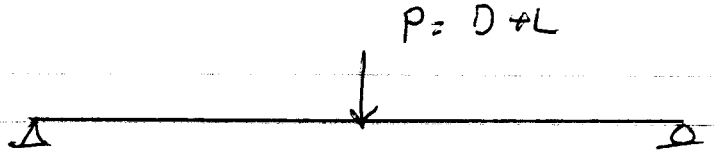
6.28



SPAN = 25'
6 x 14 DF-L SELECT STRUCTURAL
$C_M = 1.0$, $C_t = 1.0$
LATERAL SUPPORT @ ENDS ONLY

$$F'_b = F_b C_D C_M C_t C_L C_F C_{fu} C_i C_r C_f \qquad l_u = 25'$$

$F_b = 1600$ psi
$E = 1.6(10)^6$ psi
$C_D = 1.0$
$C_M = 1.0$
$C_t = 1.0$
$C_F = \left(\frac{12}{13\frac{1}{2}}\right)^{1/9} = 0.987$
$C_{fu} = 1.0$
$C_i = 1.0$
$C_r = 1.0$
$C_f = 1.0$

$$l_u/d = 25'(12''/ft)/13\tfrac{1}{2} = 22.2 > 7$$

$$l_e = 1.63\, l_u + 3d = 1.37(25')(12''/ft) + 3(13.5) = 451.5''$$

$$R_B = \sqrt{\frac{l_e d}{b^2}} = \sqrt{\frac{451.5(13.5)}{(5.5)^2}} = 14.19 < 50 \checkmark$$

$$F_b^* = 1600(.987) = 1579.2 \text{ psi}$$

$$F_{bE} = \frac{K_{bE} E'}{R_B^2} = \frac{.439(1.6)(10)^6}{(14.19)^2} = 3488 \text{ psi}$$

$$C_L = \frac{1 + (F_{bE}/F_b^*)}{1.9} - \sqrt{\left[\frac{1 + (F_{bE}/F_b^*)}{1.9}\right]^2 - \frac{F_{bE}/F_b^*}{.95}}$$

6.28 cont

$$\left(F_{bE}/F_b^{*}\right) = 2.21$$

$$C_L = \frac{1+2.21}{1.9} - \sqrt{\left[\frac{1+(2.21)}{1.9}\right]^2 - \frac{2.21}{.95}} = .963$$

$$F_b' = .963\,F_b^{*} = .963(1579.2) = 1520 \text{ psi}$$

$$f_b = \frac{M}{S} = \frac{PL}{4S} = \frac{P(25')(12''/ft)}{4(167.1)_{in^3}} = .4488P$$

$$P = 1520/.4488 = 3386 \text{ lb}$$

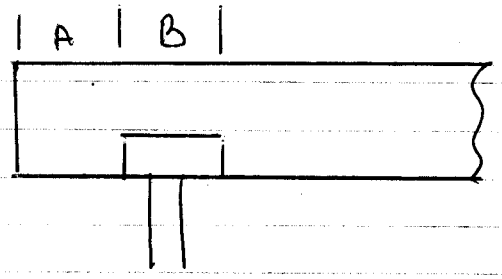
CHECK DEFLECTION

$$\Delta = \frac{3386 \text{ lb}\,(25\times12)^3}{48(1.6)(10)^6(1128 \text{ in}^4)} = 1.055'' < \frac{\ell}{240} = \frac{25(12)}{240} = 1.25''$$

✓

$$\boxed{P = 3386 \text{ lb}}$$

6.34



a) 4x12 No 1 DF-L, M ≤ 19%, A = 12", B = 5"
LOADS = D + S

FIND MAX REACTION

$$f_{c\perp} = R/A = R/5"(3\tfrac{1}{2}") = R/17.5_{in^2}$$

$$F'_{c\perp} = F_{c\perp} C_M C_t C_i C_b$$

NOT WITHIN 3" OF END
BEARING < 6" IN LENGTH
∴ C_b FROM TABLE 3.10.4

$$C_b = \frac{l_b + .375}{l_b} = \frac{5 + .375}{5}$$

$$= 1.075$$

$$F'_{c\perp} = 625(1.075)$$
$$= 672 \text{ psi}$$

$$672 \text{ psi} \cdot (17.5 \text{ in}^2) = R$$

$$R = 11760 \text{ lb} \quad (\text{MAX REACTION})$$

b) 5 1/8 x 33 DF GLULAM 24F-V4 MC = 18%, A = 0, B = 12"

