

G454: Basic surveying methods

Surveying is used to characterize the topography of some area of interest, such as a hillslope, reach of stream, landslide scar, parking lot, etc. The instrumentation used and the level of detail in data collection are dictated by the purpose of the survey (accuracy required), landscape characteristics, and time and budget constraints. In this class, we'll mainly be interested in measuring hillslope gradients, stream cross sections, and stream longitudinal profiles. We will mainly use hand levels and stadia rods (more accurate surveying typically uses either a total station or a level mounted on a tripod). Hillslope gradients can also be measured with a Brunton or inclinometer. The following outlines the basic procedure for surveying with a hand level; this is a very basic description and there are many aspects of surveying not noted here.

- Surveying equipment
 - Stadia rod: an expandable rod with height measurements shown on the rod
 - Hand level: A small cylinder (~15 cm x 2 cm) with telescope lens and focus that allows the reading of numbers on stadia rod
 - Field notebook and pencil
- Surveying jobs
 - Surveying works quickly with 3 people: one to operate the hand level (the surveyor), one to record readings the surveyor calls out in a field notebook (the recorder), one to hold the stadia rod (the rod-person). The surveyor can also do the recording.
- Basic method
 - The basic method is for the rod person to move along the transect you are measuring (which you'll lay out with a measuring tape), with the surveyor sighting the hand level to the stadia rod at each position and reading the height of the stadia rod that they are level with. The surveyor will periodically have to move, when their eye height is no longer level with any position on the stadia rod, or when trees or other obstructions block their view of the rod.
- Steps to survey
 - Measure the eye height of the surveyor. This is abbreviated as HI (height of instrument). The surveyor should always stand up straight so the HI remains consistent. Remember to record a new HI if you switch surveyors.
 - Lay a measuring tape along the area to be surveyed, anchoring the tape with rocks or other objects so it doesn't move. When measuring a hillslope, the 0 point of the tape should generally be placed at the low point of the slope.
 - For surveying an area with large elevation changes (a moderate to steep hillslope), the surveyor should position themselves in a spot where their eye height is even with somewhere near the top of the fully extended rod. The surveyor will focus the hand level on the stadia rod, level it with the leveling bubble, and call out the reading on the stadia rod that is in line with the middle cross-hair on the level. The rod person will call out the distance on the tape where they are standing.
 - The first measurement should be taken at a known or assumed benchmark. For the weathering lab, you can designate a survey point at the bottom of the valley as your benchmark (BM). When you are processing your data, assign an

approximate elevation to this spot using a topo map; all other elevations will be calculated relative to your BM.

- Creating a turning point
 - The rod person moves up the transect, and a stadia rod reading (referred to as a foresight, FS) and distance along the tape will be recorded at each spot. Eventually, the eye height of the surveyor will be level with somewhere near the bottom of the rod, or the rod will be nearly out of sight of the surveyor, and a reading will be taken here. At this point the rod-person stays in the same position, and the surveyor moves to a new position where she/he can get a reading near the top of the rod (this applies to steep hillslopes with lots of elevation change), or where the view of the next area to be surveyed is unobstructed. The surveyor then takes another reading, of a new height on the rod, at the same stadia rod location. This is called a backsight (BS), because you're shooting back to a known position. When the surveyor moves, this should be noted as a turning point (TP). TPs introduce error into a survey, so the fewer TPs, the better. From the new surveyor position, another series of foresights is collected, until a new TP is needed. Readings should be taken at breaks-in-slope (i.e., where the slope angle appears to change) and anywhere else that seems appropriate.
- Additional notes
 - Note that some of the hand levels have 3 cross-hairs. By recording the rod readings at the top and bottom cross-hairs and then calculating the difference between them (s), the horizontal distance from the surveyor to the stadia rod (L) can be determined by $L=100s$, where L and s are in meters. This step is not necessary if you have a tape for determining distance.
 - You should have a data table in your field book with separate columns for station (distance along tape), FS readings, BS readings, and notes with relevant details about each station.