

OPTICAL FIBRE :-

- ① After advent of LASER (1960) information started to transmit by light.
- ② More information may be transmitted by using light in comparison to electrical signal.
- In open atmosphere light energy dissipate in very short time. so a guiding channel is required
↳ Optical Fibre

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- ⇒ Fibre optic cable carry more data because of greater bandwidth.
- Fibre is much thinner / lighter than metal wire.
- Data is transmitted digitally not by "Analogically".
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TOTAL INTERNAL REFLECTION:-





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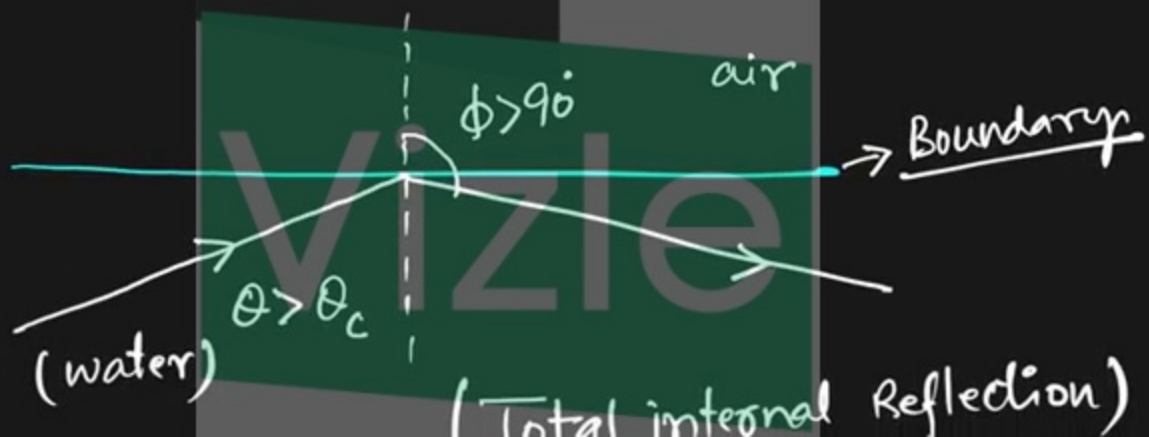
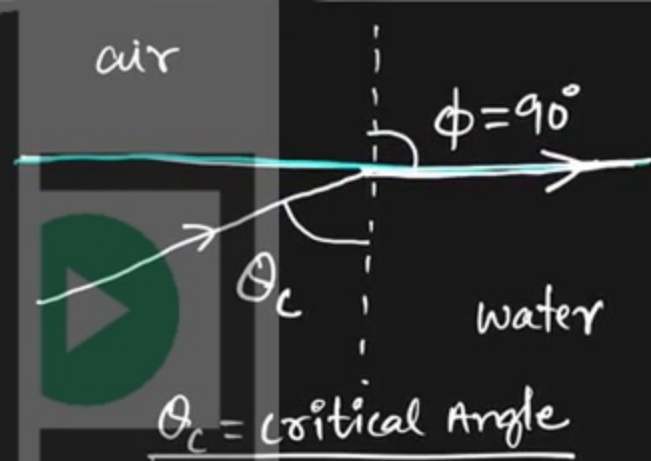
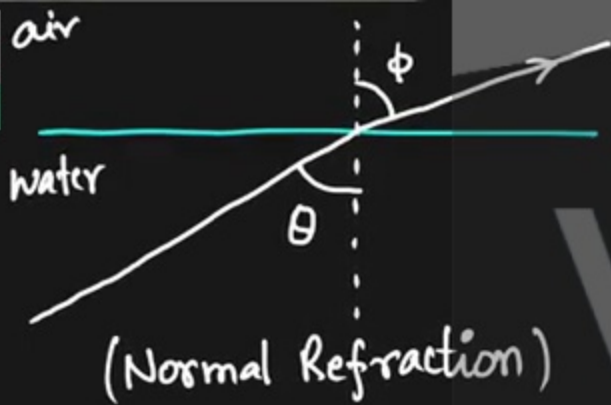
→ Fibre is much thinner / lighter than metal wire.

