INNOVATIONS AND BEST PRACTICES IN PENNDOT DISTRICT 2-0

BRIAN GRESCO, P.E., PENNDOT DISTRICT 2-0

DISTRICT MATERIALS AND GEOTECHNICAL ENGINEER

JULY 29, 2026

Pennsylvania
Department of Transportation

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Department of Transportation

*Total miles on all PA roadways

LB (1-26)

DISTRICT 2-0 PAPA BUS TOUR

- Subgrade Stabilization
- Full Depth Reclamation
- Highly Modified Asphalts (HiMA)
- Longitudinal Joint Incentive/Disincentive
- Void Reducing Asphalt Membrane (VRAM)
- Echelon Paving
- Full Width Paving

SUBGRADE STABILIZATION

- Chemical Stabilization
  - Lime
  - Cement
  - Fly Ash & Bitumen
- Mechanical Stabilization
  - Reworking and Blending
  - Densification
- Geosynethics and Physical Reinforcement
  - Geogrids
  - Geotextiles
- Removal and Replacement
  - Excavation and backfill

SUBGRADE STABILIZATION

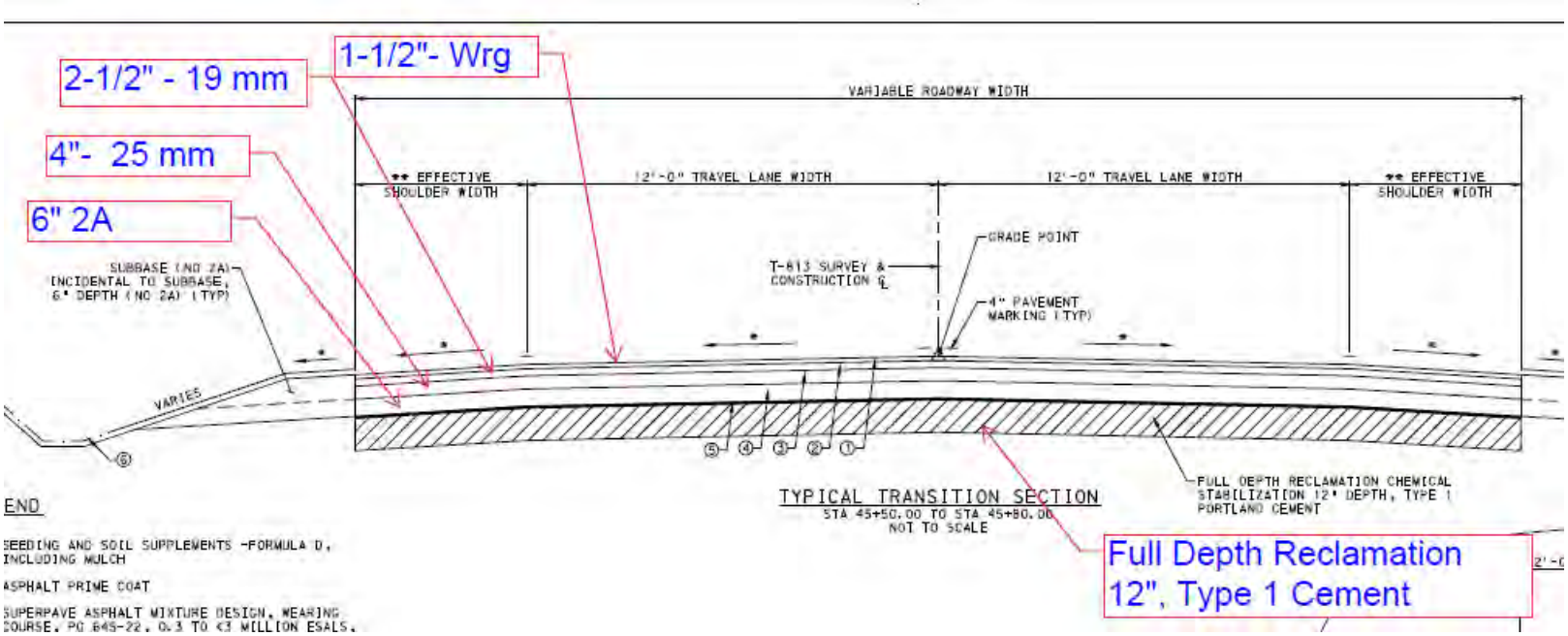
- Projects
  - Sandy Township Industrial Drive (ECMS 106745)
  - SR 0080-B18 Centre County (ECMS 3142)
- Subgrade stabilization
  - Mixing subgrade soil material with cement, and water and then compacting to create an improved subgrade
- Benefits
  - Cost and Time Savings- Uses in situ materials instead of removing and replacing with new material. Not expending finite resources at quarry to excavate and produce rock fill. Quicker than tradition remove and replace
  - Moisture Control- Dries out wet subgrades. Reduces freeze thaw potential (A-4 Soils)
  - Increased - Bearing Capacity. Possible reduction in pavement thickness

SUBGRADE STABILIZATION

- Process
  - Test Pits- Obtain representative soils samples for testing
  - Lab Testing- Soil classification/gradation, moisture, proctor, organic content
  - Mix Design-
    - Various dosage rates (3-10%) of Type 1 Cement mixed with soil samples to achieve Unconfined compressive strength of 200-900 psi after 7-day curing
  - Stabilization
    - Apply cement using spreader truck at the calculated rate
    - Reclaimer mixes soil and cement. Reclaimer can inject water during this process at this time to achieve optimum moisture content
    - Compaction begins with a sheepsfoot roller
    - Fine grading completed with dozer/grader
    - Compaction and seal the surface with smooth drum roller
    - Water sprayed over finished surface and during the 7-day curing process as required.
  - Testing, Acceptance criteria
    - Testing soil conditions ahead of stabilization to confirm soil conditions and moisture
      - Stabilization process adjusted based on these results if necessary. New mix designs may be necessary.
    - 3 samples for each 2000 SY cement- Molded and compressive testing completed
    - Density – Test strip established using nuclear gauge. 95% of the maximum density of laboratory mixes

