

Final Structural Condition Assessment  
West Sand Lake Fire District No. 1  
West Sand Lake, New York

Appendix C  
Sample Calculations

LOADING PARAMETERS

FIREHOUSE :

- BC-NYS (new construction)

Occupancy Category IV "Essential Facility"

$I_s = 1.2$   
 $I_w = 1.15$   
 $I_g = 1.5$

} "IMPORTANCE FACTORS"

$V = 90$  MPH WIND VELOCITY  
 $p_g = 40$  psf GROUND SNOW LOAD

- SNOW PARAMETERS

$C_e = 0.9$

$C_t = 1.0$

$P_f = .7 C_t C_e I_s p_g = .7(0.9)(1.0)(1.2)(40) = 30.24$  psf

NO UNBRANDED LOAD REQD.

- WIND PARAMETERS

EXPOSURE B - SUBURBAN, METHOD I, ASCE 7, FIG. 6-2

WALLS:  $w_{115} = 8.5$  psf  $(1.2) = 10.2$

ENDWALLS =  $12.8$  psf  $(1.2) = 15$

- SEISMIC

LATITUDE =  $42.013413^\circ$  LONG =  $73.608727^\circ$

$S_a = .227g$   $S_i = .068g$   $F_a = 1.2$   $F_v = 1.7$

SITE CLASS C ASSUMED

$S_{MS} = .2724g$   $S_{M1} = .1156g$   $S_{D5} = .1016g$   $S_{D1} = .077$

SEISMIC DES CAT = C  $C_s = S_{D5}/e_{11} = .1016g/(3/15) =$

9.1% DEAD = EQUIV. LAT FORCE

LOADING PARAMETERS (CONT.)

• FIREHOUSE (CONT.)

$$W = f(30\%SL + DL) = (.3(30) + 4) = 13$$

$$\text{SEISMIC WEIGHT} \approx 80' \times 60' \times 13 = 62.4 \text{ K}$$

$$\text{BASE SHEAR} \approx W C_s (.7)_{ASD} = 3.97 \text{ K}_{ASD}$$

(EQUATES TO  $\approx 4.14$  PSF)

$$\text{Area wall} = \frac{H}{W} \times 60 = 960 \text{ SF}$$

• EXISTING BUILDING CODE (APPLICABLE UNLESS OCCUPANCY CAT MODIFICATION)

• SNOW • (USE 1973 CODE)  $p_g = 45 \text{ psf}$   $p_f = 45 \text{ psf}$   
TAB. C 304.3

• WIND • 15 PSF TAB. C 301.4a

MUSEUM / COMMUNITY HALL

BC-NYS - EXISTING CONSTRUCTION = 45 PSF Level  
20.6 PSF @ 12 slope

BC-NYS - NEW CONSTRUCTION

$p_g = 40 \text{ psf}$  Occ Cat II  $I_s = 1.0, I_q = 1.0, I_w = 1.0$   
UNLESS USE CHANGES

$C_e = .9$   $C_t = 1.0$

$p_f = .7 C_e C_t I_p p_g = .7 (.9) (1.0) 40 = 25.2 \text{ PSF}$

SLIDING SNOW LOAD =  $.4 p_f W = .4 (25.2) (5.5/2) = 78.12$   
 $78.12 (13.3/15) = 69$   
 $69 / 13.3 = 5.18 \text{ psf ADPL}$   
DUE TO SLIDING

BALANCED SL =  $25.2 + 5.18 = 30.3 \text{ psf} \pm$

LIVELOAD = 100 PSF @ MUSEUM (ACCESS) ) NEW AND  
= 50 PSF @ OFFICE ) EXISTING BC  
125 PSF @ STORAGE

LOADING PARAMETERS (CONT.)

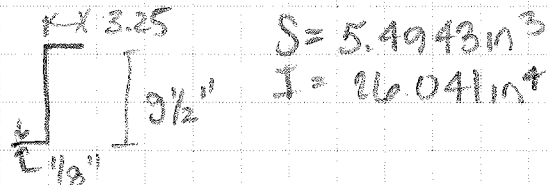
◦ RESIDENCE:

LL = 40 PSF LIVING SPACES (1ST FL)  
 LL = 30 PSF SLEEPING ROOMS (2ND FL)  
 LL = 50 PSF (IF CONVERTED TO OFFICE)

◦ STRENGTH CALCULATIONS

◦ FIREHOUSE:

◦ purlins @ 5'-0" OC



$$M_{all} = .66 F_y S = .66(36) 5.49 = 130.5 \text{ k}$$

$$M = wL^2/9 = w(20)^2/9 \times 5' \div 1000 \times 12 = 130.96$$

$w \leq 48.9 \text{ PSF CAPACITY}$

|            |    |     |                        |
|------------|----|-----|------------------------|
|            | LL | DL  |                        |
| OLD CODE = | 15 | + 3 | = 18 $\approx$ 48.9 OK |
| NEW CODE = | 26 | + 3 | 29 $\leq$ 48.9 OK      |

STRENGTH CALCULATIONS (CONT.)

MUSEUM:

2ND. FLOOR JOISTS

|    |          |           |
|----|----------|-----------|
| DL | FLOORING | 1         |
|    | Plywood  | 2         |
|    | JOISTS   | 1         |
|    | CEILING  | 2         |
|    | MEP      | 4         |
|    |          | <u>10</u> |

10 PSF

LL = 50 PSF (BC NEW OR EXIST)  
OFFICE SPACE

WEST SPAN

$f_b$  OLD WOE = 1450 FOR NORMAL DURATION, Durofire #2

$1.5 \times 7 @ 16" OC$   $S_x = 12.25 in^2$  SPAN = 15'

$w = (10 DL + 50 LL) 16/12 = 80 pif$

$M = wl^2/8 = 2250 in^2$

$f_b = M/S = 2204 psi$

$\bar{f}_b = 1450(1.15) = 1667$  EXIST BC 132%  
= 977.5 psi NEW BC 225% } NO GOOD

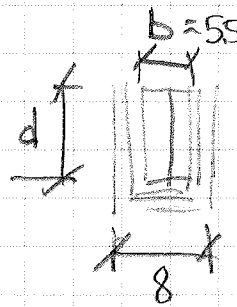
EAST SPAN

$2 \frac{3}{4} \times 7.5 @ 16" CC$   $S_x = 25.78 in^2$  SPAN = 12'

$w = 80 pif$   $M = wl^2/8 = 1440 in^2$   $V = 480 \#$

$f_b = M/S = 670 psi$   $f_v = 3V/2bd = 39.9 psi$

$\bar{f}_b = 1.15(1450) = 1667 > 670$  EXIST BC  
=  $1.15(1.15)(850) = 1124 > 670$  NEW BC



2ND FLOOR STEEL BEAMS

ASSUME: W8x18 S: 15.2 SPAN = 15'

$w = 10(15) DL + 50(15) LL = 900 pif$

$M = wl^2/8 = 900(15)^2/8 = 25312 in^2 = 303.75 in^2$

$M_{ALL} = F_b S_x = .66(36)15.2 = 361.15 in^2 > 303.75 in^2$  (OK)

Result - USING 125 PSF IN STORAGE -  $w/3 \times 8$   $f_b = \frac{M}{S} = \frac{135(16)(15)^2}{12 \times 8 / 25.70} = 2359 psi$  (NB)

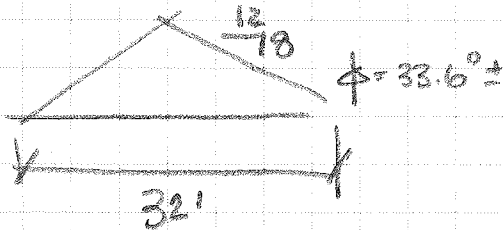
STRENGTH CALCULATIONS (CON.)

MUSEUM:

Basement  $b_f = 5.75''$  : try W5x16 very conservative  
 $S = 8.51$  Max = 202  $M = (70DL + 100) 59'' / (2(12) / 8)$   
 $= 151''k < 202$  : OK

COMMUNITY HALL:

