



Cuyahoga County Engineer's Office

Robert C. Klaiber, Jr., P.E., P.S.

County Engineer

# Cuyahoga County Constructs a Perpetual Pavement

Presented by:

Brian S. Driscoll, P.E.

Chief Highway Design Engineer

Ohio Transportation Engineering Conference

October 28, 2008

- ▶ The planning, design and construction of Cuyahoga County's Cedar Rd. Project From Brainard Rd. to Lander Rd. Constructed in 2007/2008.
- ▶ The Project Was Designed and Constructed as a Perpetual Pavement





# Perpetual Pavement: A Quick Primer

## ► From FPO Website:

- ...the concept produces a deep-strength asphalt pavement that can resist structural fatigue for a long time (at least 50 years)...

■

## ► From Asphalt Pavement Alliance (APA):

- ... paving design process, that with routine maintenance, extends the useful life of a roadway to half a century or more.

# Perpetual Pavement: A Quick Primer

## ► How it Works:

- High Performing Surface Course (3")
- Rut Resistant Upper Layers (?")
- Fatigue Resistant Asphalt Base (3"-4")

# Perpetual is a Big Word!

- ▶ PERPETUAL Pavement
- ▶ SUPERpave
- ▶ SMOOTHseal
- ▶ Warm Mix Asphalt

# Perpetual is a Big Word!

► I had a couple of questions:

- Perpetual: Is it just marketing?
- Can you really build an asphalt pavement that lasts 50 years?
- I KNOW we can build a concrete pavement that lasts 50 years!

91-4-0

STATE OF OHIO  
DEPARTMENT OF HIGHWAYS

**WILSON MILLS ROAD**  
COUNTY ROAD NO. 73

CUYAHOGA COUNTY  
VILLAGES OF RICHMOND HEIGHTS,  
HIGHLAND HEIGHTS, AND MAYFIELD

CONVENTIONAL SIGNS

INDEX OF SHEETS

LINE DATA

FEEDBACK

LOCATION PLAN

DEPARTMENT OF COMMERCE  
BUREAU OF PUBLIC ROADS

820

# Wilson Mills Road - 1958

## 9" Reinforced Concrete Pavement





**LOCATION MAP**  
2" = 200'  
0 2000 4000 8000  
SCALE IN FEET

LONGITUDE: 81°-25'-35"

AND STATE ROUTES

UNDERGROUND UTILITIES  
NO (2) WORKING DOWNS  
**BEFORE YOU DIG**  
800-365-2764 (TOLL FREE)  
UTILITIES PROTECTION SERVICE  
NEW MEMBERS  
NOT BE CALLED DIRECTLY  
- AND -  
800-925-0988 (TOLL FREE)  
TO OIL & GAS PRODUCERS  
GROUND PROTECTION SERVICE

PLAN PREPARED BY:  
CUYAHOGA COUNTY ENGINEER OFFICE  
6 SUMMIT STREET  
MELAND, OHIO 44113  
(216) 348-3800

## CUYAHOGA COUNTY

# WILSON MILLS ROAD ICR - 731

### 2007 OPERATIONS

### RESURFACING PROGRAM

## CITIES OF RICHMOND HEIGHTS AND HIGHLAND HEIGHTS

## STATE OF OHIO

**PROJECT DESCRIPTION**  
THE WORK WITHIN THE LIMITS OF THIS IMPROVEMENT INCLUDES THE RESURFACING OF 1.8 MILES OF ROADWAY, THE REMOVAL OF THE EXISTING ASPHALT CONCRETE WEARING COURSE, REPLACEMENT OF DEGRADED PAVEMENT BASE, THE CONSTRUCTION OF A FIBERIZED ASPHALT OVERLAY, THE INSTALLATION OF ADA COMPLIANT CURB RAMPS AND OTHER RELATED ITEMS AS SHOWN ON THE PLANS OR STIPULATED IN THE SPECIFICATIONS, PLAN NOTES, PROPOSAL NOTES OR ELSEWHERE IN THE BID PACKAGE.

