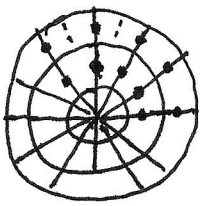
CONSTRUCT LAYER τ, ρ MATRICES FROM ISO SLAT MODEL

FOR EACH INCIDENT DIRECTION $\vartheta_I, \varphi_I = (\vartheta_n, \varphi_m)$ ← BASIS GRID VALUES

ELEMENT WEIGHT = $\cos(\vartheta_I)\, d\vartheta_I\, d\varphi_I$ ← DEFINED BY BASIS GRID



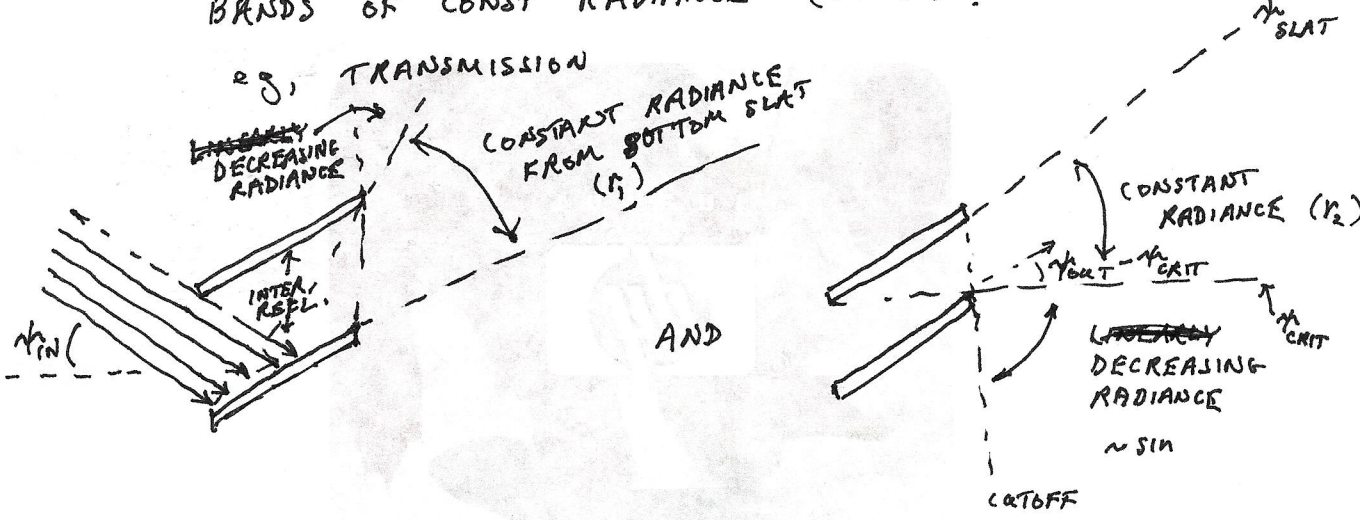
(SEE LBNL-34716 FIG 2A)

RESOLVE INCIDENT (ϑ, φ) INTO φ AND PROFILE ANGLE ψ (SEE FIG PROFILE ANG.PDF)

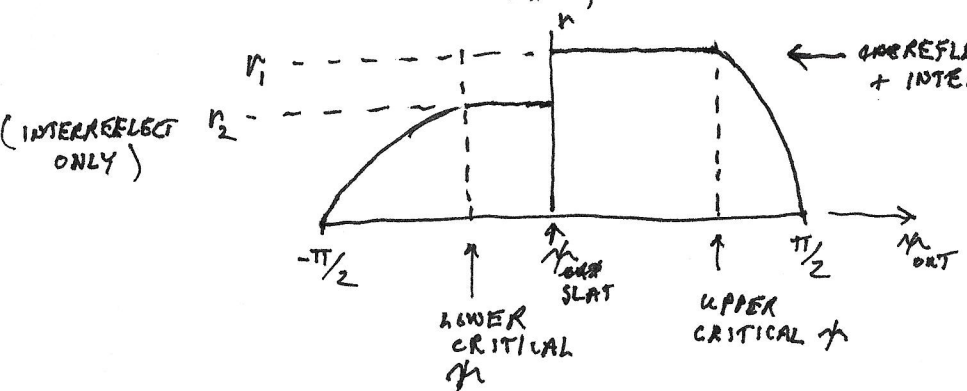
~~$\tan(\psi) = \tan(\vartheta)\cos(\varphi)$~~ $\tan(\psi) = \tan(\vartheta)\sin(\varphi)$

(ISO MODEL IS 2D PROFILE ANGLE MODEL)

NOW APPLY ISO MODEL. THIS WILL PRODUCE BANDS OF CONST RADIANCE (IN ψ):



SO IN ψ_{OUT}, RADIANCE PLOT LOOKS LIKE:



