

# Structural Calculations Supplemental Calculations

Revised Exterior Deck Calculations

## Muller-Dhillon Residence

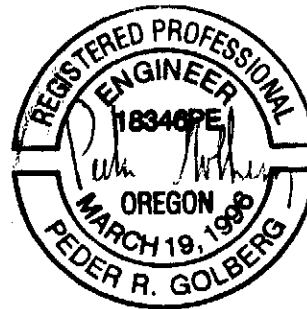
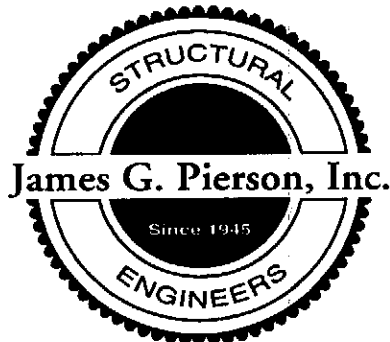
3425 SW Heather Lane  
Portland, Oregon 97201

for

**William J. Hawkins III**

**Architect FAIA**

1425 Southwest 20<sup>th</sup> Ave..  
Portland, Oregon 97201



EXPIRES: JUNE. 30, 07

*James G. Pierson, Inc.*

Consulting Structural Engineers

320 S.W. STARK SUITE 535 PORTLAND, OR. 97204  
(503) 226-1286 FAX 226-3130

June 15, 2006

**Addition and Alteration for  
Roger Muller & Daisy Dhillon  
Portland, Oregon 97201**

Structural Calculations are provided herein for the modifications to the exterior decks at the Muller and Dhillon residence located at 3425 SW Heather Lane in Portland, Oregon. The techniques and principles of structural analysis used for these calculations conform to generally accepted standards of the engineering community. The design is performed in accordance with our understanding of the 2005 Oregon Residential Specialty Code (Oregon version of the International Residential Code) and the 2003 Oregon Structural Specialty Code.

These calculations have been prepared based upon architectural drawings by William Hawkins Architects. The final drawings, and conformance to the structural recommendations of these calculations, are the responsibility of William Hawkins Architects.

**GENERAL PROJECT SCOPE DISCUSSION:**

This project consists of remodeling the main floor and adding a 2<sup>nd</sup> floor (with new roof) plus a new deck .

**STRUCTURAL DESIGN PARAMETERS**

Deck Uniform Dead Load (tile)	40 PSF
Deck Uniform Live Load	40 PSF
Foundation Bearing Pressure	1500 PSF
Seismic Forces	Site Class D1
Wind Forces	100 MPH Exposure B

## MULLER DECK CHECK AND CONNECTION DETAILS

## LOWER DECK CALCULATIONS

## CHECK 2x10 JOISTS @ 16" OC

$$L = 40 \text{ psf}$$

$$D = 40 \text{ psf}$$

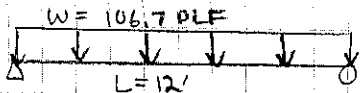
$$A_T = \left(\frac{16'}{12}\right)(12') = 16 \text{ SF}$$

$$W = (D + L)(W_T) = (40 + 40)\left(\frac{16'}{12}\right) = 106.7 \text{ PLF}$$

$$V = \frac{WL}{2} = \frac{(106.7 \text{ PLF})(12 \text{ LF})}{2} = 640 \#$$

$$M = \frac{WL^2}{8} = \frac{(106.7 \text{ PLF})(12 \text{ LF})^2}{8} = 1920.6 \text{ FT}\#$$

$$f_v = \frac{VQ}{I\bar{z}} = \frac{3V}{2A} = \frac{3(640 \#)}{2(15.44 \text{ in}^2)} = 62.2 \text{ PSI} \leq F_v' = F_v(C_D \times C_M \times C_T \times C_i)$$



$$\Delta = \frac{5WL^4}{384EI} = \frac{(106.7 \text{ PLF})\left(\frac{16'}{12}\right)(12 \cdot 12)^4}{384(1600000)(98.93)} = 0.0629 \text{ in}$$