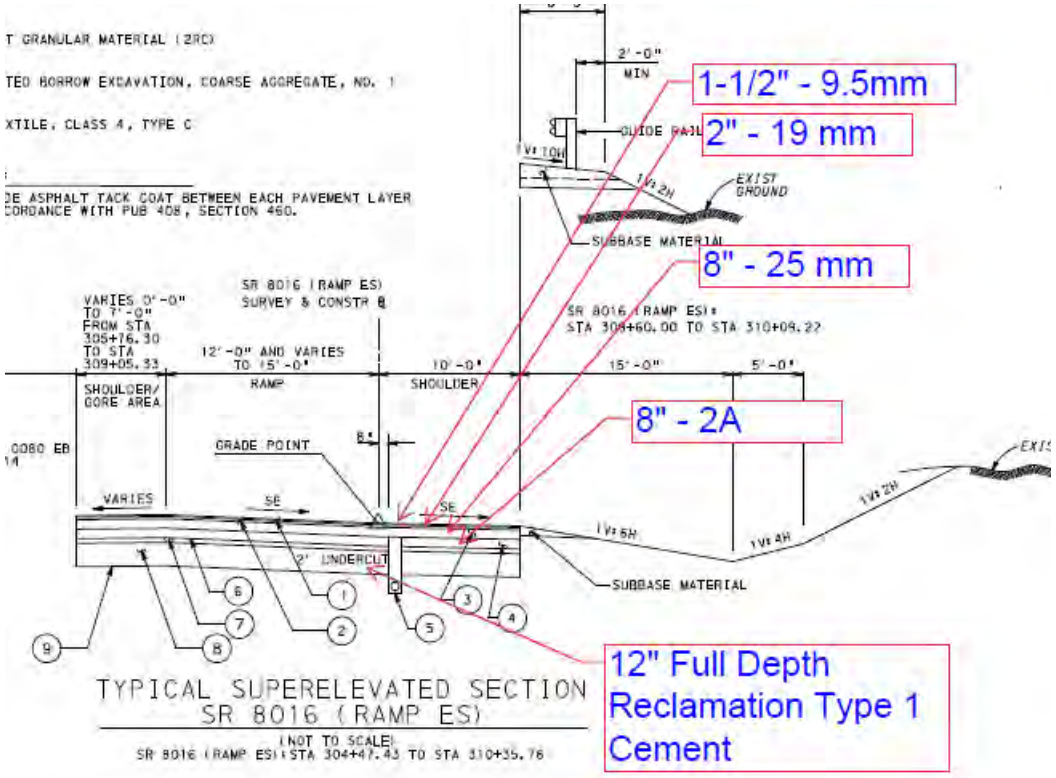
SUBGRADE STABILIZATION

- Sandy Twp. Industrial Drive – (ECMS 106745)



SUBGRADE STABILIZATION

- 0080-B18 - Ramp ES (ECMS 3142)



SUBGRADE STABILIZATION

- Sandy Township Industrial Dr - Pictures

SUBGRADE STABILIZATION

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SUBGRADE STABILIZATION

- Sandy Township Industrial Dr

SUBGRADE STABILIZATION

- Sandy Township Industrial Dr -

SUBGRADE STABILIZATION

- 0080-B18 Pictures

SUBGRADE STABILIZATION

- 0080-B18 Pictures

SUBGRADE STABILIZATION

- 0080-B18 Pictures

SUBGRADE STABILIZATION

- 0080-B18 Pictures

SUBGRADE STABILIZATION

- 0080-B18 Pictures

FULL DEPTH RECLAMATION

- Projects
  - GR 2-25-ST6 Potter (ECMS 122517)
  - T-605 Industrial Park Road Clfd - (ECMS 116245)
- Full Depth Reclamation
  - Pulverize and blend the existing distressed asphalt roadway surface and its underlying base and subgrade materials, mix with cement, compacted and cured to make a homogenous stabilized base.
- Benefits
  - Cost and Time Savings- Reconstruction. Uses in situ materials instead of removing and replacing with new material. Not expending finite resources at quarry to excavate and produce rock fill. Quicker than tradition remove and replace
  - Moisture Control- Dries out wet subgrades. Reduces freeze thaw potential (A-4 Soils)
  - Increased - Bearing Capacity. Possible reduction in pavement thickness

FULL DEPTH RECLAMATION

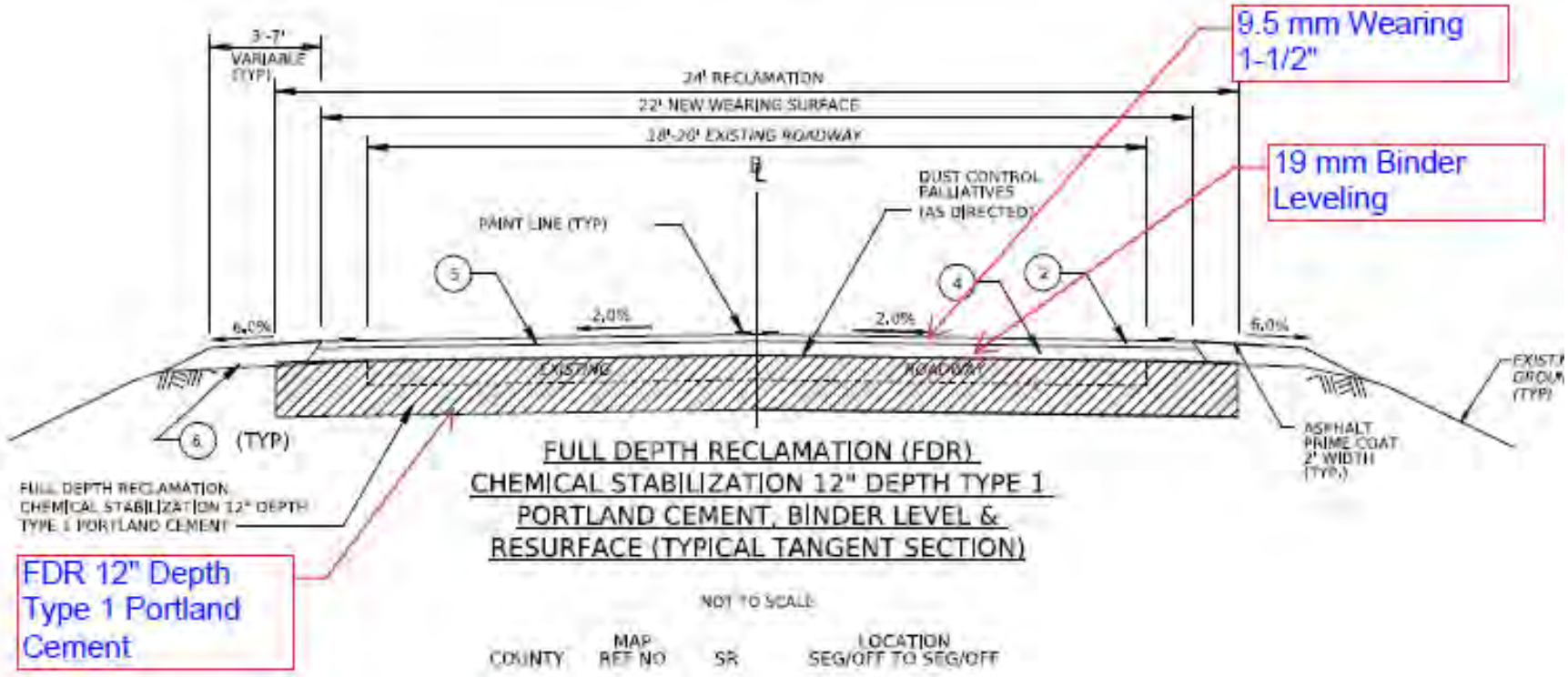
- Process
  - Test Pits/Core Borings- Obtain representative soils samples for testing
  - Lab Testing- Soil classification/gradation, moisture, CBR
  - Mix Design
    - Various dosage rates (3-8%) of Type 1 Cement mixed with soil samples to achieve Unconfined compressive strength of 200-500 psi after 7-day curing
  - Pulverization/Shaping
    - Pulverize the roadway materials to specified depth, grade to specified cross slope compact to non movement. May add water at this process
  - Stabilization
    - Apply cement using spreader truck at the calculated rate
    - Reclaimer mixes distressed asphalt roadway, underlying base, soil and cement. Reclaimer can inject water during this process at this time to achieve optimum moisture content
    - Compaction begins with a sheepsfoot roller
    - Fine grading completed with dozer/grader
    - Compact and seal the surface with smooth drum roller
    - Water sprayed over finished surface and during the 7-day curing process as required.

