

I.The Longest Bridges in the World

1.Africa:

6th October Bridge

Information:

The **6th October Bridge** is an elevated highway in central Cairo, Egypt.

The 20.5 kilometres (12.7 mi) bridge and causeway crosses the Nile twice from the west bank suburbs, east through Gezira. Island to Downtown Cairo, and on to connect the city to the Cairo International Airport to the east.

Its name commemorates the date of The Crossing , which commenced the outbreak day of the Yom Kippur War in 1973.

The bridge and causeway were completed in 1996, with construction taking nearly 30 years. It began in 1969 with the modest, 130 metres (430 ft) long Phase 1, which only spanned the smaller west branch of the Nile from Gezira to Agouza (built from May 1969 to August 1972). Phase 9 completed the 21.193 kilometres (13.169 mi) long final length in 2005. The 6th October Bridge and Flyover runs from the Agricultural Museum in Dokki east to the Autostrade in Nasr City

The 6th October Bridge has been called the spinal cord of Cairo, with approximately half a million Cairene people using it on a daily basis. Due to its role as Cairo's central East West automobile and truck route, the bridge and causeway is nearly always crowded with traffic, with the trip from one end to another taking up to 45 minutes.

2.Asia:

Information: The Danyang Kunshan Grand Bridge is a 164.8 kilometre (102.4 mi) long viaduct on the Beijing Shanghai High Speed Railway. It is the world's longest bridge.

The bridge is located on the rail line between Shanghai and Nanjing in Jiangsu province

The bridge runs roughly parallel to the Yangtze River, about 8 to 80 km (5 to 50 mi) south of the river.

It passes through the northern edges of population centers (from west to east) beginning in Danyang, Changzhou, Wuxi, Suzhou, and ending in Kunshan.

There is a 9 kilometre long (5.6 mi) section over open water across Yangcheng Lake in Suzhou.

It was completed in 2010 and opened in 2011. Employing 10,000 people, construction took four years and cost about \$8.5 billion. The Danyang Kunshan Grand Bridge currently holds the Guinness World Record for the longest bridge in the world in any category as of June 2011.

The building of the Danyang Kunshan Grand Bridge lasted four years, using the workforce as strong as 10 thousand people and resources that reached the cost of \$8.5 billion.

The Danyang Kunshan Grand Bridge currently holds the Guinness World Record for the longest bridge in the world in any category as of June 2011.

3. North America:

Lake Pontchartrain Causeway

Information:

The Lake Pontchartrain Causeway, sometimes only the causeway, is a fixed link composed of two parallel bridges crossing Lake Pontchartrain in southern Louisiana, United States. The longer of the two bridges is 23.83 miles (38.35 km) long. The southern terminus of the causeway is in Metairie, Louisiana, a suburb of New Orleans. The northern terminus is at Mandeville, Louisiana.

Since 1969, it was listed by *Guinness World Records* as the longest bridge over water in the world; in 2011, in response to the opening of the longer Jiaozhou Bay Bridge in China, *Guinness World Records* created two categories for bridges over water: continuous and aggregate lengths over water. Lake Pontchartrain Causeway then became the longest bridge over water (continuous) while Jiaozhou Bay Bridge the longest bridge over water (aggregate).

The bridges are supported by 9,500 concrete pilings. The two bridges feature a bascule, which spans the navigation channel 8 miles (13 km) south of the north shore.

The idea of a bridge spanning Lake Pontchartrain dates back to the early 19th century and Bernard de Marigny, the founder of Mandeville. He started a ferry service that continued to operate into the mid 1930s. In the 1920s, a proposal called for the creation of artificial islands that would then be linked by a series of bridges. The financing for this plan would come from selling home sites on the islands. The modern causeway started to take form in 1948 when Ernest M. Loeb Jr. envisioned the project. Due to his lobbying and vision, the Louisiana Legislature created what is now the Causeway Commission. The Louisiana Bridge Company was formed to construct the bridge, which in turn appointed James E. Walters Sr. to direct the project.

The original causeway was a two lane span, measuring 23.86 miles (38.40 km) in length. It opened in 1956 at a cost of \$46 million. This included not just the bridge, but three approach roads on the north end and a long stretch of road on the south end. A parallel two lane span, 1/100th of

a mile (15 m) longer than the original, opened on May 10, 1969, at a cost of \$30 million.

Since its construction, the causeway has operated as a toll bridge. Until 1999, tolls were collected from traffic going in each direction. To alleviate congestion on the south shore, toll collections were eliminated on the northbound span. In May 1999, the standard tolls for cars changed from \$1.50 in each direction to a \$3 toll collected on the North Shore for southbound traffic. In 2017, the toll was raised to fund safety improvements on the bridge. The toll changed from \$3.00 with cash and \$2.00 with a toll tag to \$5.00 with cash and \$3.00 with a Toll Tag.

The opening of the causeway boosted the fortunes of small North Shore communities by reducing drive time into New Orleans by up to 50 minutes, bringing the North Shore into the New Orleans metropolitan area. Prior to the causeway, residents of St. Tammany Parish used either the Maestri Bridge on U.S. Route 11 or the Rigolets Bridge on U.S. Route 90, both near Slidell, Louisiana; or on the west side, via U.S. Route 51 through Manchac, Louisiana.