$$\Delta = 0.315'' \leq \frac{L}{240} = 0.6 \text{ in} \quad \text{OK}$$

$$f_b = \frac{M}{S_x} = \frac{(1920.6 \text{ FT}\#)(12)}{(24.44 \text{ in}^3)} = 943.0 \text{ PSI} \leq F_b' = F_b(C_D \times C_M \times C_T \times C_L \times C_F \times C_{Fu} \times C_i \times C_r \times C_F)$$

$$= 95 \text{ PSI} (1.0 \times 1.0 \times 1.1 \times 1.0) = 104.5 \text{ PSI} \quad \text{OK}$$

$$= 1340 (1 \times 1 \times 1 \times 1 \times 1.1 \times 1 \times 1 \times 1.15 \times 1) = 1695.1 \text{ PSI} \quad \text{OK}$$

## CHECK 5'8" x 12" GLULAM BEAM

$$L = 40 \text{ psf}$$

$$D = 40 \text{ psf} + \text{DL JOISTS} = 40 + \frac{(4.07 \text{ PLF})(10)(12 \text{ LF})}{(12' + 13.625')} = 59 \text{ PSF}$$

$$A_T = (6')(13.625') = 81.75 \text{ SF}$$

$$W = (D + L)(W_T) = (40 + 59)(6') = 594 \text{ PLF}$$

$$V = \frac{(594 \text{ PLF})(13.625 \text{ LF})}{2} = 4046.6 \#$$

$$M = \frac{(594 \text{ PLF})(13.625 \text{ LF})^2}{8} = 13783.8 \text{ FT}\#$$

$$f_v = 98.7 \text{ PSI} \leq F_v' = F_v(C_D \times C_M \times C_T) = (240)(1.0 \times 1.0 \times 1.0) = 240 \text{ PSI} \quad \text{OK}$$

$$f_b = 1344.8 \text{ PSI} \leq F_b' = F_b(C_D \times C_M \times C_T \times C_L \times C_V \times C_{Fu} \times C_c \times C_F)$$

$$= (2000)(1.0 \times 1.0 \times 1.0 \times 1.0 \times 1.0 \times 1.0 \times 1.0 \times 1.0) = 2000 \text{ PSI} \quad \text{OK}$$

$$C_V = \left(\frac{21}{13.625}\right)^{1/10} \left(\frac{12''}{12''}\right)^{1/10} \left(\frac{5.125''}{5.125''}\right)^{1/10} = 1.04 \leq 1.0$$

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Project  
MULLER DECK

Location

Client  
HAWKINS

Job no.

Date  
06-13-06

Sheet no.

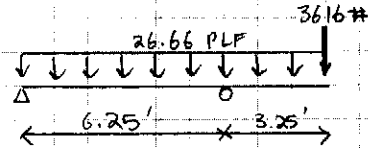
1

CHECK 3/8" x 12" GLULAM BEAM

$L = 40 \text{ PSF}$   
 $D_{PL} = (\frac{1}{2})(40 \text{ PSF})(163.5 \text{ SF}) + \frac{1}{2}(40 \text{ PLF})(10)(12 \text{ LF}) + \frac{1}{2}(14.95 \text{ PLF})(13.625) = 3616 \#$   
 $A_T = (\frac{8}{12})(9.5') = 6.33 \text{ SF}$   
 $W = L W_T = (40 \text{ PSF})(\frac{8}{12}) = 26.66 \text{ PLF}$

$$\Delta = \frac{Pa}{3EI} (L+a) = \frac{(3616\#)(3.25 \times 12)^2}{3(1.7E6)(450)} (9.5) = 0.023 \text{ in}$$

$$\Delta = 0.023 \text{ in} \leq \frac{L}{240} = 0.48 \text{ in} \quad \text{OK}$$

