Cross Sections and End Area Volumes

SUPPLEMENT TO INROADS SURVEY

Supplemental Lab Cross Sections and Volumes

Objectives

Upon completion:

• You will be able to create cross sections showing the multiple surfaces and to calculate end-area volumes between as-designed and as-constructed surfaces.

Getting Started

- **1** Start InRoads
 - On the MicroStation Manager dialog,
 - Set the **Project** to *KYTC Roadway*
 - Navigate to *c*:*ztrain*
 - Select the MicroStation design file *kytc_3D.dgn* and choose **OK**

MicroStation starts and opens the design file, then InRoads starts as normal.

2 Open your project data files

- Select File > Open
- Set the Files of type to InRoads Files
- Open
 - Civil_V8i.xin
 - WBMtnPrkway.alg (the geometry project)
 - Constructed Surface.dtm (the surveyed asconstructed surface)
 - Proposed Berm.dtm (the as-designed surface)
 - SurveyMound.dtm (the surveyed existing ground)

Review the data

- **3** Display a perimeter
 - Turn off **Style** lock



- Select Surface > View Surface > Perimeter
- Set the Surface to *SurveyMound*
- Select Apply

| new Perimeter | r | |
|-------------------|---------------|-------------|
| Surface: SurveyMo | und 🔽 | Apply |
| | | Close |
| | | Preferences |
| Symbology: | | Help |
| Object | Name | |
| Perimeter | Exterior Boun | dary 📃 |

The outer limit of the surface triangles is displayed in the design file



• Close the Perimeter dialog

4 View triangles

- Select Surface > View Surface > Triangles
- Select Apply

| 🖌 View Triangles 🛛 🔀 | | | | | | |
|----------------------|-------------|---|-------------|--|--|--|
| Surface: | SurveyMound | ~ | Apply | | | |
| Fence Mode: | Ignore | ~ | Close | | | |
| Colored Model | | | Preferences | | | |
| 📃 Mesh | | | Help | | | |
| Symbology: | | | | | | |
| Object | Name | | | | | |
| Triangles | | | | | | |



• Review the triangles, then use MicroStation to **Delete** them

The display of the triangles is a graphic group. If Graphic Group lock is on, they are deleted as one.

5 View contours

- Select Surface > View Surface > Contours
- Choose **Preferences** and Load *EX Contours*
- Select Apply

| | View Contours | | | |
|---|-------------------|---|--------------|------|
| | Main Advanced | Labels | | |
| | Surface: | SurveyMound 🗸 | Help | |
| | Fence Mode: | Ignore 🗸 | | |
| | Interval: | 2.00 | | |
| | Minors per Major: | 4 | | |
| | Symbology: | | | |
| | Object | Name EX Contours (Ma | ain) BYL | |
| | Major Contours | EX Contours (Int EX Contours (Int EX Contours (M) | termediatBYL | |
| | Major Labels | Default | BYL | |
| | Major Depressio | n Co n Co | | |
| | | | | |
| | | | 21222 | |
| | Apply | | Llose | |
| | | | | oden |
| | | | - 1140 | |
| • | Review the con | tours | | |
| • | Close the Cont | ours dialog | | |

• Use MicroStation to **Delete** the contours

6

Displaying surface coordinates

There are several ways to plot the coordinates and elevations of the surface points. This is one way to label coordinates in your design file.

6 Write surface coordinate information into the design file using the Tracking command.

- Select Tools > Tracking > Tracking
- Choose Activate
- Move the cursor around inside the perimeter

| 🚟 Tracking | | |
|----------------|----------------|----------|
| Northing: | N 3801217.38 | Activate |
| Easting: | E 5548835.78 | Settings |
| Latitude: | | Close |
| Longitude: | | |
| Elevation: | Elev 1151.7671 | Help |
| Slope: | Slp 19.73% | |
| Aspect: | A 107^06'07'' | |
| Station: | Sta 2+32.7984 | |
| Offset: | -122.5015 | |
| Dual Dimension | : (37.34) | |

Notice that the information in the Tracking dialog box updates as the cursor moves across the screen.

