The CEDRA Corporation's

COMMAND OF THE MONTH

A monthly information bulletin April 2007

FEATURED COMMAND

Plotting Cross-Section Data Tables

Application Description

In last month's issue we discussed the process of defining a horizontal alignment. As stated in that issue, a horizontal alignment could be used to extract cross-sections and a profile from:

(a) contour strings (polyline features with an elevation attribute),
(b) 3D polygons or
(c) a TIN dataset as created with the 3D Analyst®.

The information comprising the cross-sections and profile are stored in Cross-Section Data Tables and Profile Data Tables, respectively. These tables are simple dBase files which contain pertinent information describing the cross-sections and profile. The question becomes how does one visualize the contents of these tables.

The December 2005 issue of Command of the Month discussed the process of plotting a Profile Data Table so as to visualize its contents. This month's issue of Command of the Month discusses the process of visualizing a Cross-Section Data Table.

The CEDRA Solution

To address the application of visualizing a Cross-Section Data Table, the CEDRA-AVland™ software offers the CEDRA-AVland-CrossSections toolbar, see Figure 1. This toolbar is available only for ArcGIS® users. Specifically, the [Plot Cross Sections] menu item within this toolbar is the command which we will be discussing.

> ***Command Of The Month bulletin***
>
> *This month's issue discusses the process of plotting one or more cross-section data tables.*

Plot Cross Sections - Overview

The basic concept behind the operation of the [Plot Cross Sections] command is that the user identifies a Cross-Section Data Table for processing and specifies certain information as to how the features, which are to be created representing the cross-sections, are to appear.

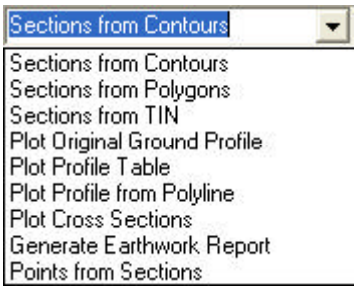

Figure 1
CEDRA-AVland-CrossSections Toolbar

Up to ten Cross-Section Data Tables can be superimposed. That is to say, more than one Cross-Section Data Table can be processed during a single session of the [Plot Cross Sections] command.

The features which are created, representing the cross-sections, are stored in a personal geodatabase whose name follows the algX.mdb convention. The character X denotes the current active horizontal alignment ID.

Within the algX.mdb geodatabase will be two datasets called xsc_Xln and xsc_Xtx, where X denotes the current active horizontal alignment ID. The ln and tx extensions to the dataset names

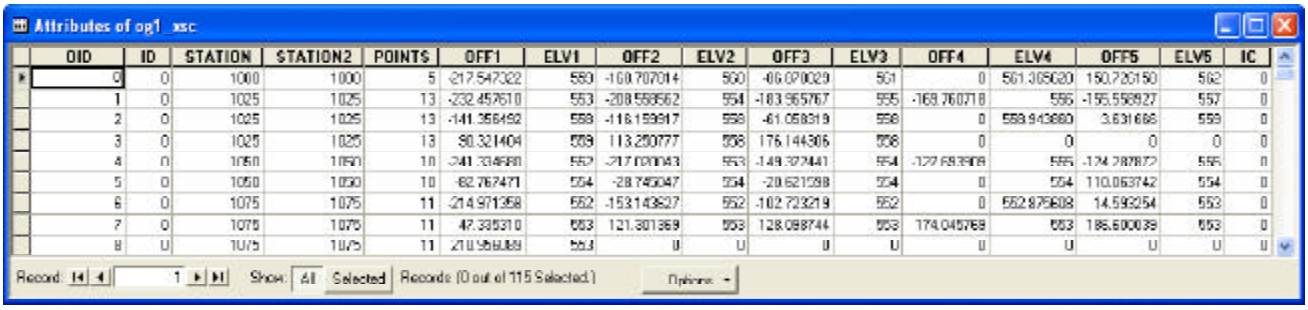

Figure 2 - Sample Cross-Section Data Table

The CEDRA Corporation™
Total CADD for Engineers™
Bridging Engineering and GIS™

151 Sully's Trail - Suite 6
Pittsford, New York 14534
Phone: 585-232-6998
Fax: 585-262-2042
E-mail: cedra@cedra.com
URL: http://www.cedra.com

denote where the line and annotation features reside, respectively.

The Cross-Section Data Table

Shown in Figure 2 is a sample Cross-Section Data Table. A cross-section is comprised of two or more shots. A shot is defined in terms of an offset and an elevation.

Within the cross-section data table, the field STATION will contain the station value of the cross-section. Note that the + character does not appear in the station value, so that a station of 10+00 would appear as 1000. This field contains Double type values.

The field POINTS contains the number of shots that comprise a cross-section. This field contains Long type values.

A cross-section will be comprised of one or more records with a maximum number of 5 shots per record. In addition, a shot is stored under the OFFx and ELVx fields, where x is a value between 1 and 5. These fields contain Double type values.

