Cuyahoga County Engineer's Office

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County Engineer

Cuyahoga County Constructs a Perpetual Pavement

Presented by:
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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

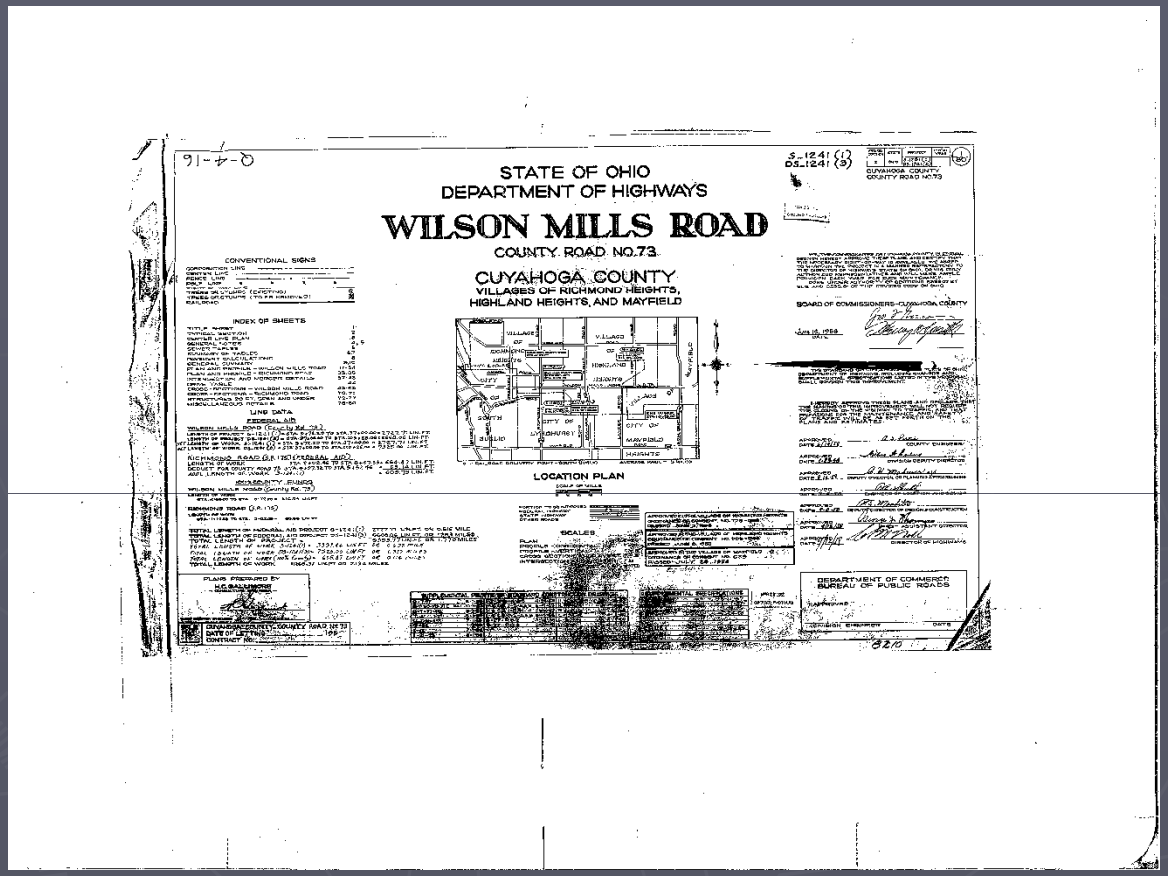
- How it Works:
  - High Performing Surface Course (3”)
  - Rut Resistant Upper Layers (?”)
  - Fatigue Resistant Asphalt Base (3”-4”)

Perpetual is a Big Word!