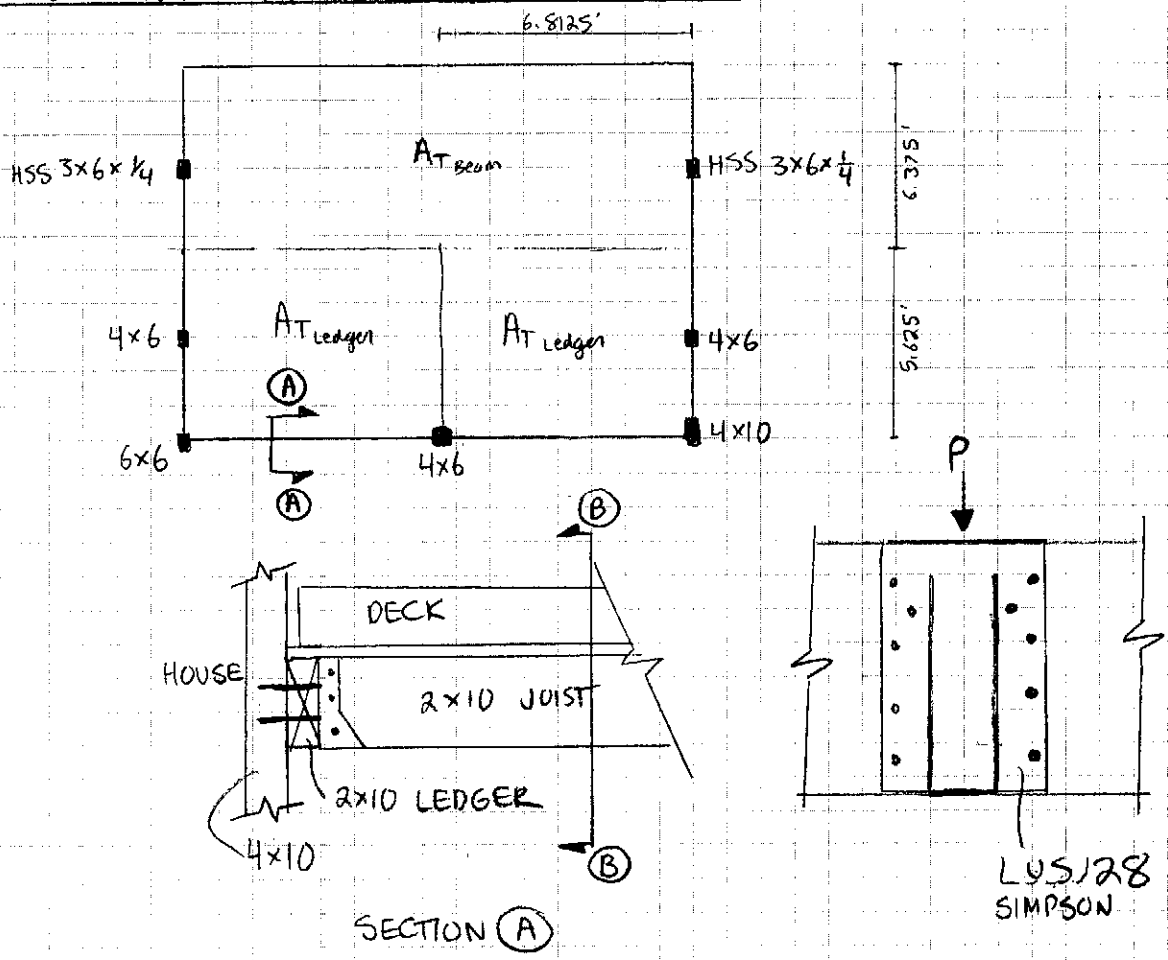


VALUES FROM ENERAC  
SEE PRINT-OUT IN BACK

$$f_v = 147.1 \text{ PSI} \leq F'_v = 276.0 \text{ PSI} \quad \text{OK}$$

$$f_b = 1903.1 \text{ PSI} \leq F'_b = 2300.0 \text{ PSI} \quad \text{OK}$$

CHECK LEDGER CONNECTION TO JOISTS AND HOUSE



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	Location		Date
	Client	HAWKINS	Sheet no.
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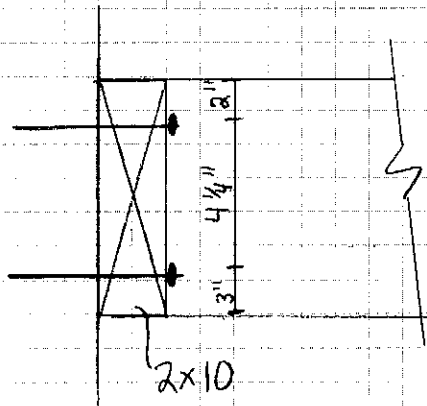
TO CONNECT JOISTS TO LEDGER,  
 USE SIMPSON HANGER LUS 28  
 3-10d JOIST NAILS  
 6-10d FACE NAILS

$$W = (59 \text{ PSF})(6 \text{ LF}) = 354 \text{ PLF}$$

SDS  $\frac{1}{4} \times 4\frac{1}{2}$  SIMPSON WOOD SCREWS  $\rightarrow V_{CAPAC} = 240 \# \text{ ea}$

