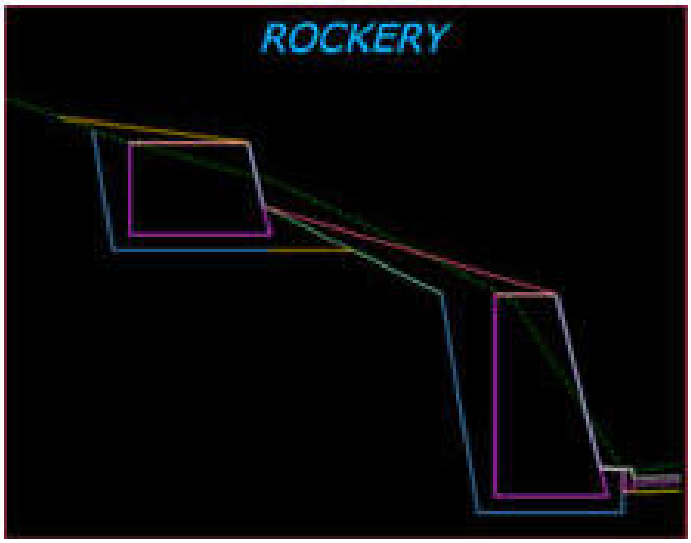
ROCKERY

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About Layout Procedures (For *CFLHD employees*)

The FLH criteria library supports nine wall types; Parapet, MSE, Soil Nail, SMSE, Cut, Fill, Gabion, Guardwall and Rockery. Creating a constructible wall layout is an iterative process, which requires the involvement of the Highway Engineer as well as the Structural and/or Geotechnical Engineer. The process requires two or three phases, depending upon the wall type or complexity.

Workflow: Rockery Layout

1 PHASE 1 – Basic Design and Evaluation

The first phase consists of creating the initial proposed cross sections, using the version of X30 Generation criteria dated 09/2007 or later and conducting some rockery evaluations. Although CFLHD default AdHoc attributes can be used in this phase, it is highly recommended to obtain as many design parameters as possible from the Geotechnical Report or engineer. Doing this can eliminate extra design iterations in order to finalize a layout. From these cross sections, chains and profiles are stored for the Rockery Design Phase 1. This information, along with a the Phase 2 development and a preliminary layout, is then given to the Geotechnical Engineer, to determine the final project specific design criteria that will be required and to assist in the development of the final layout.

1.1 CREATING THE FIRST GENERATION ROCKERY DESIGN

1.1.2 Set the default Adhoc Attributes. *Open the Design and Computation manager and double click on the Prop. Rockery Wall item. Adjust the default AdHoc attributes for the Rockery dimensions to match those shown on the CFL Rockery detail or as provided from Geotechnical resources (Engineer or report); see the figure below. Change the value by; double clicking on the value, typing in the new value and hitting enter. Note: It is highly recommended to use as many project specific variables as is initially known. This may reduce much of the work to finalize the design*.

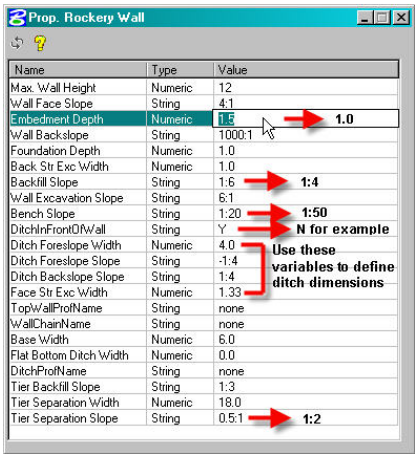

Figure 1-1: Adjust Default AdHoc Attributes

1.1.3 Draw the Planimetrics. *Draw the Rockery AdHoc line in the plan view. The line drawn in plan view will represent the horizontal offset of the front face of wall where it intersects with the embedment depth as shown below. Only place one tier to start, even if it is assumed that there will be more than one final tier. As a tip: Extend the Rockery line a minimum of 20-ft (7 m) beyond the original estimated limits. (It is easier to shorten, rather than to lengthen.)*

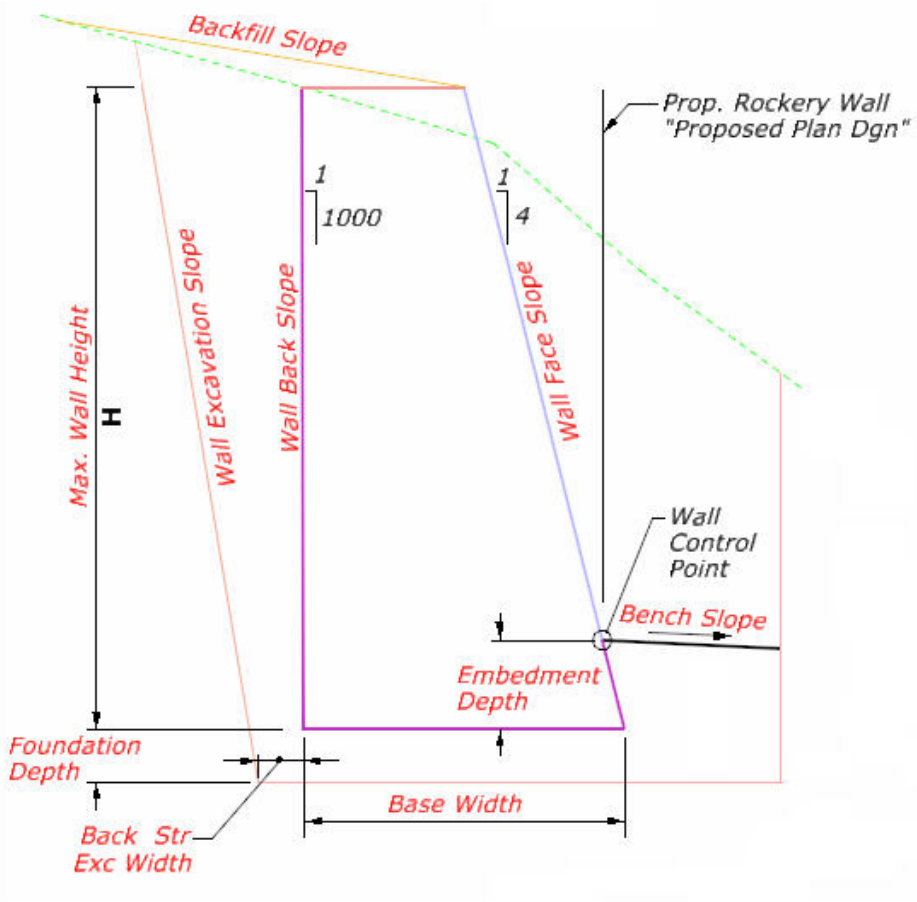

Figure 1-2: Rockery Design Parameters

1.1.4 Place Pattern lines. *Draw pattern lines every five feet through the Rockery site in the mainline pattern file. Use a different level for the pattern lines than the mainline cross section pattern lines. Additional cross sections may be required at the beginning and end to determine where the rockery should begin and end.*

1.1.5 Generate 1st run of proposed cross sections. *Cut existing ground cross sections based on the pattern lines created. Run the proposed cross sections for the 1st (base) tier of rockery. A second tier of Rockery will be required if the wall height is at the maximum and the 1:4 backfill slope above the Rockery cannot tie to existing ground. Refer to figure 1-2 above. If a second tier is required, it will be placed as a part of Phase 2.*

1.2 CREATING THE DESIGN CHAINS AND PROFILES FOR THE ROCKERY

1.2.2 Open the Reports & XS Quantities.

Select this tab from the Road Project Manager Dialog box as shown in the figure below.

