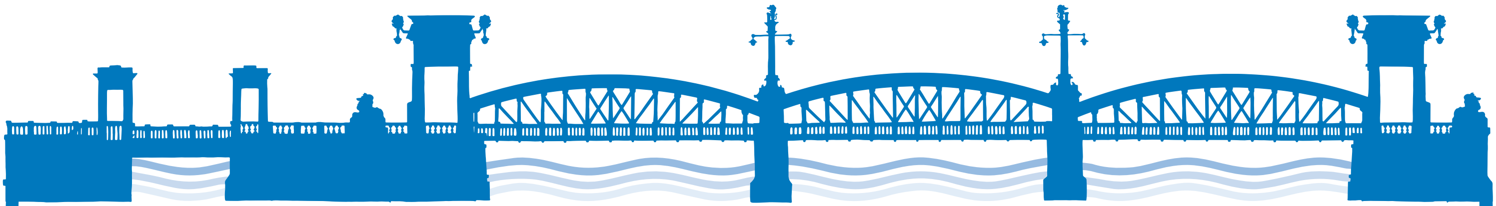
The Rochester Bridge Trust was founded in 1399 to provide a crossing over the River Medway in Kent. The Trust still provides free bridges today.

The Trust is passionate about bridge building and wants to encourage young people to find out more about bridges and become as enthusiastic as we are!

Our education kit contains loads of information, fun activities and interesting facts. You can work through the whole kit which contains a school term's worth of activities or just try a session or two.

It's up to you!

Content by Sue Threader BEng CEng MICE



About the Rochester Bridge Trust

The first bridge at Rochester was built by the Romans soon after the invasion of Britain in AD43. Once the Romans left, their bridge was maintained by the local people of Kent until the 14th century. In 1381, the River Medway froze solid and, when the thaw came, the ice and floodwater swept away the Roman Bridge.

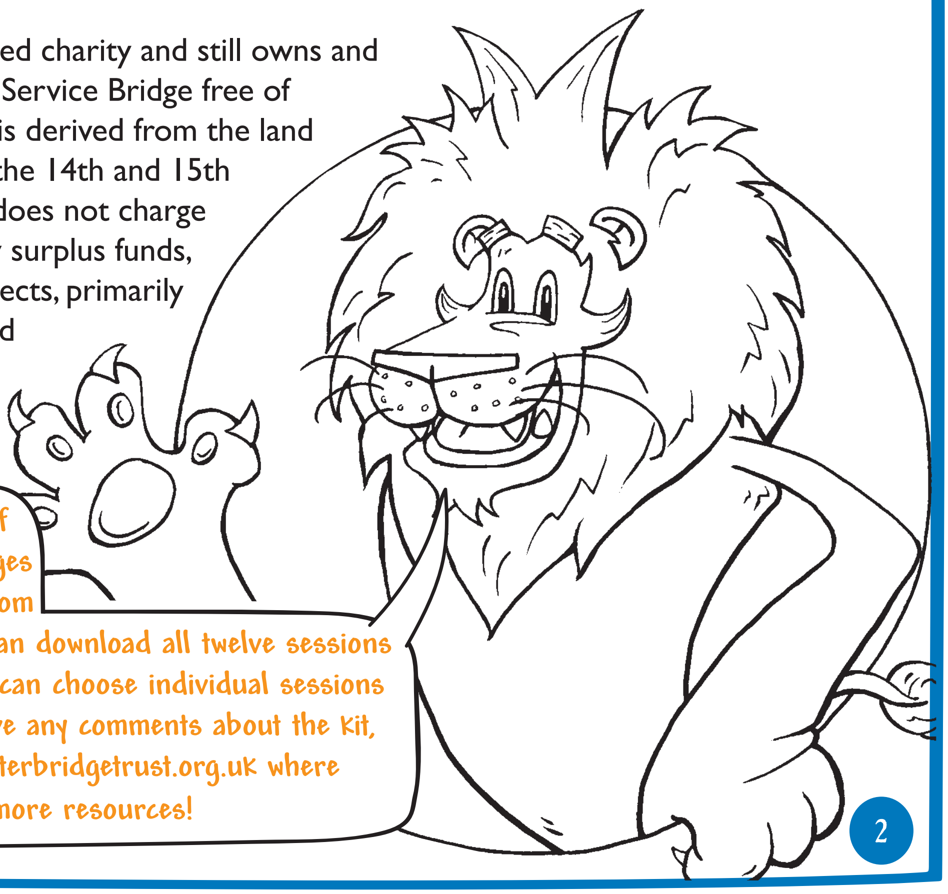
Two benefactors built a new stone bridge one hundred yards upstream which was opened in September 1391. Their names were Sir John de Cobham and Sir Robert Knolles. Together the benefactors also persuaded their friends and acquaintances to make donations of land and money for the perpetual maintenance of Rochester Bridge. In 1399, King Richard II granted letters patent which allowed the Rochester Bridge Trust to be set up to care for the bridge and its property. Two Wardens were appointed to manage the bridge.

