HMA Intermediate Layer Corrections, Needs and Proven Practices

HMA Pavement Smoothness Technology Forum

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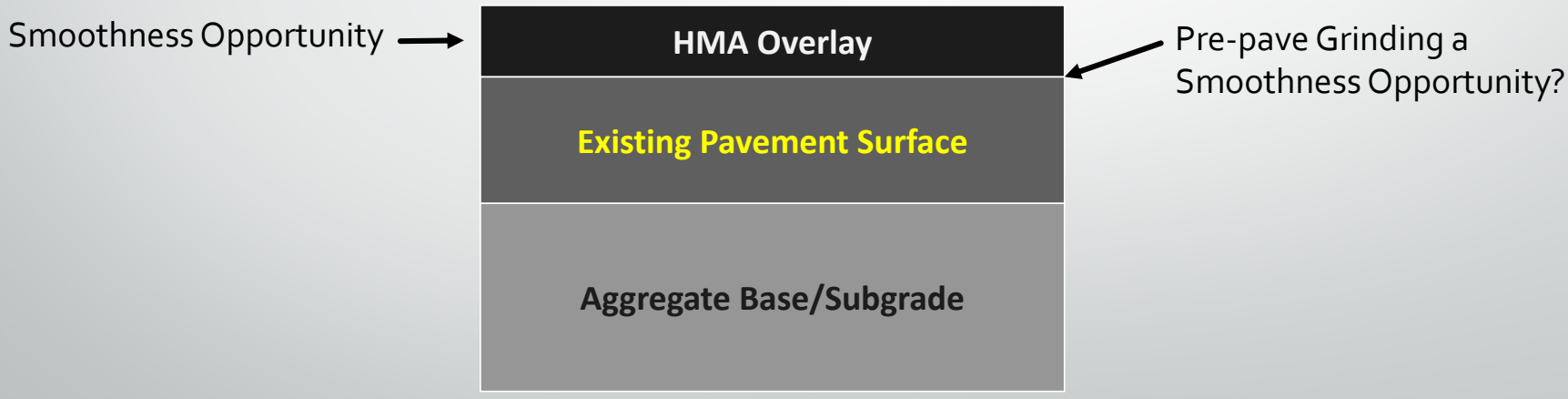
Goals For This Session

- Distinguish Between Intermediate Layers
- Evaluate Smoothness Requirements of Intermediate Layers
- Demonstrate an Effective Way to Obtain Smoothness of Intermediate Layers

