Integrated Optics Couplers

Integrated Optics

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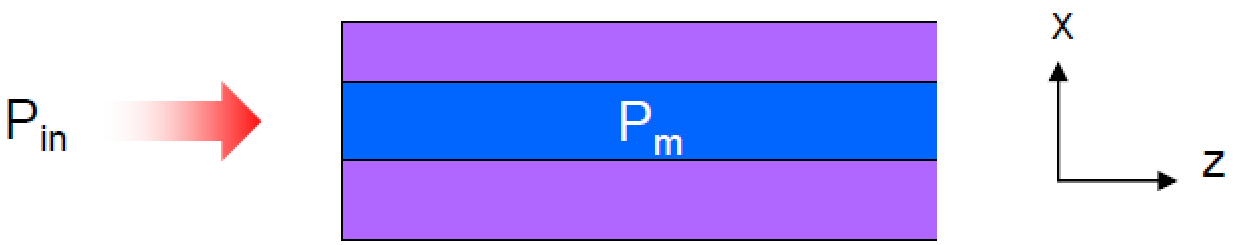


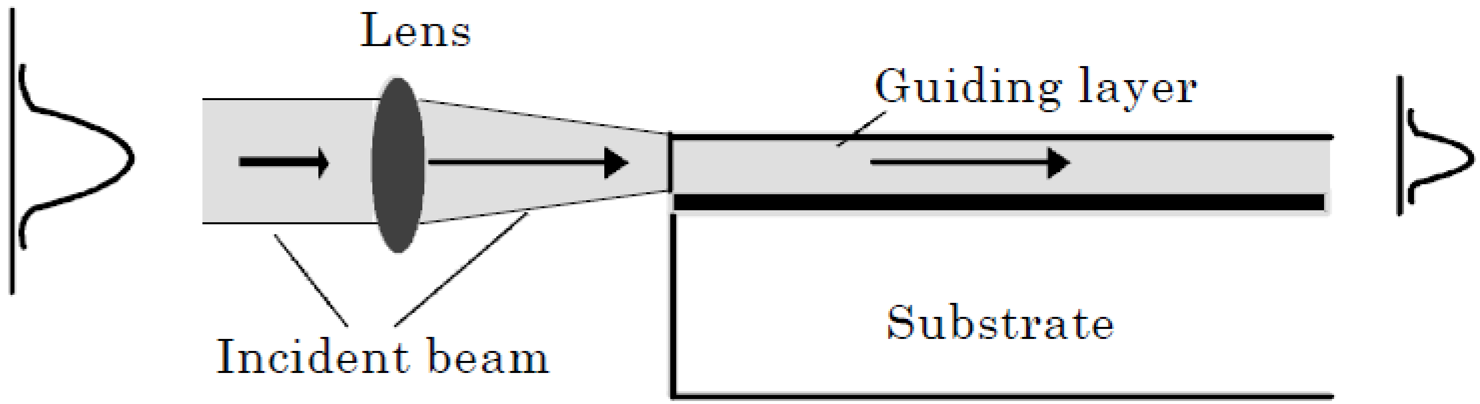
Coupling efficiency to the m-th mode

$$\eta_m = \frac{P_m}{P_{in}}$$

Coupling loss (dB)

$$L = 10\log\frac{P_{in}}{P_m}$$

Transverse Coupling



$$\eta_{\mathrm{cm}} = \frac{\left[\int A(x) B_m^*(x) \mathrm{d}x\right]^2}{\int A(x) A^*(x) \mathrm{d}x \int B_{\mathrm{m}}(x) B_{\mathrm{m}}^*(\dot{x}) \mathrm{d}x},$$

$A(x,y)$ = Field Distribution of Incident Beam
$B_m(x,y)$ = Field Distribution of the m-th mode

