

# Solution to Problem 71

LINE C-E = R x sin $\phi$ = 2640, SO $\sin\phi = \frac{2640}{R}$

ARC LENGTH M-E = 2640.5 = R x $\phi$ (IN RADIANS), SO $\phi = \frac{2640.5}{R}$

$$\frac{\sin\phi}{\phi} = \frac{2640 / R}{2640.5 / R} = 0.999810642$$

FROM TRIGONOMETRY, $\sin\phi = \phi - \frac{\phi^3}{3!} + \frac{\phi^5}{5!} - \frac{\phi^7}{7!} + \ldots$

$$0.999810642 = 1 - \frac{\phi^2}{6} + \frac{\phi^4}{120} - \ldots, \text{ FROM WHICH}$$

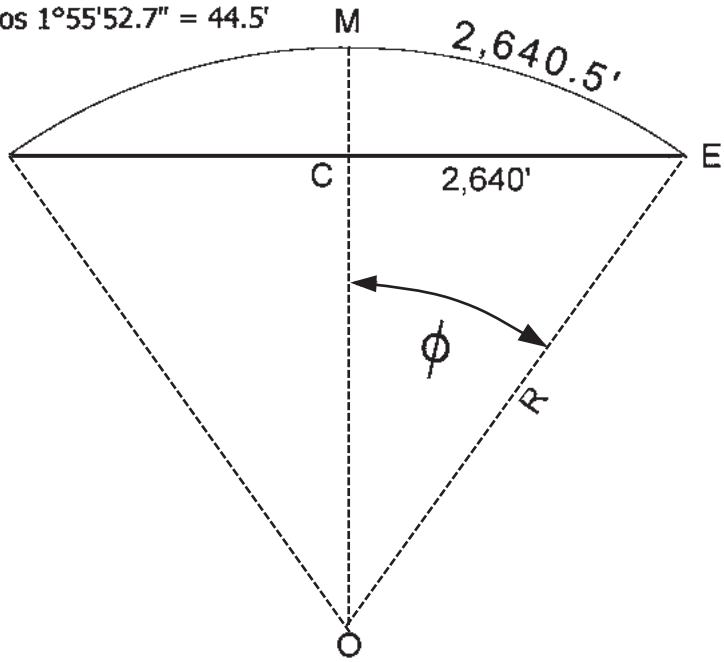
$\phi^4 - 20\,\phi^2 + 0.02272297 = 0$ AFTER DROPPING ALL TERMS ABOVE $\phi^4$

USING THE QUADRATIC EQUATION TO SOLVE FOR $\phi^2$ AND THEN TAKING THE SQUARE ROOT OF THE RESULT YIELDS A GOOD APPROXIMATION:

$\phi$ = 0.033707759 RADIANS OR 1°55'52.7"

FROM WHICH R= 2640.5 / 0.033707759 = 78,335.08'

MAKING C-M = 78,335.08 – 78,335.08 cos 1°55'52.7" = 44.5'





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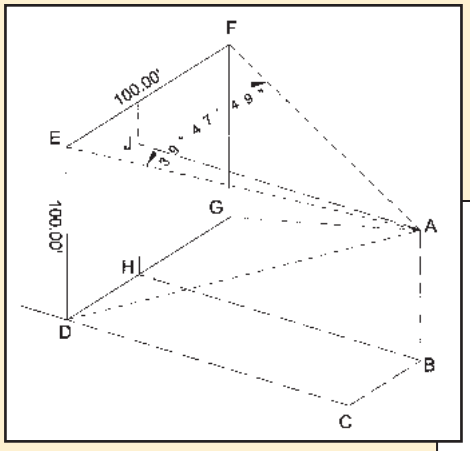
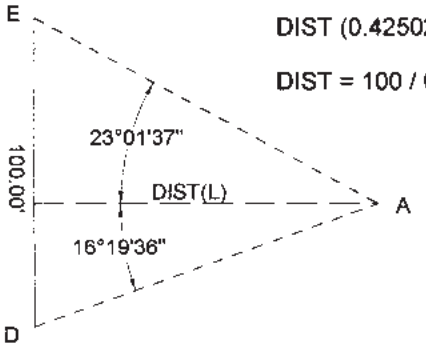



ON THE LEFT SIDE: (DIST) tan 23°01'37" + (DIST) tan 16°19'36" = 100.00

DIST (0.425029929 + 0.292925752) = 100

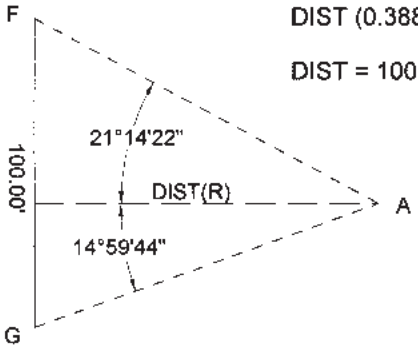
DIST = 100 / 0.717955681 = 139.284'



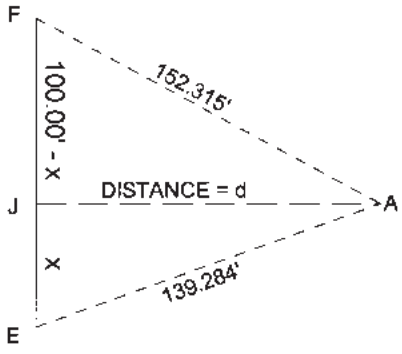

ON THE RIGHT SIDE: (DIST) tan 21°14'22" + (DIST) tan 14°59'44" = 100.00

DIST (0.388666657 + 0.267866055) = 100

DIST = 100 / 0.656532712 = 152.315'




FROM THE TOP:




$d^2 = 139.284^2 - x^2$ & $d^2 = 152.315^2 - (100 - x)^2$

$139.284^2 - x^2 - 152.315^2 + 100^2 - 200x + x^2 = 0$

from which x = 31.001' and 100-x = 68.999'

and d = 135.790'

J-E in this sketch is equivalent to B-C or H-D and equals the distance from the prolongation of the left side of the building

Note: arctan x/d = 12°51'37" & arctan (100 -x) / d = 26°56'11" the sum of which is 39°47'48"