$$F'_{c\perp} = C_M C_t C_b F_{c\perp}$$

BECAUSE A < 3" $C_b = 1.0$

$F_{c\perp} = 650$ psi, $C_M = 0.53$

$$F'_{c\perp} = .53(1.0)(1.0)(650 \text{ psi})$$
$$= 344.5 \text{ psi}$$

$$R = 344.5(5\tfrac{1}{8})(12) = 21{,}190 \text{ lb}$$

7.2 5⅛ x 15 DF AXIAL COMBO 5 GLULAM
1" ϕ BOLTS IN A SINGLE ROW
D + S LOADS, PINS CONNECTED, MC = 10%, C_t = 1.0

a) FIND ALLOWABLE AXIAL TENSION LOAD

$$F'_t = C_D C_M C_t F_t$$

$$= 1.15(1.0)(1.0)(1600\ psi) = 1840\ psi \qquad \text{(TABLE 5B)}$$

$$A_n = A_g - \text{HOLES} = (5\tfrac{1}{8})(15) - (1\tfrac{1}{16}")(5\tfrac{1}{8}) = 71.43\ in^2$$

$$P = 71.43\ in^2\ (1840)\ psi = 131{,}431\ lb$$

b) MC = 15% NO CHANGE IN RESULT

c) MC = 18%

$C_M = 0.8$ $\quad F'_t = .8(1840) = 1472\ psi$

$$P = 71.43\ in^2\ (1472)\ psi = 105{,}145\ lb$$

d) BENDING COMBO 24F-V8 GLULAM

$F'_t = 1265\ psi$ $\quad P = 71.43\ in^2\ (1265\ psi) = \cancel{88570}\ 90360\ lb$

7.13 6x8 No. 1 DF-L, $C_m = 1.0$, $C_t = 1.0$, $C_i = 1.0$
D+S COMPRESSION AXIAL

a) P GIVEN $\ell_u = 5'$, $A_g = 41.25\ in^2$

$$F_c' = F_c C_D C_M C_t C_F C_i C_p$$

$$= 1000psi\,(1.75)(1.0)(1.0)(1.0)(1.0)\,C_p$$

$K_e = 1.0$, $\ell_e = 60''$, $\ell_e/d = 60/(5\frac{1}{2}) = 10.91$

$$F_c^* = 1.15(1000) = 1150\ psi$$

$$F_{cE} = \frac{.3(1.6)(10)^6}{(10.91)^2} = 4033\ psi$$

$$F_{cE}/F_c^* = 4033/1150 = 3.51$$

$$C_p = \left(\frac{1+3.51}{2(.8)}\right) - \sqrt{\left[\frac{1+3.51}{2(.8)}\right]^2 - \frac{3.51}{.8}} = 0.93$$

$$F_c' = .93(1150\ psi) = 1070\ psi$$

$$P = 41.25\ in^2(1070\ psi) = 44{,}140\ lb$$

c) $\ell_u = 11'$, $\ell_e/d = 24 < 50$

$$F_{cE} = \frac{.3(1.6)(10)^6}{(24)^2} = 833.3\ psi \qquad F_{cE}/F_c^* = 0.725$$

$$C_p = \left(\frac{1+.725}{1.6}\right) - \sqrt{\left(\frac{1+.725}{1.6}\right)^2 - \frac{.725}{.8}} = 0.572$$

$$F_c' = .572(1150) = 658\ psi \qquad P = 658(41.25) = 27140\ lb$$

7.13 e) $\ell_e = 19'$ $\frac{\ell_e}{d} = \frac{19(12)}{5\frac{1}{2}} = 41.45$

$$F_{cE} = \frac{.3(1.6)(10)^6}{(41.45)^2} = 279.4 \text{ psi}$$

$$F_{cE} / F_c^* = 279.4 / 1150 = .243$$

$$C_p = \left(\frac{1+.243}{1.6}\right) - \sqrt{\left(\frac{1+.243}{1.6}\right)^2 - \frac{.243}{.8}} = 0.229$$

$$F_c' = .229(1150) = 263.3 \text{ psi}$$

$$P = 41.25 \text{ in}^2 (263.3) = 10863 \text{ lb}$$

7.15 $D = 20^K$, $L = 90^K$, $L_r = 40^K$ 8¾ x 15 AXIAL 2 DF

$L_1 = 22'$ (STRONG AXIS BENDING)
$L_2 = 10'$
$L_3 = 12'$ (CONTROLS WEAK AXIS BENDING)

