

## Workshop exercise example CHASM3.4

### Exercise 1:

### Editing, running and analysing simulation output

1. Having opened *design.chr*, click on  to open the **Hydrology Dialogue Box**. From this window, it is possible to view and edit the geometry of the slope, the soil type, the vegetation component, the storm data and boundary conditions.
2. Click  to open the **Vegetation Dialogue Box**. Here the user can choose between three options; **no interception model, using canopy model or using vegetation model**. For the purpose of this simulation, the default is the **no interception model**. As such the slope is bare, as indicated in the top right-hand corner of the window.
3. Click  to exit the **Vegetation Dialogue Box** and return to the **Hydrology Dialogue Box**.
4. Similarly, now click on  to view the soil strength parameters for the slope. Click  to return to the **Hydrology Dialogue Box**.
5. To view the **Storm Dialogue Box** click on  This window shows the total length of the simulation, the start and stop times of the storm and the associated rainfall intensities.

At present the default is a 1hr storm at 10mm/hr over a total simulation length of 10hrs.

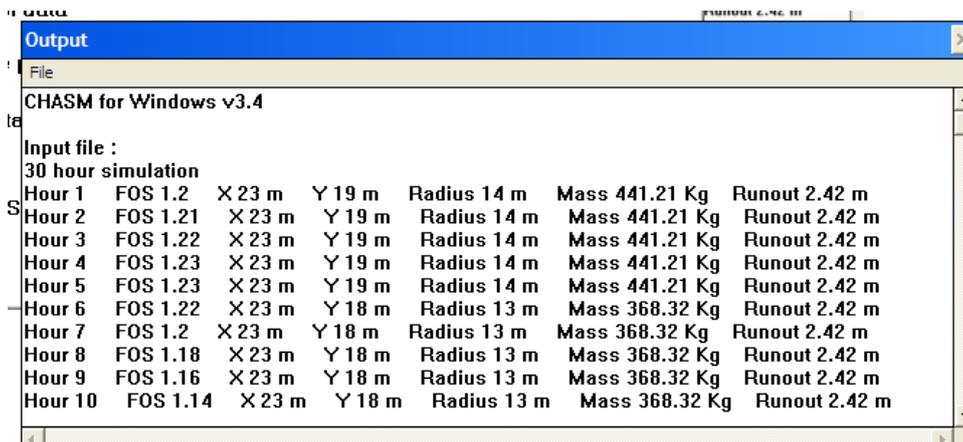
**NOW EDIT this to a total simulation length of 30hrs with a storm occurring between hours 5 and 10 (i.e. storm start time = 5, storm stop time = 10) and edit the rainfall intensity to 20mm/hr for each hour of the storm.**

6. Click  to return to the **Hydrology Dialogue Box**. Click  once again to return to the **Main Dialogue Box**.
7. Click  to open the **Stability Dialogue Box**. For the purpose of this simulation, the Bishop circular analysis is used whereby the position of the slip grid and the radius increment are defined.

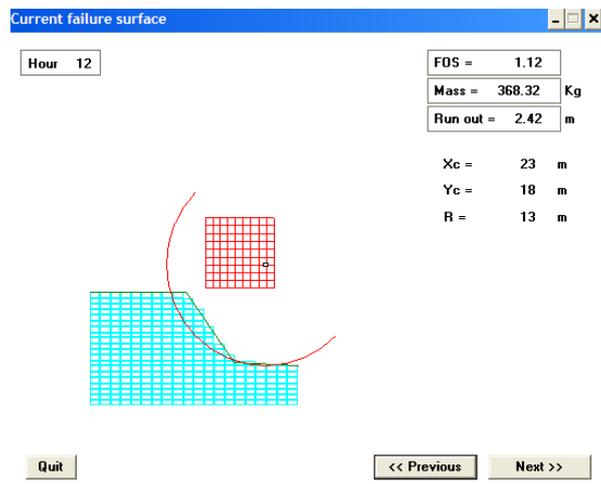
**NOW EDIT the X Y co-ordinates of grid start to X=15, Y=15**

Click  to return to the **Main Dialogue Box**.

- Click  to run the simulation. The output consists of the minimum factor of safety, the x-y co-ordinates of the slip grid and the radius for the minimum factor of safety and, finally the mass of material lying above the slip surface. When the simulation has finished, simply drag the **output** window to the bottom of the screen.



