FINAL PROJECT

FORCE ESTIMATION ON SCOLIOTIC SPINE FIXATION USING ONE-DIMENSIONAL ELEMENT WITH SPACE FRAME STRUCTURE MODEL

Conducted as One of The Requirements to Finish

The Undergraduate Program

BY:

MUHAMAD ADLI HAWARIYAN

NBP.1610912038

MECHANICAL ENGINEERING DEPARTMENT
ENGINEERING FACULTY
ANDALAS UNIVERSITY
PADANG

2023

APPROVAL FORM

FORCE ESTIMATION ON SCOLIOTIC SPINE FIXATION USING ONE-DIMENSIONAL ELEMENT WITH SPACE FRAME STRUCTURE MODEL

Conducted By:

MUHAMAD ADLI HAWARIYAN

NBP.1610912038

Final Project is Conducted to Finish The Undergraduate Program of Mechanical Engineering in Andalas University

Padang, March 16th 2023

Approved By :

Supervisor,	**Co-Supervisor,**
Dr. Eng. Meifal Rusli	**Prof. Dr.-Ing. Mulyadi Bur**
NIP. 197505272000031	**NIP. 195808211986031002**

PREFACE

Praise and thanksgiving, we pray to Allah because we were able to complete the task of this paper for the blessings of His grace and guidance. This paper is a mechanical engineering writing as one of the requirements to finish the undergraduate program. Every effort has been made to the maximum extent possible; of course, this cannot be separated from the help of Allah SWT and various parties.

For this reason, the author would like to thank Dr. Eng. Meifal Rusli as the primary supervisor and Prof. Dr. –Ing. Mulyadi Bur as the co-supervisor who has provided direction, guidance, suggestions, and discussions in completing this final project. Thank you profusely to my whole family, especially my beloved parents, Risma Yetti Idris and Yan Handri, for all the prayers and enormous mental support to finish this study report. These four wisest individuals are the ones that the author will keep in his heart forever.

Thanks to the official MATLAB forum, MathWorks, as the shining lighthouse of my ship of knowledge, as my compass in the maze of confusion in the logic process, and as the apple to my pie of study. The author mainly spent 70% of the time consumed at MathWorks because of needing more knowledge of the intermediate syntax program of MATLAB and the uniqueness of the task given by the supervisor. Without MathWorks, there will be more time delays.

Last but not least, thanks to myself for triumph in getting out from crestfallen hope, having confusions so thick that the author forgets forgetting, abysmal brain synapse, and no-gym life. Now the author is starting to reread more academic books, encouraged to focus, hit the gym almost daily, have a reasonably good TOEFL score (the latest score is 540), and learn IELTS for future steps in life.

It cannot be separated from all that the author is fully aware of deficiencies in information and other aspects. For example: Why not use an irregular spine shape/surface area completely? Why assume all elements are elastic? Why not input stress value as one of the parameters for choosing the implicit force given in the loop? Therefore, a nice cup of tea time discussion is one of the ways to solve the problem. Please hit up the author's email.

ABSTRACT

Scoliosis, in a simple manner, is a sideways curvature of the spine. A sideways curvature of the spine is most often diagnosed in adolescents. Adolescent Idiopathic Scoliosis was a common disorder in 2012, with a frequency of 0.47 to 5.2 percent. Many problems have been observed in the case of scoliosis surgery utilising pedicle screws and implant rods, such as excessive load at the screw, which makes both the screw and the implant rod break during the correction in the long run, putting scoliosis patients in danger of paralysis. Research on the magnitude of the estimated force of correction by exerting force on the implant rods and screws was done by Yuichiro Abe and Remel Salmigo, each of them using ANSYS 11.0 to analyse earlier investigations that used patient data resulting from forces acting on the Z-Y plane and the other X-Y plane. Based on this research, a study was conducted using a complete spine model in a one-dimensional space frame model to evaluate the correction force applied to the pedicle screw's placement. One of the methods to calculate the generated corrective force needed to make Scoliosis into a proper shape is Finite Element Method (FEM). Using the Finite Element Method, each disc and vertebral body are modelled into a one-dimensional space frame element structure. This study used a MATLAB syntax program to conduct the Finite Element Method. Changing the way of space frame MATLAB program, the input consists of mechanical properties, initial position, ideal position, precision, and forces are being added implicitly. As a validation, the results were compared to the Moment-Area Method. The result is in the form of deflection with the difference between the two being minuscule. It means the result of this study is relatively accurate. From this statement, the program can be applied to scoliosis cases. The distributed generated forces were obtained with how much penetration points of generated force around mid-points was fairly achieved. Even though X-Y plane was slightly focused at one point, Cobb Angle for each plane is lower than 4o for X-Y plane and 7o for Z-Y plane, which is at the ideal zone of the Cobb Angle. Therefore, the generated corrective forces for scoliosis case is achieved.

Keywords: Corrective Force, Finite Element Method, MATLAB, Spine