Research Report
KTC-01-29/FR107-01-1I

KENTUCKY TRANSPORTATION CENTER

College of Engineering

CONSTRUCTION MONITORING AND PROCEDURES FOR I-275 "WARRANTY PROJECT" KENTON/BOONE COUNTIES

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Construction Monitoring and Procedures for I-275 "Warranty Project" Kenton/Boone Counties.

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16. Abstract

In the summer of 2000, it was decided by the Kentucky Transportation Cabinet that a portion of eastbound and westbound I-275 needed repair due to fatigue. The design was 10 inches PCC or 13 inches of asphaltic concrete for Section B, and 9 inches PCC or 12 inches of asphaltic concrete for Section A. Alternate bids were accepted from asphalt and concrete contractors with a required warranty of 10 years or 10,000,000 ESAL's, which ever came first.

The Kentucky Transportation Center will be monitoring the performance of the pavement for the duration of the warranty and will be submitting an annual report showing any distress.

This report details the construction process and shows just a few of the minor problems that were encountered after the completion of construction.

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INTRODUCTION

Project Description

Interstate 275 in Boone and Kenton Counties (MP 1.05 - 7.15) has been in service for more than 20 years. This rehabilitation project consists of the eastbound lanes from MP 1.04 - 4.07 and both east and westbound from MP 4.07 - 7.15. The westbound lanes from MP 1.04 - 4.07 were rehabilitated in 1991. This project consists of two and three lane sections in each direction. The two-lane section is located between stations 378+10 to 440+20 eastbound, and 378+10 to 386+50 westbound. The three-lane section is located between stations 440+20 to 737+00 eastbound and 386+50 to 584+00 westbound. Research Report KTC-00-06 "I-275 Warrantied Pavement, Boone/Kenton Counties Kentucky" details the pavement design, life cycle cost analysis and bidding of the project.

Original Project Design

The original pavement design consisted of continuously reinforced concrete pavement in the westbound direction from MP 1.05 - 4.07. The remaining pavement was conventional 11" of PCC pavement over 6" of DGA with a keyway between driving lanes. The project was broken into to design sections based on projected traffic loadings as follows:

Section 1

I - 275, Boone/Kenton Counties Kentucky
Eastbound from MP 1.05 - 4.06
3 - Lanes
Original Construction--1973
11" Jointed Reinforced Concrete Pavement over 6" of Dense-Graded Aggregate Base

MP 1.99 - 4.06
56,000 AADT, 11.5% Trucks
14,603,000 Equivalent Single Axle Loads (ESALs)* for 20 years;
29,206,000 ESALs* for 40 years

MP 1.05 - 1.99
76,000 AADT, 11.5% Trucks
21,400,000 ESALs* for 20 years; 42,400,000 ESALs* for 40 years

Section 2

I-275, Boone County, Kentucky
East and Westbound MP 4.06 - 7.15
3-lanes

Original Construction--1977
11" Jointed Reinforced Concrete Pavement over 6" of Dense-Graded Aggregate Base

47,000 AADT, 11.5% Trucks
10,700,000 ESALs* for 20 years; 21,400,000 ESALs* for 40 years

*Note: ESALs calculated using Kentucky Load Equivalency Factors (Report No. UKTRP-81-17, Kentucky Transportation Center, University of Kentucky, 1981).

Rehabilitation History/Maintenance History

The westbound lanes from MP 1.05 - 4.07 were rehabilitated in 1991. This rehabilitation consisted of the rubblization of the existing continuously reinforced PCC pavement, the addition of a 4-inch asphalt treated drainage blanket followed by a 9" conventional PCC pavement.

The remainder of the project has seen increasing deterioration of the pavement structure in recent years. The historical rideability of the project is given in Figure 1. Figures 2 and 3 illustrate typical distresses that were found throughout the project. Extensive patching of the deteriorated joints had become overwhelming. During a project recently completed that retrofitted the shoulder joints with dowels to facilitate the maintenance of traffic for the major rehabilitation, a separate item was included to do extensive full width patching of distressed areas. This activity virtually eliminated the need to continue to do pothole patching. The net effect was to provide for a consistent foundation for the anticipated rehabilitation.

Figure 1. Historical Rideability

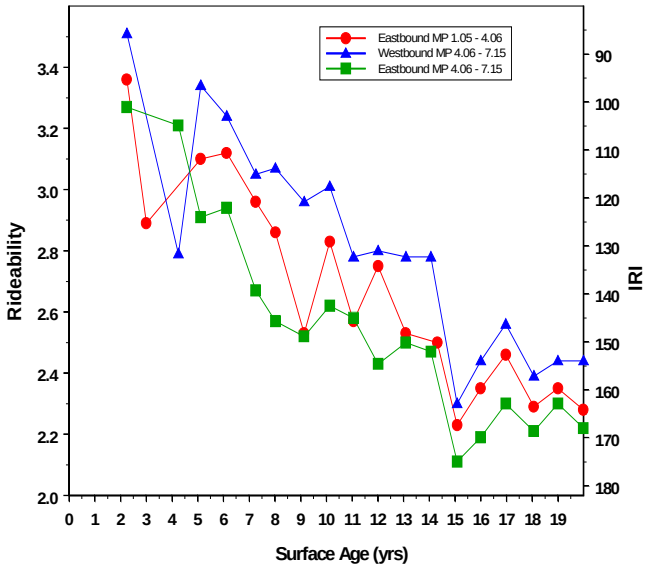

Figure2: Pavement Distress.

Figure 3: Pavement Distress.