As an example, if a cross-section is comprised of 10 shots, two records would appear in the Cross-Section Data Table for that cross-section. If a cross-section is comprised of 11 shots, three records would appear in the Cross-Section Data table with the last four shots on the third record containing values of zero.

Note that shots are stored in the table with the left-most shot (OFF1, ELV1), on the first record for a cross-section, followed by the remaining shots in an offset ascending order (left-most to right-most). A cross-section is generated by connecting the shots in the sequential offset order in which they appear in the table.

Although there are commands within CEDRA-AVland that will create a Cross-Section Data Table, such as the [Sections from Contours] command, this table could be created using any other means. The important point to remember is that the fields, which are shown in Figure 2 with the exception of ID, STATION2 and IC, must be present in the table. The fields ID, STATION2 and IC are not used by the [Plot Cross Sections] command at this point of time.

Plotting One Cross-Section Data Table

Presented below is the operational process that the [Plot Cross Sections] command follows in producing cross-section drawings for a single Cross-Section Data Table. The process assumes the existence of one or more Cross-Section Data Tables within the ArcMap document.

A. Locating the Cross-Section Data Tables

In plotting cross-sections, the Cross-Section Data Table(s) to be processed can reside in:

(a) The current active data frame (the one in which the line and annotation features to be generated by the [Plot Cross Sections] command are to appear), or
(b) In another data frame.

The reason for allowing the Cross-Section Data Table(s) to reside in a data frame other than the current active data frame is best illustrated by the [Sections from Contours] command which can be used to develop the Cross-Section Data Table. When the [Sections from Contours] command is used to create a Cross-Section Data Table, the user is in a data frame that is in world coordinate units, such as state plane coordinates. However, the cross-section drawing generated by the [Plot Cross Sections] command is typically drawn in a drawing sheet coordinate system of inches (millimeters).

If the user were to use the [Plot Cross Sections] command in the same data frame where the [Sections from Contours] command was executed the user would have the cross-sections, which are in a drawing sheet coordinate system, in the same data frame as the world coordinate model. As a result there would be two different coordinate systems residing in the same data frame, which is totally permissible, if this is desired by the user.

However, for simplicity and clarity, it is recommended that one data frame be used to view the world coordinate model and another to display the cross-sections. Where the Cross-Section Data Table resides depends on how the Cross-Section Data Table was created and/or which data frame it was added to.

So that, in the case where the cross-sections are to be stored in a separate data frame, the user should:

1. Create a data frame that will contain the new cross-section drawing with the {Insert} [Data Frame] command.

2. Set the Map and Distance units of this new data frame to be inches (millimeters) using the {View} [Data Frame Properties...] command.

3. Select the [Horizontal Alignment ID] command to set the current active horizontal alignment ID. This value is used to control where the features, which are created representing the cross-sections, are to be stored. The [Horizontal Alignment ID] command resides in the CEDRA-AVland-HAlignmentMenus toolbar.

4. Select the [Change Text Properties] command to set the Text Size property. This value is used to control the size of the annotation which represents the cross-section datum and station values, as well as, the offsets and scale annotation which appear at the bottom of a cross-section drawing sheet. This command appears in the CEDRA-AVcad-Menus toolbar.

5. Select the [Plot Cross Sections] command.

Upon activation of the [Plot Cross Sections] command, the command will search the current active data frame for any and all Cross-Section Data Tables that may reside within it. If any such tables are found, the program will continue as indicated in Section B below.

If no Cross-Section Data Tables are found in the current active data frame, the command will prompt the user, see Figure 3, to select the data frame within which the desired Cross-Section Data Table(s) reside.

6. Select the name of the appropriate data frame from the choice list, shown in Figure 3, click at the:

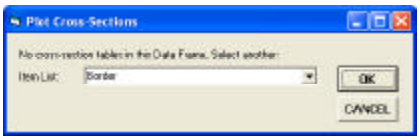

Figure 3
Data Frame Specification

- *Cancel* button to terminate the command, or the
- *OK* button to continue with the processing.

B. Specifying the Cross-Section Drawing Sheet Parameters

Once the command determines which data frame contains the Cross-Section Data Tables which are available for processing, the dialog box of Figure 4(a) appears enabling the user to identify the cross-section drawing parameters.