After Hurricane Katrina on August 29, 2005, videos collected showed damage to the bridge. The storm surge was not as high under the causeway as it was near the I 10 Twin Span Bridge, and damage was mostly limited to the turnarounds. A total of 17 spans were lost. Structural foundations remained intact. The causeways have never sustained major damage of any sort from hurricanes or other natural occurrences, a rarity among causeways. The existing fiber optic cable plant was blown out of its tray but remained intact per optical time domain reflectometer (OTDR) analysis. With the I 10 Twin Span Bridge severely damaged, the causeway was used as a major route for recovery teams staying in lands to the north to get into New Orleans. The causeway reopened first to emergency traffic and then to the general public with tolls suspended on September 19, 2005. Tolls were reinstated by mid October of that year.

The Lake Pontchartrain Causeway is one of seven highway spans in Louisiana with a total length of 5 miles (8.0 km) or more. The others are, in

order from longest to shortest, the Manchac Swamp bridge on I 55, the Atchafalaya Basin Bridge on I 10, the Louisiana Highway 1 Bridge, the Bonnet Carré Spillway Bridge on I 10, the Chacahoula Swamp Bridge on U.S. 90, the Lake Pontchartrain Twin Spans on I 10, and the LaBranche Wetlands Bridge on I 310. The Maestri Bridge comes close, but runs short by two tenths of a mile at roughly 4.8 miles (7.7 km) in total length.

Louisiana is also home to the Norfolk Southern Lake Pontchartrain Bridge, which at 5.8 miles (9.3 km) is one of the longest railway bridges in the United States. The southern end of the Manchac Swamp Bridge (on the western edge of Lake Pontchartrain) is the western end of the I 10 Bonnet Carré Spillway Bridge (on the southwestern edge of Lake Pontchartrain), and the northern end of the LaBranche Wetlands Bridge is the eastern end of the I 10 Bonnet Carré Spillway Bridge; so these three bridges, by name, are in fact one contiguous bridge. The total driving distance on continuous elevated roadway is over 38 miles (61 km).

4. Europe

The Crimean Bridge

Information:

The Crimean Bridge also called the Kerch Strait Bridge, or colloquially the Kerch Bridge is a pair of parallel bridges constructed by the Russian Federation to span the Strait of Kerch between the Taman Peninsula of Krasnodar Krai and the Kerch Peninsula of Crimea (Russian annexed, mostly internationally recognised as part of Ukraine)

With a length of 19 km (11.8 mi), it is the longest bridge Russia ever built and is often considered to be the longest bridge of Europe.

In January 2015, the multibillion dollar contract for the construction of the bridge was awarded to Arkady Rotenberg's Stroygazmontazh.

Construction of the bridge commenced in May 2015.

the road bridge was inaugurated by Russian President Vladimir Putin on 15 May 2018 and opened for non truck cars on 16 May and for trucks on 1 October while the completion of the rail link is scheduled for 2019

The bridge was christened the Crimean Bridge after an online vote in December 2017, while Kerch Bridge and Reunification Bridge were the second and third most popular choices.

The road bridge, opened in 2018, quickly overtook the Kerch Strait ferry as a preferred route of communication of Crimea with rest of the *de facto* Russian territory. In first 12 hours of operation it broke traffic record of the ferry, established in August 2017, after the bridge was opened for trucks in October 2018, truck transportation through ferry virtually ceased, and after first full year of operation (May 2018–May 2019) road bridge served more than three times bigger traffic than Kerch Strait ferry served in entire 2017. Since the road bridge is free of charge, in comparison to ferry, it is claimed that users of the bridge saved more than 16 billion rubles. The bridge is said to have been contributed to increase of number of tourists visiting in Crimea, with bridge traffic peaked in summer months—on 5 August 2018 the bridge had broken a single day record for car traffic, with 32,000 vehicles crossing the span, followed by over 33,000 vehicles on 12 August that year and over 35,000 a year later

5. South and Central America :

President Costa e Silva Bridge

INFORMATION:

President Costa e Silva Bridge, commonly known as the Rio Niterói Bridge, is a box girder bridge crossing Guanabara Bay, in the State of Rio de Janeiro in Brazil. It connects the cities of Rio de Janeiro and Niterói. It is currently the longest prestressed concrete bridge in the southern hemisphere, and the sixth longest in the world. From its completion in 1974 until 1985 it was the world's second longest bridge, second only to the Lake Pontchartrain Causeway.

The concept dates to 1875, when a bridge and tunnel connection was envisioned between two cities separated by Guanabara Bay and connected by road only via inland journey of more than 100 kilometers (62 mi) through the city of Magé.

In 1963, a working group was created to study a bridge building project. On December 29, 1965, an executive committee was formed to run the bridge building program. President Artur da Costa e Silva signed a decree on August 23, 1968, authorizing the project for the bridge. The bridge program was run by Minister of Transport Mario Andreazza.

Construction began symbolically on August 23, 1968, in the presence of Queen Elizabeth II of the United Kingdom and Prince Philip, Duke of Edinburgh alongside Mario Andreazza in on their first, and thus far only, visit to Brazil. Actual work began in January 1969.

Construction of the bridge in 1971.

