CHAPTER 1

INTRODUCTION

1.0 Introduction

In designing the bridges, an engineer need to completely understand the problem to be solved. To design a safety and longevity bridges, they have to consider different types of loads, how and where they need to apply the load. They also have to undergo several steps that usually need in designing bridges such as understanding the problems, determining the potential loads of bridges, calculating the highest possible loads and calculate the amount of material need to counteract the loads.

Retrofit is one of the important features of maintenance. It is can be defined as upgrading or strengthening the bridge structural quality to enhance the performance of the bridge. Strengthening and retrofit methods are different from the repairing and it includes a component host. Most bridges are in need for the retrofit and strengthening every 15 years. There are a lot of strengthening methods like steel pre-stressed girders, micro piles, pile caps, extended footings, abutment wall, wall piers and column bent pier. Other than that, there are also concrete deck repair by patching, epoxy injection, silica fumes and salvaging of existing railing and beam where it is customary to retain the existing ones. If demolition

needs to be conducted, extra care is strictly prohibited to ensure the features that required for continuity are not damage.

There are a few ways to retrofit bridge structure to prevent it from collapse. It is because these physical strengthening or restoration has its own style of design and construction. Any method of strengthening should be investigated first so that it will comply with the situation of the damaged bridge. The method chosen must be also economical and constructible with as low as possible impact to the traveling public.

Many bridges will be distress after a certain life span. It is more economical to strengthen the bridge rather than demolish it and build a new one. This can be done by using an external pre-stressing and other strengthening method (Muthuramu, Jeyakumar, Sadish-Kumar, & Palanichamy, Strengthening of reinforced concrete beam using external prestressing, 2002). External pre-stressing is a way where concrete structural members are pre-stressed longitudinally by using tendons that is located completely at the outside of the concrete section. Nowadays, external pre-stressing has been considered as one of the most powerful techniques in strengthening or rehabilitating the existing concrete bridges (Lou & Xiang, Introduction, 2006). It has been commonly used in the construction of concrete bridges because it provides advantages of economic feasibility and easy applicability. Furthermore, it can also be applied to not only bridge structures but to building structures too. Some more studies have to be carried out to enhance a better understanding of this technique.

Larger increase in the deflection will develop and also a very deep crack may develop instantaneously if the loads are kept constant after cracking happen to the structure. Therefore, cracking and deformation characteristics of the structural members are important in design. The composite beam that is externally pre-stressed is purposely employed in the bridge engineering to strengthen the existing structures mainly. This practice can also be applied to either the deck of concrete bridges and continuous steel beam or to only single span bridges. Deterioration of the existing bridges is mainly caused by the increased in the traffic loading on those bridges, progressive structural aging of the bridges and the corrosion of the reinforcement from various causes such as the weathering condition which

has become the major causes all over the world. The traffic volumes that are coming from the heavy trucks on the bridges have risen to the level that exceeds the values design at the time of the design. Therefore, many of the bridges has suffered fatigue damage from the case of heavy traffic volume and in need of urgent repair and strengthening.

External pre-stressing can also be identified by which the tendons are placed outside of structural element. This is to facilitate the flexural resistance and can be refers to a post-tensioning method (Ng & Tan, Introduction, 2005). It will be efficiently in strengthening the existing concrete beam and also in the construction of segmental box girder. Pre-stressed concrete beam's advantages include large flexural rigidity, torsion rigidity, good integral performance and high stability and others. However, there is no provision of design for the pre-stressed concrete beams in the current standard. At ultimate state, the stress in the external pre-stressing tendons needs to be identified to calculate the ultimate strength of the strengthened member.

In response to the demand of efficient and faster transportation systems, there are an increase in the traffic volume and weight of the highway system around the world. The increases of vehicle loads will also cause the over- loading on the bridges. This problem should be considered in designing or assessing the bridge. As a result, most bridges today required to carry loads greater than the original design (Daly & Witarnawan, 1997). The technique of external pre-stressing has become popular because of the minimal disruption to the traffic flow and only need a short time to install the system or rapid installation. This is the major cause that leads to the failure or cracking of bridge that need an urgent repair and strengthening to maintain its function.

1.2 Problem Statement

For certain bridges such as flyover, there is a limitation for the height of vehicle to pass under the flyover. Sometimes, there is a certain vehicle such as lorry especially that are not allowed to pass under it because of the height limitation that will cause the failure to the bridge when it rammed the beam girder of the bridge. The cracking that caused by the