
Example Data for UTEXASED4 - Educational Version of the UTEXAS Software

Section 1 - Introduction

Five example data files are provided with UTEXASED. The examples are designed to illustrate the various features available in UTEXASED4 and consist of the following:

Example 1 – An automatic search is conducted to find a critical circle.

Example 2 – The factor of safety is calculated for an individual, selected noncircular shear surface passing through a thin, soft clay seam beneath an embankment.

Example 3 – Same as Example 2 except an automatic search is performed to locate a critical noncircular shear surface.

Example 4 – This example is for a manual, interactive search to locate a critical circle for an embankment on a stratified soil foundation.

Example 5 – This example is for a steep slope strengthened with geogird reinforcement. An automatic search is conducted to locate a critical circle.

The examples are described in the following sections. The (binary) data files are provided with UTEXASED4 and can be run by opening them from the UTEXASED4 file menu. You can also change the data files and re-save them if you wish.

Section 2 – Example Problem 1

Example 1 is an analysis of the stability of an embankment resting on a foundation consisting of 10 feet of saturated clay underlain by sand. The groundwater table is located 3 feet below the surface of the foundation (toe of the slope). The cross-section and properties for the slope are shown in Fig. 1.

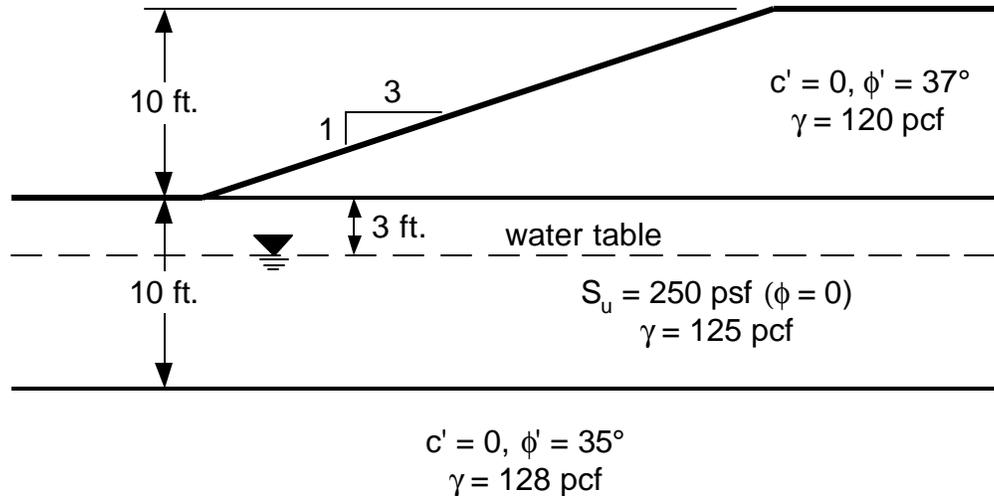


Figure 1 – Slope for Example Problem 1

The data for this problem are configured for an automatic search to locate a critical circle. To run the data first open the input data file (EXAMPLE 1.DAT) using **Open** from the **File** menu. After opening the input data file, the data are read and the slope geometry is displayed. Choose **Do Computations** from the **Run** menu to start the automatic search. After choosing a delay and the number of circles to save from the dialog box that is displayed, the computations will start. You will see each trial circle displayed in gray with the circle having the lowest factor of safety displayed in red. Once the search is completed, position the cursor in the display window and click. The trial circles are then erased and the most critical circle (lowest factor of safety) found by the automatic search is shown along with the distribution of stresses along the shear surface. If you chose to save some of the other trial shear surfaces, they will also be displayed (in dark red). The distribution of stresses along the shear surface is only shown for the most critical circle.

Section 3 – Example Problems 2 and 3

Examples 2 and 3 consist of the stability computations for the slope shown in Fig. 2. The slope consists of an embankment resting on a primarily sand foundation with a 1 foot thick layer of soft, saturated clay. For Example 2 the factor of safety is calculated for the single, noncircular shear surface shown in Fig. 2. For Example 3, an automatic search is conducted to find a more critical shear surface, beginning with the shear surface analyzed in Example 2.

To run Example 2, first open the Example 2 data file (EXAMPLE 2.DAT) by choosing **Open** from the **File** menu. Next, choose **Do Computations** from the **File** menu. The factor of safety and the distribution of stresses along the shear surface are then computed and displayed. Example 3 is run in the same way as Example 2, but using the EXAMPLE 3.DAT data file. When you choose **Do Computations** after opening the Example 3 data file you will first be asked to choose a delay time between successive trial shear surfaces and the number of shear surfaces to save. Once you have done this, the search starts and the various trial shear surfaces are displayed. Upon completion of the search the most critical shear surface is displayed along with the distribution of stresses along the surface.

