



**MULHERN+KULP**  
RESIDENTIAL STRUCTURAL ENGINEERING

7220 Trade Street, Suite 295, San Diego, CA 92121 ▶ p 619-650-0010 ▶ [mulhernkulp.com](http://mulhernkulp.com)

# CALCULATION PACKAGE

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May 12, 2023

LNL Builds

2430 74<sup>th</sup> Ave SE

Mercer Island,  
Washington

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MULHERN & KULP STRUCTURAL ENGINEERING, INC.

Prepared By:

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*Project Engineer*

**Nicholas J. Martignetti, P.E.**

*Associate Owner + San Diego Office Director*



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*Signature, Seal & Date*



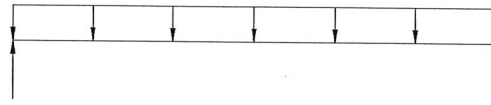
**BEAM & HEADER CALCULATIONS**

BEAM DESCRIPTION: **74P. ROOF RAFTERS**

B1

PARAMETERS:

L = 9.42 FT  
W = 0.08 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 0.30$  K      $V_D =$  [ ] K      $< V_{ALL} = 1.94$  K      ADEQUATE  
 $M_{MAX} = 0.89$  K-FT      $< M_{ALL} = 2.96$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.062$  IN.      $L/9994 < L/240$       ADEQUATE

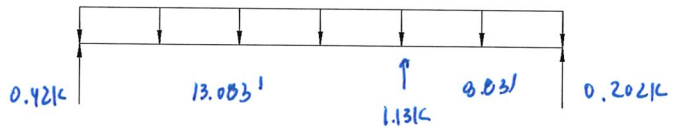
HEM-FIR #2 2x12 @ 24" O.C.

BEAM DESCRIPTION: **ROOF RAFTER (TWO-SPAN)**

B2

PARAMETERS:

L = VAMEI FT  
W = 0.08 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 1.13$  K      $V_D =$  [ ] K      $< V_{ALL} = 1.94$  K      ADEQUATE  
 $M_{MAX} = 7.34$  K-FT      $< M_{ALL} = 2.96$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.124$  IN.      $L/9994 < L/240$       ADEQUATE

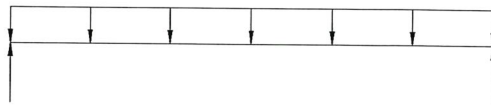
HEM-FIR #2 2x12 @ 24" O.C.

BEAM DESCRIPTION: **ROOF BEAM @ BED 3**

B3

PARAMETERS:

L = 18.25 FT  
W = 0.367 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 3.35$  K      $V_D =$  [ ] K      $< V_{ALL} = 13.469$  K      ADEQUATE  
 $M_{MAX} = 15.3$  K-FT      $< M_{ALL} = 30.36$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.64$  IN.      $L/340 < L/240$       ADEQUATE

DF-DF 24F-V4 5 1/2" x 12" GLB



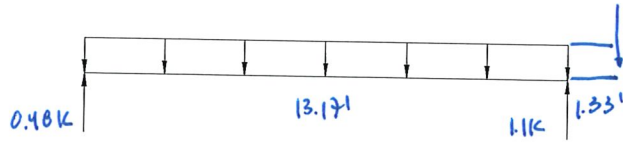
**BEAM & HEADER CALCULATIONS**

BEAM DESCRIPTION: FLWH BM @ LAUNDRY / HALL (LANTID)

B4

PARAMETERS:

L =  FT  
W =  KLF  
P =  K



ANALYSIS:

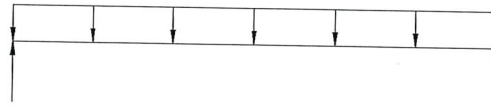
$R_{MAX} =$  K  $V_D =$  K  $< V_{ALL} =$  K  ADEQUATE  
 $M_{MAX} =$  K-FT  $< M_{ALL} =$  K-FT  ADEQUATE  
 $\Delta_{TL} =$  IN.  $L/$   $< L/240$   ADEQUATE

BEAM DESCRIPTION: FLWH BM @ HALL

B5

PARAMETERS:

L =  FT  
W =  KLF  
P =  K



ANALYSIS:

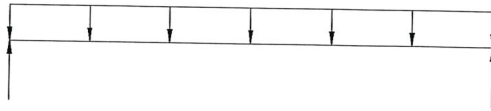
$R_{MAX} =$  K  $V_D =$  K  $< V_{ALL} =$  K  ADEQUATE  
 $M_{MAX} =$  K-FT  $< M_{ALL} =$  K-FT  ADEQUATE  
 $\Delta_{TL} =$  IN.  $L/$   $< L/240$   ADEQUATE

BEAM DESCRIPTION: HIGH WINDOW HALL @ BED 2

B6

PARAMETERS:

L =  FT  
W =  KLF  
P =  K



ANALYSIS:

$R_{MAX} =$  K  $V_D =$  K  $< V_{ALL} =$  K  ADEQUATE  
 $M_{MAX} =$  K-FT  $< M_{ALL} =$  K-FT  ADEQUATE  
 $\Delta_{TL} =$  IN.  $L/$   $< L/240$   ADEQUATE



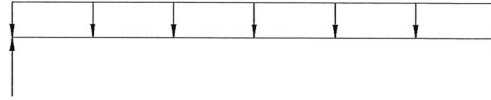
**BEAM & HEADER CALCULATIONS**

BEAM DESCRIPTION: INT. HORIZ @ W/L / BATH / PRIMARY

B7

PARAMETERS:

L = 2.03 FT  
W = 0.565 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 0.0$  K      $V_D =$  [ ] K      $< V_{ALL} = 3.502$  K      ADEQUATE  
 $M_{MAX} = 0.57$  K-FT      $< M_{ALL} = 3.438$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.004$  IN.      $L/1991$       $< L/240$       ADEQUATE

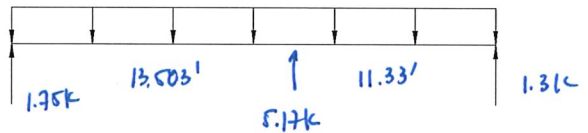
DF-L NO.2 4x8 HDR

BEAM DESCRIPTION: ROOF RIDGE @ PRIMARY (2-SPAN CONT.)

B8

PARAMETERS:

L = Varies FT  
W = 0.330 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 5.17$  K      $V_D =$  [ ] K      $< V_{ALL} = 5.434$  K      ADEQUATE  
 $M_{MAX} = 6.56$  K-FT      $< M_{ALL} = 7.004$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.19$  IN.      $L/859$       $< L/240$       ADEQUATE

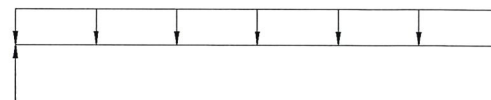
DF-L NO.2 4x12 RIDGE

BEAM DESCRIPTION: TYP. EXT. HDR @ 2ND FLR

B9

PARAMETERS:

L = 8.0 FT  
W = 0.193 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 0.773$  K      $V_D =$  [ ] K      $< V_{ALL} = 3.502$  K      ADEQUATE  
 $M_{MAX} = 1.55$  K-FT      $< M_{ALL} = 3.438$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.1$  IN.      $L/959$       $< L/240$       ADEQUATE

DF-L NO.2 4x8 HDR



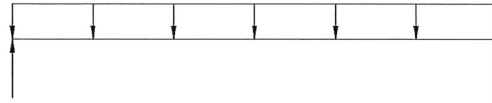
**BEAM & HEADER CALCULATIONS**

BEAM DESCRIPTION: TYP. EXT. HDR C 1<sup>ST</sup> FLOOR

B10

PARAMETERS:

L = 8.0 FT  
W = 0.48 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 1.84$  K      $V_D =$  [ ] K <  $V_{ALL} = 3.88$  K      ADEQUATE  
 $M_{MAX} = 3.68$  K-FT <  $M_{ALL} = 4.49$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.114$  IN.      $L/836 < L/240$       ADEQUATE

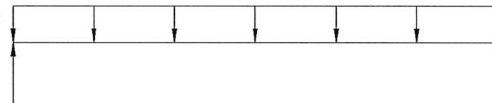
DF-L NO. 2 4x10 HDR

BEAM DESCRIPTION: 2<sup>ND</sup> FLOOR FRMB - FLUSH BTM C PRIMARY

B11

PARAMETERS:

L = 4.33 FT  
W = 0.52 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 1.13$  K      $V_D =$  [ ] K <  $V_{ALL} = 3.885$  K      ADEQUATE  
 $M_{MAX} = 1.21$  K-FT <  $M_{ALL} = 4.492$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.011$  IN.      $L/999 < L/240$       ADEQUATE

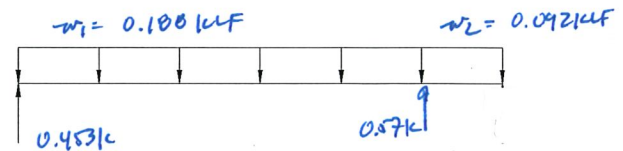
DF-L NO. 2 4x10

BEAM DESCRIPTION: 2<sup>ND</sup> FLOOR FRMB - FLUSH BTM C BA3

B12

PARAMETERS:

L = VARIES FT  
W = VARIES KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 0.57$  K      $V_D =$  [ ] K <  $V_{ALL} = 2.310$  K      ADEQUATE  
 $M_{MAX} = 0.54$  K-FT <  $M_{ALL} = 1.72$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.03$  IN.      $L/999 < L/240$       ADEQUATE

DF-L NO. 2 4x6



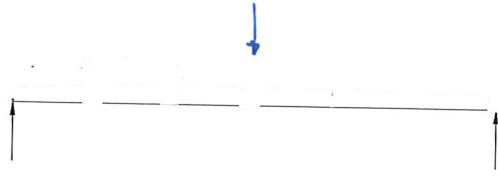
**BEAM & HEADER CALCULATIONS**

**BEAM DESCRIPTION:** 2ND FLR FRMB - STAIR BEAM

B13

**PARAMETERS:**

L = 7.5 FT  
W = N/A KLF  
P = 0.57 K



**ANALYSIS:**

$R_{MAX} = 0.285$  K  $V_D =$  [ ] K  $< V_{ALL} = 7.100$  K  ADEQUATE  
 $M_{MAX} = 1.07$  K-FT  $< M_{ALL} = 8.04$  K-FT  ADEQUATE  
 $\Delta_{TL} = 0.009$  IN.  $L/9999 < L/240$   ADEQUATE

DF-L NO.2 6x12

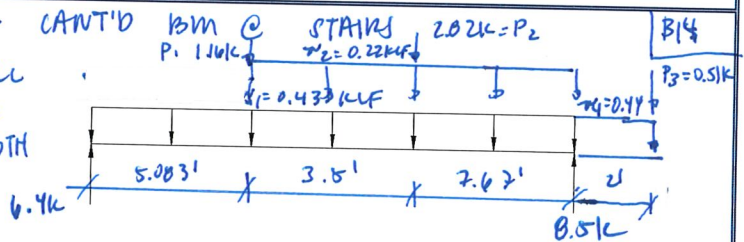
**BEAM DESCRIPTION:** 2ND FLR FRMB - CANT'D BM @ STAIRS 202K=P2

B14

**PARAMETERS:**

L = VARIES FT  
W = VARIES KLF  
P = VARIES K

SEE ENERCALL  
OUTPUT FOR  
OVERSTRENGTH



**ANALYSIS:**

$R_{MAX} = 8.5$  K  $V_D =$  [ ] K  $< V_{ALL} = 12.0$  K  ADEQUATE  
 $M_{MAX} = 33.31$  K-FT  $< M_{ALL} = 43.47$  K-FT  ADEQUATE  
 $\Delta_{TL} = 0.486$  IN.  $L/401 < L/240$   ADEQUATE

DF-DF 2YF-V4 3/2" x 18" 6WB

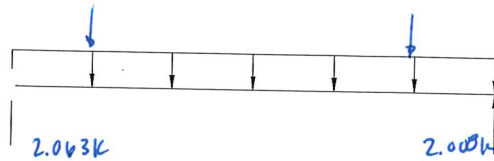
**BEAM DESCRIPTION:** 2ND FLR FRMB - CANT'D BM C GARAGE

B15

**PARAMETERS:**

L = 20.583 FT  
W = 0.067 KLF  
P = VARIES K

SEE ENERCALL  
OUTPUT FOR  
OVERSTRENGTH



**ANALYSIS:**

$R_{MAX} = 2.063$  K  $V_D =$  [ ] K  $< V_{ALL} = 11.95$  K  ADEQUATE  
 $M_{MAX} = 9.55$  K-FT  $< M_{ALL} = 26.73$  K-FT  ADEQUATE  
 $\Delta_{TL} = 0.529$  IN.  $L/467 < L/240$   ADEQUATE

TJ MICRALAM 2.0E (3) 1 3/4" x 11 7/8" LVC



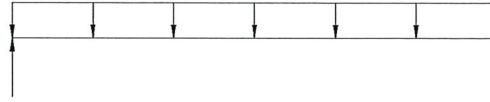
**BEAM & HEADER CALCULATIONS**

BEAM DESCRIPTION: 2ND FLR FRMB - FLUSH BM @ ENTRY

B16

PARAMETERS:

L = 6.75 FT  
W = 0.478 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 1.611$  K  $V_D =$  [ ] K  $< V_{ALL} = 12.0$  K  ADEQUATE  
 $M_{MAX} = 2.72$  K-FT  $< M_{ALL} = 43.42$  K-FT  ADEQUATE  
 $\Delta_{TL} = 0.007$  IN.  $L/999$   $< L/240$   ADEQUATE

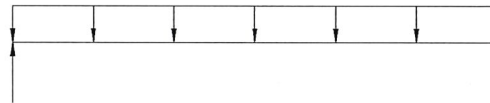
DF-DF 24F-V4 3/2" x 10" 6LB

BEAM DESCRIPTION: GARAGE E HPR

B17

PARAMETERS:

L = 14.25 FT  
W = 0.904 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 8.0$  K  $V_D =$  [ ] K  $< V_{ALL} = 16.76$  K  ADEQUATE  
 $M_{MAX} = 32.5$  K-FT  $< M_{ALL} = 47.43$  K-FT  ADEQUATE  
 $\Delta_{TL} = 0.55$  IN.  $L/351$   $< L/240$   ADEQUATE

DF-DF 24F-V4 5/2" x 15" 6LB

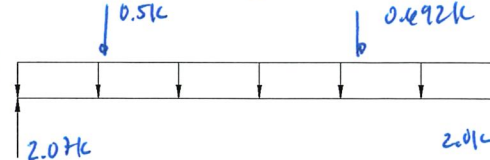
BEAM DESCRIPTION: 2ND FLR FRMB - FLUSH BM @ GARAGE

B18

PARAMETERS:

L = 20.5 FT  
W = 0.140 KLF  
P = VAPMEJ K

↓ SEE ENVELOPE FOR OVERSTRENGTH OUTPUT



ANALYSIS:

$R_{MAX} = 2.07$  K  $V_D =$  [ ] K  $< V_{ALL} = 13.61$  K  ADEQUATE  
 $M_{MAX} = 9.76$  K-FT  $< M_{ALL} = 30.74$  K-FT  ADEQUATE  
 $\Delta_{TL} = 0.545$  IN.  $L/451$   $< L/240$   ADEQUATE

TJ MICROLAM 2.0E (3) 1 3/4" x 11 7/8" LVL



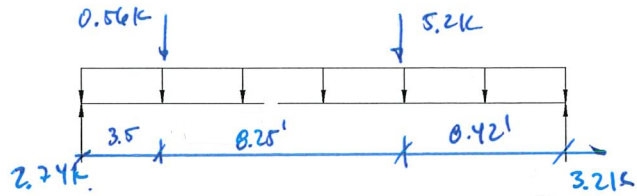
**BEAM & HEADER CALCULATIONS**

BEAM DESCRIPTION: 2ND FLOOR FRAMING - FLUSH BM @ DINING

B19

PARAMETERS:

L = 20.17 FT  
W = 0.013 KLF  
P = VARIOUS K



ANALYSIS:

$R_{MAX} = 3.2$  K       $V_D =$  [ ] K <  $V_{ALL} = 12.8$  K       ADEQUATE  
 $M_{MAX} = 26.73$  K-FT <  $M_{ALL} = 43.47$  K-FT       ADEQUATE  
 $\Delta_{TL} = 0.526$  IN.       $L/400 < L/240$        ADEQUATE

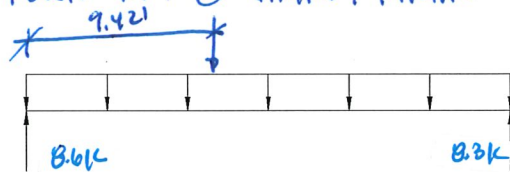
DF-DF 24F-V4 3 1/2" x 18" GLB

BEAM DESCRIPTION: 2ND FLOOR FRAMING - FLUSH BM @ DINING / KITCHEN

B20

PARAMETERS:

L = 23 FT \* SEE ENVELOPE FOR OVERSTRENGTH OUTPUT  
W = 0.658 KLF  
P = 1.05 K



ANALYSIS:

$R_{MAX} = 8.6$  K       $V_D =$  [ ] K <  $V_{ALL} = 23.32$  K       ADEQUATE  
 $M_{MAX} = 52.3$  K-FT <  $M_{ALL} = 96.95$  K-FT       ADEQUATE  
 $\Delta_{TL} = 0.402$  IN.       $L/572 < L/240$        ADEQUATE

DF-DF 24F-V4 5 1/2" x 24" GLB

**VOID**





**MULHERN+KULP**  
RESIDENTIAL STRUCTURAL ENGINEERING

PROJECT NAME: 2430 74TH AVE SE  
LNL BUILDS  
M&K PROJECT #: 01B-22081  
ENGINEER: LGH  
DATE: 12-DEC-22

### BEAM & HEADER CALCULATIONS

**VOID**

**VOID**

**VOID**



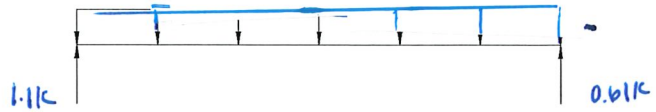
**BEAM & HEADER CALCULATIONS**

BEAM DESCRIPTION: FLUSH SIDE BEAM @ COV'D PECK

B25

PARAMETERS:

L = 12.42 FT  
W = 0.87 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 2.27$  K       $V_D =$  [ ] K <  $V_{ALL} = 5.35$  K       ADEQUATE  
 $M_{MAX} = 7.06$  K-FT <  $M_{ALL} = 13.95$  K-FT       ADEQUATE  
 $\Delta_{TL} = 0.24$  IN.       $L/572$  <  $L/240$        ADEQUATE

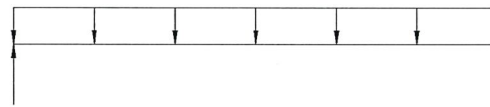
TO MICROLAM 20'E, 1 3/4" x 1 1/4" LVL

BEAM DESCRIPTION: ENTRY BOOK HEADER

B20

PARAMETERS:

L = 4.33 FT  
W = 0.495 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 1.07$  K       $V_D =$  [ ] K <  $V_{ALL} = 2.31$  K       ADEQUATE  
 $M_{MAX} = 1.16$  K-FT <  $M_{ALL} = 1.72$  K-FT       ADEQUATE  
 $\Delta_{TL} = 0.05$  IN.       $L/9994$  <  $L/240$        ADEQUATE

DF-L NO.2 4x8 HDR

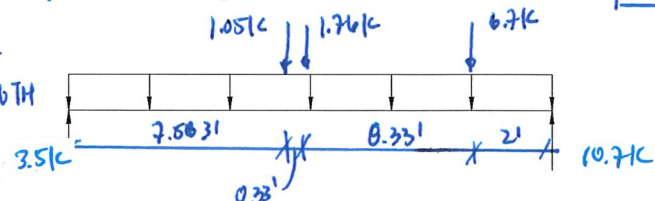
BEAM DESCRIPTION: 2ND FLR PKMB - FLUSH BM @ DIMMB

B27

PARAMETERS:

L = 10.25 FT  
W = 0.10 KLF  
P = VARIES K

PJEE EMERGENCY FOR OVERSTRENGTH OUTPUT



ANALYSIS:

$R_{MAX} = 10.7$  K       $V_D =$  [ ] K <  $V_{ALL} = 20.11$  K       ADEQUATE  
 $M_{MAX} = 23.2$  K-FT <  $M_{ALL} = 66.14$  K-FT       ADEQUATE  
 $\Delta_{TL} = 0.276$  IN.       $L/702$  <  $L/240$        ADEQUATE

DF-DF 24FV4 5 1/2" x 10" GWS



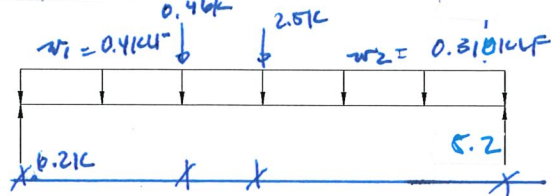
**BEAM & HEADER CALCULATIONS**

BEAM DESCRIPTION: 2ND FUR FRMB - FLUSH b m @ STAIRS / DINING B28

PARAMETERS:

L = 16.25 FT  
W = VARYING KLF  
P = VARYING K

\*SEE ENERCALL FOR OVERSTRENGTHING OUTRT



ANALYSIS:

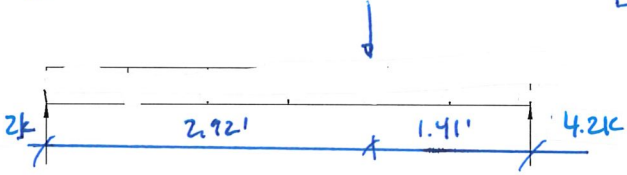
$R_{MAX} = 6.2$  K  $V_D =$  [ ] K  $< V_{ALL} = 20.11$  K  ADEQUATE  
 $M_{MAX} = 28.26$  K-FT  $< M_{ALL} = 68.31$  K-FT  ADEQUATE  
 $\Delta_{TL} = 0.263$  IN.  $L / 740 < L / 240$   ADEQUATE

DF-DF 24F-V4 5 1/2" x 10" GLB

BEAM DESCRIPTION: COAT CLOSET HDR B29

PARAMETERS:

L = 4.33 FT  
W = N/A KLF  
P = 6.2 K



ANALYSIS:

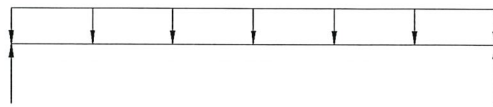
$R_{MAX} = 4.2$  K  $V_D =$  [ ] K  $< V_{ALL} = 7.47$  K  ADEQUATE  
 $M_{MAX} = 5.9$  K-FT  $< M_{ALL} = 14.39$  K-FT  ADEQUATE  
 $\Delta_{TL} = 0.017$  IN.  $L / 999+ < L / 240$   ADEQUATE

DF-DF 24F-V4 3 1/2" x 10 1/2" GLB

BEAM DESCRIPTION: 2ND FUR FRMB - FLUSH b m @ STAIRS B30

PARAMETERS:

L = 5.0 FT  
W = 0.160 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 0.4$  K  $V_D =$  [ ] K  $< V_{ALL} = 20.11$  K  ADEQUATE  
 $M_{MAX} = 0.5$  K-FT  $< M_{ALL} = 68.31$  K-FT  ADEQUATE  
 $\Delta_{TL} = 0.015$  IN.  $L / 999+ < L / 240$   ADEQUATE

DF-DF 24F-V4 5 1/2" x 10" GLB



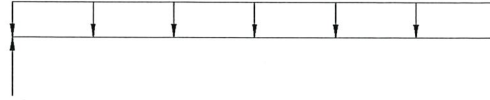
**BEAM & HEADER CALCULATIONS**

BEAM DESCRIPTION: TYP. DECK JOIST

B31

PARAMETERS:

L = 12.33 FT  
W = 0.093 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 0.574$  K      $V_D =$  [ ] K <  $V_{ALL} = 1.30$  K      ADEQUATE  
 $M_{MAX} = 1.77$  K-FT <  $M_{ALL} = 19.16$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.379$  IN.      $L/390 < L/240$       ADEQUATE

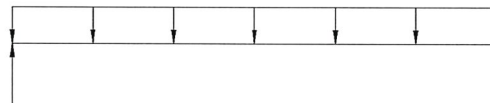
HEM FIR #2 2x10 @ 16" O.C.

BEAM DESCRIPTION: DECK BEAM

B32

PARAMETERS:

L = 21.25 FT  
W = 0.132 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 4.59$  K      $V_D =$  [ ] K <  $V_{ALL} = 17.57$  K      ADEQUATE  
 $M_{MAX} = 24.4$  K-FT <  $M_{ALL} = 41.25$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.711$  IN.      $L/350 < L/240$       ADEQUATE

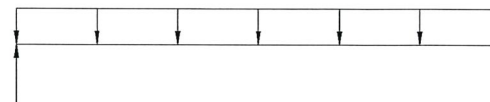
DF-DF 24F-V4 5 1/2" x 15" GLB

BEAM DESCRIPTION: TYP. EXT. HDR @ BASEMENT

B33

PARAMETERS:

L = 5.0 FT  
W = 0.553 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 7.4$  K      $V_D =$  [ ] K <  $V_{ALL} = 2.45$  K      ADEQUATE  
 $M_{MAX} = 1.73$  K-FT <  $M_{ALL} = 2.989$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.044$  IN.      $L/994 < L/240$       ADEQUATE

DF-L NO.2 4x8 HDR



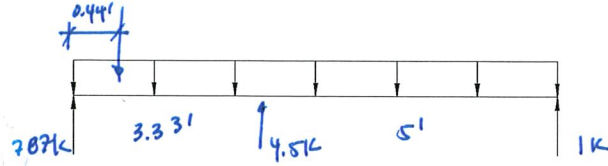
**BEAM & HEADER CALCULATIONS**

BEAM DESCRIPTION: DOOR / WINDOW HDR e ADJ DINING / LIVING

B34

PARAMETERS:

L =  FT  
W =  KLF  
P =  K



ANALYSIS:

$R_{MAX} = 7.87$  K      $V_D =$   K <  $V_{ALL} = 8.745$  K      ADEQUATE  
 $M_{MAX} = 3.30$  K-FT <  $M_{ALL} = 14.85$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.007$  IN.      $L/999$  <  $L/240$       ADEQUATE

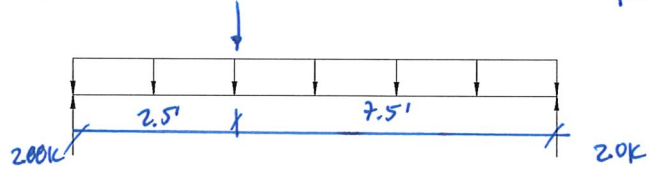
DF-DF 24F-V4 5 1/2" x 9" 6LB HDR

BEAM DESCRIPTION: WINDOW HDR e ADJ LIVING / KITCHEN

B35

PARAMETERS:

L =  FT  
W =  KLF  
P =  K



ANALYSIS:

$R_{MAX} = 2.00$  K      $V_D =$   K <  $V_{ALL} = 6.4$  K      ADEQUATE  
 $M_{MAX} = 6.4$  K-FT <  $M_{ALL} = 10.86$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.3$  IN.      $L/400$  <  $L/240$       ADEQUATE

DF-DF 24F-V4 3 1/2" x 9" 6LB HDR

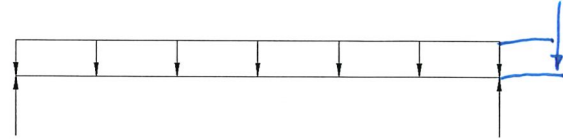
BEAM DESCRIPTION: 1<sup>ST</sup> FUR FRMB - PART'D BEAM e ADJ DINING

B30

PARAMETERS:

L =  FT  
W =  KLF  
P =  K

• SEE EMERCALL FOR OVERSTRENGTH & HD OUTPUT



ANALYSIS:

$R_{MAX} =$   K      $V_D =$   K <  $V_{ALL} =$   K      ADEQUATE  
 $M_{MAX} =$   K-FT <  $M_{ALL} =$   K-FT      ADEQUATE  
 $\Delta_{TL} =$   IN.      $L/$   <  $L/240$       ADEQUATE

TU MICRALAM 2.0E 1 3/4" x 11 7/8" LVL



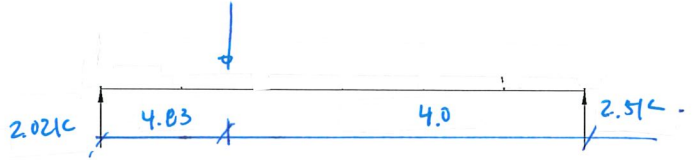
**BEAM & HEADER CALCULATIONS**

BEAM DESCRIPTION: 1<sup>st</sup> FLR FRMB - FLUSH BEAM @ HALL

B37

PARAMETERS:

L = 8.03 FT  
W = N/A KLF  
P = 4.52 K



ANALYSIS:

$R_{MAX} = 2.5$  K      $V_D =$  K <  $V_{ALL} = 9.081$  K      ADEQUATE  
 $M_{MAX} = 7.9$  K-FT <  $M_{ALL} = 10.25$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.225$  IN.      $L/470$  <  $L/240$       ADEQUATE

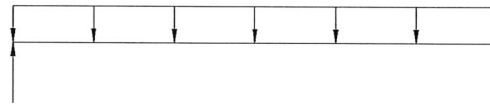
D MICROLAM 2x6 1 3/4" x 11 7/8" LVL

BEAM DESCRIPTION: INT. HDR C STAIRWAY

B38

PARAMETERS:

L = 3.33 FT  
W = 0.606 KLF  
P = N/A K



ANALYSIS:

$R_{MAX} = 1.0$  K      $V_D =$  K <  $V_{ALL} = 3.045$  K      ADEQUATE  
 $M_{MAX} = 0.84$  K-FT <  $M_{ALL} = 2.989$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.009$  IN.      $L/999$  <  $L/240$       ADEQUATE

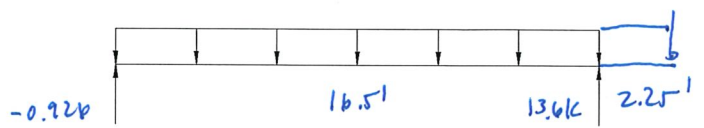
DF-L NO.2 4x8 HDR

BEAM DESCRIPTION: 1<sup>st</sup> FLR FRMB - FLUSH BEAM @ ADJ PRIMARY @

B39

PARAMETERS:

L = VARIES FT  
W = 0.067 KLF  
P = 11.3 K



ANALYSIS:

$R_{MAX} = 11.42$  K      $V_D =$  K <  $V_{ALL} = 48.96$  K      ADEQUATE  
 $M_{MAX} = 25.5$  K-FT <  $M_{ALL} = 64.87$  K-FT      ADEQUATE  
 $\Delta_{TL} = 0.165$  IN.      $L/327$  <  $L/240$       ADEQUATE

W10x22 STL BEAM



**BEAM & HEADER CALCULATIONS**

BEAM DESCRIPTION: INT FLR FRMG - FLUSH BM CANT'D C ADV PRIMARY BYO

PARAMETERS:

L = [ ] FT *SEE GENERAL OUTPUT FOR OVERSTRENGTH & HD*  
W = [ ] KLF  
P = [ ] K



ANALYSIS:

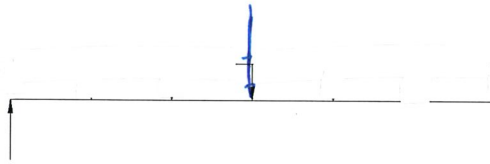
$R_{MAX} = [ ] K$      $V_D = [ ] K < V_{ALL} = [ ] K$      ADEQUATE  
 $M_{MAX} = [ ] K-FT < M_{ALL} = [ ] K-FT$      ADEQUATE  
 $\Delta_{TL} = [ ] IN.$      $L / [ ] < L/240$      ADEQUATE

TJ MICROWALL 20E 1 3/4" x 1 7/8" LVL

BEAM DESCRIPTION: ADV PRIMARY WINDOW HDR BY1

PARAMETERS:

L = [ 8.0 ] FT  
W = [ N/A ] KLF  
P = [ 1.85 ] K



ANALYSIS:

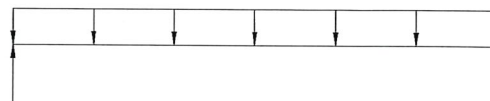
$R_{MAX} = [ 0.78 ] K$      $V_D = [ ] K < V_{ALL} = [ 3.502 ] K$      ADEQUATE  
 $M_{MAX} = [ 2.1 ] K-FT < M_{ALL} = [ 3.438 ] K-FT$      ADEQUATE  
 $\Delta_{TL} = [ 0.16 ] IN.$      $L / [ 597 ] < L/240$      ADEQUATE

DF-L NO.2 4x8 HDR

BEAM DESCRIPTION: INT HDR @ GARAGE /MB BY2

PARAMETERS:

L = [ 3.17 ] FT  
W = [ 1.82 ] KLF  
P = [ N/A ] K



ANALYSIS:

$R_{MAX} = [ 2.9 ] K$      $V_D = [ ] K < V_{ALL} = [ 3.05 ] K$      ADEQUATE  
 $M_{MAX} = [ 2.29 ] K-FT < M_{ALL} = [ 2.96 ] K-FT$      ADEQUATE  
 $\Delta_{TL} = [ 0.023 ] IN.$      $L / [ 999+ ] < L/240$      ADEQUATE

DF-L NO.2 4x8 HDR



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Project Title:  
 Engineer:  
 Project ID:  
 Project Descr:

## Wood Beam

Project File: Beams.ec6

LIC#: KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION:** B14 w/ Overstrength

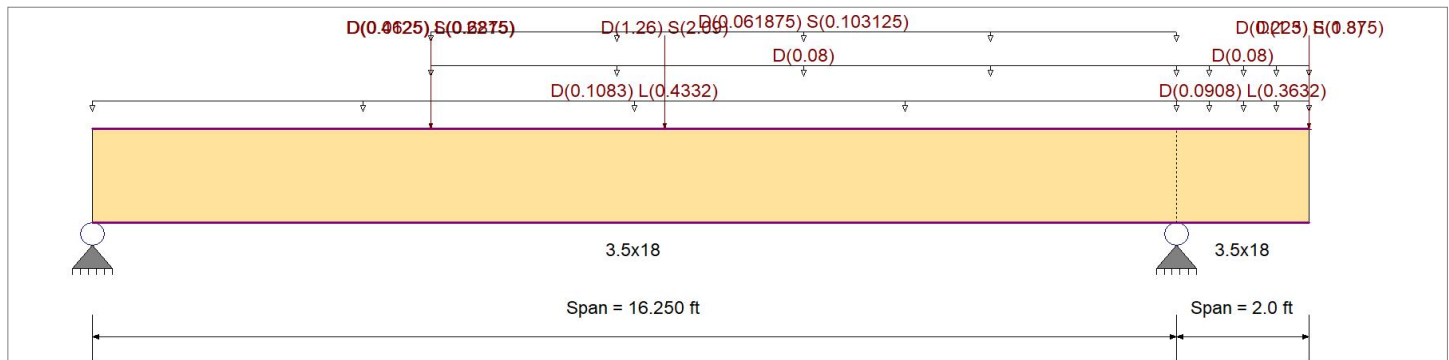
### CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

### Material Properties

|   |           |             |                           |
|---|-----------|-------------|---------------------------|
| Analysis Method : Allowable Stress Design | Fb +      | 2,880.0 psi | E : Modulus of Elasticity |
| Load Combination : ASCE 7-16              | Fb -      | 2,220.0 psi | Ebend- xx                 |
|   | Fc - Prll | 1,980.0 psi | Eminbend - xx             |
| Wood Species : DF/DF                      | Fc - Perp | 780.0 psi   | Ebend- yy                 |
| Wood Grade : 24F-V4                       | Fv        | 318.0 psi   | Eminbend - yy             |
|   | Ft        | 1,320.0 psi | Density                   |
|   |           |             | 31.21 pcf                 |