FULL DEPTH RECLAMATION

- Process
  - Testing, Acceptance criteria
    - Testing pulverized material to confirm soil moisture
      - Stabilization process adjusted based on these results if necessary. New mix designs may be necessary.
    - 3 samples for each 3000 SY - Molded and compressive testing completed
    - Density – Test strip established using nuclear gauge. 95% of the maximum density of laboratory mixes
- References- Pub 242 Appendix J
- Cement- Stabilized Subgrade Soils ISU

FULL DEPTH RECLAMATION

- GR 2-25-ST6 Potter

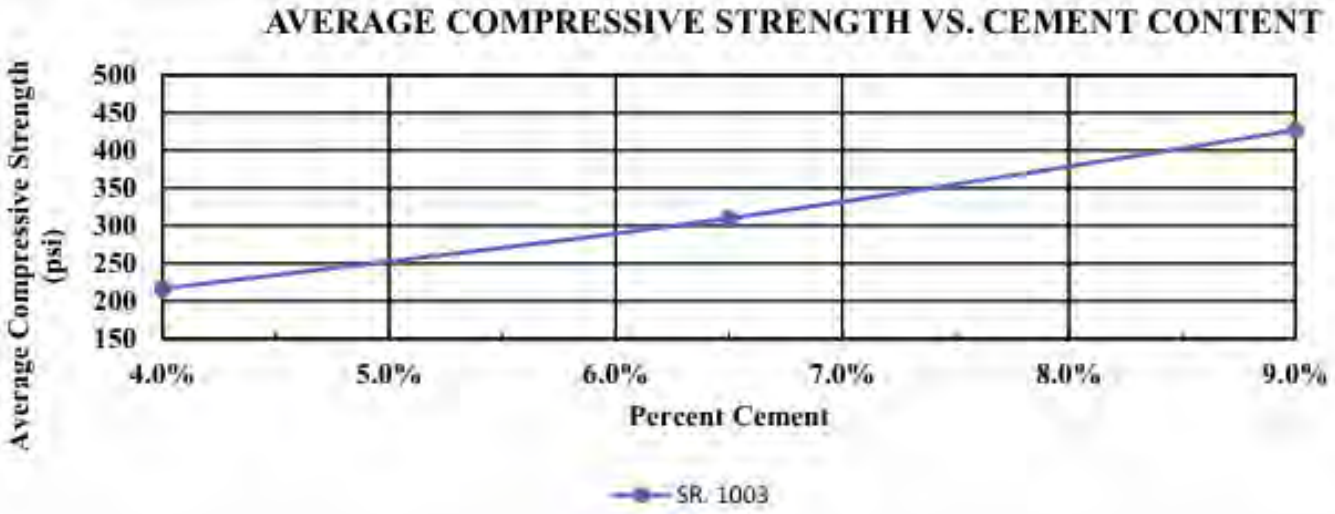


FULL DEPTH RECLAMATION

- GR 2-25-ST6 Potter

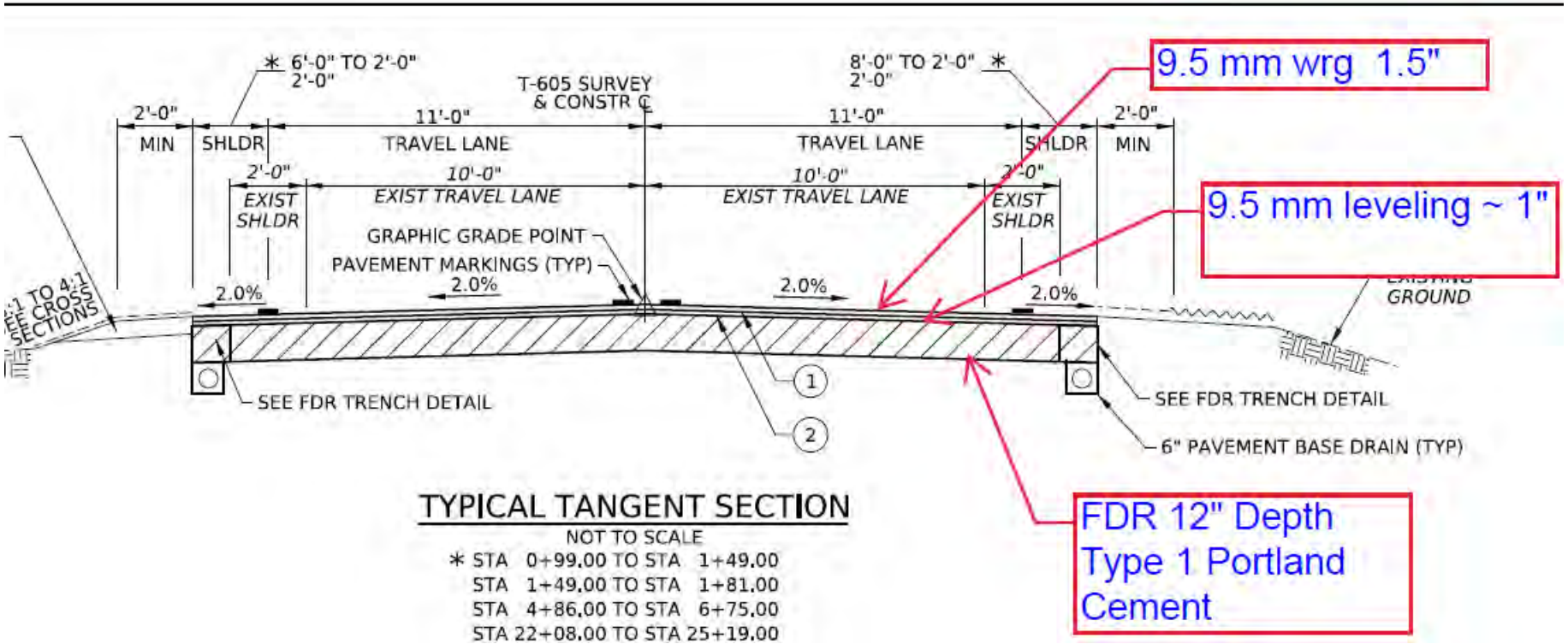
SUMMARY OF 7 DAY COMPRESSIVE STRENGTH TESTING

Test Pit No.	Portland Cement	Individual 7 Day Compressive Strength (psi)	Average 7 Day Compressive Strength (psi)
Composite Sample	4%	235, 209, 205	217
	6.5%	291, 326, 313	310
	9%	420, 410, 451	427



