Bridging the Gap

All Aboard: History, Culture, and Innovation on the Florida East Coast Railway

Grade Level:

8th Grade

Materials:

Book:
- Bridges! *Amazing Structures to Design, Build and Test* by Carol A. Johnson and Elizabeth J. Rieth

Photo of:
- Henry M. Flagler
- Different Bridge Types

Map of:
- The FEC Railway Showing Key West Extension
- The FEC Extension to Key West

Materials:
- Paper
- Pencils
- Spaghetti Noodles
- Hot Glue Guns
- Glue Sticks
- Weights
- Large Plastic Tubs
- Chart Paper
- Markers
- Rulers

Curriculum Connections:

Social Studies, Science, Art, English Language Arts, Florida Education

Objectives:

Students will be introduced to the Overseas Railway and will learn about different types of bridges (arch, beam, suspension, cable-stayed, truss). They will work collaboratively to build a bridge and test it to see how it holds weight.

Standards:

SS.8.G: Geography
VA.68.H: Historical and Global Connections
VA.68.F: Innovation, Technology, and the Future

Corresponding Map Hot Spot:

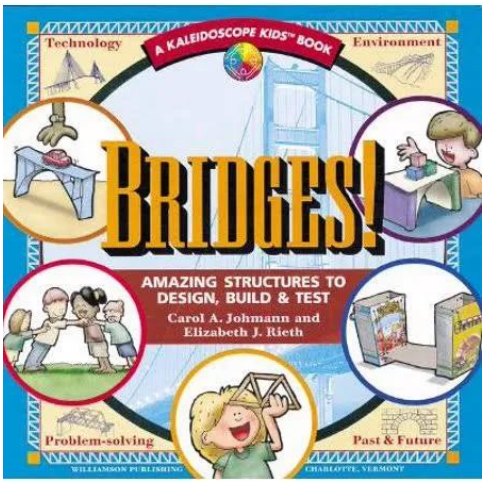
Seven Mile Bridge, FL

Lesson Procedure

Introduction:

Introduce the theme of the lesson, the Florida East Coast Railway Key West Extension. Have a brief discussion about the importance of connecting the Keys with mainland Florida, inviting the students to imagine what life would have been like before the Overseas Railway and later, the Overseas Highway. Use the pictures of the railroad and Henry Flagler (the man responsible for the railroad project) to facilitate this discussion.

Discuss how civil engineers work to design bridge structures that are strong. Use the book, *Bridges! Amazing Structures to Design, Build and Test* by Carol A. Johnson and Elizabeth J. Rieth to facilitate this and point out different bridge types. Ask the students what things engineers should take into consideration when planning a bridge (loads, materials, distance, etc.).



Divide the students into two teams. Tell them that today they will be engineers working to build the Seven Mile Bridge on the Key West Extension. They will be competing against each other in this challenge. Their building materials? Spaghetti noodles! Set up two tables one foot apart (this is the gap they must bridge) and place a large tub under it (to catch any falling noodles).

Key Terms:

Parts of a Bridge

Deck – The deck on a bridge is used by pedestrians and drivers to cross the bridge.

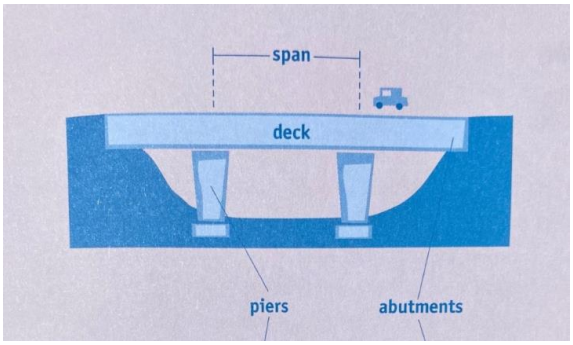
Supports – These support the bridges deck.