NEED 2 SCREWS PER LINEAR FOOT OF LEDGER  
 USE 4 SCREWS FOR INCREASED F.S.  
 NOT A WITHDRAWAL CONNECTION

USE (5) SDS  $\frac{1}{4} \times 4\frac{1}{2}$  SIMPSON WOOD SCREWS  
 PER 16 INCHES OF LEDGER TO CONNECT  
 LEDGER TO HOUSE. TOTAL (51) SCREWS, STAGGER. ::::



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	Location		Date
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UPPER DECK CALCULATIONS

CHECK 2x8 JOISTS @ 16" OC

$$A_T = \left(\frac{16}{12}\right)(9.75') = 13 \text{ SF}$$

$$W = (40+40)\left(\frac{16}{12}\right) = 106.7 \text{ PLF}$$

$$V = 520.2 \text{ \#}$$

$$M = 1267.9 \text{ FT\#}$$

$$f_v = \frac{3(520.2)}{2(12.19)} = 64 \text{ PSI} \leq F_v' = (95 \text{ PSI})(1.0 \times 1.0 \times 1.0 \times 1.0) = 95 \text{ PSI} \quad \text{OK}$$

$$f_b = \frac{(1267.9)(12)}{(15.23)} = 1000 \text{ PSI} \leq F_b' = (1240 \text{ PSI})(1.0 \times 1.0 \times 1.0 \times 1.0 \times 1.1 \times 1.0 \times 1.0 \times 1.15 \times 1) = 1568 \text{ PSI} \quad \text{OK}$$

CHECK 5 1/8" x 12" GLULAM BEAM

OK BY ENGINEERING JUDGEMENT. SEE P1 OF CALCS.

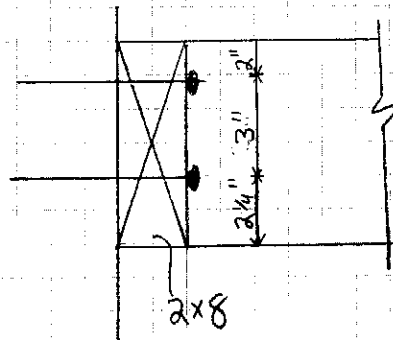
CHECK 3 1/8" x 12" GLULAM BEAM

OK BY ENGINEERING JUDGEMENT. SEE P2 OF CALCS.

