Chapter Two

Literature review

2.1.Introduction:

A bridge is a work of a construction is intended to provide a transit corridor for anynatural orartificialbarrier.

Add to that there are four main factors define a bridge as Model, Span, traveland materials.

Bridgesare exposedtoseveral types ofloadsthat distinguish themasacreation ofcomplexanalysis, design, and whichgeneratedinsideBridges.

Assessment of their likely structural response to loading requires a different procedure to that adopted in their design.When assessing the response of an existing slab bridge, the structural form is already determined. It will have been subjected to an unknown load history [1].

2.2. Components and elements of bridges:

The main parts of bridge Components as follow:

- Superstructure consists of aslabfloors andbeamsinconcrete bridgesor mannequinstablets andgablesand archesin the case ofsteelbridges.
- -Substructure consists of peripheral stents and moderation and foundationsBearings, as illustrated inFig. (2.1).

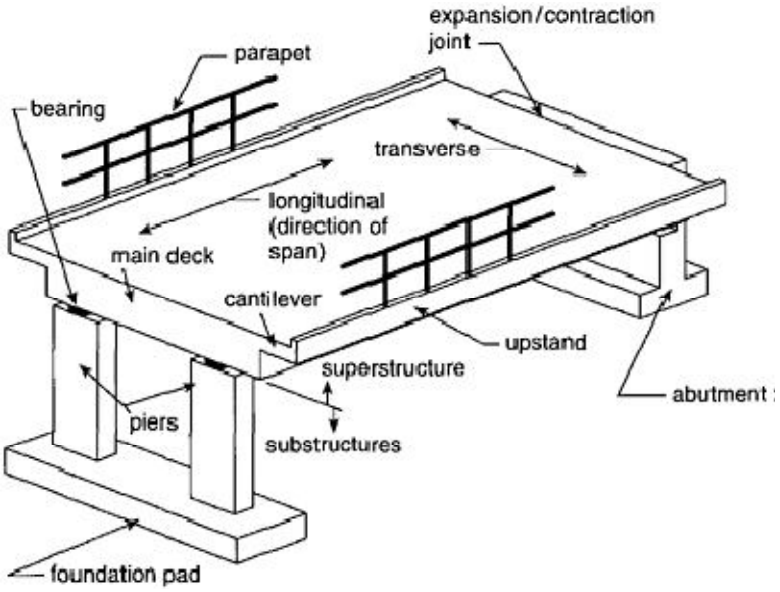

Fig.(2.1) : Components and elements of bridges.

2.3. Types of Bridges:

The type of bridges suitable for a site depends on several factor including span which it the most important. Choice of material and shape go together, method of construction.

1-Arch Bridges. 2-Beam Bridge. 3- Truss Bridge.

4-Suspension Bridges.5-Floating Bridge. 6-Cable stayed Bridge.

7-Rigid frame Bridge [1].

2.4. History of the bridges:

Bridges is a way for the continuity of roads across waterways or valleys or roads Orthogonal with it, we find that the main part in the development of building bridges was associated with the level of development of the productive forces through the ages, and perhaps the occurrence of part of the tree on both sides of a table, which is led mostly to the idea of creating a human being crossing through various obstacles.

Deliberately rights previously to build suspension bridges primitive plants flexible by linking them by a valley to the other party. With the development of road-building has become a necessity. The bridges in the beginning in the form of arch of stone or concrete or wooden bridges and then became hails of metal and reinforced concrete.

One of the most remarkable feats of Roman engineering was the Pont du gard aqueduct which was built near Nimes in southern France in 19BC,and it remains complete to this day .

It was designed to carry water across the river gard, a tributary of the Rhone. The water was conveyed in a deep, mortar –lined channel above the third tier The piers here are as wide as the spans .Which give the impression of a continuous masonry wall which has been punctuated by semi-circular openings [1].

2.5. Bridges uses:

The bridges are required to carry pedestrian,rail, or vehicular traffic cross roads, gorges and open water.

And also are used at the same time in carrying the service lines (eg electricity cables water pipe lines, oil, etc.).

2.6. Classification of bridges:

Bridge can be characterized or classified in several ways depending on the objective of classification. Bridges are always classified in terms of the bridge superstructures which can be classified according to the following characteristics:

2.6.1. By material:

Bridges can be identified by the material from which their superstructures namely,timber,concrete, andsteel. This is not to suggest that only one kind material exclusively to build these bridges in their entirely. Often a combination of material is used in bridge building, for example:

(1) Stone bridges:

It is inherently strong and bridges need to be simple maintenance And also be curved, resist the loads and stresses by pressure [1].

(2) Concrete bridges:

Include bridges built from both reinforced concrete and prestressedconcrete .a Reinforced ConcreteBridge generally has all its super-structural elements, such as deck,stringers, andparapets, built from reinforced concrete.

