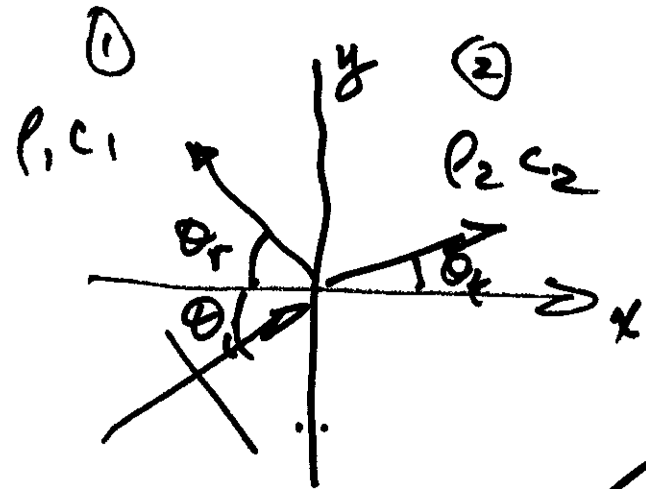
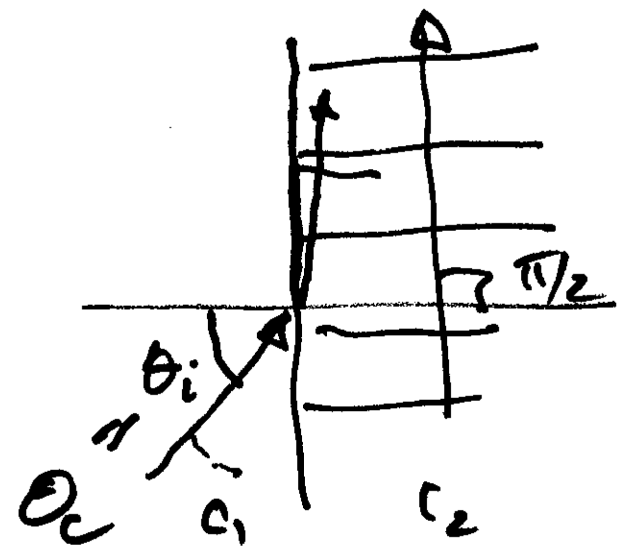


$$\boxed{\frac{\sin\theta_t}{\sin\theta_i} = \frac{c_2}{c_1}}$$

Snell's law

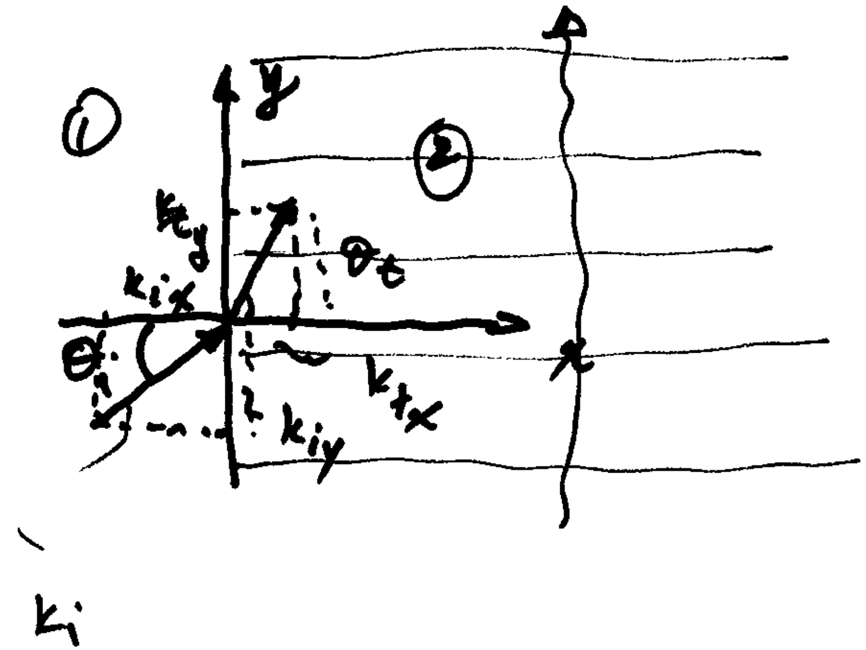
R, T $\qquad \zeta_{21}$

Critical Angle



$c_2 > c_1$

Transmitted Field



$$\tilde{p}_t = P_t e^{-j(k_{tx}x + k_{ty}y)}$$

$$k_{ty} = k_{iy} = k_1 \sin\theta_i$$

$$k_{tx} = k_2 \cos\theta_t$$

$$= \pm k_2 \sqrt{1 - \underbrace{\left(\frac{c_2}{c_1}\right)^2 \sin^2\theta_i}_{1 \text{ when } \theta_i = \theta_c}}$$

