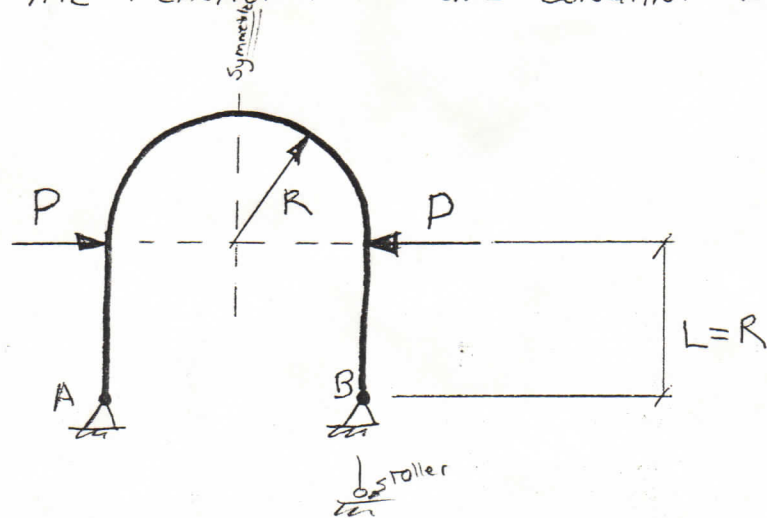


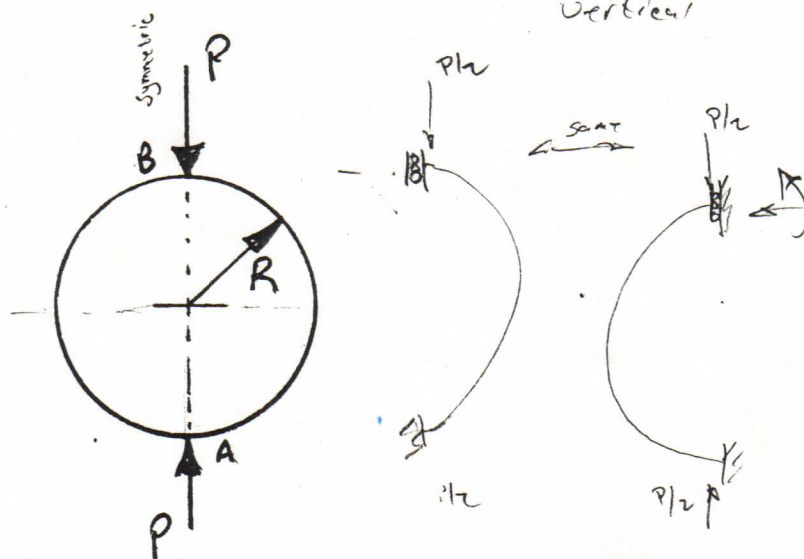
CE 519

HW #3

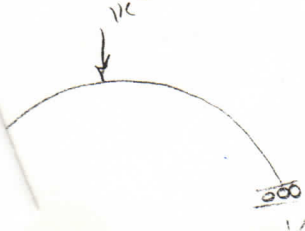
DETERMINE THE REACTIONS. ASSUME CONSTANT  $EI$ .



DETERMINE THE CHANGES IN THE HORIZONTAL AND VERTICAL DIAMETERS, ASSUME CONSTANT  $EI$ .



CONSIDER THE USE OF SYMMETRY,

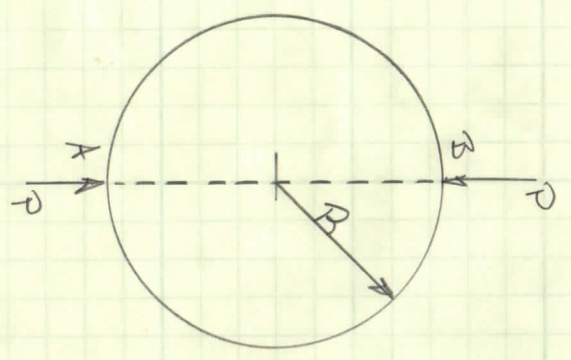


once have

Horizontal

# Problem #2

Determine the changes in the horizontal and vertical diameters. Assume constant EI