Figure 4(a)
Cross-Section Sheet Specification

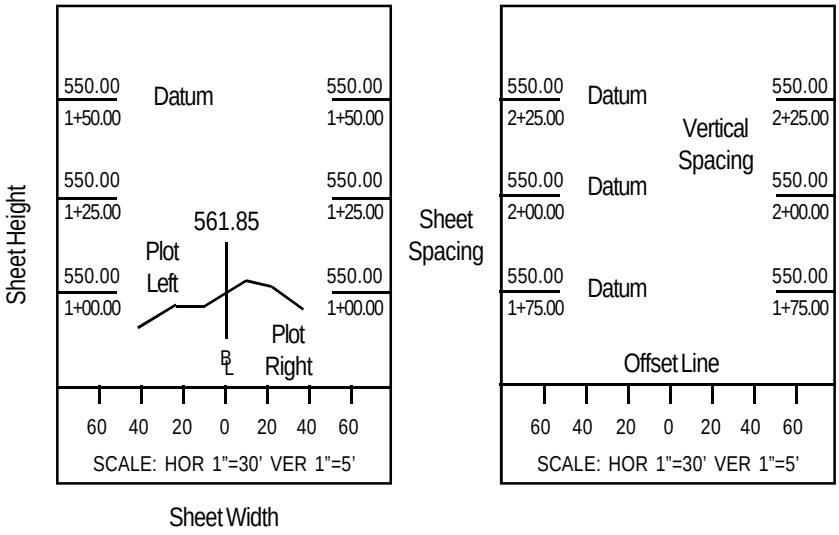

Figure 4(b) - Cross-Section Sheet Parameters

In plotting cross-sections, the command will create individual drawing sheets and place as many as possible within each drawing sheet the cross-sections.

Shown in Figure 4(b) are two typical cross-section drawing sheets identifying some of the parameters which are prompted for in Figure 4(a).

7. Enter the desired values for each of the parameters, shown in Figure 4(a), click at the:

- *Cancel* button to terminate the command, or the
- *OK* button to continue with the processing.

Beginning at the top of the dialog box, the user is able to control the following:

Data Line 1 - Beginning Station

The starting station value that should be processed. All cross-section station values within the cross-section data table that are greater than or equal to this value will be processed up to the ending station value. In Figure 4(b), the value for this parameter is 100.

Data Line 2 - Ending Station

The ending station value. In Figure 4(b), this value is 225.

Data Line 3 - Distance to Plot LEFT

The maximum offset to the left of the centerline that is to be processed. This value can exceed the maximum left offset within the Cross-Section Data Table. If the cross-section offset left of the centerline exceeds the value entered in this parameter, the command will interpolate an elevation at the offset specified in this data field and terminate the cross-section at this offset.

Data Line 4 - Distance to Plot RIGHT

The maximum offset to the right of the centerline that is to be processed. This value can exceed the maximum right offset within the Cross-Section Data Table. If the cross-section offset right of the centerline exceeds the value entered in this parameter, the command will interpolate an elevation at the offset specified in this data field and terminate the cross-section at this offset.

Data Line 5 - Sheet Width

The overall sheet width.

Data Line 6 - Sheet Height

The overall sheet height.

Data Line 7 - Top Margin

The space reserved at the top of a drawing sheet between the last cross-section's datum and the top of the drawing sheet. Note that this value must be greater than or equal to zero.

Data Line 8 - Bottom Margin

The space reserved at the bottom of a drawing sheet. This value is used to determine the distance between the first cross-section's datum and the bottom of the drawing sheet. The position of the first datum on a cross-section drawing sheet is computed by adding the bottom margin value and the vertical spacing value (data line 10 parameter). Note that this value must be greater than or equal to zero.

Data Line 9 - Horizontal Sheet Spacing

The space between the cross-section drawing sheets.

Data Line 10 - Vertical Section Spacing

The spacing between cross-section datums. Note that at a cross-section datum, the elevation of the datum will appear, as well as, the station value of the cross-section.

Data Line 11 - Horizontal Scale

The horizontal scale to be used.

Data Line 12 - Vertical Scale

The vertical scale to be used.

Data Line 13 - Offset Ticks Interval

The offset interval where vertical grid lines or ticks along the offset line, which appears at the bottom of a drawing sheet, are to be placed. Note that the Text Size property within the [Change Text Properties] command controls the size of the annotation which is displayed below the offset line.

Data Line 14 - Plot the Full Grid

Indicates whether or not a grid is to be superimposed upon a cross-section.

C. Identifying the Cross-Section Data Table to Process

Once the drawing sheet parameters have been specified, the command prompts the user to identify the Cross-Section Data Table to be processed.

8. Select the name of the appropriate Cross-Section Data Table from the choice list, shown in Figure 5, click at the:

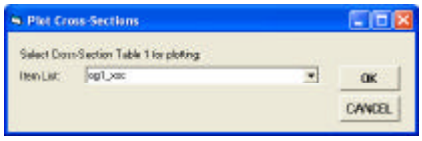

Figure 5
Cross-Section Data Table Specification

- *Cancel* button to terminate the command, or the
- *OK* button to continue with the processing.

D. Specifying the Cross-Section Drawing Attributes

Once the Cross-Section Data Table has been identified, the user is prompted for the attributes to be used when generating the line and/or annotation features representing the cross-sections.

