Transportation Demographics

- Roads
- Marine Highway
- Airports

E = Emulsion Stabilization
F = Foamed Asphalt Stabilization
C = Portland Cement Stabilization
Alaska’s Experience in FDR

• **Reclaim** existing pavement (HMA) and crushed aggregate base (CABC)

• **Reclaim** HMA + CABC & **Stabilize** With;
  - Portland Cement
  - Foamed Asphalt
  - Emulsion
  - Chemical Stabilization with Fiber Reinforcing
Roads Selected for FDR and Base Stabilization
Selection Process Elements

- Maximize Use of Local & Existing Materials
- Life Cycle Cost and Initial Cost To Build Structural Section
- Design Vehicle
  - ESALS for Highways – Legal Loads
  - Design Aircraft e.g. Boeing 737-400
Additive Selection

- State has a **stabilized base policy** due to thaw weakening of unbound bases that require spring weight restrictions.
- Mechanistic design considerations of higher $M_R$ for additives that bind RAP & CABC.
- Aircraft over 100,000 lbs require stabilized base due to wheel loadings.
Additive Selection Factors

- Cost effectiveness allowing use of local materials in embankments;
  - silts
  - material with high moisture contents
- Aggregate Size – Pit Run NFS Embankment With +3” Aggregate is Hard to Process in Place
Portland Cement Stabilization

- RAP & CABC and Embankment Stabilization
  - Absorbs Water From Existing Soil
  - Rigid Stabilization, More Difficult to Recycle
Portland Cement Stabilization

Stabilized Sub-Base (Local Silt) for Bethel Airport
Bethel Silt Cement Stabilization

- **Gradation**
  - 100% passing the #30 sieve
  - 97% passing the #50 sieve
  - 26% passing the #200 sieve

- **Maximum Dry density**
  - 109 pcf @ 13.5 % moisture

- **Frost Susceptibility**
  - No plasticity Index but high capacity of moisture and permeability
## Portland Cement Stabilization

### Soil Cement Base Alternative

<table>
<thead>
<tr>
<th>Pay Item Number</th>
<th>Pay Item description</th>
<th>Quantity</th>
<th>Pay Unit</th>
<th>Unit Bid Price</th>
<th>Amount Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-100a</td>
<td>Mobilization and Demobilization</td>
<td>All Req'd</td>
<td>lump sum</td>
<td>$260,000.00</td>
<td>$260,000.00</td>
</tr>
<tr>
<td>P-152a</td>
<td>Unclassified Excavation</td>
<td>80,400</td>
<td>cubic yard</td>
<td>$6.00</td>
<td>$482,400.00</td>
</tr>
<tr>
<td>P-152h(1)</td>
<td>Borrow Embankment</td>
<td>66,500</td>
<td>cubic yard</td>
<td>$7.00</td>
<td>$465,500.00</td>
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<tr>
<td>P-152h(2)</td>
<td>Type A Borrow Embankment</td>
<td>25,800</td>
<td>cubic yard</td>
<td>$7.30</td>
<td>$188,340.00</td>
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<tr>
<td>P-209b</td>
<td>Crushed Aggregate Base Course</td>
<td>800</td>
<td>ton</td>
<td>$55.00</td>
<td>$44,000.00</td>
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<tr>
<td>P-301a</td>
<td>Soil Cement Base Course</td>
<td>52,700</td>
<td>square yard</td>
<td>$8.60</td>
<td>$453,220.00</td>
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<tr>
<td>P-301b</td>
<td>Portland Cement</td>
<td>1,500</td>
<td>ton</td>
<td>$425.00</td>
<td>$637,500.00</td>
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</table>

Total Basic Alternative Bid = $2,530,960.00

### Crushed Aggregate Base Alternative

<table>
<thead>
<tr>
<th>Pay Item Number</th>
<th>Pay Item description</th>
<th>Quantity</th>
<th>Pay Unit</th>
<th>Unit Bid Price</th>
<th>Amount Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-100a</td>
<td>Mobilization and Demobilization</td>
<td>All Req'd</td>
<td>lump sum</td>
<td>$350,000.00</td>
<td>$350,000.00</td>
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<tr>
<td>P-152a</td>
<td>Unclassified Excavation</td>
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<td>cubic yard</td>
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<td>$513,600.00</td>
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<tr>
<td>P-152h(1)</td>
<td>Borrow Embankment</td>
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<td>$452,200.00</td>
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<tr>
<td>P-152h(2)</td>
<td>Type A Borrow Embankment</td>
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<td>cubic yard</td>
<td>$7.30</td>
<td>$189,070.00</td>
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<tr>
<td>P-209b</td>
<td>Crushed Aggregate Base Course</td>
<td>35,600</td>
<td>ton</td>
<td>$55.00</td>
<td>$1,958,000.00</td>
</tr>
</tbody>
</table>

Total Basic Alternative Bid = $3,462,870.00

Difference Between Soil-Cement Alternative and Crushed Aggregate Base Alternative = $931,910.00
Foamed Asphalt Stabilization
Foamed Asphalt Train in Homer, Ak
Foamed Asphalt Stabilization

Highways: Existing Pavement & Base, 6” Total Depth
• Homer, Seward, Soldotna, Wasilla, Fairbanks, Bethel

Airports: FDR 15” Existing CABC & Subbase
• St. Paul Airport, St. George Airport

Mine Roads: Stabilize Existing Subbase
• Red Dog Zinc Mine
Red Dog Zinc Mine - Tech Cominco
Knik Construction Co., 2002
- Haul truck: 240 ton ~ 480k lbs, 11 axles
- 33 trucks/day; 105 psi tire pressure
- Traffic volume: 27M ESALs over a 10-year design period
- 5-in crushed rock added
- Stabilization depth: 10”
- 3.0% ± 0.3% foamed asphalt
- AC-2.5 at 330°F
- 2.5% water
Foam Asphalt Stabilization

- Produces Flexible Bound System in One Pass
- Recycles existing materials
- Restores smoothness,
- Eliminates Reflective Cracking In Existing HMA, Upgrade PG of Asphalt Cement in HMA
- Foamed Asphalt **Agglomerates** Fine Aggregate (Does Not Coat Large Aggregate)
- Increased $M_R$ From 65 ksi to 110ksi
Evaluate Material

Foamed Asphalt Will Not Bind Pure Silts or Clay Materials Using CIR
In this example:
- expansion = 24 times
- half-life = 13 s (≈ 20 s – 7 s)

Original volume of the unfoamed bitumen = 1

Half-life (s)

Foamed bitumen at max. expansion

Measuring bucket with unfoamed bitumen

Relationship between foaming properties

Expansion

Half-Life

Percentage water added

Heat-flare (s)
Indirect Tension Test

Specifications require Field ITS > 85% Lab ITS or Increase HMA Thickness At Contractor’s Expense.
Foamed Asphalt Stabilization

- Total Cost of Foaming: Approx $10/sq.yd. (6” deep)
- Cost of Equal Strength of HMA: Approx. $20/sq.yd
Emulsified Treated Base in SE Alaska

- Performance- Has been very successful

- Typical Modulus obtained: 100 to 130 KSI

- Cost has varied over 10 year period, typically

  $1.50 - $2.50 \text{ yd}^2/\text{inch}

Includes mixing, asphalt emulsion & cement powder
Construction Issues

- Placement and grading of mixture, time limited
- Compaction based upon control strip
- Curing
- WEATHER!!!!!!!!!!!!!!!
- Placement of final wearing surface, either HMA or BST
FDR w/Emulsified Treated Base
Deep Compaction with Pad Foot Roller
Thank You,
Questions?