Smith Construction

M 189 Job in Iron River Job

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
INTELLIGENT COMPACTION MAPPING OF SUBBASE AND AGGREGATE BASE

a. Description. This work consists of utilizing Intelligent Compaction (IC) Technology to map the uniformity and relative stiffness of the constructed sand subbase layer and the aggregate base layer at the locations where trunk line pavement construction will occur with the exception of driveways and approaches. IC is a process that uses vibratory rollers equipped with a measurement and documentation system that automatically records compaction parameters in real time and roller location by Global Positioning System. IC data will be considered when selecting density test locations for Quality Assurance.

Provide a sufficient number of IC rollers and associated equipment to complete the compaction requirements for the subbase and aggregate base layers. IC rollers may be used during all production work and will be required for evaluation of the compaction operation. IC documentation of proof rolling measurement passes is required for the specified layers.

b. Materials. Materials for subbase and aggregate base must be in accordance with the plans and standard specifications.

c. Equipment. Provide the Engineer with the proprietary IC software and access to web-based data storage until 6 months after the final grading work is accepted. This software must allow the capability to export roller files that were transferred to web-based storage as detailed in subsection f. of this special provision. Provide an instrumented roller(s) meeting the following:

1. IC rollers must be self-propelled single smooth drum vibratory rollers equipped with accelerometers mounted in or about the drum to measure the interactions between the rollers and compacted materials.

2. The output from the roller is designated as the Intelligent Compaction Measurement Value (IC-MV). It represents the stiffness of the material.

3. IC rollers must include an integrated on-board documentation system that is capable of displaying real-time color-coded maps of IC-MVs, roller location, number of roller passes, machine settings, roller speed, frequency and amplitude of roller drums. The display unit must be capable of transferring data by means of a USB port.

4. Real Time Kinematic Global Positioning System (RTK-GPS) radio and receiver units must be mounted on each IC roller. The horizontal datum referenced in the RTK-GPS must use the Michigan State Plane Coordinate system, unless a local coordinate system has been specified by the Engineer. The State Plane Coordinate Zone for this project is Zone 2111 North. The vertical datum referenced in the RTK-GPS must be North American Vertical Datum of 1988 (NAVD 88) unless a local vertical datum has been specified by the Engineer.

From: Jason Whitaker
Nortrax

SW 990
Set up

5. Base Stations. Ground mounted or virtual GPS base units that record values in northing, easting and the elevation data in feet using the State Plane Coordinate System along with the longitude/latitude of the IC-MV must be provided. The GPS base station must broadcast updated correction data to the GPS receivers on the IC rollers and the hand held rovers during operation with a survey tolerance of not greater than 1.6 inches in both horizontal (x and y) directions.

6. Rover. A portable hand-held GPS radio/receiver for locating in-place density measurements must be provided.

7. Provide RTK-GPS and IC rollers that operate within the following tolerances:

INTELLIGENT COMPACTION TOLERANCE REQUIREMENTS	
Parameter	**Tolerance (+/-)**
Roller Position (northing, easting and elevation)	1.6 inch
Roller Speed (forward)	0.3 mph
Frequency	2 Hz
Amplitude	0.008 inch

d. Data Analysis Software. Use standardized data analysis software (Veda Alfa Vr.8.0 or later). It is available for download at www.intelligentcompaction.com. Veda will utilize the IC-MV data from the IC roller for analysis of coverage, uniformity, and stiffness values during production and proof rolling of aggregate base and subbase lifts. At a minimum, the following information must be exportable to either ASCII or Text Format or directly importable to the Veda software for processing:

1. File name.

2. Date and time stamps.

3. Machine manufacturer, model and type.

4. Drum width and diameter.

5. Roller and drum weight.

6. Roller RTK-GPS positions with northing, easting, elevation, longitude and latitude.

7. Roller speed, pass count and travel direction (forward or backward).

8. Drum frequency and amplitude.

9. IC-MV, reporting resolution for independent IC-MVs in the roller moving direction and 90 degrees to the roller moving direction.

