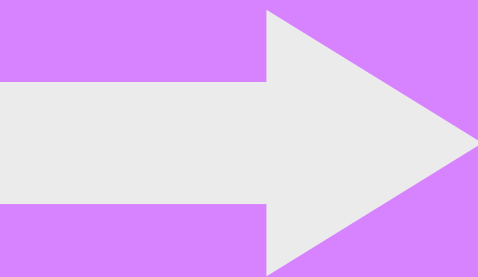


Building Bridges

Learning Objective:

To explore ways in which arches are used to strengthen bridges.





How are they still standing??!!



Even though they are made of heavy brick and stone, these bridges are all still standing strong after many, many years!



Why did the engineers of these bridges use brick and stone?



Until developments in technology and engineering meant that engineers could construct large beams made of iron and later, steel or concrete, the best way to construct long, strong and long-lasting bridges was with arches made of brick or stone.

Why might materials such as wood not be so good for spanning large distances, or for building bridges crossing water?



Timber is a good building material. It is strong, hard-wearing, flexible and easily cut and carved into different shapes. However, it is not always suitable for building bridges...



It is not as hard-wearing as stone. It cannot be used to build pillars which stand in water - the timber would rot!



Stone is very strong, hard-wearing and does not rot. However, some stone can be brittle; it shatters easily. Stone is not suitable for making long beams.



For stone to be used in bridge construction, different designs are required that do not use long beams.

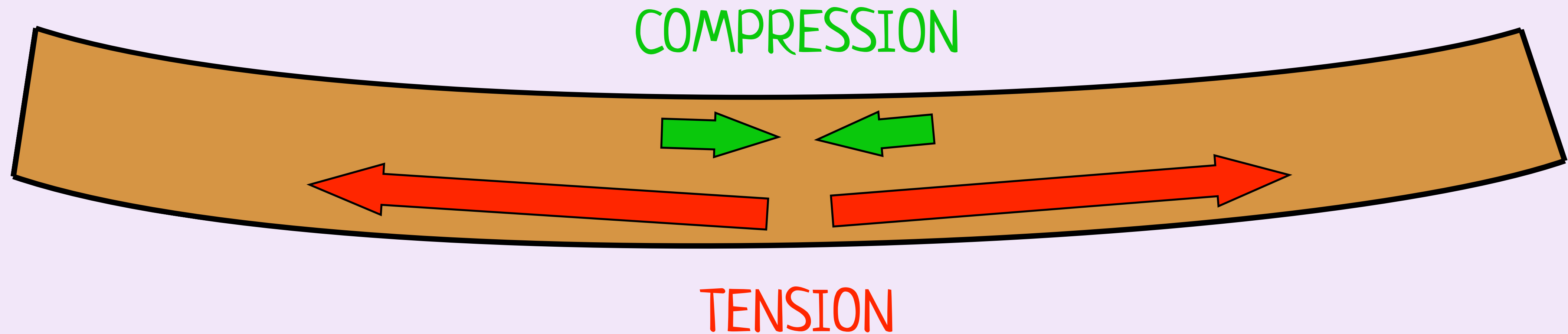


Thin slabs or beams made of stone or brick would break easily, but thick blocks of stone like those used to make this bridge are strong.