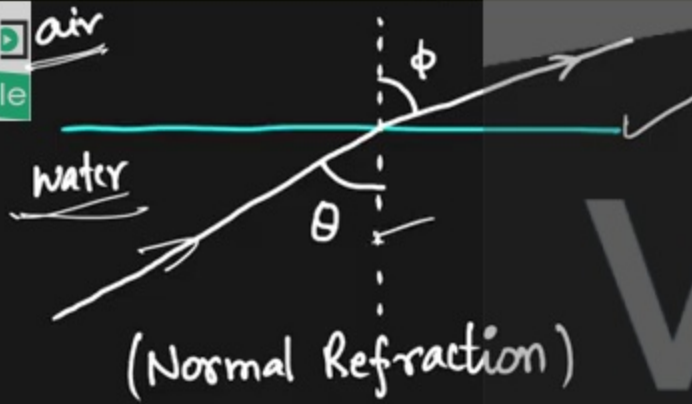
→ Data is transmitted digitally not by "Analogically"

→ Attenuation in fibre is much less than metal wire

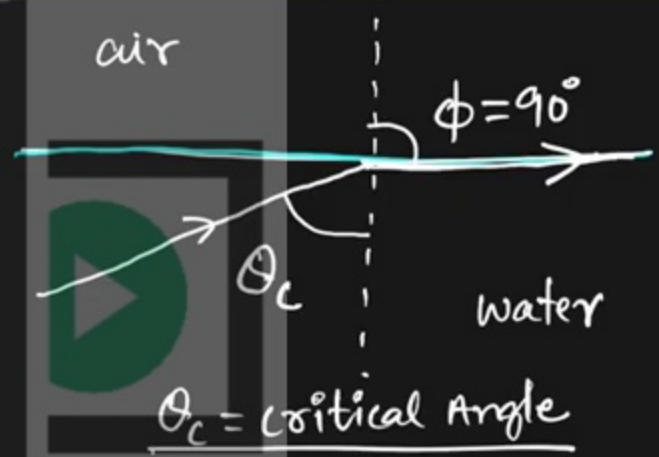
TOTAL INTERNAL REFLECTION:-



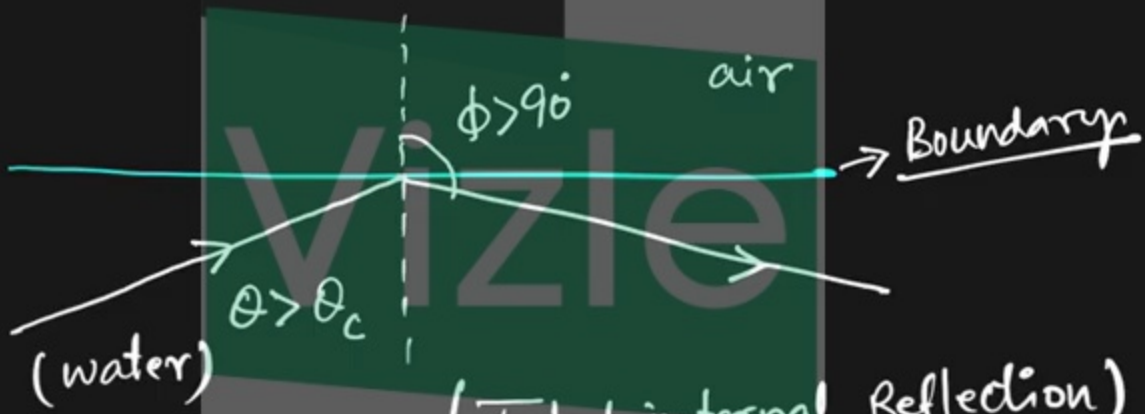




(Normal Refraction)



$\theta_c = \text{critical angle}$



(Total internal Reflection)



20° 35°

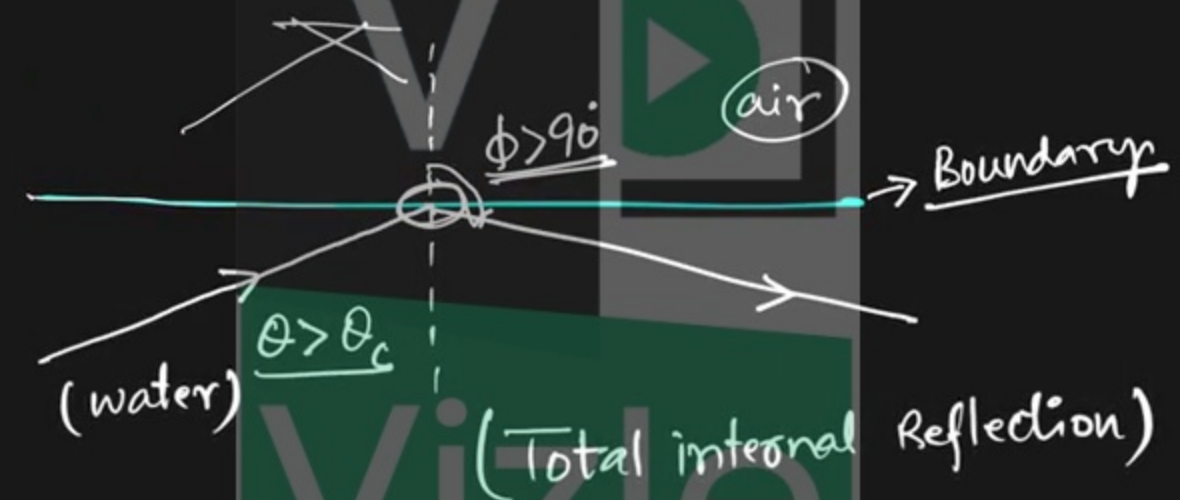
$\sin \theta$



water

(Normal Refraction)

