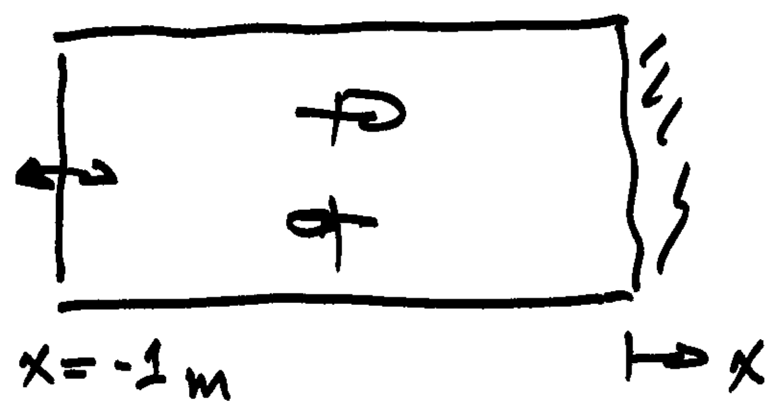
Oct. 23 rd Midterm

1.



$$\tilde{p} = e^{-jkx} + 0.8\, e^{+jkx}$$

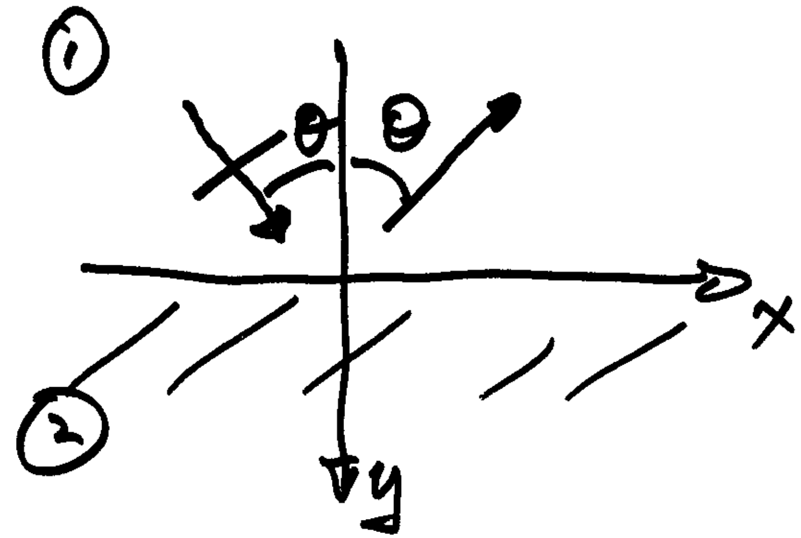
$$\tilde{u}_x = -\frac{1}{j\omega\rho_0}\frac{d\tilde{p}}{dx}$$

$$I_x = \frac{1}{2}\mathrm{Re}\{\tilde{p}(x)\,\tilde{u}_x^*\}$$

$$W = I_x S$$

$$\tilde{z} = \frac{\tilde{p}(x)}{\tilde{u}_x(x)}$$

2



$y<0$

$$\tilde{p}_1 = \underbrace{e^{-jk_x x} e^{-jk_y y}} + R \underline{\qquad\qquad}$$

$$\tilde{u}_{y_1} = -\frac{1}{j\omega\rho_0}\frac{d\tilde{p}}{dy} \qquad y \leq 0$$

$$I_y = \frac{1}{2}\mathrm{Re}\{\tilde{p}_1 \tilde{u}_{y_1}^*\} \qquad y = 0$$

3. $$\tilde{p}(x,t) = A e^{-\alpha x} e^{-i\beta x} e^{j\omega t}$$

A = complex α + β are real numbers

$$\hat{u}_x = -\frac{1}{j\omega\rho}\frac{d\hat{p}}{dx}$$

$$\frac{1}{\rho_0 c}\tilde{p}$$

$$\underset{\sim}{I}_x = \frac{1}{2}\mathrm{Re}\{\tilde{p}\,\hat{u}_x^*\}$$

4.