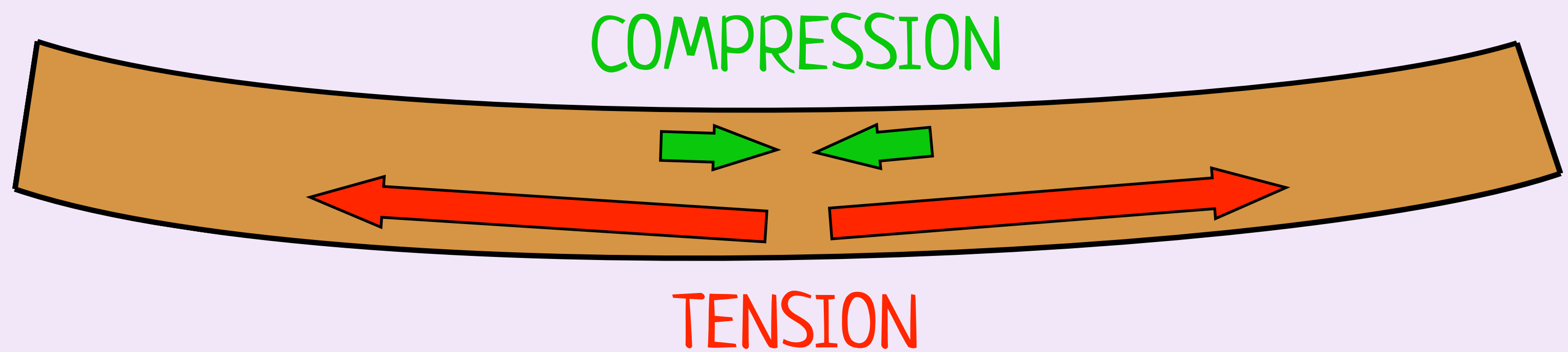


This ancient bridge in Arkadiko, Greece is thought to be the oldest arch bridge still standing. It is over 2000 years old!

How arches work



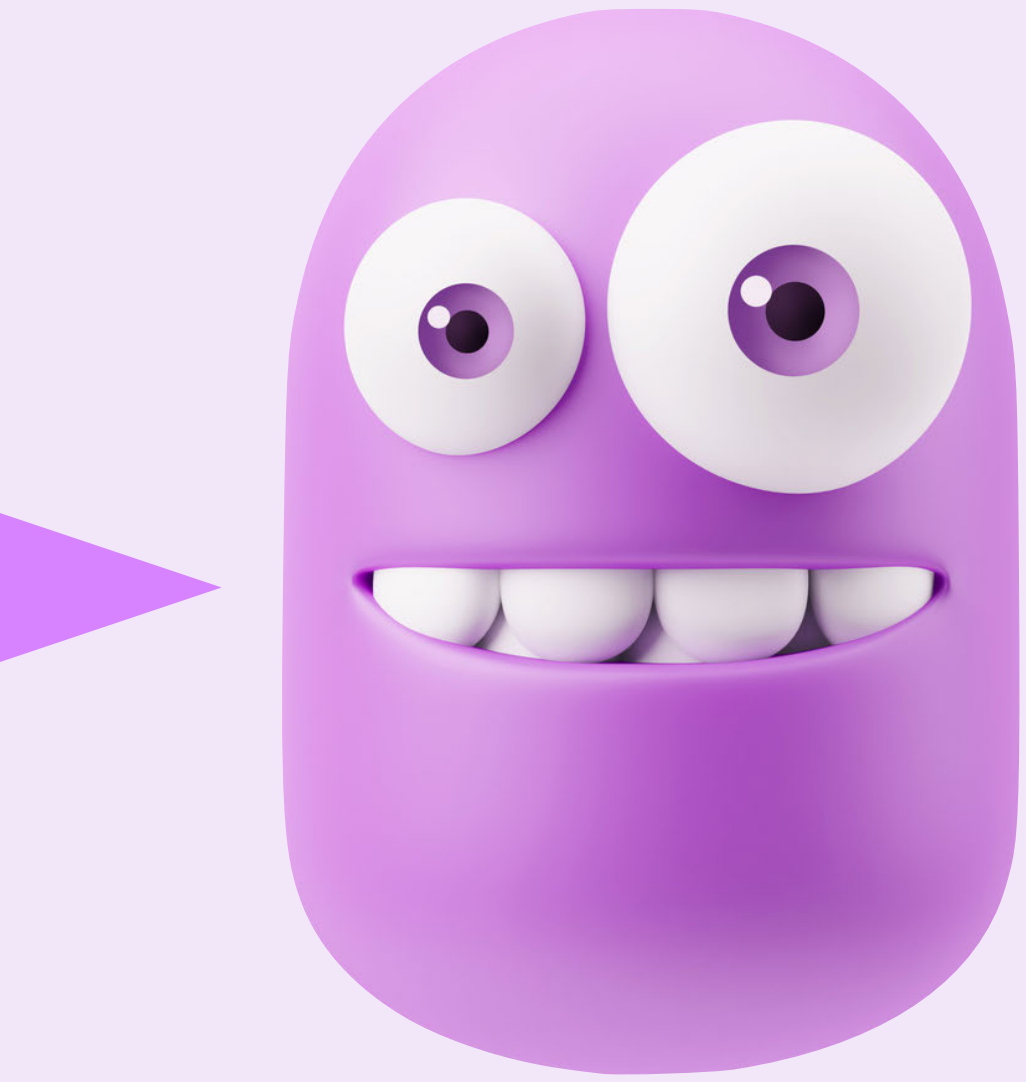
Stone breaks easily under tension, but can withstand HUGE compression forces. When long beams are used in bridge construction, they bend slightly under their own weight and as weight passes over them. Compression and tension forces act on the beam at the same time.



