

FORENSIC STUDY ON RURAL ROAD PAVEMENT FAILURES ALONG PARIT SUMARTO

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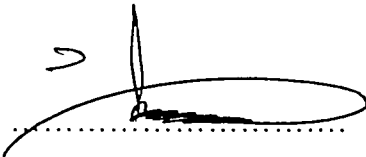
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**This dissertation is submitted as a fulfillment of
the requirements for the award of the Degree Of
Master of Civil Engineering**

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ABSTRACT

Road deformation was occurred so prevalent on rural roads of Batu Pahat vicinity moreover when it's constructed on soft ground. This study presents the results of forensic investigation of a deterioration portion of the Parit Sumarto rural road. This road had been selected as represent of most common types of road deterioration found in Batu Pahat vicinity through field survey conducted for month in August, 2006. The deformation occurred at the right side of the road which located adjacent to the open drain. No deformation seen at the opposed side. The deterioration mechanism hypotheses may due to inadequate layer thicknesses and inappropriate geometry conditions. Extensive field and laboratory testing was conducted to verify the hypotheses. Field investigation was initiated by nondestructive testing (NDT) like ground penetrating radar (GPR) to observe pavement layer thickness and subsurface condition. Mini falling weight deflectometer (MFWD) measure the modulus of the unbound layer and lastly density gauge (DG) for density measurement. Subsequently destructive testing (DT) like dynamic cone penetrometer (DCP) for assessment of unbound layer and thickness determination was conducted. Also, coring and trenching to obtain samples for further laboratory tests. Two locations were trench; one at deteriorated section and one were outside the deteriorated location. MFWD results in this study revealed unsatisfactory as they are significant low. Layer thickness determination via GPR, DCP and trenching was at acceptable differences. The data obtained from NDTs, DTs and laboratory were than used in 2D finite element method (Plaxis) and multilayer elastic analysis (Kenlayer). By using Plaxis in this study, it is found that the root cause of the deformation was inappropriate geometrical design pertaining to road shoulder width. Meanwhile, Kenlayer analysis had shown that apparent differences in road layer thicknesses seem to be a contribution factor in deformation. In this study, evaluation of instrumentations used is also discussed to determine its suitability and effectiveness.

ABSTRAK

Enapan jalan sering terjadi lazimnya pada jalan kampung di sekitar kawasan Batu Pahat, tambahan pula apabila ia dibina di kawasan tanah lembut. Kajian ini mempersembahkan keputusan kajian forensik dari bahagian jalan yang rosak di jalan kampung Parit Sumarto. Jalan ini telah dipilih mewakili kerosakan jalan yang banyak dijumpai di sekitar kawasan Batu Pahat melalui tinjauan tapak selama sebulan pada bulan Ogos, 2006. Enapan berlaku di bahagian kanan jalan yang berhampiran dengan parit. Hipotesis mekanisma kerosakan mungkin disebabkan ketidakcukupan ketebalan lapisan jalan dan ketidaksesuaian keadaan geometri jalan. Ujian tapak dan makmal telah dijalankan untuk menentusahkan hipotesis tadi. Kajian tapak dimulai dengan Ujian Tanpa Musnah (UTM) seperti *GPR* untuk menentukan ketebalan lapisan jalan dan meninjau keadaan bawah tanah. *MFWD* bagi menentukan modulus keanjalan dan yang terakhir adalah *DG* untuk mengukur ketumpatan. Kemudian, Ujian Musnah (UM) seperti *DCP* untuk menilai keadaan lapisan jalan dan juga menentukan ketebalan lapisan jalan. Selain itu, *coring* dan korekan dijalankan untuk mendapatkan sampel bagi ujian di makmal seterusnya. Dua kawasan telah dikorek; satu di kawasan yang mengalami kerosakan dan satu lagi di kawasan yang tiada berlaku kerosakan. Keputusan *MFWD* tidak memuaskan kerana nilainya sangat rendah. Perbezaan ketebalan lapisan jalan yang ditentukan melalui *GPR*, *DCP* dan korekan adalah kecil. Data-data yang diperolehi dari UTM, UM dan ujian makmal kemudiannya digunakan dalam analisis 2D *finite element* (Plaxis) dan *multilayer elastic* (Kenlayer). Dengan menggunakan perisian Plaxis dalam kajian ini, didapati punca sebenar kepada kerosakan adalah ketidaksesuaian rekabentuk geometri jalan iaitu kelebaran bahu jalan. Ini telah menyebabkan enapan berlaku lebih besar di kawasan laluan tayar kenderaan terutamanya yang terletak berhampiran dengan parit. Sementara itu, dari analisis Kenlayer telah menunjukkan perbezaan ketebalan lapisan jalan juga adalah penyumbang kepada enapan. Tesis ini juga ada membincangkan kesesuaian dan keberkesanan alat yang telah digunakan.

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LIST OF SYMBOLS

AC	Asphalt Concrete
ADT	Annual Daily Traffic
CBR	California Bearing Ratio
DCP	Dynamic Cone Penetrometer
DG	Density Gauge
DO	District Office
DT	Destructive Test
E	Modulus Elasticity
ESAL	Equivalent Standard Load
FWD	Falling Weight Deflectometer
GPR	Ground Penetrating Radar
KPRJ	Kumpulan Prasarana Rakyat Johor
NDT	Non-Destructive Test
PCC	Pozzolan Cement Concrete
PWD	Public Work Department

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APPENDIX	TITLE
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CHAPTER I

INTRODUCTION

1.1 Preamble

Maintenance as define by AASHTO is “the preservation and keeping of each type of road, roadway, roadside structure, and facility as nearly as possible in its original condition as constructed or as subsequently improved, and the operation of highway facilities and service provide satisfactory and safe transportation” (Oglesby and Hicks, 1982). In the event of structural failure, major rehabilitation works are needed. Some rehabilitation efforts failed and resulted in a very costly maintenance financing. In Malaysia, problems of rural road failures are very pertinent and seem unavoidable moreover when it’s constructed on soft ground. Undulating of road surfaces, longitudinal cracks and rutting, large potholes and sudden structural failure were several common failures for rural roads on soft ground condition in Malaysia (Masirin et al., 2005). It is either failed to sustain its design life or performed unsatisfactory during its service to the public thus creating a dangerous environment to road users who are likely to be involved in road accidents.