Example . In a triangulation survey, the altitudes of two stations A and B, 110 km apart, are respectively 440 m and 725 m. The elevation of a peak P situated at 65 km from A has an elevation of 410 m. Ascertain if A and B are intervisible, and if necessary, find by how much B should be raised so that the line of sight nowhere be less than 3 m above the surface of ground. Take earth's mean radius as 6400 km and the mean coefficient of refraction as 0.07.

Solution

The distance of visible horizon given by Eq.

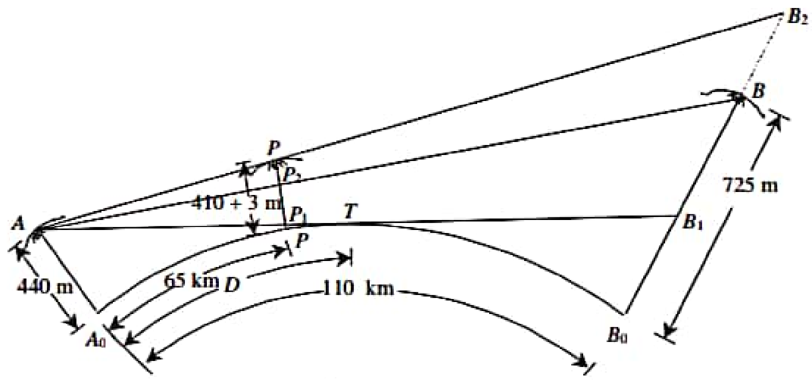
$$h = \frac{D^2}{2R}(1-2m)$$

$$D^2 = \frac{2Rh}{(1-2m)}$$

$$D = \sqrt{\frac{2 \times 6400h}{(1-2\times 0.07)\times 1000}}$$

$$= 3.85794\sqrt{h} \text{ kilometre}$$

$$= 3.85794\sqrt{440} = 80.92 \text{ km.}$$



Fig

Therefore

$$P_0T = D - A_0P_0$$

$$= 80.92 - 65 = 15.92 \text{ km.}$$

$$P_0P_1 = \left(\frac{P_0T}{3.85794}\right)^2$$

$$= \left(\frac{15.92}{3.85794}\right)^2 = 17.03 \text{ m.}$$

$$TB_0 = A_0B_0 - A_0T$$

$$= 110 - 80.92 = 29.08 \text{ km.}$$

$$B_0B_1 = \left(\frac{TB_0}{3.85794}\right)^2$$

$$= \left(\frac{29.08}{3.85794}\right)^2 = 56.82 \text{ m.}$$

$$BB_1 = B_0B - B_0B_1$$

$$= 725 - 56.82 = 668.18 \text{ m.}$$

From similar Δ's AP_2P_1 and ABB_1, we get

$$\frac{P_2P_1}{A_0P_0} = \frac{BB_1}{A_0B_0}$$

$$P_2P_1 = \frac{A_0P_0\, BB_1}{A_0B_0}$$

$$= \frac{65 \times 668.18}{110} = 394.83 \text{ m.}$$

Therefore $$P_2P_0 = P_2P_1 - P_1P_0$$

$$= 394.83 + 17.03 = 411.86 \text{ m.}$$

Since the line of sight has to be 3 m above the ground surface at P, the elevation of P may be taken as 410 + 3 = 413 m, or PP_0 = 413 m. The line of sight fails to clear P by PP_2 = 413 – 411.86 = 1.14 m. Thus the amount of raising required at B is BB_2.

From similar Δ's APP_2 and AB_2B, we get

$$\frac{BB_2}{A_0B_0} = \frac{P_2P}{A_0P_0}$$

$$BB_2 = \frac{A_0B_0\, P_2P}{A_0P_0}$$

$$= \frac{110 \times 1.14}{65} = 1.93 \text{ m} \simeq 2 \text{ m.}$$

Example . Solve the Example by Capt. McCaw's method.
(Fig.).

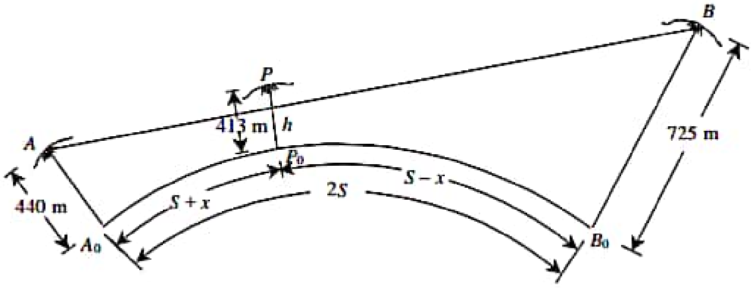


Fig.

It is given that

$$2S = 110 \text{ km}$$

$$S = \frac{110}{2} = 55 \text{ km}$$

and $S + x = 65$ km

$$x = 65 - S$$

$$= 65 - 55 = 10 \text{ km.}$$

From Capt. McCaw's formula, we have

$$h = \frac{1}{2}(h_B + h_A) + \frac{1}{2}(h_B - h_A)\frac{x}{s} - (S^2 - x^2)\operatorname{cosec}^2 \xi \frac{(1-2m)}{2R}$$

$$= \frac{1}{2} \times (725 + 440) + \frac{1}{2} \times (725 - 440) \times \frac{10}{55} - (55^2 - 10^2) \times 1 \times \frac{(1 - 2 \times 0.07)}{2 \times 6400} \times 1000$$

$$= 582.5 + 25.909 - 196.523$$

$$= 411.89 \text{ m.}$$

Here h is same as P_2P_0 obtained in Example 6.5. The line of sight fails to clear the line of sight by 413 – 411.89 = 1.11 m. The amount of raising BB_2 required at B is calculated now in a similar manner as in Example 6.5. Thus

$$= \frac{110 \times 1.11}{65} = 1.88 \text{ m} \approx 2 \text{ m.}$$