

PARAMETRIC ANALYSIS OF CORRUGATED PLATE BY USING ANSYS
FINITE ELEMENT SOFTWARE

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A project report submitted in partial fulfillment of the
requirements for the award of the degree of
Master of Engineering (Civil-Structure)

Faculty of Civil Engineering
University Technology Malaysia

JANUARY 2013

ألى الخيمة التي ترعرعت على طيب ترابها وشربت من عذب مائها وحوتني وعلمتني معنى
الحضارة والحياة الى بلدي العراق

الى عمود تلك الخيمة الى من كنت الؤذبة اذا ضاقت الارض بما وسعت الى من علمني معنى
الحياة الى ابي

الى اوتار تلك الخيمة الى من نهلت من طيب اصلها الى مصدر الضوء الذي اضاء لي الحياة
الى الى من وفقني الباري ببركة دعائها الى امي

To my country Iraq

To my dear father

To my beloved mother

ACKNOWLEDGEMENT

I would like to express sincere gratitude and special appreciation to my supervisor, Assoc. Prof. Dr.Suhaimi Abu Bakar, for his invaluable guidance, meaningful contributions and untiring efforts, advices and encouragements throughout this project. Without his valuable suggestions and ideas, this report could not have been successfully accomplished.

Finally, I would like to express my heartfelt to my family and to all my friends for their utmost support and motivation throughout this research work.

ABSTRACT

In this study, ANSYS finite element software is used to analyse unstiffened and stiffened trapezoidal and sinusoidal corrugated plates due to uniform distributed vertical load. Different boundary conditions of corrugated plate are considered. The results were compared with the mesh free Galerkin method found in literature to show the convergence and accuracy of ANSYS finite element analysis. The stiffened and unstiffened of trapezoidal and sinusoidal corrugated plate are model using 3D finite element with type of element is shell181. It is found that the results from ANSYS are in good agreement with solution by mesh free Galerkin method. The effectiveness of stiffener plate was found obvious to reduce the deflection. Many profiles of trapezoidal corrugated plate are also analyzed based on ANSYS finite element software in order to choose the optimum shape between them and carry greater loads with less deflection and stresses.

ABSTRAK

Dalam kajian ini, unsur terhingga ANSYS digunakan untuk menganalisis plat beralun trapezoid dan sinusoid yang diperkukuh dan tidak diperkukuh akibat beban teragih seragam menegak. Keadaan sempadan yang berbeza bagi plat beralun diambil kira. Keputusan telah dibanding dengan kaedah jaringan bebas Galerkin yang ditemui daripada literatur untuk menunjukkan penumpuan dan ketepatan analisis unsur terhingga ANSYS. Plat trapezoid dan sinusoid yang diperkukuh dan tidak diperkukuh dimodelkan menggunakan kaedah unsur terhingga 3D dengan jenis unsur adalah shell181. Keputusan daripada ANSYS menunjukkan persetujuan yang baik dengan penyelesaian oleh kaedah Galerkin jejaring bebas. Keberkesanan plat pengukuh didapati jelas berupaya untuk mengurangkan pesongan. Banyak jenis profil plat beralun trapezoid juga dianalisis menggunakan perisian unsur terhingga ANSYS bagi menentukan bentuk yang paling optimum dan dapat menanggung pembebanan yang tinggi serta menghasilkan pesongan dan tegasan yang lebih kecil.

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LIST OF SYMBOLS

FSDT – first order shear deformation

$b_i(x)$ - corresponding coefficients

$q_i(x)$ - the monomial basis functions

m - The number of basic functions

$W(X-XI)$ - the weight function

μ_x, μ_y – Poisson's ratio in x and y directions

E_x, E_y and E_μ - the nominal elastic properties of the equivalent orthotropic plate

N_y – the axial force

M - The uniform moment

M_y - the non-uniform moment

B_y - the flexure rigidity in y direction

h - The thickness of the plate.

G_{xy} – the transvers shear stress

2D – two dimensional

3D – three dimensional

L - The length of the plate

W - The width of the plate

F - The height of one corrugation

C - The width of one corrugation

d – effective depth of slab

Θ - The trough angle

N - The number of the corrugation

CHAPTER 1

INTRODUCTION

1.1 Introduction

The corrugated metal sheet was first invented at the beginning of the nineteenth century, but after the Second World War when the developments in the car industry and the important to save material in construction, gave a large push on the development of the cold formed elements in the construction world.

Now the corrugated plates are found in most branches of engineering practice. The corrugations improve the strength of the plates to the weight ratio and reinforce it. Because of these feature, they are widespread in roofing, wall, girder in the bridge, tunnels pipe, decking and sandwich plate core structures as shown in Figure 1.1.



Figure 1.1 Application of corrugated steel plate.

1.2 Problem Statements

The accuracy to predict deflection and stresses of trapezoidal and sinusoidal corrugated plate based on mesh free Galerkin method is still questionable.

The deflection prediction due to different trough angle of trapezoidal corrugated plate such as 45° , 60° and 90° is found limited in the literature and the influence of the stiffener on the trapezoidal and sinusoidal corrugated plate is also found limited in the literature.

1.3 Aims and objectives

The main aims of this research are to:

- 1- Compare the results of ANSYS finite element analysis with mesh free Galerkin method [14].
- 2- Comparison of deflection for trapezoidal and sinusoidal corrugated plate if stiffener is present along the center line of the plate based on ANSYS analysis results.
- 3- Comparison in analysis results when change the trough angle of the trapezoidal corrugated plate is different.
- 4- Find the maximum stress and deflection of trapezoidal and sinusoidal corrugated plate due to uniform vertical loads on under different boundary conditions.

1.4 Scope and limitation of study

The scope of this study are:

- 1- Derivation of equivalent flexure rigidities for trapezoidal corrugated plate.
- 2- Using finite element software ANSYS to analysis the stiffener and non-stiffener sinusoidal and trapezoidal corrugated plate.
- 3- Only simply supported and clamped supports are considered.
- 4- Only vertical distribution of uniform loads are considered.
- 5- Material is assumed as linear elastic.
- 6- Analyse the trapezoidal corrugated plate with different trough angles.

1.5 Organization of report

This report is organized as follows: Following chapter 1, previous related research is presented in the literature review in Chapter 2. Details of the finite element modeling ANSYS and the properties of shell181 are presented in Chapter 3. The interpretation and discussion of the results including the effect of boundary conditions and stiffener plate on the corrugated plate are discussed in Chapter 4. Finally, conclusions and recommendations are presented in Chapter 5.

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