10. State Plane Coordinate Zone and offset to Coordinated Universal Time (UTC) (hours).

11. Number of IC data points.

12. Automatic feedback control (on or off) if available on the equipment.

e. IC Training. The IC vendor must provide up to two consecutive days of IC training as needed for the appropriate Department and Contractor staff. One day of classroom training at a location in the close proximity of the project as approved by the Engineer and one day of field training within the limits of the project is required prior to implementing IC operations. At a minimum, the staff to receive the IC training is as follows:

Iron River on Site

1. Department staff:

   A. Inspectors.

   B. Construction Engineer and assistants.

   C. Density Control Specialists.

   D. IC Initiative Team.

2. Contractor staff:

   A. Operators of the instrumented rollers

   B. QC field representative

   C. Field grading superintendent

   D. Other Contractor specified

The training conducted by the IC vendor must cover at a minimum the following topics:

1. General background information on IC and GPS.

2. Hands on operation of the IC system including on-board documentation system, proprietary software use and setup.

3. Roller certification.

4. Verification of IC GPS accuracy.

5. Details on the system relevant to both the Contractor and Department. At a minimum:

   A. data transfer.

   B. data backup.

C. recommended operator settings.

D. data storage capacity of on-board documentation system.

E. base station and GPS use.

f. Construction.

1. Develop and implement a project specific Quality Control (QC) plan for subbase and aggregate base layer material construction that is based on roller compaction parameters, moisture, density and other QC practices and that will provide ongoing IC data to the Engineer. The materials must be placed and compacted in accordance with the standard specifications to meet density requirements detailed in the Density Testing and Inspection Manual (Manual).

2. Verify the proper setup each day prior to the start of the IC work. In the presence of the Engineer, the Contractor, GPS representative and IC roller manufacturer must verify the proper setup and accuracy of the GPS, IC roller(s) and the rover(s) using the same datum as follows:

A. At a location nearby or within the project limits, the GPS base station must be established and the IC roller and the GPS rover tied into the base station.

B. Verification that the roller and the rover are working properly and that there is a connection with the base station.

C. The coordinates of the roller from the on-board display must be recorded.

D. Remove the receiver from the rover and place on top of the roller receiver and record the coordinates shown on the rover display.

E. Compare the roller and rover coordinates. If they are within 1.6 inches, the comparison is acceptable. If not, corrections must be made as needed and the above steps repeated until verification is acceptable. Work must not begin until proper verification has been obtained.

3. Construct test strip utilizing IC technology. At a location agreed upon by the Engineer and Contractor, construct at least one test strip to establish a rolling pattern for each lift of subbase and aggregate base material. The subbase layer must be constructed in at least two lifts. Construct additional test strips when a change has been made to the source, gradation, type of material, moisture, lift thickness or as directed by the Engineer. Each test strip may be left in place and included as part of the project. The test strips should be constructed to approximately 100 feet long and 20 feet wide within the project limits unless otherwise directed by the Engineer.

Initiate the test strip with two passes with the IC roller. After two passes, mark and take three density and moisture content measurements at randomly selected locations at least 2 feet from the edge of the material course. Take additional density and moisture content measurements at the three original locations after every 2 subsequent passes of the roller. Continue to compact the test strip until the target maximum density as required in the

Manual is achieved. After the test strip has been constructed, place and compact each subbase and aggregate base layer in a similar manner to meet required density specification.

Determine the moisture content of the subbase and aggregate base material at the beginning of and during compaction in accordance with the Manual. Maintain the moisture content of the specified material during compaction within the acceptable range as specified in the Manual.

4. Proof roll the finished subbase and aggregate base layers over the full width of the layer using the same IC rollers throughout the project. Provide the locations for the proof rolling measurement passes to the Engineer at least 24 hours in advance. All required information detailed in subsection d. of this special provision must be recorded during compaction efforts. Conduct proof rolling with IC rollers moving in the forward direction only at a speed of 3 mph and using the vendor recommended drum weight, frequency and amplitude. Turn mapping off when not performing measurement passes. Provide to the Engineer immediate viewing of the measurement pass data as requested. After completion of the measurement pass, provide to the Engineer both printed and electronic copies of the compaction data files before placing successive layers.

5. Final compaction acceptance of the subbase and aggregate base layers will be based on Department-performed field density and moisture content measurements in accordance with the Manual. GPS measurements for all density test locations must be obtained utilizing the rover. Rework and recompact material that fails to meet the applicable density requirements before the next lift is placed. Perform this work at no additional cost to the Department.

g. Measurement and Payment. The completed work, as described, will be measured as a lump sum and paid for at the contract price using the following pay item:

Pay Item	**Pay Unit**
Intelligent Compaction	Lump Sum

Intelligent Compaction includes all labor, equipment and materials necessary to perform the work as described. The construction of additional test strips will not be paid for separately but will be included in this item of work. MDOT will provide density testing on initial test strips, and those additional test strips ordered or approved by the Engineer.

Payment for subbase and aggregate base work will be paid for with standard pay items.