(Q1)

CONTINUITY: $k_{11} \frac{1}{r}(r p_r)_r + k_\perp p_{zz} = 0$

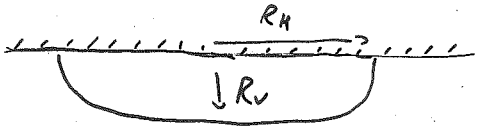
Let $r = R_H \xi$, $z = R_V \zeta$

$$\Rightarrow \frac{k_{11}}{R_H^2} \frac{1}{\xi}(\xi p_\xi)_\xi + \frac{k_\perp}{R_V^2} p_{\zeta\zeta} = 0$$

Let $\frac{R_V^2}{R_H^2} := \frac{k_\perp}{k_{11}} = \alpha$ (*)

$$\Rightarrow \nabla^2 p = 0 \quad \text{(ISOTROPIC)}$$

Now suppose the shape is an Ellipsoid:



$$\text{Volume} = \frac{2\pi\phi}{3} R_V R_H^2 = Qt$$

$$\Rightarrow R_V = \frac{3Qt}{2\pi\phi R_H^2}$$

Sub into (*):

$$\left(\frac{3Qt}{2\pi\phi}\right)^2 = \alpha R_H^6$$

$$\Rightarrow R_H = \alpha^{-1/6}\left(\frac{3Qt}{2\pi\phi}\right)^{1/3}$$

$$R_V = \alpha^{1/3}\left(\frac{3Qt}{2\pi\phi}\right)^{1/3} \quad \square.$$

SCALING: Source pressure: $p \sim \frac{\mu Q}{k R_V}$

Hydrostatic (Gravity) pressure: $p \sim \Delta\rho g R_V$

Balance: $R_v^2 = \frac{Q}{K} \quad : \quad K = \frac{k \Delta \rho g}{\mu}$.

$$\Rightarrow H^* = \left(\frac{Q}{K}\right)^{1/2} \quad \text{Critical Thickness.}$$

$$R_v = \alpha^{1/3}\left(\frac{3Qt}{2\pi\phi}\right)^{1/3} = \left(\frac{Q}{K}\right)^{1/2}$$

$$\Rightarrow t = \frac{2\pi\phi}{3Q\alpha} \cdot \left(\frac{Q}{K}\right)^{3/2}$$

$$t^* = \frac{2\pi\phi}{3\alpha}\left(\frac{Q}{K^3}\right)^{1/2}$$

□.