NUMERICAL MODELLING IN INVESTIGATION OF ROAD FAILURE ON MALAYSIAN PEAT SOIL

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SESI PENGAJIAN: 2007/2008

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Specially dedicated to my beloved mother and father, family and friends. Thanks for all the patience and love. May The Almighty Allah SWT bless you all always.

Acknowledgement

Syukur Alhamdulillah, with the blessing of The Almighty, the Projek Sarjana have been successfully completed within the given time frame. I would like to take this oppertunity to thank my project supervisor, Assoc. Prof. Ir. Azizan bin Abd. Aziz, co-supervisor, Dr. Chan Chee Ming, Mrs. Hasruniza Hassan from Pontian Public Work Department, all the lecturers of FKAAS especially Mr. Felix Ling Ngeeh Leh, Assoc. Prof. Dr. Kemas Ahmad Zamhari and Mr. Ir Agus b Sulaeiman, and the lab technicians, Mr. Amir Zaki, Mr. Rahim and Mrs. Hazliyana. Only with their support and guidance I managed to finish this project and my studies in Universiti Tun Hussein Onn Malaysia.

I would also like to convey my thanks to my beloved parents, Mr. Andi Yusoff bin Andi Achok and Mrs Junaidah bt Dasuki, and my family members for their guidance and supports throughout my studies. Only with their support and blessings I have managed to continue my study this far.

I also would like to thank all my friends especially Wan Aishah, Hakimi, Zafrah and Amirul Balkis for their help and support throughout this study.

Thank You.

ABSTRACT

Road failures are prevalent to common pavement distress, involving cracks and surface deformation, principally when it is constructed on organic soil type. Currently, there is no guideline and specification provided in designing a proper road model associated with this problem. Thus, this matter has lead to get a concerned from Pontian Public Work Department in order to find a solution of the problems. This project will focus in a numerical modelling on a problematic road at Pengkalan Raja Pontian, Section 41, and KM 48 considering cracks and settlement problems of the pavement. It deals with comparison between modelling result and remedial measurement for geotechnical structures. A wide-ranging of field and laboratory testing were conducted to get an input data into the modelling analysis. At survey observation, a full scale of cross section pattern will be reviewed to failure recognizing with the modeling and actual onsite testing. In conjunction to this matter, the series of several trials modelling determining the root cause of the failures and its remedies have been successfully conducted to verify the results. PLAXIS V8.1 software program have been chosen for this analysis related to finite element method. The model complied with actual patterns of the pavement due to failure mechanism, cause(s) of failures and probable remedies of failures for future prevention as well.

ABSTRAK

Kegagalan tanah lazimnya berlaku terhadap turapan jalan raya yang melibatkan retakan/rekahan dan ubahbentuk pada permukaan jalan terutamanya apabila dibina di atas tanah gambut. Pada masa ini, masih tiada lagi garis panduan ataupun spesifikasi yang disediakan dalam rekabentuk untuk mendapatkan model jalan raya yang sesuai dengan keadaan tanah yang bermasalah seperti ini. Oleh sebab yang demikian, atas perhatian daripada Jabatan Kerja Raya daerah Pontian, mereka telah menjalankan usaha untuk mengenalpasti penyelesaian masalah tersebut. Projek ini akan difokuskan secara permodelan menggunakan nombor merujuk kepada jalan yang bermasalah yang dikenalpasti pada jalan Pengkalan Raja, Seksyen 41, KM 48 melibatkan masalah keretakan dan pemendapan terhadap struktur turapan jalan. Ia melibatkan perbandingan antara keputusan permodelan dan pemulihan pada struktur geoteknik sendiri. Kajian menyeluruh di tapak dan makmal telah dijalankan bagi mendapatkan data-data yang diperlukan untuk menganalisa model tersebut. Secara amnya, tinjauan yang dijalankan adalah pada skala penuh untuk keratan rentas yang mana ia dilakarkan bagi mendapatkan lakaran kegagalan jalan yang bersesuaian dengan model dan kajian yang dilakukan di tapak. Sehubungan dengan itu, beberapa cubaan model bagi menentukan punca kegagalan dan cara mengatasinya telah berjaya dilakukan sekaligus mengesahkan keputusan yang diperolehi. Program PLAXIS versi 8.1 telah dipilih dalam analisis ini yang berkaitan dengan kaedah pengiraan elemen secara terbatas. Model yang dihasilkan adalah bersesuaian dengan pola sebenar turapan yang berhubung dengan mekanisma kegagalan, punca masalah dan rawatan bagi kegagalan tersebut termasuklah langkah pecegahan di masa akan datang.

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LIST OF ABBREVIATIONS

AASTHO	American Association of State Highway and Transportation Officials
BRIS	Beach Ridges Interspersed with Swales
DCP	Dynamic Cone Penetration Tests
EPS	Expanded Polystyrene
FE	Finite Element
FWD	Falling Weight Deflectomoter
GPR	Ground Penetrating Radar
IRE	Institute of Road Engineering
MARDI	Malaysian Agriculture Research and Development Institute
MIMOS	Structures Modelling and In Situ Measurements
PPWD	Pontian Public Work Department
TOT	Training of Teachers Programme

LIST OF SYMBOLS

c	cohesion
C_c	compression index
C_α	coefficient of secondary consolidation
f	function of stress state
ϕ	friction angle
P_p	pre-consolidation stress
v	poisson's ratio
κ^*	modified swelling index
λ^*	modified compression index
μ^*	modified creep index
σ	stress
τ	shear stress
ψ	dilatacy angle

CHAPTER I

INTRODUCTION

1.1 Problem statement

Since 1980's, local authorities in Johore especially Pontian Public Work Department (PPWD) received many reports toward damage road at Pengkalan Raja area. About 30%-40% of total roads in Pontian district experienced varieties in road pavement failure. Years after years, terminal serviceability may occur sooner, than more roads defect will reveal. Maintenance and rehabilitation cost imposed high financial burden to road agencies particularly when federal roads are taking into the consideration. If the cause of failure is confined to the upper layers, then the repair can be relatively inexpensive; however, if the problems are related to structural deficiencies in the base or subgrade, then much more extensive and expensive repairs will be required.

In conjunction toward PPWD study, a survey has been conducted at Pengkalan Raja area for a few months since September 2007. From the observation, it should highlight that cracking and deformations were major distress found in Pengkalan Raja federal road according to the type of soil laid there. Peat soil commonly influences the road problems where the failures apparent to happen at most areas. With a concerned from PPWD about their road and has applied thin overlays resurfacing at the