SUBGRADE STABILITY CHALLENGES WITH RUBBLIZE AND ROLL PAVEMENT REHABILITATION













Christopher Merklin, PE, Administrator, ODOT
Office of Geotechnical Engineering

Ohio Department of Transportation

HOW DID WE GET HERE?

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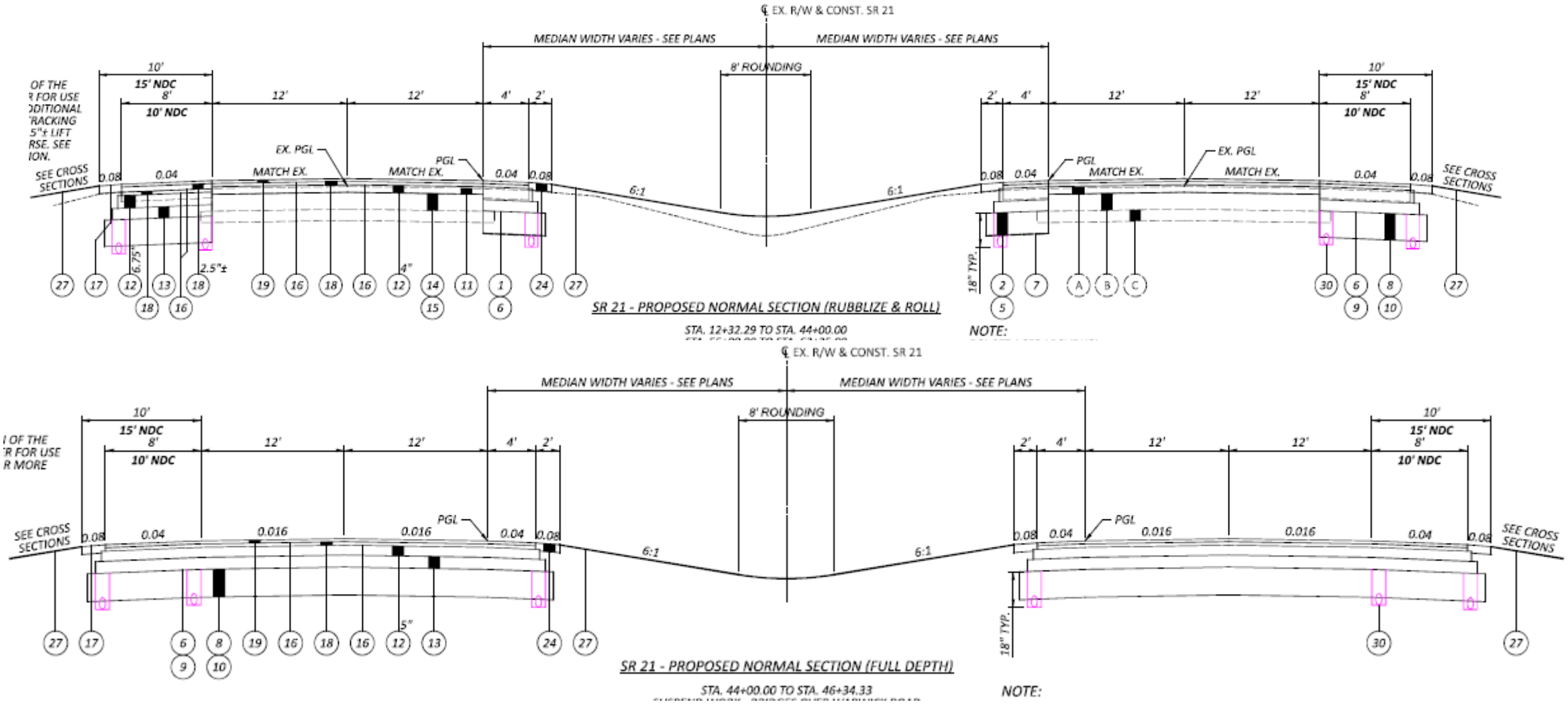
WAY-21-0.00

- Major arterial route – 6 miles of major rehab
  - 4-Lane divided road
  - 2 Proposed R-cut intersections, 2 Proposed at grade intersections, 4 Bridge rehabilitations
  - $30M DB contract, but…
  - ODOT performs borings, designs pavement (9” Rubblize and Roll, 7.25” asphalt), intersections, etc.
  - Full depth replacement at outside shoulder widenings, intersections, bridge approaches with 14” cement stabilization