Unique Project Features

The Kentucky Transportation Cabinet has been working to develop performance-related specifications and enhanced QC/QA programs into their new 2000 Specifications. It is anticipated that these changes will be cost effective and will enhance the long-term performance of the projects on which they are used.

The next logical step in this process was to evaluate the feasibility of using warranties on projects. It is anticipated that constructing a warranted pavement structure would;

- Stimulate contractor workmanship to lead to improved pavement performance,
- Encourage more competition,
- Stimulate contractor innovation,
- Potentially reduce the overall project life-cycle-cost.

A life-cycle cost analysis done for the purpose of determining the most cost-effective rehabilitation strategy indicated that over a 40- year period, there was no significant difference in life-cycle cost for an overlay using asphalt concrete when compared with a structurally equivalent overlay using Portland cement concrete. The lack of a clearly preferred alternative was the basis for bidding alternative pavement types on this project. The addition of warranties for workmanship for each pavement type also is believed to more clearly focus each industry on the objective of providing a long-lasting, high-quality product. Furthermore this is believed to minimize functional differences between the two pavement types.

The pavement warranties provided a means to share the responsibility between the contractor and the Transportation Cabinet for constructing a quality product. Bidding alternative pavement types allowed two competing industries to bid on a selected project and provide the Transportation Cabinet with a five-year to a 10-year warranty. Each pavement type was designed to meet the same structural requirements over a 40-year analysis period. Therefore, the two alternative designs could be considered structurally equivalent. The combination of a warranty and the alternate bidding provided a potential means to functional equivalence between the alternatives during the warranty period. This was accomplished by developing performance levels for pavement smoothness (ride quality) and other distresses such that the two alternate pavement types were functionally equivalent. In addition, it allowed the contractor to utilize innovative concepts to modify various aspects of the construction process to meet the performance requirements established. This process also assisted in maintaining a consistent level of service and workmanship for the project throughout the warranty period.

This warranted project extended beyond the typical bidding of a fixed warranty, and it allowed the contractor the option of extending the basic five-year warranty to a maximum of 10 years. Each additional year of warranty permitted the contractor to receive a credit to be used to determine the successful bidder.

Background and History of Project Bidding

Kentucky has historically selected successful bidders in the traditional manner described below:

- Total Labor and Materials – "A" type bidding
- Owner Specifications – "Method Specifications"
- Contract Time – Working Days or Fixed Completion Date

In recent years Kentucky has used an "A + B" type of bidding concept for selected projects. This concept is described as follows:

- Total Labor and Materials – "A"
- Owner Specifications – "Method Specifications"
- Contract Time – Owner assigns a value of working day and the Contractor bids the number of working days to completion at an owner assigned rate – "B"
- Low Bid is evaluated on the Basis of "A + B"

The bidding procedure evaluated on this project involved an "A + B - C" concept, with the "C" component representing the value of the warranty provided by the contractor. The bid package was evaluated as follows:

- Total Labor and Materials – "A"
- Incorporation of selected Performance Related Specifications
- Contract Time – Owner assigned a value of working days and the Contractor bid the number of working days to completion at an owner assigned rate – "B".
- The owner assigned a value for each year of warranty from 5 - 10 years. The contractor had the option to bid extended year(s) of warranty for his product.
- Low bid was evaluated on the basis of "A + B – C"

Warranty Value

Several different scenarios for the determination of the value associated with each year of warranty have been evaluated. One method would be to utilize the cost of a single rehabilitation for the complete job to establish some type of prorated warranty value for various years. It was determined however, that a better methodology would be to utilize the anticipated user cost which would be realized if the need for rehabilitation occurred.

The value of the warranty was determined based on the anticipated user delays cost determined from FHWA DP-115 "Probabilistic Life-Cycle-Cost Analysis" procedures. The value of the warranty was determined to be the user delay cost associated with a single lane closure for 24 hours per day for 30 days during each year of the warranty period. The contractor was required to provide a 5-year warranty and receive no credit for bid evaluation purposes. A detailed analysis of this procedure is included in Research Report KTC-00-06 "I-275 Warranted Pavement, Boone/Kenton Counties, Kentucky".

CONSTRUCTION PROCEDURES

Maintenance of Traffic

The traffic control plan for the construction project consisted of maintaining two lanes of traffic in each direction. This was accomplished by constructing median cross-over and diverting all traffic to one direction of the roadway. Two lanes were maintained in each direction separated by a moveable concrete barrier. No traffic backups were observed due to this traffic control scenario.

In preparation for the construction of the median cross-over, traffic was shifted to the outside asphalt shoulder of the westbound direction. Within 36 hours of diverting traffic, substantial rutting and other distresses were observed in the shoulder pavement. Figures 4 through 7 illustrate the condition of the shoulder pavement.

Figure 4. Shoulder Failure.

In Figures 5 through7 there is considerable distress due to traffic being shifted to the shoulders. The surface of the shoulders separated from the base, and severe rutting and shoving occurred at this location. This distress prompted (Kentucky Transportation Cabinet) to request the contractor to make necessary repairs (change order No. 2). The Kentucky Transportation Center tested the shoulder using the falling weight deflectometer. The test showed that sub-grade/base rehabilitation would be necessary.

Figure 5. Shoulder Failure.

Figure 6: Shoulder Failure.

Figure 7. Shoulder Failure.

Shoulder Repair

Several areas of weakened pavement structure were observed along the length of the project. It was determined that the shoulder should be replaced from station 366+54 to 578+92 westbound.

The shoulders were reconstructed as follows:

1.25" Class C AC surface PG 64-22
3.00" Class C AC base PG 64-22
3.75" Class C AC base PG 64-22
4.00" cement treated drainage blanket
8.00" #2 stone
4" longitudinal edge drain
Fabric-Geotextile Type IV.

