


## UTW Performance of Ultra-thin Concrete


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District Materials Manager  
PennDOT District 5-0



### UTW Performance – SR100

**Project:** 67436  
**District:** 05 **County:** Lehigh  
**SR:** 100 **Section:** POC  
**Municipality:** Upper Macungie

**Scheduled Let:** 05/22/2003  
**Anticipated NTP:** 07/21/2003  
**Required Completion:** 10/30/2003



### UTW Performance – SR100


- **Prime Contractor:**  
Barletta Materials & Construction, Inc.
- **Subcontractor:**  
No. 1 Contracting Corporation
- **Producer:**  
Casilio Concrete



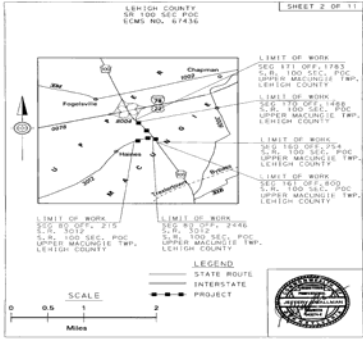

### UTW Performance – SR100

**Description:**

Project involved bituminous overlay and milling, ultra-thin white topping, pavement markings, loop sensors, and other miscellaneous construction from approximately 600 feet south of the intersection with Schantz Road at segment 0160 offset 0254 to approximately the interchange ramps for I-78 at segment 0171 offset 1783 and on SR3012 (Schantz Road) from approximately 1200 feet east of the structure over Iron Run at segment 0080 offset 0215 to the intersection with SR100 at segment 0080 offset 2246.




### UTW Performance – SR100

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**Background:**

This project was a maintenance contract and originally was going to be bituminous pavement. However after further consideration, and because of the condition of the previous roadway and extreme amount of heavy truck traffic, it was decided to substitute with portions of whitetopping overlay.




### UTW Performance – SR100

**Pavement History:**

SR100 Segment 0170-0171

1987- OGS Subbase / Depth 11"  
 Bituminous Concrete Base Course / Depth 7"  
 ID-2 Binder Course / Depth 2"  
 Bituminous Wearing Course ID-2 / Depth 1.5"

2003- Milling / Depth 2.25"  
 Superpave HMA (PG76-22) 19mm Wearing (E) / Depth 2.25  
 Whitetopping / Depth 4" (Intersections of Stroh Drive / Penn Drive)  
 Segment 0170 (36' wide x 459' length)  
 Segment 0171 (42' wide x 499' length)



### UTW Performance – SR100

**Pavement History: (continued)**

SR3012 Segment 0080

1958 to 1987- Crushed Aggregate Base Course / Depth 6"  
 Bituminous Wearing Course / Depth 1", Depth 2", Depth 2.5",  
 Depth 1.5"

1987- Scratch Bituminous Wearing Course ID-2 / Depth 0.5"  
 Bituminous Wearing Course ID-2 / Depth 1.5"

1995- Bituminous Wearing Course ID-2 / Depth 1"  
 1997- Scratch Bituminous Wearing Course ID-2 / Depth 0.5"  
 Bituminous Wearing Course ID-2 / Depth 1.5"

2003- Milling / Depth 2.25"  
 Superpave HMA (PG76-22) 19mm Wearing (E) / Depth 2.25

Milling / Depth 5.5" (Intersection- 48' wide x 2046' length)  
 Superpave HMA (PG76-22) 25mm Binder / Depth 3.25 (Intersection- 48' wide x 2046' length)  
 Superpave HMA (PG76-22) 19mm Wearing (E) / Depth 2.25  
 (Intersection- 48' wide x 2046' length)




### UTW Performance – SR100

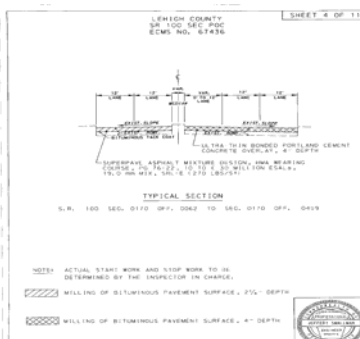
**Design Designation: (2003)**

SR100-Segment 0170-0171  
 Highway Classification **PRINCIPAL ARTERIAL**  
 current Average Daily Traffic (ADT) is 21,000 vehicles  
 with 16% truck traffic.

SR3012-Segment 0080  
 Highway Classification **MINOR ARTERIAL**  
 current Average Daily Traffic (ADT) is 13,000 vehicles  
 with 18% truck traffic.



