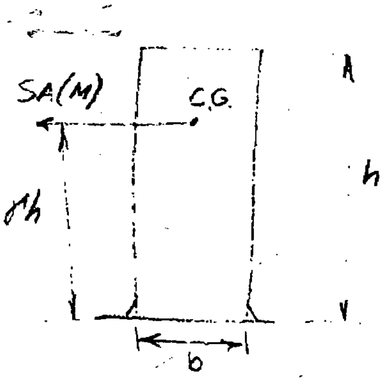
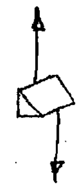
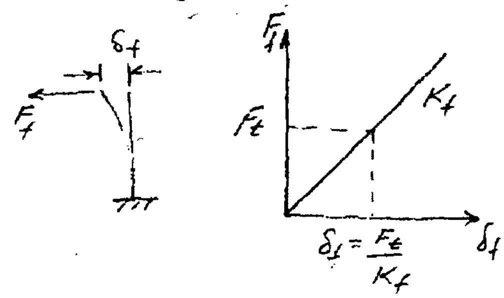
Overturning Resistance Model

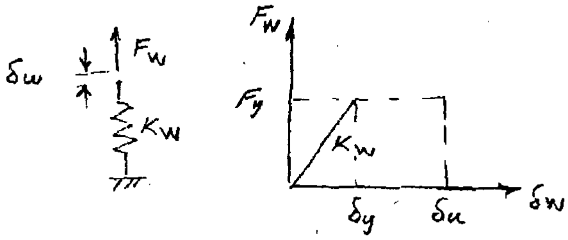




Transverse loading of weld support attachment



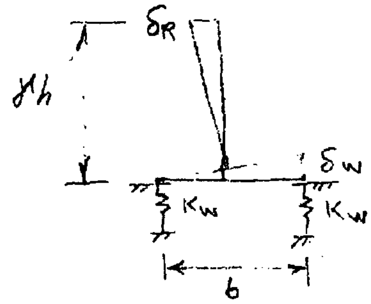
Equipment Resistance Function (linear)



Anchorage Resistance Function (non-linear)

$\delta_u / \delta_y = \mu$ - assume non-linear behavior of support attachment only

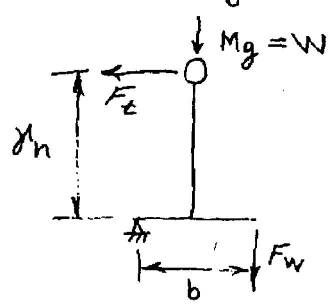
Overturning Kinematics



Let $e = \frac{\gamma h}{b}$

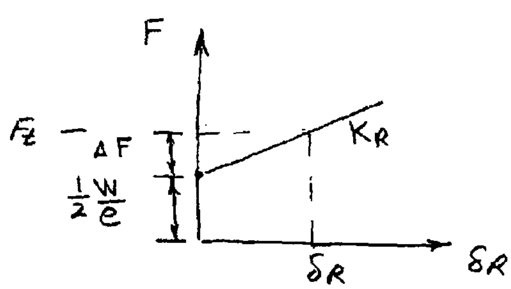
$$\delta_R = (\gamma h)\frac{\delta_w}{b} = e\,\delta_w$$

