

Strengthening Base instead of Paving:

Regional Local Road Conference

Rapid City, South Dakota

October 21 & 22, 2009

OVERVIEW

- ROAD TYPES
 - BASE STRENGTHENING APPLIES TO ALL
- KEY CONSIDERATIONS for SUCCESS
 - PAVEMENT ASSESSMENT
- REHAB SELECTION
 - ASSURE PERFORMANCE
- QUESTIONS/COMMENTS

ROAD TYPES

- GRAVEL

- What are my current costs?
- What are my future needs?

- RURAL HMA

- Staged construction/perpetual pavements

- URBAN HMA

- Adding strength to existing design

- INTERSTATE HMA – Mn/Road

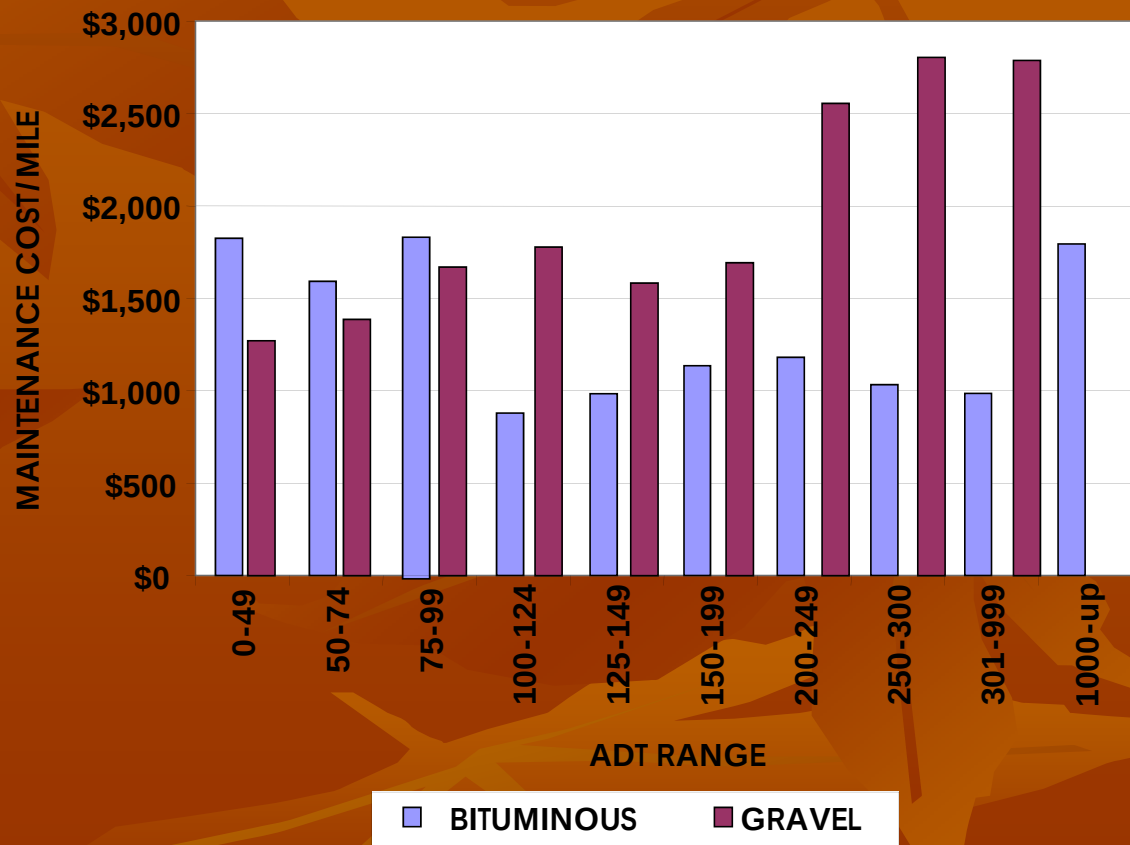
GRAVEL (Unpaved)



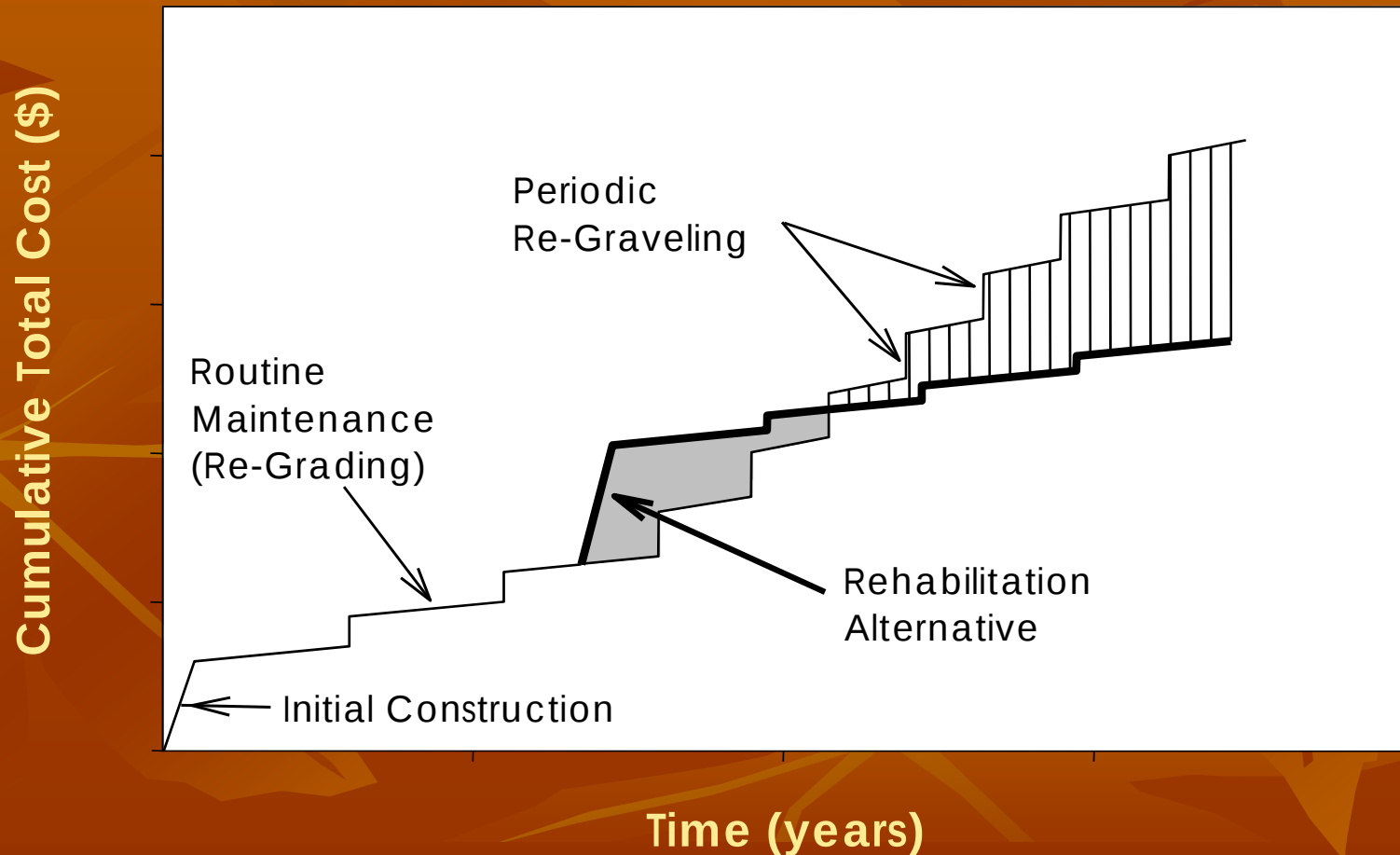
Lincoln Highway between Ames and Nevada, 1918.
(Courtesy: Iowa State Highway Commission)

