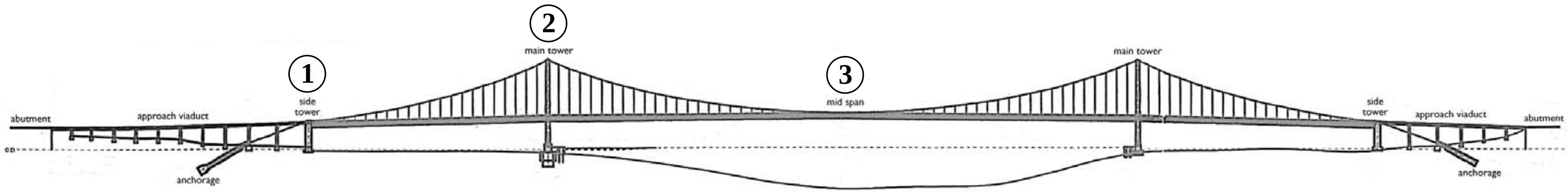
Walk the Forth Road Bridge



Stop 1: Side Tower

You're now standing on top of one of what is known as the Side Tower.

To the south is the approach viaduct, which is a significant structure in its own right at 438 metres long.

To the north is the suspended span – everything from here to the north viaduct, 1,822 metres away, is suspended from the two main cables.

South Viaduct

The South Viaduct is supported by ten concrete piers and this side tower. It is actually two separate structures with an expansion joint three piers along (this is visible from the footpaths and carriageway).

The viaducts are made up from a concrete deck sitting on top of twin steel box girders and steel cross girders. The box girders in turn sit on bearings on top of the abutment, side tower and piers.

The piers on the South Viaduct between the expansion joint and the side tower are designed to flex whereas the remainder are on roller bearings which allow the structure to move through live load and temperature changes.

A contract to replace all the bearings on the viaducts is currently out to tender.

Side Tower

From the ground, the side tower on which we're standing looks like a wider version of the concrete piers supporting the viaduct. It needs to be stronger because it's not only helping to support the viaduct but also load from the main cable as it diverts down towards the Anchorages.

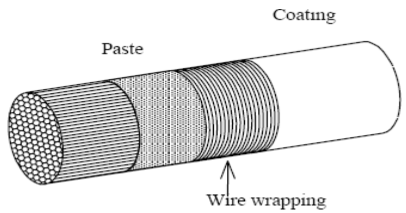
Main Cable

The entire self weight of the bridge, all the traffic (and your own weight!) between the Side Towers from here to the North Viaduct is suspended from the bridge's two main cables.

The main cables are supported by the two main towers then diverted over the side towers and anchored into concrete-filled tunnels bored into the rock on either shore.

Each main cable is made up of 11,618 individual galvanised high tensile steel wires, compacted into a bundle approximately 60 centimetres in diameter.

The cables were formed by spinning a few wires at a time back and forth across the estuary, gradually building up a cable capable of taking the load of the bridge. When spinning was complete the cable was hexagonal in shape – it was then compacted into the round shape we see today. Because the individual wires are circular even compacting them together leaves thousands of gaps within the cable. As a result almost 20% of the cable is voided. The compacted cable was then wrapped laterally with 9 gauge galvanised wire and further protected by painting using red lead paste between the cable and wrapping wire and the whole cable was then painted.



This technique for spinning parallel wire suspension cables was first developed by the noted civil engineer, John Roebling, on the Brooklyn Bridge in the 19th century, and has subsequently been used on the Golden Gate, the Severn and many other famous suspension bridges worldwide.

Stop 2: Main Tower

The two main towers support the majority of the bridge's weight.

The top platform which supports the Aircraft warning lights sits 157.128 metres above sea level. The carriageway at the main towers sits 58.704 metres above sea level.

Each tower leg was designed to take a vertical force of 10,629 tons. Of which 9,310 tons are dead load (the weight of the structure transferred through the main cables) and 1319 tons are transient loads (due to traffic, wind and temperature).