- Close the **Tracking** dialog
- Review any of the other surfaces as desired

Creating Cross Sections

- **7** Create cross sections showing the existing surface, designed surface and as constructed surface
 - Right-click on the WBLeftLane alignment in the Explorer as shown and choose View



This is the alignment you are about to use for cutting sections.

 Choose File > Project Options and Load the 10 Scale preference

| 🖀 Project Options 📃 🗖 🔀 | | | | | | | |
|--------------------------|--------------------|----|-------------|----------|----------------|--|--|
| Precision | Genera | əl | Units an | d Format | Geometry | | |
| Tolerances | Factors | Ab | breviations | Rail | Sight Distance | | |
| Text Scale F | Text Scale Factor: | | | | Help | | |
| Cell Scale Fa | Cell Scale Factor: | | 10.0000 | | | | |
| Line Style Scale Factor: | | 10 | 10.0000 | | | | |

Apply and Close

- Choose Evaluation > Cross Section > Create Cross Section
- Choose Preferences and load 10 Scale SXS
- Set the **Interval** to **25**
- Set the Left offset to -250
- Set the **Right offset** to **50**
- Toggle on all three surfaces as shown

| Cross Sections | | | | | |
|----------------|--|---|--|------------------|------|
| File | Mode: Refresh () Start: 0+00.00 Set Name: Create: Interval: Left Offset: Right Offset: Vertical Exaggeration: Show Data Outside Surfaces: Dipicct Default | Display On Display Stop: 3+65.41 WBLeftLane Vindow and Data V 25.00 -250.00 50.00 1.00 Elevation Range Name Default | ay Off | ч. | |
| | ea Volumes ☐ Default ⊠ Proposed Berm ⊠ SurveyMound ⊠ Constructed Surfa | PR Template EX Ground Line I ce EX Ground Line I | B' Elev. B' Elev. B' Properties | YL YL None | |
| | | Apply | Preference | ces Close | Help |

In the **Tree** structure, choose *Include*

| Create Cross Section | | |
|--|--|--|
| Create Cross Section General Source Controls Custom Layout Axes Grid Details ASCII or LandXML | Surface Crossing Features Adjust Range Projected Features Ahead Band: 10.00 Back Band: 10.00 Components Annotation Volumes Mass Haul Diagram | |
| | Storm and Sanitary Crossing Structures Projected Structures Ahead Band: 10.00 Back Band: 10.00 | |

Notice options that you can include.

Crossing Features displays feature that actually cross the line 'cut' by the cross section. Their display is controlled by the feature style associated with the individual features. You can use **Update Cross Sections** to display feature individually.

Projected Features allows you to show features on a cross section that fall within a band-width of the cross section, rather than only those that the section actually crosses. This is useful for projecting both breaklines and random points to the sections, such as trees or structures.

Components allow you to display the components from the template in the cross section, in addition to the ground surface. Remember, the only proposed ground surface you have is the finished grade, so you will need components to show the subgrades and for computing volumes. There will be duplicate lines, since the ground surface is also made up of components that will be displayed. If you do not want to show all components, you can leave this option off and turn on individual components with the Update Cross Sections command or make sure the components you do not want to show on the sections use feature styles that do not have the cross section option toggled on. Notice the other include options. Annotation will annotate the ground surfaces (not the features), and Volumes will compute and annotate end areas. Both of these can also be accomplished later with the Cross Section Annotation and End Area Volume commands respectively.

- Leave all of the options toggled **off** for now
- Using the tree structure, look at the other options in the **Cross Section** dialog
- Apply and identify (<D>) a clear area in your design file.

When you select a location with the $\langle D \rangle$, you are giving it the lower left corner of the first section.

• Close the Create Cross Sections dialog

8 Review the cross sections

 Use Evaluation > Cross Section > Cross Section Viewer to review the sections



Notice on the sections that two of the surfaces appear with the same symbology. You'll change the assigned symbology and update the sections to reflect the change.

(Here the grid lines have been turned off to better see the surfaces.)

9 Assign a symbology and update the sections

The Update option allows you to re-display surfaces or features without re-creating the sections. Here, you'll use it to re-display a surface with different symbology.

