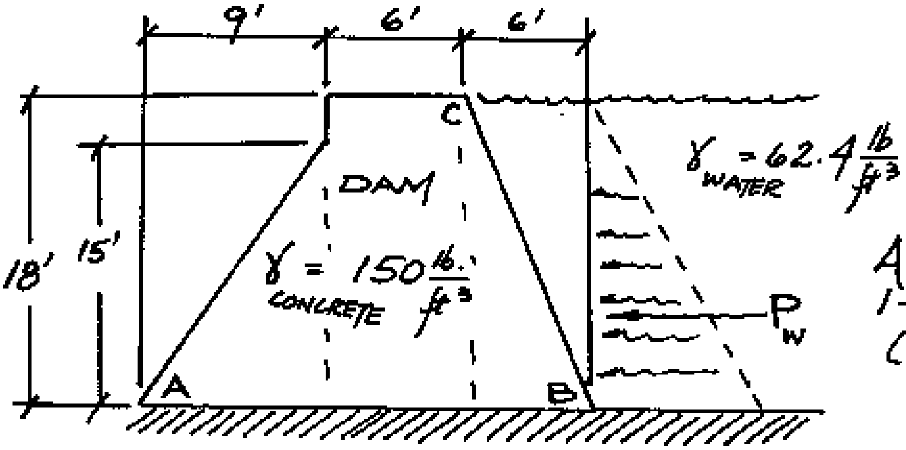
MECH 234 + 235

HYDROSTATIC FORCES

PROB. 5-89

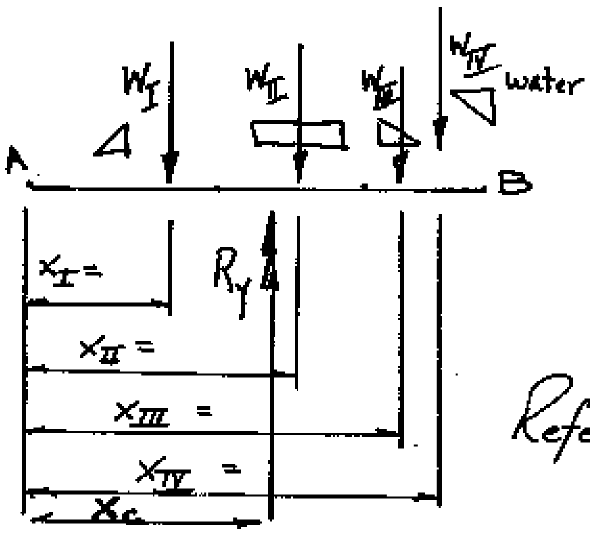
p. 248



ANALYZE for a 1-FT. DEEP SECTION (INTO THE PAPER)

(a.) REACTIONS ON BASE AB

Need to determine Total Resultant FORCE = Weight



$W = \gamma\,(\text{Volume})$

$= \gamma\, A_x\, t$ where $t = 1\text{-FT. WIDE}$

γ = specific wt. = $\dfrac{\text{wt.}}{\text{Volume}}$

Volume = (Cross Sectional Area)(thickness)

Refer to p. 241 for HORIZONTAL FORCE of WATER.

