

Emley Moor Tower in Huddersfield is 330.5m high and is the tallest freestanding structure in the UK.

Bridgewater Place in Leeds is 110m high and is the tallest building in Yorkshire.

Build the **tallest** tower you can from a **single** sheet of A4 paper.



You may use **scissors** but no glue, sticky tape or other materials.

Is the tallest tower the best tower?

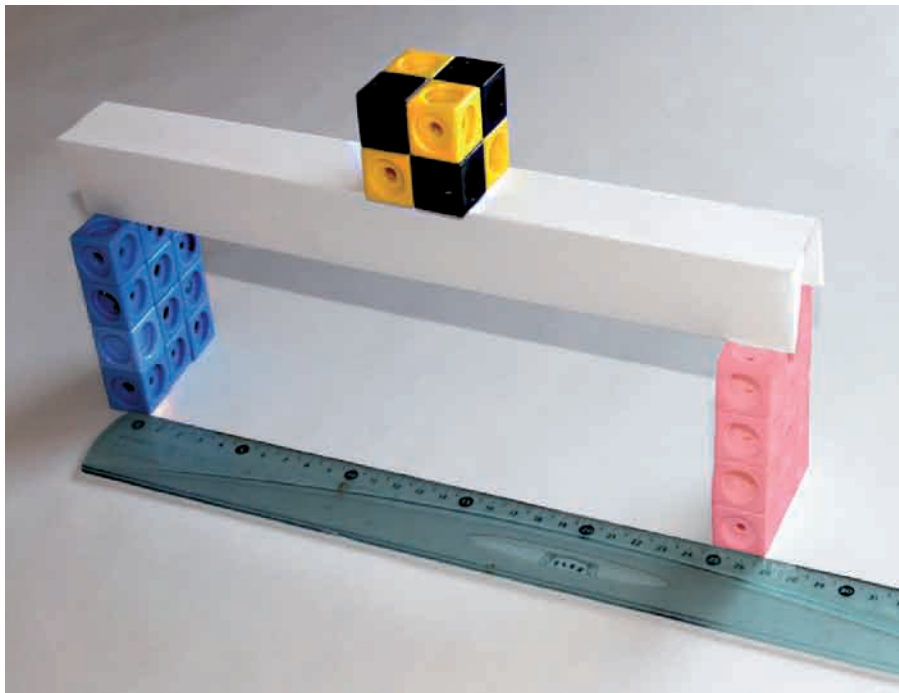


making things work

Bridges are everywhere; over roads, over rivers and canals, spanning estuaries and joining islands to the mainland.

Sometimes bridges have to span great distances.

The **Humber Bridge** held the world record, 1410m, for the longest single span suspension bridge for 17 years until 1998.



Photos: Peter Smith Associates

Build the **longest** bridge you can from a **single** sheet of A4 paper.

It has to support a block of **8 cubes** at its centre.

You may use **scissors** but no glue, sticky tape or other materials.

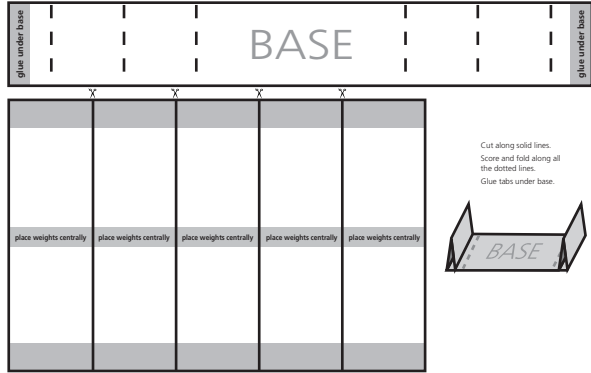


Engineers are challenged to make structures which are strong, light and efficient.

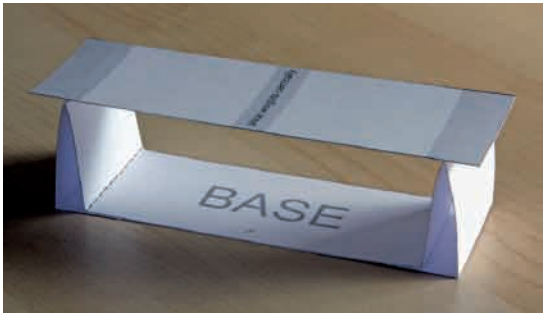
They use **triangulation**, **suspension** techniques and **arches** to achieve this.



Lendal Bridge



Make a bridge from card using the cut-out sheet



Photos: Peter Smith Associates

How many cubes can you place near the centre before the bridge collapses?

What happens when you change the number of layers of card?

Number of layers in span	Number of cubes supported
1	
2	
3	

Now bend one piece of card and use it as an **arch**. How does this affect the strength of your bridge?



glue under base

BASE

glue under base

✂

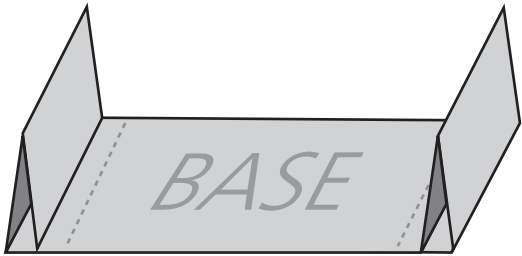
✂

✂

✂

place weights centrally	place weights centrally	place weights centrally	place weights centrally	place weights centrally

Cut along solid lines.
 Score and fold along all
 the dotted lines.
 Glue tabs under base.



