



The Ohio Department of Transportation Office of Research & Development Executive Summary Report

Investigation of Pavement Cracking on SR-4 and Demonstration of Multi-Head Breaker in Fracturing Reinforced PCC Pavements Before AC Overlay

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Problem:

A. Need for Follow-up Evaluation of the SR-4 Project

In 1993, ODOT constructed test sections on State Route 4 (SR-4) to study the effectiveness of Breaking and Seating (B/S) as a rehabilitation strategy for retarding reflection cracking in asphalt overlays of jointed reinforced concrete pavements. After nine years service, the break and seat test sections displayed relatively few reflection cracks. In 2004, however, a significant number of transverse cracks were observed to have occurred directly over the underlying joints in the concrete layer. To determine the implications of this recent cracking on the expected performance and maintenance requirements of future break and seat projects, an in-depth forensic analysis of the nature and mechanism of the cracking was needed.

B. Need for Comparative Assessment of Alternative Pavement Breaking Equipment

The pavement breaking operation on the SR-4 project was performed with a pile hammer. Several other types of pavement breakers are now available, including the Multi-Head Breaker (MHB) and Resonant Pavement Breaker (RPB). Performance claims for this competitive equipment include increased production rates and the ability to produce a variety of controlled breaking patterns (hence, permitting pre-overlay fracturing techniques to be used on distressed concrete pavements). To permit ODOT to evaluate the merits of these performance claims—and thus to provide for more informed, cost-effective decisions regarding the type(s) of equipment permitted to be used on future concrete pavement rehabilitation projects--the evaluation of the SR-4 project needed to be expanded to include a comparable assessment of projects constructed with the MHB and RPB equipment.

Objectives:

This evaluation had three basic objectives:

- To determine the cause of the recent cracking on the SR-4 project, and the implications on the performance of future break and seat projects.
- To determine the extent to which the pile hammer, MHB, and RPB equipment consistently produce the pavement breaking patterns and fractured particle sizes required by ODOT specifications.
- To compare the features of the three types of breaking equipment with respect to other factors bearing on the issue of cost-effectiveness (e.g., achievable production rates, unit construction cost, particle shape, etc).

Description:

To accomplish these objectives, a program of field evaluations was undertaken on the SR-4 project and three other test projects. On two of the latter projects (I-70 in Madison County and I-71 in Fayette County), the MHB equipment was used to break the pavement; on the third project (SR-36 in Coshocton County), the RPB equipment was used.



At each test site, a test pit was dug and a visual assessment of the condition of the fractured pavement overlay and subbase/subgrade was made. Measurements were made of the fracturing pattern at the surface of the concrete and gradation tests were performed to determine the particle size distribution at various depths within the fractured slab. On the MHB and RPB projects, deflection tests were performed to determine the effect of the observed breaking patterns on the stiffness of the pavement layers.



To complement the field observations made on ODOT projects, the researchers met with staff of the Arkansas DOT to discuss their experience with the MHB and RPB equipment gained as part of a monumental (\$1.3 billion, 360 centerline mile) five-year concrete pavement rehabilitation program now nearing completion in that state.

Conclusions & Recommendations:

- Examination of test pit material indicated that the pile hammer used in constructing the B/S sections on the SR-4 project did not provide the vertical through cracking and steel debonding required by the project specifications. Despite this, the overlay on the B/S section provided vastly superior reflection crack performance than the untreated control section. Thus, break and seat still appears to be a viable, cost-effective technique for retarding reflection cracks in overlays of Ohio's jointed reinforced concrete pavement.
- The MHB equipment generally appears capable of consistently providing the breaking patterns and particle sizes required for B/S projects. Use of the MHB on ODOT rubblization projects is more problematic: in the studied sample of projects, not all contractors using this equipment provided the desired results. A more extensive sampling is thus required to definitively establish the suitability of the MHB equipment for rubblization.
- The RPB equipment appears capable of providing the fractured particle size distribution and steel debonding required by ODOT specifications. However, on the COS-36 project, meeting those specifications *retarded*-- but did not *prevent*--the subsequent occurrence of reflection cracking. A more extensive sampling is thus required to assess the adequacy of the current rubblize specifications.
- Improvements in ODOT's specifications for fractured slab techniques are needed. On all types of fracturing projects, the quality control requirements need to be modified to require that test pits be more frequently used to ensure that the specified particle size distributions are in fact being achieved throughout the depth of the slab. On rubblize projects, the present particle size distribution requirements need to be re-examined to ensure that the fracturing operation will avoid, not merely delay, reflection cracking in the subsequent overlay.

Implementation Potential:

- Needed specification changes to provide improved quality assurance on fractured slab projects can be achieved on a near-term basis with a low level of effort. Determining the specifics of any needed changes in the particle size distribution requirements of the rubblization specification will require further, in-depth research.
- A definitive determination of the suitability of the MHB equipment for use on ODOT rubblize projects will require further research.