QC/QA for Embankment Construction

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Historical Background
QC/QA Specification
Quality Control
Quality Assurance
Responsibilities
Quality Control Plan (QCP)
Construction
Future Goals
Questions
INDOT Old Specification

Embankment Construction

- Compaction as per INDOT Spec Section 203
- Lift Thickness: 8 inch Loose & 6 inch compacted
- Density: 95% of Maximum Dry density (T-99)
- Moisture: -3 to +1 of OMC
- LOI: < 7%
- Test Frequency for acceptance:
  - One density test per 1400 cyds/Two lanes
  - One Moisture test per/day

(Note): If compaction >105%, check for soil target density & moisture with One point proctor
INDOT Old Specification

Pavement Subgrade Construction

- Compaction as per INDOT Spec Section 207
- Thickness of Prepared Subgrade: 24 inches
- Soil:
  - Maximum Dry Density > 100 PCF
  - Liquid Limit < 50
  - LOI & Ca/Mg < 3%
- Compaction:
  - Lift Thickness: 6 inch compacted
  - Density: = 100% of Maximum Dry Density
  - Moisture: -3 to +1 of OMC
Test Frequency for acceptance:
- One density test per 1400 cyds/Two lanes
- One Moisture test/day

(Note: If > 105%, check for soil target with one point Proctor)
Motivation Behind the Change

- To eliminate the use of nuclear gauge for safety reasons
- The DCP & LWD are portable, easy to operate, It takes only a couple of minutes to learn how to use correctly
- Devices Measure strength and modulus of material
- The modulus would relate reliably with design parameters such as CBR, shear strength and resilient modulus
- Precise enough to accept with confidence
- DCP is an effective tool to identify weak layers when penetration rates are plotted vs. depth
- Readings are not affected by minor shrinkage cracks in soils
- Inspector does not have to stay on grade all the time
Current INDOT Specification

Embankment Construction:

- Compaction as per INDOT Spec Section 203
- Soil:
  - Density: > 90 pcf
  - LOI: < 7%
- Compaction:
  - Lift Thickness: 6 inches compacted
  - Strength: DCP Blow Counts as per Section 203 or
  - Density: 95% of Maximum Dry Density (T-99)
  - Moisture: -3 to +2 of OMC
- Test Frequency for acceptance:
  - 3 Tests/2000 cyds/Two lanes
  - One Moisture test every 4 hours

(Note: If soil changes, perform one point Proctor)
Current INDOT Specification

Pavement Subgrade Construction

The subgrade shall be constructed uniformly transversely across the width of the pavement including the shoulders

- 14” Chemical Modification in accordance with 215,
- 12” Aggregate No. 53 in accordance with 301,
- Geogrid in accordance with 214 placed UNDER 12” Aggregate
- 24” Soil Compaction to 100% of Maximum Dry Density.
Current INDOT Specification

Pavement Subgrade Construction

- Compaction as per INDOT Spec Section 207
- Thickness of Prepared Subgrade: 24 inches
- Soil:
  - Maximum Dry Density > 100 PCF
  - Liquid Limit ≤ 50
  - LOI & Ca/Mg ≤ 3%
  - Sulfate content ≤ 1000 ppm
- Compaction:
  - Lift Thickness: 6 inch compacted
  - Density: = 100% of Maximum Dry Density
  - Moisture: -3 to +2 of OMC

(Note: If soil changes, perform one point Proctor)
Compaction Control Devices

- Old Testing Devices:
  - Nuclear Gauge
  - Sand Cone

- New Testing Devices:
  - DCPT
  - LWD
  - Sand Cone
  - Moisture Probe
  - Microwave
Compaction Testing Devices

Microwave Oven  Dynamic Cone Penetrometer  Light Weight Deflectometer

Moisture Probe  Nuclear Gauge
Motivation to adopt QC/QA based Specs

Based on several demo projects, it was concluded to change our conventional specs to QC/QA based specs due to the following reasons:

- Require less manpower to supervise
- Provide more flexibility to the contractor
- Contractor takes primary responsibility of his work
- Better management of fill material and its placement
- Fewer failed tests during quality assurance
- Better construction practices with specs compliances
- Contractor’s involvement in specs development
- More economical
Demo QC/QA Projects

- US-6 (Elkhart Co.)
- US-24 (Allen Co.)
- US-31 (Howard Co.)
- SR-25 (Tippecanoe Co.)
- US-50 (Jennings Co.)

