The CEDRA Corporation's

COMMAND OF THE MONTH

A monthly information bulletin December 2005

FEATURED COMMAND
Original Ground Profile Plotting

Application Description

In the November issue of Command of The Month we discussed the methodology of assembling a Plan and Profile (P&P) drawing. This month we back track a little to discuss the task of producing, or plotting an annotated original ground profile, which has been previously defined by: (a) other CEDRA-AVland commands, (b) field survey, or (c) any other means in terms of stations and elevations.

Profile plotting is very similar to generating a graph, which many of us first learned how to do back in grade school. Profile plotting, however, is different from producing a graph in that the scales along the X and Y axes are almost always different, and that the starting point of a profile does not always begin at zero. In addition, profiles are often broken up into several individual profiles, rather than one overall profile. Furthermore, there are various types of profiles with each type of profile containing different information that requires annotation.

As stated at the outset of this bulletin, we will only be discussing in this issue the plotting of an annotated original ground profile, or profile of any other surface. The other types of profiles, such as those of the proposed or design surface, sewer mains, water lines, and other surfaces can also be generated using CEDRA software, and superimposed upon the original ground profile. Future issues of Command of the Month will address the plotting of these types of profiles.

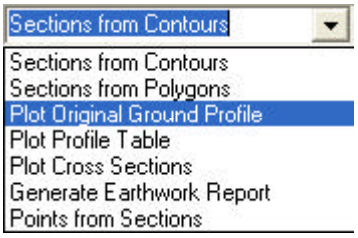

Figure 1
Cross-Section/Profile commands Combo-Box

The CEDRA Solution

The CEDRA-AVland™ software possesses several tools which produce fully annotated profiles. The primary tool that is used to produce a profile is the [Plot Original Ground Profile] command, which can be found in the {Cross-Section/Profile commands} combo-box within the **CEDRA-AVland-CrossSections** toolbar, as shown in Figure 1.

> ***Command Of The Month bulletin***
>
> *This month's issue discusses the methodology of producing, or plotting an annotated original ground profile.*

The [Plot Original Ground Profile] command processes a Profile Data Table to produce not only the lines which represent the profile surface, but also, a fully annotated profile grid.

In addition, the command stores information related to the profile grid, which enables other CEDRA-AVland commands to compute and position station and elevation values that may not lie on and along the ground profile itself.

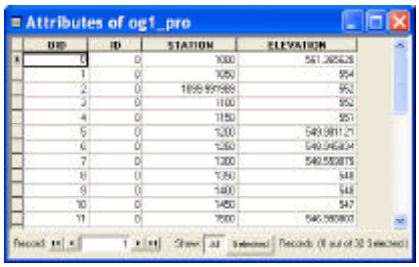

Figure 2
Sample Profile Data Table

The Profile Data Table

The Profile Data Table is a dBase table which may contain as many attributes as the user desires, and which represents a single profile surface. This table must contain two attributes (fields) called STATION and ELEVATION. These two fields, as their names indicate, contain the station and elevation value for a single point on the profile. A point on the profile surface is represented by a single record in the Profile Data Table. There is no limit to the number of points which may appear in a Profile Data Table. The profile surface is generated by connecting the points, in the Profile Data Table, in the sequential order they appear in the table.

Figure 2 illustrates a sample Profile Data Table with the required STATION and ELEVATION fields. Although there are commands within CEDRA-AVland that will produce this type of table, such as the [Sections from Contours] command, this table could be created using any other means. The important point to

The CEDRA Corporation™
65 West Broad Street
Rochester, New York 14614

Total CADD for Engineers™
Bridging Engineering and GIS™
Phone: 585-232-6998
Fax: 585-262-2042
E-mail: cedra@cedra.com
URL: http://www.cedra.com

remember is that the STATION and ELEVATION fields must be present in the table.

Plotting a Profile Data Table

Presented below is the operational process that the [Plot Original Ground Profile] command follows in producing an original ground profile drawing. The process assumes the existence of one or more Profile Data Tables.

A. Locating the Profile Data Tables

In plotting a profile, the Profile Data Table 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 Original Ground Profile] command are to appear), or

(b) In another data frame.

The reason for allowing the profile data table 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 Profile Data Table. When the [Sections from Contours] command is used to create a Profile Data Table, the user is in a data frame that is in world coordinate units, such as state plane coordinates. However, the profile drawing generated by the [Plot Original Ground Profile] command is typically drawn in a drawing sheet coordinate system of inches (millimeters).

If the user were to use the [Plot Original Ground Profile] command in the same data frame where the [Sections from Contours] command was executed, see Figure 1, the user would have the profile, which is 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 profile. Where the Profile Data Table resides depends on how the Profile Data Table was created and/or which data frame it was added to.

So that, in the case where the original ground profile drawing is to be stored in a separate data frame, the user should:

- Create a data frame that will contain the new profile drawing,
- Set the Map and Distance units of this new data frame to be inches (millimeters).
- Select the [Plot Original Ground Profile] command.

Upon activation of the [Plot Original Ground Profile] command, the command will search the current active data frame for any and all Profile Data Tables that may reside within it. If any such tables are found, the program will continue as indicated in the section below. However, if no Profile 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 Profile Data Table resides.

