FINITE ELEMENT ANALYSIS OF BOX GIRDER BY USING ANSYS SOFTWARE

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ABSTRACT

In this research, a steel box girder was analyzed ANSYS program with the Monte Carlo simulation direct sampling probabilistic method. The objective of this analysis is to modeling the box girder in an ANSYS FEM design, check the frame structure of box girder in force and moments, axial + bending and stress and strain graph and to determine the result based on difference graph. In addition, the structure is checked accordingly both to Eurocode 2 and Eurocode 3. Nowadays box girder is widely used for the construction of the bridge. It is very convenient to place the electric cable or any other necessary equipment which the designer wish to go through it. A significant advantage of box girder is able to support large amounts of weight in the same length compared to the I-beam. The continuing expansion of the road network throughout the world mainly in traffic greatly improved results of extensive city population and urban growth. Span range is more for box girder-bridge as the comparison of the T shaped beam-bridge produces a relatively small number of piers with the valley width and the resulting economic. From the results of simulation, we get to know the real behaviour of the structure under the applied loads. In probabilistic analysis, we get the results of probabilistic density function plot, cumulative distribution function plot and histogram plot by 1000 times of simulation for any input and output.

ABSTRAK

Dalam kajian ini, satu galang kotak keluli dianalisis oleh program ANSYS dengan simulasi Monte Carlo persampelan langsung kaedah kebarangkalian. Objektif kajian ini adalah untuk model galang kotak dalam reka bentuk menggunakan perisian ANSYS FEM, struktur bingkai kotak galang momen, paksi + lentur dan tekanan dan graf tegang serta untuk menentukan keputusan berdasarkan perbezaan graf. Di samping itu, struktur diperiksa dengan sewajarnya kepada kedua-dua Eurocode 2 dan Eurocode 3. Pada masa kini kotak galang digunakan secara meluas dalam pembinaan jambatan. Ia adalah sangat mudah untuk meletakkan kabel elektrik atau apa-apa kelengkapan lain. Kelebihan besar kotak galang mampu menyokong banyak berat badan dalam tempoh yang sama berbanding dengan I-rasuk. Pengembangan berterusan rangkaian jalan raya di seluruh dunia terutamanya dalam trafik bertambah baik hasil daripada penduduk bandar yang luas dan pertumbuhan bandar. Pelbagai span adalah lebih untuk kotak galang jambatan sebagai perbandingan T berbentuk rasuk jambatan menghasilkan sebilangan kecil jeti dengan lebar lembah dan menyebabkan ekonomi. Dari hasil simulasi, kita mengenali tingkah laku sebenar struktur di bawah beban yang dikenakan. Dalam analisis kebarangkalian, kita akan mendapat keputusan kebarangkalian plot fungsi ketumpatan, fungsi taburan kumulatif plot dan histogram plot dengan 1000 kali simulasi bagi apa-apa input dan output.

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LIST OF SYMBOLS

tw	Web thickness
tf	Flange thickness
hw	Height of web
i	Height
b	Width
d	Depth
A	Area of section
I	Moment of inertia
W_{pl}	Plastic modulus
i	Radius of gyration
N	Axial load
V	Shear force
M	Moment
α	Imperfection factor
$\gamma M0$	Partial actor for resistance of cross-sections whatever the class is
$\gamma M1$	Partial factor for resistance of members to instability assessed by member checks
λ	Slenderness value
$Ø$	Value to determine the reduction factor
X	Reduction factor
L_{cr}	Buckling Length
K_{zy}	Interaction factor

LIST OF ABBREVIATIONS

2D	Two Dimensional
3D	Three Dimensional
CIVIFEM	Civil Finite Element Method
ChckAxis	Check Axis
LS	Load Step
DOF	Degree of Freedom
GAUS	Gaussian (Normal) Distribution
TGAU	The Truncated Gauss Distribution
DENS	Density
ELASTIC	Elastic Modulus
POISON	Poison Ratio
LOAD	Point Load
PDF	Probabilistic Density Function
CDF	Cumulative Distribution Function
MAXIMUMDEFLECTION /MAX_DEFLECTION	Maximum Deflection

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Finite element analysis is to replace the complicated problems with relatively simple problems and then solving. It will solve the field as many as by little interconnection finite element subdomains, for each unit there is a suitable approximate solution, and then solve the domain always satisfy condition, so as to get the solution of the problem. This solution is not the exact solution, but approximate solution, because the actual problem is replaced by a simple question. Since most practical problems difficult to get the accurate solution, and the finite element calculation not only high precision, but also can adapt to various kinds of complicated shapes, and therefore become an effective means of engineering analysis (Corley, 2004).

