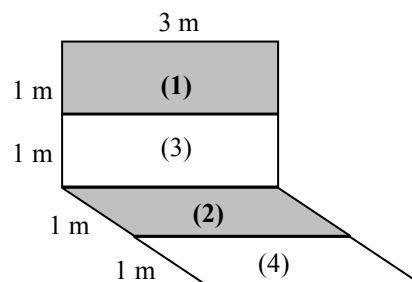**15-57** The view factors between the rectangular surfaces shown in the figure are to be determined.

Assumptions The surfaces are diffuse emitters and reflectors.

Analysis We designate the different surfaces as follows:

        shaded part of perpendicular surface by (1),
        bottom part of perpendicular surface by (3),
        shaded part of horizontal surface by (2), and
        front part of horizontal surface by (4).

(*a*) From Fig.15-6

$$\left.\begin{array}{l} \dfrac{L_2}{W}=\dfrac{1}{3} \\[2mm] \dfrac{L_1}{W}=\dfrac{1}{3} \end{array}\right\} F_{23}=0.25 \quad \text{and} \quad \left.\begin{array}{l} \dfrac{L_2}{W}=\dfrac{2}{3} \\[2mm] \dfrac{L_1}{W}=\dfrac{1}{3} \end{array}\right\} F_{2\rightarrow(1+3)}=0.32$$

superposition rule : $F_{2\rightarrow(1+3)}=F_{21}+F_{23}\longrightarrow F_{21}=F_{2\rightarrow(1+3)}-F_{23}=0.32-0.25=0.07$

reciprocity rule : $A_1=A_2\longrightarrow A_1F_{12}=A_2F_{21}\longrightarrow F_{12}=F_{21}=\mathbf{0.07}$

(*b*) From Fig.15-6,

$$\left.\dfrac{L_2}{W}=\dfrac{1}{3}\ \text{and}\ \dfrac{L_1}{W}=\dfrac{2}{3}\right\} F_{(4+2)\rightarrow3}=0.15 \quad \text{and} \quad \left.\dfrac{L_2}{W}=\dfrac{2}{3}\ \text{and}\ \dfrac{L_1}{W}=\dfrac{2}{3}\right\} F_{(4+2)\rightarrow(1+3)}=0.22$$

superposition rule : $F_{(4+2)\rightarrow(1+3)}=F_{(4+2)\rightarrow1}+F_{(4+2)\rightarrow3}\longrightarrow F_{(4+2)\rightarrow1}=0.22-0.15=0.07$

reciprocity rule : $A_{(4+2)}F_{(4+2)\rightarrow1}=A_1F_{1\rightarrow(4+2)}$

$$\longrightarrow F_{1\rightarrow(4+2)}=\dfrac{A_{(4+2)}}{A_1}F_{(4+2)\rightarrow1}=\dfrac{6}{3}(0.07)=0.14$$

superposition rule : $F_{1\rightarrow(4+2)}=F_{14}+F_{12}$

$$\longrightarrow F_{14}=0.14-0.07=\mathbf{0.07}$$

since $F_{12}=0.07$ (from part *a*). Note that F_{14} in part (*b*) is equivalent to F_{12} in part (*a*).

(*c*) We designate

        shaded part of top surface by (1),
        remaining part of top surface by (3),
        remaining part of bottom surface by (4), and
        shaded part of bottom surface by (2).

From Fig.15-5,

$$\left.\begin{array}{l} \dfrac{L_2}{D}=\dfrac{2}{2} \\[2mm] \dfrac{L_1}{D}=\dfrac{2}{2} \end{array}\right\} F_{(2+4)\rightarrow(1+3)}=0.20 \quad \text{and} \quad \left.\begin{array}{l} \dfrac{L_2}{D}=\dfrac{2}{2} \\[2mm] \dfrac{L_1}{D}=\dfrac{1}{2} \end{array}\right\} F_{14}=0.12$$

superposition rule : $F_{(2+4)\rightarrow(1+3)}=F_{(2+4)\rightarrow1}+F_{(2+4)\rightarrow3}$

symmetry rule : $F_{(2+4)\rightarrow1}=F_{(2+4)\rightarrow3}$

Substituting symmetry rule gives

$$F_{(2+4)\rightarrow1}=F_{(2+4)\rightarrow3}=\dfrac{F_{(2+4)\rightarrow(1+3)}}{2}=\dfrac{0.20}{2}=0.10$$

reciprocity rule : $A_1F_{1\rightarrow(2+4)}=A_{(2+4)}F_{(2+4)\rightarrow1}\longrightarrow(2)F_{1\rightarrow(2+4)}=(4)(0.10)\longrightarrow F_{1\rightarrow(2+4)}=0.20$

superposition rule : $F_{1\rightarrow(2+4)}=F_{12}+F_{14}\longrightarrow 0.20=F_{12}+0.12\longrightarrow F_{12}=0.20-0.12=\mathbf{0.08}$