### UTW Performance – SR100



LEHIGH COUNTY  
 SR 100 SEC. PDC  
 ECMS NO. 67436

SHEET 4 OF 11

ULTRA THIN BONDED PORTLAND CEMENT CONCRETE OVERLAY, 4" DEPTH

SUPERPAVE ASPHALT MIXTURE DESIGN, 19MM WEARING (E) 2.25" DEPTH


BITUMINOUS WEARING COURSE, ID-2 1.5" DEPTH

TYPICAL SECTION  
 S.R. 100 SEC. 0170 OFF. 0062 TO SEC. 0170 OFF. 0419


NOTE: ACTUAL START WORK AND STOP WORK TO BE DETERMINED BY THE INSPECTOR IN CHARGE.

WILLING OF BITUMINOUS PAVEMENT SURFACE, 2 1/2" DEPTH

WILLING OF BITUMINOUS PAVEMENT SURFACE, 4" DEPTH



### UTW Performance – SR100



LEHIGH COUNTY  
 SR 100 SEC. PDC  
 ECMS NO. 67436

SHEET 5 OF 11

ULTRA THIN BONDED PORTLAND CEMENT CONCRETE OVERLAY, 4" DEPTH

SUPERPAVE ASPHALT MIXTURE DESIGN, 19MM WEARING (E) 2.25" DEPTH


BITUMINOUS WEARING COURSE, ID-2 1.5" DEPTH

TYPICAL SECTION  
 S.R. 100 SEC. 0171 OFF. 0548 TO SEC. 0171 OFF. 1048

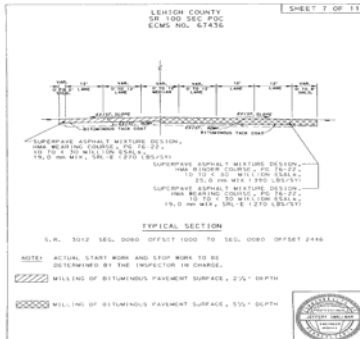
NOTE: ACTUAL START WORK AND STOP WORK TO BE DETERMINED BY THE INSPECTOR IN CHARGE.

WILLING OF BITUMINOUS PAVEMENT SURFACE, 2 1/2" DEPTH

WILLING OF BITUMINOUS PAVEMENT SURFACE, 4" DEPTH



### UTW Performance – SR100



LEHIGH COUNTY  
 SR 100 SEC. PDC  
 ECMS NO. 67436

SHEET 7 OF 11

ULTRA THIN BONDED PORTLAND CEMENT CONCRETE OVERLAY, 4" DEPTH

SUPERPAVE ASPHALT MIXTURE DESIGN, 19MM WEARING (E) 2.25" DEPTH


BITUMINOUS WEARING COURSE, ID-2 1.5" DEPTH

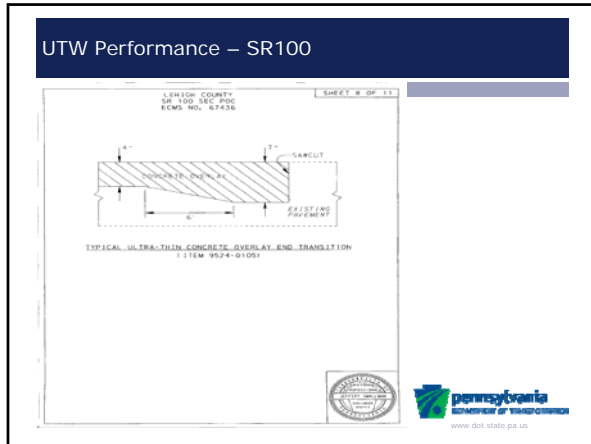
TYPICAL SECTION  
 S.R. 3012 SEC. 0080 OFFSET 1000 TO SEC. 0080 OFFSET 2446

NOTE: ACTUAL START WORK AND STOP WORK TO BE DETERMINED BY THE INSPECTOR IN CHARGE.

WILLING OF BITUMINOUS PAVEMENT SURFACE, 2 1/2" DEPTH

WILLING OF BITUMINOUS PAVEMENT SURFACE, 3 1/2" DEPTH






**UTW Performance – SR100**

**Project Specific Special Provision** was utilized for the **ULTRA-THIN PORTLAND CEMENT CONCRETE OVERLAY, 4" DEPTH**


- Accelerated Strength Portland Cement Concrete reinforced with polypropylene fibers
- Design a concrete mix for ASPCC having a 28 day minimum compressive strength of 4000 psi for acceptance and a 24 hour minimum compressive strength of 3000 psi.
- When the overlay depth is less than 3 inches, use No. 8 coarse aggregate instead of No. 57 coarse aggregate.
- Use a cement factor of 650 pounds minimum per cubic yard and a water/cement ratio of 0.42 maximum. Add fiber at the rate of 3.0 pounds minimum per cubic yard.