Cost-plus work was performed because slip ramps and crossovers were already under construction when it was determined that the shoulders should be re-constructed. Details of above changes are given in Change Order No. 2. Figures 8 through 11 outlined the procedures utilized for reconstruction of the shoulders.

Reconstruction of Shoulder

- In Figure 8, a Geo-textile Type IV fabric was used to keep aggregate from migrating into an already weak sub-grade. This added structure and provided a good foundation for rebuilding the shoulders.

- In Figures 8 and 9, a 4-inch drain pipe was used to aid in the removal of water from the aggregate and sub-grade. This prevented water from being trapped under pavement thereby causing future problems. A cement-treated aggregate is then placed around the 4-inch pipe to protect the pipe from being punctured by the No. 2 stone.

- In Figure 10, additional structure was added by placing No. 2 stone (8 inches) in thickness over the Geo-textile fabric.

- In Figure 11, a cement treated drainage blanket (4 inches) in thickness was placed over the No. 2 stone to allow water to flow through to the 4-nch drainage pipe. After the cement-treated drainage blanket was placed, it was then treated with a curing agent. After curing is complete, three lifts of an asphaltic concrete mixture, totaling 8 inches, was added.

- Shoulder was resurfaced with 8 inches of asphalt.

Figure 8. Geo-textile Type IV Fabric and 4-inch Longitudinal Drain Pipe.

Figure 9. 4-inch Drainage Pipe and Fabric Being Covered by Cement Treated Aggregate.

Figure 10. Placing No. 2 Stone.

Figure11. Placement of Cement-Treated Drainage Blanket.

General Construction Time Schedule

Construction of mainline pavement on I-275, eastbound, began August 22, 2000. Construction on the westbound lanes started October 22, 2000 and was completed November 24, 2000. An overview of the paving timeline along with QC results are given in Table 1. A summary of the construction timeline is as follows.

Construction Timeline

Letting date:	3/31/2000
Award date:	4/28/2000
Shoulder repair:	6/09/2000 - 7/16/2000
Lane restrictions:	5/31/2000 - 12/16/2000

Mainline Paving

Approximately 98 percent of the concrete used on this project was slip-formed while the remainder was hand-placed. Of the slip-formed areas, approximately 1053 linear feet of concrete was placed each day on the eastbound two-lane section and 1618 on the three lane section.

Approximately 1455 linear feet of concrete was placed each day on the three lanes of the westbound side. The pavers were supplied material from a number of trucks (10 to 22) depending on the daily needs. Trucks were supplied by three 10-cubic-yard batch plants. The joint spacing on this project was 15 feet. Tie bar baskets were also used to facilitate placement of the 36 ft. wide pavement. Hook bolts were used to attach tie bars on each shoulder.

The Paveset Company provided a road profiler to attain a longitudinal profile of the project before any paving was to start. The profile data was programmed into the pavers to assist the pavers in achieving the proper amount of bond breaker to be placed (one inch nominal). Once the bond breaker is placed, a grade wire was aligned along both sides of the mainline allowing the pavers to follow this wire to maintain proper PCC thickness. In an effort to provide access to the concrete supply trucks, a gantry was attached to the pavers allowing trucks passage without disturbing the wire grade line. See Figure 13.

Paving on this project marks the first time a contractor attempted to pave 36 feet of roadway in one pass. To achieve this feat, the Harper Company had to retrofit a 24 foot paver. Figure 12 shows the paving train starting with a conveyer dumping concrete across all three lanes. Following behind the conveyer is a CMI spreader, spreading 24-36 feet of concrete, depending upon the number of lanes to be paved. An auger on the front of this spreader moves the concrete evenly across lane. A CMI Model 550 follows, lightly finishing the concrete in preparation for the crew to bull float. At the end of the paving train is the CMI 250, tining machine placing tine marks on the pavement.

Shoulder Paving

Shoulders were slip formed and paved after completion of mainline. The shoulders are 10 feet in width and crowned on the high side of the super elevation at the mid point. They are tied to the mainline, and Dowell baskets were used at transverse saw joints. Shoulder and mainline thicknesses are the same; however, there was no warranty on the shoulders.

Table 1. Paving Time Schedule and Quality Control Data.