- PERPETUAL Pavement
- SUPERpave
- SMOOTHseal
- Warm Mix Asphalt

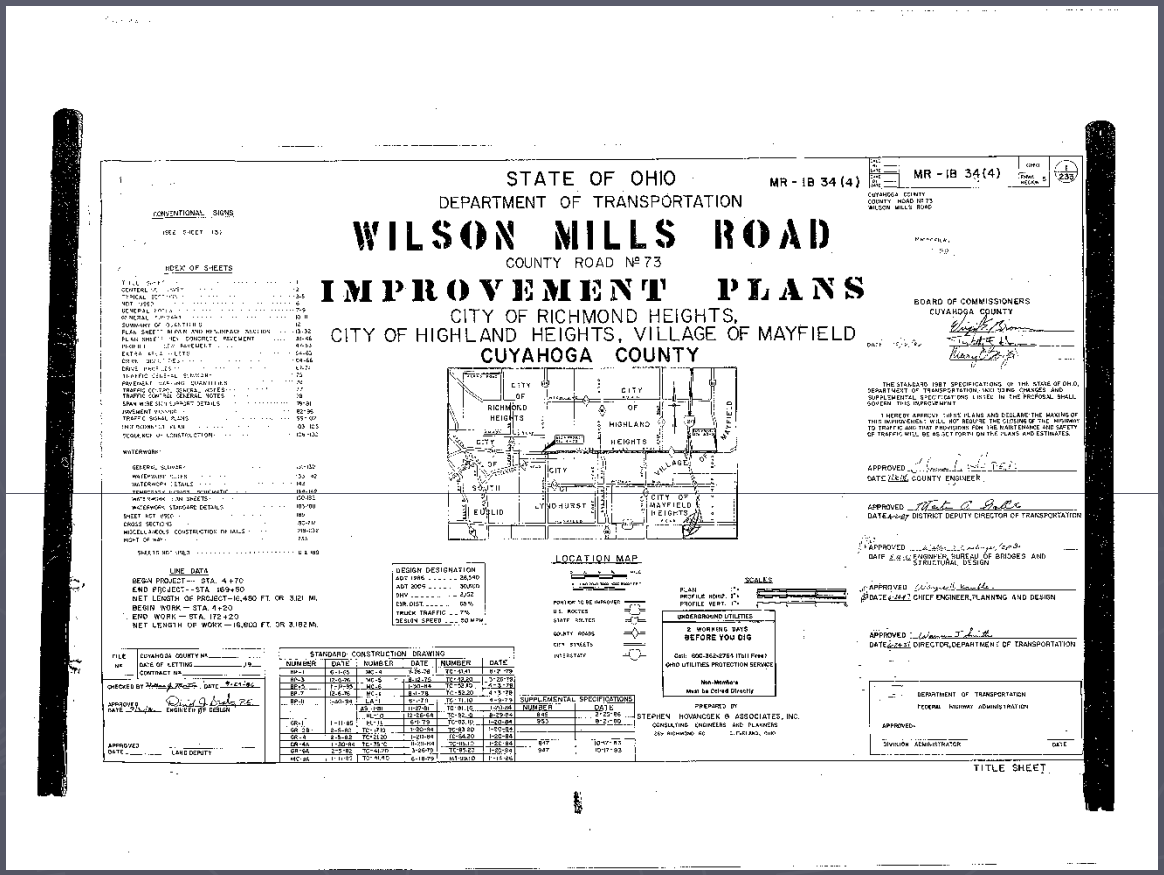
Perpetual is a Big Word!

- 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!



