STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

BEVERLY EAVES PERDUE
GOVERNOR

EUGENE A. CONTI, JR.
SECRETARY

Memo to: Wally Bowman, PE
Division Engineer, Division 5

From: Clark Morrison, PE
State Pavement Design Engineer

Subject: I-85 Pavement Evaluation and Recommendations
From Midland Terrace Road to Falls Lake in Durham County,
And from US 15 to NC 56 in Granville County
Division 5

Date: October 8, 2010

At the request of Ms. Jennifer Evans – Proposal Engineer in Division 5, the Pavement Management Unit tested the pavement of I-85 in Durham and Granville Counties. The project limits were from Midland Terrace Rd. to Falls Lake in Durham County (about 5.3 miles), and from US 15 to NC 56 in Granville County (about 5.7 miles). We conducted FWD tests and cored the pavement in the outside travel lane in both directions of the route. In addition, we also evaluated the existing pavement condition of the ramps and loops located within the project limits. The following is a summary of our tests and recommendations:

Tests and Evaluation

- Pavement construction history suggests the presence of composite pavements in both tested sections – asphalt on top of jointed concrete pavement (JCP) in Durham County, and asphalt on top of continuously reinforced concrete pavement (CRCP) in Granville County.
- The pavement in the Durham County section exhibits severe reflective cracking, except for where the concrete slabs were removed and replaced with asphalt pavement. Reflective cracks have been sealed. The pavement in Granville County exhibits low severity longitudinal fatigue cracking.
- FWD (Falling Weight Deflectometer) analyses done for a 10-year design life suggests no need of structural overlay in either of the tested sections.
- Coring showed the presence of 4-6” of asphalt on top of 9.0” concrete (JCP) in Durham County. Also, where slabs were replaced with asphalt, pavement was 10-14.5” of asphalt on ABC. In Granville County, cores consisted of 9-10” of asphalt on top of 9.0” of concrete (CRCP).

Recommendations

- Durham County section - Mill 1.5” of the existing pavement surface and replace it with S9.5C, and then overlay with another lift of S9.5C (if funding allows the overlay).
- Granville County section - Mill 1.5” of the existing pavement surface and replace it with S9.5C.
- Mainline paved shoulders, both sections – Generally in good condition. Could be left as is, or treated same as the mainline pavement.

- Ramps and loops – Mill and fill 1.5" as the adjacent mainline. See Page 3 of this letter for more details.

Durham County Section
Construction history data shows that the original pavement structure consisted of jointed concrete pavement on ABC. The section was later overlaid with asphalt and some of the slabs replaced (also with asphalt). Currently, the most developed pavement distress is the reflective cracking at the underlying concrete joint locations, both transverse and longitudinal. Where concrete slabs were removed and replaced with asphalt, distress is minimal. All cracks have been sealed, but some reopened. Current traffic along this section of I-85 is about 41,000 vehicles per day of which 20% is truck traffic. We assumed a 2.1% annual growth, which puts 2030 traffic projection at 61,000 vehicles per day. For the purpose of this design, we have used trucks at 8% duals and 12% tractor-trailers (TTST).

FWD tests were conducted at every 1,000' on average. Temperature and load corrected deflections under the center of the FWD plate ranged from 2.54 to 7.62 mils in the northbound direction, and from 2.89 to 6.92 mils in the southbound direction. The average deflections were 4.39 and 4.29 mils respectively (See attached graphs). The calculated deflection limit is 7.80 mils. FWD analyses show no need of structural overlay for all tested locations except for three locations in the northbound direction.

Eight cores were taken over the length of the project – four in each direction. Cores suggested the presence of 4-6" of asphalt on top of 9.0" concrete (JCP). Where slabs were replaced with asphalt, cores were 10-14.5" thick and consisted of surface, intermediate and base courses, built on ABC. Cores were generally in good condition. If this pavement were being constructed today for a 20-year design period, it would consist of 14-16" of asphalt on ABC or 12-13" of jointed concrete pavement.

We conducted DCP test at one of the coring locations where concrete was removed and replaced with asphalt. This test was rejected due to extreme ABC strength. Our visual inspection of the core location confirmed the presence of ABC underneath the asphalt. Subgrade Modulus values calculated from the FWD tests were above 10,000 psi (considered adequate) at all tested locations in both directions.

