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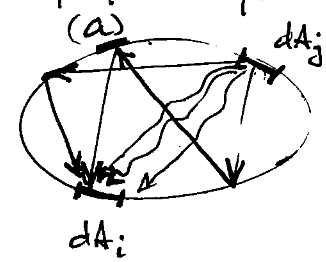
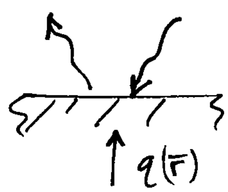
LAST TIME: RADIATION NETWORK, PARTIALLY SPECULAR / PARTIALLY DIFFUSE



SPECULAR VIEW FACTOR —

$$dF^s_{dA_i-dA_j} \quad \frac{\text{POWER INTERCEPTED} \begin{cases}\text{DIRECTLY} + \\ \text{SPECULAR VIA MULTI-REFLEC.}\end{cases}}{\text{TOT. DIFFUSE POWER LEAVING } dA_j}$$

$$dF^s_{dA_i-dA_j} = dF_{dA_i-dA_j} + \rho^s_a\, dF_{dA_i(a)-dA_j} + \cdots$$



$$q'' = \varepsilon E_b - \overset{=\varepsilon}{\tilde{\alpha}} H = \varepsilon(E_b - H)$$

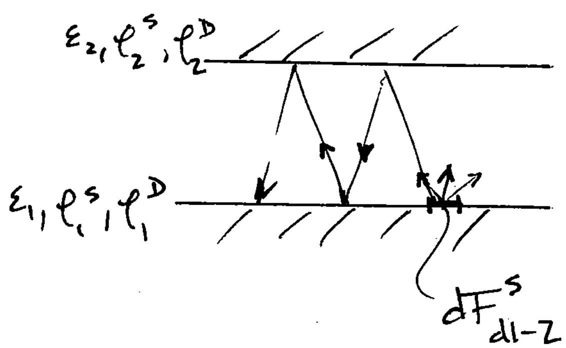
$$q'' = J^{TOT} - H$$

ρ

$$J^{TOT} = \rho^s H + \underbrace{\overbrace{\rho^D H + \varepsilon E_b}^{\text{DIFFUSE RADIATION}}}_{J \text{ (WHAT WE NORMALLY THINK OF AS RADIOSITY)}}$$

$$q'' = J - (1-\rho^s)H$$

$$H(\vec r) = \int J(\vec r\,')\, dF^s_{dA-dA'} + H_o$$



$$dF^s_{d1-2} = 1 + \rho_1^s\rho_2^s + (\rho_1^s\rho_2^s)^2 + \cdots$$

$$= \frac{1}{1-\rho_1^s\rho_2^s} = F^s_{12} \quad \left(\overset{*}{\text{LARGER THAN 1}}\right)$$

SINCE dA IS

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LOOK @ ABSORBED POWER —

$$\underset{\alpha_2^s}{(1-\rho_2^s)} = F_{12}^s = \frac{1-\rho_2^s}{1-\rho_1^s\rho_2^s} < 1 \quad \therefore \text{OK}$$

SUMMATION RULE —

$$\sum_{j=1}^{N} (1-\rho_j^s) F_{ij}^s = 1$$

$$F_{12}^s = F_{21}^s$$

$$q_1'' = J_1 - [1-\rho_1^s] J_2 F_{21}^s$$

$$q_2'' = J_2 - [1-\rho_2^s] J_1 F_{12}^s$$

$$q_1'' = \frac{\varepsilon_1}{\rho_1^D}\left[(1-\rho_1^s)E_{b_1} - J_1\right]$$

$$q_2'' = \frac{\varepsilon_2}{\rho_2^D}\left[(1-\rho_2^s)E_{b_2} - J_2\right]$$

$$q_1'' = -q_2'' = \frac{E_{b_1} - E_{b_2}}{\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1}$$

(∞-PARALLEL PLATE RESULT IS SAME FOR BOTH SPECULAR & DIFFUSE)

