Mapping Lesson Overview

- Set up station together the first time with instructor demonstrating
    1. Unpack the total station and check that all screws are loose
    2. Level the tool using legs, showing tips on controlling movement and making it sturdy
    3. While demonstrating how to level, discuss the tool:
        a. What does this tool let us do? It makes measuring the three-dimensional location of points on the landscape much easier and more precise.
        b. When we set up this station, we give it a fixed location on our arbitrary grid. The instrument then measures the locations of other points relative to itself (a known point), outputting those locations based on our grid system.
        c. How do these tools work? Spatial relationships between points
        d.Why do we choose the total station or the GPS for particular tasks? Strategy behind balancing precision, accuracy, research objectives
        e.Why do we use both GPS and total station at most sites? Georeferencing, precision
    4. Instructor sets up observation station coordinates
    5. Instructor recruits student to hold rod at backsight, completes station setup (be sure to repeat what is said during backsighting to student holding the rod when they come back)
    6. Instructor demonstrates measuring 2-3 coordinates
    7. After this, instructor doesn't use total station at all except to help a student. Students must practice using the instrument and develop a sense of the grid by watching the numbers move as the prism moves and is measured.
- Divide responsibilities among crew: station operator, prism, coordinate recording on paper
    - I suggest switching jobs after outlining each trash mound or recording all the test pits in one trash mound (switch about 6 times)
    - If there are more than 6 students, some students may not be on the instrument station but if they are recording the points on paper and watching the instrument station they usually have a good idea of how to work it
    - It is especially helpful to be nearby but make them work out the details together with the help of written instructions

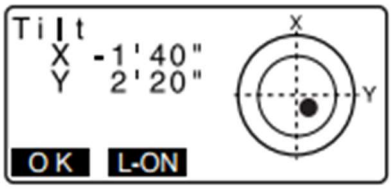
Setting up the Observation Station

Tips: The options shown on the bottom of the screen correspond to the unlabeled buttons in the row just below. The ESC button is like the "Back" button and does not necessarily erase what you've done, so don't be afraid to push it.

Station Setup

*Unlock all knobs if they are not unlocked! They should be unlocked every time the instrument station is inside the case so they don't get damaged when the case is bumped.

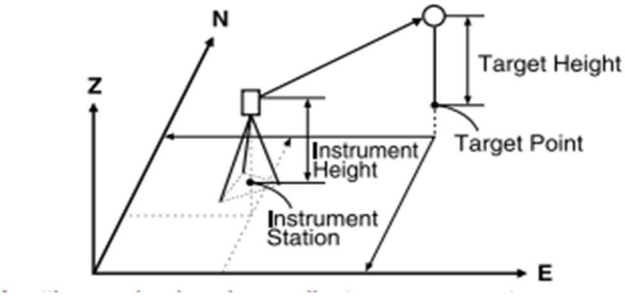
1. Choose a fixed location for the station and mark it in some way.
2. Set up the legs at the station point (central datum), with the goal of having the three legs equal distances apart (forming an equilateral triangle), then attach the station to the top
3. Turn on the total station, it should open to a screen which shows the leveling bubble and 2 buttons. **Press "L-ON"** to turn the laser plummet on. The laser should be on the center of the mark you made designating the instrument station point (central datum).



4. Adjust the length of the legs one at a time to level the station most of the way - make sure the bubble is within the inner circle of the indicator.
    a. Tip: Hold the sliding portion of the leg in place while you unclip it to avoid messing up your leveling progress! Be gentle and deliberate.
    b. BE RESILIENT, this may take you 30 minutes the first few times!
    c. The laser may turn itself off after a short time to save battery; press the button under "L-ON" to turn the laser plummet back on.
5. Use fine adjustment knobs and the screen display of the leveling indicator bubble to complete leveling.
6. Double-check that the laser still points to the center of your mark on the ground. If it doesn't, adjust the legs until it does, and start leveling again.
7. Once the bubble is exactly on the middle + indicated on the screen (fully level), **press the OK button.**
    a. Once you press the button, the machine will go to a menu list, this is not an indication that you did not level the station.