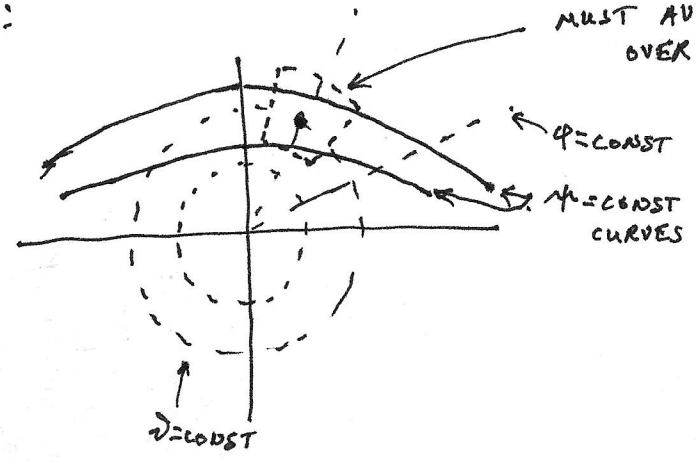
THIS OUTPUT DISTRIBUTION IS TRANSFORMED BACK INTO THE ϑ, φ VARIABLES, TO PRODUCE AN $r(\vartheta_o, \varphi_o)$ DISTRIBUTION:

JACOBIAN

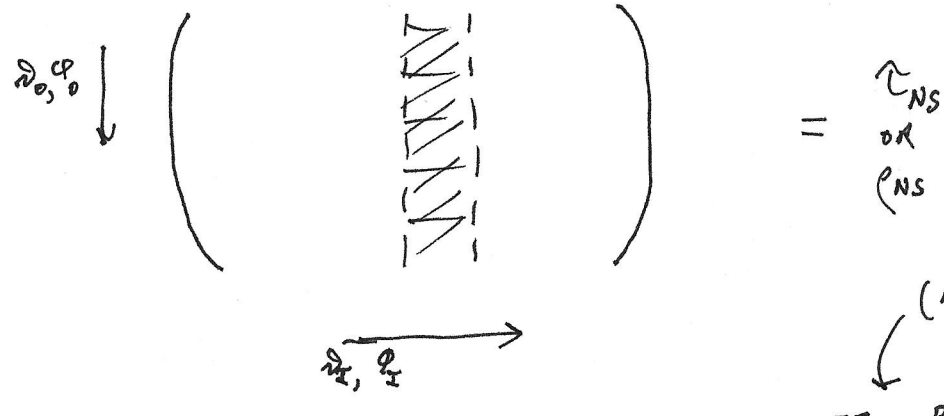
$$r(\vartheta_o, \varphi_o)\, d\vartheta_o\, d\varphi_o = r(\vartheta, \varphi) \frac{\partial(\vartheta_o, \varphi_o)}{\partial(\vartheta, \varphi_o)} d\vartheta\, d\varphi_o$$

$$\begin{vmatrix} \frac{\partial \vartheta_o}{\partial \vartheta} & \frac{\partial \vartheta_o}{\partial \varphi_o} \\ 0 & 1 \end{vmatrix} = \frac{\partial \vartheta_o}{\partial \vartheta}$$

THE TRANSITION ϑ_o = CONST VALUES BECOME CURVES IN ϑ, φ :



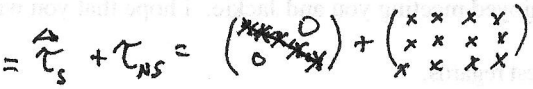
THIS GIVES THE OUTGOING ~~RADIANCE~~ RADIANCE DISTRIBUTION FOR THE $\Delta\vartheta_o \Delta\varphi_o$ BINS IN THE OUTGOING DIRECTIONS FOR THIS (ϑ_I, φ_I). FROM THIS, CAN CALCULATE & FILL IN THE (ϑ_I, φ_I) COLUMN OF THE (TRANSMITTANCE OR REFLECTANCE) MATRIX:



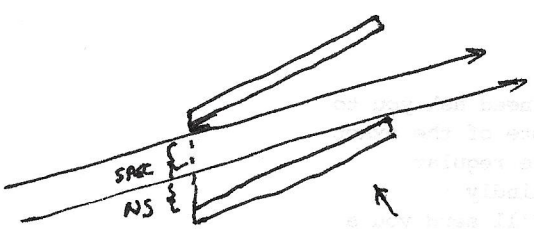
AFTER GOING THRU ALL (ϑ_I, φ_I) ⟹ COMPLETE BIDIRECTIONAL MATRIX

(1) NOTE THAT APPLYING THE ISO MODEL ASSUMING IDEALLY DIFFUSING SLATS GIVES AN OUTPUT DISTRIBUTION FOR THE NON-SPECULAR PART THAT IS NOT IDEALLY DIFFUSE

(2) THERE IS ALSO A SPECULAR TRANSMITTANCE PART (NO REFLECTANCE, BECAUSE OF IDEAL DIFFUSER ASSUMPT — BUT NOTE THAT NONSPECALAR HAS BOTH TRANSMITTANCE & REFLECTANCE)