Intermediate Layers

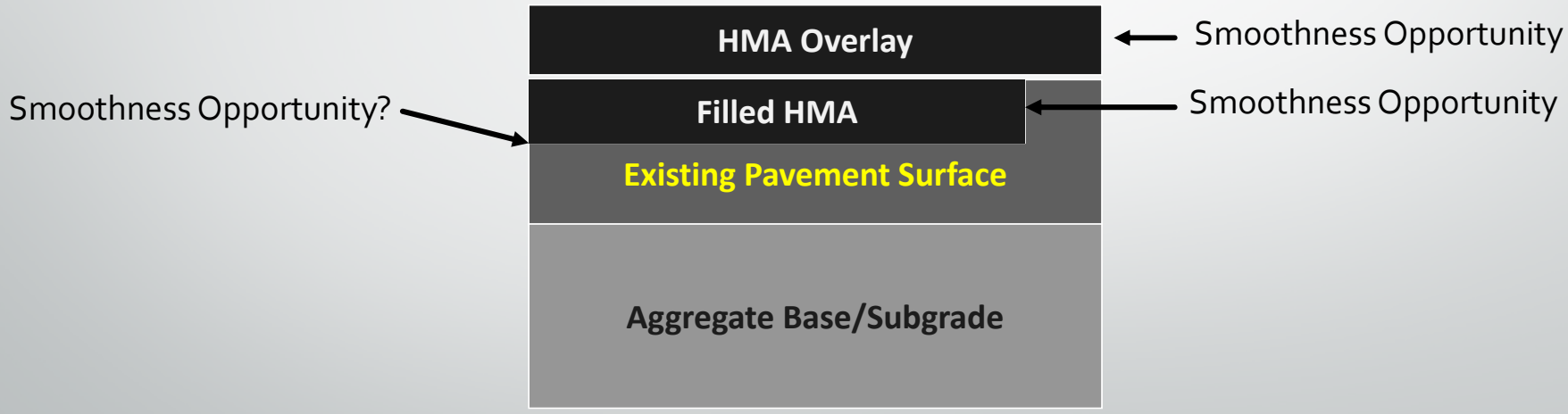
HMA Intermediate Layers

Existing Asphalt Surface Prior to Overlay



HMA Intermediate Layers

Mill and Fill
With or Without Overlay

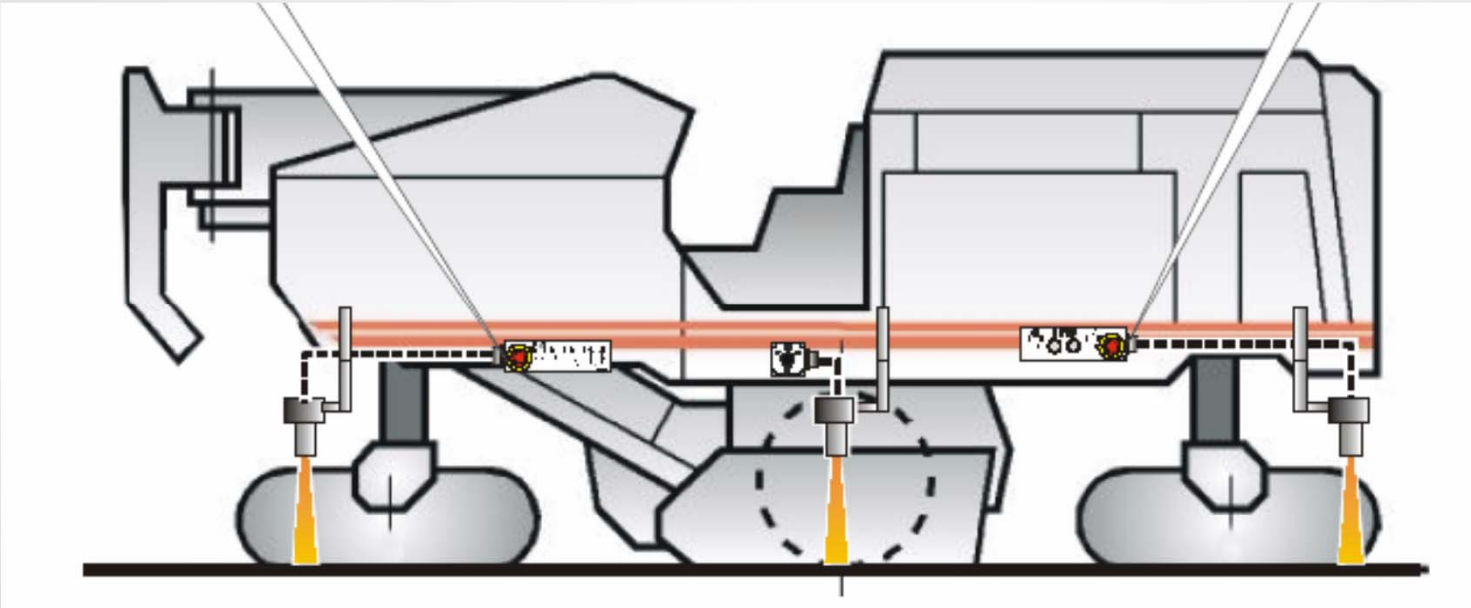


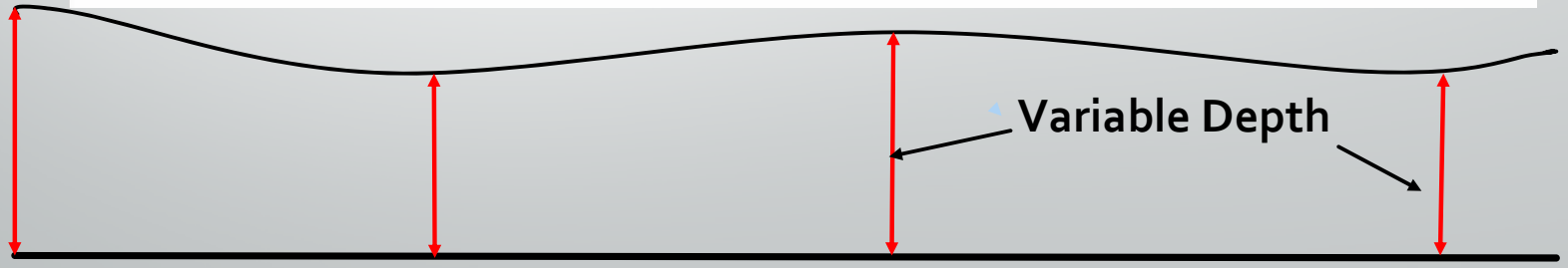
Making Milling a Smoothness Opportunity

Can aid upper layer smoothness if:

- Maintain appropriate continuous speeds – Do not out run the pattern. Do not stop with drum still in cut
- Maintain the mill's mechanical systems
- Transition well into and out of cuts
- Maintain and replace cutting tools and blocks as needed
- Clean milled surface well
- Depending on type and thickness of overlay use fine tool pattern
- Good control systems (averaging system on existing surface, matching shoe on milled surface) are used

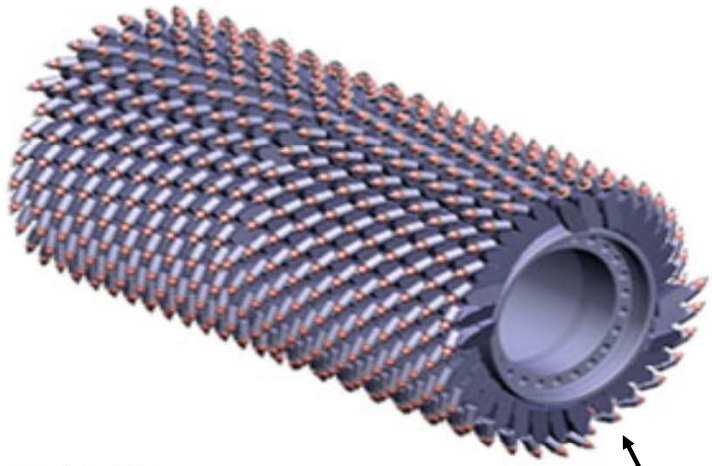
Using Averaging System to Obtain Smoother Intermediate Surface



