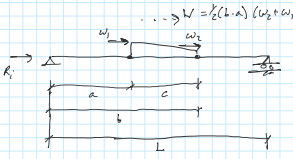
Linear Axial Load

Tuesday, January 24, 2023 3:14 PM

$\therefore W = \frac{1}{2}(b-a)(\omega_2+\omega_1) = \frac{1}{2}c(\omega_2+\omega_1)$



$\omega(x) = \omega_1 + t(\omega_2 - \omega_1) = \omega_1 + \frac{x-a}{c}(\omega_2-\omega_1)$

$t = \frac{(x-a)}{c}$

AXIAL

$0 \le x \le a$

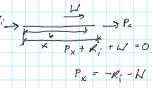
$P(x) = -R_1$

$a \le x \le b$

$$P(x) = -\frac{(w_2-w_1)x^2}{2c} + \frac{(aw_2-bw_1)x}{c} + c_1$$

$b \le x \le L$

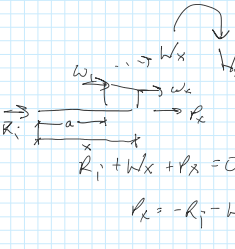
$P(x) = -R_1 - \underbrace{\frac{1}{2}c(\omega_2+\omega_1)}_{W}$



$P_x + R_1 + W = 0$

$P_x = -R_1 - W$

REDUCES TO WHERE COMPONENT w/o x HAS BEEN REPLACED BY C_1



$\therefore W_x \quad W_x = \frac{1}{2}(x-a)(\omega_1+\omega_x)$

$R_1 + W_x + P_x = 0$

$P_x = -R_1 - W_x$

$\omega_x = \omega_1 + \left(\frac{x-a}{c}\right)(\omega_2-\omega_1)$

DEFORMATION

$0 \le x \le a$

$u(x) = \left[-R_1 x + C_2\right]\frac{1}{EA}$

$a \le x \le b$

$$u(x) = \left[-\frac{(w_2-w_1)x^3}{6c} + \frac{(aw_2-bw_1)x^2}{2c} + c_1 x + c_3\right]\frac{1}{EA}$$

$b \le x \le L$

$u(x) = \left[\left(-R_1 - \frac{1}{2}c(\omega_2+\omega_1)\right)x + c_4\right]\frac{1}{EA}$

UNKNOWNS = 4

① $u(0) = 0$

② $P(a) =$ CONSTANT

③ $u(a) =$ CONSTANT

④ $u(b) =$ CONSTANT

① $c_2 = 0$

②
$$c_1 = -\frac{a^2w_2 - 2abw_1 + a^2w_1 + 2R_1b - 2R_1a}{2(b-a)}$$

③
$$c_3 = \frac{a^2(aw_2 - 3bw_1 + 2aw_1)}{6(b-a)}$$

④
$$c_4 = \frac{(2b^2 - ab - a^2)w_2 + (b^2 + ab - 2a^2)w_1}{6}$$