The bridge was constructed by a consortium of Brazilian companies led by Camargo Correa SA (for the concrete works) and by Cleveland Bridge & Engineering Company and Redpath Dorman Long in association with Montreal Engenharia de Brazil (for the steel navigation spans). It is 13.29 kilometres (8.26 mi) long 8.836 kilometres (5.490 mi) over water and the bridge's 300 metre (980 ft) central span is 72 metres (236 ft) high in order to allow the passage of hundreds of ships entering and leaving the bay every month. At the

time it was completed, the central span was the longest box girder in the world; it has since been surpassed by the 301 metre (988 ft) main span of the Stolma Bridge (1998) and the 330 metre (1,080 ft) main span of the second Shibano Bridge (2006). It carries 140,000 vehicles daily, which pay a toll only when entering Niterói of R\$4.30 (as of June 2018), about US\$1.10, GBP £0.85 or €0.97. It has 18 access points and eight overpasses.

The bridge opened on March 4, 1974, with the official name of President Costa e Silva Bridge. Rio Niterói started as a descriptive nickname that soon became better known than the official name. Today hardly anyone refers to it by its official name.

Officially, it is part of federal highway BR 101. From 1 June 1995, it was under the management of Ponte S.A. under a 20 year concession until 1 June 2015 since when Ecoponte has managed the bridge.

In 1977, the famous Brazilian singer Maysa died in a car crash on the bridge.

The bridge was featured in the 2011 film *Fast Five*. The Puerto Rican bridge Teodoro Moscoso doubled for the bridge during the last moments of the film.

In 2012 a bill was introduced to change its official name, President Costa e Silva Bridge the second president of the Brazilian military dictatorship between 1964 and 1985 to Herbert de Souza Bridge, which has annoyed the Brazilian military.

II. The HIGHEST Bridges in the world

1. ASIA:

The Duge Bridge

INFORMATION:

The Duge Bridge is a cable stayed bridge on the border between the provinces of Guizhou and Yunnan in China. As of 2016, the bridge is the highest in the world with the road deck sitting over 565 metres (1,850 feet) above the Beipan River. The bridge is part of the G56 Hangzhou Ruili Expressway between Qujing and Liupanshui. The eastern tower measures 269 m (883 ft) making it one of the tallest in the world.

The bridge spans 1,340 m (4,400 ft) between Xuanwei city, Yunnan and Shuicheng County, Guizhou.

Construction of the bridge began in 2011. The bridge was completed on 10 September 2016. It was inaugurated on 29 December 2016.

The vertical limestone cliffs drop so deep that much of the river is in shadow during the day. Spaced every 50 kilometers along its length are a collection of epic road and railway bridges that have pushed the boundaries of China's bridge engineering community.

Due to be completed in 2016, the G56 expressway is the last of Guizhou's great East West routes that will allow easy access into nearby Yunnan Province across terrain that was previously inaccessible to normal cars and trucks. The entire 4 lane divided highway stretches an incredible 2,935 kilometers from the city of Hangzhou near Shanghai to the border of Burma near Tibet. The extreme geography along the G56 has produced not only the world's highest bridge over the Beipanjiang River near Duge, Guizhou but also the World's Highest Suspension Bridge several kilometers further west near Puli, Yunnan.

Today the Province of Guizhou is home to more high bridges than every other country on earth combined. By 2020 Guizhou will have more than 250 bridges over 100 meters high as measured from the road or rail deck to the water. Compare that with Italy which has the world's second greatest number of high bridges with only 40 spans exceeding 100 meters in height.

Of the world's 20 super high spans that exceed 300 meters from deck to water, all are in China except for 3.

2. North America:

The Baluarte Bridge

INFORMATION:

The Baluarte Bridge, officially the Baluarte Bicentennial Bridge, is a cable stayed bridge in Mexico. It is located between the municipalities of Concordia in Sinaloa and Pueblo Nuevo in Durango, along the Durango Mazatlán highway, Mexico 40D. The bridge has a total length of 1,124 m (3,688 ft), with a central cable stayed span of 520 m (1,710 ft). With the road deck at 403 m (1,322 ft) above the valley below, the Baluarte Bridge is the third highest cable stayed bridge in the world, the seventh highest bridge overall and the highest bridge in the Americas.

Construction of the bridge began in 2008, it was inaugurated in January 2012 and opened to traffic in late 2013. The bridge forms part of a new highway linking the Atlantic and Pacific coasts of northern Mexico and has reduced the travelling time between Durango and Mazatlán from approximately 6 to 2.5 hours.

The bridge's four lane roadway, 20 metres (66 ft) wide by 1,124 metres (3,688 ft) long, is supported at a height of 403 metres (1,322 ft) above the Baluarte riverbed by 12 piers, two of which are also pylons (towers). Each of the two pylons measures 18 by 8.56 metres (59.1 by 28.1 ft) at its base, widens in the centre to carry the roadway before tapering upwards to 8 by 4.10 metres (26.2 by 13.5 ft) wide at its top; the taller, P5, is 169 metres (554 ft) high. 76 steel cables pass over saddles in the pylons to form 152 suspenders in a two plane semi fan layout. The tallest intermediate pier, P9, is 148 metres (486 ft) high.

It crosses a gorge in the Sierra Madre Occidental mountains with a clearance of 390 metres (1,280 ft) below the deck, substantially taller than

the Eiffel Tower. Its clearance is 120 metres (390 ft) higher than that of the previous record holder, France's Millau Viaduct, which has a clearance of 270 metres (890 ft). The bridge's central span, 520 metres (1,710 ft) long, is also the longest cable stayed span in North America, 37 metres (121 ft) longer than that of the John James Audubon Bridge in St. Francisville, Louisiana.