$D+L/1 = 110^K$

$D+L+L_r/1.25 = 150/1.25 = 120^K$

CONTROLLING CASE IS $D+L+L_r = 150^K$

CONTROLLING BUCKLING CONDITION

$\frac{22(12)}{15} = 17.6$, $\frac{12(12)}{8.75} = 16.46$

$F'_c = F_c C_D C_M C_t C_p$

$= 1600\ psi\,(1.25)(1.0)(1.0)\,C_p = 2000\ psi = F_c^*$

$F_{cE} = \frac{(.418)(1.6)(10)^6}{(17.6)^2} = 2159\ psi$

$F_{cE}/F_c^* = 2159/2000 = 1.080$

$C_p = \frac{1+1.08}{2(.9)} - \sqrt{\left(\frac{1+1.08}{2(.9)}\right)^2 - \frac{1.08}{.9}} = 0.788$

$F'_c = .788(2000\ psi) = 1576\ psi$

$P = (8.75")(15")(1576\ psi) = 206,850\ lb$

7.18 $D = 20^K$, $S = 55^K$ No. 1 DF-L. $K_e = 1.0$ BOTH X & Y
$C_M = 1.0$, $C_t = 1.0$, $C_i = 1.0$

a) $\ell_e = 8' = 96''$, $D+S = 75^K$

$$\frac{D+S}{C_D} = 65.2^K$$

TRY 10 x 10 BASED ON TABLE 5.3c pg L-20 OF SUPPLEMENTS.

$F_c = 1000$ psi;

$F_c^* = F_c C_D C_M C_t C_F C_i$

$= 1000(1.15)(1.0)(1.0)(1.0)(1.0) = 1150$ psi

$$F_{cE} = \frac{.3(1.6)(10)^6}{(96/9.5)^2} = 4700 \text{ psi}$$

$F_{cE}/F_c^* = 4700/1150 = 4.087$

$$C_P = \left(\frac{1+4.087}{1.6}\right) - \sqrt{\left(\frac{1+4.087}{1.6}\right)^2 - \left(\frac{4.087}{.8}\right)} = 0.943$$

$F'_c = .943(1150 \text{ psi}) = 1085$ psi

$A_g = 75^K / 1.085$ KSI $= 69.12$ in^2

8x10 $A_g = 71.25$ in^2

10x10 $A_g = 90.25$ in^2

7.18 CONT.

TRY 8"x10"

$$F_{cE} = \frac{.3(1.6)(10)^4}{(96/7.5)^2} = 2930 \text{ psi}$$

$$F_{cE}/F_c^* = \frac{2930}{1150} = 2.55$$

$$C_p = \frac{3.55}{1.6} - \sqrt{\left(\frac{3.55}{1.6}\right)^2 - \frac{2.55}{.8}} = 0.901$$

$$F'_c = .901(1150) = 1036 \text{ psi}$$

$$P = 1036(71.25 \text{ in}^2) = 73860 \text{ lb} < 75^K \text{ O.G.}$$

USE THE 10" x 10" DF-L No. 1

c) 14' LENGTH, TRY 10"x10"

$$F_{cE} = \frac{.3(1.6)(10)^4}{(168/9.5)^2} = 1535 \text{ psi}$$

$$F_{cE}/F_c^* = 1535/1150 = 1.335$$

$$C_p = \left(\frac{2.335}{1.6}\right) - \sqrt{\left(\frac{2.335}{1.6}\right)^2 - \frac{1.335}{.8}} = 0.78$$

$$F'_c = .78(1150) = 879.4 \text{ psi}$$

$$P = 879.4(90.25) = 81{,}000 \text{ lb} > 75000 \text{ lb} \checkmark$$

USE 10x10 No. 1 DF-L

e) $\ell = 22'$ TRY 10×12

$$F_{cE} = \frac{.3(1.6)(10)^6}{\left(\frac{264}{9.5}\right)^2} = 621.6 \text{ psi}$$

$$F_{cE}/F_c^* = 0.54$$

$$C_p = \left(\frac{1.54}{1.6}\right) - \sqrt{\left(\frac{1.54}{1.6}\right)^2 - \left(\frac{.54}{.8}\right)} = 0.461$$

$$F'_c = .461(1150 \text{ psi}) = 530 \text{ psi}$$

$$P = 530 \text{ psi}(109.3 \text{ in}^2) = 57929 \text{ lb} < 75^K \text{ N.G.}$$

TRY 12×12 = $A_g = 132.3 \text{ in}^2$

$$F_{cE} = \frac{.3(1.6)(10)^6}{(265/11.5)^2} = 904.$$

$$F_{cE}/F_c^* = .786$$

$$C_p = \left(\frac{1.786}{1.6}\right) - \sqrt{\left(\frac{1.786}{1.6}\right)^2 - \frac{.786}{.8}} = 0.603$$

$$F'_c = .603(1150) \text{ psi} = 693 \text{ psi}$$

$$P = 693(132.3) = 91730 \text{ lb} > 75000 \checkmark$$

USE 12×12 No.1 DE-L