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End-Butt Coupling

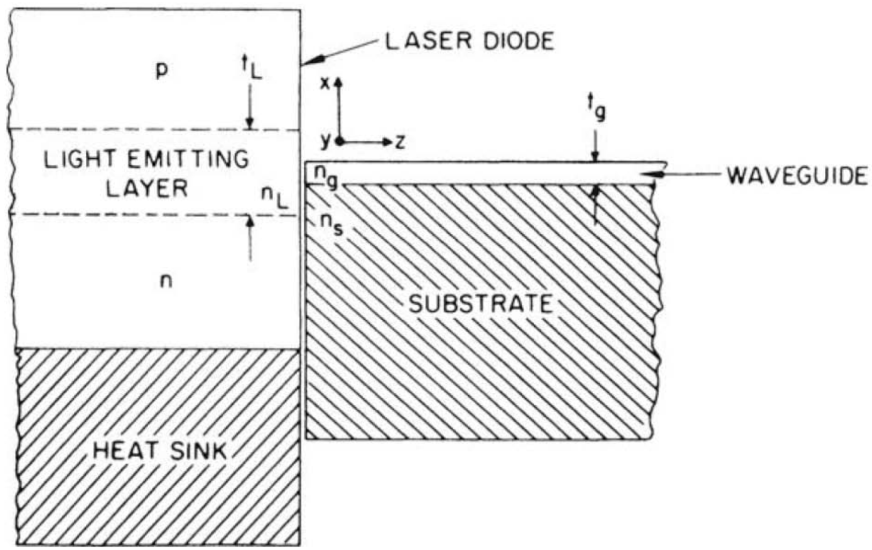

Fig. 7.2 Parallel end-butt coupling of a laser diode and thin-film waveguide

$$\eta_m = \frac{64}{(m+1)^2\pi^2}\cdot\frac{n_L n_g}{(n_L+n_g)^2}\cdot\cos^2\left(\frac{\pi t_g}{2t_L}\right)\cdot\frac{1}{\left[1-\left(\frac{t_g}{(m+1)t_L}\right)^2\right]^2}\cdot\frac{t_g}{t_L}\cdot\cos^2\left(\frac{m\pi}{2}\right)$$

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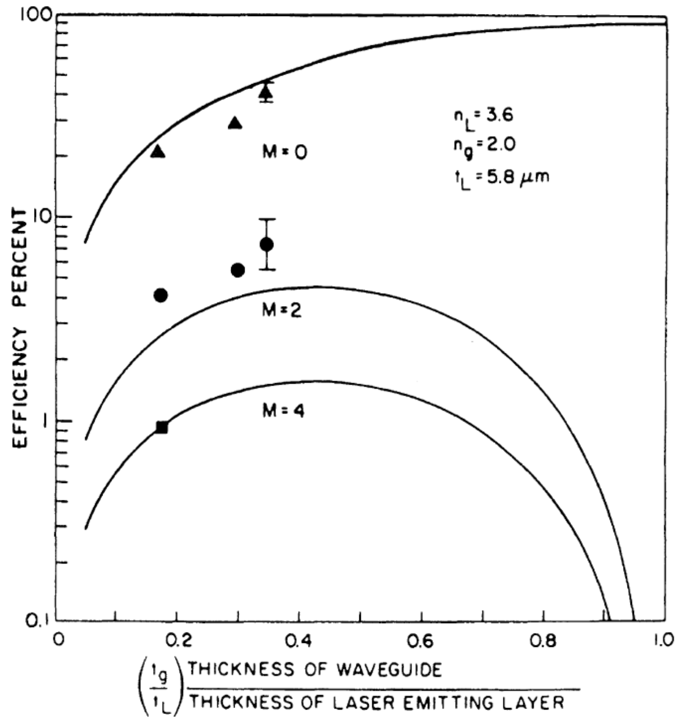
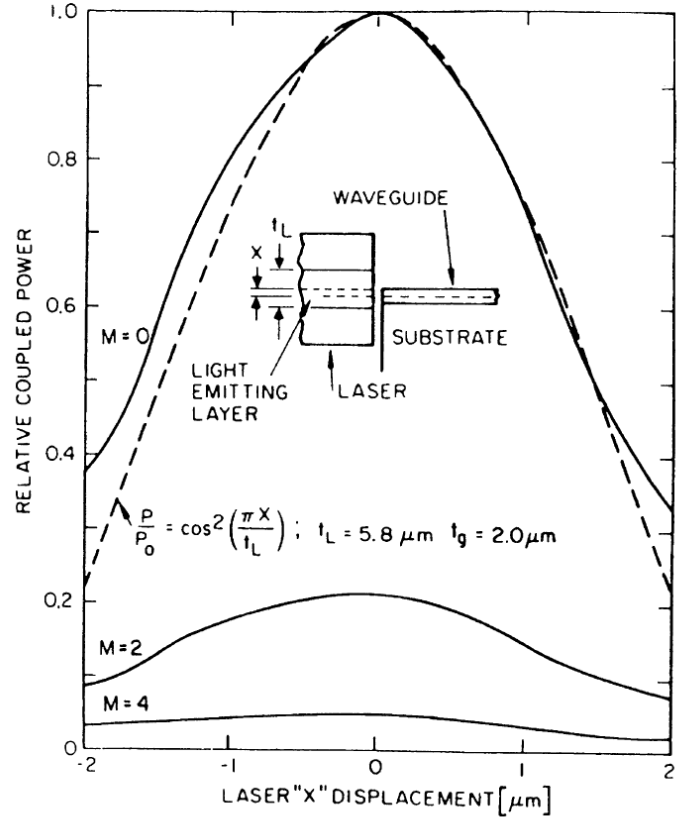
End-Butt Coupling





