

Illinois Department of Transportation

District 5 - Paris, Illinois

30 Year Continuously Reinforced Concrete Pavement



Clark County



FAI ROUTE 70
SECTION 12(53,54)R&S(12-53)RA-2
CLARK COUNTY
ACIM-704(135)141
CONTRACT NO. - 70044

Extended Life Continuously Reinforced Concrete Pavement 30-Year Pavement Design

BACKGROUND:

In the spring of 1999 Illinois' General Assembly passed legislation that included the Illinois Department of Transportation's (IDOT) implementation of a Demonstration Project as part of its 5 year program for fiscal years 2000 through 2004. The Demonstration Project would include the awarding of 10 contracts arising out of its 5 year program that would utilize pavements designed for a 30 year life cycle. This legislation was in response to public outcry that pavements need to last longer, require less repair, and reduce traffic interruptions. IDOT's effort to develop a 30 year pavement design began in 1997, when European pavement design was being touted by some as producing far superior pavements compared to the United States.

After review it was determined that there is not a true "European" design for pavement. Each country is as different as each state in the US. However, there are three underlying themes that are common in the European pavement community. The first is they are willing to pay a premium for high quality, durable materials. Second, their outlook for the facility is very long term. Third, they are willing to invest in a much deeper pavement structure. At the time of these reviews Michigan completed and reported on their experience with designing and constructing European pavement sections. Michigan's advice was to choose design features very carefully. Many of the "European" features were costly with very limited benefit, as viewed by Michigan. This was likened to Danish Ham, in that just because it is imported and costs more does not mean it will taste better.

A series of meetings with the Concrete Paving Industry, Contractors, the University of Illinois, and IDOT staff was conducted. They were asked to review and provide input on a proposed specification and design features developed by IDOT Engineers. Some of the key objectives were to review design features, estimate cost, insure the technology being required in the pavement was "off the shelf", and include those features that provided the largest return on investment. The meetings concluded with final proposed specifications for plan development.

IDOT selected a section of Federal-Aid Interstate 70 in Clark County to be reconstructed with the new 30 year design policy. In addition to the 30 year design of the pavement, this section included several new specifications to enhance the performance and durability of the concrete pavement and structures. The section begins approximately 1 mile west of Illinois Route 1 and extends easterly to the Indiana state line. A location map is attached as Exhibit A.

DESCRIPTION OF PROJECT:

This \$74 million project, one of the largest downstate interstate reconstruction projects, involved the reconstruction of 10 miles of the 33 year old FAI 70 pavement. This project included the reconstruction of the Illinois Route 1 and US Route 40 interchanges, the ramps and parking areas of the Cumberland Road Rest Area, raising five (5) overhead structures and reconstructing ten (10) mainline and one (1) overhead structure. In addition to being one of the largest downstate projects, it also included one of the most aggressive work schedules awarded by IDOT. During the planning phase Illinois' Secretary of Transportation announced that this project would be completed in one construction season. The announcement was made as a result of IDOT's goal of reducing traffic interruptions to the public. This project was on IDOT's October 19, 2001, letting and included a completion date of October 31, 2002. The contract was awarded to Walsh Construction of Chicago, Illinois on November 9, 2001.

The work included in this project consisted primarily of:

1. Raising and reconstructing the eastbound and westbound FAI 70 pavement and FAI 70 mainline bridges (over IL 1, over Big Creek, over Little Creek, over Crooked Creek, and over Hawks Creek) from west of Township Road (TR) 107 to the Illinois-Indiana State Line along the eastbound and westbound lanes of FAI 70 (approximately 9.99 miles), utilizing 6:1 foreslopes and CRC pavement.
2. Realigning and reconstructing the ramps at the interchanges along FAI 70 at IL 1 and US 40.
3. Removing the Eastbound (Structure Number 012-0001) and Westbound (Structure Number 012-0002) FAI-70 bridge structures over the abandoned railroad and filling the existing opening underneath.
4. Resurfacing approximately 0.58 miles of Illinois Route 1 at the IL 1 and FAI 70 interchange.
5. Pavement widening and traffic signal modernization at the intersection of IL 1 and Trefz Drive.
6. Raising and re-decking the bridge that carries US 40 over FAI 70, and resurfacing approximately 0.55 miles of US 40 at the US 40 and FAI 70 interchange.
7. Raising the township road bridges over FAI 70 at TR 107, TR 272A, County Highway 20, and TR 340, and reconstructing the adjacent roadways approximately 1000 feet north and south of FAI 70.
8. Reconstructing the Rest Area parking lots, constructing a retaining wall along FAI 70 at this location, and reconstructing the adjacent ramps.
9. Reconstructing the ramps at the weigh station, resurfacing the parking lot, and relocating the Automatic Vehicle Identification and Weigh-In-Motion detectors.
10. Pavement marking, tree removal, lighting, and all incidental and collateral work necessary to complete the project in staged construction.

