SOFTWARE DEVELOPMENT FOR FLEXIBLE PAVEMENT THICKNESS DESIGN BASED ON AASTHO AND ROAD NOTE 31

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ABSTRACT

Nowadays, road and surface failure has become a critical issue in our country on the flexible pavement which reflects to a bad quality and error during design stage. The thickness design of flexible pavement has become crucial element in the overall efficiency of highway structure system to give a good performance and high serviceability under a traffic loading during the expected design period. The objectives of this study are to develop flexible pavement thickness design software for AASHTO and Road Note 31 by using Visual Basic 6.0. The result comparison between both methods was carried out shown in different of thickness and different percentage of cost evaluations between AASHTO and Road Note 31. This computer software could produce the design thickness of each layer for flexible pavement structure in graphical layout for both design methods. Therefore, the users can easily analyze and compared the result obtained to select the best design alternative between AASHTO and Road Note 31 based on cost and thickness different. The result analysis obtained from this computer software also can be saved and view in a report file to be printed or keep as soft copy for reference in the future. Besides, the result analysis obtained by this computer software is also been compared with the manual calculation (theory) and shown that the computer software has the same and exact result with the manual calculation (theory). Thus, the performance of this computer software was successful tested and validated. Therefore, computer software of flexible pavement thickness design is a very useful tool in highway engineering especially to design the thickness of flexible pavement. By applying the computer program, the design stage can be made in a very short time period of design process and help to minimize the error factor compare to manual calculation or conventional method. Computer software also can give a high accuracy and quality of result for pavement thickness design.

ABSTRAK

Pada masa kini, kegagalan permukaan dan struktur turapan jalan boleh lentur telah menjadi isu yang semakin kritikal yang mungkin berpunca daripada hasil rekabentuk yang kurang berkualiti dan kesilapan dalam proses merekabentuk. Oleh itu, rekabentuk ketebalan jalan telah menjadi elemen yang penting untuk menentukan keberkesanan sistem struktur jalan untuk menanggung beban trafik yang tinggi di sepanjang tempoh perkhidmatannya. Objektif kajian bagi projek ini adalah untuk menghasilkan aplikasi komputer dengan menggunakan *Microsoft Visual Basic 6.0* bagi merekabentuk turapan boleh lentur berdasarkan kaedah AASHTO dan Road Note 31. Hasil keputusan rekabentuk ketebalan turapan bagi kedua-dua kaedah ini telah dibandingkan antara satu sama lain dalam bentuk peratusan dari segi perbezaan ketebalan dan juga penilaian kos pembinaan. Aplikasi komputer ini juga boleh menunjukkan hasil lapisan rekabentuk struktur turapan dalam bentuk grafik bagi kedua-dua kaedah yang telah dijalankan. Oleh itu, pengguna boleh menganalisa dan membuat perbandingan terhadap hasil keputusan yang dicapai dengan lebih mudah dan cepat untuk memilih alternative rekabentuk yang lebih bijak dan baik antara AASHTO dan Road Note 31 dari segi kos dan ketebalan turapan yang berbeza. Keputusan yang telah dianalisa daripada aplikasi komputer ini juga boleh disimpan dalam bentuk laporan file bagi tujuan dirujuk semula dan dicetak sebagai rujukan pada masa depan. Selain itu, keputusan aplikasi komputer ini juga telah dibandingkan dan didapati adalah sama dengan keputusan yang dikira secara manual. Oleh itu, telah terbukti bahawa aplikasi komputer ini telah berjaya diuji dan dijustifikasikan. Dengan ini, aplikasi komputer rekabentuk ketebalan turapan lentur adalah amat berguna dalam kejuruteraan jalan raya bagi merekabentuk turapan jalan dengan lebih mudah, menjimatkan masa dan tenaga serta membantu mengurangkan kesilapan manusia jika dibandingkan dengan kaedah lama iaitu pengiraan secara manual. Aplikasi komputer juga boleh mencapai ketepatan dan kejituan keputusan yang tinggi bagi menjamin kualiti rekabentuk turapan boleh lentur.

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CHAPTER 1

INTRODUCTION

1.1   Introduction

Rapid natural growth of road traffic has become a major concern of many highway departments worldwide. Therefore, the demand of road pavement construction has become importantly and critically to provide an enough road platform for the users from the time to time. Flexible pavement or known as hot mix asphalt has become a famous highway construction material in our country (Malaysia) in term of easy to assess the bitumen recourses from our oil and gas product and economic aspect if compare to the other expensive material such as rigid pavement. In general, flexible pavement is a relatively thin surface of Asphalt Concrete Pavement (ACP) over a base and sub-base resting on a sub-grade.

Nowadays, road and surface failure has become a critical issue in our country on the flexible pavement shown a bad quality and an error in the design stage. The thickness design of flexible pavement has become crucial element in the overall efficiency of highway structure system to give a good performance and high serviceability under a traffic loading during the expected design period.

