

**ACCELERATED IMPLEMENTATION OF INTELLIGENT COMPACTION TECHNOLOGY FOR
EMBANKMENT AND SUBGRADE SOILS**

Description: This work shall consist of Contractor support of a research project which will be conducted for approximately one week during placement and compaction of embankment or subgrade soils. The purpose of the research is to demonstrate Intelligent Compaction (IC) technology, to evaluate the benefits of IC technology for compaction of embankment and subgrade soils compared to conventional compaction equipment and practices, to accelerate the development of IC specifications and to identify and prioritize needed improvements and research in IC equipment.

The IC test results will not be used for approval or rejection of the project materials testing but will be only used to support the research study.

IC for soils is defined as the gathering of data from a self-propelled vibratory system involved with the measurement and recording of roller position, date/time, speed, vibration frequency, vibration amplitude, pass count, travel direction, and compaction measurement value. A Real Time Kinematic (RTK) based Global Positions System (GPS) shall be used for determining the position of the rollers and mapping of IC measurements.

Construction Requirements

I. Time Frame

The IC research team will be conducting experiments for approximately 5 to 6 consecutive working days. The consecutive working days do not include days when work cannot occur due to weather conditions. The specific dates that the support work is needed will be established during the IC research project pre-construction meeting at least 2 weeks in advance of the work. For planning purposes, the IC research team has targeted the IC field demonstration 60-90 days after the notice to proceed is given.

II. Equipment

The IC research team will provide the IC roller(s) at no cost to the project. Depending on the type of materials to be used as part of the project, a smooth drum and a pad foot drum roller by at least 2 different manufacturers will be utilized. The Contractor shall be responsible for onsite transportation of the rollers to the designated locations and to the Department's open house which will be within relatively close proximity to the project as discussed during the pre-construction meeting. To support the IC research operations a GPS System, up to approximately 200 gallons (757 L) of diesel fuel, and construction equipment shall be provided as described below.

III. Operators

Operators provided by the Contractor shall coordinate with the IC research team during placement of the test beds to ensure that material types, percentage and uniformity of moisture content and lift thickness are satisfactory.

IV. Test Bed

a. Test Bed Preparation

During the test bed preparation, equipment provided by the Contractor shall consist of a sufficient number of haul trucks, and sufficient equipment to properly place the material, obtain proper moisture content, and to level the material in uniform lifts at the thickness designated by the IC research team. Where possible, the equipment used on the research test beds will be the same equipment used on the remainder of the project. The Contractor's equipment and operators shall be needed for approximately 2 to 3 hours per day. For the remainder of the day, the Contractor may use their equipment on the remainder of the project. The IC research team will use the IC rollers to compact the test bed material placed by the Contractor.

b. Test Bed Construction

Prior to test bed construction, the underlying grade and embankment lifts shall be in accordance with all applicable provisions of 201 and 203. During construction of the test bed, the Contractor's equipment and operator's time to place, moisture condition and grade the test bed material will be needed for about 2 to 3 hours per day. The IC research team will compact the test bed material. The test beds shall be 20-30 ft (6-9 m) in width and 100-200 ft (30-60 m) in length and will consist of a single lift of embankment or subgrade material, as shown in Fig. 1.

The Contractor shall place and mix this material to meet specific lift thickness and moisture contents. Various moisture contents will be specified by the IC research team between optimum minus 3% and optimum plus 2%, or as determined by soil characterization. The tolerances on specified mixing depths and moisture contents are plus or minus 2 in. (50 mm) and plus or minus 2%, respectively.

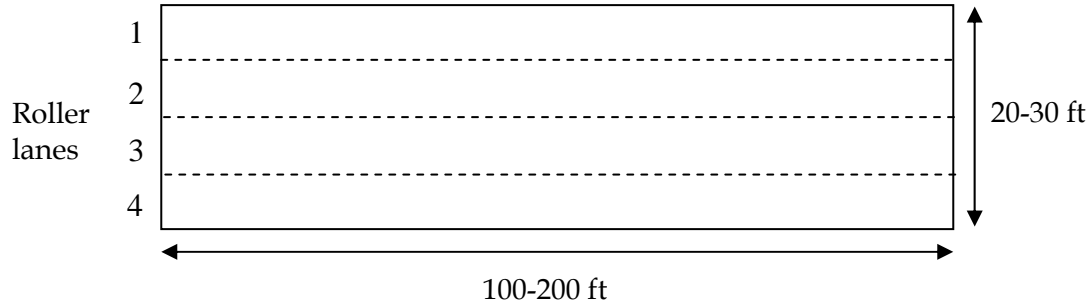


Fig. 1 Layout of Test Beds.

The approximate number and location of the test beds will be established at the pre-construction meeting. Test bed locations will be selected to be out of the way of the Contractor's normal operations and near the IC mobile laboratory. This work will be scheduled at times that are convenient for the Contractor and the IC research team. During the construction of the test bed, the IC research team will work with the Contractor to verify the material type, characterize the soil per 903, measure lift depth, and determine the percentage and uniformity of moisture content in a timely manner. The IC research team will place in-ground instrumentation prior to the placement of the test bed material. The IC research team will approve the test bed placement before the equipment is removed from the test bed location.