3.EUROPE:

The Millau Viaduct

INFORMATIO

The Millau Viaduct is a cable stayed bridge that spans the gorge valley of the Tarn near Millau in Southern France. In an Anglo French partnership, it was designed by the French structural engineer Michel Virlogeux and English architect Norman Foster. As of November 2018, it is the tallest bridge in the world, having a structural height of 336.4 metres (1,104 ft).

The Millau Viaduct is part of the A75 A71 autoroute axis from Paris to Béziers and Montpellier. The cost of construction was approximately € 394 million. It was built over three years, formally inaugurated on 14 December 2004, and opened to traffic two days later on 16 December. The bridge has been consistently ranked as one of the great engineering achievements of all time, and received the 2006 Outstanding Structure Award from the International Association for Bridge and Structural Engineering.

In the 1980s, high levels of road traffic near Millau in the Tarn valley were causing congestion, especially in the summer due to holiday traffic on the route from Paris to Spain. A method of bypassing Millau had long been considered, not only to ease the flow and reduce journey times for long distance traffic, but also to improve the quality of access to Millau for its local businesses and residents. One of the solutions considered

was the construction of a road bridge to span the river and gorge valley. The first plans for a bridge were discussed in 1987 by CETE, and by October 1991 the decision was made to build a high crossing of the Tarn by a structure of around 2,500 metres (8,200 ft) in length. During 1993 1994, the government consulted with seven architects and eight structural engineers. During 1995 1996, a second definition study was made by five associated architect groups and structural engineers. In January 1995, the government issued a declaration of public interest to solicit design approaches for a competition.

In July 1996 the jury decided in favour of a cable stayed design with multiple spans, as proposed by the Sogelerg consortium led by Michel Virlogeux and Norman Foster. The decision to proceed by grant of contract was made in May 1998; then in June 2000, the contest for the construction contract was launched, open to four consortia. In March 2001, Eiffage established the subsidiary Compagnie Eiffage du Viaduc de Millau (CEVM), and was declared winner of the contest and awarded the prime contract in August.

4.AFRICA:

The Bloukrans Bridge

INFORMATION

The Bloukrans Bridge is an arch bridge located near Nature s Valley, Western Cape, South Africa. Constructed between February 1980 and June 1983, the bridge stands at a height of 216m above the Bloukrans River. Its central span is 272m and the bridge is 451m in length in total. Its primary use is that of a road bridge, carrying national route N2.

Bloukrans Bridge is the site of the world s highest commercial bridge bungee jumping, Bloukrans Bridge Bungy, operated by Face Adrenalin since 1997. The Bloukrans River below forms the border between the Eastern Cape and Western Cape provinces and is located in the Tsitsikamma region of the Garden Route.

In 1990, the Bloukrans River Bridge became the first African bridge for bungee jumping. Face Adrenalin has been operating the Bloukrans Bridge Bungy accident free since 1997. Mohr Keet set a Guinness World Record as the oldest person to bungy jump when he jumped from Bloukrans Bridge on 6 April 2010 at the age of 96.

Scott Huntly broke the world record for the Most bungee jumps in a day when he jumped from Bloukrans Bridge 107 times in nine hours on 11 May 2011. Scott completed the project to raise funds for local communities.

The world record for the most bungy jumps in 24 hours was held by South African Bill Boshoff who performed 101 bungy jumps in 14 hours and 23 minutes at Bloukrans on 10 May 2002.

The record stood until 16 August 2008 when Mike Heard broke the record with 103 bungy jumps within 24 hours from Auckland's Harbour Bridge.

Veronica Dean Boshoff set a world record for achieving 19 jumps in one hour on 9 May 2002.

5.SOUTH AMERICA:

Rio Grande Railway Bridge

INFORMATION:

The highest railway bridge ever built in Central America at 340 feet (104 mtrs), the Rio Grande bridge is also the highest bridge in the country of Costa Rica. One of the first balanced cantilever truss bridges ever built, the design is very similar to the Viar Viaduct in France which was constructed the same year. Although it resembles an arch, each half of the structure is like a separate bridge connected at the crown. A heavier distribution of weight on one end of the bridge will have a greater influence on how much of an arch effect will occur within the central span.

Built to carry the narrow gauge Pacific Railway of Costa Rica, the line is no longer in use. A 310 foot (94 mtr) high road bridge crosses the gorge next to the railway bridge. Both bridges are located 26 miles (42 kms) northwest of San Jose.

III.The Tallest Bridges In The World:

1.EUROPE:

INFORMATION:

The Great Belt Fixed Link is a multi element fixed link crossing the Great Belt strait between the Danish islands of Zealand and Funen. It consists of a road suspension bridge and a railway tunnel between Zealand and the small island Sprogø in the middle of the Great Belt, and a box girder bridge for both road and rail traffic between Sprogø and Funen. The total length is 18 kilometres (11 mi).The Great Belt Bridge (Danish: Storebæltsbroen) commonly refers to the suspension bridge, although it may also be used to mean the box girder bridge or the link in its entirety. Officially named the East Bridge, the suspension bridge has the world's third longest main span (1.6 km (1 mi)), and the longest outside Asia. It was designed by the Danish firms COWI and Ramboll.