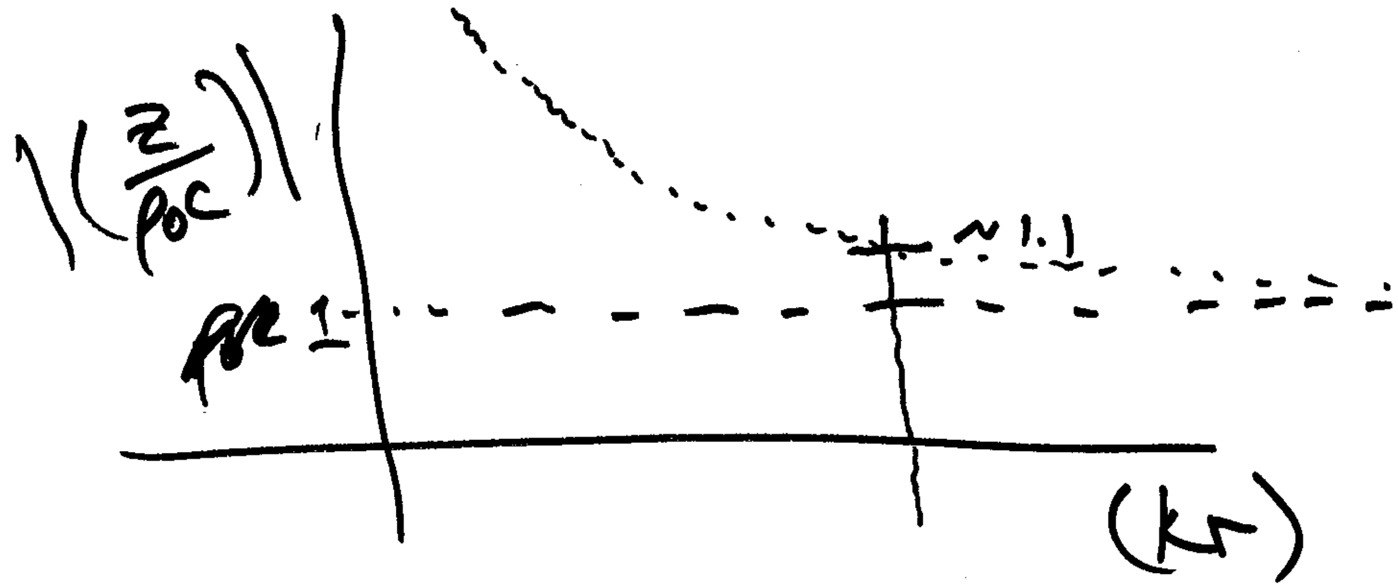
$$\tilde{p}(r,\theta) = \frac{A}{r^{1/2}} \sin\theta \, e^{-jkr}$$

$$\bar{u} = -\frac{1}{j\omega\rho_0} \nabla \hat{p}$$

see page 520

$$I_r = \frac{1}{2} \mathrm{Re}\{\tilde{p}(r,\theta)\, \hat{u}_r(r,\theta)\}$$

5.11.6C



5.12.2

$$\frac{|p|^2}{2} = p_{rms}^2$$

speed = velocity

$p = \beta s$

5.12.3

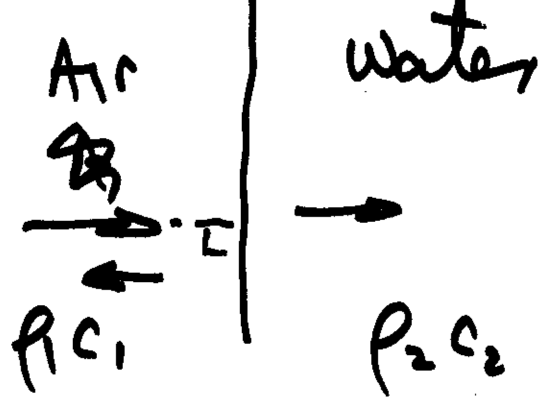
Oct. 23

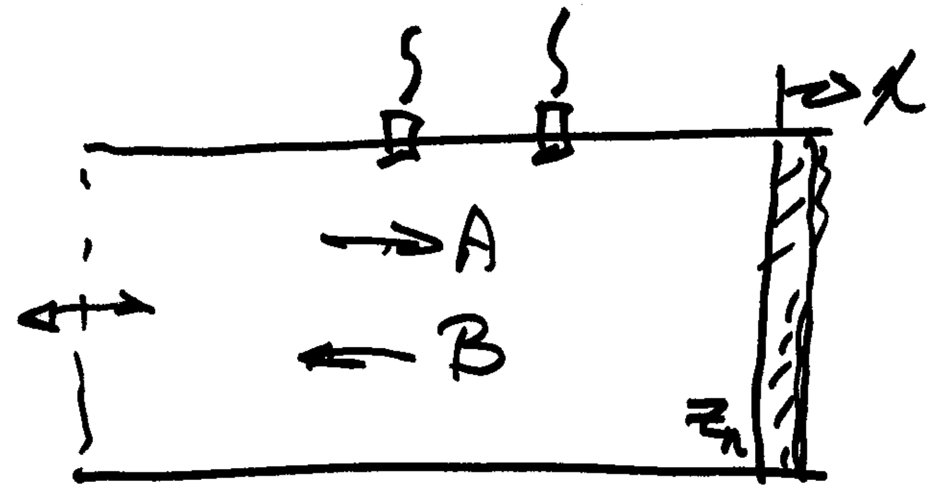
4.0 Fundamentals of Reflection and Transmission