FULL DEPTH RECLAMATION

- T-605 Industrial Park Road Clfd



TYPICAL TANGENT SECTION

NOT TO SCALE

* STA 0+99.00 TO STA 1+49.00
STA 1+49.00 TO STA 1+81.00
STA 4+86.00 TO STA 6+75.00
STA 22+08.00 TO STA 25+19.00

FULL DEPTH RECLAMATION

- GR 2-25-ST6 Potter

FULL DEPTH RECLAMATION

- GR 2-25-ST6 Potter

FULL DEPTH RECLAMATION

- T-605 Industrial Park Road

FULL DEPTH RECLAMATION

- T-605 Industrial Park Road

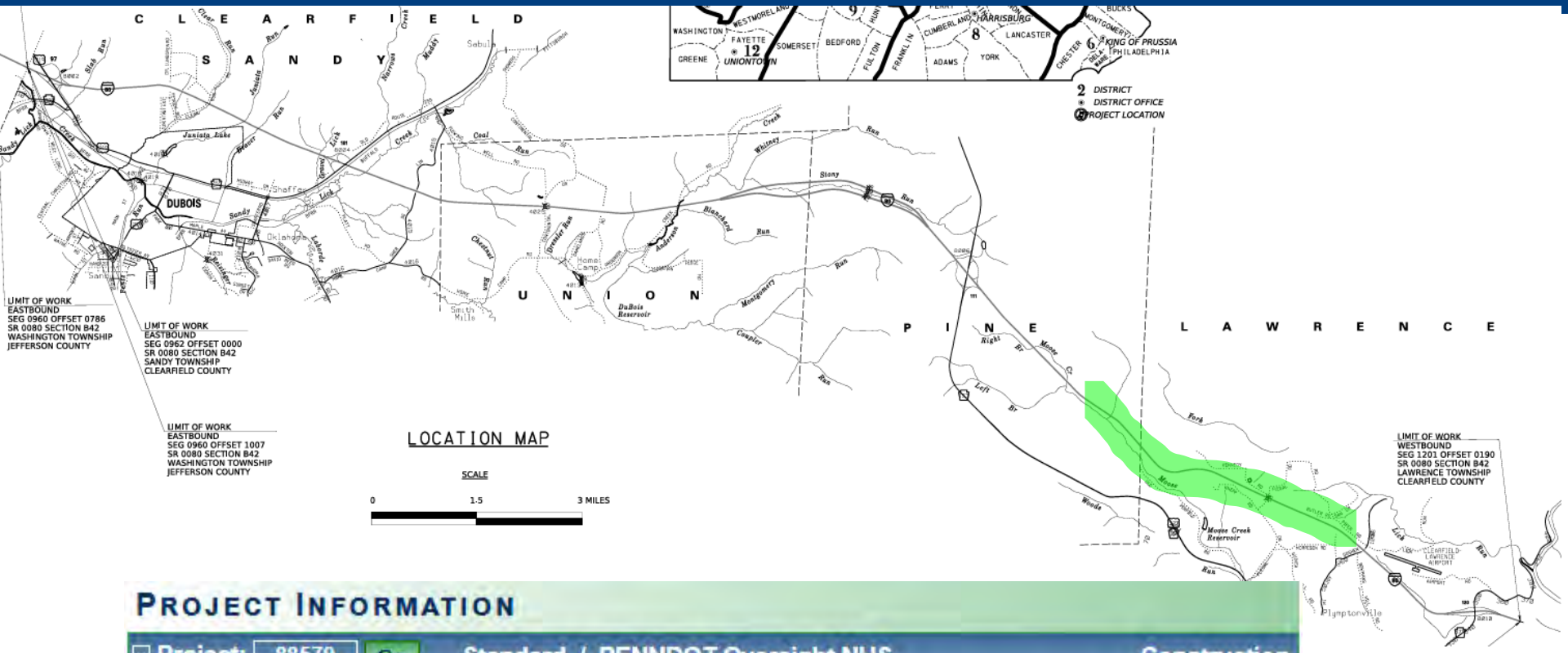
FULL DEPTH RECLAMATION

- T-605 Industrial Park Road

FULL DEPTH RECLAMATION

- T-605 Industrial Park Road

HIGHLY MODIFIED ASPHALTS (HIMA)



PROJECT INFORMATION

Project: 88579 Go Standard / PENNDOT Oversight NHS Construction

Short Description:	I-80 Preservation MM 96 to MM 119			Org Code:	0200
County:	Clearfield	SR:	80	Section:	B42
District:	02	Group ID:	---	Municipality:	SANDY

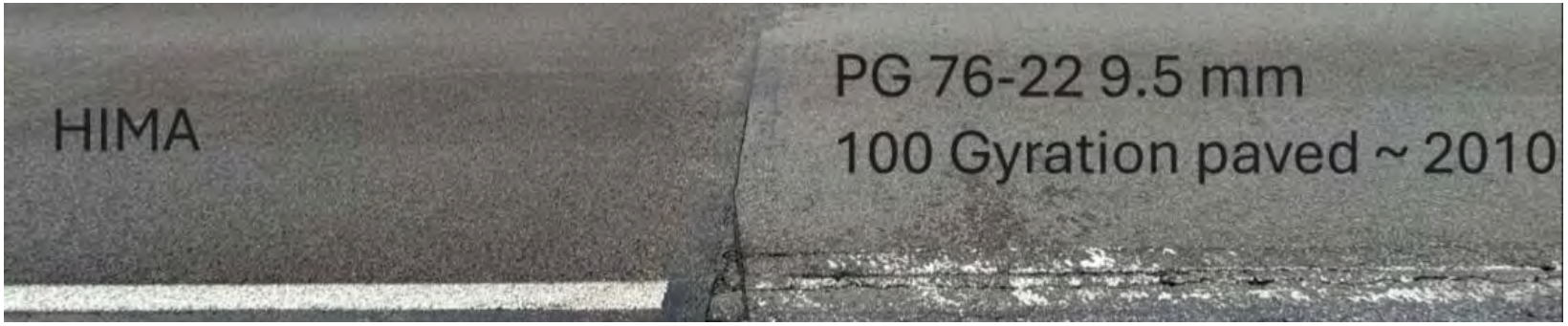
Why This Pilot?