(3)Prestressed Concrete Bridge:

More used the seas in the long and prevent cracks of concrete under operating loads and thus improve the resistance of the bridge loads repeated. The easy of implementation and installation.

(4)Steel bridges:

Steel bridges has a superstructure that consists of reinforced concrete supported on steel stringers ,truss highway and railroad bridges built motely from steel .

Deck may consist of a steel plate deck instead of conventional concrete deck also there is the pre-stressed steel bridges.

(5)Aluminum bridges:

Very few aluminum bridges exist. At least eight aluminum bridges , including two – four span structures and two bascule bridge in England , are in service High corrosion resistance are the two most significant factors in favor of aluminum as a construction material for bridges.

(6) Composite bridges:

A reinforced concrete slabs or Prestressed based on beams of iron Characterized this type of composite bridges in the provision of large quantities of iron. Ranges between (8 - 60%) compared rail bridges.

(7) Timber bridges:

The first bridge to be built in the United State was timber, mostly covered truss bridges. Today timber bridges are seldom built except in parks and recreational facilities, and in logging areas of forest.

(8) Other material:

Other material have been tried for bridge construction, perhaps purely as experiments with new material. Reinforced with steel diagonals to carry tension was built in Isreal in 1975.

2.6.2. Classification by span lengths:

In bridge engineering, it is customary to identify bridges as short - span, medium span, and long- span, depending on the span lengths.

1- Short – span bridges (6 to 38 m).
2- Medium - span bridges (38 to 121m).
3- Long - span bridges (over 121m) [1] .

2.6.3. Classification by structural form:

Bridges are classified by structural form this is necessary because the methods of analysis used depend on the structural form, classification is as follows:

1- Beam Bridge:

Consists of a horizontal beam supported at each end by piers. The weight of the beam pushes straight down on the piers, as shown in Fig. (2.2). the farther apart its piers, the weaker the beam becomes. This is why beam bridges rarely span more than 250 m.

When something pushes down on the beam, the beam bends. Its top edge is pushed together, and its bottom edge is pulled apart [6].

Fig.(2.2) : Beam Bridge.

2- Arch Bridge:

An arch is sometimes defined as a curved structural member spanning an opening and serving as a support for the loads above the opening. Many of the masonry arch bridges built for the last 2000 years are in the middle of cities whose residents consider these bridges not only necessary for commerce but also for their beautiful appearance , as shown in Fig. (2.3) can span up to 800 m.

An arch rib acts like a circular beam restrained not only vertically but also horizontally at both ends and thus results in vertical and horizontal reactions at

the supports. The horizontal reaction causes axial compression in addition to bending moments in the arch rib. The bending moments caused by the horizontal force balances those due to gravity loads. Comparing with the axial force, the effect of the bending moment is usually small. That is why the arch is often made of materials that have high compressive strength such as concrete, stone, or brick [6].

Fig. (2.3) : Arch Bridge.

3- Truss Bridge:

The truss bridge is built with many small, straight, steel bars used to support heavy weights. These bars often are fixed into small triangles to create a strong support base.

Every bar in this cantilever bridge experiences either a pushing or pulling force. The bars rarely bend. This is why cantilever bridges can span farther thanbeam bridges, asillustrated in Fig .(2.4) below[6].

Fig. (2.4) :Truss Bridge.

4- *Suspension* Bridges:

This kind of bridges can span 2,000 to 7,000 m .way farther than any other type of bridge. Most suspension bridges have a truss system beneath the roadway, to resist bending and twisting, as shown in Fig. (2.5) .

In all suspension bridges, the roadway hangs from massive steel cables, which are draped over two towers and secured into solid concrete blocks, called anchorages, on both ends of the bridge. The cars push down on the roadway but because the roadway is suspended, the cables transfer the load into compression in the two towers. The two towers support most of the bridge's weight [6].

Fig.(2.5) : Suspension Bridges.

5 - Cable-Stayed Bridge:

The cable-stayed bridge, like the suspension bridge, supports the roadway with massive steel cables, but in a different way. The cables run directly from the roadway up to a tower, forming a unique "A" shape, as shown in Fig.(2.6).

Fig. (2.6): Cable-stayed Bridge.

Cable-stayed bridges are becoming the most popular bridges for medium-length spans (between 500 and 3,000 m)[6] .

6 - Floating Bridge:

Pontoon bridges are supported by floating pontoons with sufficient buoyancy to support the bridge and dynamic loads. While pontoon bridges are usually temporary structures, some are used for long periods of time, as shown in Fig. (2.7).

Permanent floating bridges are useful for traversing features lacking strong bedrock for traditional piers. Such bridges can require a section that is elevated, or can be raised or removed, to allow ships to pass [6]

Fig. (2.7) :FloatingBridge.