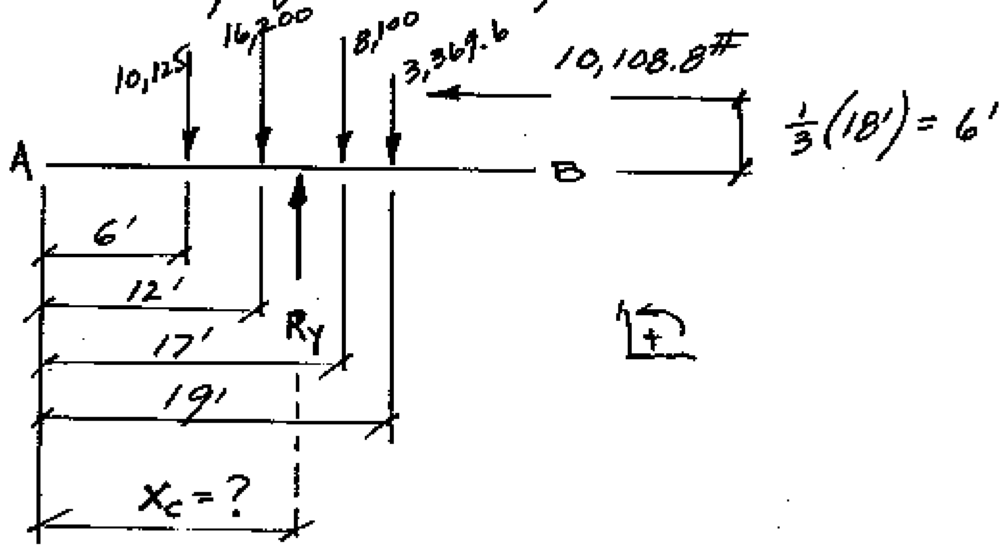
FORCE = WEIGHT	CENTROIDS from A
$W_I = \left(150\,\frac{lb}{ft^3}\right)\left(\frac{1}{2}\times 9'\times 15'\right)(1') = 10{,}125\ lb.$	$x_I = \frac{2}{3}(9') = 6'$
$W_{II} = \left(150\,\frac{lb}{ft^3}\right)(6'\times 18')(1') = 16{,}200\ lb.$	$x_{II} = 9' + \frac{1}{2}(6') = 12'$
$W_{III} = \left(150\,\frac{lb}{ft^3}\right)\left(\frac{1}{2}\times 6'\times 18'\right)(1') = 8{,}100\ lb.$	$x_{III} = 15' + \frac{1}{3}(6') = 17'$
$W_{IV} = \left(62.4\,\frac{lb}{ft^3}\right)\left(\frac{1}{2}\times 6'\times 18'\right)(1') = 3{,}369.6\ lb.$	$x_{IV} = 15' + \frac{2}{3}(6') = 19'$

$\Sigma = 37{,}794.6\ lb. = \boxed{R_y \uparrow = 37{,}794.6\ lb}$

$\Sigma F_x = 0 = R_x - P_w \quad \therefore R_x = (A_{x_{wt}})(w) = \left(\frac{1}{2}\times 1'\times 18'\right)\left(62.4\,\frac{lb}{ft^3}\times 18'\right)$

$\boxed{R_x = 10{,}108.8\ lb \rightarrow}$

(b.) Determine Point of Application of the Resultant Weight.
(and don't forget the Horiz. Force due to the water.)



$$\Sigma M_A = 0 = R_Y X_c - (10{,}125^{\#} \times 6') - (16{,}200^{\#} \times 12') - (8{,}100^{\#} \times 17')$$
$$- (3{,}369.6^{\#} \times 19') + (10{,}108.8^{\#} \times 6')$$

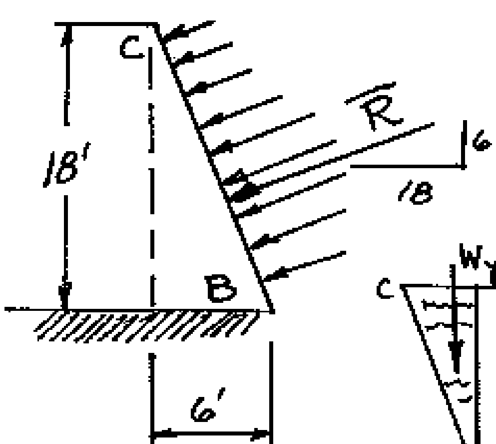
where $R_Y = 37{,}794.6$ lb.

$$\therefore X_c = \frac{60{,}750'^{\#} + 194{,}400'^{\#} + 137{,}700'^{\#} + 64{,}022.4'^{\#} - 60{,}652.8'^{\#}}{37{,}794.6^{\#}}$$

$X_c = 10.48'$

(c.) Determine Resultant of Water Pressure Forces on surface BC.

Refer to p.241 & SAMPLE 5.10



$\vec{R} = \bar{W}_x + \bar{W}_y$ previously calculated

$= \sqrt{(10{,}108.8^{\#})^2 + (3{,}369.6^{\#})^2}$

$\vec{R} = 10{,}655.6$ lb $\theta = 18.43°$