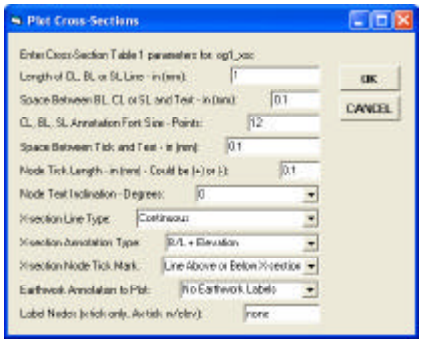

Figure 6
Cross-Section Plotting Specification

9. Enter the desired values for each of the parameters, shown in Figure 6, click at the:

- *Cancel* button to terminate the command, or the
- *OK* button to continue with the processing.

Beginning at the top of the dialog box, the user is able to control the following:

Data Line 1 - Length of CL, BL or SL

The length of the vertical line that represents the centerline, baseline or station line location (0.0 offset).

Data Line 2 - Space Between BL

The spacing between the vertical line that represents the centerline, baseline or station line location and the annotation (CL, BL or SL).

Data Line 3 - CL, BL, SL Font Size

The font size in points of the annotation denoting the centerline, baseline or station line location.

Data Line 4 - Space Between Tick & Text

The spacing between a node tick and its elevation annotation. A node tick refers to a shot within a cross-section.

Data Line 5 - Node Tick Length

The length of the node tick.

Data Line 6 - Node Text Inclination

The text angle for the annotation at a node tick or shot, see Figure 7.

Figure 7
Node Text Inclination Choice List

Data Line 7 - X-section Line Type

The line style to be used for the cross-section data table being processed, see Figure 8.

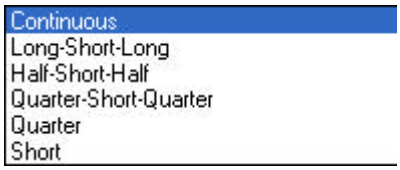

Figure 8
Line Type Choice List

Based upon the line style selected, the line feature attributes (DSL and DSS) will contain the values shown below:

Style	DSL	DSS
Continuous	0.0	0.0
Long-Short-Long	1.0	1.11
Half-Short-Half	0.5	1.11
Quarter-Short	0.25	1.11
Quarter	0.25	0.25
Short	0.1	0.1

Data Line 8 - X-section Annotation Type

The type of annotation to appear below and above the vertical line that represents the centerline, baseline or station line location, see Figure 9.

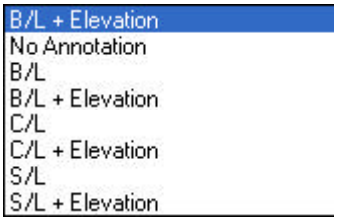

Figure 9
Annotation Type Choice List

Data Line 9 - X-section Node Tick Mark

The position of the node tick, which indicates the location of a shot on the cross-section, see Figure 10.

Figure 10
Node Tick Location Choice List

Data Line 10 - Earthwork Annotation

The type of earthwork annotation to appear on the cross-section, see Figure 11. Note, in order to compute earthwork values at least two cross-section data tables must be processed.

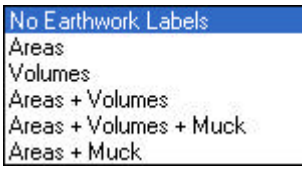

Figure 11
Earthwork Annotation Choice List

Data Line 11 - Label Nodes

The nodes or shots to be marked on a cross-section. If *none* is specified no node ticks or elevation values will appear for the cross-section. If the user wishes to have a node tick displayed, the user enters the desired shot number. For example, if shots 5 and 10 are to have a node tick displayed at their locations, the user should enter *5 10* in this data field. If the user wishes to have the elevation at these shots displayed, in addition to the node tick, the user should enter *A5 A10* in this data field. The character A denotes annotate the elevation at the shot. At least one blank character must separate the shot(s) to be processed.

10. In the case where only one cross-section data table is to be processed. From Figure 12, click at the:

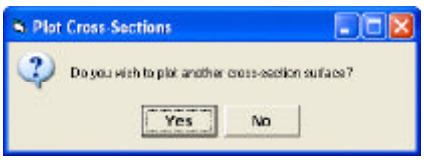

Figure 12
Superimposing a Cross-Section Data Table Query

- *No* button to denote that no other cross-section data tables are to be processed.

At this point, the command will begin processing the cross-section data table. If the command determines that there are existing cross-section features in the data frame. A query similar to the one shown in Figure 13 will appear. As such, click at the:

Figure 13
Replace Existing Cross-Section Features Query

- *Cancel* button to terminate the command, the
- *No* button to add to the existing features, or the
- *Yes* button to delete the existing cross-section features and continue with the processing.

As the command processes the cross-sections in the Cross-Section Data Table, a message in the status bar area will appear indicating the station value of the cross-section that is being processed, as well as, the Ending Station value specified in Step 7. Once all of the stations within the specified station range have been processed, the command will display the cross-section drawing sheets that have been created.

