Differential Leveling

Importance of Leveling

- The determination of elevations is called ***leveling***
- Measuring relative elevations changes is a comparatively simply process
- Precise and accurate control of relative elevations are critical to most construction projects

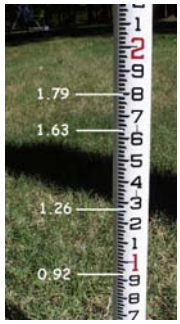
Differential Leveling

The Level

- A ***level*** consist of a high-powered telescope
- The level is attached to a spirit or bubble level that keeps the line of sight of the telescope horizontal

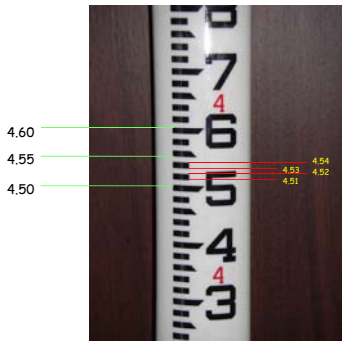
Differential Leveling

Level Instrument



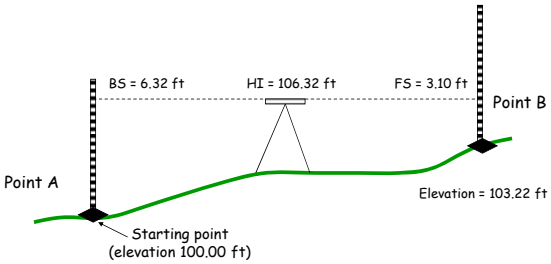
Differential Leveling

Level Instrument



Differential Leveling

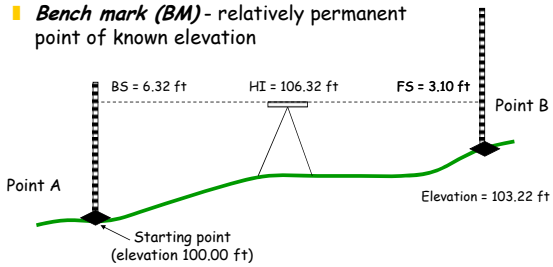
Definitions



Differential Leveling

Definitions

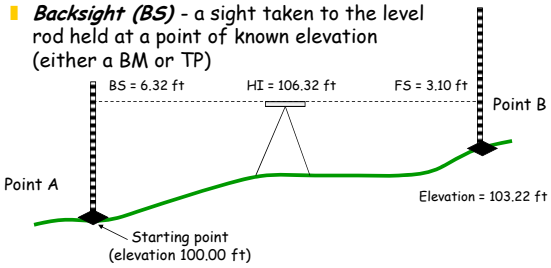
- ***Bench mark (BM)*** - relatively permanent point of known elevation



Differential Leveling

Definitions

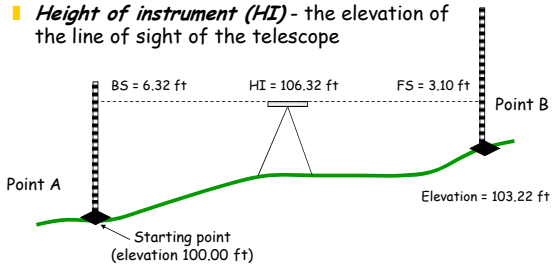
- ***Backsight (BS)*** - a sight taken to the level rod held at a point of known elevation (either a BM or TP)



Differential Leveling

Definitions

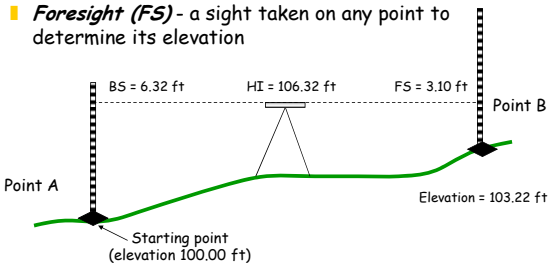
- ***Height of instrument (HI)*** - the elevation of the line of sight of the telescope