Date	Direction	Station Start	Station Stop	Thickness (in)	Length (ft)	Air Content (%)	Compressive Strength (psi)
8/31/2000	EB	388+10	398+59	9	1,049	5.6	5,747
8/30/2000	EB	398+59	411+60	9	1,301	6	5,380
10/6/2000	EB	411+50	432+00	9	2,100	5.9	6,213
8/29/2000	EB	432+00	436+50	9	450	5.5	5,438
10/3/2000	EB	436+41	440+05	9	364	5.2	6,287
9/9/2000	EB	440+05	458+50	9	1,845	5.1	5,686
9/8/2000	EB	458+40	478+40	9	2,000	5.6	5,812
10/4/2000	EB	478+50	485+50	9	700	6.1	5,392
9/7/2000	EB	485+20	493+00	9	780	5.7	5,228
9/6/2000	EB	493+00	510+00	9	1,700	5.7	5,727
9/5/2000	EB	510+00	531+00	9	2,100	6	5,725
9/1/2000	EB	531+00	550+60	9	1,960	6	5,400
8/31/2000	EB	550+50	571+46	9	1,596	5.6	5,747
9/28/2000	EB	571+10	574+00	9	290	6.1	6,633
9/30/2000	EB	574+00	594+10	9	2,010	6.2	5,741
9/28/2000	EB	594+50	596+81	10	231	6.1	6,633
8/29/2000	EB	598+97	613+05	10	1,408	5.5	5,438
8/28/2000	EB	613+05	629+86	10	1,681	5.4	5,545
8/26/2000	EB	629+86	642+74	10	1,288	5.3	5,764
8/25/2000	EB	624+74	659+52	10	3,478	5.6	5,918
9/18/2000	EB	659+25	661+11	10	186	5.8	5,804
8/24/2000	EB	661+11	681+86	10	2,075	5.5	5,844
8/23/2000	EB	681+86	700+50	10	1,864	5.5	5,759
8/22/2000	EB	700+50	711+37	10	1,087	5.7	5,793
8/22/2000	EB	711+37	722+00	10	1,063	5.7	5,793
8/21/2000	EB	722+00	734+75	13	1,275	6	5,847
9/1/2000	EB	734+75	736+07	13	132	6	5,400
10/23/2000	WB	388+10	407+24	9	1,914	5.3	6,301
11/4/2000	WB	407+45	409+93	9	248	5.7	5,934
10/24/2000	WB	409+93	412+00	9	207	6.1	5,429
10/9/2000	WB	411+60	432+00	9	2,040	5.8	6,301
10/25/2000	WB	432+00	455+35	9	2,335	5.6	5,946
10/26/2000	WB	455+35	477+00	9	2,165	5.8	5,989
11/15/2000	WB	477+00	480+64	9	364	6	6,033
11/16/2000	WB	481+86	484+50	9	264		
10/27/2000	WB	484+00	508+25	9	2,425	6.2	5,743
10/28/2000	WB	508+25	527+71	9	1,946	5.8	5,851
10/30/2000	WB	527+71	531+45	9	374	6	5,972
10/31/2000	WB	531+45	554+30	9	2,285	5.9	5,998
11/1/2000	WB	554+30	567+92	9	1,362	5.6	5,862
11/1/2000	WB	567+92	568+12	12	20	5.6	5,862
10/27/2000	WB	568+12	573+10	12	498	6.2	5,743
10/26/2000	WB	573+14	577+92	12	478	5.8	5,989

Figure 12. Paving Train (Courtesy Tom Hale Construction Digest).

Figure 13. Paving Train with View of Gantry (Courtesy Tom Hale Construction Digest).

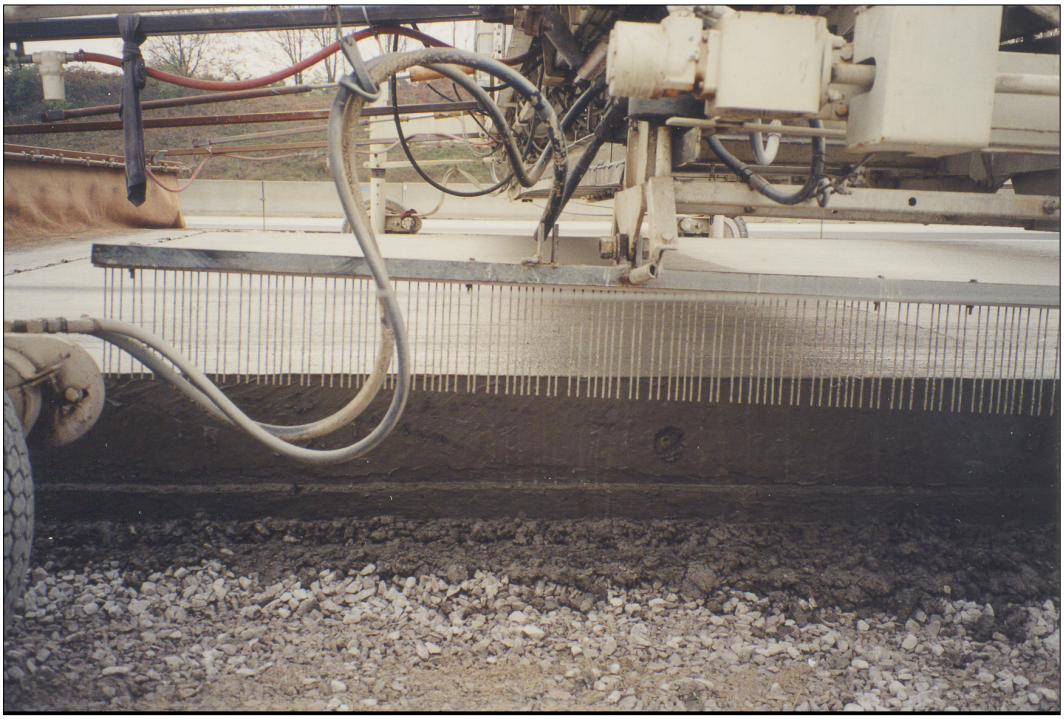

Figure 14. CMI Model 250, 36-foot Tining Machine.

Mix Design

Table 2 shows the mix design for mainline paving.

Table 2. Mainline Mix Design

	Weight (lbs.)	**Source**
Cement	451	Southdown
Fly Ash	113	Irvine
Fine Aggregate	1330	Welch Sand & Gravel
Course Aggregate	1888	Mulzer at Charleston
Water	165	
Air Content	5.5%	

Change Orders

There were a total of ten change orders on this project. These change orders pertained to rehabilitation of shoulders and other unforeseen problems. However, approximately 44% of the money allocated for these change orders was for early completion and ride bonuses. The remainder of the money allocated was used for rehabilitation and unforeseen problems. The sum of all the change orders was $6,718,070. There were $2,940,000 dollars allocated for early completion and ride bonuses. Of that $2,277,769 was used. The following paragraphs are a summary of the change orders.