Traffic's effect on maintenance costs/mile

- Roads grouped by traffic volumes and surface type
- An increase in traffic should lead to an increase in maintenance costs, particularly for gravel roads
 - More gravel needed
 - More blading and smoothing of road surface needed



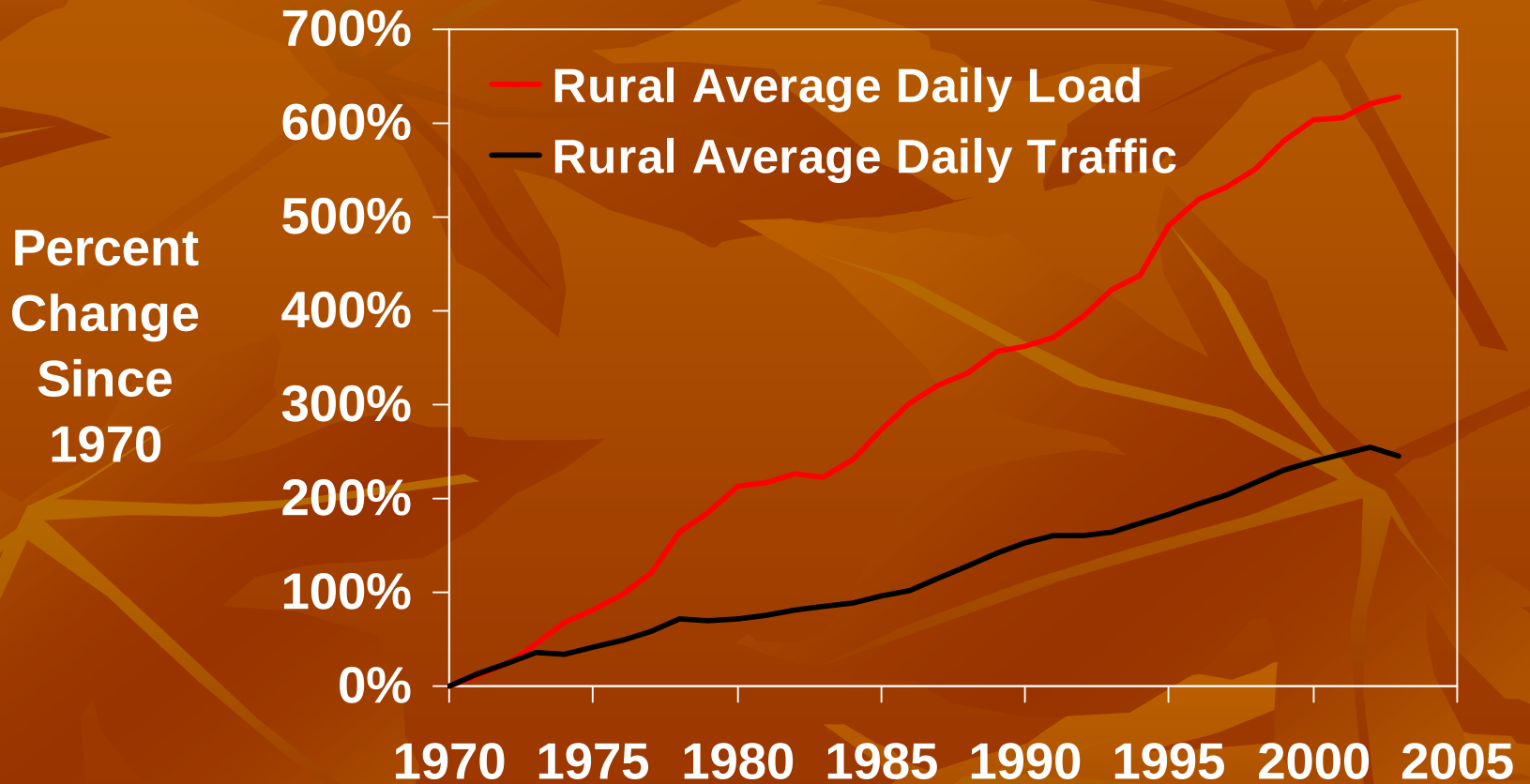
Cumulative maintenance costs/mile over time for a gravel road



RURAL HMA (Limited Design)

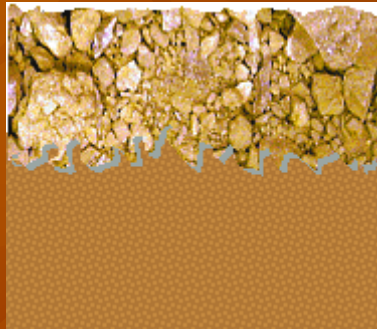
- Limited Pavement and Mix Design
 - Pavement designs assume stronger base
 - Mix designs were economized
 - Performance suffers as expectations rise >
- Staged Construction options
 - Rehab economics
- Perpetual Pavement Design Goal
 - Current research providing more tools

