An Evaluation of Pavement Drainage Interstate 64, Rowan-Carter Counties

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AN EVALUATION OF PAVEMENT DRAINAGE
INTERSTATE 64, ROWAN-CARTER COUNTIES

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and
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INTRODUCTION

Problems encountered on three resurfacing projects on Interstate 64 in Rowan-Carter Counties (FRI 64-7(28), FRI 64-7(29), and FRI 64-8(48)) are reported. These projects were completed on July 23, 1983. The final inspection report, dated August 9, 1983, indicated problems were already appearing in the pavement surface. Also, during construction, a change order was issued (No. 4) that permitted additional tonnage of bituminous concrete base to be used in replacing portions of the original pavement that had disintegrated, possibly due to water collecting on the subgrade. On August 18, 1983, the FHWA requested, by letter, that the Kentucky Department of Highways investigate problems occurring on those projects.

During the winter of 1983-1984, potholes began to appear. Most appeared to have been caused by water in the pavement layers. Also, most of those potholes appeared to be concentrated toward the western end of the projects.

The Division of Materials conducted an in-depth investigation of the pavement mixture and concluded the mixture appeared to be within specification limits. On March 26, 1984, the Kentucky Transportation Research Program was asked to study the geology and geometrics of this section of highway and recommend the location and type of a pavement drainage system as a possible remedial measure. This report addresses only the drainage problems of these projects and does not address other problems associated with the
bituminous mixture.

GEOLOGY

One terminus of these projects is at the western edge of the Soldier geologic quadrangle; the projects extend through the Grahn, Olive Hill, Grayson, and Rush quadrangles, respectively. In the western half of the Soldier Quadrangle (Figure 1), the I64 centerline is located largely along the sandstone and conglomerate ridgetops of the lower portion of the Breathitt Formation. In the eastern half of the quadrangle, I64 crosses Fleming Fork, Flat Fork, and Reeves Branch of Tygarts Creek.

After crossing Smith Run of Tygarts Creek in the western portion of the Olive Hill Quadrangle (Figure 2), I64 again crosses a ridge comprised of the lower portion of the Breathitt and Lee Formations. For the remainder of the Olive Hill quadrangle, the highway hugs the north slope of the valley created by Trough Camp Creek. In that area, the highway is in the Newman Limestone Formation and the Nada and Cowbell Members of the Upper Borden Formation. In the eastern extreme of the Olive Hill quadrangle, I64 skirts another ridge of the lower portion of the Breathitt and Lee Formations.

In the western half of the Grahn quadrangle (Figure 3), I64 generally is located in sandstones, shales, and underclays of the middle portion of the Breathitt Formation.
In the eastern half of the quadrangle, the highway is located on the north slope of the Davis Fork Valley. In that area, the highway again intersects the lower portions of the Breathitt and Lee Formations. In the extreme eastern portion of the Grahn quadrangle, the highway is located in the floodplain of Barrett Creek.

In the western two-thirds of the Grayson quadrangle (Figure 4), I-64 continues to traverse in the floodplains of Barrett Creek and Little Sandy River. In the eastern third of the quadrangle, I-64 again intersects ridges of the lower portion of the Breathitt and Lee Formations.

At the eastern end of the project (Rush quadrangle, Figure 5), I-64 generally is located in the flood plains of Wilson Creek and Mile Branch. However, near the center of the quadrangle, the highway traverses ridges comprised of the Breathitt Formation.

Bedding in the project area generally dip from west to east. However, in some localized areas, the beds dip from northwest to southeast.

VISUAL OBSERVATIONS

Two inspections were made of the project, and a photolog was made of the geology and areas of water damage. It was noted that most water damage occurred in cuts and downgrade from those cuts in transitions from cut to fill. Because bedding planes dipped to the east, seepage zones usually
were observed on both faces of a rock cut. Where the beds dipped to the southeast, seepage zones were observed on the north or northwest faces of rock cuts.

Because shales and plastic underclays will not permit groundwater to drain vertically, water must move laterally through interbedded sandstones and shales. When a highway cuts through the bedding, the water outcrops and moves down the face of the cut and eventually into the ditches.