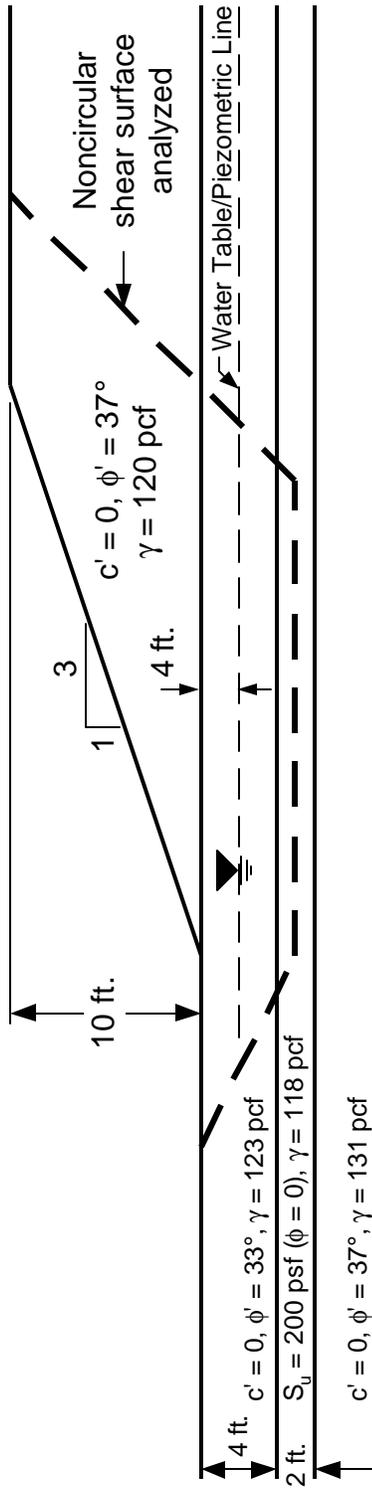


Figure 2 – Embankment Resting on Foundation with Thin, Soft Seam for Example Problems 2 and 3.

Section 4 – Example Problem 4

Example 4 consists of the embankment resting on a horizontally stratified soil foundation shown in Figure 4. Stability calculations are performed for short-term, end-of-construction conditions, using undrained shear strengths and total stresses for the fine-grained soils and drained shear strengths and effective stresses for the freely draining soil layers. This example is setup for a manual, interactive search. For each trial center point the radii are varied such that circles range from being tangent to the top of the lowest strata (24 foot deep) to being tangent to a horizontal line at the elevation of the toe of the slope. Initially the range in radius is divided into ten increments. The increment size is reduced as the search for a critical radius proceeds until the increment in radius is no more than 0.5 foot.

To run the sample data for Example 4, first open the data file (EXAMPLE 4.DAT) using **Open** from the **File** menu. Once the data are read and displayed, choose **Start** from the **Interactive** menu. A dialog box is displayed asking you if you want windows to be arranged automatically; you should generally choose “Yes”. A new, second window that is used to plot the factor of safety vs. the radius for each center point then appears. Nothing is displayed in the second window until you choose the first center point. Place the cursor at the location of the first trial center point in the first, main display window where the slope is displayed and click to enter the trial center. Repeat this process for other trial center points. For each center point entered you should see the factor of safety plotted vs. the radius in the second window. After you have entered three center points for which the factor of safety could be successfully computed, contours of factor of safety are drawn to aid you in selecting additional center points. The minimum factor of safety for the most recently chosen center point (with the “critical” radius) as well as the overall minimum factor of safety found at any stage are both displayed in the lower right of the Status Bar at the bottom of the main display window. The center point producing the lowest factor of safety is also specially highlighted in the graphics display. Continue to select trial center points until you are satisfied you have found the minimum factor of safety.

At any point during the interactive search you can suspend the search by choosing **Halt** from the **Interactive** menu. The most critical circle found to that point is then displayed along with the distribution of stresses along the shear surface. To resume the interactive search choose **Resume** from the **Interactive** menu.