$\hat{\tau}_{BLIND} = \hat{\tau}_s + \tau_{NS} =$ 

"SPECULAR" TRANS:



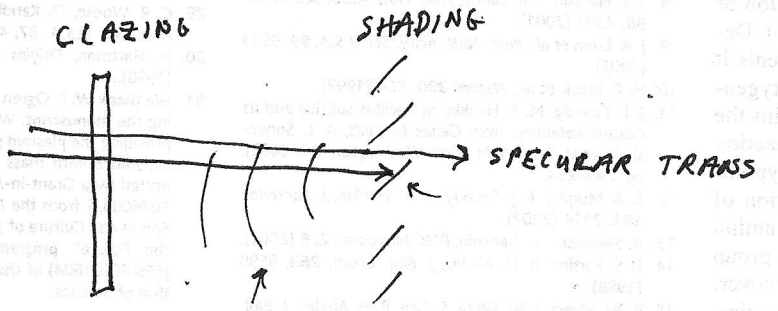
τ_s IS BASICALLY A RATIO OF PROJECTED AREAS

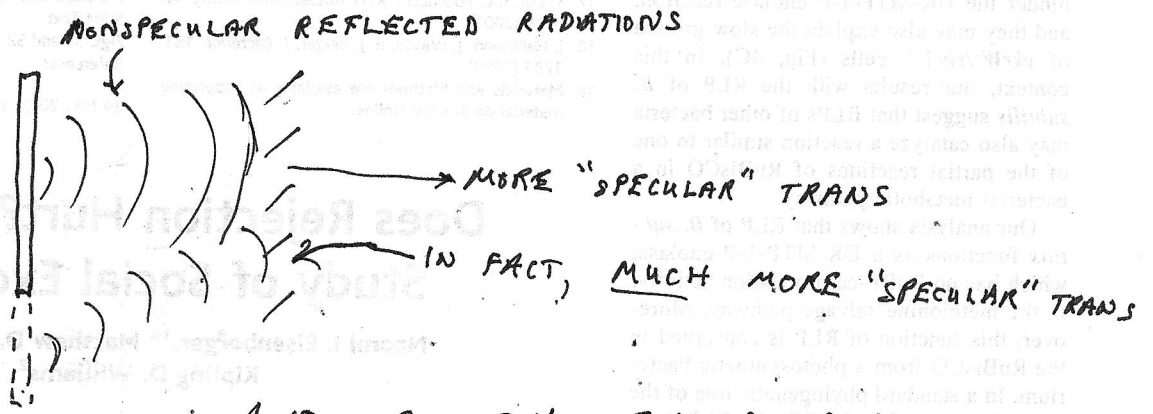
BECAUSE THE INCIDENT DIRECTIONS COVER 2π SOLID ANGLE, THERE WILL ALWAYS BE SOME LARGE ELEMENTS IN THE SPECULAR TRANS. MATRIX [WHICH IS DIAGONAL, i.e., $(\theta_o, \phi_o) = (\theta_I, \phi_I)$]

(3) YOU HAVE TO APPLY THE MODEL TWICE, ONCE FOR LEFT-MOVING (IN THESE DIAGS) & ONCE FOR RIGHT-MOVING.

ALL LAYERS HAVE BOTH FRONT- τ^f, ρ^f AND BACK-INCIDENT τ^R, ρ^R PROPERTY MATRICES, WHICH MUST BE KEPT DISTINCT. SIMILARLY FOR SYSTEMS THE FRONT- AND BACK-INCIDENT MATRICES ARE EQUAL IFF THE LAYER/SYSTEM IS FRONT-BACK SYMMETRIC.

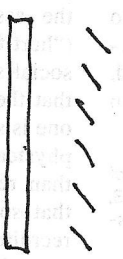
(4) NOTE THAT THIS MEANS THAT PROBLEMS LIKE "SPECULAR" TRANSMISSION (IN THE SHADING'S TERMS) OF NON-SPECULAR RADIATION DUE TO INTERREFLECTION WITH THE GLAZING IS AUTOMATICALLY HANDLED CORRECTLY BY THE CALCULATION. THIS WOULD BE A KNOTTY PROBLEM OTHERWISE. (e.g. SEE CH 30 OF LATEST ASHRAE HANDBOOK)





AND SO ON FOR DOUBLE, TRIPLE REFLECTANCE

(5) NOTE BY APPLYING THE ISO MODEL COLUMN-BY-COLUMN, IT GIVES A BIANGULAR DEPENDENCE ABSENT FROM THE NAIVE MODEL:



MODEL WOULD GIVE LARGE $\overleftrightarrow{\tau}_s$ AT SOLAR NOON ($\psi = 90°$) BUT SMALL $\overleftrightarrow{\tau}_s$ NEAR SUNDOWN ($\psi = 0°$)