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling



### Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loading

Load for Span Number 1

- Uniform Load : D = 0.010, L = 0.040 ksf, Tributary Width = 10.830 ft, (Floor)
- Uniform Load : D = 0.010 ksf, Extent = 5.083 --> 16.250 ft, Tributary Width = 8.0 ft, (Wall)
- Point Load : D = 0.06250, L = 0.2215 k @ 5.083 ft, (B13)
- Uniform Load : D = 0.0150, S = 0.0250 ksf, Extent = 5.083 --> 16.250 ft, Tributary Width = 4.125 ft, (Roof)
- Point Load : D = 0.4125, S = 0.6875 k @ 5.083 ft, (B4)
- Point Load : D = 1.260, S = 2.090 k @ 8.583 ft, (B3)

Load for Span Number 2

- Uniform Load : D = 0.010, L = 0.040 ksf, Tributary Width = 9.080 ft, (Floor)
- Uniform Load : D = 0.010 ksf, Tributary Width = 8.0 ft, (Wall)
- Point Load : D = 0.2250, S = 0.3750 k @ 2.0 ft, (B11)
- Point Load : D = 1.30, E = 1.80 k @ 2.0 ft, (SW #201)

### DESIGN SUMMARY

**Design OK**

|                                     |           |                   |                                    |   |                  |
|-------------------------------------|-----------|-------------------|------------------------------------|---|------------------|
| <b>Maximum Bending Stress Ratio</b> | =         | <b>0.621</b> : 1  | <b>Maximum Shear Stress Ratio</b>  | = | <b>0.425</b> : 1 |
| Section used for this span          |           | <b>3.5x18</b>     | Section used for this span         |   | <b>3.5x18</b>    |
| fb: Actual                          | =         | 2,056.17 psi      | fv: Actual                         | = | 135.16 psi       |
| Fb: Allowable                       | =         | 3,312.00 psi      | Fv: Allowable                      | = | 318.00 psi       |
| Load Combination                    | =         | +D+0.750L+0.750S  | Load Combination                   | = | +D+L             |
| Location of maximum on span         | =         | 8.534ft           | Location of maximum on span        | = | 14.797 ft        |
| Span # where maximum occurs         | =         | Span # 1          | Span # where maximum occurs        | = | Span # 1         |
| <b>Maximum Deflection</b>           |           |                   |                                    |   |                  |
| Max Downward Transient Deflection   | 0.226 in  | Ratio = 861 >=360 | Span: 2 : E Only                   |   |                  |
| Max Upward Transient Deflection     | -0.086 in | Ratio = 560 >=360 | Span: 2 : L Only                   |   |                  |
| Max Downward Total Deflection       | 0.486 in  | Ratio = 401 >=180 | Span: 1 : +D+0.750L+0.750S-0.5250E |   |                  |
| Max Upward Total Deflection         | -0.178 in | Ratio = 268 >=180 | Span: 2 : +D+0.750L+0.750S-0.5250E |   |                  |

### Overall Maximum Deflections

| Load Combination         | Span | Max. "-" Defl | Location in Span | Load Combination         | Max. "+" Defl | Location in Span |
|--------------------------|------|---------------|------------------|--------------------------|---------------|------------------|
| +D+0.750L+0.750S-0.5250E | 1    | 0.4859        | 8.170            |                          | 0.0000        | 0.000            |
|                          | 2    | 0.0000        | 8.170            | +D+0.750L+0.750S-0.5250E | -0.1780       | 2.000            |





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Project Title:  
 Engineer:  
 Project ID:  
 Project Descr:

**Wood Beam**

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION: B14 w/ Overstrength**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

| Load Combination         | Support 1 | Support 2 | Support 3 |
|--------------------------|-----------|-----------|-----------|
| Overall MAXimum          | 6.439     | 11.153    |           |
| Overall MINimum          | 0.222     | -2.022    |           |
| D Only                   | 2.246     | 4.949     |           |
| +D+L                     | 5.873     | 9.309     |           |
| +D+S                     | 4.054     | 7.445     |           |
| +D+0.750L                | 4.966     | 8.219     |           |
| +D+0.750L+0.750S         | 6.322     | 10.091    |           |
| +0.60D                   | 1.347     | 2.970     |           |
| +D+0.70E                 | 2.091     | 6.364     |           |
| +D-0.70E                 | 2.401     | 3.534     |           |
| +D+0.750L+0.750S+0.5250E | 6.206     | 11.153    |           |
| +D+0.750L+0.750S-0.5250E | 6.439     | 9.030     |           |
| +0.60D+0.70E             | 1.192     | 4.385     |           |
| +0.60D-0.70E             | 1.503     | 1.554     |           |
| L Only                   | 3.627     | 4.360     |           |
| S Only                   | 1.808     | 2.496     |           |
| E Only                   | -0.222    | 2.022     |           |
| E Only * -1.0            | 0.222     | -2.022    |           |



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## Wood Beam

Project File: Beams.ec6

LIC#: KW-06017913, Build:20.22.3.16

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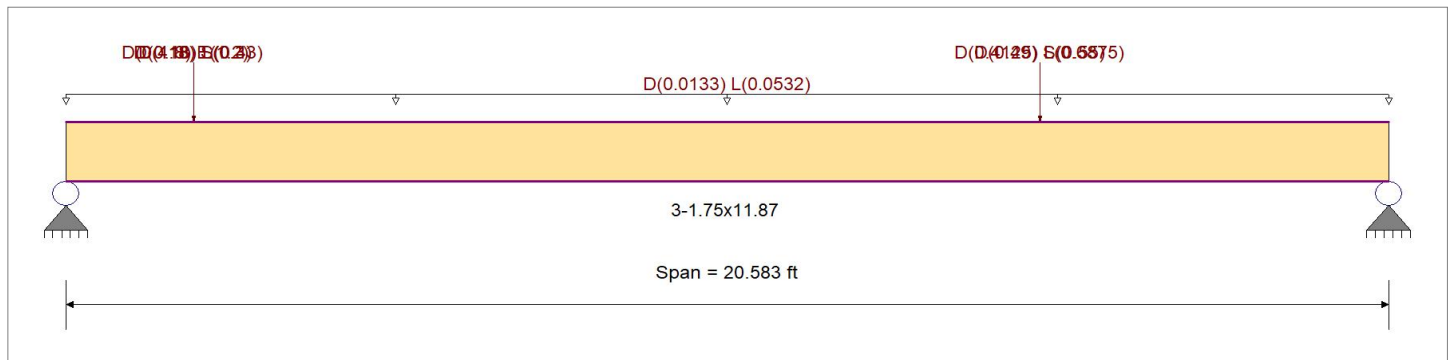
**DESCRIPTION:** B15 w/ Overstrength

### CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

### Material Properties

|  |           |             |                           |            |
|--|-----------|-------------|---------------------------|------------|
| Analysis Method : Allowable Stress Design                              | Fb +      | 3,120.0 psi | E : Modulus of Elasticity |            |
| Load Combination : ASCE 7-16   | Fb -      | 3,120.0 psi | Ebend- xx                 | 1,900.0ksi |
|  | Fc - Prll | 3,012.0 psi | Eminbend - xx             | 965.71 ksi |
| Wood Species : iLevel Truss Joist                                      | Fc - Perp | 900.0 psi   |                           |            |
| Wood Grade : MicroLam LVL 1.9 E  | Fv        | 342.0 psi   |                           |            |
|  | Ft        | 1,866.0 psi | Density                   | 42.010pcf  |
| Beam Bracing : Beam is Fully Braced against lateral-torsional buckling |           |             |                           |            |



### Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added  
 Uniform Load : D = 0.010, L = 0.040 ksf, Tributary Width = 1.330 ft, (Floor)  
 Point Load : D = 0.180, L = 0.30 k @ 2.0 ft, (B4)  
 Point Load : D = 0.4125, L = 0.6875 k @ 15.170 ft, (B4)  
 Point Load : D = 0.4180, S = 0.430 k @ 2.0 ft, (BWA)  
 Point Load : D = 0.490, S = 0.550 k @ 15.170 ft, (BWA)  
 Point Load : D = 1.80, E = 1.20 k @ 2.0 ft, (SW #203)

### DESIGN SUMMARY

**Design OK**

|                                   |   |                     |         |                             |    |                     |                                    |
|-----------------------------------|---|---------------------|---------|-----------------------------|----|---------------------|------------------------------------|
| Maximum Bending Stress Ratio      | = | <b>0.334</b>        | 1       | Maximum Shear Stress Ratio  | =  | <b>0.244</b>        | 1                                  |
| Section used for this span        |   | <b>3-1.75x11.87</b> |         | Section used for this span  |    | <b>3-1.75x11.87</b> |                                    |
| fb: Actual                        | = | 1,041.19psi         |         | fv: Actual                  | =  | 83.57 psi           |                                    |
| Fb: Allowable                     | = | 3,120.00psi         |         | Fv: Allowable               | =  | 342.00 psi          |                                    |
| Load Combination                  |   | +D+L                |         | Load Combination            |    | +D+L                |                                    |
| Location of maximum on span       | = | 12.620ft            |         | Location of maximum on span | =  | 0.000 ft            |                                    |
| Span # where maximum occurs       | = | Span # 1            |         | Span # where maximum occurs | =  | Span # 1            |                                    |
| <b>Maximum Deflection</b>         |   |                     |         |                             |    |                     |                                    |
| Max Downward Transient Deflection |   | 0.287 in            | Ratio = | <b>860</b>                  | >= | 360                 | Span: 1 : L Only                   |
| Max Upward Transient Deflection   |   | -0.080 in           | Ratio = | <b>3068</b>                 | >= | 360                 | Span: 1 : E Only * -1.0            |
| Max Downward Total Deflection     |   | 0.687 in            | Ratio = | <b>359</b>                  | >= | 180                 | Span: 1 : +D+0.750L+0.750S+0.5250E |
| Max Upward Total Deflection       |   | 0 in                | Ratio = | <b>0</b>                    | <  | 180                 | n/a                                |

### Maximum Forces & Stresses for Load Combinations

| Load Combination | Segment Length     | Span # | Max Stress Ratios |       |                |                  |                |                |                |                | Moment Values  |      |      | Shear Values |          |         |      |      |      |      |
|------------------|--------------------|--------|-------------------|-------|----------------|------------------|----------------|----------------|----------------|----------------|----------------|------|------|--------------|----------|---------|------|------|------|------|
|                  |                    |        | M                 | V     | C <sub>d</sub> | C <sub>F/V</sub> | C <sub>i</sub> | C <sub>r</sub> | C <sub>m</sub> | C <sub>t</sub> | C <sub>L</sub> | M    | fb   | F'b          | V        | fv      | F'v  |      |      |      |
| D Only           | Length = 20.583 ft | 1      | 0.192             | 0.197 | 0.90           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00 | 1.00 | 5.55         | 539.34   | 2808.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| +D+L             | Length = 20.583 ft | 1      | 0.334             | 0.244 | 1.00           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00 | 1.00 | 10.71        | 1,041.19 | 3120.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| +D+S             | Length = 20.583 ft | 1      | 0.212             | 0.187 | 1.15           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00 | 1.00 | 7.83         | 761.03   | 3588.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| +D+0.750L        | Length = 20.583 ft | 1      | 0.235             | 0.182 | 1.25           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00 | 1.00 | 9.41         | 915.11   | 3900.00 | 0.00 | 0.00 | 0.00 | 0.00 |



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**Wood Beam**

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION: B15 w/ Overstrength**

**Maximum Forces & Stresses for Load Combinations**

| Load Combination           | Segment Length | Span # | Max Stress Ratios |       |                |                  |                |                |                |                |                | Moment Values |          |         | Shear Values |        |        |      |
|----------------------------|----------------|--------|-------------------|-------|----------------|------------------|----------------|----------------|----------------|----------------|----------------|---------------|----------|---------|--------------|--------|--------|------|
|                            |                |        | M                 | V     | C <sub>d</sub> | C <sub>F/V</sub> | C <sub>i</sub> | C <sub>r</sub> | C <sub>m</sub> | C <sub>t</sub> | C <sub>L</sub> | M             | fb       | F'b     | V            | fv     | F'v    |      |
| +D+0.750L+0.750S           |                |        |                   |       |                | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           |               |          | 0.00    | 0.00         | 0.00   | 0.00   | 0.00 |
| Length = 20.583 ft         | 1              |        | 0.300             | 0.222 | 1.15           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 11.08         | 1,077.14 | 3588.00 | 3.64         | 87.49  | 393.30 |      |
| +0.60D                     |                |        |                   |       |                | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           |               |          | 0.00    | 0.00         | 0.00   | 0.00   |      |
| Length = 20.583 ft         | 1              |        | 0.065             | 0.067 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 3.33          | 323.60   | 4992.00 | 1.52         | 36.47  | 547.20 |      |
| +1.130D+1.750E             |                |        |                   |       |                | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           |               |          | 0.00    | 0.00         | 0.00   | 0.00   |      |
| Length = 20.583 ft         | 1              |        | 0.185             | 0.209 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 9.50          | 923.71   | 4992.00 | 4.75         | 114.29 | 547.20 |      |
| +1.130D-1.750E             |                |        |                   |       |                | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           |               |          | 0.00    | 0.00         | 0.00   | 0.00   |      |
| Length = 20.583 ft         | 1              |        | 0.097             | 0.042 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 5.00          | 486.47   | 4992.00 | 0.96         | 23.06  | 547.20 |      |
| +1.097D+0.750L+0.750S+1.3  |                |        |                   |       |                | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           |               |          | 0.00    | 0.00         | 0.00   | 0.00   |      |
| Length = 20.583 ft         | 1              |        | 0.250             | 0.233 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 12.85         | 1,249.65 | 4992.00 | 5.30         | 127.62 | 547.20 |      |
| +1.097D+0.750L+0.750S-1.31 |                |        |                   |       |                | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           |               |          | 0.00    | 0.00         | 0.00   | 0.00   |      |
| Length = 20.583 ft         | 1              |        | 0.209             | 0.108 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 10.73         | 1,043.46 | 4992.00 | 2.46         | 59.20  | 547.20 |      |
| +0.4701D+1.750E            |                |        |                   |       |                | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           |               |          | 0.00    | 0.00         | 0.00   | 0.00   |      |
| Length = 20.583 ft         | 1              |        | 0.120             | 0.136 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 6.16          | 599.32   | 4992.00 | 3.08         | 74.19  | 547.20 |      |
| +0.4701D-1.750E            |                |        |                   |       |                | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           |               |          | 0.00    | 0.00         | 0.00   | 0.00   |      |
| Length = 20.583 ft         | 1              |        | 0.028             | 0.031 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.44          | 139.71   | 4992.00 | 0.71         | 17.19  | 547.20 |      |

**Overall Maximum Deflections**

| Load Combination         | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|--------------------------|------|---------------|------------------|------------------|---------------|------------------|
| +D+0.750L+0.750S+0.5250E | 1    | 0.6865        | 10.367           |                  | 0.0000        | 0.000            |

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

| Load Combination         | Support 1 | Support 2 |
|--------------------------|-----------|-----------|
| Overall MAXimum          | 4.257     | 2.244     |
| Overall MINimum          | -1.083    | -0.117    |
| D Only                   | 2.539     | 1.035     |
| +D+L                     | 3.538     | 2.118     |
| +D+S                     | 3.072     | 1.482     |
| +D+0.750L                | 3.289     | 1.848     |
| +D+0.750L+0.750S         | 3.688     | 2.183     |
| +0.60D                   | 1.524     | 0.621     |
| +D+0.70E                 | 3.298     | 1.117     |
| +D-0.70E                 | 1.781     | 0.953     |
| +D+0.750L+0.750S+0.5250E | 4.257     | 2.244     |
| +D+0.750L+0.750S-0.5250E | 3.119     | 2.122     |
| +0.60D+0.70E             | 2.282     | 0.703     |
| +0.60D-0.70E             | 0.765     | 0.539     |
| L Only                   | 0.999     | 1.083     |
| S Only                   | 0.533     | 0.447     |
| E Only                   | 1.083     | 0.117     |
| E Only * -1.0            | -1.083    | -0.117    |



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Project Title:  
 Engineer:  
 Project ID:  
 Project Descr:

## Wood Beam

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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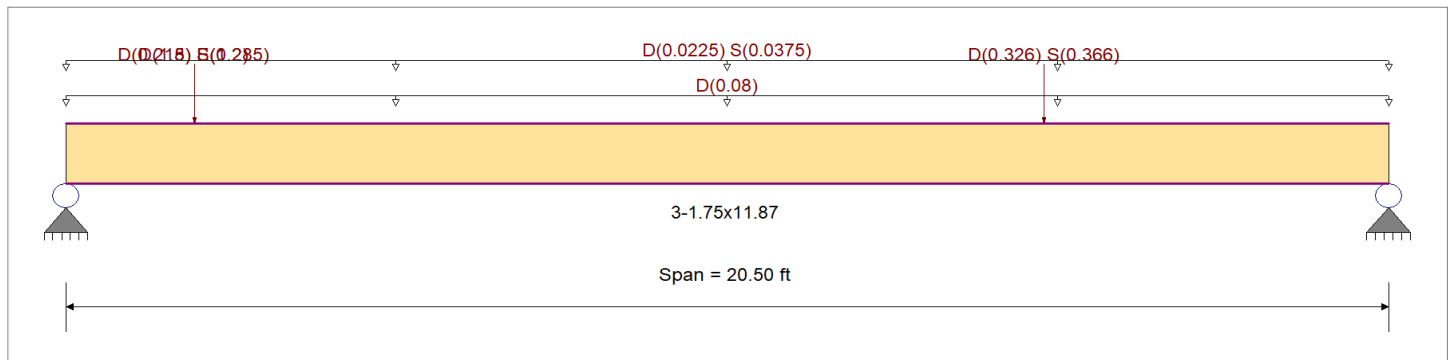
**DESCRIPTION:** B18 w/ Overstrength

### CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

### Material Properties

|  |           |             |                           |
|--|-----------|-------------|---------------------------|
| Analysis Method : Allowable Stress Design                              | Fb +      | 3,120.0 psi | E : Modulus of Elasticity |
| Load Combination : ASCE 7-16   | Fb -      | 3,120.0 psi | Ebend- xx                 |
|  | Fc - Prll | 3,012.0 psi | Eminbend - xx             |
| Wood Species : iLevel Truss Joist                                      | Fc - Perp | 900.0 psi   |                           |
| Wood Grade : MicroLam LVL 1.9 E  | Fv        | 342.0 psi   |                           |
| Beam Bracing : Beam is Fully Braced against lateral-torsional buckling | Ft        | 1,866.0 psi | Density                   |
|  |           |             | 42.010pcf                 |



### Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added

- Uniform Load : D = 0.010 ksf, Tributary Width = 8.0 ft, (Wall)
- Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 1.50 ft, (Roof)
- Point Load : D = 0.2150, S = 0.2850 k @ 2.0 ft, (BWA)
- Point Load : D = 0.3260, S = 0.3660 k @ 15.170 ft, (BWA)
- Point Load : D = 1.80, E = 1.20 k @ 2.0 ft, (SW #203)

### DESIGN SUMMARY

**Design OK**

|                                     |   |                     |         |                                   |    |                     |                         |
|-------------------------------------|---|---------------------|---------|-----------------------------------|----|---------------------|-------------------------|
| <b>Maximum Bending Stress Ratio</b> | = | <b>0.312</b>        | 1       | <b>Maximum Shear Stress Ratio</b> | =  | <b>0.225</b>        | 1                       |
| Section used for this span          |   | <b>3-1.75x11.87</b> |         | Section used for this span        |    | <b>3-1.75x11.87</b> |                         |
| fb: Actual                          | = | 1,118.96psi         |         | fv: Actual                        | =  | 123.19 psi          |                         |
| Fb: Allowable                       | = | 3,588.00psi         |         | Fv: Allowable                     | =  | 547.20 psi          |                         |
| Load Combination                    |   | +D+S                |         | Load Combination                  |    | +1.130D+1.750E      |                         |
| Location of maximum on span         | = | 9.951ft             |         | Location of maximum on span       | =  | 0.000ft             |                         |
| Span # where maximum occurs         | = | Span # 1            |         | Span # where maximum occurs       | =  | Span # 1            |                         |
| <b>Maximum Deflection</b>           |   |                     |         |                                   |    |                     |                         |
| Max Downward Transient Deflection   |   | 0.184 in            | Ratio = | 1333                              | >= | 360                 | Span: 1 : S Only        |
| Max Upward Transient Deflection     |   | -0.080 in           | Ratio = | 3081                              | >= | 360                 | Span: 1 : E Only * -1.0 |
| Max Downward Total Deflection       |   | 0.661 in            | Ratio = | 371                               | >= | 180                 | Span: 1 : +D+S          |
| Max Upward Total Deflection         |   | 0 in                | Ratio = | 0                                 | <  | 180                 | n/a                     |

### Maximum Forces & Stresses for Load Combinations

| Load Combination | Segment Length    | Span # | Max Stress Ratios |       |                |                  |                |                |                |                | Moment Values  |      |      | Shear Values |          |         |      |      |      |      |
|------------------|-------------------|--------|-------------------|-------|----------------|------------------|----------------|----------------|----------------|----------------|----------------|------|------|--------------|----------|---------|------|------|------|------|
|                  |                   |        | M                 | V     | C <sub>d</sub> | C <sub>F/V</sub> | C <sub>i</sub> | C <sub>r</sub> | C <sub>m</sub> | C <sub>t</sub> | C <sub>L</sub> | M    | fb   | F'b          | V        | fv      | F'v  |      |      |      |
| D Only           | Length = 20.50 ft | 1      | 0.288             | 0.223 | 0.90           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00 | 1.00 | 8.33         | 810.04   | 2808.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| +D+S             | Length = 20.50 ft | 1      | 0.312             | 0.217 | 1.15           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00 | 1.00 | 11.51        | 1,118.96 | 3588.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| +D+0.750S        | Length = 20.50 ft | 1      | 0.290             | 0.207 | 1.15           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00 | 1.00 | 10.71        | 1,041.13 | 3588.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| +0.60D           | Length = 20.50 ft | 1      | 0.097             | 0.075 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00 | 1.00 | 5.00         | 486.03   | 4992.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| +1.130D+1.750E   |                   |        |                   |       |                | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00 | 1.00 |              |          | 0.00    | 0.00 | 0.00 | 0.00 | 0.00 |



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Project Title:  
 Engineer:  
 Project ID:  
 Project Descr:

**Wood Beam**

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION: B18 w/ Overstrength**

**Maximum Forces & Stresses for Load Combinations**

| Load Combination      | Segment Length | Span # | Max Stress Ratios |       |                |                  |                |                |                |                |                | Moment Values |      |       | Shear Values |                |         |        |        |        |
|-----------------------|----------------|--------|-------------------|-------|----------------|------------------|----------------|----------------|----------------|----------------|----------------|---------------|------|-------|--------------|----------------|---------|--------|--------|--------|
|                       |                |        | M                 | V     | C <sub>d</sub> | C <sub>F/V</sub> | C <sub>i</sub> | C <sub>r</sub> | C <sub>m</sub> | C <sub>t</sub> | C <sub>L</sub> | M             | fb   | F'b   | V            | f <sub>v</sub> | F'v     |        |        |        |
| Length = 20.50 ft     | 1              |        | 0.232             | 0.225 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 1.00  | 11.92        | 1,158.88       | 4992.00 | 5.12   | 123.19 | 547.20 |
| +1.130D-1.750E        |                |        |                   |       |                | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 |       |              | 0.00           | 0.00    | 0.00   | 0.00   | 0.00   |
| Length = 20.50 ft     | 1              |        | 0.142             | 0.060 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 7.27  | 706.94       | 4992.00        | 1.36    | 32.83  | 547.20 |        |
| +1.097D+0.750S+1.313E |                |        |                   |       |                | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 |       |              | 0.00           | 0.00    | 0.00   | 0.00   |        |
| Length = 20.50 ft     | 1              |        | 0.258             | 0.223 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 13.25 | 1,288.90     | 4992.00        | 5.08    | 122.20 | 547.20 |        |
| +1.097D+0.750S-1.313E |                |        |                   |       |                | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 |       |              | 0.00           | 0.00    | 0.00   | 0.00   |        |
| Length = 20.50 ft     | 1              |        | 0.194             | 0.098 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 9.95  | 967.21       | 4992.00        | 2.24    | 53.80  | 547.20 |        |
| +0.4701D+1.750E       |                |        |                   |       |                | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 |       |              | 0.00           | 0.00    | 0.00   | 0.00   |        |
| Length = 20.50 ft     | 1              |        | 0.130             | 0.142 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 6.67  | 649.12       | 4992.00        | 3.24    | 77.88  | 547.20 |        |
| +0.4701D-1.750E       |                |        |                   |       |                | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 |       |              | 0.00           | 0.00    | 0.00   | 0.00   |        |
| Length = 20.50 ft     | 1              |        | 0.039             | 0.026 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 2.03  | 197.18       | 4992.00        | 0.60    | 14.44  | 547.20 |        |

**Overall Maximum Deflections**

| Load Combination | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|------------------|------|---------------|------------------|------------------|---------------|------------------|
| +D+S             | 1    | 0.6614        | 10.175           |                  | 0.0000        | 0.000            |

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

| Load Combination  | Support 1 | Support 2 |
|-------------------|-----------|-----------|
| Overall MAXimum   | 4.075     | 2.171     |
| Overall MINimum   | -1.083    | -0.117    |
| D Only            | 2.954     | 1.488     |
| +D+S              | 3.691     | 2.171     |
| +D+0.750S         | 3.506     | 2.001     |
| +0.60D            | 1.772     | 0.893     |
| +D+0.70E          | 3.712     | 1.570     |
| +D-0.70E          | 2.196     | 1.406     |
| +D+0.750S+0.5250E | 4.075     | 2.062     |
| +D+0.750S-0.5250E | 2.938     | 1.939     |
| +0.60D+0.70E      | 2.530     | 0.975     |
| +0.60D-0.70E      | 1.014     | 0.811     |
| S Only            | 0.737     | 0.683     |
| E Only            | 1.083     | 0.117     |
| E Only * -1.0     | -1.083    | -0.117    |





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## Wood Beam

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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### DESCRIPTION: B18 w/ Overstrength

#### Maximum Forces & Stresses for Load Combinations

| Load Combination                           | Segment Length | Span # | Max Stress Ratios |       |                |                  |                |                |                |                | Moment Values  |      |       | Shear Values |         |                |        |        |
|--|----------------|--------|-------------------|-------|----------------|------------------|----------------|----------------|----------------|----------------|----------------|------|-------|--------------|---------|----------------|--------|--------|
|  |                |        | M                 | V     | C <sub>d</sub> | C <sub>F/V</sub> | C <sub>i</sub> | C <sub>r</sub> | C <sub>m</sub> | C <sub>t</sub> | C <sub>L</sub> | M    | fb    | F'b          | V       | f <sub>v</sub> | F'v    |        |
| Length = 20.50 ft<br>+1.130D-1.750E        | 1              | 1      | 0.455             | 0.195 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00 | 23.38 | 2,273.32     | 4992.00 | 4.45           | 106.95 | 547.20 |
| Length = 20.50 ft<br>+1.097D+0.750S+1.313E | 1              | 1      | 0.145             | 0.063 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00 | 7.46  | 725.34       | 4992.00 | 1.42           | 34.24  | 547.20 |
| Length = 20.50 ft<br>+1.097D+0.750S-1.313E | 1              | 1      | 0.442             | 0.198 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00 | 22.69 | 2,207.16     | 4992.00 | 4.51           | 108.47 | 547.20 |
| Length = 20.50 ft<br>+0.4701D+1.750E       | 1              | 1      | 0.214             | 0.099 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00 | 10.99 | 1,068.79     | 4992.00 | 2.24           | 53.94  | 547.20 |
| Length = 20.50 ft<br>+0.4701D-1.750E       | 1              | 1      | 0.288             | 0.120 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00 | 14.79 | 1,438.83     | 4992.00 | 2.73           | 65.72  | 547.20 |
| Length = 20.50 ft                          | 1              | 1      | 0.050             | 0.027 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00 | 2.57  | 249.82       | 4992.00 | 0.62           | 14.88  | 547.20 |

#### Overall Maximum Deflections

| Load Combination  | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|-------------------|------|---------------|------------------|------------------|---------------|------------------|
| +D+0.750S+0.5250E | 1    | 0.9278        | 9.876            |                  | 0.0000        | 0.000            |

#### Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination  | Support 1 | Support 2 |
|-------------------|-----------|-----------|
| Overall MAXimum   | 3.702     | 2.535     |
| Overall MINimum   | -0.863    | -0.337    |
| D Only            | 2.696     | 1.846     |
| +D+S              | 3.433     | 2.529     |
| +D+0.750S         | 3.249     | 2.358     |
| +0.60D            | 1.618     | 1.107     |
| +D+0.70E          | 3.301     | 2.081     |
| +D-0.70E          | 2.092     | 1.610     |
| +D+0.750S+0.5250E | 3.702     | 2.535     |
| +D+0.750S-0.5250E | 2.796     | 2.181     |
| +0.60D+0.70E      | 2.222     | 1.343     |
| +0.60D-0.70E      | 1.013     | 0.872     |
| S Only            | 0.737     | 0.683     |
| E Only            | 0.863     | 0.337     |
| E Only * -1.0     | -0.863    | -0.337    |



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Project Title:  
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## Wood Beam

Project File: Beams.ec6

LIC#: KW-06017913, Build:20.22.3.16

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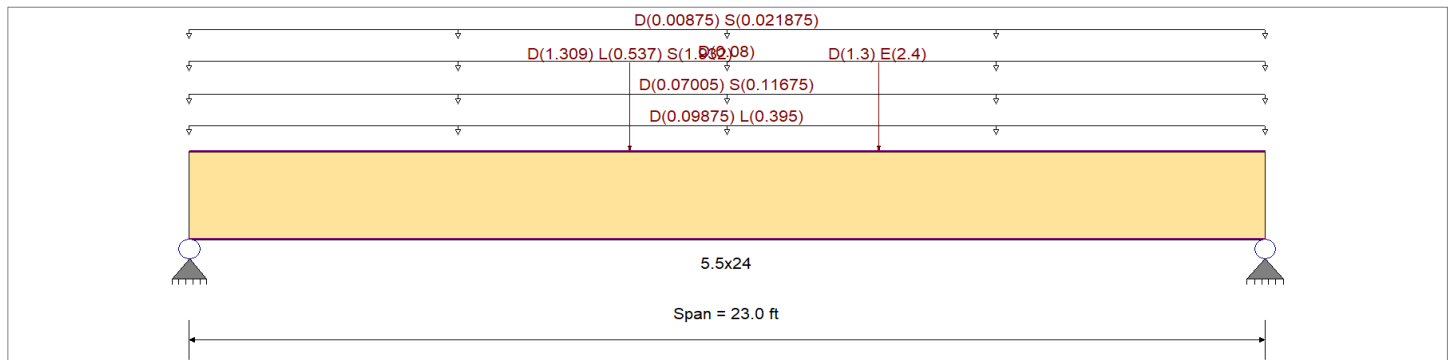
**DESCRIPTION:** B20 w/ Overstrength

### CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

### Material Properties

|  |           |             |                           |            |
|--|-----------|-------------|---------------------------|------------|
| Analysis Method : Allowable Stress Design                              | Fb +      | 2,880.0 psi | E : Modulus of Elasticity |            |
| Load Combination : ASCE 7-16   | Fb -      | 2,220.0 psi | Ebend- xx                 | 1,800.0ksi |
|  | Fc - Prll | 1,980.0 psi | Eminbend - xx             | 950.0ksi   |
| Wood Species : DF/DF   | Fc - Perp | 780.0 psi   | Ebend- yy                 | 1,600.0ksi |
| Wood Grade : 24F-V4  | Fv        | 318.0 psi   | Eminbend - yy             | 850.0ksi   |
|  | Ft        | 1,320.0 psi | Density                   | 31.210pcf  |
| Beam Bracing : Beam is Fully Braced against lateral-torsional buckling |           |             |                           |            |



### Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added

- Uniform Load : D = 0.010, L = 0.040 ksf, Tributary Width = 9.875 ft, (Floor)
- Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 4.670 ft, (Roof)
- Uniform Load : D = 0.010 ksf, Tributary Width = 8.0 ft, (Wall)
- Point Load : D = 1.309, L = 0.5370, S = 1.932 k @ 9.420 ft, (B19)
- Uniform Load : D = 0.010, S = 0.0250 ksf, Tributary Width = 0.8750 ft, (Roof)
- Point Load : D = 1.30, E = 2.40 k @ 14.750 ft, (SW #205)

### DESIGN SUMMARY

**Design OK**

|                                   |   |               |              |                             |   |                                    |     |
|-----------------------------------|---|---------------|--------------|-----------------------------|---|------------------------------------|-----|
| Maximum Bending Stress Ratio      | = | <b>0.492</b>  | 1            | Maximum Shear Stress Ratio  | = | <b>0.280</b>                       | : 1 |
| Section used for this span        |   | <b>5.5x24</b> |              | Section used for this span  |   | <b>5.5x24</b>                      |     |
| fb: Actual                        | = | 1,301.62psi   |              | fv: Actual                  | = | 89.03 psi                          |     |
| Fb: Allowable                     | = | 2,644.06psi   |              | Fv: Allowable               | = | 318.00 psi                         |     |
| Load Combination                  |   | +D+L          |              | Load Combination            |   | +D+L                               |     |
| Location of maximum on span       | = | 11.080ft      |              | Location of maximum on span | = | 21.069 ft                          |     |
| Span # where maximum occurs       | = | Span # 1      |              | Span # where maximum occurs | = | Span # 1                           |     |
| <b>Maximum Deflection</b>         |   |               |              |                             |   |                                    |     |
| Max Downward Transient Deflection |   | 0.239 in      | Ratio = 1154 | >=360                       |   | Span: 1 : L Only                   |     |
| Max Upward Transient Deflection   |   | -0.083 in     | Ratio = 3316 | >=360                       |   | Span: 1 : E Only * -1.0            |     |
| Max Downward Total Deflection     |   | 0.570 in      | Ratio = 484  | >=180                       |   | Span: 1 : +D+0.750L+0.750S+0.5250E |     |
| Max Upward Total Deflection       |   | 0 in          | Ratio = 0    | <180                        |   | n/a                                |     |

### Overall Maximum Deflections

| Load Combination         | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|--------------------------|------|---------------|------------------|------------------|---------------|------------------|
| +D+0.750L+0.750S+0.5250E | 1    | 0.5698        | 11.584           |                  | 0.0000        | 0.000            |

### Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 |
|------------------|-----------|-----------|
| Overall MAXimum  | 10.349    | 10.501    |
| Overall MINimum  | -0.861    | -1.539    |
| D Only           | 4.201     | 4.332     |
| +D+L             | 9.061     | 9.094     |
| +D+S             | 6.936     | 6.717     |





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Project Title:  
Engineer:  
Project ID:  
Project Descr:

## Wood Beam

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION:** B20 w/ Overstrength

### Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination         | Support 1 | Support 2 |
|--------------------------|-----------|-----------|
| +D+0.750L                | 7.846     | 7.903     |
| +D+0.750L+0.750S         | 9.897     | 9.693     |
| +0.60D                   | 2.521     | 2.599     |
| +D+0.70E                 | 4.804     | 5.409     |
| +D-0.70E                 | 3.598     | 3.254     |
| +D+0.750L+0.750S+0.5250E | 10.349    | 10.501    |
| +D+0.750L+0.750S-0.5250E | 9.445     | 8.885     |
| +0.60D+0.70E             | 3.123     | 3.676     |
| +0.60D-0.70E             | 1.918     | 1.522     |
| L Only                   | 4.860     | 4.762     |
| S Only                   | 2.735     | 2.385     |
| E Only                   | 0.861     | 1.539     |
| E Only * -1.0            | -0.861    | -1.539    |