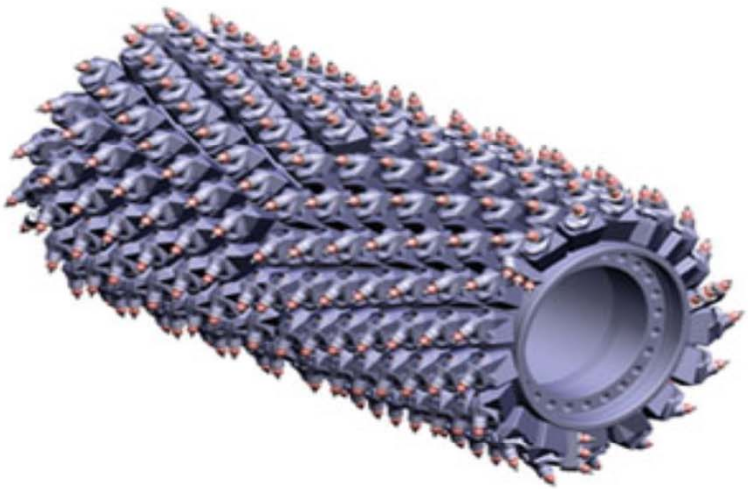


Surface Texture

Fine milling drum
LA6x2
pick spacing:
6 x 2 mm

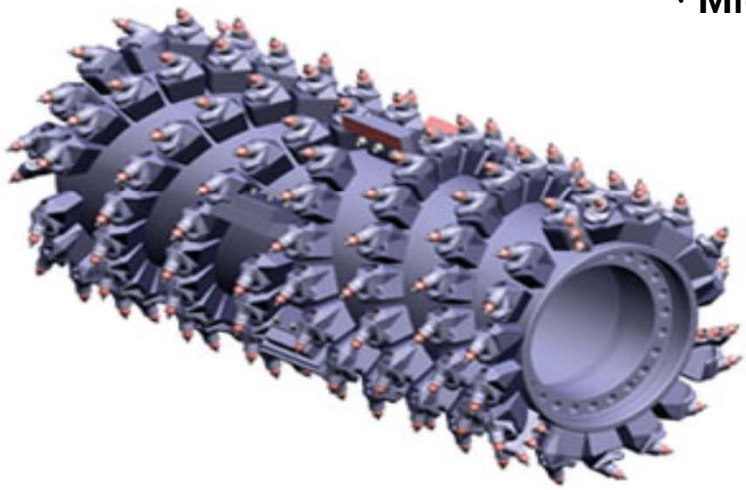


Fine milling drum
LA8
pick spacing:
8 mm



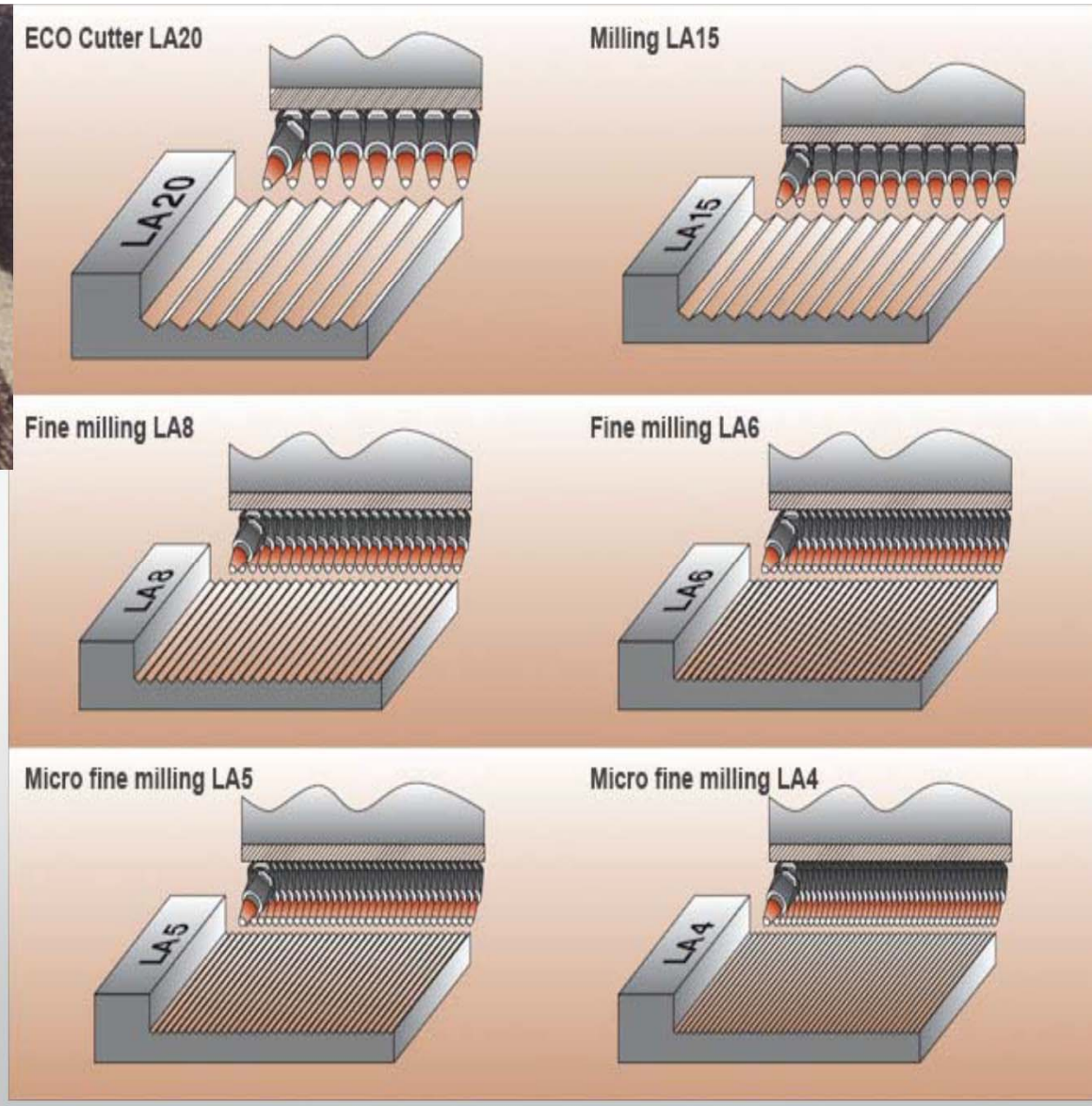
Micro Milling Drum

Milling drum LA15
pick spacing:
15 mm



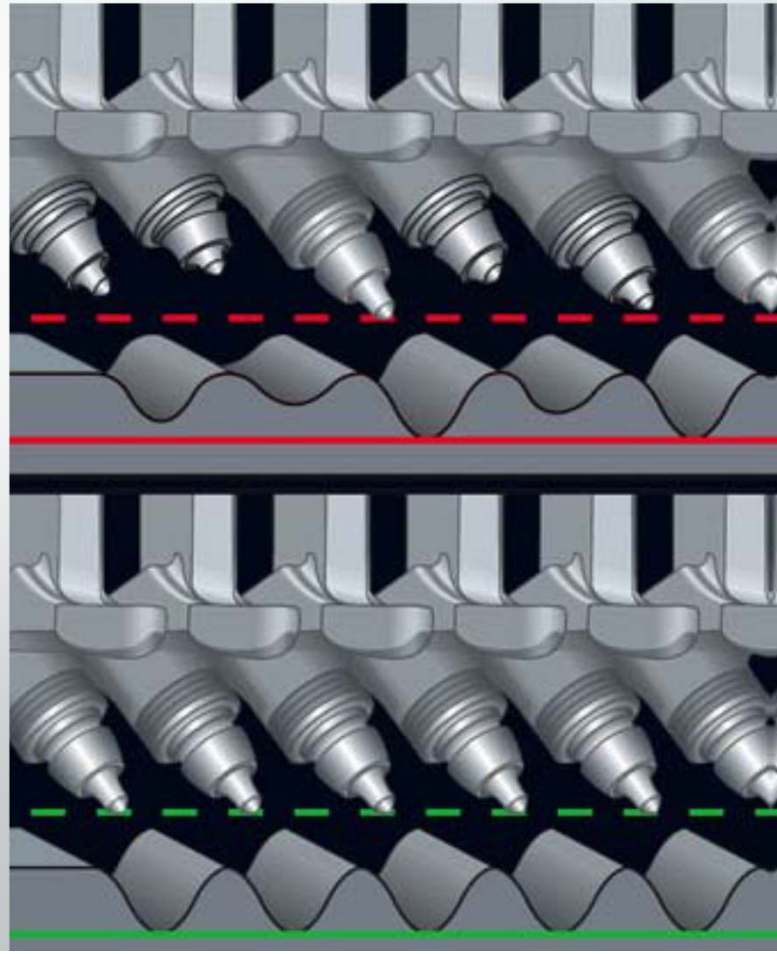
Standard Milling Drum

Standard Milling Drum



Micro Milling Drum

Tool Wear and Poor Surface Texture



Making Milling a Smoothness Opportunity

Not as effective if:

- Mill depth must be at the specified depth and follow existing surface
- Paving operation does not use milled surface for control
- Good paving practices are not utilized

But how much does it aid in smoothness of upper layers?