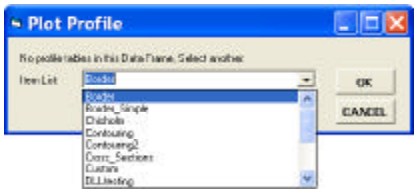

Figure 3
Specify Data Frame Choice List

B. Identifying the Profile Data Table to Process

Once the command determines which data frame contains Profile Data Tables available for processing, the command displays the dialog box of Figure 4 asking the user to identify the specific Profile Data Table to be processed. In this dialog box there are two choice list data

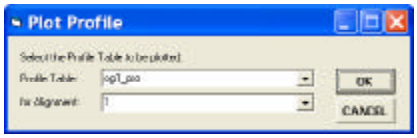

Figure 4
Plot O.G. Profile Initial Dialog Box

fields with scroll down arrows, which operate as follows:

(a) Scrolling down in the first data field will display a list of the available Profile Data Tables followed with the option *Profile Grid only* as shown in Figure 5 (note that in this figure, the list of available Profile Data Tables contains only one table). From this list, the user may select the table of the desired original ground profile to be plotted, or the *Profile Grid only* option.

Figure 5
Profile Grid only option

The *Profile Grid only* option is used when the user wishes to regenerate the profile grid without destroying any other information that may appear on the profile. This provides the user the ability to create the original ground profile, and then go back and modify the profile grid without regenerating the original ground profile.

(b) Scrolling down in the second data field will display a list of the various horizontal alignment ID numbers that have been generated. The user may select from this list the alignment ID to which the desired Profile Data Table corresponds.

Alternatively to scrolling down and selecting the appropriate alignment ID, the user may enter a value directly into the second data field.

Once the user has specified the appropriate information in both data fields,

the *OK* button can be selected to continue with the profile plotting.

C. Specifying the Profile Plotting Parameters

Following the specification of the Profile Data Table to be processed, and its corresponding horizontal alignment ID, the user can specify the desired profile grid and annotation parameters. Figure 6 illustrates the multi-input dialog box that is displayed by the command. In this dialog box there are eleven key entry data fields, and three scroll down choice list data fields (identified below) for specifying the various profile grid parameters that the user can control.

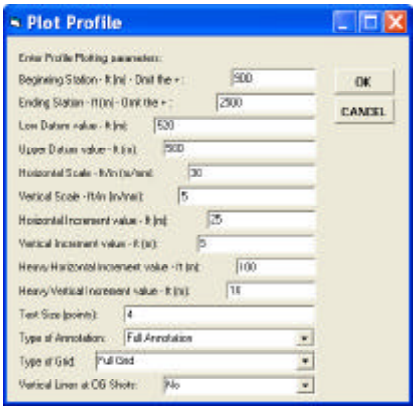

Figure 6
Profile Plotting Parameters

The first four parameters described below pertain to station and elevation values. It is noted that these parameters pertain to the profile grid, and not to the actual profile. Thus these values should be such that they are respectively smaller or larger than the low and high station and elevation values of the actual ground profile, so that the ground profile will fit within the grid, and preferably with sufficient room to place additional information such as notes, or even profiles of other surfaces.

Data Field 1 - Start Station

This field represents the starting station of the profile grid. Note that the + sign is omitted. For example, the station 9+00 would be entered as 900.

Data Field 2 - End Station

This field represents the ending station of the profile grid. Note that the + sign is omitted as was the case with the starting station value.

Data Field 3 - Law Datum

This field contains the low datum value for the profile grid. This value denotes the lowest elevation of the profile grid.

Data Field 4 - Upper Datum

This field contains the high elevation value for the profile grid. This value denotes the highest elevation of the profile grid.

Data Field 5 - Horizontal Scale

This field contains the desired horizontal scale expressed in feet per inch (meter per millimeter).

Data Field 6 - Vertical Scale

This field contains the desired vertical scale expressed in feet per inch (meter per millimeter).

The next four parameters pertain to intermediate and heavy vertical and horizontal intervals and grid lines or tick marks (see Data Field 13 below). A horizontal interval creates vertical lines or tick marks (stations), while a vertical interval creates horizontal lines or tick marks (elevations). The terms intermediate and heavy pertain to the line weight or thickness. Intermediate lines or tick marks are assigned a PEN attribute value of 11, while heavy lines or tick marks are assigned a PEN attribute value of 10. For example, if the horizontal grid interval is 20, and the horizontal heavy interval is 100, the lines or tick marks at stations 10+00, 11+00, 12+00 and so on will be thick, while the in-between stations at +20, +40, +60 and +80 will be thin. A similar analogy may be inferred for the vertical grid interval (elevation) lines or tick marks.

Note that native ArcMap functionality can be used to classify the layer containing the profile grid lines based upon the PEN attribute.

Alternatively to using native ArcMap functionality, the [Update CEDRA Classifications] command within the {CEDRA commands} combo-box on the **CEDRA-AVcad-Menus** toolbar can be used. This command offers many options in classifying a layer, three of which however, will classify a layer based upon the PEN attribute. These options are:

Update Active CEDRA Classifications
Update All CEDRA Classifications
Update Visible CEDRA Classifications

The user simply selects the option that is desired. The differences between the options is only in which layer(s) are processed during the classification.

Data Field 7 - Horizontal Grid Interval

This field contains the horizontal (station) grid interval, also referred to as the intermediate horizontal interval. This value is applied to the start station of Data Field 1 to introduce along the X axis a vertical line or tick mark.

Data Field 8 - Vertical Grid Interval

This field contains the vertical (elevation) grid interval, also referred as the intermediate vertical interval. This value is applied to the low elevation datum of Data Field 3 to introduce along the Y axis a horizontal line or tick mark.

Data Line 9 - Horizontal Heavy Interval

This field contains the interval along the X axis (station) where a heavy grid line or tick is to replace an intermediate line or tick mark. The stations at these lines or ticks are referred to by some as full stations.

Data Line 10 - Vertical Heavy Interval

This field contains the interval along the Y axis (elevation) where a heavy grid

line or tick is to replace an intermediate line or tick mark.