when $\theta_i = \theta_c$ $\quad k_{tx} = \pm k_2\sqrt{1-1} = 0$

no prop in the x-direction

when $\theta_i > \theta_c$

$$\sin\theta_t = \underbrace{\frac{c_2}{c_1}\sin\theta_i}_{>1}$$

when $\theta_i > \theta_c$

$$\sin\theta_t > 1$$

$$\sin\theta_t = \frac{e^{j\theta_t} - e^{-j\theta_t}}{2j}$$

$|\sin\theta_t|$ can be >1 when θ_t is imaginary or complex

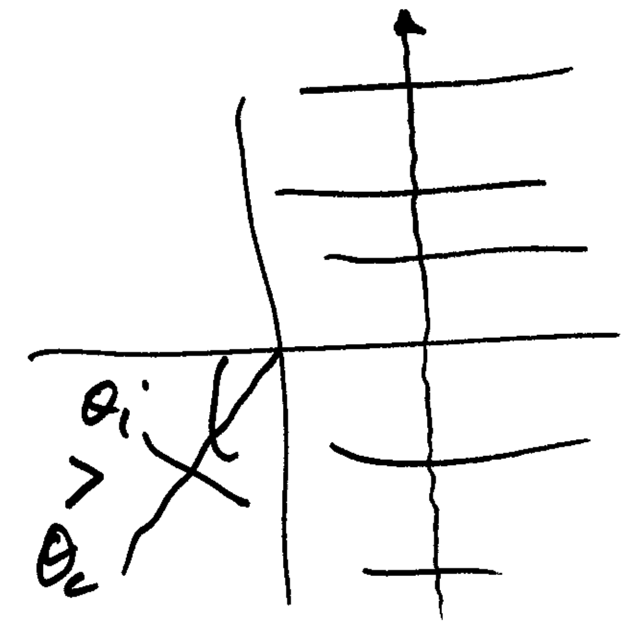
$$\theta_i > \theta_c \qquad k_{t_x} = \pm k_2 \sqrt{\underbrace{1 - \underbrace{\left(\frac{c_2}{c_1}\right)^2 \sin^2\theta_i}_{\sin\theta_t \, > \, 1}}_{\text{negative}}}$$

$$k_{t_x} = \pm k_2 \sqrt{(-1)\underbrace{\left[\left(\frac{c_2}{c_1}\right)^2 \sin^2\theta_i - 1\right]}_{\text{positive}}}$$

$$= \pm j\, k_2 \sqrt{\left(\frac{c_2}{c_1}\right)^2 \sin^2\theta_i - 1} \rightarrow \gamma \text{ real + positive}$$

