ARCH 631. Remaining Formulas of Final Exam
from Lectures, Examples, and Assignments
(also see Formulas of Exams 1-3)

$M_{max(simply\ supported)} = \frac{wl^2}{8}$	$\Delta_{max} \le \Delta_{limit}$	$M_u \le \phi M_n$ or $M_a \le M_n/\Omega$
1.4D 1.2D + 1.6L + 0.5(L_r or S or R) 1.2D + 1.6(L_r or S or R) + (L or 0.5W) 1.2D + 1.0W + L + 0.5(L_r or S or R) 1.2D + 1.0E + L + 0.2S 0.9D + 1.0W 0.9D + 1.0E	$P_u \le \phi P_n$ or $P_a \le P_n/\Omega$ $I_{req'd} = \frac{(\Delta_{formula} \cdot I)}{\Delta_{limit value}}$	$r = \sqrt{\frac{db^3}{12(bd)}} = \frac{b}{\sqrt{12}}$ $f_v = \frac{V}{A_{nv}} \le F_v$
$w = w' \times tributary\ width$	$F_{vm} = \frac{1}{2}\left[\left(4 - 1.75\left(\frac{M}{Vd}\right)\right)\sqrt{f'_m}\right] + 0.25\frac{P}{A_n}$ where M/Vd is positive and cannot exceed 1.0	$F_{vs} = 0.5\left(\frac{A_v F_s d}{A_{nv} s}\right)$
$w_{adjusted} = w_{ll-have}\left(\frac{L/360}{L/400}\right)^{table}_{need}$	$F_{v-max} = 3\sqrt{f'_m}$ for $M/Vd \le 0.25$ $F_{v-max} = 2\sqrt{f'_m}$ for $M/Vd \ge 1.0$	$F_v = F_{vm} + F_{vs}$
$KL_x = \frac{KL_y}{(r_x/r_y)}$		$A_{nv} = bh - A_s$
$P_a = [0.25 f'_m A_n + 0.65 A_{st} F_s]\left[1 - \left(\frac{h}{140r}\right)^2\right]$ for h/r ≤ 99 (reinforced)		$\frac{P}{A} \le q_a$
$P_a = [0.25 f'_m A_n + 0.65 A_{st} F_s]\left(\frac{70r}{h}\right)^2$ for h/r > 99 (reinforced)		$q_u = \frac{P_u}{A}$
$V_{u1} = BL'q_u$	$\phi V_{n1} = \phi 2\lambda\sqrt{f'_c}Bd \quad \phi = 0.75$	$L_m = \frac{B}{2} - \frac{\bullet}{2}$ where • is smaller dimension of column
$V_{u2} = P_u - q_u(c+d)(b+d)$	$b_o = 2(c+d) + 2(b+d)$	$M_u = q_u \frac{BL_m^2}{2}$
$\phi V_{n2} = \phi\left(2 + \frac{4}{\beta}\right)\lambda\sqrt{f'_c}b_o d \le \phi 4\lambda\sqrt{f'_c}b_o d \quad \phi = 0.75$	$P = \frac{\gamma h^2}{2}$ at h/3	$P_{e1} = \frac{\pi^2 EI}{(L_{c1})^2}$
$\frac{P_r}{P_c} \ge 0.2: \frac{P_r}{P_c} + \frac{8}{9}\left(\frac{M_{rx}}{M_{cx}} + \frac{M_{cy}}{M_{ry}}\right) \le 1.0$		$B_1 = \frac{C_m}{1 - \alpha(P_u/P_{e1})} \ge 1.0$
$\frac{P_r}{P_c} < 0.2: \frac{P_r}{2P_c} + \left(\frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}}\right) \le 1.0$		$C_m = 0.6 - 0.4\frac{M_1}{M_2}$ where $M_1 < M_2$
$I_{req'd} \ge \frac{\Delta_{toobig}}{\Delta_{limit}} I_{trial}$	$V_u \le \phi V_n = \phi(0.6 F_{yw})t_w d \quad \phi = 1.0$	$M_r = B_1 M_{nt}$

$R_u \le \phi R_n$	bearing: $R_u \le \phi r_n tn$	shear: $R_u \le \phi r_n n$
$\phi R_n = \phi(0.6)F_y A_g \quad \phi = 1.0$	$\phi R_n = \phi(0.6)F_u A_{nv} \quad \phi = 0.75$	$U_{bs} = 0.5$ when tensile stress is non-uniform
$R_u \le \phi(0.6F_u A_{nv} + U_{bs}F_u A_{nt} \le 0.6F_y A_{gv} + U_{bs}F_u A_{nt}) \quad \phi = 0.75$		l is the largest of: $m = \frac{N-0.95d}{2}$ $n = \frac{B-0.8b_f}{2}$ $\lambda n'$ where $n' = \frac{\sqrt{db_f}}{4}$ and $\lambda = \frac{2\sqrt{X}}{(1+\sqrt{1-X})} \le 1$
$X = \frac{4db_f}{(d+b_f)^2}\cdot\frac{P_u}{\phi_c P_p} = \frac{4db_f}{(d+b_f)^2}\cdot\frac{P_u}{\phi_c(0.85f'_c)BN} \quad \phi_c = 0.65$		
$P_p = 0.85f'_c A$	$t_{min} = l\sqrt{\frac{2P_u}{0.9F_y BN}}$	
$f_b - f_a \le F_t$	$f_b = \frac{Mc}{I} = \frac{M}{S}$	$M = Pe$
$f_a + f_b \le F_b$	$M \le M_s = A_s F_s(jd) \quad j = 0.909$	$\frac{f_a}{F_a} + \frac{f_b}{F_b} \le 1$
$f_a \le F_a$	$F_v = 1.5\sqrt{f'_m} \le 120\ psi$ unreinforced	$f_v = \frac{VQ}{I_n b} = \frac{3V}{2A}$ solid rectangle
with $M = Vh, M/Vd = h/d$	$F_b = 0.45f'_m$ reinforced	$F_b = 0.33f'_m$ unreinforced
$F = \mu N$	$SF = \frac{M_{resist}}{M_{overturning}} \ge 1.5-2$	$SF = \frac{F_{horizontal-resist}}{F_{sliding}} \ge 1.25-2$