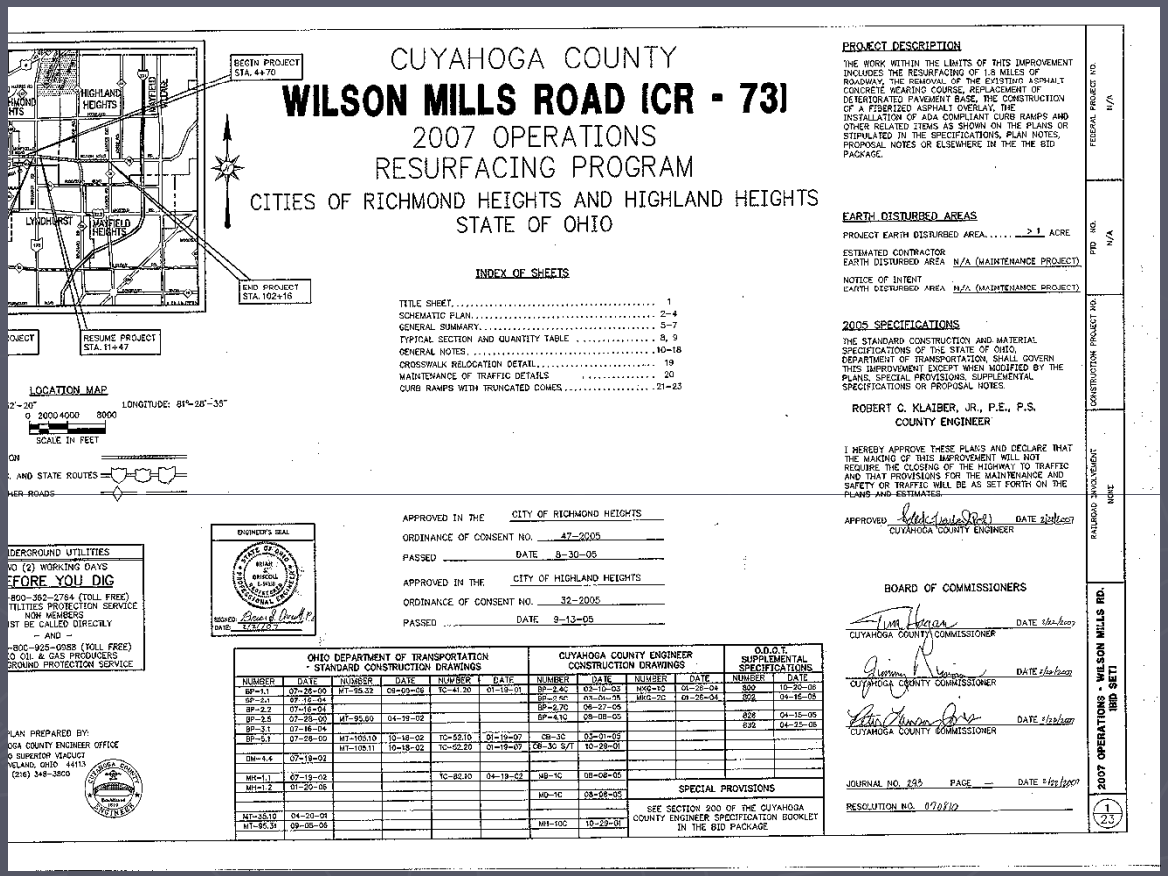
Wilson Mills Road - 1958

9” Reinforced Concrete Pavement


STATE OF OHIO
DEPARTMENT OF TRANSPORTATION
MR - 1B 34 (4)
WILSON MILLS ROAD
COUNTY ROAD Nº 73
IMPROVEMENT PLANS
CITY OF RICHMOND HEIGHTS,
CITY OF HIGHLAND HEIGHTS, VILLAGE OF MAYFIELD
CUYAHOGA COUNTY
INDEX OF SHEETS
LOCATION MAP
BOARD OF COMMISSIONERS
CUYAHOGA COUNTY
STANDARD CONSTRUCTION DRAWING
SUPPLEMENTAL SPECIFICATIONS
STEPHEN HOVANCSEK & ASSOCIATES, INC.
CONSULTING ENGINEERS AND PLANNERS
TITLE SHEET