Change Order # 1

Central Office personnel requested a partnering meeting to discuss any concerns there may be before starting the project. It was hoped that any questions or misunderstandings might be answered at this time.

Change Order #2

Rehabilitation to the shoulder is discussed above (shoulder repairs). Due to the unforeseen delays caused by the failure of the existing detour pavement on the westbound shoulders, an agreement was reached by Central Office Construction and the FHWA to provide an additional incentive of $10,000 per day, or portion thereof, for the early completion of this project, for the time this project is completed prior to the original contract incentive period. The original incentive was $25,000 per day, or any portion thereof, for completion before the 380 calendar days, as bid on the project, up to a maximum of three percent of the original contract award amount. This three percent cap allows for a maximum of $693,848.34 to be awarded under the original agreement if the project is completed 27.754 days early. Therefore, this additional incentive will apply to early completion time over and above the 27.754 days as established by the original days bid, and/or, added per this and subsequent change orders, engineering delays of five days will be given for this additional work in accordance with the contractor's verbal agreement of June 15, 2000. This will be final and full compensation and consideration of time for completion of this work.

Change Order #3

It was recommended by the contractor that steel piles HP12x53 be used instead of placing class A concrete on solid rock in the abutments on the bridges over the Erlanger service road on I-275.

Change Order #4

Fill the existing cellular abutments with flowable fill and modify the existing wingwalls rather than remove and replace. This will correct any problem associated with the cellular abutments. They have been approved by the Central Office Bridge Department.

Change Order #5

Overlay and replace the shoulders with load transfer assemblies because from time to time traffic will be shifted onto the shoulders. In the original plans, the contract didn't address this issue. Type three rumble strips are to be cut into the overlaid and replaced shoulders. Also, a new wooden pole and No. 2 ASCR Triplex wire were installed to provide temporary lighting on crossovers and slip ramps. Due to median being raised 1 ft. and crossover construction, the contractor was instructed to remove, store, and reinstall existing median reference markers.

Change Order #6

After inspection by District and Central Office Bridge personnel it was determined that the KY. 20 bridge over I-275 and the two bridges carrying traffic over the Enlarger service road were in need of repair. Construction phasing allows for a latex concrete overlay to be constructed with no further impact on traffic. The FHWA concurred and gave verbal approval for the overlays. It was also agreed that this work would be done only if contract time was not affected, therefore, meaning no additional days will be allowed for this work contrary to the contract proposal concerning additional time.

Change Order #7

This change order provides the money to pay for rideability bonuses. RI bonuses range from 0-5 percent. Tables 4 and 5 show the bonus paid for each section in each direction.

Change Order #8

This change makes funds available to pay for the early completion bonus.

Change Order #9

Below is a list of the changes made:

- An erosion control blanket was used to establish a better stand of seeding in the immediate area of median boxes.
- Pot-holes needed repair on the eastbound and westbound lanes.
- Removal of existing shoulders that failed on the westbound side I-275 that are not covered by other items and with regards to the sub-grade in the crossovers and slip ramps.
- Flow-able fill backfill material at the bridge end bents in lieu of structure granular backfill materials that were proposed in the original plans. Central Office Construction personnel instructed the contractor to install flow-able fill materials at the Elijah Creek bridges and the bridges over the Erlanger service road.
- Due to widening of bridges on I-275 eastbound over Erlanger service road, the shoulders just east of the bridges had to be replaced. Axle sensors for Artimus were destroyed with the shoulder replacement; therefore, the contractor was instructed to install new axle sensors.
- The original contract did not have bid items for epoxy coated reinforced steel on the bridges over the Erlanger service road on I-275. Central office construction personnel instructed the contractor to utilize epoxy coated reinforced steel in the super structure of the bridges over the Erlanger road on I-275.
- The original plans did not address the removal and reinstallation of the existing panel signs in the gore areas. Due to slip ramps being constructed in these areas the contractor was instructed to remove the panel signs and to reinstall them after the slip ramps were no longer necessary.
- The original contract did not have a bid item for wire 14/1 pair. Due to detour construction on Ramp 5 at Mineola Pike and Ramp G at KY. 212 the 14/1 pair wire was destroyed. The contractor was instructed to restore the two signal systems to original working order.
- District Office Construction personnel instructed the contractor to repair a slide on Ramp 3 at Mineola Pike.
- District office construction personnel instructed the contractor to install a left arrow ahead at KY. 237 and temporary ramp C to better control the volume of traffic.
- District Office Construction personnel instructed the contractor to replace the PCC pavement at the end of Turfway bridge on I-275 in the westbound due to cracks and failure of the pavement. This work had to be completed on a weekend due to traffic being reduced to one lane, therefore, 24 hour high early, PCC was utilized.

Change Order #10

The following modifications will be made to the project in reference to the ride index notes and methods of measurement as found in Section 3.7.16: The RI will be calculated and based on all lanes averaged together per Section A, eastbound, section A, westbound and Section B, westbound as set forth in Section 3.13 of the proposal. The threshold limits will diminish by ESAL'S as

schedule in Section 3.13. Corrective work as described in section 3.8 of the project will only be deemed necessary if after the RI threshold limit has been surpassed and it is determined that the Profile Index is above 8 inches per segment, per lane, as determined by the California Profilograph supplied by the contractor.

INCENTIVES

The original contract established an incentive of $25,000 per day up to a maximum of three percent of original award amount if project is completed early. Of the 380 calendar days contractor has to finish the project, if finished 27.754 days early they will receive the maximum bonus in the amount of $693,843.34.