Overturning Mechanics



$$F_t(\gamma h) = F_w b + Mg\frac{b}{2}$$

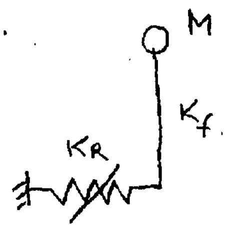
$$F_t = \frac{F_w}{e} + \frac{Mg}{2e}$$



$$\Delta F = F_t - \frac{Mg}{2e} = \frac{F_w}{e}$$

$$\Delta F = K_R\,\delta_R = K_R e\,\delta_W = \frac{K_W\,\delta_W}{e}$$

$$K_R = K_W / e^2$$

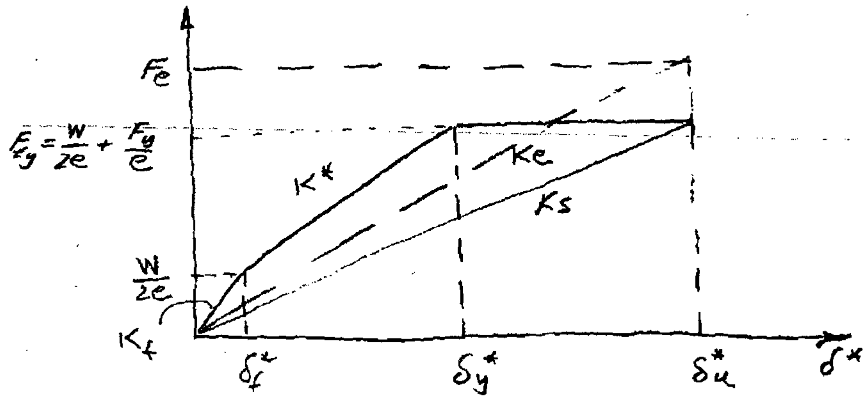


Series Stiffness

$$\frac{1}{K^*} = \frac{1}{K_f} + \frac{1}{K_R}$$

$$K^* = \frac{K_f K_R}{K_f + K_R} = K_f \frac{1}{1 + K_f/K_R}$$

Series Resistance Function (1/4 cycle)



Secant Stiffness

$$K_s = \frac{F_{ty}}{F_{ty}/K_f + e\delta_u}$$

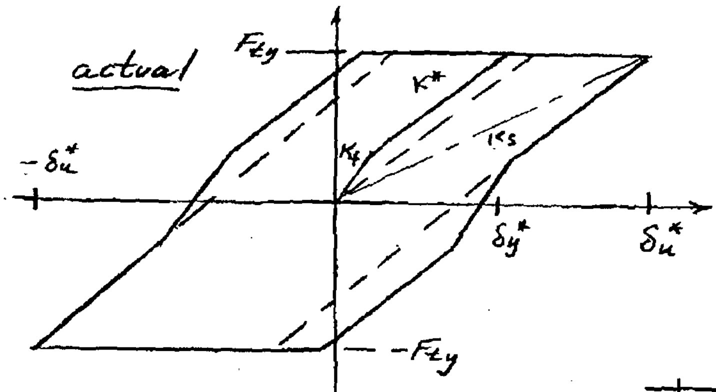
$$\delta_f^* = \frac{W}{2e}\frac{1}{K_f}$$

$$\delta_y^* = F_{ty}/K_f + e\,\delta_y$$

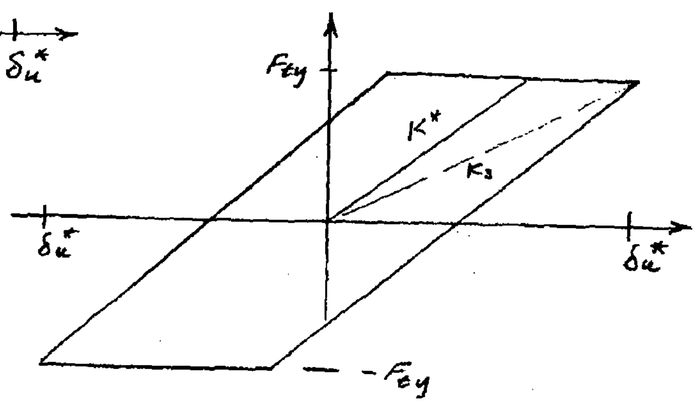
$$\delta_u^* = F_{ty}/K_f + e\,\delta_u$$

Full Reverse Cycle Hysteretic Loop

actual



approximate



– *as a conservative approximation, ignore the effect of dead weight restoring force on hysteresis*

Define :

$$f_s = \frac{1}{2\pi}\sqrt{K_s/M}$$

$$f_f = \frac{1}{2\pi}\sqrt{K_f/M}\ , \quad K_f = (2\pi f_f)^2 M$$

Let

$$X = \frac{K_s}{K_f} = \frac{f_s^2}{f_f^2} = \frac{F_{ty}}{F_{ty}/K_f + e\,\delta_u} = \frac{1}{1 + \frac{e\,\delta_u K_f}{F_{ty}}}$$

$$= \frac{1}{1 + \frac{e(2\pi f_f)^2\,\delta_u}{F_{ty}/M}}$$

Let $\quad F_{ty}/M = F_{SM}\, SA_r\ , \quad SA_r < SA(f_f, \beta_f)$

$$X = \frac{1}{1 + \frac{(2\pi f_f)^2\,\delta_u}{\frac{F_{SM}}{e}\, SA_r}}$$

if $\quad SA_c = \frac{F_{SM}}{e}\, SA_r$

$$\boxed{X = \frac{1}{1 + \frac{(2\pi f_f)^2\,\delta_u}{SA_c}}}$$

Given that the definition for X is taken as above and the hysteresis is approximated as indicated, then the same reduction procedure used for the shear resistance model applies, except that A is determined with $SA_c = \frac{F_{SM}}{e} SA_r$. The remainder of the procedure remains the same.