BASE STABILIZATION

Topics Covered:

1. What is Base Stabilization?
2. Base Material Issues
3. Benefits of Base Stabilization
4. Where to use Base Stabilization
5. What is FDR and SFDR
6. Benefits of SFDR
7. Stabilization Considerations
8. Fundamental Control Factors
9. Project Profiles
10. Construction Procedures
What is Base Stabilization?

Stabilization is the permanent physical and chemical alteration of soils and aggregates to enhance their engineering properties, thus improving the load bearing capacity of a sub-grade or sub-base to support pavements and foundations (ARRA).
Base Material Issues

- Limited availability of quality aggregates
- Expensive aggregates costs
- Inadequate structural integrity
- Gravel loss
  - The addition of new aggregate material is the major maintenance operation/cost on unpaved roads.
  - It is estimated that a gravel road losses about 1” material per year.
  - 4 major influences of gravel loss are
    - Weathering
    - Traffic
    - Blading Maintenance
    - Drainage
  - Estimated cost to add 1” new aggregate material= $4,000-$6,000
Benefits of Base Stabilization

- Can reduce base layer thickness by increasing the structural integrity of the base.

- Can reduce base layer and/or concrete or asphalt surface thickness.

- Enhances existing aggregates.

- Serves as a compaction aid.

- Provides stability to unbound Full Depth Reclamation (FDR) reclaimed asphalt and aggregate materials between final base and paving.

- Provides a good platform for placing pavements.

- Enhances the ability to obtain more uniform density in asphalt.

- Helps prevent gravel loss, pot holes, wash-boarding, and helps reduce blading frequency on aggregate surfaced roadways.

- Very user-friendly, application can be performed in various weather conditions.

- Enhances existing base material properties.
Where to use Base Stabilization

Aggregate Surface and Base Material

RAP Approximately 50% Bituminous 50% Aggregate Blend

Aggregate Base

SURFACE

BASE

SUB-GRADE
What is FDR & SFDR

“Full-depth reclamation is a reclamation technique in which the full flexible pavement section and a predetermined portion of the underlying materials are uniformly crushed, pulverized, or blended, resulting in a stabilized base course. Further stabilization may be obtained through the use of available additives.”

–Asphalt Recycling & Reclaiming Association
Benefits of SFDR

Attributes:

- Eliminates all existing surface distresses
- Stabilization turns a deficient pavement structure into a new homogeneous section with increased structural capacity
- Reduces impact on underground utilities and structures
- Conserves non-renewable resources and reduces trucking
- Deteriorated subgrade or base can be reshaped to restore surface profile and drainage
- Cost savings compared to other rehabilitation methods
- Reduces community impacts, traffic disruptions and user inconvenience
- Reduces contractor change orders resulting from unstable soil/base conditions

***PPRA Pavement Preservation & Recycling Alliance***
Stabilization Considerations

- Cutbacks or Road Mix
- Proprietary Products (Base One®)
- Asphalt Emulsion
- Foamed Asphalt or Lime
- Fly Ash or Cement

Flexible to Stiff
Granular to Organic Clay
FUNDAMENTAL CONTROL FACTORS
SET YOUR PROJECT UP FOR SUCCESS

1.) Proper Aggregate Material (spec on next slide)
2.) Proper Stabilizing Agent
3.) Proper Mixing of Stabilizing Agent and Aggregate Material
4.) Proper Compaction/Optimum Moisture Content
   HIGHER COMPACTION EFFORT RESULTS IN A HIGHER DENSITY AT A LOWER MOISTURE CONTENT
5.) Proper Crown- about 4%
6.) DRAINAGE-DRAINAGE-DRAINAGE
Gravel Surfacing – New Specification
By Dale C. Heglund, NDLTAP

Gravel Road Warrior

In 2014, NDLTAP launched an effort to improve gravel roads in the state. With approximately 60,000 miles of local county, township and city gravel roadway miles in the state, the need to provide outreach became a core focus item for the NDLTAP team. Blade training was developed to help operators understand the need for a 4% cross slope (i.e., twice the slope of a paved road), the importance of binder in quality gravel, roadway shape, equipment technologies, motor grader maintenance, gravel road failure mechanisms, pretend blading and much more. Special thanks to Bryon Fuchs, Justin Ramsey and Eric Gaasland. NDDOT team members, for their efforts to create the new Gravel Surfacing specification.