HIGHLY MODIFIED ASPHALTS (HIMA)

Binder Comparison

PG64E-22	PG76E-28HP
Standard polymer-modified binder	Highly modified polymer binder
Current PennDOT practice	Performance-focused application
Proven performance	Increased elasticity and recovery
Used on many interstate projects	Intended for severe loading environments

The objective was not to determine whether HiMA can replace PG64E-22, but to determine where the additional performance justifies the increased cost.



Stretch Armstrong- gel filled action figured first sold in 1976 by Kenner

The beginning of Polymer Modified Asphalts

Was he made with PG 76E-28HP?

Stretch Armstrong was made of latex rubber filled with corn syrup

From Google AI

Latex Rubber is a type pf polymer modifier used in asphalt. Often SBR (styrene-butadiene rubber) is blended into bitumen. This creates a flexible, highly elastic and durable binder know as polymer-modified asphalt.

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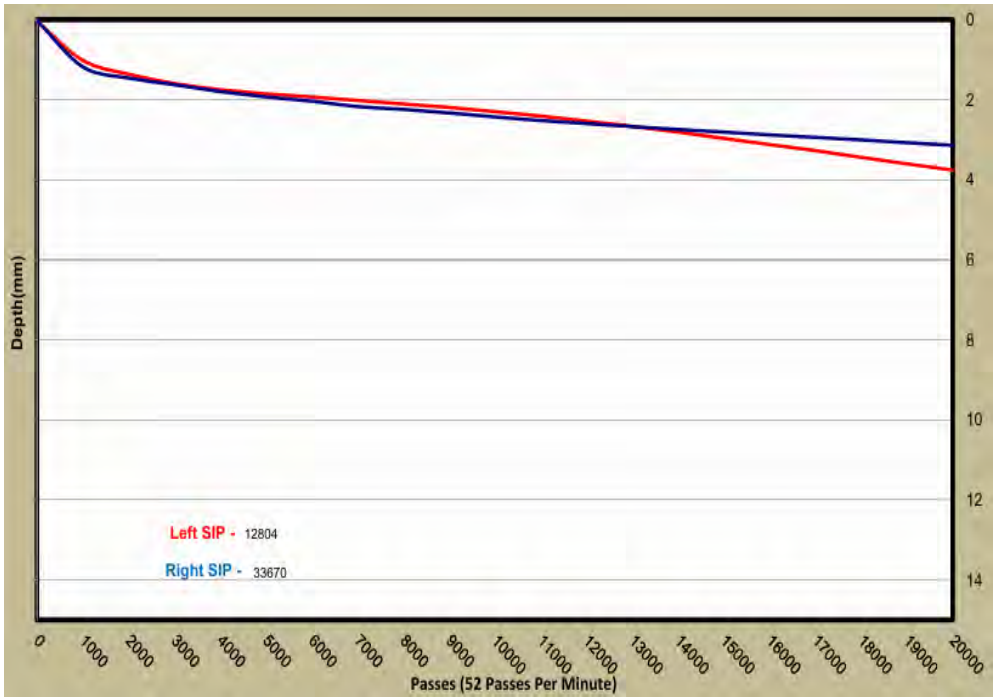
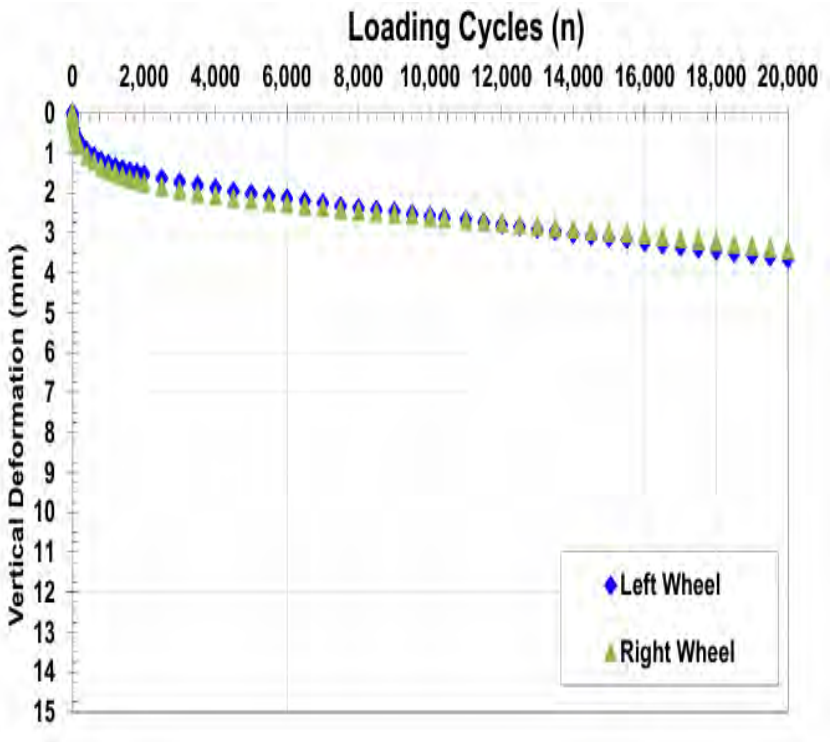
Laboratory Performance – Hamburg