An additional $10,000 per day incentive was also added in change order No. 2. This change order resulted in a total incentive of 2,131,490.00

As was outlined in the Special Note for Warranted Pavement, the contractor was also eligible for a pavement smoothness incentive based on the Profile Index (PI) determined using the Rainhart Model 860 Profilograph. This incentive was based on a percentage of the square yard cost of the warranted pavement. The incentive for PI is as follows:

In/mile
<1.5 = +0.05
1.5 - 2.5 = +0.03
2.6 - 4.0 = +0.01
4.1 - 8.0 = +no adjustment
>8.0 = remedial work needed

Table 3 shows all the incentive money paid, while Tables 4 and 5 outline the incentives that were achieved for each paving section.

Table 3. Incentives.

Initial Time Incentive	$ 693,848
Additional Time Incentive	$ 2,131,490
Eastbound Rideability Bonus	$ 89,991
Westbound Rideability Bonus	$ 56,288
Total	$ 2,971,617

Table 4. I-275 Eastbound Profilograph Values by Section.

I-275 Eastbound				
Begin	**End**	**Length**	**PI**	**Bonus (%)**
38825	39825	1000	1.69	3
39825	40825	1000	1.16	5
40825	41825	1000	2.48	3
41825	42825	1000	2.22	3
42825	44025	1200	2.42	3
44025	45025	1000	2.43	3
45025	46025	1000	1.48	5
46025	47025	1000	1.48	5
47025	47825	800	1.85	3
47825	48550	725	Bridge	Bridge
48550	51450	2900	3.70	1
51450	52450	1000	2.38	3
52450	53450	1000	2.05	3
53450	54450	1000	2.38	3
54450	55450	1000	2.43	3
55450	56450	1000	1.85	3
56450	57450	1000	3.06	1
57450	58450	1000	2.38	3
58450	59450	1000	2.16	3
59450	60450	1000	2.64	1
60450	63450	3000	2.96	1
63450	64450	1000	2.64	1
64450	65450	1000	2.38	3
65450	66450	1000	1.48	5
66450	67450	1000	2.06	3
67450	68450	1000	2.42	3
68450	69450	1000	1.21	5
69450	70450	1000	1.79	3
70450	71450	1000	2.42	3
71450	72450	1000	3.43	1

Table 5. I-275 Westbound Profilograph Values by Section.

I-275 Westbound				
Begin	**End**	**Length**	**PI**	**Bonus (%)**
38825	39825	1000	2.32	3
39825	40825	1000	2.32	3
40825	41825	1000	2.16	3
41825	42825	1000	2.43	3
42825	43825	1000	2.11	3
43825	44825	1000	2.27	3
44825	45825	1000	2.11	3
45825	46825	1000	1.74	3
46825	47675	850	1.43	5
47675	48475	800	Bridge	Bridge
48475	51475	3000	2.01	3
51475	52475	1000	1.79	3
52475	53475	1000	3.91	1
53475	54475	1000	1.48	5
54475	55475	1000	1.74	3
55475	56475	1000	2.43	3
56475	57792	1317	2.33	3

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WARRANTY THRESHOLD EVALUATION

KY Transportation Center personnel walked the entire length of the project and documented observed areas of distress. These distresses include various epoxy patches, small cracks at the intersection of slab corners, small areas of spalled aggregate along sawed joints and pop outs. It should be noted that at this time none of these distresses are at a level which would exceed thresholds established in the "Special Note for Warranted Pavement". The initial visual distress survey was conducted in December 2000. Table 6 provides a key to the location of each distress outlined below. Examples of the observed distresses are contained in Figures 15 through 20. The location of each occurrence of these distresses is provided in Tables 8 and 9.

Table 6. Pavement Distress Key.

le	left edge		ll	left lane
re	right edge		rwp	right wheel path
ls	left shoulder		bwp	between wheel path
rs	right shoulder		lwp	left wheel path
rl	right lane		all	all of lane
ml	middle lane			

The Kentucky Transportation Cabinet, Pavement Management Branch measured the longitudinal profile of the project using a K.J. Law Model T6500 profilometer. Based on Section 3.7.16 of the special note for warranted pavements a minimum RI of 3.55 must be achieved after construction. These profile measurements were expressed in terms of International Roughness Index (IRI) and Rideability Index (RI) for the project sections outlined in Change Order No. 10. A summary of these results is given in Table 7.

Table 7. IRI and RI Values by Section.

Section	IRI	RI
Section A MP 4.05 - 7.15 (Eastbound)	76.55	3.58
Section A MP 4.05 - 7.15 (Westbound)	68.97	3.70
Section B MP 1.06 - 4.05 (Eastbound)	78.74	3.55

Table 8. Visual Distress Survey Performed by the Kentucky Transportation Center (Eastbound).