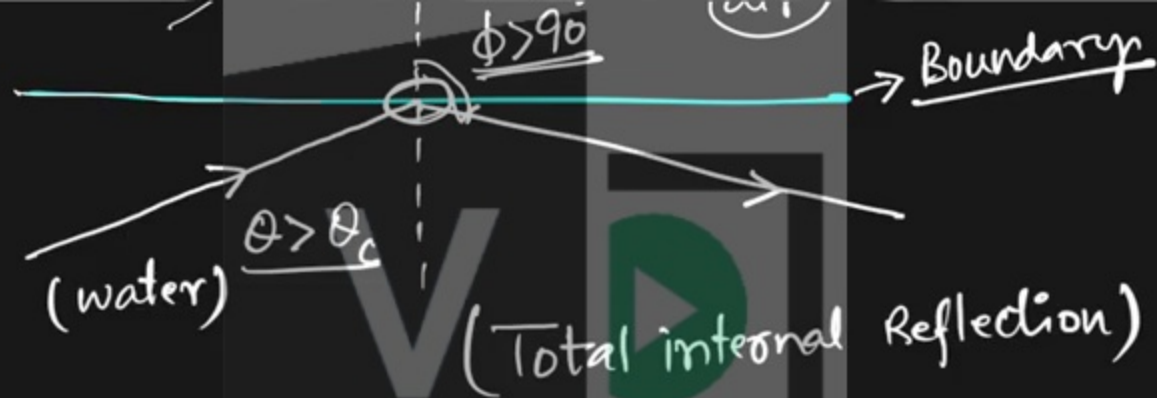
$\theta_c = \text{critical Angle}$



(water)

(Total internal Reflection)

→ Total internal reflection takes place only when, light ray enters from denser medium towards the



→ Total internal reflection takes place only when, light ray enters from denser medium towards the boundary of rarer medium (water → air)

→ refractive index → dense medium's nature

$$n_A = 1.5$$

so B is more dense than A

boundary
→ refractive index → dense medium's nature

$$\frac{\mu_A = 1.5}{\mu_B = 1.8}$$

so B is more dense than A

→ So, in Fibre core and cladding are selected to satisfy the condition of total internal reflection.

