At boundary

\[ \frac{\partial p}{\partial y} = 0 \]

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\[ \frac{\partial v}{\partial y} = 0 \]

At the interface

\[ v = V_0 \]

At the interface

\[ v = \frac{V_0}{2} \]

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The density and viscosity (air and water) are different.

Consider two fluids with substraction.

\[ \text{At} \quad x = 0 \]

In no slip condition, \( u = v = w = 0 \) \( x = 0 \)

Boundary Conditions

1. Steady
2. Incompressible
3. Parallel (\( u = 0 \) everywhere)
4. laminar
5. Newtonian
6. P = P, everywhere
7. 2D flow (\( v = 0 \))
8. Gravity acts as \( \frac{\partial p}{\partial y} = -g \)

Calculation: The velocity in the film

\[ \text{Due to the Flow, only Gravity} \]

\[ \text{Infinite mass flow, no pressure forces} \]

Flow of a thin film down a vertical

NS - Example 1
\[
\frac{x}{2} = y \quad \frac{2}{2} = m \quad \Rightarrow \quad y = x + a
\]

\[
(x - y - \frac{x}{2})^2 = n
\]

\[\frac{\sqrt{x}}{y} = \theta - \theta_0 \]

\[y = \left(\frac{x}{m_2}\right)^2 + c, \quad c \in \mathbb{R}
\]

\[\frac{x}{m_2} = \frac{2}{m_2} c_2 + c, \quad c_2 \in \mathbb{R}
\]

\[\frac{x}{m_2} + c_2 = \frac{2}{m_2} \quad \text{Direction NS}
\]

\[
\text{Hence:} \quad w = v(x, t)
\]

\[
\frac{\partial v}{\partial t} + \frac{1}{\rho} \frac{\partial p}{\partial x} = 0
\]

\[
\text{Fully Developed}
\]

\[
\text{Incompressible Continuity Equation:}
\]