$$= \pm j\gamma$$

transmitted field



$$\hat{P}_t = P_t\, e^{-jk_{tx}x}\, e^{-jk_{ty}y}$$

$$= P_t\, e^{-j(\pm j\gamma)x}\, e^{-jk_{ty}y}$$

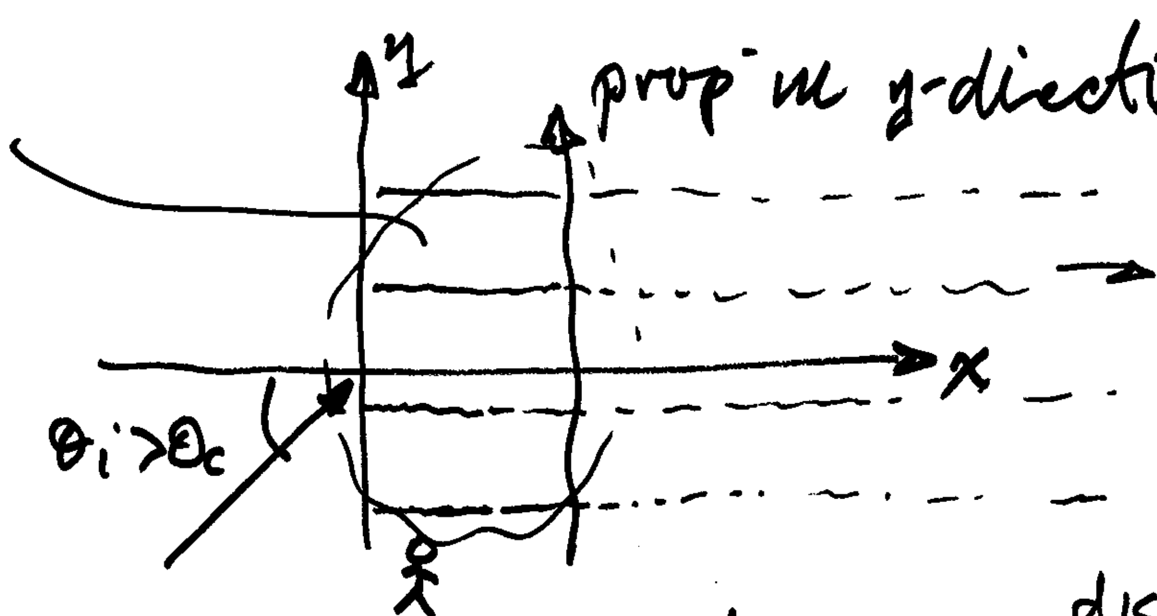
k_{ty}: $k_1 \sin\theta_i$

$$= P_t\, e^{\pm\gamma x}\, e^{-j(\underbrace{k_1 \sin\theta_i}_{\text{always real (for real } \theta_i)})y}$$

$e^{\pm\gamma x}$: pure exponential growth or decay. away from the interface

$e^{-j(k_1 \sin\theta_i)y}$: always represents prop in the y-direction nearfield

prop in y-direction



exponential decay in the x-direction

$\theta_i > \theta_c$

$|R| = 2$

you would hear something

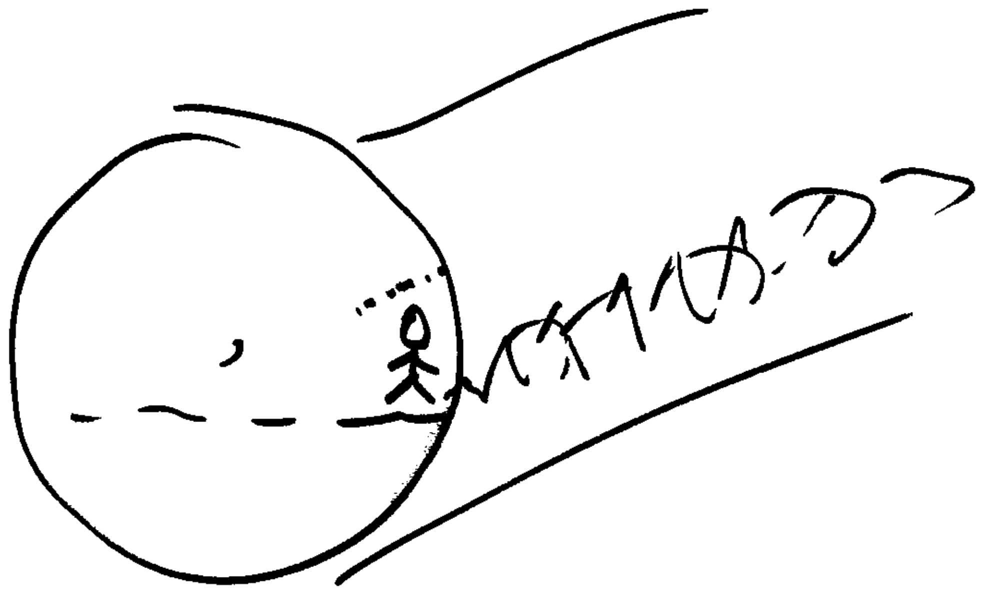
discard the exponentially growing solution on physical grounds