Interstate Expectations

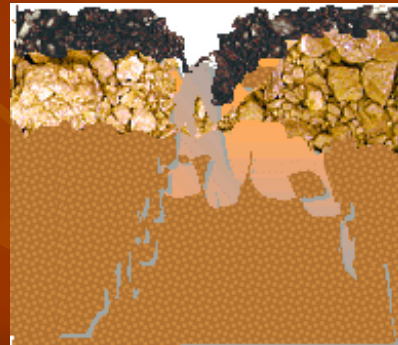


Staged Construction options

Granular pavement
needing upgrading



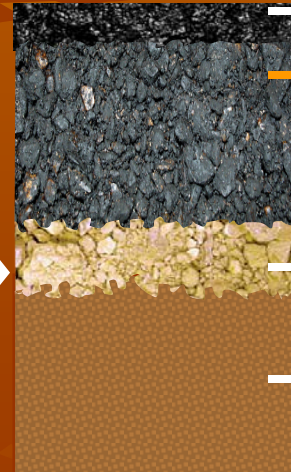
Bituminous pavement
needing repair



GBS



FDR



Overlay

6-10 inch
stabilized material

Granular base

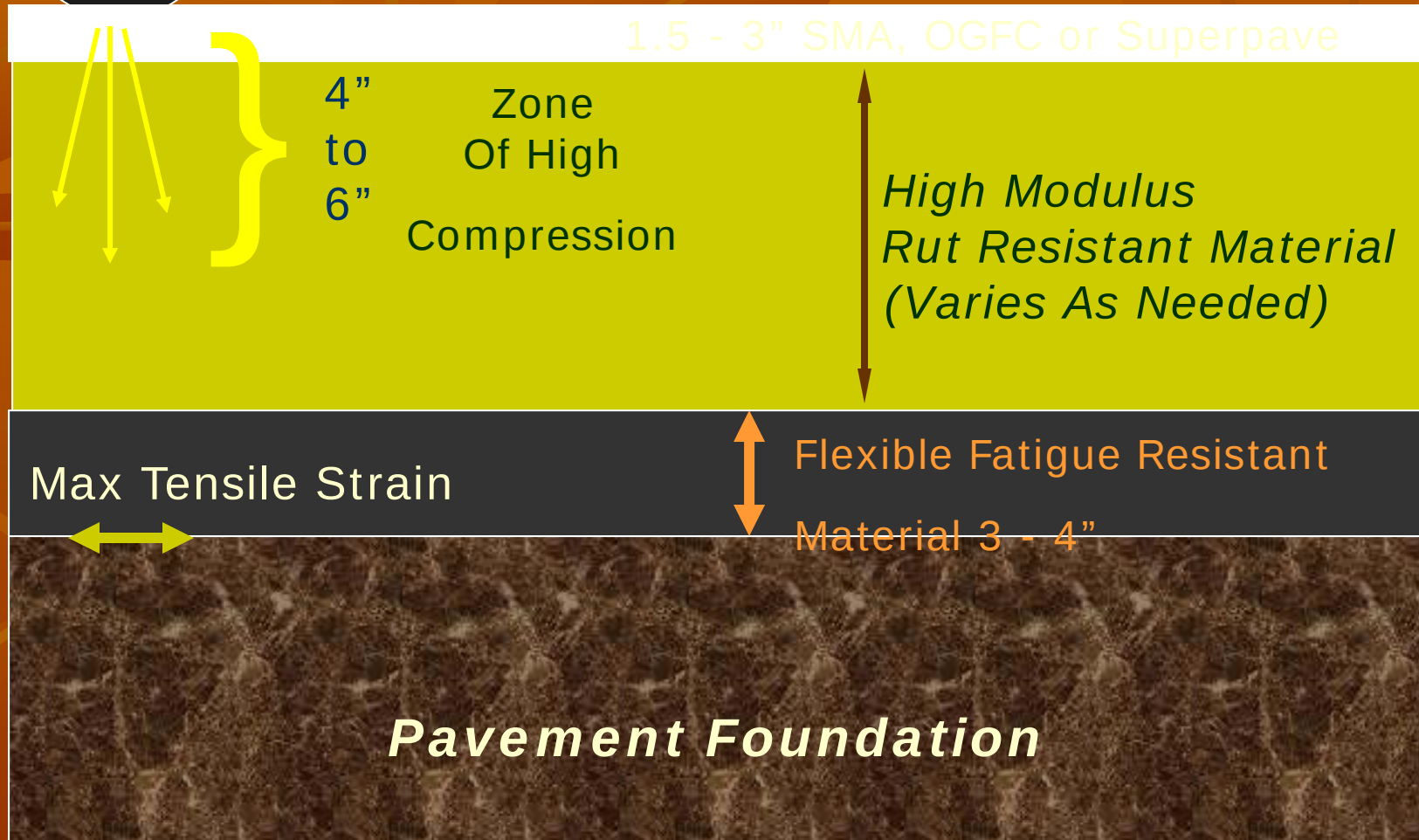
Soil

Perpetual Pavement Design Goal

- Proper roadway/pavement assessment
- Selection of best rehab option
- Selection of process and materials
- Best Practices Construction (manage risk)
- Lowest Life Cycle Cost (LLC)
- Optimized Performance (safety,ride,durability)



APA Perpetual Pav't



URBAN HMA



INTERSTATE HMA

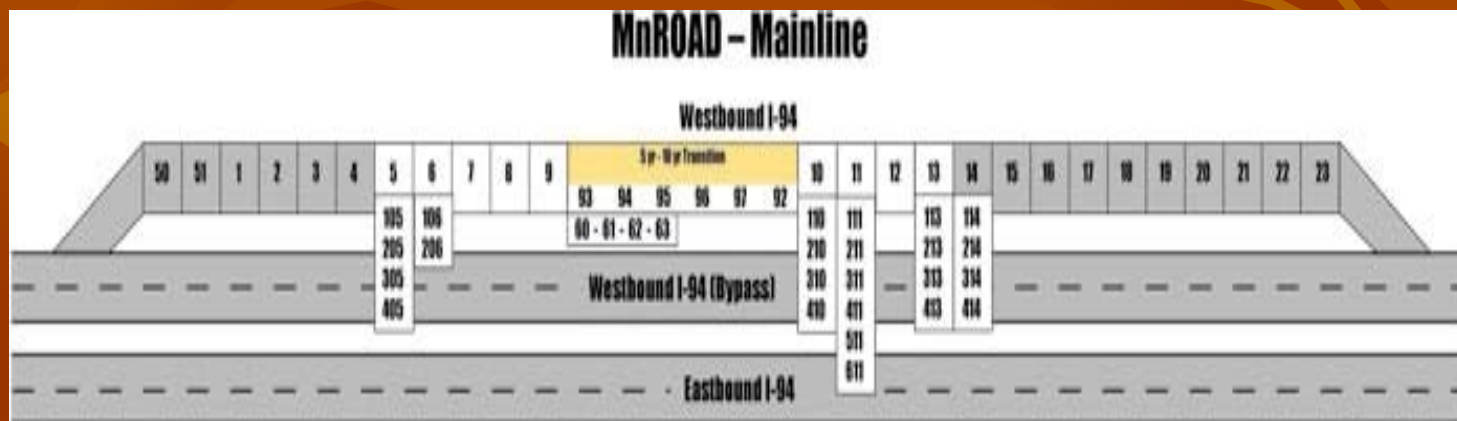
Mn/Road – I 94



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



Mn/Road – I 94



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



1.5 - 3" SMA, OGFC or Superpave

2-3" } Zone
Of High
Compression

*High Modulus
Rut Resistant Material*

Max Tensile Strain

Flexible Fatigue Resistant
Material 6 - 8"