**EARTH DISTURBED AREAS**  
PROJECT EARTH DISTURBED AREA..... > 1 ACRE  
ESTIMATED CONTRACTOR EARTH DISTURBED AREA N/A (MAINTENANCE PROJECT)  
NOTICE OF INTENT EARTH DISTURBED AREA N/A (MAINTENANCE PROJECT)

**2005 SPECIFICATIONS**  
THE STANDARD CONSTRUCTION AND MATERIAL SPECIFICATIONS OF THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION SHALL GOVERN THIS IMPROVEMENT EXCEPT WHEN MODIFIED BY THE PLANS, SPECIAL PROVISIONS, SUPPLEMENTAL SPECIFICATIONS OR PROVISIONAL NOTES.

ROBERT C. KLAIBER, JR., P.E., P.S.  
COUNTY ENGINEER

I HEREBY APPROVE THESE PLANS AND DECLARE THAT THE MAKING OF THIS IMPROVEMENT WILL NOT REQUIRE THE CLOSING OF THE HIGHWAY TO TRAFFIC AND THAT PROVISIONS FOR THE MAINTENANCE AND SAFETY OF TRAFFIC WILL BE AS SET FORTH ON THE PLANS AND ESTIMATES.

APPROVED: *[Signature]* DATE: 8/13/05  
COUNTY ENGINEER

**BOARD OF COMMISSIONERS**  
*[Signature]* DATE: 8/13/05  
CUYAHOGA COUNTY COMMISSIONER  
*[Signature]* DATE: 8/13/05  
CUYAHOGA COUNTY COMMISSIONER  
*[Signature]* DATE: 8/13/05  
CUYAHOGA COUNTY COMMISSIONER

JOURNAL NO. 735 PAGE 1 DATE: 8/13/05  
RESOLUTION NO. 070819

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**APPROVED IN THE CITY OF RICHMOND HEIGHTS**  
ORDINANCE OF CONSENT NO. 47-2005  
PASSED DATE 8-30-05

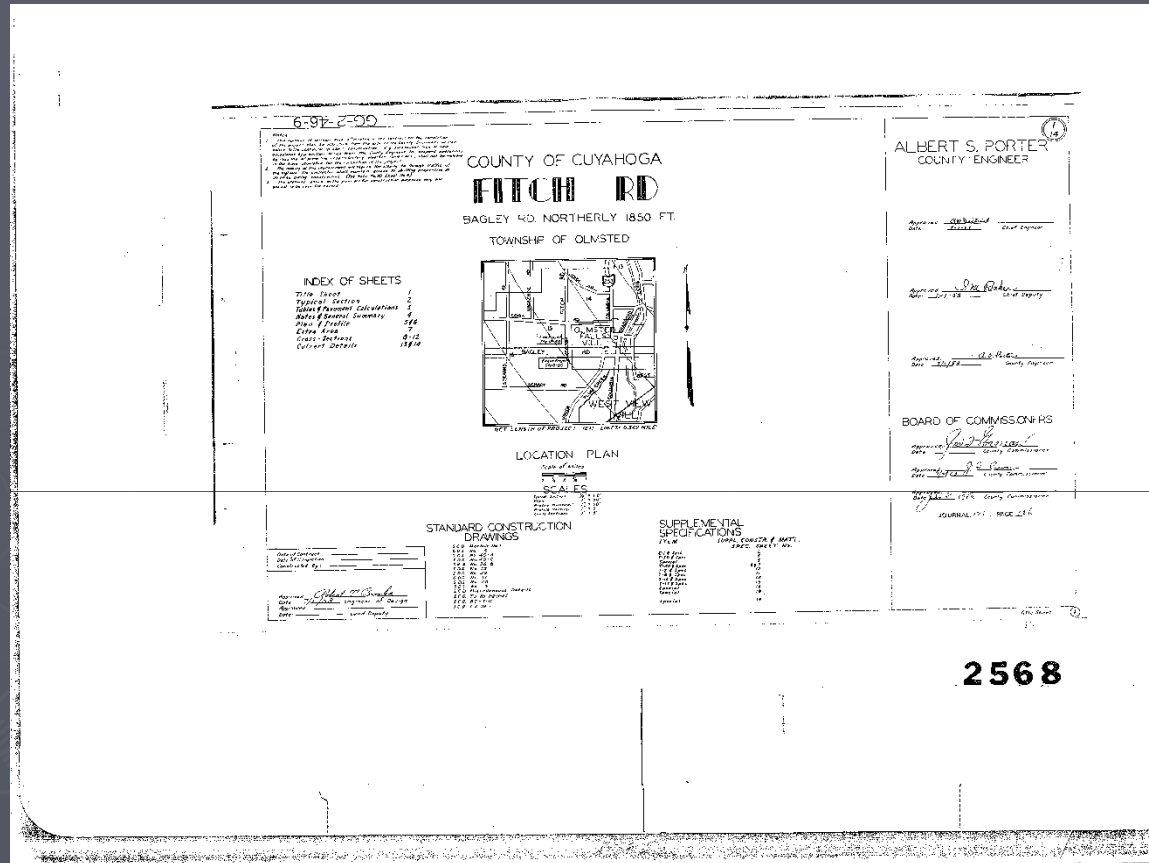
**APPROVED IN THE CITY OF HIGHLAND HEIGHTS**  
ORDINANCE OF CONSENT NO. 32-2005  
PASSED DATE 8-13-05