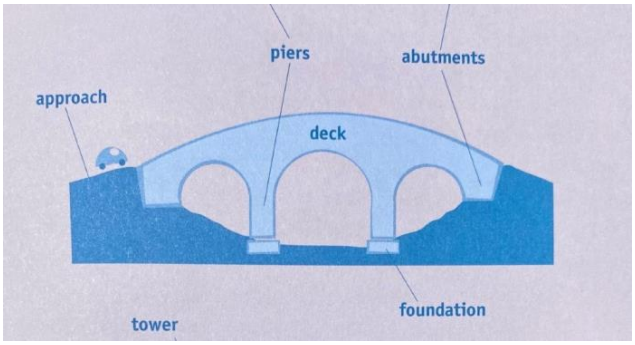
Span – The span is the distance between the supports.

Foundations – Supports rest on bridge foundations.

Approach – The approach is the space or road that is right before the bridge begins.

Beam and Arch Bridge Terms

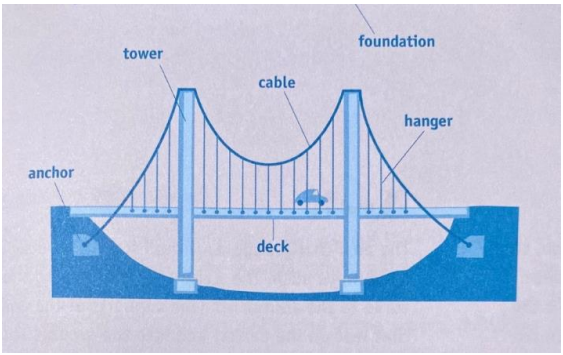




Abutments – These are found on beam and arch bridges. They are the supports found at the ends of the bridge.

Piers – These are found on beam and arch bridges. These are the supports in the middle of the bridge.

Suspension Bridge Terms



Towers – In a suspension bridge, the middle supports, which are also the tallest, are called the towers.

Cables – Long wire cables are strung over the towers and secured in anchors buried underground.

Anchors – These buried anchors secure the cable wires that are strung over the support towers.

Hangers – These run from the cables to the deck to hold the bridge up.

Source: *Bridges! Amazing Structures to Design, Build and Test*

Planning:

Give each group a piece of paper and have them plan out their bridge. What type of bridge will it be? How will it support weight? Refer to the different types of bridges and make sure their bridges are at least a foot long.

Bridge Building:

Give each team a box of spaghetti and a hot glue gun. Discuss glue gun safety and monitor this as they work. Demonstrate how to glue noodles together. Allow the students to construct their bridges.

Challenge Time:

When the students have finished the construction of their bridges, tell them it's time to test those bridges! Have the first team bring their bridge up to the table and set it across the span. Show the students the weights. Tell them that you are going to place weights on it and we will see just how many they can hold before breaking. Make a big deal out of this and allow the team members to cheer for their bridge. Begin placing weights on the bridge, continue until it collapses. Write the number of weights down for Bridge 1 on the chalkboard, whiteboard, or a piece of chart paper. Repeat with Bridge 2 and see which bridge was stronger.

Closure:

Review the concepts of strength in bridges.

Additional Resources:

Overseas Railway Timeline

This timeline on the Key West Art & Historical Society's website provides additional information about Henry M. Flagler's life, career, history and the development of the Florida East Coast Railway and extension to Key West, Florida.

Online Collections Database

With a collecting history that extends back to 1949, the Key West Art & Historical Society has unrivaled collections of contemporary and historic art and artifacts. Its collections, which number more than 35,000 works in all media, range from historical to present-day and span the entire Florida Keys.

