

## ABSTRACT

Ahmed, Anwaar. Ph.D., Purdue University, May, 2011. Pavement Damage Cost Estimation using Highway Agency Maintenance, Rehabilitation and Reconstruction Strategies. Major Professor: Samuel Labi.

Highway agencies continue to face increased needs for funding the maintenance, rehabilitation and reconstruction (MR&R) of their existing and planned highway infrastructure. This situation is exacerbated by growing travel demand, aging infrastructure, and higher user expectations. In order to generate funds for MR&R, highway agencies utilize various mechanisms for charging highway users. For user fees to be efficient and equitable, they must reflect appropriately, the share of damage occasioned by each user class. Past studies that have estimated such user costs in the specific context of highway pavements were plagued with a number of debilitating limitations ranging from lack of appropriate data, unrealistic assumptions, simplistic approaches, and inadequate consideration of influential criteria.

Following an explicit and documented recognition and discussion of these limitations, this dissertation introduced a more comprehensive and rational framework for generating key data from which such user costs can be determined. The framework calculates the cost of marginal pavement damage per highway user by relating the highway agency expenditure (associated with the maintenance, rehabilitation and reconstruction strategies) to the levels of highway use or loading. The dissertation prepared the relevant inputs for the framework, including an establishment of pavement families; identification of MR&R treatment types; development of MR&R strategies (treatment timings); traffic projections; and performance predictions. Using the developed MR&R strategies, the marginal pavement damage cost was estimated for pavement segments with different age, surface type and functional class. In assessing the consequences of the limitations of past studies, the dissertation assessed the impact, on the unit pavement cost, of excluding a specific cost category, non-consideration of non-truck traffic, and mischaracterizations of the pavement damage and load relationship. The dissertation also utilized random-parameter econometric models to quantify the variation of marginal pavement damage costs across individual roadway segments. The framework developed in this dissertation can be used by highway agencies to establish or update road user charges for their highway networks comprehensively and equitably.