FINITE ELEMENT ANALYSIS OF PRESTRESSED PRETENSION CONCRETE T-BEAM

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اهدى كل تحياتي وشكري وتقديري الى كل من ساهم في انجاح هذا البحث
واخص بالذكر استاذي الفاضل البروفسور بدر الهشام بن احمد ، عائلتي الكبيرة
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ABSTRACT

Prestressed concrete constructions become a one of the famous constructions method. The stresses occurred in concrete and reinforcement became kind of complex due to prestressing and applying loads. And in reasons of costs and time for lab tests, Three-dimensional nonlinear finite element model of prestressed reinforced concrete T-beam had been developed in this study. This lead to the requirement by codes of practice to obtain design parameters for each new system by extensive full-scale testing. According to the high costs and time consuming for laboratory tests. Many researchers tried to propose alternative methods of small-scale testing and finite element models. These methods are still being refined to make them more accurate and practical for use in design offices. In this study we are going to develop a model to simulate a model had been tested at lab of structure in Universiti Teknologi Malaysia and to obtain the best method of modeling the specimen. At the end of this study it should be aim to develop a 3D finite element model of prestressed concrete T-beams and analyzed them using finite element software, ANSYS package. Interface elements will be used for modeling bond interaction between concrete, reinforcement and prestressed force in tendons. And by applying loads up to ultimate loads and plot the graph of loads verses displacement in linearity region, and by increasing loads up to non-linearity region will be illustrated in the criteria of flexure behavior. The results was be verified against published experimental data for test on T-beam done in Universiti Teknologi Malaysia. It is expected that, by using the mentioned combination, a more accurate model was be achieved as compared to result out from tests.

ABSTRAK

Pembinaan konkrit prategasan menjadi salah satu kaedah pembinaan yang terkenal. Tegasan yang berlaku dalam konkrit dan tetulang menjadi jenis kompleks kerana prategasan dan memohon beban. Dan sebab-sebab kos dan masa untuk ujian makmal, Tiga dimensi linear model unsur terhingga prategasan konkrit bertetulang T-beam telah dibangunkan dalam kajian ini. Ini membawa kepada keperluan oleh kod amalan untuk mendapatkan parameter reka bentuk untuk setiap sistem baru oleh ujian skala penuh yang luas. Menurut kos yang tinggi dan mengambil masa yang lama untuk ujian makmal. Ramai penyelidik cuba untuk mencadangkan kaedah alternatif ujian kecil-kecilan dan model unsur terhingga. Kaedah-kaedah ini masih sedang diperhalusi untuk membuat mereka lebih tepat dan praktikal untuk digunakan di pejabat-pejabat reka bentuk. Dalam kajian ini kita akan membangunkan model untuk mensimulasikan model telah diuji di makmal struktur di Universiti Teknologi Malaysia dan untuk mendapatkan kaedah terbaik model spesimen. Pada akhir kajian ini, ia harus bertujuan untuk membangunkan model unsur terhingga 3D T-rasuk konkrit prategasan dan dianalisis menggunakan perisian unsur terhingga, pakej ANSYS. Unsur Antara Muka akan digunakan untuk bon model interaksi antara tetulang konkrit, dan daya dalam tendon prategasan. Dan dengan menggunakan beban sehingga beban muktamad dan plot graf sesaran ayat beban di rantau kelinearan, dan dengan meningkatkan beban sehingga ke rantau bukan kelinearan akan digambarkan dalam kriteria kelakuan lenturan. Keputusan telah disahkan terhadap data yang diterbitkan eksperimen bagi ujian ke atas T-beam yang dilakukan di Universiti Teknologi Malaysia. Ia dijangka bahawa, dengan menggunakan gabungan yang disebutkan, model yang lebih tepat dapat dicapai berbanding mengakibatkan keluar dari ujian.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Recently a lot of methods had been discovered to understand the behavior and responses of the structure elements due to the effects of applied loads. For past few centuries an experimental method and different methods have been utilized to study the response of structural elements such as try and error for analyze for individual elements.

Those methods of analysis had been developed in cause of time consuming and high costs for that materials which used in the analyzing methods, till the finite element method (FEM) had been discovered, which will be considered in this thesis as the most methods to obtain the behavior of prestressed pretention concrete T-beam. And by applying the service load and the ultimate load for this study and by understanding the load-deflection relation, cracks, and stresses responses parameters will be developed. results will be compared with the experimental one.

Unfortunately, early attempts to accomplish this were also very time consuming and infeasible using existing software and hardware. In recent years, however, the use of finite element analysis has increased due to progressing knowledge and capabilities of computer software and hardware. It has now become the choice method to analyze concrete structural components. The use of computer software to model these elements is much faster, and extremely cost-effective.

The parameters of prestressed concrete beam were used to model a beam and study of those parameters effects on load-deflection curve. By using finite element method can predict the characteristic points on load-deflection response curve were compared to experimental one.

By understanding the behavior of the component materials in each particular element and study the interaction between all materials and the effects on each on other, is consider one of the basic of using the finite element method to get and predict the result after analysis and compare that by one which got from test results. And by understanding that, the use and efficiency of the software can appear and derive to similarity results of experimental tests.

The accuracy of using finite element modeling and compare the results to experimental one will be the conclusion of this thesis.

1.2 Problem Statement

Due to the cost and timing limitations of full-scale tests, and small-scale tests to some extent; development of a reliable analytical software model is desirable.

Previous researchers developed some models based on combination of: software used analysis type, element types & material properties. Their results could not completely match experimental data, although some were very close. By using finite element method (FEM) by computer software, ANSYS, we are trying to produce a model which closely resembles the experimental data available. And which of available methods are available in ANSYS gives accurate results to experimental one.

1.3 Objectives and Outline

Evaluate and investigate the use of finite elements method for analysis of prestressed reinforced concrete beam is the first objective, second objective is demonstrate the behavior and effect of prestressed concrete beam according to distribution of loads, third understand the prestressed reinforced concrete beam behavior in linear and nonlinear zone and the forth is to predict the ultimate capacity load of prestressed reinforced concrete beam.

The following objectives must be fulfilled:

i) To determine the most capable methods and techniques that available in finite element analysis and can be applied for prestressed concrete beam finite element analysis.
ii) To developed a 3D model of prestressed concrete beam in ANSYS software and use the available modelling methods.
iii) To determine the most accurate techniques in ANSYS to predict the experimental results.

1.4 Significance of Study

It is hoped that this research will propose a reliable and effective finite element model which can be used for predicting the behaviour of prestressed concrete beams. If this is achieved, then the need for expensive time-taking laboratory tests can be reduced up to some extent. The model may be used for both educational and practical applications.

1.5 Scope of Study

The scope of this study will be to model a prestress pretension concrete T-beam of 18 m long by finite element package (ANSYS). Loading was applied at service load condition to study the behaviour of the beam. The beam was then loaded until ultimate failure when the deflection increased nonlinearly. In the test at service load limit, it was found that the beam still in elastic behaviour, with only some negligible fine cracks within allowable limit. The ultimate bending moment was observed to be 1.5 times that of bending moment at service loading condition. Tow plane stress finite element models, which will be created by ANSYS software and analysed. To verify the reliability of ANSYS, a simple supported prestressed pretention concrete beam will be analyzed using different materials properties. Later a cross section and convergence studies will carry out on a T-section prestressed pretension concrete beam to determine the reliability of the model

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