Data Field 11 - Font Size

This field contains the desired text size (in points) for the annotation of the station values, along the X axis, and the elevation values, along the Y axis, on both sides of the profile grid, to be generated by the command.

Data Field 12 - Type of Annotation

This field contains the choice list shown in Figure 7 presenting the types of profile grid annotation that are available. The selection of the option:

Full Annotation annotates the stations and elevations, and displays the horizontal and vertical scales.

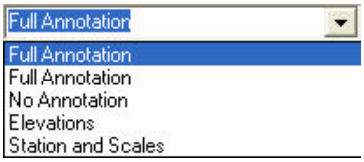

Figure 7
Available Profile Annotation Types

No Annotation does not generate any annotation.

Elevations annotates the elevation values only.

Station and Scales annotates the station values and the horizontal and vertical scales only.

Data Field 13 - Type of Grid

This field contains the choice list of Figure 8 presenting the available profile grid types. Figures 9 through 13 illustrate the various types of profile grids. As can be seen, the user has the ability to create a full grid (Figures 9, 10 and 11) or a grid with ticks marks (Figures 12 and 13). In addition, the user is able to control the manner in which the station values are annotated.

Regarding the position of the horizontal and vertical scales along the bottom of the grid, it is noted that they are always displayed in the center of the grid.

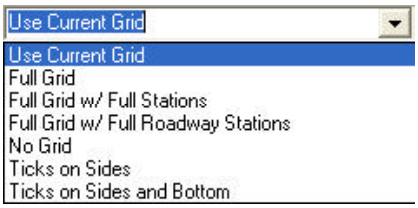

Figure 8
Available Profile Grid Types

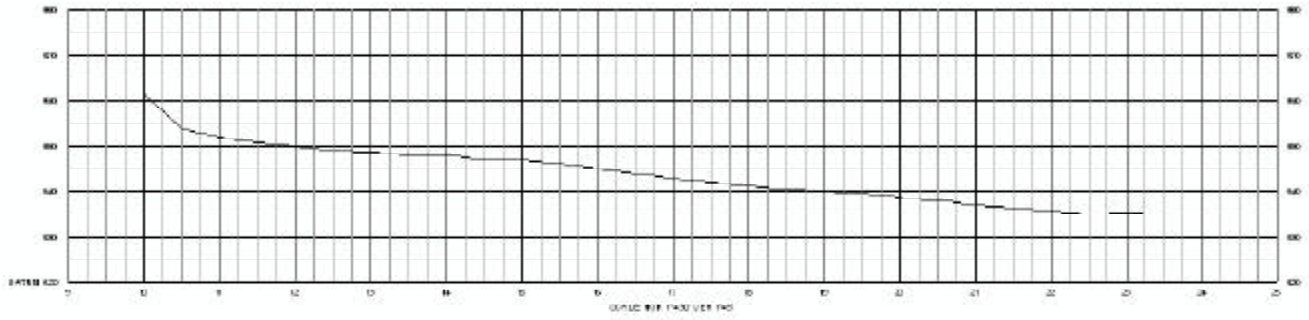

Figure 9 - Profile with the parameter Type of Grid set to Full Grid

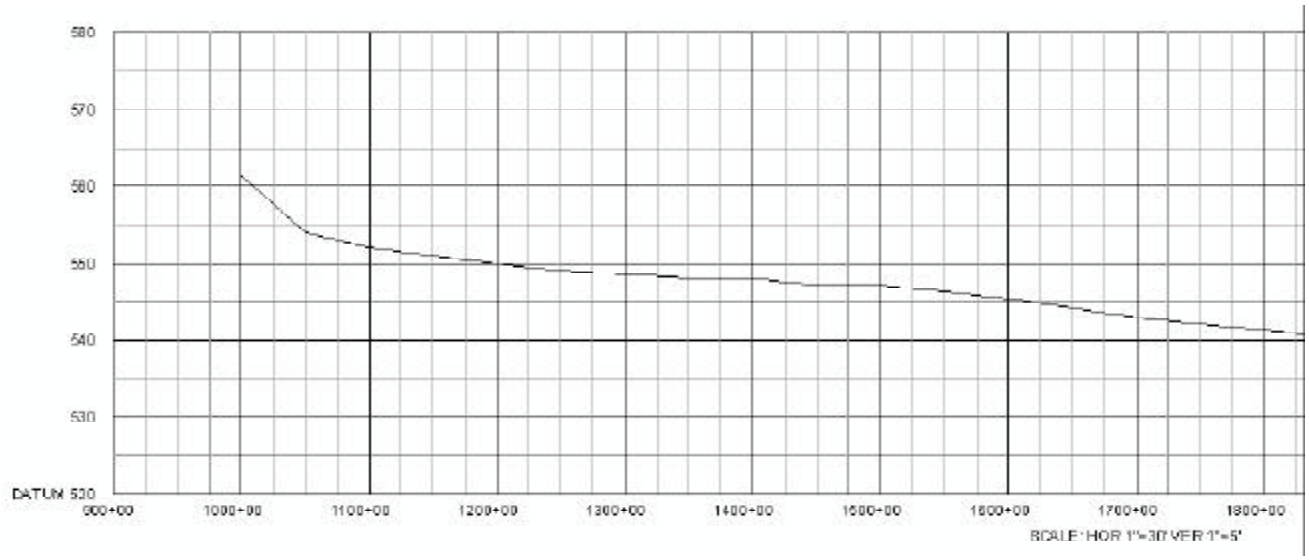

Figure 10 - Profile with the parameter Type of Grid set to Full Grid w/ Full Stations