Shown in Figure 14 are two cross-section drawing sheets containing a single Cross-Section Data Table with a full grid superimposed upon the cross-sections. In addition, no node ticks or earthwork were generated and the B/L + Elevation annotation type was selected. Figure 15 contains a "blowup" of two of the cross-sections that were processed.

A dBase table called XSECTIONData will contain the responses given by the user during the operation of this command. So that, when the command is re-invoked, the previous entries made by the user will appear as the default values.

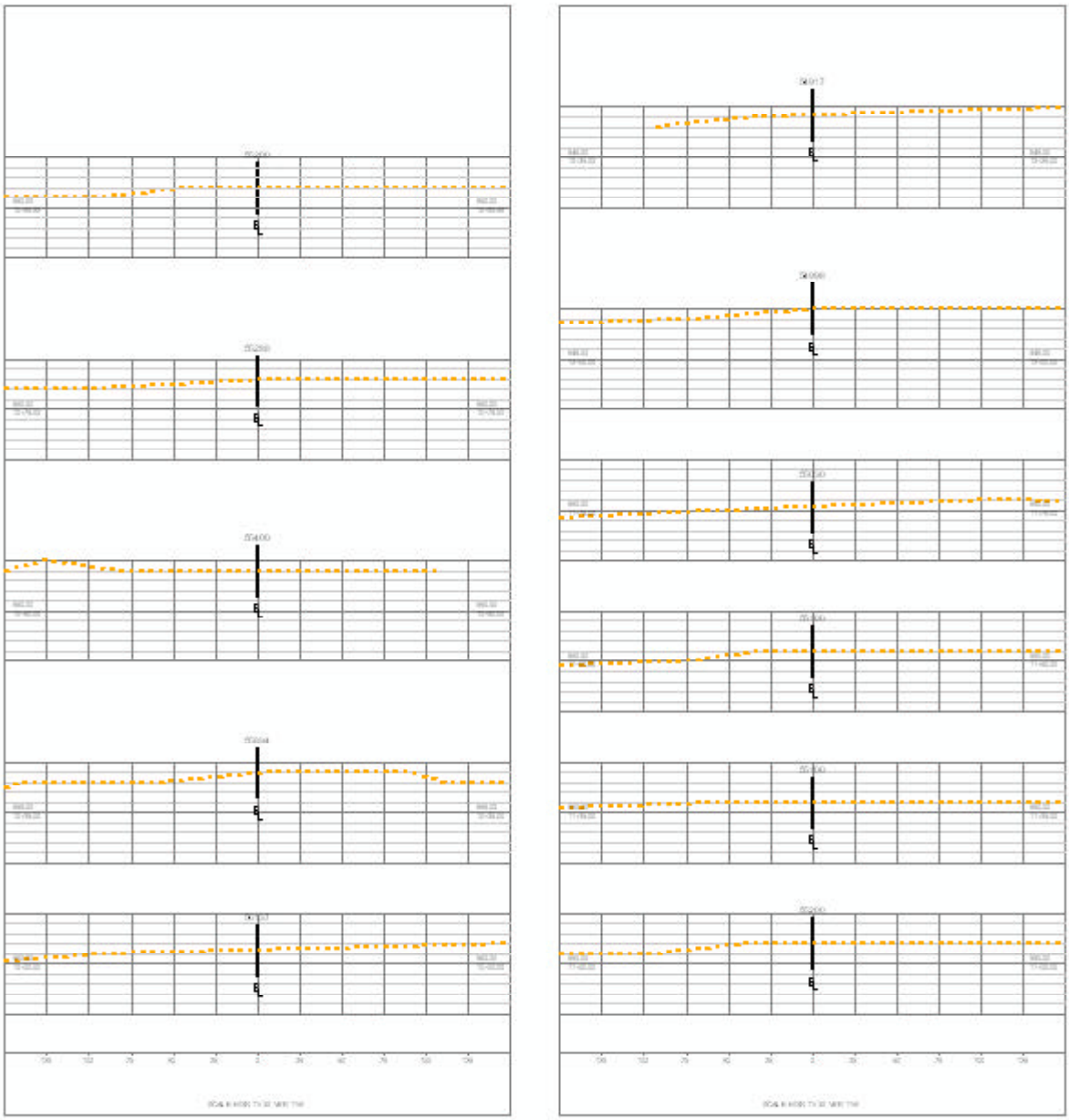

Figure 14 - Two Cross-Section Drawing Sheets generated by plotting One Cross-Section Data Table with a Full Grid

Plotting Multiple Cross-Section Data Tables

In the case where more than one Cross-Section Data Table is to be processed, the user is able to specify for each Cross-Section Data Table its own set of drawing attributes. That is to say, the user can control the "look" of each Cross-Section Data Table as they are superimposed upon each other.

In addition, when more than one Cross-Section Data Table is processed, the user is able compute earthwork quantities and have these values placed upon the cross-section.

