6.1 GIVEN: A ROOF BEAM w/ LOAD P = 2$^{K}$ BASED ON D+L$_r$
SPAN = 8' , $\ell_u$ = 0'
4x8 No 1 DF-L
MC ≤ 19%
ALLOWABLE Δ = L/360

a) FIND SIZE CATEGORY , = DIMENSION LUMBER
b) $F_b$ = 1000 psi

$F_v$ = 180 psi

$E$ = 1,700,000 psi

c) $F'_b = F_b C_D C_M C_t C_L C_F C_{fu} C_i C_r C_f$

= 1000 (1.25)(1.0)(1.0)(1.0)(1.3)(1.0)(1.0)(1.0)(1.0)
= 1625 psi

$F_v' = F_v C_D C_M C_t C_i$
= 180(1.25)(1.0)(1.0)(1.0) = 225 psi

$E' = E C_M C_t C_i C_T$ = 1,700,000 psi

d) $f_b = \frac{\frac{2000\,lb(8\times12)}{4}}{30.66} = 1566$ psi $= \frac{M}{S}$ < 1625 psi o.k.

$f_v = 1.5\frac{V}{A} = \frac{1.5(1000\,lb)}{25.38\,in^2} = 59.1$ psi < 225 psi o.k.

$\Delta = \frac{PL^3}{48EI} = \frac{2000\,lb(8'\times12''/ft)^3}{48(1{,}700{,}000\,psi)(111.1\,in^4)} = 0.20''$ < $\frac{8(12)}{360} = .27''$

6.6 GIVEN: ROOF BEAM 24F-1.8E 3⅛" x 21" GLULAM
w/ SPAN = 24'. $\ell_u = 0$
$P = 1.5^K$ FROM D+S
MC < 16%
$\Delta \leq L/240$

a) $F_b = 2400$ psi
$F_v = 240$ psi
$E_x = 1.8(10)^6$ psi
$E_y = 1.6(10)^6$ psi

b) $F'_b = F_b C_D C_M C_t (C_L \text{ OR } C_v) C_{fu} C_c C_f$
$= 2400(1.15)(1.0)(1.0)(0.98)(1.0)(1.0)(1.0) = 2705$ psi

$C_v$ FROM EQ 5.3-1 $= 0.98$ FOUND IN TABLE 4.5 OF GLULAM SUPPL.

$F'_v = F_v C_D C_M C_t = 1.15(240) = 276$ psi

$E'_x = E C_M C_t = 1.8(10)^6$ psi
$E'_y = E C_M C_t = 1.6(10)^6$ psi

c) $f_b = \frac{M}{S} = \frac{1.5^K(1000 \text{ lb/K})(24')(12''/ft)}{(4)\ 229.7 \text{ in}^3} = 470$ psi < 2705 ~~N.G.~~ O.K.

$f_v = 1.5\frac{V}{A} = 1.5\left(\frac{750}{65.63}\right) = 17.1$ psi < 276 O.K.

$\Delta = \frac{PL^3}{48EI} = \frac{1500(24)^3(12)^3}{48(1.8)(10)^6(2412)} = 0.18''$ ~~0.35~~
< 1.2" O.K.

d) $.35(.18'') = .063''$ = DEAD LOAD $\Delta$

USE CAMBER $= 1.5(.063) = 0.09$ SAY 0.10"

6.14 $w_D = 200$ lb/ft

$w_S = 300$ lb/ft

$w_{TL} = 500$ lb/ft

SPAN = 20'

5 x 19 1/4 24F-1.7E SP

MC < 16%

$\Delta_S \leq L/360$

$\Delta_{DxS} \leq L/240$

a) $F_b = 2400$ psi

$F_v = 270$ psi

$E_x = 1.7(10)^6$ psi

$E_y = 1.5(10)^6$ psi

b) $F'_b = F_b C_D C_M C_t (C_L \text{ or } C_V) C_{fu} C_c C_f$

$= 2400(1.15)(1.0)(1.0)(0.98)(1.0)(1.0)(1.0) = 2705$ psi

$F'_v = F_v C_D C_M C_t = 190$ psi $(1.15) = 218.5$ psi

$E'_x = 1.7(10)^6$ psi

$E'_y = 1.3(10)^6$ psi

c) $f_b = \frac{M}{S} = \frac{500 \text{ lb/ft } (20 \cdot 12 \text{"/ft})^2}{(12) \quad 8(308.8)} = 972$ psi $< 2705$ O.K.