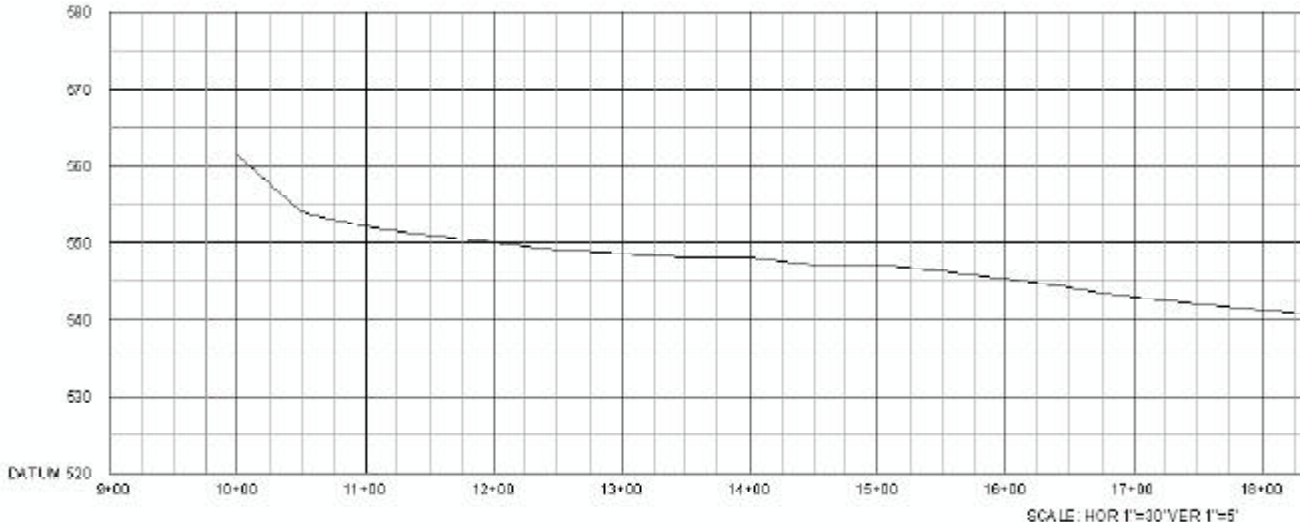

Figure 11 - Profile with the parameter Type of Grid set to Full Grid w/ Full Roadway Stations

