CHAPTER 5 CONVECTION AND INFILTRATION IN ROOMS AND CAVITIES

5.3 Wind Heat Transfer Coefficient

Wind heat transfer coefficients often need to be calculated for building exterior surfaces and solar collectors. Under still air conditions, the convective heat transfer coefficient is about 5 W/(m²·degC). For forced convention due to wind, the relationship employed in the example below is recommended (Duffie and Beckman, 1983).

$V := 20 \cdot \frac{1000}{3600}$ wind speed (m/sec)

$L := 2$ characteristic length

$$hc := 8.6 \cdot \left(\frac{V^{0.6}}{L^{0.4}}\right) \frac{W}{m^2 \cdot \Delta°C}$$

$$h_{wind} := \text{if}\left(hc > 5 \frac{W}{m^2 \cdot \Delta°C}, hc, 5 \frac{W}{m^2 \cdot \Delta°C}\right)$$

$$h_{wind} = 18.236 \frac{W}{m^2 \cdot \Delta°C}$$

Linearized radiative coefficient:

$$hr = \varepsilon \cdot \sigma \cdot 4 \cdot Tm^3$$

where

$\varepsilon := 0.9$ emissivity

$\sigma := 5.67 \cdot 10^{-8} \frac{W}{m^2 \cdot K^4}$ (Stefan-Boltzmann constant)

$Tm = \frac{Ts + To}{2} = \frac{\left(Ts^2 + To^2\right) \cdot (Ts + To)}{4}$ mean temperature, K

$To := -5\ \Delta°C$

$Ts := 5\ \Delta°C$

Outside and surface temperatures

$Tm := \left(273\ \Delta°C + \frac{To + Ts}{2}\right)$

$hr := \varepsilon \cdot \sigma \cdot 4 \cdot Tm^3$ $\quad hr = 4.153\ \frac{W}{m^2 \cdot \Delta°C}$

$ho := h_{wind} + hr$ $\quad ho = 22.389\ \frac{W}{m^2 \cdot \Delta°C}$

combined exterior film coefficient

References

Duffie & Beckman. 1980. *Solar Engineering of Thermal Processes.* J. Wiley & Sons.