Pavement Foundation

KEY CONSIDERATIONS

- What are short and long term plans for road?
- What Roadway History information is available?
- Do I know the root cause of pavement issues?
- What options fit my desired result?
- What additional information do I need to evaluate my options?
- Where can I go for help?

Where can I go for help?

Asphalt Recycling and Reclaiming Association

ARRA – www.arra.org

Pavement Interactive Website - www.pavementinteractive.org

National Asphalt Pavement Association

NAPA – www.hotmix.org

National Center for Pavement Preservation

NCPP - www.pavementpreservation.org

Transportation Engineering and Road Research Alliance

TERRA – www.terraroadalliance.org

Federal Highway Administration

FHWA – www.fhwa.dot.gov/pavement

Rehabilitation Selection BARM

Pavement Distress Mode	Candidate Rehabilitation Techniques							
	CP	HIR	CIR	Thin HMA	Thick HMA	FDR	Combination Treatments	Reconstruction
Raveling								
Potholes								
Bleeding								
Skid Resistance								
Shoulder Drop Off								
Rutting								
Corrugations								
Shoving								
Fatigue Cracking								
Edge Cracking								
Slippage Cracking								
Block Cracking								
Longitudinal Cracking								
Transverse Cracking								
Reflection Cracking								
Discontinuity Cracking								
Swells								
Bumps								
Sags								
Depressions								
Ride Quality								
Strength								

Most Appropriate → Least Appropriate

Pavement Assessment

Keys to Success

Determine the Root Cause

- Springtime (preferred) structural evaluation by agency or consulting engineer
 - Structure; layer evaluations
 - Drainage
 - Distresses
 - Road needs



Dynamic Cone
Penetrometer (DCP)

Pavement and Material Assessment

Keys to Success

- Strength testing options to identify weak areas and determine subgrade strength/modulus:
 - Falling Weight Deflectometer (FWD)
 - California Bearing Ratio (CBR) or R-Value
 - Dynamic Cone Penetrometer (DCP)
 - Proof rolling (granular surfaces only)

Pavement Assessment Pavement Condition/Distress Survey

Pavement Condition Data
can be collected either **Manually**
or with **Automated** equipment.



Pavement Assessment

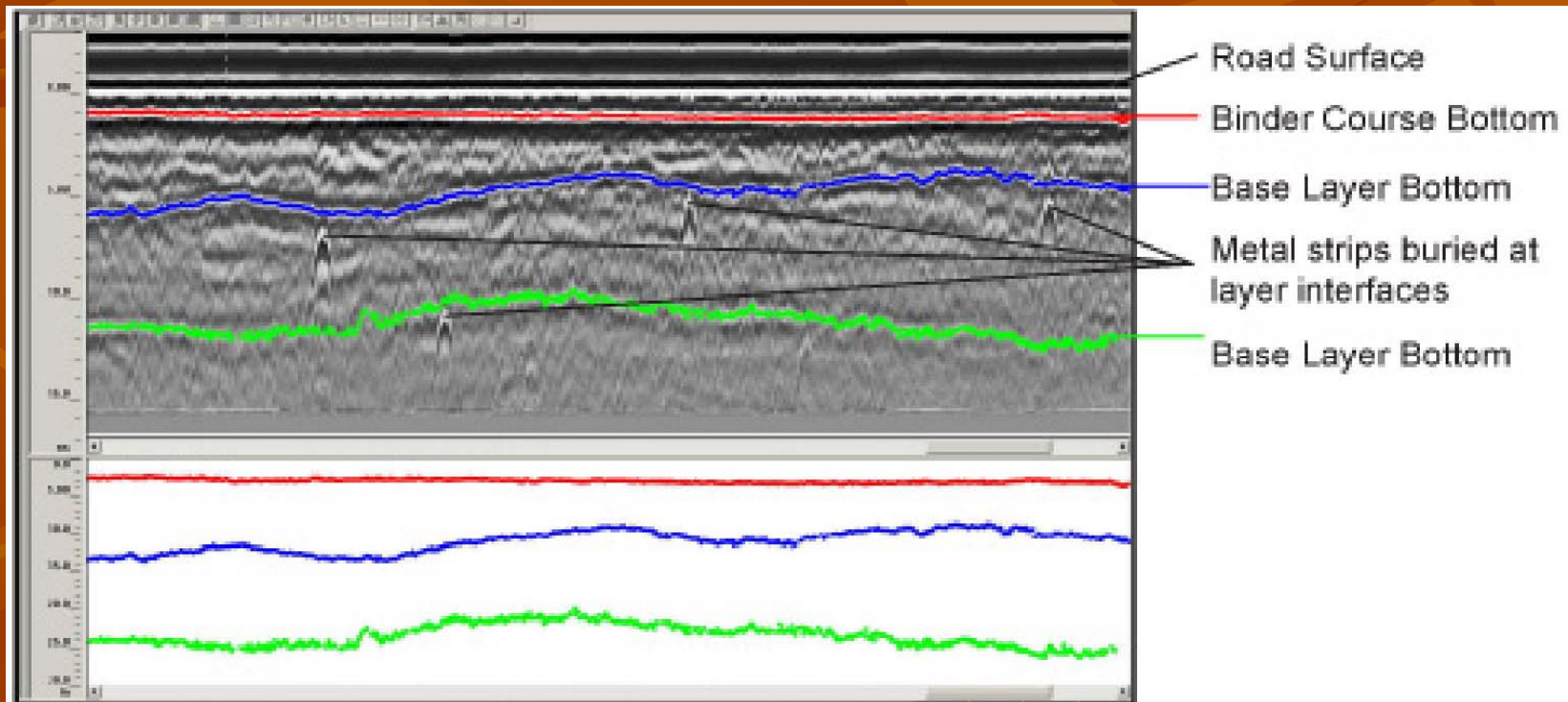
Pavement Strength Evaluation

- Ground Penetrating Radar (GPR) Data
 - Provides a “picture” of pavement structure
 - Used for FWD Analysis



