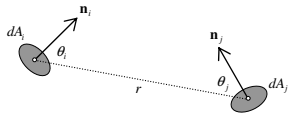
VIEW FACTORS

for diffuse surfaces (emit, absorb and reflect diffusely) separated by transparent medium

Catalog of View Factors: http://www.me.utexas.edu/~howell/

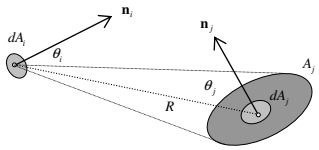
TWO DIFFERENTIAL AREAS



$F_{dA_i \to dA_j}$ = *fraction of radiation leaving area dA_i and intercepted by the area dA_j*

$$F_{dA_i \to dA_j} = \frac{\cos\theta_i \cdot \cos\theta_j}{\pi r^2} \cdot dA_j \qquad (13.0)$$

DIFFERENTIAL AND FINITE AREAS

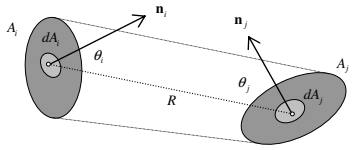


$F_{dA_i \to A_j}$ = *fraction of radiation leaving area dA_i and intercepted by the area A_j*

$$F_{dA_i \to A_j} = \int_{A_j} \frac{\cos\theta_i \cdot \cos\theta_j}{\pi R^2}\, dA_j \qquad (13.00)$$

$$F_{A_i \to dA_j} = \frac{1}{A_i} \int_{A_i} \frac{\cos\theta_i \cdot \cos\theta_j}{\pi R^2}\, dA_j dA_i \qquad (13.000)$$

TWO FINITE AREAS



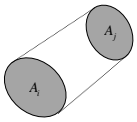
F_{ij} = *fraction of radiation leaving area A_i and intercepted by the area A_j*

$$F_{ij} = \frac{1}{A_i} \int_{A_i} \int_{A_j} \frac{\cos\theta_i \cdot \cos\theta_j}{\pi R^2}\, dA_i\, dA_j \qquad (13.1)$$

$$F_{ji} = \frac{1}{A_j} \int_{A_i} \int_{A_j} \frac{\cos\theta_i \cdot \cos\theta_j}{\pi R^2}\, dA_i\, dA_j \qquad (13.2)$$

VIEW FACTOR RELATIONS

RECIPROCITY

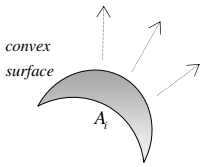


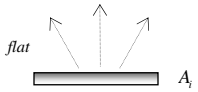
$$A_i F_{ij} = A_j F_{ji} \qquad (13.3)$$

CONVEX SURFACE

surfaces without self-illumination

$$F_{ii} = 0$$

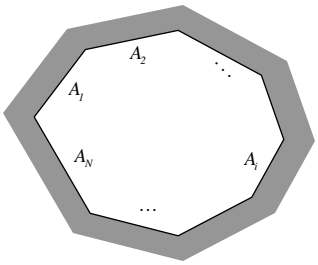




rays emitted by a surface are not intercepted by a surface itself

ENCLOSURE

enclosure consists of N surfaces $A_1, A_2, \ldots, A_N$



MATRIX OF VIEW FACTORS

N^2 = *total number of view factors*

$$\begin{bmatrix} F_{11} & F_{12} & \cdots & F_{1N} \\ F_{21} & F_{22} & \cdots & F_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ F_{N1} & F_{N2} & \cdots & F_{NN} \end{bmatrix}$$

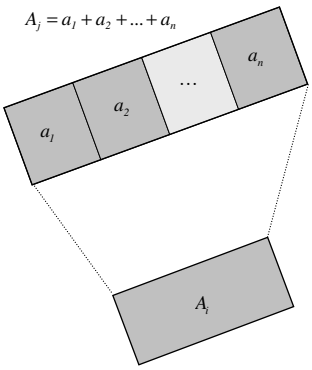
SUMMATION RULE

$$F_{i1} + F_{i2} + \ldots + F_{iN} = 1 \qquad i = 1,2,\ldots,N \quad N \text{ equations} \qquad (13.4)$$

$$A_i F_{ij} = A_j F_{ji}$$

Reciprocity Rule $\frac{N^2 - N}{2}$ *equations*

COMPOSITE AREA

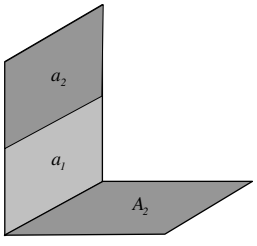


$$F_{A_i \to A_j} = F_{A_i \to a_1} + F_{A_i \to a_2} + \ldots + F_{A_i \to a_n} \qquad (13.5)$$

$$F_{A_j \to A_i} = \frac{a_1 F_{a_1 \to A_i} + a_2 F_{a_2 \to A_i} + \ldots + a_n F_{a_n \to A_i}}{A_j} \qquad (13.7)$$

EXAMPLE

$A_1 = a_1 + a_2$



$F_{A_1 \to A_2}$ = *from the Table 13.2*

$F_{a_1 \to A_2}$ = *from the Table 13.2*

$$F_{A_1 \to A_2} = \frac{a_1 F_{a_1 \to A_2} + a_2 F_{a_2 \to A_2}}{A_1} = \frac{a_1 F_{a_1 \to A_2} + A_2 F_{A_2 \to a_2}}{A_1}$$

$$F_{A_2 \to a_2} = \frac{A_1 F_{A_1 \to A_2} - a_1 F_{a_1 \to A_2}}{A_2}$$

$$F_{a_2 \to A_2} = \frac{A_1 F_{A_1 \to A_2} - a_1 F_{a_1 \to A_2}}{a_2}$$