NDDOT Special Provision – Gravel Surfacing SP 714(14)

<table>
<thead>
<tr>
<th>Sieve Size Or Testing Method</th>
<th>Aggregate Gravel Surfacing Percent passing or Test Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td>100</td>
</tr>
<tr>
<td>¾&quot;</td>
<td>70 – 100</td>
</tr>
<tr>
<td>No. 4</td>
<td>38 – 75</td>
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<tr>
<td>No. 8</td>
<td>22 – 62</td>
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<tr>
<td>No. 30</td>
<td>12 – 45</td>
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<tr>
<td>No. 200</td>
<td>7 – 15</td>
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<td>Plasticity Index (PI)</td>
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<tr>
<td>NDT T 113, Shale (max %)</td>
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</tr>
<tr>
<td>AASHTO T 96, L.A. Abrasion (max %)</td>
<td>50%</td>
</tr>
<tr>
<td>NDDOT 4, Fractured Faces¹</td>
<td>10%</td>
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</table>

Continuous improvement, a way of life for local leaders.

October 1, 2018

[Signature]
PROJECT PROFILES

NEW AND RECONSTRUCTION
LOCATION
Mountrail County, ND

PROJECT
BIA #6 Loop

PROJECT TYPE
New Construction

APPLICATION METHOD
Reclaim/Inject BASE ONE®

PROTOTYPE DATE
2015

American Engineering & Testing, Inc. conducted testing in 2015. Results are as follows:

<table>
<thead>
<tr>
<th>Design Parameter</th>
<th>Range</th>
<th>Test Results with BASE ONE®</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO Structural Layer Coefficient (Granular Base)</td>
<td>0.11-0.14</td>
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<td>MnDOT Effective Granular Equivalency (Granular Base)</td>
<td>0.8-1.0</td>
<td>1.8</td>
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<tr>
<td>MnPAVE ME Resilient Modulus (Granular Base)</td>
<td>9,720 - 27,540</td>
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</tr>
<tr>
<td>Tonnage</td>
<td>Design 10</td>
<td>11.2</td>
</tr>
</tbody>
</table>

PROJECT DETAIL
BIA #6 original design was 6" of Superpave FAA45 over 18" aggregate base on top of 12" cement treated subgrade (SN=3.96).

A Value Engineering Proposal was accepted with a new design of 6" Superpave FAA45 over 8" stabilized aggregate base with BASE ONE® on top of 12" cement treated base (SN=4.68).

By eliminating 10" of aggregate base, the customer was able to save approximately $2,000,000 on the 11.5 mile project.
LOCATION
Richland County, ND

PROJECT
County Road #8

PROJECT TYPE
Reconstruction

APPLICATION METHOD
Blade Mix

PROJECT DATE
2009

PROJECT DETAIL
County stabilized top 6" of new 12" aggregate base with BASE ONE®. County added 5" bituminous surface.

County was able to omit 3" of aggregate base material by using a structural layer coefficient number given to BASE ONE® through test results. County was able to save $499,500 on the 9 mile project.

American Engineering & Testing, Inc. conducted testing in 2013. Results are as follows:

<table>
<thead>
<tr>
<th>Design Parameter</th>
<th>Range</th>
<th>Test Results with BASE ONE®</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO Structural Layer Coefficient (Granular Base)</td>
<td>0.11-0.14</td>
<td>.22</td>
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<tr>
<td>MnDOT Effective Granular Equivalency (Granular Base)</td>
<td>0.8-1.0</td>
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<td>Tonnage</td>
<td>Design 10</td>
<td>11.9</td>
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</table>
LOCATION
Kandiyohi County, MN

PROJECT
CSAH #22

PROJECT TYPE
Reconstruction Project – 1 mile

APPLICATION METHOD
Blade Mix

PROJECT DETAIL
Kandiyohi County took over this township road and only added BASE ONE® to the north 1/2 mile. They wanted to do a test section to see if they could see a benefit with the addition of BASE ONE®. The original plan was to add BASE ONE® to the south 1/2 mile. However, when construction started, they felt the north 1/2 mile had inferior material, so it was decided to add the BASE ONE® to the north 1/2 mile section.

