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In-Place Recycling

Full Depth Reclamation (FDR)

The Process

Presented by: Brett Gaither

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Franklin Delano Roosevelt

THE NEW DEAL

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FDR

- 32nd President of the United States
- In office 1933-1945
- Elected to 3 terms
- Father of the New Deal...Relief, Recovery, Reform



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The Other New Deal



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What is it?

Full Depth Reclamation (FDR) Is a pavement rehabilitation technique in which the full flexible pavement section and predetermined portion of the underlying material are uniformly pulverized or blended, resulting in a stabilized base course. (ARRA)

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When should you consider FDR?

- Pavement end of life cycle
- When you need to remove & replace
- When maintenance cost start adding up
- Looking to rebuild
- Wanting to add structure/stability





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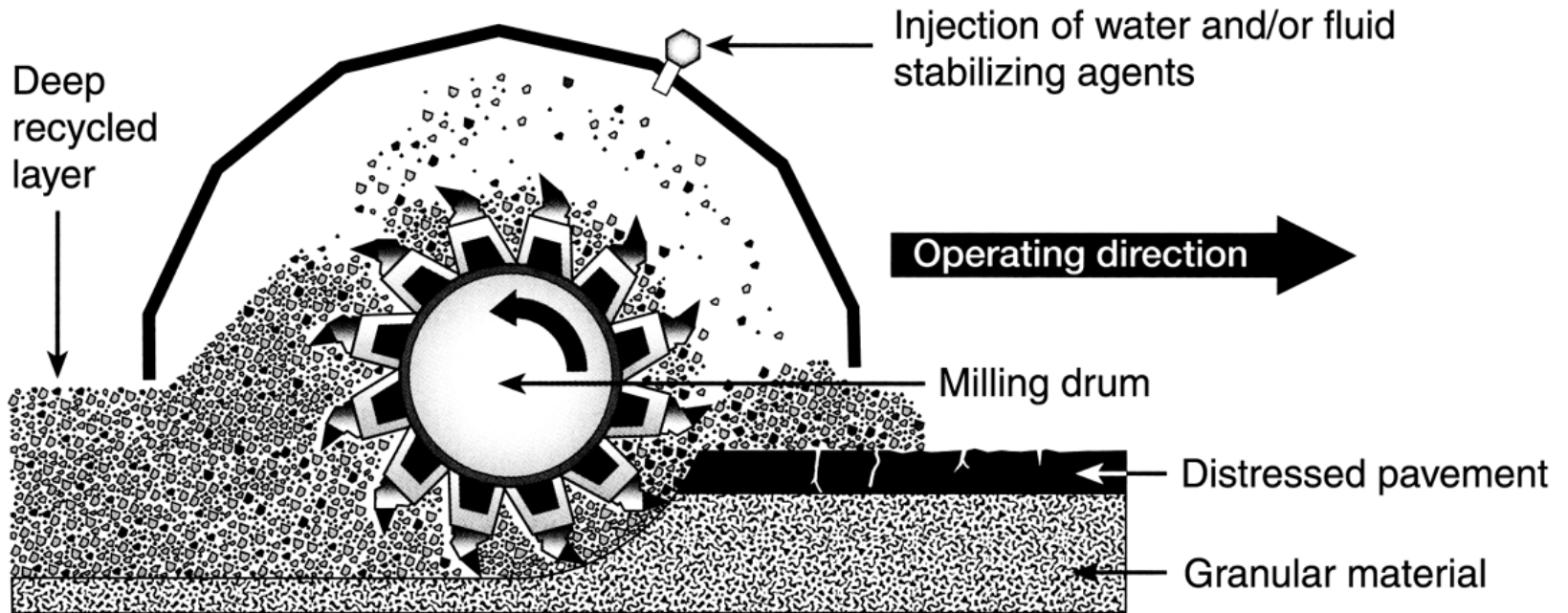
Mixing



Full Depth Reclamation



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Cutting Head



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Types of FDR

- Mechanical Stabilization
 - Aggregates
- Chemical Stabilization
 - Lime, Cement, Fly-Ash
- Bituminous Stabilization
 - Engineered Emulsion
 - Foamed Asphalt (not common in the Midwest)
- Combination



FDR STEPS

- **Project evaluation & Mix design**
- Initial pulverization
 - Mechanical stabilization: [add rock](#)
- Compaction & grading
- Stabilization/additives: [cement, asphalt emulsion, foamed asphalt, fly ash, or lime.](#)
- Initial compaction, grading, & final compaction
- Cure
- Surface – [asphalt, micro, chip-seal, concrete.](#)