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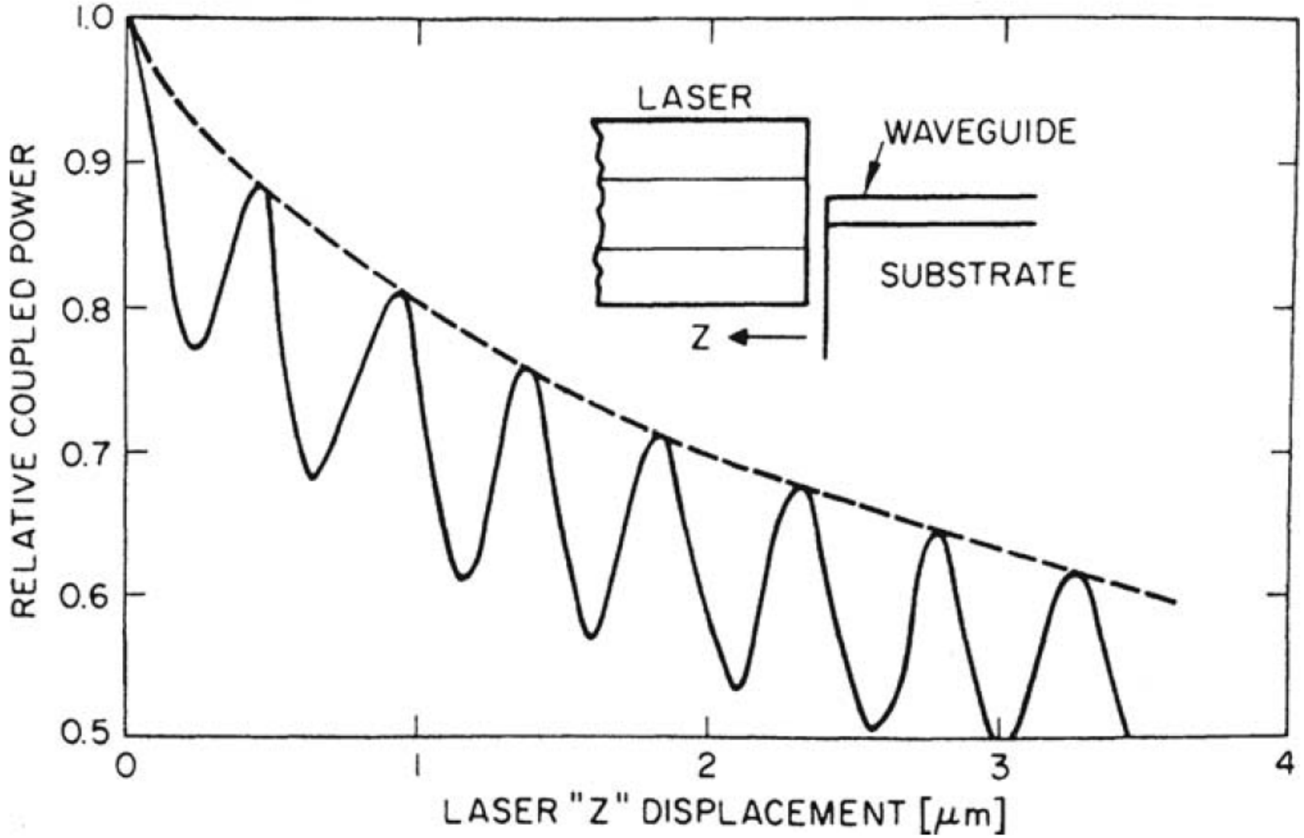
End-Butt Coupling