Due to the increase of live loading through traffic, the tower legs were strengthened between 1994 and 1998. This involved the installation of new more slender columns inside the existing legs. Approximately 60% of the total load in the towers was transferred from the existing to the new columns through a jacking operation.

The towers are cellular in construction with 5 cells horizontally and 11 sections vertically. Lifts located in the SE and NW towers provide access to tower top and pier head.

The tower legs were designed to deflect 1131mm at the top from the combined effects of traffic and temperature.

Main expansion joint

The main expansion joints, which allow the deck to expand and contract as required by weather and the weight of traffic, are designed to allow about 1.7 metres of movement, and are embedded into the roadway between the legs of the main tower.

The join where the main span overlaps the side span is visible on the surface of the pedestrian/cycle path. If you look closely you can see this moving in response to the weight of traffic, wind and temperature.

Stop 3: Mid Span

The road at mid span sits **63.276 metres** above sea level, that is a rise of over 4.5 metres from the level at the towers..

When the depth of the truss and our maintenance gantries are taken into consideration this leaves an air draft of **41.6 metres** at high tide for shipping passing under the bridge.

The bridge is designed to sway **7.1 metres** in either direction in a 110mile/hour wind.

The truss is designed to deflect approximately **4.1 metres** at mid span under a combination of live load and temperature.

Navigation lights are positioned on the bottom chord of the truss to assist shipping in the navigation channel – these are designed to be visible from at least 5 miles.

Two **longitudinal steel trusses** span the length of the suspended structure on the east and west of the bridge. These trusses are approximately 9 metres deep. Lateral and diagonal girders span between these every 9 metres. The carriageway and footpaths are supported by, and sit independently from, these lateral and diagonal girders.

The total surface area of the steel in the trusses is 202,000 square metres. In total there is 270,000 square metres of steel on the bridge to be painted.

The complete deck structure is suspended from the main cables by steel **hangers formed from high tensile wires. The hangers** are positioned every 18 metres (at alternative cross girders). The hangers were replaced between 1997 and 2000.

Main cable corrosion

In 2005, following guidance established in the USA the main cables were inspected internally, the first such inspection undertaken outwith the USA.

Surprisingly a significant level of corrosion and broken wires were discovered.

Calculations indicated that the current strength loss was estimated to be between 8% and 10%. It was reasonably assumed that future strength would continue to deteriorate leading to traffic restrictions.

To monitor future wire breaks an Acoustic Monitoring System was installed throughout both cables in order to identify any clusters which may cause problems. Some of the sensors for these are visible from the footpath.

In order to try to slow down or halt the corrosion, the cables have now been fitted with a dehumidification system; the principle is very simple. It is known that the rate of corrosion reduces dramatically below a relative humidity (RH) of 60%, and stops completely below 45% RH

The cables are dehumidified by drawing air into one of the three plant rooms visible on the west of the bridge. Air in these plant rooms is dehumidified to an RH of approx 20% initially. Fans within the plant room then inject dry air into the cables so as to remove the water.

Injection sleeves are visible close to mid span on both cables.

If successful, dehumidification should negate the requirement for future traffic restrictions.

Route of new bridge

To the west of the bridge the route of the planned Forth Replacement Crossing can be seen. One of its three towers will sit on the Beamer Rock, where a lighthouse is currently visible.

For further information on the bridge, its design and history, please visit our brand new website:

www.forthroadbridge.org

FORTH ROAD BRIDGE

Walk the Forth Road Bridge

The Forth Road Bridge is one of the worlds' most significant long span suspension bridges. With a main span of 1006 metres between the two towers, it was the fourth longest in the world and the longest outside the United States when it opened in 1964. In total, the structure is over 2.5 km long. A staggering 39,000 tonnes of steel and 125,000 cubic metres of concrete was used in its construction.

Follow this guide to discover this iconic structure for yourself.

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