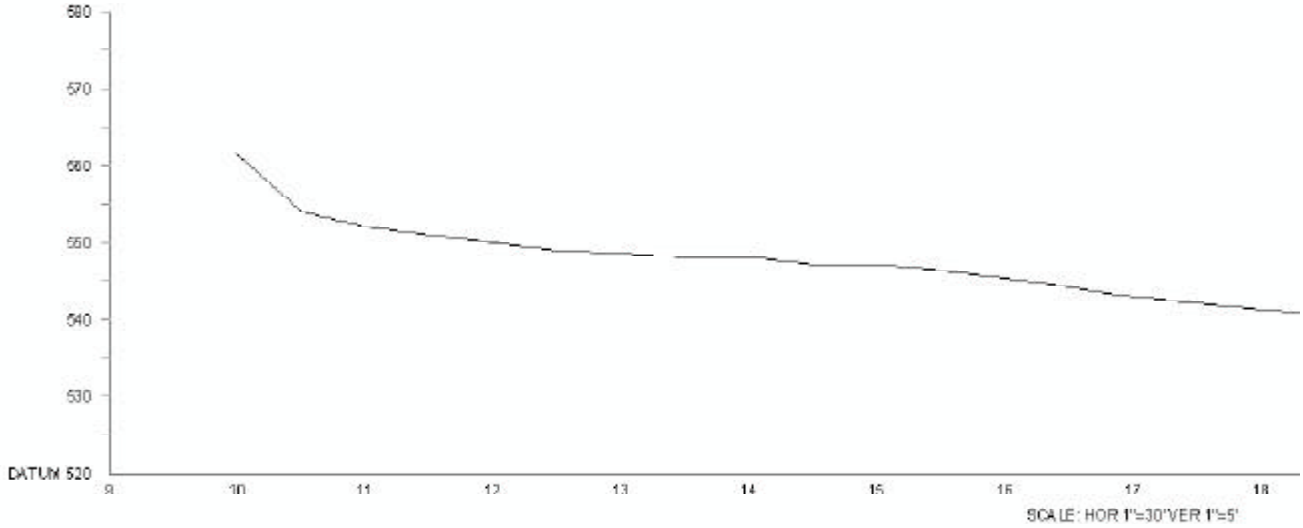

Figure 12 - Profile with the parameter Type of Grid set to Ticks on Sides

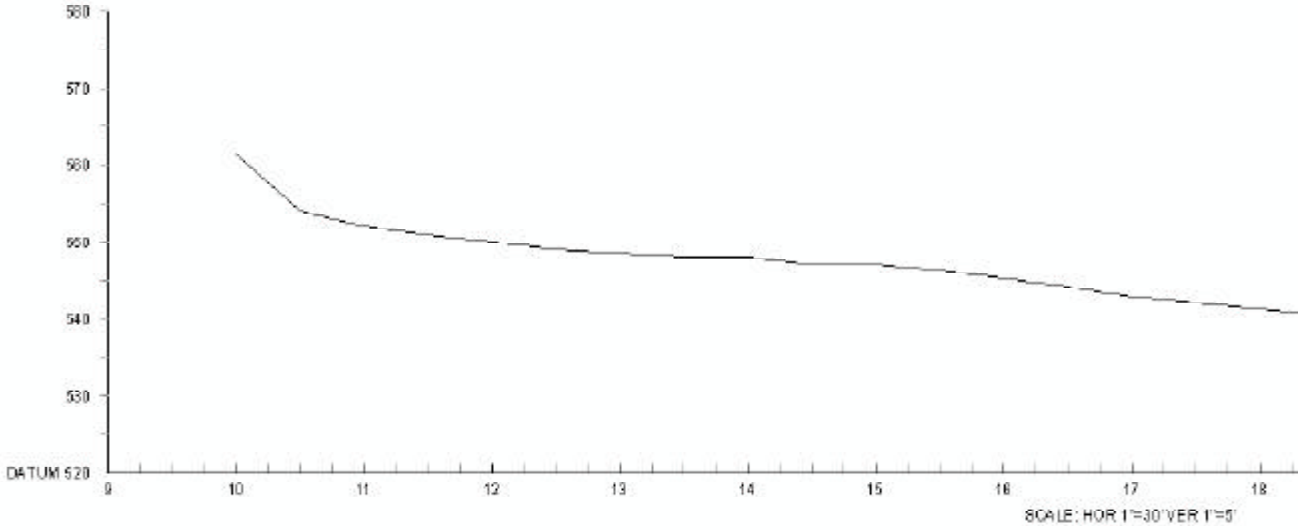

Figure 13 - Profile with the parameter Type of Grid set to Ticks on Sides and Bottom

The reason that the scales shown in certain of the above figures are offset from the center is that the profile of these figures was clipped to the limits shown for readability.

Also note that when either the Full Annotation or Elevations option is selected, for the Data Field 12 parameter, grid elevations will be displayed on both sides of the grid as shown in Figure 9. Again readability is the reason for grid elevations not appearing on the right side of the remaining figures.

Data Field 14 - Draw Vertical Lines

This field contains a Yes/No choice list with which the user can indicate if a vertical line at every point in the profile surface should be created. This line will be drawn from the profile surface down to the low datum of the profile grid.

Once the user has specified the desired information, the *OK* button can be selected to generate the profile drawing.

D. Profile Storage Location

The features (lines and annotations) that comprise the profile will be stored in a Personal GeoDatabase (PGD) called *algX*, where X denotes the horizontal alignment number with which the profile is associated.

Within the PGD *algX*, there will be three datasets called *grd_Xln*, *grd_Xtx* and *pro_Name*, where *Name* represents the name of the profile data table that was processed and X denotes the horizontal alignment number with which the profile is associated.

The *grd_Xln* dataset will contain the line features representing the profile grid, the *grd_Xtx* dataset will contain the annotation features associated with the profile grid and the *pro_Name* dataset will contain the line features representing the profile surface.

Note that it is the *grd_Xln* layer that can be classified, based upon the PEN attribute, to differentiate between intermediate and heavy grid lines.

The parameters specified by the user for creating the profile grid will be stored in a dBase table called *PROFILEData*. This table will contain the starting and ending station limits, the low and upper elevation values, as well as, all of the other values specified by the user for the remaining parameters shown in Figure 6. In so doing, if the user wishes to regenerate the profile for the specific Profile Data Table, the values which were last entered will appear as the defaults.

Profile Data Table Elevation Annotation

Once the Profile Data Table has been processed, a fully annotated profile will be created similar to one of the profiles shown in Figures 9 through 13. To enhance the profile it may be desired to interpolate elevations along the profile surface and have these elevations converted into annotation and superimposed upon the profile.

The tool that can be used to produce this type of annotation is the [Annotate Surface Elevations] command, which can be found in the {Vertical Alignment commands} combo-box within the **CEDRA-AVland-VAlignmentMenus** toolbar, as shown in Figure 14.

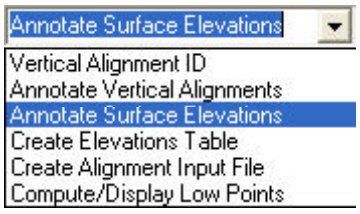

Figure 14
Vertical Alignment commands Combo-Box

A. Locating the PROFILEData Table

Like the [Plot Original Ground Profile] command, the [Annotate Surface Elevations] command processes a Profile Data Table but also processes the PROFILEData table, which was created by the [Plot Original Ground Profile] command. The information stored in the PROFILEData table enables the [Annotate Surface Elevations] command to compute station and elevation values.

Prior to invoking the [Annotate Surface Elevations] command, the user should activate the data frame containing the profile drawing to which elevation annotation is to be added.

Upon activation, the [Annotate Surface Elevations] command searches the active data frame for the PROFILEData table. If one can not be found, the user is informed and asked to select the data frame, from a choice list message box, that does contain the appropriate PROFILEData table.

B. Locating the Profile Data Tables

Once the location of the PROFILEData table has been ascertained, the command will search the current active data frame for any and all Profile Data Tables that may reside within it. If any such tables are found, the program will continue as indicated in the section below. However, if no Profile 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 Profile Data Table resides.

C. Specifying the Elevation Annotation Parameters

Once the command determines which data frame contains Profile Data Tables available for processing, the command displays a dialog box similar to that shown in Figure 15.

This multi-input dialog box contains 10 data fields from which the user can control the type and placement of elevation annotation. The first two data fields are used to identify the profile and profile surface to be processed. The remaining fields are used to describe the range, type, position and size of the elevation annotation.

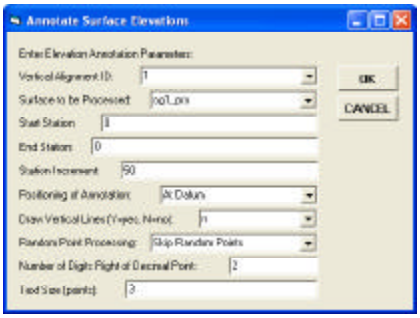

Figure 15
Annotate Surface Elevations
Multi-input Dialog Box

In generating elevation annotation, the user specifies a station range and an interval. The command begins at the starting station and computes an elevation. The next station processed is equal to the current station value plus the interval. This process repeats until the end station value is exceeded. All station values processed, inclusive of the station range, will have an elevation value computed for them.