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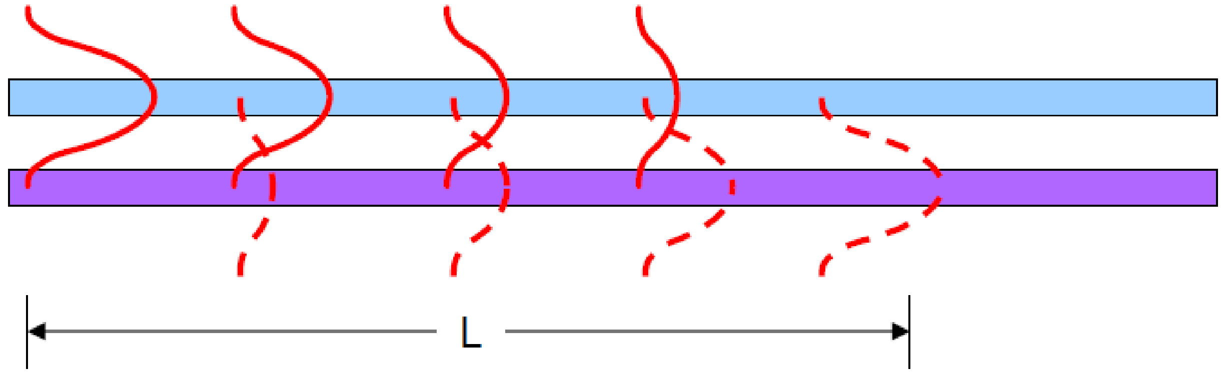
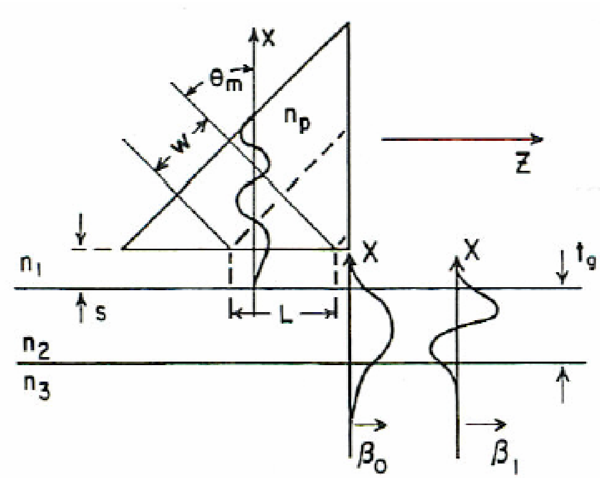
Prism Coupling



$$\kappa L = \frac{\pi}{2}$$

κ: Coupling coefficient (depending on overlap integral between the prism mode and the waveguide mode)



$$L = \frac{W}{\cos\theta_m} = \frac{\pi}{2\kappa}$$

For a given L, the coupling coefficient required for complete coupling:

$$\kappa = \frac{\pi\cos\theta_m}{2W}$$

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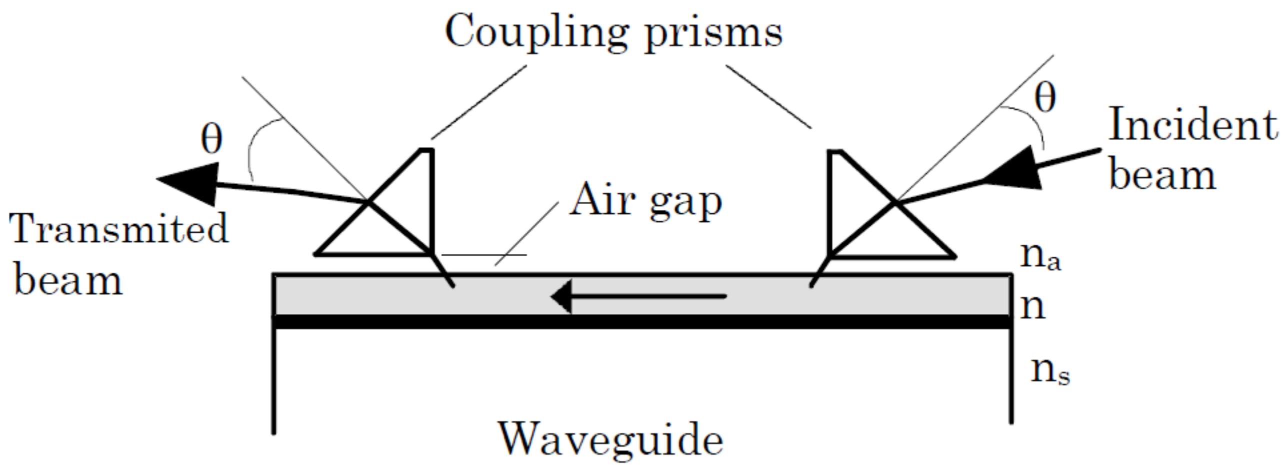
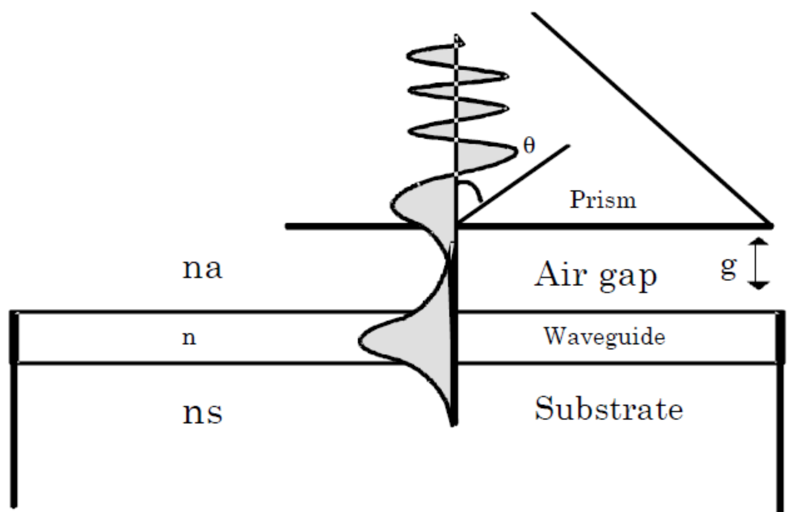
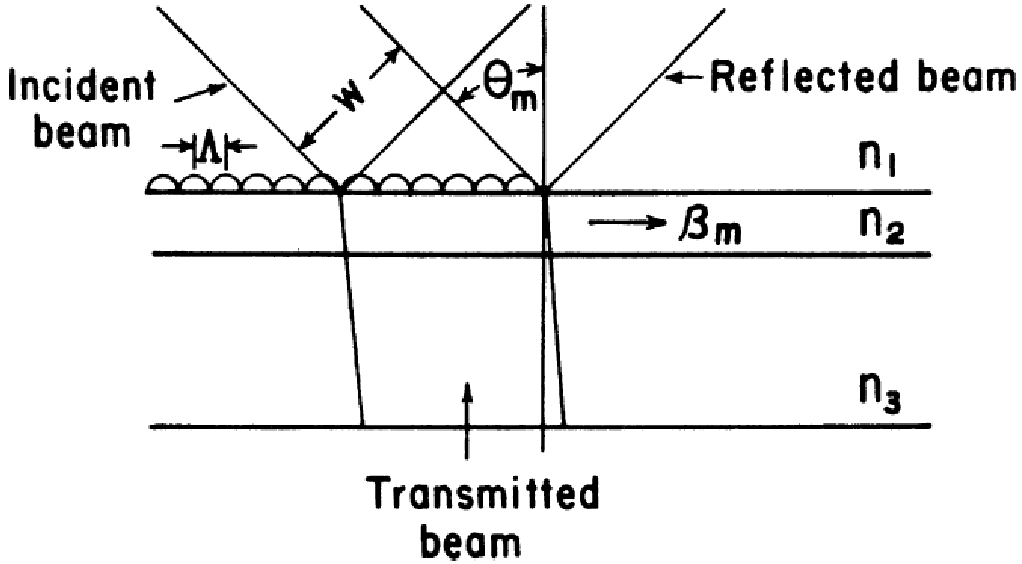
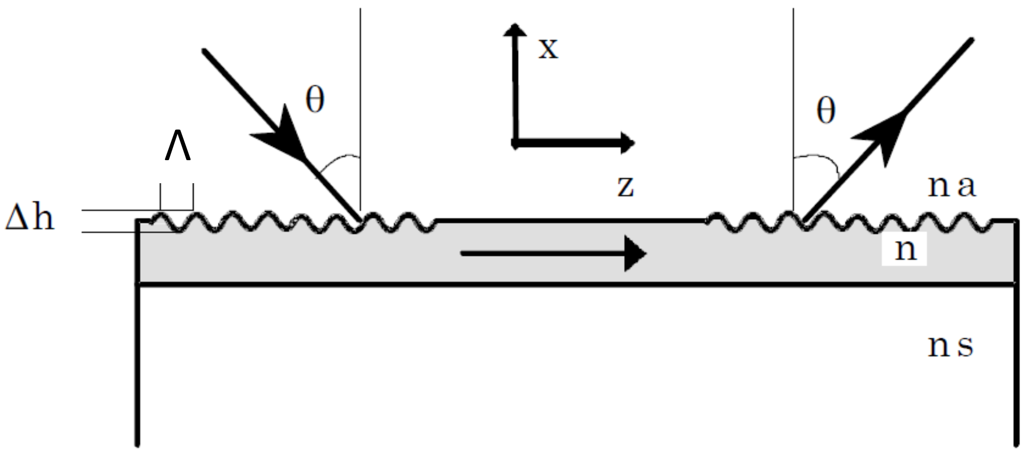
Prism Coupling





