

Problem (1)

A level instrument at point A is used to sight a level rod at B where AB=350.00 m. Calculate the combined curvature and refraction effect. If the rod reading is 3.852 m, what should be the correct rod reading?

Solution

$$CR = 0.0675 k^2 = 0.0675 \times (350/1000)^2 = 0.008 \text{ m}$$

$$\text{The correct rod reading} = 3.852 - .008 = 3.844$$

Problem (2)

It is required to establish Two Benchmarks (A and B) within a construction project site. Differential leveling loop is carried out from BM X and back to BM X whose elevation is 325.255 m. Rod readings are as given in the table below. (a) Do arithmetic check and compute closure error and allowable errors. Is the error accepted? (b) Adjust elevation of all points.

Point	BMX	TP1	TP2	A	B	TP3	TP4
BS	1.752	1.492	1.036	1.527	1.333	1.414	1.361
FS	2.313	0.854	0.349	1.128	0.989	2.362	1.906

Point	BS	HI	FS	Elevation	Adj. Elev.
BMx	1.752		325.255	325.255	
		327.007			
TP1	1.492		0.854	326.153	326.151
		327.645			
TP2	1.036		0.349	327.296	327.292
		328.332			
A	1.527		1.128	327.204	327.198
		328.731			
B	1.333		0.989	327.742	327.734
		329.075			
TP3	1.414		2.362	326.713	326.703
		328.127			
TP4	1.361		1.906	326.221	326.209
		327.582			
BMx			2.313	325.269	325.255
Σ	9.915		9.901		
Δ		0.014		0.014	

the allowable error = $6.1 \sqrt{7} = 16.1 \text{ mm}$
 Closure error = $325.26 - 325.255 = 0.014 \text{ m} = 14 \text{ mm}$
 closure error < allowable Accepted

$$\text{correction} = -14/7 = -2 \text{ mm}$$

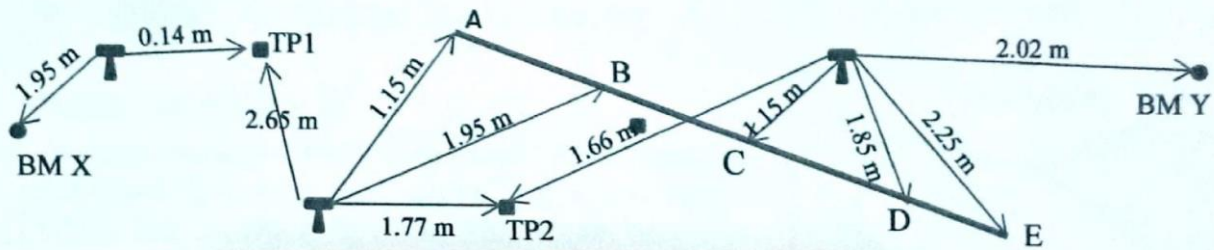
Problem (3)

- (a) Write the following distances as 50-m stationing: 325.25 m, 88.35 m, and 22.88 m.
(b) Convert the following 25-m stationing to distances: 12+00.00, 05+05.65, and 00+12.09 m.

- a) 6 + 25.25, 1+38.35, 0+22.88
b) 12 x 25 = 300 m, 5 x 25 + 5.65 = 130.65 m, 12.09 m

Problem (4)

A leveling line is executed from BM X = 275.22 m to BM Y = 277.52 m. The purpose is to perform profile leveling along line ABCDE as shown in the figure. Adjust the level line, and compute adjusting elevation of all profile points along the line.