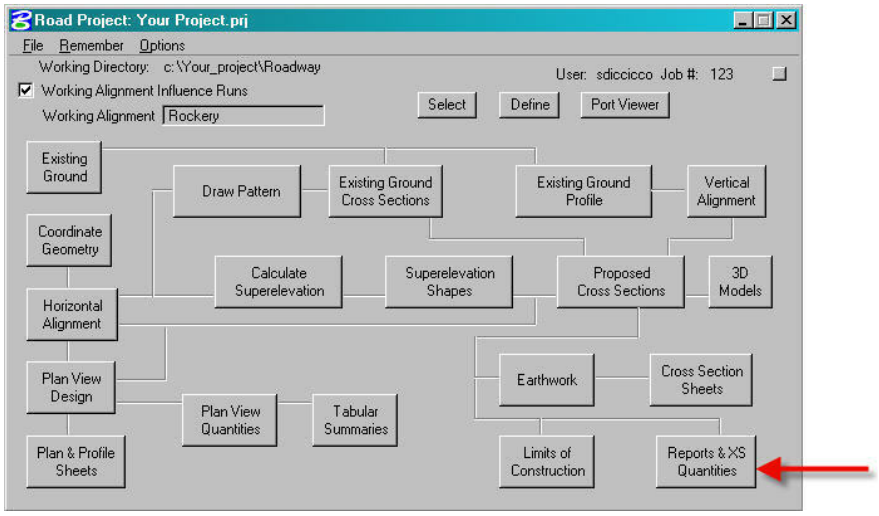

Figure 1-3: Reports & XS Quantities

1.2.3 Open the Profile Grade Report tools.

Click on the Profile Grade button in the XS Report dialog box. This will open the Profile Grade Report dialog box. Fill in the Begin and End Station of the Rockery station range as shown below. Do not include cross sections that do not require a Rockery.

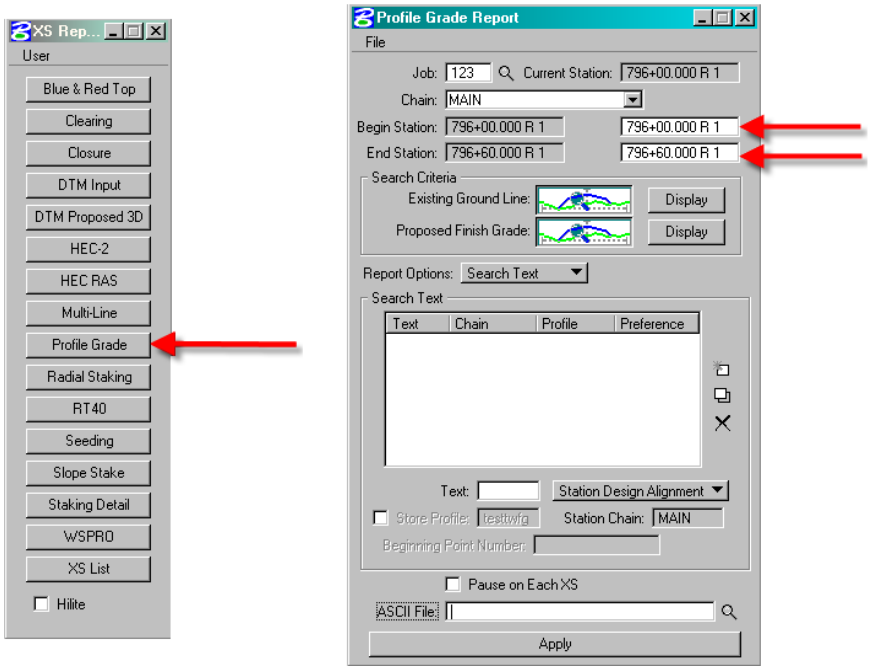

Figure 1-4: Profile Grade Report

1.2.4 Define the Existing Ground Line. *Under Search Criteria, click on the button next to Existing Ground Line. Add the Lv Names to the Existing Ground Line dialog as shown below. The Existing Ground Line should only have the existing ground level (X_E_Ground_XS) in the Lv Names. Close the dialog box.*

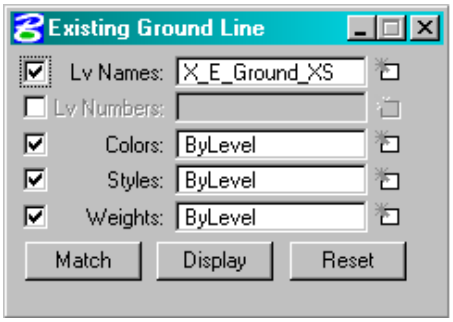

Figure 1-5: Existing Ground Line Dialog

1.2.5 Define the Proposed Finished Grade. *Under Search Criteria, click on the button next to the Proposed Finish Grade. Add the Lv Names to the Proposed Finish Grade dialog. The Proposed Finish Grade must travel from catch point to catch point, and it must pass through the text points RK1, RK2, RK5 and RK10 (See Figure 1-9 for text locations). The following levels must be specified for a Rockery: X_P_RK_Wall_Backfill; X_P_RK_Wall_Face; X_P_RK_Wall_Back; X_P_RK_Wall_Tier and X_P_RK_Wall_Top. Close the dialog box.*

Figure 1-6: Proposed Finish Grade Dialog

1.2.6 Add in the Search Text. *Pull down the Search Text menu and fill in the text dialog box as shown below. Select Station Text Alignment from the pull down menu. The Beginning Point Number should not be a point used in any other chain. Click on the Add tab to populate the search text field.*

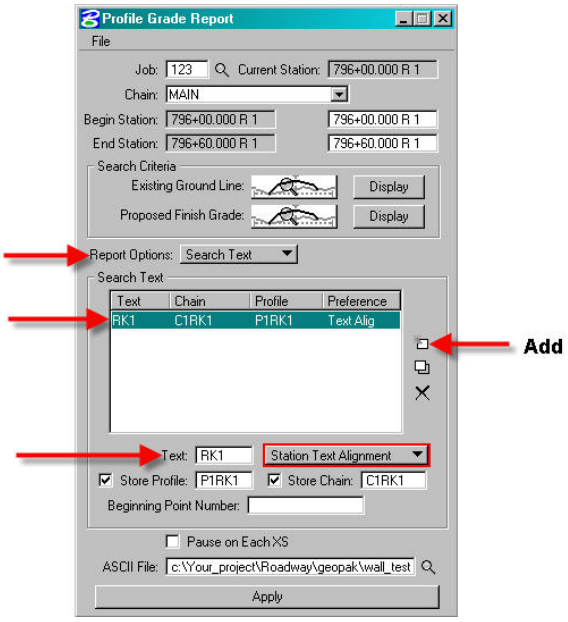

Figure 1-7: Profile Grade Report

1.2.7 Generate the rockery chains and profiles. *Add the search text for; the bottom of Rockery (RK2), the top of Rockery (RK5) and excavation tie to existing ground point (RK10) as shown in the figure below. Click on the Add tab to add the text to the search text box. Click on the apply button to generate the chains and profiles based on the locations of the RK1, RK2 RK5 and RK10 text (See Figure 1-9).*