- US 31 (Tipton Co.)
- I-69 (Hamilton Co.)
- SR 641 (Vigo)
QC/QA Specification

Description

- This work shall consist of the construction of a soil embankment and pavement subgrade in accordance with 105.03, 203 and 207.

- The requirements dictate that the Contractor shall develop and implement a Quality Control Plan (QCP) and perform quality control testing for soil embankment and pavement subgrade.

- INDOT will perform quality assurance testing.
Quality Control (QC) is a process where the contractor performs the required testing to insure the quality of his work or deliverables.

Quality Control (QC) also refers to the verification that the deliverables are of acceptable quality and complete in accordance with the Specs.

Quality Control (QC) testing data Shall be maintained and provided to INDOT on a daily basis.
Quality Assurance (QA) refers to the process to accept the deliverables with verification of compliance with Specs.

Quality Assurance (QA) also refer to a way of preventing mistakes or defects in various stages of construction and avoiding problems during & post construction.

Quality Assurance (QA) testing is performed by INDOT after receiving QC data from contractor.

Quality Assurance (QA) data will be kept as a part of project record.
Responsibilities

- **Quality Control:** The construction contractor will be responsible for the quality of construction in the finished product and for compliance with the construction documents, drawings, and specifications.

- **Quality Assurance:** The Project Engineer will have ultimate responsibility for the oversight of construction and for conformance with the construction drawings, specifications, and quality assurance requirements.
Quality Control Plan (QCP)

**General Requirements:** The contractor shall submit a QCP for the contract in accordance with ITM 803.

- The QCP shall describe how the Contractor proposes to manage the materials, equipment, and operations on the contract for the embankment & Subgrade construction.

- The QCP shall be project specific, signed, dated, and submitted by contractor’s representative 15 days prior to commencing the embankment/subgrade operation.

- Embankment/subgrade Operation shall not begin until QCP has been accepted.
Quality Control Plan (QCP)

- General Requirements (cont’d)

  - The Department will review the QCP and approve if meets the requirements as stated.

  - Any change to the approved QCP shall be provided in writing for approval. No revisions shall be implemented until the approval is obtained.

  - The Department may ask to replace ineffective or unqualified equipment or quality control personnel if not functioning as expected.
Quality Control Plan (QCP)

- **Quality Control Team:** The qualification of the team members shall be in accordance with ITM’s 803, 506, 508, 509, 512, 513.

- **QCP Field Manager** shall be qualified in accordance with ITM 803 and responsible for conducting tests and inspection to implement QCP.

- **Quality Control Technician** shall be qualified under ITM 506, 508, 509, 512 & 513 to perform the following:
  - Construct a test section to establish roller pattern and number of passes for achieving DCP blow count.
Quality Control Plan (QCP)

Quality Control Technician (Cont’d):

- Develop procedures for spreading, mixing, and pulverizing to achieve required compaction for soil modification.

- Develop procedures for testing & monitoring compaction operations such as checking moisture content, strength, stiffness of the embankment or chemically stabilized soils.

- Prepare and submit Daily QC Test Report including deficiency analysis (if any) to Project the Engineer.
Quality Control Plan (QCP)

Testing Facility:

- The testing facility shall be located on site and accessible to Department Personnel to witness quality control activities.

- The facility shall be equipped with proper testing devices needed for testing.