WORK COMPLETION SCHEDULE:

Completion Date

The Contractor was required to complete all contract items and safely open all roadways to traffic by 11:59 PM on, October 31, 2002. The Contractor was allowed 15 working days after October 31, 2002 to complete all clean-up work, permanent seeding, sod placement, landscaping, permanent erosion control items, and punch list items. Under extenuating circumstances the Engineer was allowed to direct that certain items of work, not affecting the safe opening of the roadway to traffic, be completed within the working days allowed for clean up work and punch list items. Temporary lane closures for this work was allowed at the discretion of the Engineer.

Start of Work

The Contractor was not be allowed to proceed with any operations that would require permanent lane or shoulder closures prior to March 1, 2002 for the FAI 70 eastbound pavement and interchange ramps, IL 1, the Rest Area, and the Weigh Station, nor prior to July 7, 2002 for the FAI 70 westbound pavement and interchange ramps, the Rest Area ramps adjacent to FAI 70, and the Weigh Station ramps adjacent to FAI 70. Daytime lane closures were allowed with the written permission from the Engineer.

Stage Construction Time Restrictions

The Contractor was to complete the east 2.5 miles of the eastbound lanes of FAI 70 and the eastbound ramps of US 40, including raising and painting all beams over the eastbound lanes on the US 40 bridge, prior to 11:59 PM on May 23, 2002.

All work was suspended on FAI 70 from the crossover west of the US 40 interchange to the Illinois/ Indiana State Line and opened to four-lane, two-way traffic from 12 Midnight on May 24, 2002, to 11:59 PM on July 7, 2002.

The Contractor was to complete the west 7.5 miles of the eastbound lanes of FAI 70 and the eastbound ramps of IL 1 prior to 11:59 PM on July 2, 2002.

The Contractor was not allowed to proceed with the reconstruction of the westbound lanes of FAI 70 until midnight of July 7, 2002.

The Contractor was to complete the east 2.5 miles of the westbound lanes of FAI 70 and the westbound ramps of US 40 prior to 11:59 PM on August 29, 2002.

All work was suspended on FAI 70 from the crossover west of the US 40 interchange to the Illinois/ Indiana State Line and opened to four-lane, two-way traffic from 12 Midnight on August 30, 2002, to 11:59 PM on September 3, 2002.

The Contractor was to complete the west 7.5 miles of the westbound lanes of FAI 70 and the westbound ramps of IL 1 prior to 11:59 PM on October 31, 2002.

All work was suspended for the Memorial Day, Fourth of July and Labor Day Holidays, between the following times and dates:

12 Midnight on May 24, 2002 and 11:59 PM on May 27, 2002

12 Midnight on July 3, 2002 and 11:59 PM on July 7, 2002

12 Midnight on August 30, 2002 and 11:59 PM on September 3, 2002

SUMMARY OF MAJOR PAY ITEMS:

<u>Pay Item</u>	<u>Quantity</u>
Earth Excavation	164,000 Cu. Yd.
Embankment	380,220 Cu. Yd.
4" Top Soil	16,166 Cu. Yd.
Aggregate Sub-base, 12"	244,611 Sq. Yd.
Pipe Underdrain Removal	226,584 Ft.
Pipe Underdrain	252,515 Ft.
Reinforcement Bars, Epoxy Coated	1,191,810 Lbs.
Portland Cement Concrete Jointed Pavement	73,754 Sq. Yd.
Continuously Reinforced Concrete Pavement	284,900 Sq. Yds.
Portland Cement Concrete Shoulders	237,900 Sq. Yd.
Furnishing & Erecting Precast Prestressed I-Beams	8,384 Ft.
Furnishing & Erecting Structural Steel	25,871 Lbs.
Concrete Structures	2,063 Cu. Yd.
Bridge Deck Protective Coat	13,933 Sq. Yd.
Bituminous Concrete Superpave	220,000 Tons
QC/QA Concrete	209,500 Cu. Yd.

CONTRACT SPECIFICATIONS:

Incentive/Disincentive Payment Plan

The contract included an incentive/disincentive payment based on the Contractor's performance in completing all contract items and safely opening all roadways to traffic during each stage of construction. The incentive/disincentive ranged from \$5,000 ~ \$40,000 per day with a maximum of 30 incentive days payable. The disincentive was not limited.

Extended Life Pavement (30 Years)

Existing Pavement Types and Cross Section

Mainline and Ramps

The existing pavement consisted of 7 ¾ inch and variable bituminous overlay on 8 inch continuously reinforced concrete pavement on a 4 inch bituminous base for a total pavement structure of 19 ¾ inches.

