

REVIEW OF SUSPENSION BRIDGE

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ABSTRACT

A suspension bridge is a types of bridge which consist of deck, towers, vertical suspenders and suspension cables. A bridge is a structure built to span a valley, body of water, or other physical obstacle, for the purpose of providing passage over the obstacle. Now a days suspension bridges are the new innovation in bridge technology of all the bridge types till now. The suspension bridge allows for the longest span ranging from 600 to 2,000+ m. This type of bridge has cables between the towers & the cables hold vertical suspender cables that bear the weight of the deck below.

Keywords: Deck, Towers, Vertical Suspenders, Suspension Cables.

I. INTRODUCTION

A typical suspension bridge is a continuous girder suspended by suspension cables and vertical suspenders, which pass through the main towers and at the end on big anchorages that hold them. The main forces in suspension bridge are in tension in cables and in towers there will be compression. The deck, which is usually a truss or a box girder, is connected to the suspension cables by vertical suspender cables called hangers, which are also in tension. The load is transferred by cables to towers, which transfer to the anchorages on both ends of the bridge then to the ground.

The design of a suspension bridge is simple and straightforward, and takes advantage of several techniques to distribute the weight of the bridge safely and evenly.

Merits over other bridge types

- These bridges used for longer span.
- Suspension bridges are more economical compare to other types of bridge.
- The maintenance of these bridge are more easier than others.
- It has more flexibility due to adjustable configuration.
- During the construction of bridge requirement of below access of deck is less.

Limitation over other bridge types

- Suspension bridges can face problem to bear concentrated heavy weights.
- Due to storms and high speed wind can start swaying or shaking the bridge.
- It has lower deck stiffness compare to the other bridges.
- Few suspension bridges need substantial foundation work on it.
- The entire bridge can collapse if the single cable fails.

II. HISTORY

Suspension bridge are one of the oldest form of engineering, constructed by primitive peoples using vines for cables and mounting the road or walkway directly the cables. In the 4th century there are cables plaited bamboo suspension bridge was introduced in India later of iron chain with roadway suspended. Their origination appeared in China and the South Americas. Earliest versions of suspension bridges was made by Thangtong Gyalpo, Tibetan saint and bridge builder from the 15th century. He made over 58 iron chain suspension bridges around the Tibet and Bhutan and one of his bridges abidance until 2004 when it was destroyed by a flood. These type of bridges used iron chains suspended from ground level over rivers. The suspension bridges which spotted in the South Americas were non-metallic, the structure made of fibre were used. Those structures were described in the West in the mid of 18th century. The first iron chain suspension bridge on the land of United States was made at Jacob's Creek in Westmoreland County, Pennsylvania in 1801. The first bridge which fitted with all necessary components of modern suspension bridge was designed by James Finley who exclusive a system for suspending a rigid deck from cables in 1808. The first was Brown's Union Bridge, which is completed in 1823. Thomas Telford's Menai Strait Bridge, an eye bar chain structure, was the most important Civil Engineering feat of the first 50 years of the nineteenth century. The bridge, completed in 1826, had a 176m

main span. These structure inspired worldwide interest that led to widespread employment. The cables which are consisting of different types of wire for suspension were used in place of chains for the first time in 1930 by French engineers. After sometime John Roebling, American inventor, found a way to spin the cables at the place of constructing instead of transporting them prefabricated on the site. After that suspension bridges became popular because they allowed to bridge spaces that could not be bridged with conventional methods. The advantages are this types of bridge it can made with the longer span than other types of bridge, it is more economical bridge due less use of materials; during construction it does not require access from below so it doesn't matter much what is below nor how high is bridge; it is more earthquake-proof than other types; and it can be modified easily to accommodate wider vehicles or to add more lanes. When it compared with other bridge these suspension bridges are usually compared by the length of their main span (longest span they have). Akashi Kaikyō Bridge was the longest span of suspension bridge across the world from 1998 but, it surpassed from world longest span till now is 1915 Çanakkale Bridge which opened recently in 2022. The main span has 2,023m meters in length and it situated in Gelibolu and Lapseki in Turkey.

