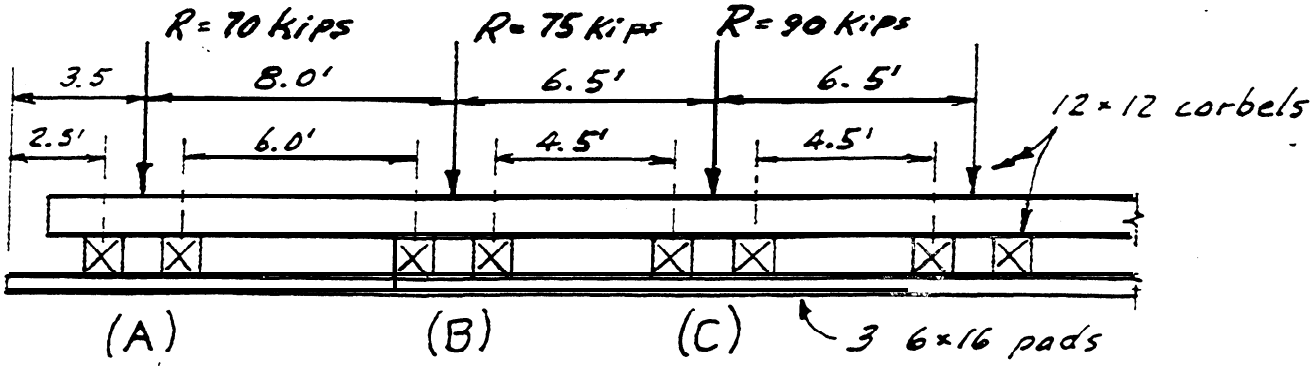
EXAMPLE 13 CONTINUOUS PAD - MULTIPLE CORBELS



$S_{pad} = 288 \text{ in}^3$

R = total vertical load reaction

Allow. soil brg. value = 4000 psf.

Check Exterior Post A [Section 7-2.03C(2)]

1. Calculate effective length of pad

$$L_e = \frac{t}{12} + \frac{S}{P} = \frac{12}{12} + \frac{288}{70} = 5.11'$$

2. Find limiting length on outside of post

Edge distance = 2.50'

$$\frac{0.8L_e}{2} = \frac{0.8(5.11)}{2} = 2.04'$$

Compared values are unequal; therefore, system is asymmetrical for analysis

$L_1 = 2.04'$

3. Find preliminary limiting length on inside of post

$\frac{1}{2}$(corbel spacing) = $\frac{1}{2}(6.0) = 3.00'$

$\frac{1}{2}(L_e) = \frac{1}{2}(5.11) = 2.56' = PL_2$

4. Find fictitious limiting length

Edge distance + m = 2.50 + 2.0 = 4.50'

(m = distance between corbel centerlines)

