ABSTRACT

The thesis focuses on applying a Mechanistic-Empirical (M-E) approach to enhance the design of flexible pavement, primarily dealing with compacted subgrade layers and developing models for determining layer thickness for optimized performance. Using stress and strain criteria, it evaluates the thickness of compacted subgrade on top of a weaker natural subgrade based on load repetitions and subgrade strength, applying standards like IRC-37:2018.

The thesis extends into a two-layer subgrade model using Boussinesq's method, suggesting modifications for IRC/MORD's prescribed thickness. It also develops a stress-based Mechanistic-Empirical model for granular layer thickness in low-volume road pavements, achieving close alignment with existing guidelines.

Using Odemark's method, the study calculates radial tensile and vertical compressive strain limits as per IRC-37:2018, determining layer thickness for various axle loads. Findings show that granular layer thickness significantly affects rutting.

For perpetual pavements, a strain-based model sets thickness criteria based on fatigue and rutting limits, identifying fatigue failure as critical. Bituminous overlays are designed using stress and deflection control for existing flexible pavements, with comparative analysis showing reliable performance using stress-based methods. A Base Layer Index (BLI) is introduced to assess overlay curvature under loads.

Sensitivity analysis highlights bituminous layer modulus as critical in determining overlay thickness. The study examines overloading impacts, emphasizing its role in shortening overlay life. Residual life estimation methods for flexible pavements based on surface deflection, CBR, and axle load repetitions are proposed, demonstrating their significance in predicting maintenance needs.

Finally, algorithms using Python, Mathematica, and Java create user-friendly GUIs for pavement and overlay design.

Keywords: Compacted/Natural Subgrade, Mechanistic-Empirical design, Overlay thickness, Odemark’s Method.