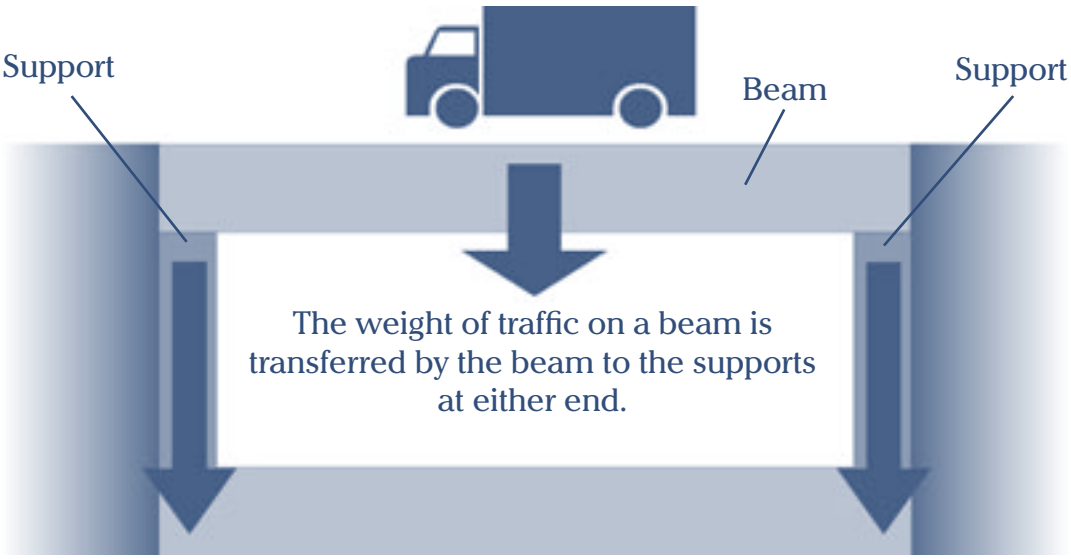
Robert Stephenson

Bridges

Bridges are man made structures that support people or vehicles as they cross an obstacle such as a river, gorge, railway or road. There are many types of bridges such as **beam bridges, arch bridges, suspension bridges** and **cable-stay bridges**. The type of bridge used depends on the **span** (the distance the bridge must stretch without support) needed.

In early times people bridged streams with simple log bridges. The oldest surviving bridges are called “clapper” bridges. They are made of stone slabs supported at either end by piles of stones. “Clapper” comes from the latin word *claperius* meaning pile of stones.

The first real bridges were made from logs joined together to make beams and supported on stone supports.



Design of a simple bridge.

Soon bridges needed to be longer so bridges with a support in the middle were built.

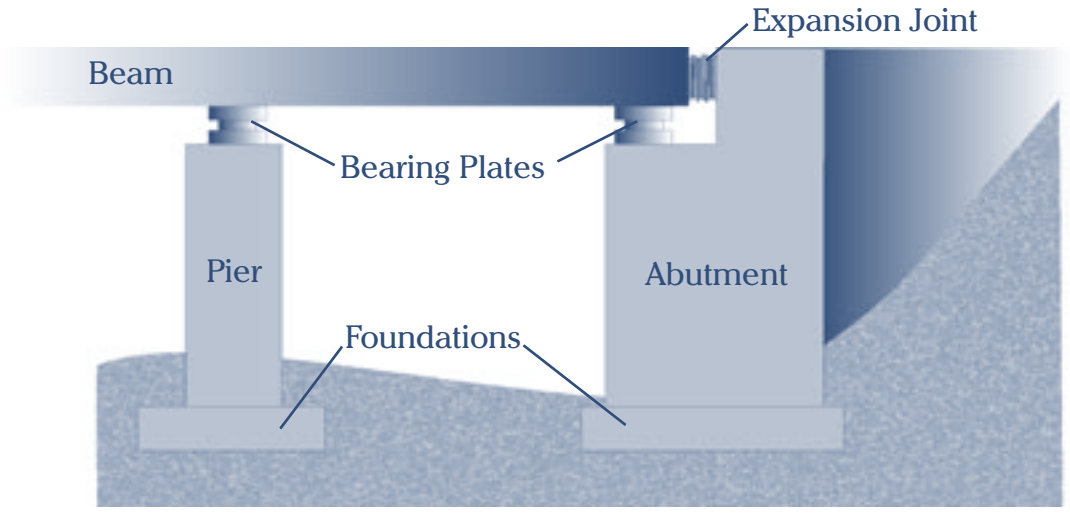
But the Romans built stone arched bridges that were stronger and could support more vehicles crossing over. After the Romans, most bridges were made of wood on stone abutments

By the eighteenth century engineers had once more worked out how to build long, low stone arched bridges; but then they realised they could make bridges from iron which was stronger than wood or stone. They began designing iron-arched bridges like the first iron bridge built in 1779 at Ironbridge that spans the River Severn in Shropshire. Later these engineers designed suspension bridges that used iron cables to hold them up. These bridges were very strong but unsuitable to carry the new steam locomotives and trains due to swaying.

Arch bridges are either filled or open.