$\frac{1}{2}(0.8L_e) = \frac{1}{2}(0.8)(5.11) = 2.04 = FL_1$

Post A Continued

5. Calculate ASYM length

From AYSM formula, $L_{ASYM} = 2.40'$

6. Find limiting length on inside of post

PL_2 (step 3) $= 2.56'$

$L_{ASYM} = 2.40' < 2.56'$; $L_2 = 2.40'$

7. Calculate soil pressure

Bearing length $= L_1 + m + L_2$

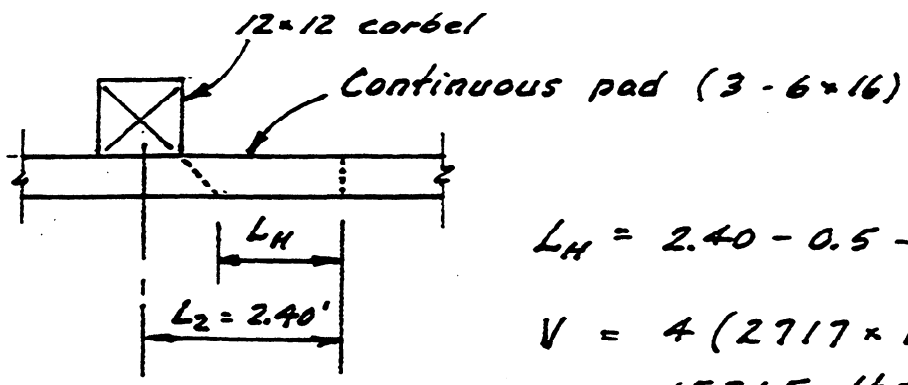
$= 2.04 + 2.00 + 2.40 = 6.44'$

Bearing area $= 4(6.44) = 25.76\ \square'$

Soil pressure $= \frac{P}{A} = \frac{70000}{25.76} = 2717$ psf

$2717 < 4000$ allowable - OK

8. Calculate horiz. shear on long side



$L_H = 2.40 - 0.5 - 0.5 = 1.40'$

$V = 4(2717 \times 1.40)$

$= 15215$ lbs.

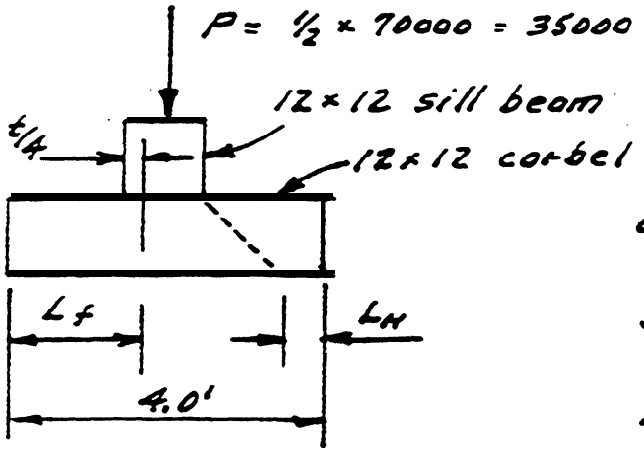
$H = \frac{3V}{2A} = \frac{3(15215)}{2(6 \times 16 \times 3)} = 79$ psi

79 psi < 140 allow. OK

Post A Continued

Check Corbels

Assume total vertical load is distributed equally to the two corbels.



$$w = \frac{35000}{4} = 8750 \text{ lbs/foot}$$

$$S = \frac{(12)(12)^2}{6} = 288 \text{ in}^3$$

$$A = (12 \times 12) = 144 \text{ in}^2$$

1. Calculate compression perpendicular to grain

$$f_c = \frac{P}{A} = \frac{35000}{12 \times 12} = 243 \text{ psi}$$

243 psi < 450 allow. OK

2. Calculate horiz. shear stress

$$L_H = 4.0/2 - 0.5 - 1.0 = 0.5'$$

$$V = 0.5 \times 8750 = 4375 \text{ lbs}$$

$$H = \frac{3V}{2A} = \frac{3(4375)}{2(144)} = 46 \text{ psi}$$

46 psi < 140 psi allow. OK

3. Calculate bending stress

$$L_f = 4.0/2 - 1.0/2 + 1.0/4 = 1.75'$$

$$M = \frac{wL^2}{2} = \frac{(8750)(1.75)^2}{2} = 13398 \text{ ft-lbs}$$

$$f_b = \frac{M}{S} = \frac{(13398)(12)}{288} = 558 \text{ psi}$$

558 psi < 1800 allow. OK

Check Interior Post B [Section 7-2.03C(1)]

1. Calculate effective length of pad

$$L_e = \frac{t}{12} + \frac{S}{P} = \frac{12}{12} + \frac{288}{75} = 4.84'$$

2. Find limiting length on short (right) side

$$\frac{L_e}{2} = \frac{4.84}{2} = 2.42'$$

$$\frac{\text{corbel spacing}}{2} = \frac{4.50}{2} = 2.25' = L_1$$

Compared values are unequal; therefore, system is asymmetrical for analysis.

