Bridges and how they work

Definition

A bridge is a structure which provides passage over an obstacle without closing the way beneath. The passage may be required for a road, a railway, pedestrians, a canal or a pipeline. The obstacle which needs to be crossed may be a river, a road, railway or a valley.

“ Of all inventions, the alphabet and the printing press alone excepted, those inventions which a bridge distance have done the most for the civilization of our species”. By Thomas B. Macaulay

Importance of Bridges

Bridges have always d prominently in human history. Cities have sprung up at a bridgehead or where at first a river could be forded at any time of the year. Some examples are London, Oxford, Cambridge, and Innsbruck. Many battles have been fought up till now for cities and bridges. The mobility of an army at war is often affected by the availability of bridges to cross rivers. That is the reason why, emphasis is made on military training to learn how to destroy existing bridges while retreating and also how to build new ones while advancing.

Historical Development

The history of development of bridge construction is most likely linked with the history of human civilization. Bridge Structures can be classified into four basic types: beam bridges, cantilever bridges, suspension bridges and arch bridges. The first bridges were made by nature. The tree accidentally falling across a stream was the earliest example of a beam type bridge. Similarly, the natural rock arch formed by erosion of loose soil and the creepers hanging fro the tree to tree allowing monkeys to cross from one bank to the

other was the earliest forms of arch and suspension bridges. The ancient who first felled and used a tree to cross a stream was the first bridge builder. Since the primitive man was a wanderer in search of food and shelter from the elements, the first structures he built were bridges (1).

Components of a Bridge

The main parts of a bridge structure are as follows:

1) Decking, consisting of a slab, girders, trusses, etc

2) Bearings for the decking

3) Abutments and piers

4) Foundations for the abutments and piers

5) River training works, like revetments for slopes at the abutments, aprons at the bed level

6) Approaches to the bridge to connect the bridge proper to the roads on either side

7) Handrails, guard stones, etc

Types of Bridges

There are several types of bridges which exist in the world. The type of bridges to be used depends on the aim, the location, the environment, the length of the span, the materials which are available and also their costs; some of them are the Arch Bridge, the Beam Bridge, Cable- Stayed Bridge, Cantilever Bridge, Covered Bridge, Movable Bridge, Suspension Bridge, Truss Bridge,.

The Arch Bridge

Arch bridge is one of the earliest types of bridges. China had started to build stone arch bridges in very early times. Arches are, indeed, very strong bridges. The weight does not push ‘ straight down on the bridge but instead it’s carried outward along the curve of the arch to the supports at both ends. The ends, which are known as abutments, carry the load and keep the arch and the roadway above it in its place.

Since 250 B. C, the Chinese were building stone arch. The Chao-Chow Bridge which was built around 600 A. D. is the most long-lived vehicular bridge today. It is situated about 350 km South of Peking, and it is a stone arch bridge of a single-span of 37. 4m and rise of 7. 23m, with a roadway width of 9m. The reason of its longevity was that the ‘ voussoirs’ (wedge shaped stone) were made exactly to match and there was no mortar joint.

Beam Bridge

A beam bridge is one of the simplest types of bridge, which is also to be known as the girder bridge. It is a horizontal beam which is supported by piers at both ends. A beam bridge is the best design to span short distances that are not more than 250 feet, because the farther apart the piers, the weaker the bridge becomes. That’s why; support columns are used along the bridge if the beam bridge is long. A beam bridge is usually built with concrete and steel.

Cable- Stayed Bridge

Cable-stayed bridges are bridges which have cables attached to the towers. Cable-stayed bridges are mostly used for medium span between 500 and 2,

800 feet. The cables can also be attached to the towers with different patterns.

I. Cables extend from several points on the road to a common point at the top of the tower in the pattern known as radial pattern.

II. Cables extend from several points on the road to points at different heights along the tower, parallel to one another, in a pattern which is known as parallel pattern,

Cable-stayed bridges have recently become more and more popular for long span bridges in the range of about 200m. A well-known bridge in this type is the Maracaibo Lake Bridge in Venezuela which was built in 1963.