A shale generally is composed of thin, parallel layers of water-deposited materials. During later geologic times, these layers may have been cracked and broken, thus permitting small channels to form through which water can move. Thus, depending upon the dip of exposed layers in the ditch lines, water might enter the shales and move laterally to areas under the pavement. Conditions could exist so the water is held under the pavement and drains downgrade of the highway. Thus, water pressures increase until zones of weaknesses permit the water to escape either to the side or upward toward the surface of the pavement.

Correlations of observations with area geology indicated the worst drainage problems occurred in locations where the highway cut through ridges that were capped by the lower portions of the Breathitt and Lee Formations. Areas having drainage problems are indicated on the enclosed geologic strip maps. These same areas are also recommended for remedial drainage, to be discussed later. The photolog showed many of those areas had water seeping from the cut
faces.

Inspection also revealed many ditch lines in the area were blocked, hindering free drainage. Consequently, ponding was observed in numerous places, and it is likely that water seeps laterally into the pavement layers.

In two places, it appeared water was entering the pavement layers from surface water seeping into the embankment on the high side of the superelevation. The condition, then, was not related to a groundwater condition.

RECOMMENDATIONS

As already mentioned, delineated areas (by red lines) on the geologic strip maps indicate locations where a pavement drainage system is recommended. When drains are to be placed along the outside shoulder, they should be placed at the edge that is farther from the centerline of the roadway. When placing drains along the inside shoulder, they should be constructed at the edge of the shoulder that is closer to the centerline. Drains placed at this location and at this depth should intercept water draining from the cuts and should lower groundwater levels well below the pavement layers. These drains should be a minimum of 5 feet in depth. Four-inch perforated pipe should be placed at the bottom of the trench, and the trench should be backfilled with a free draining material. The perforated pipe should be enclosed with a sock to prevent clogging.
The following is a list of locations where drains are recommended. Station numbers are as accurate as may be taken from the geologic quadrangles; however, precise surveys should be made in the field before construction begins. Also, the numbers on the geologic maps refer to the numbered items that follow:

1. Westbound lanes - Stations 3010+38 to 3023+19,
2. Westbound lanes - Stations 3118+03 to 3133+41,
3. Eastbound lanes - Stations 3118+03 to 3135+97,
4. Westbound lanes - Stations 3138+53 to 3153+91,
5. Eastbound lanes - Stations 3138+53 to 3205+17,
6. Westbound lanes - Stations 3251+31 to 3266+69,
7. Eastbound lanes - Stations 3251+31 to 3282+07,
8. Eastbound lanes - Stations 3297+45 to 3338+46,
9. Westbound lanes - Stations 3317+95 to 3338+46,
10. Eastbound lanes - Stations 3394+84 to 3407+66,
11. Westbound lanes - Stations 3561+45 to 3574+26,
12. Eastbound lanes (inside shoulder) - Stations 682+25 to 690+54,
13. Eastbound lanes (inside shoulder) - Stations 741+81 to 757+18
14. Westbound lanes - Stations 969+92 to 975+05,
15. Westbound lanes - Stations 1023+75 to 458+25,
16. Westbound lanes - Stations 847+84 to 858+10,
17. Eastbound lanes (inside shoulder) - Stations 863+22 to 873+48,
18. Eastbound lanes (inside and outside shoulders) Stations 891+42 to 901+67,
19. Westbound lanes - Stations 1022+14 to 1042+64,
20. Eastbound lanes - Stations 1027+26 to 1050+33.

At two locations (indicated by green lines) on the strip maps (Grayson and Rush quadrangles), it is recommended that a shallow (18-inch) pavement edge drain be placed on the high side of the superelevations. In both locations, this would be on the inside edge of the eastbound lanes. It appeared the major source of water at those sites was surface water seeping into the embankment, and travelling in the pavement layers along the pavement cross slope. The station numbers for these two sites are as follows:

21. Eastbound lanes (inside shoulder) - Stations 642+80 to 668+43, and

22. Eastbound lanes (inside shoulder) - Stations 1088+78 to 1109+28

It also was noted during field inspection that many ditches had talus and weathered rock that was preventing free drainage. Ponded water was noted in many of those locations. It is recommended that all ditches on these projects be cleaned and maintained periodically.