Point	BS	IS	FS	HI	Elev.	Adj. Elev.
BM X	1.95				275.22	275.22
				277.17		
TP1	2.65		0.14		277.03	277.02
				279.68		
A		1.15			278.53	278.51
B		1.95			277.73	277.71
TP2	1.66		1.77		277.91	277.89
				279.57		
C		1.15			278.42	278.39
D		1.85			277.72	277.69
E		2.25			277.32	277.29
BM Y			2.02		277.55	277.52
S	6.26		3.93			
D		2.33			2.33	
Closure error = 325.26-325.255 = 0.03 m 30 mm						
correction = -30/3 = -10 mm						

Problem (5)

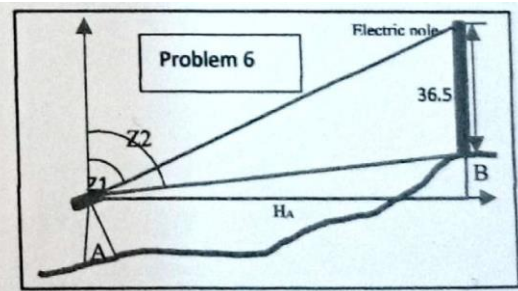
Point	A	B	C	D	E
Stationing	0+00.00	1+00.00	2+00.00	3+00.00	3+11.80

Stationing of profile points along line ABCDE of problem (4) are given in the table above using 20-m stationing. It is required to have 5% grade along line ABCDE such that grade elevation at A is equal to elevation of A. Compute grade level elevation at all stations, and the amount of cut & fill.

point	stationing	Distance	Adj.Elev.	Formation	Diff.	Cut/Fill
A	0+00.00	0	278.51	278.51	0	
B	1+00.00	20	277.71	279.51	-1.8	F
C	2+00.00	40	278.39	280.51	-2.12	F
D	3+00.00	60	277.69	281.51	-3.82	F
E	3+11.8	71.8	277.29	282.1	-4.81	F

Problem (6)

A theodolite is set up at point A. The purpose is to determine the horizontal distance AB to an electric tower at B whose height is 36.50 m. Measured zenith angle to the top of the pole is $z_1 = 65.2500^\circ$, and the zenith angle to the bottom of the tower is $z_2 = 80.3500^\circ$. Compute Distance AB.



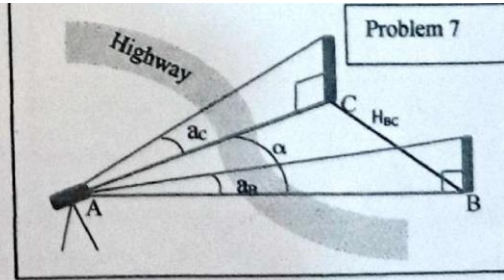
$$\text{Vertical angle to the top} = 90 - 65.2500 = 24.75$$

$$\text{Vertical angle to the bottom} = 90 - 80.35 = 9.65$$

$$\text{Distance AB} = 36.5 / (\tan(24.75) - \tan(9.65)) = 125.442 \text{ m}$$

Problem (7)

A Theodolite at A is used to sight two identical poles at B and C on the other side of a highway. Height of the two poles = 20.00 m. Measured vertical and horizontal angles are: $a_B = 11.7356^\circ$, $a_C = 17.4230^\circ$, $\alpha = 48.1118^\circ$. Compute horizontal distances: AB, AC, and BC.



$$\text{Distance AB} = 20 / \tan(11.7356) = 96.275 \text{ m}$$

$$\text{Distance AC} = 20 / \tan(17.4230) = 63.730 \text{ m}$$

$$BC^2 = AB^2 + AC^2 - 2 \times AB \times AC \times \cos(48.1118)$$

$$BC = 71.674 \text{ m}$$

Problem (8)

- a) Compute combined curvature and refraction correction for distance AB= 100.00 m, 200.00 m.
b) The length of a level loop= 500 m, closure error $E_c = 5 \text{ mm}$. What is the leveling precision?

a) $CR = .0675 \times (0.1)^2 = 6.75 \text{ E-4 m} = 0.675 \text{ mm}$

$CR = .0675 \times (0.2)^2 = 2.7\text{E-3 m} = 2.7\text{mm}$

b) $M = 5/\sqrt{0.5} = 7 < 8$ 2nd order class 2