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FINITE ELEMENT MODEL APPROACH TO DETERMINE AN EFFECTIVE LAYOUT AND SUPPORT CONDITIONS FOR CONCRETE BLOCK PAVING

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THIS THESIS WAS SUBMITTED TO THE DEJ?ARTMENT OF CIVIL ENGINEERING OF THE UNIVERSITY OF MORATUWA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

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Abstract

There has been an intensive process of urbanization which has brought about need for rapid construction of roads and related infrastructure during the end of the last century. Therefore development of economical road construction methods is a high priority for a developing country like Sri Lanka. Concrete block paving is one of the predominant road construction method used in most of the developing counties due to economic adaptability. This method has also been emerged as a cost effective road construction method suitable for certain local conditions. But in Sri Lanka this technique is yet to be developed to a fully fledge road construction method. This can be attributed to a dearth of the technical expertise and knowledge. As a result, there is a great need to develop knowledge and establish proper methods of block paving suitable for local conditions. The aim of this research is to evaluate the state of support conditions and effective block laying patterns which can be used to improve concrete block paving technology.

Prototype concrete block paving model development, support conditions and their improvements were mainly considered in the development stage of this study. Laboratory scale prototype concrete block pavement model was developed and their surface deflection basin was measured with four different arrangements. A three dimensional (3-D) finite element model was developed to measure elastic deflection behavior of concrete block pavement ,with SAP2000 structural analysis software. This Finite Element Model (FEM) was used to simulate field conditions of a concrete block pavement and it was verified with the deflection values observed in the prototype model. The verified software model was used to perform a parametric study in order to determine necessary improvements for weaker support conditions and find effective laying arrangement in the concrete block paving.

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Developed design charts and field observations are used to propose subgrade improvement methods for weaker support conditions. Therefore it's recommended to

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introduce concrete block laying work for low volume roads which are having subgrade strength higher than 10% (CBR).

FEMs were developed to evaluate performance of the laying patterns. Four different block laying patterns were tested against breaking action and vertical loading. Finally it was possible to conclude that herring bond pattern is more suitable for road construction work with better performance.

DECLARATION

I, W.P.H. Gunaratha hereby declare that the content of this thesis is the output of original research work carried out over a period of 15 months at the Department of Civil Engineering, University of Moratuwa, Sri Lanka. Whenever others' work is included in this thesis, it is appropriately acknowledged as a reference.

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ACKNOWLEDGEMENT

I gratefully acknowledge my sincere gratitude to my supervisor, Dr. M.A. Wasantha Kumara, University of Moratuwa for giving me the opportunity to undertake this research study and providing valuable advice and support throughout the research study. I would like to acknowledge and appreciate the advice given by professor J.M.S.J Bandara, University of Moratuwa, coordinator of my research and Dr. H.L.D.M. A. Judith, Road Development Authority, Sri Lanka.

The support given by Prof.W.P.S. Dias (Head, Department of Civil Engineering), and Prof. S.A.S. Kulathilake (Research Coordinator, Department of Civil Engineering) is acknowledged gratefully. I thank all the other lecturers for the positive attitude they adopted in promoting research at Civil Engineering Department.

I owe a very special gratitude to research students at the Transportation Engineering Division of the Department of Civil Engineering University of Moratuwa for giving me the support throughout the research and Mr. A.A. Senadeera of Road Development Authority for providing material and equipments, which was nessary for the prototype model development.

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I would like to take this opportunity to extend my heartfelt appreciation to all the academic and non academic staff of the University of Moratuwa, who has assisted me in numerous occasions. Furthermore I would like to put on record the staff attached to Road Development Authority for their contributions in numerous ways.

W. P. H. Gunarathna

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