$$\mu_2 = 1.4$$

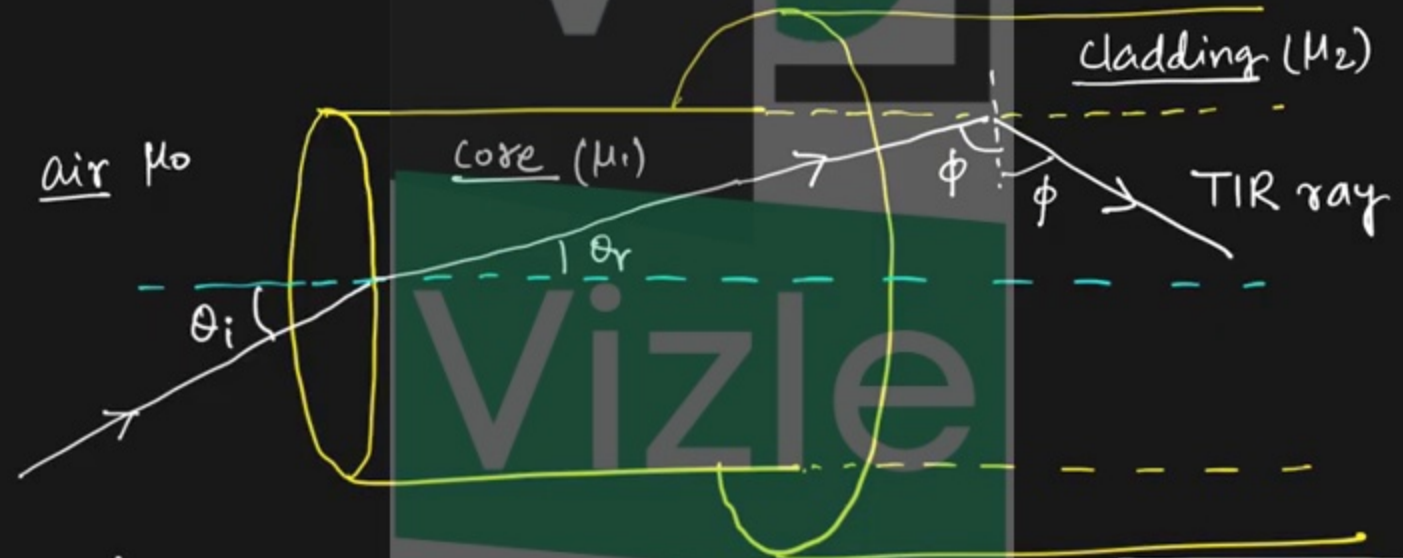
— cladding

$$\mu_1 = 1.5$$

— core

$\mu_1 = 1.5$ - core

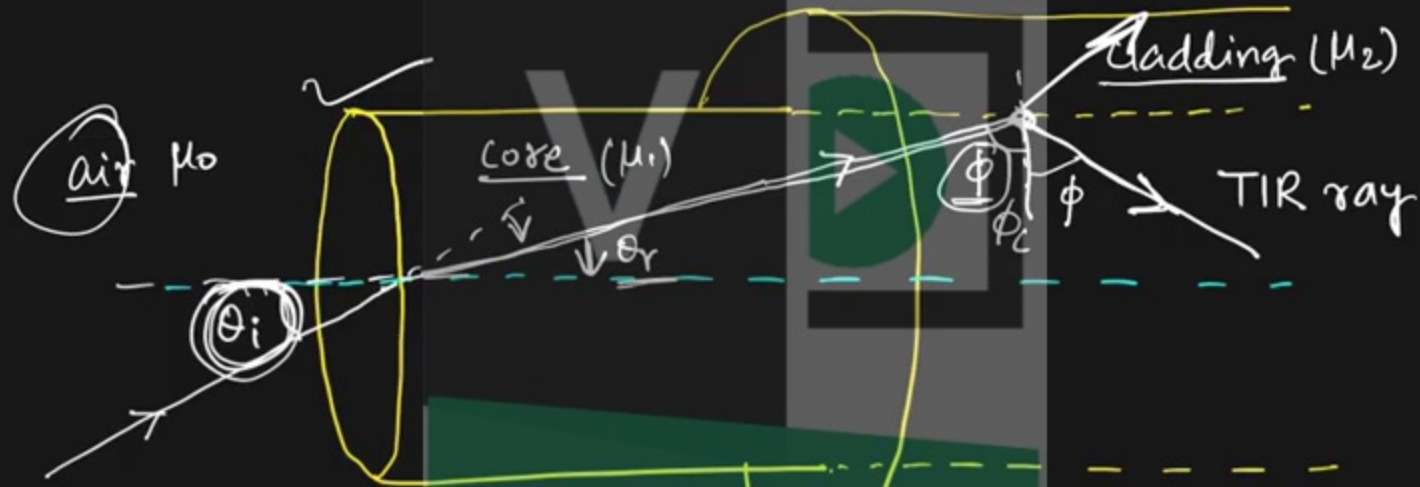
Acceptance angle and Numerical Aperture:-



When $\theta_i = \theta_c$ $\theta_r = \theta_c$ $\phi = 90^\circ$ $\mu_1 \sin \theta_c = \mu_2$

Acceptance angle and Numerical Aperture:-

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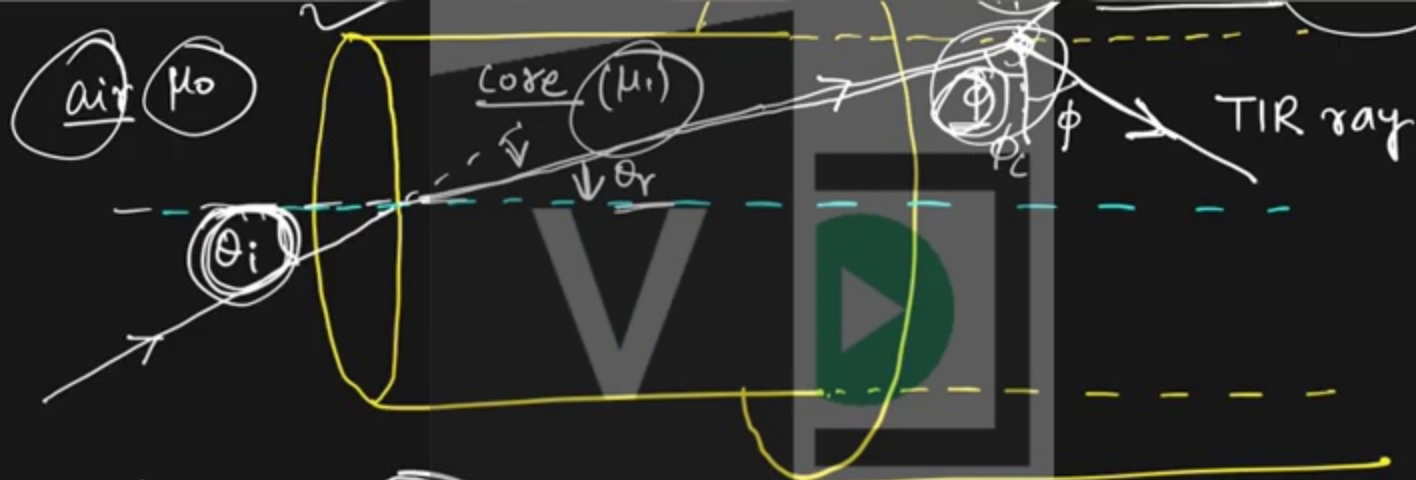
when $\theta_i = \theta_{i \max}$ $\phi > \phi_c$ (critical angle)