 Choose Surface > Surface Properties and set Surface to Constructed Surface

| Main Advance | ed | | | | | | |
|----------------|-----------------------|-----------------------|---------------|--------|----------|---------|--------|
| Surface: | Constructe | d Surface 😽 | | | | | Report |
| Name: | Constructe | d Surface | | | | | Help |
| Description: | As Built Su | rface | | | | _ | |
| Maximum Lengtł | n: 0.00 | | | | | | |
| Preference: | PR Feature | e 🗸 | | | | | |
| Туре: | Existing | ~ | -Data Totals- | Active | Features | Deleted | Total |
| 🔲 Use Extende | d Data Check: | S | Random: | 33 | 1 | 143 | 176 |
| 📃 Lock Triangu | lation | | Breakline: | 760 | 14 | 3699 | 4459 |
| Data Range- | |) | Contour: | 0 | 0 | 0 | 0 |
| Point Type: | Total | ~ | Inferred: | 0 | | 0 | 0 |
| Northing: | Minimum 3801068.04 | Maximum 3801360.64 | Interior: | 0 | 0 | 0 | 0 |
| Easting: | 5548517.62 | 5548977.84 | Exterior: | 0 | 0 | 0 | 0 |
| Elevation: | 1109.77 | 1139.02 | All Points: | 793 | 33 | 3842 | 4635 |
| | | | Triangles: | 1430 | | 52 | 1482 |

• Set the **Type** to **Design**

| Туре: | Existing | * |
|-----------------|----------------------|--------|
| Use Extended [| Existing Design | |
| Lock Triangulat | Substratum Ignore | Design |
| Point Type: | Total | * |

In order to later calculate volumes between two surfaces, one must be set to Existing and another to Design. • On the **Advanced** tab under the **Profiles** section, set the symbology to *MISC InRoads*

| H | Surfa | ce Prope | erties | | | | | |
|---|-----------|------------|--------------------|----------|--------|----------|--------------|---------|
| M | 1ain 🛛 | Advanced | | | | | | |
| | Surfac | e: Cor | structed Surface 🗸 | | | | | |
| | - Cross | Sections- | | | | | | |
| | Symbo | ology: MIS | iC InRoads | | ~ | 📃 Use F | eatures Only | Help |
| ļ | | | | | | | | |
| | - Profile | s | | | | | | |
| | Symbo | Def | ault | | * | Lock S | symbologies | |
| | Offset | Distance | Symbology | Color | Offset | Distance | Symbology | y Color |
| | 1. | 0.00 | Default | × | Э. | 0.00 | Default | |
| | 2: | 0.00 | Default | * | 10: | 0.00 | Default | ✓ |
| | 3: | 0.00 | Default | ~ | 11: | 0.00 | Default | ✓ |
| | 4: | 0.00 | Default | ~ | 12: | 0.00 | Default | ✓ |
| | 5: | 0.00 | Default | × | 13: | 0.00 | Default | ¥ |
| | 6: | 0.00 | Default | ~ | 14: | 0.00 | Default | × |
| | 7: | 0.00 | Default | ~ | 15: | 0.00 | Default | ¥ |
| | 8: | 0.00 | Default | ~ | 16: | 0.00 | Default | × |
| Ľ | | | | | | | | |
| | | | | Apply | | ise | | |
| | | | | | | | | |

• Apply, then Close the Surface Properties box

The Constructed Surface ground line will now display on the Cross Sections using this Named Symbology.

- Set the **Surface** to *Proposed Berm*
- On the Main tab, set the Type to *Existing*