Pavement Assessment

Pavement Strength Evaluation



Pavement Assessment

Surface, Base and Subgrade Analysis

- Coring
 - Determination of pavement thickness, layering, condition of each layer, bonding between layers, presence of materials related to distress and strength
- Soil Borings/GPR
 - Thickness, type or classification, moisture content, contamination, strength determination



Pavement and Materials Assessment

Approximate Costs

- Coring - \$1,000 to \$1,500 (per project < 2 miles)
- Soil / pavement borings ~\$1,000 (per mile)
- FWD w/ analysis - \$2,000 to \$5,000 (per project < 2 miles)
- Sampling & subgrade testing - \$2,500 (per project < 2 miles)
- DCP - equipment costs \$1,500 (per project < 2 miles)

**Costs will vary depending on many factors,
especially mobilization and traffic control**

REHAB SELECTION

- Review pavement history
 - Typical sections
 - Existing distress and root cause of the problem
- Identify Rehab Options
 - CIR
 - FDR
 - Material Considerations
- Select for Success (I have done my homework)

CIR (Train Method)



1. MATERIAL ADDITIVE TRUCK

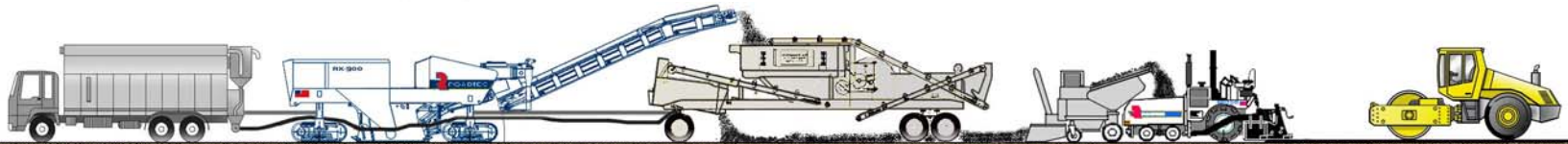
2. MILLING MACHINE
(Roadtec)

3. CRMX-2 SCREENING, CRUSHING
AND MIXING TRAILER

4. WINDROW LOADER

5. PAVER MACHINE
(Roadtec)

6. HEAVY ROLLER



Cutting Width Min. 2500 mm - Max. 3810 mm
Cutting Depth 0 - 335 mm

2.44 m to 6.0 width

Pavement In-Place Recycling from Roadtec

CIR (w/o Train)



Cold In-place Recycling (CIR)

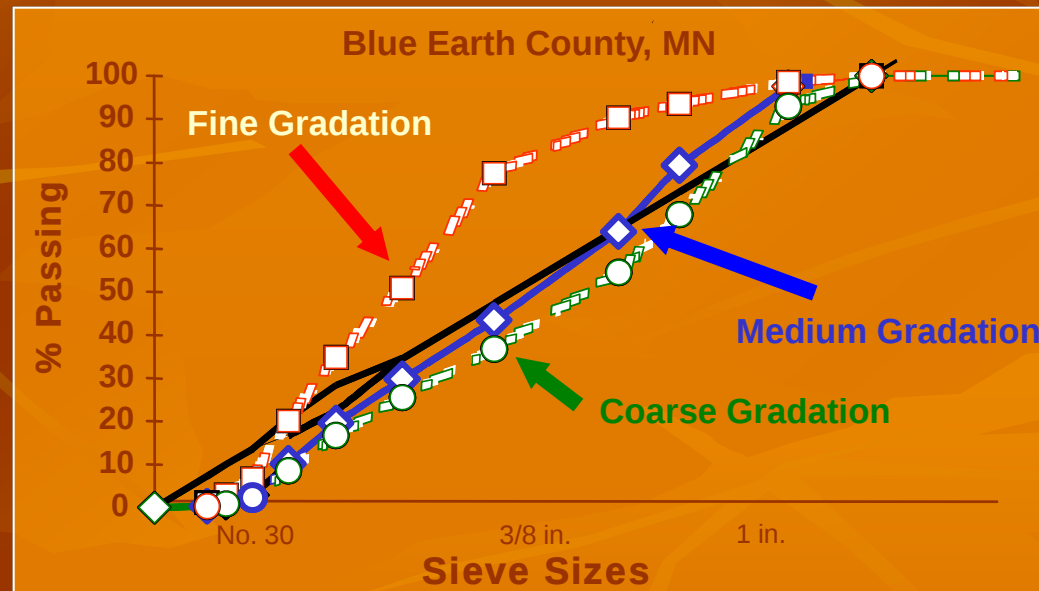
Fundamentals of CIR

- Conventional
 - No mix design
 - 2% Emulsion
 - QC requirements
 - Two gradations per day
 - 100% passing 1-1/2"
 - 90-100% passing 1"
 - Control strip
- Engineered
 - Defined sampling protocol
 - Engineered design
 - Performance-related specs
 - Early strength & long term durability

Cold In-place Recycling (CIR) Mix Design

RAP/Base Analysis

- Foamed Asphalt, Engineered Emulsion and Fly Ash
 - Field cores crushed to 3 gradation bands
 - A design made for at least 2 gradations



Cold In-place Recycling (CIR)

Engineered CIR

Less Raveling – Lab & Field



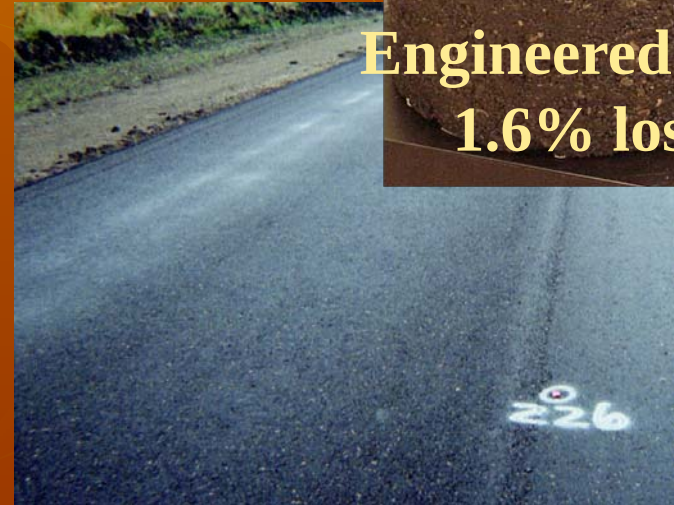
Conventional CIR
25.7% mass loss



Engineered CIR
1.6% loss



Raveling in the field



Samples & field photos from
CSAH No. 20,
Blue Earth County, MN

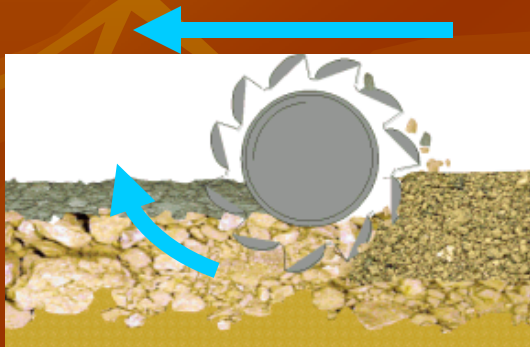
Full Depth Reclamation (FDR)