when $\theta_i > \theta_c$ no propagation away from the boundary

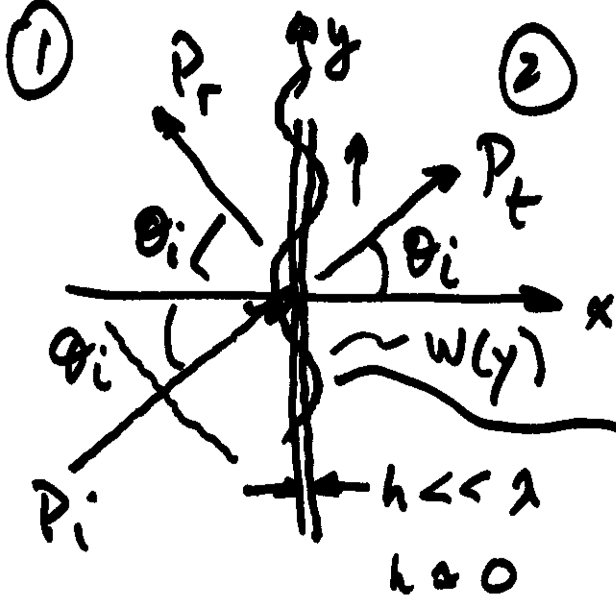
- sound field in the transmitted region - inhomogeneous plane waves
- prop in one direction + decay $\perp$ to that direction

There is a sound field in region 2
when $\theta_i > \theta_c$ - but it decays
exponentially away from the interface

when θ_i increases beyond θ_c
γ increases
rate of decay increases
& nearfield becomes
smaller.



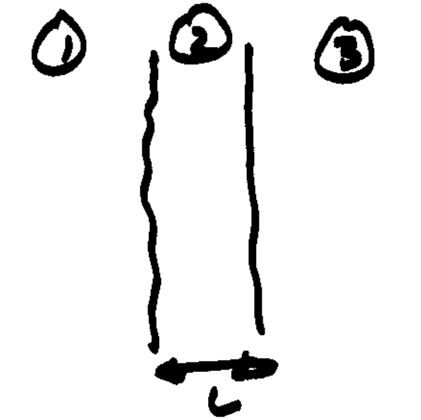
4.3.2 Reflection and Transmission at a limp, thin panel



no flexural stiffness (rubber sheet)

transverse displacement of the panel in response to the sound field

$\rho_1 c_1 = \rho_2 c_2 = \rho_0 c$



$k_2 L << 1$

panel mass/unit area $= m_s$

one additional unknown $w(y)$

3 b.c.'s are necessary

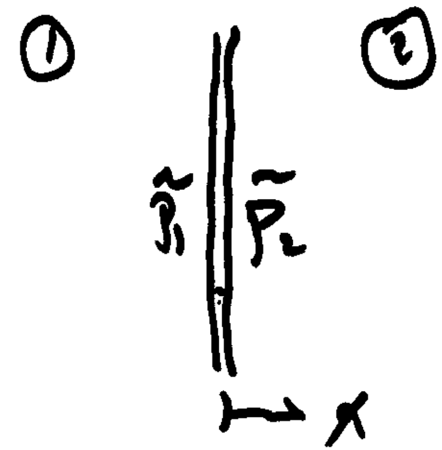
(1)

$$\tilde{p}_1 = P_i e^{-j(k_x x + k_y y)} + P_r e^{+j(k_x x - k_y y)}$$

$$\tilde{u}_{1x} = \frac{P_i}{\rho_0 c} \cos\theta_i \, e^{-j(k_x x + k_y y)} - \frac{P_r}{\rho_0 c} \cos\theta_i \, e^{+j(k_x x - k_y y)}$$

$$k_x = k \cos\theta_i \qquad k = \frac{\omega}{c}$$

$$k_y = k \sin\theta_i$$



panel is accelerated
in the x-direction
by the pressure difference
across it

"Limp" - no flexural stiffness
- no free wave prop possible in the panel
- responds only at the point where the force is applied
- surface of local reaction

accel at any point on the panel
= pressure diff across the panel at that point

F = ma / per unit area basis

$$\left.(\hat{p}_1 - p_2)\right|_{x=0} = m_s \frac{\partial^2 \tilde{w}}{\partial t^2}$$] at each point

EOM