The CEDRA Corporation's

COMMAND OF THE MONTH

A monthly information bulletin   **October 2008**

FEATURED COMMAND

Creating Offset Features
and Buffers

Application Description

Many times we ArcGIS® users have come across the need to create a line that is parallel and offset from another line or a string of lines. If you've come across this situation, you probably have also needed to create a buffer about a line or a string of lines.

This application not only arises in parcel mapping work, but also in a number of other geometric construction applications.

The CEDRA Solution

To address this application, the CEDRA-Offset-Tools toolbar, see Figure 1, can be employed. As can be seen from Figure 1, four tools are available to the user.

The **Offset 1** tool ≡ enables the user to create parallel lines from an existing **line** feature, be it a *two-point line* or a *polyline*, or an existing **polygon** feature.

The **Offset 2** tool ⌐ enables the user to create parallel curves from an existing curve. Note that a curve is actually a polyline feature which:

a. Has an attribute called RAD or RADIUS with a numeric value that is nonzero, or

b. Has an attribute called ENTITY with a value of ARC or CIRCLE.

If the above items **a** and **b** are not satisfied, the polyline is not identified as a curve and as such not processed by this tool.

Figure 1
CEDRA-Offset-Tools Toolbar

The **Offset 3** tool ⌐ enables the user to create parallel lines from a string of line and/or curve features. This tool combines the functionality of the first two tools in the toolbar with the added ability to process features that are connected in series, thereby forming a "string".

> ***Command Of The Month bulletin***
>
> *This month's issue discusses the tools in the CEDRA-Offset-Tools toolbar, which enable the user to create parallel and offset line/curve features.*

The **Offset 4** tool ⌁ enables the user to create point features which are offset from two existing line features. The tool computes the point of intersection between the two lines and uses this point as the starting point from which the user can specify plus and offset values. The first line will control the direction of the plus value, while the second line that is selected will control the direction of the offset value.

Summarizing the functionality of the tools within the CEDRA-Offset-Tools toolbar, if the user is dealing with a single feature, the ≡ or ⌐ tool can be used, depending upon the type of fea-

ture being processed, that is, a line or a curve. If the user is dealing with a string of features, then the ⌐ tool should be employed.

The ⌁ tool is more of a specialty tool that was created based upon a user's request and as such, may or may not be applicable for others.

1. Offset Parallel Lines

With the ≡ tool the user is able to:

a. Establish a number of equally spaced lines offset to a given two point line, polyline or polygon,

b. Create a polygon from a polyline,

c. Create a polyline from a polygon or

d. Create two point lines that represent the segments which comprise a polyline or polygon.

If this tool is used on a curve, the curve is treated as a polyline, and not as a curve, thus creating a series of chords. To create a concentric curve, use the ⌐ tool presented subsequently to this tool. If the selected line is a polyline or polygon, options b, c and d, described above, apply, otherwise option a is in effect. To use this tool:

1. Pick the ≡ tool.

2. Pick at an existing two point line, polyline or polygon to define the base element.
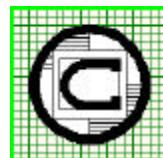
Figure 2
Feature Selection Confirmation

3. Confirm the selection, see Figure 2. Selecting the *Cancel* button results in the command being aborted. Selecting the *No* button results in the program searching for another feature in the proximity of the user's selection made in Step 2, while selecting the *Yes* button confirms the selection of the feature.

If the confirmed selected element is determined to be:

A. **Two point line,** a small blue cross, denoting the positive offset direction from the base element, is displayed slightly offset from said element, see Figure 3. Additionally, a dialog box similar
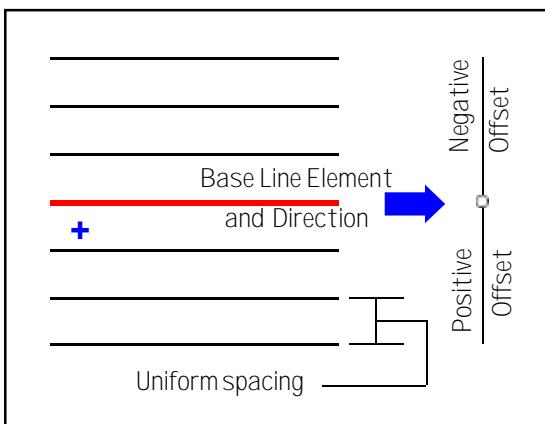

Figure 3
Sample Two-Point Line with Six Offset Lines

to that shown in Figure 4 or Figure 5 will be displayed.