**OHIO DEPARTMENT OF TRANSPORTATION**  
STANDARD CONSTRUCTION DRAWINGS

NUMBER	DATE	NUMBER	DATE	NUMBER	DATE	NUMBER	DATE	NUMBER	DATE	NUMBER	DATE
SP-1.1	07-12-09	SP-1.2	07-12-09	SP-1.3	07-12-09	SP-1.4	07-12-09	SP-1.5	07-12-09	SP-1.6	07-12-09
SP-2.1	07-12-09	SP-2.2	07-12-09	SP-2.3	07-12-09	SP-2.4	07-12-09	SP-2.5	07-12-09	SP-2.6	07-12-09
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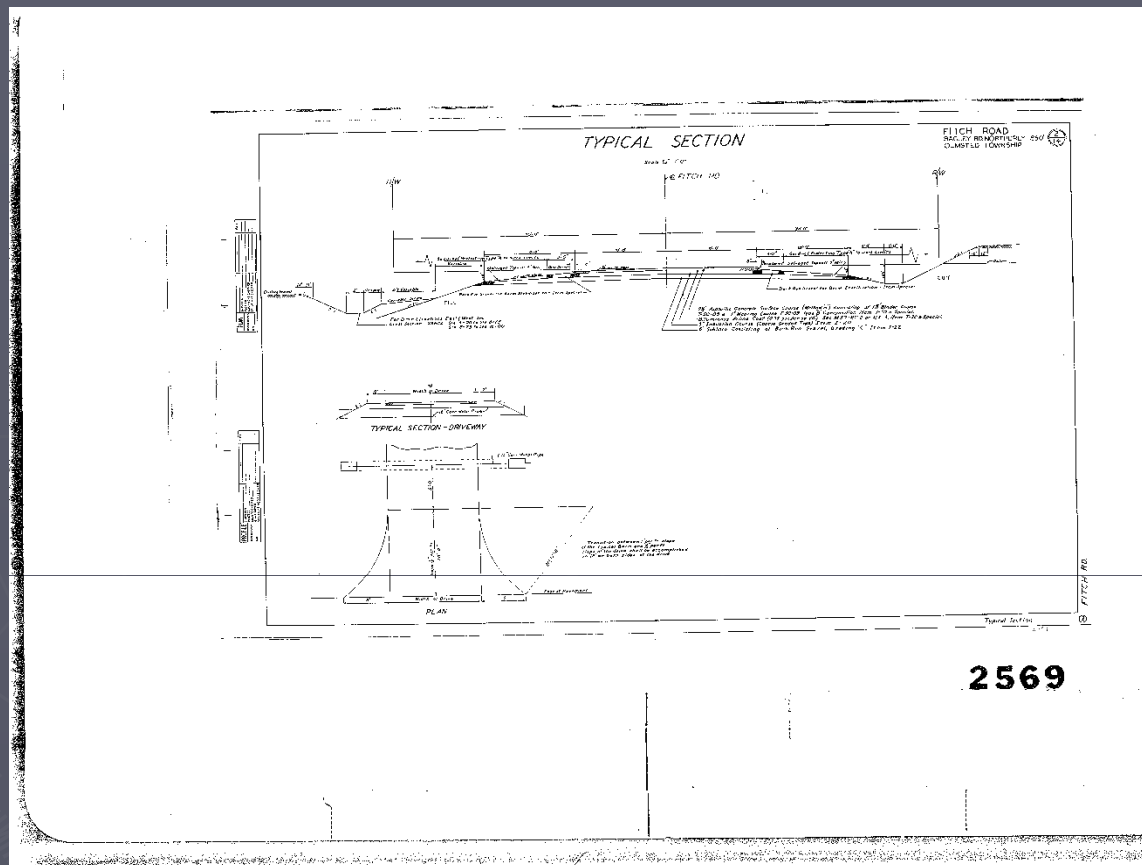
# Perpetual is a Big Word!