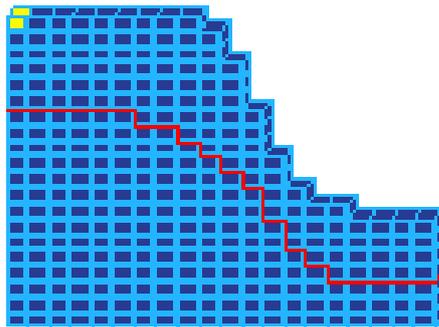
- To analyse the results, first access **Graphics/Cross-Sections** from the pull-down menu at the top of the **Main Dialogue Box**. This screen allows the user to 'play' through the simulation, examining the slip surface for each hour and its corresponding factor of safety.



- Finally, by entering **Graphics/Hydrology** it is possible to view the pore-water pressures through the slope at the time of the minimum factor of safety.

## **Exercise 2:** **Change the water table**

1. In the **Hydrology inputs** window change the water table in each column [using the 'current column' and 'water table height' options] to represent a higher water table similar to that shown below:



2. Compare the results with those from exercise 1

## **Exercise 3:** **example to edit geotechnical properties & compare results**

1. Using the same input file **design.chr**, access the **Hydrology Dialogue Box**.
2. Now re-enter the **Main Dialogue Box** and click on  to redefine the soil type. At present the permeability is set at  $1e-05$  m/s with a cohesion value of  $0$  kN/m<sup>2</sup> and a friction value of  $33^\circ$ .

**For the example, simply edit these so that the permeability is  $9e-5$  m/s with a cohesion value of  $6$  kN/m<sup>2</sup> and a friction angle of  $35^\circ$ . This will be applied to the whole slope as only one soil type is specified (i.e. Type 1).**

3. Access the **Hydrology Dialogue Box** and click on  to check the soil parameters of the slope for the current cell highlighted in the visual display.
2. Return to the **Main Dialogue Box** and run the simulation. Once again, drag the **output** window to the bottom of the screen. Access **Graphics/Cross-section** and **Graphics/Hydrology** to analyse the output.
3. Now try running another simulation with a different soil permeability of  $9e-6$ , using the same process as in step 2. **Compare the results.**

**Exercise 4:**  
**Adding the third dimension – Soil Water Convergence and Divergence**

1. Using the same test slope, *design.chr*, enter the **Main Dialogue Box**. In the left-hand portion of the window there is an option to add 3D graphics and alter the breadth of each column.
2. Firstly, a divergent slope will be examined. To do this, simply start at the top of the slope (i.e. in column 1) and increase the column breadth as you move down through the slope cross-section. From the toe of the slope (i.e. column 20) to the end of the cross-section, the column breadth may be either increased or kept constant.
3. Having edited the geometry of the slope, run the simulation and analyse the results.
4. Now repeat the editing process for a convergent slope. This time the column breadth will decrease down the slope. Ideally, to make a comparison between the results for convergence and divergence, the same curvature or angle should be used. Once again, run the simulation and compare the output.

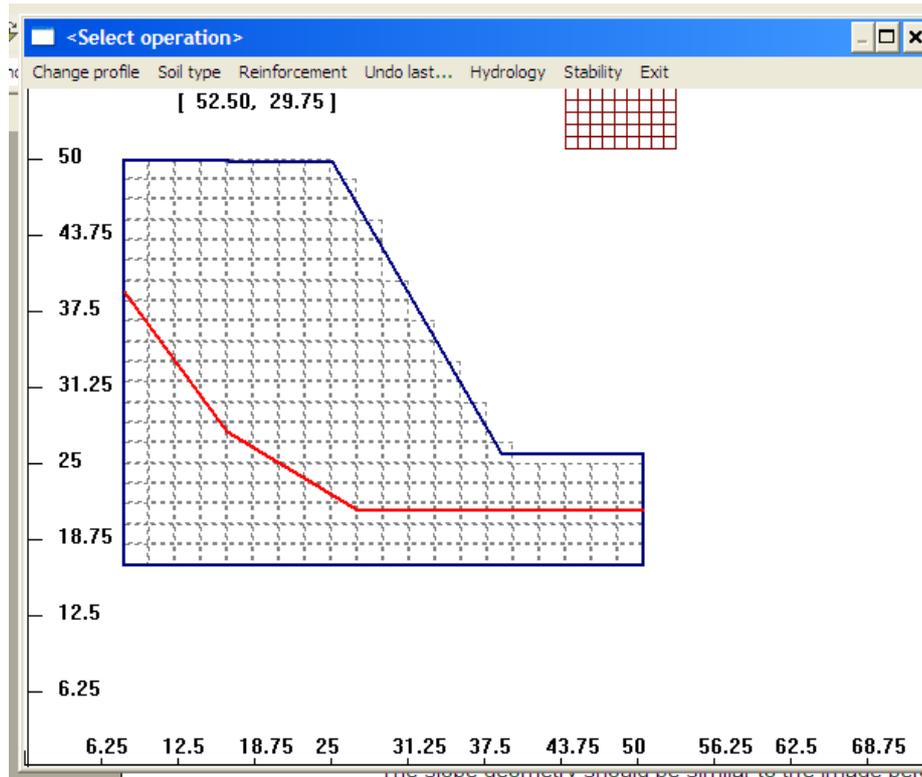
**Note: There are preloaded convergent and divergent slope geometries which can also be used : con.chr & div.chr**

