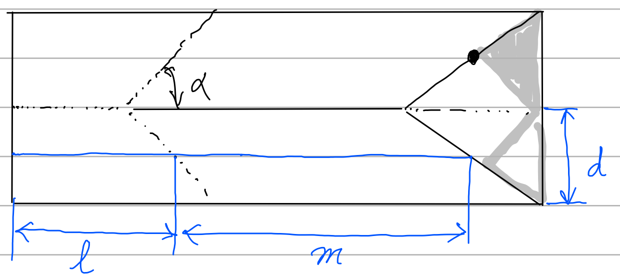
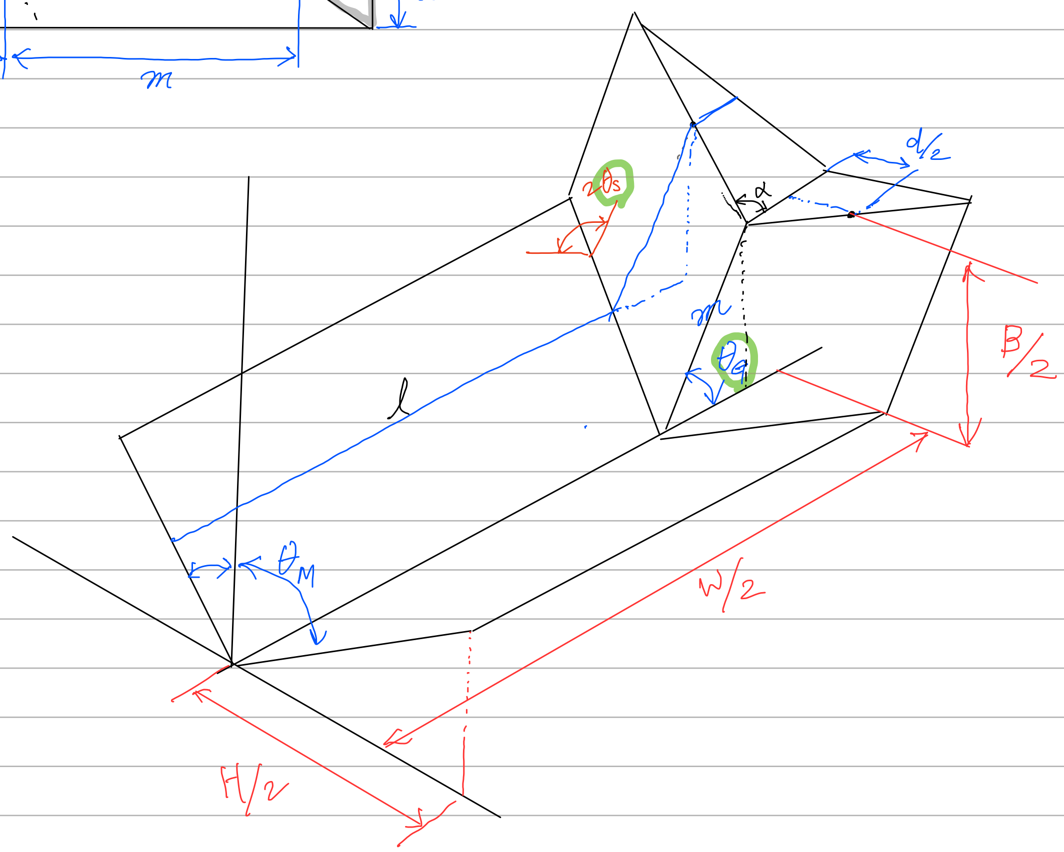




$$B/2 = m \sin\theta_G + \frac{d}{2}\cos\theta_M$$

$$W/2 = l + m\cos\theta_G + \frac{d}{2}\cdot\frac{1}{\tan\alpha}$$

$$H/2 = d\cdot\sin\theta_M$$

$$\nu_{HB} = -\frac{\varepsilon_B}{\varepsilon_H} = -\frac{dB/B}{dH/H} = -\frac{dB}{dH}\cdot\frac{H}{B}$$