Data Field 1 - Vertical Alignment ID

This field is used to specify the Vertical Alignment ID that the Profile Data Table is associated with. That is, the value entered for this parameter is used to determine the appropriate record in the PROFILEData table. This is done by comparing the value entered by the user with those which appear under the AlignID field in the PROFILEData table. When a match is made, the command extracts the profile grid parameters (start station, end station, horizontal and vertical scales, etc.) stored in that record.

Data Field 2 - Surface to be Processed

This field represents the profile surface to be processed. In addition to processing a Profile Data Table, this command is able to process a Proposed Ground surface. Shown in Figure 16 is a typical choice list drop-down that would appear for this parameter.

The choice list that is presented will contain a list of the Profile Data Tables which can be processed along with two

Figure 16
Profile Data Table Choice List

other options called Proposed Ground and Delete Surface Annotation. Selection of the Proposed Ground option denotes that the elevations are not to be interpolated along a Profile Data Table but rather, along a proposed ground surface. The Delete Surface Annotation option will delete the existing elevation annotation for the Vertical Alignment ID specified in the first data field. This option is a short cut to using native ArcMap functionality to delete features.

Data Field 3 - Start Station

This field represents the starting station for the range of stations to be processed. Note that the + sign is omitted. For example, the station 9+00 would be entered as 900.

Data Field 4 - End Station

This field represents the ending station for the range of stations to be processed. Note that the + sign is omitted as was the case with the starting station value.

Data Field 5 - Station Increment

This field represents the station increment value. This value is added to the starting station successively until the end station is exceeded.

Data Field 6 - Positioning Annotation

This field contains the choice list drop-down shown in Figure 17. As can be seen the user is able to position the elevation annotation in a variety of locations.

Shown in Figures 20 through 25 are examples of where the elevation annotations will appear for each of the options listed in Figure 17.

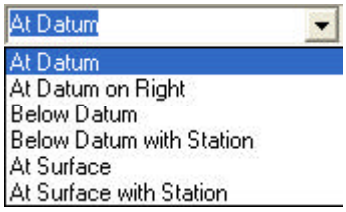

Figure 17
Elevation Positioning Choice List

Note that since the elevation annotations are stored as annotation features in a Personal GeoDatabase, the user is able to reposition and/or modify the annotation as desired. That is to say, once the annotation is created, the user should feel free to modify the annotation, if need be.

Data Field 7 - Draw Vertical Lines

This field contains a Yes/No choice list with which the user can indicate if a vertical line at every point in the profile surface should be created. This line will be drawn from the profile surface down to the low datum of the profile grid.

Data Field 8 - Random Point Processing

This field contains a choice list drop-down denoting how random points are to be handled when a Proposed Ground surface is to be processed, see Figure 18.

Figure 18
Random Point Processing Choice List

If a Profile Data Table is to be processed, this parameter has no effect on the elevation annotation that is created.

Data Field 9 - Digits Right of Decimal

This field enables the user to control the number of digits which appear to the right of the decimal point in the elevation annotation. This value must be greater than zero.

Data Field 10 - Font Size

This field contains the desired text size (in points) for the annotation of the station values, along the X axis, and the elevation values, along the Y axis, on both sides of the profile grid, to be generated by the command.

Once the user has specified the desired information, the *OK* button can be selected to generate the annotation features.

Should the Vertical Alignment ID that is being processed contain elevation annotation, the query message box shown in Figure 19 will be posed. The user is able to: (a) overwrite or replace the existing elevation annotation, (b) append or add to the existing elevation annotation, or (c) abort the command.

Figure 19
Overwrite Existing Annotation Query

When producing roadway profiles, it is desirable to have both original ground and proposed ground elevations displayed. Since these surfaces share the same Vertical Alignment ID, the annotation features for each of these surfaces will reside in the same dataset. As such, the user can select this command to process the original ground surface, afterwards, the command can be re-selected to process the proposed ground surface. The command will then display this query, at which point, the user can select the No button to denote that the annotation features are to be added to the elevation annotation dataset. In so doing, both original and proposed ground annotations will appear on the profile.

