AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Engineering Physics and Mathematics

Plate Stresses and Deformations Due to In-Plane and Out-Plane Loads

A Thesis submitted in partial fulfilment of the requirements of the degree of
Master of Science in Physics, Engineering Mathematics and Engineering Mechanics
(Engineering Physics and Mathematics)

By

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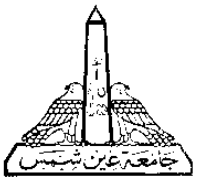
Cairo, Egypt - (2016)



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Thesis Summary

The present thesis introduces new displacement and stress functions for rectangular plate in general coordinates under the entire applicable boundary conditions with any in plane or out-plane loading. These developed functions are easy and fast to be used by engineers in construction sites or manufacturing facilities by just simple calculator or Excel ® sheets. The method of analysis depends mainly on the minimum energy concept and appropriate real polynomials in the functions at the points coordinates over the plate area. The current study introduces then a simple method of analysis seeking acceptable and accurate results. The bending moment and shear forces functions can also be derived from the present achieved displacement functions.

The results from the present derived equations are compared to the results of Timoshenko of the same plate cases if possible, and to new analytical methods like symplectic method for the cases not presented by Timoshenko. Moreover, Ansys ®, the design program, is also used to compare the present results for some cases. Many different assumptions and trials were carried on to most cases of plate problems to seek acceptable and accurate results, which are characterized by easiness and fastness in use.

The calculations and the derived functions were carried on by the aid of the well-known mathematical programs “Matlab ® and Maple ®”. They were used in finding derivatives and integrations of the mathematical functions.

This thesis consists of nine chapters and an appendix including a conclusion part and list of figures, list of tables, list of symbols, and bibliography:

Chapter 1: This introductory chapter shows the motivation and the target of this work. It focuses on the scope of this thesis and clarifies its organization flow.

Chapter 2: This chapter contains most required information for the stresses and deflection of the plates and mathematical history of the study of their problems. It also includes definitions of the subject and important terms.

Chapter 3: This chapter presents information on the deformation of the rectangular plates $a \times b$ with no free edges. It contains a conclusion about the results from the new derived equations for the plate deformation with the compared results.

Chapter 4: This chapter presents information on the deformation of the rectangular plates $a \times b$ with two opposite free edges and others are not free. It contains a conclusion about the results from the new derived equations for the plate deformation with the compared results.

Chapter 5: This chapter presents information on the deformation of the rectangular plates $a \times b$ with only one free edge and others are not free. It contains a conclusion about the results from the new derived equations for plate the deformation with the compared results.

Chapter 6: This chapter presents information on the deformation of the rectangular plates $a \times b$ with two adjacent free edges and others are not free. It contains a conclusion about the results from the new derived equations for the plate deformation with the compared results.

Chapter 7: This chapter presents information on the deformation of the rectangular plates $a \times b$ with three free edges and the other is not free. It contains a conclusion about the results from the new derived equations for the plate deformation with the compared results.

Chapter 8: This chapter presents information on the deformation of the rectangular plates $2a \times 2b$ with all edges free. It contains a conclusion about the results from the new derived equations for the plate deformation with the compared results.

Chapter 9: This chapter presents information on the deformation of the circular plates $r = a$ with different boundary conditions. It contains a conclusion about the results from the new derived equations for the plate deformation with the compared results.

Key words: plate, deformation, stresses, simply supported edge, clamped edge, free edge, minimum energy concept, in-plane load, out-plane load

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