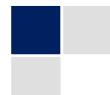


EXTERNAL FORCED CONVECTION HEAT TRANSFER CORRELATIONS

Case	Regime flow	Correlations	Conditions
PARALLEL FLOW OVER A FLAT PLATE	Laminar	$C_{f,x} = \frac{0.664}{Re_x^{1/2}}$	$Re_x < 5 \times 10^5$ $Pr > 0.6$
		$Nu_x = \frac{h_x \cdot x}{k} = 0.332 Re_x^{0.5} Pr^{1/3}$	
	Turbulent	$C_{f,x} = \frac{0.059}{Re_x^{1/5}}$	$5 \times 10^5 \leq Re_x \leq 10^7$ $0.6 \leq Pr \leq 60$
		$Nu_x = \frac{h_x \cdot x}{k} = 0.0296 Re_x^{0.8} Pr^{1/3}$	
	Laminar	$C_f = \frac{1.33}{Re_L^{1/2}}$	$Re_L < 5 \times 10^5$
		$Nu = \frac{h \cdot L}{k} = 0.664 Re_L^{0.5} Pr^{1/3}$	
	Turbulent	$C_f = \frac{0.074}{Re_L^{1/5}}$	$5 \times 10^5 \leq Re_L \leq 10^7$ $0.6 \leq Pr \leq 60$
		$Nu = \frac{h \cdot L}{k} = 0.037 Re_L^{0.8} Pr^{1/3}$	
	Combined	$C_f = \frac{0.074}{Re_L^{1/5}} - \frac{1742}{Re_L}$	$5 \times 10^5 \leq Re_L \leq 10^7$ $0.6 \leq Pr \leq 60$
		$Nu = \frac{h \cdot L}{k} = (0.037 Re_L^{0.8} - 871) Pr^{1/3}$	



EXTERNAL FORCED CONVECTION HEAT TRANSFER CORRELATIONS

Case	Regime flow	Correlations	
		local Nusselt Number (Nu_x)	average convection coefficient (h)
ISOTHERMAL SURFACE WITH AN UNHEATED STARTING SECTION OF LENGTH (ξ)	Laminar	$Nu_x = \frac{Nu_x \text{ (for } \xi=0\text{)}}{\left[1 - (\xi/x)^{3/4}\right]^{1/3}} = \frac{0.332 Re_x^{0.5} Pr^{1/3}}{\left[1 - (\xi/x)^{3/4}\right]^{1/3}}$	$h = \frac{2 \left[1 - (\xi/x)^{3/4}\right]}{1 - \xi/L} h_{x=L}$
	Turbulent	$Nu_x = \frac{Nu_x \text{ (for } \xi=0\text{)}}{\left[1 - (\xi/x)^{9/10}\right]^{1/9}} = \frac{0.0296 Re_x^{0.8} Pr^{1/3}}{\left[1 - (\xi/x)^{9/10}\right]^{1/9}}$	$h = \frac{5 \left[1 - (\xi/x)^{9/10}\right]}{1 - \xi/L} h_{x=L}$
Case	Regime flow	Correlations	
		local Nusselt Number (Nu_x)	
UNIFORM HEAT FLUX OVER A FLAT PLATE	Laminar	$Nu_x = 0.453 Re_x^{0.5} Pr^{1/3}$	
	Turbulent	$Nu_x = 0.0308 Re_x^{0.8} Pr^{1/3}$	
Case	Geometry	Correlations	
		Average Nusselt Number (Nu)	
CROSS FLOW OVER A CYLINDER AND SPHERE	Cylinder	$Nu_{cyl} = \frac{h \cdot D}{k} = 0.3 + \frac{0.62 Re_x^{0.5} Pr^{1/3}}{\left[1 + (0.4/Pr)^{2/3}\right]^{1/4}} \left[1 + \left(\frac{Re}{282\,000}\right)^{5/8}\right]^{4/5}$	
	Sphere	$Nu_{sph} = \frac{h \cdot D}{k} = 2 + \left[0.4 Re^{1/2} + 0.06 Re^{2/3}\right] Pr^{0.4} \left(\frac{\mu_\infty}{\mu_s}\right)^{1/4}$	