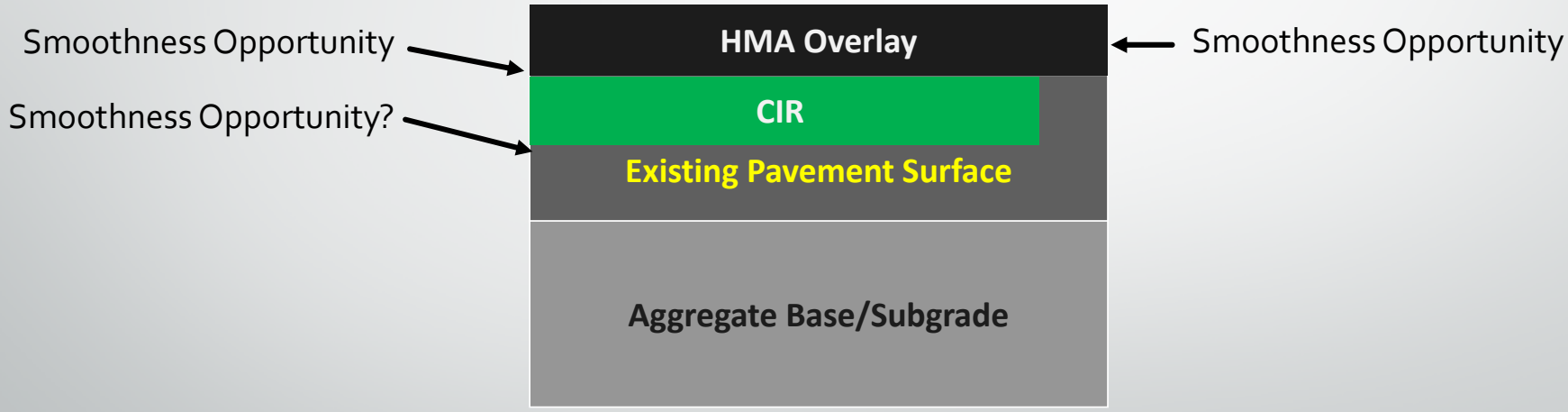
Needs more evaluation

Probably less than currently thought

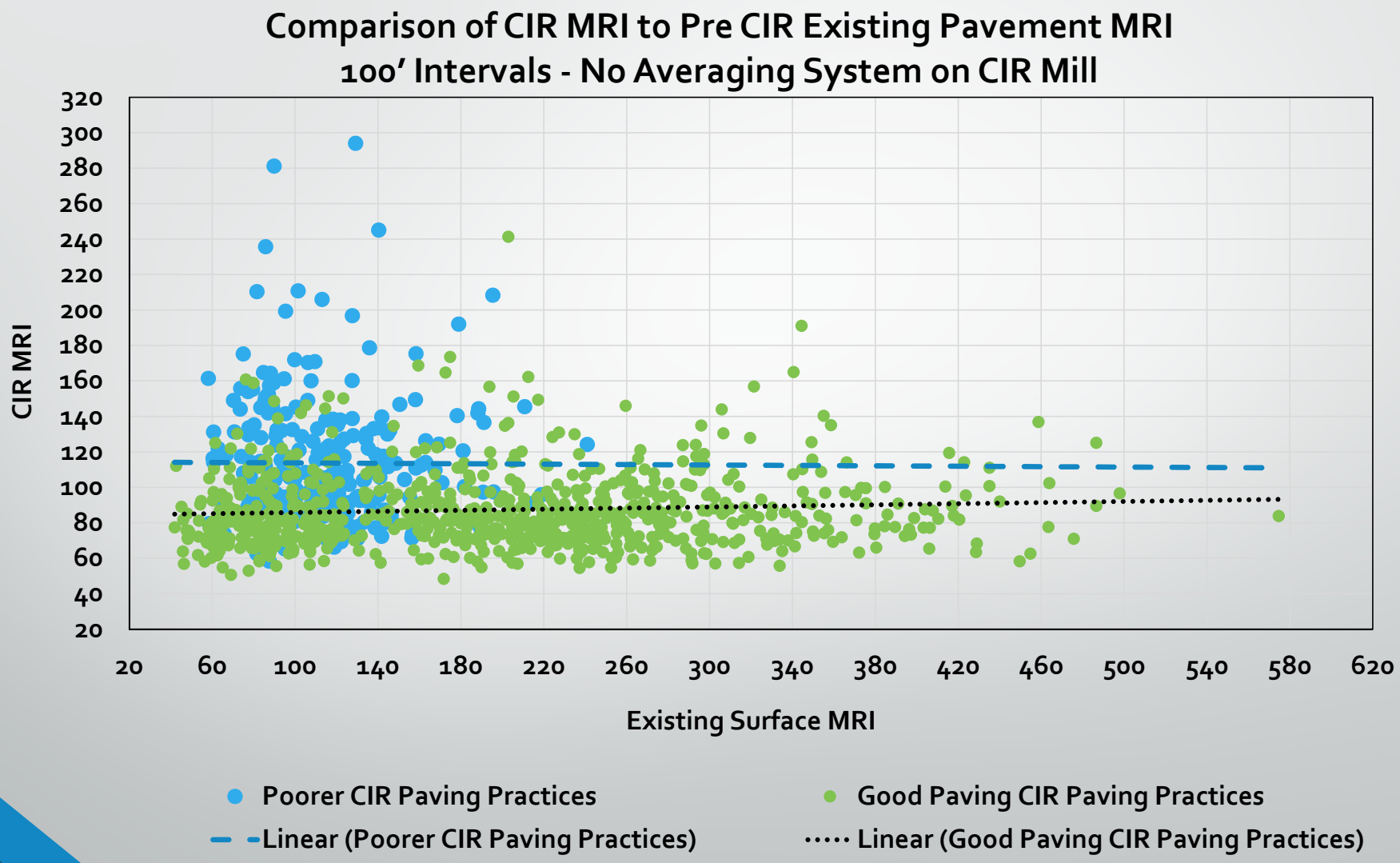
Likely similar to CIR and HMA Intermediate layers

HMA Intermediate Layers

CIR with Overlay



Variable Depth Milling on CIR Using Averaging System


Comparison of CIR MRI to Pre CIR Existing Pavement MRI
100' Intervals - No Averaging System on CIR Mill
CIR MRI
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
20
60
100
140
180
220
260
300
340
380
420
460
500
540
580
620
Existing Surface MRI
Poorer CIR Paving Practices
Good Paving CIR Paving Practices
Linear (Poorer CIR Paving Practices)
Linear (Good Paving CIR Paving Practices)