- All testing equipment shall be calibrated in accordance with ITM.
Quality Control Plan (QCP)

- **Soil Management** shall include the following:
  - Identify Borrow pit location
  - Identify cut sections
  - Soil profiles of borrow pit and cut sections in order to maintain uniformity during placement & compaction
  - Plan to deal with any variations in soils such as using one point proctor for target numbers
Material Sampling & Testing: The procedures for sampling and testing of soils and the frequency of tests shall be identified and shall include the following as a minimum:

- The soil moisture content shall be in accordance with INDOT Specs. Section 203.23
- The in-place strength determination shall be in accordance with INDOT Specs. Section 203.23 & 215.09
- Maximum Dry Density and Optimum Moisture content determination in the field (One Point Proctor) shall be in accordance with ITM if soil type changes.
Material Sampling & Testing (Cont’d):

- Mix Design and acceptance for chemical modification shall be in accordance with INDOT Specs. section 215.02.

- The in-place stiffness determination shall be in accordance with INDOT Specs. Section 203-R-628.
Proofrolling procedure shall be developed and include for the following:

- **Embarkment Foundation**: proofrolling prior to the placement of first lift of embankment in accordance with Sec 203.26

- **Pavement subgrade**: proofrolling of prepared subgrade shall be required to detect any rutting more than ½ inch
Response to Test Results: Procedures for corrective action shall be developed when tests do not meet the INDOT requirements. Procedures shall include as a minimum the following:

- Moisture: when the moisture tests do not meet the requirements of Sec 203.23 & 215.10
- Strength: when the DCP blow counts do not meet the criteria of Section 203.23
- Maximum Dry Density & Optimum Moisture Content: If a change in soil type is noticed
Response to Test Results (Cont’d):

- Chemical Modification: uniform spreading, mixing, pulverizing, strength and stiffness were not met in accordance with Section 215.09 and 203.23

- Proofrolling: exhibited pumping and/or rut of ½ inch or more during Proofrolling

- Deficient Areas: The procedure for reworking deficient areas when identified by QC or QA testing
The Contractor shall provide the following documentation at the completion of soil embankment and pavement subgrade operation each day:

- **Quality Control Tests Data:** The results from all tests performed shall be clearly documented on hard copies and/or electronically and shall be identifiably related to the test results in the diary.

- **Equipment:** Documentation of the manufacturer, model, spreader, pulverizer and type of rollers used each day.
**Diary:** The Quality Control Technician shall maintain a diary, either electronic and/or hard copy. The diary shall be an open format book with at least one page designated for each day. The Diary shall be kept on file until the completion of work and final acceptance of contract. Every entry in the Diary shall be signed. Entries in the diary shall include the following as a minimum:

- Weather conditions including amount of rain if any.
- Location of borrow pit or common excavation.
- Location/quantity of soil placement and compaction including lift numbers.
- Proofrolling prior to start of embankment and the complete coverage.
Diary (cont’d):

- Mixed design by an approved Geotechnical consultant as per sec. 215.
- Time of sample collected & tested.
- Nonconforming tests and the resulting appropriate action taken.
- Change in key personnel.
- Significant changes in equipment or operations which may affect the placement or compaction of the embankment/pavement subgrade.
- Deficient areas and response to test results.
- Any significant event or problem.
Acceptance of Work

Acceptance of compaction will be determined on the basis of tests performed by the Engineer.

**Test Section** is required to determine number of passes, rolling pattern etc and details are as follow:

- Test section shall be constructed with the available equipment for each soil type in accordance with Specs Sec. 203, ITM 513 & ITM 803 in the presence of the Engineer.

- The soil in the test section shall meet the requirements of 203.09, 207, and 215.
Test Section (Cont’d)

- Test Section shall be 100 ft long x 20 ft wide x 1 foot thick.

- The location of Test Section shall be proofrolled as per 203.23

- The Test Section shall be constructed in two 6” lifts placed in accordance with 203.22

- Moisture tests shall be in accordance with ITM 506 at 2 random locations and 4 DCP tests in each lift.

- Test Section shall be constructed in the presence of Geotechnical Services Representative.
Acceptance of Work (Cont’d)

Acceptance Criteria using DCP & LWD:

- The acceptance of embankment compaction will be in accordance with Section 203.23

- The compaction acceptance of chemically modified soils and its moisture will be determined by Sec 215 and 203 R 628.