CHECK LEDGER CONNECTION TO JOISTS AND HOUSE

TO CONNECT JOISTS TO LEDGER,  
USE SIMPSON HANGER LUS 28  
16-10d FACE NAILS  
3-10d x 1 1/2 JOIST NAILS

TO CONNECT LEDGER TO HOUSE,  
USE (5) SDS 1/4 x 4 1/2 SIMPSON  
WOOD SCREWS, (5) @ 16" STAGGER



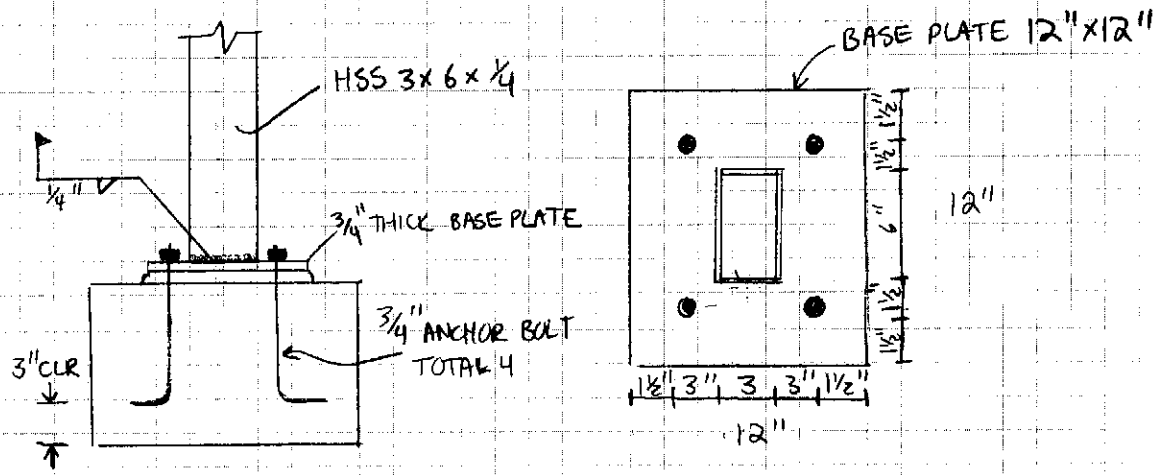
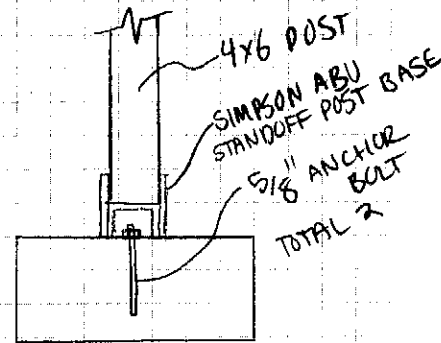
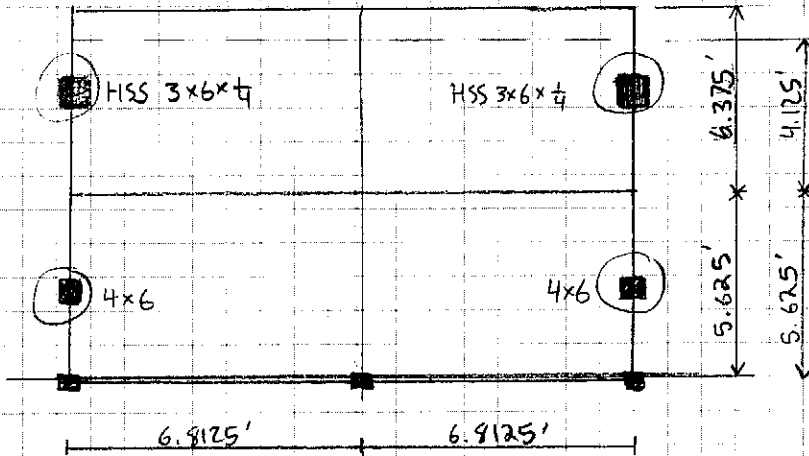
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Project	MULLER DECK	Job no.
Location		Date
Client	HAWKINS	06-13-06
		Sheet no.
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TRENCH FOOTING

ASSUME 1500 PSF BEARING CAPACITY



- DL DECK = 40 PSF
- LL DECK = 40 PSF
- DL 2x10 = 4.07 PLF
- DL 5 1/8" x 12" GLULAM = 14.95 PLF
- DL 3 1/8" x 12" GLULAM = 6.84 PLF
- DL 2x8 = 3.22 PLF

$$\begin{aligned}
 P_{HSS} &= \left[ \begin{array}{l} \text{MAIN LEVEL} \\ (40 \text{ PSF})(6.8125')(6.375) + (40)(6.8125')(4.125) \end{array} + \begin{array}{l} \text{SECOND LEVEL} \\ (3.22)(5)(4.125) + (14.95)(4.125) + (6.84)(4.125) \end{array} \right] 2 \\
 &= (40.07)(5)(6.8125) + (6.84)(6.8125) = 6165.9\# = 3304.7\#_{(L)} + 2861.3\#_{(DL)} \\
 P_{4x6} &= \left[ (40.5.625)(6.8125) + (4.07)(5)(6.8) + (6.84)(6.8) \right] 4 \\
 &= 6316.6\# = 3251.0\#_{(L)} + 3065.6\#_{(DL)}
 \end{aligned}$$