- ▶ OK, we can build a concrete pavement that meets the definition of “perpetual”.
- ▶ Hey, it needed the help of some asphalt didn't it!
- ▶ But, can we build a long-life full-depth asphalt pavement?



# Fitch Road - 1953

## Original Construction



2569

## Fitch Road - 1953

2-1/2" Asphaltic Surface Course T-50

5" Insulation Course

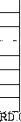
6" Subbase



.....

# Fitch Road - 1989

## Operations Resurfacing Program



# Structural Shoulder Construction

FINAL BID PLANS  
HIGHWAY DESIGN COPY

**NOTES:**  
THE CONTRACTOR SHALL COOPERATE WITH THE ENGINEER IN PROJECTING AND PRESERVING ADJACENT TRAFFIC WITHIN THE HIGHWAY AS REQUIRED BY SEC. 5519-05 OF THE REVENUE CODE OF OHIO.  
THE STATIONS SHOWN ON THE PLANS ARE FOR CONSTRUCTION PURPOSES AND ARE NOT TO BE USED FOR RECORD.

**CONVENTIONAL PLAN SYMBOLS**  
— COUNTY LINE  
— CORPORATION LINE  
— CENTER LINE  
— RAILROAD TRACKS

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TYPICAL SECTIONS . . . . . 14 - 18

**SPECIFICATIONS**  
THE CONSTRUCTION AND MATERIAL SPECIFICATIONS DATED 1995 PUBLISHED BY THE OHIO DEPARTMENT OF TRANSPORTATION (ODOT) SHALL GOVERN THIS PROJECT EXCEPT WHEN MODIFIED BY THE PLANS, SPECIAL PROVISIONS, SUPPLEMENTAL SPECIFICATIONS OR PROPOSAL NOTES.

