$n_1 > n_2$

Snell's Law

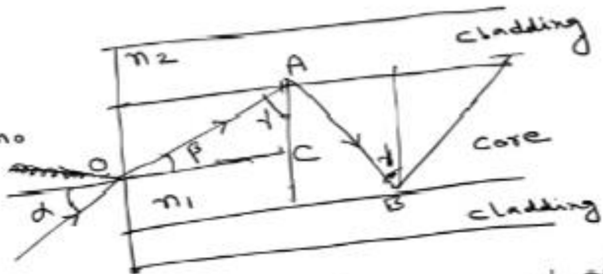
$$\frac{\sin i}{\sin r} = \frac{n_2}{n_1}$$

i_c $\quad r = 90^\circ$

critical angle $\underline{i_c}$

$$\sin i_c = \frac{n_2}{n_1}$$

$n_1 > n_2 > n_0$



$\gamma > i_c$ $\quad \sin\gamma = \frac{n_2}{n_1}$

$$i_c = \sin^{-1}\left(\frac{n_2}{n_1}\right)$$

$\overline{OA} = a, \ \overline{OC} = c, \ \overline{AC} = b$

$\triangle OAC$

$b^2 + c^2 = a^2$

Snell's Law

$$\frac{b^2}{a^2} + \frac{c^2}{a^2} = 1$$

$n_0 \sin\alpha = n_1 \sin\beta$

$$\frac{b^2}{a^2} = 1 - \frac{c^2}{a^2}$$

$n_0 \sin\alpha = n_1\sqrt{1 - \frac{n_2^2}{n_1^2}}$

numerical aperture (N. A.)

$$\frac{b^2}{a^2} = 1 - (\sin\gamma)^2$$

$$= 1 - \frac{n_2^2}{n_1^2}$$

$\text{N. A.} = n_0 \sin\alpha$

$= n_1\sqrt{1 - \frac{n_2^2}{n_1^2}}$

$\sin\beta = \frac{b}{a} = \sqrt{1 - \frac{n_2^2}{n_1^2}}$

$= \sqrt{n_1^2 - n_2^2}$

$$n_0 \sin \alpha = \sqrt{n_1^2 - n_2^2}$$

$$\sin \alpha = \frac{\sqrt{n_1^2 - n_2^2}}{n_0}$$

$$\alpha = \sin^{-1}\left(\frac{\sqrt{n_1^2 - n_2^2}}{n_0}\right)$$

acceptance angle

1. cladless fibre
2. Graded index fibre $n_1(r)$
3. step index fibre