Henry M. Flagler

Photo: Key West Art & Historical Society

Florida East Coast Railway Showing the Key West Extension

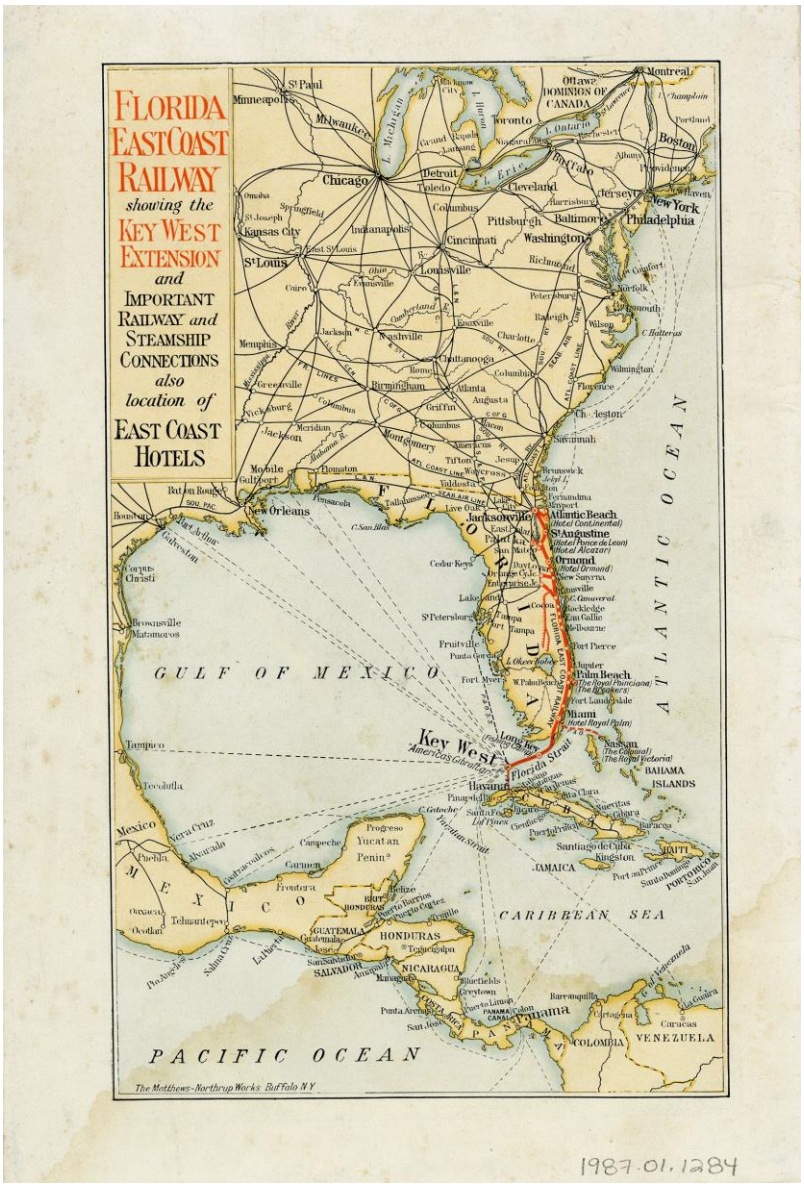


Photo: Key West Art & Historical Society

Florida East Coast Railway Key West Extension

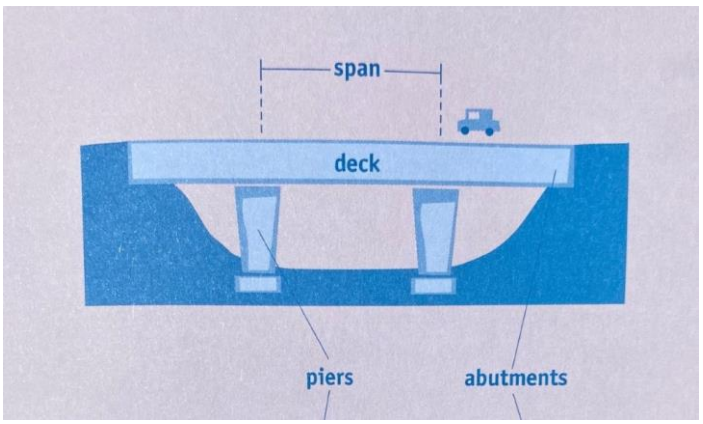
Photo: Florida East Coast Railway

Types of Bridges

Beam Bridge:

Beam bridges are the simplest structural forms for bridge spans. The weight of the load is passed along the beam, and down through the bridge supports to the ground.