Chapter 6

4.1 Introduction

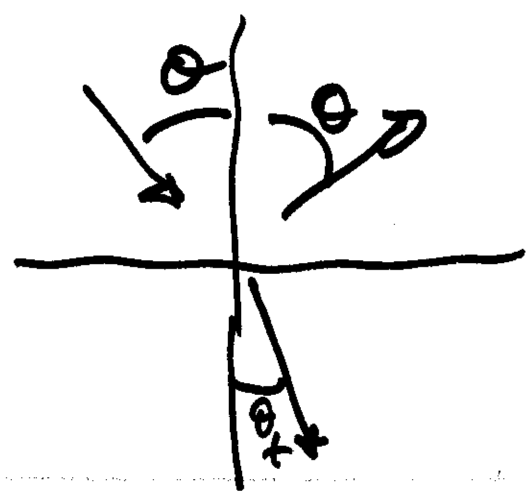
Two Fluid





$$\hat{p}(x) = A e^{-ikx} + B e^{ikx}$$

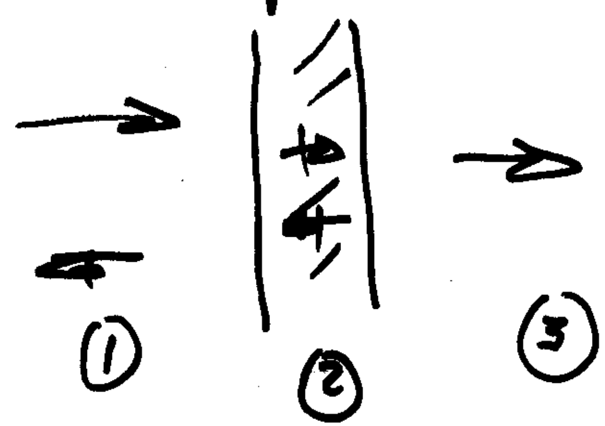
$$R = \frac{B}{A}$$



Cases:

(1.) sound in a semi-infinite medium
hitting a second semi-infinite medium

1a - finite depth intermediate layer



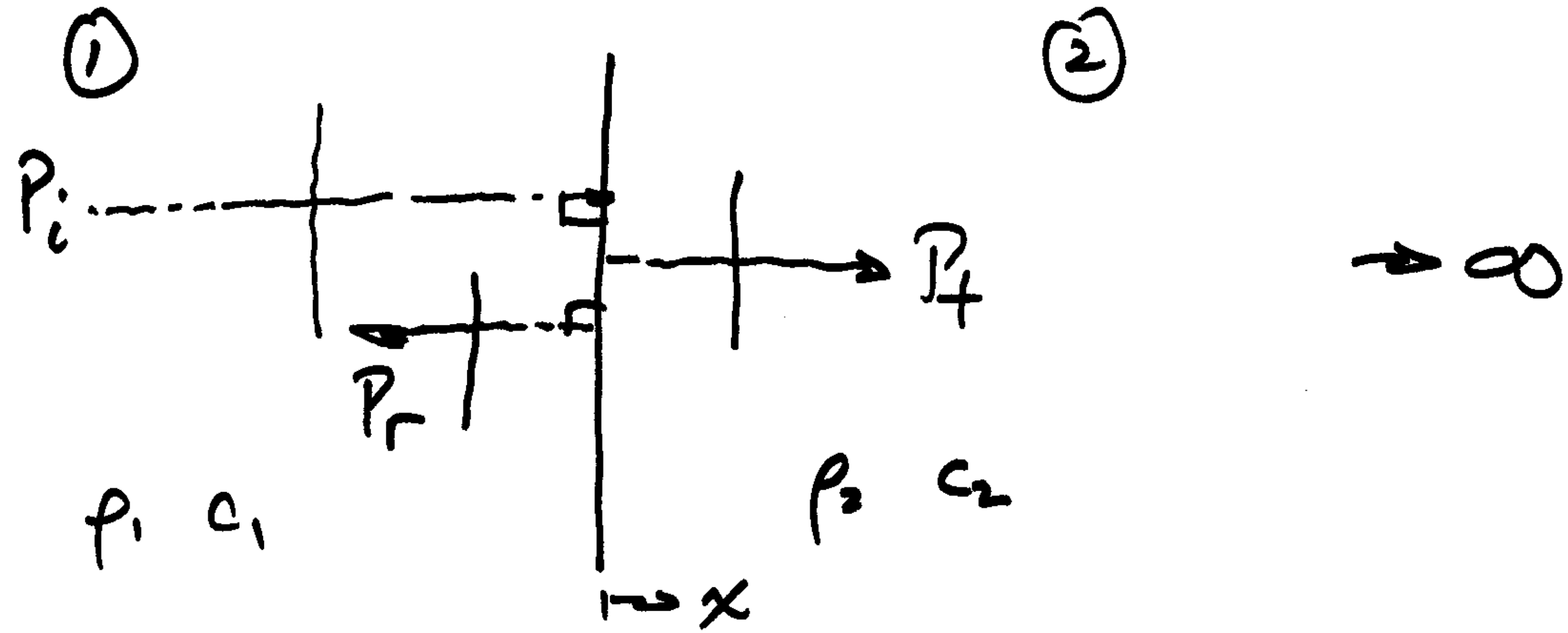
(2) Sound transmission through
a limp barrier