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	Location		Date
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$$\text{NET SOIL PRESSURE } q_n = \frac{P}{A_{\text{FTG}}} \rightarrow A_{\text{FTG}} = \frac{D+L}{q_n}$$

ACI LOAD COMBINATIONS FOR FOOTING DESIGN:  $U = 1.2D + 1.6L$  (ACI 9-2)

HSS 6x3x1/4 POST FOOTING:

$$A_{\text{FTG, MIN}} = \frac{1.2(2861.3\#) + 1.6(3304.7\#)}{1500 \text{ psf}} = 5.8 \text{ SF}$$

USE 2.5' x 2.5' x 1.0' CONC. FTG. FOR HSS 6x3x1/4 POSTS

4x6 POST FOOTING:

$$A_{\text{FTG, MIN}} = \frac{1.2(3065.6\#) + 1.6(3251.0\#)}{1500 \text{ psf}} = 5.9 \text{ SF}$$

USE 2.5' x 2.5' x 1.0' CONC. FTG. FOR 4x6 POSTS

FOOTING REINFORCEMENT

USE 3-#4 x 2'-0" TRANSVERSE, AND  
3-#4 x 2'-0" LONGITUDINAL REINFORCING

(SEE FOOTING DETAILS FOR DRAWING)

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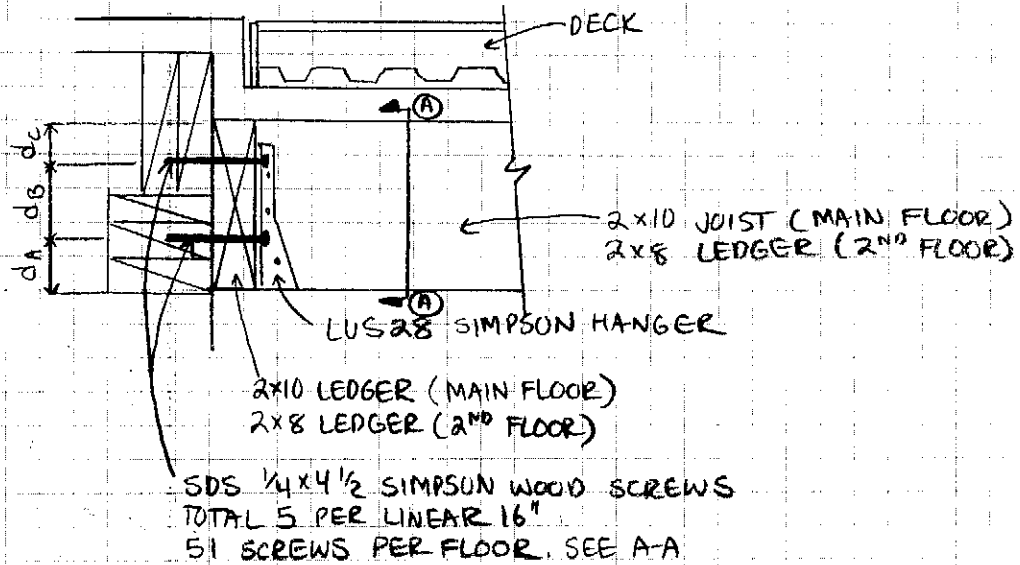
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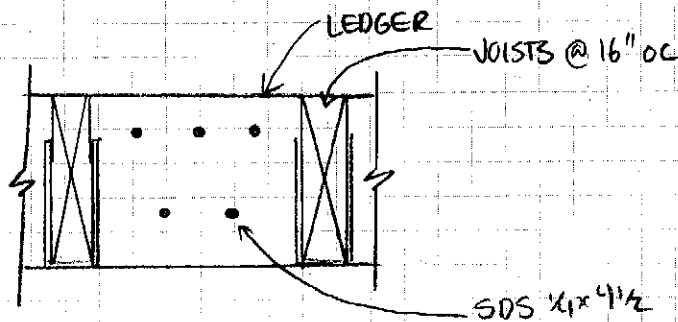
Project	MULLER DECK	Job no.
Location		Date
Client	HAWKINS	Sheet no. 6