$$\boxed{\sin \phi_c = \frac{\mu_2}{\mu_1}}$$

$$\boxed{\sin \theta_{i \max} = \frac{\sqrt{\mu_1^2 - \mu_2^2}}{\mu_0}}$$

$\mu_0 = 1$ (air)

$$\boxed{\sin \theta_o = \sqrt{\mu_1^2 - \mu_2^2}}$$



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$$\boxed{\sin \theta_o = \sqrt{\mu_1^2 - \mu_2^2}} \quad \mu_0 = 1 \text{ (air)}$$

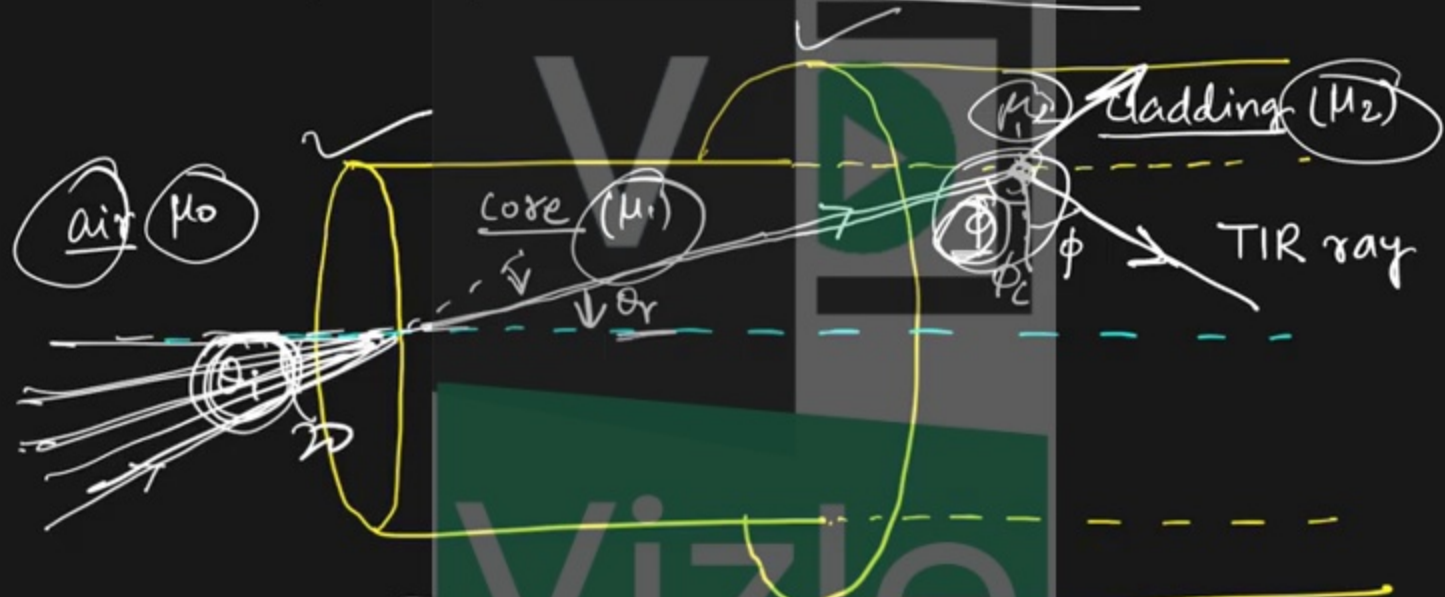
$\theta_{i \max} = \theta_o = \text{Acceptance Angle.}$

Acceptance cone

lost ray



Acceptance angle and Numerical Aperture:-



when $\theta_i = \theta_{i \max}$

$\phi > \phi_c$ (critical angle)