7- Rigid Frame Bridges:

The members are rigidly connected in or rigid frames. Unlike the truss and the arch bridges that will be discussed in the following subsection, all the members are subjected to both axial force and bending moments.

The members of a rigid frame bridge are much larger than those in a typical building. Consequently stress concentrations occur at the junctions of beams and columns that must be carefully designed using[1].

2.6.4. Classification According to the axis of the bridge:

1. Straight bridge or arch arched
2. Curved bridge where the longitudinal axis of the bridge which is not straight.
3. Oblique bridge where the bridge not be perpendicular to the stents, the angle at which the inclined angle by calling Milan Bridge.

2.6.5. Classification According to the type of support:

Simple bridge support - Continuous Bridge - Cantilever bridges – end fixed bridge - Bridges with frame.

2.6.6. Classification According to the status of the floor of the bridge:

Bridge surface (Bridge with a higher ground beams main bearing bridge).

Bridge half superficial (Bridge is ground through the main load-bearing beams of the bridge).

Bridge tunnel (Bridge is ground down the main load-bearing beams of the bridge).

2.6.7. Classification According to the vertical clearance between the floor of the bridge and the level of the surface of the river for the purposes of navigation:

1-Navigational bridges allow the passage of ships and divided into:

- Bridges fixed.

-Bridges Animations.

2- Non-navigational bridges do not allow the passage of ships.

2.7. Advantages of different types of bridges:

Beam Bridge (Simple, Good for short distance and relatively cheap to construct).

Truss Bridge (Simple design, Small size, Can be constructed with few materials Fairly light and Strong) .

Suspension Bridges (Transfers force to its ends, Can be built high enough to allow boats to pass under them and Flexible).

Arch Bridge (Natural support system,Strong, Can cope with bending forces and Can be constructed with simple materials).

Cable-Stayed Bridge (that the load on the span are balanced on both sides of the pier).

2.8. Elements of bridge:

Bridges are composed mainly from the following [7] :

(1)Superstructure.

(2) Substructure.

(1)**Superstructure elements:**

- Main bearing element:

(i) Truss:

Trusses are placed above the deck slab, the load transmitted to it by axial stresses for long distances its preferred increasing member depth to resist moment [7] .

(ii) Arch:

In which the loads are transferred to the foundation by arches as the main structural element, axial compression in the arch rib is the main structural action combined with some bending. The horizontal thrust at the ends is resisted either by the foundations or by a tie running longitudinally for the full span length [7] .

(iii) Cable:

The basic elements for all cables in modern cable supported bridge is steel wires which is stronger than ordinary structural steel , in most cases the steel wires is cylindrical shape with diameter about 5 mm[7].

(iv) Girder:

Flexure or bending between vertical supports is the main structural action in this type .girder is concrete, steel composite or pre-stressed concrete. They may be further sub-divided into simple, continuous suspended or cantilevered span [7].

(2)Deck:

A bridge deck is defined as the bridge structure between piers and abutments which carries and supports the load applied to the bridge.

Deck bridges are the simplest and least expensive structure that can be built for small spans up to 40 ft (12 m). These bridges can be built on groundsupported false work or constructed of precast elements. Construction details and form work are the simplest of any bridge type.

Their appearance is neat and simple, especially for low, short spans. Precast slab bridges continuity over transverse joints at the piers, which is necessary to improve the riding quality of the deck and to avoid maintenance problems. Span lengths can be increased by use of prestressing [2] .

(3) Elastomeric Bearing:

An elastomeric bearing is made of elastomer (either natural or synthetic rubber). It accommodates both translational and rotational movements through the deformation of the elastomer.

Elastomer is flexible in shear but very stiff against volumetric change. Under compressive load, the elastomer expands laterally. To sustain large load without excessive deflection, reinforcement is used to restrain lateral bulging of the elastomer[1] .

(2)Substructure :

(1) Abutment :

As a component of a bridge, the abutment provides the vertical support to the bridge superstructure at the bridge ends, connects the bridge with the approach roadway, and retains the roadway base materials from the bridge spans[1].

(2) Piers :

Piers are intermediate supports between adjoining bridge span .

(3) Piles :

A bridge foundation is part of the bridge substructure connecting the bridge to the ground. A foundation consists of man-made structural elements that are constructed either on top of or within existing geologic materials. The function of a foundation is to provide support for the bridge and to transfer loads or energy between the bridge structure and the ground A deep foundation is a type of foundation where the embedment is larger than its maximum plane dimension. The foundation is designed to be supported on deeper geologic materials because either the soil or rock near the ground surface is not competent enough to take the design loads or it is more economical to do so.

(4) Wing wall :

Wing walls are walls that extend a bridge abutment to return the side slopes of the earth embankment [1].