Roof Trusses



DL = BC metal 1  
 ply 2.4  
 Surf 1  
4.9 = 5 psf

TC SW 1  
 Cell 1  
 MEP 2  
 INSUL 1  
5.0 psf

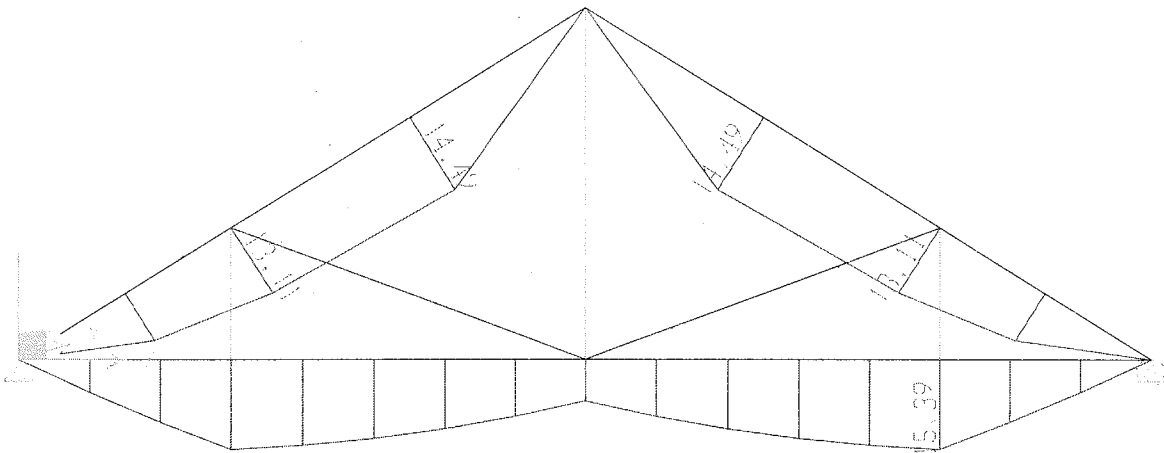
SNOW EX, BC = 20.68 psf (1973 TAB. C 304.3)

ACTUAL CONDITIONS

SPF GRADE #2, 1/4" LA Stamp observed  
 $F_b = C_r C_D C_F F_b = 1.15(1.15)(1.3/875) = 1509 \text{ psi}$   
 $M_{all} = F_b S_x = 1509(1.15)(5.5)^2 / 6 = 11.37''k$

ETABS RESULT ( @ 20.68 psf,  $M_{actual} = 11.99''k$  , 27% overstrength

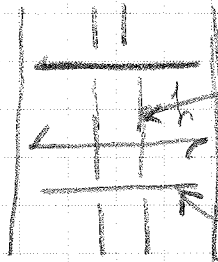
WSLFD 1101  
p. C6 of C7  
NEW 3/6/02



SCALE \_\_\_\_\_

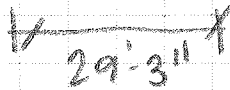
STRENGTH CALCULATIONS (CONT.)

COMMUNITY HALL:



$D = 57/8, w = 31/4, t_f = 1/8$  assume 6" AM. STD. HIST. SHAPE  
 $S = 6.92 @ 7.5'$

$D = 15 1/16, w = 5.45, t_f = .45$  assume 15" AM. STD. BM.  
 $S = 56.6 in^3 @ 9'-0" OC$

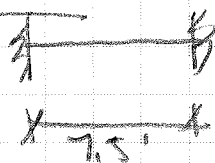


LOADS:

- DL = FLOOR FINISH 1.0
- 1" DECK 2.0
- ONCEWAY 5.0
- M&P 4.0
- SW 3.0

15 PSF DL + 100 LL

JOISTS:



$$M = wL^2/9 = 2(15+100)(7.5)^2/9 = 19375 \text{ in-lb} = 17250 \text{ in-lb}$$

$$V = 3V/2bd = 3(386)/2(25)(7.5) = 29 \text{ psi OK by insp.}$$

$$f_b = M/S = 17250 / (25 \cdot 7.5^2/12) = 736 \text{ @ by insp.}$$

$$F_b = C_D C_t C_F f_b = 1.0(1.15)(1.2)850 = 1173 > 736 \text{ @}$$

DOUBLE FIRE R 2 required

BEAMS

6" STD.

$$w = 115(7.5) = 862.5 \text{ plf}$$

$$M = wL^2/8 = 862.5(9)^2/8 = 8732.8 \text{ in-lb} = 104.79 \text{ in-lb}$$

$$M_{all} = .66 F_y S = .66(36)6.92 = 164 \text{ in-lb} > 104 \text{ @}$$

CROSSERS

15" STD.

$$w = 115(9) = 1035 \text{ plf}$$

$$M = wL^2/8 = 1035(22.25)^2/8 = 110688 \text{ in-lb} = 1328 \text{ in-lb}$$

$$M_{all} = .66 F_y S = .66(36)48.7 = 1349 \text{ in-lb} > 1328 \text{ @}$$