Comparison of Existing Pavement MRI to After CIR MRI at 100' Intervals With Good Paving Practices

MRI Range	Data Pts	Existing MRI Ave	CIR MRI Ave	% Improv.
< = 60	34	53.7	76.6	-42.6%
61 - 70	35	65.7	83.8	-27.5%
71 - 80	44	76.4	89.3	-16.9%
81 - 90	56	86.6	84.0	3.0%
91 - 100	34	96.2	85.8	10.8%
101 - 120	54	110.9	88.7	20.0%
121 - 140	23	130.7	89.4	31.6%
141 - 180	77	164.0	90.4	44.9%
181 - 240	166	211.6	86.4	59.2%
241 - 300	85	268.1	88.5	67.0%
301 - 400	84	342.5	89.4	73.9%
401 < =	28	441.0	89.4	79.7%
All	**720**	**194.5**	**87.3**	**55.1%**

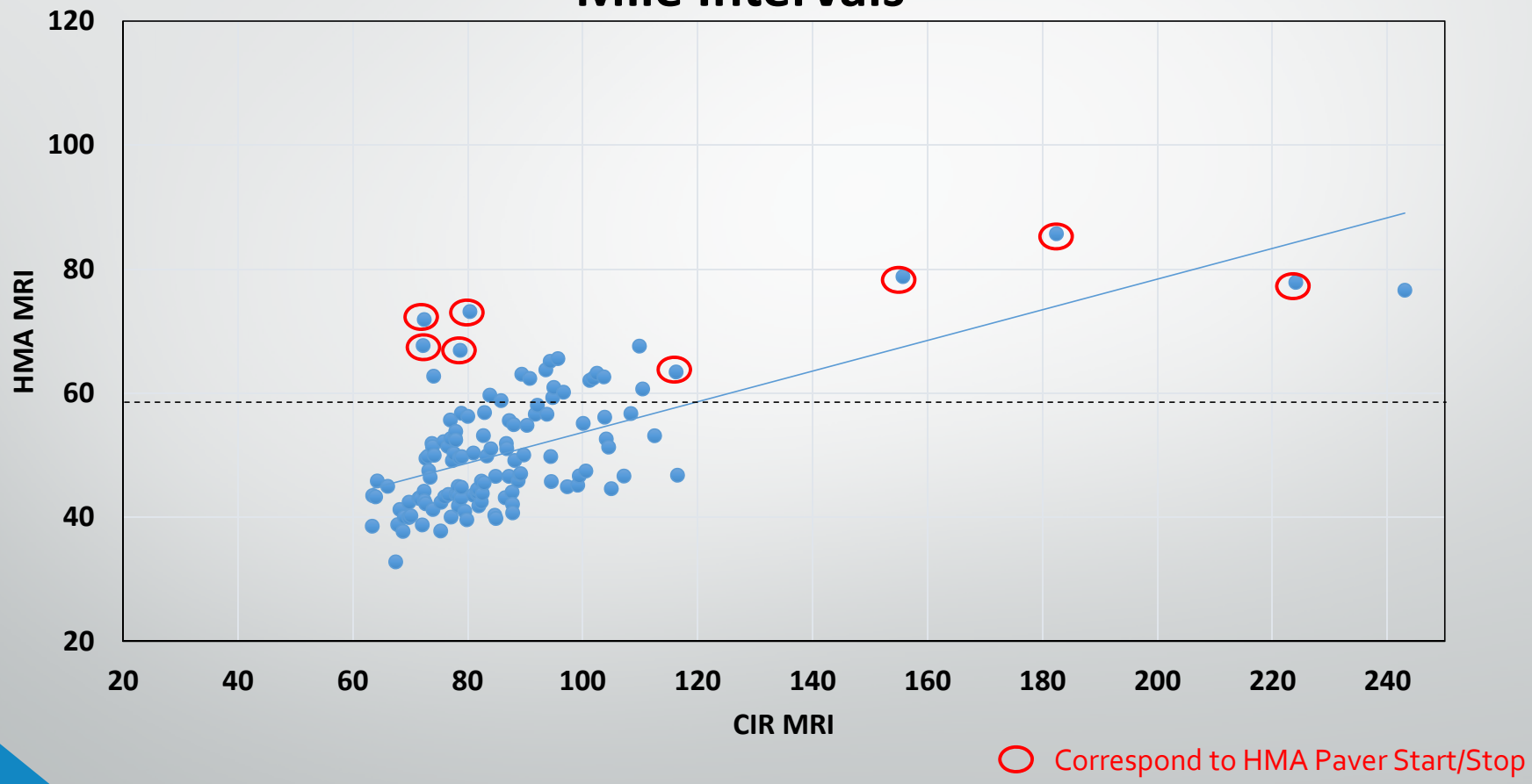
Relationship of CIR MRI and ALR to an HMA Overlay MRI and ALR?