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Project Specific Special Provision (continued)


- Submit the Quality Control Plan for approval before the start of the project.
- Completely clean milled pavement surface. Remove all deleterious materials prior to overlaying. Sprinkle to thoroughly dampen the bituminous surface immediately prior to placement.
- Saw joints as soon as concrete has hardened sufficiently to permit sawing without excessive raveling. Space joints equidistant longitudinally and transversely (determine spacing using formula of 1 foot of joint spacing per 1 inch depth of cement concrete overlay). Saw joints with a green cut saw to a depth of D/3 and a minimum width of 1/8 inch. The joints are not to be sealed.



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Project Specific Special Provision (continued)


- Allow curing materials to remain in place and maintain as specified, for a period of 24 hours or until the concrete has reached 3000 psi compressive strength.
- Provide adequate insulating blankets to prevent rapid heat loss when the ambient air temperature is 65 degrees F or less. Remove any insulation when a minimum compressive strength of 3000 psi has been attained. Remove insulation at such a rate that the temperature change in the concrete does not exceed 40 degrees F within any one hour period. If a temperature change in the concrete in excess of 40 degrees F occurs within any one hour period, whether insulation is used or not, the work is defective.



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Project Specific Special Provision (continued)


- Sample plastic concrete, for compressive strength testing for opening to traffic, in accordance with the approved quality control plan. Test the concrete for compressive strength prior to opening to traffic. Concrete pavement that has not attained a minimum 24 hour compressive strength of 3000 psi at the time of opening to traffic will be considered defective work.



**UTW Performance – SR100**

Project Specific Special Provision (continued)

- An off-site test slab is required 2 weeks prior to placement of accelerated concrete pavement on the project. Construct the test slab one lane width wide and 12' long. Use the concrete mix design in accordance with this special provision in the test slab. Establish a target value for the consistency during placement of the test slab. The slump for production shall be the consistency of the test slab plus or minus 1-inch.





UTW Performance – SR100

**PROJECT:**


- Coring of the existing roadway was performed in order to make sure that the base for the whitetopping would be sufficient without any required repairs.
- The placement was performed on four (4) consecutive weekends (Saturday and Sunday) because of the amount of traffic in general and to appease the general public from major interruptions.
- Concrete overlay test slab 12' x 12' x 4" thick was performed by the subcontractor for hauling simulation and compressive strength evaluation of 8, 12, 16, 24 hours.

### UTW Performance – SR100

Accelerated Strength Portland Cement Concrete (ASPPC)  
 Mix Design: **ONE CUBIC YARD** Water/Cement Ratio = 0.36 (Trial)


Cement Type 1S (70/30)	752 lbs.
Polypropylene Fibers	3 lbs.
Water	271 lbs.
Coarse Aggregate	1725 lbs.
Fine Aggregate	1211 lbs.
Air Entraining Admixture	oz/cy
Water Reducing Admixture	oz/cy
Accelerating Admixture	oz/cy
High Range Water Reducing Admixture	oz/cy

Compressive Strength: 24 Hours = 3510  
 7 Day = 5173  
 28 Day = 5411




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- Concrete placement used mix # 1 (w/c ratio .35) with 3½ " slump plus or minus 1".
- To finish the pavement, because of the traffic and placement width, 14' and 28' roller screeds were used. 10' straight edges were used to manually float and finish concrete.
- No load transfer units or other reinforcement was required on this project.



### UTW Performance – SR100

- Curing was utilized by using plastic and blankets ASAP.
- Joints were sawed as soon as concrete had hardened sufficiently to permit sawing without raveling. (1/8" width, 4' intervals in both traverse and longitudinal direction)  
 D/3 + 1/8" or approximately 1½ "
- Cylinders taken on last truck and field cured.




### UTW Performance – SR100

Days of Placement:  
 9/27/03, 10/4/03, 10/11/03, 10/18/03,

Average compressive strength: (3800 Square Yards)

18 hours =	2847 psi
22 hours =	3042 psi
24 hours =	3073 psi
36 hours =	3696 psi
2 day =	4076 psi
7 day =	4832 psi
28 day =	5271 psi








- UTW Performance – SR100 (Picture 2009)
- Cost analysis was not performed up to the time of the project letting, however the decision to use whitetopping was based on past maintenance cycle repairs every couple of years and rapid decrease in ride quality.
  - The whitetopping overlay has not reached the end of its life and therefore final conclusions cannot be made. However, the performance has already exceeded the expectations of the District.
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QUESTIONS ?

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