The link replaced a ferry service, which had been the primary means of crossing the Great Belt. After more than 50 years of debate, the Danish government decided in 1986 to construct a link; it opened to rail traffic in 1997 and to road traffic in 1998. At an estimated cost of DKK 21.4 billion (1988 prices), the link is the largest construction project in Danish history. It has reduced travel times significantly; previously taking one hour by ferry, the Great Belt can now be crossed in ten minutes. This link and the Oresund Bridge (built 1995-1999) have together enabled driving from mainland Europe to Sweden and the rest of Scandinavia through Denmark.

Operation and maintenance are performed by A/S Storebelt under Sund & Belt. Construction and maintenance are financed by tolls on vehicles and trains. Cyclists are not permitted to use the bridge, but cycles may be transported by train or bus.

The Great Belt ferries entered service between the coastal towns of Korsør and Nyborg in 1883, connecting the railway lines on either side of the Belt. In 1957, road traffic was moved to the Halsskov Knudshoved route, about 1.5 kilometres to the north and close to the fixed link.

Construction drafts for a fixed link were presented as early as the 1850s, with several suggestions appearing in the following decades. The Danish State Railways, responsible for the ferry service, presented plans for a bridge in 1934. The concepts of bridges over Oresund (152 million DKK) and Storebælt (257 million DKK) were calculated around 1936. In 1948, the Ministry for Public Works (now the Ministry of Transport) established a commission to investigate the implications of a fixed link.

The first law concerning a fixed link was enacted in 1973, but the project was put on hold in 1978 as the Venstre (Liberal) party demanded postponing public spending. Political agreement to restart work was reached in 1986, with a construction law (Danish: *anlegslov*) being passed in 1987.

The design was carried out by the engineering firms COWI and Ramboll together with Dissing+Weitling architecture practice.

Construction of the link commenced in 1988. In 1991, Finland sued Denmark at the International Court of Justice, on the grounds that Finnish built mobile offshore drilling units would be unable to pass beneath the bridge. The two countries negotiated a financial compensation of 90 million Danish kroner, and Finland withdrew the lawsuit.

The link is estimated to have created a value of 379 billion DKK after 50 years of use.

2.ASIA:

The Sutong Yangtze River Bridge

INFORMATION:

The Sutong Yangtze River Bridge is a cable stayed bridge that spans the Yangtze River in China between Nantong and Changshu, a satellite city of Suzhou, in Jiangsu province.

With a span of 1,088 metres (3,570 ft), it was the cable stayed bridge with the longest main span in the world in 2008 2012. Its two side spans are 300 metres (980 ft) each, and there are also four small cable spans. The bridge received the 2010 Outstanding Civil Engineering Achievement award (OCEA) from the American Society of Civil Engineers.

Two towers of the bridge are 306 metres (1,004 ft) high and thus the third tallest in the world. The total bridge length is 8,206 metres (26,923 ft). Construction began in June 2003, and the bridge was linked up in June 2007. The bridge was opened to traffic on 25 May 2008 and was officially opened on 30 June 2008. Construction has been estimated to cost about US\$1.7 billion.

The completion of the bridge shortens the commute between Shanghai and Nantong, previously a four hour ferry ride, to about an hour. It brings Nantong one step closer to becoming an important part of the Yangtze River Delta economic zone, and has further attracted foreign investors into the city. The bridge is also pivotal in the development of poorer northern Jiangsu regions.

The tower is an inverted Y shaped reinforced concrete structure with one connecting girder between tower legs. The bridge deck is a steel box girder with internal transverse and longitudinal diaphragms and fairing noses at both sides of the bridge deck. The total width of the bridge deck is 41 metres including the fairing noses.

3.NORTH AMERICA:

The Mezcala Bridge

INFORMATION:

The Mezcala Bridge is a cable stayed bridge located in the state of Guerrero on Highway 95D in Mexico. It spans the Balsas River (known locally as the Mezcala River) close to the western Pacific coast of the country. This bridge, with a total length of 891 m (2,923 ft) and six uneven spans completed in 1993, has been in service since 1994 as a toll bridge.

It was the world's *tallest* bridge from its opening in 1993 to 1998 when the Akashi Kaikyo Bridge in Japan was opened. It was also the *highest* bridge in Mexico and the second highest multiple cable stayed bridge to be built in the world.

The Mezcala Bridge was built as part of the 1989-1994 highway restructuring program in Mexico, which reduced the distance of Highway 95 between Cuernavaca and Acapulco by 49 km.

The bridge suffered a fire in one of its cable systems in March 2007 when there was an accident on the main deck. The fire resulted when a coconut carrying truck collided with two school buses. The bridge was only partially closed until the damaged cable was replaced.

A new national highway program was initiated in Mexico between 1989 and 1994. Under this program, the federal highway Cuernavaca-Acapulco, also called the Route of the Sun, was proposed to be re-routed to reduce the distance, as well as travel time. A new planned route of 263 km (163 mi) length was drawn which reduced the distance by 49 km (30 mi) between Cuernavaca and Acapulco, and also reduced the travel time between Mexico City and the port of Acapulco to about 3.5 hours.

However, this rerouting of the highway required crossing of the Balsas River (also known as the Mezcala River) at a location (150 km (93 mi) from Cuernavaca where the river width from bank to bank varied from 800-1,000 m (2,600-3,300 ft). The hill slopes on the banks were also found to be steep. Consequently, the Mezcala bridge was planned and designed to cross the river. This bridge is also known by the name Mezcala Solidaridad bridge.

