ODOT Project Manager Training

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Survey Issues

- **Pre-construction survey**
- **Utility Relocation Survey**
- ***O.G. before or after grubbing***
- **Pre-construction Meeting**
- **Checking contractors**
- ***Verifying DTM Volumes***
- **Miscellaneous Topics**

Pre-construction Survey

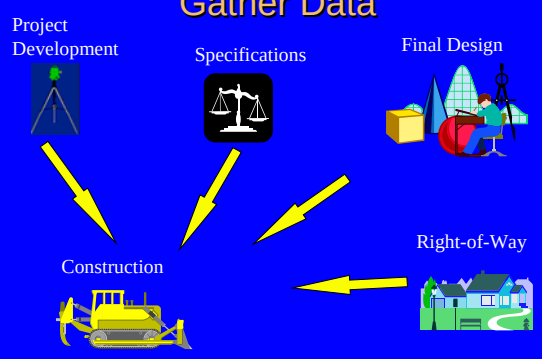
Purpose

Confirm preparation for construction

Timing

At or near bid letting

Gather Data



Pre-construction Survey
A) Gather Design Data

1) Control Data - Horizontal and Vertical
2) Original Ground DTM
3) Project Plans - Hard Copy and Digital
4) Specifications
5) Alignments - Horizontal and Vertical
6) New Roadway DTM
7) R/W Data – Maps, descriptions, obligations

Pre-construction Survey
B) Field Work

1) Check Project Development Survey Data
   a) Network Cross Ties
   b) Vertical Ties
   c) DTM Confidence Points
   d) Document Check Results

Confidence Points

Errors Associated with DTMs

- Instrument setup on wrong point
- Backsight observation to wrong point
- Incorrect instrument height
- Incorrect target height
- Incorrect coding of collected data
- Malfunctioning Theodolite and/or EDM
- Measurements placed improperly

Confidence Points

- Random Points Measured in the Field to Verify the Accuracy of a Digital Terrain Model
- To Provide Evidence Just Prior to Construction that the DTM is a Reasonable Representation of the Original Ground for Computation of Volumes and Pay Quantities

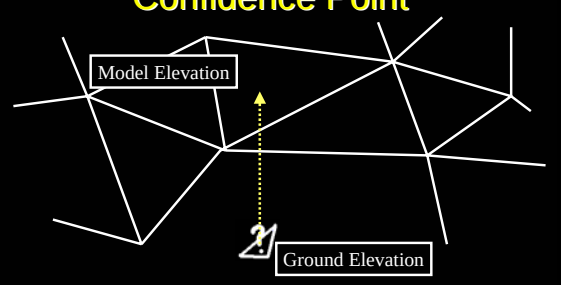
Confidence Points (Field Procedures)

- Use Total Station for Data Collection
- Verify Instrument Location
  - Backsight Check
  - Elevation check
- Measure At Least 10 Points Per Setup
- Attach Appropriate Confidence Point Type Feature to Measurement
- Collect Raw Observation Data

Confidence Points (Office Procedures)

- Reduce Raw Observation Data
- Do Not Include Confidence Points in DTM Computation
- Examine DTM Elevation at Confidence Point (N,E) Position
- Compare Field Elevation to DTM Elevation
- Perform Statistical Analysis

Confidence Point



Confidence Point Types

- **Surfaced** - Hard Surfaces (A.C. or Concrete Pavement, Bridge Decks, and Walks)
- **Graded** - Graded and Possibly Compacted Surfaces but Not Intended to be the Traveled Way
- **Natural** - Surfaces in Their Natural State
- **Rugged** - Extremely Irregular Surfaces (Large Rock Outcroppings, Rocky River Bottoms, etc..)

Error Tolerances

Type	Imperial	Metric
Surfaced	+/- 0.1 ft	+/- 30 mm
Graded	+/- 0.3 ft	+/- 100 mm
Natural	+/- 0.6 ft	+/- 200 mm
Rugged	+/- 1.5 ft	+/- 500 mm

Number Needed

- Minimum of 10 per DTM data collection instrument setup

Or

- 2% of the total number of Contourable Points used to create the DTM

Placement

- Must represent all surface types contained in the DTM
- Proportioned according to the percentage of the various types of surfaces depicted by the DTM
- Must provide a good sampling of the overall model
- Must be placed randomly

Confidence Point Standards

- Two-Thirds of all errors must fall within the Error Tolerances
- 100% of all errors must fall within three times the Error Tolerances

