CHAPTER 1

INTRODUCTION

1.1 Background

Bridge is a structure that is built over a railway, river, or road so that people or vehicles can cross from one side to the other. Another definition of the bridge is a structure built to span physical obstacles without closing the way underneath such as a body of water, valley, or road, for the purpose of providing passage over the obstacle. A bridge is included in an important component of the road because it determines the maximum load of vehicles that can pass through the road [1].

The history of the bridge has been very long along with the occurrence of transportation between humans with other humans and with the environment around, various - kinds of shapes and construction materials used to change in accordance with the progress of the era and technology ranging from the construction of a very simple bridge to use construction that can be spelled out very great. The first bridge was made using wood tied to cross the river. The use of reeds or other fibers knitted together can bind the materials used to build the bridge at first [1].

The bridge is the most important part in the transportation of land and sea. Generally bridges are used for connecting roads across rivers, hills, mountains, connections between road access (intersections not intersect), or inter island links. Sometimes appropriate technical analysis and needs in the field required a bridge with a long stretch. User convenience factor is one of the important variables in determining type and model of long span bridge [2].

There are many different types of bridges, each type og bridge has a spesific purpose and can be applied in different situations. The bridge type depends on the function of the bridge, field where the bridge will be built, material to be used, the load of the plan to be passed and the funds have available to build it. Types of bridges in terms of structure [1]:

1. Beam bridge

Beam bridge are horizontal beams supported ar each end by substructure units and can be either simply supported when the beams only connect across a single span, or contiuous when the beam are connected across two or more spans. When there are multiple spans, the intermediate supports are known as piers [1].

The world's longest beam bridge is Lake Pontchartrain Causeway in southern in The United State, at 23,83 miles (38,35 km), with individual spans of 56 feet (17 m). Beam bridges are the simplest and old type of bridge in use today, and are a popular type [1].

Figure 1.1. Beam Bridge (Source:[3])

2. Truss bridge

A truss bridge is a bridge whose load-bearing superstructure is composed of a truss. This truss is a structure of connected elements forming triangular units. The connected elements (typically straight) may be stressed from tension, compression, or sometimes both in response to dynamic loads. Truss bridges are one of the oldest types of modern bridges. The basic types of truss bridges shown in this article have simple designs which could be easily analyzed by nineteenth and early twentieth century engineers. A truss bridge is economical to construct owing to its efficient use of materials [1].

Figure 1.2. Truss Bridge (Source: [4])

3. Arch bridge

Arch bridges have abutments at each end. The weight of the bridge is thrust into the abutments at either side. With the span of 220 metres (720 ft), the Solkan Bridge over the Soča River at Solkan in Slovenia is the second largest stone bridge in the world and the longest railroad stone bridge. Its arch, which was constructed from over 5,000 tonnes (4,900 long tons; 5,500 short tons) of stone blocks in just 18 days, is the second largest stone arch in the world [1].

Figure 1.3. Arch bridge (Source:[5])

4. Tied arch bridge

Tied arch bridges have an arch-shaped superstructure, but differ from conventional arch bridges. Instead of transferring the weight of the bridge and traffic loads into thrust forces into the abutments, the ends of the arches are restrained by tension in the bottom chord of the structure. They are also called bowstring arches [1].

The world's current largest arch bridge is the Chaotianmen Bridge over the Yangtze River with a length of 1,741 m (5,712 ft) and a span of 552 m (1,811 ft) in Chongqing, China [1].

Figure 1.4. Tied arch bridge (Source:[6])

5. Suspension bridge

Suspension bridges are suspended from cables. The earliest suspension bridges were made of ropes or vines covered with pieces of bamboo. In modern bridges, the cables hang from towers that are attached to caissons or cofferdams. The caissons or cofferdams are implanted deep into the bed of the lake, river or sea [1].

Figure 1.5. Suspension bridge (Source:[7])

6. Cable-stayed bridge

The cable-stayed bridge is a bridge with a static structure system that is not necessarily a high degree, where the workforce is influenced by the stiffness of the main bridge supporting components, namely the floor vehicle system (plate, long beam, and transverse beam) along with cable and main pylon [8].

Cable-stayed bridges using high-powered cables as a hanger connected directly to the girder of a tower. Cable-stayed bridge has several types, namely: fan type, harp type, radial type. Each type of cable-stayed bridge has advantages and disadvantages to bear the workload on the bridge structure itself [2].

Figure 1.6. Cable-stayed bridge (Source:[9])

From the six type those bridge, this final assignment will design and calculated cantilever spar cable-stayed bridge.

1.2 Cantilever Spar Cable Stayed Bridge

A cantilever spar cable-stayed bridge will where in this final assignment designed and calculated, is a modern variation of the cable-stayed bridge. This design has been pioneered by the structural engineer Santiago Calatrava in 1992 with the Puente del Alamillo in Seville, Spain. In two of his designs, the force distribution does not depend solely upon the cantilever action of the spar (pylon), the angle of the spar away from the bridge and the weight distribution in the spar serve to reduce the overturning forces applied to the footing of the spar. In contrast, in his swinging Puente de la Mujer design (2002), the spar reaches toward the cable supported deck and is counterbalanced by a structural tail. In the Assut de l'Or Bridge (2008), the curved backward pylon is back-stayed to concrete counterweights [10].

Figure 1.7. Puente del Alamillo (Source:[11])

1.3 Problem Limitations

In designing and calculating cantilever spar cable-stayed bridge some limitations have made:

1. Maximum bridge span is 275 m and a height of pylon is 150 m
2. Using the MIDAS Civil, SAP2000, spColumn computer program to analyze the behavior of the main structure as a whole
3. Planning baseline design of this bridge based on “Rancangan Standar Nasional Indonesia” (RSNI) regulations T-02-2005, RSNI T-03-2005, Pd T-04-2004-B, Pd T-12-2005-B

1.4 Objective of The Study

From the description above, the objectives of the final assignment report can be designed as follow:

1. Design and calculation Cantilever Spar Cable-Stayed Bridge
2. Getting knowledge about the structure of Cantilever Spar Cable-Stayed Bridge

1.5 Scope of Study

To achieve this objective, the research begins with a literature review of information relating to the design and calculation of Cable-Stayed Bridge and Cantilever Spar Cable-Stayed Bridge. All books, journals, papers, proceedings pertaining to the design and calculation of Cable-Stayed Bridge and Cantilever Spar Cable-Stayed Bridge will be reviewed. The literature review will then be followed by the methodology. In the methodology chapter, dimensions of pylon, cable, a deck will be determined. The calculation of the bridge structure will be given in chapter 4, while the results will be given and discussed in chapter 5.