Online Surveying FE 208
Lectures 13

Differential Leveling

Learning Objectives for this Lecture

1. **Know the definitions for differential leveling terminology**
2. **Understand the methodology for differential leveling**
3. **Be able to read a set of differential leveling notes**
4. **Be able to calculate elevation differences using the differential leveling method**
5. **Be able to write correct differential leveling note format**
6. **Be able to write the level note end check**

Differential leveling

The most common method

Terms to know:

Benchmark – BM, BM_x (x = a number for the BM), TBM, TBM_x

A relatively permanent object having a marked point with known elevation referenced to some datum. This can also be a temporary position point established as vertical and/or horizontal control for a specific project. If so, this is called ***Local Control***. All FS are negative.

Foresight – FS

A level rod reading used for the purpose of establishing a position elevation in order to move the level gun to a new position. ***This is almost always taken to a turning point***

Backsight – BS

A level rod reading taken as the first shot from a new instrument setup. BS are usually taken to a turning point established just prior to the level gun being moved. For a new survey, the BS is always the first shot taken to a benchmark. ***Always begin with a BS***. All BS are positive

Intermediate foresight – IFS
This is similar to a FS, except that it is taken to an intermediate station to determine elevation. Most textbooks do not mention intermediate fore sights, however they are common in practice. All IFS are negative.

Turning point - TP_x
A turning point is used when the instrument is no longer able to see the next point in the survey or is unable to accurately read the level rod because of distance. A turning point is always a semi-permanent point. The practice is to take a FS to the turning point, move the level gun, and then take a BS to the same turning point.

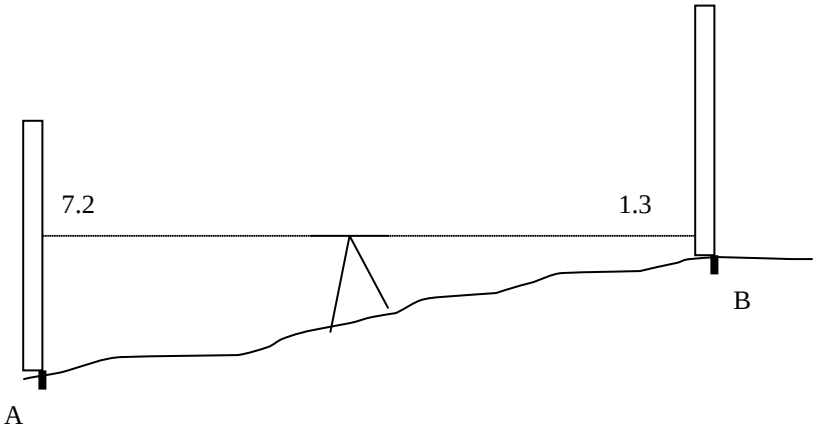
Height of instrument – HI

The height of the instrument is the leveled height of the level gun in reference to an elevation known

Methodology

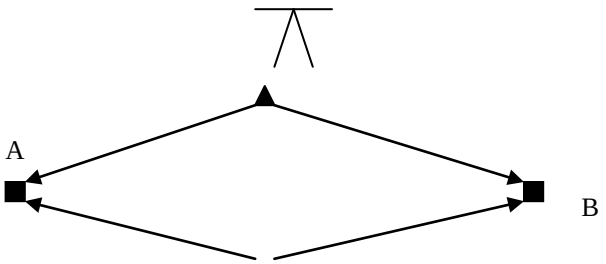
1. Level the instrument used – in most cases a level gun

2. Level rod is held at the point of interest and read.



3. Differences in rod readings = elevation differences between those points.

4. Level course is closed in a loop of some distance.



Field notes

The first reading is ***always*** a backsight **(BS)** followed by a set of intermediate foresights **(IFS)** and finally a foresight (FS).

The IFS can be eliminated if you are only interested in a final elevation or some variation can be done.

Rules:

1. Elev (prev) + BS = HI

2. HI – FS = Elev (new)

3. HI – IFS = Elev (new)

Example: Determine BM2 and Close!

BM2 = ?

BM1 = 519.44

2. Take a BS on the BM1

3. Elevation + BS = HI

	"+"		"-"	"-"	
STA	BS	HI	FS	IFS	ELEV
BM1	8.71	528.15			519.44
			0.46		
TP1	11.72	539.41			527.69
	4. Take a shot on the next point				
TP2				5. HI – FS = Elev	
TP3					
BM2					
TP4					
TP5					
BM1					

1. Start with an elevation on BM1

519.44 + 8.71 = 528.15

528.15 - 0.46 = 527.69

527.69 + 11.72 = 539.41

	"+"		"-"	"-"		
STA	BS	HI	FS	IFS	ELEV	
BM1	8.71	528.15			519.44	
						519.44 + 8.71 = 528.15
TP1	11.72	539.41	0.46		527.69	**528.15 - 0.46 = 527.69**
						527.69 + 11.72 = 539.41
TP2	7.91	546.36	0.96		538.45	**539.41 - 0.96 = 538.45**
						538.45 + 7.91 = 546.36
TP3	8.37	554.51	0.22		546.14	**546.36 - 0.22 = 546.14**
						546.14 + 8.37 = 554.51
BM2	0.21	553.39	1.33		553.18	**554.51 - 1.33 = 553.18**
						553.18 + 0.21 = 553.39
TP4	0.68	541.30	12.77		540.62	**553.39 - 12.77 = 540.62**
						540.62 + 0.68 = 541.30
TP5	2.61	531.36	12.55		528.75	**541.30 - 12.55 = 528.75**
						528.75 + 2.61 = 531.36
BM1			11.95		519.41	**531.36 - 11.95 = 519.41**
	BS SUM		FS SUM			
	40.21		40.24			
		Diff	-0.03	END-BEG	-0.03	

Differential leveling check

Because the differential leveling elevations are dependent upon the BS reading and the FS reading, we would expect that in a perfect closed level loop that the sum of the BS readings = the negative sum of the FS readings.

The final elevation closed on, should agree with the sums of the differences. In other words, if the difference in the sums was -0.03, as above, then we should calculate a final elevation that is -0.03 different from the beginning elevation of the same point.

The proper note form for the check is shown above.

The check not only calculates the ***mis-closure***, but also ensures that a math error has not been done in the notes calculations