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Evaluation & Mix Design



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Type & Typical Trial % of Stabilizer (by weight)	Characteristics of Reclaimed Pavement Materials
Hydrated Lime or Quicklime (2 to 6%)	Reclaimed asphalt pavement (RAP) having some amount of silty clay soils from sub-grade with a plasticity index of greater than 10.
Class C Fly Ash (8 to 14%)	Materials consisting of 100% RAP or blends of RAP and underlying granular base or soil. The soil fraction can have plasticity or be similar to soils acceptable for lime treatment.
Portland Cement (3 to 6%)	Materials consisting of 100% RAP or blends of RAP and underlying granular base or non plastic or low plasticity soils. There should be sufficient fines to produce and acceptable aggregate matrix for the cement treated base (CTB) produced.
Emulsified Asphalt (1 to 3%)	Materials consisting of 100% RAP or blends of RAP and underlying granular base or non plastic or low plasticity soils. The max. percent passing the No. 200 sieve should be less than 25%, the plasticity index less than 6 or the sand equivalent 30 or greater, or the product multiplying the P.I. and the percent passing the No. 200 being less than 72.



Structural Layer Coefficients

- Dry pulverization 0.11 per inch
- Bituminous stabilized 0.20 per inch
- Cement stabilized base 0.20 per inch
- Asphalt binder 0.40 per inch
- Cold-in-place 0.35 per inch



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Initial Pulverization



- Mechanical Stabilization
 - Add Rock
- Initial Pulverization
 - Chemical
 - Bituminous

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Grading & Compaction



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Proof-Roll

- Loaded tandem truck
- Identify unsuitable areas
- Fix identified areas prior to additive



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FDR STEPS

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- Stabilization/additives:
 - Chemical & Bituminous
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Chemical Additives



- Lime
 - Quicklime
 - Hydrated Lime
- Cement
 - Portland Type 1
- Fly Ash
 - Class C

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Incorporate Water



- Cementitious
 - Cement
 - Fly Ash
 - -1 to +2 of OMC
- Lime
 - +4 of OMC
- Bituminous
 - -1 to +2 OMC

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Bituminous Additives



- Engineered Emulsions
 - CSS1H
 - Road Science
 - SEM
- Foamed Asphalt

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Compaction



- **Cementitious**
 - 10 ton Pad-foot, single/double drum vibratory roller
 - 96 to 98% Max. Dry
- **Bituminous**
 - 10 ton Pad-foot, pneumatic, single/double drum vibratory roller
 - 96 to 98% Max. Dry

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Final Grading & Compaction



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Final Compaction



- Single or Double Drum
 - Static Mode
- Pneumatic Tired

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FDR STEPS!

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Curing for Chemical FDR



- Maintain Moisture
- Water Curing
 - As needed
- Bituminous
 - SS1h (dilute 60%)
 - Sand Blotter (opt.)
- Strength Gain
 - 300 to 500 psi
 - 3 to 7 days

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Curing for Bituminous FDR



- Moisture Evaporation
 - 7 to 10 days
- Gain strength
 - Immediate Strength

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New Surface



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Typical Surfaces

- Hot Mix Asphalt
- Concrete
- Chip Seal
- Micro
- Cape Seal
- Aggregate Base

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FDR STEPS to Success!

- **Project evaluation – mix design**
- Initial pulverization
 - Mechanical stabilization: [add rock](#)
- Initial compaction & grading
- Stabilization/additives: [cement, asphalt emulsion, foamed asphalt, fly ash, or lime.](#)
- Final compaction & grading
- Cure
- Surface – [asphalt, micro, chip-seal, concrete.](#)



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Typical FDR Applications

- Aggregate roads
- Aggregate staging areas/lots
- Asphalt roads
- Asphalt parking lots
- Airport taxiways (asphalt)
- Tennis courts
- Asphalt running tracks
- **ALL THINGS ASPHALT**