Summarizing, when multiple Cross-Section Data Tables are to be processed, the user should click the *Yes* button in Step 10, at which point, Steps 8 and 9 are repeated for the additional Cross-Section Data Table. This sequence repeats until the user selects the *No* button in Step 10, thereby indicating that no other Cross-Section Data Tables are to be processed.

The steps presented below illustrate how two Cross-Section Data Tables can be processed. The first Cross-Section Data Table represents an original ground surface, while the second Cross-Section Data Table that is processed represents a proposed roadway surface. In addition, in these steps it is shown how earthwork quantities can be computed and displayed.

The original ground surface to be processed is the same as that discussed in Steps 1 through 8 previously, so that:

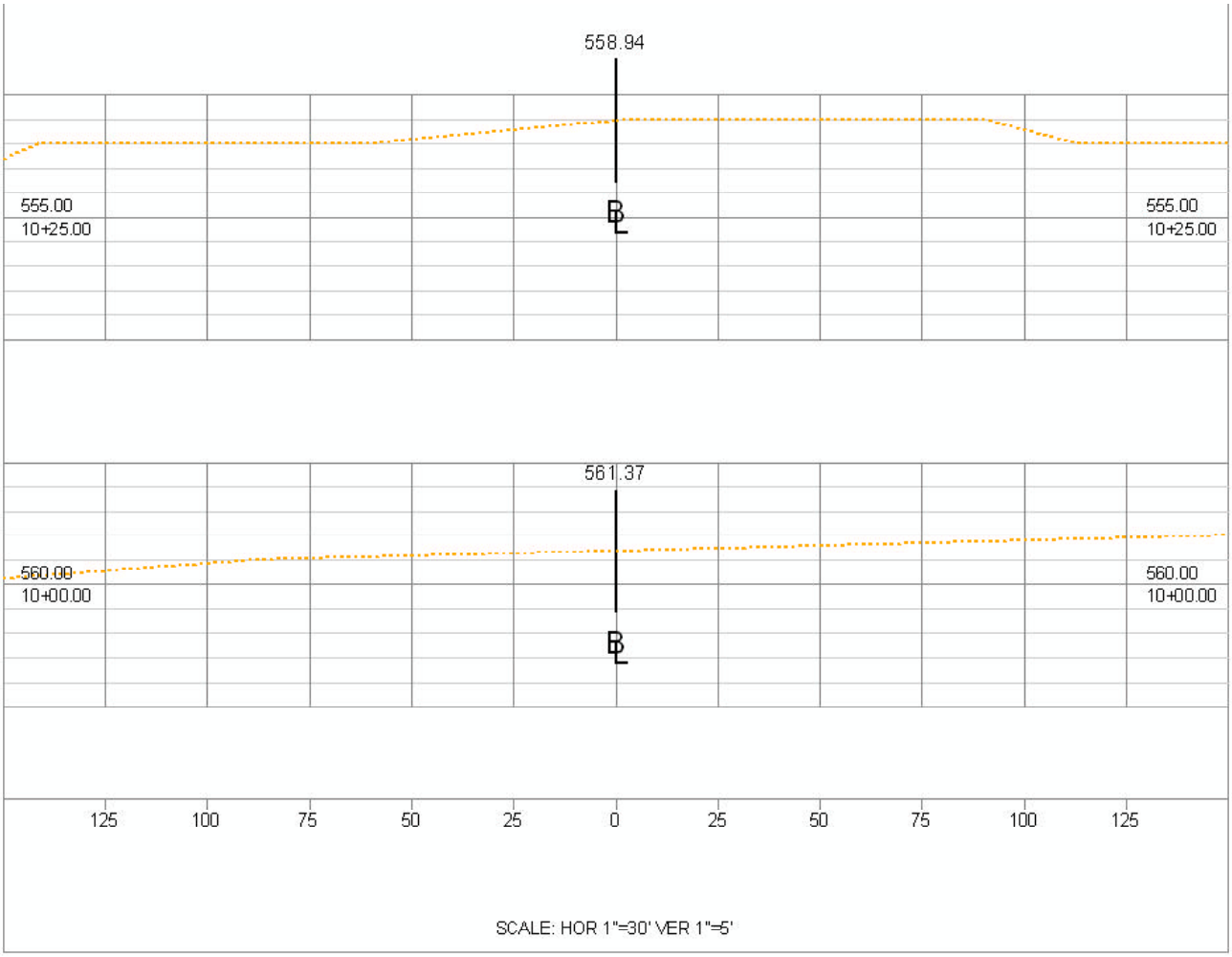

Figure 15 - "Blowup" of Cross-Sections generated by plotting One Cross-Section Data Table with a Full Grid

9. Enter the values for each of the parameters, shown in Figure 16, click at the:

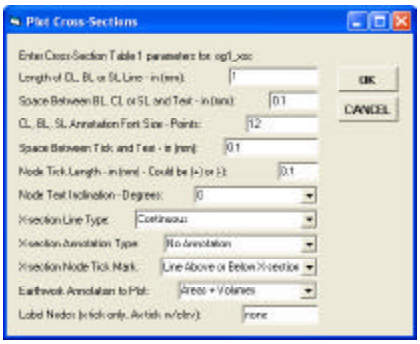

Figure 16
Cross-Section Plotting Specification

- *Cancel* button to terminate the command, or the
- *OK* button to continue with the processing.