SAMPLE SLIDE



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GEOTECHNICAL PROFILE

- Rubblize and Roll is not an option when the average N_{60L} value for the subgrade below the existing pavement is less than 12.
- During construction, the Rubblize and Roll is attempted before an area is selected for excavation and replacement. **The actual excavation areas will be selected based on the inability to Rubblize and Roll.**

GEOTECHNICAL PROFILE

Chemical Stabilization Options		
320	Rubblize & Roll	Option
206	Cement Stabilization	Option
	Lime Stabilization	No
206	Depth	NA

Excavate and Replace Stabilization Options	
Global Geotextile Average(N60L):	0"
Average(HP):	0"
Global Geogrid Average(N60L):	0"
Average(HP):	0"

Design CBR	9

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	0%	HP ≤ 0.5	1%
$N_{60} < 12$	8%	0.5 < HP ≤ 1	1%
$12 \leq N_{60} < 15$	10%	1 < HP ≤ 2	17%
$N_{60} \geq 20$	64%	HP > 2	40%
M+	19%		
Rock	3%		
Unsuitable	9%		

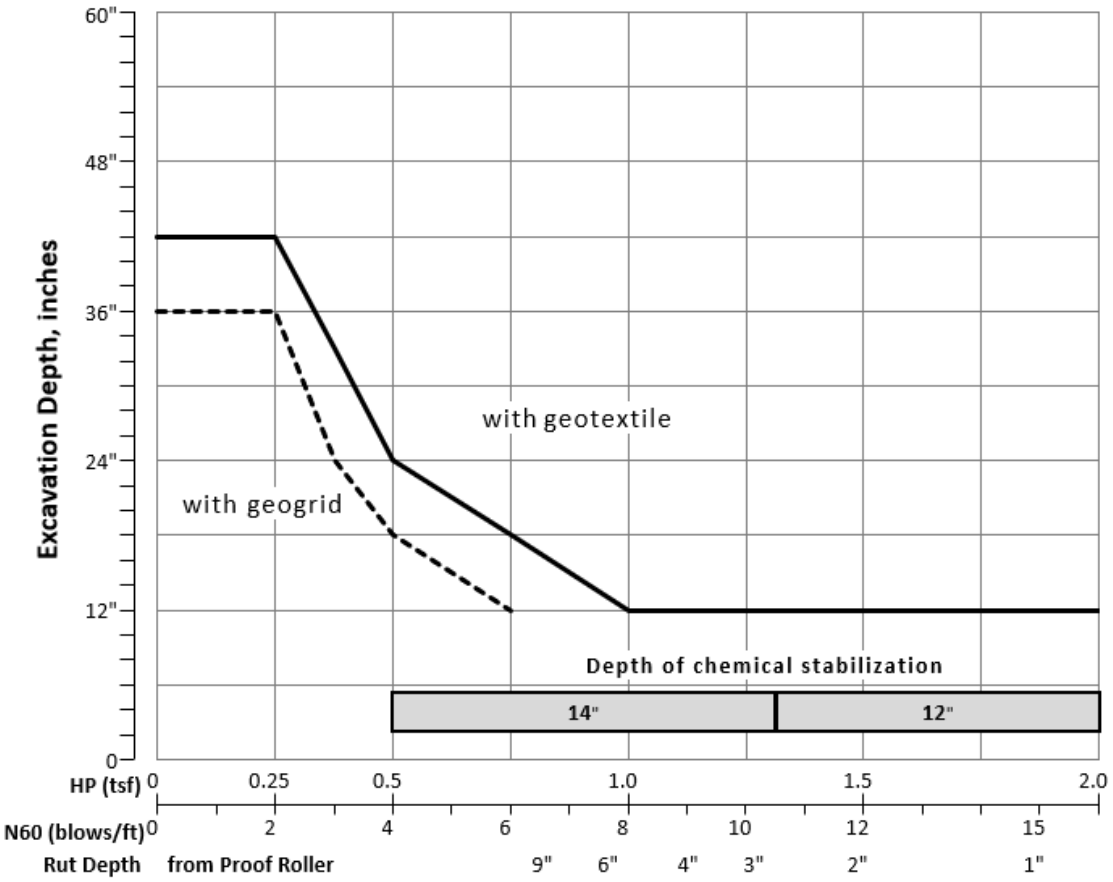
Excavate and Replace at Surface	
Average	0"
Maximum	0"
Minimum	0"

