Digital Inspection Workshop
3D Models, Rovers, Data Collectors, Base Stations
Concord, NH
December 11, 2018
Outline

• Brief History
• Vision and Goals
• Implementation
• Workshop Goals
Paradigm Shift: Stakes to AMG

Used to have lots of stakes

Now have very few stakes
AMG Equipment
Vision

- Independent grading inspection in a stakeless AMG world
- Use of Contractor’s 3D model for area and volume calculations
- Statewide CORS network
Goals

- Develop a working GNSS specification
- Provide necessary tools and training to use 3D models
- Include the design 3D model in the bid package
  - Less reliance on TIN model based on 2D plans
- Statewide CORS Network
3D Models – TIN (Triangular Irregular Network)
3D Models
SPECIAL PROVISION

Section 670 – MISCELLANEOUS INCIDENTALS

Item 670.822 - GNSS Construction Inspection Equipment

Description

1.1 Work shall consist of furnishing, configuring, installing, maintaining, and removing Global Navigation Satellite System (GNSS) equipment as needed for use by the Engineer, including building the digital surface models as necessary and downloading them into the Contractor provided data collectors, and the training of Department staff on the use of the GNSS equipment provided.

Equipment

2.1 The GNSS Construction Inspection Equipment shall include all necessary components; communication devices, integrated antennas, receiver, and cables; data collectors; operating manuals; attachments; and fastening hardware to meet the minimum requirements described herein.

(a) GNSS equipment provided for a single Contract shall be the same model and manufacturer, and shall include, and be licensed to operate, the same version of GNSS planning/processing software (such as Carlson Survey, Trimble Business Center HCE, or similarly functioned software), and data collection software. The data collection system utilized by the Contractor and Engineer shall be the same. All software provided (including firmware) shall be the most current available or in use by the Contractor. GNSS equipment shall be of the same age as those actively in use by the Contractor. To verify the age of the GNSS equipment, the Contractor shall provide a dated copy of the manufacturer’s receipt(s) for the purchase, lease, or rental of the equipment.

(b) GNSS planning/processing software shall have the following minimum capabilities:

1. Surfaces
   • Build surfaces by triangulation or rectangular grids
   • Calculate earthwork volumes between triangulation or grid surfaces
   • Create surfaces from collected data points
   • Calculate 2D and 3D surface areas from existing and collected data points
(m) **GNSS rover** shall include one (1) fixed or collapsible height rover rod of two (2) meters (6.56 feet) in length, one attachable bipod which is compatible with the rover rod, and one topo shoe.

(n) GNSS equipment set up to operate as a **base station** shall include all necessary additional cables, hardware, fasteners, or accessories necessary to install the equipment in a fixed semi-permanent location. This set up will not be considered as a rover unit and therefore will not require a rover, a bipod, or a topo shoe.

(o) If a high accuracy machine control system is to be utilized for fine grading, a **high accuracy measurement system** shall be made available for Department use to check prepared fine graded surfaces. If the supplied GNSS unit is not capable of utilizing the high accuracy system, one that is shall be made available for the purposes of fine grade checking. (This unit will not be considered an additional unit as it will only be made available for fine grading purposes.) High accuracy systems may include, but are not limited to, Laser Tied GPS and **Ultimate Total Station machine guidance**.
GNSS Special Provision (cont.)

(a) Digital Terrain Models
- DTM(s) representing the existing ground in DGN format.
- DTM(s) representing the design surfaces in DGN format.
  (Include boundaries of the design, e.g. EP to EP or slope line to slope line)
- DTM(s) representing the existing ground in LandXML format.
- DTM(s) representing the design surfaces in LandXML format.
  (Include boundaries of the design, e.g. EP to EP or slope line to slope line)
- Automated Machine Grading (AMG) Surface Model.

(b) Alignment Data Files
- Geometry files containing horizontal and vertical geometry in DGN format.
- Geometry files containing horizontal and vertical geometry in LandXML format.

(c) Other Files
- MicroStation® cross section design files (DGN & DXF formats).
- MicroStation® ROW design file (DGN & DXF formats).
- MicroStation® existing ground features (DGN & DXF formats).
State of Practice - Strengths

• Collaborative GNSS Specification
  – Ongoing educational outreach effort
• Highway Design has institutionalized 3D models in their roadway designs
• Contractors using electronic data provided to reduce their work effort and cost!
Implementation Team

- Highway Design
- Survey
- NH AGC
- Construction
State of Practice - Developments

- Working to standardize the use of Rovers and Data Collection equipment within the Bureau of Construction
- Working with Survey to establish a CORS network in NH
  - Currently all surrounding states have a CORS network
  - Would eliminate the use of the Contactor’s Base Station
  - We have recently received Executive Office support to begin the process
Workshop Objectives

• State of Practice of 3D models, rovers, data collectors and CORS network by lead states
• Guidance documents on standardizing use of rovers and data collectors by field inspectors
• Training requirements to fully implement Digital Inspection
• Organizational changes to fully implement Digital Inspection
Paradigm Shift: Paper to Digital

Paper plans becoming less “useful”
Digital model becoming the final design product

The Future of Transportation!!!
History at VTrans

- Limited
- Approximately 5 years
- Approximately 20 projects
- No Design Models built
Contract language

• Paper takes precedence

• 2 Items
  – Global Positioning System Machine Control Grading
  – GNSS Construction Inspection Equipment
Items

- Global Positioning System Machine Control Grading
  - Model Created by Contractor after award
  - Inspectors provided a rover
  - Bid Price range $17,000 - $68,000
Items

- GNSS Construction Inspection Equipment
  - Base Station, Rover, and Repeater if needed
  - Training provided to field staff
  - Bid Price about $30,000
Next Steps for Design

• Survey
• Model built in design and used in bidding
• Contract Modifications
• Information Transfer and Format
Next Steps for Construction

• More than checking grade
  – Quantities
• Sub-Contractors
• Fabrication submission and review
• Real time Record Plans
• Asset Management
• Records Retention
Scott Bickford  
Assistant Program Manager

Shawn Smith  
Senior PM  
Interstate

Brian Luce  
Senior PM  
Pavement Design/Quality

Denis Lovely  
Senior PM  
LCP/Pugmill

Mike Lenko  
Senior Tech

Assistant Tech  
Jeanne Kannegieser

Derek Nener-Plante  
CE III  
State Pavement Engineer

Karen Gross  
AE  
Pavement Design/Quality

Barry Breton  
Senior Tech

State Project  
Construction Superintendents

George Morrell, Reg 1
Tim Pelotte, Reg 2
Scott Cook, Reg 3
Jared Stanley, Reg 4
Roger Barnes, Reg 5

Summer Assignment

PM 1  
Region 1  
Ryan Hodgman

PM 1  
Region 1  
John McDonough

PM 1  
Region 2  
Tom Stevens

PM 1  
Region 3  
Mark Shibles

PM 1  
Region 4  
Jeramy Parker

PM 1  
Region 5  
Ryan Sullivan

Maine DOT Highway Program
**Ron Taylor is currently on alternate assignment as the Resident Engineer on the Sarah Mildred Long Bridge replacement project.**
Construction Layout
Enter 3D Modeling
34 alignments
Efficiency
Material Quantities
Material Quantities
Fine Grading
Future for us

• 3D design enhancements – 3D model as bid package

• Integration of satellite images to put a real life look on the design

• Enhanced estimation of quantities

• Field use of model becoming more mainstream

• Field use for quantification of unsuitable materials (i.e. ledge, undercuts)

• Asset documentation through electronic as-builts