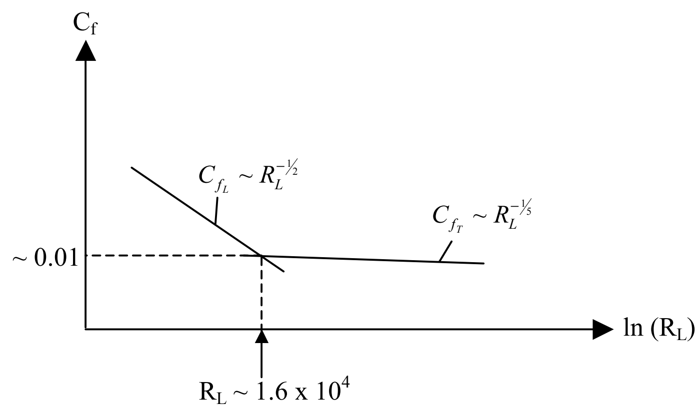
Summary of Boundary Layer over a Flat Plate

<table>
<tr><th colspan="2">Laminar (Blasius')</th><th colspan="2">Turbulent (1/7 power law)</th></tr>
<tr><td colspan="2">$\frac{\delta}{x} \sim R_x^{-1/2}$</td><td colspan="2">$\frac{\delta}{x} \sim R_x^{-1/5}$</td></tr>
<tr><td colspan="2">$\delta^* \cong 1.72 \times R_x^{-1/2} \sim \sqrt{x}$</td><td colspan="2">$\delta^* = \frac{\delta}{8} \cong 0.047 x R_x^{-1/5} \sim x^{4/5}$</td></tr>
<tr><td colspan="2">$\tau_o \cong 0.332 \rho U_o^2 R_x^{-1/2}$</td><td colspan="2">$\tau_o \cong 0.0227 \rho U_o^2 R_\delta^{-1/4}$
$\cong 0.029 \rho U_o^2 R_x^{-1/5}$</td></tr>
<tr><td colspan="2">$D \cong 0.664 \rho U_o^2 (BL) R_L^{-1/2}$</td><td colspan="2">$D \cong 0.03625 \rho U_o^2 (BL) R_L^{-1/5}$</td></tr>
<tr><td>$C_f = 1.328 R_L^{-1/2}$</td><td colspan="2">$C_f = \frac{D}{0.5 \rho U_o^2 (BL)}$</td><td>$C_f = 0.0725 R_L^{-1/5}$</td></tr>
</table>



For τ_o, the cross-over is at $R_x \sim 3.4 \times 10^3$, i.e.

$(\tau_o)_{laminar} > (\tau_o)_{turbulent}$ for $R_x < 3.4 \times 10^3$
$(\tau_o)_{laminar} \sim (\tau_o)_{turbulent}$ for $R_x \sim 3.4 \times 10^3$
$(\tau_o)_{laminar} < (\tau_o)_{turbulent}$ for $R_x > 3.4 \times 10^3$

Therefore, for most prototype scales: $(C_f)_{turbulent} > (C_f)_{laminar}$
$(\tau_o)_{turbulent} > (\tau_o)_{laminar}$