For the next 457 years, the Wardens looked after the medieval bridge. Major improvements were carried out by the civil engineer, Thomas Telford, in 1827. However the increase in road and rail traffic as a result of the industrial revolution meant the stone bridge's days were numbered.

In 1856, the Trust completed a new cast-iron arch bridge on the line of the original Roman Bridge. It was designed by Sir William Cubitt who had been the civil engineer for the Crystal Palace built for the Great Exhibition in 1851. The old medieval bridge was then blown up for the Wardens by the Royal Engineers using gunpowder.

The Victorian Bridge was reconstructed in 1914 as a bowstring truss and is today known as the Old Bridge. A second road bridge, the New Bridge was opened to traffic in 1970. Between the two road bridges there is the Service Bridge which carries pipes and cables across the river.

The Rochester Bridge Trust is a registered charity and still owns and maintains the two road bridges and the Service Bridge free of charge to the public. The Trust's money is derived from the land and money given by the benefactors in the 14th and 15th Centuries. It receives no public money, does not charge tolls and does not raise funds. With any surplus funds, the Trust supports other charitable projects, primarily the preservation of historic buildings and education projects in the field of engineering, particularly civil engineering.



Session 3 – Loads and Forces

Aims & Objectives

- *To understand the* **forces** *that act in bridges*
- *To recognise and describe* **tension** *and* **compression**
- *To show that forces must be balanced for a bridge to stand up*

You Will Need:

- ☐ A3 card
- ☐ Toy car
- ☐ Laptop, projector & screen
- ☐ "Slinky®" spring
- ☐ Large sponge, marked along one side with lines 1 inch apart
- ☐ Range of everyday materials, e.g. string, elastic bands, small tower of Lego® bricks, uncooked spaghetti, bread rolls, building blocks, stickle bricks, cardboard tubes
- ☐ Large book
- ☐ HANDOUT: Forces in a Beam Bridge

Session Activities

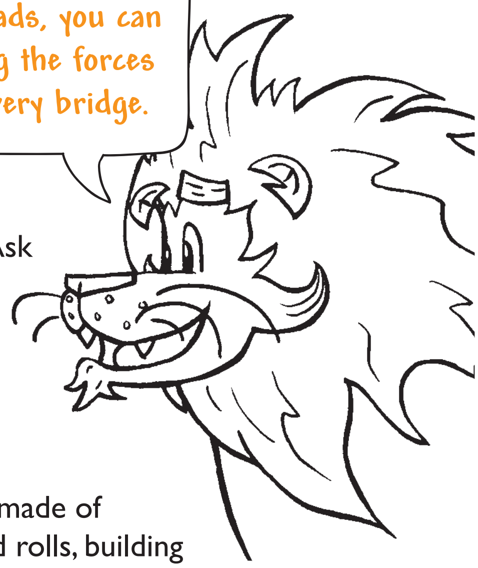
1. Compression & Tension

Remind students that:

- **Dead load** is the bridge's own weight which does not change or move; and **live load** is mainly the weight of what the bridge is carrying and moves and changes constantly.

Explain that these **loads** *cause* **forces** *inside the bridge:*

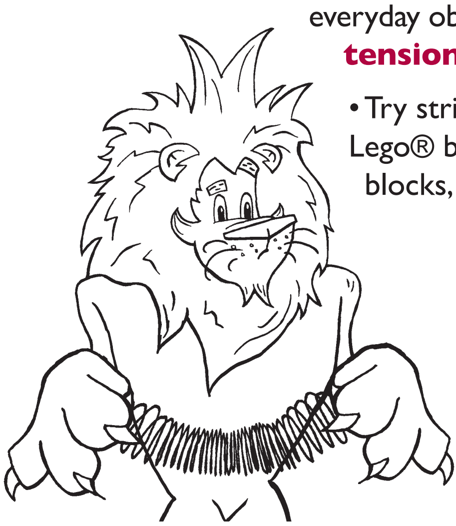
- **Tension**: Using a "Slinky" spring, pull from each side. This force is **tension** which always tries to make things longer. Think of it as a stretching force. Ask the children to hold hands in pairs and pull. Feel the **tension**.



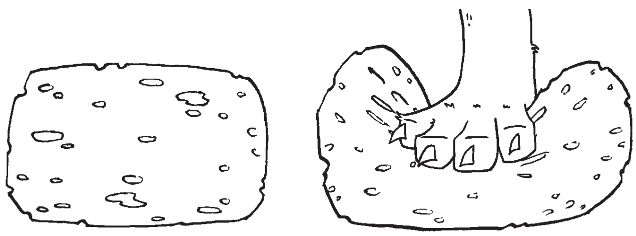
- **Compression**: Using a sponge, push down hard. This force is **compression** which always tries to make things shorter or smaller. Think of it as a squashing force. Ask the children, in pairs, to put palms of hands together and push. Feel the **compression**.

- Divide the children into groups and ask them to examine a series of everyday objects. Are they stronger under **tension**, **compression** or both?

