Solution to Problem 120F

The flow can be generated by superposition of the uniform stream, ($\phi = Ux$), a sink of strength, Q, at the point $C(0, h)$ and an image sink of the same strength at $C'(0, -h)$. So that:

$$\phi = Ux - \frac{Q}{4\pi}\ln\{x^2 + (y-h)^2\} - \frac{Q}{4\pi}\ln\{x^2 + (y+h)^2\}$$

Therefore:

$$u = \frac{\partial \phi}{\partial x} = U - \frac{Qx}{2\pi}\frac{1}{x^2 + (y-h)^2} + \frac{1}{x^2 + (y-h)^2}$$

Then:

$$u_A = U + \frac{Q}{2\pi h} \quad \text{and} \quad u_B = U - \frac{Q}{2\pi h}$$

By Bernoullis equation:

$$p_A + \frac{\rho}{2}u_A^2 + v_A^2 = p_B + \frac{\rho}{2}u_B^2 + v_B^2$$

$$p_A - p_B = \frac{\rho}{2}\left(u_B^2 - u_A^2\right)$$

So:

$$p_A - p_B = -\frac{\rho Q U}{\pi h}$$