

Interesting Bridges

THE ROCHESTER BRIDGE – THE OLD BRIDGE, ROCHESTER

9GR2+V9 Rochester
(Google Maps Plus Code)

The Old Bridge carries the road from Rochester to Strood. This bridge was originally constructed in 1856 and stands on piers made of cast iron cylinders sunk through the riverbed to the rock underneath, hidden behind stone walls.

The flat span of the bridge on the Strood side was a swing bridge which could be moved out of the way so that ships with tall masts could pass through. This part is called the Old Ships' Passage but it can no longer be moved.



In 1914 the main part of the bridge was changed and it is now a bowstring-shaped truss bridge made mainly of steel. Each part is shaped like a bow which would be used to shoot arrows. The main bridge is divided into three sections called the Strood span (140 feet long), the main span (170 feet long) and the Rochester span (140 feet long).

The Old Bridge has two lanes for traffic plus a cycle lane and a footway for pedestrians. The bridge is decorated with a range of animals and plants, as was the style for Victorian construction. There are four bronze lions that act as guardians at either end of the bridge, as well as goats, wheat and flowers.





ALBERT BRIDGE, LONDON

FRJM+PC Richmond, London (Google Maps Plus Code)

Albert Bridge is a steel-chain suspension bridge, using a rigid chain suspension principle patented by Roland Mason Ordish – the designer of this bridge – using steel rods instead of conventional chains.

Sir Joseph Bazalgette carried out an inspection in 1884 and, finding corrosion, replaced the cables with steel chains and the whole structure was strengthened. Unfortunately, the bridge still showed signs of wear and, in 1972, two central piers were added to support the central span.

The bridge is illuminated at night by 4,000 LEDs and features London's last surviving tollbooths, which retain a notice to soldiers to break step when marching over the bridge: this is to avoid resonance in the structure, leading to damage.



Photo by Jonathon Hoffman on Unsplash

ANJI (ZHAOZHOU) BRIDGE, CHINA

PQC9+WP Zhao County, Shijiazhuang, Hebei, China (Google Maps Plus Code)

This is the oldest bridge to survive from the Sui Dynasty, crossing the Xiao River in what is now the Hebei province in northeast China. The Zhaozhou or Great Stone Bridge (Anji means safe passage) was designed by the master stonemason Li Chun in the late 6th century. It is a limestone segmental arch bridge, whose stone blocks are held together with cement and X-shaped cast iron joints.

The Xiao River is wide and fast flowing, so piers could not be built, and a semi-circular arch – such as the Romans would have constructed – would have meant a very high bridge. Li Chun created this shallower curved arch, reducing the weight of the arch by introducing the smaller cut out segment arches in the spandrels, and helping to protect the bridge from flooding.



Photo by Zhao 1974 via Wikimedia

BLACKFRIARS BRIDGE, LONDON

GV5W+V6 London (Google Maps Plus Code)

Since the 1750s, there had been a bridge across the Thames at Blackfriars, but after a century it became clear the structure had deteriorated so significantly that it could not be maintained any further: a new bridge was needed.

A new railway bridge was to be built just downstream, and to ensure marine traffic could navigate them easily, both bridges had to be designed with the same number of arches. Joseph Cubitt was therefore tasked with designing both.

The road bridge was opened in 1869 by Queen Victoria. It is a five arch wrought iron bridge, faced in granite, with red polished granite columns sitting on the cutwaters, supporting viewing platforms projecting from the roadway above.

These columns have ornate carvings in Portland stone depicting the wildlife of the Thames: it is said that the bridge marks the point between the tidal/salt water part of the Thames and the fresh water part, which is reflected by the carvings, with fresh water birds and plants on the upstream side, and seaweed and birds from the estuary on the downstream side.



Photo by Viktor Forgacs on Unsplash



BROOKLYN BRIDGE, NEW YORK, UNITED STATES

*P243+C7 New York, United States of America
(Google Maps Plus Code)*

New York is still one of the most populous cities in the entire United States of America, and is formed of over 36 islands.

Most of the business of New York is done on one particular island, Manhattan, as it was in the late 1800s. At that time, people would have to travel between the islands by ferry, taking a considerable time.

John A. Roebling designed his large suspension bridge well before the crossing had been approved, and ironically, had his foot broken by a ferry, eventually dying of tetanus from the injury before ground had even been broken on the construction.

Fortunately, his son was keenly observant, and took over the project – the bridge's design towering over any contemporary construction on either island. The construction of the towers was arduous, requiring caissons sunk up to 24m, and the resultant Caisson's disease left Washington Roebling virtually blind and unable to walk.