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## Wood Beam

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION:** B27 w/ Overstrength

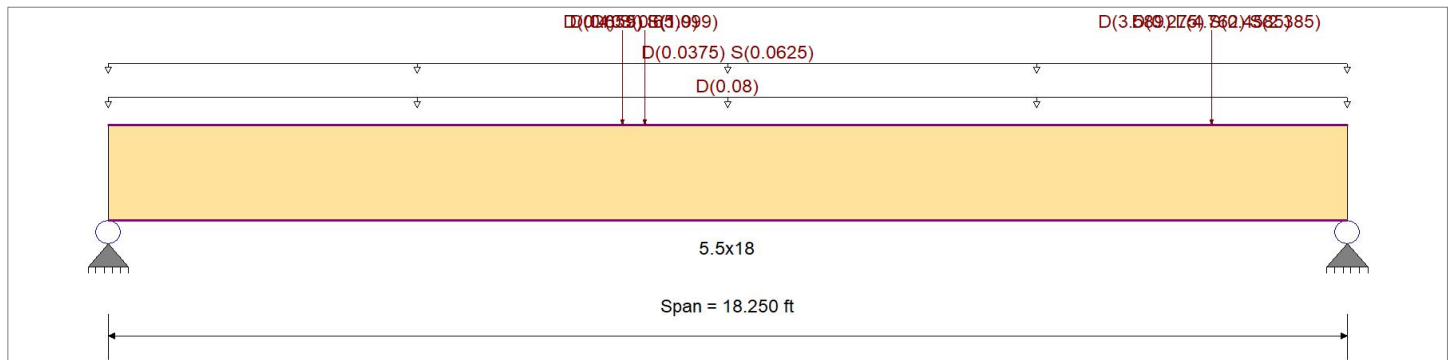
### CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

### Material Properties

|   |           |             |                           |
|---|-----------|-------------|---------------------------|
| Analysis Method : Allowable Stress Design | Fb +      | 2,880.0 psi | E : Modulus of Elasticity |
| Load Combination : ASCE 7-16              | Fb -      | 2,220.0 psi | Ebend- xx                 |
|   | Fc - Prll | 1,980.0 psi | Eminbend - xx             |
| Wood Species : DF/DF                      | Fc - Perp | 780.0 psi   | Ebend- yy                 |
| Wood Grade : 24F-V4                       | Fv        | 318.0 psi   | Eminbend - yy             |
|   | Ft        | 1,320.0 psi | Density                   |
|   |           |             | 31.210pcf                 |

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling



### Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added

- Uniform Load : D = 0.010 ksf, Tributary Width = 8.0 ft, (Wall)
- Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 2.50 ft, (Roof)
- Point Load : D = 3.589, L = 4.762, S = 2.385 k @ 16.250 ft, (B20)
- Point Load : D = 0.2750, S = 0.4585 k @ 16.250 ft, (P.A.)
- Point Load : D = 0.40, S = 0.650 k @ 7.583 ft, (B22)
- Point Load : D = 0.6590, S = 1.099 k @ 7.920 ft, (B8)
- Point Load : D = 0.50, E = 1.90 k @ 7.920 ft, (SW #202)

### DESIGN SUMMARY

**Design OK**

|                                   |   |                              |                             |                                    |                  |
|-----------------------------------|---|------------------------------|-----------------------------|------------------------------------|------------------|
| Maximum Bending Stress Ratio      | = | <b>0.366</b> 1               | Maximum Shear Stress Ratio  | =                                  | <b>0.456</b> : 1 |
| Section used for this span        |   | <b>5.5x18</b>                | Section used for this span  |                                    | <b>5.5x18</b>    |
| fb: Actual                        | = | 1,631.12psi                  | fv: Actual                  | =                                  | 166.79 psi       |
| Fb: Allowable                     | = | 4,455.87psi                  | Fv: Allowable               | =                                  | 365.70 psi       |
| Load Combination                  |   | +1.097D+0.750L+0.750S+1.313E | Load Combination            |                                    | +D+0.750L+0.750S |
| Location of maximum on span       | = | 7.926ft                      | Location of maximum on span | =                                  | 16.785 ft        |
| Span # where maximum occurs       | = | Span # 1                     | Span # where maximum occurs | =                                  | Span # 1         |
| <b>Maximum Deflection</b>         |   |                              |                             |                                    |                  |
| Max Downward Transient Deflection |   | 0.152 in Ratio =             | <b>1438</b> >=360           | Span: 1 : S Only                   |                  |
| Max Upward Transient Deflection   |   | -0.085 in Ratio =            | <b>2578</b> >=360           | Span: 1 : E Only * -1.0            |                  |
| Max Downward Total Deflection     |   | 0.399 in Ratio =             | <b>548</b> >=180            | Span: 1 : +D+0.750L+0.750S+0.5250E |                  |
| Max Upward Total Deflection       |   | 0 in Ratio =                 | <b>0</b> <180               | n/a                                |                  |

### Overall Maximum Deflections

| Load Combination         | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|--------------------------|------|---------------|------------------|------------------|---------------|------------------|
| +D+0.750L+0.750S+0.5250E | 1    | 0.3995        | 9.391            |                  | 0.0000        | 0.000            |

### Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 |
|------------------|-----------|-----------|
| Overall MAXimum  | 4.754     | 11.682    |
| Overall MINimum  | -1.075    | -0.825    |
| D Only           | 2.385     | 5.182     |
| +D+L             | 2.907     | 9.422     |



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**Wood Beam**

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION: B27 w/ Overstrength**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

| Load Combination         | Support 1 | Support 2 |
|--------------------------|-----------|-----------|
| +D+S                     | 4.269     | 9.031     |
| +D+0.750L                | 2.777     | 8.362     |
| +D+0.750L+0.750S         | 4.190     | 11.249    |
| +0.60D                   | 1.431     | 3.109     |
| +D+0.70E                 | 3.138     | 5.759     |
| +D-0.70E                 | 1.633     | 4.605     |
| +D+0.750L+0.750S+0.5250E | 4.754     | 11.682    |
| +D+0.750L+0.750S-0.5250E | 3.625     | 10.816    |
| +0.60D+0.70E             | 2.184     | 3.686     |
| +0.60D-0.70E             | 0.678     | 2.532     |
| L Only                   | 0.522     | 4.240     |
| S Only                   | 1.884     | 3.849     |
| E Only                   | 1.075     | 0.825     |
| E Only * -1.0            | -1.075    | -0.825    |



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## Wood Beam

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION:** B27 w/ Overstrength

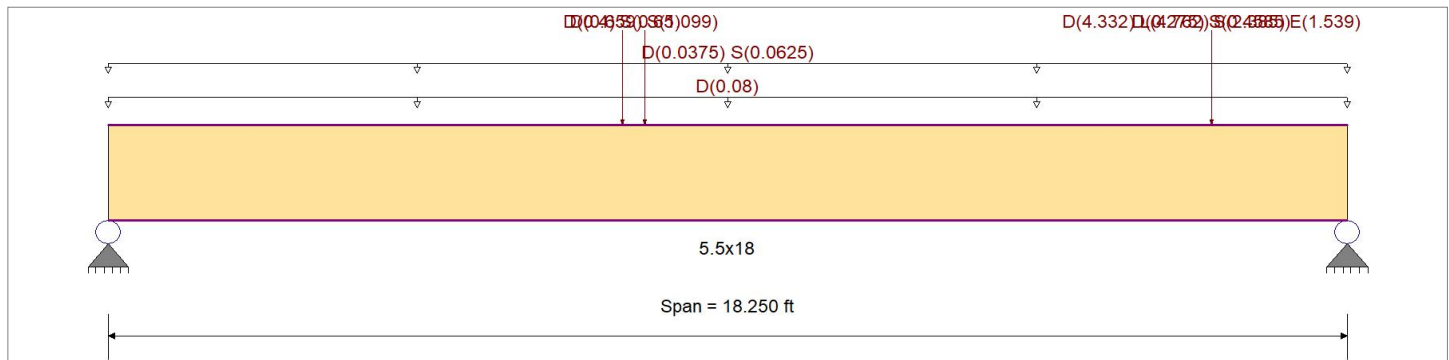
### CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

### Material Properties

|   |           |             |                           |
|---|-----------|-------------|---------------------------|
| Analysis Method : Allowable Stress Design | Fb +      | 2,880.0 psi | E : Modulus of Elasticity |
| Load Combination : ASCE 7-16              | Fb -      | 2,220.0 psi | Ebend- xx                 |
|   | Fc - Prll | 1,980.0 psi | Eminbend - xx             |
| Wood Species : DF/DF                      | Fc - Perp | 780.0 psi   | Ebend- yy                 |
| Wood Grade : 24F-V4                       | Fv        | 318.0 psi   | Eminbend - yy             |
|   | Ft        | 1,320.0 psi | Density                   |
|   |           |             | 31.210pcf                 |

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling



### Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added

- Uniform Load : D = 0.010 ksf, Tributary Width = 8.0 ft, (Wall)
- Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 2.50 ft, (Roof)
- Point Load : D = 4.332, L = 4.762, S = 2.385, E = 1.539 k @ 16.250 ft, (B20)
- Point Load : D = 0.2750, S = 0.4585 k @ 16.250 ft, (P.A.)
- Point Load : D = 0.40, S = 0.650 k @ 7.583 ft, (B22)
- Point Load : D = 0.6590, S = 1.099 k @ 7.920 ft, (B8)

### DESIGN SUMMARY

**Design OK**

|                                     |   |                  |              |                                   |   |                                    |   |
|-------------------------------------|---|------------------|--------------|-----------------------------------|---|------------------------------------|---|
| <b>Maximum Bending Stress Ratio</b> | = | <b>0.334</b>     | 1            | <b>Maximum Shear Stress Ratio</b> | = | <b>0.475</b>                       | 1 |
| Section used for this span          |   | <b>5.5x18</b>    |              | Section used for this span        |   | <b>5.5x18</b>                      |   |
| fb: Actual                          | = | 1,068.09psi      |              | fv: Actual                        | = | 173.52 psi                         |   |
| Fb: Allowable                       | = | 3,202.65psi      |              | Fv: Allowable                     | = | 365.70 psi                         |   |
| Load Combination                    |   | +D+0.750L+0.750S |              | Load Combination                  |   | +D+0.750L+0.750S                   |   |
| Location of maximum on span         | = | 9.858ft          |              | Location of maximum on span       | = | 16.785 ft                          |   |
| Span # where maximum occurs         | = | Span # 1         |              | Span # where maximum occurs       | = | Span # 1                           |   |
| <b>Maximum Deflection</b>           |   |                  |              |                                   |   |                                    |   |
| Max Downward Transient Deflection   |   | 0.152 in         | Ratio = 1438 | >=360                             |   | Span: 1 : S Only                   |   |
| Max Upward Transient Deflection     |   | -0.023 in        | Ratio = 9396 | >=360                             |   | Span: 1 : E Only * -1.0            |   |
| Max Downward Total Deflection       |   | 0.356 in         | Ratio = 614  | >=180                             |   | Span: 1 : +D+0.750L+0.750S+0.5250E |   |
| Max Upward Total Deflection         |   | 0 in             | Ratio = 0    | <180                              |   | n/a                                |   |

### Overall Maximum Deflections

| Load Combination         | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|--------------------------|------|---------------|------------------|------------------|---------------|------------------|
| +D+0.750L+0.750S+0.5250E | 1    | 0.3563        | 9.591            |                  | 0.0000        | 0.000            |

### Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 |
|------------------|-----------|-----------|
| Overall MAXimum  | 4.077     | 12.413    |
| Overall MINimum  | -0.169    | -1.370    |
| D Only           | 2.184     | 5.627     |
| +D+L             | 2.706     | 9.867     |
| +D+S             | 4.068     | 9.476     |



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Project ID:  
Project Descr:

## Wood Beam

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION:** B27 w/ Overstrength

### Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination         | Support 1 | Support 2 |
|--------------------------|-----------|-----------|
| +D+0.750L                | 2.575     | 8.807     |
| +D+0.750L+0.750S         | 3.988     | 11.694    |
| +0.60D                   | 1.310     | 3.376     |
| +D+0.70E                 | 2.302     | 6.586     |
| +D-0.70E                 | 2.066     | 4.667     |
| +D+0.750L+0.750S+0.5250E | 4.077     | 12.413    |
| +D+0.750L+0.750S-0.5250E | 3.900     | 10.974    |
| +0.60D+0.70E             | 1.428     | 4.335     |
| +0.60D-0.70E             | 1.192     | 2.417     |
| L Only                   | 0.522     | 4.240     |
| S Only                   | 1.884     | 3.849     |
| E Only                   | 0.169     | 1.370     |
| E Only * -1.0            | -0.169    | -1.370    |



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## Wood Beam

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION:** B28 w/ Overstrength

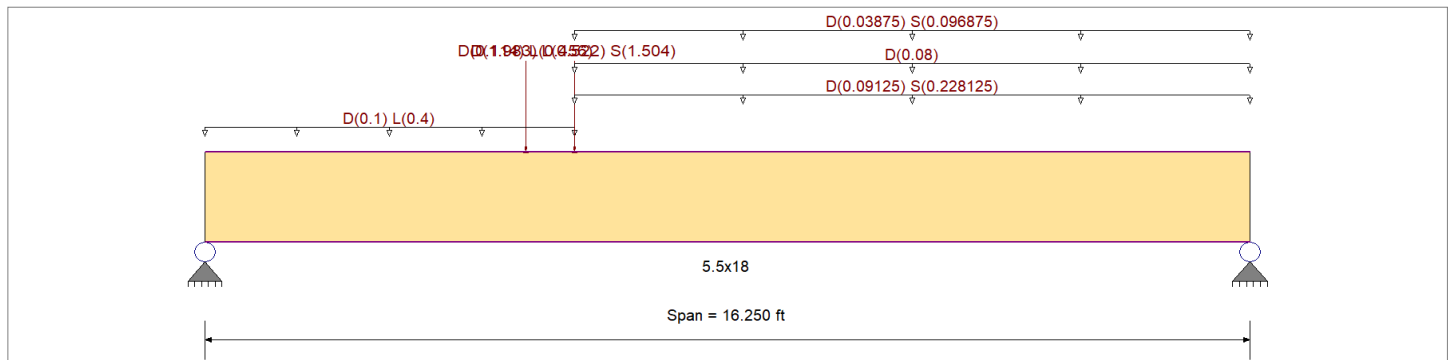
### CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

### Material Properties

|   |           |             |                           |
|---|-----------|-------------|---------------------------|
| Analysis Method : Allowable Stress Design | Fb +      | 2,400.0 psi | E : Modulus of Elasticity |
| Load Combination : ASCE 7-16              | Fb -      | 1,850.0 psi | Ebend- xx                 |
|   | Fc - Prll | 1,650.0 psi | Eminbend - xx             |
| Wood Species : DF/DF                      | Fc - Perp | 650.0 psi   | Ebend- yy                 |
| Wood Grade : 24F-V4                       | Fv        | 265.0 psi   | Eminbend - yy             |
|   | Ft        | 1,100.0 psi | Density                   |
|   |           |             | 31.210pcf                 |

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling



### Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loading

Load for Span Number 1

Uniform Load : D = 0.010, L = 0.040 ksf, Extent = 0 --> 5.750 ft, Tributary Width = 10.0 ft, (Floor)

Point Load : D = 1.983, L = 0.5220, S = 1.504 k @ 5.750 ft, (B27)

Point Load : D = 0.1140, L = 0.4560 k @ 5.0 ft, (B13)

Uniform Load : D = 0.010, S = 0.0250 ksf, Extent = 5.750 --> 16.250 ft, Tributary Width = 9.125 ft, (Roof)

Uniform Load : D = 0.010 ksf, Extent = 5.750 --> 16.250 ft, Tributary Width = 8.0 ft, (Wall)

Uniform Load : D = 0.010, S = 0.0250 ksf, Extent = 5.750 --> 16.250 ft, Tributary Width = 3.875 ft, (Upper Roof)

### DESIGN SUMMARY

**Design OK**

|                                   |   |                                    |                             |   |                  |
|-----------------------------------|---|------------------------------------|-----------------------------|---|------------------|
| Maximum Bending Stress Ratio      | = | <b>0.423</b> : 1                   | Maximum Shear Stress Ratio  | = | <b>0.276</b> : 1 |
| Section used for this span        |   | <b>5.5x18</b>                      | Section used for this span  |   | <b>5.5x18</b>    |
| fb: Actual                        | = | 1,141.70psi                        | fv: Actual                  | = | 84.25 psi        |
| Fb: Allowable                     | = | 2,700.04psi                        | Fv: Allowable               | = | 304.75 psi       |
| Load Combination                  |   | +D+0.750L+0.750S                   | Load Combination            |   | +D+0.750L+0.750S |
| Location of maximum on span       | = | 5.753ft                            | Location of maximum on span | = | 0.000ft          |
| Span # where maximum occurs       | = | Span # 1                           | Span # where maximum occurs | = | Span # 1         |
| <b>Maximum Deflection</b>         |   |                                    |                             |   |                  |
| Max Downward Transient Deflection |   | 0.120 in Ratio = <b>1622</b> >=360 | Span: 1 : S Only            |   |                  |
| Max Upward Transient Deflection   |   | 0 in Ratio = <b>0</b> <360         | n/a                         |   |                  |
| Max Downward Total Deflection     |   | 0.263 in Ratio = <b>740</b> >=180  | Span: 1 : +D+0.750L+0.750S  |   |                  |
| Max Upward Total Deflection       |   | 0 in Ratio = <b>0</b> <180         | n/a                         |   |                  |

### Overall Maximum Deflections

| Load Combination | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|------------------|------|---------------|------------------|------------------|---------------|------------------|
| +D+0.750L+0.750S | 1    | 0.2633        | 7.888            |                  | 0.0000        | 0.000            |

### Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 |
|------------------|-----------|-----------|
| Overall MAXimum  | 6.186     | 5.348     |
| Overall MINimum  | 2.074     | 2.842     |
| D Only           | 2.720     | 2.505     |
| +D+L             | 5.266     | 3.237     |