LEDGER CONNECTION DETAILS



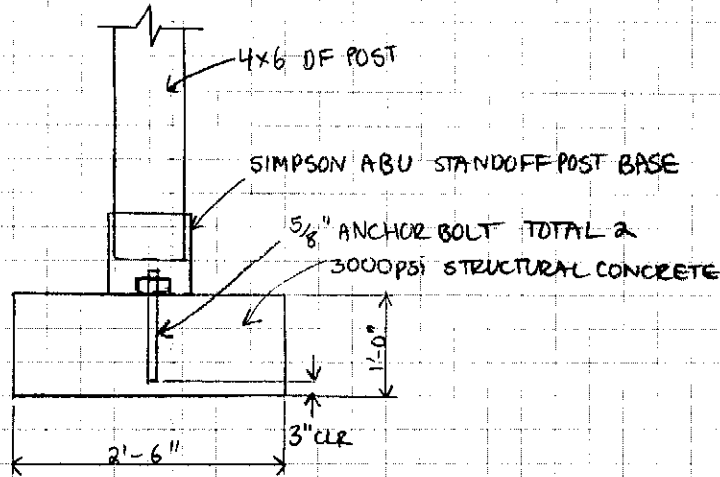
	dA	dB	dC
MAIN FLOOR	3"	4 1/2"	2"
2ND FLOOR	2 1/4"	3"	2"



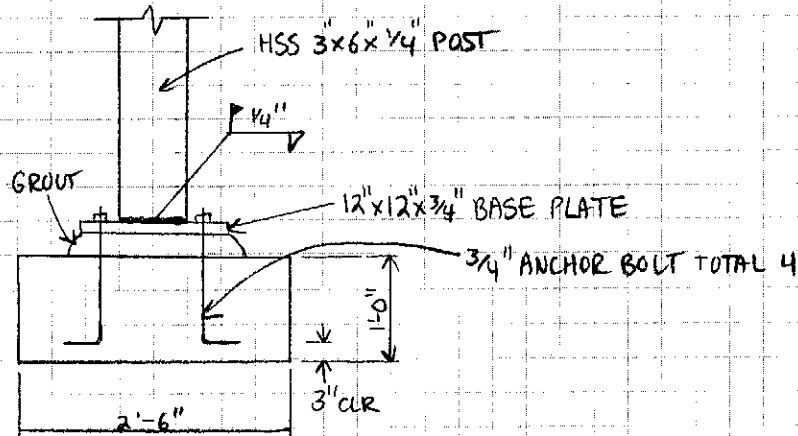
SECTION A-A

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	Location		Date 06-14-06
	Client	HAWKINS	Sheet no. A

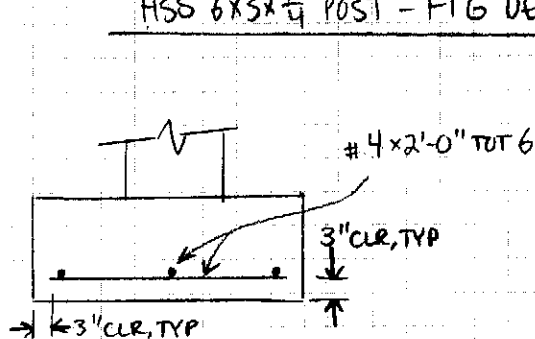
FOOTING DETAILS



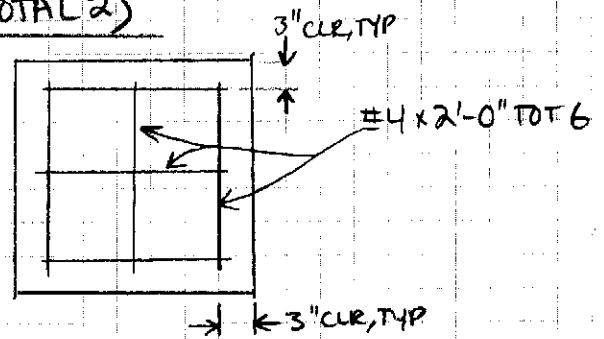
4x6 DF POST - FTG DETAIL (TOTAL 2)



