

**15-50** A cylindrical enclosure is considered. The view factor from the side surface of this cylindrical enclosure to its base surface is to be determined.

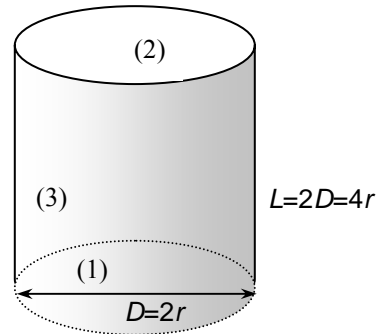
**Assumptions** The surfaces are diffuse emitters and reflectors.

**Analysis** We designate the surfaces as follows:

- Base surface by (1),
- top surface by (2), and
- side surface by (3).

Then from Fig. 15-7

$$\left. \begin{aligned} \frac{L}{r_1} &= \frac{4r_1}{r_1} = 4 \\ \frac{r_2}{L} &= \frac{r_2}{4r_2} = 0.25 \end{aligned} \right\} F_{12} = F_{21} = 0.05$$



summation rule :  $F_{11} + F_{12} + F_{13} = 1$

$$0 + 0.05 + F_{13} = 1 \longrightarrow F_{13} = 0.95$$

$$\text{reciprocity rule : } A_1 F_{13} = A_3 F_{31} \longrightarrow F_{31} = \frac{A_1}{A_3} F_{13} = \frac{\pi r_1^2}{2\pi r_1 L} F_{13} = \frac{\pi r_1^2}{8\pi r_1^2} F_{13} = \frac{1}{8} (0.95) = \mathbf{0.119}$$

**Discussion** This problem can be solved more accurately by using the view factor relation from Table 15-3 to be

$$R_1 = \frac{r_1}{L} = \frac{r_1}{4r_1} = 0.25$$

$$R_2 = \frac{r_2}{L} = \frac{r_2}{4r_2} = 0.25$$

$$S = 1 + \frac{1 + R_2^2}{R_1^2} = 1 + \frac{1 + 0.25^2}{0.25^2} = 18$$

$$F_{12} = \frac{1}{2} \left\{ S - \left[ S^2 - 4 \left( \frac{R_2}{R_1} \right)^2 \right]^{0.5} \right\} = \frac{1}{2} \left\{ 18 - \left[ 18^2 - 4 \left( \frac{1}{1} \right)^2 \right]^{0.5} \right\} = 0.056$$

$$F_{13} = 1 - F_{12} = 1 - 0.056 = 0.944$$

$$\text{reciprocity rule : } A_1 F_{13} = A_3 F_{31} \longrightarrow F_{31} = \frac{A_1}{A_3} F_{13} = \frac{\pi r_1^2}{2\pi r_1 L} F_{13} = \frac{\pi r_1^2}{8\pi r_1^2} F_{13} = \frac{1}{8} (0.944) = \mathbf{0.118}$$