Full Depth Reclamation (FDR)

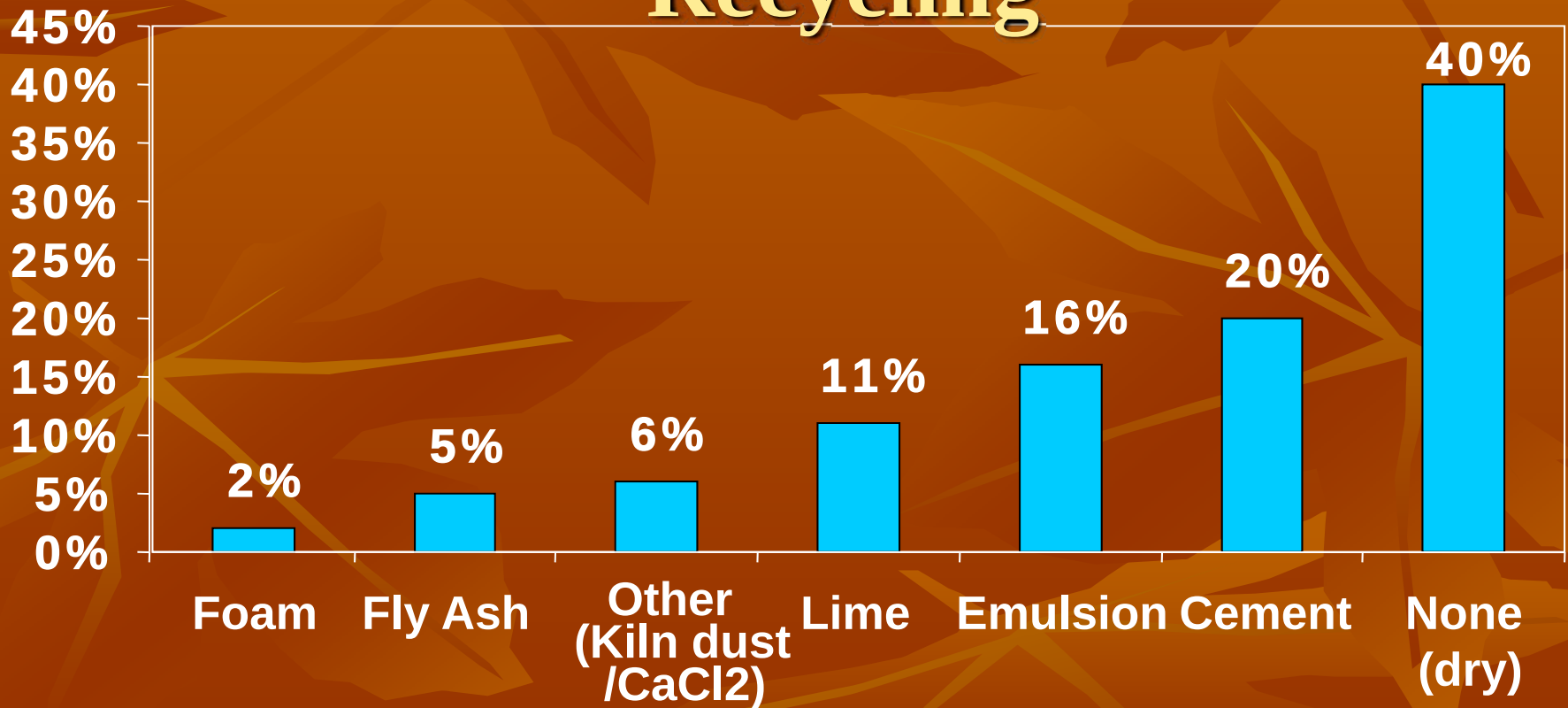
Types of FDR

- **Mechanical stabilization** - FDR without addition of binder (Pulverization)
- **Chemical stabilization** - FDR with chemical additive (Calcium or Magnesium Chloride, Lime, Fly Ash, Kiln Dust, Portland Cement, etc.)
- **Bituminous stabilization** - FDR with asphalt emulsion, emulsified recycling agent, or foamed/expanded asphalt additive



Full Depth Reclamation (FDR)

Types of FDR Additives Used in Recycling



Full Depth Reclamation (FDR)

Keys to Success

- Pavement & material assessment
- Engineered mix design
 - Choose correct additive for the application
- Performance-related specifications
- Construction guidelines & QC specs



Full Depth Reclamation (FDR)

Keys to Success

Engineered Mix Design



Superpave Gyratory Compactor



Cohesimeter



Lab Mixer

Full Depth Reclamation (FDR)

Keys to Success

Engineered Mix Design

- Virgin aggregate or RAP may be needed
 - To increase depth of finished structural layer
 - To improve gradation
 - Cleanliness (P200)
 - Material quality
 - Grading