$f_v = \frac{1.5(500 \text{ lb/ft})(20')(1/2)}{96.25 \text{ in}^2} = 77.9$ psi $< 270$ O.K.

$\Delta_{DxS} = \frac{5wL^4}{384EI} = \frac{5\left(\frac{500}{12} \text{ lb/in}\right)(20 \times 12)^4}{384(1.7)(10)^6(2972)} = 0.36" < \frac{20(12)}{240} = 1"$ O.K.

$\Delta_S = 0.36\left(\frac{300}{500}\right) = 0.22" < \frac{20(12)}{360} = 0.67"$ O.K.

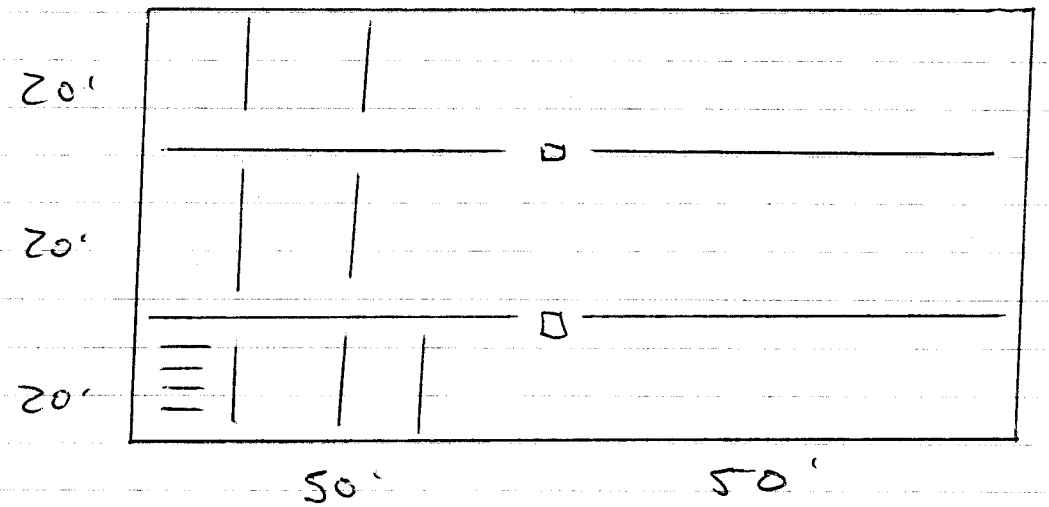
d) CAMBER $= 1.5(.14") = 0.21"$ CAMBER.

6.37 GIVEN: ROOF FRAMING PLAN

TOTAL DEAD LOADS

SUBPURLINS (2x4 @ 24") = 7.0 psf
PURLINS (4x14 @ 8') = 8.5 psf
GIRDER (TO BE SIZED) = 10 psf

FLAT ROOF, $C_M = 1.0$, $C_t = 1.0$




a) CHECK No 1 & BETTER DF-L SUBPURLINS FOR STRENGTH & DEFLECTION SPAN = 8"

$L_r = 20$ psf

$F_b = 1200$ psi
$F_v = 180$ psi
$E = 1.8(10)^6$ psi

$$F'_b = F_b C_D C_M C_t C_L C_F C_{fu} C_i C_r C_f$$
$$= 1200(1.25)(1.0)(1.0)(1.0)(1.5)(1.0)(1.0)(1.15)(1.0) = 2588 \text{ psi}$$

$$f_b = \frac{M}{S} = \frac{(27 \text{ lb/ft}^2)(2')(8')^2(12"/ft)}{8(3.063 \text{ in}^3)} = 1692 \text{ psi} < 2588$$

O.K.

