

ENGINEERING MARVELS

Bridges with breath-taking design that pushed the boundaries of construction.

The UAE is home to some of the most dizzying and ambitious works of architecture in the world. The Burj Khalifa, Burj Al Arab, Sheikh Zayed Grand Mosque, The Palm, The Frame – with each passing year the list of concrete-and-steel marvels in the country grows.

Now a new project will add to that list. Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, recently announced the construction of the AED394 million Shindagha Bridge Project. Part of the AED5 billion Shindagha Corridor, its stunning design is based on the mathematical symbol of infinity (∞).

When complete, the bridge will span 295 metres, 150 metres of which will be over Dubai Creek. Sitting 15.5 metres above water, it will carry six lanes of traffic in each direction, as well as a pedestrian crossing.

As Dubai embarks on yet another feat of monumental engineering, we look at other bridges around the world that pushed boundaries to the limit – and then beyond.



Above: Shindagha Bridge Project

ENGINEERING





GOLDEN GATE BRIDGE

San Francisco, USA

No bridge anywhere captures the hearts and minds of the people who visit it quite like the Golden Gate Bridge. An American icon, it's an internationally recognised symbol of American ingenuity and know-how. *Frommer's Travel Guide* describes it as "possibly the most beautiful, certainly the most photographed, bridge in the world".

The masterwork of architect Joseph B Strauss, whose statue graces the southern observation deck, the bridge connects San Francisco to Marin County in the north. It took seven years and \$35 million (more than \$500 million in today's money) to build, and at the time of its opening in 1937, it was both the longest and the tallest suspension bridge in the world, with a main span of 1280 metres and a height of 227 metres.

The colour of the bridge is called "international orange" and was chosen because it complements the natural surrounding and enhances its visibility in foggy conditions.

The bridge is popular with pedestrians and cyclists, and was built with walkways on either side of the traffic lanes. More than 10 million people visit

it each year. That translates, on average, to 27,000 visitors per day.

SYDNEY HARBOUR BRIDGE

Sydney, Australia

The Australian capital has one of the most beautiful natural harbours in the world. Sail into it, and you will pass two renowned structures – Sydney Opera House and Sydney Harbour Bridge.

Known locally as "the coathanger", Sydney Harbour Bridge's design was influenced by the Hell Gate Bridge in New York City. Rising to a height of 135 metres, it is the world's tallest steel arch bridge, connecting the northern suburbs of Sydney with the city centre. It opened in 1932, weighs more than 39,000 tonnes, spans 500 metres and is 48 metres wide. It carries eight lanes of traffic, two railway lines, a footpath and a dedicated cycle path.

In his book *Down Under*, American travel writer Bill Bryson wrote: "From a distance it has a kind of gallant restraint, majestic but not assertive, but up close it is all might. It soars above you, so high that you could pass a ten-storey building beneath it, and looks like the heaviest thing on earth. Everything that is in it – the stone blocks in its four towers, the latticework



of girders, the metal plates, the six-million rivets (with heads like halved apples) – is the biggest of its type you have ever seen.”

The bridge offers a great way to appreciate the full beauty of the city, and if you are not afraid of heights, you can even climb it. BridgeClimb Sydney conducts tours over the arch. Clad in overalls and clipped to a safety line, you can walk and climb 1500 metres over the famous bridge for breathtaking views and a priceless memory.

✠ THE FORTH BRIDGE

Queensferry, Scotland

Considered a wonder of the engineering world when it opened in 1890, Scotland’s famous cantilever railway

bridge, which spans the Firth of Forth, is now a UNESCO World Heritage Site and a fine example of Victorian engineering and craftsmanship.

Designed by Sir John Fowler and Sir Benjamin Baker and built by Sir William Arrol & Co, the 8296-foot long railway bridge connects the north-east and south-east of Scotland.

Consisting of three separate four-tower high, double-cantilevers supported by granite piers, 5000 men constructed the Forth Bridge with 54,000 tons of steel, 20,950 cubic metres of granite, 6780 cubic metres of stone, 49,200 cubic metres of concrete, 50 tons of cement and seven million rivets.

According to UNESCO, which describes the bridge as of “outstanding universal value”, the Forth





Bridge is “a masterpiece of creative genius because of its distinctive industrial aesthetic, which is the result of a forthright, unadorned display of its massive, functional structural elements.

“The Forth Bridge is an extraordinary and impressive milestone in the evolution of bridge design and construction during the period when railways came to dominate long-distance land travel, innovative in its concept, its use of mild steel, and its enormous scale.”

🇫🇷 MILLAU VIADUCT

Millau, France

When it opened in 2004, the spectacular Millau Viaduct in France set new standards in both planning design and construction – without mentioning the record it set as the largest cable-stayed bridge in Europe.

At 2.4 kilometres long, and 270 metres above the River Tarn at its highest point, the viaduct spans a



two-kilometre valley in the Massif Central mountain range and forms the final link in the Paris to Barcelona highway.

Designed by English architect Sir Norman Foster and French structural engineer Michel Virlogeux, the bridge cost almost €400 million.

At the time of its opening, *The Washington Post* said: "This may be the lightest, sleekest bridge design anywhere. Framed by the surroundings, it is pure environmental sculpture."

DANYANG-KUNSHAN GRAND BRIDGE

Jiangsu, China

It probably comes as no surprise that the longest bridge in the world is in China. The Danyang-Kunshan



Grand Bridge forms part of the Beijing to Shanghai High-Speed Railway. Opened in June 2011, it spans a whopping 165 kilometres. With a workforce of 10,000 people assigned to building it, the bridge was constructed from 450,000 tons of steel in just four years, at a cost of around \$8.5 billion.

Located on the rail line between Shanghai and Nanjing in East China's Jiangsu province the bridge is in the Yangtze River Delta where lowland rice paddies, canals, rivers and lakes characterize the geography. 