Title of Thesis: **Total Pages：181**

Development of Performance Prediction Models for Rigid Pavements Using LTPP Database

Name of Institute：Department of Civil Engineering, Tamkang University

Graduate date：January, 2007 **Degree Conferred**：Master of Science

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Abstract

Performance predictive models have been used in various pavement design, evaluation, rehabilitation, and network management activities. As pavement design evolves from traditional empirically based methods toward mechanistic-empirical, the equivalent single axle load (ESAL) concept used for traffic loads estimation is no longer adopted in the recommended Mechanistic-Empirical Pavement Design Guide. The success of the new design guide considerably depends upon the accuracy of pavement performance predictions. Thus, this study will first investigate its goodness of fit and strive to develop improved performance prediction models for rigid pavements using the Long-Term Pavement Performance (LTPP) database (http://www.datapave.com or LTPP DataPave Online).

Exploratory data analysis (EDA) of the response variables indicated that the normality assumption with random errors and constant variance using conventional regression techniques might not be appropriate for prediction modeling. Therefore, without assuming the error distribution of the response variable, generalized linear model (GLM) and general additive model (GAM) along with quasi-likelihood estimation method and Poisson distribution were adopted in the subsequent analysis. Box-Cox power transformation technique, visual graphical techniques, as well as the systematic statistical and engineering approach proposed by Lee were frequently adopted during the prediction modeling process.

By keeping only those parameters with significant effects and reasonable physical interpretations in the model, various tentative performance prediction models were developed. The goodness of the model fit was further examined through the significant testing and various sensitivity analyses of pertinent explanatory parameters. The tentatively proposed predictive models appeared to reasonably agree with the pavement performance data with the exception of spalling models, although their further enhancements are possible and recommended.

Keywords：Rigid Pavement, Faulting, Cracking, Spalling (or Joint Deterioration), LTPP, Performance, Prediction Model.