

UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

SOLVING BIHARMONIC EQUATION  
OF LINEAR ANALYSIS OF THIN PLATES  
BY USING FINITE DIFFERENCE METHOD

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Report submitted in partial fulfillment of the requirement  
for the degree of  
Bachelor of Science (Hons.) Mathematics  
Center of Mathematics Studies  
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JANUARY 2018

## ACKNOWLEDGEMENTS

IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL

Alhamdulillah. Thanks to Allah SWT, whom with His willing giving us and our friends the opportunity to complete this Final Year Project (FYP) in title of Solving Biharmonic Equation Of Linear Analysis Of Thin Plates By Using Finite Difference Method. This project report was prepared for student in final year to complete the undergraduate program that leads to the degree of Bachelor of Science (Hons) Mathematics.

Firstly, a very special thanks goes out to, Madam Nurul Akma Binti Mohd Rasat, as our supervisor who had guided us to complete our task during two semesters session 2016/2017. She had given us the appropriate knowledge in order to make us more understand about Finite Difference Method clearly. She also spend her time giving her explanation before we begin to work on the assessment.

Besides, deepest thanks and appreciation to our panels, Dr Roliza bt. Md Yasin and Miss Farahanie bt. Fauzi for their acceptance on our proposal last semester and gives opportunity to us doing more research about the analysis of thin plate. Besides, also thanks to their encouragement and providing all the necessary information during this project work. In a conclusion, we would not forget to thank to our parents, family, and others for their cooperation, encouragement, suggestion and full of support for the report completion, from the beginning till the end. They are willing to share their information and explanation to do this project in a right way. They also give us a lot of ideas about the task and give some technique to complete this project.

## TABLE OF CONTENTS

<b>ACKNOWLEDGEMENTS</b>	<b>ii</b>
<b>TABLE OF CONTENTS</b>	<b>iii</b>
<b>LIST OF FIGURES</b>	<b>v</b>
<b>LIST OF TABLES</b>	<b>vi</b>
<b>ABSTRACT</b>	<b>vii</b>
<b>1 INTRODUCTION</b>	<b>1</b>
1.1 Research Background	1
1.2 Problem Statement	2
1.3 Research Objective	3
1.4 Significant Of Project	3
1.5 Scope Of Project	3
<b>2 LITERATURE REVIEW</b>	<b>5</b>
<b>3 METHODOLOGY</b>	<b>12</b>
3.1 To derive the equation of equilibrium	12
3.2 The relationship between direct strain and shear strain	13
3.3 To discretize Biharmonic equation of thin plates	14
3.4 To derive the equation of Finite Difference Method (FDM)	15
3.5 To calculate nodes of thin plates	16
<b>4 IMPLEMENTATION</b>	<b>17</b>
4.1 To derive the equation of equilibrium	17
4.2 The relationship between direct strain and shear strain	18

## ABSTRACT

This report addresses the problem to learn the values of deflection at nodal points of adopted network by solving Biharmonic equation using Finite Difference Method (FDM). Biharmonic equation is a fourth order partial differential equation for continuum mechanism of linear elasticity of thin plate. By varying loads on thin plate, it will give different values of deflection at each nodes. To present these results, the Biharmonic equation is discretized and solved by using FDM. The deflection is calculated at each nodal points by using MATLAB software. It was found that the more loads is placed on thin plate, the higher the values of deflection at each nodes obtained. All these results gained were compared with previously published work for validation. It is concluded that FDM can effectively solved these problems of plate deflection, stress, strain and others. In addition, FDM method can be used to solve more complex problems in accordance to the future problems.

# 1 INTRODUCTION

## 1.1 Research Background

Elasticity is a mechanical behavior of thin plate to determine the value of deflection that relates between stress and moments, stress and strain. Stress is defined as a force that can adjust the physical body, while strain can change the shape of the object when stress is applied. According to Dolianin et al. (2010), the thickness of plate can be categorized into two types which is thin and thick plate. If the thickness of the plate is less than 0.1 (smaller than its two dimensions), then it is classified as thin plate. Otherwise, it is called thick plate. Compared to thick plate, thin plate is less heavy and can easily deformed to produce lots of products.

Thin plate problems can be solved by using mathematical and non-mathematical model. Non-mathematical model consists of exponential and graphical model. Graphical model is the collections of probability distribution according to the structure of underlying graph. This model is applied in various field, such as image processing and control theory. Meanwhile, exponential model is frequently used for growth and decay situation. For example, growth of bacteria, prediction of fish dynamic, birth rate and others.

However, mathematical modeling is the use of various mathematical structure such as diagram, graphs, scatter plots and equations to represent a real word situation. Exact and approximate solution are involved in mathematical model to identify the solution. Approximate solution is divided into two types which are analytical and numerical methods. Analytical method is a set of technique to solve mathematical problem. If the analytical method is difficult to solve, then the numerical method can be applied. Numerical method is a fundamental equation using boundary conditions. There are some examples of numerical methods which are Finite Element Method (FEM), Finite Difference Method (FDM) and Finite Volume Method (FVM) that can be used to calculate deflection of thin plate. Therefore, mathematical model make it easy to solve deflection problems and thus it is most suitable to be used in this report.