4a. Enter in the indicated data fields:

1st, the uniform spacing of the parallel lines (positive offset places the parallel lines to the right of the base line, a negative to the left, and a zero offset aborts the command),
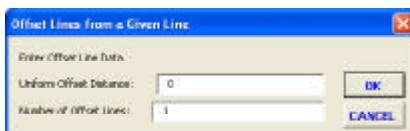
Figure 4
Two-Point Line Offset Dialog Box

2nd, the number of parallel lines to be created and

3rd, the extended data, see Figure 5 (data lines 3, 4 and 5). These data lines appear only if the Enter Extended Data property is active. If it is not, then only the first two data fields will appear, see Figure 4. Note that the [AVcad Properties...] command can be used to control the setting of the Enter Extended Data property. The default elevations displayed in Figure 5 are those of the base element.

Selecting the *OK* button results in the parallel lines being displayed. The command remains active to repeat Step 4a. Click at the *Cancel* button to terminate the command.

B.   Polyline, the option of selecting *All of the Polyline*, *A Portion of the Polyline*, or *A Portion Clipped to the View* is offered, see Figure 6.

When processing a polyline, the tool needs to know which portion of the polyline should be processed. Therefore, the first option enables the user to produce an offset line to the entire base element, while the other two options produce a line offset over a portion thereof.

The difference between the second and
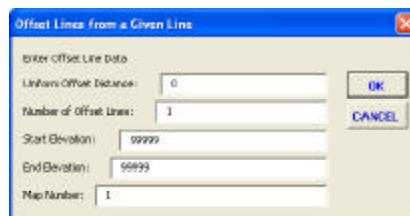
Figure 5
Two-Point Line Offset Dialog Box
with Extended Data Active
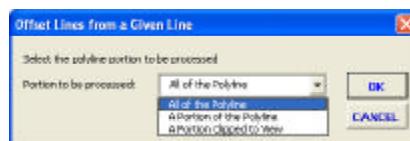
Figure 6
Polyline Portion Processing Query

third options is that the second option searches the entire polyline to define the base element, while the third option searches only the portion within the extent of the view space, thus speeding the process if a polyline extends beyond the view extent.

4b. Select the desired option. Selecting the *Cancel* button results in the command being aborted, while selecting the *OK* button continues the processing.

◗ If the ***All of the Polyline*** option is selected, a small blue cross denoting the positive offset direction is displayed slightly offset from the base polyline, and near the pick of the base line selection, (see Figure 7). Note that the setting
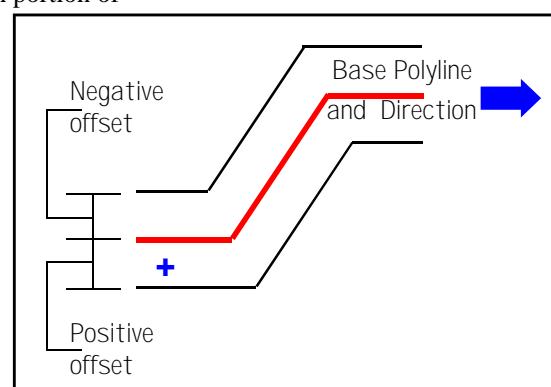

Figure 7
Sample Polyline with Two Offset Polylines
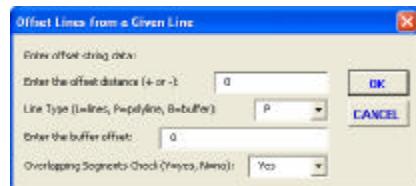
Figure 8
Polyline Offset Dialog Box

Figure 9
Create Polygon for Closed Polyline

Figure 10
Create Polyline for Polyline

of the Enter Extended Data property has no effect in this mode of operation.