Source: *Bridges! Amazing Structures to Design, Build and Test*



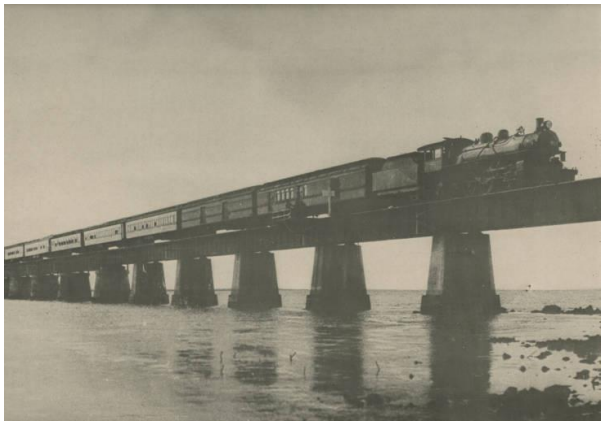
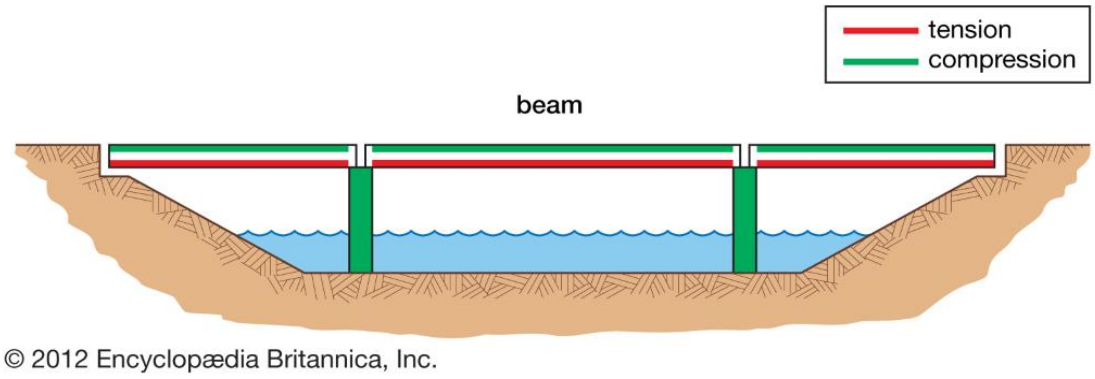


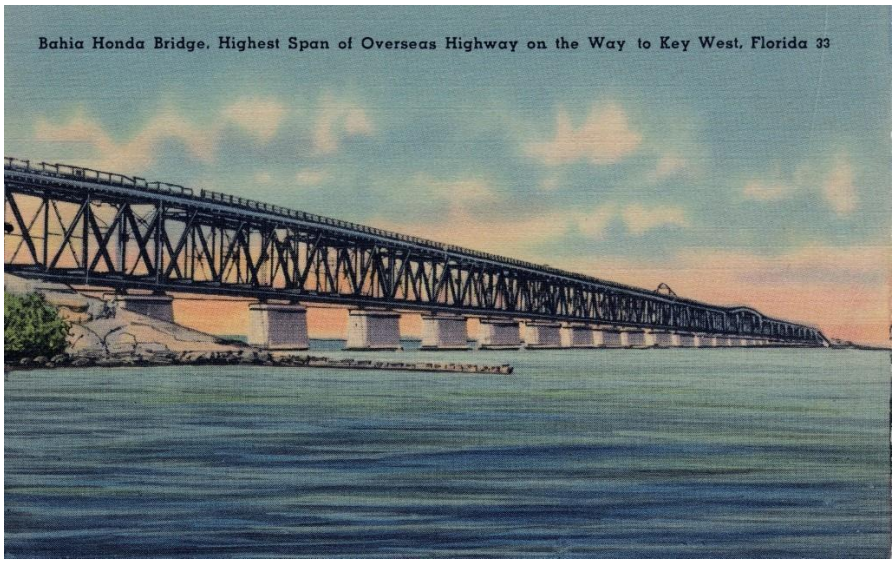
Photo: (left) Bridges! Amazing Structures to Design, Build and Test
(right) Broward County Library Digital Archives