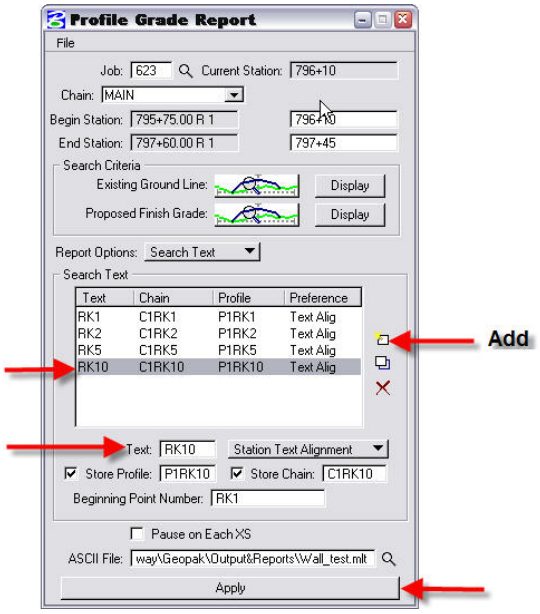

Figure 1-8: Profile Grade Report

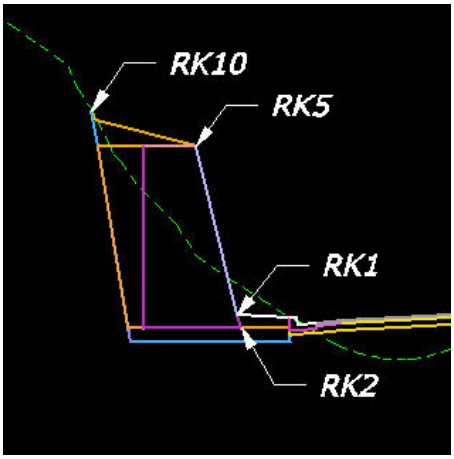

Figure 1-9: Search Text Locations for First Tier of Rockery

1.2.8 Create a new design file for the profiles. *(See CADD Standards Manual for naming conventions). Open the Draw Profile from the Geopak Road Tools dialog as shown in the figure below.*

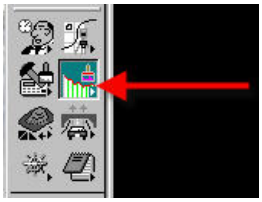

Figure 1-10: Geopak Draw Profile Tool

1.2.9 Open the Profile Cell Control. *Select the bottom of Rockery chain (C1RK1) in the Draw Profile Dialog box. Click on the dialog for Profile Cell Control as shown below.*

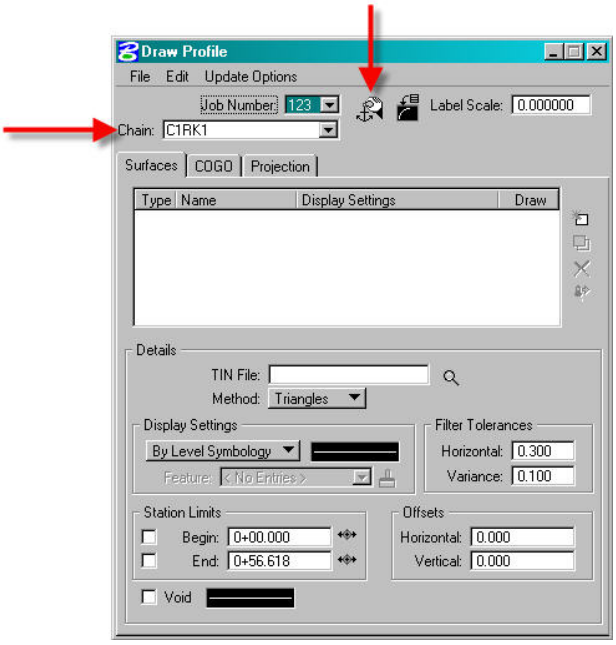

Figure 1-11: Geopak Draw Profile Tool

1.2.10 Define the rockery chain for the Profile Cell. *Click on the Place Profile Cell in the Profile Cell Control dialog box as shown in the figure below.*

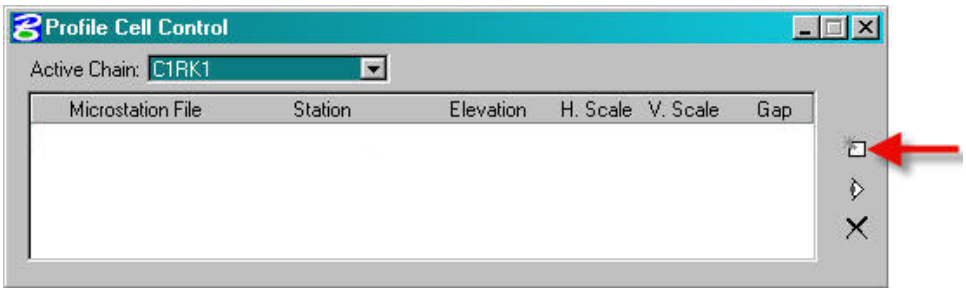

Figure 1-12: Profile Cell Control

1.2.11 Place the Profile Cell. *Enter the beginning station, lowest elevation and 1:1 scale in the Place Profile dialog box. Then place the curser in the View 1 and click to place the profile cell as shown below. The Profile Cell Control will appear with the Active Chain information. Close the Profile Cell Control box.*

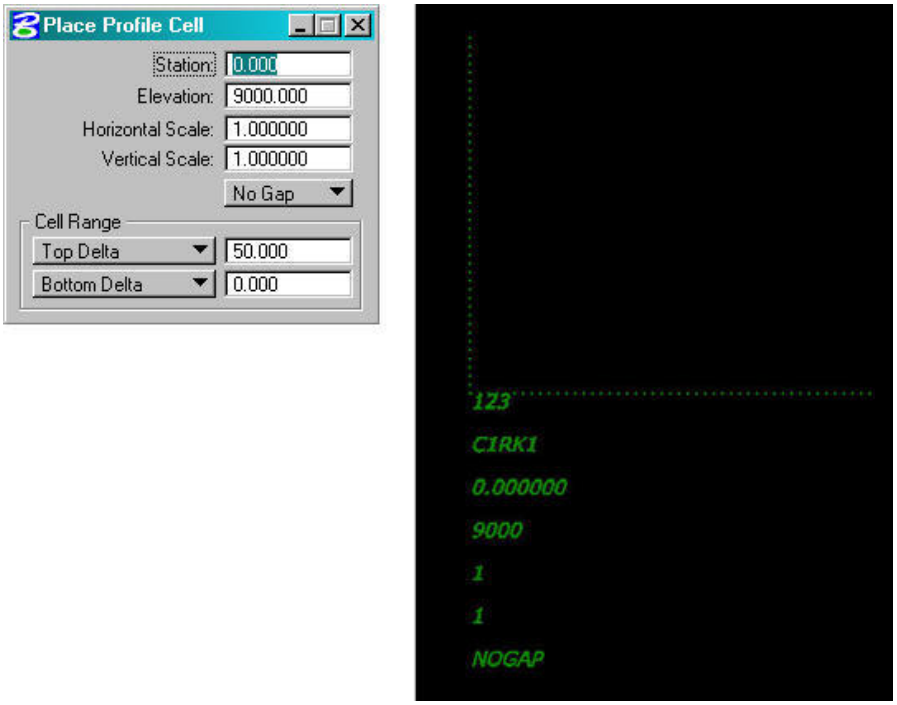

Figure 1-13: Place Profile Cell

1.2.12 Set the profile Display Settings. *Click on the COGO tab in the Draw Profile box. Double click on the By Feature field. Select the Design Profile feature from the database as shown below. Verify/complete the appropriate settings.*