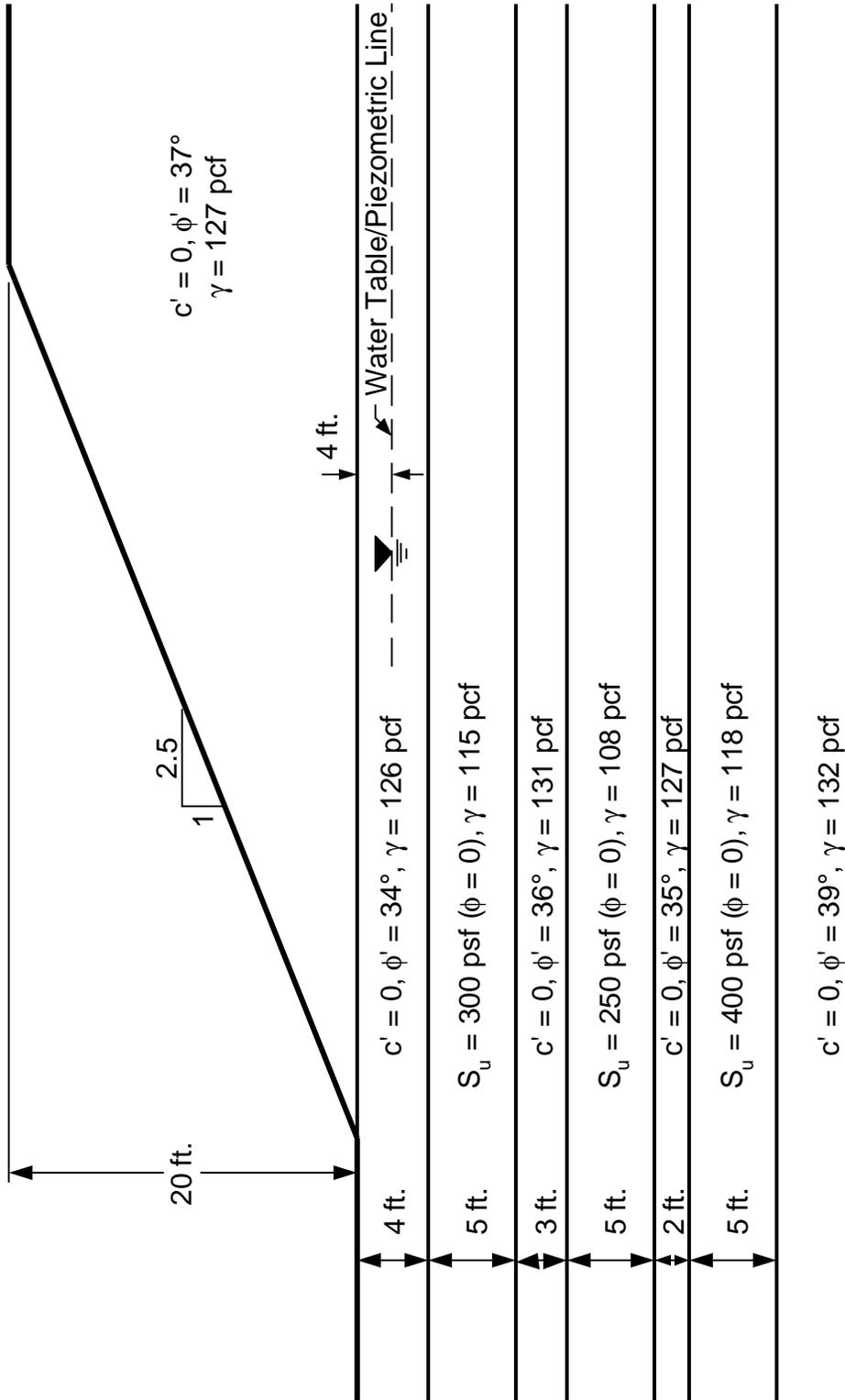


Figure 3 – Embankment Resting on Stratified Soil Foundation for Example Problem 4.

Section 5 – Example Problem 5

Example No. 5 is an analysis of the steep reinforced slope shown in Fig. 4. This example is similar to one presented by Duncan et al (1998) for a cohesionless slope except for two changes: First, a thin layer of soil with cohesion was added at the face of the slope to prevent the slope from failing by shallow sloughing. This shallow layer has no effect on the factor of safety for the deeper shear surfaces of interest. Ordinarily, the face of a reinforced slope would be strengthened by either wrapping the reinforcing material around the face of the slope and/or by placing shorter, secondary reinforcing between the primary reinforcing layers. The use of a thin soil layer with cohesion is an easy way of simulating the strengthening of the slope face to prevent the automatic search from searching out a very shallow shear surface. Without some strengthening of the face the minimum factor of safety is found for a very shallow circle where essentially the failure can be modeled as an infinite slope, i. e. $F = \tan\phi'/\tan\beta$ (β = slope angle). [Note: The full version of UTEXAS4 also allows you to designate a minimum weight of soil to be considered; shear surfaces involving lesser weights are ignored in searching for a minimum factor of safety.]. The second change that was made to the example presented by Duncan et. al was to add a surcharge of 240 psf at the top of the slope. Similar surcharges are often employed when designing reinforced slopes carrying highway traffic.

