Road Reclamation
Solutions That Save Time & Money

Dan Wegman
Jonathan Pease
Steve Monlux

32nd Annual North Central Local Roads Conference

Rapid City, SD - October 18-19,2017

Introduction

Why should we take a step forward from traditional road construction methods?

Road Recycling techniques spread budget dollars, increases strength, saves time AND IT WORKS!

How do we know?

Mix Design Experience, Field Experience, Engineering Experience, First Hand Experience

Agenda

- Dan Wegman
  - In-Place Recycling, How & Why it Works
- Jonathan Pease
  - FDR, Saving Time & Money While Saving Resources
- Steve Monlux
  - Soil Cement Roads in Richland County MT

In-Place Recycling
How & Why it Works

Dan Wegman, Braun Intertec

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Stabilization Options

- Cutbacks/Roadmix
- Proprietary Products – (Base One)
- Engineered Emulsion
- Lime/chlorides
- Foamed Asphalt
- Flyash/Cement
- Combinations of above

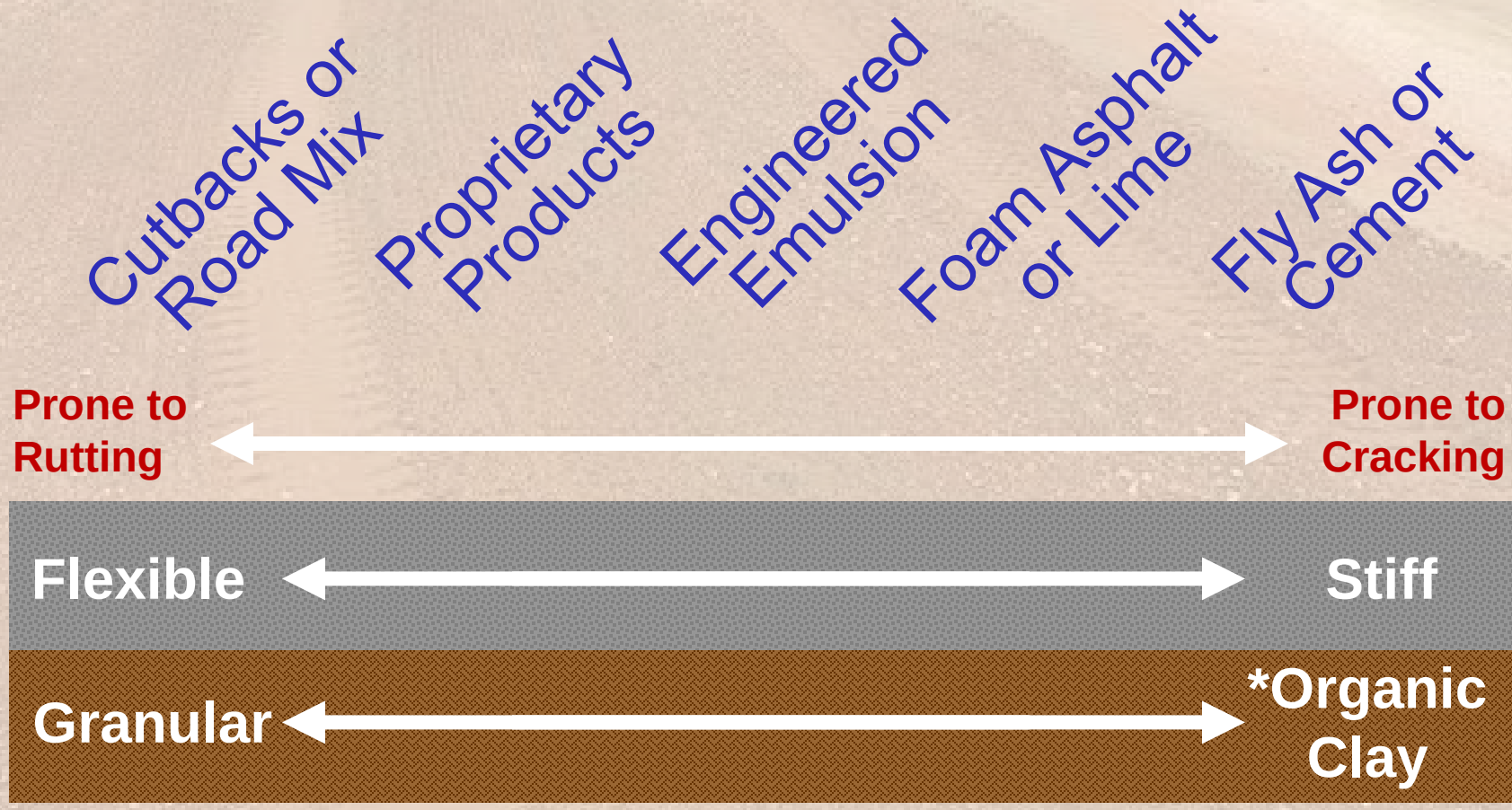
Identifying Roads for Rehabilitation

- Extensive structural distress; could be accompanied by functional distress

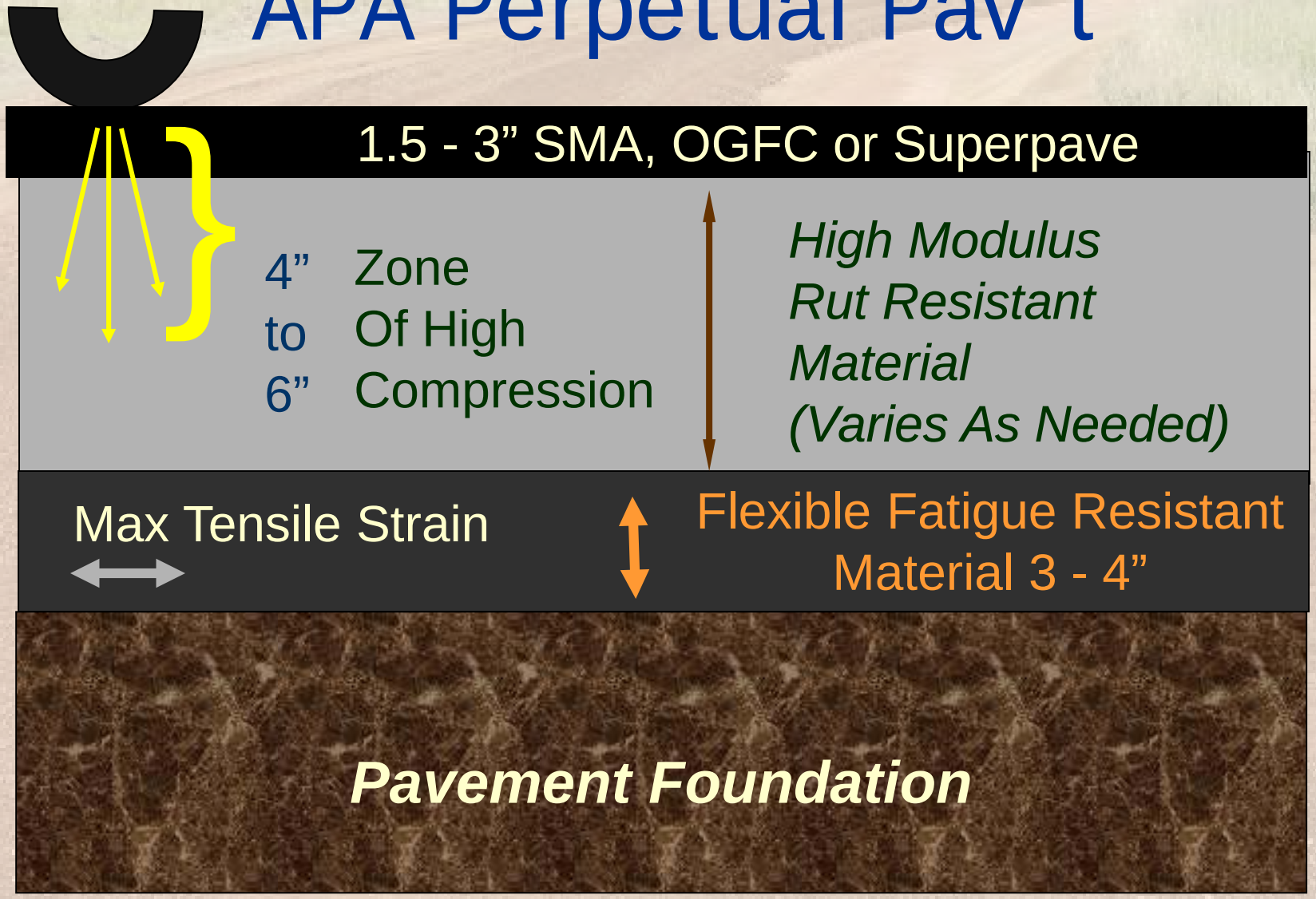
-Adequate base strength stability
-Works areas/soft spots need to be corrected
-Subgrade quality/Drainage
-Sufficient base depth
Patching; OK, but adds variability in materials

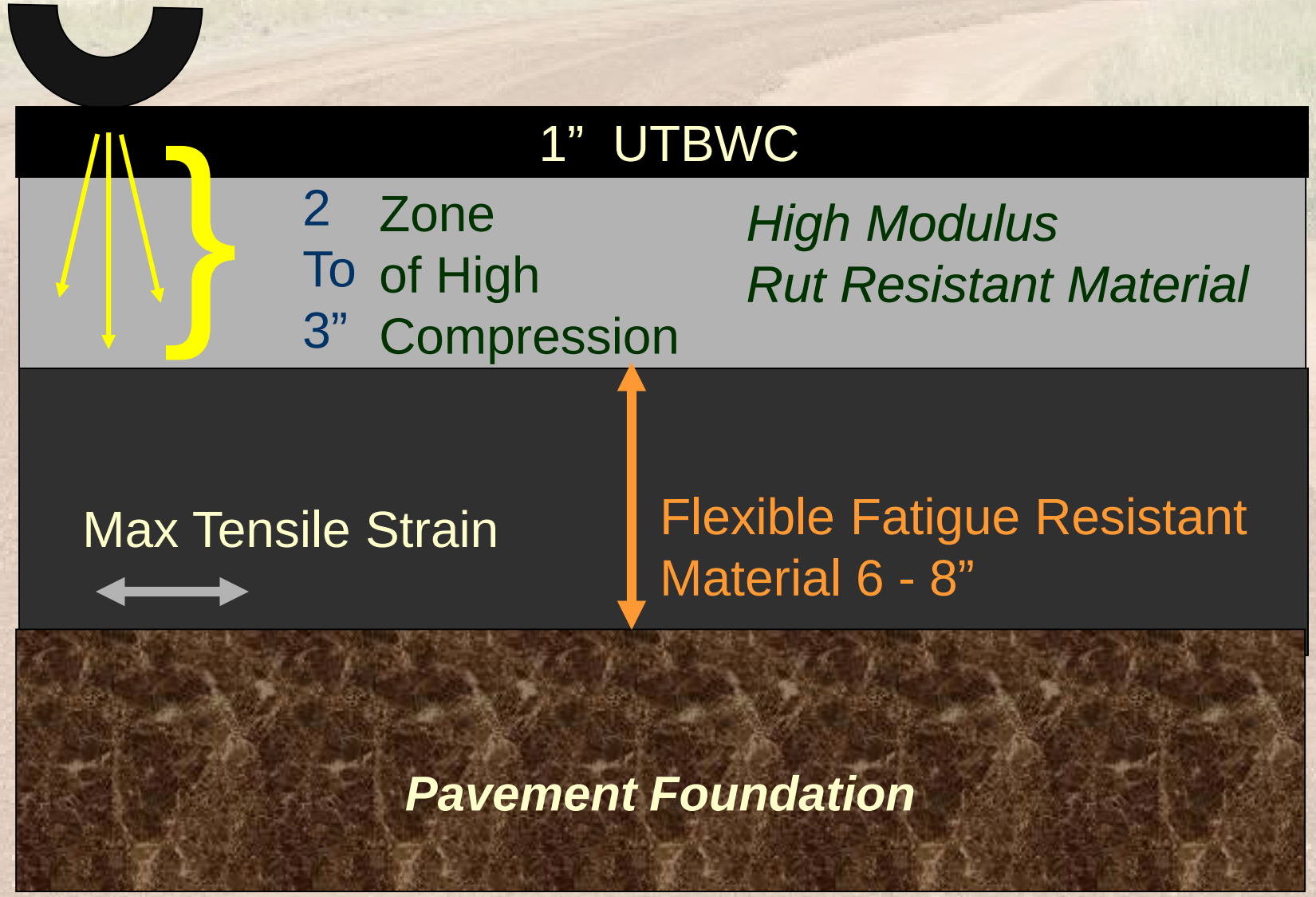
Full Depth Reclamation (SFDR) Keys to Success – Strength & Flex