$$\sin \phi_c = \frac{\mu_2}{\mu_1}$$

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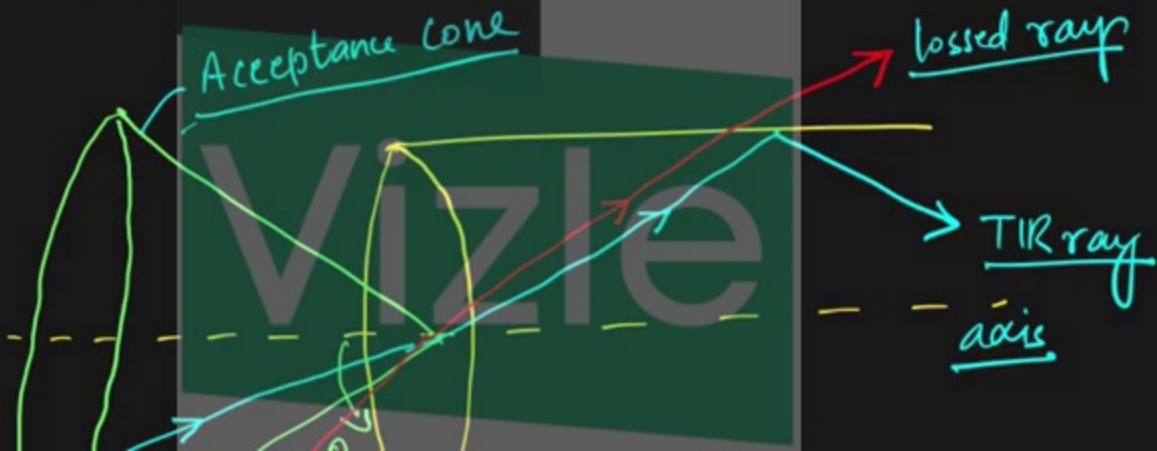
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$\theta_{i \max} = \theta_0 = \text{Acceptance Angle}$



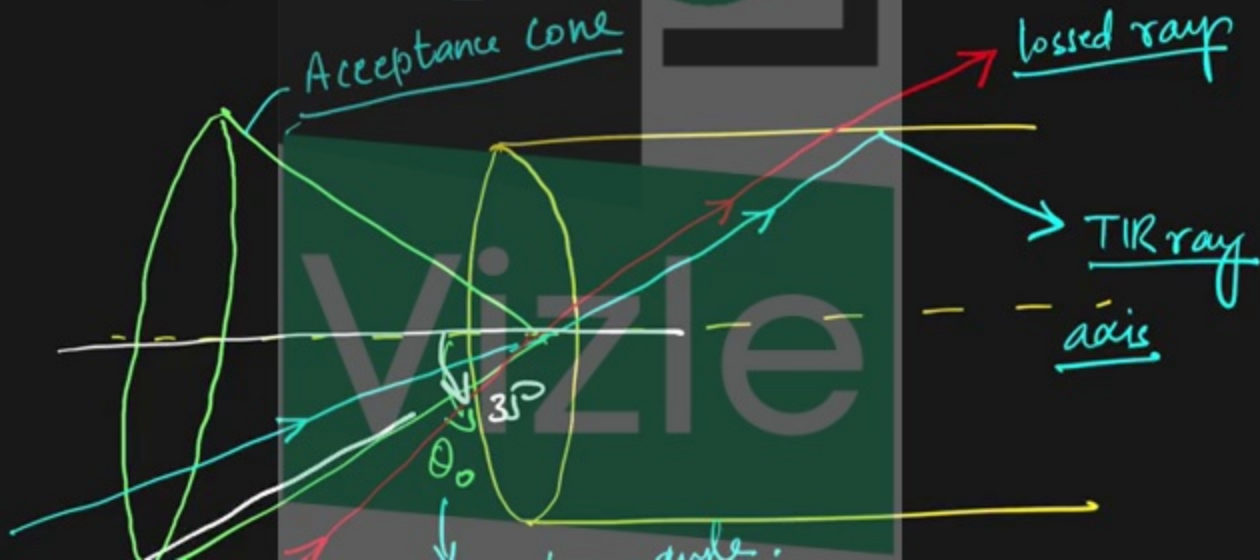
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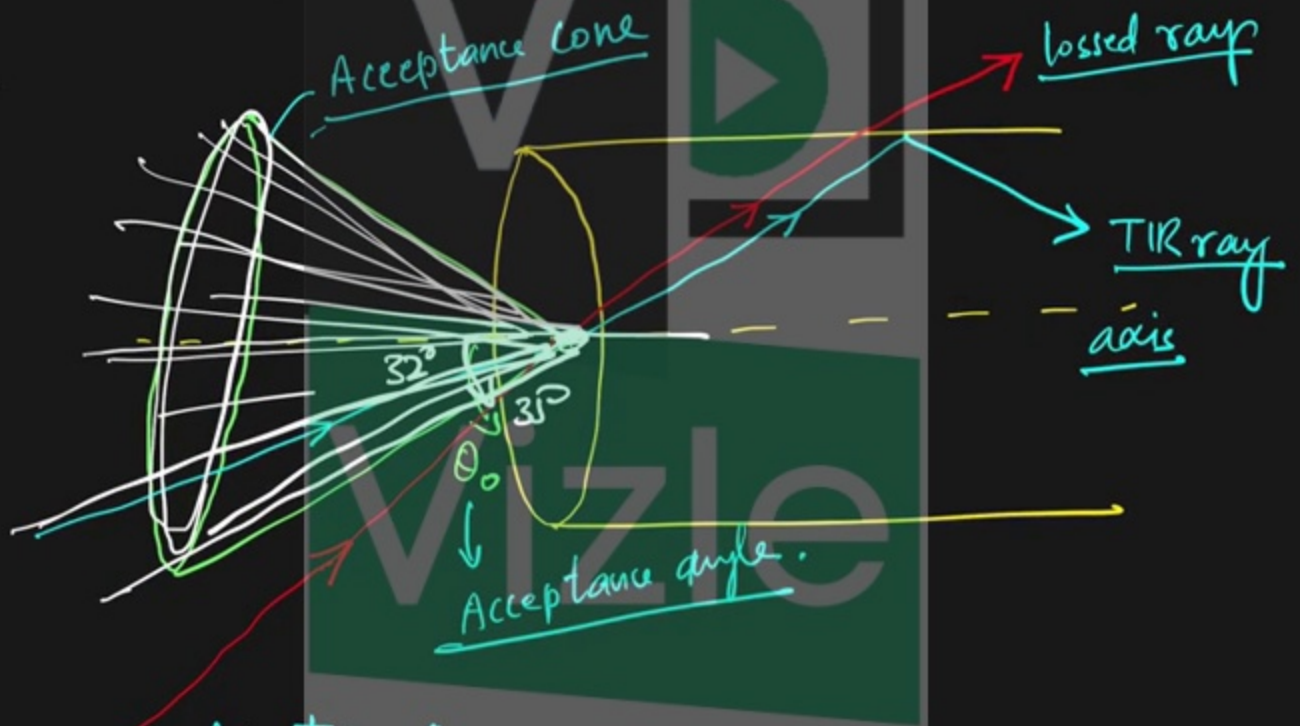