In 2010, as part of Mexico's celebrations for its bicentennial, a series of roads were deemed to be part of Ruta 2010, that commemorated various paths taken during military campaigns. Highway 95 was a part of the path called The Sentiments of the Nation Route, which included the connection between Mexico City and Acapulco. The route commemorated a military campaign led by José María Morelos.

4.SOUTH AND CENTRAL AMERICA:

Panama's Centennial Bridge

INFORMATION:

Panama's Centennial Bridge is a major bridge crossing the Panama Canal. It was built to supplement the overcrowded Bridge of the Americas and to replace it as the carrier of the Pan American Highway. Upon its opening in 2004, it became the second permanent crossing of the canal.

The Centennial Bridge is the second major road crossing of the Panama Canal, the first being the Bridge of the Americas. (Small service bridges are built in the lock structures at Miraflores and Gatún Locks, but these bridges are only usable when the lock gates are closed and have limited capacity.

The Centennial Bridge is located 15 km (9.3 mi) north of the Bridge of the Americas and crosses the Culebra Cut (Gaillard Cut) close to the Pedro Miguel locks. New freeway sections, connecting Arraijan in the west to Cerro Patacon in the east via the bridge, significantly alleviate congestion on the Bridge of the Americas.

The bridge is a cable stayed design with a total span of 1,052 m (3,451 ft). The main span is 420 m (1,380 ft) and clears the canal by 80 m (262 ft), allowing large vessels to pass below it. The bridge is supported by two towers, each 184 m (604 ft) high. The deck carries six lanes of traffic across the canal.

The Centennial Bridge is designed to withstand the earthquakes which are frequently recorded in the canal area. It was built by the German construction firm Bilfinger.

The West Tower was built about 50 m inland to allow space for the future widening of the Panama Canal.

A shot of the bridge was shown in a GMC commercial that aired in the United States in 2006. The commercial was about GMC taking inspiration from great engineering achievements.

5.AFRICA:

The Mohammed VI Bridge

INFORMATION:

The Mohammed VI Bridge is a cable stayed bridge that spans the valley of the Bouregreg River near Rabat in Morocco. It is named after the current king of Morocco.

The bridge is characterised by its architecture comprising two 200 meters high arched towers, which symbolize the new doors to the cities of Rabat and Salé. The deck is supported by two sets of 20 pairs of parallel multi strand stay cables.

The structure forms part of the new 41.5 km Rabat motorway bypass around the city of Rabat and will improve traffic congestion in Hay Riad, the capital's western residential suburb

As the longest cable stayed bridge in Africa with two 200 meter high pylons, the Mohamed VI Bridge has vertiginous dimensions. Officially opened by His Majesty the King of Morocco in July 2016, it is part of a major project aimed at decongesting the traffic of the capital.

Setec performed the design of the structure, the control of execution studies and construction methods and a permanent on site technical assistance to Autoroutes du Maroc (owner/engineer)

Situated on the motorway bypassing Rabat in Morocco, this way across the Bouregreg River is the longest cable stayed bridge on the African continent. Spanning 954.30 m, it comprises a cable stayed viaduct and an independent span viaduct with prestressed beams. The architectural

design, particularly of its 2 pylons, combines modernity and influences from traditional Moroccan culture.

IV.The Oldest Bridges In The World:

1.ASIA:

The Anji Bridge

INFORMATION:

The Anji Bridge is the world's oldest open spandrel segmental arch bridge of stone construction. Credited to the design of a craftsman named Li Chun, the bridge was constructed in the years 595-605 during the Sui dynasty (581-618). Located in the southern part of Hebei Province, it is the oldest standing bridge in China.

The bridge is also commonly known as the Zhaozhou Bridge

About 25 km from the southeast of Shijiazhuang city, Hebei province, built in AD 595 in the Sui Dynasty, Zhaozhou Bridge is the earliest and best preserved open spandrel stone arch bridge now in existence.

With a total length of 51 m, and a span of 37 m, the bridge is a single arch stone bridge that has the longest span and history. The bridge is sophisticated yet elegantly constructed.

The two smaller spans in the shoulders of the bridge were an innovation in the history of bridge construction, giving the stone bridge an elegant design.

Zhaozhou Bridge has its own architectural features: the length of the span and the smoothness of the arc not only cut the use of materials but also facilitates travel. The two small spans in the two shoulders increase the drainage area to ease the flow of water, cut the use of materials, lighten the bridge, and enhance its stability.

With a history of about 1,400 years, Zhaozhou Bridge has gone through numerous natural disasters, including at least 10 floods, 8 wars and many earthquakes. In

1996, a 7.6 magnitude earthquake hit Xingtai, about 40 km from the bridge, but it remained safe and sound.

Starting from 581 CE, the Sui dynasty reasserted imperial control over the competing powers that had ruled various regions of China since the decline of the Han dynasty in the third century. Thus immense public works projects were carried out, including the rebuilding of two grand imperial capitals, the excavation of the 2400 kilometer long Grand Canal, and major improvements to the fortifications that predated the Great Wall.

