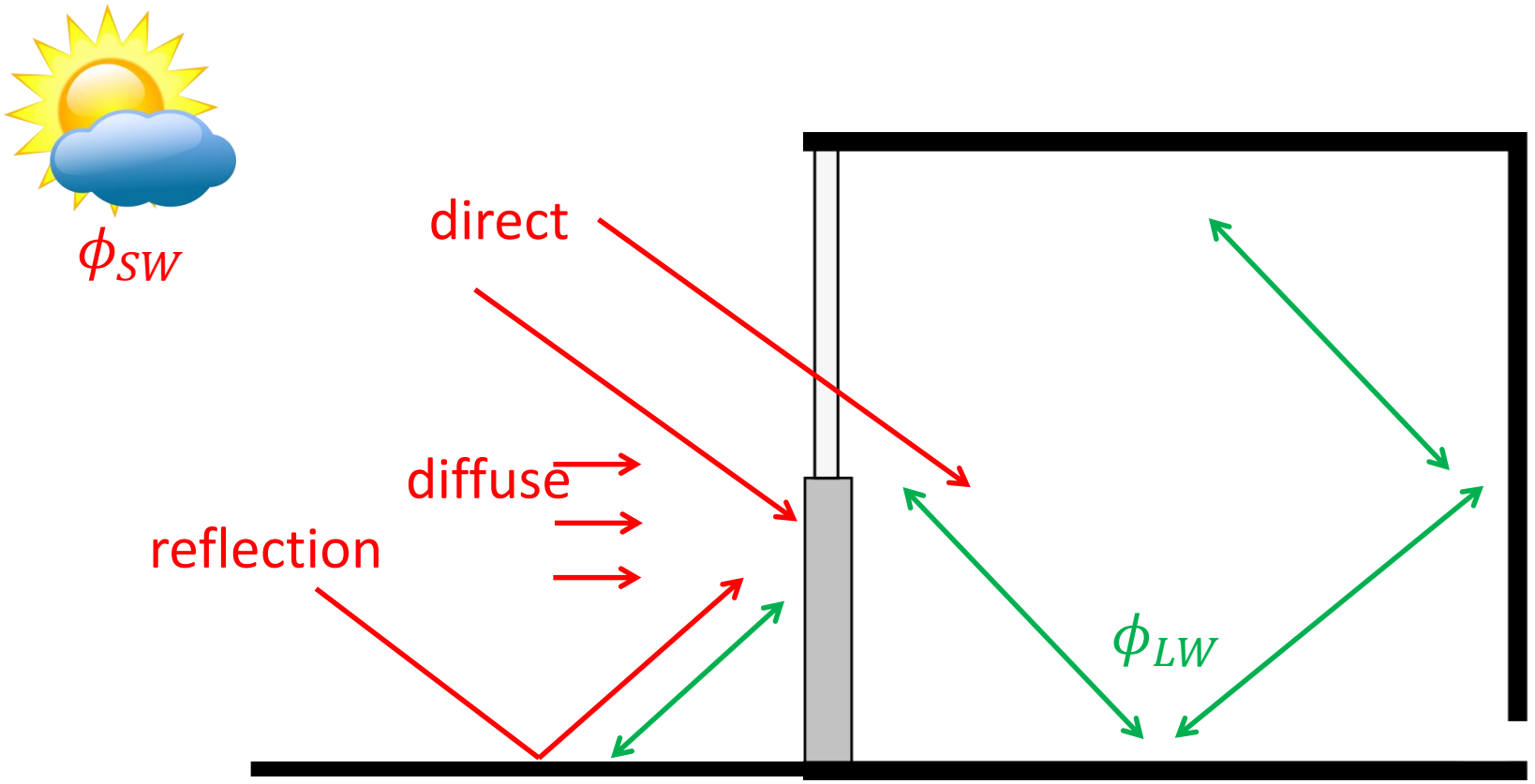
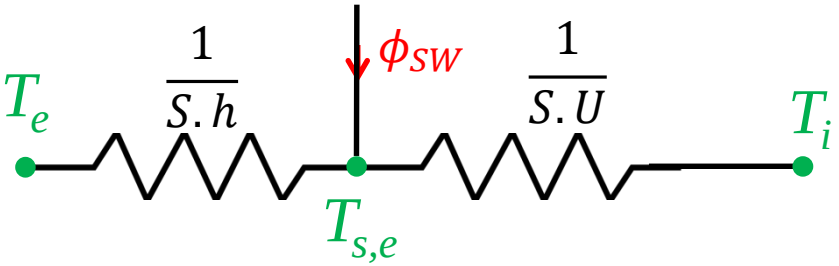
Heat transfer in buildings

