1a. $\tau_2 = \rho_2 g \sin\alpha \,(h_2 - z)$

$\tau_1 = \rho_1 g \sin\alpha \,(h_1 - z) + \rho_2 g \sin\alpha \,(h_2 - h_1)$

1b. $v_1 = \frac{\rho_1 g}{\mu_1} \sin\alpha \left(h_1 z - \frac{1}{2} z^2\right) + \frac{\rho_2 g}{\mu_1} \sin\alpha \,(h_2 - h_1) z$

$$v_2 = g \sin\alpha \Big[\frac{\rho_2}{\mu_2}\left(h_2 z - \frac{1}{2} z^2\right) - \frac{\rho_2}{\mu_2}\left(h_2 h_1 - \frac{1}{2} h_1^2\right)$$

$$+ \frac{\rho_2}{\mu_1}\left(h_2 h_1 - h_1^2\right) + \frac{\rho_1}{\mu_1}\left(\frac{1}{2} h_1^2\right) \Big]$$

1c $\tau_2 \big|_{z=h_1} = \rho_2 g \sin\alpha \,(h_2 - h_1) = \rho_2 g \sin\alpha \, h_2 (1 - h_1/h_2)$

$\hat{=} \rho_2 g \sin\alpha \, h_2$

$\sin\alpha = \frac{1}{2}$, $\rho_2 g = 2\ \mathrm{kN/m^3}$, $h_2 = 1.5\text{–}2\ \mathrm{m}$

$\tau_2 \approx 1.5 - 2\ \mathrm{kPa}$

τ_2 er oppunder grensen for flytespenningen.

Det er fare for ras.

2a. $\varepsilon_{11} = \varepsilon$, $\varepsilon_{22} = \gamma$, $\varepsilon_{12} = 0$

$$P_{11} = E\varepsilon = \lambda(\varepsilon + \gamma) + 2\mu\varepsilon$$

$$P_{22} = 0 = \lambda(\varepsilon + \gamma) + 2\mu\gamma, \quad P_{12} = 0$$

$$\{\varepsilon\} = \begin{pmatrix} \varepsilon & 0 \\ 0 & \gamma \end{pmatrix}, \quad \{P\} = \begin{pmatrix} E\varepsilon & 0 \\ 0 & 0 \end{pmatrix}$$

2b. $$E\varepsilon = P_{11} = \frac{4\mu(\lambda+\mu)}{\lambda + 2\mu}\varepsilon$$

$$0 = P_{22} = \lambda\varepsilon + \gamma(\lambda + 2\mu)$$

gir $$\frac{\gamma}{\varepsilon} = -\frac{\lambda}{\lambda + 2\mu}$$ Poissons forhold for mediet

3a. 1. Trykkgradienten i grensesjiktet er lik trykkgradienten utenfor grensesjiktet

2. hastighet i langsretning mye større enn hastighet i tversretning

3. endring i langsretning mye mindre enn i tversretning

3b. $\frac{\partial u}{\partial x} + \frac{\partial w}{\partial z} = 0$ kontinuitetsligning.

$$u\frac{\partial u}{\partial x} + w\frac{\partial u}{\partial z} = \cancel{-\frac{1}{\rho}\frac{\partial p}{\partial x}} + \nu\left(\cancel{\frac{\partial^2}{\partial x^2}} + \frac{\partial^2}{\partial z^2}\right)u$$

z-komponent trenger ikke, $w \ll u$.

Randbetingelser

$u = w = 0$ på $z = 0$

$u = U_0$ på $z = \delta$

$\mu\frac{\partial u}{\partial z} = 0$ på $z = \delta$

3c. Randbet. $u = 0$ på $z = 0$

$u \to U_\infty$ når $z \to \infty$

$\mu\frac{\partial u}{\partial z} \to 0$ når $z \to \infty$

3d. $A = U_0$, $B = 0$, $C = -U_0$, $k_1 = k_2 = \sqrt{\frac{\omega}{2\nu}}$

3e. Lign. for den mekaniske energien

$$\frac{\partial}{\partial t}\left(\frac{1}{2}u^2\right) = \nu u\frac{\partial^2 u}{\partial z^2}$$

Lign. f. den tot. energien

$$\frac{D}{Dt}(T+V+E) = \frac{1}{\rho}\frac{\partial}{\partial z}\left(\mu\frac{\partial u}{\partial z}u\right)$$

$D/Dt = \partial/\partial t + u\frac{\partial}{\partial x} = \frac{\partial}{\partial t}$. $V = 0$

Subtraksjon gir $\rho\frac{\partial E}{\partial t} = \mu(\partial u/\partial z)^2 = \Delta$