

Deterioration Prediction of Pavement Load Bearing Capacity from FWD Data

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Abstract : Expressways in Japan have been built in an accelerating manner since the 1960s with the aid of rapid economic growth. About 40 percent in length of expressways in Japan is now 30 years and older and has become superannuated. Time-related deterioration has therefore reached to a degree that administrators, from a standpoint of operation and maintenance, are forced to take prompt measures on a large scale aiming at repairing inner damage deep in pavements. These measures have already been performed for bridge management in Japan and are also expected to be embodied for pavement management. Thus, planning methods for the measures are increasingly demanded. Deterioration of layers around road surface such as surface course and binder course is brought about at the early stages of whole pavement deterioration process, around 10 to 30 years after construction. These layers have been repaired primarily because inner damage usually becomes significant after outer damage, and because surveys for measuring inner damage such as Falling Weight Deflectometer (FWD) survey and open-cut survey are costly and time-consuming process, which has made it difficult for administrators to focus on inner damage as much as they have been supposed to. As expressways today have serious time-related deterioration within them deriving from the long time span since they started to be used, it is obvious the idea of repairing layers deep in pavements such as base course and subgrade must be taken into consideration when planning maintenance on a large scale. This sort of maintenance requires precisely predicting degrees of deterioration as well as grasping the present situations of pavements. Methods for predicting deterioration are determined to be either mechanical or statistical. While few mechanical models have been presented, as far as the authors know of, previous studies have presented statistical methods for predicting deterioration in pavements. One describes deterioration process by estimating Markov deterioration hazard model, while another study illustrates it by estimating Proportional deterioration hazard model. Both of the studies analyze deflection data obtained from FWD surveys and present statistical methods for predicting deterioration process of layers around road surface. However, layers of base course and subgrade remain unanalyzed. In this study, data collected from FWD surveys are analyzed to predict deterioration process of layers deep in pavements in addition to surface layers by a means of estimating a deterioration hazard model using continuous indexes. This model can prevent the loss of information of data when setting rating categories in Markov deterioration hazard model when evaluating degrees of deterioration in roadbeds and subgrades. As a result of portraying continuous indexes, the model can predict deterioration in each layer of pavements and evaluate it quantitatively. Additionally, as the model can also depict probability distribution of the indexes at an arbitrary point and establish a risk control level arbitrarily, it is expected that this study will provide knowledge like life cycle cost and informative content during decision making process referring to where to do maintenance on as well as when.

Keywords : deterioration hazard model, falling weight deflectometer, inner damage, load bearing capacity, pavement

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