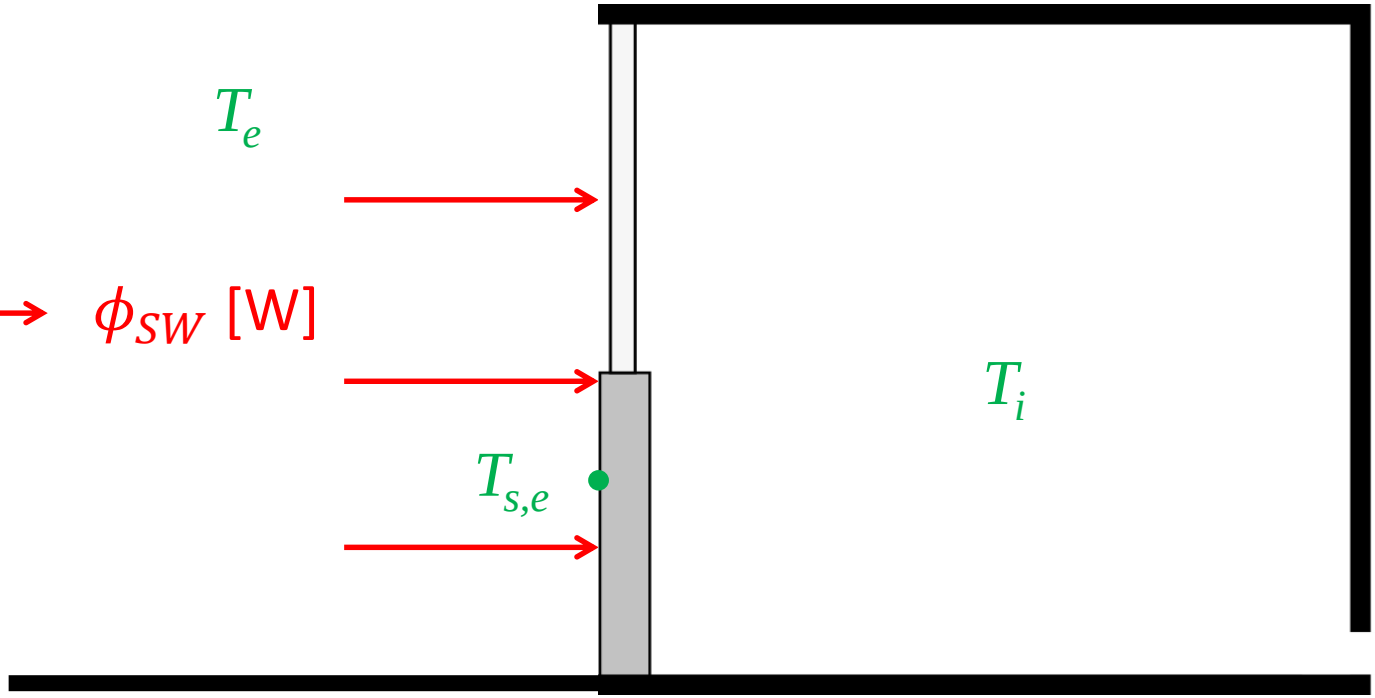
Video n°4

Shortwave radiation

Simon Rouchier
Polytech Annecy-Chambéry
Université Savoie Mont Blanc


ϕ_{SW}
direct
diffuse
reflection
ϕ_{LW}

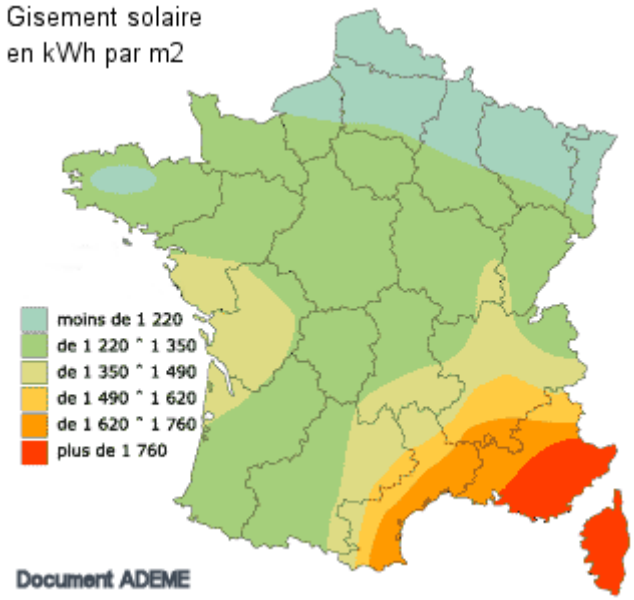

T_e
$\frac{1}{S.h}$