Date	Route	Dir	Sec	Station	Distress	Lane	Location
12/4/00	I - 275	EB	2	404+12	corner crack	rl	le
12/4/00	I - 275	EB	2	405+67	core	ls	
12/4/00	I - 275	EB	2	406+25	chips along edge of pavement	ls	le
12/4/00	I - 275	EB	2	406+27	chips along edge of pavement	ls	le
12/4/00	I - 275	EB	2	406+30	chips along edge of pavement	ls	le
12/4/00	I - 275	EB	2	409+80	epoxy patch	ll	le
12/4/00	I - 275	EB	2	409+80	epoxy patch	ls	re
12/4/00	I - 275	EB	3	419+68	epoxy patch	ls	le
12/4/00	I - 275	EB	4	424+60	epoxy patch	rl	lwp
12/4/00	I - 275	EB	5	442+35	epoxy patch	ml	rwp
12/4/00	I - 275	EB	6	452+11	pop out	ll	lwp
12/4/00	I - 275	EB	6	452+13	pop out	ll	lwp
12/4/00	I - 275	EB	6	453+62	epoxy patch	ll	re
12/4/00	I - 275	EB	7	455+00	epoxy patch	ml	
12/4/00	I - 275	EB	7	455+30	epoxy patch	ml	lwp
12/4/00	I - 275	EB	7	461+71	d crack	rl	bwp
12/4/00	I - 275	EB	10	493+00	d crack (patched)	ml	rwp
12/4/00	I - 275	EB	11	494+10	epoxy patch	ml	re
12/4/00	I - 275	EB	11	496+50	epoxy over bad saw joint	rs	re
12/4/00	I - 275	EB	11	502+01	corner crack	rl	re
12/4/00	I - 275	EB	12	504+95	core	rs	
12/4/00	I - 275	EB	12	506+65	d crack (patched)	rs	
12/4/00	I - 275	EB	12	510+27	d crack (patched)	rl	re
12/4/00	I - 275	EB	13	516+30	core (patched)	rs	
12/4/00	I - 275	EB	14	525+50	pop out	rl	rwp
12/4/00	I - 275	EB	14	526+74	pop out	rl	rwp
12/4/00	I - 275	EB	14	529+40	core	rs	

Table 8 Continued. Visual Distress Survey Performed by the Kentucky Transportation Center.

Date	Route	Dir	Sec	Station	Distress	Lane	Location
12/4/00	I - 275	EB	15	543+95	d crack	rl	rwp
12/4/00	I - 275	EB	16	549+79	core	rs	
12/4/00	I - 275	EB	16	551+60	d crack	ll	lwp
12/4/00	I - 275	EB	17	554+91	d crack	ls	le
12/5/00	I - 275	EB	19	575+00	core	ml	rwp
12/5/00	I - 275	EB	20	592+39	core	rl	bwp
12/5/00	I - 275	EB	21	598+60	d crack	ll	rwp
12/5/00	I - 275	EB	23	623+20	core	ll	rwp
12/5/00	I - 275	EB	24	629+76	epoxy patch	ml	lwp
12/5/00	I - 275	EB	24	633+24	core	ml	bwp
12/5/00	I - 275	EB	25	637+96	core	ml	bwp
12/5/00	I - 275	EB	25	642+75	d crack	ll	lwp
12/5/00	I - 275	EB	27	662+50	core	ll	rwp
12/5/00	I - 275	EB	31	698+98	core	ll	lwp
12/5/00	I - 275	EB	34	729+50	epoxy patch	ml	bwp

Table 9. Visual Distress Survey Performed by the Kentucky Transportation Center (Westbound).

Date	Route	Dir	Sec	Station	Distress	Lane	Location
11/29/00	I - 275	WB	19	577+92	epoxy patch	rl	rwp
11/29/00	I - 275	WB	16	544+27	corner crack	ml	re
11/29/00	I - 275	WB	14	531+35	corner crack	ml	re
11/29/00	I - 275	WB	14	531+20	corner crack	ml	re,le
11/29/00	I - 275	WB	14	530+93	corner crack	ml	re,le
11/29/00	I - 275	WB	14	530+78	corner crack	ml	re,le
11/29/00	I - 275	WB	14	530+63	corner crack	ml	re,le
11/29/00	I - 275	WB	14	530+33	corner crack	ml	re,le
11/29/00	I - 275	WB	14	530+18	corner crack	ml	re,le
11/29/00	I - 275	WB	14	530+03	corner crack	rl	le
11/29/00	I - 275	WB	14	530+03	d crack	ml	re
11/29/00	I - 275	WB	14	529+75	corner crack	ml	re
11/29/00	I - 275	WB	14	529+60	corner crack	ml	re,le
11/29/00	I - 275	WB	14	529+15	corner crack	rl	le
11/29/00	I - 275	WB	14	528+84	corner crack	ml	re,le
11/29/00	I - 275	WB	14	528+54	corner crack	ml	re
11/29/00	I - 275	WB	14	528+39	corner crack	ml	re,le
11/29/00	I - 275	WB	14	528+09	corner crack	ml	re,le
11/29/00	I - 275	WB	14	528+09	d crack	ml	re
11/29/00	I - 275	WB	14	527+94	corner crack	ml	re,le
11/29/00	I - 275	WB	14	527+79	corner crack	ml	re,le
11/29/00	I - 275	WB	14	525+55	corner crack	ml	le
11/29/00	I - 275	WB	14	524+95	corner crack	ml	le
11/29/00	I - 275	WB	13	523+90	corner crack	ml	le
11/29/00	I - 275	WB	13	514+73	corner crack	ml	re
11/29/00	I - 275	WB	13	514+13	corner crack	ml	re
11/29/00	I - 275	WB	12	513+22	corner crack	ml	re

Table 9 Continued. Visual Distress Survey Performed by the Kentucky Transportation Center.

Date	Route	Dir	Sec	Station	Distress	Lane	Location
11/29/00	I - 275	WB	12	512+77	corner crack	ml	re
11/29/00	I - 275	WB	12	512+50	corner crack	ml	le
11/29/00	I - 275	WB	12	511+12	corner crack	ml	le
11/29/00	I - 275	WB	12	511+12	corner crack	ll	re
11/29/00	I - 275	WB	12	509+50	corner crack	ml	re
11/29/00	I - 275	WB	12	509+12	corner crack	ml	le
11/29/00	I - 275	WB	12	508+90	corner crack	ml	le
11/29/00	I - 275	WB	12	508+90	corner crack	rl	le
11/29/00	I - 275	WB	12	508+75	corner crack	ll	re
11/29/00	I - 275	WB	4	427+25	corner crack	ml	re
11/29/00	I - 275	WB	4	425+60	epoxy patch	ll	le
11/29/00	I - 275	WB	4	423+75	epoxy patch	rl	re
11/29/00	I - 275	WB	4	423+65	d crack	rl	re
11/29/00	I - 275	WB	4	423+63	epoxy patch	rl	re
11/29/00	I - 275	WB	4	423+50	d crack	rl	re
11/29/00	I - 275	WB	3	410+15	epoxy patch	rl	re

Figure 15. Westbound Corner and D Cracks.