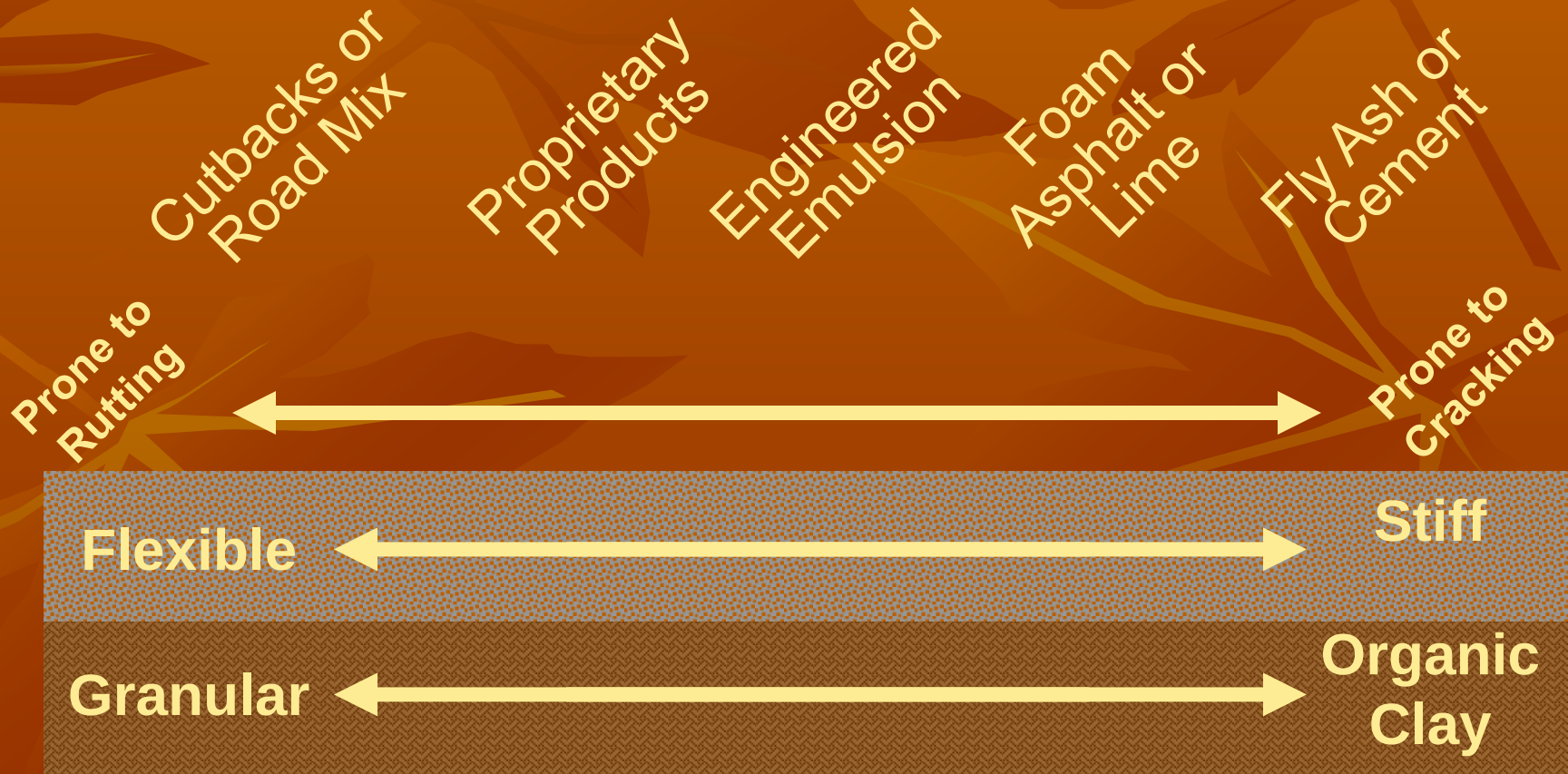


Add rock

Full Depth Reclamation (FDR)

Keys to Success

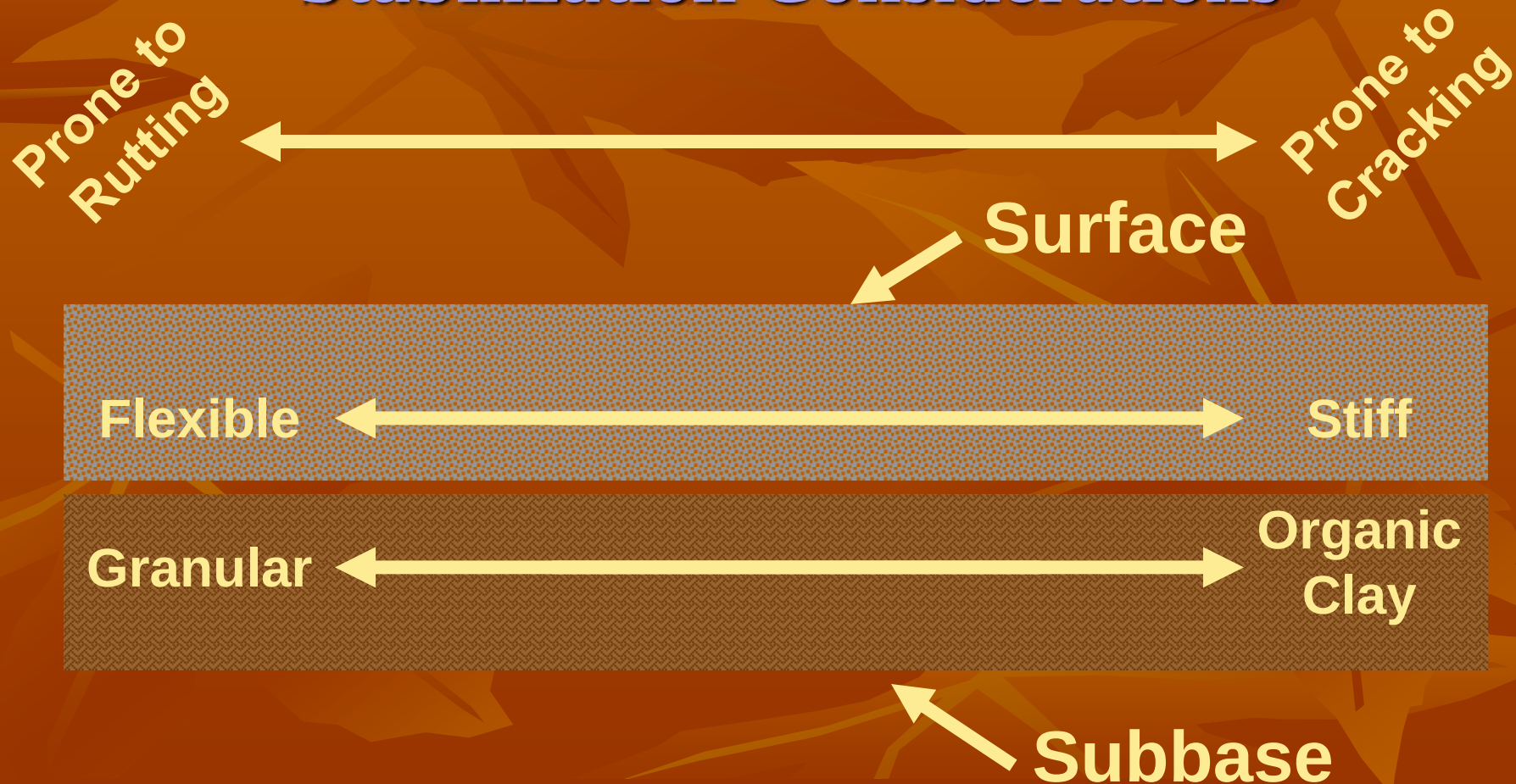
Stabilization Considerations



Full Depth Reclamation (FDR)