ϕ_{SW}
$\frac{1}{S.U}$
T_i
$T_{s,e}$

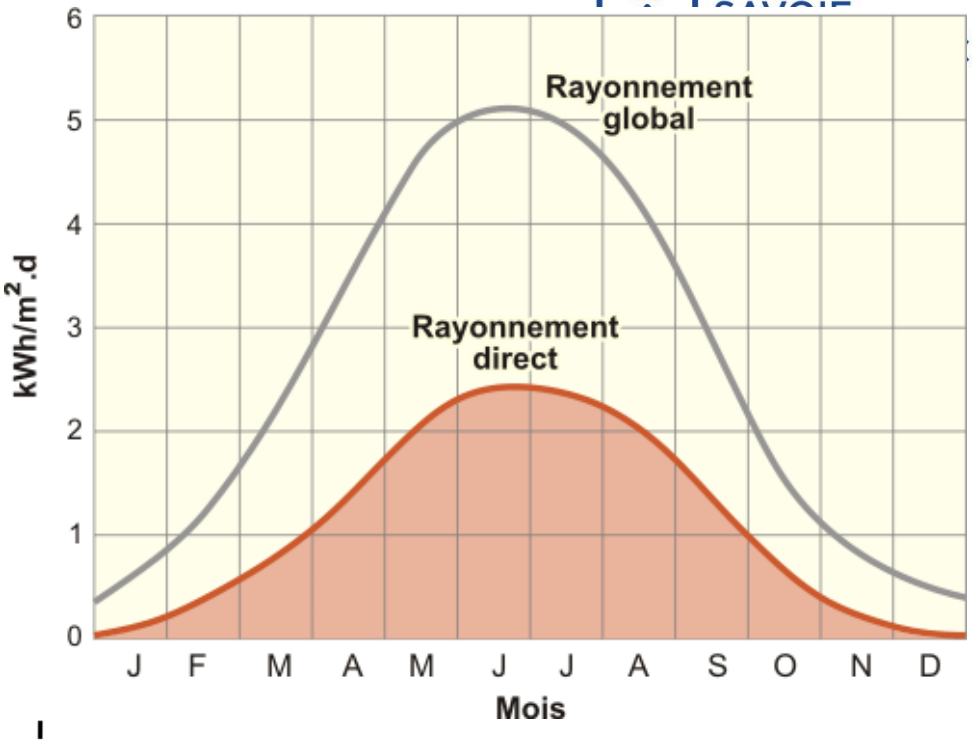

T_e
direct
diffuse
reflected
ϕ_{SW} [W]
T_i
$T_{s,e}$

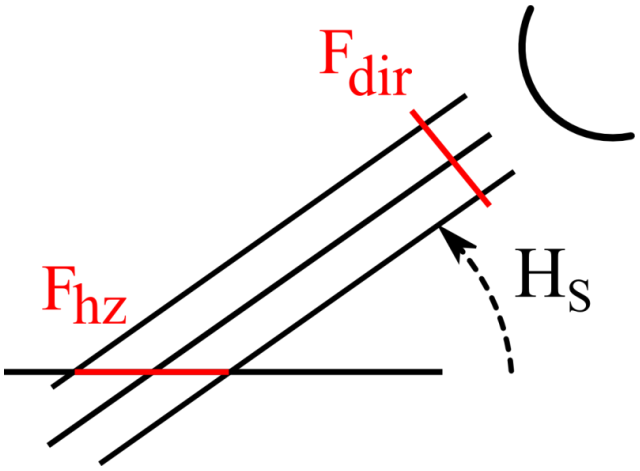
POLYTECH ANNECY-CHAMBÉRY

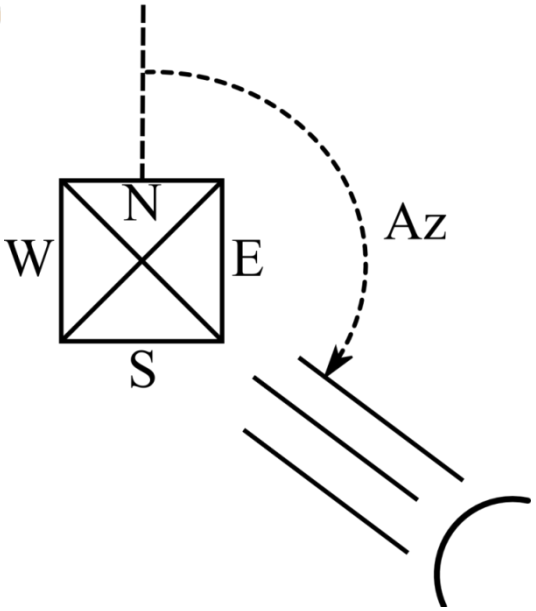