Stabilization Considerations



APA Perpetual Pav't




1” UTBWC
2 To 3”
Zone of High Compression
High Modulus Rut Resistant Material
Max Tensile Strain
Flexible Fatigue Resistant Material 6 - 8”
Pavement Foundation

Structural Benefit

- The Stabilization process will increase the structural coefficient of the material
- The structural coefficient of Stabilized material is dependent upon:
  - Stabilizing Material
  - Amount of P200 (fines)
  - Angularity of recycled material

I - 94 Albertville
Mn/Road – I 94

- Cell 2
  - 50% RAP
- Cell 3
  - 75% RAP
- Cell 4
  - 100% RAP

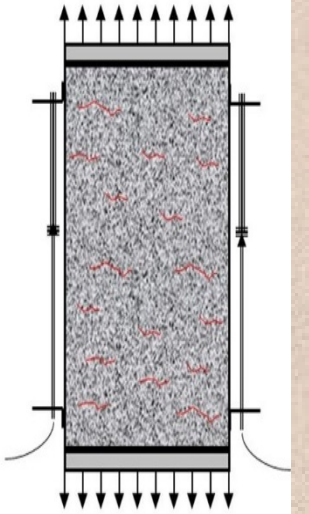
Base Stabilization Cells 2,3,4

Cell 2	50% RAP	6 inch Stab.	4% EE
Cell 3	75% RAP	6 inch Stab.	3% EE
Cell 4	100% RAP	8 inch Stab.	.075% EE
SHLD	50% RAP	4 inch Stab.	4.5% EE

MnRoad Cells 2,3,4

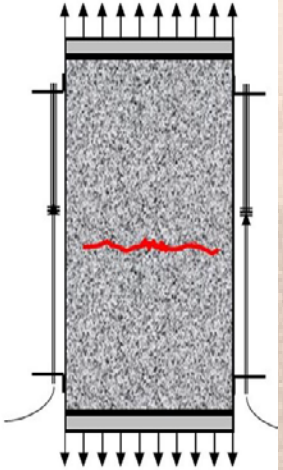
Fatigue Cracking Origins: Material Factors

- Initiation
  - Microscopic defects and incompatibilities amplify applied stress and microcracks form



Fatigue Cracking Origins: Material Factors

- Initiation
  - Microscopic defects and incompatibilities amplify applied stress and microcracks form
- Coalescence
  - Microcracks grow and coalesce into macrocracks
- Propagation
  - Macrocracks move through the asphalt concrete ultimately showing up as visible flaws on pavement surface



UNIVERSITY OF ARKANSAS

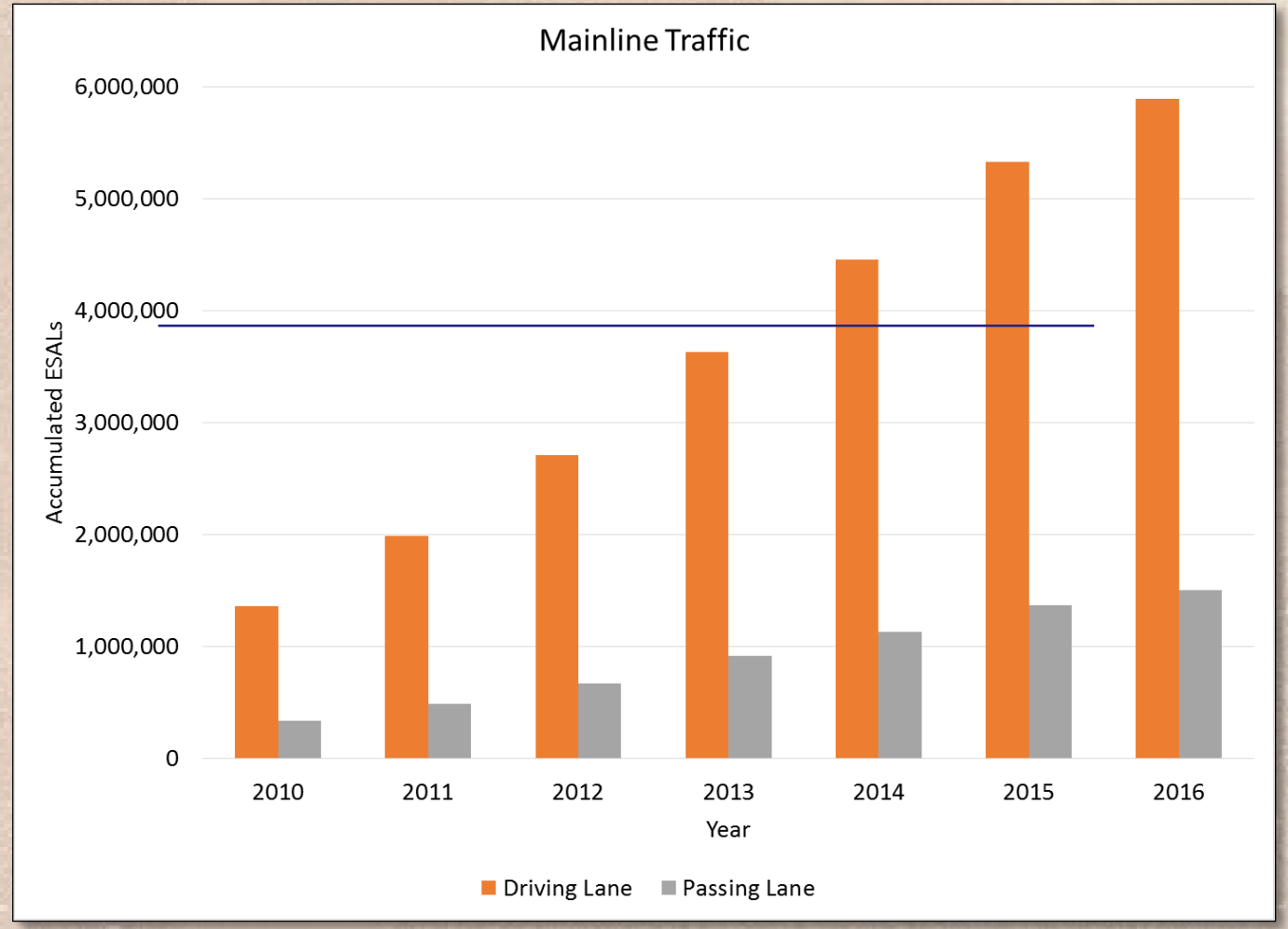
AAPT Association of Asphalt Paving Technologists