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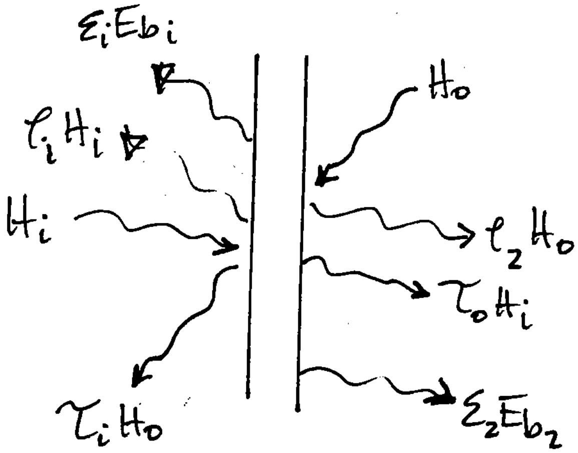
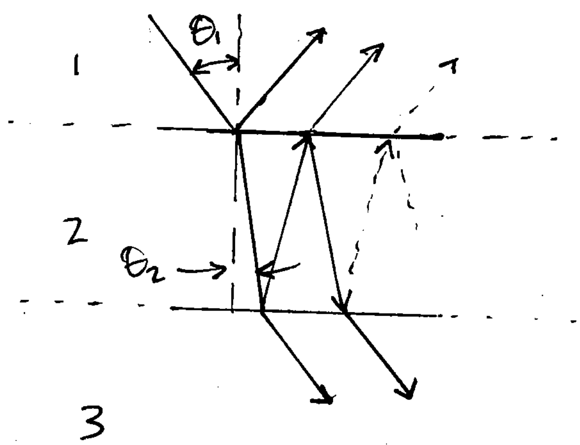
SEMI TRANSPARENT WINDOW –



* BE CAREFUL WHEN BALANCING ENERGY



$\rho_i \equiv$ REFLECTED ~~ACROSS~~ FROM SURFACE i

$\therefore \downarrow$

$(1-\rho_i) \equiv$ WHAT CROSSES SURFACE i

$$I(d_2) = I(0)\underbrace{e^{-\alpha d/\cos\theta_2}}_{\equiv \tau} = I(0)\tau$$

$$R_{SLAB} = \rho_{12} + (1-\rho_{12})\tau\rho_{23}\tau(1-\rho_{21}) + \tau^2(1-\rho_{12})\rho_{21}\tau\rho_{23}\tau(1-\rho_{21})$$

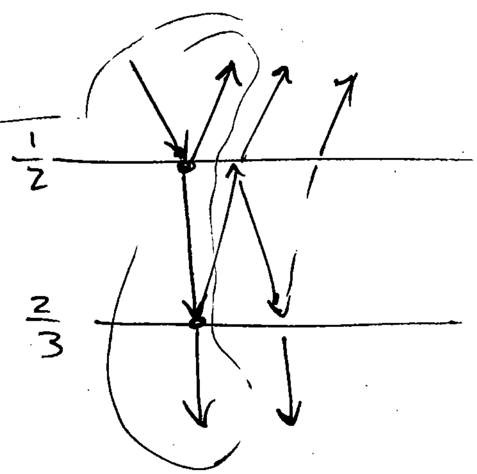
$$\rho_{12} = \rho_{21}$$

$$= \rho_{12} + \rho_{23}(1-\rho_{12})^2\tau^2\left[1 + \rho_{12}\rho_{23}\tau^2 + (\rho_{12}\rho_{23}\tau^2)^2 + \cdots\right]$$

$$= \rho_{12} + \frac{\rho_{23}(1-\rho_{12})^2\tau^2}{1-\rho_{12}\rho_{23}\tau^2}$$

$$\tau_{SLAB} = \frac{(1-\rho_{12})(1-\rho_{23})\tau}{1-\rho_{12}\rho_{23}\tau^2} \qquad A_{SLAB} = 1 - R_{SLAB} - \tau_{SLAB}$$

ALTERNATIVE APPROACH



ENERGY BALANCE AT SURFACES 1-2, 2-3

~~WILL HAVE~~

WILLHAVE 4EQNS & 4UNKOWNS IF INCLUDING NORMALIZATION

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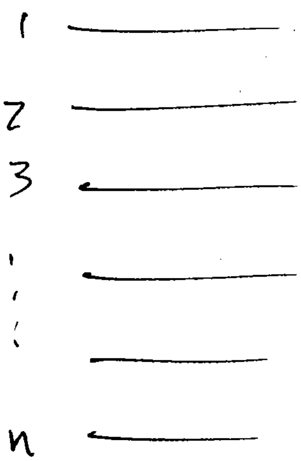
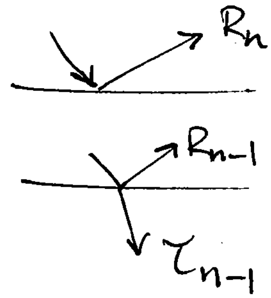
MULTIPLE LAYERS Ç 3, pp96 MODEST





$$R_n = R_1 + \frac{\tau_1^2 R_{n-1}}{1 - R_1 R_{n-1}}$$ (OUR RECURSIVE RELATION)