5b. Enter in the indicated data fields of Figure 8:

1st: The offset from the base element (see notes below pertaining to a zero offset value).

2nd: *P* to create an offset polyline, *L* to create individual two point offset lines rather than a polyline, or *B* to create a buffer polygon.

3rd: The buffer polygon offset.

4th: *Y* to check for overlapping segments, or *N* to skip the check. *Regarding this issue of overlapping segments, reference is made to the commentary at the end of this issue of Command of the Month.*

Selecting the *OK* button results in the parallel lines being created and stored in the current active layer. The command remains active to repeat Step 5b. Click at the *Cancel* button to terminate the command.

◆ Note, if a **zero offset** value is specified and the polyline forms a **closed figure**, that is, the start and end points of the polyline are identical, the tool will pose the query shown in Figure 9.

6b. Select the *Yes* button to create a polygon feature storing the feature in the current active layer, after

which the command terminates, or the *No button* to indicate that a polygon is not to be created and continue processing.

If the *No* button is selected, the query shown in Figure 10 will be displayed.

7b. Select the *Yes* button to create a polyline feature and store it in the current active layer, after which the command terminates, or the *No button* to terminate the command without creating any new feature.

◆ Note, if a **zero offset** value is specified and the polyline forms an **open figure**, that is, the start and end points of the polyline are not identical, the tool will pose the query shown in Figure 10.

6b. Select the *Yes* button to create a polyline feature storing the feature

in the current active layer, after which the command terminates, or the *No button* to terminate the command without creating any new feature.

◆ Note that if the user specifies that a buffer is to be created by selecting the *B* option for the second parameter, the program will check to see if both the offset distance and the buffer offset values are equal to zero.
 • **If they are**, an appropriate error message will be displayed. Once the warning message is dismissed, the dialog box of Figure 8
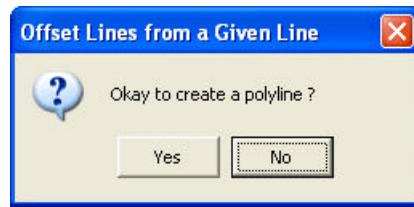
reappears, at which point new values can be specified.

 • **If not**, the program will create the buffer polygon as specified, and store it in the current active layer.

After the buffer polygon has been created, the command will terminate. Note that the offset distance value may be either positive or negative, the sign of which, will dictate the side that the offset elements will appear on. When creating a buffer polygon, the *buffer offset* should be positive in sign and will always oppose the side indicated by the offset distance value.

◗ If the *A Portion of the Polyline*, or *A Portion Clipped to the View* option is selected, the message below is displayed in the status bar.

Pick point 1 of the polyline portion to be offset -- Portion is defined from Point 1 to Point 2

5b. Pick at two locations near the base polyline to denote the start and end of the new offset line. In making these picks, note that:

● Each pick is projected on the base polyline to define the start or end points.

● If a pick can create a point of projection within the limits of two segments of the base polyline, the one to be used by the program is the one with the smallest offset.

● If a pick is made outside the limits of the base polyline, then the first
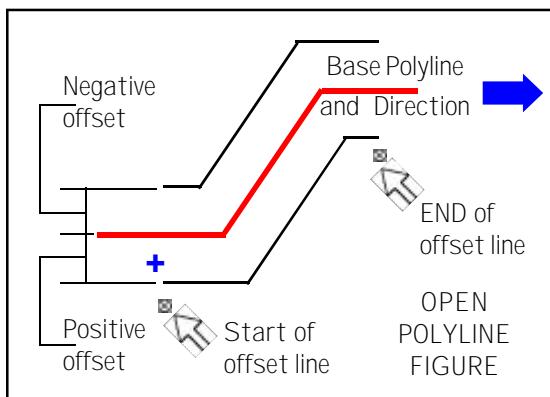
Figure 11 - Open Polyline

or last segment of the base line is considered extended to the point of projection.

