BRIDGES

The growth of Plymouth is partly explained by the connectivity provided by the River Tamar and the River Plym. However, these rivers limited direct road and rail access to the east and west. The earliest bridge crossing of the Plym was upstream at the medieval ‘Plym Bridge’. The nearest Tamar crossing was via the 16th century bridge at Gunnislake.

Only fords or ferries crossed the dangerous tidal estuaries. It was in the 19th century that Civil Engineers provided the first fixed bridges at Laira and Saltash, and a ‘floating bridge’ at Torpoint. The Tamar Road Bridge was completed in 1961.

CROSSING THE PLYM AND THE TAMAR

In the 1820s, James Meadows Rendel proposed suspension bridges to cross the Plym at Laira and the Tamar at Saltash. By 1827, only his revised design for a cast iron bridge at Laira had been completed. However, in the 1830s, Rendel designed the forerunners of the three large chain ferries or ‘floating bridges’ that still cross the Tamar at Torpoint.

In the 1850s, early thoughts to take the Cornwall Railway across the Tamar using Rendel’s Torpoint Chain Ferry were superseded by Isambard Kingdom Brunel’s plans for a high-level viaduct at Saltash, where the river narrows. Brunel came up with various design solutions before he settled upon his famous and unique bow arch self-supporting wrought and cast iron viaduct, completed in 1859 and still in use today.

By 1961-2, there was the replacement concrete bridge at Laira and an impressive new road bridge at Saltash. Work on the Tamar Bridge crossing, then Britain’s longest suspension bridge, began in 1959. Designed by Mott Hay and Anderson, two 67metre (220ft) tall concrete towers support a pair of steel main cables, together weighing 850 tonnes, and the suspended structure is 642 metres long.

As built, the Tamar Bridge had just three lanes, catering for a maximum vehicle weight of 24 tonnes and had been designed for 20,000 vehicle crossings a day. By 1990, usage was already twice that design capacity and maximum vehicle weights had increased to 38 tonnes.
A NEW LEASE OF LIFE FOR THE TAMAR BRIDGE

Extending the useful life of bridges depends on several factors, including regular inspection, monitoring and maintenance. In the 1990s, to meet future requirements, there was a need for the Tamar Bridge to carry ever-heavier lorries. In addition, it had to cope with an increasing volume of vehicles - way above the numbers envisaged when the Bridge was first designed.

For the Civil Engineers tasked with evaluating the strength and capacity of the Tamar Bridge, a further challenge was the need for vehicles to continue to cross the river whilst any improvements or new works took place.

PIONEERING SOLUTIONS

In 1994, after over 30 years of use, comprehensive structural inspection and computer-aided modelling took place to assess the strength of the Bridge. The steel suspension cables, towers and cable anchorages all passed. However, the concrete road deck and the trusses underneath were unable to carry the proposed 44-tonne lorries, in the long term.

Traditional options included a new replacement bridge, involving a long lead-time and a great cost, or the diversion of traffic long distances onto other low capacity river crossings whilst strengthening work took place. The novel solution, devised by civil engineers from Hyder Consulting Ltd., was to attach cantilever lanes projecting from either side of the Bridge. These initially provided additional lanes onto which traffic was diverted whilst the concrete deck was replaced with lightweight steel, and they were then left in situ for permanent use.

Cleveland Bridge (UK) Ltd undertook the work between 1999 and 2001. Steel plating was also added to the truss and 18 additional cables were installed and stressed to help handle the higher loads on the bridge structure during the project. The effect of removing the concrete and adding more steel increased the weight of the suspended structure by just 25 tonnes. This strengthening and widening scheme was a civil engineering first. It was duly recognised in the British Construction Industry and the ICE Historic Bridge and Infrastructure Awards of 2002.