3. Find fictitious limiting length

$\frac{1}{2}$ corbel spacing + m = 2.25 + 2.00 = 4.25

(m = distance between corbel centerlines)

$L_e/2$ (from step 2) = 2.42' = FL_1

4. Calculate ASYM length

From ASYM formula, $L_{ASYM} \doteq 2.40'$

5. Find limiting length on long side

$\frac{1}{2}$ corbel spacing = $\frac{1}{2}$ (6.0) = 3.00'

L_{ASYM} = 2.40' = L_2

6. Calculate soil pressure

Bearing length = $L_1 + m + L_2$

= 2.25 + 2.00 + 2.40 = 6.65'

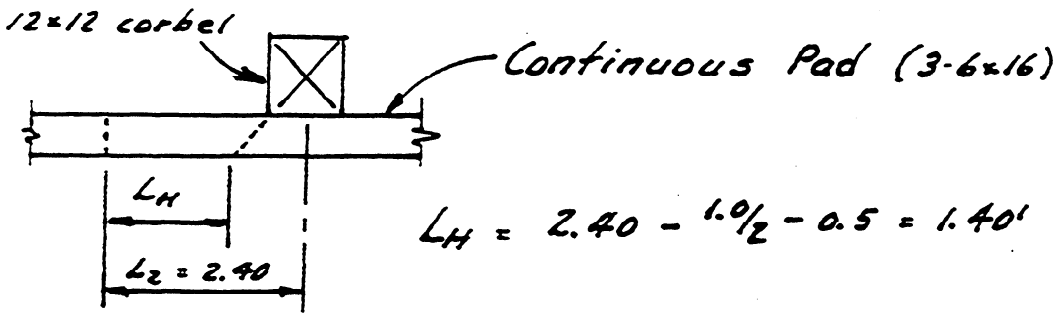
Bearing area = 4 (6.65) = 26.6 $\square'$

$$\text{Soil pressure} = \frac{P}{A} = \frac{75000}{26.6} = 2820 \text{ psf}$$

2820 < 4000 allowable - OK

Post B Continued

7. Calculate horiz. shear stress on long side



$L_H = 2.40 - 1.0/2 - 0.5 = 1.40'$

$V = 4(2820)(1.40) = 15792$ lbs.

$$H = \frac{3V}{2A} = \frac{3(15792)}{2(6 \times 16 \times 3)} = 82 \text{ psi}$$

82 psi < 140 allowable - OK

Check Corbels

Corbels are OK by inspection.

(Note: Post B corbel is same as Post A corbel; therefore, stresses are proportional to the applied load. Critical stress is $C_\perp$ so that:

$C_\perp$ (Post B) = $75/70$ (243) = 260 psi)

Check Interior Post C [Section 7-2.03C(1)]

1. Calculate effective length of pad

$$L_e = \frac{t}{12} + \frac{S}{P} = \frac{12}{12} + \frac{288}{90} = 4.20'$$

2. Find limiting length

$$\tfrac{1}{2} \text{ corbel spacing} = \tfrac{1}{2}(4.5) = 2.25'$$

$$L_e/2 = 4.20/2 = 2.10' = L_1 = L_2$$

3. Calculate soil pressure

$$\text{Bearing length} = L_1 + m + L_2$$

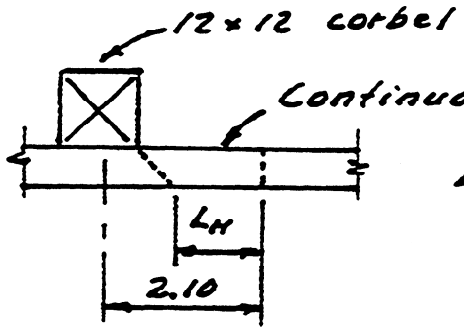
$$= 2.10 + 2.00 + 2.10 = 6.20'$$

(m = distance between corbel centerlines)

$$\text{Bearing area} = 4(6.20) = 24.8\ \square'$$

$$\text{Soil pressure} = \frac{P}{A} = \frac{90000}{24.8} = 3629 \text{ psf}$$

4. Calculate horiz. shear stress



$$L_H = 2.10 - 1.0/2 - 0.5 = 1.10'$$

$$V = 4(3629 \times 1.1) = 15968 \text{ lbs}$$

$$H = \frac{3V}{2A} = \frac{3(15968)}{2(6 \times 16 \times 3)} = 83 \text{ psi}$$

83 psi < 140 allowed <u>OK</u>

Check Corbels

Corbels OK by inspection

(See page D-13-5. $C_L = 90/70\,(243) = 312$ psi.)