ANSYS software is the combination of filed form of financial structure, fluid mechanics, electric, magnetic, acoustic analysis. It's concentrated in one of the large general-purpose finite element analysis software (Liang, 2003). It is developed by the world's largest ANSYS finite element analysis software company from United States. It can interface with most CAD software, sharing and exchange of data. For specific areas of physics, ANSYS software allows users to delve deeper to solve a wider range of issues to deal with more complex situations, like the field of construction, exploration, geology, water conservancy, transportation, electric power, mapping, land, environment, forestry, metallurgy etc.

The box girder refer to the cross-sectional like a box in the form of beam. When the bridge span is huge, perform box girder is the best, it's closed thin-walled section of its torsional stiffness beneficial for the bridge and curved bridge of cantilever construction. It has a large area of the roof and floor, can effectively resist the positive and negative moment reinforcement and satisfy the need. It has the good dynamic characteristics and small shrinkage deformation value (Hanson, 2009).

In this research, Finite Element Methods (FEM) models were used to stimulate the characteristic behavior of the steel, concrete and reinforcement steel structure using ANSYS+CIVILFEM 12.0 program. CivilFEM is the ANSYS civil engineering special software package based on the structure of civil engineering for a variety of numerical simulation of design and checking (Watson, 2007).

CivilFEM ANSYS powerful analysis ability and CivilFEM provides for civil engineering special functions and modules together, in order to meet the special needs of the civil engineering industry, provides a powerful tool for the design of a variety of high-end civil engineering analysis (Weng, 2008).

1.2 Problem Statement

In the modern century of bridge construction field, box girder is a significant component of many form of bridge, so, the box girder structures must be designed well with appropriate calculation to make sure it can support the load and it is safe for using in a long period of time (Mansur, 2008). Even though there are several methods which can be used to analysis the behavior of box girder structure, in order to make the procedure easier and specific, finite element method (FEM) is used through ANSYS software.

In the bridge construction process, in order to meet the alignment, driving comfort, people's aesthetic and other requirements, often perform the bridge in a variety

of curve form and special-shaped bridge structure. But, in modern days, those requirements is not that easily to accomplish. In order to validate it feasibility and reliability, this study test the box girder by load though ANSYS+CIVILFEM software (Salam, 2007).

1.3 Objective

The purpose of this study is to investigate the structural characteristic and behavior of box girder by using finite element software ANSYS.

(i) To modeling the box girder in an ANSYS FEM design.

(ii) To verify box girder pass all the code checking.

(iii) To check the frame structure of box girder in force and moments, axial + bending and stress and strain graph.

(iv) To determine the result based on difference graph.

1.4 Scope of Study

This research is mainly concentrate on generating a 3-Dimension model though the ANSYS+CIVILFEM software. Those focused on the analysis the box girder using the EUROCODE 2 and applying the parameter to generate the results in ANSYS. For the purpose of accomplish the research objectives, there are few researches scope is necessary to be followed. Such as study the parameters of box girder in EURCODE and characteristic of the structure (Warzak, 2001).

This research will applying different size and type of box girder, generating different result by applying different loading on box girder. The result of this research will be comparing for come out the best result due to complete the research study. Explore ANSYS+CIVILFEM software though tutorial to get more and more familiar with operating the software (Warzak, 2001).