Types of Bridges

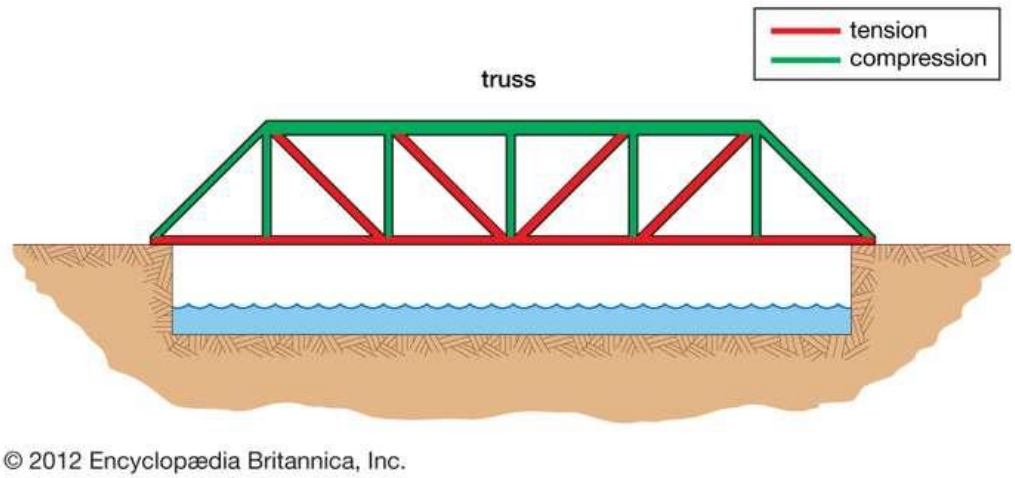
Truss Bridge:

A truss bridge is similar to a beam bridge. The truss is a lightweight option added to the top or bottom of the structure to provide additional support.



Bahia Honda Bridge, Highest Span of Overseas Highway on the Way to Key West, Florida.

Photo: Key West Art & Historical Society

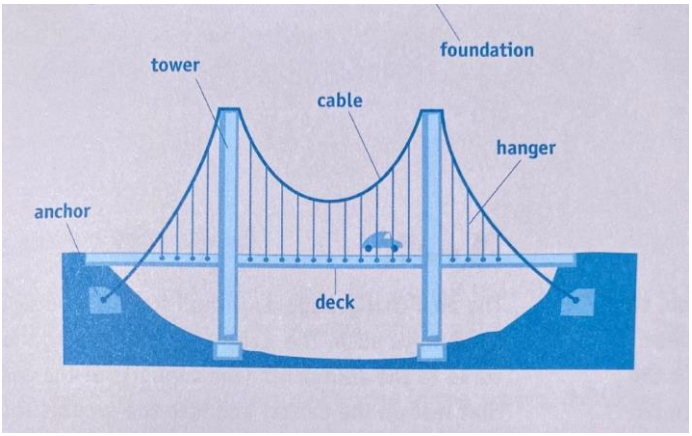


Types of Bridges

Suspension Bridge:

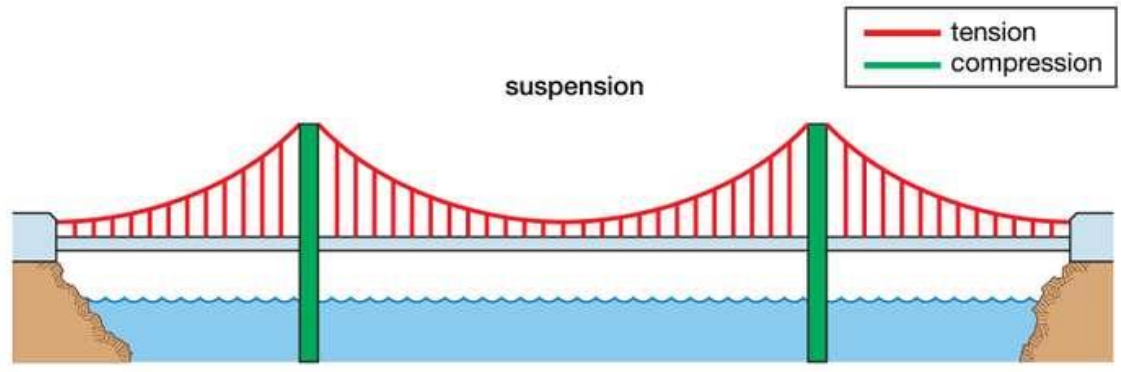
The load pulls down on hangers, which pull on cables. The cables pull on the towers and anchors, and the anchors pull back, or resist the pull on them, because they are heavy and buried in the ground. All of these parts are in tension. The towers are also compressed and as the cables push down on them and their foundations.

Source: *Bridges! Amazing Structures to Design, Build and Test*



The Golden Gate Bridge in San Fransisco, California.

Photo: (left) *Bridges! Amazing Structures to Design, Build and Test*
(right) Golden Gate Bridge Highway & Transportation District

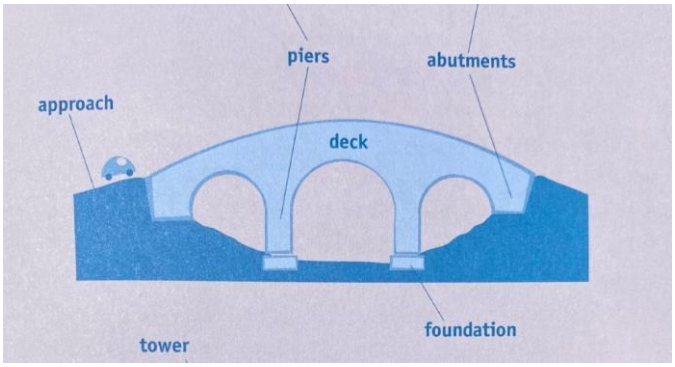


Types of Bridges

Arch:

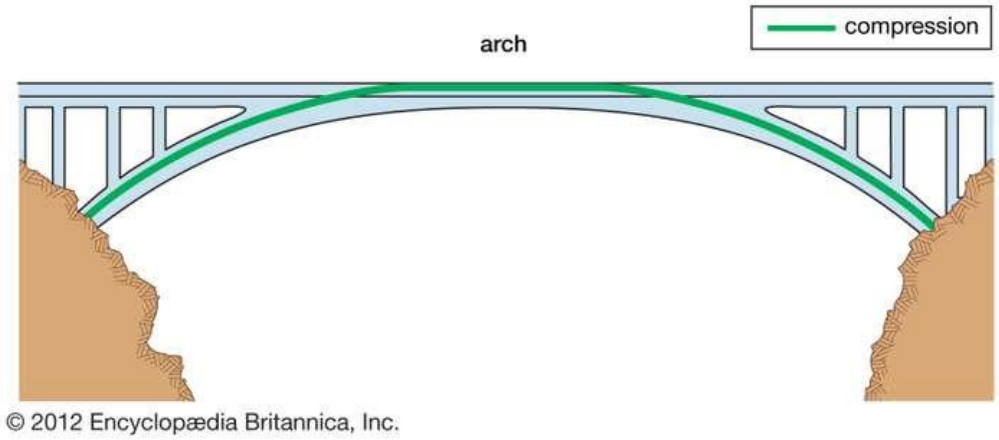
The arch changes the downward force of gravity into a sideways push. The weight is carried along the curve to the abutments and into the ground. This creates lots of compression, but little tension.

Source: *Bridges! Amazing Structures to Design, Build and Test*



Overseas Railway Train on Long Key Viaduct.

