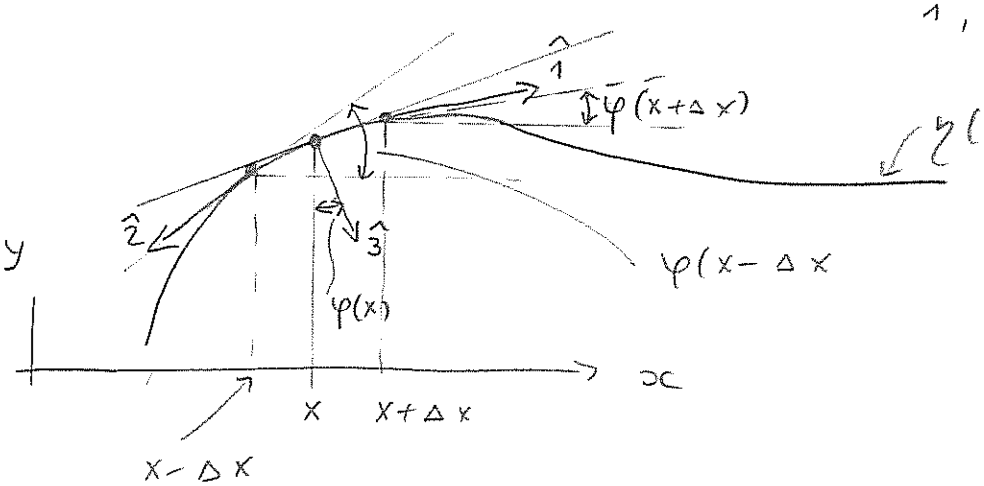


$\hat{1}, \hat{2}, \hat{3}$ unit vectors.

$\tan\varphi(x) = \dfrac{\partial \eta(x)}{\partial x}$

$$\hat{1} = (\cos\varphi(x+\Delta x),\ \sin\varphi(x+\Delta x))$$

$$\hat{2} = (-\cos\varphi(x-\Delta x),\ -\sin\varphi(x-\Delta x))$$

$$\hat{3} = (\sin\varphi(x),\ -\cos\varphi(x))$$

$$\hat{1} \approx \left(\cos\varphi(x) + \Delta x \frac{d}{dx}\cos\varphi(x),\ \sin\varphi(x) + \Delta x \frac{d}{dx}\sin\varphi(x)\right)$$

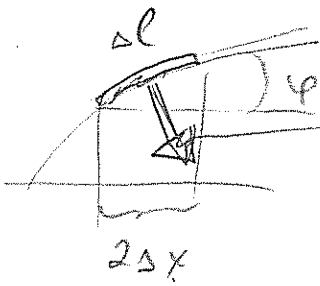
$$= (\cos\varphi(x), \sin\varphi(x)) + \Delta x\,(\cos\varphi', \sin\varphi') \leftarrow \text{all @ } x$$

$$' \equiv \frac{d}{dx}$$

$$\hat{2} \approx (-\cos\varphi, -\sin\varphi) + \Delta x\,(\cos\varphi', \sin\varphi')$$

$$\hat{3} = (\sin\varphi, -\cos\varphi)$$

surface tension



$$f_\perp = \alpha\,(\hat{1}\cdot\hat{3} + \hat{2}\cdot\hat{3}) = \alpha\,(\hat{1}+\hat{2}, \hat{3})$$

$$\Delta l \cos\varphi \approx 2\Delta x$$

$$f_\perp = \alpha\, 2\Delta x\,(\sin\varphi\cos\varphi' - \cos\varphi\sin\varphi')$$

work in "small slope approx."

so

$$\Delta \ell \approx 2\Delta x \quad , \quad \varphi \approx \frac{\partial \eta}{\partial x}$$

$$f_\perp \approx -\alpha \, \Delta \ell \, \varphi' = -\alpha \, \Delta \ell \, \frac{\partial^2 \eta}{\partial x^2}$$

so extra pressure is