Control JMF



Avg Rut @ 20k = 3.4mm

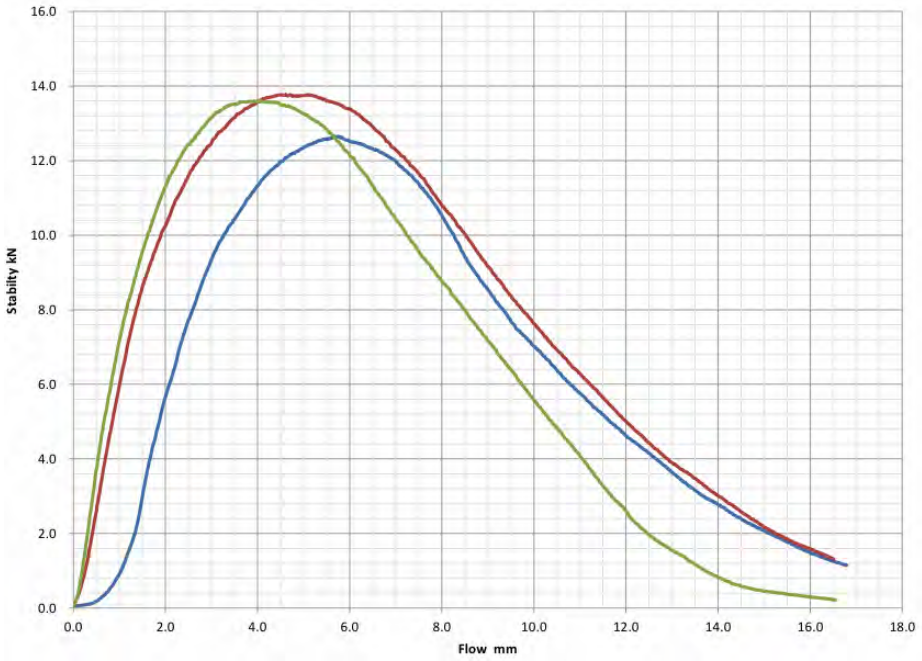
HiMA JMF



Avg Rut @ 20k = 3.5mm

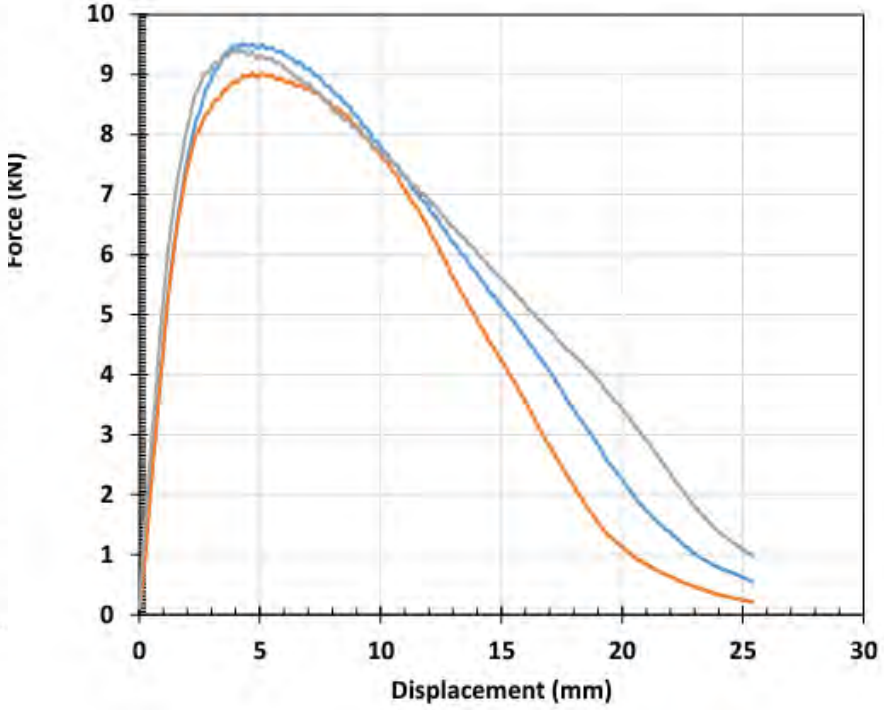
Laboratory Performance – CT Index

Control JMF



Peak Stability = 13.3kN
CT Index = 384

HiMA JMF



Peak Stability = 9.3kN
CT Index = 2196

HIGHLY MODIFIED ASPHALTS (HIMA)

HIGHLY MODIFIED ASPHALTS (HIMA)

2024

2025

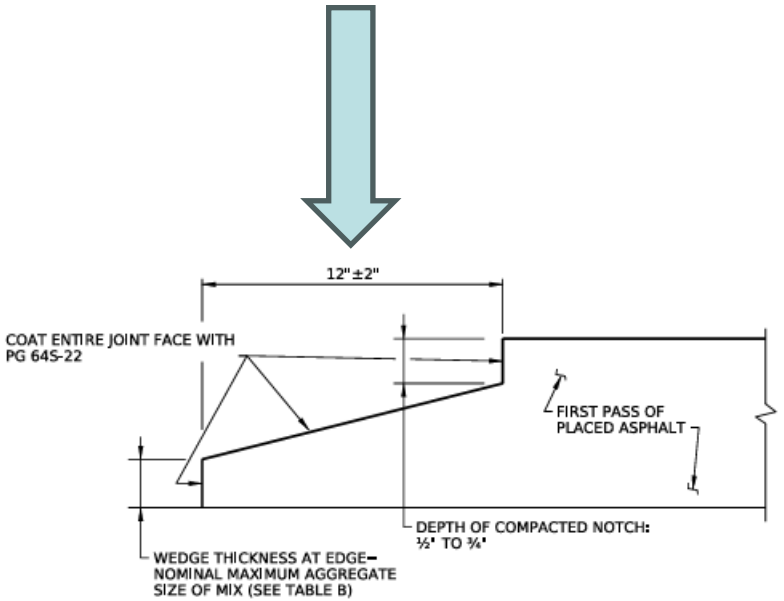
HIGHLY MODIFIED ASPHALTS (HIMA)

LONGITUDINAL JOINT INCENTIVE/DISINCENTIVE

- Projects
  - Number of projects used on in 2025 and previous years
  - Goal:
    - Provide an incentive to construct joints at a higher density and achieve a longer lasting pavement
  - Lessons Learned:
    - Critical to construct a proper wedge joint with the dimensions indicated in the RC-28M standard

Longitudinal Joint Incentive/Disincentive

- Critical to have ½" to ¾" depth of compacted notch
- Density Cores taken 6" away from joint line



LONGITUDINAL NOTCHED WEDGE JOINT

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Longitudinal Joint Incentive/Disincentive

	Longitudinal Joint Density Summary					
Year	**2025**	**2024**	**2023**	**2022**	**2021**	**2020**
Lots Tested	28	22	10	20	18	33
% Density Range	88.7-97.9	86.3-98	89.7-96.6	88.8-98.1	89.0-97.5	88.1-97.9
% Average Density	93.7	93.4	93.3	93.5	92.4	94.1
Incentive Lots	25	16	8	14	10	29
Zero Lots	2	3	2	6	8	3
Disincentive Lots	1	3	0	0	0	1
Total $ for Incentive Lots	156,450	$91,950	$51,000	$85,375	$35,325	$212,175
Total $ for Disincentive Lots	-12,500	-$23,500	0	0	0	-$1,750
Delta (Incentive – Disincentive)	$143,950	$68,450	$51,000	$85,375	$35,325	$210,425

REF: Section 405 Evaluation of Bituminous Pavement
Longitudinal Joint Density and Payment of Incentive/Disincentive