The goal of pavement thickness design is to determine the number, material composition and thickness of the different layers within a pavement structure required to accommodate a given loading regime. This includes the surface course as well as any underlying base or subbase layers.

Nowadays, computer software applications are widely used and can be apply in design of flexible pavement thickness. Computer software can help to make the design process become easily, faster and high accuracy result can be obtain. By using the application of software in highway engineering, it can help the highway engineer or designer to provide a good design with a high confidences level without any error if compare to the manual calculation previously.

This study focuses on the development of a software application for flexible pavement thickness design base on AASHTO and Road Note 31 method by using Visual Basic 6.0. This software will be useful to run the design process with a high result accuracy obtained in order to provide a good quality of thickness design for flexible pavement and made comparison between both method to select the best design alternative in term of thickness and economic evaluation.

1.2   Problem Statements

Road and surface failure such as cracking, depression and pothole has become a critical issue in our country on the flexible pavement where it involves a very high maintenance cost every year. One of the reasons causing these failures happened is improper or error of pavement thickness design.

Currently, most of highway design departments or agencies were still practice the conventional method by referring the hardcopy of manual design guideline and calculation. Therefore, human factor in term of making mistake and error cannot fully avoid in their design. Besides, manual calculation design also considering a longer time period, energy and operating cost. A problem can be occur when an emergency or immediately highway project are needed to be proposed in a very short time of design period. Therefore, there was a need to use computer software to solve this problem to propose a faster and accurate design of work for any emergency project.

Besides, the design of pavement thickness can become complicated where it's involve many data, graphs and particular selection of properties for different type of layer and condition in pavement design stage. Therefore, there was a needed of computer software to help manage and store this data or information in the system for easily searching and use this data every time in the design stage by using computer software.

There is also less of this kind thickness design software technology currently for highway engineering in our country. Therefore, there was a need to develop a software specialist in pavement thickness design to replace the previous conventional and traditional method for an advance technology in highway engineering.

1.3   The Important of Study

Effective pavement design is one of the most important aspects in highway design. The pavement is the portion of the highway which is most obvious to the motorist. Therefore, the thickness of pavement are playing an important role to support all the traffic loading and its must be design accurately to avoid any failure of pavement structure.

Nowadays, computer software can help to make our life become easy especially in highway engineering to design the thickness of flexible pavement. By applying the computer program, the design stage can be made in a very short time period of design process. Beside, computer software can help to minimize the error factor compare to manual calculation or conventional method. Therefore, computer software can give a high accuracy and quality of result for pavement thickness design.

Visual Basic is Microsoft's high-level object-oriented rapid application development environment for the Windows platform. Visual Basic programmers make user friendly interfaces and easy to used when design the pavement thickness. The programmer then adds code to respond to user interactions with the controls to get the design result need. Beside, computer software (Visual Basic) also can act as an importance database system to store and install all the important data and properties from complicated table or chart translated into visual basic coding. Therefore, user can easily search for this kind of data and make selection option directly from the program software developed.

In conjunction to that, the result or report obtains from the software developed can be easily stored and recorded as softcopy in the system file or can be directly printed on the sport as a hard copy for evidence and future reference.

The purpose of software development in the field of highway are useful in design stage, analytical solving, the need to test, evaluate and demonstrate a proposed course of action before implementation, to make research, learn and train people. Confidence would be gained from the performance of the software developed and to be justified before the design is proposed.

Besides, the software developed also become useful for any relevant body or associations in highway engineering such as JKR and IKRAM, highway engineer and designer, university lecturers and students for their learning and practical, and local authority to approve any design of highway project.

Computer software is an integral part of everyday life, not only in the use of personal computers but also behind the scenes of every business transaction, engineering, research and studies. Therefore, by applying the computer software in thickness design of flexible pavement can give a significant function to avoid any wrong design that may cause failure of pavement and involve high maintenance cost in the future. Besides, it's also can save time, energy and builds up a high level of comfortable, confident and greater effort in term of pavement thickness design.

1.4 **Objectives of the Study**

The aim of the study is to develop a program model of flexible pavement thickness design by Road Note 31 and AASHTO Guide.

The objectives of this study are:

1. To develop a thickness design software of flexible pavement by using Visual Basic 6.0 programming language

2. Comparison between AASHTO and Road Note 31 method in term of thickness and economic evaluation to select the best design alternative.

1.5 **Scope of Study**

The scope of this study is mainly focus on the flexible pavement thickness design by using Road Note 31 and ASSTHO guideline. Furthermore, the computer software will be develop by using application of visual basic 6.0 for design interface, function or coding system and generate a report file for reference. Comparison were been made between AASHTO and Road Note 31 method in term of thickness and economic evaluation to select the best design alternative. Besides, the computer software to be develop also will be tested and verify with the theory and manual calculation comparison.

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