Wilson Mills Road - 1987

3” Asphalt Overlay



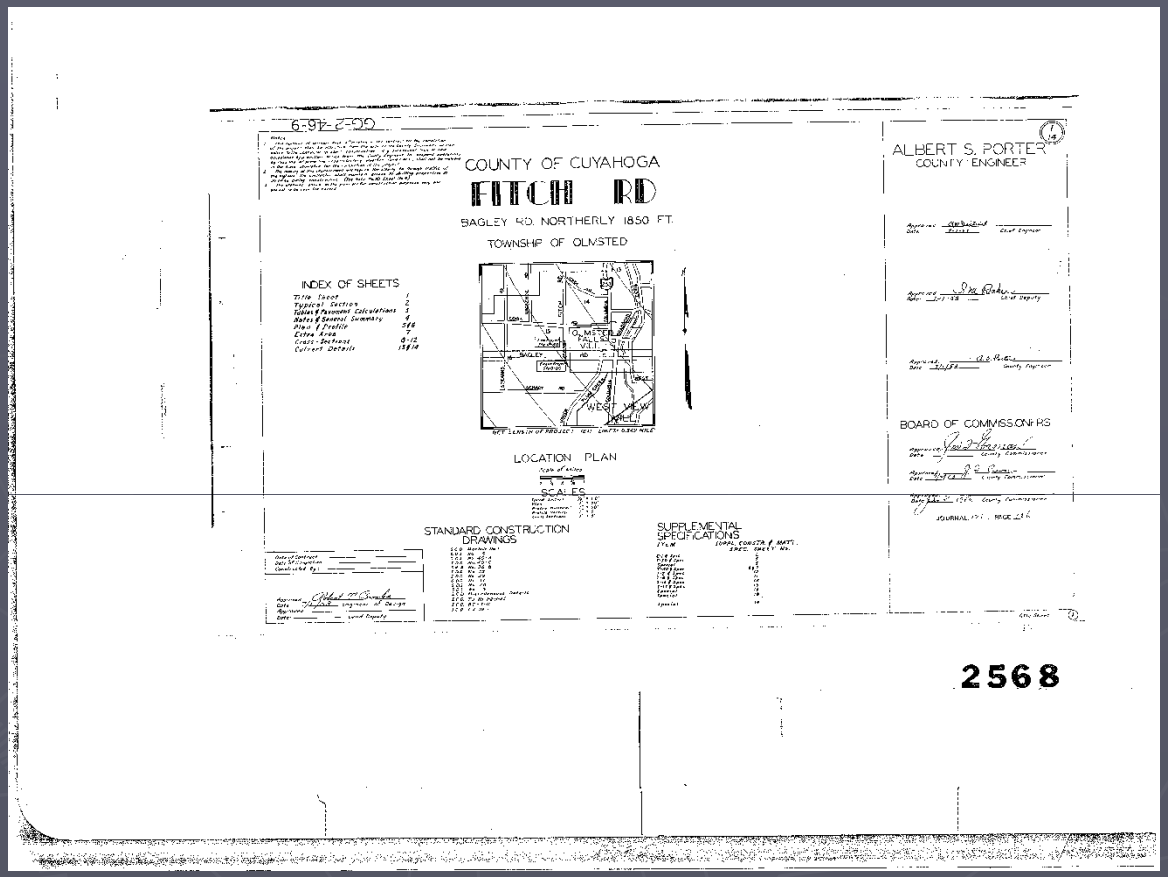
Wilson Mills Road - 2007

Wearing Course Removed

3” Asphalt Overlay

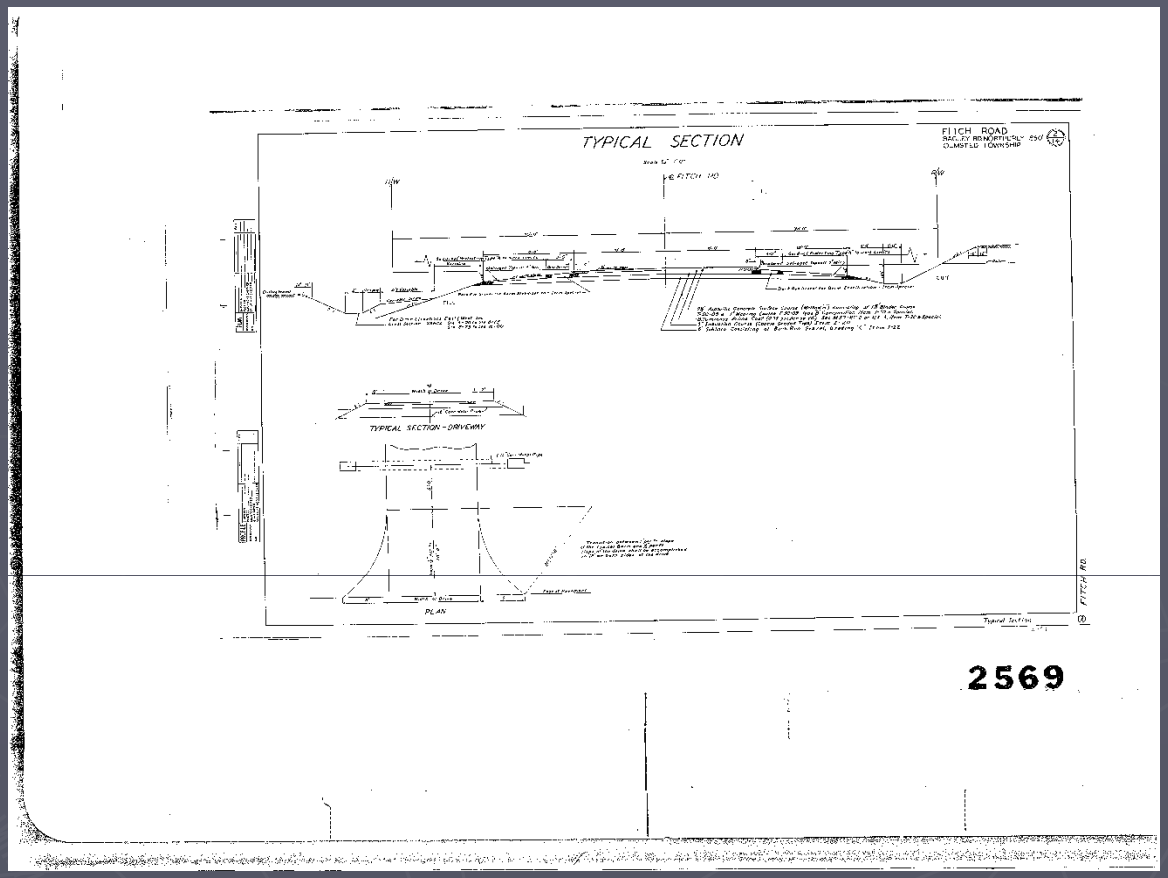
Perpetual is a Big Word!