From Figure 16 it can be seen that earthwork quantities are desired by the Areas + Volumes response to the *Earth Annotation to Plot* parameter. As such, we are now able to specify the appropriate Shrink, Swell and Much factors that are to be used in the calculations.

10. Enter the appropriate values and from Figure 17, click at the:

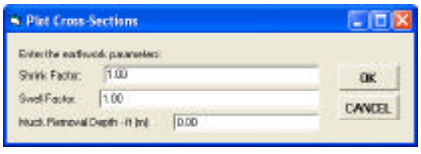

Figure 17
Earthwork Calculation Factors

- *Cancel* button to terminate the command, or the
- *OK* button to continue with the processing.

11. In this case where two cross-section data tables are to be processed. From Figure 18, click at the:

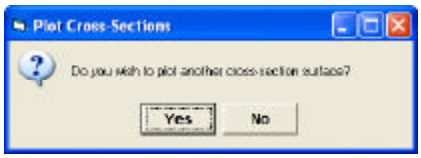

Figure 18
Superimposing a Cross-Section Data Table Query

- *Yes* button to denote that another cross-section data table is to be processed.

It is at this point we will specify the name of the second Cross-Section Data Table to be specified and repeat the process of specifying the cross-section drawing attributes which should be used.

12. Select the name of the appropriate Cross-Section Data Table from the choice list, shown in Figure 19, click at the:

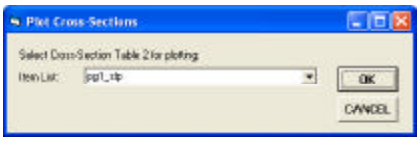

Figure 19
Second Cross-Section Data Table Specification

- *Cancel* button to terminate the command, or the
- *OK* button to continue with the processing.

13. Enter the values for each of the parameters, shown in Figure 20, click at the:

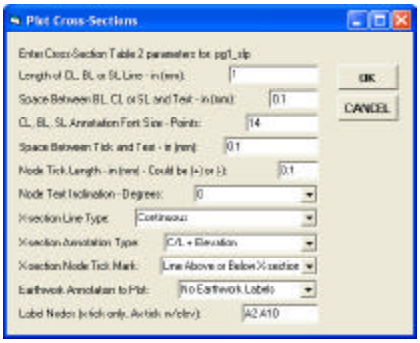

Figure 20
Cross-Section Plotting Specification

- *Cancel* button to terminate the command, or the
- *OK* button to continue with the processing.

14. Since we have specified the attributes for both Cross-Section Data Tables. From Figure 21, click at the:

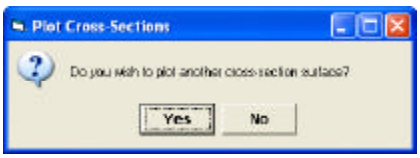

Figure 21
Superimposing a Cross-Section Data Table Query

- *No* button to denote that no other cross-section data tables are to be processed.

At this point, the command will begin processing the cross-section data table. If the command determines that there are existing cross-section features in the data frame. A query similar to the one shown in Figure 22 will appear. As such, click at the:

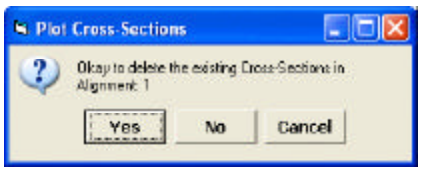

Figure 22
Replace Existing Cross-Section Features Query

- *Cancel* button to terminate the command, the
- *No* button to add to the existing features, or the
- *Yes* button to delete the existing cross-section features and continue with the processing.

As the command processes the cross-sections in the Cross-Section Data Table, a message in the status bar area will appear indicating the station value of the cross-section that is being processed, as well as, the Ending Station value specified in Step 7. Once all of the stations within the specified station range have been processed, the command will display the cross-section drawing sheets that have been created.

Shown in Figure 23 is a "blowup" of one cross-section for both Cross-Section Data Tables that were processed. In reviewing Figure 23 note the following pertaining to the first Cross-Section Data Table processed (identified in Step 8). The dashed orange line represents the first Cross-Section Data table:

a. The No Annotation response to the *X-section Line Type* parameter indicates that no vertical line or annotation should appear at the zero offset. That is, the baseline, centerline or stationline location.

b. The Areas + Volumes response to the *Earth Annotation to Plot* parameter indicates that earthwork quantities are to be generated between this Cross-Section Data Table and the one which is immediately identified (Step 12).