**STANDARD CONSTRUCTION DRAWINGS**

NUMBER	DATE	REVISION	DATE	NUMBER	DATE	REVISION	DATE
BP-11	7-28-00	* ME-50	10-29-04	MT-27.10	14-19-02	PC-41.10	11-19-01
* BP-41C	10-29-01	* ME-70	10-29-04	MT-27.11	4-18-02	PC-41.20	6-19-01
				MT-105.10	4-18-04	TC-42.10	10-22-01
				MT-105.11	4-25-04	TC-42.10	4-20-01
* ME-11	7-25-01			* ME-11C	11-16-01	TC-42.10	4-20-01
* ME-11C	10-29-01			* ME-20	3-24-05		
* ME-11C	10-29-01						

**SUPPLEMENTAL SPECIFICATIONS**

NUMBER	DATE
806	10-29-01
870	3-27-01
877	4-17-01
878	1-27-01
885	7-05-01
887	10-29-01
889	11-02-01

**UNDERGROUND UTILITIES**  
2. MARKING PLAYS BEFORE YOU DIG  
Call, Excavate, Care, Cover, or Call  
Once you have located the utility, you must be careful to mark it.

**LOCATION MAP**  
END PROJECT STA. 33+75  
END PROJECT STA. 27+80  
RESUME PROJECT STA. 9+56.3  
SUSPEND PROJECT STA. 9+19.5  
BEGIN PROJECT STA. 0+12

**COUNTY OF CUYAHOGA**  
**OPERATIONS RESURFACING PROGRAM:**  
**FITCH ROAD (CR-170)**  
**MACKENZIE ROAD (CR-86)**  
**IN OLMSTED TOWNSHIP, OHIO**

**APPROVED:** \_\_\_\_\_  
**DATE:** \_\_\_\_\_  
**COUNTY ENGINEER**

**APPROVED:** \_\_\_\_\_  
**DATE:** \_\_\_\_\_  
**COUNTY COMMISSIONER**

**APPROVED:** \_\_\_\_\_  
**DATE:** \_\_\_\_\_  
**COUNTY COMMISSIONER**

**APPROVED:** \_\_\_\_\_  
**DATE:** \_\_\_\_\_  
**COUNTY COMMISSIONER**

**BOARD OF CUYAHOGA COUNTY COMMISSIONERS**

**ROBERT C. KLABER JR., P.E., P.S.**  
**CUYAHOGA COUNTY ENGINEER**

**TITLE SHEET**  
**OPERATIONS PROGRAM**  
**FITCH RD. CR. 170**  
**MACKENZIE RD. CR. 86**

**312 OLMSBURY**  
**CLEVELAND, OHIO 44113**  
**(714) 319-1800**

# Fitch Road - 2002

## Operations Resurfacing Program



# Quick Review

- ▶ Perpetual Pavement = 50+ Year Useful Life
- ▶ Multiple Asphalt Layers Designed Mechanistically to Resist Long-Term Structural Problems Such As Fatigue and Rutting
- ▶ History Has Shown That This CAN Be Accomplished With BOTH Concrete AND Asphalt Pavements!



# Project Overview

- ▶ Cedar Road Reconstruction and Widening
- ▶ From Brainard Rd. to Lander Rd.
- ▶ In the Cities of Lyndhurst, Mayfield Heights, and Pepper Pike



# Project Overview

- ▶ Design and Construction Managed by the Cuyahoga County Engineer's Office
- ▶ Plans Prepared by DLZ
- ▶ Design Assistance Provided by Flexible Pavements of Ohio
- ▶ Contractor: Burton Scot Contractors, LLC
- ▶ Bid Amount: \$5,160,899.00



# Project Overview

- ▶ Approximately 0.7 Miles of Full-Depth Full-Width “Perpetual Pavement” Between Brainard Rd. and Lander Rd.
- ▶ Some Composite Pavement West of Brainard
- ▶ Some Composite Pavement on Brainard
- ▶ Some Composite Pavement on Lander

# Project Overview

- ▶ New Lane Configuration Varies and Isn't Really Important Here
- ▶ Project Also Includes:
  - Sanitary Sewer
  - Storm Sewers and Culverts
  - Sidewalk
  - Traffic Signals