Intermediate ALR Compared to HMA Overlay ALR

Location	ALR Length (ft)	ALR Locations	CIR ALR With Corresponding HMA ALR <200	201 - 225	226 - 250	251 - 300	301 - 400	400 >	No Corresponding ALR
Left Wheel Paths									
CIR Base 3"	1751	118	88	10	4	8	4	4	
HMA Final 1.8"	175	14	1	0	0	0	1	1*	11
Right Wheel Paths									
CIR Base 3"	4218	269	187	41	17	14	7	3	
HMA Final 1.8"	150	6	0	0	0	0	2	2*	2

* Locations at start of project.

CIR MRI and Corresponding HMA MRI in 0.10 Mile Intervals

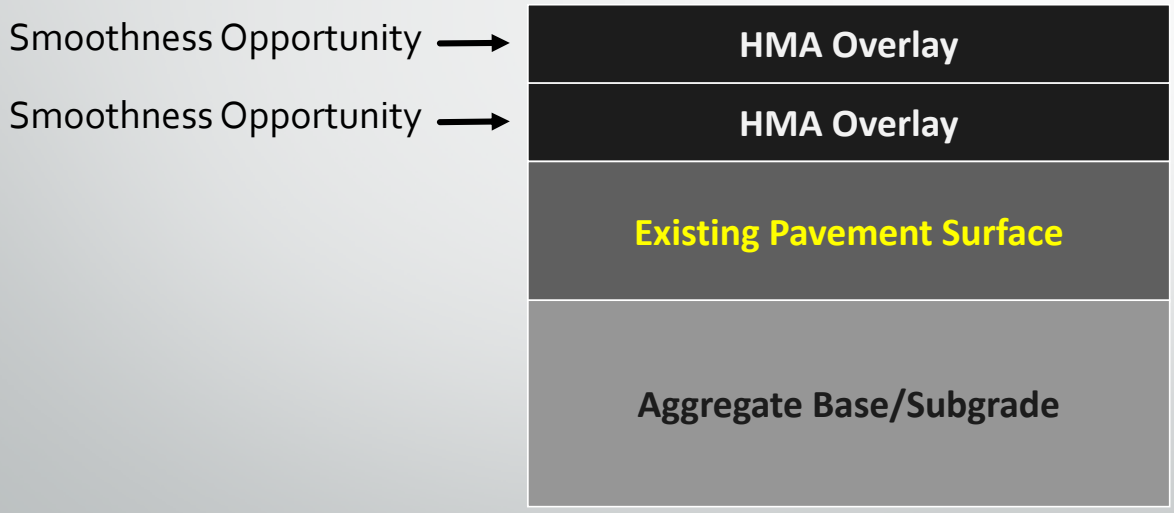


100' Fixed Intervals Sorted Into Pre CIR MRI Ranges As Indicated

CIR MRI	Total Data Pts	Ave Corr. CIR MRI	Ave. HMA MRI	Data Pts > 60 MRI	HMA Final MRI % > 60	% > 65	%>70	%>75	%>80
< = 60	40	56.3	45.0	3	7.5%	5.0%	0.0%	0.0%	0.0%
61 - 70	131	66.4	45.7	11	8.4%	6.1%	4.6%	0.8%	0.0%
71 - 80	197	75.4	47.1	16	8.1%	3.0%	1.5%	1.0%	0.5%
81 - 90	180	84.5	49.3	25	13.9%	6.7%	3.9%	1.1%	0.6%
91 - 100	103	95.4	52.0	26	25.2%	11.7%	5.8%	2.9%	0.0%
101 - 120	75	108.5	56.7	32	42.7%	24.0%	16.0%	8.0%	5.3%
121 - 140	34	126.6	56.4	12	35.3%	23.5%	17.6%	11.8%	8.8%
141 - 180	8	163.3	67.5	5	62.5%	62.5%	50.0%	25.0%	12.5%
All	**768**	**84.1**	**49.5**	**130**	**16.9%**	**9.2%**	**5.7%**	**2.6%**	**1.3%**