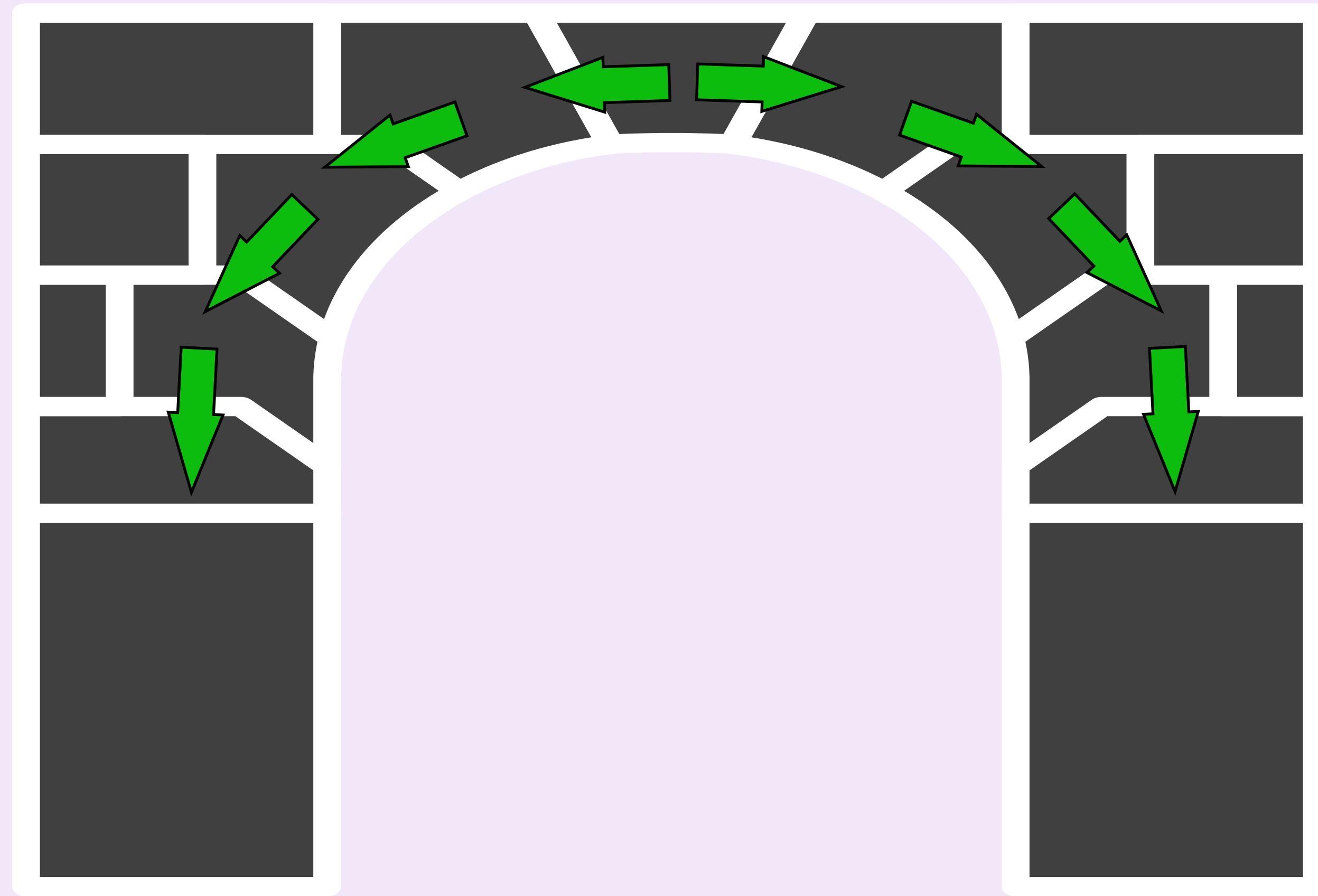
The inside of a bending beam or slab is being compressed and squeezed. The outside of a bending beam is under tension, being stretched.



Try drawing a picture on a piece of sponge or an eraser. What happens to the drawing when you bend it?