% Proposed Subgrade Surface	
Unstable & Unsuitable	45%
Unstable	40%
Unsuitable	6%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	28	18	3.06	21	15	6	26	15	41	13	10	3
Maximum	90	30	4.50	40	21	22	67	39	91	26	16	16
Minimum	6	6	0.50	15	12	1	6	4	11	5	0	0

Classification Counts by Sample

ODOT Class	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	6	1	34	38	0	1	0	0	27	150	19	0	14	2	0	0	0	0	292
Percent	2%	0%	12%	13%	0%	0%	0%	0%	9%	51%	7%	0%	5%	1%	0%	0%	0%	0%	100%
% Rock|Granular|Cohesive	2%	86%									12%								100%
Surface Class Count	4	1	21	28	0	1	0	0	12	76	5	0	5	1	0	0	0	0	154
Surface Class Percent	3%	1%	14%	18%	0%	1%	0%	0%	8%	49%	3%	0%	3%	1%	0%	0%	0%	0%	100%



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
3.06	0.50	HP
17.79	6.00	N60L

Average HP
Average N_{60L}

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CONSTRUCTION SEQUENCE

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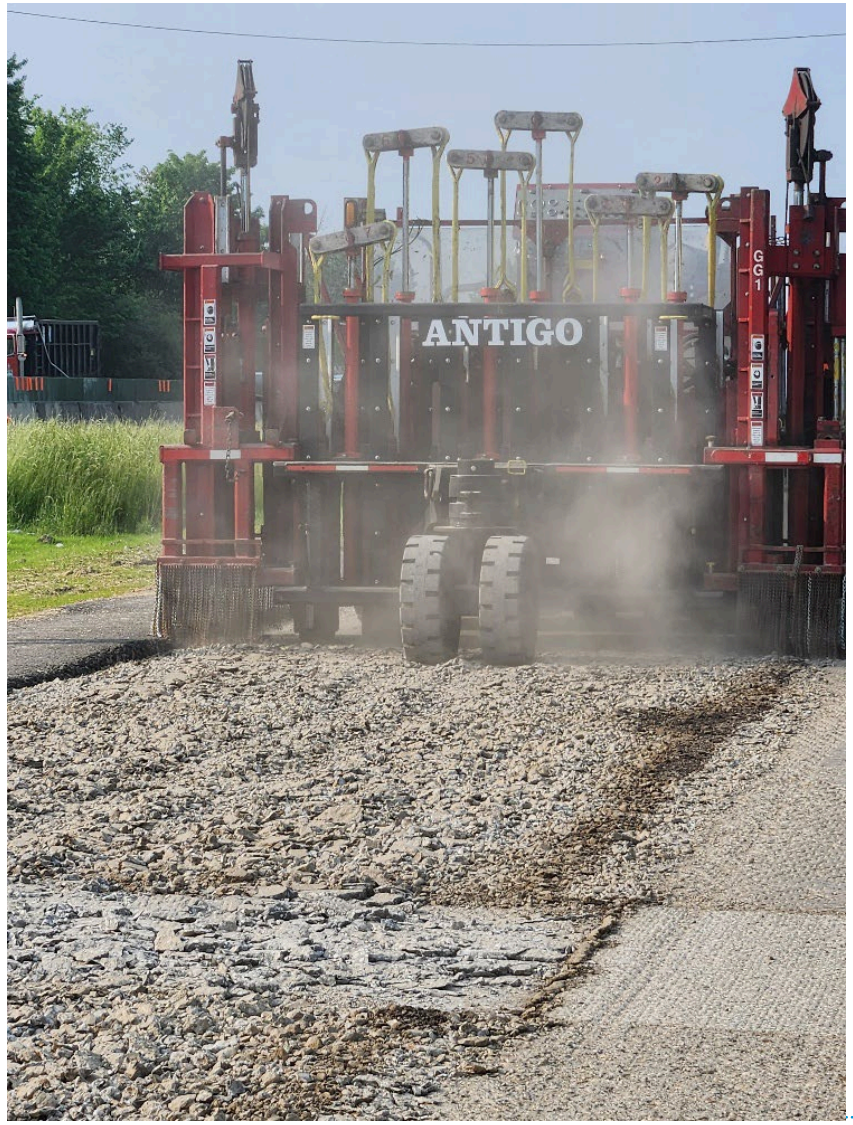

https://youtu.be/Qj5tBPmLBXA

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CONSTRUCTION SEQUENCE

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CONSTRUCTION SEQUENCE

- Rubblize and Roll requirements
  - ≥75% with maximum dimension < 3 inches above steel
  - ≥90% with maximum dimension < 9 inches below steel (100% < 12 inches)

- All of the rubblized concrete met the gradation requirements, so no problem with the subgrade, right?