6b. If the figure is open, as depicted in Figure 11, go to Step 5b of the ***All of the Polyline*** description.

If the figure is closed, as depicted in Figure 12, two blue circles appear at the base polyline vertices nearer to the first of the above two picks. *The direction of the base polyline is defined from the first pick towards the second in a counterclockwise rotation, and the polyline portion between these picks, which includes the two blue circles, is referred to as the inside portion, while its supplement is referred to as the outside portion.*

**7b.** Select the *Inside* option, or the *Outside* option as defined above
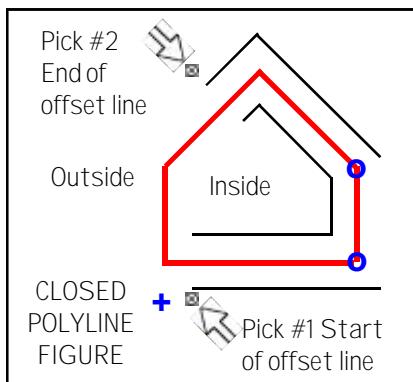
Figure 12
Closed Polyline

and indicated in Figure 13. If the *Cancel* button is selected, the command is aborted, otherwise, go to Step 5b of the above ***All of the Polyline*** description.

C. Polygon, the program informs the user that a polygon has been selected, and asked whether it is desirable to continue, or not.

4c. Click at the *Yes* button to continue and go to Step 5b of the ***All of the Polyline*** description, or click at the *No* button to abort the tool.

2. Offset Concentric Curves

As stated above, the ⌐⌐ tool enables the user to create parallel or concentric curves from a polyline feature which has an attribute that defines the polyline as a curve. Figure 14 illustrates a base curve and how the offset value is treated in generating concentric curves. To use this tool:

1. Pick the ⌐⌐ tool.

2. Pick at an existing polyline feature.

3. Confirm the selection.

4. Enter in the indicated data fields of Figure 15:

1st, the uniform spacing of the concentric curves. Note that a positive spacing places the concentric curves on the outside the base curve, a negative spacing places the concentric curves on the inside, and a zero spacing aborts the command),

2nd, the number of concentric curves to be created, and

Figure 13
Inside/Outside Choice List

3rd, the extended data, lines 3, 4 and 5 of Figure 5, provided that the Enter Extended Data property is active. The default elevations displayed are those of the base element.

Selecting the *OK* button results in the concentric curves being created and stored in the current active layer. The command remains active to repeat Step 4. Click at the *Cancel* button to terminate the command.
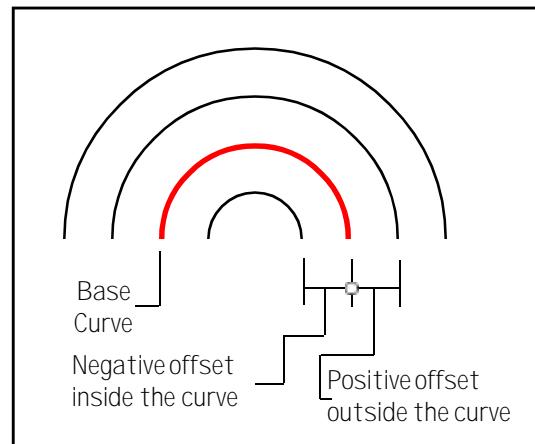

Figure 14
Sample Curve with Three Curves

3. Offset Strings and Buffers

This tool provides two types of functionality:

First, it enables the user to define a base string of lines, polylines and/or curves

Figure 15
Curve Offset Dialog Box

(base string) and then establish:

- A string of lines and/or curves offset from the base string,

- A polyline offset from the base string,

- A polygon from the base string, or

- A polygon that buffers the base string. Upon completion, and only if a buffer polygon is not to be created, the command remains active to establish additional similar elements. Note, to create a polyline offset from a single polygon feature, the user should use the ☰ tool, not this tool.

Second, it enables the user to select a string of elements, and retain it as a group of selected features for further manipulation by use of the native *ArcView* functionality.