ARIZONA STATE UNIVERSITY

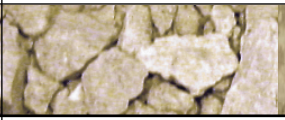
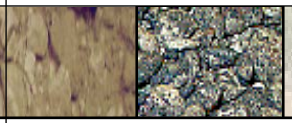
Design Life: 3.5 M ESAL (SEM Materials)

The ESAL level is expected to occur in a time period of approximately five years.

Estimated traffic (I-94): Feb.09 – fall 16: ~ 6.0 M ESAL



Structural Coefficients, AASHTO example

Base Treatment	Existing Road Material			
	Very Dirty	Rounded Agg High Fines	Med Quality Agg Med Fines	High Quality Agg High RAP
				
Untreated	< 0.10	0.10 - 0.12	0.12 - 0.14	≥ 0.14
Hydrated Lime	0.12	0.14	N/A	N/A
Cement (CTB/Soil Cement)	0.14 - 0.23 *Depends upon % cement & material; lower for less cracking*			
Emulsion*	0.12	0.12 - 0.16	0.16 - 0.20	0.20 - 0.23
EE Granular Base Stabilization	N/A	0.18 - 0.20	0.21 - 0.22	
EE Full Depth Reclamation	N/A		0.22 - 0.24	0.25 - 0.28
Foam*				0.25
EE CIR				0.28 - 0.33+
HMA, Nova Chip®			0.34 - 0.40	0.40 - 0.44

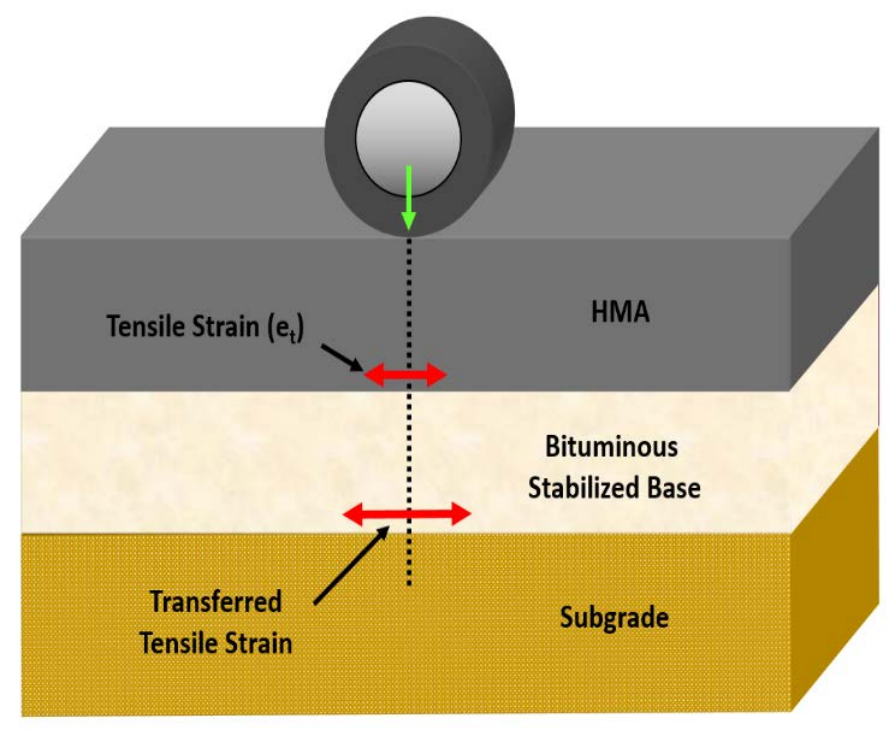
** Values are from the literature. All values here are generalized; each agency has own point of view. FDR validated by FWD*

Coefficients depend upon:

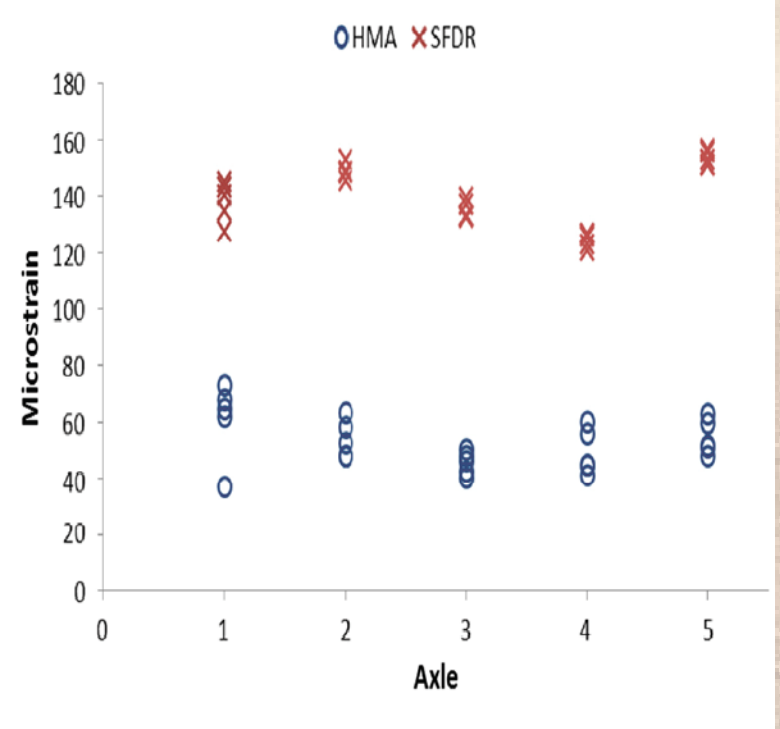
1. Material quality
2. Passing the mix design criteria
3. Passing quality control requirements