American Engineering & Testing, Inc. conducted testing in 2016 and 2018. Results are as follows:

<table>
<thead>
<tr>
<th>Design Parameter</th>
<th>Range</th>
<th>2016 Test Results with BASE ONE®</th>
<th>2016 Test Results Without BASE ONE®</th>
<th>Spring 2018 Test Results with BASE ONE®</th>
<th>Spring 2018 Test Results Without BASE ONE®</th>
</tr>
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<tbody>
<tr>
<td>AASHTO Structural Layer Coefficient (Granular Base)</td>
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<td>0.24</td>
<td>0.15</td>
<td>0.23</td>
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<td>0.8-1.0</td>
<td>1.7</td>
<td>1.1</td>
<td>1.6</td>
<td>1.1</td>
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<td>160,000</td>
<td>35,000</td>
<td>67,000</td>
<td>22,000</td>
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<td>Design 9</td>
<td>13.3</td>
<td>12.7</td>
<td></td>
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</table>

2016 testing was before pavement layer - 2018 testing was after pavement layer
PROJECT PROFILES

STABILIZED FULL DEPTH RECLAMATION
LOCATION
Wilkin County, MN

PROJECT
County Road #8

PROJECT TYPE
Stabilized Full Depth Reclamation

APPLICATION METHOD
Reclaim/Inject BASE ONE®

PROJECT DATE
2015

PROJECT DETAIL
Fall 2014 - Reclaimed 8” material.
Summer 2015 - Reclaimed and injected BASE ONE® into the 8”.
Summer 2015 - Added 3” Class 5 and stabilized with BASE ONE®.
2015 - Added 5.5” bituminous.
**By stabilizing 8” SFDR and the 3” additional Class 5 with BASE ONE® the county was able to reduce the pavement thickness 1.5”, a savings of $580,000 on the 10 mile project.

American Engineering & Testing, Inc. conducted testing in Spring 2015 (without BASE ONE®) and Spring 2016 (with BASE ONE®). Results are as follows:

<table>
<thead>
<tr>
<th>Design Parameter</th>
<th>Range</th>
<th>Spring 2016 Test Results with BASE ONE®</th>
<th>Spring 2015 Test Results/no BASE ONE®</th>
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<tbody>
<tr>
<td>AASHTO Structural Layer Coefficient (Granular Base)</td>
<td>0.11-0.14</td>
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<td>Tonnage</td>
<td>Design 10</td>
<td>15.7</td>
<td>5.6</td>
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LOCATION
Mahnomen County, MN

PROJECT
CSAH #4

PROJECT TYPE
Stabilized Full Depth Reclamation

APPLICATION METHOD
Reclaim/Inject BASE ONE®

PROJECT DATE
2015

American Engineering & Testing, Inc. conducted testing in 2016. Results are as follows:

<table>
<thead>
<tr>
<th>AASHTO</th>
<th>Design Standards</th>
<th>Test Results with BASE ONE®</th>
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<tbody>
<tr>
<td>Structural Layer Coefficient</td>
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<td>(Granular Base)</td>
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<td>Resilient Modulus</td>
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<td>Tonnage</td>
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LOCATION
Pope County, MN

PROJECT
CSAH #28 - Lowry

PROJECT TYPE
Stabilized Full Depth Reclamation

APPLICATION METHOD
Blade Mix

PROJECT DATE
2008

County reclaimed 8" material – 4" old bituminous and 4" aggregate base. Stabilized top 4" with BASE ONE®. Added 3.5" bituminous surface.

American Engineering & Testing, Inc. conducted testing in Fall 2011 and Spring 2015. Test results are as follows:

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<tr>
<th>Design Parameter</th>
<th>Range</th>
<th>Fall 2011 Test Results with BASE ONE®</th>
<th>Spring 2015 Test Results with BASE ONE®</th>
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<td>1.7&quot;</td>
<td>1.5&quot;</td>
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<td>147,000</td>
<td>102,000</td>
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<tr>
<td>Tonnage</td>
<td>Design 9</td>
<td>16.8</td>
<td>14.6</td>
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LOCATION
Lake of the Woods County, MN

PROJECT
CSAH # 8

PROJECT TYPE
Stabilized Full Depth Reclamation

APPLICATION METHOD
Blade Reclaim/Inject

PROJECT DATE
2017

American Engineering & Testing, Inc. conducted testing in Spring 2018. Test results are as follows:

<table>
<thead>
<tr>
<th>Design Parameter</th>
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<th>Test Results with BASE ONE®</th>
<th>Test Results/no BASE ONE® (1/2 mile)</th>
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<td>.14</td>
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<td>1.5</td>
<td>1.0</td>
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<tr>
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<td>84,000</td>
<td>27,400</td>
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<tr>
<td>Tonnage</td>
<td>Design 10</td>
<td>14.9</td>
<td>12.6</td>
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</tbody>
</table>
PROJECT PROFILES

