CHAPTER 1

INTRODUCTION

1.1 Background

Bridges are a common feature of the built environment and one of the key elements of civil engineering. The basic principles of bridge design are dependent on the load-bearing structure whether flat, convex or concave. These are better known as beam, arch or suspension bridges. [1]

Beam bridges are either simple beam or cantilever structure generally constructed from steel truss or pre-stressed concrete units. The simple beam bridge is horizontally self-supporting and transmits loads vertically through piers or abutments. The cantilever bridge transmits loads through piers central to the beam. Figure 1.1 shown the beam bridge construction. [1]

Figure 1.1 Beam Bridge

Arch bridges consist of a load bearing arch in a state of compression, the strength and stability of which allows them to carry greater loads than beam bridges. The arch support the horizontal deck of the bridge either from above or below. Figure 1.2 shown the arch bridge construction. [1]

Figure 1.2 Arch Bridge

Suspension bridges consist of towers secured by cables that suspend the central structural span or deck. The tower foundation may be constructed using caisson or cofferdam techniques, whilst the cable anchorages can be secured through anchorage tunnels to suitable ground on either end of the bridge. Figure 1.3 shown the suspension bridge construction. [1]

Figure 1.3 Suspension Bridge

Of these three basic options, various designs are very possible. The choice of bridge design will be determined by height water level, soil conditions and the clear range needed. Traditionally, steel construction has been most commonly used for very long spans, however, concrete arches are now also used for large bridges. For large single span bridges, suspension bridges are the most common, with high tensile strength of steel cables providing a very economical design solution compared to other support options. [2]

Engineers in the nineteenth century understood that a continuous bridge across various supports would distribute the burden between them. This will result in a lower pressure on the support beam or truss and means that a longer span can be built. Some 19th century engineers patented a continuous bridge with a midpoint midrange. The use of hinges in multi-span systems presents the advantage of static and bridge determination systems that can handle differential settlement of foundations. Engineers can more easily calculate the strength and pressure with the hinges on the girder. [2]

Heinrich Gerber was one of the engineers who got a patent for the hinged beam (1866) and was recognized as the first to build it. Hassfurt Bridge over the Main river in

Germany with a 124 foot (38 meter) center range was completed in 1867 and is recognized as the first modern cantilever bridge. [2]

Kentucky High Bridge by C. Shaler Smith (1877), Cantilever Niagara Bridge by Charles Conrad Schneider (1883) and Poughkeepsie Bridge by John Francis O'Rourke and Pomeroy P. Dickinson (1889) all important early uses of cantilever design. The Kentucky River Bridge stretches a gorge that is 275 feet (84 meters) in full advantage and full of the fact that work, or temporary support, is not needed for the main range of cantilever bridges. [2]

The most famous early cantilever bridge is Forth Bridge. This bridge is held by a record for the longest time span in the world for twenty-nine years, until it was defeated by the Quebec Bridge. Benjamin Baker illustrates the structural principles of the suspended landscape in the photo on the left. The suspended range, where Kaichi Watanabe sat, was seen in the middle. The need to resist compression is seen in the use of wooden poles while the upper chord tension is indicated by the outstretched arm. The action of the outer foundation as an anchor for cantilever is seen in the counterweight placement. [2]

Cantilever bridges are bridges that are built using cantilever, a horizontal structure into space, supported only at one end. For small bridges, cantilever may be a simple block; however, large cantilever bridges are designed to handle traffic using roads or rails constructed of structural steel, or support beams built on pre stressed concrete. The steel frame support bridge is a major engineering breakthrough, which can reach distances of more than 1,500 feet (460 m), and can be easier to use. Cantilever bridges structure which at least acts as a berth to maintain other parts that surpass supporting docks. A simple cantilever range is formed by two cantilever arms extending from the opposite side of the obstacle to be crossed, meeting in the middle. In general variants, suspended spans, support arms do not meet in the center instead, they support a mid-frame bridge that rests on the tip of the cantilever arm. Suspended ranges can be constructed outside the location and lifted into place, or built on the spot using special travel assistance. Figure 1.4 show cantilever box girder bridge [2]

Figure 1.4 Cantilever Box Girder Bridge

1.2 Objective of the Study

Based on the background above the objective of the study is to design and calculate cantilever bridge using concrete box girder

1.3 Problem Limitation

For design and calculate of the cantilever bridge is limited only for upper structure and concrete material

1.4 Scope of the Study

The scope of this research begins with finding information and reviews of the literature relating to the calculation and design of cantilever bridges and box girder. The design of the box girder bridge will be carried out based on standard bridge construction data and calculations will be given in Chapter 4, while the results will be given and discussed in Chapter 5. In addition, design drawings will be given in the appendix.