Proposed Pavement Types and Cross Section

Mainline

Concrete Overlay

The pavement design consisted of 12 inches of continuously reinforced concrete pavement (CRCP) constructed on a minimum of 4 inches of existing bituminous surface & binder overlays on the existing 8 inch CRCP.

Pavement Replacement

The pavement design consisted of 13 inches of CRCP with a 6 inch bituminous base course on 12 inches of aggregate sub-base for a total pavement structure of 31 inches.

Interchange Ramps

Pavement Replacement

The pavement design consisted of 10 inches of jointed reinforced concrete pavement (JRCP) with a 6 inch of bituminous base course on 12 inches of aggregate sub-base for a total pavement structure of 28 inches.

Rest Area Ramps & Parking Areas

Pavement Replacement

The pavement design consisted of 12 inches of JRCP with a 6 inch bituminous base course on 12 inches of aggregate sub-base for a total pavement structure of 30 inches.

Aggregates

The aggregates in the concrete mixture, make up around 70% of the volume of concrete pavement. To produce a High Durability Concrete, the aggregate used was restricted to more durable freeze-thaw resistant sources. This eliminated aggregate sources that are known to provide at least 20 years of service, but may not reach the required 30 year life. For 20 year pavements, the freeze-thaw rating expansion limit must be less than 0.060%. For the 30 year pavements, the expansion limit must be under 0.040%. This restriction along with the large volume of material required for this project, eliminated many of the producers from within a 50 mile radius of the project. There was 188,550 ton of coarse aggregate used for the production of the concrete in this contract.

Reinforcing Steel

Rusting of steel reinforcement in concrete pavements can cause deterioration of the concrete due to the expansive force of the corrosion. It can also structurally weaken pavements, leading to cracking, roughness, and the need for patching. The 30 year design required all tie-bars and longitudinal bars to be epoxy coated. This is the same as the technology used by the Department in other highly salted, and critical applications; such as, new bridge decks which have used "green bar" epoxy coated steel for the past 25 years. In addition to being epoxy coated, the bar sizes and spacing were revised from the 20 year design pavement as noted below:

20 Year Design

Longitudinal Bar - No. 7 at 7 ¼"(12" CRCP) & 6 ½"(13" CRCP) cts

Transverse Bar – No. 4 at 18" cts

Tie Bars - No. 6x30 at 30" cts

Top Cover - 3 ½"

30 Year Design

Longitudinal Bar - No. 7 at 6 ¼"(12" CRCP) & at 5 ¾"(13" CRCP) cts

Transverse Bar – No. 4 at 24" cts

Tie Bars - No. 8x30 at 24" cts

Top Cover - 4"

Curing of Pavement

For the pavement to cure, it must be kept in a moist condition to gain strength. The pavement was cured for 7 days versus the typical 3 days using standard spray-on curing membrane. During the curing period no traffic, including construction traffic, was allowed on the pavement. The additional days of curing ultimately provide stronger concrete with a reduced permeability, key factors in providing a pavement that is more resistant to stresses, abrasion, winter freeze/thaw and deicers.

Aggregate Sub-Base-12”

In the areas of pavement replacement the aggregate sub-base consisted of two lifts of coarse aggregate (CA). The initial lift consisted of 9 inches of an open-graded CA with a nominal maximum aggregate size of 6-inches for crushed stone, slag and concrete and 4 inches for crushed gravel. The final lift consisted of a 3 inch cap of CA with a nominal maximum aggregate size of 3 inches.

High Performance Concrete

In 1999, the Department awarded its first contract to utilize High Performance Concrete (HPC). The use of HPC in bridges in Illinois has been on a continual increase from that time. This contract included the use of HPC and a specification that required aggregate optimization of the coarse aggregate in the mixes on eleven (11) bridges. The High Performance Concrete specification allowed the Contractor to chose from six (6) different mix designs. It also required the use of fogging equipment attached to the finisher or separate work bridge, cotton mats, and a 14 day cure period.

The Aggregate Optimization specification was used to improve the workability of the mixes. The specification required the coarse aggregate to be uniformly blended and the percent passing the 12.5 mm (1/2 inch) sieve be a minimum of 50 percent. The producer was allowed to combine two or more coarse aggregate sizes.

Bridge Deck Sealers

Due to the increased use of anti-icing and de-icing salt solutions, IDOT has started a research investigation on the effectiveness of bridge deck sealers and laminates. Current specifications only require the application of boiled linseed oil when a bridge deck is constructed after October 15th and opened to traffic prior to the following April 15th. Three (3) types of penetrating water-repellent concrete sealers were used in this contract. The sealers selected had the most favorable test results in the salt scaling tests performed by IDOT's Bureau of Materials and Physical Research Laboratory. The sealers contained silane, siloxane, or a combination of the two. This investigation will continue for five years and should determine the most cost effective technique for protecting bridge deck concrete from deterioration.

