
VDOT

2006 Southeastern States Pavement Management And Design Conference

May 7-10, 2006

Panama City, Florida

Jointed Plain Concrete Pavement, Case study

Mohamed Elfino, PhD, PE
VDOT/ Materials Division

Shabbir Hossain, PhD, PE
Virginia Transportation Research Council

Presentation Outline

Background

Objectives

Pavement Performance History

- Field Distress Survey
- Functional Evaluation
- Structural Evaluation

Investigation of Premature Distress

Impact of Drainage Design and Construction

Recommended Remedial Action

Conclusions

Background

- Jointed Plain Concrete Pavements (JPCP)
- 15 ft joint spacing
- US 460 in Appomattox County, Virginia.
- Four-lane divided primary highway
- 2003 Traffic variable 11,000 to 14,000 ADT with 14% and 6% trucks (SU &TT).
- Built during the 1993 and 1994 construction seasons.

Background-Pavement Structure

- 9 inches (225 mm) of doweled JPCP
- 4-inch (100 mm) Cement-Stabilized Open Graded Drainage Layer (OGDL)
- 6 inches (150 mm) of soil cement.
- Tied Concrete Shoulder
- Longitudinal Pavement Edgedrain

Background-Pavement Condition

- Isolated areas of the 2.8-mile-long project showed signs of premature failure (since 1998), mainly mid-slab cracking, faulting, settlement, and spalling.


INCHES
1
066D
2
LUFKIN
3

Pavement Condition

Objectives

- Assess the premature failure in terms of severity and frequency
- Identify the failure mechanism
- Recommend remedial action

Pavement Performance

- Field Distress Survey
  - Eastbound lanes have more distress (24% of the slabs)
  - Westbound lanes have less distress (12% of the slabs)
  - All distresses are in the travel lanes only

Pavement Performance

Functional Evaluation

- EB 2003, IRI 87 inch/mile
- EB 2005, IRI 116 inch/mile
- WB 2003, IRI 71 inch/mile
- WB 2005, IRI 83 inch/mile

Pavement Performance

Structural Evaluation

- FWD, Load Transfer Efficiency (LTE)
- Tested 15% of all slabs (2005)

		EB	WB
– (<50%)	Low LTE	73% vs.	36%
– (51-75%)	Medium LTE	21% vs.	28%
– (>75%)	High LTE	6% vs.	36%

Investigation of Premature Distress

- Investigated Section – 0.25 mile
- Field Cores
  - Concrete Compressive Strength (6000 psi)
  - Drainage Layer
    - Clogged in distressed area
    - Clear in undamaged area
  - Soil Cement (700 psi)
  - Subgrade – A-4 and A-5 with a soaked CBR 3.0%


Hole #2
Approx 8x10s
Soil Cement
Ziploc

Partially Eroded Soil Cement Core

Investigation of Premature Distresses

- Subgrade evaluation using the Standard Penetration Test (SPT)
- The uncorrected Blows (N) is between 1 and 7 very week soil
- Soil classification is A-4 & A-5

Investigation of Premature Distress

- Video inspection of Pavement Edgedrain
- All outlets are clear
- All the longitudinal pipes are clear

Removed Slab

Failure Mechanism


6 2 '93


WILLIAMS
CORP
CATERPILLAR

Projected (ESAL) for 30 years: 8,000,000

Reliability level (%): 95

Overall standard deviation: 0.35

28-day mean modulus of rupture for PCC: 650 psi

28-day mean modulus of elasticity for PCC : 3,705,000 psi

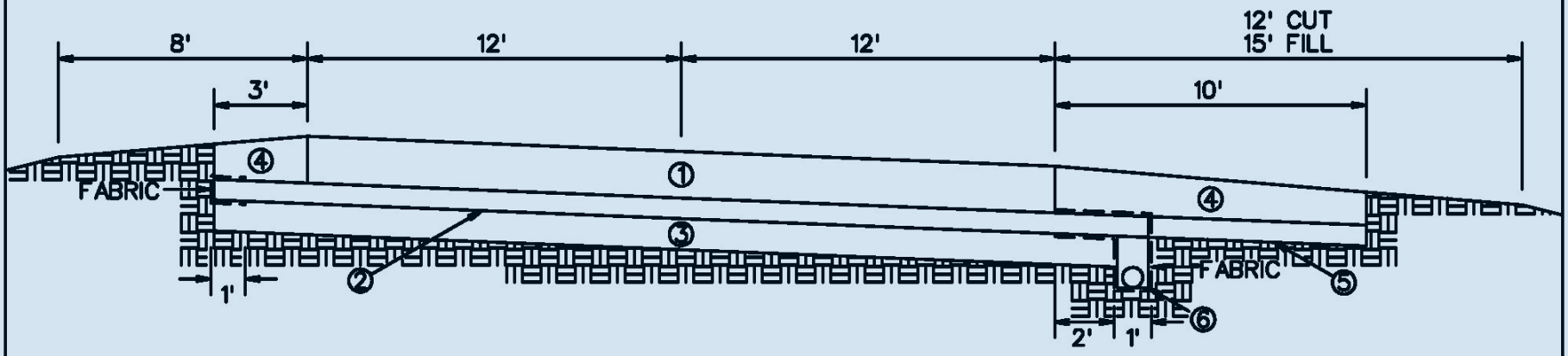
Load transfer coefficient, J factor: 3.20

Modulus of subgrade reaction (K value): 193 psi/in

Overall drainage coefficient (Cd): 1.20

Initial serviceability: 4.5

Terminal serviceability: 2.5.



LEGEND:

① JOINTED PLAIN CONCRETE PAVEMENT (JPCP)

② CEMENT STABILIZED DRAINAGE LAYER

③ HYDRAULIC CEMENT SOIL

④ JPCP - VARIABLE DEPTH

⑤ 21 A/B - AGGREGATE

⑥ STANDARD UD-4

Remedial Action

1. Remove 3ft of the concrete shoulder adjacent to the mainline.
2. The next step is digging out the native soil which caused the drainage blockage
3. Replace with a permeable aggregate course.
4. The 3 ft shoulder slab can be replaced with fresh concrete and tie bars.
5. Reseal all joints as needed
6. This recommendation would re-establish both the positive drainage and the edge support.

Conclusions

The lessons learned from this investigation are as follows:

1. Quality construction in accordance with proper sequence is essential for long-life concrete pavement.
2. It is important to conduct pre-paving conferences, where the designer shares the new features of his design and emphasize the critical issues to the project personnel and the contractor.
3. Quality assurance is essential in preventing premature pavement failure.
4. Concrete pavement requires stable and dry foundation in order for it to provide long life.
5. Adequate documentation of the construction activities can play an important role in detecting the failure mechanism, if any, at early stages.


VDOT
From Mud to Mobility
1906
2006
VIRGINIA DEPARTMENT OF TRANSPORTATION

Thank You,

Questions !