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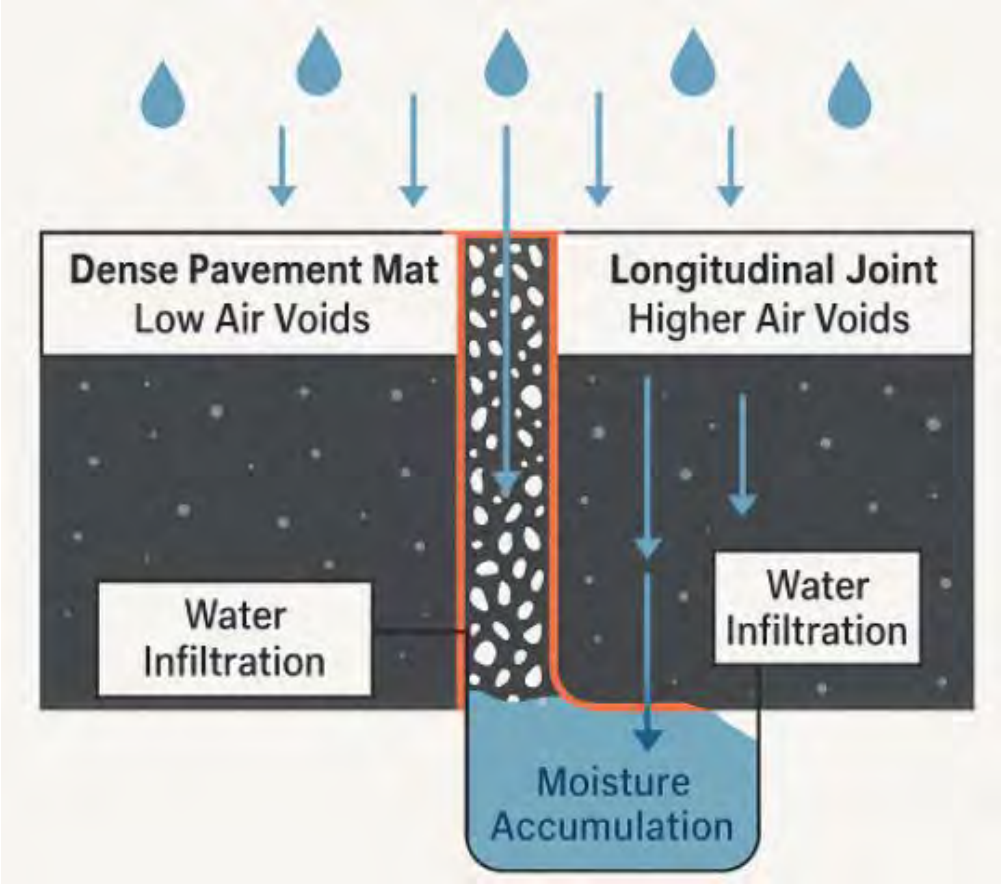
VOID REDUCING MEMBRANE (VRAM)

- Longitudinal joints consistently contain higher air voids than the pavement mat.
- Higher voids increase permeability.
- Water infiltration leads to:
  - Cracking
  - Raveling
  - Stripping
  - Early deterioration
  - Joint failures often appear within the first 3 years.

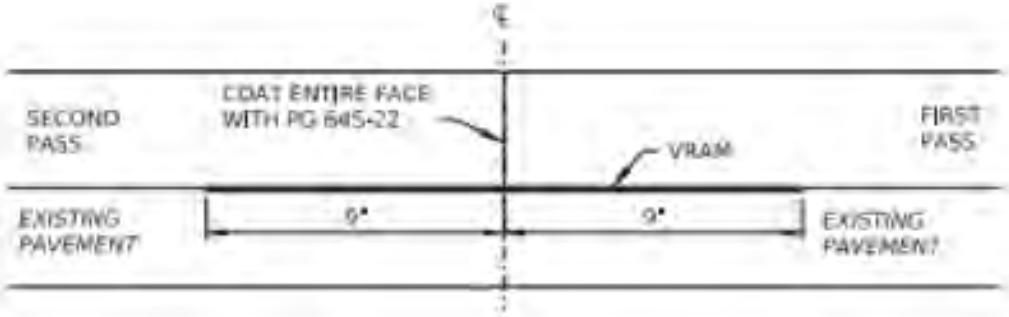


VOID REDUCING MEMBRANE (VRAM)

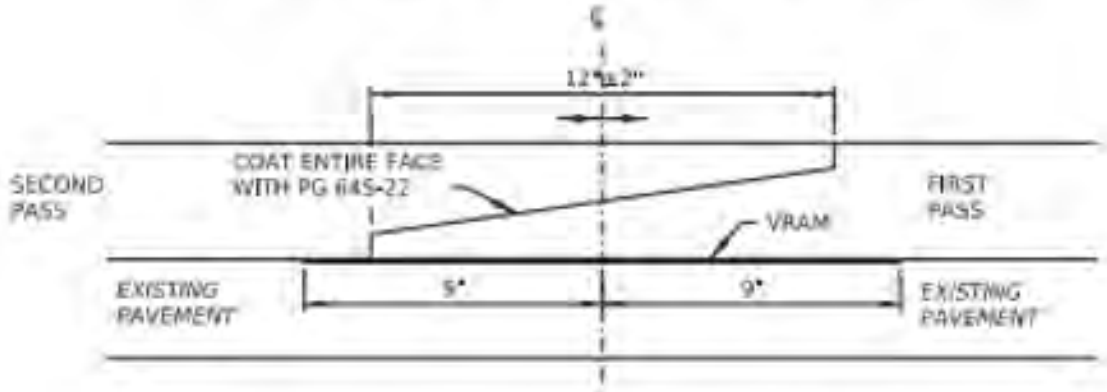
VRAM Process

- Spray an 18-inch strip of polymer modified asphalt over the binder course.
- Material is centered beneath the future longitudinal joint.
- Heat from the wearing course reactivates the material.
- Asphalt wicks upward into the joint voids.
- Reduces permeability while maintaining enough air voids to prevent bleeding.

VOID REDUCING MEMBRANE (VRAM)



VRAM VERTICAL JOINT DETAIL



VRAM NOTCH WEDGE JOINT DETAIL

VOID REDUCING MEMBRANE (VRAM)

- VRAM

VOID REDUCING MEMBRANE (VRAM)

Project	County	ECMS
SR 0219-537	McKean	4405
SR 0080-B42	Clearfield	88579
SR 0080-B43	Centre	88577
SR 0080-B50	Centre	109238

VOID REDUCING MEMBRANE (VRAM)

ECMS	$/LF	LF	$
E4405	$ 4.90	34,060	$ 166,894.00
E88579	$ 2.75	474,746	$ 1,305,551.50
E88577	$ 3.20	36,833	$ 117,865.60
E109238	$ 3.25	60,035	$ 195,113.75
Avg/Total	$ 3.53	605,674	$ 1,785,424.85

VOID REDUCING MEMBRANE (VRAM)

Goals

✓ Reduce joint permeability
✓ Increase joint durability
✓ Reduce premature cracking and raveling
✓ Extend pavement service life

Lessons Learned

Accurate application rate is essential.
Surface must be clean and dry.
Center membrane beneath the joint.
Product has demonstrated successful statewide performance.
Now supported through:

- Standard Special Provision
- Pub. 242 guidance

VOID REDUCING MEMBRANE (VRAM)

Summary

- Longitudinal joints remain the weakest portion of asphalt pavement.
- VRAM reduces permeability by filling joint air voids.
- Proven on multiple PennDOT pilot projects statewide.
- Straightforward construction process.
- Expected to improve long-term pavement performance while reducing maintenance.

ECHELON PAVING

- Projects
  - SR 0322-B06 Centre (ECMS 96820)
  - SR 0080-B42 Clearfield (ECMS 88579)
  - SR 0080-B43 Centre (ECMS 88577)
  - SR 0080-B50 Centre (ECMS 109238)
- Goals:
  - Construct hot joint for Better long-Term Performance
- Lessons Learned
  - Busy operation. A lot of construction equipment operating in a small area.