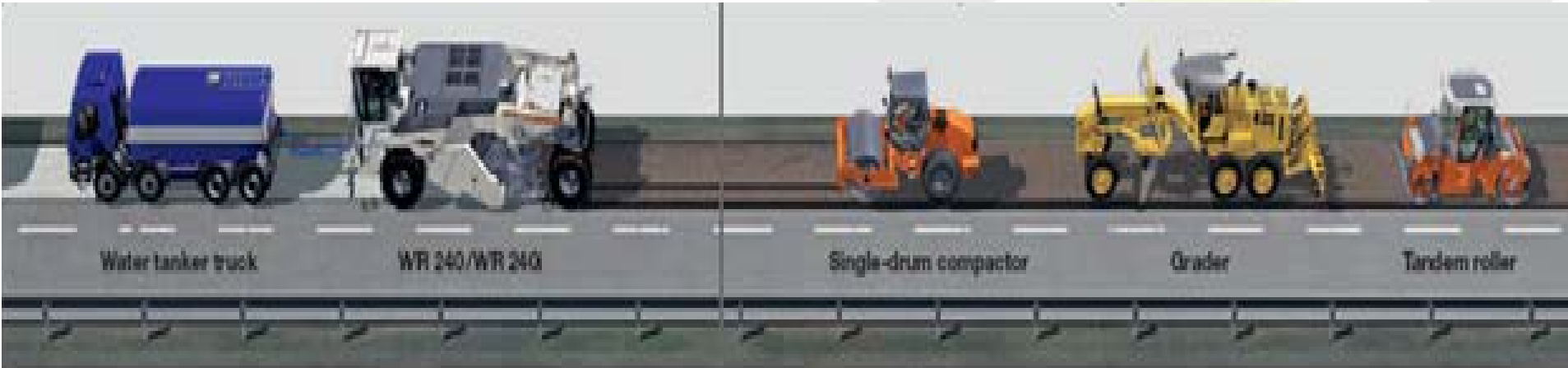


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Mechanical



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Chemical

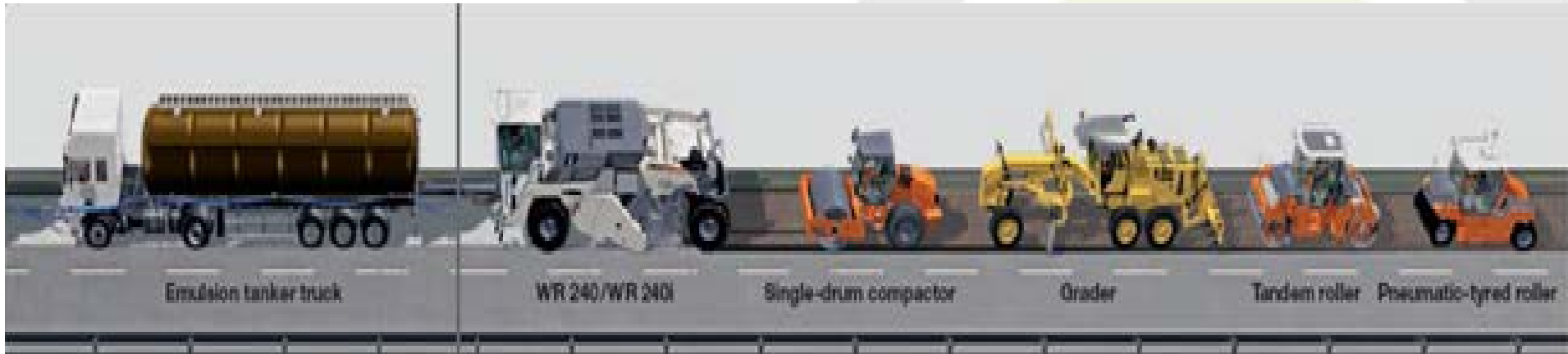


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Bituminous



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FDR vs. R&R

Case Studies

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Boone County, Missouri Gibbs Road



- 10,000 Square Yards
- 9-inches of treated base
- 6% Portland Cement
- 3-inch wearing surface
- 40% SAVINGS

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City of Hartford, Illinois

Maple Street



- 5,500 Square Yards
- 12-inches of treated base
- 5% Portland Cement
- 3-inch wearing surface
- 35% SAVINGS

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Benefits of FDR

- Pulverizes all asphalt failures
- Addresses some sub-grade deficiencies
- Incorporates underlying material in mix
- Provides for the conservation of non-renewable resources
- The base can be reshaped to restore proper surface profile and drainage
- Provides significant structural improvement with the addition of additive



Benefits

- Gives you the flexibility to choose the type and thickness of the wearing surface
- Significant savings over removal and replacement of existing asphalt and aggregate base
- Single lane closures can be achieved
- Reclaimed materials add years of longevity to your new roadway, parking lots, tennis courts, etc.



Average Unit Costs

- Processing (6"-12"): \$3.00 to \$6.00/sy
 - Initial Pulverization
 - Compaction
 - Grading
 - Water Curing
- Cement: \$110/ton
- Emulsion: \$3.00/gal



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Thank You!

Byrne & Jones Construction
Stabilization Division

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