**Exercise 5:**  
**Define Window – building an input file**

1. Close *design.chr* via the **File/Close** option and click on **Graphics/Define** in the hydrology dialogue box.
2. Click **Change profile/Zoom** to zoom in or out of the x and y-axes according to the size of the slope in question. In this test case, zoom to 75%.
3. The co-ordinates which define the slope for this case area as follows (in metres):

$X_1 = 0.0$	$Y_1 = 50.0$
$X_2 = 30.0$	$Y_2 = 50.0$
$X_3 = 40.0$	$Y_3 = 25.0$
$X_4 = 50.0$	$Y_4 = 25.0$
$X_5 = 50.0$	$Y_5 = 15.0$
$X_6 = 0.0$	$Y_6 = 15.0$

The slope geometry should be similar to the image below (also includes water table and slip grid).



4. To draw the slope click **left mouse button**, then drag the mouse to the required co-ordinates and left click again.
5. Repeat this until the slope geometry is defined. Click **right mouse button** to draw the vertical line through the x-axis. **Right** click again to define the base of the slope and intersect with the y-axis.
6. Click **Hydrology/Draw cells** to automatically define the mesh. Mesh dimensions may be changed through **Hydrology/Change cells**. However, the default setting of 20 by 20 cells is adequate for this example.
7. Access **Hydrology/Water table** option and draw water table by clicking the **left mouse button** and dragging the cursor. **Right** click to finish the water table. Try drawing the water table from co-ordinates 0.0, 30.0 to the toe of the slope at 40.0, 25.0.
8. Differential soil horizons may be included by accessing **Soil type/Strata\***, respectively. These are drawn in the same manner as the water table and slope geometry. For the first simulation, simply assume a homogenous soil with strength parameters of 6 kN/m<sup>2</sup> and 35° (as in St. Lucia example – test case 2).
9. Place the slip grid by clicking **Stability/Slip grid location**. **Left** click on the screen to move the grid to the desired co-ordinates. For this example, place the centre of the grid at co-ordinates 50.0, 50.0.
10. The default grid may be edited by accessing **Stability/Define grid**. For computational purposes the **initial radius** should be changed so that the slip circle intersects with the slope after only a few searches. As such change the initial radius to 15m and the radius increment to 1m. In

conjunction with this the **grid increment** should be changed to 3m for both the x and y-axes.

11. Click **Exit** to return to the **Main Dialogue Box**. Click  to access the other dialogue boxes to add new or edit existing components (e.g. change the storm input data).
12. Click  to start the simulation.

\* If more than one soil type is applied to the slope, then the soil parameters should be defined by clicking  in the Main Hydrology Box.

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## **Exercise 6:** **Vegetation modelling**

**NOTE:** this version for this training course is a Beta version of the code, the vegetation component of which is under enhancement & development...the current calculations will not be accurate. The exercise below is illustrative of the bioengineering capabilities that are being enhanced.

1. Enter the **Hydrology Dialogue Box** and click on  to enter the **Vegetation Dialogue Box**.

To make bioengineering comparisons In this version of CHASM, you must **first** undertake an initial simulation with **NO** vegetation [ie click the **no interception** option]. Keep the results file so that comparison with a vegetated slope can be made

Having completed the 'no interception' case then, in the top left-hand corner of the window, change the option from **no interception** to **using vegetation model**.

2. Now scroll down through each of the columns in the top right-hand portion of the window and select vetiver (cropped). A corresponding change to the effective permeability and strength parameters may be seen as the vegetation is added to each column.
3. Now try running the simulation to see if the vetiver counteracts the adverse effect of slope convergence. It is important to note here that when the simulation comes to an end, the slope is returned to its default setting of a bare slope. As such, for each simulation the vegetation will have to be 're-planted'.
4. Try using some other vegetation types and possibly varying the soil permeability to ascertain the circumstances under which the vegetation may affect slope stability.