| Main Advanced | 1 | | | | | | |
|---------------------|----------------------|---------------------------------------|---------------|--------|----------|---------|----------------|
| <u>S</u> urface: | Proposed | Berm 🔽 | | | | | <u>R</u> eport |
| <u>N</u> ame: | Proposed 8 | 3erm | | | | | <u>H</u> elp |
| Description: | Proposed 8 | Berm | | | | | |
| Maximum Length: | 0.00 | | | | | | |
| Preference: | EX Ground | i 🗸 | | | | | |
| Туре: | Existing | · · · · · · · · · · · · · · · · · · · | -Data Lotals- | Active | Features | Deleted | Total |
| Use Extended | Data Check | s | Random: | 33 | 1 | 149 | 182 |
| Lock Triangula | ation | | Breakline: | 235 | 13 | 267 | 502 |
| Data Range | | | Contour: | 0 | 0 | 0 | 0 |
| <u>P</u> oint Type: | Total | * | Inferred: | 0 | | 0 | 0 |
| Northing: 3 | Minimum 801068.04 | Maximum 3801360.64 | Interior: | 0 | 0 | 0 | 0 |
| Easting: 5 | 548517.62 | 5548977.84 | Exterior: | 0 | 0 | 0 | 0 |
| Elevation: | 1109.77 | 1139.02 | All Points: | 268 | 16 | 416 | 684 |
| | | | Triangles: | 376 | | 52 | 428 |

• Apply, then Close the Surface Properties box

- Choose Evaluation > Cross Section > Update Cross Sections
- Toggle the **Cross Section Set** to the last one you created

| K Cross Sections | | |
|--|---|------|
| File | | |
| Cross Section Set: WBLettLane Create Cross Section Annotate Cross Section General Surfaces Components Crossing Features Projected Features Storm and Sanitary Tend-Area Volumes | Mode: Refresh Display On Display Off Start: 0+00 Stop: 3+65 Surface: Name Description Proposed Berm SurveyMound Existing Ground from Survey Constructed Surface As Built Surface Image Surface Image Surface | |
| | Apply Preferences Close | Help |

- In the Tree structure at left, highlight **Surfaces** under *Update Cross Section*
- Set the Mode to Refresh
- In the **Surface** area, highlight *Proposed Berm and Constructed Surface*
- Choose Apply
- Close the Update Cross Sections dialog



The sections now show the surfaces in different symbologies and one is known as the Design and one the Existing.

End Area Volumes

- **11** Calculate end area volumes for the new set of cross section
 - Choose Evaluation > Volume > End Area Volume
 - Set the **Cross Section Set** to the complete set of sections where you displayed the components
 - Select the *General* branch of the tree structure
 - Toggle on both the Proposed Berm and the Constructed Surface surfaces
 - Toggle on Create XML Report



Choose Apply

The volumes are calculated, the cross sections annotated and the **Report Browser** appears with the default report format (style sheet).

Note: If this is the first time a report is created on your machine, you may be asked to select a style sheet first.

| Program Files\Bentley\InRoads Group V8.11\VML Data\en\ | | Baseline | | ×. | Cut | ά÷γ¥e; | XX | - Fill | .×× | | Cut | |
|--|---|----------|--------|------|-------------|----------|-------------|--------|----------|--------|----------|---------------------|
| Evaluation | ^ | Station | Factor | Area | Volume | Adjusted | Factor Area | Volume | Adjusted | Factor | Volume A | djusted |
| AverageCrossSlopeArea.xsl | _ | 0+00.00 | 1.00 | 0.00 | 0.0 | 0.0 | 1.00 17.73 | 0.0 | 0.0 | 1.00 | 0.0 | 0.0 |
| BasicEndAreaVolumeBalanceStation.xsl | | 0+25.00 | 1.00 | 0.00 | 0.0 | 0.0 | 1.00 24.39 | 19.5 | 19.5 | 1.00 | 0.0 | 0.0 |
| An BasicVolume.xsl | | 0+50.00 | 1.00 | 0.00 | ×0.0 | 0.0 | 1.00 33.16 | 26.6 | 26.6 | 1.00 | 0.0 | ×0.0 |
| Ag LiossSection xsl | | 0+75.00 | 1.00 | 0.00 | 0.0 | 0.0 | 1.00 62 46 | 44.3 | 44.3 | 1.00 | 0.0 | 0.0 |
| At CrossSectionASCIIInputFormat.xsl | | 1+00.00 | 1 00 | 0.00 | 0.0 | 0.0 | 1.00 39.89 | 47.4 | 47.4 | 1.00 | 0.0 | ×0.0 |
| CrossSectionASCIIInputFormatFeature.xsl | _ | 1+25.00 | 1.00 | 0.00 | 0.0 | | 1.00 51.64 | 42.4 | 42.4 | 1.00 | 0.0 | 0.0 |
| CrossSectionASCIIInputFormatWithPencodes.xsl | | 1+50.00 | 1.00 | 0.00 | × | < X. | 1 00 46 34 | 45.4 | × 45 4 | 1.00 | × | × |
| CrossSectionDesignSurfaceFeatures.xsl | | 1475.00 | 1.00 | 0.00 | | A | 1 00 75 76 | 66.6 | 66.6 | 1.00 | 0.0 | |
| Ag CrossSectionGradebook.xsl | | 1475.00 | 1.00 | 0.00 | ~ | < | 1.00 75.76 | 00.0 | × 00.0 | 1.00 | × | ~ |
| A) CrossSectionGradebook/A/de vil | | 2+00.00 | 1.00 | 0.00 | 0.0 | 0.0 | 1.00 65.58 | 65.4 | 65.4 | 1.00 | | 0.0 |
| All CrossSectionReinte vel | | 2+25.00 | 1.00 | 0.00 | 0.0 | 0.0 | 1.00 77.32 | 66.2 | 66.2 | 1.00 | 0.0 | 0.0 |
| All CrossSectionPointal int yal | | 2+50.00 | 1.00 | 0.00 | 0.0 | 0.0 | 1.00 65.82 | 66.3 | 66.3 | > 1.00 | 0.0 | 0.0 |
| A CrossSectorProfiel.ist.sd | | 2+75.00 | 1.00 | 0.00 | 0.0 | 0.0 | 1.00 70.69 | 63.2 | 63.2 | 1.00 | 0.0 | 0.0 |
| A CrossSectionSlopeStakeListing xsl | | 3+00.00 | 1.00 | 0.00 | 0.0 | 0.0 | 1.00 64 03 | 62.4 | 62.4 | 1.00 | 0.0 | 0.0 |
| | | | | | ~ <u>**</u> | ~ ** | | | | A | | |