Confidence Point Analysis

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CONFIDENCE POINT EVALUATION - Metric (meters)

Type              Total Pts   Valid   Pass   Fail   Fail-3X   %Pass   %Fail-3X
----------------  ---------   -----   ----   ----   -------   -----   --------
SURFACED -CONF_S      116       116    111      5        0     95.7       0.0
GRADED   -CONF_G      289       289    204     68        7     70.6       5.9
NATURAL  -CONF_N      412       408    408      0        0    100.0       0.0
RUGGED   -CONF_R       56        37     25     12        3     67.6       8.1


CONFIDENCE POINT LISTING

SURFACED -CONF_S  ( tolerance = +/- 0.030 )

 #          ID             X Coord     Y Coord     Elev   DTM-Elev  Delta  Pass/Fail
---- ---------------- ----------- ----------- -------- -------- ------- ---------
   1 200419            147573.744  408103.199  43.502   43.471   0.030 Pass
   2 200420            147577.634  408093.822  43.355   43.487   0.132 Fail
   3 200421            147571.501  408085.680  43.599   43.644   0.045 Pass
   4 200422            147562.146  408075.870  45.078   45.013   0.066 Pass
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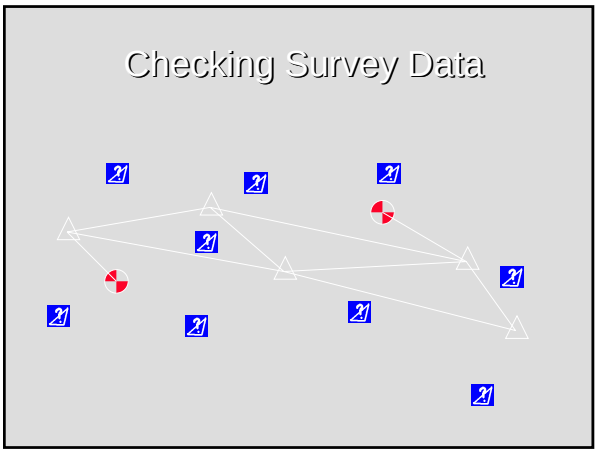

