Landslides – Activity 2

Excel Factor-of-Safety

# Excel Exercise

1. Open up the Excel *FS\_Exercise.xls* file.
2. There are 3 parts to this spreadsheet: 1) the factor of safety (FS) equation and its parameters, 2) the calculation section, and 3) visualizing results and study questions.
3. Review the equation, its general meaning, and the make up of *resisting* and *destabilizing* forces. Go over each of the parameters of the equation. Review the units of the parameters.
4. In Part 2, example values of parameters (low, middle, high) are provided. Formulas that calculate the two elements (A and B) of the FS equation are provided. Click on the boxes, look at the formulas within, and try to match the formula to the equation in Part 1.
5. Perform your own calculation by entering in values in the blue boxes and watch the “Your Results” change.
6. Perform sensitivity test by keeping all the parameters the same and adjusting only one, such as slope angle or cohesion. Some parameters have a lot of influence of the FS compared to others. This is a sensitivity analysis.
7. Part 3 provides a graph where you can see where their results plot compared to the 3 examples. Are they above or below FS=1?
8. Address the following questions in your exercise:
9. What does it mean when FS = 1?
10. What are the units of FS? (*Hint: Cancel out the units*)
11. What happens to the first element (A) of the FS equation when cohesion is 0?
12. What is FS when slope is 0? (*Hint: can you divide by 0?)*
13. What is FS when soil depth is great (like 30 m) and soil is saturated? Why do you think that is?
14. Why do you think the example with the highest value of cohesion resulted in a FS < 1?
15. What parts of this equation are likely to be influenced by climate? How does this depend on where you are and what time of year?

# Graphing Exercise

In this exercise, you will create a graph of the factor-of-safety (y-axis) and slope (x-axis) for two different soil wetness conditions: Rw = 1 (saturated soil) and Rw = 0.1 (dry conditons). Set the Rw=1. Record the FS value as you change the slope in increments of 5 degrees (from 0 to 45 degrees) in the table below. Repeat this, but set the Rw=0.1. On graph paper, plot the FS vs Slope for each of the Rw conditions (2 columns below). Address the following questions:

1. How does the FS change as slope increases?
2. Is the relationship between slope and FS linear (straight line) or not?
3. For the same slope, which Rw line has the higher FS? Explain why this is the case.

|  |  |  |
| --- | --- | --- |
| Slope | Factor of Safety whenRw = 1 | Factor of Safety whenRw = 0.1 |
| 0 |  |  |
| 5 |  |  |
| 10 |  |  |
| 15 |  |  |
| 20 |  |  |
| 25 |  |  |
| 30 |  |  |
| 35 |  |  |
| 40 |  |  |
| 45 |  |  |

# Study Questions

1. What hillslope factor-of-safety value would you consider building a house on? When wouldn’t you?
2. Does geology play a roll in the factor-of-safety value? How?
3. Would it be wise to clear trees on a hillslope with an estimated factor-of-safety value of 1? What parameters within the equation do trees affect?
4. Does the factor-of-safety value provide information about how large a landslide might be or how far it might travel?