equation

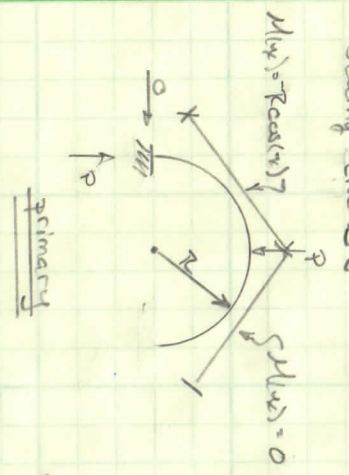
$$\Delta_{10} + V\delta_{11} + M\delta_{12}$$

$$\Delta_{20} + V\delta_{21} + M\delta_{22}$$

$$\text{Note } \Delta_{10} = \Delta_v$$

$$\Delta_{20} = \theta_H$$

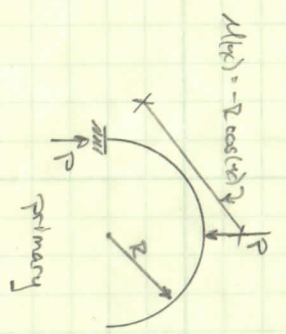
Getting the  $\Delta$ 's consider the use of symmetry



Note  $ds = R d\theta$

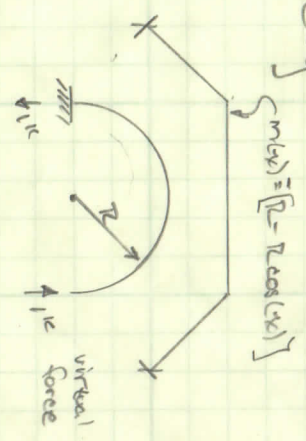
$$\therefore \Delta_{10} = \frac{P}{EI} \int_{\pi/2}^{\pi} (-R \cos(\theta)) (R - R \cos(\theta)) R d\theta$$

$$\therefore \Delta_{10} = -1.785 \frac{P R^3}{EI}$$

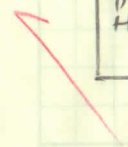
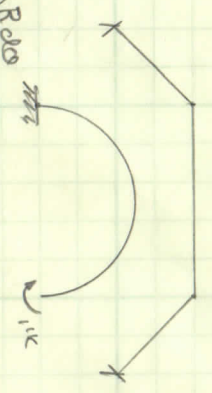


$$\therefore \theta_H = \frac{P}{EI} \int_{\pi/2}^{\pi} [-R \cos(\theta)] [1] R d\theta$$

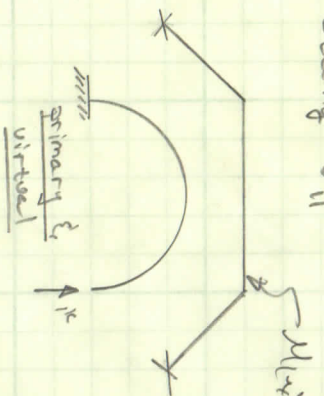
$$\therefore \theta_H = \frac{P R^2}{EI}$$



$$m(\psi) = 1$$



Getting  $\delta_{11}$



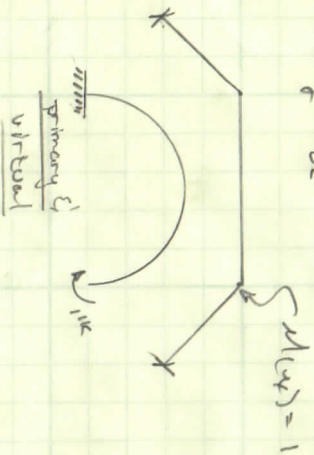
$$M(x) = -[2r - 2r \cos(x)]$$

from previous examples  $M(x) = m(x)$

$$\therefore \delta_{11} = \int_0^{\pi/2} \int_0^{\pi/2} [- (2r - 2r \cos(x))^2] r dx d\theta$$

$$\therefore \delta_{11} = \frac{4.71 r^3}{EI}$$

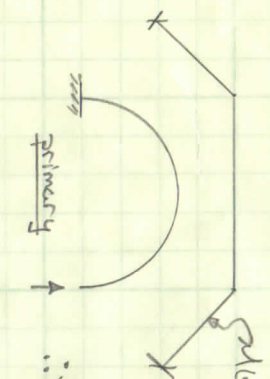
Getting  $\delta_{12}$



$$\therefore \delta_{12} = \frac{1}{EI} \int_0^{\pi/2} \int_0^{\pi/2} (1)^2 r dx d\theta$$