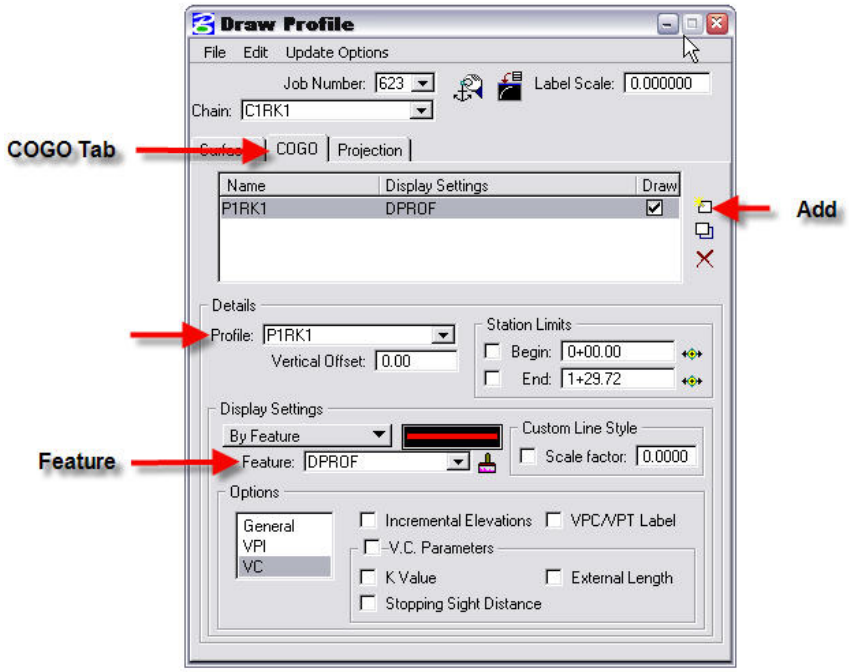

Figure 1-14: Profile Display Settings

1.2.13 Display the Control Point Profile (P1RK1). *Select the Layout Chain/Rockery Control Point Profile (P1RK1) and click on the Add COGO Profile Settings as shown above. The bottom of Rockery profile will display in the design file.*

Figure 1-15: Draw Profile of the Control Point of the First Tier of the Rockery

1.2.14 Set Display Settings for additional profiles. *Click on the Projection tab in the Draw Profile dialog box. Select the chain and profile for the RK2 text. Double click on the By Level Symbology field and select the symbology as shown in the figure below and click on OK.*

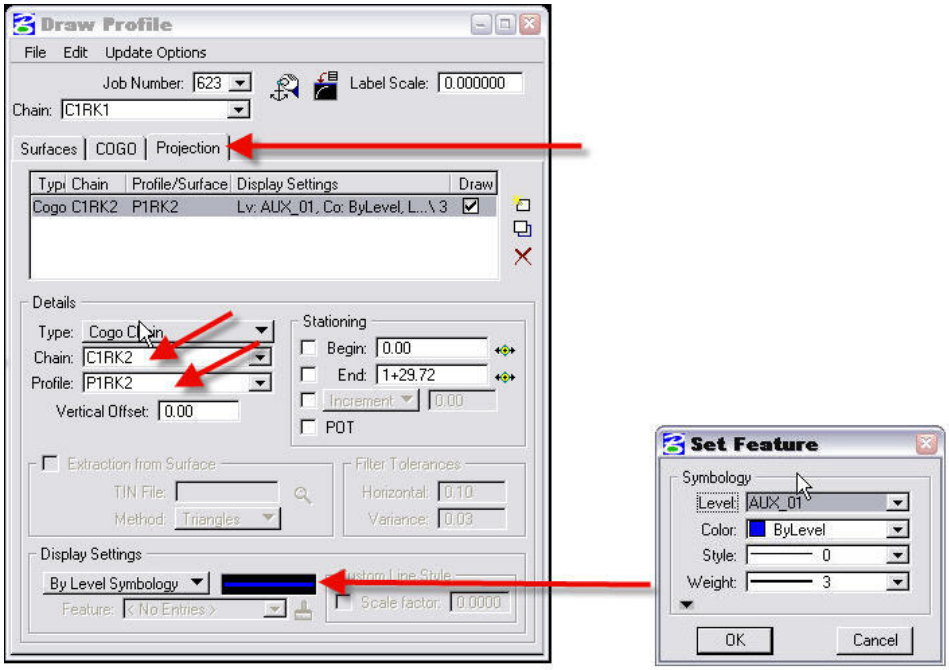

Figure 1-16: Projection of Profile for RK2

1.2.15 Display, or Project, additional profiles. *Click on the Add COGO Profile Settings as shown below. The bottom of Rockery profile will be displayed in the design file. Follow the same steps for the RK5 and RK10 profiles. Note that RK2 and RK5 are bottom and top (preliminary) of the Rockery. RK10 is a temporary profile that will eventually be turned off.*

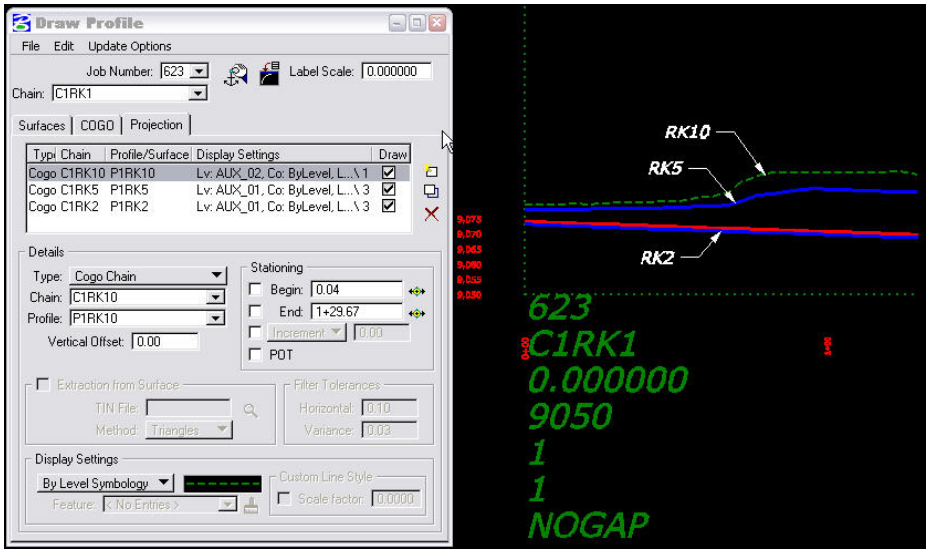

Figure 1-17: Draw Profiles of the First Tier of the Rockery

1.3 REVIEW AND EVALUATE THE INITIAL DESIGN

1.3.2 Review the cross sections and determine if additional tiers of Rockery are required. *RK10 represents the point where the excavation ties to existing ground. The top of rockery plus the Backfill Slope must be at, or above RK10. In the cross section file, measure the vertical difference between the intersection of the backfill slope/excavation slope and the top of rockery. If the elevation (profile) of the RK10 point exceeds the proposed maximum height of the rockery plus this vertical distance, than an additional tier is needed.*