In computing elevation values, when processing a Profile Data Table, the com-

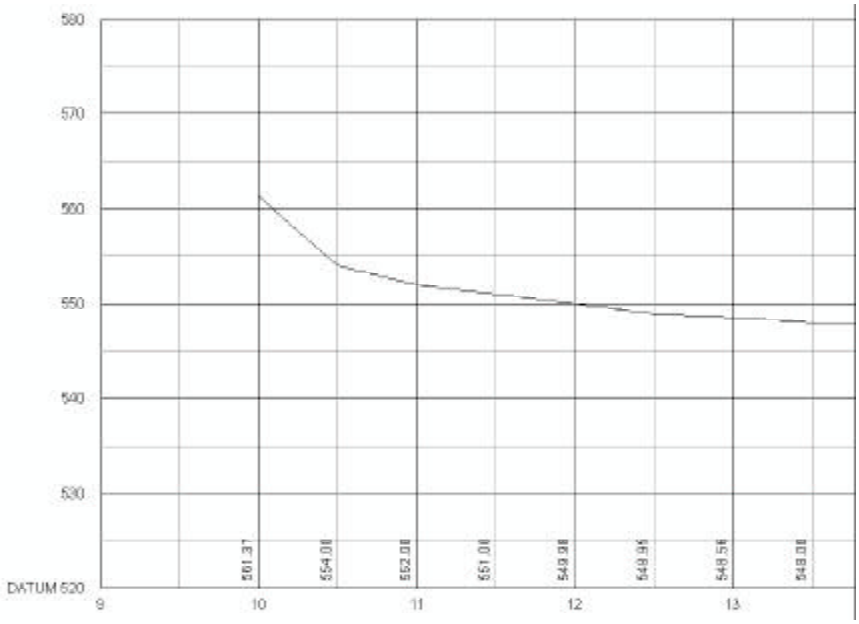

Figure 20
Elevation Annotation created using the At Datum option

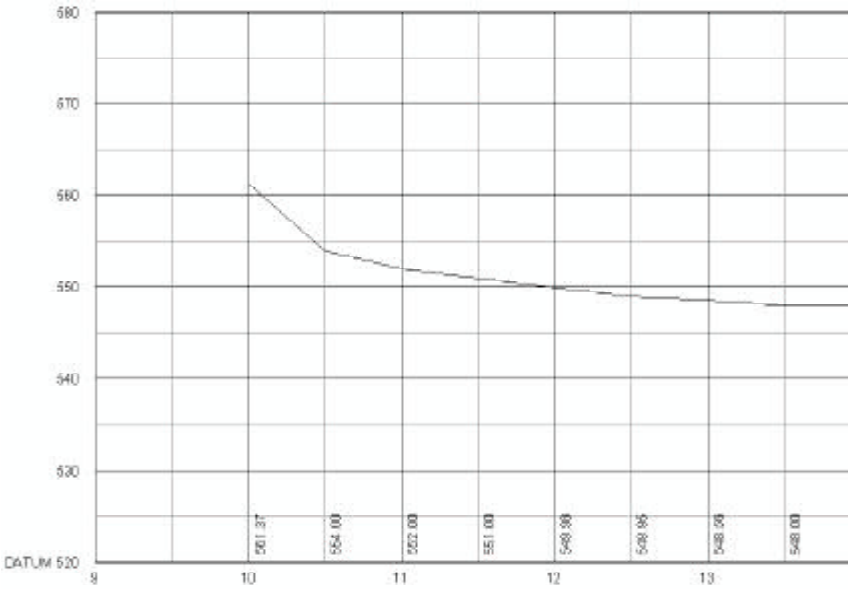

Figure 21
Elevation Annotation created using the At Datum on Right option

mand interpolates an elevation at a given station value. If a station value is encountered which is outside the extent of the profile surface, an elevation of zero is computed.

D. Annotation Storage Location

The features (annotations and if need be, lines) that comprise the annotation will be stored in a Personal GeoDatabase (PGD) called *algX*, where X denotes the horizontal alignment number with which the Profile Data Table is associated with. This value is extracted from the PROFILEData table and appears under the HORZ_ALIG attribute.

Within the PGD *algX*, there will be two datasets called *elv_Zln* and *elv_Ztx*, where *Z* represents the Vertical Alignment ID specified in the first data field of Figure 15. The *elv_Zln* dataset will contain data only if the option Below Datum or Below Datum with Station is selected. Line features are created only when either of these two options are selected, otherwise, only annotation features are created.

Summary

The profile plotting process described above pertains only to the plotting of the profile of a surface may it be that of top of ground or sub-ground surface. Having developed such a profile, additional similar type profiles may be superimposed provided they are within the confines of the first profile's alignment limits. In such cases, when first specifying the plotting parameters of Figure 6, consideration should be given to the station and elevation limits of the profiles to be superimposed. Superimposition of additional profiles may be accomplished by use of the CEDRA-AVland [Plot Profile Table] command, as shown in Figure 1.

Note that the Profile Data Table that is generated by the [Plot Original Ground Profile] command is one long profile of an entire alignment, which, depending upon the available paper and desired scales may fit on one or more drawing sheets. For those cases which require more than one drawing sheet to represent an entire profile the reader is referred to last month's issue of Command of the Month.