Key to Improved Performance

Max Tensile Strain



50% less on HMA



Cost per Remaining Service Life Year Added Bituminous Treatments

Terry Beaudry MEO Mtg. 2017

Treatment	HPMA Cost/Lane Mile	RSL Years	$/RSL/Year Added
CIR	$154,251	17	$9,074
Reclamation	$237,212	24	$9,884
Medium Mill/OL	$160,660	15	$10,711
Thick Mill/OL	$211,550	17	$12,444

Recycle in Place
What are some of the barriers?

Paradigm Shift

- **Moving from "standard protocol" decision making**

Agency Issues

- **Must be understood and accepted by all**
- **Must be committed to by top management**
- **Must have buy-in from Industry**
  - **Remove stigma that recycle is lower quality or "less value" than new construction**

Industry Pressures

- **Introducing new technologies**
- **Competition from industry ("rehab" and material suppliers)**

Public Perception

- **"Very positive once fully understood?"**

Full Depth Reclamation

How & Why it Works

Jonathan Pease, Rock Solid Stabilization & Reclamation, Inc.

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RIGHT PROCESS at the RIGHT TIME on the RIGHT PROJECT for the RIGHT PRICE

- Visual site investigation
- Subsurface investigation (includes subgrade)
- Is there a need for water control?
- Classify & Quantify each layer to determine existing condition/performance
- choose the "right team" of civil engineer, geotechnical engineer, contractor, material supplier, and equipment manufacturers
- Mix Design and/or recommendations for all varying conditions
- Test Strip
- Cost comparison of available options
- Fix subgrade drainage issues if needed
- Realize and inform customer that there can be field changes due to unforeseen circumstances
- Infield QC/QA when possible

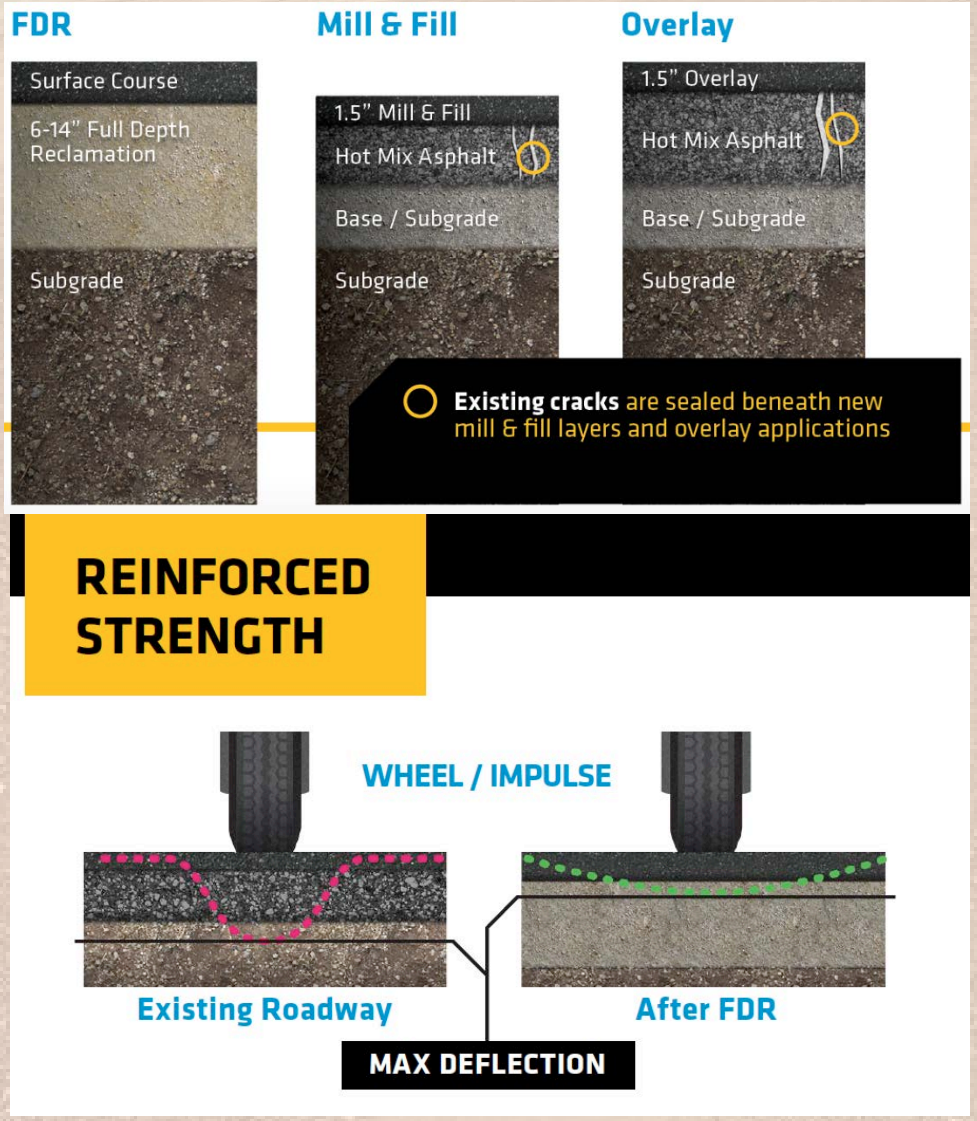
A RECLAIMER & A COLD RECLYCLING MILL ARE NOT THE SAME

The Reclaimer uses a powerful milling and mixing rotor to granulate and mix the existing soil without added binders