HSS 3x6x1/4 POST - FTG DETAIL (TOTAL 2)

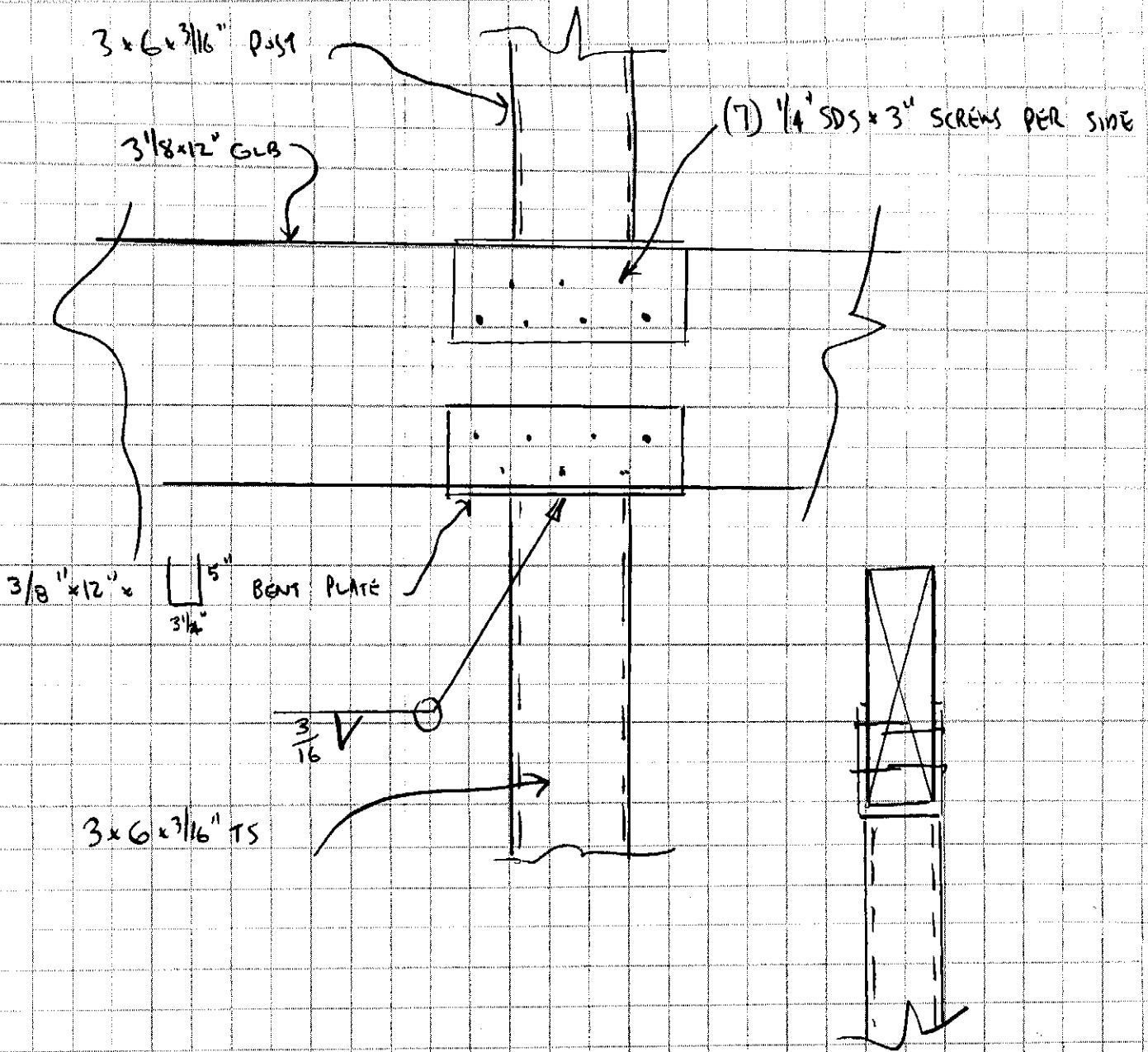


FTG - ELEVATION



FTG - PLAN VIEW

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	Location	Date 06-14-06
	Client HAWKINS	Sheet no. B



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Project

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Location

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Date

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