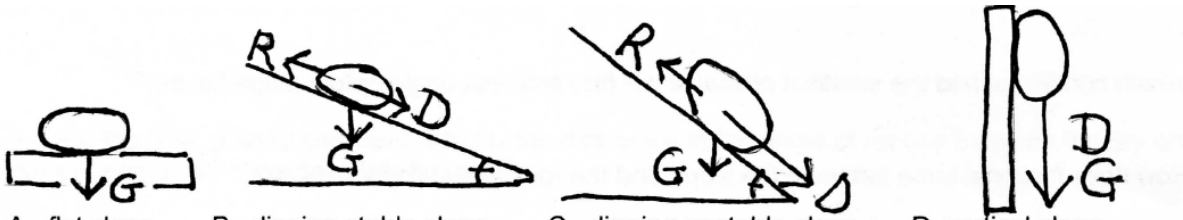
GEOL 1102
GEOLOGIC HAZARDS PART 4 - SLOPE STABILITY AND MASS WASTING

I. FACTORS IN SLOPE STABILITY

The **critical slope angle** (also called the **angle of repose**) is the maximum angle a slope can attain before it fails. This is the angle at which the slope will become unstable and the material will begin to slide down.

For the first experiment, you will be given two boards - one that is smooth and sanded and one that has a rough surface. These boards represent different types of slopes. You will also be given 2 rocks of equal size but different weights (masses) representing different material on top of each slope.

When the slope is flat (fig. 1a), the only force acting upon the rock is the downward force of gravity. Raise one end of the board, but not so much that the rock moves. There are now 3 forces acting on the rock- the downward force of gravity, the resisting frictional and cohesive forces keeping the rock in place, and the force parallel to the slope pulling the rock downward. As long as the gravitational and resistant forces are greater than the force pulling the rock down the slope, the rock will not move (fig. 1b). Raise the board until the rock just begins to move. At this point, the force pulling the rock down the slope is greater than that of the gravitational and resistant force. This angle, where the slope begins to fail, is the critical angle (angle of repose; fig. 1c). If the board is tilted to vertical, there is only downward force of gravity pulling the rock down.



A. flat slope. B. dipping stable slope C. dipping unstable slope D. vertical slope

Figure 1.

You will make 4 measurements of the critical slope angle for each board and each rock, and then calculate the average critical angle.

	measurement 1	measurement 2	measurement 3	measurement 4	average critical angle
Rough board with light weight rock					
Rough Board with heavy rock					
Smooth board with light weight rock					
Smooth Board with heavy rock					

Now spray each board with water and make 4 more measurements of the critical slope angle. Calculate the average.

	measurement 1	measurement 2	measurement 3	measurement 4	average critical angle
Wet Rough board with light weight rock					
Wet Rough Board with heavy rock					
Wet Smooth board with light weight rock					
Wet Smooth Board with heavy rock					

1. Which conditions had the highest critical angle (the largest angle before slope failure)?

2. Which conditions had the smallest critical angle (the smallest angle before slope failure)?

3. How does frictional force between the slope and the rock affect slope stability?

4. What factors affect the frictional force?

5. How does weight (mass) affect slope stability?

In loose, unconsolidated sediment, the angle of repose depends on the size and shape of the grains, as well as the affects of adding water. With small amounts of water, there will be a cohesive force between the grains. With greater amounts of water, the friction between the grains is decreased. In addition, the weight of the water will increase the forces pulling the material down slope.

For this part of the lab exercise, you will pour sediment into a large pile and measure the steepest slope possible before the sediment begins to collapse down slope. First determine the angle of repose in dry sediment. Then, spray the sediment with water and determine if the angle of repose is affected. Finally, for those sediments where it is possible, saturate the sediments and determine the angle of repose.**

** Your instructor will have a separate container for the wet sediments. DO NOT put wet sediments back with dry sediments!!!!!

GRAIN SIZE	ANGLE OF REPOSE (DRY)	ANGLE OF REPOSE (DAMP)	ANGLE OF REPOSE (WET, SATURATED)
rounded gravel, >2mm			
angular gravel, >2mm			
sand size			
silt size			

6. Which dry sediment had the steepest angle of repose? Why do you think this sediment has the steepest angle of repose?

7. Does adding water affect all sediment sizes in the same way? How does sediment size affect the angle of repose for wet sediment?

8. For the finer grained sediment, what is the difference in the angle of repose between the dry and damp sediments? Why does this happen?