*If you need to go back to the Tilt screen, go to the top level menu (press ESC a lot), OBS mode, press FUNC for page 2 of options, then select TILT

8. Tell the total station where it is within your arbitrary grid:
    a. **Press FUNC** to go into Observation Mode
    b. **Press Coord.** for Coordinate Measurement menu
    c. **Select Occ. Orien.** (occupied point orientation) using the arrow key pad and pressing ENT
    d. Set Datum coordinates using the number pad and arrow keys:
       North: 1000
       East: 1000
       Z: 100
       PT: [Choose a name]
       HI: [Measure the height of the station from the ground to the line marked on the



       side of the instrument, in meters, and enter it here]
        i. Tips for Entering Words into Total Station:
            1. To get another letter from the same key you need to move the cursor or else pressing a different key will move the cursos
            2. Pressing Shift will modify the text in the following order: upper case, lower case, numeric
    e. Scroll down with arrow keys to reach the next page of the form. On this page set the following:

       CD (Code): [Type of point defined by you - use from list or add to list]

       Operator Name: [Enter your name]
    f. On the third page, set the Date, Time, Weather / Wind
    g. On the fourth page, set the Temperature, Pressure, Atmosphere PPM

*If you get into an unexpected page at any time, press FUNC and look for the right page, and if that doesn't work, press ESC multiple times until you reach the highest level menu, then start over.

Backsight

9. Identify a location for a Backsight: is there another accessible, fixed, easy to locate point nearby? This will be used to orient the observation station in space. Send a team member to stand at that spot with the point of the prism rod touching the ground and the prism facing the station.

10. On the page where you're setting up the instrument station coordinates (Occ. Orien. pages), **press BS NEZ** (backsight by coordinate location)

11. Fill in the Northing, Easting, and vertical (Z) coordinates of your backsight location, then **press OK** (do not press Load).

    a. If this is the first backsight for the site and orientation of the arbitrary grid does not matter based on the research plan (consult the supervisor!), measure the straight line distance to the backsight using a measuring tape, and subtract this from either the North or East coordinate. Then, proceed to the next step, making sure to press MEAS in step 13 instead of YES. This will measure the three-dimensional location of the backsight for you (checking your vertical distance is especially important) and you can proceed as normal from there.

    b. If this is the first backsight and the grid needs to be aligned to something other than the backsight, you will need to use trigonometry to calculate the Northing and Easting distances from the instrument to the backsight. Make a triangle between the instrument, the backsight location, and a third point straight in one cardinal direction from the instrument. Based on your understanding of the grid, you can use the distances between these three points to calculate the coordinates for the backsight point. The straight line distance (hypoteneuse) will be useful later in the backsighting process (Step 15).

12. Focus the instrument station on the backsight.

13. On the screen, the station's angle with respect to the grid is displayed in the "Azimuth" field, as well as the Vertical Angle (ZA) and Horizontal Angle (HA-R) to the backsight. If you are setting up a backsight using a fixed angle and distance, change the Azimuth field. Otherwise, **press YES**.

14. **Press MEAS** (measure), let the station take at least 3 measurements (beeps), and press STOP.

*This step is for ensured accuracy and precision. Pressing YES here will set the backsight at the current location and skip Step 15.

15. On the backsight distance check screen, you will see the calculated value (numerical distance based on the coordinates you entered), the measured height distance value, and the difference between those two numbers (dHD). If the difference is sufficiently low for your research plan, **press HT.** If not, press ESC, check the alignment of the station and the backsight, and measure again (Start at Step 12).