CONSTRUCTION SEQUENCE

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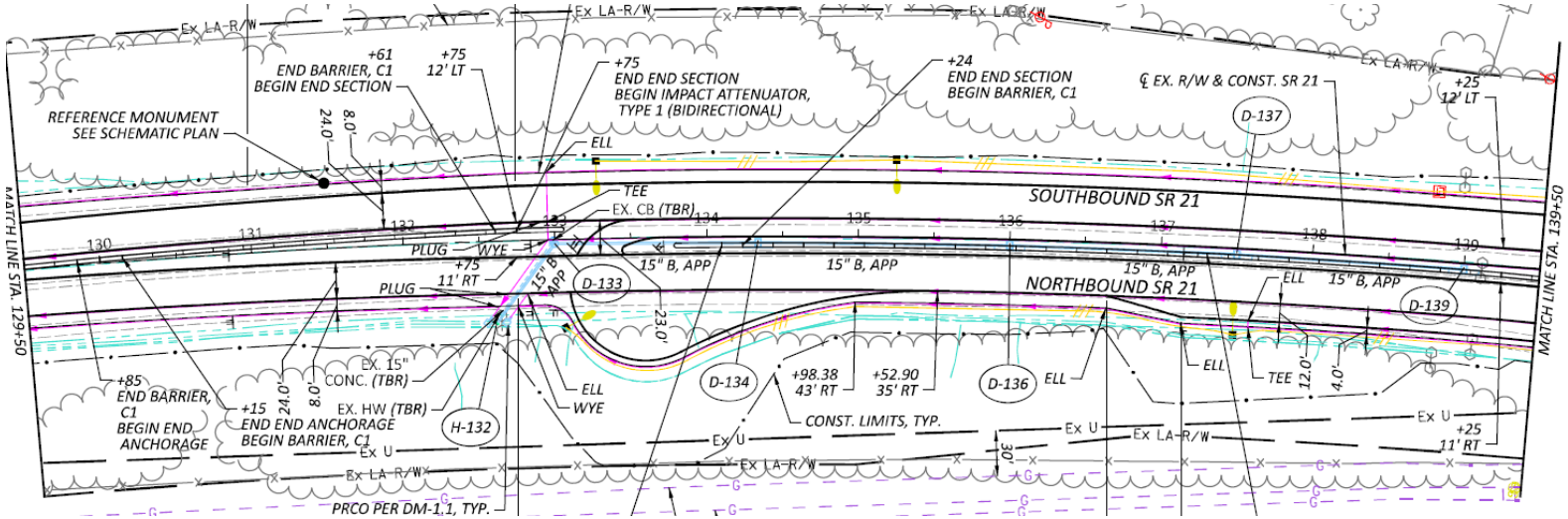
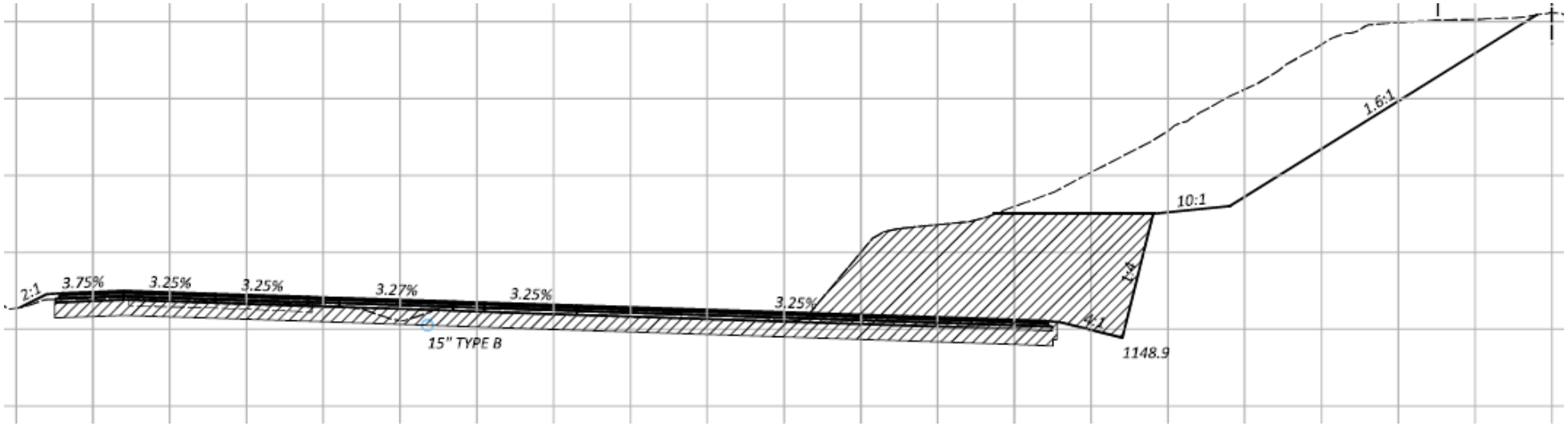
CONSTRUCTION SEQUENCE