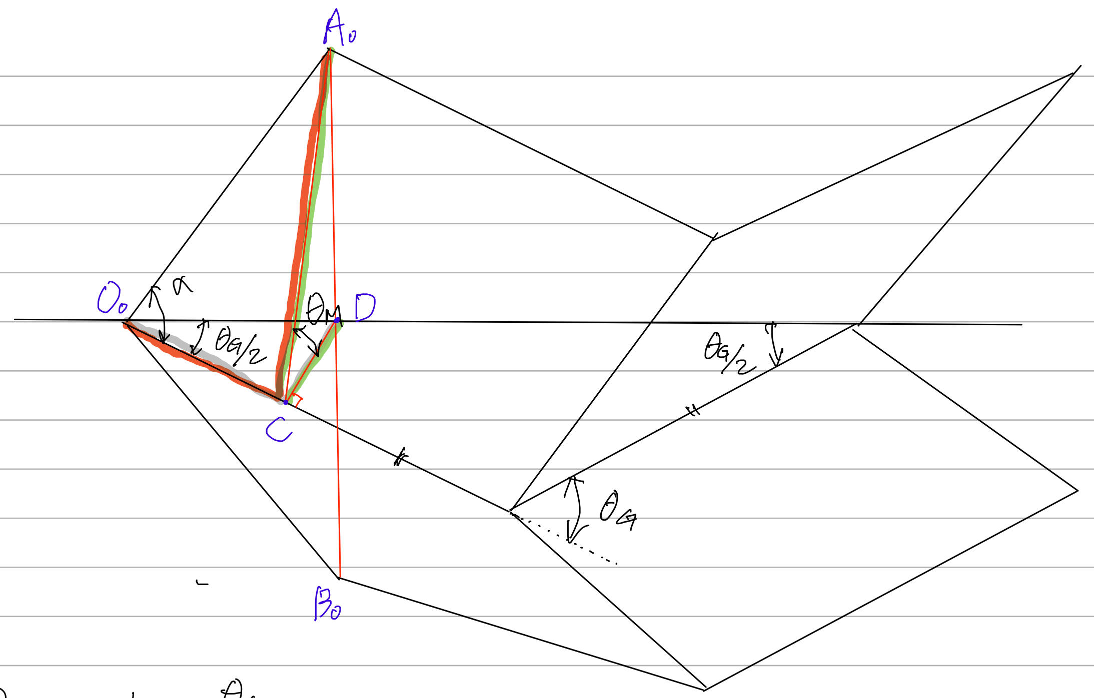
$$B = 2\left(m\sin\theta_G + \frac{d}{2}\cos\theta_M\right)$$

$$H = 2d\sin\theta_M$$

②

$$dB = 2m\cos\theta_G\cdot d\theta_G - d\sin\theta_M\, d\theta_M$$

$$dH = 2d\cos\theta_M\, d\theta_M$$



$$\frac{\overline{CD}}{\overline{O_0C}} = \tan\frac{\theta_G}{2}$$

$$= \frac{\overline{A_0C}}{\overline{O_0C}} \times \frac{\overline{CD}}{\overline{A_0C}} = \tan\alpha\cdot\cos\theta_M$$

$$\therefore \boxed{\tan\frac{\theta_G}{2} = \tan\alpha\cos\theta_M \quad —①}$$

Derivative of ①

$$d\left(\frac{\sin\theta_G/2}{\cos\theta_G/2}\right) = \frac{\cos\theta_G/2\cdot\cos\theta_G/2 - \sin\theta_G/2\cdot(-\sin\theta_G/2)}{\cos^2\theta_G/2}\cdot\frac{1}{2}d\theta_G$$

$$= \tan\alpha\cdot(-\sin\theta_M)\,d\theta_M$$

$$\boxed{d\theta_G = -2\tan\alpha\cos^2\frac{\theta_G}{2}\cdot\sin\theta_M\,d\theta_M \quad —②}$$

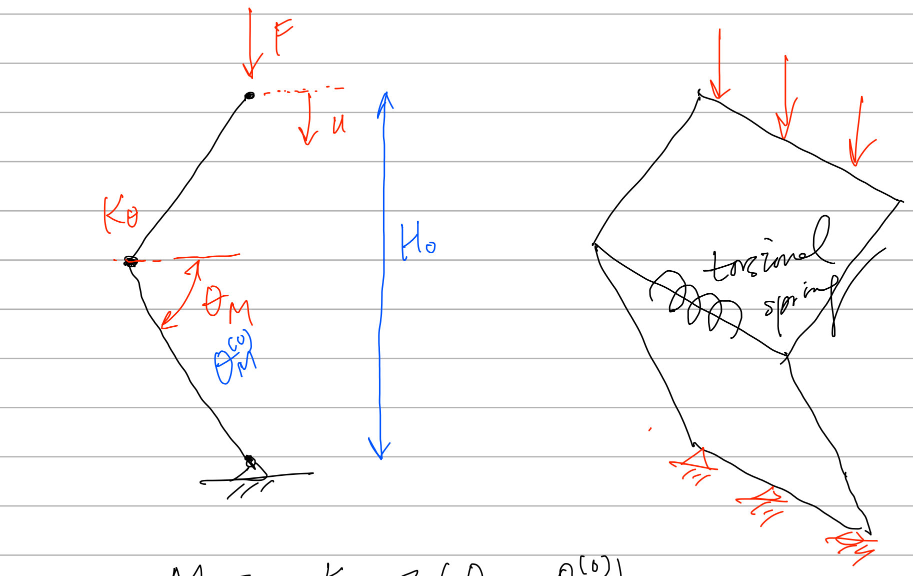
$$\gamma_{HB} = -\frac{dB}{dH}\cdot\frac{H}{B}$$