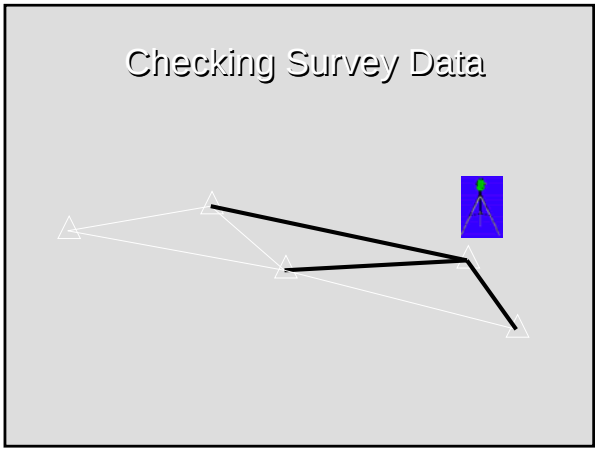

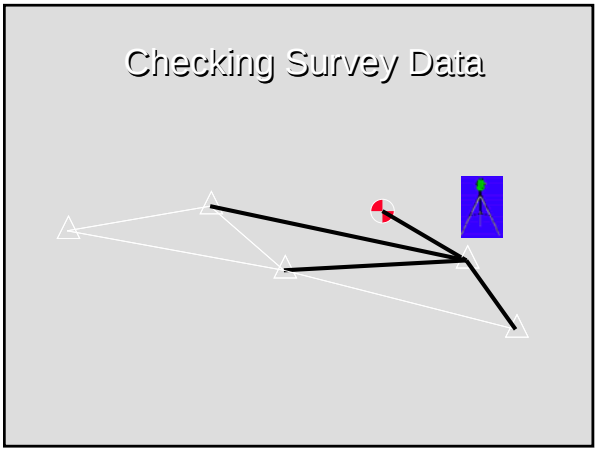

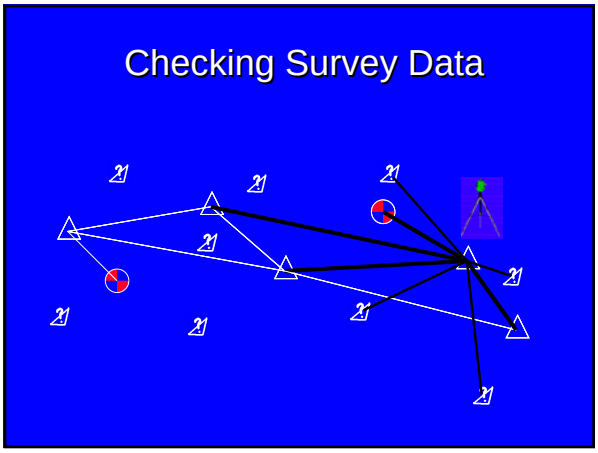

Pre-construction survey

B) Field Work

Document

Results

Utility Relocation Survey

- Not required by SP305
- Very difficult to bid
- May need done prior to bid letting
- ODOT responsibility

O.G. before or after grubbing
Areas of conflict

- Standard Specification (330.82)
- Use of Location DTM for pay quantities

O.G. before or after grubbing
Options

1) Cross section the project
2) Ignore location DTM – build a new DTM
3) Modify the contract by special provision
4) Write a change order

Pre-construction Survey Meeting

- Mandatory
- 2 weeks before any survey work begins
- Participants
  - Contractor's Survey Personnel, PM, Inspector, ODOT Survey Crew Chief
- Purpose

Pre-construction Survey Meeting
Suggested topics

1)Personnel Qualifications (SP305.10)

00305.10 Personnel - Provide technically qualified personnel capable of performing required tasks in a timely and accurate manner. Perform work under the direction and review of a professional land surveyor registered in the state of Oregon.

The survey crew leader is responsible for:

- becoming familiar with the plans and specifications.
- determining notes and documentation required for types of survey work.
- determining the accuracy required for each survey stake.
- using appropriate equipment and methods.
- keeping close communication with the project inspector(s), Project Manager, and ODOT survey crews working on the project.
- being familiar with the varying construction survey requirements of post-tensioned, precast, cast-in-place, timber and steel structures, for bridge work and other applicable work involving structural concrete.
- Notifying project inspector of conflicts and/or changes necessary due to utilities, etc.

Pre-construction Survey Meeting
Suggested topics

2) Control points

a) Values

b) Descriptions

Pre-construction Survey Meeting
Suggested topics

3) Delivery of data
   a) Lead time
   b) Format (SP305.77)
   c) Level of detail (FG, SG, Profile –vs- grade sheet, etc)

Checking Contract Surveyors

- Construction Stakes
- Grading courses - Confidence Points
- "Staking Tolerances"

Staking Tolerances

ITEMS	HORIZONTAL	VERTICAL
Box Culverts	+/- 30 mm	+/- 15 mm
Bridge Substructures	+/- 10 mm	+/- 10 mm
Bridge Superstructures	+/- 5 mm	+/- 5 mm
Clearing and Grubbing Stakes	+/- 300 mm	n/a
Construction Centerline Control Points	+/- 15 mm	+/- 10 mm
Construction Centerline Station Points	+/- 30 mm	+/- 15 mm
Curbs, Walks, and Bikepaths	+/- 10 mm	+/- 5 mm
Grade Stakes - Roadway Subgrade	+/- 50 mm	+/- 15 mm
Grade Stakes - Top of Rock	+/- 50 mm	+/- 10 mm
Grade Stakes - Roadway Finish	+/- 30 mm	+/- 5 mm
Manholes, Inlets, and Culverts	+/- 30 mm	+/- 10 mm
PCC Pavement	+/- 30 mm	+/- 5 mm
Slope Stakes and References	+/- 100 mm	+/- 30 mm
Traffic Markings	+/- 50 mm	n/a
Walls - Retaining, MSE, Sound, etc.	+/- 30 mm	+/- 15 mm
Wetland Mitigation Control Stakes	+/- 50 mm	+/- 50 mm
Luminaire and Signal Poles (incl. ftgs.)	+/- 50 mm	+/- 10 mm

Staking Tolerances

- SP305
  15 mm for Subgrade
  10 mm for Rock Grades
- 330.70
  0.02 m for Subgrade
  641.45
  15 mm Rock Grades
- Superseded by Special Provisions

Verifying DTM Volumes

- Requires validating 2 DTMs
- Requires validating software computation

Verifying DTM Volumes

A) Requires validating 2 DTMs
   1) Confidence point Process
      a) Confidence points
      b) Backsight checks
      c) Elevation Checks
   2) Cross Sections
   3) Random Profile

Verifying DTM Volumes

B) Requires validating software computation

1) Sweep test

2) Spot checks – difficult to do