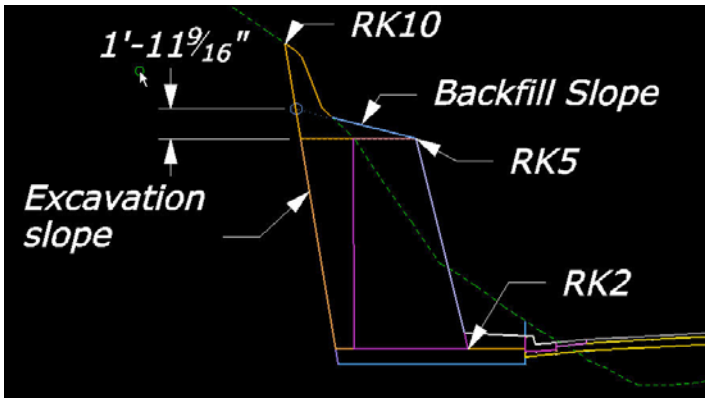

Figure 1-18: Evaluate cross sections for Additional Rockery Tiers

1.3.3 Evaluate additional tiers through the profile. *To further evaluate the need for additional tiers, add a profile showing the maximum height plus the backfill slope height. Within the Draw Profile dialog, select the bottom of wall profile (RK2). Add the maximum height and vertical backfill height and use this value to set the Vertical Offset. Then change the level symbology and "add" a new profile.*

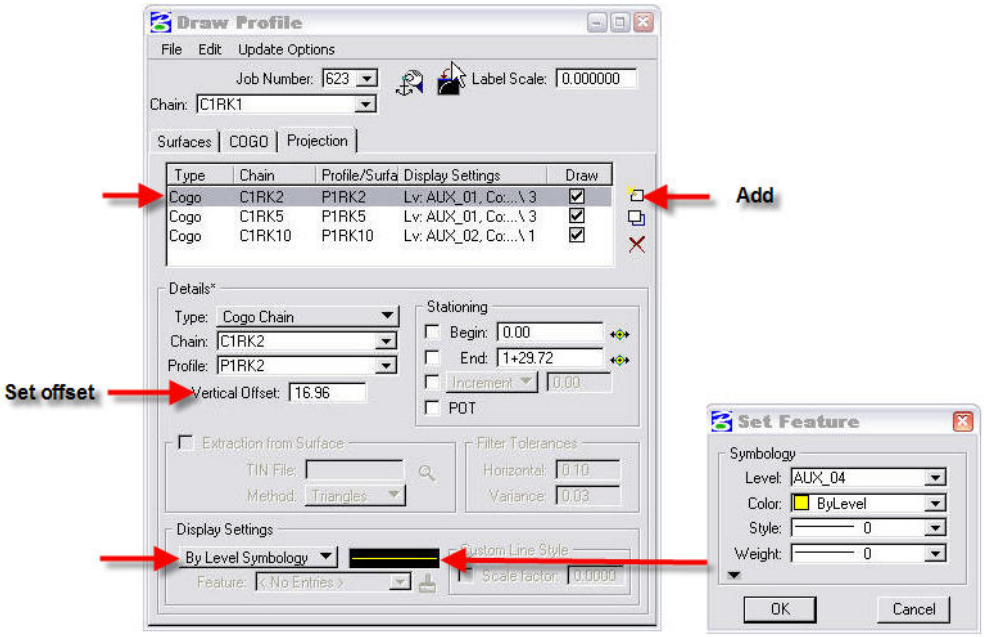

Figure 1-19: Add profile to evaluate the need for additional tiers

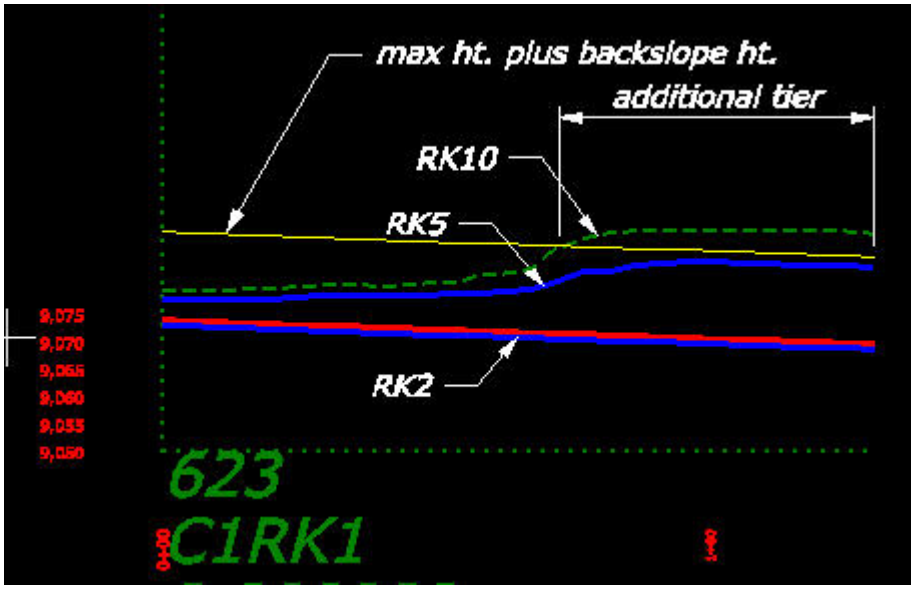

Figure 1-20: Review the profile

1.3.4 Open the Profile Labeling Tool. *Select the profile labeling tool as shown below. In the profile labeler, select the Profile Settings tab. A profile cell control dialog will appear. Select Identify Cell and click and accept the profile cell in the drawing. Use the Profile Labeling Tool to get the station limits for any required upper tier as shown in figure1-23. Write down these limits as they will be important in Phase 2.*