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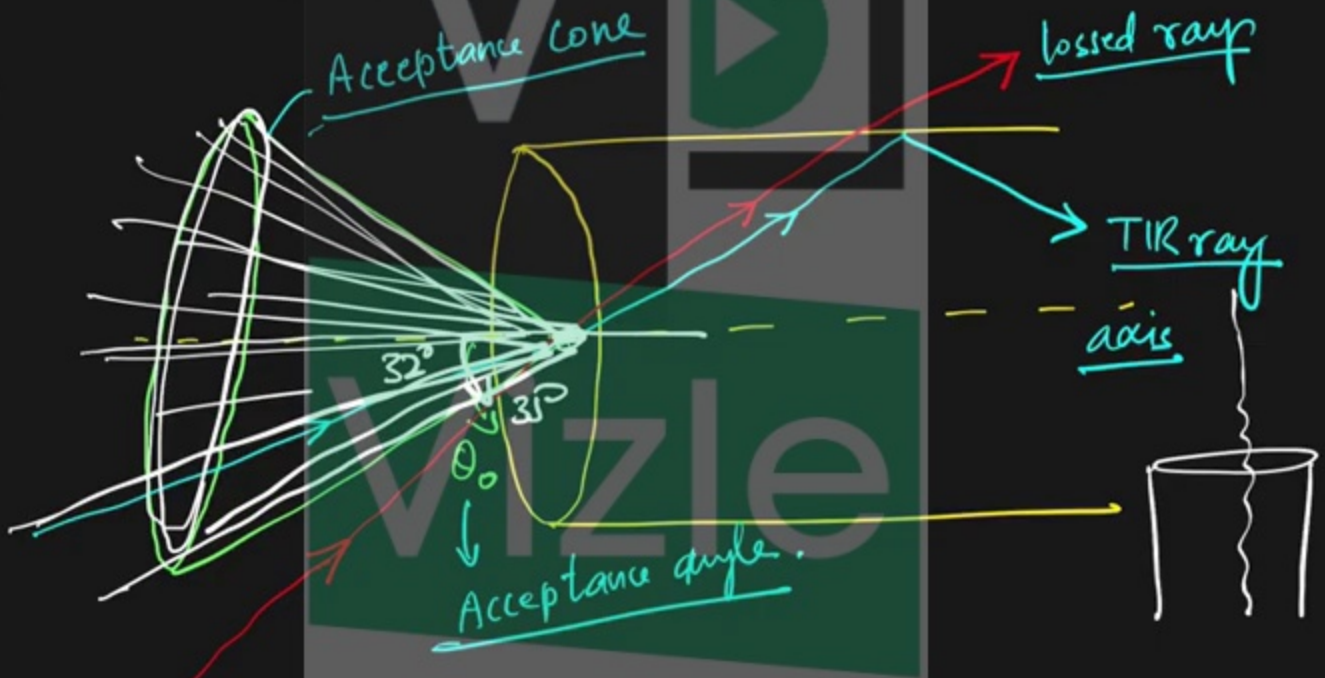
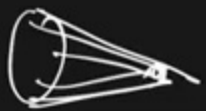