UNIVERSITÉ SAVOIE

Global horizontal irradiance





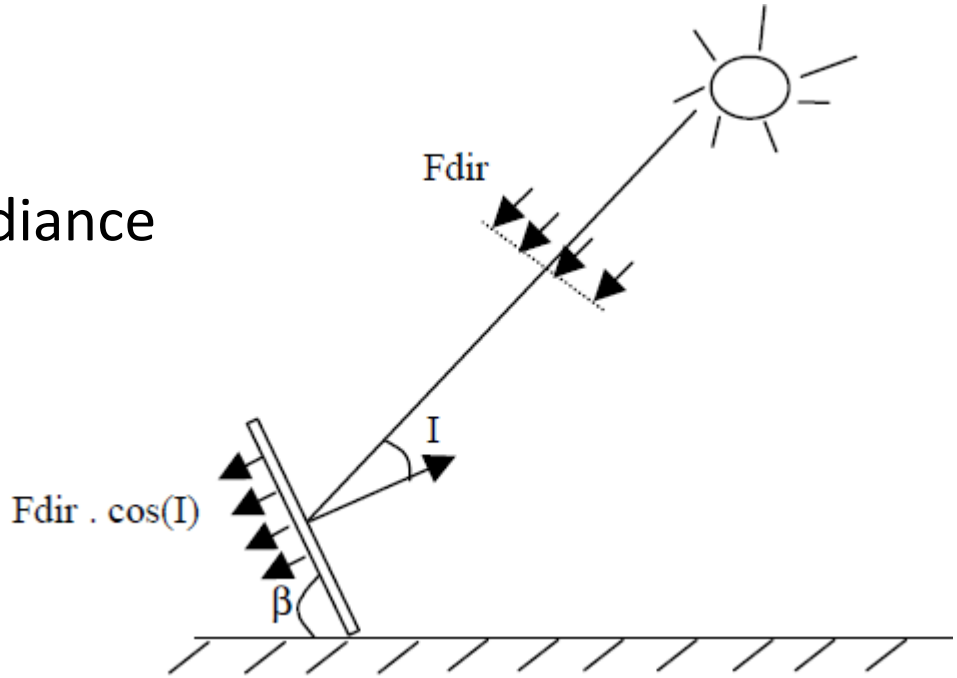




$F_{dir,Hz}$	[W/m²]
$F_{dif,Hz}$	[W/m²]
H_S	[°]
Az_S	[°]

Direct solar irradiance

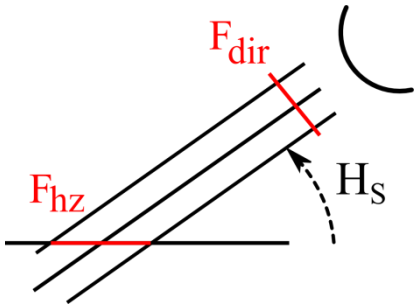
E_{dir} [W/m²]