His wife, Emily Warren Roebling, took over in his absence for the next eleven years and was honoured with the first ride across the bridge when it opened in 1883. The towers are constructed from granite, limestone and cement, and the deck is suspended from steel cables.



Photo by Hannes Richter on Unsplash

CHARLES BRIDGE, PRAGUE, CZECH REPUBLIC

*3CP6+HH Prague 1, Czechia
(Google Maps Plus Code)*

In the 1100s, medieval Prague was flourishing, but the castle and cathedral were separated from the town by the fast-flowing Vltava River.

King Vladislaus instructed construction of the Judith Bridge to enable the people of Prague to reach his castle. However when that crossing was damaged by a flood, a new bridge was needed. Originally named the Stone Bridge, it was constructed in 1342 and later re-named the Charles Bridge after the Emperor Charles IV.

It is a stone bridge consisting of 16 semi-circular arches, and at more than 500m total span, the Charles Bridge was the longest and strongest bridge in medieval Europe.



Photo by Sergey Mind on Unsplash



CLIFTON SUSPENSION BRIDGE, BRISTOL

F93C+XV Bristol (Google Maps Plus Code)

The Clifton Suspension Bridge is a striking construction crossing the River Avon. Designed by Isambard Kingdom Brunel to meet the dual challenges of the deep river gorge and the high volume of marine traffic, it is a Grade I-listed structure and is one of the oldest surviving iron suspension bridges in the world.

It opened in 1864, and even now carries traffic across as part of the B3129, linking Bristol to a town called Leigh Woods in Somerset.



The crossing took 35 years from the initial competition for the design of the bridge to the completion of the construction. The towers are red sandstone faced with limestone and stand 76m above the high-water mark of the river, with wrought iron chains.

It is, and has always been, a toll bridge – it currently costs one pound per motorised vehicle to cross, which goes towards the maintenance of the bridge. There is a weighbridge on both approaches to the bridge; if the vehicle exceeds four tonnes, the barriers lock, preventing the vehicle from crossing.

ERASMUS BRIDGE, ROTTERDAM, NETHERLANDS

WF5P+JR Rotterdam, Netherlands (Google Maps Plus Code)

This bridge was opened in 1996 to connect the city centre to the dockland of Rotterdam. It is a cable-stayed, bascule bridge.

The longer span has a fan arrangement of cables to support the deck, while the backstays are tied to an intermediate abutment pier, which houses the mechanism to lift the bascule bridge section. This is the largest and heaviest bascule in Europe, required to allow taller vessels to pass beyond the bridge, as the clearance for ships beneath the main span is around 12.5m.



Photo by Martin Falbisoner via Wikimedia



FORTH BRIDGE, QUEENSFERRY, SCOTLAND

2J26+7J Inverkeithing (Google Maps Plus Code)

Bridging the Forth was a huge engineering challenge, and one that was made even more sensitive following the Tay Bridge disaster, where the bridge crossing another vital river had collapsed. Completed in 1890, the huge steel cantilevered bridge, designed by Benjamin Baker and John Fowler, replaced an ancient ferry crossing between North and South Queensferry. It linked Edinburgh with the North East of Scotland, resulting in an unbroken railway network between London and Aberdeen. Inscribed as a UNESCO World Heritage site in 2015, in the highest category, it is a design that is recognised across the globe. It was the longest cantilever in the world until 1917 and today carries over 200 trains a day, carrying over 3 million passengers a year.

The Rochester Bridge Trust's Arkwright Scholars visited Edinburgh, the Forth Bridge and the Falkirk Wheel in July 2019. We had the opportunity to climb to the top of the bridge, as well as other areas the public would not normally get to see.



Photo by Esteban on Unsplash



HEATHERWICK'S ROLLING BRIDGE

GR9G+94 London (Google Maps Plus Code)

Installed in August 2004, the Rolling Bridge spans an inlet of the Grand Union Canal, towards the head of Paddington Basin in London. The Grand Union Canal links London to Birmingham, with the Paddington basin at the very head of the London arm of the canal. The Rolling Bridge was designed by the Heatherwick Studio with structural engineers SKM Anthony Hunts. It is a 12m steel and timber footbridge made from 8 triangular segments which, when access is needed, slowly curl up until its two ends meet, forming an octagonal sculpture that stands on one side of the canal towpath. If you would like to see it roll in person, the team demonstrate the action every Wednesday and Friday at midday, and on Saturdays at 2pm. Search for Heatherwick's rolling bridge on YouTube to see the bridge in action.