THIN SURFACE OVERLAY TREATMENTS
**LOCATION**
Pettis County, MO

**PROJECT**
Hughesville Rd.

**PROJECT TYPE**
Stabilized Full Depth Reclamation

**APPLICATION METHOD**
Reclaim/Inject BASE ONE®

**PROJECT DATE**
2016

American Engineering & Testing, Inc. conducted testing in 2017. Results are as follows:

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<tr>
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</thead>
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<td>0.8-1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>MnPAVE ME Resilient Modulus (Granular Base)</td>
<td>9,720 - 27,540</td>
<td>99,000</td>
</tr>
<tr>
<td>Tonnage</td>
<td>Design 7 ton</td>
<td>8.7</td>
</tr>
</tbody>
</table>

**PROJECT DETAIL**
Reclaimed existing chip seal and base 8”.
Reclaimed/injected BASE ONE® 3” in depth.
Added a 1” chip seal surface.
**BASE ONE®**  
Base Stabilizer

**PROJECT PROFILE**

**LOCATION**  
Township

**PROJECT**  
Deroxe Road

**PROJECT TYPE**  
Base Stabilization / Otta Seal & Chip Seal

**APPLICATION**  
Blade Mix/Spray Truck

**PROJECT DATE**  
2010

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**PROJECT DETAILS**

- Added 4” of new base material
- Stabilized top 4” with BASE ONE®
- Applied an Otta Seal surface treatment
- Added a chip seal the following year

Bid to add base material and place a bituminous surface on this section was $299,000. The stabilized base and Otta Seal/Chip Seal cost $115,000, **saving the township $184,000.**

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<table>
<thead>
<tr>
<th>Design Parameter</th>
<th>Range</th>
<th>Test Results with BASE ONE®</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO Structural Layer Coefficient (Granular Base)</td>
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<td>MnDOT Effective Granular Equivalency (Granular Base)</td>
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<tr>
<td>MnPAVE ME Resilient Modulus (Granular Base)</td>
<td>9,720 - 27,540</td>
<td>99,000</td>
</tr>
<tr>
<td>Tonnage</td>
<td>Design 7 ton</td>
<td>8.7</td>
</tr>
</tbody>
</table>
**LOCATION**
Beltrami County, MN

**PROJECT**
CSAH 34

**PROJECT TYPE**
Stabilized Full Depth Reclamation – 6 miles

**APPLICATION**
Reclaim and Inject BASE ONE®

**PROJECT DATE**
2014

• County reclaimed existing 4” of old bituminous and 4” underlying base
• Added 2” new aggregate base material
• Reclaimed/injected BASE ONE® into top 4” of the 10” blended material
• Added double chip seal

2015
• Added one more chip seal

<table>
<thead>
<tr>
<th>Design Parameter</th>
<th>Range</th>
<th>Test Results with BASE ONE®</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO Structural Layer Coefficient (Granular Base)</td>
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<tr>
<td>MnPAVE ME Resilient Modulus (Granular Base)</td>
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</tr>
<tr>
<td>Tonnage</td>
<td>Design 7</td>
<td>10.3</td>
</tr>
</tbody>
</table>
PROJECT PROFILES

GRAVEL SURFACE STABILIZATION
SUCCESSFUL RESULTS:

- Polk County was able to skip a regraveling cycle in 2018 on the projects stabilized with BASE ONE®, saving the county over $150,000 in 2018.
- Blading was reduced to one time per month vs one time per week, saving the county wear and tear on equipment.
- Gravel roads that were impassable, muddy, and sloppy in the spring are now nice stabilized gravel roads.
LOCATION
Cass County, ND

PROJECT
Cass County #3

PROJECT TYPE
11.4 Mile Gravel Road Stabilization

APPLICATION METHOD
Reclaim/Inject BASE ONE®

PROJECT DATE
2016

PROJECT DETAIL
The county first installed drain tile a couple of years ago to address the subgrade moisture issues. This increased performance somewhat, but they still had structural issues. The county mixed in 5.5% of Portland cement into 12” of the subgrade just above the drain tile to address the subgrade issues. To increase performance of the driving surface, the county reclaimed/injected BASE ONE® in 4.5” of ND Modified Class 13 aggregate surface material. A light coat of chloride was added to the surface to minimize dust.