- R&R Spec
  - Do not allow traffic on the rubblized pavement before the asphalt concrete base and intermediate courses are in place.
    - No proof rolling

  - Do not allow more than 48 hours to elapse between rubblizing the pavement and placing the initial asphalt concrete course. However, in the event of rain, the Engineer may waive this time limitation to allow sufficient time for the rubblized pavement to dry to the Engineer's satisfaction.

SIDE BAR – R-CUT





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SIDE BAR – R-CUT

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CONSTRUCTION SEQUENCE

- 2024
  - NB constructed up to intermediate course of asphalt
  - Outside shoulder of SB constructed (chemically stabilized subgrade, underdrains, asphalt)
- 2025
  - Flip traffic to NB
  - Construct SB
  - Surface course on everything
  - Complete the project one construction season early!

CONSTRUCTION SEASON WEATHER COMPARISON

	Month	Precip	Monthly Average
Began milling mainline 6/25/24	Jun-24	1.04	2.97
	Jul-24	2.96	
	Aug-24	6.61	included a 4.25 inches on 8/4/2024
Begn R&R 9/23/24	Sep-24	3.4	
Began paving over R&R 9/25/24	Oct-24	0.85	
Began milling mainline 3/24/25	Apr-25	5.02	4.35
Began R&R 6/5/25	May-25	4.76	
Began paving over R&R 6/6/25	Jun-25	3.28	

2025 CONSTRUCTION

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2025 CONSTRUCTION

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2025 CONSTRUCTION

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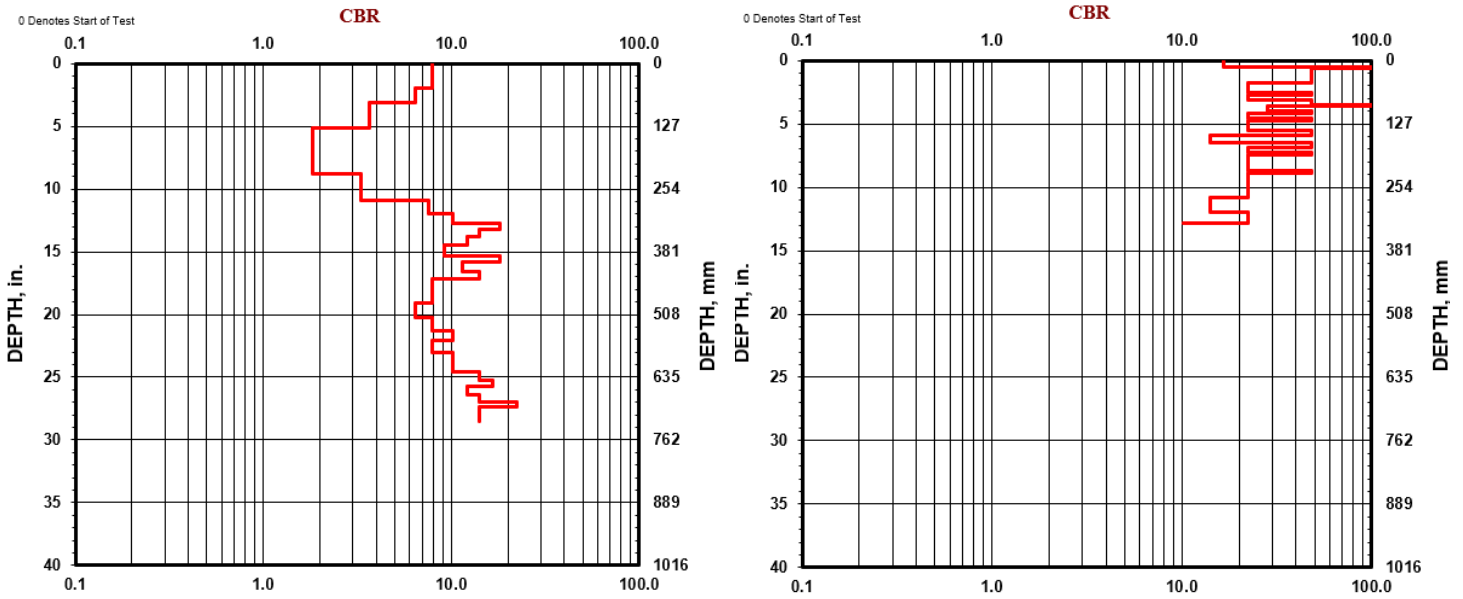
TROUBLESHOOT