1. Pick the 🔲 tool.

2. Pick at an existing line, polyline or curve element to define the start of the base string, also referred to as the seed element. The choice list message box of Figure 16 will appear.
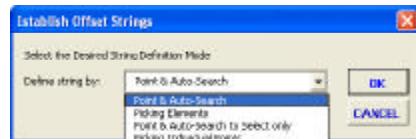
Figure 16
Mode of Operation Choice List

3. Select the:
   (a) *Point & Auto Search* option to have the program search for a contiguous string of elements,

   (b) *Pick Elements* option to have the user select contiguous elements individually, element by element,

   (c) *Point & Auto Search to Select Only* option to have the program search for a contiguous string of elements without creating any off-

set lines, or polygon, and retaining the string as a set of selected elements, or

(d) *Pick Individual Points* option to allow the user to make picks defining an implied polyline. See Figure 17 for a pictorial representation of a string.
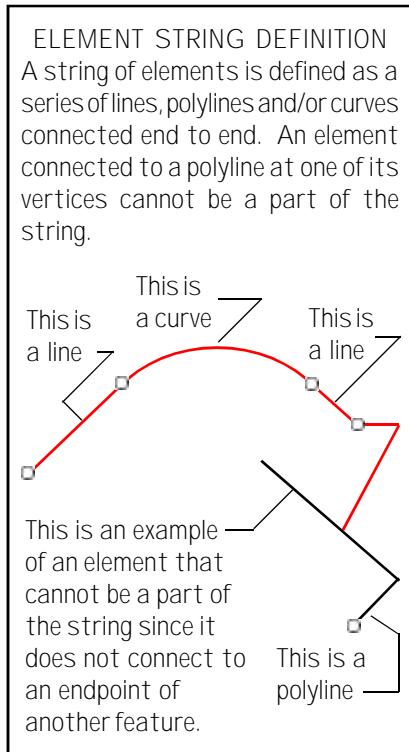

Figure 17
String Definition

4. Select the desired option. Selecting the *Cancel* button results in the command being aborted, while selecting the *OK* button continues the processing.

A. Point & Auto-Search Option, and Point & Auto-Search to Select Only Option

The command begins to search for a feature that it will use as the seed element in the string. If no element is found, an error message is displayed and the command terminates. If an element is found, the command highlights the feature and queries the user for confirmation, see Figure 18. At this point,

Figure 18
Seed Feature Confirmation Query

5a. Click at the *Yes* button to confirm the selection and continue with the processing, click at the *No* button to have the command search for another feature and repeat the confirmation process, or click at the *Cancel* button to abort the command.

The program proceeds to select contiguous string elements until it encounters a fork. This auto-search element selection routine assumes that the next contiguous element is located at the end node of the first element selected under Step 2.

▶▶ If there is no element connected at the forward end of the seed element (Case 1 in Figure 19), the program asks if it should reverse the direction of the seed element.

6a. Click at the *Yes* button to confirm and continue with the auto-search, or click at the *No* button to complete the base string selection; go to Step 8a.

▶▶ If an element is connected to each end of the seed element (Case 2 in Figure 19), and if the program selects a direction opposite to that desired, continue with Step 7a, rejecting the selected path as many times as one is asked, and then rejecting the selected string in Step 8a. Thereafter, use the [Flip/Reverse Lines] command to reverse the direction of the seed string element, and then repeat this command from its beginning.

▶▶ When the program encounters a fork, it assumes a path and asks the user for confirmation in the form of a query window. If the feature that is found is very small in length or falls outside the

Case 1 - No connecting element at the forward end of the seed element.