1.5 Research Outcomes

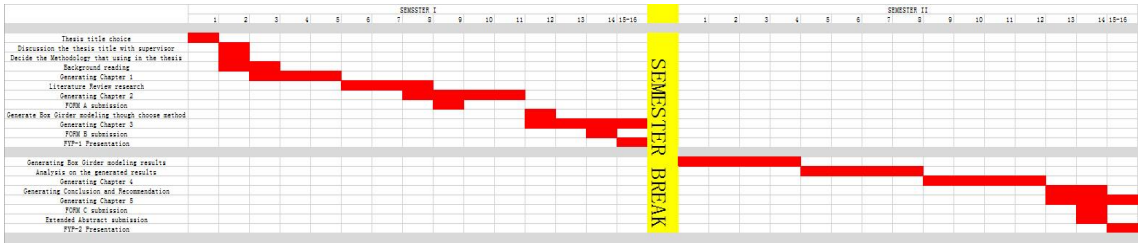
Obtain the bending moment diagram, shear force diagram, deformed shape diagram and reinforcement factor diagram though ANSYS software.

1.6 Research Questions

(i) What is the moment characteristic behavior of box girder during subjected loading?

(ii) What is the critical status of box girder at subjected loading? What does it effected the bridge when it applied into actual construction site?

1.7 Work Schedule



1.8 Summary of the Chapter

In this chapter, mainly briefly discusses about reinforced concrete, research topic, research problems. Simply introduces how to do research of this study.

CHAPTER 2

LITERATURE REVIEWS

2.1 Introduction

Box girder is a type of building structure beam, are often made of steel, although in the past the iron is commonly used for construction land. The beam of this type, the integrity of the beam using one or more closed cell structure, rather than an I-shaped steel and H steel has an open end. Bridge construction often requires the use of box girder, the other structures, such as buildings (Jiang, 2012). This type of beam generally can keep more weight than I-shaped beam, it will have more resistance to torsional damage or distortion.

The bridge sometimes have a larger scale, design and construction of box beam. Bridge curved or bent particularly benefit from this design because of the anti-torsion ability of box girder. Concrete can be poured into the appropriate shape, usually in the bridge deck, add the torsional rigidity of the whole structure. Characteristics of box girder design can have only one cell, or the box, and the multi cell system of other design features include many box (Liu, 2003). Box shape other than rectangular or tapered structure in order to meet the specific design, each box can accommodate. This is sometimes referred to as the design of honeycomb beam.

Bridge construction has made the importance of world level today. Bridge box girder in any road network use the key element is more and more popular, in bridge

engineering because of its good stability, applicable, economic, aesthetic, structural efficiency. The structural behavior of box girder is complex, it is difficult to analyze the actual situation, through the conventional method. One or two simply supported box girder bridges in this study by prestressed concrete analysis is moving load according to India road Congress (IRC: 6) recommendations, prestressed code (IS: 1343) according to the IRC: 18 specifications. Analysis of box girder-bridge by SAP 2000 and 14 wizard with a parabolic prestressed with full section. Various span / depth ratio that get the ingredients of the depth, stress and deflection criteria are met standards (Chen, 2007).

The continuing expansion of the road network throughout the world mainly in traffic greatly improved results of extensive city population and urban growth. Many of the changes and development of various bridges leads to this expansion. The bridge type is related to provide maximum efficiency, materials and construction techniques used, for a particular span, and application. To reduce the dead load, unnecessary material, which is not utilized to its full capacity, is removed out of section, this results in the shape of box girder or cellular structures, depending upon whether the shear deformations can be neglected or not (Lucy, M., 2009). Span range is more for box girder-bridge as the comparison of the T shaped beam-bridge produces a relatively small number of piers with the valley width and the resulting economic.

Box girder is connected by a common flange at the top and bottom two web. Closed cell, forming a greater torsion stiffness and strength than an open part is to select the common causes of the box beam structure of this feature (Lucy, M., 2009).

Box girder is rarely used in buildings (box column is sometimes used, but these axial load not loaded in bending). They can be used in special circumstances, such as when the beam load for eccentric shaft (Lucy, M., 2009).

From the point of view of box girder bearing universal application, their indifference whether it is positive or negative moment and their torsional stiffness; from the point of view of economy (Qiang, 2002).