Grating Coupling





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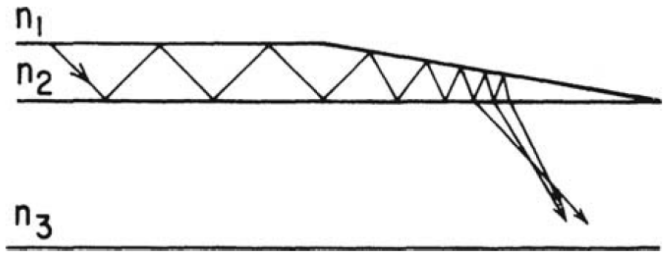
Waveguides Tapers



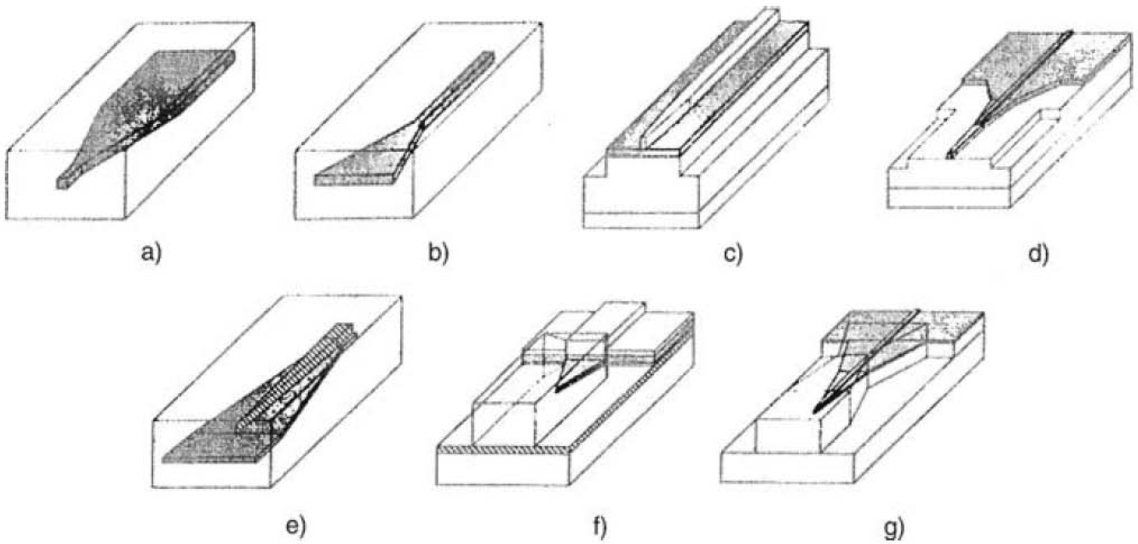


Fig. 7.12 a–g Lateral taper designs. **a** Lateral down-tapered buried waveguide. **b** Lateral up-tapered buried waveguide. **c** Single lateral taper transition from a ridge waveguide to a fiber-matched waveguide. **d** Multisection taper transition from a ridge waveguide to a fiber-matched waveguide. **e** Dual lateral overlapping buried waveguide taper. **f** Dual lateral overlapping ridge waveguide taper. **g** Nested waveguide taper transition from a ridge waveguide to a fiber-matched waveguide [26] ©1997 IEEE

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