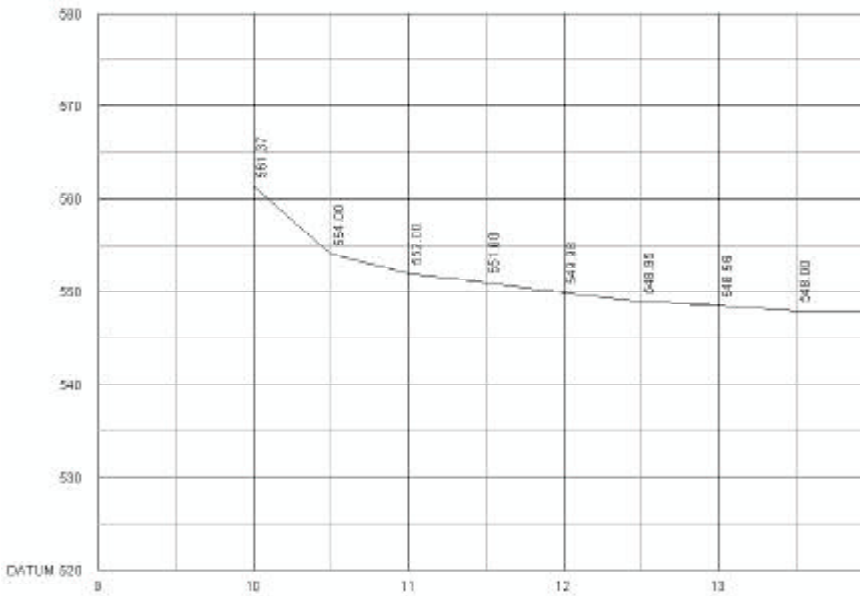

Figure 22
Elevation Annotation created using the At Surface option

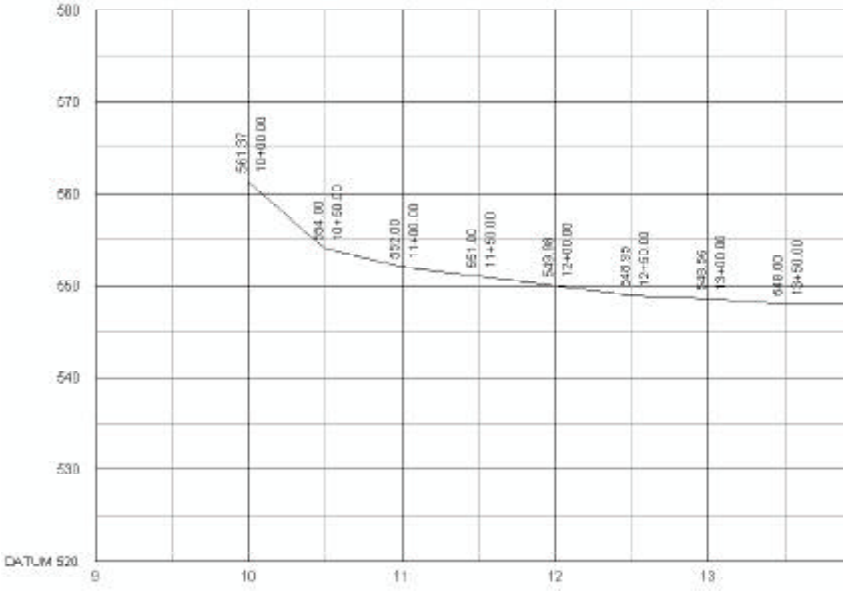

Figure 23
Elevation Annotation created using the At Surface with Station option

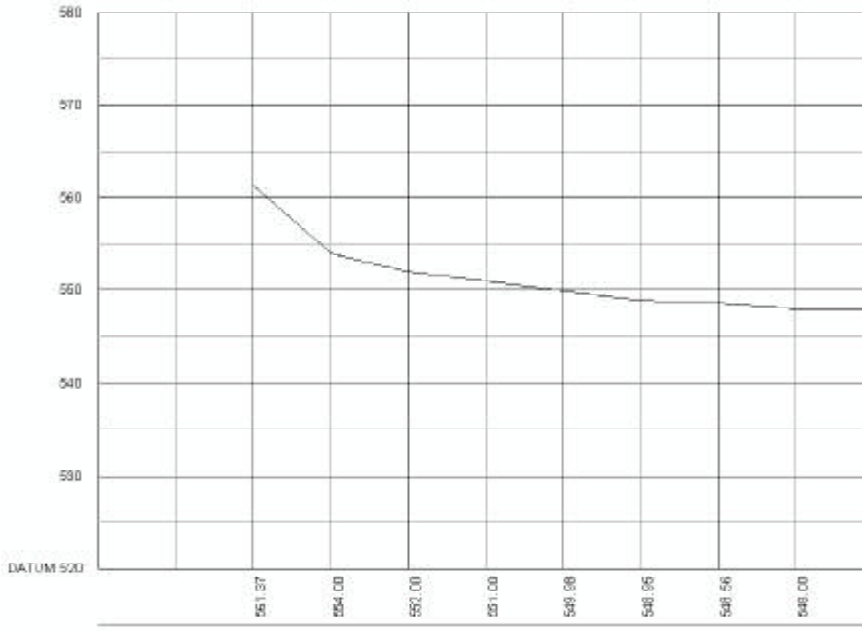

Figure 24
Elevation Annotation created using the Below Datum option

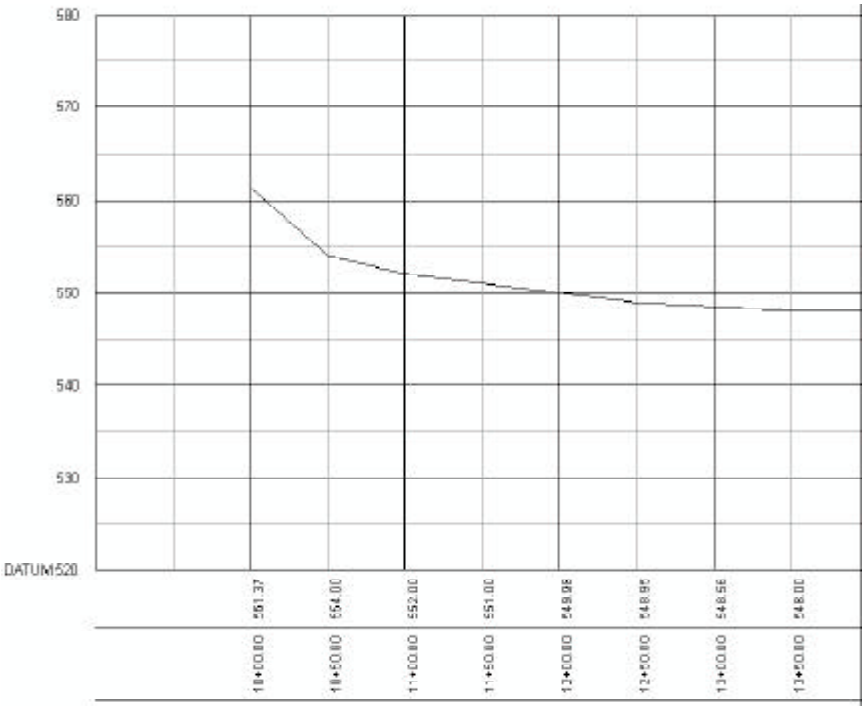

Figure 25
Elevation Annotation created using the Below Datum with Station option

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