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Solution

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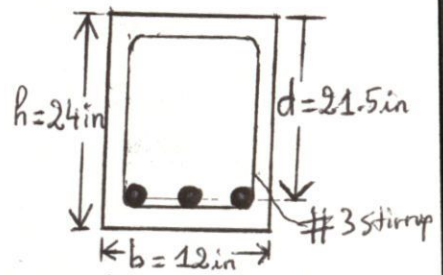
$f_y = 60\,ksi$; $f'_c = 4\,ksi$; $S = 10\,in$



$A_c = (b)(h) = (12\,in)(24\,in) = 288\,in^2 = 2\,ft^2$

$W_L = 0.4\,kips/ft$

$W_{SW} = (\gamma_c)(A_c) = \left(0.150\frac{kips}{ft^3}\right)(2\,ft^2)$

$W_{SW} = 0.30\,kips/ft$

$W_{TOT} = 0.01 + W_{SW} = 0.01 + 0.3 = 0.31\,kips/ft$

$F_R = \left(1.012\frac{kips}{ft}\right)(24\,ft) = 24.288\,k$

$W_u = 1.2(W_{TOT}) + 1.6(W_L) = 1.2(0.31) + 1.6(0.4) = 1.012\,kips/ft$

$A_x = 0$

12 ft

L = 24 ft

$A_y = 12.144\,kips$ $B_y = 12.144\,kips$

$+\circlearrowleft \sum M_A = 0 \; ; \; (-24.288\,kips)(12\,ft) + (B_y)(24\,ft) = 0$

$B_y = 12.144\,kips$

$+\uparrow \sum F_y = 0 \; ; \; A_y + B_y = 24.288\,kips$

$A_y = 24.288\,kips - 12.144\,kips = 12.144\,kips$

$V(kips)$ $(0, 12.144)$ 12.144

$m = \frac{Y_2 - Y_1}{X_2 - X_1} = \frac{-12.144 - 12.144}{24 - 0} = -1.012$

$V = mx + b \Rightarrow V(x) = -1.012x + b \; ; \; (0, 12.144)$

$V(x) = [-1.012x + 12.144]\,kips$

$V_{u@d} = V(d) = -1.012\left(\frac{21.5}{12}\right) + 12.144 = 10.3\,kips$

$10.3 = V_{u@d}$

$x(ft)$

$(24, -12.144)$ -12.144

(a) $V_{u@d} = 10.3\,kips$

$V_c = 2 b_w d \sqrt{f'_c}$

$= 2(12\,in)(21.5\,in)\sqrt{4{,}000\,psi}$

$= 32{,}634.70545\,lbs$

$V_c = 32.6\,kips$

$\phi V_c = (0.75)(32.6\,kips)$

$= 24.45\,kips$

(b) $\phi V_c = 24.5\,kips$

(c) $\frac{\phi V_c}{2} = \frac{24.45}{2} = 12.225\,kips$

(d) $V_{u@d} = 10.3\,kips < \frac{\phi V_c}{2} = 12.225\,kips$

Therefore, no stirrups required