The idea of using cable-stays to support a bridge has been around for a while,

It was first applied in the 1800’s in England (incorporated with suspension bridges), many of which had failed due to insufficient resistance to wind pressure (but also failure of the designer, and failure to understand the mechanics of such a bridge.)
But in the 1900’s, several factors contributed to successful implementations:

- Better methods of structural analysis of statically indeterminate structures (via computers by using structural analysis software).
- Development of orthotropic steel decks.
- High strength steels, new methods of fabrication and erection.

Deck, tower, and pier are made of reinforced concrete.

A box girder supports the deck so as to reduce buckling of the deck from high compressions, twisting or torsion, and distribute among the stays non-uniform loads.
Cables are made of high strength steel, usually encased in a plastic or steel covering that is filled with grout, a fine grained form of concrete, for protection against corrosion.
**Classifications**

**radial**: cables connect evenly throughout the deck, but all converge on the top of the pier.

**harp**: cables are parallel, and evenly spaced along the deck and the pier.

**fan**: a combination of radial and harp types.

**star-shaped**: cables are connected to two opposite points on the pier.

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**Simple analysis of radial bridge**

*Given*: the weight of the deck is 60 units, so each segment along the deck is 10 units, the angle each cable makes with the deck

→ can easily calculate the tension in each cable using trigonometry principle.

*Significance*:
- ✓ cables further along the deck must endure a higher tension than cables closer to the pier.
- ✓ axial component along the deck is minimal (compared to harp).
- ✓ however, cables congest the very top of the pier.
**Simple analysis of harp bridge**

*Given*: the weight of the deck is 60 units, so each segment along the deck is 10 units, the angle each cable makes with the deck

→ can easily calculate the tension in each cable using trigonometry principle

**Significance:**
- All cables endure the same high tension.
- Axial component along the deck is higher (compared to radial).
- Causes 'bending moments' in the tower.

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**Quick points to be made**

- Buying different size cables for the radial bridge may or may not reduce the total cost compared to harp bridge (because you can buy in bulk).
- So the fan bridge is a structural and economic compromise.
- The star shaped bridge only may have aesthetic value (it is structurally flawed).
- Some bridges combine elements of the suspension bridge and the cable stayed bridge together.
Cantilever building method

[Diagram of cantilever building method with labels: formtraveler, forestay cable, barge crane, backstay cable, closure pour, closure pour]

Samples

[Image of Coalbrookdale Bridge, UK]
...continued

Gi-Lu bridge, Taiwan

...continued

Runyang bridge, China
...continued

Lerez River Bridge, Spain

...continued

Suramadu bridge, Indonesia
**Pros.**

- construction method is simple (cantilever method).
- appropriate for our span, although they are typically built for larger spans.
- however, elements of the cable stayed bridge may be employed.
- simple to design (as opposed to the suspension bridge).

**Cons.**

- may require building pier, or at least a tower on either side of the site.
- more susceptible to damage by wind forces.
- similarly, it is weak in the sense of torsion and twisting.
- although cheaper than suspension bridges, can be more expensive for short spans (as opposed to truss bridges).

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**Thanks for your attention and success with your study!**