$$= -\frac{\left[2m\cos\theta_G\cdot\left(-2\tan\alpha\cos^2\frac{\theta_G}{2}\cdot\sin\theta_M\right)\cancel{d\theta_M} - d\sin\theta_M\,\cancel{d\theta_M}\right]}{2d\cos\theta_M\,\cancel{d\theta_M}}$$

$$\times\ \frac{2d\sin\theta_M}{2m\sin\theta_G + d\cos\theta_M}$$

$$= \frac{4m\tan\alpha\cos\theta_G\cos^2\frac{\theta_G}{2} + d}{2m\sin\theta_G + d\cos\theta_M}\cdot\sin\theta_M\cdot\tan\theta_M$$

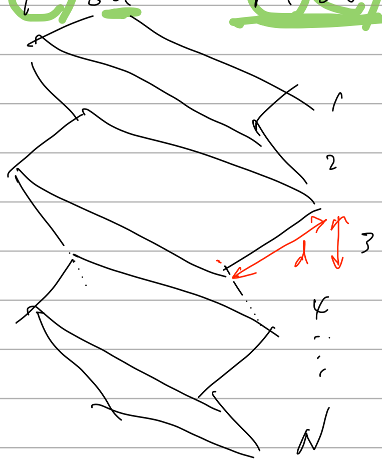
Force – displacement relationship



$$M = K_\theta \cdot 2(\theta_M - \theta_M^{(0)})$$

Principle of virtual work

$$F\,\delta u = M\,\delta\theta$$



Moments applied to creases

$$M_M = K_\theta \cdot 2(\theta_M - \theta_M^{(0)})$$

$$M_S = K_\theta \cdot 2(\theta_S - \theta_S^{(0)})$$

$$\sin\frac{\theta_G}{2} = \sin\alpha\cos\theta_S \quad - ③$$

Using principle of virtual work

$$F\,\delta u = n_M \cdot M_M \cdot 2\delta\theta_M + n_S \cdot M_S \cdot 2\delta\theta_S$$

$$H_0 - u = N d \sin\theta_M$$

$$\delta u = -N d \cos\theta_M\,\delta\theta_M$$

Derivative of ③

$$\cos\frac{\theta_G}{2} \cdot \frac{1}{2}\delta\theta_G = \sin\alpha\,(-\sin\theta_S) \cdot \delta\theta_S$$

$$\delta\theta_s = -\frac{1}{2}\cdot\frac{\cos\theta_q/2\cdot}{\sin\alpha\ \sin\theta_s}\cdot\delta\theta_q$$

$$= -\frac{1}{2}\cdot\frac{\cos\theta_q/2}{\sin\alpha\ \sin\theta_s}\cdot\left(-2\tan\alpha\ \cos^2\frac{\theta_q}{2}\cdot\sin\theta_M\right)\delta\theta_M$$

(By using eq.②)

$$= \boxed{\frac{\cos^3\theta_q/2\cdot\ \sin\theta_M}{\cos\alpha\ \sin\theta_s}\delta\theta_M}$$

$$F\cdot(-Nd\cos\theta_M)\cdot\cancel{\delta\theta_M} = n_M\cdot 2K_\theta\cdot(\theta_M-\theta_M^{(0)})\cdot 2\cancel{\delta\theta_M}$$
$$+\ n_s\cdot 2K_\theta(\theta_s-\theta_s^{(0)})\cdot 2\cdot\frac{\cos^3\theta_q/2\cdot\ \sin\theta_M}{\cos\alpha\ \sin\theta_s}\cdot\cancel{\delta\theta_M}$$

$$F = -\frac{4K_\theta}{Nd\cos\theta_M}\left[n_M(\theta_M-\theta_M^{(0)})+n_s\cdot(\theta_s-\theta_s^{(0)})\frac{\cos^3\theta_q/2\cdot\sin\theta_M}{\cos\alpha\ \sin\theta_s}\right]$$