HMA Intermediate Layers

Base Course HMA Pavement



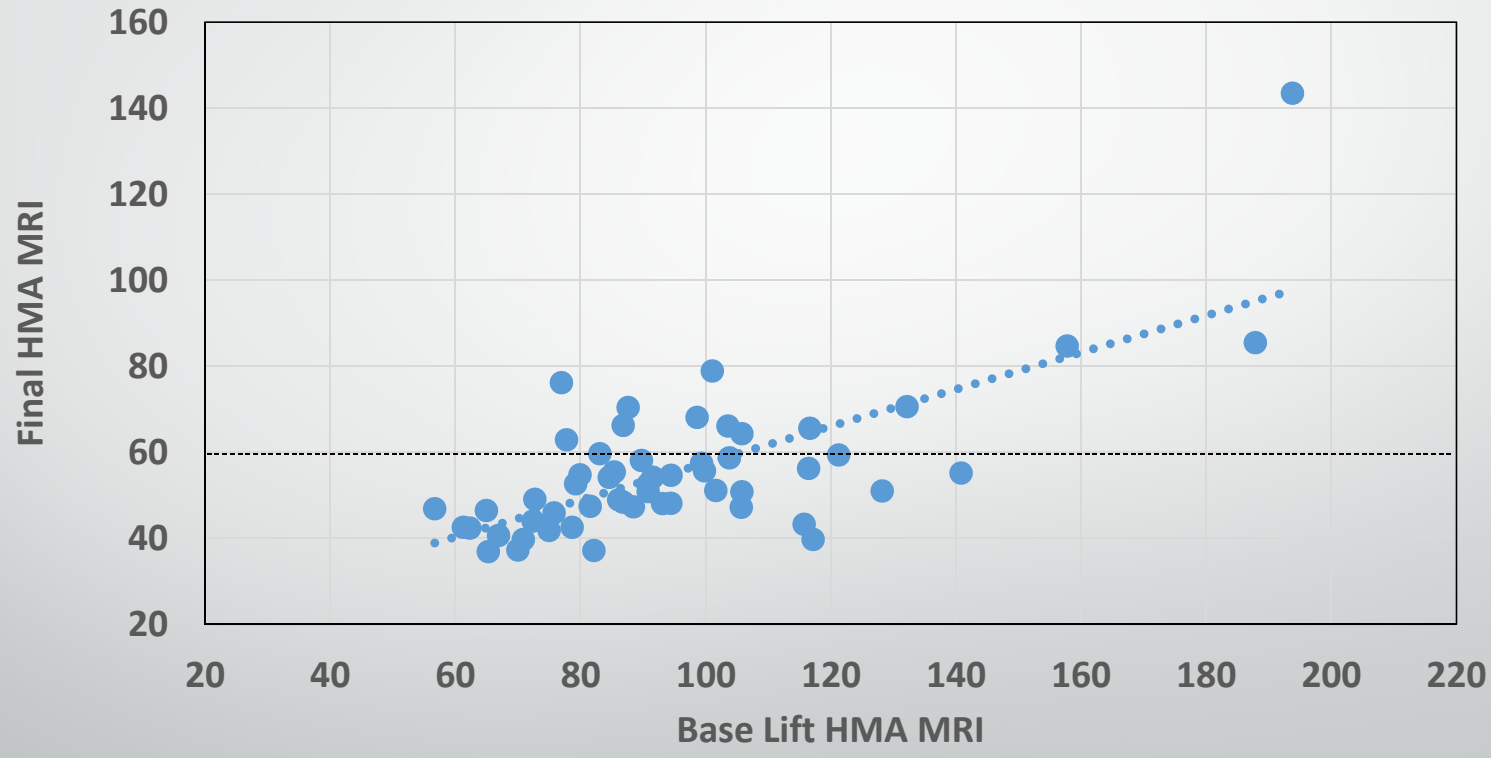
Relationship of Intermediate MRI and ALR to an HMA Overlay MRI and ALR?

Intermediate HMA ALR Compared to HMA Overlay ALR

Location	ALR Length (ft)	ALR Locations	Base Lift ALR With Correspond. Final ALR <200	201 - 225	226 - 250	251 - 300	301 - 400	400 >	No Corresponding ALR
Left Wheel Paths									
HMA Base 2"	127	7	3	3	1				
HMA Final 2"	0	0	0	0	0				
Right Wheel Paths									
HMA Base 2"	786	52	42	4	3	2	1		
HMA Final 2"	81	3	0	0	0	1*	1		1

* Locations at start of project.

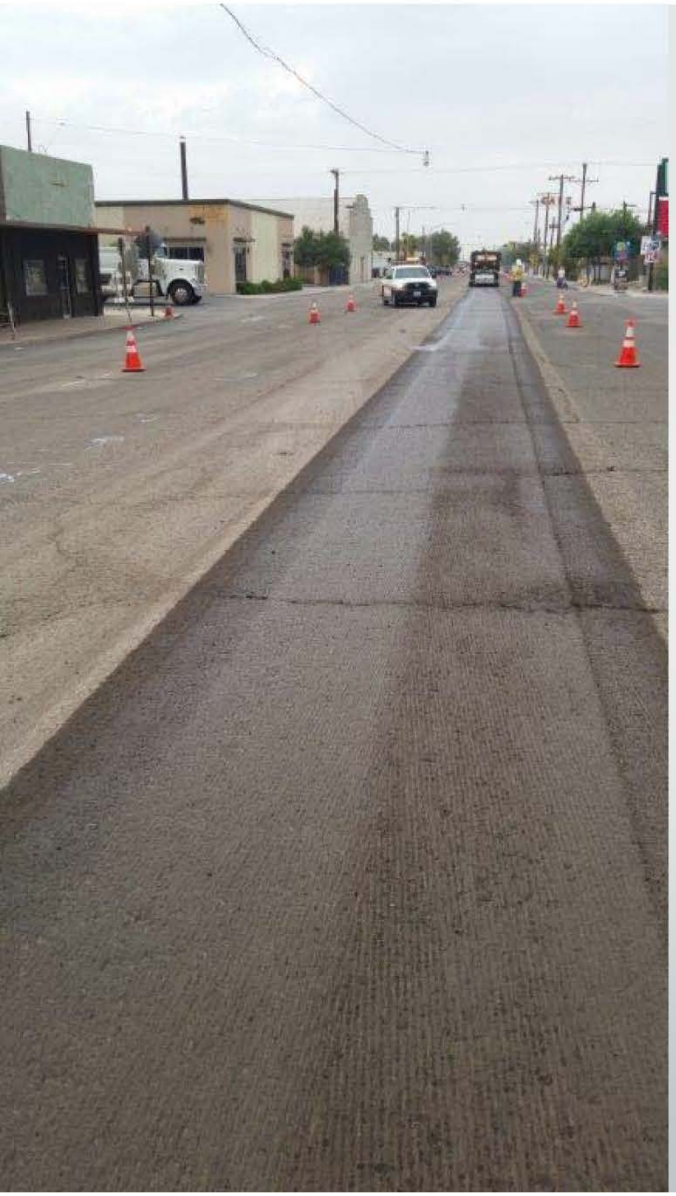
Final Lift HMA MRI Compared to Intermediate Base Lift HMA MRI

