Best Practice: Earthwork Volume Calculations

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Best Practice: Earthwork Volume Calculations
Dirt, Rock, Concrete, and Asphalt

- “It’s in the Civil DNA”, we quantify everything.
- Critical to Decision Making
  - Optioneering to Final Design
  - Dictates Cost
Volume Methods

- Analyze Volume Tools
  - Terrain Model to Terrain Model
  - Terrain Model to Plane
  - Terrain Model to Volume

- Component Quantities
  - Dynamic Sections

- Element Component Quantities

- MicroStation Element Information
  - ECX Attribution and Imodels

- Create Cut & Fill Volumes

- Cross Sectional
  - End Area Volumes
Volumes Methods

- How is it Calculated?
- What is Calculated?
- When can it be Calculated?
- What outputs can I get?
- Uses and Examples
Analyze Volume Tools

- Analyze Volume Tools
  - Terrain Model to Terrain Model
  - Terrain Model to Plane
  - Terrain Model to Volume
- Shrink and Swell Factors
- Save Results Output to CAD
- Definable Boundary to Limit Extent
- Prismoidal Calculation
Analyze Volume Tools - Terrain to Terrain
Uses

- Stockpiles
- Strip Mining
- Basin & Detention Pond Volumes
- Basis Earthwork
- Staged Earthwork
- Used Anytime…
Analyze Volume Tools - Terrain to Plane
Corridor Component Quantities

• Component Quantities
  ▪ Corridors & Linear Template Objects

• Provides Volumes & Areas
  ▪ Volumes for Closed Components
    – Asphalt/Concrete/Curb
  ▪ Areas for Non-Closed Components
    – Uses Seeding/Top Soil

• Unit Cost to Enable Quick Estimate

• EAV Results based off Template Drop Interval & Design Stage

  ***Does not take account of Clipping****
Closed vs. Open Components
Component Quantities Uses

- Quick Estimate
  Line & Grade Submissions
- Conceptual to Preliminary Design
- Overlay Alternatives
- Design Tool
Element Component Quantities

- Summation All components in Objects Selected

- Objects Supported
  - Corridors
  - Linear Templates
  - Surface Template
  - Civil Cells

- Provides Volumes & Areas
  - Volumes for Closed Components
    - Asphalt/Concrete/Curb
  - Areas for Non-Closed Components
    - Uses Seeding/Top Soil

- Unit Cost to Enable Quick Estimate
Element Component Quantities

- Prismoidal Approach
  - Values are coming from the 3D Model
  - More Accurate than EAV approach
  - MicroStation Element Info

- Accounts for Clipping
Element Component Quantities
Element Component Quantities Uses

- Quick Estimate of Components
- Conceptual to Final Design
- Does not include Earthwork Cut & Fill
- Excellent for Quantity Take-Off

**Work in Conjunction with Earthwork tools**
MicroStation Element Information

- Core MicroStation…available to all.
  - Drafter to Construction
- Volume & Area for Closed Component
- Area for Open Components
- MicroStation Volume Tool
  - Selection Set is Support
- Component Healing with Clipping
Volumes and Area Values carries to i-model

***Through ODBC Drivers to Export to Excel, Access, and more....
MicroStation Element Information Uses

- Values Persisted to all Stakeholders
- Conceptual to Final Design
- Excellent for Quantity Take-Off
- BIM
MicroStation Volume of Component Element
Create Cut & Fill Volumes

- Ability to Create Closed 3D meshes of Cut and Fill

- Prismoidal Approach
  - Formulates Between Terrain Models
  - Creates and Symbolizes different Elements for Cut & Fill
Track Cut and Fill with Ballast Elements
Ballast Cut and Fill Element Volumes
Ballast Cut and Fill Element Volumes
Create Cut & Fill Volumes Uses

- Values Persisted to all Stakeholders
  MicroStation Element
- Conceptual to Final Design
- Excellent for 3D Quantity Take-Off of Earthwork
- Construction & Sequencing
- 4D and 5D Simulation
- Earthwork is now included into BIM
Cross Sectional

- **End Area Volumes**
  - The “Old” but Accepted Method
  - Verify Calculation on Paper

- **Equation**

\[ V = \frac{A_1 + A_2}{2} L \]

Where:
- \( V \) = Volume
- \( A_1 \) = Cross section area of first side
- \( A_2 \) = Cross section area of second side
- \( L \) = Length between the two areas

- **Required Cross Sections**
  - Published/Submission

- **Accuracy Dependent on Cross Section Frequency**
End Area Volumes

- Unsuitable Materials by Station
- Classifications
- Compaction/Expansion by Station
- Volume Exceptions
- Added Quantities
- Forced Balance
- Mass Haul Diagram
Cross Sectional Uses

- Standard & Accepted Delivery Method
- Road/Rail/Mining
- Conceptual to Final Design
  Needed only for Submissions

Future Gold Standard will be?
Thank you for your time
Have a great conference