

98 Longitudinal waves in thin rods

(steel). Then let

$$\begin{aligned} l_1 &= 0.457 \text{ m} = 18 \text{ in}, & l_2 &= 2l_1, \\ d_1 &= 1.5 d_2, & d_2 &= 2.54 \text{ cm} = 1.0 \text{ in}, \\ c_1 &= c_2 = 5.08 \times 10^3 \text{ m s}^{-1} = 20 \times 10^4 \text{ in s}^{-1}, \\ V_1 &= V = 6.10 \text{ m s}^{-1} = 240 \text{ in s}^{-1}, & V_2 &= 0, \end{aligned} \quad (2.4.5)$$

in which d_1, d_2 refer to the rod diameters. Following the procedures of the previous, simpler problem, we have at $t = 0$,

$$\begin{aligned} f'_1(x) &= -g'_1(x) = -V/2c_1, \\ f'_2(x) &= g'_2(x) = 0. \end{aligned} \quad (2.4.6)$$

This initial wave structure at the instant of collision is shown in Fig. 2.16 for

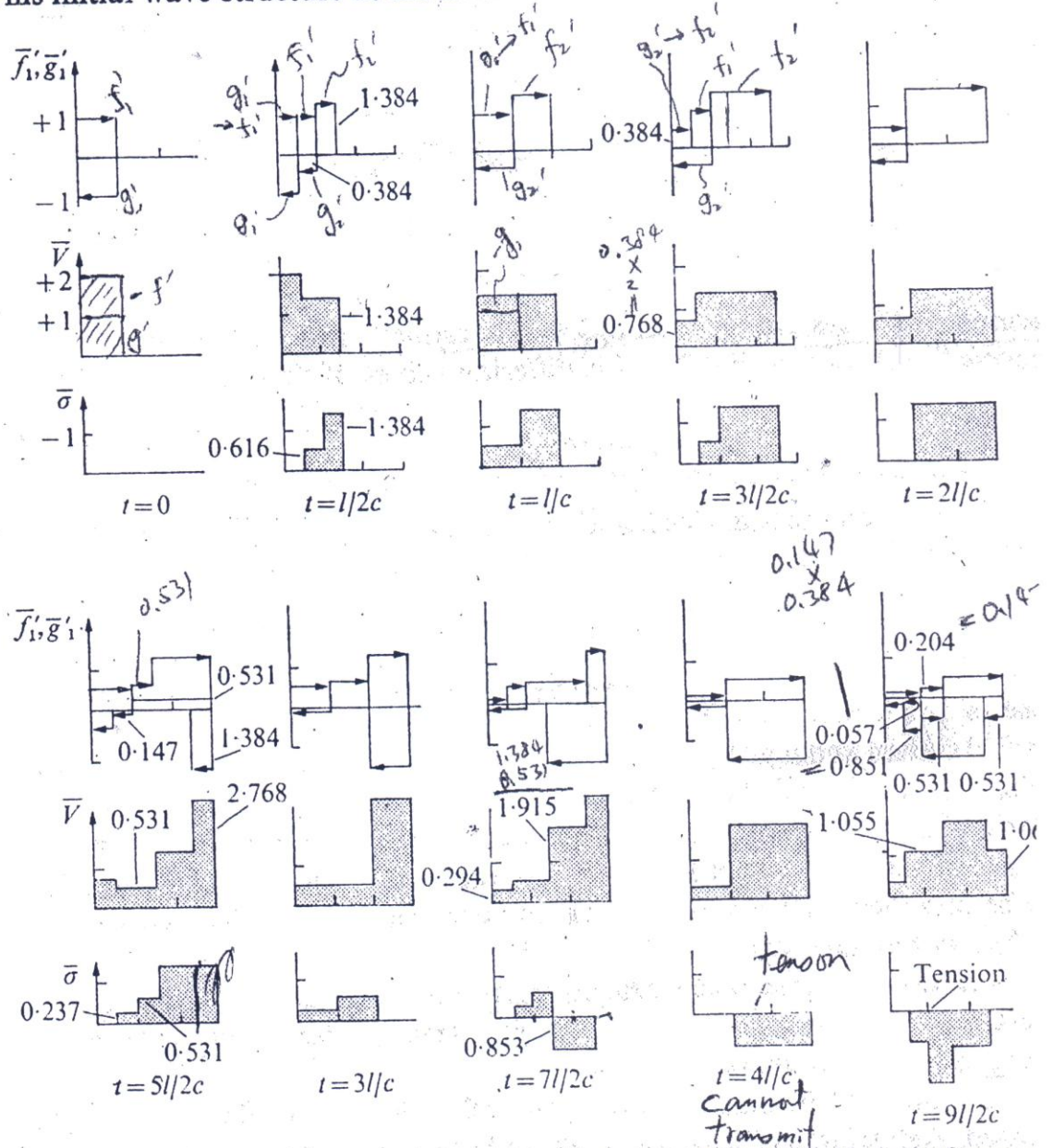


FIG. 2.16. Several stages in the wave propagation resulting from impact of two rods differing in cross-section and length.

$$\bar{t} = 8$$

$$AB: \quad \bar{\sigma} = -0.147 + 0.147 = 0$$

$$\bar{v} = -(-0.147) + 0.147 = 0.294$$

$$BC: \quad \bar{\sigma} = -0.531 + 1.384 = 0.835 \quad (\text{ten.})$$

$$\bar{v} = -(-0.531) + 1.384 = 1.915.$$

CD: same as BC

$\bar{v}$ on rod 2 $>$ $\bar{v}$ on rod 1.

$\bar{\sigma}$ on rod 2 is tension.

$\bar{\sigma}$ on rod 1 is zero.

$\therefore$ wave cannot transmit from rod 2 to rod 1, except the interface is glued.

