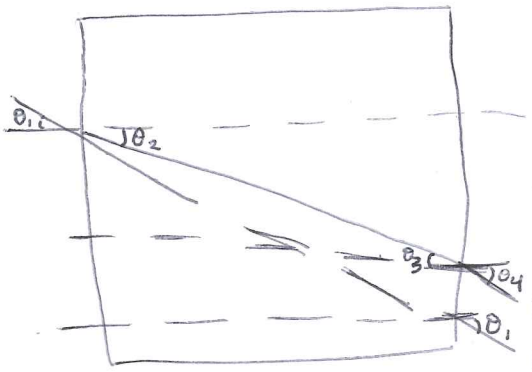
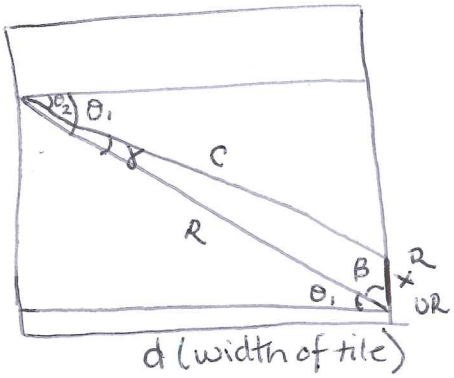


*The Refracted & Unrefracted beams are parallel, therefore L doesn't matter

$\theta_2 = \theta_3$

$\theta_1 = \theta_4$



$R = \frac{d}{\cos\theta_1}$

$\beta = \frac{\pi}{2} - \theta_1$

$\cos\beta = \sin\theta_1$ (phase shift)

$c^2 = x^2 + R^2 - 2xR\cos\beta$ | law of cosines

$x^2 = R^2 + c^2 - 2Rc\cos\gamma$ | law of cosines

$\theta_2 = \theta_1 - \gamma$

$n_1\sin\theta_1 = n_2\sin\theta_2$

$n_2 = \frac{n_1\sin\theta_1}{\sin(\theta_1 - \gamma)}$

$\gamma = \cos^{-1}\left(\frac{R^2 + c^2 - x^2}{2Rc}\right)$

$$\gamma = \cos^{-1}\left(\frac{\frac{d^2}{\cos^2\theta_1} + x^2 + \frac{d^2}{\cos^2\theta_1} - \frac{2xd\sin\theta_1}{\cos\theta_1} - x^2}{\frac{2d}{\cos\theta_1}\left(x^2 + \frac{d^2}{\cos\theta_1} - 2xd\tan\theta_1\right)^{1/2}}\right)$$

$$\gamma = \cos^{-1}\left(\frac{\frac{2d^2}{\cos^2\theta_1} - \frac{2xd\sin\theta_1}{\cos\theta_1}}{\frac{2d}{\cos\theta_1}(c)}\right)$$

$$\gamma = \cos^{-1}\left(\frac{\frac{d}{\cos\theta_1} - x\sin\theta_1}{\left(x^2 + \frac{d^2}{\cos^2\theta_1} - 2xd\tan\theta_1\right)^{1/2}}\right) = \theta_1 - \theta_2$$

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