To run Example 5, first open the data file (EXAMPLE 5.DAT) by choosing **Open** from the **File** menu. Then choose **Do Computations** from the **Run** menu. Computations then proceed much like the computations in Example 1.

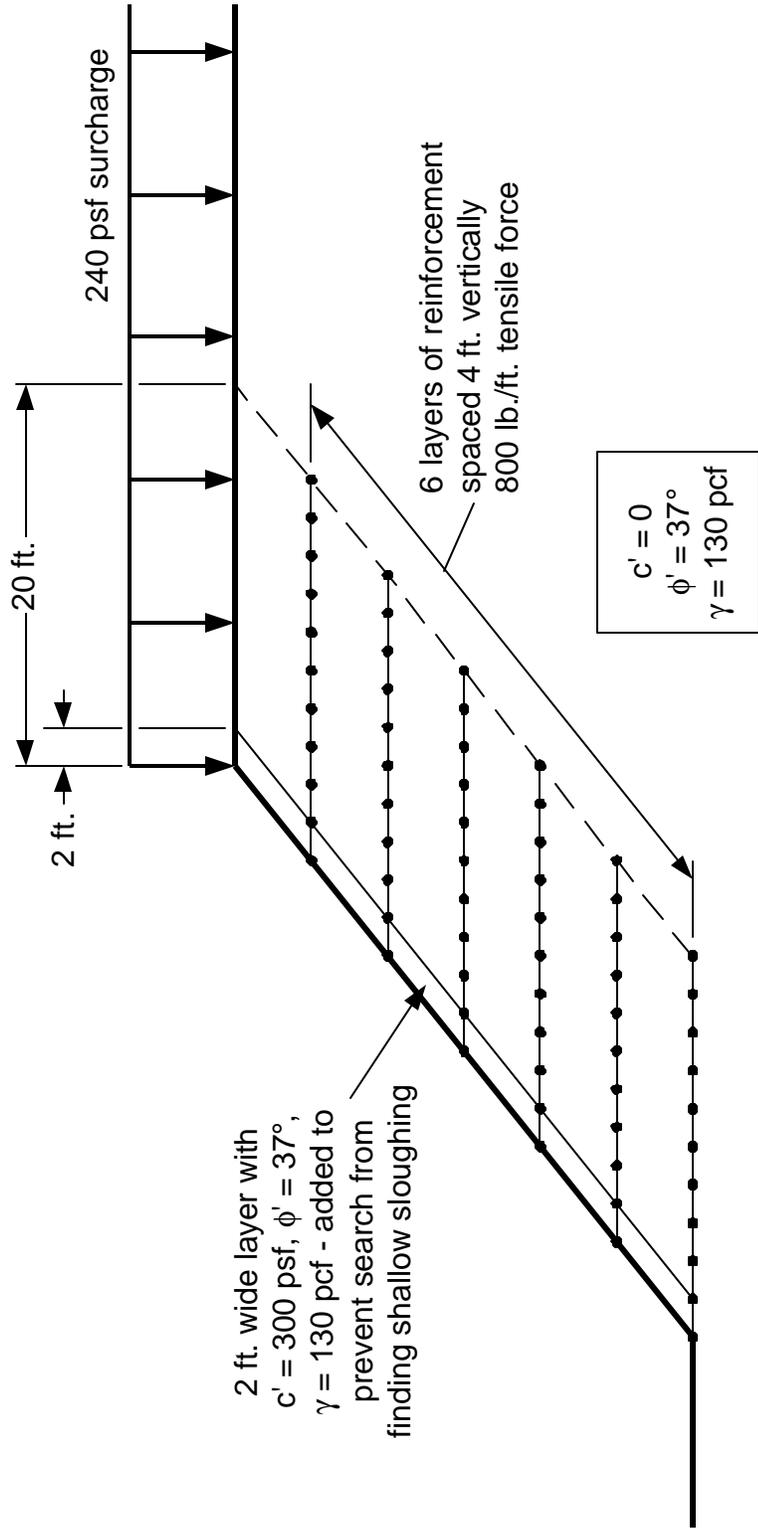


Figure 4 - Slope Reinforced with Geogrid for Example Problem 5.

Section 6 - References

Duncan, J. Michael, Bak Kong Low, Vernon R. Schaefer and David Bentler (1998), "STABGM 2.0 – A Computer Program for Slope Stability Analysis of Reinforced and Unreinforced Embankments and Slopes," Department of Civil Engineering, Virginia Tech, Blacksburg, April, 1998.