# Conventional Asphalt Pavement

- ▶ Pavement Type Selection: Decision Made Early On. 2002 or 2003 ?
- ▶ Choice was Full-Depth Flexible.
- ▶ “Perpetual Pavement” Was (practically) Unknown

# Conventional Asphalt Pavement

- ▶ DLZ Provided a Conventional Full-Depth Flexible Pavement Design
- ▶ Used All the Regular Parameters:
  - Current ADT (22676)
  - Design ADT (23421)
  - Trucks 5%
  - B:C Ratio 2:1
  - Directional Distribution (57% Eastbound)
  - Mr 7200 PSI (From Geotechnical Report)
  - CBR 6 (From Geotechnical Report)
  - G.I. 8 to 11 (From Geotechnical Report)

# Conventional Asphalt Pavement

- ▶ Follow the Design Guidelines in Section 200 and 400 of the ODOT Pavement Design & Rehabilitation Manual

# Conventional Asphalt Pavement

## ► The Result: Design Structural Number: 4.5

- 448 AC Surface  $1.25'' \times 0.35 = 0.44$
- 448 AC Intermediate  $1.75'' \times 0.35 = 0.61$
- 302 Bitum. Agg. Base  $9'' \times 0.35 = 3.15$
- 304 Aggregate Base  $6'' \times 0.14 = 0.84$
- Total Pavement Structure  $18'' = 5.04$

# Perpetual Pavement

- ▶ OK, Finally Let's Talk About Perpetual Pavement!
- ▶ We had DLZ Talk To Flexible Pavements of Ohio
- ▶ Flexible Pavements of Ohio Turned to Their Own Experts to Provide a Perpetual Pavement Design



# Perpetual Pavement

- ▶ The Resulting Perpetual Pavement Design:
  - 1.5" 442 AC Surface Course, 12.5 mm Superpave Type A (446), PG 70-22M
  - 1.75" 442 AC Intermediate Course, 19mm Superpave Type A (446), PG 70-22M
  - 4.75" 302 Bit. Agg. Base, PG 64-22 Compacted to 93% Minimum Density
  - 4" 302 Bit. Agg. Base, PG 64-22 Designed at 3% Air Voids, Compacted to 94% Minimum Density
  - 6" 304 Aggregate Base
  - TOTAL PAVEMENT STRUCTURE = 18"

# Perpetual Pavement Cost Factors

- ▶ But Could We Afford the “Good Stuff”?
- ▶ Flexible Pavements of Ohio Estimated Perpetual Pavement to Be 10% More Than Conventional Full-Depth Flexible Pavement

# Perpetual Pavement Cost Factors

► Cost of Perpetual Pavement (From Cedar Rd. Bid Tabs)

► Area of Perpetual Pavement = 22,464 S.Y.

■ Item 442 1-1/2" Surface	\$121,680
■ Item 407 Tack for Int.	\$ 1,864
■ Item 442 1-3/4" Intermediate	\$131,040
■ Item 407 Tack for Int.	\$ 1,864
■ Item 302 4-3/4" 93% Min. Density	\$275,652
■ Item 407 Tack	\$ 3,792
■ Item 302 4" 3% Air, 94% Den.	\$232,035
■ Item 408 Prime Coat	\$ 23,667
■ Item 304 6"Agg. Base	\$142,272
■ Item Spl. Geotextile Fabric	\$ 28,080
■ Item 204 Subgrade Compaction	\$ 33,699
■ TOTAL	\$995,645

# Perpetual Pavement Cost Factors

- ▶ Total Bid Price = \$5,160,899.00
- ▶ Total Cost of Perpetual Pavement = \$995,645\*
- ▶ So a 10% Premium for Perpetual Pavement Means We Paid About \$100,000 More.
- ▶  $\$5,160,899 / \$5,060,899 = 102\%$
- ▶ Therefore, We Can Assume That We Paid a 2% Premium Over Total Cost of Project.