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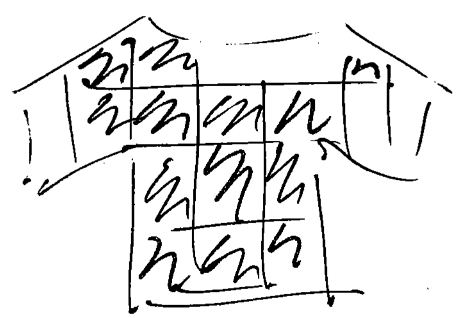
* NONGRAY SURFACE

$$E_b = \int_0^\infty E_{b\lambda}\, d\lambda = \underbrace{\sum_{m=1}^{M} E_{b\lambda}^{(m)}}$$ TREAT EACH "BAND" SEPARATELY

$$q = \int_0^\infty q_\lambda\, d\lambda = \sum_{m=1}^{M} q_\lambda^{(m)}$$

$$J_j^{(m)} \quad H_j^{(m)}$$



$$q_\lambda'' = \varepsilon_\lambda E_{b\lambda} - \alpha_\lambda H_\lambda$$

$$H_\lambda(\bar{r}) = \int J_\lambda(\bar{r}')\, dF_{dA-dA'} + H_0(\bar{r})$$

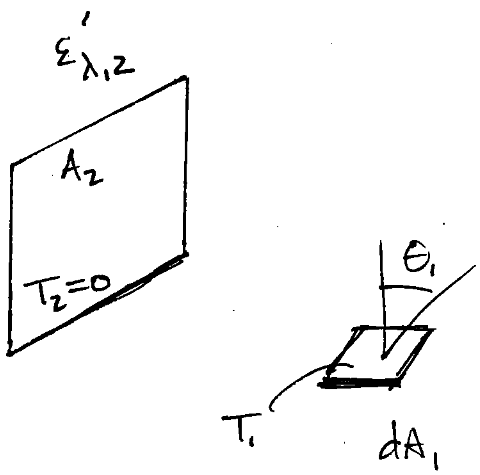
N SURFACES $$q''^{(m)} = J_\lambda^{(m)} - \left[\int J_\lambda^{(m)}(F')\, dF_{dA-dA'} + H_o^{(m)} \right]$$

m EQNS./SURFACE

USE $J_\lambda = \varepsilon_\lambda E_{b\lambda} + \rho_\lambda H_\lambda$

$$\underbrace{2}_{\text{UNKOWNS } q,\, J_\lambda}(N \times m) + \underbrace{N}_{N-q_\lambda \text{ EQNS}} \quad \Big\} \text{ TOTAL UNKNOWNS}$$

MONTE CARLO



$\varepsilon'_\lambda(\lambda, \theta_1, T_1)$

$d\dot{Q}_{1\to 2}$

HEAT LEAVING 1 $\equiv d\dot{Q}_{e1}$

$$d\dot{Q}_{e_1} = \varepsilon_1(T_1)\, \sigma T_1^4\, dA_1$$

$$\varepsilon_1(T_1) = \frac{\int_0^\infty \int_\Omega \varepsilon'_{\lambda,1} I'_{\lambda,1}(\lambda, T_1) \cos\theta \, d\Omega\, d\lambda}{\sigma T_1^4}$$

DISCRETIZE LIGHT LEAVING dA_1 INTO "BUNDLES"

TAKE N BUNDLES

$$W = \frac{d\dot{Q}_{e,1}}{N}$$

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$S \equiv$ BUNDLES REACHING A_2 AND ABSORBED BY A_2

$$d\dot{Q}_{12} = WS$$

$$dP_\lambda' = I_{b\lambda}(\lambda, T_1)\,\varepsilon_\lambda' \cos\theta \, dA_1 \sin\theta \, d\theta \, d\phi \, d\lambda$$

$$\frac{dP_\lambda'(\phi = 2\pi)}{\varepsilon_1 \sigma T_1^4 \, d\theta \, d\lambda} = \implies P(\lambda, \theta) \equiv \text{PROBABILITY}$$