Seed element and direction

Case 2 - Connecting elements at end of the seed element.
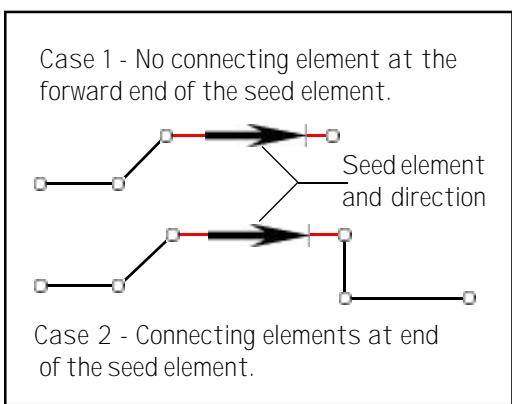
Figure 19
Connecting Features Options

extent of the view, the command automatically changes the view making the feature visible. Upon completion of the base string definition, the command returns the user to the view that was displayed when the command was initially activated.

7a. Click at the *Yes* button to confirm and continue, or click at the *No* button to select another path. Clicking *No*, the query is repeated until a path is accepted. If no path is accepted, and all paths have been exhausted, the base string is considered as defined; go to Step 8a.

▶▶ When the program encounters an element having an endpoint that matches the start endpoint of the base string, the base string is considered defined; continue with Step 8a.

8a. Confirm the selection and continue with Step 9.

Under the *Point & Auto Search to Select Only* option only, this step terminates the command.

B.   Pick Elements Option

The program prompts the user to select the next element of the base string until an element is picked twice, at which time the base string is considered defined; the user is asked for confirmation

5b. Confirm and continue with Step 9, or click at the *Cancel* button to

abort the command. Alternatively, click at the *No* button to ask for permission to remove the last element. If permission is not given, the command aborts. If permission is granted, the last course is removed, and the user is asked to select the next element.

C.   Pick Individual Points Option

The program prompts the user to make picks in the map area, defining an implied polyline, until a pick is made twice, which signals that the base string is considered defined. As the picks are made, red plus signs will be displayed indicating the location of the pick.

5c. Once a location has been picked twice continue with Step 9, or select another tool to abort the implied polyline definition.

Under Any Option to Create an Offset Element String

A small blue cross is displayed denoting the positive offset side of the base string.

9. Enter in the indicated data fields of Figure 8.

  1st,   the offset from the base element (see notes below pertaining to a zero offset value).

  2nd,   *P* to create an offset polyline, *L* to create individual two point offset lines rather than a polyline, or *B* to create a buffer polygon.

  3rd,   the buffer polygon offset.

  4th,   *Y* to check for overlapping segments, or *N* to skip the check (see the commentary at the end of this issue of the Command of the Month).

Selecting the *OK* button results in the parallel lines being created and stored in the current active layer. The command remains active to repeat Step 5b. Click at the *Cancel* button to terminate the command.

◆ Note, if a **zero offset** value is specified and the polyline forms a **closed figure**, that is, the start and end points of the polyline are identical. The tool will pose the query shown in Figure 9.

6b. Select the *Yes* button to create a polygon feature storing the feature in the current active layer, after which the command terminates, or the *No button* to indicate that a polygon is not to be created and continue processing.

If the *No* button is selected, the query shown in Figure 10 will be displayed.

7b. Select the *Yes* button to create a polyline feature storing the feature in the current active layer, after which the command terminates, or the *No button* to terminate the command without creating any new feature.

◆ Note, if a **zero offset** value is specified and the polyline forms an **open figure**, that is, the start and end points of the polyline are not identical. The tool will pose the query shown in Figure 10.

6b. Select the *Yes* button to create a polyline feature storing the feature in the current active layer, after which the command terminates, or the *No button* to terminate the command without creating any new feature.

◆ Note, if the user specifies that a buffer is to be created by selecting the *B* option for the second parameter, the program will check to see if both the offset distance and the
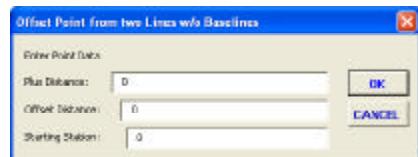
Figure 20
Offset Points Dialog Box

buffer offset values are equal to zero.

If they are, an appropriate error message is displayed. Once the warning message is dismissed, the dialog box of Figure 8 reappears.

