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Executive Summary Report

EVALUATION OF RUBBLIZATION PROJECTS IN OHIO

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Project Background

Concrete pavements are highly susceptible to variations in temperature. During summer months, the concrete pavements expand and, contract during winter months. Such movements, particularly at the joints in concrete pavements during winter months, exert tremendous strain on the overlying asphalt concrete (AC) layer. When the strain exerted exceeds what the AC layer can absorb, a crack develops in the AC layer at the interface of concrete pavement. With time, the crack in the AC layer propagates to the surface. These cracks, termed reflection cracking -- which begin as a pattern of narrow, difficult-to-seal cracks that mirror the joints and cracks in the underlying concrete pavement – permit water to enter the pavement, triggering early deterioration of the overlay, increase in life-cycle costs and a reduction in the useful life of the pavement. Rubblization and Roll (R/R) is one of the widely used methods by various state agencies in the US for the rehabilitation of existing concrete and composite pavements. R/R involves breaking exposed concrete pavement into small fragments using heavy duty pavement breakers and rolling the fragments using a heavy duty roller. The rubblized material is transformed into crushed based layer and covered by an AC overlay. Theory suggests that, this procedure minimizes movements in concrete slabs and thereby reduce the chance of occurrence of reflection cracking. A successful R/R can result in improved overall pavement performance, increased life of pavements, reduced maintenance needs and lower life-cycle costs. Realizing the potential benefits of R/R as a technique for rehabilitation of in-service concrete and composite pavements, ODOT has constructed 27 projects since 1988. Performance of constructed pavements is generally good. However, it has been observed that many factors such as type and condition of concrete slabs, type and condition of underlying materials, type of breaker and so on can contribute to variations in performance. A thorough understanding of the role these factors play in the performance of pavements is essential in successful application of R/R technique in the future. This study is an attempt to systematically analyze the performance characteristics of ODOT's completed R/R projects and to develop guidelines regarding improved specifications.

Study Objectives

The objectives of the study are to: (i) conduct a comprehensive assessment of the performance of ODOT's R/R projects, (ii) evaluate the influence of pavement breakers, (iii) review R/R practices in other states, (iv) review specification regarding subgrade characteristics for the selection of candidate projects for R/R,

Description of Work

The study was conducted in three parts namely, (i) performance evaluation of Ohio's R/R projects, (ii) overview of national perspective, and (iii) field demonstration of pavement breakers. The Pavement condition Rating (PCR) data

was processed to objectively analyze the effectiveness of rubblization on the functional condition of the constructed pavements. The Falling Weight Deflectometer (FWD) data was analyzed to compare the structural conditions of the R/R pavements. Data was collected from other state DOTs to register the performance of their R/R pavements and to learn of their experience with R/R projects. Finally, a 1-day field demonstration of rubblization was conducted to demonstrate the capabilities of pavement breakers operating in Ohio to rubblize under identical conditions. This task was of particular value to verify the compliance of pavement breakers with ODOT specification 320.

Research Findings & Conclusions

The study led to the following primary conclusions:

- R/R is an effective concrete and composite pavement rehabilitation technique. Results show an overall improvement in pavement performance.
- The performance period of surface layer of R/R pavements is estimated to be 11.7 years.
- The application of preventive maintenance treatment, depending on the type used in Ohio, extends the performance period of the constructed pavement; thereby implying consecutive application of PM treatments will result in R/R pavements achieving or exceeding a design life of 20 years.
- Rubblization contributes to significant changes in structural condition; the process transforms the rigid concrete layer into a flexible base.
- Lately, there are several variants of MHB. ODOT should change the equipment specification to allow other variants of MHBs.
- There is no adequate data available to relate fragment size to performance. However, based on the data from the demonstration study, it is inferred that ODOT should change the fragment specification to allow up to 12" fragments.
- ODOT's quality control/quality assurance procedure requires digging a test pit at the beginning of the project to investigate the size and shape of fragments. This procedure is not consistently applied in all projects. ODOT would benefit by adopting a more stringent QC/QA procedure.
- It is important to revise ODOT's policy regarding the criteria for the selection of candidate projects for rubblization and validate the threshold value established.

Implementation Recommendations

The following changes to specifications are proposed:

- Item 320.03: Remove '*….mounted laterally in pairs with half the hammers in a forward row and the remainder diagonally offset in a rear row*', so as to allow other variants of MHB.
- Item 320.04: Modify the construction details as described to allow larger particles. *Adjust the rubblizing procedure to maintain the proper particle sizes. Control the speed of the rubblizing equipment such that: (i) 100% of the rubblized particles above the reinforcing steel is reduced to 1 to 2" in size, (ii) 90% of the rubblized particles below the reinforcing steel will not exceed 9" in their largest dimension, and (iii) no particles under the steel will exceed 12" in their largest dimension.*
- Item 320.04: Include the following in construction details so as to institute improved QC/QA procedure. *Rubblize the test section according to this specification. After rubblizing about 300', the Engineer will designate a location within the 300'. Excavate a test pit to check for particle size through the thickness of the concrete. Additionally, check the particle sizes on the surface, approximately within 50' on either side of the test pit. Using a standard digital camera with at least 1 MB resolution, take vertically downward images of particles in the test pit and at two locations outside the test pit within 50'. Use a fragmentation software generate a particle distribution curve. Following this, take digital images of the surface at every 1000' intervals and analyze the particle sizes using the fragmentation software. Make test pits as and when necessary, such as change in subgrade soil, change in moisture condition. At least one test pit should be made for each production day or 7040 SY whichever is greater.*
- GB 1: Revise the specification as follows. *Rubblize and Roll rehabilitation technique is not an option when the minimum NL value for the subgrade soil is below 10.*