Lab 2: Differential Leveling

Objective: To introduce the method of differential leveling and to learn basic techniques of leveling, and to practice standard note taking protocol for fieldwork.

Preparation: Read chapters 4 and 5 in the *Elementary Surveying, 11th ed.* Textbook.

Instruments to be used: Check out the following equipment:

1. Automatic Level
2. Tripod
3. Leveling Rod
4. Simple calculator (your own)

Overview: Differential leveling is the most common method for measuring elevations of monuments or objects (Figure 2.1). In this most commonly employed method, a telescope with suitable magnification is used to read graduated rods held on fixed points.

![Figure 2.1 Differential leveling (Figure 5.4 in the textbook)](image-url)
Figure 2.2 Differential leveling notes for Figure 2.1 (Figure 5.5 in the textbook)

Procedure:

1. Students are divided into groups. One set of measured data to be recorded for each group in one of the field books during the leveling procedure. However, each person in the group must make a sketch in his/hers field book during the leveling procedure (this will be checked by the TA). The measured data can be copied by each party in his/hers own field book after fieldwork.

2. Locate the beginning benchmark \((\text{elev.} = 59.854 \text{ m}, \ \text{latitude} = 47^\circ34'18'' \text{N}, \ \text{longitude} = 52^\circ44'12'' \text{W})\) located close to the wall of the Education building, Memorial University, at east side of intersection of westerland Road and Prince Phillip Drive, tablet in north concrete foundation, 65 cm from northwest corner, 10 cm above ground level. This will be your starting station and first backsight \((\text{BS})\). (See Figure 2.4).
3. The instructor will assign an area for each group and each group will choose two points in their own parcel. Mark these points by a wooden peg and conduct a level loop to determine the elevation of these points and your starting point (BM).

4. Once the starting station is found and two points are identified, locate another suitable turning point towards your assigned area to serve as a foresight (FS) station.

5. Set up your Level within sight of both stations, making sure you have even sight distances. This is critical to assure even balance of the BS and FS. Be sure to securely implant the tripod into the ground to minimize errors due to settlement.

6. Set the level rod on the BS station; to ensure that it is level, hold it lightly between the tips of your fingers until it rocks very gently indicating it is perpendicular with the gravitational surface (a rod level may also be used, if available). Your lab instructor will show you how to do this if necessary.

7. Adjust the crosshairs so that they are clear and distinct when you look through the eyepiece. See Figure 2.3 for a typical instrument layout. Direct the instrument towards the level rod and adjust the focus knob until the rod is crisp and clear. You will have to adjust the parallax for different instrument operators.

8. Take readings at the top, middle, and bottom line to the nearest millimeter and average the top and bottom lines; these should be within a millimeter of your middle observation. If not, there is a blunder in your reading and you must observe the station again. Record the middle reading to your field book.

9. Repeat steps 7 and 8 for the foresight station. When you check your FS distance in comparison to the BS, you should be within ±10 meters of having equal distance legs. If not, you must move your foresight accordingly to create equal sight legs.

10. If within sight distance tolerance, LEAVE THE LEVEL ROD IN PLACE at the FS station, pick up the level and repeat steps 5-9 sufficient times to reach to the two points in your parcel.

11. Once you get to the two points in your parcel, repeat steps 5-9 in a loop to determine the elevation of the starting point (BM).
12. Perform a closure analysis on your loop. The loop misclosure should be less than $0.0062(m) \times \sqrt{n}$; where $n$ is the number of instrument setups. Compare actual misclosure with allowable and share with the TA prior to ending the lab. If your loop misclosure exceeds the allowable value, you must repeat the measurements.

13. Adjust the error through the points as instructed in Figure 2.2 of this manual.

14. Pick up your equipment, clean and return it to the equipment room. Make sure your notes are COMPLETE.

Figure 2.3 Parts of an automatic level (Figure 4.9 in the textbook)
Figure 2.4 Location of the benchmark and individual parcels