- During the placement of the base asphalt the adjacent lane paved previously began to show signs of failure under loading.
- Initial limits of concern: 3800 feet x 24 feet

- 6/25/2025 Perform FWD and DCP, and test asphalt cores

TROUBLESHOOT

- Asphalt – Stability OK
- DCP – Variable, but mostly OK
- FWD – Alarming!



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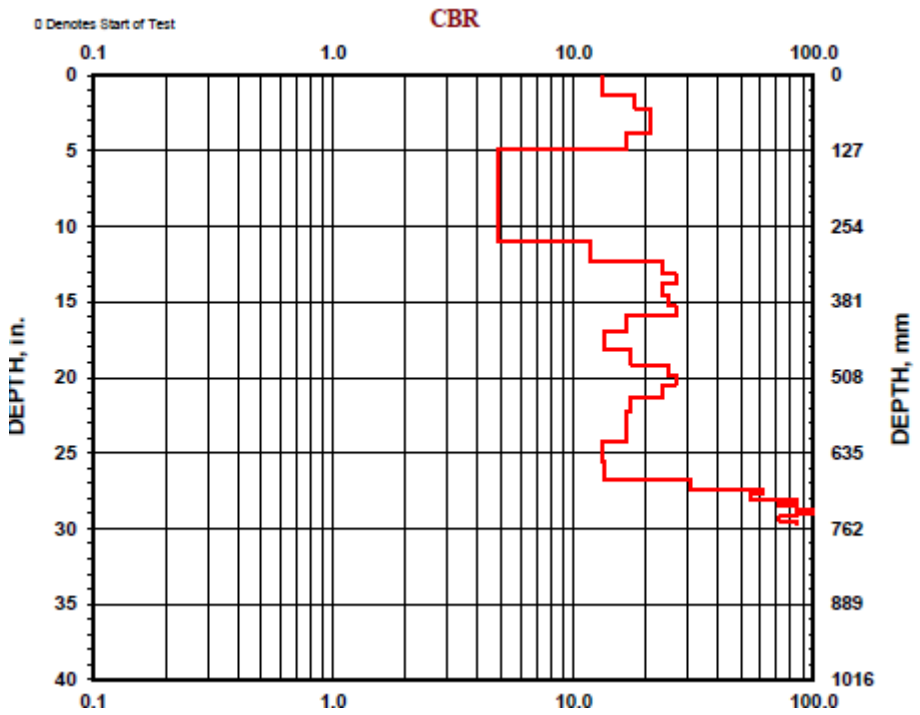
TROUBLESHOOT

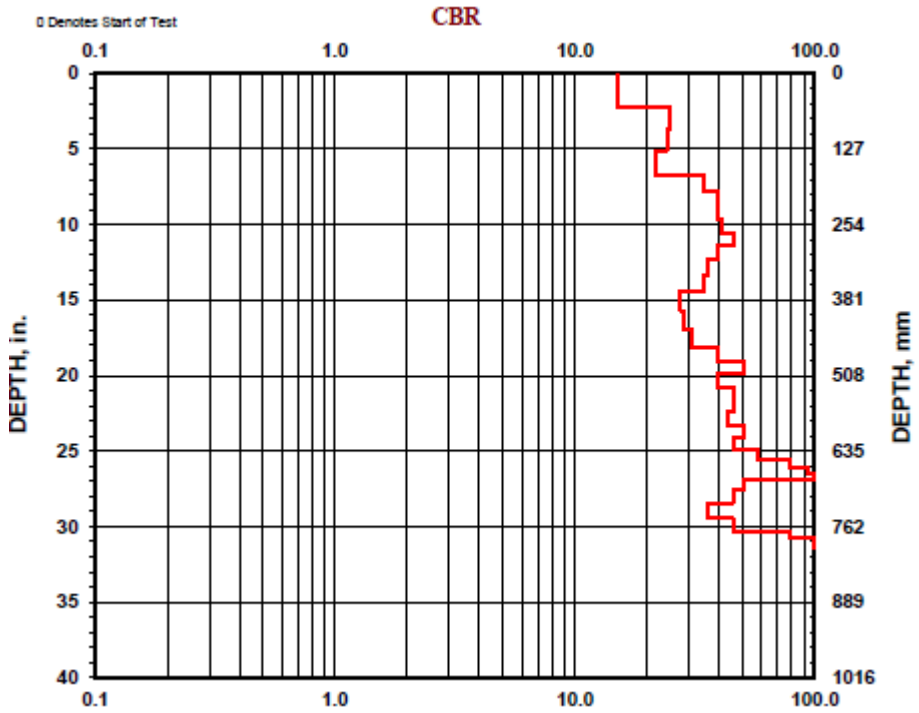
- FWD testing showed very high deflections, structure deficiencies of 5.5 to 7.5 inches.
- District now concerned about ALL R&R (19,175 feet).