Figure 1-21: Open the Profile Labeling Tool

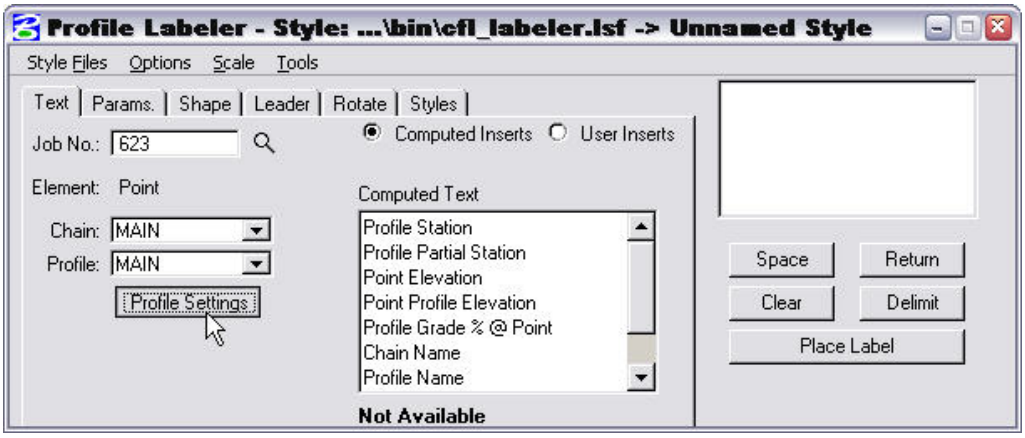

Figure 1-22: Set the Profile Settings

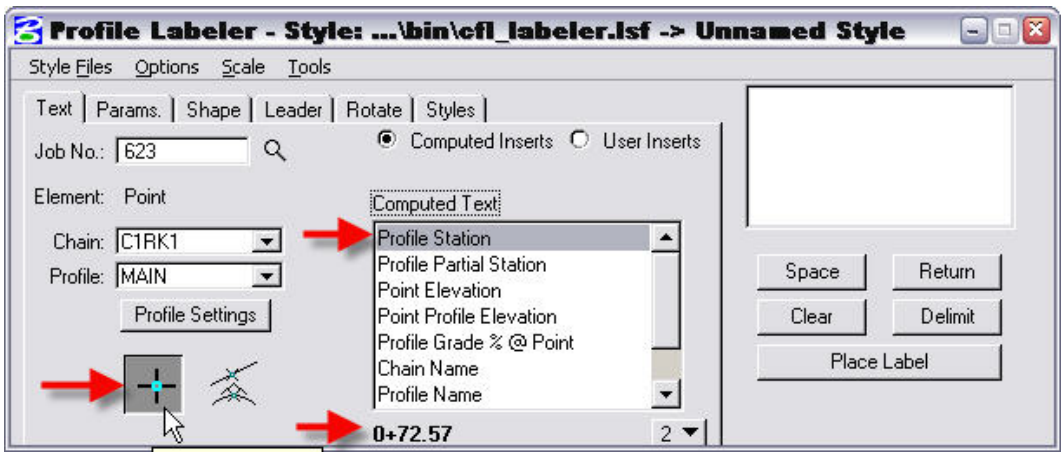

Figure 1-23: Find/label a station in profile

2 *PHASE 2 – Developing the Preliminary Design*

After the completion of Phase 1, there is now a 1st iteration design of the base tier, and it is known if additional tiers are needed. The second phase consists of producing proposed cross sections and profiles that reflect a constructible Rockery design and to finalize the limits of all rockery tiers. This information is given to the Geotechnical Engineer for review. Additional iterations of Phase 2 procedures may be required as a part of Phase 3. There is not a set way to design a rockery. Engineering judgment and opinions of the Geotechnical Engineer and partnering agencies will affect how to finalize the rockeries. These guidelines assume that more than one tier is necessary to complete the rockery design. Use these steps as a guide to completing each rockery design.

2.1 UPDATE THE LOWER TIER PROFILES

2.1.2 Create a new top of Rockery (Tier 1) profile. *First, create a top of rockery profile "P1RKtop". The profile P1RK5 could be used, but this could also be more easily overwritten in error. Make a vertical offset profile as in the tips below. Open COGO, then open the profile offset dialog as shown.*

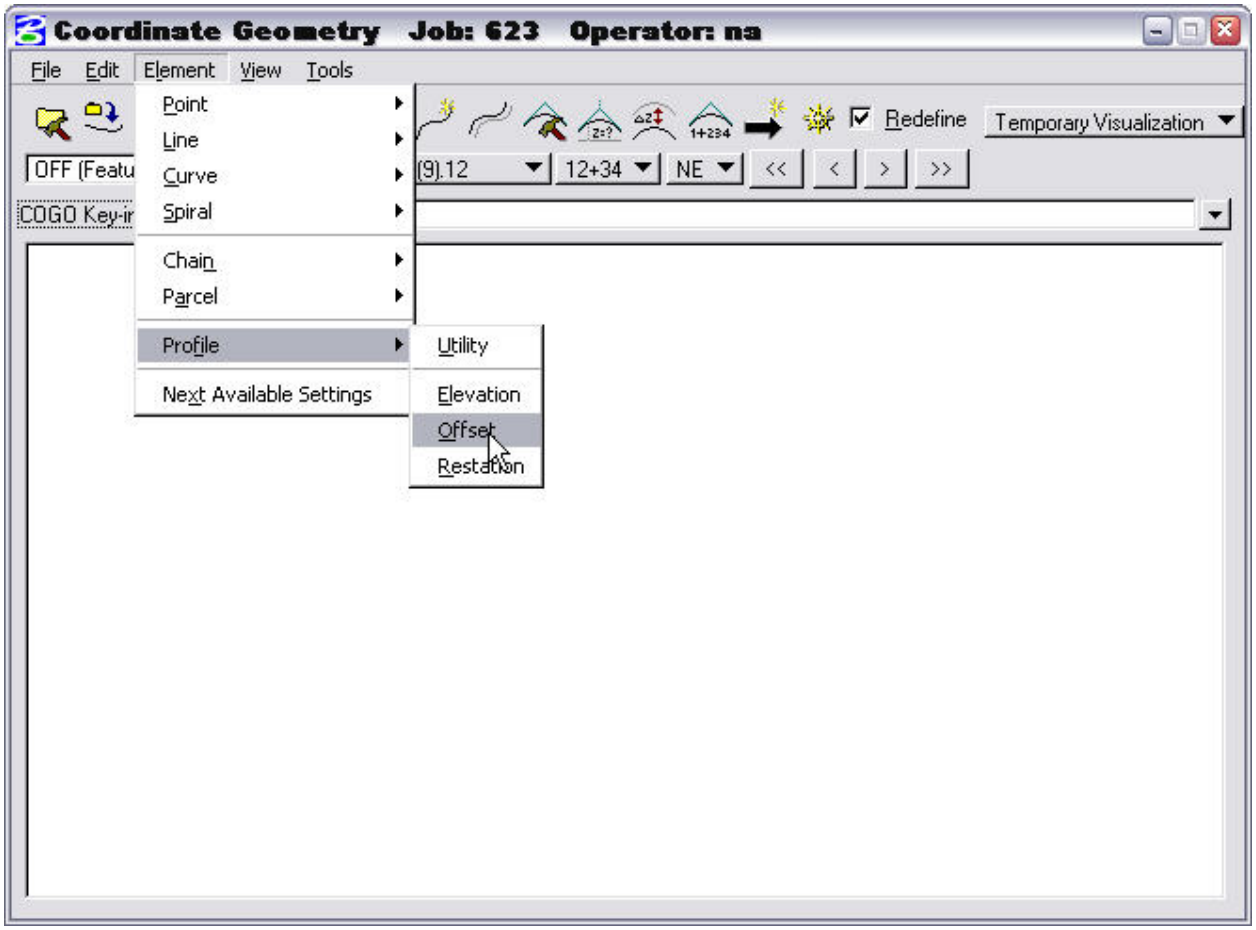

Figure 2-1: Open COGO/Profile/Offset

2.1.3 Store the new top of Rockery (Tier 1) profile. *Select the bottom of rockery profile P1RK2 as the source profile, set the proposed top of rockery profile name, add in the vertical offset (use a height of just less than the max height), add to the dialog and select Create Profile.*

