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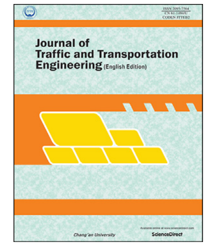

Original Research Paper

Prediction of performance and evaluation of flexible pavement rehabilitation strategies

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HIGHLIGHTS

- A test section is established with five full depth reclamation (FDR) strategies.
- Five FDR strategies (control, calcium chloride, Portland cement, asphalt emulsion, and geogrid) are introduced.
- Prediction of FDR performance is made by using AASHTOWare Pavement ME Design (Pavement ME).
- Evaluation of FDR performance is made with different additives and strategies.
- Portland cement appears to be the best based on limited prediction and evaluation.

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ABSTRACT

Five test sections with different additives and strategies were established to rehabilitate a State-maintained highway more effectively in Rhode Island (RI): control, calcium chloride, asphalt emulsion, Portland cement and geogrid. Resilient moduli of subgrade soils and subbase materials before and after full depth rehabilitation were employed as input parameters to predict the performance of pavement structures using AASHTOWare Pavement ME Design (Pavement ME) software in terms of rutting, cracking and roughness. It was attempted to use Level 1 input (which includes traffic full spectrum data, climate data and structural layer properties) for Pavement ME. Traffic data was obtained from a Weigh-in-Motion (WIM) instrument and Providence station was used for collecting climatic data. Volumetric properties, dynamic modulus and creep compliance were used as input parameters for 19 mm (0.75 in.) warm mix asphalt (WMA) base and 12.5 mm (0.5 in.) WMA surface layer. The results indicated that all test sections observed AC top-down (longitudinal) cracking except Portland cement section which passed for all criteria. The order in terms of performance (best to worst) for all test sections by Pavement ME was Portland cement, calcium chloride, control, geogrid, and asphalt emulsion. It was also observed that all test sections passed for both bottom up and top down fatigue cracking by increasing thickness of either of the two top asphalt layers. Test sections with five different base/subbase materials were evaluated in last two years through visual condition survey and measurements of deflection and roughness to confirm the prediction, but there was no serious distress and roughness. Thus these experiments allowed selecting the best rehabilitation/reconstruction techniques for the particular and/or similar highway, and a framework was formulated to select an optimal technique and/or strategy for future

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rehabilitation/reconstruction projects. Finally, guidelines for long-term evaluation were developed to verify short-term prediction and performance.

1. Introduction

It has been estimated that the amount of miles of truck traffic on our highways will be increasing and surpassing all other modes of freight shipments in the near future. Tractor trailers and heavy vehicles account for a majority of the damage on highways (Lee and Peckham, 1990). The States, especially Rhode Island (RI), are having a hard time keeping up with and paying for maintenance and rehabilitation (M & R). This means there will be more wear on our highways than ever before, and the States will have to do more M & R with less funding. To meet upcoming highway demand, the Rhode Island Department of Transportation (RIDOT) has been testing alternative subbase materials as reclamation strategies, and has been expanding their use. To meet up best rehabilitation strategy/technique for a pavement, it is necessary to predict its performance over a certain number of years.

In the 1980's, RIDOT had a program to reclaim pavements throughout the State. The reclamation of the roads restored bearing capacity that has been lost over the years of use. Route 165 was one of the roads and was programmed to be re-reclaimed using four different strategies and a control in 2013 as shown in Fig. 1.

1.1. *Significance of study*

Asphalt or flexible pavements are usually designed for 20 years' usage, and generally consist of four layers (i.e., subgrade soils, granular subbase, granular or asphalt base, and asphalt surface). With the pass of time the top asphalt surface of pavement deteriorates quickly due to heavy truck traffic, if not properly designed, and end up having different kinds of asphalt distresses, e.g., rutting, fatigue cracking, thermal cracking, and roughness. To maintain and rehabilitate pavement, there should be a solution or strategy to meet up the 20 years of designed life. RIDOT used different rehabilitation strategies in the past for M & R, such as use of reclaimed asphalt pavement (RAP), reclamation, subbase stabilization, and geo reinforcement etc. In the present study, different types of reclamation and subbase stabilization strategies used on RI Highway (i.e., Route 165 in Exeter) were focused.

Fig. 1 – A view of Route 165 before rehabilitation in 2013.

1.2. *Background and history*

Route 165 was last reconstructed in 1986. The roadway was reclaimed to a depth of five inches (5 in.) and mixed with calcium chloride. The pavement thickness, after resurfacing, was one and a half inches (1.5 in.) of bituminous surface course and two and a half inches (2.5 in.) of bituminous modified type binder course over a five inches (5 in.) cold recycled base layer mixed with a ratio of 1:2 bituminous pavement/gravel and eight inches (8 in.) of existing gravel subbase layer (Fig. 2).

A geotechnical engineering exploration and analysis were conducted for the request of RIDOT by V.A. Nacci and associates, soil and foundation consulting engineers (Nacci, 1987). It may be noted that, Route 165 was originally built on soft deposits (swamp). Depending on the nature of the soft deposit, original construction dealt with this in one of two ways: one was by removal of the unsuitable material and the other was by floating the embankment on the soft soil, often with considerable settlement (Nacci, 1987). Eleven tests were completed for the reconstruction, which found embankments consisting of sand, some gravel, silt, fibrous organic deposits (peat), and organic silt (USDA, 1981). Other tests indicated that Route 165 was built on glacial till and stratified kame deposits (RIDOT, 2013). There were pockets in the granite bedrock near the surface, which contributed to a high water table. An exploration and analysis found

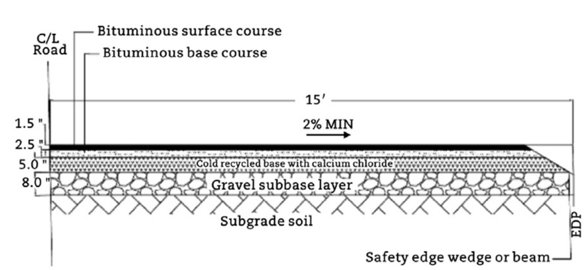

Fig. 2 – Cross section of Route 165 after rehabilitation in 1986.