- 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

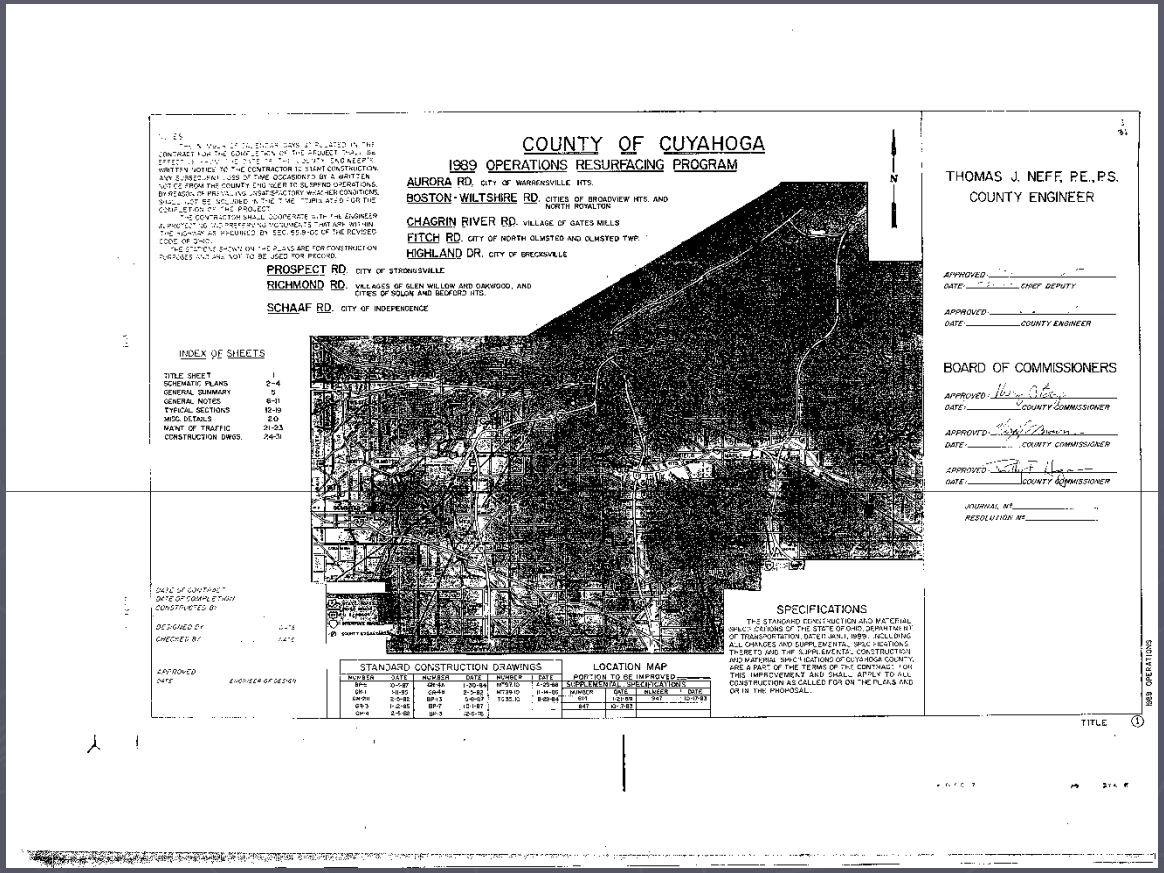


Fitch Road - 1953

2-1/2” Asphaltic Surface Course T-50

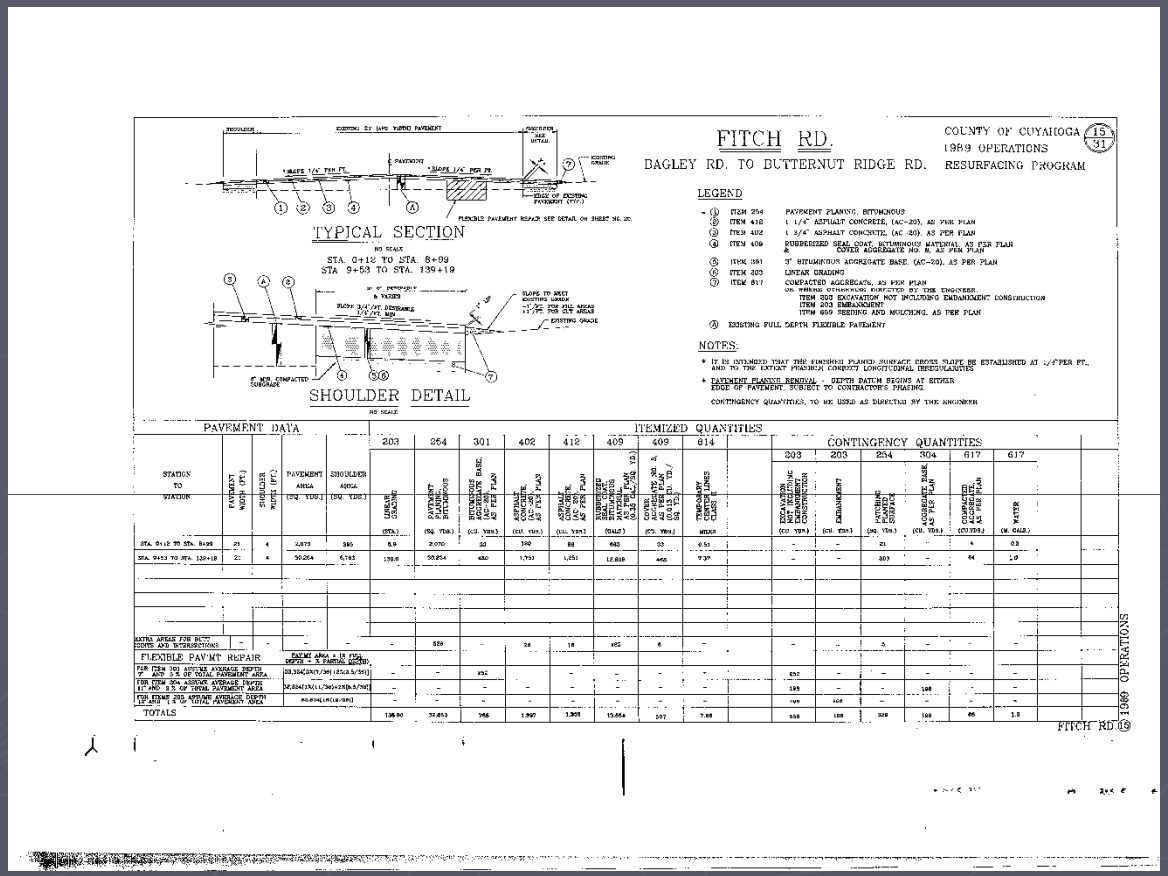
5” Insulation Course

6” Subbase



Fitch Road - 1989

Operations Resurfacing Program



FITCH RD.

BAGLEY RD. TO BUTTERNUT RIDGE RD.

COUNTY OF CUYAHOGA
1989 OPERATIONS
RESURFACING PROGRAM

TYPICAL SECTION

NO SCALE

STA. 0+12 TO STA. 8+99
STA 9+53 TO STA. 139+19

SHOULDER DETAIL

NO SCALE

LEGEND

- ① ITEM 254 PAVEMENT PLANING, BITUMINOUS
- ⑥ ITEM 418 1 1/4" ASPHALT CONCRETE, (AC-20), AS PER PLAN
- ⑧ ITEM 402 1 3/4" ASPHALT CONCRETE, (AC-20), AS PER PLAN
