GENERAL ANALYSIS OF LIVE LOAD IN SINGLE SPAN BRIDGE

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STUDENT’S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Pengesahan unsur-unsur struktur dalam jambatan keluli penting bagi mana-mana jambatan lama yang sedia ada. Kekuatan kelelahan untuk struktur terutama keluli bergantung kepada keadaan alam sekitar, peningkatan beban, kemerosotan dan penuaan semula jadi. Oleh itu, penilaian untuk menentukan sejauh mana jambatan dapat menampung beban sepanjang tempoh itu mesti dilakukan. Penyebab utama kerosakan struktur keluli boleh menjadi keletihan dengan kakisan dan haus dalam kegagalan struktur yang paling. Tujuan kajian ini adalah untuk mengkaji keupayaan reka bentuk jambatan yang sedia ada dan mengenal pasti ubah bentuk yang mungkin untuk jambatan yang sedia ada. Dalam makalah ini, penilaian jambatan menggunakan perisian SAP2000 kerana ia telah terbukti menjadi program struktur tujuan umum yang paling bersepadu, produktif dan praktikal. Model rumit boleh dijana dan disusun dengan templat yang dibina dengan kuat. Menggunakan model komputer, jambatan itu diuji dan dianalisis dengan kes beban yang diberikan dalam program ini. Hasilnya kemudian digunakan untuk menentukan selebihnya kapasiti jambatan kereta api keluli.

ABSTRACT

A verification of structural elements in steel bridges is important for any old existing bridges. Fatigue strength for the structure especially steel is relies upon the environmental condition, increasing of load, deterioration and natural aging. Therefore, an evaluation to determine how long the bridge can sustain the load over the period must be done. The main causes of steel structure damage can be fatigue with corrosion and wear in most structural failure. The purpose of this study is to investigate the design capacity of the existing bridge and identify the possible deformation for that existing bridge. In this paper, the assessment of the bridge is using the SAP2000 software as it has been proven to be the most integrated, productive and practical general purpose structural program. A complex models can be generated and meshed with powerful built in templates. Using the computer model, the bridge was tested and analyzed with the load cases assigned in the program. The outcomes were then used to decide the rest of the capacity of the steel railroad bridge.

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LIST OF SYMBOLS

kN	kilo Newton
m	meter
C	Celsius

LIST OF ABBREVIATIONS

IBC	International Building Code
BCA	Building Code of Australia
EN	European Standard
BS	British Standard
IEM	Institute of Engineers Malaysia
IRC	Indian Road Congress
AASHTO	American Association of State Highway Transportation Official

CHAPTER 1

INTRODUCTION

1.1 Introduction

Steel structure is one of the building materials that has been using for years in construction. Steel is used everywhere in construction world for construct buildings, bridges and warehouses as their numerous benefits comparing with concrete. Due to time passes, fatigue load will develop on the steel structure. Fatigue load is where the materials weaken by continuous load. It usually causes by the stress or loads on the structures over a period of time. Under repeated application of traffic loads, fatigue damage accumulates in bridge decks and/or in the main superstructure elements (Guo, Frangopol and Chen, 2012).

As in Malaysia, we have several bridges that used steel as main component. Nibong Tebal Bridge which is located in Penang is a steel arch bridge. Nibong Tebal Iron Bridge was built as an overpass to the railway tracks that run under it. One of the famous old steel bridges in Malaysia is Victoria Bridge in Kuala Kangsar. It is a double intersection warren truss bridge and was a single track railway. Victoria Bridge had been used since 1990 but now no longer in use. As well as in Kelantan, we have Guillemard Bridge which is a single track railway truss bridge with 600 m long. It is one of the oldest railway bridges after Victoria and said to be the longest railway bridge in country. While in Johor, Segamat Railway Bridge is a steel pratt girder type bridge that has been built by British in 1993. Also in Malaysia, a bridge that acts as tourist attraction is Langkawi Sky Bridge. It is a suspended bridge with single pylon where hangs about 100 m above ground.

Eventually all those structures and bridges will reach it limits and affected the fatigue life. There are three stages of fatigue failure which are initiation, propagation and final rupture. In the initiation stage, the fatigue fracture is very small but if this stage can be prevented, they will be no fatigue fracture. The propagation stage where the crack start to change direction and the area of crack can be detected. On the final stage, the fatigue crack gradually increases and weakens the structure. It also can be a complete fracture where the cracks are visible on the surface.

1.2 Problem Statement

Steel girder bridge, like other structure, deteriorates over time due to environmental effects, material fatigue and overloading. It is quite evident that the bridge infrastructure is aging (Czarnecki and Nowak, 2008). As the life expectancy of steel is 30 to 50 years, it can be reduced to half if corrosion or overloading happened. Old steel bridges in Malaysia have been exists for a long period of time and accommodate live loads every day that will decrease the strength of the structure. To maintain or extending the bridges life, we need to find a design capacity on old bridge within time.

1.3 Objectives

The main purpose of this research is:

a. To investigate the design capacity of existing bridge.

b. To investigate possible deformation for existing bridge.

1.4 Scope of Research

To satisfy the objectives, we will focus on a railway steel bridge of. By referring to Eurocodes, the steel bridge will be modelled in simulation process by using SAP 2000. The simulation will be simulating load cases for the bridge where we will use the dead load, live load and vehicles load. From the simulation, the data of the stress and deformed shape of the bridge will be obtained. The verification of design capacity and deformation of a structure are going to be referred according to MS EN 1992 and MS EN 1993. We will also validate the result of simulation by doing manual calculation and comparing the both result. The SAP 2000 will show how the vehicle load can cause deformation to steel structure within time and we can discuss on determine the design capacity of a steel bridge.

1.5 Significance of Research

To verify the simulation result of structure design capacity according to Eurocode 1 with capacity life with respect to different load cases.

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