  - Try string, elastic bands, a small tower made of Lego® bricks, uncooked spaghetti, bread rolls, building blocks, stickle bricks and cardboard tubes.



Tension



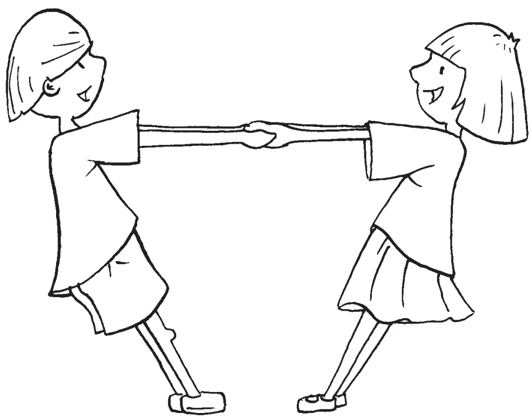
Compression

2. The Balance of Forces

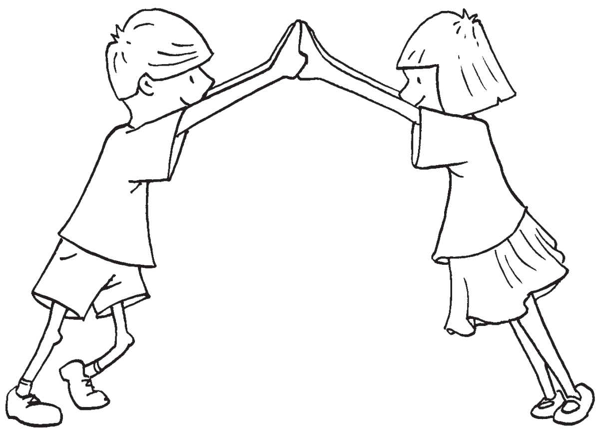
- Place a large book on the desk. It is at rest because gravity, the force that pulls objects towards the centre of the earth, pulls down on it as much as the table pushes up on it. The forces are balanced.
- Push the book horizontally across the table. The book moves across the table. It is no longer at rest because the forces are not in balance any more. How do we get the forces balanced again?
    - Either push with an equal force in the opposite direction; or
    - Apply a pulling force in the opposite direction to the push (taking care not to allow the book to rotate).

Ask the children to stand up in pairs facing each other with palms together to form a "human bridge".

- Ask them to feel how much they need to push to make their bridge balanced, strong and steady.
- Ask them to try this standing back-to-back and leaning their weight against each other. If they can balance their **forces**, their "bridge" will stand still and not move. If the **forces** are NOT in balance, their bridge – and indeed any bridge – will fail!
- Ask the children to hold hands and lean out until they achieve balance. Encourage them to feel the **tension** in their arms.



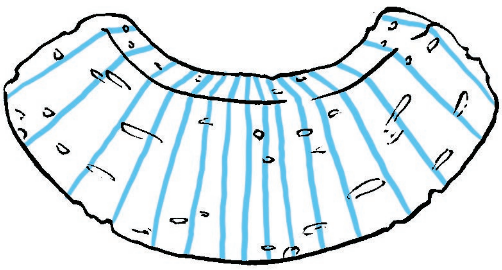
Tension



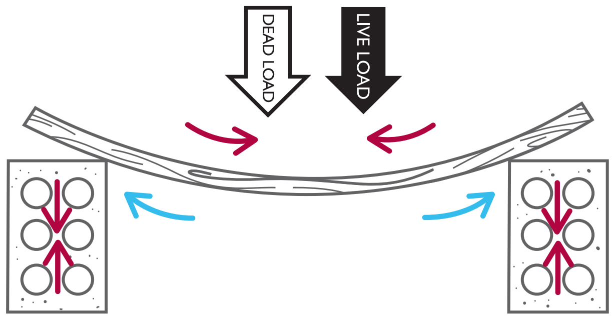
Compression

3. Forces in a Beam Bridge

- Place two tables or desks about 40 centimetres apart and place a sheet of A3 card across the gap to make a simple Beam Bridge. Place a toy car in the centre to act as the live load.
- Ask the children whether there is any **tension** in the **Beam Bridge**. If so, where is it coming from?
- Take the sponge with vertical lines on. Bend it like a **Beam Bridge** carrying a heavy **live load**. Observe that the lines at the top are closer together – so what is the force? **Compression**
- Observe that the lines at the bottom get further apart – so what is the force? **Tension**
- So there is **tension** in the beam of a **Beam Bridge**.
- Look at **Forces in a Beam Bridge (Handout)** of the forces in a **Beam Bridge** and discuss.
- Discuss how an engineer might try to cope with these forces to make a **Beam Bridge** really strong.



The forces in a **Beam Bridge** can be demonstrated visually using a large sponge, marked along the sides. When a force is applied from above, the top of the sponge shows **compression** and the bottom of the sponge shows **tension**.



The forces in a Beam Bridge.

Forces in a Beam Bridge (Handout)