#4.2

Use $C_m = 0.0785k^2$, $R_m = 0.011k^2$

a) 1km: $C_m = 0.0785\ km$

$R_m = 0.011\ km$

b) 5km: $C_m = 0.0785(5)^2$

$= 1.9625\ km$

$R_m = 0.011(5)^2$

$= 0.275\ km$

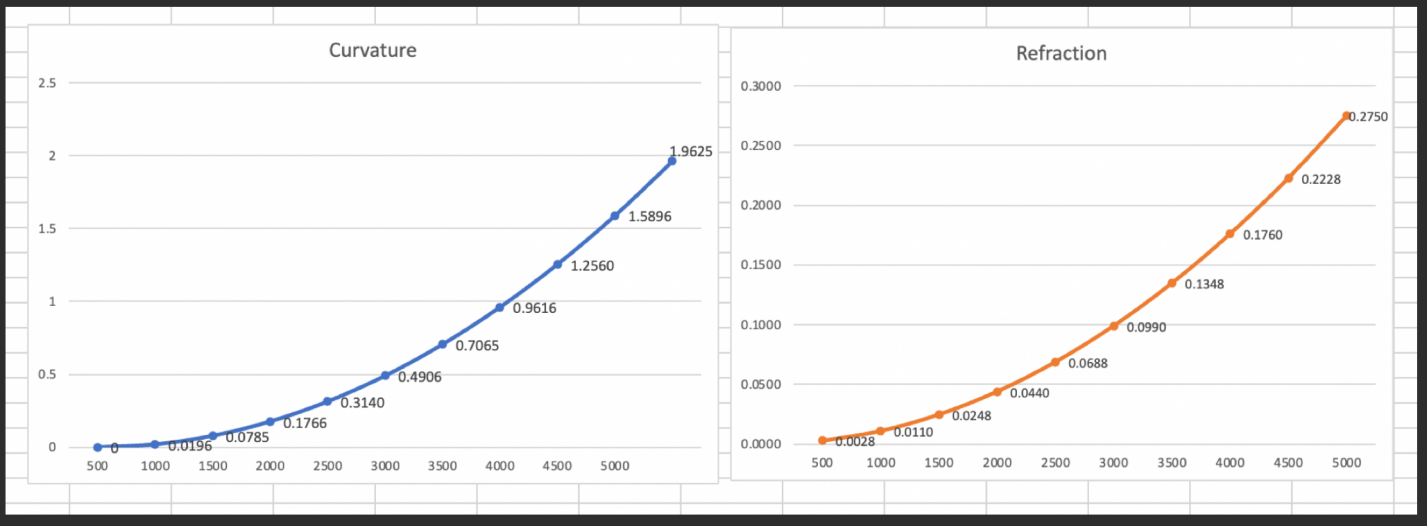
c) 10km: $C_m = 0.0785(10)^2$

$= 7.85\ km$

$R_m = 0.011(10)^2$

$= 1.1\ km$

# #4.5




# #4.6

Benchmark is a relatively permanent object, natural or artificial, having a marked point whose elevation above or below a reference datum is known or assumed.

