Akashi Kaikyo Bridge
Akashi Kaikyo Bridge is between Kobe City and Awaji Island, in Japan.

Akashi Kaikyo Bridge is the longest *suspension bridge* on the world.
Length of Akashi Kaikyo Bridge is about **1991 meters** and the highest point is **282.8 meters**.
7 important inventions were used in Akashi Kaikyo Bridge.

- These inventions was used in seven bridges. There is great technological newness each one of them.
GOLDEN GATE BRIDGE 1,280m
VERRAZANO NARROWS BRIDGE 1,298m
• We need to look historical developing to understand that how can Akashi Kaikyo Bridge be long like that.
• This developing starts with Ironbridge that length is 30 meters in the 18th century in England.

• **Cast iron** was used for the first time in the construction of Ironbridge.

• Ironbridge the presence of iron in place of stone bridges greater than 30 meters can be done using the proof.
• Akashi Kaikyo Bridge must be light as possible. So they builded **prefabricated components** like Ironbridge.
• There were more than 250,000 tons of steel in that structure.
• Steel had a big problem. *(Corrosion)*
• Engineers solved this problem with robots.
• These robots check wear scar in structure with remote control to protect bridge.

• When there is a problem painter robots go and repair wear places.
• There are 3 **sleds** under the bridge. They help workers to renew. Thus traffic don’t stop.
LEAP 2: THE SUSPENSION BRIDGE
• Menai Bridge was builded to pass Menai Strait in the 19th century.

• Menai Bridge is first modern suspension bridge in the 19th century.
• They digged a tunnel (18 meters) to fasten both sides of strait.

• Strong iron frames was put end of the tunnel. Chains were fastened with **bolt**. Each bolt is 3 meters.
• These immobilization points are holding the platform (177 meters) for 180 years.
• Huge **ropes** was used instead of chain in Akashi Bridge but there aren’t stones like Menai to hold.

• So they need to make immobilizations points to coastline.
• Firstly huge **hole** was opened for the foundation.

• Then the hole was completed with 230,000 cubic meters of cement.
• These metal frames were used to hold ropes.

• Frames being immerset in to the concrete.
• After finish it was made concrete mass (50 meters) completing spaces.
• Engineers used the iron that was formed to the wire to support in Niagara Waterfall.

• Engineers know that they won’t pass rope at a time.
• So they connected each wires to stabilizers with **bobins**.

• In this way they obtained a rope. (3640 meters)
• They needs 4 ropes to keep it afload.
• Niagara Bridge was opened 1855. It transported first train that go from America to Canada.
• Tuday ropes of Akashi Bridge can lift 90 Niagara Bridge.

Part of rope in Akashi Bridge

Diameter is more than 1 meter
• Firstly they stretched guide rope with helicopter.

• Than they carried first package that has 128 wires.
• They took 290 package from side to other side. Than they made rope.
• Every one of ropes is 25,000 tons.

• Length of wires that inside of the ropes can cover the world 8 times.
• They decided to build bridge that its width is 600 meters on the river between Brooklyn and Manhattan in 1874.
• Workers should go down under 24 meters of waters to make stabilizer docks.

• They used **caisson**. Caisson is inverted box.
• Firstly they buildt caisson dry area. Then they bring the river pulling.

• After that they immersed to bottom of the sea with granite blocks.
• When this structure immersed to bottom of water it was full.

• They emptied water in caisson.
• Workers down to the bottom caissons filled with concrete.

• Now they are foundation of supporting towers.
• Foundation of towers had to be thrown to the bottom 60 meters below the water.

• In here steel caisson was used.

✓ Height : 70 meters
✓ Width : 80 meters
• After caissons put seabed, sea water is thrown completing with wet cement.

• Finally cement cover is put on the caisson.
• The structure is ready anymore and foundation of tower is ready to make.
• Golden gate bridge was designed in 1933. (the longest suspension bridge = 1280 meters)

• They need raise towers to extent the way.
• Stronger and lighter materials were used for towers of bridge.

• 4 plates brought together to form a shaft 11 meters in height.
• These plates are combined to form a structure resembling a honeycomb.

• **Cranes** are lifting and placing the shaft.
• Steel towers, also allows flexing under pressure from the rope.

• Towers can carry more than 50,000 tons.
• Nowadays, the longest suspension bridge towers, in Japan, Akashi Bridge Towers.

• 300 meters in length.
• Each of towers consists of 30 parts.

• The upper and lower parts of each section sanded and polished.
• Later towers began to be made.
• Towers have 100 floors.
• In the interior of the tower honeycomb structure allows them to be lighter and stronger.

• Steel parts were combined with **welding**.

• Connection points were fastened with bolts.
• Building higher towers allows the suspension bridges to be longer.
LEAP 6 WIND
• Straight-edged bridge is barrier against blowing wind.

• When the wind hits the bridge, pull up or push down the bridge.

• When the platform moves, the bridge starts to bend.

• The solution is putting elevation sides of the bridge.
• In 1946, 1.6 km wide, a bridge would be made on Verrazano-Narrows.
• They decided to resist the wind, platform hardening.

• So, the bridge would not bend and twist.
• They builded lightweight **skeleton unit** by combining small steel stickses.
• When 75 units combined, occurred a **steel cage**.
• Completed in 1964 the Verrazano - Narrows Bridge was the world's tallest bridge, and heavy.
• This design was very successful so Japan used the concept of open box to reinforce Akashi Bridge platform after 30 years.
• It is difficult to bend or flex.
• First line of defence against earthquake of bridge is undergoing in towers of bridge.

• Towers of bridge were made from steel to be flexible.

• When concussion, towers moves with the ground and absorb shock.
• There are a second measure of protection each of the towers.

• We call it shock absorbing pendulum.
• When a tower leans into vibration, shock absorber prevent to fall over lying on opposite side of the tower.

• pendulum
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