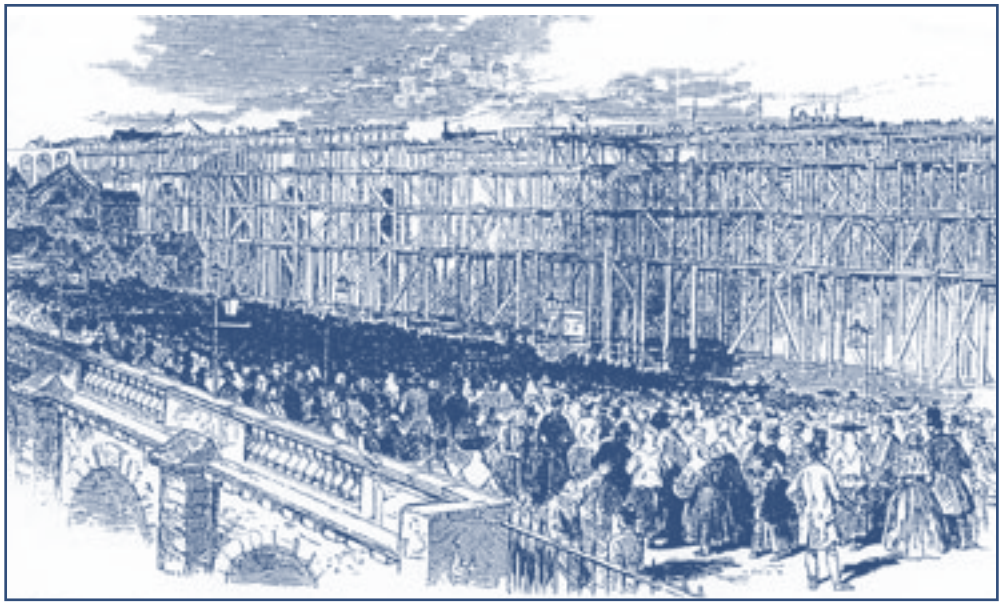
To lessen the forces on the supports or abutments a bowstring or tied arch is used to absorb the thrust from the arch.
This was the solution adopted on the High Level Bridge in Newcastle

Modern bridges have to take huge weights and cope with expansion and contraction of the decks during hot and cold weather. So engineers allow for this by using expansion joints and bearing plates.



A modern bridge design.

The beams rest on the bearing plates that allow them to move and twist and gaps are left at each end to allow for expansion. These gaps are filled with special joints that stop water leaking into the gaps.



The building of the High Level Bridge

The High Level Bridge - Newcastle

There had been proposals for a high level bridge to span the River Tyne at Newcastle from the 1770s because vehicles and pedestrians were finding it more and more difficult to climb up from the low bridge at the bottom of the river valley.

Between 1837 and 1845 schemes to build a high level bridge multiplied due to the advent of the railways.

Eventually Newcastle Council selected a scheme proposed by George Hudson's York, Newcastle & Berwick Railway Company but they wanted the line to approach from the south because they wanted Newcastle to become a centre of the developing rail network in the North East.

Robert Stephenson, chief engineer for the railway company, designed the bridge and Thomas Elliott Harrison (later chief engineer of the North East Railway Company) prepared the working drawings. It was to be a double-decked structure with the road below and the railway on top. The upper deck would support three railway tracks on timber bearings resting on cast iron cross girders. The three tracks were a compromise to keep the costs down. Stephenson wanted four tracks.

In October 1845 two houses, one on each side of the river, were white - washed to act as site markers. They were replaced in April 1846 when two white poles were placed on their sites and the demolition of properties began. In total 650 families in Newcastle and 130 families in Gateshead were moved out to enable the bridge to be built.

Three piers were constructed on the riverbed inside cofferdams. They rested on elm tree foundations driven into the riverbed by two of James Naysmyths's new steam driven pile drivers.

Many different builders were involved with the construction of the bridge itself. Rush & Lawton of York were responsible for the stonework of the northern approach viaducts and the river piers; Wilson & Gibson of Newcastle were responsible for the stonework of the southern approach while the bridge iron works went to Hawks Crawshay of Gateshead.

The High Level Bridge

The builders constructed a temporary wooden bridge on the foundations and built the new bridge upwards. This wooden structure was strong enough to carry locomotives pulling materials onto the bridge.

Inevitably there were some accidents with such an undertaking and in August 1849 John Smith, a shipwright, working on the bridge fell toward the river below. He was saved from plunging to his death when the seat of his trousers caught on a nail protruding from the bridge. This broke his fall and enabled his workmates to pull him to safety.

The bridge was completed amazingly quickly. The first segment of the first arch was laid on July 10th 1848, the ironwork was linked end to end in May 1849 and the last arch was finished on 7th June 1849. On that day George Hawks, Mayor of Gateshead, and a director of Hawks Crawshay, hammered in the last key in the tension chain.

The first passenger train crossed the High Level Bridge at 9.30am on 15th August 1849 only thirteen months after the ironwork was begun.

On 28th September 1849 Queen Victoria officially opened the 1,337 ft long bridge on her way back from Scotland. The Royal Train stopped in the middle of the bridge and dignitaries from Newcastle and Gateshead greeted her.

Four months later the road deck was completed as a toll bridge.

For the next 57 years it carried all the rail traffic for the East Coast mainline until in 1906 the King Edward V11 Bridge was built across the river to relieve pressure on the High Level Bridge.

Robert Stephenson designed the huge Viaduct over Dean Street, which conveyed the main North/South railway line through Newcastle. He also designed the Royal Border Bridge at Berwick for the York, Newcastle & Berwick Railway Company.

Dean Street Viaduct