Granville County Section
Construction history data shows that the original pavement structure consisted of continuously reinforced concrete pavement on ABC. The section was later overlaid with asphalt. The most developed pavement distress is the low to moderate severity longitudinal fatigue cracking in the wheel paths. Current traffic along this section of I-85 is about 32,000 vehicles per day of which 20% is truck traffic. We assumed a 2.2% annual growth, which puts 2030 traffic projection at 50,000 vehicles per day. For the purpose of this design, we have used trucks at 8% duals and 12% tractor-trailers (TTST).

FWD tests were conducted at every 1,000' on average. Temperature and load corrected deflections under the center of the FWD plate ranged from 2.67 to 4.54 mils in the eastbound direction, and from 2.11 to 4.18 mils in the westbound direction. The average deflections were 3.58 and 3.30 mils respectively (See attached graphs and information). The calculated deflection limit is 7.80 mils. FWD analyses show no need of structural overlay for all tested locations in both directions.

Seven cores were taken over the project length. Cores suggested the presence of 9-10" of asphalt on top of 9.0" of concrete (CRCP). Cores were generally in good condition. We took two cores on top of fatigue cracks. Both cracks were ¼" deep. One of the cores was located at transverse (most likely on top of expansion joint) crack and the pavement was cracked full-depth. If this pavement were being constructed today for a 20-year design period, it would consist of 14-15" of asphalt on ABC or 12-13" of concrete.

We conducted DCP test at one of the coring locations. DCP graph suggested the presence of 4" ABC, which is consistent with the construction history data. Visual inspection of the core location confirmed the presence

of ABC. Subgrade Modulus values calculated from the FWD tests were above 10,000 psi (considered adequate) at all tested locations in both directions. (See attached graphs).

Durham County Section Recommendations

Our main goals in considering pavement recommendations for this section of I-85 were to address the existing cracking, improve pavement ride quality and extend its service life. The pavement in the Durham County section exhibits severe reflective cracking. Cracks have been sealed. Where concrete slabs have been replaced with asphalt, the pavement is currently in good condition and does not show visual distress. Our cores suggested the pavement consists of 4-6" asphalt on top of 9" jointed concrete, or in the asphalt only sections; of 10-14.5" of asphalt on ABC. FWD analysis for a 10-year design life suggested no need of structural overlay. Based on our test results and pavement evaluation we recommend the following:

Mainline – Mill 1.5" of the existing pavement surface and replace it with S9.5C, surface mix. Overlay the entire pavement with 1.5" S9.5C. Two lifts of new surface will provide a thick layer of asphalt to delay the reappearance of reflective cracks. A non-woven fiberglass/polyester fabric could also be used as an interlayer between the existing and the new asphalt to further mitigate the reflective cracks.

Paved Shoulders – Shoulders in the mainline are generally in good condition and could be left as is, or milled and filled and/or overlaid along with the through lanes.

Ramps and Loops – Where ramps and loops consist of asphalt pavement, mill 1.5" and replace with S9.5C, and then overlay with another lift of surface. In the concrete sections; overlay with 1.5" S9.5C. Shoulders along the ramps are generally in poor condition. We recommend removing the existing pavement there and replacing it with 8" ABC and 3.0" S9.5C surface course.

Granville County Section Recommendations

Similarly to the Durham section, our goal was to evaluate the existing pavement conditions and give recommendations which provide longer pavement service life and better ride quality. The pavement in the Granville County section exhibits low to moderate severity longitudinal fatigue cracking in the wheel paths as well as occasional transverse cracking which is probably located on top of the CRC expansion joints. These distresses allow water to penetrate the surface and accelerate pavement deterioration. Asphalt thickness was 9-10" on top of 9" of concrete. FWD deflection analyses done for a 10-year design life suggested no need of structural overlay. However, addressing pavement distresses at this point in its service life will be beneficial for preserving its structural integrity and improve long-term performance. Based on our test results and evaluation we recommend the following:

Mainline – Mill 1.5" of the existing pavement surface and replace it with S9.5C, surface mix.

Paved Shoulders – Shoulders in the mainline are generally in good condition and could be left as is, or milled and filled with new surface as the through lanes.

Ramps and Loops – Mill 1.5" and replace it with S9.5C. Where the shoulder pavement exhibits high drop-off and severe cracking, remove the existing pavement and replace it with 8" ABC and 3.0" S9.5C.

Please advise if you have any questions.

CSM/vgm