Making things work : Bridges and structures

Description

This topic sets challenges which require pupils to be constructive, creative and think strategically about simple structures.

Activity 1: Tallest tower

Activity 2: Longest bridge

Activity 3: Testing bridge design

Tallest tower and **Longest bridge** are similar activities and challenge pupils, working in groups of 3 or 4, to create structures from a single sheet of A4 paper, the tallest free-standing tower and the longest possible span between two end supports, respectively. For both activities provide scissors and lots of scrap paper and give your pupils time to experiment.

You may wish to suggest strategies such as folding, corrugating, using 'box' sections, and cutting and interlocking sections to make a structure taller or longer than the length of an A4 sheet.

In **Tallest Tower** the tower which is the tallest may not be the 'best' tower. Deciding which is the best tower provides excellent opportunities to consider the data collection aspects of data handling. For example, marks could be awarded for height, stability and elegance. Work with the class to decide on the design criteria and then re-run the activity.

Resources

*160gsm craft card,
strong contact adhesive,
scissors, multilink cubes.*

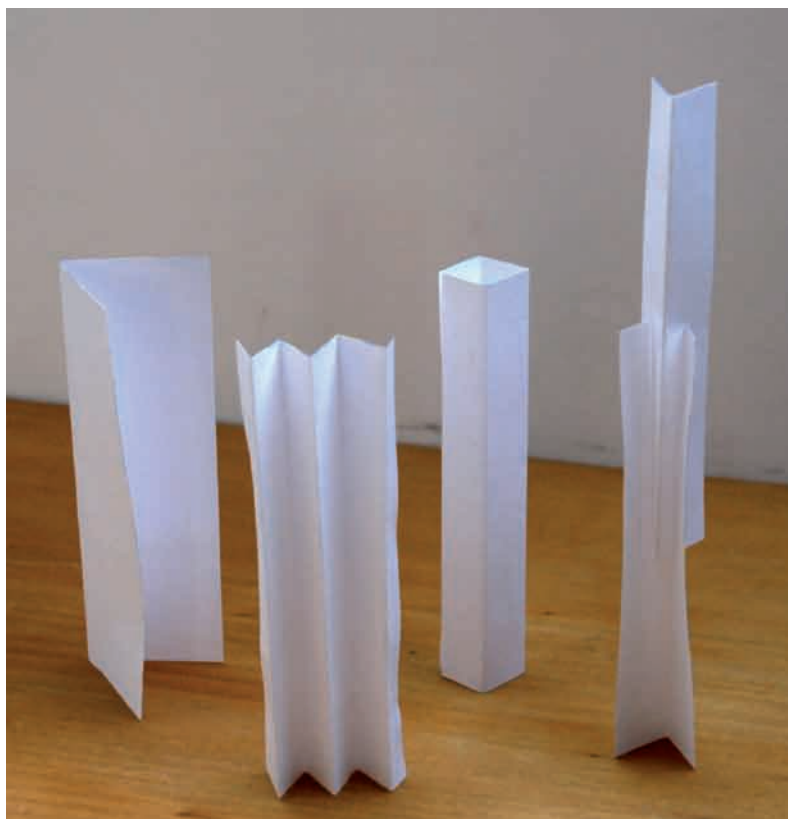


Photo: Peter Smith Associates

Record the design criteria and allow each group to give a score for each criterion. Record all the marks awarded by the groups on a spreadsheet projected on to a whiteboard or on the board.

Discuss how to aggregate the marks awarded fairly. Should the average of all the marks be found or should the highest and lowest mark in each category be left out? Is the mean, or the median score a fairer measure?

Making things work : Bridges and structures

In **Testing bridge design** pupils build a bridge and test it to 'destruction' by adding weights until the bridge collapses. They add further layers to the span section and record the weight each trial will support. Finally, they change the design to include an arch, and re-test their bridge.

The bridge is made from the template on the bridge construction cut-out sheet, which should be photocopied onto an A4 sheet of 160gsm craft card or similar. A strong contact adhesive is needed for the bridge supports and your pupils may need extra copies of the horizontal span sections.



Lendal Bridge



Emley Moor Tower

In the first part of the activity, where only horizontal spans are used, encourage your pupils to conjecture how the number of Multilink cubes supported by the bridge will increase as each new 'layer' is added.

In the second part, when testing the arch, pupils may be surprised by how much the strength is increased. Using two card sections, one as the arch and one as the span, can be about 4 times stronger than two cards across the top of the supports.

Encourage your pupils to use systematic strategies to investigate the best combination of arches and spans to use with three, four or five strips of card. This could include laminating several spans using strong contact adhesive.

The mathematics

All three activities offer opportunities to develop the group work and communication skills needed to work collaboratively. In both **Tallest tower** and **Longest bridge** pupils work strategically, plan and implement different design strategies and test their designs. The pupils will consider data collection and work with measures of average. **Testing bridge design** raises issues of experimental design and record keeping and requires the use of systematic strategies.