# Perpetual Pavement Cost Factors

- ▶ Let's Compare to Conventional Full-Depth Flexible
  - DLZ Had Provided a Pavement Design for Conventional Full-Depth Flexible Pavement.
  - Our Cedar Rd. Project Contained Conventional Pavement Courses Such as 448 Intermediate and 448 Surface.
  - The Only Bid Item Not Available in the Cedar Rd. Contract Was the Conventional 302 Bituminous Aggregate Base.

# Perpetual Pavement Cost Factors

## ► Let's Compare to Conventional Full-Depth Flexible

- Cedar Rd.: 442 Surface 12.5 mm Type A (448) – 936 C.Y. @ \$130.00
- Cedar Rd. 448 Surface Type 1 – 780 C.Y. @ \$118.00
- Cedar Rd. 442 Intermediate 19mm Type A (448) 1092 C.Y. @ \$120.00
- Cedar Rd. 448 Intermediate Type 2 – 1092 C.Y. @ \$105.00



# Perpetual Pavement Cost Factors

## ► Let's Compare to Conventional Full-Depth Flexible

- Fortunately For Us, We had Bid a Conventional Full-Depth Flexible Road Project at Around the Same Time.
- This Project Contained 302 Bituminous Aggregate Base.
- Bassett-Crocker Rd.: 302 Bit. Agg. Base – 5617 C.Y. @ \$100.00
- Cedar Rd.: 302 Bit. Agg. Base 3% Air Compacted to 94% Min. Density – 2495 C.Y. @ \$93.00
- Cedar Rd.: 302 Bit. Agg. Base Compacted to 93% Minimum Density – 2964 C.Y. @ \$93.00

# Perpetual Pavement Cost Factors

## ► Let's Compare to Conventional Full-Depth Flexible

■ Item 448 1-1/4" Surface	\$ 92,040
■ Item 407 Tack for Int.	\$ 1,864
■ Item 448 1-3/4" Intermediate	\$114,660
■ Item 407 Tack for Int.	\$ 1,864
■ Item 302 9" Bit. Agg. Base	\$561,700 ***
■ Item 408 Prime Coat	\$ 23,667
■ Item 304 Agg. Base	\$142,272
■ Item Spl. Geotextile Fabric	\$ 28,080
■ Item 204 Subgrade Compaction	\$ 33,699
■ TOTAL	\$999,846

# Cost Factors

- ▶ What About --- Gulp! --- CONCRETE??
- ▶ Our (County Standard) Minimum Thickness Would Be 10"
- ▶ Burton Scot Bid \$42.50 / sy for 9" RCP
- ▶ On Crocker-Stearns (10" RCP), Low Bidder = \$39.50 / sy
- ▶ Average of All Crocker-Stearns Bidders = \$47.00 / sy

# Cost Factors

## ► Cost of Concrete Pavement

■ Item 451 10" RCP	\$1,055,808
■ Item 304 6" Agg. Base	\$ 142,272
■ Item Spl. Geotextile Fabric	\$ 28,080
■ Item 204 Subgrade Compaction	\$ 33,699
■ TOTAL	\$1,259,859

►  $\$1,259,859 / \$995,645 = 127\%$

# Construction Administration Concerns

## ► Testing

- Plans Called for Item 302 Base Course To Be Placed With a Density Requirement
- County Had No Experience Testing for Density Due to Use of Item 448 on County Jobs
- Flexible Pavements of Ohio Suggested Use of ODOT SS 1055 for Both Base Courses and Intermediate / Surface Courses

# Construction Administration Concerns

## ► Other Considerations

- Both Surface and Intermediate Courses Utilize PG 70-22M Binder
- Normal ODOT Specification (442.04) Calls for PG 64-22 Intermediate Course



# Construction Administration Concerns

## ► Other Considerations (Cont.)

- Subgrade Preparation
- Utility Issues
- Maintenance of Traffic – Elevated Pavement Placement Temperatures



Questions?