6.37 cont $F_v' = F_v C_D C_M C_t C_i$

$= 180(1.25)(1.0)(1.0)(1.0) = 225$ psi

$$f_v = \frac{1.5V}{A} = \frac{1.5wL}{2A} = \frac{1.5(27\ lb/ft^2)(2')(8')}{2(5.25\ in^2)} = 61.7 \text{ psi}$$

< 225 O.K.

COMMERCIAL BLDG W/O PLASTER CEILING

$\Delta_L < L/240 = .40"$ $\Delta_{TL} < L/180 = .53"$

$$\Delta_T = \frac{5wL^4}{384EI} = \frac{5(27\ lb/ft^2)(2')(1/12)(96")^4}{384(1.8)(10)^6(5.359)_{in^4}} = 0.52" < .53" \text{ O.K.}$$

$$\Delta_L = .5159"\left(\frac{20}{27}\right) = 0.38" < 0.4" \text{ O.K.}$$

b) PURLINS 4x14 No 1 OR BETTER DF-L, SPAN = 20'

$L_r = 20$ psf $(A_t < 200$ SF)

$F_b = 1200$ psi
$F_v = 180$ psi
$E = 1.8(10)^6$ psi

$F_b' = F_b C_D C_M C_t C_L C_F C_{fu} C_i C_r C_f$

$= 1200(1.25)(1.0)(1.0)(1.0)(1.0)(1.0)(1.0)(1.0)(1.0) = 1500$ psi

$$f_b = \frac{(28.5\ lb/ft^2)(8')(20')^2(12"/ft)}{8(102.4\ in^3)} = 1336 \text{ psi} < 1500 \text{ psi O.K.}$$

$F_v' = 180(1.25) = 225$ psi

$$f_v = \frac{1.5(28.5\ lb/ft^2)(8')(20')}{2(46.38\ in^2)} = 73.7 \text{ psi} < 225 \text{ psi}$$

O.K.

6.37 CONT

$$\Delta_L < \frac{20'(12)}{240} = 1.0" \qquad \Delta_{TL} \leq \frac{20'(12)}{180} = 1.33"$$

$$\Delta_{TL} = \frac{5(28.5\ k/ft^2)(8')(1/12)(240")^4}{384\,(1.8)(10)^6(678.5\ in^4)} = 0.67" < 1.33" \quad O.K.$$

$$\Delta_L = 0.6721"\left(\frac{20}{28.5}\right) = 0.47" \quad O.K.$$

c) SELECT A 24F-1.8E DF GLULAM, SPAN = 50'

$$w = 10\ psf + L_r \qquad A_t = 1000\ ft^2$$

$L_r = 12\ psf$
$w = 22\ psf = 440\ lb/ft$
$M = \frac{wL^2}{8} = \frac{440\ psf(50)^2}{8} = 137{,}500\ ft\text{-}lb$
$= 1{,}650{,}000\ in\text{-}lb$

$F_b = 2400\ psi \qquad F_v = 240\ psi$
$E = 1.8(10)^6\ psi$

$F'_b = F_b\, C_D\, C_M\, C_t\, C_r\, C_{fu}\, C_c\, C_f \qquad C_v = ?$

USING GLULAM SPAN TABLES – PRELIM SIZE = $6\frac{3}{4} \times 28\frac{1}{2}$ ← TRY
$8\frac{3}{4} \times 25\frac{1}{2}$ FROM G-1.5

$C_v = .806$

$F'_b = 2400(1.25)(1.0)(1.0)(.806)(1.0)(1.0)(1.0) = 2418\ psi$

$f_b = \frac{1{,}650{,}000\ in\text{-}lb}{948.3} = 1740\ psi < 2403$

O.K.

6.37 CONT CHECK $\Delta$

$$\Delta_{TL} = \frac{5(440\ lb/ft)(1/12)(50\times12)^4}{384(1.8)(10)^4(12090)} = 2.84"$$

$L/180 = 3.3"$ O.K

$$\Delta_L = 2.84\left(\frac{12}{22}\right) = 1.55" < \frac{50(12)}{240} = 2.5" \text{ O.K}$$

THE SECTION IS ACCEPTABLE

$$f_v = \frac{440\ lb/ft\ \frac{(50')}{2}}{223.1}(1.5) = 74\ psi < 240\ psi \text{ O.K}$$