- The tests will be performed at the frequency described in Sec 203.23.
Acceptance of Work (Cont’d)

DCP Blow Counts Chart

<table>
<thead>
<tr>
<th>Textural Classification</th>
<th>Maximum Dry Density (pcf)</th>
<th>Optimum Moisture Content Range (%)</th>
<th>Acceptable Minimum DCP value for 6 in.</th>
<th>Acceptable Minimum DCP value for 12 in.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLAY SOILS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay</td>
<td>&lt; 105</td>
<td>19 - 24</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Clay</td>
<td>105 - 110</td>
<td>16 - 18</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Clay</td>
<td>111 - 114</td>
<td>14 - 15</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td><strong>SILTY SOILS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silty</td>
<td>115 - 116</td>
<td>13 - 14</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Silty</td>
<td>117 - 120</td>
<td></td>
<td>11</td>
<td></td>
</tr>
<tr>
<td><strong>SANDY SOILS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sandy</td>
<td>121 - 125</td>
<td>8 - 12</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Sandy</td>
<td>&gt; 125</td>
<td></td>
<td>15</td>
<td></td>
</tr>
<tr>
<td><strong>GRANULAR SOILS - STRUCTURE BACKFILL AND A-1, A-2, A-3 SOILS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 30</td>
<td></td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td></td>
<td></td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>1/2 in.</td>
<td></td>
<td></td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>1 in.</td>
<td></td>
<td></td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>
Moisture range for all soil types are as follows:

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Moisture Compaction Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay (&lt;105 lb/cu ft)</td>
<td>-2 to + 2% of optimum moisture content</td>
</tr>
<tr>
<td>Clay (105-114 lb/cu ft)</td>
<td>-2 to + 1% of optimum moisture content</td>
</tr>
<tr>
<td>Silty and Sandy (&gt;114 lb/cuft)</td>
<td>-3% of optimum moisture content and optimum</td>
</tr>
<tr>
<td>Granular</td>
<td>5 to 8%</td>
</tr>
</tbody>
</table>

Moisture tests will be performed every four hours for clayey soils once a day for silty, sandy and granular soil types.
Acceptance of Work (Cont’d)

Compaction Deficiencies

- When a deficiency is identified at the random location, the Engineer will select two additional locations for sampling in accordance with ITM 802. DCP testing in accordance with 203.23 or LWD in accordance with 203-R-628 will be performed.

- Individual locations that do not meet the DCP or moisture requirements and all locations exhibiting pumping or rutting will be considered deficient.

- If any additional locations fails to meet DCP or LWD criteria, rework as necessary before acceptance testing is resumed in that area in accordance with the table (Compaction Acceptance of Deficiencies).
## Acceptance of Work (Cont’d)

### Compaction Acceptance of Deficiencies

<table>
<thead>
<tr>
<th>Construction Areas For ≤ 6 inch Lift (ft²)</th>
<th>Deficient Area DCP or %Moisture (ft²)</th>
<th>Excessive Pumping Or Rutting?</th>
<th>Rework Required?</th>
</tr>
</thead>
<tbody>
<tr>
<td>15,000 to 75,600</td>
<td>≥1500</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>&lt;1500</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>5,000 to &lt;15,000</td>
<td>≥750</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>&lt;750</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>&lt;5,000</td>
<td>≥100</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>&lt;100</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Compaction Deficiencies

- Chemically modified subgrade shall meet the requirements of 215 or 203-R-628. Proofrolling shall cover the complete surface area. No deficient area is permitted in subgrade.
Acceptance of Work (Cont’d)

DCP blow counts for the chemically Modified Soil

- 17 blows (min) / 6 inches
- 16 blows (min) / 8 inches
- 20 blows (min) / 8 inches

Chemically Modified Soils
203-R- 628, Compaction Acceptance with LWD

Maximum allowable deflection will be in accordance with the following:

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Maximum Allowable Deflection (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lime Modified Soil</td>
<td>0.30</td>
</tr>
<tr>
<td>Cement Modified Soil</td>
<td>0.27</td>
</tr>
<tr>
<td>Aggregates over Lime Modified Soil</td>
<td>0.30</td>
</tr>
<tr>
<td>Aggregates over Cement Modified Soil</td>
<td>0.27</td>
</tr>
</tbody>
</table>

**Note:** Materials not included in the table need a test pad.
**LWD Log**

**INDIANA DEPARTMENT OF TRANSPORTATION**

**LWD TEST SECTION FOR AGGREGATE OVER SOILS**

**Test Date:** 6/10/2014

<table>
<thead>
<tr>
<th>Test Section Data</th>
<th>Subgrade LWD Info</th>
<th>LWD</th>
<th>Test Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Station</td>
<td>Type</td>
<td>Avg. Test Deflection (S_m) (mm)</td>
<td>Maximum Allowable Deflection (mm)</td>
</tr>
<tr>
<td>Ref. To Centerline</td>
<td>LWD Assigned Test Number</td>
<td>4V+1S</td>
<td>0.267</td>
</tr>
<tr>
<td>Depth of Lift (inches)</td>
<td>Avg. Test Deflection (S_m) (mm)</td>
<td>5V+2S</td>
<td>0.273</td>
</tr>
<tr>
<td>Test Section Position Number</td>
<td>Avg. Test Deflection (S_m) (mm)</td>
<td>6V+3S</td>
<td>0.267</td>
</tr>
<tr>
<td>1</td>
<td>0.379</td>
<td>6V+3S</td>
<td>0.273</td>
</tr>
<tr>
<td>2</td>
<td>0.387</td>
<td>6V+3S</td>
<td>0.266</td>
</tr>
<tr>
<td>3</td>
<td>0.375</td>
<td>6V+3S</td>
<td>0.267</td>
</tr>
<tr>
<td>4</td>
<td>0.388</td>
<td>6V+3S</td>
<td>0.275</td>
</tr>
<tr>
<td>5</td>
<td>0.392</td>
<td>6V+3S</td>
<td>0.268</td>
</tr>
<tr>
<td>6</td>
<td>0.389</td>
<td>6V+3S</td>
<td>0.272</td>
</tr>
<tr>
<td>7</td>
<td>0.394</td>
<td>6V+3S</td>
<td>0.269</td>
</tr>
<tr>
<td>8</td>
<td>0.372</td>
<td>6V+3S</td>
<td>0.256</td>
</tr>
<tr>
<td>9</td>
<td>0.354</td>
<td>6V+3S</td>
<td>0.244</td>
</tr>
<tr>
<td>10</td>
<td>0.365</td>
<td>6V+3S</td>
<td>0.255</td>
</tr>
</tbody>
</table>

**Laboratory Report Data**

- **Material Name and Type**: Cohesive or Granular (Fill or Cut)
- **Lab. SM ID (R+7 digits)**
- **Tested on Material Passing (No. 4 or 3/4" Sieve)**
- **Optimum Moisture Content (OMC) (%)**: 3/4
- **Wt. of Pan & Wet Material (W1)(lb) or (g)**
- **Wt. of Pan & Dry Material (W2)(lb) or (g)**
- **Wt. of Moisture (lb)**
- **Wt. of Dry Material**
- **% Moisture (0.1%)**

**REMARKS:**
This procedure continues until the difference of the average of the 10 LWD test between consecutive roller passes is equal to or less than 0.02 mm.

**V – VIBRATORY S – STATIC**
### INDOT Coarse Aggregates

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>53</th>
<th>73</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 in. (100 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 1/2 in. (90 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 1/2 in. (63 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 in. (50 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1/2 (37.5 mm)</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>1 in. (25 mm)</td>
<td>80-100</td>
<td>100</td>
</tr>
<tr>
<td>3/4 in. (19 mm)</td>
<td>70-90</td>
<td>90-100</td>
</tr>
<tr>
<td>1/2 in. (12.5 mm)</td>
<td>55-80</td>
<td>60-90</td>
</tr>
<tr>
<td>3/8 in. (9.5 mm)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>No.4 (4.75 mm)</td>
<td>35-60</td>
<td>35-60</td>
</tr>
<tr>
<td>No.8 (2.36)</td>
<td>25-50</td>
<td>-</td>
</tr>
<tr>
<td>No.30 (600 μm)</td>
<td>12-30</td>
<td>12-30</td>
</tr>
<tr>
<td>No.200 (75 μm)</td>
<td>5.0-10.0</td>
<td>5.0-12.0</td>
</tr>
</tbody>
</table>
METHOD OF MEASUREMENT