# #4.8

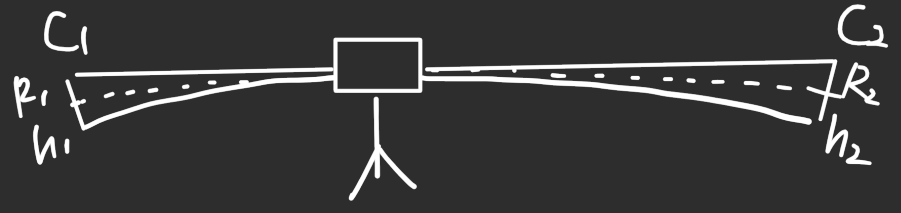

$h = 10m = Cm - Rm$

$= 0.0785k^2 - 0.011k^2$

$= 0.0674k^2$

$k = \sqrt{\frac{10}{0.0674}} = \boxed{12.1806\ km}$

#4.13




30,55 : $C_1 = 0.0785(0.03)^2$ $R_1 = 0.011(0.03)^2$

$= 7.065\times10^{-5}$ km $= 9.9\times10^{-6}$ km

$C_1 = 0.0785(0.055)^2$ $R_2 = 0.011(0.055)^2$

$= 2.3746\times10^{-4}$ km $= 3.3275\times10^{-5}$ km

$E_C = 1.6681\times10^{-4}$ km $E_R = 2.3375\times10^{-5}$

30,50 : $C_1 = 0.0785(0.03)^2$ $R_1 = 0.011(0.03)^2$

$= 7.065\times10^{-5}$ km $= 9.9\times10^{-6}$ km

$C_2 = 0.0785(0.05)^2$ $R_2 = 0.011(0.05)^2$

$= 1.9625\times10^{-4}$ km $= 2.75\times10^{-5}$ km

$E_C = -1.256\times10^{-4}$ km $E_R = -1.76\times10^{-5}$ km

25,40 : $C_1 = 0.07785(0.025)^2$ $R_1 = 0.011(0.025)^2$

$= 4.90625 \times 10^{-5}$ km $= 6.875 \times 10^{-6}$ km

$C_2 = 0.07785(0.04)^2$ $R_2 = 0.011(0.04)^2$

$= 1.256 \times 10^{-4}$ km $= 1.76 \times 10^{-5}$ km

$E_c = 7.65375 \times 10^{-5}$ km $E_R = 1.0725 \times 10^{-5}$ km

55,60 : $C_1 = 0.07785(0.055)^2$ $R_1 = 0.011(0.055)^2$

$= 2.374625 \times 10^{-4}$ km $= 3.3275 \times 10^{-5}$ km

$C_2 = 0.07785(0.06)^2$ $R_2 = 0.011(0.06)^2$

$= 2.826 \times 10^{-4}$ km $= 3.96 \times 10^{-5}$ km

$E_c = 4.513375 \times 10^{-5}$ km $E_R = 6.325 \times 10^{-6}$ km

---

#4.14 $\Delta elev = h_i + V - r$

a) 2000ft: $\Delta elev = h_i + 2000 - r$

b) 1000ft: $\Delta elev = h_i + 1000 - r$

c) 3000ft: $\Delta elev = h_i + 3000 - r$

#4.16 distance XY = 250m

zenith angle = 83°20'51" = 83.3475°

$h_i = r$

elevation of point X is 210 m above datum.

Find elevation of point Y

$\Delta elev = V + h_{CR}$

$h_{CR} = 0.0674(0.025)^2 = 4.2125 \times 10^{-5}$ km

$V = S \cos z = 0.025 \cos 83.3475^\circ$

$= 2.896183 \times 10^{-3}$ km

$\Delta elev = 2.9383 \times 10^{-3} = 2.9383$ m

elevation Y = elevation X + $\Delta elev$

$= 210 + 2.9383 =$ **212.9383 m**

---

#5.1

Leveling is the general term applied to any of the various processes by which elevations of points or differences in elevation are determined.

#5.12 Elev BM = 852.045m

Total loop = 1500m

| Point | +S (BS) | −S (FS) |
|---|---|---|
| BM 7 | 4.388 | |
| TP1 | 6.907 | 4.538 |
| BM 8 | 4.680 | 8.800 |
| TP2 | 3.730 | 5.978 |
| TP3 | 8.464 | 5.245 |
| BM 7 | | 3.598 |

| Sta. | B.S (+) | H.I | F.S (−) | Elev. | Adj Elev. |
|---|---|---|---|---|---|
| | | | | | |
| BM7 | 4.388 | | | 852.045 | 852.0425 |
| | | 856.433 | | −0.0025 | |
| TP1 | 6.907 | | 4.538 | 851.895 | 851.89 |
| | | 858.802 | | −0.005 | |
| BM8 | 4.680 | | 8.800 | 850.002 | 849.99533 |
| | | 854.682 | | −0.00667 | |
| TP2 | 3.730 | | 5.978 | 848.704 | 848.69567 |
| | | 852.434 | | −0.00833 | |
| TP3 | 8.464 | | 5.245 | 847.189 | 847.179 |
| | | 855.653 | | −0.010 | |
| BM7 | | | 3.598 | 852.055 | 852.045 |
| | Σ = +28.169 | | Σ = −28.159 | | |

page check:

852.045
+ 28.169
880.214
− 28.159
852.055 check

misclosure:

852.045
− 852.055
−0.010

−0.005 → −0.00333

−0.005 → −0.00167

Find Leveling class

$C = m\sqrt{k}$ $\quad C = 10\,mm$

$k = 1.5\,km$

$$m = \frac{C}{\sqrt{k}} = \frac{10}{\sqrt{1.5}} = 8.165\,m$$

$m > 8$, thus third order class

---

#5.35

error max: $83 \times (+1.5) = +124.5$ mm

error min: $83 \times (-1.5) = -124.5$ mm

---

#5.37 $\quad C = m\sqrt{k}$

a) $k = 20km$, 3rd-order level: $8mm \leq m < 12mm$

$8 \times \sqrt{20} \leq C < 12 \times \sqrt{20}$

$35.777 \leq C < 53.666 \quad (mm)$

b) $k = 10\,km$, 2nd-order class I level: $5 \leq m < 6$

$5 \times \sqrt{10} \leq C < 6 \times \sqrt{10}$

$15.811 \leq C < 18.974 \quad (mm)$

c) $k = 30\,km$, 1st-order class I level $\quad m < 4$

$C < 4 \times \sqrt{30}$

$C < 21.909 \quad (mm)$