Pavement Smoothness

Pavement life partly relates to how smooth the pavement is originally built. This project includes the latest in smoothness specifications called the "zero blanking band". In the past, small bumps of 0.20 inch were ignored as being a "natural" part of pavement construction. This practice results in a degree of roughness being accepted on every project. The "zero blanking band" counts all roughness, and provides incentive/disincentives to the contractor depending upon how smooth a pavement is constructed. It also provides limits of those areas that need additional corrective action such as bump grinding.

Originally investigated and adopted for 40 year pavement projects, the "zero blanking band" smoothness requirement is being adopted state-wide as part of the Illinois Smoothness Initiative. This Initiative is intended to improve constructed smoothness on all new pavements.

Variably Spaced Tining

One of the goals of IDOT was to develop a new specification that would reduce the noise level resulting from the final finish of the concrete surfaces. This contract included a special provision that revised the Department's specification for final finish of a concrete pavement. The revisions included the use of a 10 ft metal comb with steel tines variably spaced between 9/16 inch and 3-3/16 inch. The tining device was operated to produce a pattern of grooves at a 1:6 skew across the pavement. The new specification seems to have worked based on the positive feedback from the public.

Smoothness of Total Bridge Section

A pavement section is often perceived by the public as not being smooth due to the roughness of the bridge sections. A Total Bridge Section is defined as the bridge deck plus 200 feet on either side of the deck. This contract included two specifications to promote smoothness in the bridge sections.

The first specification required the grinding of the total bridge section to correct smoothness. To allow for this grinding the bridge decks were constructed with an additional ¼-inch of thickness.

The second specification was similar to the pavement's "zero blanking band" and is the first to require the use of a California Profilograph on a bridge deck. In the past, variations of 3/16 inch or less was considered acceptable. This practice results in a degree of roughness being accepted on every project. The specification included an incentive/disincentives to the contractor depending upon how smooth the Total Bridge Section was constructed.

Automated Information Management System (AIMS)

The Average Daily Traffic for this section varied from 21,000 to 24,000, with truck traffic varying from 10,900 to 11,100. Maintaining traffic and furnishing access to emergency vehicles was crucial to the successful completion of this project. The contract required the closure of the eastbound and westbound lanes during their reconstruction. Traffic was maintained by shifting traffic to either the eastbound or westbound lanes, depending on which was to be reconstructed, and providing for one lane traffic in each direction. To assist with the management of traffic, an AIMS was used to provide continuous real time monitoring of traffic within a twenty (20) mile radius of the project. The system included the use of changeable message boards, highway advisory radio systems, traffic sensors, portable cameras, CB radio advisory equipment, a website to display current traffic and message board status. All these devices were tied into one central base that provided twenty-four (24) hour surveillance. During emergencies or back up of traffic, this system would allow the District to switch message boards and other devices to alert the public to use alternate routes.

Pavement Warranty

There is a 5-year pavement warranty on the project requiring the contractor to repair any pavement related problems during this period. The warranty covers distresses associated with cracking, roughness, spalling, scaling and punchouts. The warranty is viewed more as an incentive to the contractor to do a good job during construction. If failures occur during this 5-year period they are expected to be the result of poor workmanship or substandard materials. The warranty will provide for repairs if distresses due to these problems appear.

Bridge Deck and Approach Pavement Warranty

There is a 5 year pavement warranty on the project requiring the contractor to fix any pavement related problems during this period. The warranty for the approach pavement covers distresses associated with roughness, spalling, scaling and punchouts. The warranty for the bridge deck covers distresses associated with roughness, spalling, scaling, delamination and joints. The warranty is viewed more as an incentive to the contractor to do a good job during construction. If failures occur during this 5 year period they are typically due to poor workmanship or substandard materials. The warranty will provide for repairs if distresses due to these problems appear.

Summary of Actual Completion Dates

This contract included four (4) significant completion dates, including a final completion date of October 31, 2002. This contract was on the Department's October 19, 2001 letting and had an award date of November 9, 2001. This contract had the most aggressive work schedule ever awarded by District 5 and perhaps the entire State. Listed below are comparisons of the contract completion dates and the actual completion dates along with the incentive/disincentive payment for each date. The contractor was not allowed to permanently close any lanes for the reconstruction of the ten (10) miles of interstate, including the rest area and weigh station, until March 1, 2002. Even with the aggressive work schedule the contract was completed seven (7) days ahead of schedule, with a total incentive of \$245,000.

<u>Contract Date</u>	<u>Actual Date</u>	<u>Incentive/(Disincentive)</u>
May 24, 2002	May 23, 2002	\$ 40,000.00
July 3, 2002	June 30, 2002	\$120,000.00
August 30, 2002	September 4, 2002	(\$155,000.00)
October 31, 2002	October 24, 2002	<u>\$240,000.00</u>

Total = \$245,000.00

For more information contact:

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Location Map



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