- Keeps pulverized material in same path
- Creates homogenous blend
- Adds volume/ raises grade
- > 6” compact before grading

- Collects millings into central windrow
- Utilize to remove surface asphalt if your project is sensitive to grade/ elevation

WHAT IS FDR?
Conventional Methods VS. FDR



- Traditional Methods do not treat the sub-grade issues, cracks are left behind, under a beauty patch
- FDR treats the underlying issues, strengthening the subgrade and building a stronger road for longer

TYPES OF FDR & ADDITIVES

Mechanical

- Asphalt Pulverization
  - Can add rock to change the matrix of the gravel base

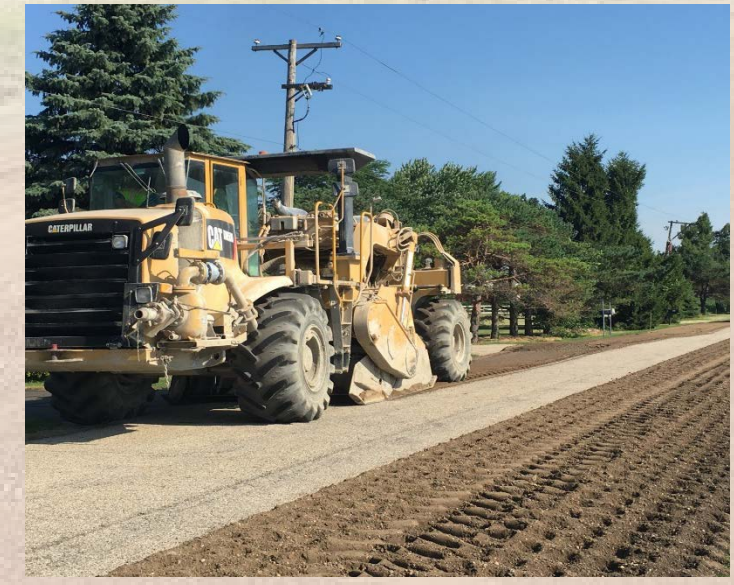
Bituminous

- Emulsified Asphalt
  - Typically 3-3.5%
- Foamed/Expanding Asphalt
  - Typically 2.5%+-
- Single pass or multiple passes for consistency with thick/irregular pavements

Chemical

- Portland Cement (dry or slurry)
  - Typically 3-6%
- Fly Ash – Type "C" not "F"
  - Typically 6-12%
- Polymers, Enzymes & Ect.

Pre-Pulverization



- Using a Reclaimer, the old asphalt and granular base is crushed & mixed to a predetermined depth.
- Water is the only additional material used in this process to achieve the required density

Pre-Shape/Grade

- Important to meet desired elevations & cross slope of the finished plans. To avoid cuts and fills after the fact

Transport

- Pneumatic hauling
- Bulkers are necessary to transport materials that will be used with a spreader

Spread

- Computerized & meter controlled for uniform distribution
- Spreaders cause less dust then old dump and spread methods, making it more environmentally friendly

Incorporating Stabilizing/Bituminous Agents

- Mixing powders w/water injection creates greater control over distribution & percentages than top dressing
- Mixing with a Tiller ensures uniform cut depth and consistent gradation

Initial Compacting/Breakdown

- Intelligent compaction
- Density testing
- Speed Control
- Proper roll patterns
- Proper “break” times
- Quality testing

Grading

- Match predetermined cross sections

Smooth Roll Finish

- Static rolling
- Initial curing
  - Wet curing (fogging)
  - Emulsify curing
- After 48 hours, micro-cracking is possible

Wirtgen FDR Animated Process

Cost Savings Benefits of FDR

Green Savings

FDR leaves a significantly smaller carbon footprint compared to traditional reconstruction methods. By using cold processes, reusing existing materials, working on-site, and reducing trucking, we decrease greenhouse gas emissions and conserve energy.

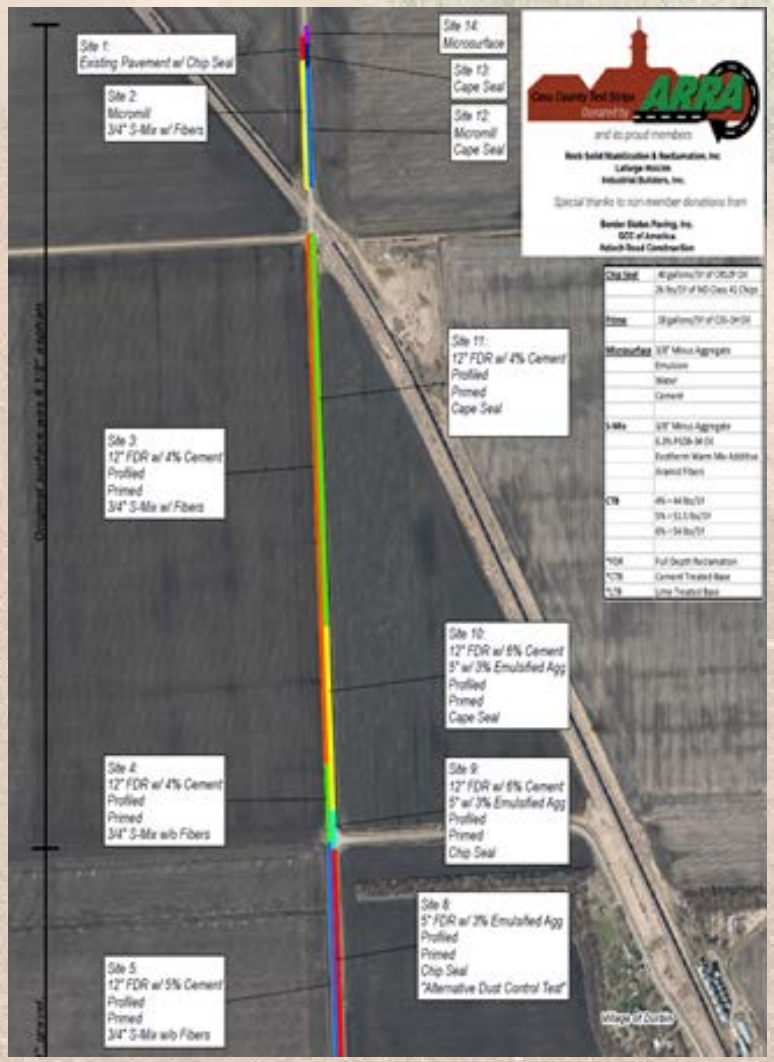
- 40 - 80 % COST SAVINGS
- 80 - 99% FEWER TRUCK LOADS
- 30 - 80% FASTER CONSTRUCTION TIMES
- UP TO 100% REUSE OF PAVEMENT & GRAVEL IN-PLACE