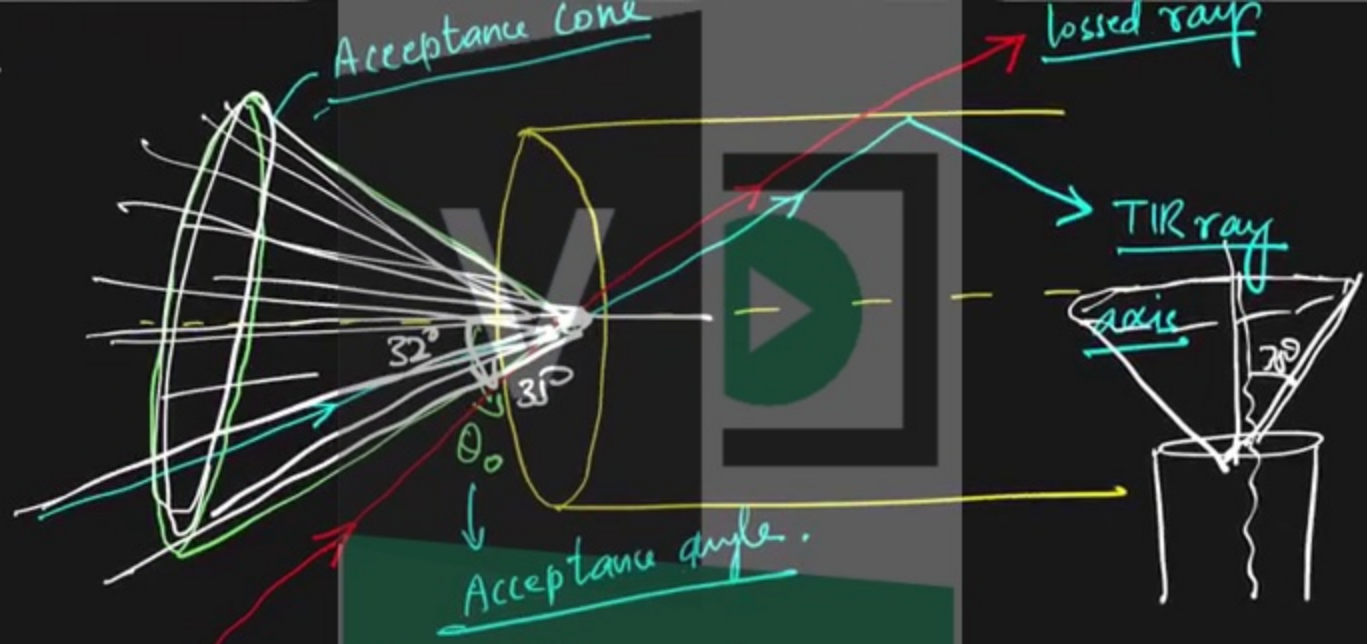
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$$\sin(\theta_0) = \sqrt{\mu_1^2 - \mu_2^2}$$

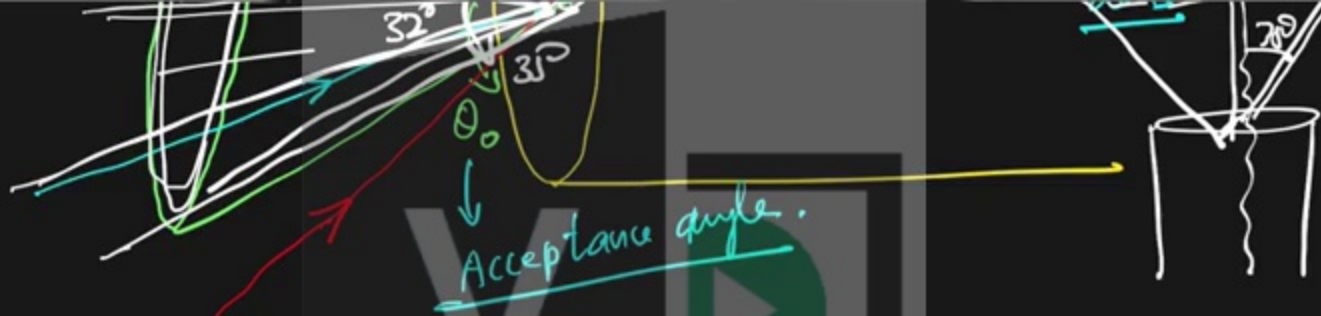
$\theta_{i \max} = \theta_0 = \text{Acceptance Angle}$





Numerical Aperture :-

"How much light can be collected by optical fiber"



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"How much light can be collected by optical fiber"

$$NA = \sin \theta_0 = \sqrt{\mu_1^2 - \mu_2^2}$$

Types of Optical Fibre :-

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