If not, the program will create the buffer polygon as specified, storing the polygon in the current active layer. After the buffer polygon has been created, the command will terminate. Note that the offset distance value may be either positive or negative, the sign of which, will dictate the side that the offset elements will appear on. When creating a buffer polygon, the *buffer offset* should be positive in sign and will always oppose the side indicated by the offset distance value.

4. Points Offset from Two Lines

As stated previously, the ╱╋ tool enables the user to create points which are offset from two two-point lines. To use this tool:

1. Pick the ╱╋ tool.

2. Pick at an existing two-point line feature (Line #1).

3. Confirm the selection.

4. Pick at an existing two-point line feature (Line #2).

5. Confirm the selection.

6. Enter in the indicated data fields of Figure 20.

1st,   the plus value.
2nd,   the offset value, and.
3rd,   the starting station value.

Selecting the *OK* button results in the offset point being created and stored in the current active layer. The command remains active to repeat Step 6. Click at the *Cancel* button to terminate the command.

Shown in Figure 21 is a schematic of how the command operates. Given the two lines, the tool computes the Point of Intersection which then becomes the beginning point for computing the offset points.

A positive plus value is along the direction of Line #1, while a negative plus value is in the opposite direction of Line #1. A positive offset value is on the right side of Line #2, while a negative offset value is on the left.
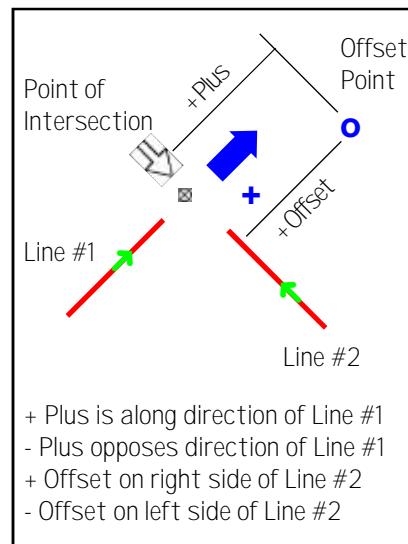
Figure 21
Offset Point Schematic

The starting station value is subtracted from thee plus value to determine the actual plus value to be used. For example, if the plus value is 1100 and the starting station value is 1000, the plus value that would be used in computing the offset point would be 100.

Overlapping Segments Check

Regarding the issue of checking for overlapping segments, reference is made to Figure 22 which displays two polylines (the selected base features) and three polylines offset from each of the two base features at 25, 50 and 75 foot offset distances. The offset polylines in the top of this figure have been created with the *Y* option in the *Overlapping Segments Check (Y=yes, N=no)* of Figure 8, while those in the bottom of this figure have been created with the *N* option. Note the difference in the third offset line at the 75 foot offset.

The *Y* option, although for most cases appears to be the desirable option, hence it is the default option, there are occasions, particularly when a polyline is comprised of lines and curves, and when the integrity of the curve portions needs to be maintained. In such cases, the *N* option is available, which may require some clean up work.
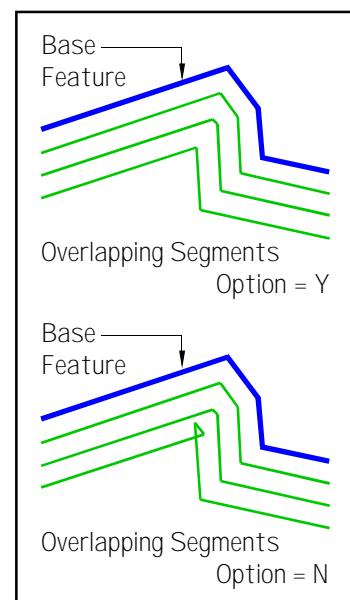

Figure 22
Overlapping Segments

Summary

We at CEDRA utilize both the Offset 1 and Offset 3 tools a lot. They are extremely powerful tools in creating offset features. If you haven't used them, we suggest that you try them out and let us know your comments. If you have suggestions on how they can be improved or modified, we would be happy to hear from you.

As always, should the reader have any suggestions on functionality that should be featured in Command of the Month, please feel free to forward them on to us.

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