Keys to Success

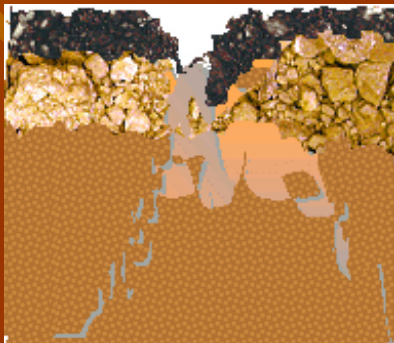
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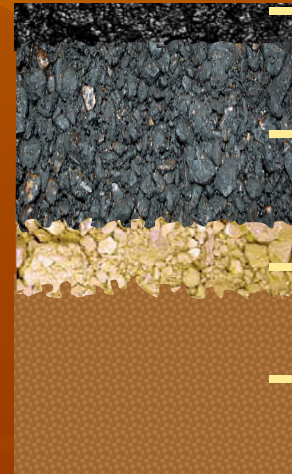
Full Depth Reclamation (FDR)

What is FDR?

Bituminous pavement
needing repair



FDR Example



Overlay

6-10 inches
stabilized material

Granular base

Soil

Full Depth Reclamation (FDR)

Keys to Success

Construction and Quality Control

- Corrective actions
 - Sub-cut & replace weak spots
 - Fix drainage
 - Fix thickness deficiency
 - Add rock
 - Widen
 - Cut out soil



Full Depth Reclamation (FDR)

Keys to Success

Construction and Quality Control

- Equipment
 - Reclaimer
 - Padfoot compactor
 - Motor grader
 - Water truck
 - Finishing Rollers



3 C's to evaluate new technology

- Constructability
- Cost
- Credibility

Constructability

- About the same as HMA but you need to manage the weather

Cost

- About the same as HMA but you need to manage the market
 - Managing the market is much easier than the weather

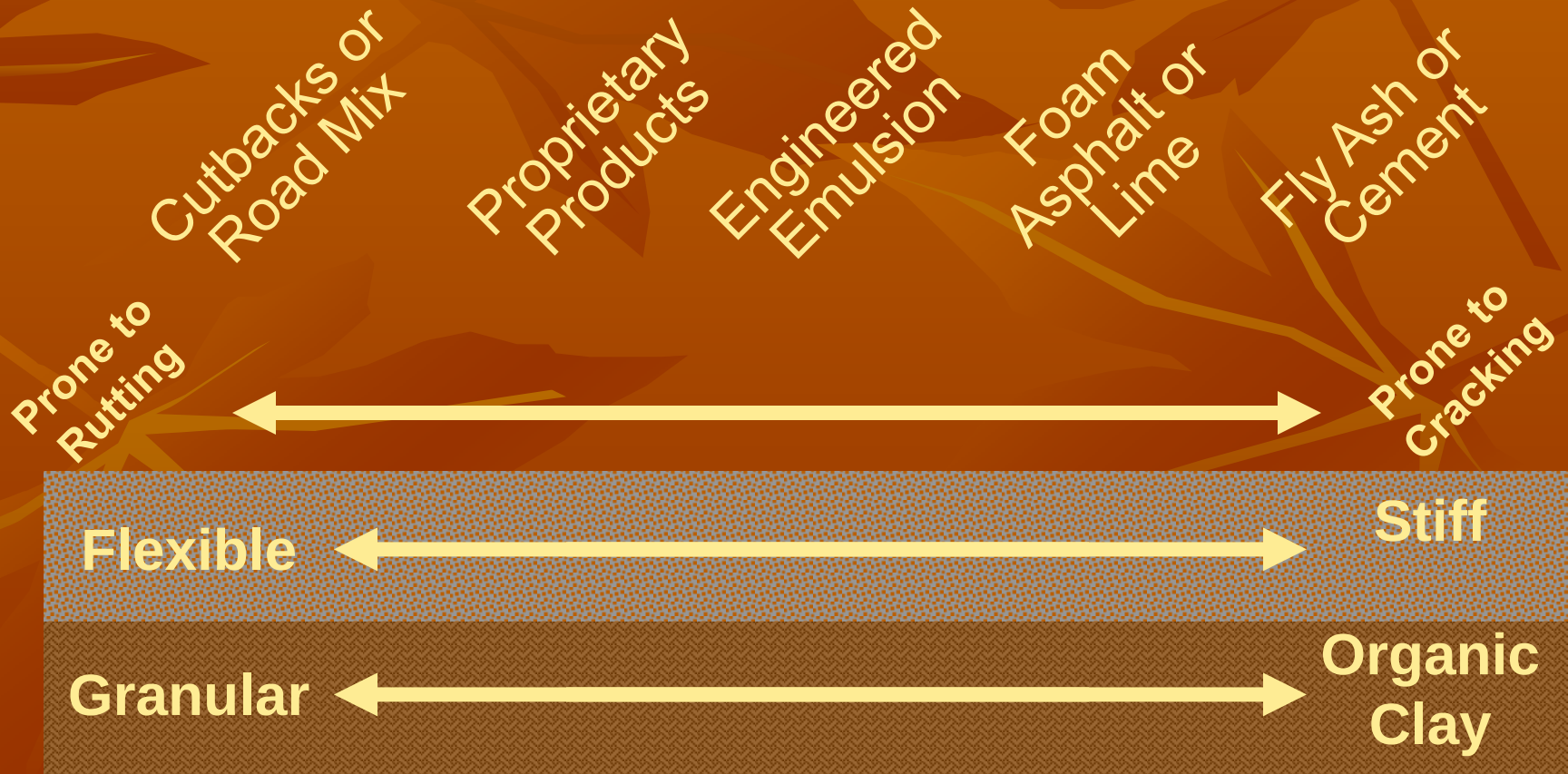
Credibility

- Engineered Emulsion is a product I will always endorse but you need to manage the process.
 - Process is very easy to manage but you need to have credibility which only comes with success

Full Depth Reclamation (FDR)

Keys to Success

Stabilization Considerations



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Thank you.

Questions?