- Test the NB Section (no stability issues, in service) to confirm the design is OK.

TROUBLESHOOT

- 7/9/2025 – 17 ADCP, FWD NB Section





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TROUBLESHOOT

- 7/9/2025 FWD NB - Additional intermediate course needed by section

Length	Start	Stop	Treatment	7/9 NB
270	0+30	3+00	Cement Stabilization	0
4100	3+00	44+00	Rubblize & Roll	0.36
234	44+00	46+34	Cement Stabilization	0
	Warwick Bridge			
182	48+09	49+90	Cement Stabilization	0
	Chippewa Creek Bridge			
219	52+81	55+00	Cement Stabilization	0
1700	55+00	72+00	Rubblize & Roll	0
229	72+00	74+29	Cement Stabilization	0
	CSX Bridge			
183	78+17	80+00	Cement Stabilization	0
1350	80+00	93+50	Rubblize & Roll	0
232	93+50	95+82	Cement Stabilization	0
	Galehouse Bridge			
4459	98+31	142+90	Undercut	0
510	142+90	148+00	Cement Stabilization	0
4750	148+00	195+50	Rubblize & Roll	0.09
2475	195+50	220+25	Cement Stabilization	0
2375	220+25	244+00	Rubblize & Roll	0.88
1000	244+00	254+00	Cement Stabilization	0
4900	254+00	303+00	Rubblize & Roll	1.46
467	303+00	307+67	Cement Stabilization	0

TROUBLESHOOT

- Now you know how we got here
- 7/14/2025 – Proof roll 5 miles of pavement
- Much improved in the last month (drainage?)
- Isolated (and few) 1/8-1/4” deflection

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TROUBLESHOOT

- Run FWD (again) every 150 feet
- Additional (asphalt) structure reduced over time

5104	Total CY	Est. Add. Cost:		$1,339,813.37	NB Passing Lane	SB Passing Lane	SB Driving Lane					
CY	Length	Start	Stop	Treatment	7/9 NB	Initial SB	Initial SB	7/29 SB	Δ (%)	8/13 SB	Δ (%)	New Add Structure (in.)
	270	0+30	3+00	Cement Stabilization	0	0	0	**0**		**0**		OK
1082	4100	3+00	44+00	Rubblize & Roll	0.36	3.44	3.08	**2.39**	22%	**2.21**	8%	2.25
	234	44+00	46+34	Cement Stabilization	0	0	0	**0**		**0**		OK
		Warwick Bridge										
	182	48+09	49+90	Cement Stabilization	0	0	0	**0**		**0**		OK
		Chippewa Creek Bridge										
	219	52+81	55+00	Cement Stabilization	0	0	0	**0**		**0**		OK
	1700	55+00	72+00	Rubblize & Roll	0	0.37	0.5	**0.27**		**0.04**	85%	OK
	229	72+00	74+29	Cement Stabilization	0	0	0	**0**		**0**		OK
		CSX Bridge										
	183	78+17	80+00	Cement Stabilization	0	0	0	**0**		**0**		OK
	1350	80+00	93+50	Rubblize & Roll	0	0.39	0.2	**0.62**		**0.33**	47%	OK
	232	93+50	95+82	Cement Stabilization	0	0	0	**0**		**0**		OK
		Galehouse Bridge										
	4459	98+31	142+90	Undercut	0	0	0	**0**		**0**		OK
	510	142+90	148+00	Cement Stabilization	0	0	0	**0**		**0**		OK
1114	4750	148+00	195+50	Rubblize & Roll	0.09	3.67	4.1	**2.89**	30%	**1.98**	31%	2
	2475	195+50	220+25	Cement Stabilization	0	0	0	**0**		**0**		OK
1184	2375	220+25	244+00	Rubblize & Roll	0.88	6.9	5.52	**4.07**	26%	**4.14**	-2%	4.25
	1000	244+00	254+00	Cement Stabilization	0	0	0	**0**		**0**		OK
1724	4900	254+00	303+00	Rubblize & Roll	1.46	4.52	4.92	**3.11**	37%	**2.91**	6%	3
	467	303+00	307+67	Cement Stabilization	0	5.78	0	**0**		**0**		