- ⑨ ITEM 409 RUBBERIZED SEAL COAT, BITUMINOUS MATERIAL AS PER PLAN & COVER AGGREGATE NO. 8, AS PER PLAN
- ⑤ ITEM 301 3" BITUMINOUS AGGREGATE BASE, (AC-20), AS PER PLAN
- ④ ITEM 203 LINEAR GRADING
- ⑦ ITEM 617 COMPACTED AGGREGATE, AS PER PLAN OR WHERE OTHERWISE DIRECTED BY THE ENGINEER
  - ITEM 203 EXCAVATION NOT INCLUDING EMBANKMENT CONSTRUCTION
  - ITEM 203 EMBANKMENT
  - ITEM 659 SEEDING AND MULCHING, AS PER PLAN
- Ⓐ EXISTING FULL DEPTH FLEXIBLE PAVEMENT

NOTES:

* IT IS INTENDED THAT THE FINISHED PLANED SURFACE CROSS SLOPE BE ESTABLISHED AT 1/4" PER FT., AND TO THE EXTENT PRACTICAL CORRECT LONGITUDINAL IRREGULARITIES
+ PAVEMENT PLANING REMOVAL - DEPTH PATCH REQUIRED AT EITHER EDGE OF PAVEMENT, SUBJECT TO CONTRACTOR'S PHASING