Table 2.1: List of longest suspension bridges in the world

Rank	Name	Main span (metres)	Year opened	Location	Country
1	1915 Çanakkale Bridge	2,023 m	2022	Gelibolu – Lapseki	Turkey
2	Akashi Kaikyo Bridge	1,991 m	1998	Kobe (Hyōgo)	Japan
3	Yangsigang Yangtze River Bridge	1,700 m	2019	Wuhan	China
4	Nansha Bridge	1,688 m	2019	Dongguan	China
5	Xihoumen Bridge	1,650 m	2009	Zhoushan	China
6	Great Belt Bridge	1,624 m	1998	Korsør – Sprogø	Denmark
7	Osman Gazi Bridge	1,550 m	2016	Dilovası – Altınova	Turkey
8	Yi Sun-sin Bridge	1,545 m	2012	Gwangyang – Yeosu	South Korea
9	Runyang Bridge	1,490 m	2005	Yangzhou – Zhenjiang	China
10	Second Dongtinghu Bridge	1,480 m	2018	Yueyang (Hunan)	China

III. TYPES OF SUSPENSION BRIDGE

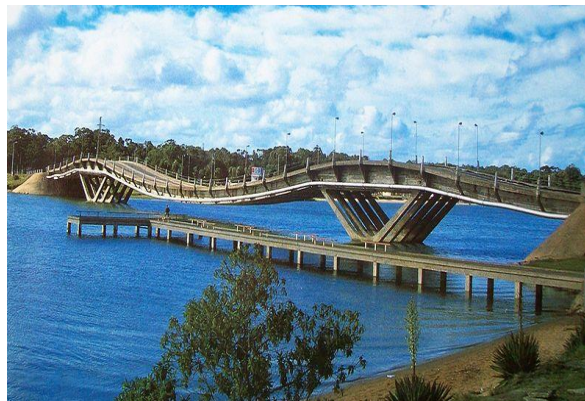
- **Simple Suspension Bridge:** These types of bridges are generally made with materials like a rope. Usually it is made as for foot bridge and also it is oldest types of suspension bridge. These bridges do not have towers or any kind of big foundation. This type of bridge have flexible deck which are supported by cables and anchorages to the ground. The materials used are simply swing by wind most of the these bridge cannot last against the natural calamities.



- **Cable-stayed Suspension bridge:** A cable-stayed bridge is the bridge which have several points in each span between and the towers supported upward with inclined cables and consists of main towers, cable-stays, and main girders. The cable-stayed bridge fulfill supports to the span with huge steel cables.



- **Stressed ribbon bridge:** It is the modification over the simple suspension bridge in which deck lies on the main cables but it is stiff but not flexible. This span has stressed in resistance that permit it to be more durable and stable than a simple span. Usually this bridge is made from steel cables, treated wood and concrete.



- **Self Anchored Suspension Bridge:** In type of suspension bridge in which the main cables connected to the ends of the deck, instead of attach to the ground by large anchorages. The design is suitable for construction a top elevated piers or in areas which have unstable soils where anchorages might be difficult to construct at that place.



IV. CONCLUSION

Today, the suspension bridge are leading long span technology in fact it is a very old form of bridge, there are primitive examples of suspension bridge use vines and ropes for cables. Typical span lengths of suspension bridge are 600 – 2,000m+ and the world's longest span till now is 1915 Çanakkale Bridge, center span is 2,023m located in Turkey. In a typical suspension bridge, towers are constructed on the piers, and the cables

are carried high above the deck in platform located at the top of the towers. The cables go downward to anchor spans from the towers of the main span, cables are usually anchored in heavy concrete or anchorages. In India there are some examples of suspension bridge are Howrah Bridge has span length of 705m, this is the oldest one and Bandra Worli Sea Link has span length of 5.6 km which is longest cable stayed suspension bridge in India.

In conclusion we can say that suspension bridge is more suitable for longer span than other bridge types due to more economical, more stability and more flexibility. It can be built high up over waterways, this is essential for any area to be able to allow passing ships to come through. There are no restriction is required from below the bridge while it is being constructed, making it a great choice for areas of that ships and waterways. Overall, the development of county also increase in the employment and interconnect with many cities or towns, the more convenient for movement of peoples due to short distance.

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