Economically, the long distance transport of goods and men was a critical component to the interests and sustainability of the ruling house. The movement of goods by land south and southwest from the North China Plain to the Central Plains around Kaifeng and Luoyang followed a path that crossed the Xiao River near Luanzhou (later Zhaozhou and now Zhaoxian) in today's Hebei province. Flowing west to east through a plain that was relatively low lying on both sides, the Xiao River was an important artery for transporting goods, but an impediment to continuous overland movement and the economic integration of China's regions

It was under these circumstances that Li Chun, who directed masons and other craftsmen, built the Anji (Safe Passage) Bridge, also called Dashi (Great Stone) Bridge. Although Chinese history credits Li Chun with the design and building of the Anji Bridge, no contemporaneous materials recorded the process, however later chronicles do make notes of it in brief.

Among the most remarkable achievements of Chinese bridge building indeed an advancement unrivaled in the world was the creation of this segmental arch bridge of wholly stone construction. This innovation, which occurred between the end of the sixth century and beginning of the seventh century, repudiated conventional wisdom that a semicircular arch was necessary to transfer the weight of a bridge downwards to where the arch tangentially meets the pier. The double pair of openings piercing both ends of the arch spandrel, which as well as accentuating its lithe curvature,

lightens the weight of the bridge and facilitates the diversion of flood waters by allowing them to pass through the auxiliary arches rather than pound against the spandrels. The Zhaozhou Bridge is celebrated as China's oldest standing bridge and the oldest open spandrel stone bridge in the world.

2.NORTH AMERICA:

The Frankford Avenue Bridge

INFORMATION:

The Frankford Avenue Bridge also known as the Pennypack Creek Bridge, the Pennypack Bridge, the Holmesburg Bridge, and the King's Highway Bridge, erected in 1697 in the Holmesburg section of Northeast Philadelphia, in the U.S. state of Pennsylvania, is the oldest surviving roadway bridge in the United States. The three span, 73 foot long (22 m) twin stone arch bridge carries Frankford Avenue (U.S. Route 13), just north of Solly Avenue, over Pennypack Creek in Pennypack Park.

The bridge was designated a National Historic Civil Engineering Landmark by the American Society of Civil Engineers in 1970. It was listed in the National Register of Historic Places in 1988.

The bridge, built at the request of William Penn to connect his mansion with the new city of Philadelphia, was an important link on the King's Highway that linked Philadelphia with cities to the north (Trenton, New York, and Boston). On March 10, 1683, the Pennsylvania General Assembly passed a law requiring the building of bridges across all of the rivers and creeks along all of the King's Highway in Pennsylvania, from the Falls of the Delaware (at Trenton, N.J.) to the southernmost ports of Sussex County (now part of the state of Delaware). The bridges, which were to be completed within 18 months, were to be ten feet wide and include railings along each side. The areas on either side of the bridges were to be cleared to facilitate horse and cart traffic. Each bridge was to be built by male inhabitants of the surrounding area; those who failed to appear were to be fined 20 shillings.

In 1970, the bridge earned an award by the American Society of Civil Engineers, Philadelphia Section, as an outstanding engineering achievement and a historic civil engineering landmark. A bronze plaque was placed on the western parapet in commemoration.

In 1803, the bridge was paved with macadam, and at its south end a toll booth was erected, remaining in operation until 1892 when the turnpike was purchased by the city of Philadelphia. The bridge was widened in 1893 to accommodate streetcars, which commenced service in 1895, and again in 1950 to better accommodate automobile traffic. It remains in use today. As of May 2018, the bridge is being reconstructed.

The bridge was designated a National Historic Civil Engineering Landmark by the American Society of Civil Engineers in 1970. It was listed in the National Register of Historic Places in 1988.

3.South and Central America:

Inca rope bridges

INFORMATION:

Inca rope bridges are simple suspension bridges over canyons and gorges and rivers (*pongos*) constructed by the Inca Empire. The bridges were an integral part of the Inca road system and exemplify Inca innovation in engineering. Bridges of this type were useful since the Inca people did not use wheeled transport traffic was limited to pedestrians and livestock and they were frequently used by Chasqui runners delivering messages throughout the Inca Empire.

The bridges were constructed using ichu grass woven into large bundles which were very strong. Part of the bridge's strength and reliability came from the fact that each cable was replaced every year by local villagers as part of their *mit'a* public service or obligation. In some instances, these local peasants had the sole task of repairing these bridges so that the Inca highways or road systems could continue to function. Repairing these bridges was dangerous, as those performing repairs often met death. An

Inca author praised Spanish masonry bridges being built, as this rendered the need to repair the rope bridges moot.

The greatest bridges of this kind were in the Apurímac Canyon along the main road north from Cusco; a famous example spans a 45 meter gap that is supposed to be the inspiration behind Thornton Wilder's 1928 Pulitzer Prize winning novel *The Bridge of San Luis Rey* (1927). Made of grass, the last remaining Inca rope bridge, reconstructed every June, is the Qiswachaka (Quechua for rope bridge), spanning the Apurimac River near Huinchiri, in Canas Province, Quechua District, Peru. Even though there is a modern bridge nearby, the residents of the region keep the ancient tradition and skills alive by renewing the bridge annually in June. Several family groups have each prepared a number of grass ropes to be formed into cables at the site; others prepare mats for decking, and the reconstruction is a communal effort. The builders have indicated that effort is performed to honor their ancestors and the Pachamama (Earth Mother)

4.AFRICA:

ARKADIKO Bridge

INFORMATION

The Arkadiko Bridge or Kazarma Bridge is a Mycenaean bridge near the modern road from Tiryns to Epidauros on the Peloponnese, Greece. Dating to the Greek Bronze Age, it is one of the oldest arch bridges still in existence and use today.