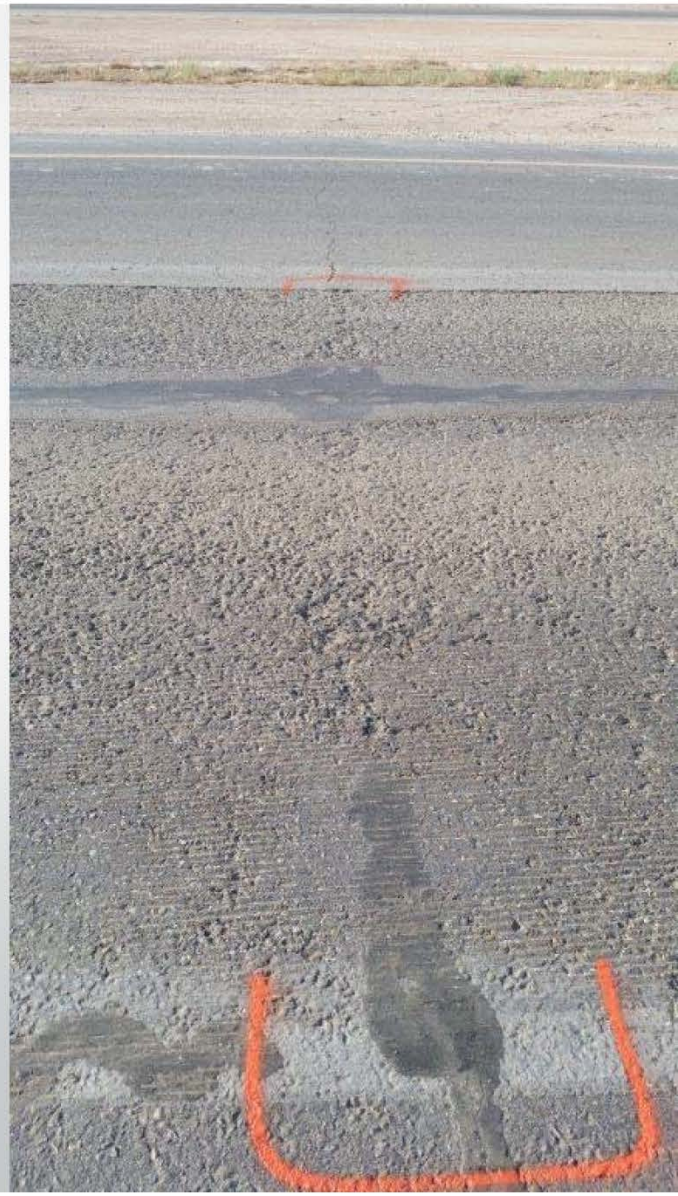


Suggested Correction Smoothness Methods for Intermediate Layers Only

Not Valid for Final HMA Corrections

- Do not use the ProVAL Smoothness Assurance Model (SAM) auto grinding system directly with a diamond grinder
  - Only models in two dimension which may cause impacts in other locations. Grinding wheels not necessarily on same profile as grinding head when large variations in transverse profile exist
  - Over estimates correction areas and tends to be slower
- Use a mill with averaging and edge control system
  - ProVAL SAM can be used to combine locations for both wheel paths and determine non-correction areas that can be skipped vs milled areas
  - Mill is faster and causes less impact in other areas
  - May need fine tools such as micro mill for less impact to surface and thin lift overlays
  - For CIR make sure the surface has been re-compacted properly. May need to mill with lower pavement temperatures
  - Do not necessarily correct dips. Correct large bumps. Raise the ALR requirement for corrections





Law of diminishing return by grinding corrections

Test Project of Corrections Techniques

- CIR Section with Test Project of one mile at end of project
- NB lane
  - No ProVAL SAM analysis
  - Micro milled with averaging system – Took 4.5 hours
  - Corrected average MRI of 95.6 in/mi to 70.7 in/mi
  - Corrected 7 areas of ALR over 180 in/mi to no areas of ALR over 180 in/mi
- SB lane
  - ProVAL SAM system followed completely using a diamond grinder – Stopped after 8 hours
  - Corrected Average MRI of 93.9 in/mi to 84.7 in/mi
  - Tried to correct 3 areas of ALR over 180 in/mi but still had 3 areas of ALR over 180 in/mi when stopped

Conclusions/Suggestions

- Probably can raise pre-pave grinding/CIR ALR to at least 250 in/mi
- Probably can raise CIR or base lift HMA MRI to at least 90 in/mi
- Existing pavement IRI appears to have little impact on CIR IRI
- When corrections on bottom layers are necessary should consider a mill and not necessarily using the ProVAL SAM auto grind system
- Paving practices appear to have the greatest impact to final smoothness
- Even with good paving practices it still may be difficult on thin final HMA lifts to meet 60 MRI without some grinding corrections to the final surface
- More test projects and data are necessary to confirm these conclusions