$$\therefore \delta_{12} = \frac{3.14 r}{EI}$$

Getting  $\delta_{21}$  &  $\delta_{22}$



$$M(x) = -[2r - 2r \cos(x)]$$

$$\therefore \delta_{21} = \frac{1}{EI} \int_0^{\pi/2} \int_0^{\pi/2} [- (2r - 2r \cos(x))] (1) r dx d\theta$$



$$\therefore \delta_{21} = \frac{-3.14 r^2}{EI}$$

$\therefore$  set up the following equation

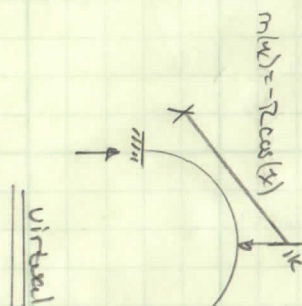
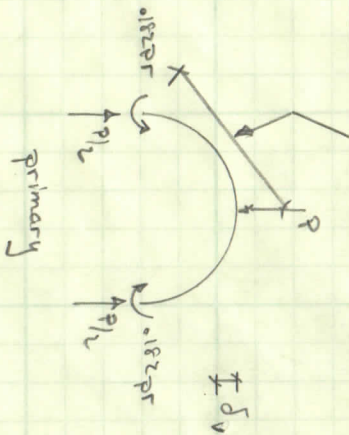
$$\begin{bmatrix} \frac{4.71 r^3}{EI} & \frac{-3.14 r^2}{EI} \\ \frac{-3.14 r^2}{EI} & \frac{3.14 r}{EI} \end{bmatrix} \begin{Bmatrix} V \\ M \end{Bmatrix} = \begin{Bmatrix} \frac{1.745 P r^3}{EI} \\ \frac{-P r^2}{EI} \end{Bmatrix}$$

$$\therefore V = -5p \quad (\text{matches natural assumptions!!})$$

$$u = .182 pr$$

### Getting actual deformations:

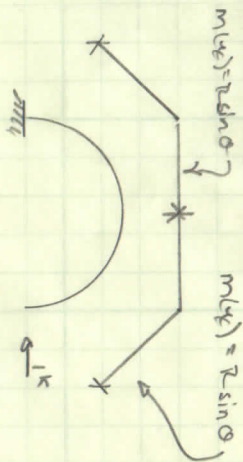
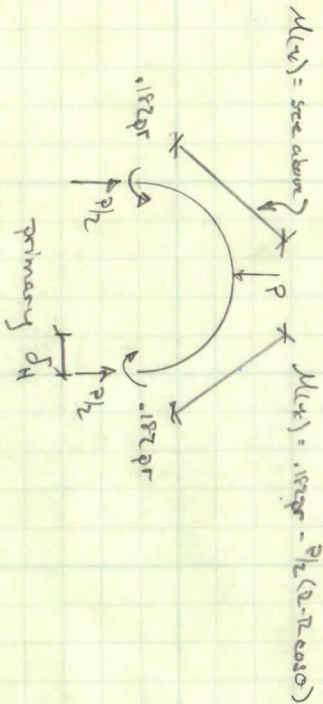
$$M(x) = .182 pr \cdot \frac{1}{2}(2 - 2\cos\theta) + P(-R\cos\theta)$$



$$\therefore \delta_v = \frac{1}{EI} \int_0^{\pi/2} [.182 pr \cdot \frac{1}{2}(1 - \cos\theta) + P(-R\cos\theta)] [-R\cos\theta] R d\theta$$

$$\therefore \delta_v = \frac{.075 pr^3}{EI}$$

$$\therefore \text{total } \delta = \frac{.15 pr^3}{EI}$$



$$\therefore \delta_H = \frac{1}{EI} \int_0^{\pi/2} [.182 pr - \frac{1}{2}P(2 - 2\cos\theta)] [R\sin\theta] R d\theta + \frac{1}{EI} \int_0^{\pi/2} [.182 pr - \frac{1}{2}P(2 - 2\cos\theta) + P(-R\cos\theta)] R d\theta$$

$$\therefore \delta_H = -.068 pr^3 + -.068 pr^3$$

$$\therefore \delta_H = \frac{.136 pr^3}{EI}$$