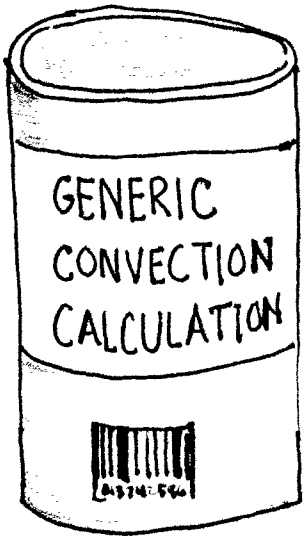
HOW TO PERFORM A



1. BECOME AWARE of THE GEOMETRY. IS IT A FLAT PLATE? A CYLINDER?

2. SPECIFY THE APPROPRIATE REFERENCE TEMPERATURE & FIND THE FLUID PROPERTIES.

USUALLY (NOT ALWAYS) YOU WANT THE

FILM TEMPERATURE:

$$T_F \equiv \frac{T_s + T_\infty}{2}$$

3. CALCULATE THE REYNOLD'S NUMBER

$$Re \equiv \frac{\rho V (L \text{ or } D \text{ etc.})}{\mu} = \frac{V (L, D \text{ etc.})}{\nu}$$

CAREFUL!

4. DECIDE IF YOU WANT THE LOCAL OR AVERAGE HEAT TRANSER COEFFICIENT.

5. SELECT THE APPROPRIATE NUSSELT CORRELATION.

(REMEMBER $Nu \equiv \frac{h (L, D \text{ etc.})}{k_{FLUID}}$.)

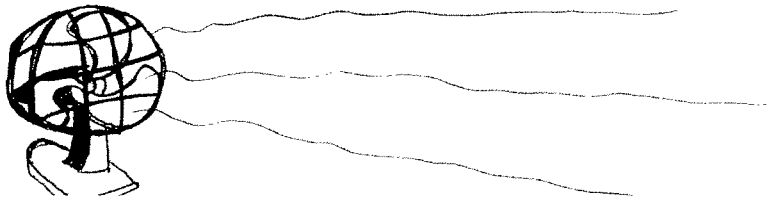
SUMMARY of CORRELATIONS (FOR EXTERNAL FLOW)

Correlations for T_S = const. Boundary Condition

Correlation	Geometry	Conditions
$C_{f,x} = 0.664Re_x^{-1/2}$	Flat plate	Laminar, Local, Use T_f
$Nu_x = 0.332Re_x^{1/2}Pr^{1/3}$	Flat plate	Laminar, Local, Use T_f, $Pr > 0.6$
$C_f = 1.328Re_L^{-1/2}$	Flat plate	Laminar, Average, Use T_f
$Nu = 0.664Re_L^{1/2}Pr^{1/3}$	Flat plate	Laminar, Average, Use T_f, $0.6 < Pr < 50$
$C_{f,x} = 0.0592Re_x^{-1/5}$	Flat plate	Turbulent, Local, Use T_f, $5 \times 10^5 < Re_x < 10^7$
$Nu_x = 0.0296Re_x^{4/5}Pr^{1/3}$	Flat plate	Turbulent, Local, Use T_f, $5 \times 10^5 < Re_x < 10^7$, $Pr > 0.6$
$C_f = 0.074Re_L^{-1/5}$	Flat plate	Turbulent, Average, Use T_f, $5 \times 10^5 < Re_x < 10^7$
$Nu = 0.037Re_L^{4/5}Pr^{1/3}$	Flat plate	Turbulent, Average, Use T_f, $5 \times 10^5 < Re_x < 10^7$, $Pr > 0.6$
$C_f = 0.074Re_L^{-1/5} - 1742Re_L^{-1}$	Flat plate	Mixed laminar and turbulent flow, Average, Use T_f, $5 \times 10^5 < Re_x < 10^7$
$Nu = (0.037Re_L^{4/5} - 871)Pr^{1/3}$	Flat plate	Mixed laminar and turbulent flow, Average, Use T_f, $5 \times 10^5 < Re_x < 10^7$, $0.6 < Pr < 60$
$Nu_D = 0.3 + \frac{0.62Re_D^{1/2}Pr^{1/3}}{[1+(0.4/Pr)^{2/3}]^{1/4}}\left[1+\left(\frac{Re_D}{282{,}000}\right)^{5/8}\right]^{4/5}$	Circular cylinder	Average, Use T_f, $Re_DPr > 0.2$
$Nu_D = 2 + [0.4Re_D^{1/2} + 0.06Re_D^{2/3}]Pr^{0.4}\left(\frac{\mu_\infty}{\mu_S}\right)^{1/4}$	Sphere	Average, Use T_∞ for all properties except μ_S, for which you use T_S, $3.5 < Re < 80{,}000$, $0.7 < Pr < 380$
$Nu = CRe^mPr^n$	Circular and noncircular cylinders	Average, Use T_f, Use Tables in text to find C, m and n and Re ranges.

Correlations for $\dot{q}$ = const. Boundary Condition

Correlation	Geometry	Conditions
$Nu_x = 0.453Re_x^{1/2}Pr^{1/3}$	Flat plate	Laminar, Local, Use T_f, $Pr > 0.6$
$Nu = 0.906Re_L^{1/2}Pr^{1/3}$	Flat plate	Laminar, Average, Use T_f, $0.6 < Pr < 50$
$Nu_x = 0.0308Re_x^{4/5}Pr^{1/3}$	Flat plate	Turbulent, Local, Use T_f, $5 \times 10^5 < Re_x < 10^7$, $Pr > 0.6$
$Nu_x = 0.0385Re_x^{4/5}Pr^{1/3}$	Flat plate	Turbulent, Average, Use T_f, $5 \times 10^5 < Re_x < 10^7$, $Pr > 0.6$



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