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## Wood Beam

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION:** B28 w/ Overstrength

### Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 |
|------------------|-----------|-----------|
| +D+S             | 4.795     | 5.348     |
| +D+0.750L        | 4.630     | 3.054     |
| +D+0.750L+0.750S | 6.186     | 5.186     |
| +0.60D           | 1.632     | 1.503     |
| L Only           | 2.546     | 0.732     |
| S Only           | 2.074     | 2.842     |



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## Wood Beam

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

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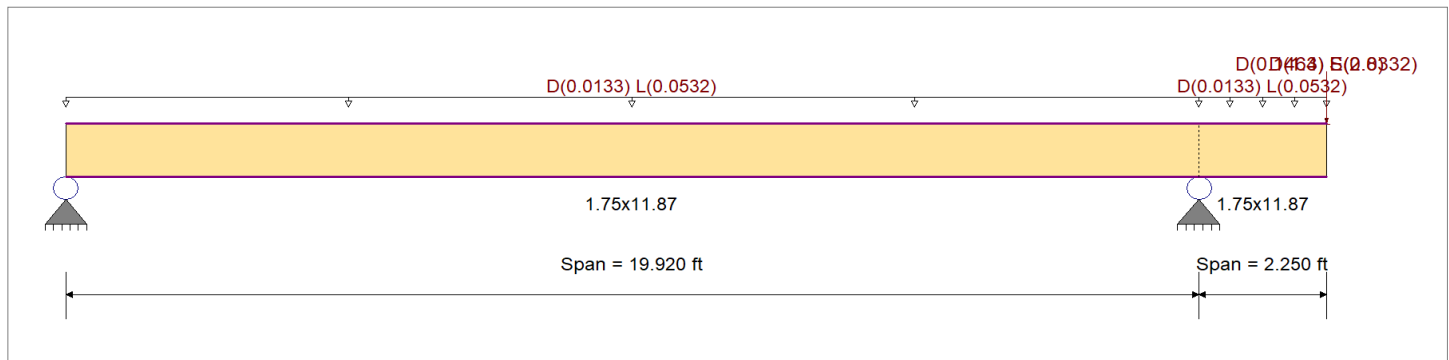
**DESCRIPTION:** B36 w/ Overstrength

### CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

### Material Properties

|  |           |             |                           |
|--|-----------|-------------|---------------------------|
| Analysis Method : Allowable Stress Design                              | Fb +      | 3,120.0 psi | E : Modulus of Elasticity |
| Load Combination : ASCE 7-16   | Fb -      | 3,120.0 psi | Ebend- xx                 |
|  | Fc - Prll | 3,012.0 psi | Eminbend - xx             |
| Wood Species : iLevel Truss Joist                                      | Fc - Perp | 900.0 psi   |                           |
| Wood Grade : MicroLam LVL 1.9 E  | Fv        | 342.0 psi   |                           |
|  | Ft        | 1,866.0 psi | Density                   |
| Beam Bracing : Beam is Fully Braced against lateral-torsional buckling |           |             | 42.010pcf                 |



### Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added

Load for Span Number 1

Uniform Load : D = 0.010, L = 0.040 ksf, Tributary Width = 1.330 ft, (Floor)

Load for Span Number 2

Uniform Load : D = 0.010, L = 0.040 ksf, Tributary Width = 1.330 ft, (Floor)

Point Load : D = 1.40, E = 2.80 k @ 2.250 ft, (SW #107)

Point Load : D = 0.1463, S = 0.03320 k @ 2.250 ft, (BWA)

### DESIGN SUMMARY

**Design OK**

|                                     |   |                   |         |                                   |    |                   |                         |
|-------------------------------------|---|-------------------|---------|-----------------------------------|----|-------------------|-------------------------|
| <b>Maximum Bending Stress Ratio</b> | = | <b>0.876</b>      | 1       | <b>Maximum Shear Stress Ratio</b> | =  | <b>0.879</b>      | 1                       |
| Section used for this span          |   | <b>1.75x11.87</b> |         | Section used for this span        |    | <b>1.75x11.87</b> |                         |
| fb: Actual                          | = | 4,374.73psi       |         | fv: Actual                        | =  | 481.17 psi        |                         |
| Fb: Allowable                       | = | 4,992.00psi       |         | Fv: Allowable                     | =  | 547.20 psi        |                         |
| Load Combination                    |   | +1.130D+1.750E    |         | Load Combination                  |    | +1.130D+1.750E    |                         |
| Location of maximum on span         | = | 19.920ft          |         | Location of maximum on span       | =  | 19.920 ft         |                         |
| Span # where maximum occurs         | = | Span # 1          |         | Span # where maximum occurs       | =  | Span # 1          |                         |
| <b>Maximum Deflection</b>           |   |                   |         |                                   |    |                   |                         |
| Max Downward Transient Deflection   |   | 0.390 in          | Ratio = | 138                               | >= | 138               | Span: 2 : E Only        |
| Max Upward Transient Deflection     |   | -0.390 in         | Ratio = | 138                               | >= | 138               | Span: 2 : E Only * -1.0 |
| Max Downward Total Deflection       |   | 0.454 in          | Ratio = | 118                               | >= | 118               | Span: 2 : +D+0.70E      |
| Max Upward Total Deflection         |   | -0.165 in         | Ratio = | 328                               | >= | 118               | Span: 2 : +0.60D-0.70E  |

### Maximum Forces & Stresses for Load Combinations

| Load Combination | Segment Length     | Span # | Max Stress Ratios |       |                |                  |                |                |                |                | Moment Values  |      |          | Shear Values |      |        |        |  |
|------------------|--------------------|--------|-------------------|-------|----------------|------------------|----------------|----------------|----------------|----------------|----------------|------|----------|--------------|------|--------|--------|--|
|                  |                    |        | M                 | V     | C <sub>d</sub> | C <sub>F/V</sub> | C <sub>i</sub> | C <sub>r</sub> | C <sub>m</sub> | C <sub>t</sub> | C <sub>L</sub> | M    | fb       | F'b          | V    | fv     | F'v    |  |
| D Only           |                    |        |                   |       |                |                  |                |                |                |                |                |      |          |              |      |        |        |  |
|                  | Length = 19.920 ft | 1      | 0.365             | 0.367 | 0.90           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 3.51 | 1,024.91 | 2808.00      | 1.56 | 112.83 | 307.80 |  |
|                  | Length = 2.250 ft  | 2      | 0.365             | 0.367 | 0.90           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 3.51 | 1,024.91 | 2808.00      | 1.56 | 112.83 | 307.80 |  |
| +D+L             |                    |        |                   |       |                |                  |                |                |                |                |                |      |          |              |      |        |        |  |
|                  | Length = 19.920 ft | 1      | 0.341             | 0.344 | 1.00           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 3.65 | 1,064.20 | 3120.00      | 1.63 | 117.71 | 342.00 |  |
|                  | Length = 2.250 ft  | 2      | 0.341             | 0.344 | 1.00           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 3.65 | 1,064.20 | 3120.00      | 1.63 | 117.71 | 342.00 |  |
| +D+S             |                    |        |                   |       |                |                  |                |                |                |                |                |      |          |              |      |        |        |  |
|                  | Length = 19.920 ft | 1      | 0.292             | 0.293 | 1.15           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 3.59 | 1,046.70 | 3588.00      | 1.60 | 115.23 | 393.30 |  |





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Project Title:  
 Engineer:  
 Project ID:  
 Project Descr:

**Wood Beam**

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION: B36 w/ Overstrength**

**Maximum Forces & Stresses for Load Combinations**

| Load Combination           | Segment Length     | Span # | Max Stress Ratios |       |                |                  |                |                |                |                |                | Moment Values |      |       | Shear Values |         |      |        |        |
|----------------------------|--------------------|--------|-------------------|-------|----------------|------------------|----------------|----------------|----------------|----------------|----------------|---------------|------|-------|--------------|---------|------|--------|--------|
|                            |                    |        | M                 | V     | C <sub>d</sub> | C <sub>F/V</sub> | C <sub>i</sub> | C <sub>r</sub> | C <sub>m</sub> | C <sub>t</sub> | C <sub>L</sub> | M             | fb   | F'b   | V            | fv      | F'v  |        |        |
| +D+0.750L                  | Length = 2.250 ft  | 2      | 0.292             | 0.293 | 1.15           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 3.59  | 1,046.70     | 3588.00 | 1.60 | 115.23 | 393.30 |
|                            | Length = 19.920 ft | 1      | 0.270             | 0.272 | 1.25           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 3.61  | 1,054.38     | 3900.00 | 1.61 | 116.49 | 427.50 |
| +D+0.750L+0.750S           | Length = 2.250 ft  | 2      | 0.270             | 0.272 | 1.25           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 3.61  | 1,054.38     | 3900.00 | 1.61 | 116.49 | 427.50 |
|                            | Length = 19.920 ft | 1      | 0.298             | 0.301 | 1.15           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 3.67  | 1,070.72     | 3588.00 | 1.64 | 118.29 | 393.30 |
| +0.60D                     | Length = 2.250 ft  | 2      | 0.298             | 0.301 | 1.15           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 3.67  | 1,070.72     | 3588.00 | 1.64 | 118.29 | 393.30 |
|                            | Length = 19.920 ft | 1      | 0.123             | 0.124 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 2.11  | 614.95       | 4992.00 | 0.94 | 67.70  | 547.20 |
| +1.130D+1.750E             | Length = 2.250 ft  | 2      | 0.123             | 0.124 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 2.11  | 614.95       | 4992.00 | 0.94 | 67.70  | 547.20 |
|                            | Length = 19.920 ft | 1      | 0.876             | 0.879 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 14.99 | 4,374.73     | 4992.00 | 6.67 | 481.17 | 547.20 |
| +1.130D-1.750E             | Length = 2.250 ft  | 2      | 0.876             | 0.879 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 14.99 | 4,374.73     | 4992.00 | 6.67 | 481.17 | 547.20 |
|                            | Length = 19.920 ft | 1      | 0.412             | 0.411 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 7.06  | 2,058.60     | 4992.00 | 3.12 | 225.13 | 547.20 |
| +1.097D+0.750L+0.750S+1.3  | Length = 2.250 ft  | 2      | 0.412             | 0.414 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 7.06  | 2,058.60     | 4992.00 | 3.14 | 226.51 | 547.20 |
|                            | Length = 19.920 ft | 1      | 0.718             | 0.721 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 12.28 | 3,583.09     | 4992.00 | 5.47 | 394.54 | 547.20 |
| +1.097D+0.750L+0.750S-1.31 | Length = 2.250 ft  | 2      | 0.718             | 0.721 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 12.28 | 3,583.09     | 4992.00 | 5.47 | 394.54 | 547.20 |
|                            | Length = 19.920 ft | 1      | 0.307             | 0.241 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 5.25  | 1,531.82     | 4992.00 | 1.83 | 132.13 | 547.20 |
| +0.4701D+1.750E            | Length = 2.250 ft  | 2      | 0.249             | 0.251 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 4.26  | 1,241.91     | 4992.00 | 1.90 | 137.12 | 547.20 |
|                            | Length = 19.920 ft | 1      | 0.741             | 0.743 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 12.68 | 3,698.45     | 4992.00 | 5.63 | 406.72 | 547.20 |
| +0.4701D-1.750E            | Length = 2.250 ft  | 2      | 0.741             | 0.743 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 12.68 | 3,698.45     | 4992.00 | 5.63 | 406.72 | 547.20 |
|                            | Length = 19.920 ft | 1      | 0.548             | 0.549 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 9.37  | 2,734.88     | 4992.00 | 4.16 | 300.20 | 547.20 |
|                            | Length = 2.250 ft  | 2      | 0.548             | 0.550 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 1.00 | 9.37  | 2,734.88     | 4992.00 | 4.17 | 300.77 | 547.20 |

**Overall Maximum Deflections**

| Load Combination | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|------------------|------|---------------|------------------|------------------|---------------|------------------|
| +D+0.70E         | 1    | 0.0000        | 0.000            | +D+0.70E         | -0.6575       | 11.796           |
|                  | 2    | 0.4536        | 2.250            |                  | 0.0000        | 11.796           |

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

| Load Combination         | Support 1 | Support 2 | Support 3 |
|--------------------------|-----------|-----------|-----------|
| Overall MAXimum          | 0.523     | 4.066     |           |
| Overall MINimum          | 0.316     | -3.116    |           |
| D Only                   | -0.044    | 1.885     |           |
| +D+L                     | 0.479     | 2.541     |           |
| +D+S                     | -0.048    | 1.922     |           |
| +D+0.750L                | 0.348     | 2.377     |           |
| +D+0.750L+0.750S         | 0.346     | 2.405     |           |
| +0.60D                   | -0.026    | 1.131     |           |
| +D+0.70E                 | -0.265    | 4.066     |           |
| +D-0.70E                 | 0.178     | -0.296    |           |
| +D+0.750L+0.750S+0.5250E | 0.180     | 4.041     |           |
| +D+0.750L+0.750S-0.5250E | 0.512     | 0.769     |           |
| +0.60D+0.70E             | -0.248    | 3.312     |           |
| +0.60D-0.70E             | 0.195     | -1.050    |           |
| L Only                   | 0.523     | 0.656     |           |
| S Only                   | -0.004    | 0.037     |           |
| E Only                   | -0.316    | 3.116     |           |
| E Only * -1.0            | 0.316     | -3.116    |           |



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Project Title:  
 Engineer:  
 Project ID:  
 Project Descr:

## Wood Beam

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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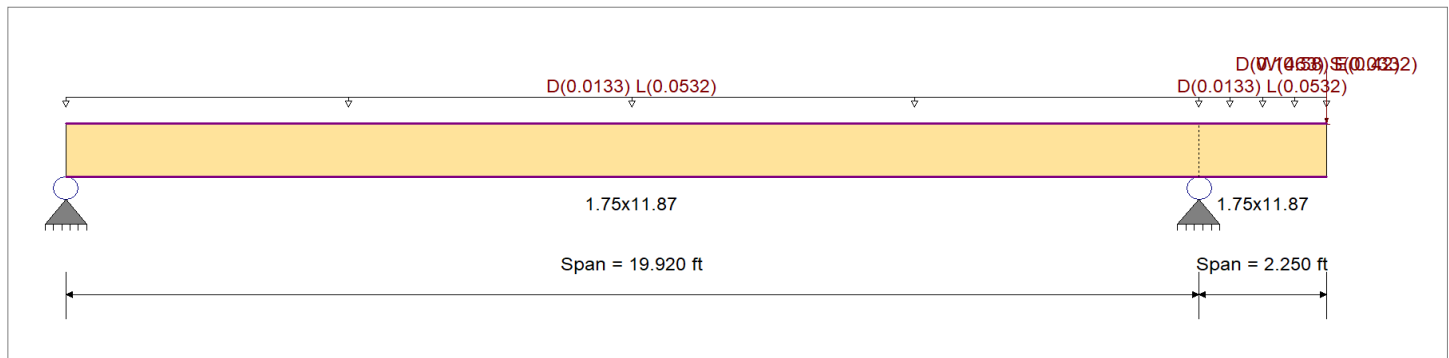
**DESCRIPTION:** B36 w/ HD

### CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

### Material Properties

|  |           |             |                           |
|--|-----------|-------------|---------------------------|
| Analysis Method : Allowable Stress Design                              | Fb +      | 2,600.0 psi | E : Modulus of Elasticity |
| Load Combination : ASCE 7-16   | Fb -      | 2,600.0 psi | Ebend- xx                 |
|  | Fc - Prll | 2,510.0 psi | Eminbend - xx             |
| Wood Species : iLevel Truss Joist                                      | Fc - Perp | 750.0 psi   |                           |
| Wood Grade : MicroLam LVL 1.9 E  | Fv        | 285.0 psi   |                           |
|  | Ft        | 1,555.0 psi | Density                   |
| Beam Bracing : Beam is Fully Braced against lateral-torsional buckling |           |             | 42.010pcf                 |



### Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added

Load for Span Number 1

Uniform Load : D = 0.010, L = 0.040 ksf, Tributary Width = 1.330 ft, (Floor)

Load for Span Number 2

Uniform Load : D = 0.010, L = 0.040 ksf, Tributary Width = 1.330 ft, (Floor)

Point Load : W = 0.580, E = 0.420 k @ 2.250 ft, (HD)

Point Load : D = 0.1463, S = 0.03320 k @ 2.250 ft, (BWA)

### DESIGN SUMMARY

**Design OK**

|                                     |   |                   |         |                                   |    |                   |                            |
|-------------------------------------|---|-------------------|---------|-----------------------------------|----|-------------------|----------------------------|
| <b>Maximum Bending Stress Ratio</b> | = | <b>0.343</b>      | 1       | <b>Maximum Shear Stress Ratio</b> | =  | <b>0.159</b>      | 1                          |
| Section used for this span          |   | <b>1.75x11.87</b> |         | Section used for this span        |    | <b>1.75x11.87</b> |                            |
| fb: Actual                          | = | 891.15psi         |         | fv: Actual                        | =  | 45.34 psi         |                            |
| Fb: Allowable                       | = | 2,600.00psi       |         | Fv: Allowable                     | =  | 285.00 psi        |                            |
| Load Combination                    |   | +D+L              |         | Load Combination                  |    | +D+L              |                            |
| Location of maximum on span         | = | 9.571ft           |         | Location of maximum on span       | =  | 19.030ft          |                            |
| Span # where maximum occurs         | = | Span # 1          |         | Span # where maximum occurs       | =  | Span # 1          |                            |
| <b>Maximum Deflection</b>           |   |                   |         |                                   |    |                   |                            |
| Max Downward Transient Deflection   |   | 0.397 in          | Ratio = | 601                               | >= | 360               | Span: 2 : W Only           |
| Max Upward Transient Deflection     |   | -0.139 in         | Ratio = | 388                               | >= | 360               | Span: 2 : L Only           |
| Max Downward Total Deflection       |   | 0.466 in          | Ratio = | 512                               | >= | 180               | Span: 2 : +0.60D+0.60W     |
| Max Upward Total Deflection         |   | -0.155 in         | Ratio = | 348                               | >= | 180               | Span: 2 : +D+0.750L-0.450W |