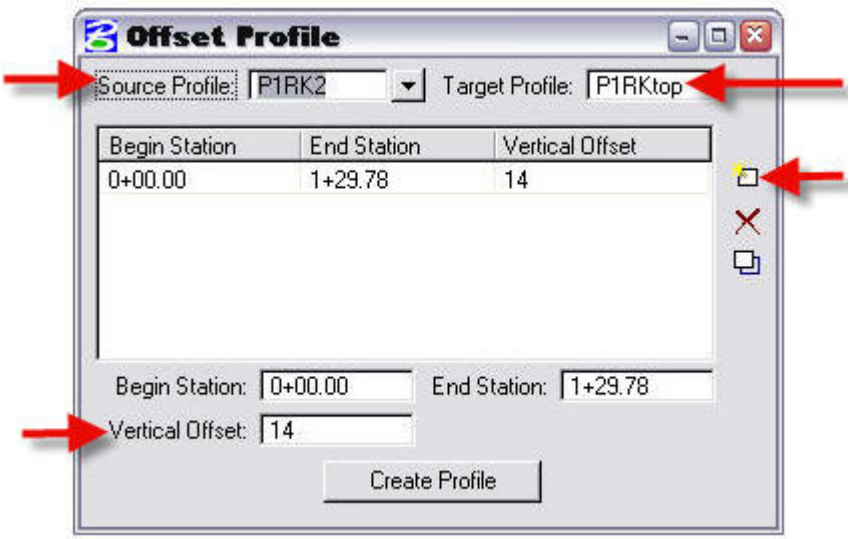

Figure 2-2: Store a profile offset

2.1.4 Open the Vertical Alignment Generator. *Open the vertical alignment tool, as shown below. Click on Identify Cell and select the profile cell for the rockery and load the top of rockery profile.*

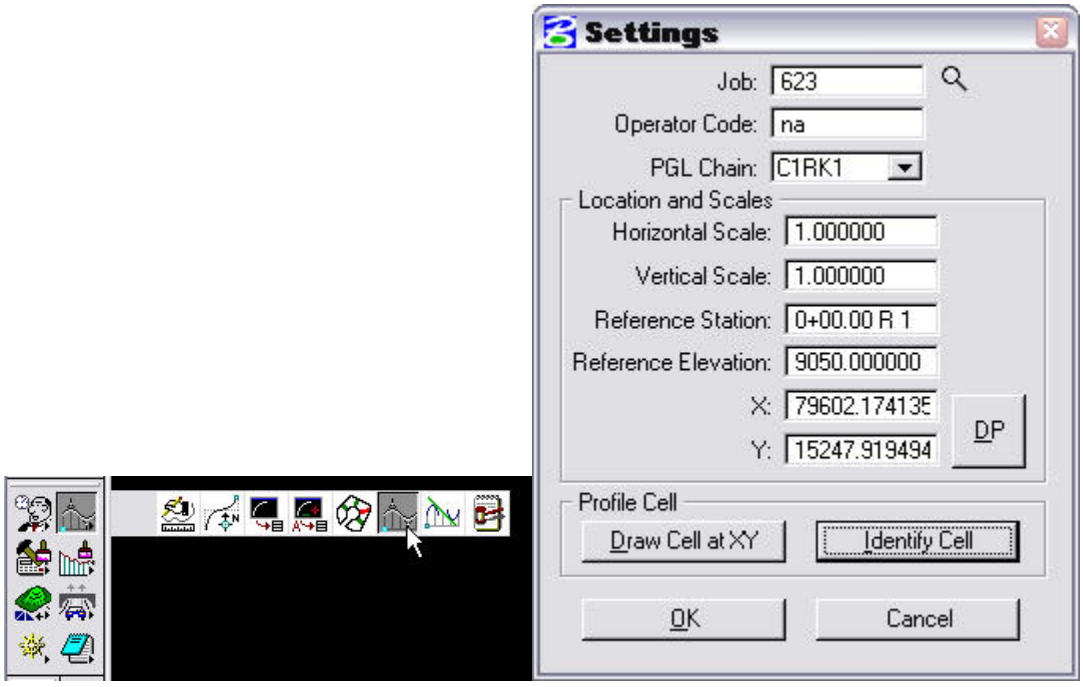

Figure 2-3: Open vertical tools and load profile

2.1.5 Edit the Top of Rockery Profile. *Modify the profile using the editor with the tips below.*

Profile Tips:

- *If this is the first attempt to set a 1st tier profile, and there are multiple tiers, it is recommended to set the proposed top of the first tier to just below the maximum height for the entire profile.*
- *In the Draw Profile dialog; load temporary profiles for the maximum and minimum values for the top of rockery. These will be the RK10 profile minus the vertical backfill slope height (max.) and the RK2 profile plus the defined max height.*
- *If additional tiers are required, set the lower tier profile at a consistent height below the upper tier. Use a profile height slightly less than the maximum defined height.*
- *Start the designed top of rockery profile by creating a profile offset of the bottom of rockery (P1RK2).*
- *Generally, it is better to have lower tiers that are taller than the upper tiers. As a guideline, upper tiers should be at least one-half the height of the lower tier.*
- *End the rockeries at an approximate 4-ft height.*
- *It may be necessary to taper the profiles from maximum heights to the end of the rockeries. Use a 1v:2h taper or similar to ensure final slope stability.*
- *In areas where there is not an additional tier above, it may be necessary to smooth out the top of wall profile. Be sure to set the profile so that the backfill slope is at or above the RK10 elevation.*
- *Ending tiers can be difficult. Ultimately, it may be necessary to hand edit and over steepen the backfill slope.*

2.2 ADD UPPER TIER AND CREATE NEXT GENERATION DESIGN

2.2.2 Replace the rockery Adhocs. *It is necessary to review the proposed profile and/or to determine the limits of the upper tier. Note: a lower tier should not be tapered down unless the upper tier has been ended. Start by modifying the Adhocs for the first tier. Open the AdHoc Attribute Manager as shown below. Click on File then Preferences. The Set Mode should be set to "Replace". Close the Preferences dialog box.*

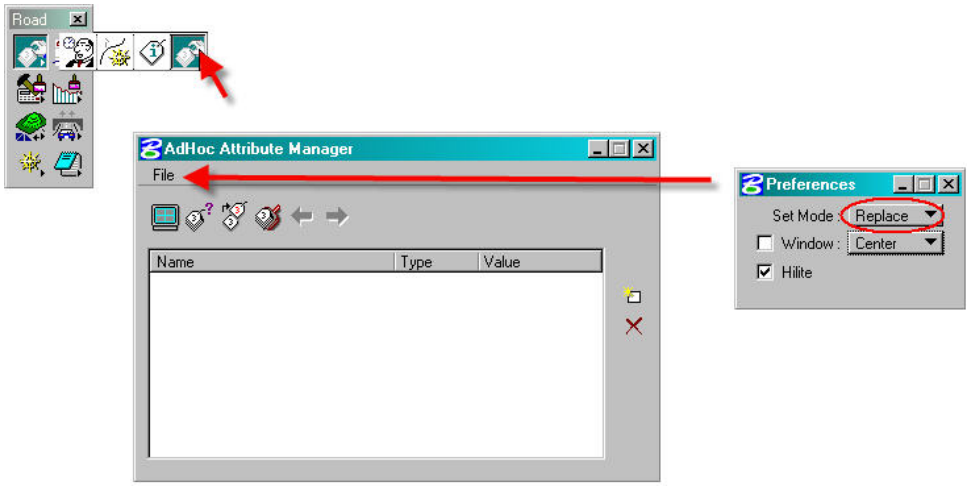

Figure 2-4: AdHoc Attribute Manager

2.2.3 Update and set the new Adhocs. *Click on the Identify Element button as shown below. Double click on the plan view Rockery line. The AdHoc Attributes of the line will then be displayed in the field. To change any of the values, click on the value and type in the desired change as shown below. Include all design parameters supplied by the Geotechnical Engineer. Update the TopWallProfName and WallChainName values. If the Design and Computation Manager is open, make sure that the 'Place Influence' and 'AdHoc Attributes' are toggled off. Click on the Set Attributes button. Click on the Rockery line to identify it, and click again to accept the changes. To check if the changes have been stored, use the Identify Element button as described above.*