Differential Leveling

Definitions

- ***Foresight (FS)*** - a sight taken on any point to determine its elevation



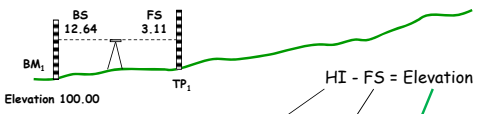
Differential Leveling

Computation of Elevations

Point	BS	HI	FS	Elevation
BM_1	12.64	112.64		100.00

Differential Leveling

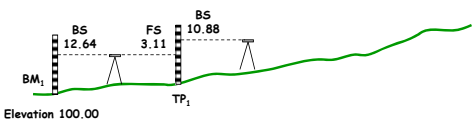
Computation of Elevations



Point	BS	HI	FS	Elevation
BM_1	12.64	112.64		100.00
TP_1			3.11	109.53

Differential Leveling

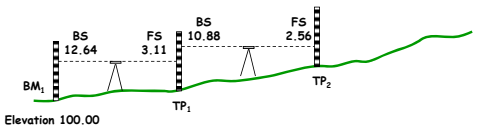
Computation of Elevations



Point	BS	HI	FS	Elevation
BM_1	12.64	112.64		100.00
TP_1	10.88	120.41	3.11	109.53

Differential Leveling

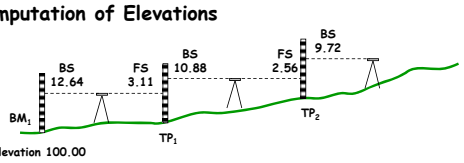
Computation of Elevations



Point	BS	HI	FS	Elevation
BM_1	12.64	112.64		100.00
TP_1	10.88	120.41	3.11	109.53
TP_2			2.56	117.85

Differential Leveling

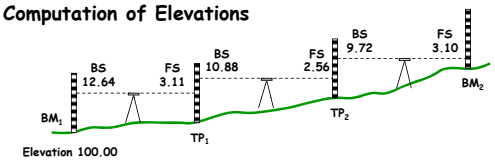
Computation of Elevations



Point	BS	HI	FS	Elevation
BM_1	12.64	112.64		100.00
TP_1	10.88	120.41	3.11	109.53
TP_2	9.72	127.57	2.56	117.85

Differential Leveling

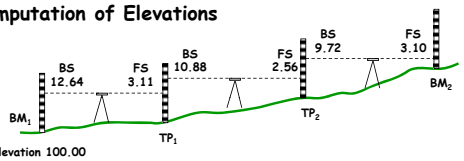
Computation of Elevations



Point	BS	HI	FS	Elevation
BM_1	12.64	112.64		100.00
TP_1	10.88	120.41	3.11	109.53
TP_2	9.72	127.57	2.56	117.85
BM_2			3.10	124.47

Differential Leveling

Computation of Elevations



Point	BS	HI	FS	Elevation
BM_1	12.64	112.64		100.00
TP_1	10.88	120.41	3.11	109.53
TP_2	9.72	127.57	2.56	117.85
BM_2			3.10	124.47

Differential Leveling

Computation of Elevations

- Check the summation of the backsight and the foresight with the change in elevation

Point	BS	HI	FS	Elevation
BM_1	12.64	112.64		100.00
TP_1	10.88	120.41	3.11	109.53
TP_2	9.72	127.57	2.56	117.85
BM_2			3.10	124.47
	+33.24		**-8.77**	

Change in elevation = **33.24 -8.77 =24.47**

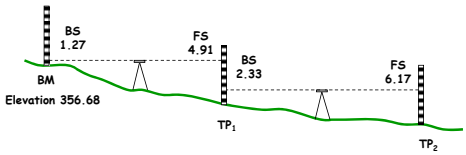
Differential Leveling

- The initial ***backsight (BS)*** is taken to a point of known elevation
- The backsight reading is added to the elevation of the known point to compute the ***height of the instrument (HI)***
- The level may be moved to a temporary point called a ***turning point (TP)***
- The elevation of a point is the ***height of the instrument (HI)*** minus the ***foresight (FS)***

Differential Leveling

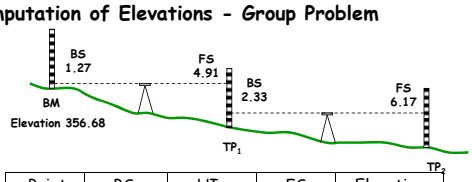
Computation of Elevations - Group Problem

- Prepare a set of level notes for the survey illustrated below. What are the elevations of points TP_1 and TP_2?



Differential Leveling

Computation of Elevations - Group Problem



Point	BS	HI	FS	Elevation
BM_1	1.27	357.95		356.68
TP_1	2.33	355.37	4.91	353.04
TP_2			6.17	349.20
	+3.60		-11.08	-7.48

Differential Leveling

Common Mistakes

- Misreading the rod - *reading 3.54 instead of 3.45*
- Moving the turning point - *use a well-defined TP*
- Field note mistakes - *work within your group to check you records*
- Mistakes with extended rod - *make sure the leveling rod is fully extended*

Differential Leveling

Common Mistakes

- Level rod not vertical
- Settling of leveling rod
- Leveling rod not fully extended or incorrect length
- Level instrument not level
- Instrument out of adjustment
- Environment - wind and heat

Differential Leveling

Suggestions for Good Leveling

- Anchor tripod legs firmly
- Check the bubble level before and after each reading
- Take as little time as possible between BS and FS
- Try to keep the distance to the BS and the FS equal
- Provide the rodperson with a level for the rod

Differential Leveling

End of Differential Leveling