American Engineering & Testing, Inc. conducted testing in June 2017. Test results are as follows:

<table>
<thead>
<tr>
<th>AASHTO</th>
<th>Design Standards</th>
<th>Test Results with BASE ONE®</th>
<th>Test Results with Soil Cement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural Layer Coefficient</td>
<td>0.06-0.14</td>
<td>0.22</td>
<td></td>
</tr>
<tr>
<td>(Granular Base) with BASE ONE®</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resilient Modulus</td>
<td>15,000-30,000</td>
<td>114,000</td>
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<tr>
<td>(Granular Base) with BASE ONE®</td>
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<td></td>
<td></td>
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<tr>
<td>Structural Layer Coefficient</td>
<td>0.12-0.18</td>
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<tr>
<td>(Soil Cement Subgrade)</td>
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<tr>
<td>Resilient Modulus</td>
<td>15,000</td>
<td>51,000</td>
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<tr>
<td>(Soil Cement Subgrade)</td>
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<tr>
<td>Tonnage</td>
<td>11.8</td>
<td>11.8</td>
<td></td>
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</tbody>
</table>
**BASE ONE®**
Base Stabilizer

**PROJECT PROFILE**

**LOCATION**
Wilkin County, MN

**PROJECT**
County Road #17

**PROJECT TYPE**
Gravel Based Stabilization

**APPLICATION METHOD**
Blade Mix

**PROJECT DETAIL**
Wilkin County does several miles of tiling per year. The following year they stabilized the material with BASE ONE®.
The county blade mixed the 2” of Class 5 and 2” recycled millings together and then stabilized the 4” of mixed material with BASE ONE®. With the new BASE ONE® stabilized mixed material Wilkin County was able to save on material loss and also reduce the amount of annual blading.

**PROJECT DATE**
2017 – County tiled County Rd.17
2018 – County brought in 2” of new Class 5 material and 2” of millings.
BASE ONE®
CONSTRUCTION
PROCEDURE
BASE ONE®

*Pre-Construction Procedure*

1. Material gradation should be performed prior to any stabilization work to verify the rock and binder content meet requirements.
   
   A. Approximately 6-15% passing the #200 sieve. Perform Hydrometer on aggregate to determine amount of clay or plastic fines.
   
   B. Of the material passing the #200 sieve, we prefer 3% be clay or plastic material.
   
   C. Gradation can be reviewed on a case by case basis.

2. Determine the appropriate amount of BASE ONE® for your project.
APPLICATION TECHNIQUES USED TO APPLY BASE ONE®
RECLAIM AND INJECT BASE MATERIAL

- Reclaim and inject stabilizer to designed depth in one pass (Example: reclaimed and stabilized 12” material)
- Compact to density specs
- Shape to grade
- Finalize compaction
**Reclaim and Inject – 2 Pass Method**

- Reclaim to designed depth on first pass
- Reclaim and inject on second pass to designed stabilized depth (Example: stabilized 6” of 12” total material)
- Compact to density specs
- Shape to grade
- Finalize compaction
ZIPPER APPLICATION

- Used for smaller projects and patch work
- Can be injected or surface applied
**Blade Mix Application**

The blade mix method may be used after reclamation, or it may also be used when adding base material during a new construction, reconstruction, or regraveling project.

1. **Spray It**
2. **Spread It**
3. **Mix It**
4. **Compact It**
COMPACCTION

General Pad Foot Width Recommendations for Reclaimed Material:

- Nothing less than 66” on any project

- Minimum 66” pad foot roller for 4” to 6” depth reclamation projects

- 84” pad foot roller for 6” to 12” depth reclamation projects
COMPACTION

Steel Drum Roller
Vibrating and Static Mode

Pneumatic Roller
THINGS TO CONSIDER WHEN WRITING BID SPECIFICATIONS

✔ It is important to make specifications clear and precise for all parties involved in the project.

✔ Require contractors to have experienced personnel onsite and to also have offsite support.

✔ Require product suppliers to have knowledge of their product and experience in its uses, have support staff, and examples of completed projects.
THINGS TO CONSIDER WHEN WRITING BID SPECIFICATIONS

☑ Require outside engineering firms and others involved in the implementation of the project to have working knowledge of everything involved.

☑ The more resources you have in place, the greater the chance you will obtain a successful project in a timely manner.
The Fundamental Control Factors for Base Stabilization are:

- Proper chemical content/dosage
- Adequate moisture content
- Thorough mixing
- Adequate compaction
- Proper curing
- Proper granular material
BASE ONE® is:

✓ Patented!
✓ Safe!
✓ Economical!
✓ Easy to use!
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