Cass County Case Study

HOW UTILIZING TESTS STRIPS CAN HELP CUT COST AND OFFER THE BEST RESULTS IN THE LONG RUN

Looking for Alternate Subgrade Solutions

- due to excessive moisture from a 25 year regional wet cycle
- Over 7 years utilized cement stabilization on over 80 miles, without any issues
- Looking for better ways to built their roads and stretch their budget ->
- ARRA Sponsored Test Strips



After Freeze/Thaw Conditions a Hybrid Cross Section was Selected for their 3-year 17mile re-grade project on County Highway 38

Tradtional Method

Co. 38 Hybrid Method

<- 1" Bond Breaker
(untreated base)

*2" HMA PLACED IN 2017, ADDITIONAL 3" HMA WILL BE PLACED THE LAST YEAR OF THE PROJECT IN 2020

What did they get?

Traditional R&R

	Description	Layer Coefficient	Drainage Coefficient	Layer Thickness (inches)	SN
Layer 1	Asphalt	0.40	1	7	2.80
Layer 2	Base A	0.10	1	10	1.00
				Total SN	**3.8**

C-38 Hybrid

	Description	Layer Coefficient	Drainage Coefficient	Layer Thickness (inches)	SN
Layer 1	Asphalt	0.40	1	5	2.00
Layer 2	Base A	0.20	1	7	1.40
Layer 3	Base B	0.10	1	1	0.10
Layer 4	Subbase	0.14	1	12	1.68
				Total SN	**5.2**

The traditional method with S_n 3.8 used previously by Cass County cost **$1,500,000** per mile.

The hybrid method with S_n 5.2 selected by Cass County will cost $1,050,000 per mile.

Savings of OVER $7.5 MILLION
Increased strength by 35%
Cost savings of 30%

Soil Cement Roads

Richland County MT

2017 Rapid City Roads Conference

Presenter:

Steve Monlux, LVR Consultants, LLC, Missoula MT

Key Personnel:

Adam Smith, Richland Co Public Works Director, Sidney

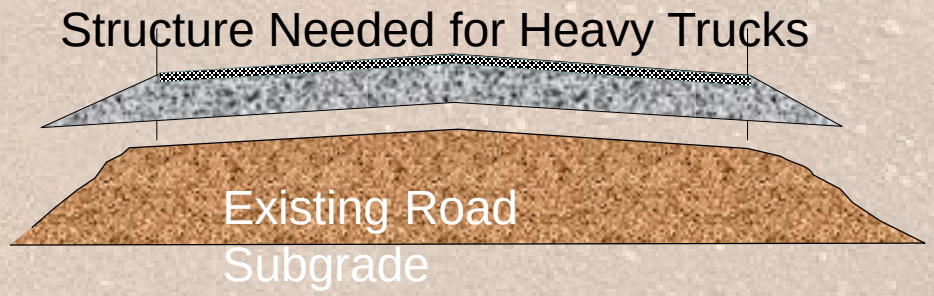
Josh Johnson, Interstate Engineering, Sidney MT

William Vischer, Pavements Engineer, Carter MT

Google “soil cement montana”

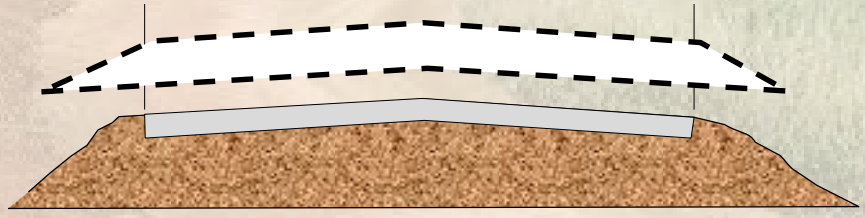
Richland Co Rural Road Problems-2010

- Road Damage → Heavy Oil Field Trucks
- Clay subgrade soils, soft spots
- Limited Resources
  - Costly Gravel
  - 10 mm$ road budget, 100mm$ problem
- Hot Mix Paving Issues
  - Not enough road width for thick gravel base layer
  - Too costly per mile
  - Construction process too slow



Answer → Subgrade Soil Stabilization

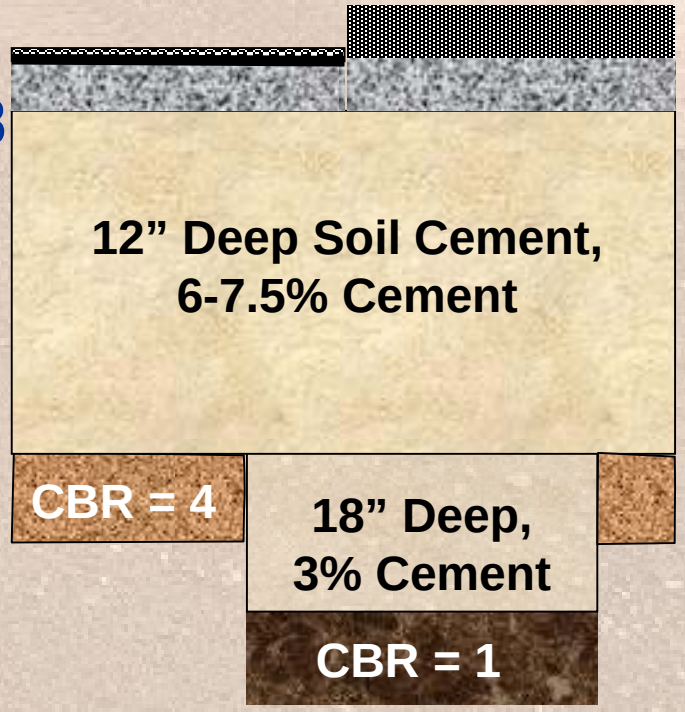
- No subgrade widening, lower cost, ½ mile/day