Photo: (left) *Bridges! Amazing Structures to Design, Build and Test*
(right) Key West Art & Historical Society

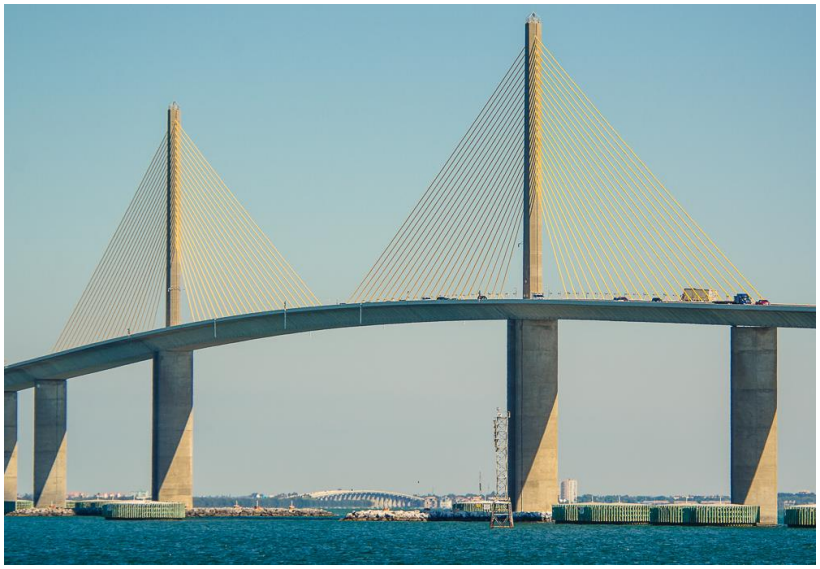


Types of Bridges

Cable-Stayed Bridge:

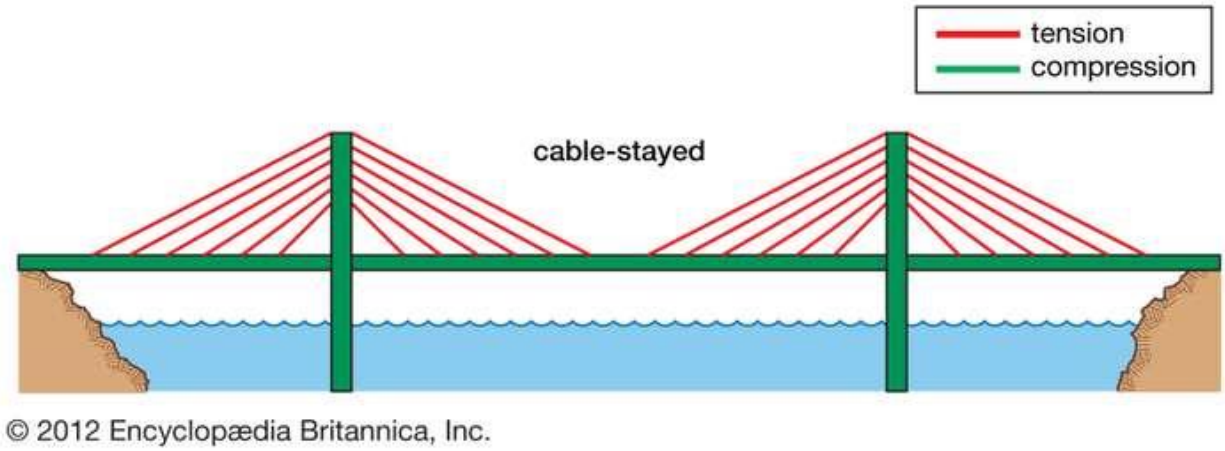
Cable-stayed bridges carry the vertical main-span loads by nearly straight diagonal cables in tension. The towers transfer the cable forces to the foundations through vertical compression.

Source: Encyclopædia Britannica



Sunshine Skyway Bridge in St. Petersburg, Florida.

Photo: Encyclopædia Britannica



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