16. Once you press HT, you will be prompted to set the instrument height (the height of the total station) and the target height (height of the prism or whatever you are using to reflect the laser).

    i. HT: [Height of target in meters - change if using prism]

    ii. HI: [Height of instrument station in meters]

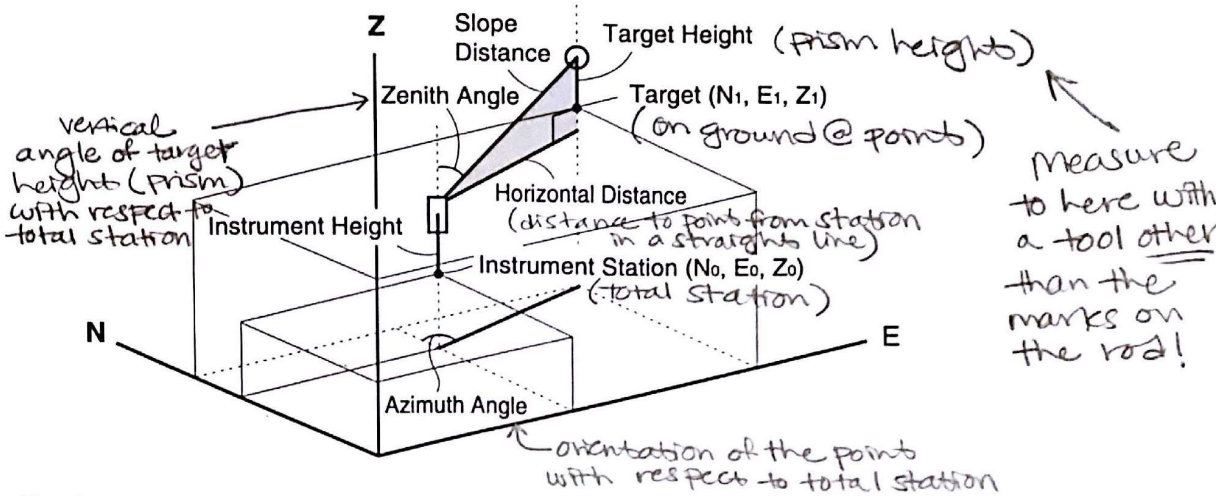
    iii. HR: [Height of rod in meters]

    Remember: Change these every time you switch from prism to reflectorless

17. If the coordinates look accurate, **press REC** (record).

18. **Press OK** to complete instrument setup.

Visual guide to terms:

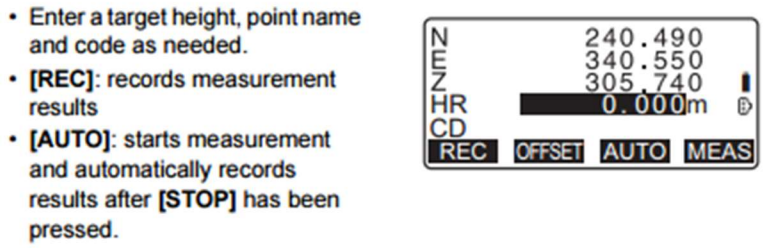


- If not measured or the space is left blank "Null" will be displayed.
  If station point Z coordinate is set to "Null" the observation result for the Z coordinate is automatically set to "Null".

Measuring Coordinate Locations

Reminder: Be sure to change Target Type [i.e. prism, reflectorless, or reflective sheet] every time you change the target.

1. If you are in any other menu, press ESC until you reach the main menu which has MEAS, SHV, 0SET, COORD on the bottom.
2. **Select COORD and press ENT** to go to the Coordinate Observation menu
3. This time, **select the Observation option and press ENT**
4. Confirm that the details on the page are correct before measuring (be sure to scroll down to see all fields!)
    a. HR: [Height of rod in meters]
    b. CD: [Code for type of feature]



    c. PT: [Point name]
5. **Press MEAS** to begin measuring; allow at least 3 successful measurements ("beeps") before pressing **STOP** to complete measurement process
    a. If you want to automatically record the point after the STOP button has been pressed, choose AUTO instead
    b. If you want to record the measurements immediately without the extra step, select REC
6. If you are writing coordinates on paper, now is the time to write the coordinates down, do not press any buttons yet! Write down the coordinates before exiting that screen.
    a. Tip: The measurement screen will show you the last measurement taken until you start measuring a new point, so be sure to write down only what is there after doing a new measurement. This seems simple but it can get confusing after 100s of points!