- Lab mix designs with subgrade soils
  - Lime, Fly Ash, Portland Cement
- 2010 Test Sections
  - 4 miles with Portland Cement – 8, 10 & 12 inch thickness
  - Wearing Surface
    - Double Chip with & without geotextile
    - Otta Seal with High Float Emulsion
    - 4" layer of gravel treated with Calcium Chloride and Bentonite Clay

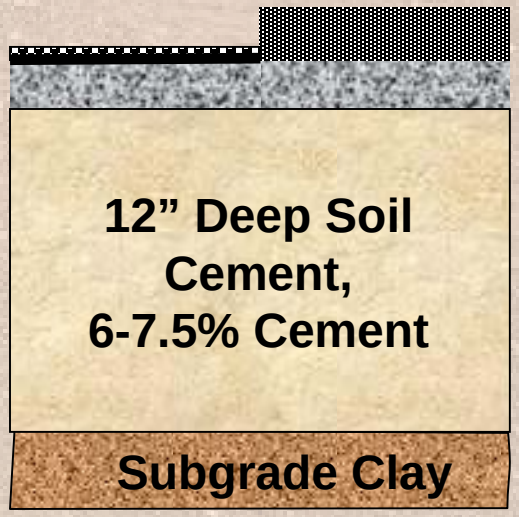
2011-2013 Soil Cement Construction

- 55 Miles Built – less than ½ cost of hot mix paving
- Worst Designs – Double Chip on Soil Cement – no gravel base
- Best Designs
  - Subgrade Soft Spot Treatment – 18 depth with 3% Cement
  - Structural Layer – 12” depth with 6% to 7.5% (depending on clay soil)
  - Wearing Surface
    - Double Chip with 3 inches gravel base
    - 3 inches hot mix with 3 inches gravel base



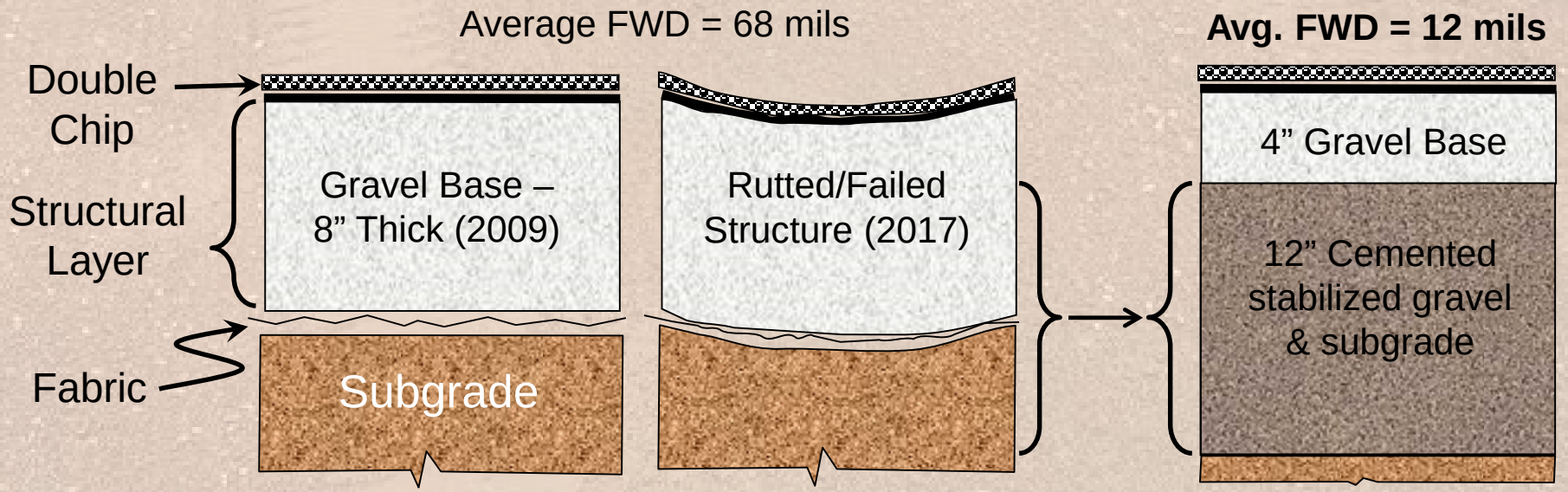
Strength Testing of Soil Cement

- Falling Weight Deflectometer on 39 miles
  - Spring & Fall for 8 years (2010-2017)
- Long Term Results after 8 years
  - Typical: 3 to 5 times as strong as gravel base
  - Worst Case: 2 times as strong as gravel base
  - Long Term Costs: much less than ½ cost of hot mix option
- Best Designs
  - Clay Soil Stabilization:
  - Wearing Surface for Heavy Truck Traffic
    - Double chip on 3 inches gravel base
    - 3 inches hot mix on 3 inches gravel base



County Road Crew Use of Portland Cement, 2015-2017

- Permanent stabilization of gravel road soft spots with 3% cement (CBR 1 → 12)
- Rebuilt 2011 soil cement problem areas – one mile in 39 miles
- Cement stabilized one mile of failed chip & gravel road



Recommendations

- Consider cost savings with soil cement for upgrading high traffic routes
- Select the right stabilizer for you soils
- Consider Portland cement for permanent repair of subgrade soft spots


Applause! Applause! Applause!

Contact Information:

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- Steve Monlux,

  stevemonlux@gmail.com

- Jonathan Pease

  jp@rocksolidsr.com

- Cass County Test Information

  https://www.casscountynd.gov/our-county/highway/pavement-testing