TWO-COURSE BONDED CONCRETE BRIDGE DECK CONSTRUCTION

Interim Report No. 3

Deck Evaluations After Three Years

by

Samuel S. Tyson
Research Engineer

(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

Virginia Highway & Transportation Research Council
(A Cooperative Organization Sponsored Jointly by the Virginia Department of Highways & Transportation and the University of Virginia)

In Cooperation with the U. S. Department of Transportation
Federal Highway Administration

Charlottesville, Virginia

December 1977
VHTRC 78-R23

TWO-COURSE BONDED CONCRETE BRIDGE DECK CONSTRUCTION

Interim Report No. 3

Deck Evaluations After Three Years

by

Samuel S. Tyson
Research Engineer

BACKGROUND

The two-course experimental decks constructed in June 1974 included protective wearing course layers consisting of a latex modified concrete, a low water-to-cement ratio PCC, and a wire fiber reinforced concrete. The decks were evaluated at the age of one year, prior to receiving traffic loadings and deicing chemical applications, to assess their condition at that time and to establish a datum for future performance evaluations. The two-course decks were compared with conventional single-lift control decks constructed on the same project.

The procedures used for deck evaluations included visual surveys and soundings on the deck surfaces, determinations of the chloride ion concentrations in the concretes, electrical potential measurements on the reinforcing steel, sonic pulse velocities through the decks, and the skid resistance of the deck surfaces. The results of this testing were presented in the report titled TWO-COURSE BONDED CONCRETE BRIDGE DECK CONSTRUCTION, Interim Report No. 2, Concrete Properties and Deck Condition Prior to Opening to Traffic.(1)

Similar tests were conducted in July 1977, when the two-course and single-lift decks were three years old. Presented here is an evaluation of the decks based on a comparison of the initial and current test results. Background information for the decks and for the test procedures may be obtained from Interim Report No. 2.(1)

DECK EVALUATIONS

Visual Surveys and Soundings

The visual survey of the decks revealed only a few shrinkage cracks in one of the latex overlays and one of the PCC overlays. These were very minor and should not impair the service life of the decks.

On one of the wire fiber overlays the soundings with the chain drag and hammer showed one small area of delaminated concrete. This area was 1.5 x 2.0 ft. (0.46 m x 0.61 m) and was located adjacent to the parapet. Because of the isolated nature of this defect it is not considered significant at this time.

Chloride Contents

The average natural chloride contents of the bridge deck concretes were originally reported to be approximately 0.4 lb. $Cl^-/yd.^3$ (0.24 kg Cl^-/m^3) higher than they should have been due to chlorides in the filter paper used in those tests. These baseline values have been corrected in Table 1, where they are presented with the current chloride contents of the deck samples. As can be seen, there is no significant difference in the chloride contents at the time of construction and at the age of three years.

Table 1

Chloride Contents of Bridge Deck Concretes at 1.75 to 2.00 inch (44 to 51 mm) Depth

Type Concrete	Chloride Content, lb. $Cl^-/yd.^3$*	
	Baseline	3-Year
Conventional	0.37	0.35
Latex	0.31	0.47
PCC	0.35	0.36
Wire Fiber	0.50	0.41

*lb. $Cl^-/yd.^3$ x 0.59 = kg Cl^-/m^3

Electrical Potentials

The magnitudes of the electrical potentials of the reinforcing steel in each of the decks remain in the range which indicates a greater than 90% probability that no corrosion of the steel is occurring. These readings were made using a copper-copper sulfate half cell, and good electrical circuits were assured by drilling to the level of the top reinforcing steel so direct connections could be made.

Sonic Pulse Velocities

Sonic pulses were transmitted through the decks at half of the original 44 locations on each span. The original and current pulse velocities are shown in Table 2. The pulse velocities have shown no significant decrease, thereby indicating that no change in the original good bond at the interface has taken place.

Table 2

Sonic Pulse Data

Span	Average Pulse Velocity, Ft./Sec.*	
	Original	3-Year
Control (EBL)	10,400	10,800
Control (WBL)	9,900	11,200
Latex (EBL)	12,900	11,400
Latex (WBL)	12,400	11,300
PCC (EBL)	12,500	12,200
PCC (WBL)	13,500	12,700
Wire Fiber (EBL)	13,200	12,400
Wire Fiber (WBL)	11,600	11,000

*ft./sec. x 0.305 = m/sec.

Skid Resistance

The skid resistances of the decks determined initially and at the age of three years are shown in Table 3. The current values of predicted stopping distance numbers (PSDN) are all somewhat lower than the original values; however, they are still indicative of excellent skid resistance on each of the control and experimental spans.

Table 3

Skid Resistance

Surface	Lane	PSDN	
		Original	3-Year
Control	EBTL	61	57
	EBPL	64	58
	WBTL	61	52
	WBPL	63	61
Latex	EBTL	66	58
	EBPL	67	61
	WBTL	64	55
	WBPL	65	60
PCC	EBTL	64	56
	EBPL	66	59
	WBTL	66	56
	WBPL	66	62
Wire Fiber	EBTL	65	56
	EBPL	66	57
	WBTL	65	57
	WBPL	65	65

SUMMARY

In general, the current data indicate that no significant changes in the condition of the experimental two-course decks have taken place during two winters of traffic and deicing operations. It is also apparent that there have been no significant differences in the overall performance of the control spans and the two-course spans during this period of time.

Of particular significance is the good condition of the bond at the interface between the base and overlay concretes as indicated by the uniformly good sonic pulse data.

RECOMMENDATION

Based upon research and field experience to date, the concept of two-course construction for bridge decks is technically sound and should be considered where economically or technically justified.

REFERENCES

1. Tyson, S. S., "Two-Course Bonded Concrete Bridge Deck Construction: Interim Report No. 2, Concrete Properties and Deck Condition Prior to Opening to Traffic," Virginia Highway & Transportation Research Council, July 1976.