(3) Reflection from an impedance
surface

Applications

- predict sound transmission through walls
    - aircraft fuselage
    - ships
- absorption & reflection from interior & exterior surfaces.

4.2 Normal Incidence Reflection and Transmission (two fluid)



$$\nabla^2 \tilde{p}_1 + k_1^2 \tilde{p}_1 = 0 \qquad \nabla^2 \tilde{p}_2 + k_2^2 \tilde{p}_2 = 0$$

$$k_1 = \omega/c_1 \qquad k_2 = \omega/c_2$$

$$\hat{p}_1 = P_i e^{-ik_1 x} + P_r e^{+ik_1 x}$$

$$\hat{p}_2 = P_t e^{-ik_2 x}$$

$$\hat{u}_1 = \frac{P_i}{\rho_1 c_1} e^{-jk_1 x} - \frac{P_r}{\rho_1 c_1} e^{+jk_1 x}$$

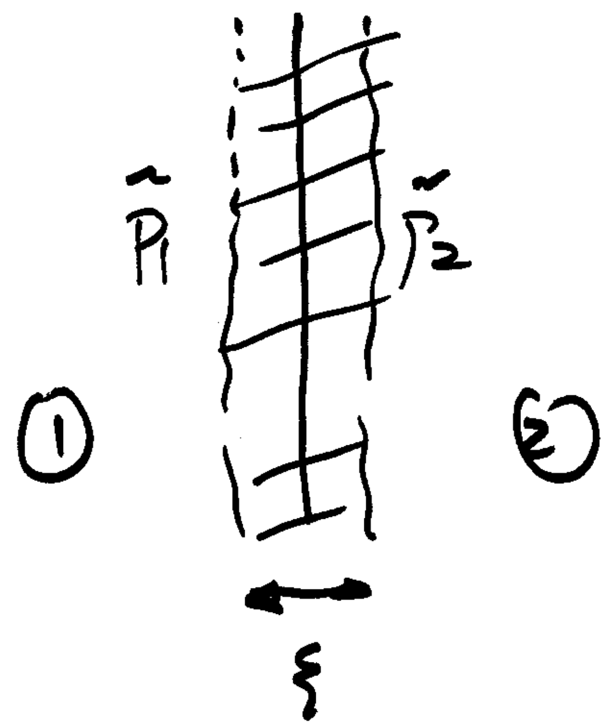
$$\hat{u}_2 = \frac{P_t}{\rho_2 c_2} e^{-jk_2 x}$$

3 constants P_i, P_r + P_t

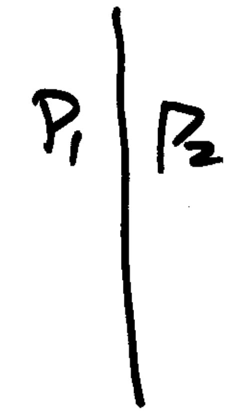
usually normalize wrt the incident sound field $\div P_i$

→ 2 unknowns

(i) Pressure Continuity Equation



$$\tilde{P}_1 - \tilde{P}_2 = \underbrace{m_s}_{\text{mass/unit area of layer thickness } \varepsilon} \tilde{a}$$



$$\tilde{a} = \frac{\tilde{P}_1 - \tilde{P}_2}{m_s}$$

when $\varepsilon \to 0$ $\quad m_s \to 0$

$\hat{a} \to \infty$ if $\hat{P}_1 \neq \tilde{P}_2$

$$\boxed{\tilde{p}_1(0) = \tilde{p}_2(0)}$$