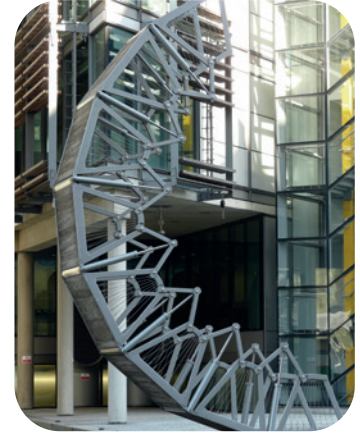


Photo by Loz Pycock via Wikimedia



Photo by Albin Olsson via Wikimedia



Photo by Albin Olsson via Wikimedia

THE IRON BRIDGE, TELFORD

JGG7+WR Ironbridge, Telford (Google Maps Plus Code)

This bridge was designated a Scheduled Ancient Monument and closed to traffic in 1934, which indicates the importance of its design to engineering. This bridge is a cast-iron arch bridge – the first of its kind. Bridges, traditionally, were built from stone, and had lasted more than a thousand years in the case of Ancient Roman arches, but at the start of the Industrial Revolution, engineers began to explore other options. One such man was Abraham Carby II, who ran the iron factory at Coalbrookdale, and wanted to demonstrate the strength of the cast iron that they had started to produce in large quantities. After his death, his son decided to fulfil his father's dream and have an iron bridge constructed over the River Severn. Apart from stone abutments, the bridge is entirely iron. The material was so new for bridge building that the construction method is essentially that of carpentry – the method for joining metal had yet to be developed.



Photo by August Schwerdfeger via Wikimedia



MENAI SUSPENSION BRIDGE, ANGLESEY, WALES

6RCP+4J Bangor (Google Maps Plus Code)

The Menai Strait is a stretch of shallow, but fast flowing, tidal waters between the main body of Wales and the island of Anglesey. Until Thomas Telford built the world's first suspension bridge in 1826, the residents had to navigate the treacherous waters, although the river was also heavily used by shipping. In the early 1800s, the closer political link with Ireland meant far more people trying to cross both the Menai Strait and the Irish Sea, so the need for the bridge was clear. It is constructed from limestone towers hung with sixteen wrought-iron chains, and the deck is suspended 30m above the river, allowing tall vessels to pass beneath. It was the longest suspension bridge until 1834 and is Grade I listed.



Photo by Rhys Morgan Jones via Wikimedia

MILLAU VIADUCT, FRANCE

32GF+X4 Millau, France (Google Maps Plus Code)

Opened in 2004, this is the tallest bridge in the world, with such a high deck that at times, any vehicles crossing it are passing through cloud (although the deck is not the highest in the world, that is the Beipanjiang Bridge in China)! The cable-stay, concrete and steel bridge stretches across the entire Tarn Valley, relieving congestion that regularly occurred on the highway in the area. The bridge is around 2.5km, or 1.5miles, in length. It is designed to look subtle and elegant, so the cables look like delicate threads and blend in against the hilly farmland.



Photo by Richard Leeming via Wikimedia

MILLENNIUM BRIDGE, LONDON

GW52+RH London (Google Maps Plus Code)

This bridge is remarkable for a number of reasons – it is the first horizontal suspension bridge, and the first bridge over the Thames in London for over a century. In 1996, a proposal for a new bridge was made and a design competition held. The winning design was described as a blade of light and aimed to blend into the landscape between the two major landmarks of the Tate Modern and St Paul's Cathedral, and not disrupt the views across the river. The footbridge is constructed of steel and aluminium and was hoped, as the name suggests, to be part of the national celebration of the new millennium. Unfortunately, the delay to opening was not the only embarrassment for the designers and engineers. When the bridge opened, with great fanfare, it began to sway as pedestrians crossed. With greater foot traffic than anticipated, the wobble became more pronounced. People began to hold on to the handrail for support and the bridge was nicknamed the wobbly bridge. Engineers monitored the bridge and found that the numbers of people using the bridge was the issue, rather than a structural one, and the natural tendency for people to fall into step with the sway caused it to be amplified. The engineers installed dampeners beneath the bridge, not only keeping the sleek design intact, but reducing the swaying motion of the bridge.



Photo by Viktor Forgacs on Unsplash

Search for millennium bridge vibrations to see a video showing the 'synchronous lateral excitation' or wobble of the bridge when it opened.



MILLENNIUM BRIDGE, LOCKMEADOW, MAIDSTONE

7GCC+49 Maidstone (Google Maps Plus Code)

In 1998 the Rochester Bridge Trust contributed £130,000 in matching funds toward a Maidstone Borough Council bid to the Millennium Commission. This successful bid led to the construction of the pedestrian bridge at Lockmeadow. This bridge is a cable-stayed aluminium footbridge that has a single pier on the Lockmeadow side of the bridge, which in turn, provides the base for the support masts from which the cables are suspended. The footbridge design was chosen by a public exhibition and connects the leisure centre and market square, and the town centre and All Saints Conservation Area.