CONTINGENCY QUANTITIES, TO BE USED AS DIRECTED BY THE ENGINEER

PAVEMENT DATA / ITEMIZED QUANTITIES

STATION TO STATION	PAVEMENT WIDTH (FT.)	SHOULDER WIDTH (FT.)	PAVEMENT AREA (SQ. YDS.)	SHOULDER AREA (SQ. YDS.)	203 LINEAR GRADING (STA.)	254 PAVEMENT PLANING BITUMINOUS (SQ. YDS.)	301 BITUMINOUS AGGREGATE BASE, AS PER PLAN (CU. YDS.)	402 ASPHALT CONCRETE, (AC-20) AS PER PLAN (CU. YDS.)	418 ASPHALT CONCRETE, (AC-20) AS PER PLAN (CU. YDS.)	409 RUBBERIZED SEAL COAT, BITUMINOUS MATERIAL AS PER PLAN (0.32 GAL./SQ. YD.) (GALS.)	409 COVER AGGREGATE NO. 8, AS PER PLAN (0.32 CU. YD./ SQ. YD.) (CU. YDS.)	614 TEMPORARY PAVEMENT MARKINGS CLASS II (MILES)
STA. 0+12 TO STA. 8+99	21	4	2,873	395	8.9	2,070	32	160	88	662	33	0.51
STA. 9+53 TO STA. 139+19	21	4	30,254	4,195	130.6	30,254	480	1,753	1,251	12,849	466	7.37
EXTRA AREAS FOR SIDE ROADS AND INTERSECTIONS	-	-	-	-	-	529	-	26	18	165	6	-
FLEXIBLE PAVMT REPAIR			PAVMT AREA + 1ft (DEPTH = 5 PARTIAL DEPTH)									
FOR ITEM 301 ABOVE AVERAGE DEPTH 3" AND 2.5% OF TOTAL PAVEMENT AREA			28,354(3ft)(1/36)(2.5/3ft)=		-	-	262	-	-	-	-	-
FOR ITEM 304 ABOVE AVERAGE DEPTH 8" AND 2.5% OF TOTAL PAVEMENT AREA			28,354(8ft)(1/36)+28(8.5/9ft)=		-	-	-	-	-	-	-	-
FOR ITEM 202 ABOVE AVERAGE DEPTH 18" AND 1.5% OF TOTAL PAVEMENT AREA			85,062(18ft)(1/36)=		-	-	-	-	-	-	-	-
TOTALS					139.50	32,853	966	1,937	1,357	13,676	507	7.88

CONTINGENCY QUANTITIES

203 EXCESS EXCAVATION NOT INCLUDING EMBANKMENT CONSTRUCTION (CU YDS.)	203 EMBANKMENT (CU. YDS.)	254 PAVEMENT PLANED BITUMINOUS (SQ. YDS.)	304 AGGREGATE BASE, AS PER PLAN (CU. YDS.)	617 COMPACTED AGGREGATE AS PER PLAN (CU.YDS.)	617 WATER (M. GALS.)
-	-	21	-	4	0.3
-	-	303	-	64	1.6
-	-	5	-	-	-
252	-	-	-	-	-
189	-	-	198	-	-
189	168	-	-	-	-
252	168	329	198	68	1.9