The corbel arch bridge belonged in Mycenaean times to a highway between the two cities, which formed part of a wider military road network. It has a culvert span of ca. 1 m and is made in the typical Mycenaean manner of Cyclopean stones. The structure is 22 metres (72 ft) long, 5.60 metres (18.4 ft) wide at the base and 4 metres (13 ft) high. The width of the roadway atop is about 2.50 metres (8 ft 2 in). The sophisticated layout of the bridge and the road indicate that they were specifically constructed for use by chariots. Built in the late Late Helladic III (ca. 1300-1190 BC), the bridge is still used by the local populace.

The Arkadiko Bridge is one of only four known Mycenaean corbel arch bridges near Arkadiko, all belonging to the same Bronze Age highway between the two cities, and all of similar design and age. One of them is the Petrogephyri bridge, which crosses the same stream 1 km to the west of the Arkadiko bridge. Otherwise similar in size and appearance, the structure has a larger span and a little higher vault. It, too, is still used as a local track.

A fifth, well preserved Mycenaean bridge is located in the wider region at Lykotroupi, where it was part of another Mycenaean main road. Its measurements are close to the Arkadiko Bridge: 5.20 metres (17.1 ft) wide at the bottom, 2.40 metres (7 ft 10 in) at the top and with a corbelled arch span of a little more than a metre. The road still features curbs for guiding fast moving chariots.

The bridge is located at the 15th kilometer of the Nauplion Epidauros highway.

5.EUROPE:

Tarr Steps Bridge

INFORMATION:

The Tarr Steps is a clapper bridge across the River Barle in the Exmoor National Park, Somerset, England. They are located in a national nature reserve about 2.5 miles (4 km) south east of Withypool and 4 miles (6 km) north west of Dulverton.

A typical clapper bridge construction, the bridge's listing assesses it as medieval in origin. The stone slabs weigh up to two tons each. The bridge is 180 feet (55 m) long and has 17 spans. It has been designated by English Heritage as a grade I listed building and Scheduled Ancient Monument.

Owned by Exmoor National Park Authority, Tarr Steps Woodland National Nature Reserve covers 33 hectares of the River Barle valley. This is mainly

Sessile Oak (*Quercus petraea*) woodland, with beech (*Fagus*), ash, sycamore (*Acer pseudoplatanus*), hazel (*Corylus*), blackberry (*Rubus*), bluebells (*Hyacinthoides non scripta*) and honeysuckle (*Lonicera*). It is internationally significant for the mosses, liverworts and lichens which flourish in the cool damp conditions. Much of the woodland was once coppiced, primarily to provide charcoal for the local iron smelting industry. The river and the valley woodlands are part of the Barle Valley Site of Special Scientific Interest and abound with wildlife, ranging from red deer to dormice, including the rare Barbastelle Bat (*Barbastella barbastellus*) and otter that feed along the unpolluted and fast flowing river.

Well marked footpaths run along the valley between Simonsbath and Dulverton and to the village of Withypool. There is a circular walk from the main car park for Tarr Steps down to the river, along the riverbank for about 1.3 kilometres (1 mi) to a footbridge and returning on the other side, crossing the river on the clapper bridge. The main car park and toilets (some 400 metres (1,312 ft) from the bridge via a footpath) can be reached from the B3223 road between Withypool and Dulverton. Parking for the disabled and refreshments are available nearer the bridge, as are information panels put up by the Exmoor National Park, giving details of Tarr Steps history and design.

Within the reserve is the scheduled monument Tarr Steps grid reference SS867321, a clapper bridge over the River Barle. The name clapper bridge comes from the Medieval Latin claperius which means pile of stones . It is an ancient form of bridge constructed with large unmortared slabs of stone resting on one another; this is the largest example of its type. There are 17 spans across 50 metres (55 yd), the top slabs weigh 12 tons and are about 39 inches (99 cm) above normal water level. The largest slab is over 8 feet (2.4 m) long and is about 5 feet (1.5 m) wide. This is one of the best known monuments on Exmoor. Its age is unknown, as several theories claim that Tarr Steps dates from the Bronze Age but others date them from around 1400 AD. It has been restored several times in recent years, following flood damage. Over the years the damage provides a good

indicator of the strength of each flood. Some of the top slabs have been washed away in extreme flood conditions and they have now all been numbered to facilitate replacement. The Exmoor National Park web site says

The stones forming the spans weigh between one and two tons each and have on occasions been washed up to 50 yards (46 m) downstream. A distinctive feature of Tarr Steps is the slabs that are raked against the ends of each pier to break the force of the river and divert floating debris. Despite this, much of the damage has been due to debris such as branches floating down with the flood and battering the bridge. Debris used to be removed once a year by farmers from the Dulverton and Hawkridge sides of the river but since the flood of 1952 it has been trapped by cables strung across the river upstream of the bridge .

The bridge was badly damaged by floodwater on 22 December 2012 when steel wires upstream (designed to protect the bridge from damaging debris) were broken by fallen trees washed down the river. Floodwaters carried away part of the bridge again on 21 November 2016, and it has since been rebuilt.