

**VALIDATION OF MECHANISTIC EMPIRICAL  
DESIGN APPROACH FOR PAVEMENT DESIGN –  
CASESTUDY FOR SRI LANKA**

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## **DECLARATION**

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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## **DEDICATION**

To  
My Loving Parents

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K.A. Ruksala Nishani Jayarathna

## ABSTRACT

Pavement design is a vital part in new road construction and rehabilitation of roads. American Association of State Highway and Transportation Officials (AASHTO) pavement design guideline and Transport Research Laboratory (U.K) Road Note 31 (TRL RN-31) guideline are widely used for designing road pavements by most of the road agencies. Both these design guidelines are empirical guidelines and based on empirical formulas developed from experimental studies conducted in extreme weather conditions. In recognition of the potential of analysing pavements and predicting their performance, pavement design agencies have been encouraging the movement towards mechanistic empirical pavement design methods. Performance models used for the empirical pavement designs are basically derived from experiments which are conducted in controlled laboratory conditions. So it should be validated before utilising for the road pavement designs. The aim of the research was to check the applicability of Mechanistic Empirical (M-E) models developed by Austroad guide for tropical climatic conditions prevails in Sri Lankan roads. The computer program CIRCLY which is based on Austroad guide was used for the analysis. Cumulative Damage Factor (CDF) given by the computer program was compared with the in service pavement condition. Pavement Condition Index (PCI) was used to represent the pavement condition. PCI values were calculated only for structural based distresses as assessed by type, severity and density according to the *ASTM method*. CDF values obtained from CIRCLY were verified with the PCI values obtained from the pavement condition. Since PCI and CDF have a good relationship, CIRCLY software which is based on Austroad pavement design guideline could be introduced as a good analytical tool for designing road pavements in tropical climatic conditions. Then the research was focused on evaluating the suitability of a mechanistic empirical pavement design tool CIRCLY to investigate a pavement failure. In this study, failure of a non-structural surface road which is failed immediately after completing the construction was selected for the analysis. This road was designed according to the Overseas Road Note 31(ORN 31) and designed with a non-structural surface type, Double Bitumen Surface Treatment (DBST). Soil samples collected from critically damaged locations were tested. Results showed that the inadequate strength of the sub base layer as the reason to the failure. Failure investigations were done using a mechanistic tool CIRCLY and reliable reclamation method was proposed.

Key words: Mechanistic Empirical pavement design, CIRCLY computer program, Pavement Condition Index (PCI), Failure analysis

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## LIST OF ABBREVIATIONS

| <b>Abbreviation</b> | <b>Description</b>   |
|---------------------|--|
| AASHTO              | American Association of State Highway and Transportation Officials |
| ABC                 | Aggregate Base Course  |
| AC                  | Asphalt Concrete   |
| CBR                 | California Bearing Ratio   |
| CDF                 | Cumulative Damage Ratio  |
| CESAL               | Cumulative Equivalent Standard Axle Load                           |
| CNSA                | Cumulative Number of Standard Axles                                |
| DBST                | Double Bitumen Surface Treatment                                   |
| DESA                | Design Equivalent Standard Axles                                   |
| ESAL                | Equivalent Standard Axle Load                                      |
| M-E                 | Mechanistic-Empirical  |
| MEPDG               | Mechanistic Empirical Pavement Design Guide                        |
| PCI                 | Pavement Condition Index   |
| RF                  | Reliability Factor   |
| SAR                 | Standard Axle Repetitions  |
| ITT                 | Indirect Tensile Test  |
| TRL Road Note 31    | Transport Research Laboratory Road Note 31                         |
| WMAPT               | Weighted Mean Annual Pavement Temperature                          |

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