Research Report
KTC-89-35

FEDERAL AID RESEARCH TASK NO. 28
PAVEMENT FAILURES: I-71
OLDHAM - HENRY COUNTIES
EACIR 71-1(64)22

by

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in cooperation with the
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and

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US Department of Transportation

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16. Abstract

Breaking and Seating has been used extensively to rehabilitate portland cement concrete pavements. In areas where specific vertical tolerances must be maintained, several methods have been used - - tapering of the asphaltic overlay, removal of the portland cement concrete replaced by full depth asphaltic concrete, or milling of the existing pavement and reducing the asphaltic concrete overlay.

Research Report UKTRP-87-26, "Breaking and Seating of Rigid Pavements" was prepared as a final report for three studies and as an interim report for Federal Aid Research Task No. 28 and two other studies. This report serves to finalize Federal Aid Research Task No. 28

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Federal Aid Research Task No. 28
Pavement Failures: I-71
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Sections of I-71 in Oldham and Henry Counties were broken and seated and overlaid with asphaltic concrete in 1984. During rehabilitation and prior to overlaying with asphaltic concrete, the existing portland cement concrete was milled to various depths in the vicinities of several underpasses. In conjunction with milling of the existing PCC pavement, 2.25 inches of asphaltic concrete base was omitted from the total thickness in order to maintain sufficient vertical clearances beneath the underpasses.

The following table contains the locations of the failures along with the milled PCC thickness, reduced AC thickness, and thicknesses of the typical section.

Site	Thickness (in.) AC	PCC (broken)	DGA
At Ky 53 Underpass Northbound Lanes	5	9	6
At Ky 53 Underpass Southbound Lanes	5	10	6
At Mt. Olive Rd. Underpass Northbound Lanes (only)	5	8	6
At US 421 Underpass Northbound Lanes (only)	5	10	6
Typical Structural Section	7.25	10	6

Pavement base and subgrade failures were observed in these areas soon after completion of rehabilitation activities. Kentucky Transportation Center personnel were requested to investigate these failures.

A detailed crack survey was conducted for all broken and seated sections of I-71 in April 1985. Deflection measurements were obtained throughout the broken and seated sections during October 1985.

Results of the crack survey indicated reflective cracking of the asphaltic concrete pavement had occurred in the vicinity of bridge approaches where the PCC pavement had not been broken and seated. Due to the absence of significant reflective cracking at the locations of failure, it was concluded that the thinned PCC pavement had been broken and seated. Deflection measurements also indicated that the thinned PCC pavement had been broken and seated.

At the time of the crack survey and deflection testing, the only area to show any signs of distress was the underpass at Mt. Olive Rd. There was extensive cracking in the outside wheel path and magnitudes of the deflections were double the deflections encountered in the normal section.

The effective modulus of broken PCC pavement is a function of particle size, as reported in UKTRP Research Report 87-26. These values range from 100,000 psi for totally crushed material, to approximately 1,000,000 psi for 30-to 36-inch pieces. A median value of 500,000 psi was used for the following strain analysis.

The strain level at the top of the subgrade for the typical field section, along with the strain level for each reduced section, is as follows. The following parameters were used for this analysis:

18,000-lb. Axleload (4 tires)
Asphaltic Concrete Modulus = 480,000 psi, Poisson's Ratio = 0.40
Broken PCC Modulus = 500,000 psi, Poisson's Ratio = 0.2
DGA Modulus = 15,800 psi, Poisson's Ratio = 0.40
Subgrade Modulus = 4,500 psi, 3000 psi, 1500 psi,
Poisson's Ratio = 0.45

Vertical Strain (in./in. x 10^{-4})

Type of Section	Subgrade CBR 1	2	3
Typical Field Section 7.25" AC/10" PCC (broken)/6" DGA	-2.59	-1.92	-1.60
Reduced Field Sections			
5" AC/10" PCC (broken)/6" DGA	-3.15	-2.31	-1.92
5" AC/9" PCC (broken)/6" DGA	-3.47	-2.54	-2.11
5" AC/8" PCC (broken)/6" DGA	-3.86	-2.81	-2.34

Using the relation presented in Report 305 the ESAL repetitions to failure, for a given level of strain, may be determined. The repetitions to failure for each section are listed below. In 1985, this section was accumulating 862,500 ESAL's per year. With this current rate of accumulation and the number of repetitions associated with each strain level, the life of the pavement may be calculated. The number of repetitions to failure for each section are listed below. The expected life of the pavement in years is shown in parentheses.

Number of ESAL Repetitions ($x10^6$)

Type of Section	Subgrade CBR		
	1	2	3
Typical Field Section 7.25" AC/10" PCC (broken)/6" DGA	6 (6.9)	20 (23)	32 (37)
Reduced Field Sections			
5" AC/10" PCC (broken)/6" DGA	2.3 (2.7)	10 (11.6)	19 (22)
5" AC/9" PCC (broken)/6" DGA	1.3 (1.5)	6.5 (7.5)	15 (17)
5" AC/8" PCC (broken)/6" DGA	.8 (.93)	4 (4.6)	10 (11.6)

It may be seen from the analysis that for a weaker subgrade, the reduced sections will reach a condition of failure in a shorter period due to the accumulation of EASL's. Failure was most probably due to a combination of insufficient subgrade support along with the reduced structural thickness of the sections.