Cantilever-Bridge

A cantilever bridge has got two arms which stick out from each pier. While one arm is anchored down on the shore, the other arm is projected toward the center. A section is built at the center which rests on the ends of the two arms. The Cantilever bridge can also be used to span great distances.

Heinrich Gerber was the world’s first modern cantilever bridge-maker who had built this type of bridge in 1867 across the river Main situated at Hassfurt, Germany, with main span of 129m. The world’s most famous Cantilever Bridge, which was built in 1889, is the Firth of Forth Bridge in Scotland, with the two main spans of 521m.

Covered Bridge

Covered bridges are bridges which were built in order to cross streams at an average distance. The roof of the bridge protects the wooden planking of the road from rain and snow. This is also beneficial to pedestrians.

Movable Bridge

Movable bridges are needed over rivers, canals or harbor entrances. Although these bridges are low, they allow the passing of boats. Bascule is a moveable bridge which has one or two sections which are raised when a boat wants to pass through.

Most of the movable bridges are railway structures in flat terrain where construction of high level bridges with vertical clearance is necessary for navigation which would involve very long and costly approaches to cater for the passing of trains. They are also found in cities, like Chicago whereby long approach arrangements are inconvenient.

Suspension Bridges

Suspension bridges are mostly used to span distances from 2, 000 to 7, 000 feet. They are longer than the other types of bridges. A suspension bridge makes use of huge main cables which extend from one end of the bridge to the other end. The cables rest on the top of the high towers and are securely attached at each end by anchorages.

The suspension bridge has become the best type of bridge suited for very long spans. In 1883, the Brooklyn Bridge was completed with a main span of 486m- the longest bridge in the world at that particular time.

Truss Bridge

A truss bridge is looks like a beam bridge except that it has triangular shape patterns known as trusses which make the bridge more strong. The trusses are usually made from straight, steel bars. They are rigid and that's why, they prevent movement when they are pushed.

With the introduction of steel, the earlier truss forms made place to more efficient forms such as the Baltimore, Parker, Pennsylvania and the K-truss types. The world's longest simple steel truss bridge span is the suspended span of J. J. Barry Bridge across Delaware River.

Railway Bridges

Railway bridges are bridges which are made across the river for the easy-going of trains from one place to another across rivers.

In Mauritius, railway bridges were built in timber and nineteen only out of 189 were constructed in masonry or steel along with volcanic rocks which were used for its basement. At the beginning, the bridges were spans made up of wooden logs or plants and at last, stones. These bridges were constructed for the easy-going of trains from one place to another across an obstacle, river or valley.

Railway

According to Wikipedia's definition of railways, " Rail transport is the means of conveyance of passengers and goods by way of wheeled vehicles running on rail tracks. In contrast to road transport, where vehicles merely run on a prepared surface, rail vehicles are also directionally guided by the tracks they run on". The track usually consists of steel rails which are installed on

sleepers and ballast on which on which the rolling stock, usually fitted with metal wheels, moves. However, other variations may also be possible, for example, slab track whereby the rails are fastened to a concrete foundation resting on a prepared subsurface.

Railways in France

Railways was legalized in France after 1842 and railway construction began with short mineral lines

Introduction of trains in Mauritius

It was in the middle nineteenth century that trains were introduced in Mauritius. People started to know the benefits of the railway system in the country. The main objective to inspire investigations to introduce railways in Mauritius was the necessity to improve transportation of sugar to go Port-Louis. At that time, there were 262 estates producing annually a crop of 125, 000 tons. The estates were situated widely across the island and there were no other means of transport except mule and horse carts' transport. As such, it required better transportation methods in the island.

The following map shows geography of Mauritius in 1862, just before the introduction of trains:

Dardenne, A. Carte de Maurice [cartographic material] : contenant la situation des principales Sucreries les limites des divers quartiers de l'Ile, les routes et le trace du chemin de fer

Map 1:

Mauritius routes in 1862, before the introduction of trains.

The railways in Mauritius played an increasing importance of transportation of sugar and also a better means for transportation. Introduction of trains in Mauritius brought about three advantages:

1) Transportation of sugar

2) Means of transportation of goods and passengers

3) Creation of employment

There was increased industrialization and people were able to travel rapidly and cheaper.