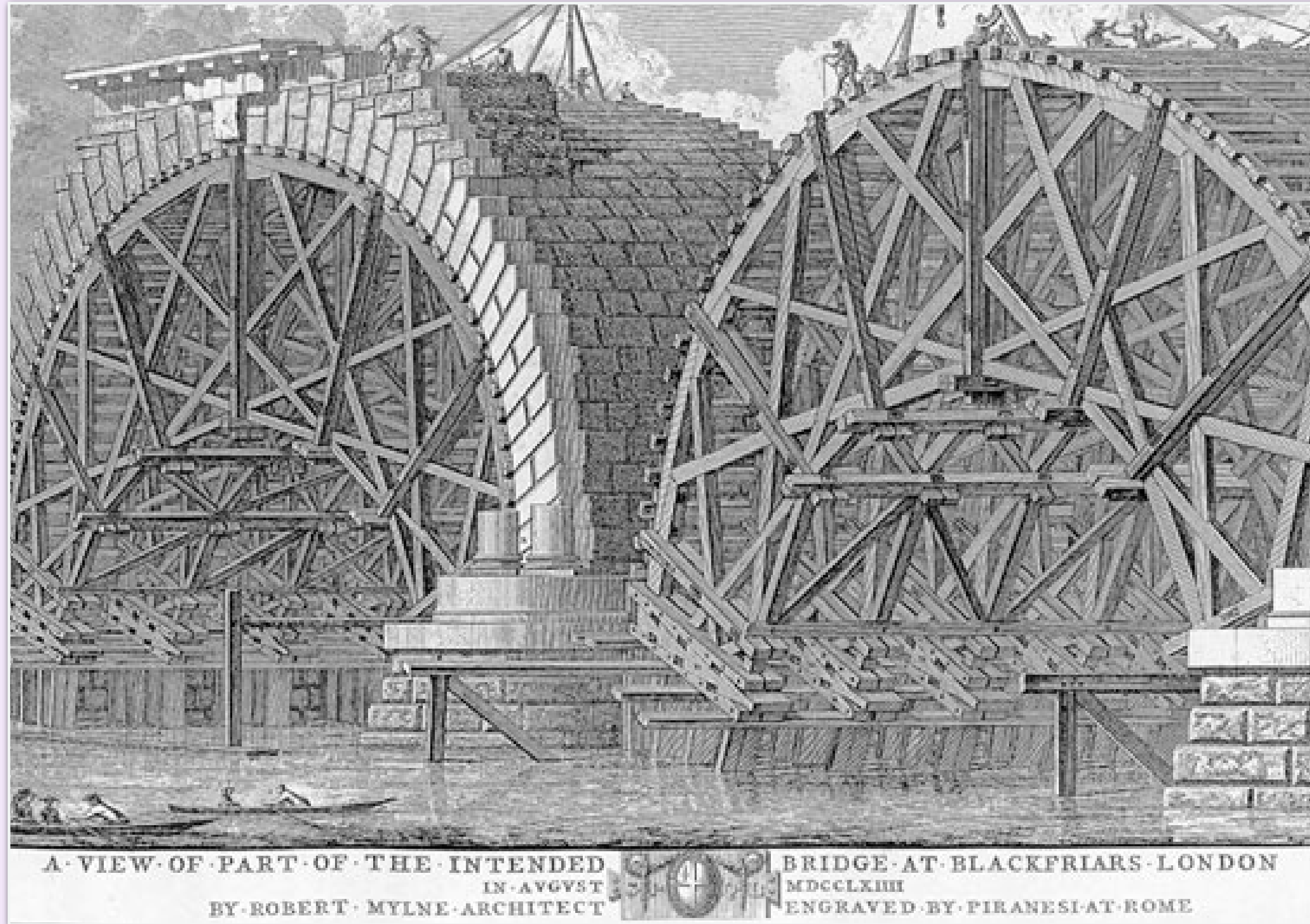


Arch bridges are designed to spread out the compression forces acting on the stone blocks and transfer them to the pillars or abutments at either end of the arch.



How were stone arch bridges built?

This drawing shows how Blackfriars Bridge in London was constructed in 1764.



1. Wooden arch frames (sometimes called falsework) are built in place.

2. Stones are built up around the arch frame.



Stones are either cut to shape so they fit neatly together, or fixed in place with mortar. The bridge is built up with more stonework around the arch, usually before the arch frame is removed. This makes the bridge stronger and creates a level surface on top.

Arch bridges can be built using many different materials..



...and have arches of different shapes and sizes.

Today we will
be exploring the
effectiveness of arches of
different shapes and sizes in
spreading the load on
bridges.

