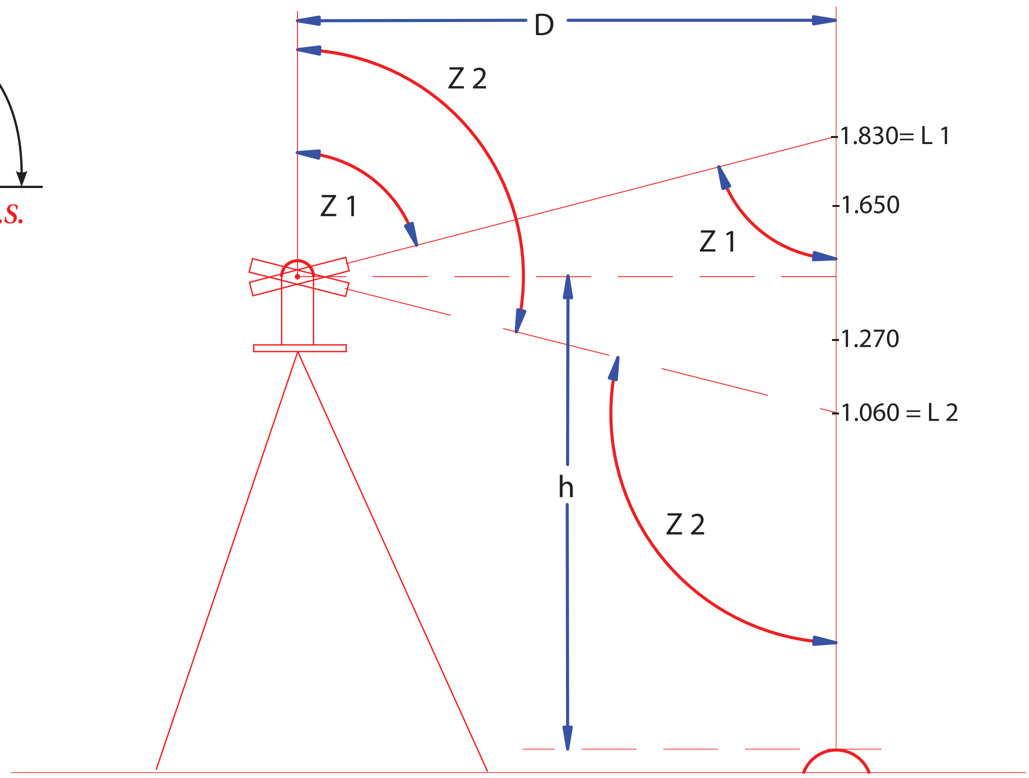
problem corner solution

Solution to Problem 148

by Dave Lindell, L.S.



First, check and adjust the zenith distances:

The adjusted zenith is given by $\dfrac{(\text{Direct} + 360°) - \text{Reverse}}{2}$

$Z_1 = (87°24'00'' + 360° - 272°35'46'') / 2 = 87°24'07''$

$Z_2 = (88°36'42'' + 360° - 271°23'04'') / 2 = 88°36'49''$

$Z_3 = (91°10'22'' + 360° - 268°49'24'') / 2 = 91°10'29''$

$Z_4 = (92°35'12'' + 360° - 267°24'34'' / 2 = 92°35'19''$

$L_1 - h = D \tan(90° - Z_1),\ \ h = L_1 - D \cot Z_1$ ....(1)

$h - L_2 = D \tan(Z_2 - 90°) = - D \cot Z_2,\ \ h = L_2 - D \cot Z_2$ ....(2)

Solving for D in (1) and substituting it into (2),
the vertical height of the trunnion axis above the bench marks is given by

$$h_1 = \frac{L_2 \cot Z_1 - L_1 \cot Z_2}{\cot Z_1 - \cot Z_2}$$

Using the 1.830 / 1.060 and 1.650 / 1.270 readings as pairs

$$h_1 = \frac{1.060 \cot 87°24'07'' - 1.830 \cot 92°35'19''}{\cot 87°24'07'' - \cot 92°35'19''} = \frac{0.130833582}{0.09058628} = 1.44430$$

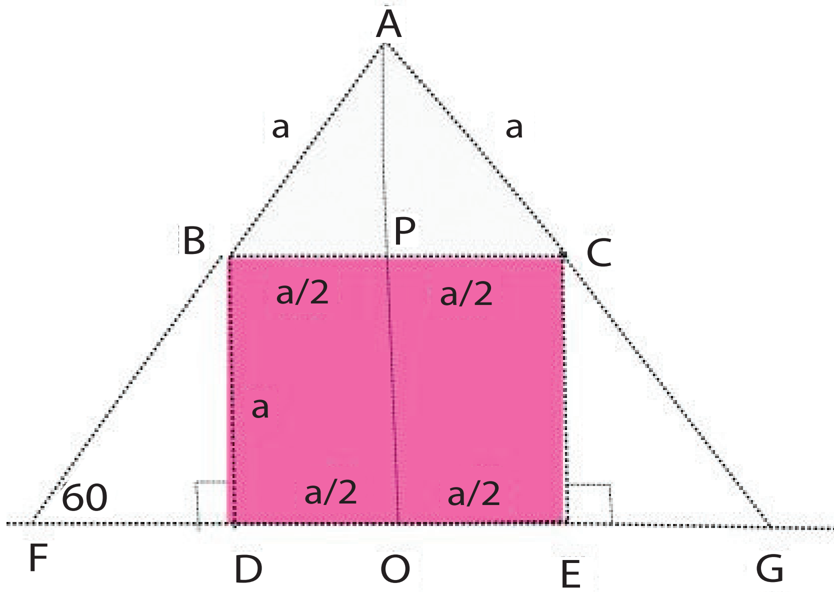
$$h_2 = \frac{1.270 \cot 88°36'49'' - 1.650 \cot 91°10'29''}{\cot 88°36'49'' - \cot 91°10'29''} = \frac{0.064570566}{0.044707418} = 1.44429$$

$$\frac{h_1 + h_2}{2} = 1.4443$$

Making the elevation of the trunnion axis 381.353 + 1.444 = 382.797 meters

Solution to Problem 149

by Benjamin Bloch, Ph.D.



a) $AP = (a^2 - a^2/4)^{1/2} = (a/2)\sqrt{3}$; $FD = a \tan 30 = a/\sqrt{3}$; $BF = (a^2 + a^2/3)^{1/2} = 2a/\sqrt{3}$;
$AF = FG = GA = a\,(1 + 2/\sqrt{3})$

b) $A(BCED) = a^2$; $A(APB) = 1/2\,(a/2)\,(a/2)\,\sqrt{3} = (a^2/8)\sqrt{3}$; $A(BDF) = 1/2\,(a/\sqrt{3})\,a = a^2/(2\sqrt{3})$

c) The area of the shaded square is a^2, while the total area of the large equilateral triangle minus the square is $2[A(APB) + A(BDF)] = 2[(a^2/8)\sqrt{3} + a^2/(2\sqrt{3})] = a^2(\sqrt{3}/4 + 1/\sqrt{3})$.

Thus, the required ratio is $a^2/[\,a^2(\sqrt{3}/4 + 1/\sqrt{3})] = (4/7)\,\sqrt{3} = (4/7)1.73205 = 0.99 \approx 1$.