PONT DU GARD, NIMES, FRANCE

WGXM+2X Vers-Pont-du-Gard, France (Google Maps Plus Code)

This is the largest Roman aqueduct still standing, completed in 18BC. A three layered semi-circular arch bridge, built from limestone, it is 360m long. Each stone is cut and shaped to fit together so perfectly, no mortar is needed to hold them in place. It is part of an aqueduct system 31miles long, that once supplied water from a remote spring to the ancient city of Nemausus, now Nimes. It is unusual in that Roman aqueducts usually transport water at or below ground level - this bridge stands around 47m tall. It is a UNESCO World Heritage Site, and since 2000, has been pedestrian only access.



Photo by Xuan Nguyen on Unsplash

PUTNEY BRIDGE, LONDON

FQ8P+RV Richmond, London (Google Maps Plus Code)

Opened in 1886, the bridge is a fairly traditional arch design of segmental arches faced with Cornish granite, and was designed by Sir Joseph Bazalgette. It is a Grade II listed structure, and despite being widened in the early 1930s, the bridge retained its appearance, including the fine three-branched gas lamps, made of cast iron. The University Boat Race between Oxford and Cambridge has started from Putney Bridge since 1845.





QEII BRIDGE, DARTFORD

F775+QC Dartford (Google Maps Plus Code)

The longest cable-stayed bridge when opened in 1991, it was built to relieve the pressure on the two-bored tunnel crossing that was already the route the M25 took between Kent and Essex. The deck is carried by two pairs of steel and concrete towers supported by concrete piers and 56 pairs of steel cables. The two reinforced concrete caissons, which support the river piers, were constructed in the Netherlands and towed across the North Sea before being sunk into place. Each caisson weighs 85,000 tonnes and is designed to withstand the impact of a 65,000 tonne vessel travelling at 18.5km per hour. It connects Dartford in Kent and Tilbury in Essex, and although was initially called Dartford Bridge, Tilbury residents argued that it should be called Tilbury Bridge, and a compromise was reached in time for Queen Elizabeth II to open it in October 1991. It is currently the only bridge built east (downriver) of Tower Bridge.



Photo courtesy of Balfour Beatty and Connect Plus

A video from the Institution of Civil Engineers as part of the celebration of the institution's bicentenary ICE 200, in the 220 People and Projects programme, featured the Dartford Crossings and can be found on their YouTube channel.

TOWER BRIDGE, LONDON

GW4F+5V London (Google Maps Plus Code)

Although people would be forgiven for thinking this Grade I listed London landmark is much older than it is judging by the Gothic-style exterior, it is in fact a Victorian engineering masterpiece. Designed by Horace Jones and John Barry, their aim was to construct a bridge that could move, and allow all vessels to pass beneath. They designed a bascule bridge, where the central deck divides into two separate leaves, or bascules (coming from the French for seesaw), and these would be lifted by steam engines at the base of the towers. Since 1976, the bridge has been fully powered by an electro-hydraulic system, rather than steam. Either side of the towers, the deck is supported by suspension cables. The towers are covered in Cornish granite, with Portland stone dressing, which are merely decorative additions to the steel-framed towers, to appear medieval, in keeping with the nearby Tower of London. The bridge opens up to 800 times a year to allow vessels to move into or from the Upper Pool of London.



Photo by Dave Francis on Unsplash

A video showing the opening of Tower Bridge from the control room can be found on the YouTube channel 1000 Londoners, featuring films produced by South London based film production company and social enterprise, Chocolate Films.

WATERLOO BRIDGE, LONDON

GV5M+97 Southwark, London (Google Maps Plus Code)

This bridge is a Grade II listed reinforced concrete cantilever bridge, faced with granite and Portland stone. Work started in 1938, but was delayed due to the Second World War, finally fully opening in November 1944. It is colloquially referred to as the ladies' bridge and it is believed to be related to the construction workforce consisting of women (as was common during the war effort). It is the only bridge to have given its name to a film.



Photo by Colin via Wikimedia

WEST INDIA QUAY FOOTBRIDGE, LONDON

GX4H+M2 London (Google Maps Plus Code)

In the 1990s, there was a drive for regeneration of the London Docklands area, and bridges were fundamental to this. This footbridge connecting each side of the dock was designed to both open as a bascule, and also be moveable, as it floats on pontoons, but has remained in position thus far. The pontoon design also permitted the bridge to be fabricated in the workshop before being transported by road and then boat, as it was towed along the Thames. Although pontoon bridges are not usually designed to be permanent, this one has piles in the dock floor, tying down the individual pontoon sections.

