

Cable Structures

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 - Equations of Equilibrium

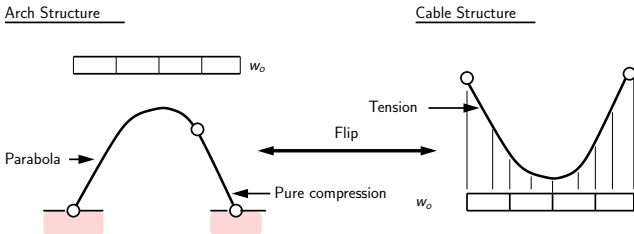
Cable Structures

Cable Structures

Cable

A cable is a **flexible structure** that **cannot resist bending**. The cable **assumes a shape** to carry the loads by tension alone.

Motivating Observation: Flip an arch upside down ...



cable elements carry loads in tension and form a parabolic shape.

Cable Structures vs Arch Structures

Arch Structures

Designer **prescribes** the **shape of the arch**, positions of hinges, loading patterns, and boundary conditions. Use analysis to find support reactions and distributions of bending moments, shear forces, axial forces.

Cable Structures

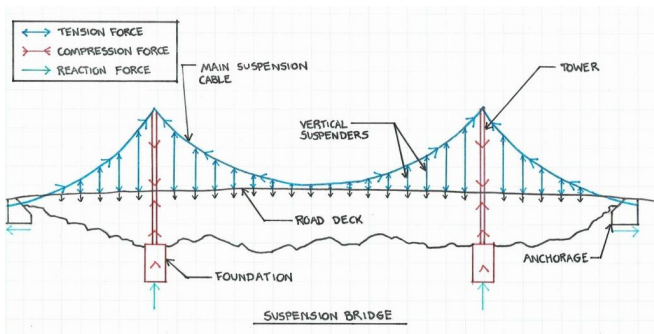
Designer prescribes the length of the cable, position of supports, and loading patterns. **Shape of the cable system is determined by loads and physics** (i.e., solution to the underlying differential equations).

Types of Cable Structure

Types of Cable Structure

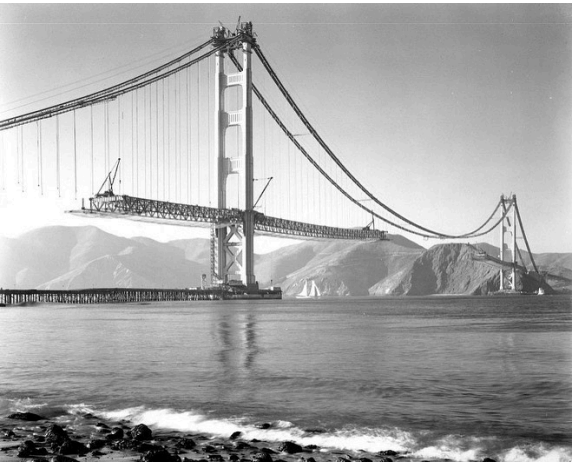
Suspension Structures

Characterized by a main cable suspended between two anchor points, with the load distributed along the length of the cable (e.g., suspension bridges and roofs).



Case Studies

Suspension: Construction of the Golden Gate Bridge (1935):



Case Studies

Suspension: Cable roof structure at Dulles Airport:



Case Studies

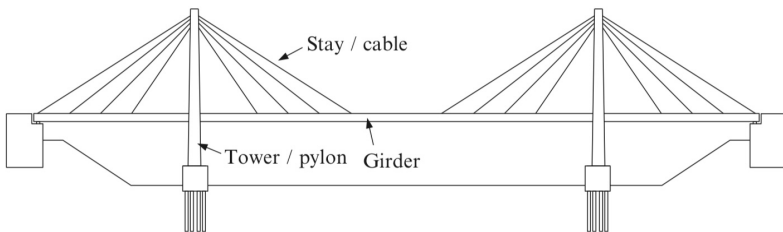
Suspension: Power lines ...