• Choose the style sheet *Volumes.xsl*

| Toop Feb | a factoria a fatally de tas | 2. Alla | | | | | | کار |
|---|--|---------------|---------------------------|------------------------------|---------------------------|--------------------------|-------|--------|
| Program Files/Bentkey/Infloeds Group V8.11VOHL Datatem/ A) Ensities extended Quartiles and A) Ensities advanced Quartiles and A) Enders Advanced State Files and | 0+25.00 Normal Cut: Normal Fill: Added Cut Added Fill: | 0.00 24.39 | 0.0 19.5 0.0 0.0 | 1.00 1.00 1.00 1.00 | 0.0 19.5 0.0 0.0 | Yes Yes Yes Yes | -19.5 | Â X |
| Alg MulpetMaterial/clumes.nl Alg Tringfol/clumes.nl Tringfol/clumes/unif/hapes.nl Alg Tringfol/clumes/unif/hapes.nl Alg Valamest I Valamest VIP antiful Acces.nl Valamest VIP antiful Acces.nl Valamest VIP antiful Acces.nl Alg Valamest VIP antiful Acces.nl Alg Valamest VIP antiful Acces.nl Valamest VIP antiful Acces.nl Alg Valamest VIP acces.nl Alg Valamest VIP antiful Acces.nl Alg Valamest VIP antiful Acces.nl Alg Valamest VIP acces.nl Alg VIP acces.nl Alg Valamest VIP acce | 0+50.00 Normal Cut: Normal Fill: Added Cut: | 0.00 33.16 | 0.0 26.6 0.0 | 1.00 1.00 1.00 | 0.0 26.6 0.0 | Yes Yes Yes Yes | -46.1 | |
| i ucenneny ji ISS j Insget Intersectorg/AgmentStations j LogAddt, LogAddescription julyRoBitAnufacturing | 0+75.00 Normal Cut: Normal Fill: | 0.00 62.46 | 0.0 44.3 0.0 | 1.00 | 0.0 44.3 0.0 | Yes | -90.4 | |

Notice the station by station volumes listed in either report.

- Experiment with any other formats you would like.
- Close the Report Browser
- Close the Volumes dialog

You do not need to save the parameters file.

12 Exit MicroStation and InRoads or move on to the Challenge

Challenge

13 Annotate the Cross Sections as shown in class.