- QC/QA Soil Embankment will be measured in accordance with 203.27 and QC/QA for chemically modified subgrade will be measured in accordance with 215.10.

BASIS OF PAYMENT

- The cost of the QC/QA Soil Embankment process shall be included in the cost of the Common Excavation and Borrow pay items. The cost of chemically modified subgrade will be paid for in accordance with 215.12.
ITM’s For Compaction Acceptance

ITM No. 506-15T
Field Determination of Moisture Content of Soil

ITM No. 508-12T
Field Determination of Deflection Using Light Weight Deflectometer

ITM No. 509-15P
Field Determination of Strength Using Dynamic Cone Penetrometer

ITM No. 512-15T
Field Determination of Maximum Dry Density and Optimum Moisture Content of Soil (AASHTO T272)

ITM No. 514-15T
Test Sections for Aggregates and Recycled Materials
Cont’d.

ITM No.914-13T
Verifying Soil Test Molds

ITM No.915-13T
Verifying Soil Compaction Rammers

ITM No. 916-14P
Verification of Calipers

Link to ITM’s
http://www.in.gov/indot/div/mt/itm/itm.htm
Link to Test Section

http://intranet.indot.state.in.us/MaterialTests/pdfs/LWDFieldTestingProcedures.pdf

http://www.in.gov/indot/files/Fieldtesting.pdf

http://intranet.indot.state.in.us/MaterialTests/pdfs/directives/dir502.pdf
Demo QC/QA Projects

US 31 (Tipton Co.)
I-69 (Hamilton Co.)
SR 641 (Vigo)
US 6 (Elkhart Co.)
US-24 (Allen Co.)
US-31 (Howard Co.)
SR-25 (Tippecanoe Co.)
US-50 (Jennings Co.)
List of Demo Projects

US-24 in Ft. Wayne
- Soil Type: A-4 Silt dominated soils (850,000 cyds fill)
- Roller Type: Vibratory

US-31 in Kokomo
- Soil Type: A-4 Silt dominated soils (200,000 cyds fill)
- Roller Type: Vibratory

US-25 in Delphi
- Soil Type: A-3 Granular soils, Test project
- Roller Type: Vibratory

US-50 in North Vernon
- Soil Type: A-6, A-7-6 Soil (200,000 cyds)
- Roller Type: Machine Drive Power Roller
List of Demo Projects

US-31 in Tipton
- Soil Type: A-4, A-6 Silt dominated soils (Qty. -120,000 cyds)
- Roller Type: Sheepfoot

SR-641 in Terre Haute
- Soil Type: A-4, A-6 Silt dominated soils (Qty. -100,000 cyds)
- Roller Type: Sheepfoot

US-6 in Elkhart
- Soil Type: A-4, A-3 dominated granular soils (Qty. ->70,000cyds)
- Roller Type: Vibratory & Sheepfoot

I-69 in Fishers
- Soil Type: A-4, A-6 loamy soils (Qty. ->20,000cyds)
- Roller Type: Sheepfoot
- Subgrade treatment: Chemical Modification(10 miles of pavement)
US 31 in Tipton County
US 6 in Elkhart County
US 6 in Elkhart County
US 6 in Elkhart County
US 50 in Jenning County
Subgrade Proof Rolling
Future Goals

- Wider Implementation
- Cut down further QA Testing
- Elimination Of Test Section
- Expend QC/QA Application on MSE Walls Construction
- Move towards Performance Based Specs
Questions?