Types of Cable Structure

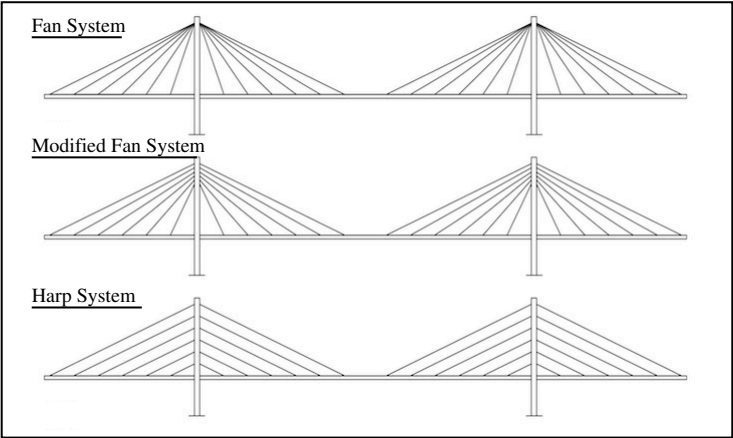
Cable-Stayed Structures

Cables are directly connected to the deck or structure, providing support and stability (e.g., cable-stayed bridges).



Types of Cable Structure

Types of Cable-Stayed Bridge:



Case Studies

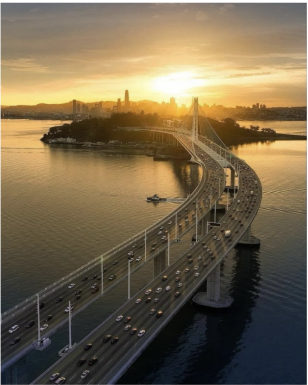
Cable-Stayed: Port Mann Bridge (Vancouver, Canada) (2012)



Construction: Kiewit Corporation, 2009-2015

Case Studies

Cable-Stayed: Oakland-Bay Bridge, East Span (2013)



Construction: Kiewit Corporation
Original budget: \$250M; Final budget: \$6.5B.

Types of Cable Structure

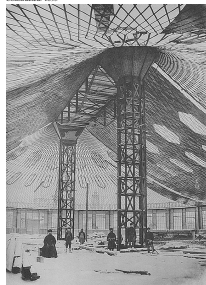
Tensile Structures

Cables serve as the primary load-bearing elements, often in combination with membranes or other materials (e.g., architectural designs for roofs and façades).

Benefits: Ideal for spanning large areas and for temporary (or weather protective) coverings.

Applications: Cable-stayed bridges, airport canopys, tensile canopies/awnings.

Constructed 1895



Case Studies

Tensile Structure: Denver International Airport



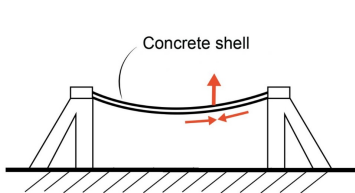
Case Studies

Tensile Structure: Brasilia National Stadium (2014)

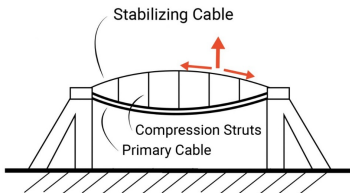


Case Studies

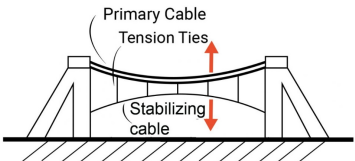
Suspension and Tension Working Together ...



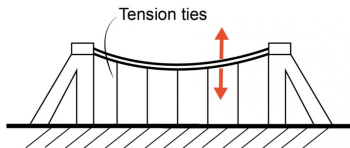
Stiffening through construction as an inverted arch (or shell)



Spreading against a cable with opposite curvature



Tensioning against a cable with opposite curvature



Fastening with transverse cables anchored

Case Studies

Tensile Structure: Suspension Bridge Structure in NZ.