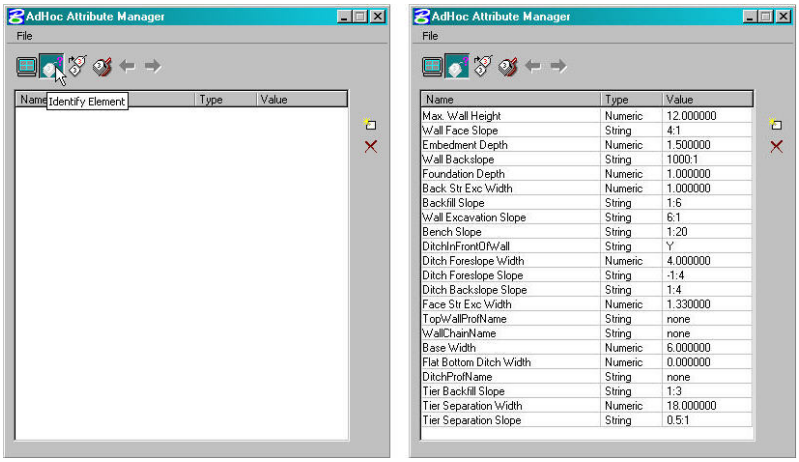

Figure 2-5: Identify Element

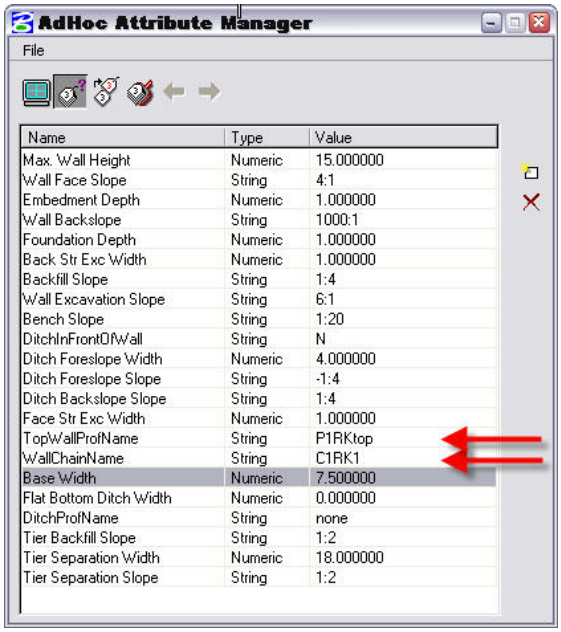

Figure 2-6: Adjust the AdHoc Values

2.2.4 Add upper tier Planimetrics. *Use the same techniques as described in Phase 1. Place the Planimetric lines through the Design and Computation manager with project specific AdHoc attributes. Set the TopWallProfName and WallChainName to none. Initially set the upper tier limits to the same as the lower tier.*

2.2.5 Re-run the proposed cross sections *with the new AdHoc attributes and new tier.*

2.3 DESIGN THE UPPER TIER

2.3.2 Set the upper tier profile and limits. *With the same process as described in Phase 1, store upper tier chains and profiles with the Profile Grade report technique. Review and evaluate if more tiers are required as in Phase 1.*

2.3.3 Create a separate profile cell for upper tiers. *Use the upper tier Control Point chain (C1RK1T2) for the new cell and draw and project the new upper tier profiles as described in Phase 1.*

2.3.4 Create a new top of rockery profile for the upper tier. *Use the process described in Phase 1 if additional tiers are necessary. Or, save the initial top profile generated from the Profile Grade report (P1RK5T2) as a new profile. Load the new top of tier profile with the Vertical Alignment Generator tools and edit using the tips from Phase 1. Note: Start upper tier end tapers from the station points noted from the end of Phase 1. Make a note of the beginning and ending stations of the upper tier profile.*

2.4 COMPLETE THE ROCKERY DESIGN

2.4.2 Project upper tier profiles on base tier profile cell. *Once the upper tier profiles are complete, use the Draw Profile tools, make the base tier profile cell the active cell and project the top, bottom and control point profiles.*

2.4.3 Finalize the lower tier profile and limits. *Now that the final limits of the upper tier are finalized, it is now possible to finalize the lower tier profile and limits. Begin the lower tier tapers before/after the upper tier begins/ends. Make a note of the beginning and ending stations of the lower tier. Modify the station limits of the bottom and control point profiles to match the ending points of the top of tier profiles.*

2.4.4 Update the rockery design. *Open your proposed plan dgn file containing the Rockery AdHoc lines. Trim the Planimetric lines of the tiers to the limits of the final profiles Use the AdHoc Attribute Manager to change the AdHoc attributes for the Rockery to include the top of Rockery profiles and the control point of Rockery tier chains, as shown below.*

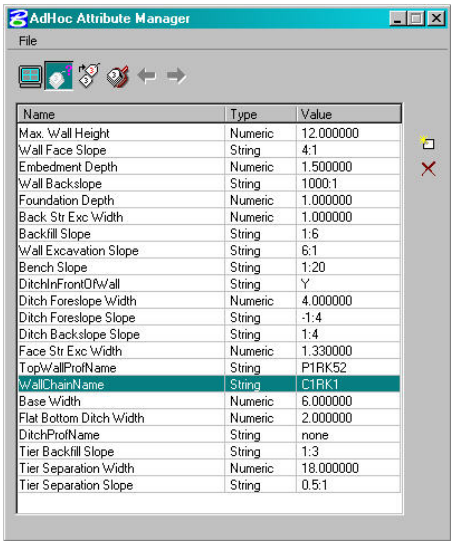

Figure 2-10: AdHoc Attribute Manager

2.4.5 Re-run the proposed cross sections *with the new AdHoc attributes. Check that all design criteria has been met at each cross section. If additional tiers are required, repeat procedures for each additional tier.*

3 *Phase 3 – Developing the Final Design*

3.1 ROCKERY REVIEW AND UPDATE

3.1.2 Create Layout dgn and files for review.

Prepare a package of information for the Geotechnical Engineer to review.

Below is a list of items for review:

- *Layout Sheet for the rockery to be included in the PS&E submittals. Prepare the layout with a similar format and content to a MSE Layout.*
- *Update and provide the CFL Rockery Detail (available on the CFLHD website).*
- *Include a print out of the AdHoc attributes for each tier.*
- *Provide a drawing illustrating the AdHoc variables (Figure 1-2)*

3.1.3 Incorporate comments.

Incorporate any comments from the Geotechnical Engineer. This may require repeating any step/s in Phase 1 or 2.