TROUBLESHOOT

- Average CBR estimated from FWD
- Increased an average of 13%
- Design CBR=9

			NB Passing Lane	SB Passing Lane	SB Driving Lane				
Start	Stop	Treatment	7/9 NB	Initial SB	Initial SB	7/29 SB	8/13 SB	%	
0+30	3+00	Cement Stabilization	8	9	9	11	10	11%	
3+00	44+00	Rubblize & Roll	14	13	12	15	14	17%	Deficient
44+00	46+34	Cement Stabilization	10	10	9	9	10	11%	
Warwick Bridge									
48+09	49+90	Cement Stabilization	12	14	12	14	13	8%	
Chippewa Creek Bridge									
52+81	55+00	Cement Stabilization	10	9	11	9	12	9%	
55+00	72+00	Rubblize & Roll	8	8	8	8	8	0%	
72+00	74+29	Cement Stabilization	10	9	7	8	8	14%	
CSX Bridge									
78+17	80+00	Cement Stabilization	8	9	n/a	n/a	8		
80+00	93+50	Rubblize & Roll	7	8	9	10	11	22%	
93+50	95+82	Cement Stabilization	6	11	9	11	12	33%	
Galehouse Bridge									
98+31	142+90	Undercut	22	19	22	23	24	9%	
142+90	148+00	Cement Stabilization	13	9	8	9	10	25%	
148+00	195+50	Rubblize & Roll	10	12	10	14	14	40%	Deficient
195+50	220+25	Cement Stabilization	12	12	11	13	14	27%	
220+25	244+00	Rubblize & Roll	9	11	8	10	8	0%	Deficient
244+00	254+00	Cement Stabilization	12	12	11	12	12	9%	
254+00	303+00	Rubblize & Roll	11	12	12	9	9	-25%	Deficient
303+00	307+67	Cement Stabilization	n/a	8	n/a	8	10		
								13%	

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CONCLUSIONS

- Construction water management is important
- We are addicted to global chemical stabilization – weatherproof
- Proof roll rubblized concrete
- If we FWD all of our new pavements, will some of them be deficient?
- Anticipate 10-25% of R&R will be unstable

CONCLUSIONS

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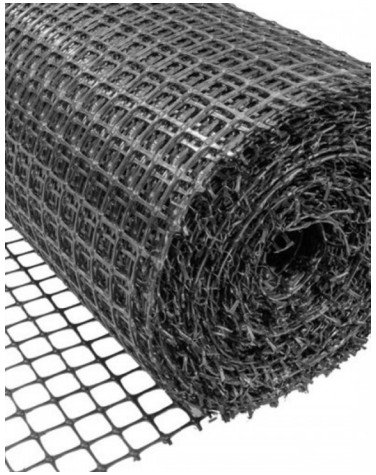
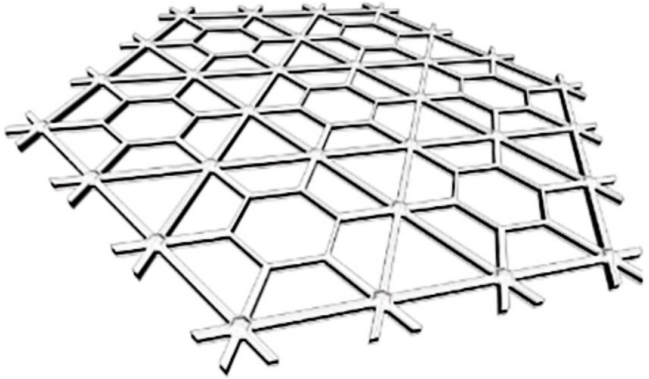
POSSIBLE SOLUTIONS

- Geogrid QPL – Type 2
  - Tensar SQ2020
  - $2.75/SY installed
- Interax NX750
  - $9.13/SY installed
  - “We observed some slight waving / rolling…due to pore pressure”





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THANK YOU