ECHELON PAVING

- Special Provision

SECTION 413/419 - SPREADING AND FINISHING

Provision Body

In accordance with Section 413/419 revised as follows:

- **Section 413.3(h)1.b Spreading and Finishing.** Revise by adding the following:

Perform echelon paving (utilizing multiple paving machines in unison) to provide a hot longitudinal joint in the final wearing courses between the travel lane, auxiliary lane and the 10 foot shoulder.

Perform paving monolithically for passing lane and the left shoulder up to a width of 18 feet.

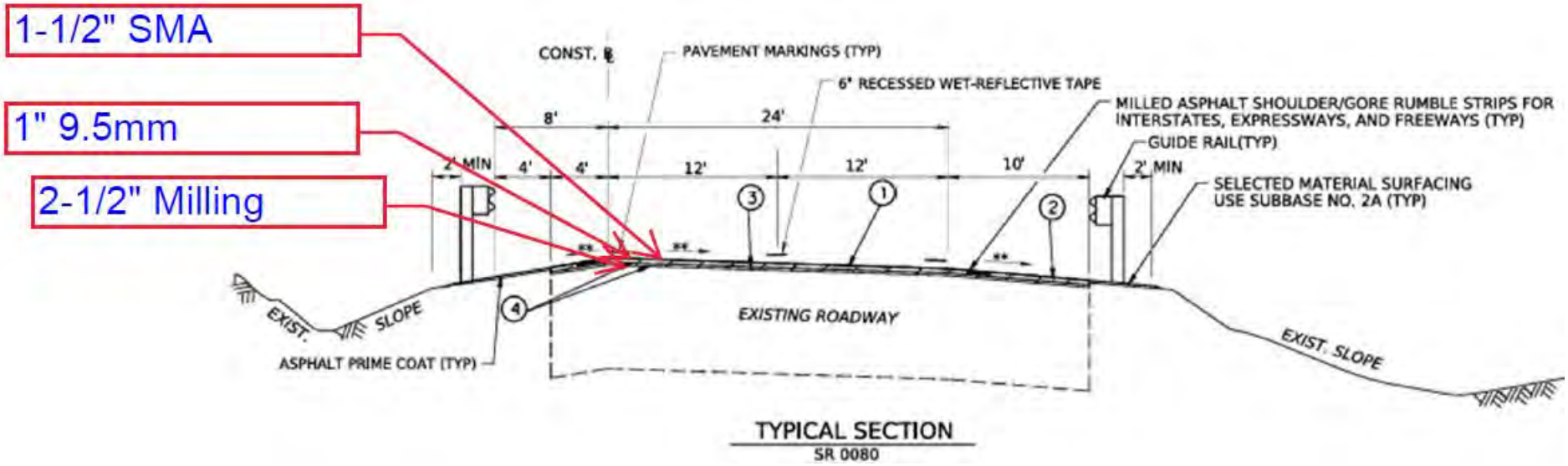
Section 419.3(i)1.b Spreading and Finishing. Revise by adding the following:

Perform echelon paving (utilizing multiple paving machines in unison) to provide a hot longitudinal joint in the final wearing courses between the travel lane, auxiliary lane and the 10 foot shoulder.

Perform paving monolithically for passing lane and the left shoulder up to a width of 18 feet.

ECHELON PAVING

- Typical Section



ECHELON PAVING

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ECHELON PAVING

FULL WIDTH PAVING

- Projects
  - SR 0080-A18 Centre (ECMS 51466)
  - Goals
    - Eliminate joints for Better/Best long-Term Performance
  - Lessons Learned
    - Best joint is no joint

FULL WIDTH PAVING

- Special Provision

SECTION 409/419 - SPREADING AND FINISHING

Provision Body

In accordance with Section 409/419 revised as follows:

- **Section 409.3(h)1.b Spreading and Finishing.** Revise by adding the following:

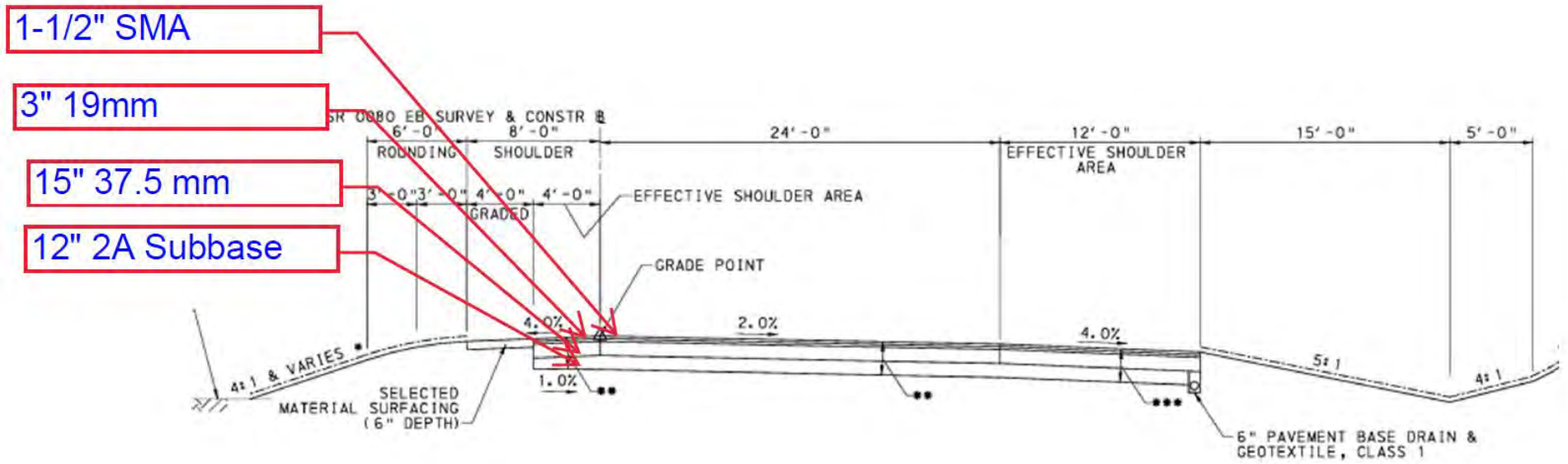
Perform paving monolithically (utilizing a paving machine capable of paving 28' width) to provide the final wearing course on SR 0080 Eastbound and Westbound between the inside shoulder, travel lane, and passing lane full width without joints.

- **Section 419.3(i)1.b Spreading and Finishing.** Revise by adding the following:

Perform paving monolithically (utilizing a paving machine capable of paving 28' width) to provide the final wearing course on SR 0080 Eastbound and Westbound between the inside shoulder, travel lane, and passing lane full width without joints.

FULL WIDTH PAVING

- Typical Section



FULL WIDTH PAVING

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