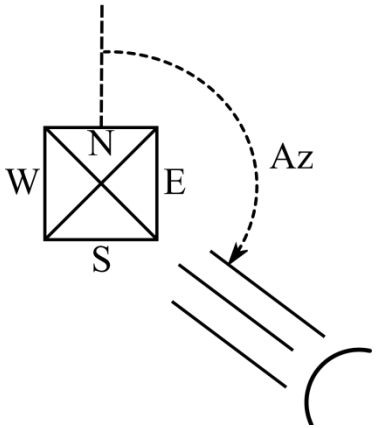


$$E_{dir} = F_{dir}\cos(I)$$

where

$$F_{dir} = \frac{F_{dir,Hz}}{\sin(H_S)}$$



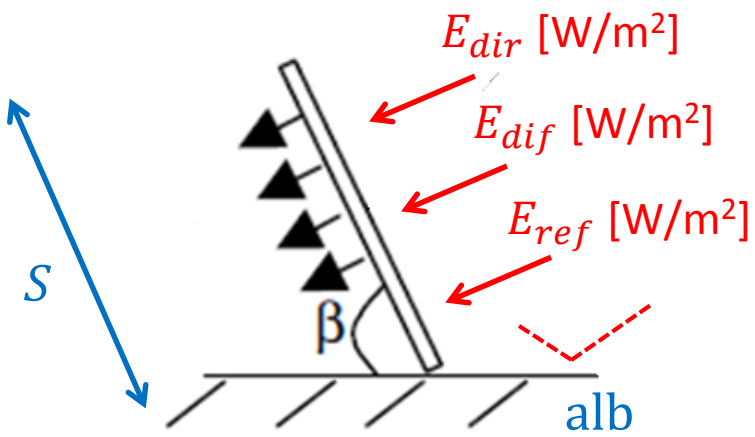


$$\cos(I) = \cos(H_S).\sin(\beta).\cos(Az_S - Az) + \sin(H_S).\cos(\beta)$$

E_{dir}	: to be calculated
$F_{dir,Hz}$; $F_{dif,Hz}$; H_S ; Az_S	: weather data
β ; Az	: building properties

Direct irradiance

$$E_{dir} = \frac{F_{dir,Hz}}{\sin(H_S)}\left[\cos(H_S).\sin(\beta).\cos(Az_S - Az) + \sin(H_S).\cos(\beta)\right]$$



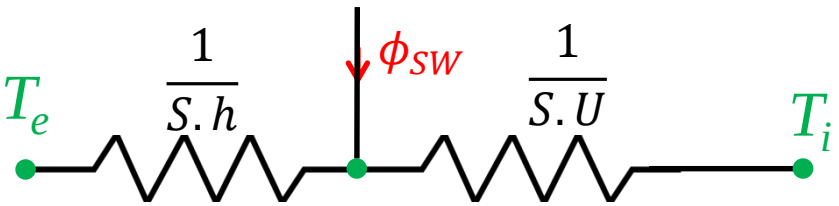
Diffuse irradiance

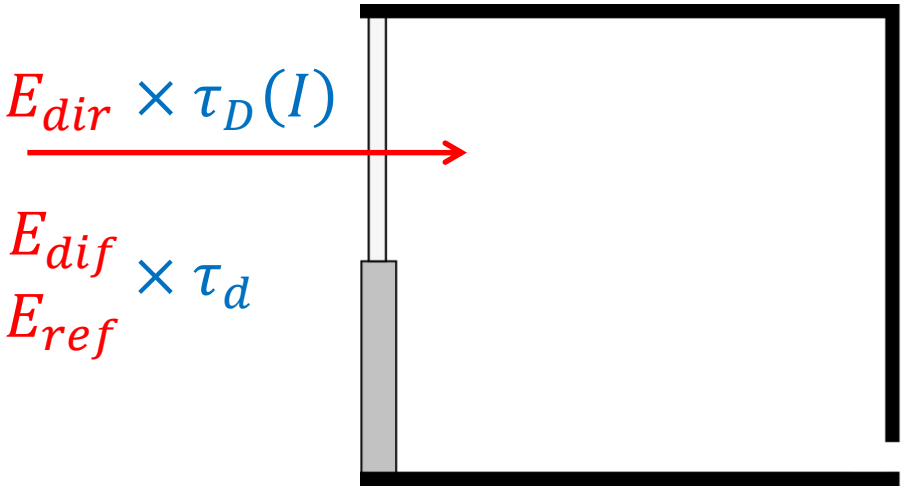
$$E_{dif} = F_{dif,Hz}\,\frac{1+\cos(\beta)}{2}$$

Reflected irradiance

$$E_{ref} = \left[F_{dir,Hz} + F_{dif,Hz}\right].\frac{1-\cos(\beta)}{2}.\,alb$$

$$\Phi_{SW} = \alpha.S.\left(E_{dir} + E_{dif} + E_{ref}\right) \quad [W]$$




$E_{dir} \times \tau_D(I)$
E_{dif}
E_{ref}
$\times \tau_d$