Figure 16: Westbound Corner Crack.

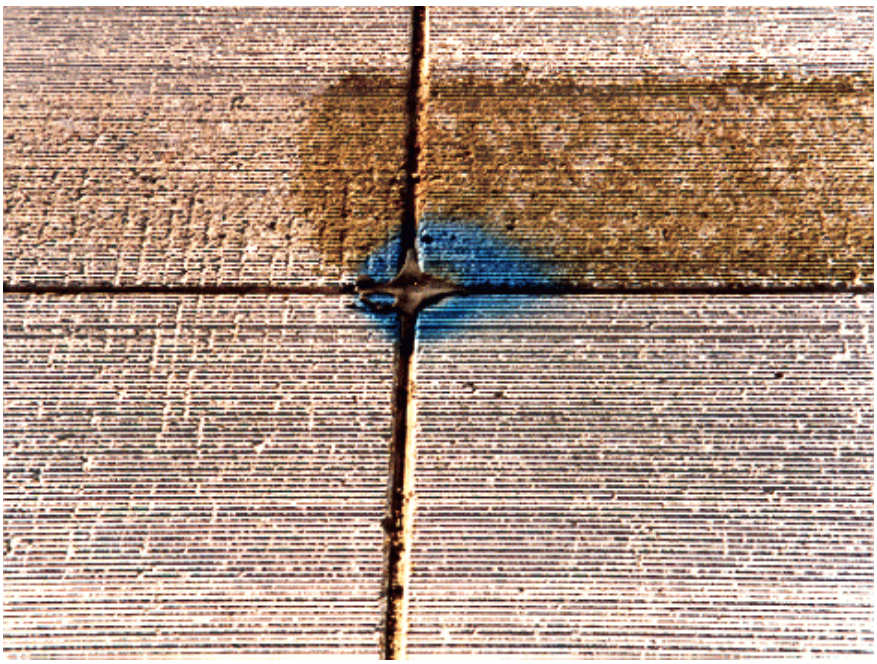

Figure 17: Westbound Patched Corner Crack.

Figure 18: Eastbound Epoxy Patch.

Figure 19: Eastbound Patched Pop Out at Station 452+13.

Figure 20: Eastbound Patched Pop Out at Station 452+13.

Overview of I-275

Comments by the Contractor

The contractor indicated he was very pleased with the final product; however, there were a few things that might have done differently. First, regarding construction, he said that they would have used two four track CMI belt spreaders to place concrete on the big spread worked much better than using one and supplementing with an MTP (Material Transfer Placer). He added that there are a number of benefits to paving as wide as possible, mainly better quality and accelerated completion times. He also indicated the wider paving would benefit the Ride Index by eliminating a longitudinal construction joint. Apparently it did improve the Ride Index. The contractor also chose to use crushed limestone instead of gravel, hook and wiggle bolts instead of bent tie bars, and hot seal neoprene instead of silicone. The contractor believes all of these improved the overall ride quality and longevity of the pavement.

The shoulders were finished in much the same manner as the mainline. The contractor saw no benefit to using a "super finisher" on a pavement that was only 10 feet in width. All of the other finishing aspects were the same. Shoulders were placed against the mainline pavement, which, in his experience, causes them to be rougher at the construction joint. As far as the existing shoulders were concerned, the contractor stated that, in the future, he thought that some preliminary investigation would be warranted.

The contractor also indicated that one of the main reasons for their success on this job was the open lines of communication, with both the District personnel and with the Central Office personnel of the Transportation Cabinet.

Comments by Personnel of the Kentucky Transportation Cabinet

Cabinet personnel stated that they were very pleased with the overall project. However, Dur Ty 1 striping tape did not perform well. It was the opinion of Cabinet personnel that this tape should not have been used in the cold weather. Temporary striping paint probably would have worked much better. Quality control appeared to be adequate. The department was making check cylinders and running air entrainment and slump tests. As for the warranty, Cabinet personnel were of the opinion it had a positive effect on the quality of work and the accelerated completion time.

The mainline was better than the shoulder and Cabinet personnel thought that it was due to the warranty. However, the shoulders appeared to be adequate, and their performance should be comparable to the mainline.

Cabinet personnel agreed with the contractor's comments pertaining to communication. A partnering meeting was held weekly at the construction office between the contractor, subcontractors and Cabinet personnel.

CONCLUSIONS

1. Because two lanes of traffic were maintained in each direction during construction, there were no traffic back-ups during the time the project was under construction.

2. There were no construction related traffic accidents in the work zones during the course of the project.

3. There were no major mainline paving problems.

4. Several of the 1000 feet sections failed to meet the required RI; however, Change Order No. 10 states that the RI will be calculated based on all lanes averaged together per Section A, eastbound, Section A, westbound and Section B, eastbound as set forth in Section 3.13 of the proposal.

5. From the results of the post construction distress survey, the most prevalent distress was small corner cracks, possibly related to the sawing process.

6. It appears the contractor and state personnel were pleased, in large part, with the progress and execution of the project.

IMPLEMENTATION

The results of the distress survey in this report will be used as baseline data for the future annual distress surveys.