Regarding the second Cross-Section Data table which was processed (identified in Step 12). The solid black line in Figure 23 represents the second Cross-Section Data table.

a. The C/L + Elevation response to the *X-section Line Type* parameter indicates that a vertical line and the CL annotation should appear at the zero offset. That is, the baseline, centerline or stationline location.

b. The A2 A10 response to the *Label Nodes* parameter indicates that for shots 2 and 10 within the cross-section, a tick and the elevation of the shot are to be displayed.

Notes

a. If the result of the following:
(PLEFT+PRIGHT) / HSCL
is less than the Sheet Width value specified in Step 7, the Sheet Width value will be ignored and the result of the equation will be used as the width of the cross-section drawing sheets. Note that:

PLEFT	Distance to plot left of the centerline.
PRIGHT	Distance to plot right of the centerline.
HSCL	Horizontal scale to be used.

b. The [Change Text Properties] command is used to control the size of the annotation. The exception to this is the BL, CL or SL annotation which is controlled by the *CL, BL, SL Font Size* parameter, specified in Step 9, Section D.

c. Regarding the line features which are created, the PEN attribute value will vary depending upon the type of line that is created. As such, the user can use the PEN attribute to

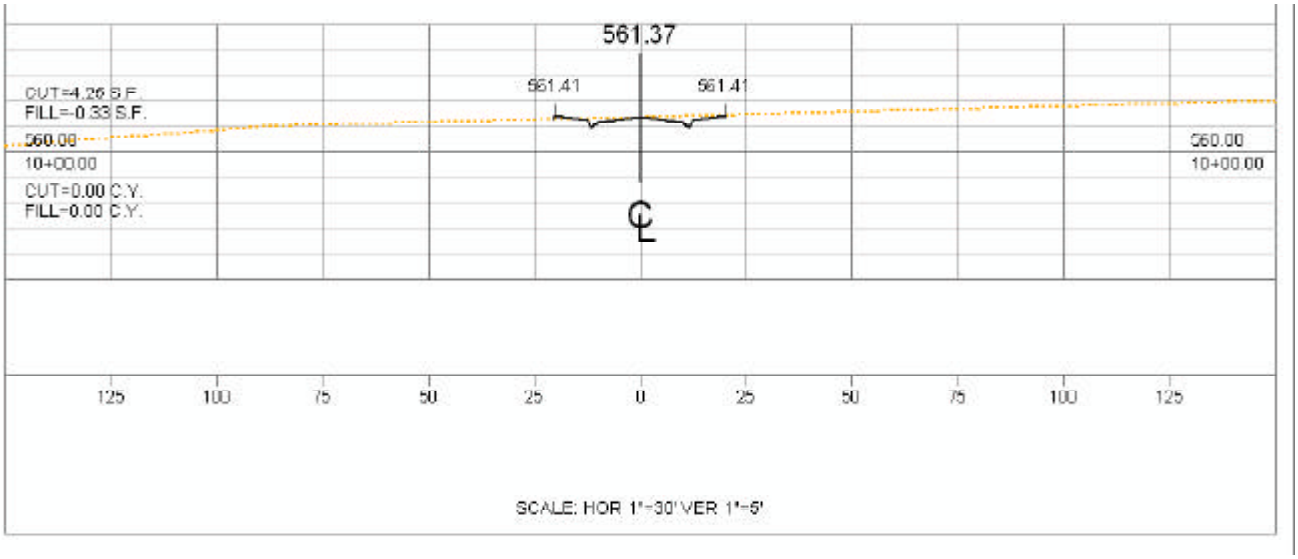

Figure 23 - "Blowup" of a Cross-Section wtih Two Cross-Section Data Tables Superimposed with a Full Grid

classify the line layer according to the PEN value. In so doing, native ArcMap functionality can be used to apply different line styles to the various classified classes. Summarizing, the various PEN values are:

Line Style	PEN
Border	2
Datum Line	2
Offset Line	2
Offset Line Ticks	2
Intermediate Full Grid Lines	1
Heavy Full Grid Lines	2
Cross-Section Data Table 1	3
Cross-Section Data Table 2	4
Cross-Section Data Table 3	5
Cross-Section Data Table 4	6
Cross-Section Data Table 5	7
Cross-Section Data Table 6	8
Cross-Section Data Table 7	9
Cross-Section Data Table 8	10
Cross-Section Data Table 9	11
Cross-Section Data Table 10	12
CL Vertical Line (w/o Full Grid)	2
CL Vertical Line (w Full Grid)	4

Summary

For those users who are involved with subdivision design, roadway design or other types of applications where cross-sections are required, the [Plot Cross Sections] command is an excellent tool for visualizing the cross-sections in a neat and structured format. As always, if there are any requests for additional functionality in plotting or visualizing cross-sections, please feel free to let us know.

If you have a request for Command Of The Month, feel free to phone, fax or e-mail your request to The CEDRA Corporation.