At the completion of the research project, the test beds may be left in place at the discretion of the Engineer. The IC research team will not be

responsible for meeting any of the specific project material, density or moisture content requirements.

V. Compaction Section

a. Compaction Section Preparation

During the preparation of the compaction section, placement, moisture conditioning and grading of the materials in the test sections shall be performed by the Contractor with the Contractor's equipment and methods per 203. However, compaction of the compaction section material will be performed by the Contractor's operators using IC research team rollers.

b. Compaction Section Construction

During construction of the compaction section, the Contractor shall perform compaction per 203 on 3 areas of up to 3 lifts of selected embankment or subgrade sections using IC rollers. The IC research team will evaluate these 1000-2000 ft (300-600m) long by full width areas of embankment or subgrade as shown in Fig. 2. The Contractor shall place the material as needed to meet the standard specification requirements of the project. The IC research team will perform IC roller calibration testing over a 100 ft section where nuclear gage moisture-density, Light Weight Deflectometer (LWD), dynamic cone penetrometer (DCP), and other data are compared to roller measurement, followed by compaction of the remainder of the full section. The IC research team will designate 10 to 20 locations to perform moisture, density and other spot testing in the calibration area and an additional 10 to 20 locations in the full section. The specific number and general locations of the compaction sections will be established in the pre-construction meeting. If possible, multiple lifts of embankment or subgrade in each compaction section can be evaluated. The Department will perform side by side informational testing and acceptance testing in coordination with the IC research team.

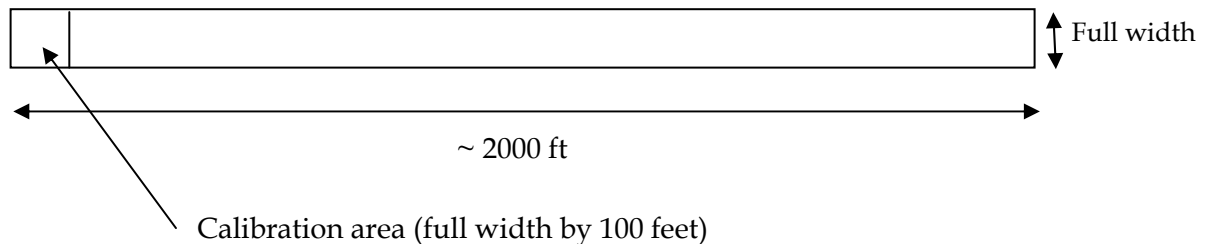


Fig. 2 Plan view of Compaction Sections.

The Department will provide the IC research team their acceptance test results in the IC testing areas for comparison with the IC results. The IC results are available to the Department and the Contractor at any time during the field demonstration.

The IC test results will not be used for approval or rejection of the project materials testing but will be only used to support the research study.

VI. Communication with IC Research Team

At least once a day, the IC research team will meet with the Contractor's project manager or superintendent to plan and coordinate the support work. At the time of the meeting, the IC research team will provide clear instructions on the location, material type, desired moisture content, lift

thickness and other details required in the preparation of the test beds, compaction sections and other types of preparation. The Contractor shall keep the IC research team aware of project changes that may effect the IC operations.

VII. ISU Mobile Testing Laboratory

The IC evaluations will be performed in a mobile field laboratory owned and operated by Iowa State University (ISU) at no cost to the project. The trailer will be moved onto the project and set up in a convenient location prior to the demonstration. The Contractor shall provide a suitable location with a solid platform approximately 50 ft (15m) long and 15 (4.5m) feet wide for the mobile laboratory. The exact location will be selected during the pre-construction meeting. The laboratory will remain in that location for the duration of the research activities.

The Contractor shall be responsible for providing electrical connections, drinking water, and sanitary facilities during the IC field demonstrations at the laboratory site. The laboratory site also needs sufficient parking for the IC research team construction vehicles and sufficient area for visitors. A parking area to support 10 vehicles should be sufficient.

VIII. Global Positioning System

IC rollers are dependent on availability of a Global Positioning System (GPS) to track roller positions during operations in order to display color-coded maps of roller pass counts, roller-integrated measurement values (RMV), and other measurements such as surface temperatures. The Contractor shall be responsible for providing the IC research team with a RTK GPS base station to acquire northing, easting, and elevation data in an established project coordination system. Universal Transverse Mercator Coordinate (UTM) is the preferred coordinate system. The UTM zone for this site in Indiana is 16N. The Contractor shall be responsible for providing one hand-held GPS rover to the IC research team. The GPS base station shall broadcast differential correction data to the rollers and hand-held rovers with tolerance of less than 1.6 in. (40 mm) in both horizontal and vertical directions.

IX. Method of Measurement

Intelligent compaction support will be paid as a lump sum. No measurement will be made.

X. Basis of Payment

Intelligent compaction support will be paid for at the lump sum contract price for providing assistance for the implementation of the research project as described herein. Payment will be full compensation for materials, equipment, fuel, operators, electricity, any delay during testing program, site preparation, use of GPS system, water tank, discing to control moisture content or any other services required for progress of the Intelligent Compaction research program.

Payment will be made under:

Pay Item	Pay Unit Symbol
Intelligent Compaction Support.	LS