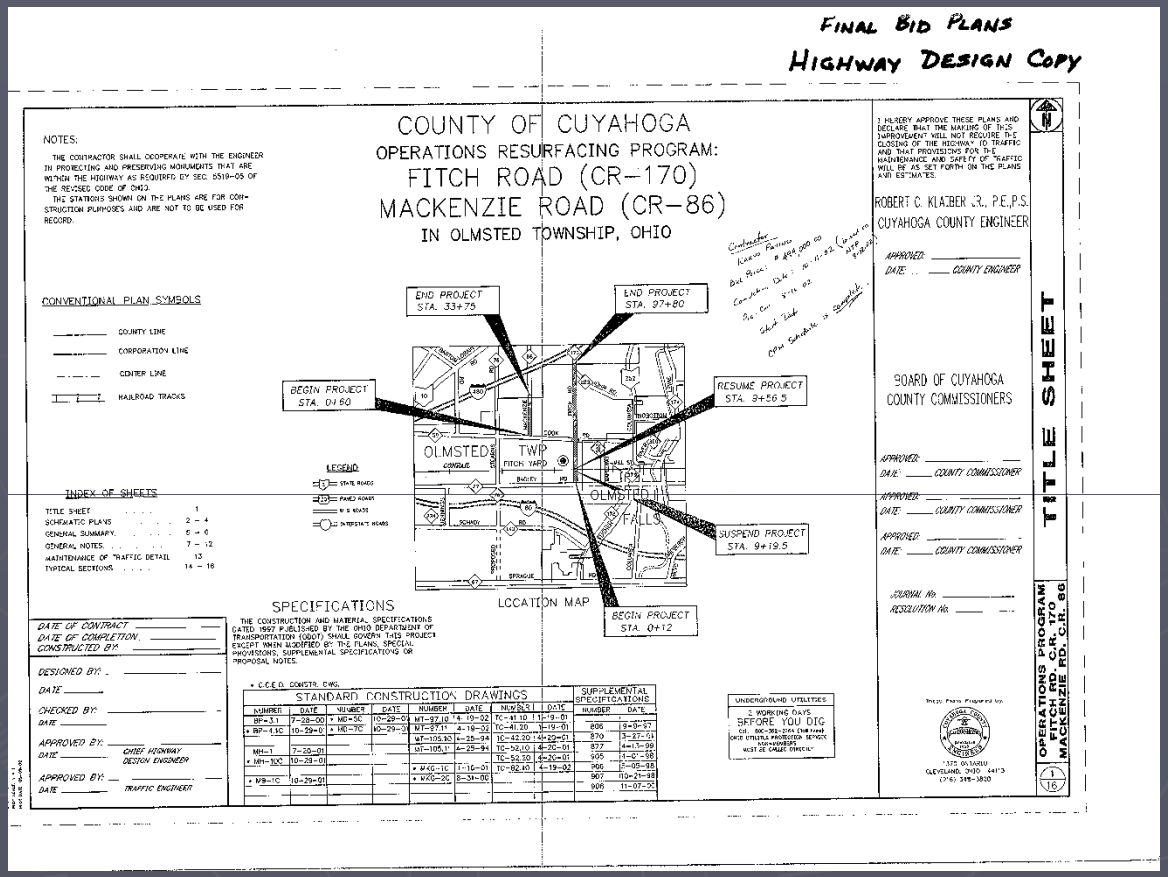
1989 OPERATIONS

FITCH RD 19

Fitch Road - 1989

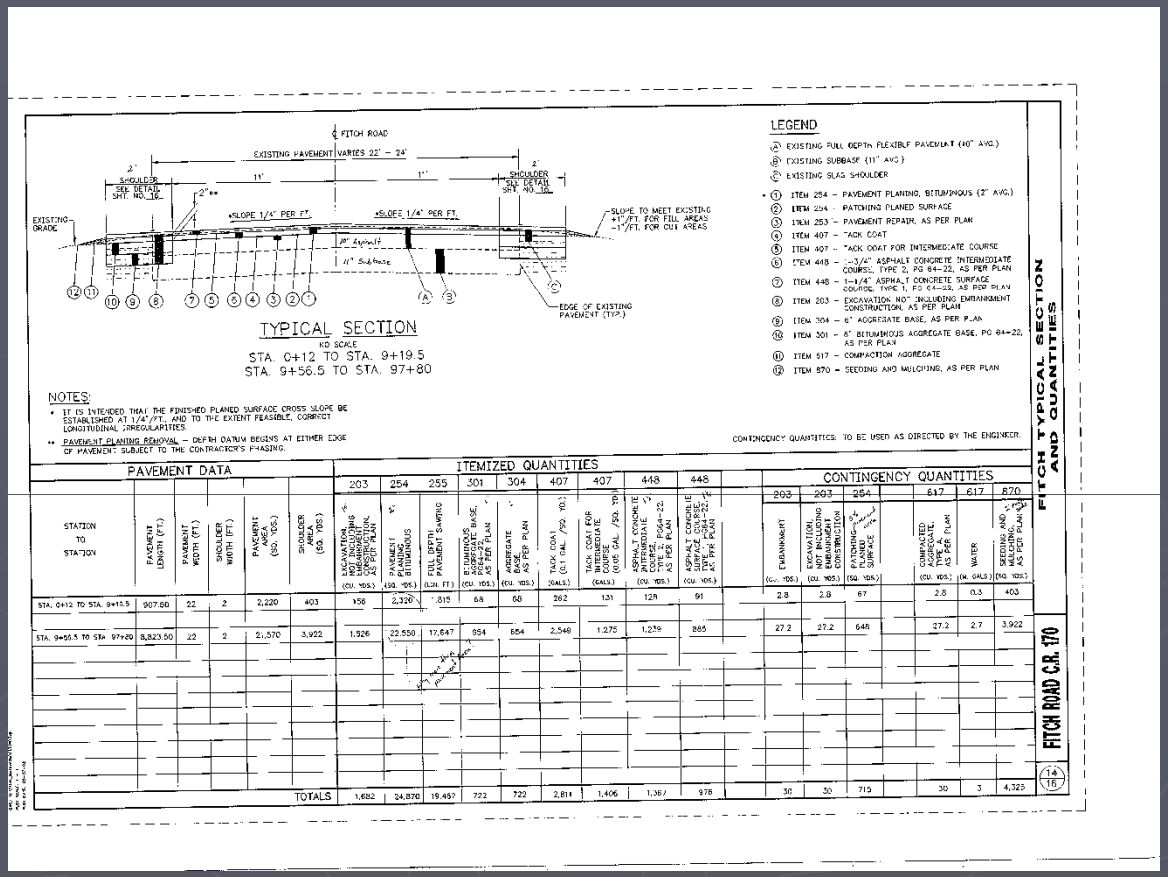
3” Mill and Fill

Structural Shoulder Construction



Fitch Road - 2002

Operations Resurfacing Program



Fitch Road - 2002

3” Mill and Fill

More Structural Shoulder Construction

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” x 0.35 = 0.44
  - 448 AC Intermediate 1.75” x 0.35 = 0.61
  - 302 Bitum. Agg. Base 9” x 0.35 = 3.15
  - 304 Aggregate Base 6” x 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?