### Maximum Forces & Stresses for Load Combinations

| Load Combination | Segment Length     | Span # | Max Stress Ratios |       |                |                  |                |                |                |                | Moment Values  |      |        | Shear Values |      |       |        |
|------------------|--------------------|--------|-------------------|-------|----------------|------------------|----------------|----------------|----------------|----------------|----------------|------|--------|--------------|------|-------|--------|
|                  |                    |        | M                 | V     | C <sub>d</sub> | C <sub>F/V</sub> | C <sub>i</sub> | C <sub>r</sub> | C <sub>m</sub> | C <sub>t</sub> | C <sub>L</sub> | M    | fb     | F'b          | V    | fv    | F'v    |
| D Only           |                    |        |                   |       |                |                  |                |                |                |                |                |      |        |              |      |       |        |
|                  | Length = 19.920 ft | 1      | 0.061             | 0.046 | 0.90           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 0.49 | 143.18 | 2340.00      | 0.16 | 11.78 | 256.50 |
|                  | Length = 2.250 ft  | 2      | 0.045             | 0.046 | 0.90           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 0.36 | 105.86 | 2340.00      | 0.16 | 11.78 | 256.50 |
| +D+L             |                    |        |                   |       |                |                  |                |                |                |                |                |      |        |              |      |       |        |
|                  | Length = 19.920 ft | 1      | 0.343             | 0.159 | 1.00           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 3.05 | 891.15 | 2600.00      | 0.63 | 45.34 | 285.00 |
|                  | Length = 2.250 ft  | 2      | 0.056             | 0.159 | 1.00           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 0.50 | 145.15 | 2600.00      | 0.23 | 45.34 | 285.00 |
| +D+S             |                    |        |                   |       |                |                  |                |                |                |                |                |      |        |              |      |       |        |
|                  | Length = 19.920 ft | 1      | 0.045             | 0.043 | 1.15           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 0.46 | 133.93 | 2990.00      | 0.20 | 14.18 | 327.75 |





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**Wood Beam**

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION: B36 w/ HD**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

| Load Combination         | Support 1 | Support 2 | Support 3 |
|--------------------------|-----------|-----------|-----------|
| D Only                   | 0.114     | 0.327     |           |
| +D+L                     | 0.637     | 0.983     |           |
| +D+S                     | 0.111     | 0.364     |           |
| +D+0.750L                | 0.507     | 0.819     |           |
| +D+0.750L+0.750S         | 0.504     | 0.847     |           |
| +D+0.60W                 | 0.075     | 0.714     |           |
| +D-0.60W                 | 0.154     | -0.060    |           |
| +D+0.750L+0.450W         | 0.477     | 1.110     |           |
| +D+0.750L-0.450W         | 0.536     | 0.529     |           |
| +D+0.750L+0.750S+0.450W  | 0.474     | 1.137     |           |
| +D+0.750L+0.750S-0.450W  | 0.533     | 0.556     |           |
| +0.60D+0.60W             | 0.029     | 0.583     |           |
| +0.60D-0.60W             | 0.108     | -0.191    |           |
| +D+0.70E                 | 0.081     | 0.654     |           |
| +D-0.70E                 | 0.147     | -0.000    |           |
| +D+0.750L+0.750S+0.5250E | 0.479     | 1.092     |           |
| +D+0.750L+0.750S-0.5250E | 0.529     | 0.601     |           |
| +0.60D+0.70E             | 0.035     | 0.523     |           |
| +0.60D-0.70E             | 0.102     | -0.131    |           |
| L Only                   | 0.523     | 0.656     |           |
| S Only                   | -0.004    | 0.037     |           |
| W Only                   | -0.066    | 0.646     |           |
| -W                       | 0.066     | -0.646    |           |
| E Only                   | -0.047    | 0.467     |           |
| E Only * -1.0            | 0.047     | -0.467    |           |



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## Wood Beam

Project File: Beams.ec6

LIC#: KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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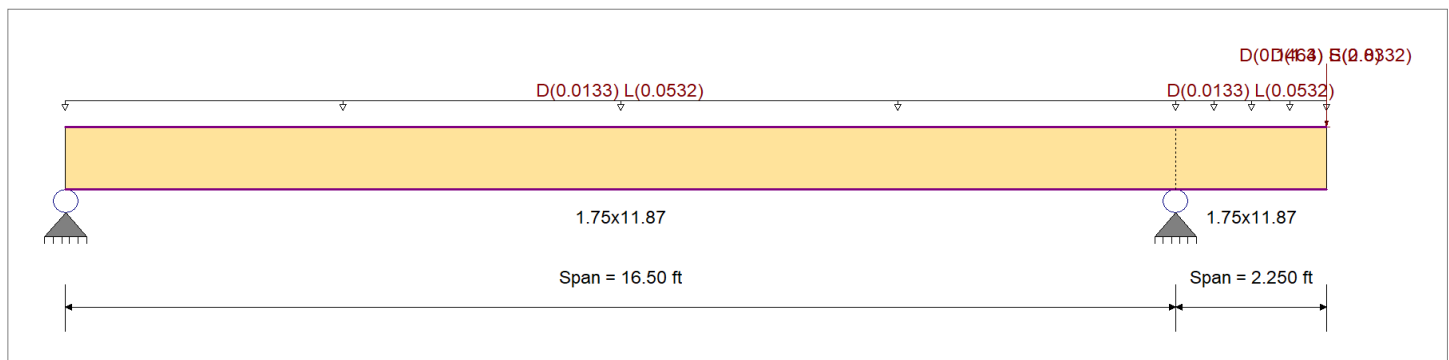
**DESCRIPTION:** B40 w/ Overstrength

### CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

### Material Properties

|  |           |             |                           |
|--|-----------|-------------|---------------------------|
| Analysis Method : Allowable Stress Design                              | Fb +      | 3,120.0 psi | E : Modulus of Elasticity |
| Load Combination : ASCE 7-16   | Fb -      | 3,120.0 psi | Ebend- xx                 |
|  | Fc - Prll | 3,012.0 psi | Eminbend - xx             |
| Wood Species : iLevel Truss Joist                                      | Fc - Perp | 900.0 psi   |                           |
| Wood Grade : MicroLam LVL 1.9 E  | Fv        | 342.0 psi   |                           |
|  | Ft        | 1,866.0 psi | Density                   |
| Beam Bracing : Beam is Fully Braced against lateral-torsional buckling |           |             | 42.010pcf                 |



### Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added

Load for Span Number 1

Uniform Load : D = 0.010, L = 0.040 ksf, Tributary Width = 1.330 ft, (Floor)

Load for Span Number 2

Uniform Load : D = 0.010, L = 0.040 ksf, Tributary Width = 1.330 ft, (Floor)

Point Load : D = 1.40, E = 2.80 k @ 2.250 ft, (SW #107)

Point Load : D = 0.1463, S = 0.03320 k @ 2.250 ft, (BWA)

### DESIGN SUMMARY

**Design OK**

|                                     |   |                   |         |                                   |    |                   |                         |
|-------------------------------------|---|-------------------|---------|-----------------------------------|----|-------------------|-------------------------|
| <b>Maximum Bending Stress Ratio</b> | = | <b>0.876</b>      | 1       | <b>Maximum Shear Stress Ratio</b> | =  | <b>0.879</b>      | : 1                     |
| Section used for this span          |   | <b>1.75x11.87</b> |         | Section used for this span        |    | <b>1.75x11.87</b> |                         |
| fb: Actual                          | = | 4,374.73psi       |         | fv: Actual                        | =  | 481.17 psi        |                         |
| Fb: Allowable                       | = | 4,992.00psi       |         | Fv: Allowable                     | =  | 547.20 psi        |                         |
| Load Combination                    |   | +1.130D+1.750E    |         | Load Combination                  |    | +1.130D+1.750E    |                         |
| Location of maximum on span         | = | 16.500ft          |         | Location of maximum on span       | =  | 16.500 ft         |                         |
| Span # where maximum occurs         | = | Span # 1          |         | Span # where maximum occurs       | =  | Span # 1          |                         |
| <b>Maximum Deflection</b>           |   |                   |         |                                   |    |                   |                         |
| Max Downward Transient Deflection   |   | 0.330 in          | Ratio = | 162                               | >= | 138               | Span: 2 : E Only        |
| Max Upward Transient Deflection     |   | -0.330 in         | Ratio = | 162                               | >= | 138               | Span: 2 : E Only * -1.0 |
| Max Downward Total Deflection       |   | 0.394 in          | Ratio = | 136                               | >= | 118               | Span: 2 : +D+0.70E      |
| Max Upward Total Deflection         |   | -0.133 in         | Ratio = | 404                               | >= | 118               | Span: 2 : +0.60D-0.70E  |

### Maximum Forces & Stresses for Load Combinations

| Load Combination | Segment Length    | Span # | Max Stress Ratios |       |                |                  |                |                |                |                | Moment Values  |      |          | Shear Values |      |        |        |      |
|------------------|-------------------|--------|-------------------|-------|----------------|------------------|----------------|----------------|----------------|----------------|----------------|------|----------|--------------|------|--------|--------|------|
|                  |                   |        | M                 | V     | C <sub>d</sub> | C <sub>F/V</sub> | C <sub>i</sub> | C <sub>r</sub> | C <sub>m</sub> | C <sub>t</sub> | C <sub>L</sub> | M    | fb       | F'b          | V    | fv     | F'v    |      |
| D Only           |                   |        |                   |       |                |                  |                |                |                |                |                |      |          |              |      |        |        |      |
|                  | Length = 16.50 ft | 1      | 0.365             | 0.367 | 0.90           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 3.51 | 1,024.91 | 2808.00      | 1.56 | 112.83 | 307.80 |      |
|                  | Length = 2.250 ft | 2      | 0.365             | 0.367 | 0.90           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 3.51 | 1,024.91 | 2808.00      | 1.56 | 112.83 | 307.80 |      |
| +D+L             |                   |        |                   |       |                |                  |                |                |                |                |                |      |          |              |      |        |        |      |
|                  | Length = 16.50 ft | 1      | 0.341             | 0.344 | 1.00           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 3.65 | 1,064.20 | 3120.00      | 1.63 | 117.71 | 342.00 | 0.00 |
|                  | Length = 2.250 ft | 2      | 0.341             | 0.344 | 1.00           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 3.65 | 1,064.20 | 3120.00      | 1.63 | 117.71 | 342.00 | 0.00 |
| +D+S             |                   |        |                   |       |                |                  |                |                |                |                |                |      |          |              |      |        |        |      |
|                  | Length = 16.50 ft | 1      | 0.292             | 0.293 | 1.15           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 3.59 | 1,046.70 | 3588.00      | 1.60 | 115.23 | 393.30 | 0.00 |



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Project Title:  
 Engineer:  
 Project ID:  
 Project Descr:

**Wood Beam**

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION: B40 w/ Overstrength**

**Maximum Forces & Stresses for Load Combinations**

| Load Combination           | Segment Length    | Span # | Max Stress Ratios |       |                |                  |                |                |                |                |                | Moment Values |       |          | Shear Values |      |        |        |
|----------------------------|-------------------|--------|-------------------|-------|----------------|------------------|----------------|----------------|----------------|----------------|----------------|---------------|-------|----------|--------------|------|--------|--------|
|                            |                   |        | M                 | V     | C <sub>d</sub> | C <sub>F/V</sub> | C <sub>i</sub> | C <sub>r</sub> | C <sub>m</sub> | C <sub>t</sub> | C <sub>L</sub> | M             | fb    | F'b      | V            | fv   | F'v    |        |
| +D+0.750L                  | Length = 2.250 ft | 2      | 0.292             | 0.293 | 1.15           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 3.59  | 1,046.70 | 3588.00      | 1.60 | 115.23 | 393.30 |
|                            | Length = 16.50 ft | 1      | 0.270             | 0.272 | 1.25           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 3.61  | 1,054.38 | 3900.00      | 1.61 | 116.49 | 427.50 |
| +D+0.750L+0.750S           | Length = 2.250 ft | 2      | 0.270             | 0.272 | 1.25           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 3.61  | 1,054.38 | 3900.00      | 1.61 | 116.49 | 427.50 |
|                            | Length = 16.50 ft | 1      | 0.298             | 0.301 | 1.15           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 3.67  | 1,070.72 | 3588.00      | 1.64 | 118.29 | 393.30 |
| +0.60D                     | Length = 2.250 ft | 2      | 0.298             | 0.301 | 1.15           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 3.67  | 1,070.72 | 3588.00      | 1.64 | 118.29 | 393.30 |
|                            | Length = 16.50 ft | 1      | 0.123             | 0.124 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 2.11  | 614.95   | 4992.00      | 0.94 | 67.70  | 547.20 |
| +1.130D+1.750E             | Length = 2.250 ft | 2      | 0.123             | 0.124 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 2.11  | 614.95   | 4992.00      | 0.94 | 67.70  | 547.20 |
|                            | Length = 16.50 ft | 1      | 0.876             | 0.879 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 14.99 | 4,374.73 | 4992.00      | 6.67 | 481.17 | 547.20 |
| +1.130D-1.750E             | Length = 2.250 ft | 2      | 0.876             | 0.879 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 14.99 | 4,374.73 | 4992.00      | 6.67 | 481.17 | 547.20 |
|                            | Length = 16.50 ft | 1      | 0.412             | 0.411 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 7.06  | 2,058.60 | 4992.00      | 3.12 | 225.13 | 547.20 |
| +1.097D+0.750L+0.750S+1.3  | Length = 2.250 ft | 2      | 0.412             | 0.414 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 7.06  | 2,058.60 | 4992.00      | 3.14 | 226.51 | 547.20 |
|                            | Length = 16.50 ft | 1      | 0.718             | 0.721 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 12.28 | 3,583.09 | 4992.00      | 5.47 | 394.54 | 547.20 |
| +1.097D+0.750L+0.750S-1.31 | Length = 2.250 ft | 2      | 0.718             | 0.721 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 12.28 | 3,583.09 | 4992.00      | 5.47 | 394.54 | 547.20 |
|                            | Length = 16.50 ft | 1      | 0.268             | 0.241 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 4.59  | 1,340.19 | 4992.00      | 1.83 | 132.13 | 547.20 |
| +0.4701D+1.750E            | Length = 2.250 ft | 2      | 0.249             | 0.251 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 4.26  | 1,241.91 | 4992.00      | 1.90 | 137.12 | 547.20 |
|                            | Length = 16.50 ft | 1      | 0.741             | 0.743 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 12.68 | 3,698.45 | 4992.00      | 5.63 | 406.72 | 547.20 |
| +0.4701D-1.750E            | Length = 2.250 ft | 2      | 0.741             | 0.743 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 12.68 | 3,698.45 | 4992.00      | 5.63 | 406.72 | 547.20 |
|                            | Length = 16.50 ft | 1      | 0.548             | 0.549 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 9.37  | 2,734.88 | 4992.00      | 4.16 | 300.20 | 547.20 |
|                            | Length = 2.250 ft | 2      | 0.548             | 0.550 | 1.60           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 1.00          | 9.37  | 2,734.88 | 4992.00      | 4.17 | 300.77 | 547.20 |

**Overall Maximum Deflections**

| Load Combination | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|------------------|------|---------------|------------------|------------------|---------------|------------------|
| +D+0.70E         | 1    | 0.0000        | 0.000            | +D+0.70E         | -0.4723       | 9.679            |
|                  | 2    | 0.3938        | 2.250            |                  | 0.0000        | 9.679            |

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

| Load Combination         | Support 1 | Support 2 | Support 3 |
|--------------------------|-----------|-----------|-----------|
| Overall MAXimum          | 0.431     | 4.126     |           |
| Overall MINimum          | 0.382     | -3.182    |           |
| D Only                   | -0.103    | 1.899     |           |
| +D+L                     | 0.328     | 2.466     |           |
| +D+S                     | -0.108    | 1.937     |           |
| +D+0.750L                | 0.220     | 2.324     |           |
| +D+0.750L+0.750S         | 0.216     | 2.352     |           |
| +0.60D                   | -0.062    | 1.139     |           |
| +D+0.70E                 | -0.370    | 4.126     |           |
| +D-0.70E                 | 0.164     | -0.328    |           |
| +D+0.750L+0.750S+0.5250E | 0.016     | 4.023     |           |
| +D+0.750L+0.750S-0.5250E | 0.417     | 0.682     |           |
| +0.60D+0.70E             | -0.329    | 3.367     |           |
| +0.60D-0.70E             | 0.205     | -1.088    |           |
| L Only                   | 0.431     | 0.567     |           |
| S Only                   | -0.005    | 0.038     |           |
| E Only                   | -0.382    | 3.182     |           |
| E Only * -1.0            | 0.382     | -3.182    |           |



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Project Title:  
 Engineer:  
 Project ID:  
 Project Descr:

## Wood Beam

Project File: Beams.ec6

LIC#: KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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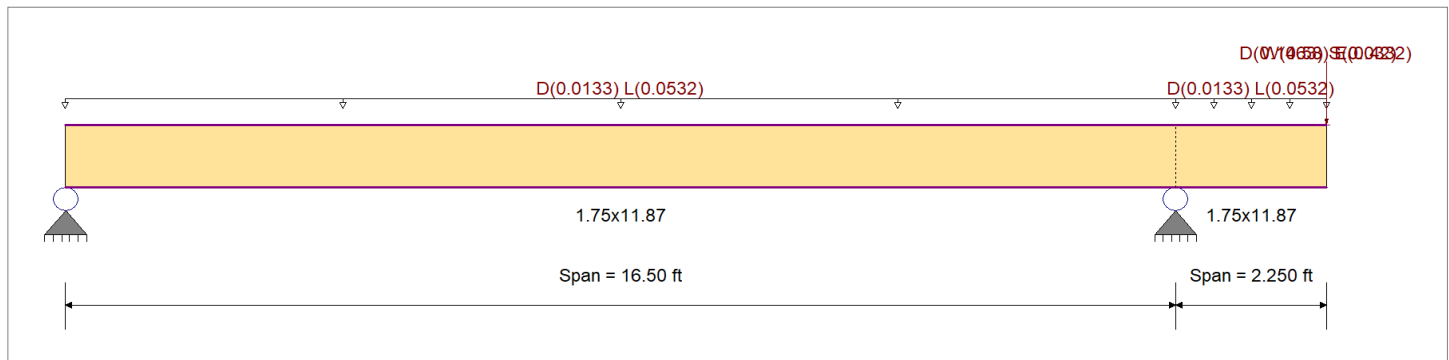
**DESCRIPTION:** B40 w/ HD

### CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

### Material Properties

|  |           |             |                           |
|--|-----------|-------------|---------------------------|
| Analysis Method : Allowable Stress Design                              | Fb +      | 2,600.0 psi | E : Modulus of Elasticity |
| Load Combination : ASCE 7-16   | Fb -      | 2,600.0 psi | Ebend- xx                 |
|  | Fc - Prll | 2,510.0 psi | Eminbend - xx             |
| Wood Species : iLevel Truss Joist                                      | Fc - Perp | 750.0 psi   |                           |
| Wood Grade : MicroLam LVL 1.9 E  | Fv        | 285.0 psi   |                           |
|  | Ft        | 1,555.0 psi | Density                   |
| Beam Bracing : Beam is Fully Braced against lateral-torsional buckling |           |             | 42.010pcf                 |



### Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added

Load for Span Number 1

Uniform Load : D = 0.010, L = 0.040 ksf, Tributary Width = 1.330 ft, (Floor)

Load for Span Number 2

Uniform Load : D = 0.010, L = 0.040 ksf, Tributary Width = 1.330 ft, (Floor)

Point Load : W = 0.580, E = 0.420 k @ 2.250 ft, (HD)

Point Load : D = 0.1463, S = 0.03320 k @ 2.250 ft, (BWA)

### DESIGN SUMMARY

**Design OK**

|                                     |   |                   |         |                   |                                   |   |                   |   |          |
|-------------------------------------|---|-------------------|---------|-------------------|-----------------------------------|---|-------------------|---|----------|
| <b>Maximum Bending Stress Ratio</b> | = | <b>0.227</b>      | :       | <b>1</b>          | <b>Maximum Shear Stress Ratio</b> | = | <b>0.131</b>      | : | <b>1</b> |
| Section used for this span          |   | <b>1.75x11.87</b> |         |                   | Section used for this span        |   | <b>1.75x11.87</b> |   |          |
| fb: Actual                          | = | 589.68psi         |         |                   | fv: Actual                        | = | 37.35 psi         |   |          |
| Fb: Allowable                       | = | 2,600.00psi       |         |                   | Fv: Allowable                     | = | 285.00 psi        |   |          |
| Load Combination                    |   | +D+L              |         |                   | Load Combination                  |   | +D+L              |   |          |
| Location of maximum on span         | = | 7.835ft           |         |                   | Location of maximum on span       | = | 15.578 ft         |   |          |
| Span # where maximum occurs         | = | Span # 1          |         |                   | Span # where maximum occurs       | = | Span # 1          |   |          |
| <b>Maximum Deflection</b>           |   |                   |         |                   |                                   |   |                   |   |          |
| Max Downward Transient Deflection   |   | 0.068 in          | Ratio = | <b>790</b> >= 360 | Span: 2 : W Only                  |   |                   |   |          |
| Max Upward Transient Deflection     |   | -0.077 in         | Ratio = | <b>704</b> >= 360 | Span: 2 : L Only                  |   |                   |   |          |
| Max Downward Total Deflection       |   | 0.210 in          | Ratio = | <b>945</b> >= 180 | Span: 2 : +0.60D+0.60W            |   |                   |   |          |
| Max Upward Total Deflection         |   | -0.090 in         | Ratio = | <b>598</b> >= 180 | Span: 2 : +D+0.750L-0.450W        |   |                   |   |          |

### Maximum Forces & Stresses for Load Combinations

| Load Combination | Segment Length    | Span # | Max Stress Ratios |       |                |                  |                |                |                |                | Moment Values  |      |        | Shear Values |      |       |        |  |
|------------------|-------------------|--------|-------------------|-------|----------------|------------------|----------------|----------------|----------------|----------------|----------------|------|--------|--------------|------|-------|--------|--|
|                  |                   |        | M                 | V     | C <sub>d</sub> | C <sub>F/V</sub> | C <sub>i</sub> | C <sub>r</sub> | C <sub>m</sub> | C <sub>t</sub> | C <sub>L</sub> | M    | fb     | F'b          | V    | fv    | F'v    |  |
| D Only           |                   |        |                   |       |                |                  |                |                |                |                |                |      |        |              |      |       |        |  |
|                  | Length = 16.50 ft | 1      | 0.045             | 0.046 | 0.90           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 0.36 | 105.86 | 2340.00      | 0.16 | 11.78 | 256.50 |  |
|                  | Length = 2.250 ft | 2      | 0.045             | 0.046 | 0.90           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 0.36 | 105.86 | 2340.00      | 0.16 | 11.78 | 256.50 |  |
| +D+L             |                   |        |                   |       |                |                  |                |                |                |                |                |      |        |              |      |       |        |  |
|                  | Length = 16.50 ft | 1      | 0.227             | 0.131 | 1.00           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 2.02 | 589.68 | 2600.00      | 0.52 | 37.35 | 285.00 |  |
|                  | Length = 2.250 ft | 2      | 0.056             | 0.131 | 1.00           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 0.50 | 145.15 | 2600.00      | 0.23 | 37.35 | 285.00 |  |
| +D+S             |                   |        |                   |       |                |                  |                |                |                |                |                |      |        |              |      |       |        |  |
|                  | Length = 16.50 ft | 1      | 0.043             | 0.043 | 1.15           | 1.000            | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           | 0.44 | 127.66 | 2990.00      | 0.20 | 14.18 | 327.75 |  |







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**Wood Beam**

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION: B40 w/ HD**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

| Load Combination         | Support 1 | Support 2 | Support 3 |
|--------------------------|-----------|-----------|-----------|
| D Only                   | 0.088     | 0.308     |           |
| +D+L                     | 0.518     | 0.875     |           |
| +D+S                     | 0.083     | 0.346     |           |
| +D+0.750L                | 0.411     | 0.733     |           |
| +D+0.750L+0.750S         | 0.407     | 0.761     |           |
| +D+0.60W                 | 0.040     | 0.703     |           |
| +D-0.60W                 | 0.135     | -0.088    |           |
| +D+0.750L+0.450W         | 0.375     | 1.030     |           |
| +D+0.750L-0.450W         | 0.446     | 0.436     |           |
| +D+0.750L+0.750S+0.450W  | 0.372     | 1.058     |           |
| +D+0.750L+0.750S-0.450W  | 0.443     | 0.465     |           |
| +0.60D+0.60W             | 0.005     | 0.580     |           |
| +0.60D-0.60W             | 0.100     | -0.211    |           |
| +D+0.70E                 | 0.048     | 0.642     |           |
| +D-0.70E                 | 0.128     | -0.026    |           |
| +D+0.750L+0.750S+0.5250E | 0.377     | 1.012     |           |
| +D+0.750L+0.750S-0.5250E | 0.437     | 0.511     |           |
| +0.60D+0.70E             | 0.013     | 0.519     |           |
| +0.60D-0.70E             | 0.093     | -0.149    |           |
| L Only                   | 0.431     | 0.567     |           |
| S Only                   | -0.005    | 0.038     |           |
| W Only                   | -0.079    | 0.659     |           |
| -W                       | 0.079     | -0.659    |           |
| E Only                   | -0.057    | 0.477     |           |
| E Only * -1.0            | 0.057     | -0.477    |           |



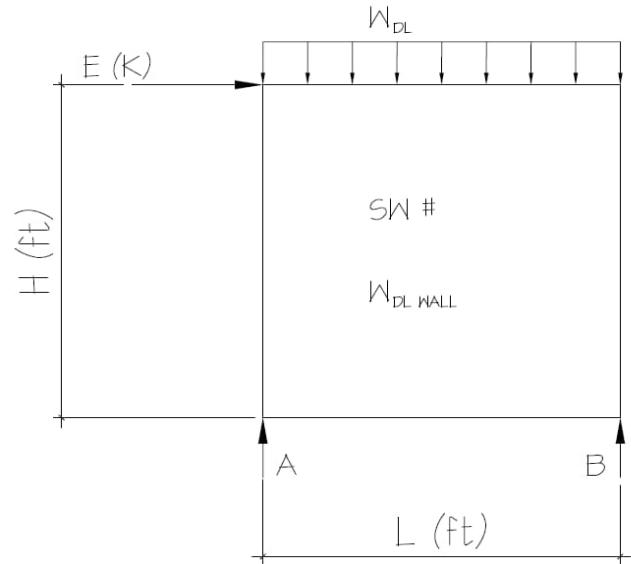
## Overstrength Calculations

### Wall Description/SW #:

200

Parameters:

L = 34.9 ft  
H = 8.0 ft  
E = 1.85 k  
 $W_{DLWall}$  = 0.08 kl f  
 $W_{DL}$  = 0.030 kl f  
 $\Omega_0$  = 2.5 (ASCE TABLE 12.2.1 FOOTNOTE G)  
SDS = 0.928



analysis:

$E_{mh} = \Omega_0 * E = 4.63$  K       $E_v = 0.2 * SDS * DL = 0.713$  K  
 $E_m = E_{mh} + E_v = 5.338$  K  
 $E_m = E_{mh} - E_v = 3.912$  K

$E_m (max) = \sum M_A = 0 = 5.34(8.0) + 0.11(34.92)(17.46) - R_b(34.92)$        $R_B = 1.9DL + 1.2E$   
 $R_a = 1.9DL - 1.2E$   
 $E_m (min) = \sum M_A = 0 = 3.91(8.0) + 0.11(34.92)(17.46) - R_b(34.92)$        $R_B = 1.9DL + 0.9E$   
 $R_a = 1.9DL - 0.9E$

check beams for axial forces shown using load combos per section 12.4.3.1 (asd)

allowable stress permitted to be increased by 1.2

see following beam calcs for load application



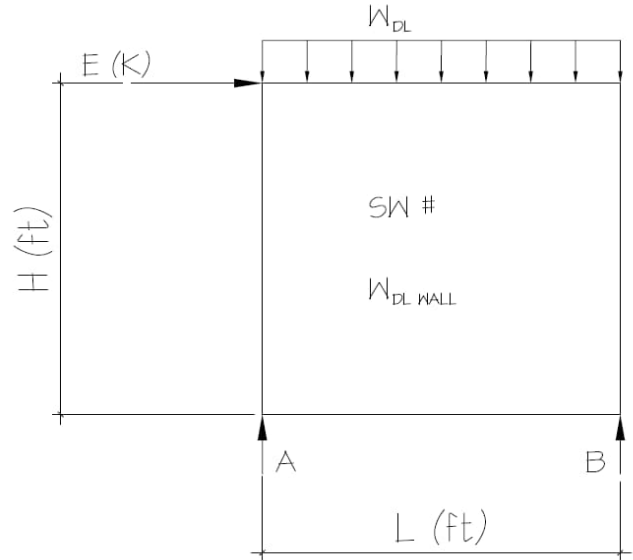
## Overstrength Calculations

### Wall Description/SW #:

201

Parameters:

|                |                                    |                                |
|----------------|------------------------------------|--------------------------------|
| L =            | <input type="text" value="15.2"/>  | ft                             |
| H =            | <input type="text" value="8.0"/>   | ft                             |
| E =            | <input type="text" value="1.15"/>  | k                              |
| $W_{DLWall}$ = | <input type="text" value="0.08"/>  | kl f                           |
| $W_{DL}$ =     | <input type="text" value="0.086"/> | kl f                           |
| $\Omega_0$ =   | <input type="text" value="2.5"/>   | (ASCE TABLE 12.2.1 FOOTNOTE G) |
| SDS =          | <input type="text" value="0.928"/> |                                |



analysis:

|                           |                                   |   |                          |                                    |   |
|---------------------------|-----------------------------------|---|--------------------------|------------------------------------|---|
| $E_{mh} = \Omega_0 * E =$ | <input type="text" value="2.88"/> | K | $E_v = 0.2 * SDS * DL =$ | <input type="text" value="0.467"/> | K |
| $E_m = E_{mh} + E_v$      |                                   |   | $E_m = E_{mh} + E_v =$   | <input type="text" value="3.342"/> | K |
| $E_m = E_{mh} - E_v$      |                                   |   | $E_m = E_{mh} - E_v =$   | <input type="text" value="2.408"/> | K |

|                              |   |         |   |
|------------------------------|---|---------|---|
| $E_m (max) = \sum M_A = 0 =$ | <input type="text" value="3.34(8.0) + 0.166(15.17)(7.585) - R_b(15.17)"/> | $R_b =$ | <input type="text" value="1.3DL + 1.8E"/> |
|                              |   | $R_a =$ | <input type="text" value="1.3DL - 1.8E"/> |
| $E_m (min) = \sum M_A = 0 =$ | <input type="text" value="2.41(8.0) + 0.166(15.17)(7.585) - R_b(15.17)"/> | $R_b =$ | <input type="text" value="1.3DL + 1.3E"/> |
|                              |   | $R_a =$ | <input type="text" value="1.3DL - 1.3E"/> |

check beams for axial forces shown using load combos per section 12.4.3.1 (asd)

allowable stress permitted to be increased by 1.2

see following beam calcs for load application



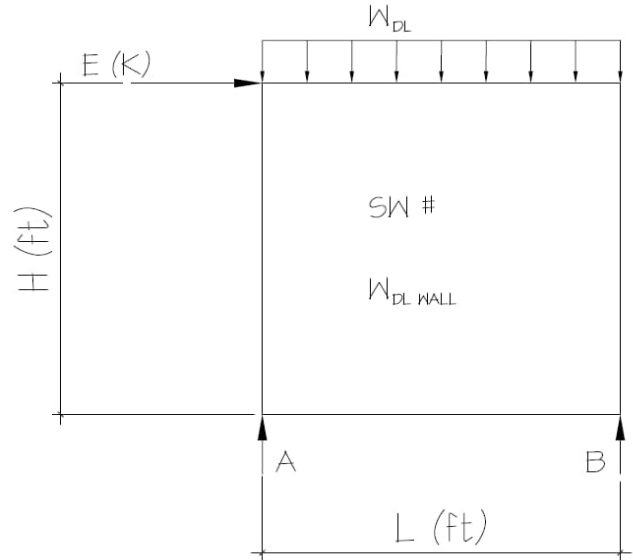
## Overstrength Calculations

Wall Description/SW #:

202

Parameters:

L = 8.0 ft  
H = 8.0 ft  
E = 0.70 k  
W<sub>DLWall</sub> = 0.08 kl f  
W<sub>DL</sub> = 0.038 kl f  
Ω<sub>0</sub> = 2.5 (ASCE TABLE 12.2.1 FOOTNOTE G)  
SDS = 0.928



analysis:

$$E_{mh} = \Omega_0 * E = 1.75 \text{ K} \quad E_v = 0.2 * SDS * DL = 0.175 \text{ K}$$

$$E_m = E_{mh} + E_v = 1.925 \text{ K}$$

$$E_m = E_{mh} - E_v = 1.575 \text{ K}$$

$$E_m (\text{max}) = \sum M_A = 0 = 1.93(8.0) + 0.118(8)(4) - R_b(8) \quad R_b = 0.5DL + 1.9E$$

$$R_a = 0.5DL - 1.9E$$

$$E_m (\text{min}) = \sum M_A = 0 = 1.57(8.0) + 0.118(8)(4) - R_b(8) \quad R_b = 0.5DL + 1.6E$$

$$R_a = 0.5DL - 1.6E$$

check beams for axial forces shown using load combos per section 12.4.3.1 (asd)

allowable stress permitted to be increased by 1.2

see following beam  
calcs for load  
application



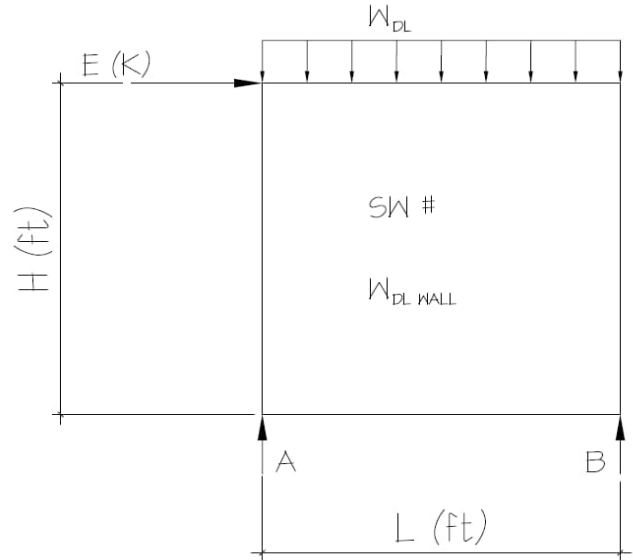
## Overstrength Cal cul ations

### Wall Description/SW #:

203

Parameters:

L = 18.3 ft  
H = 8.0 ft  
E = 0.82 k  
 $W_{DLWall}$  = 0.08 kl f  
 $W_{DL}$  = 0.114 kl f  
 $\Omega_0$  = 2.5 (ASCE TABLE 12.2.1 FOOTNOTE G)  
SDS = 0.928



analysis:

$E_{mh} = \Omega_0 * E = 2.05$  K       $E_v = 0.2 * SDS * DL = 0.660$  K  
 $E_m = E_{mh} + E_v = 2.710$  K  
 $E_m = E_{mh} - E_v = 1.390$  K

$E_m (max) = \sum M_A = 0 = 2.71(8.0) + 0.194(18.33)(9.165) - R_b(18.33)$        $R_b = 1.8DL + 1.2E$   
 $R_a = 1.8DL - 1.2E$   
 $E_m (min) = \sum M_A = 0 = 1.39(8.0) + 0.194(18.33)(9.165) - R_b(18.33)$        $R_b = 1.8DL + 0.6E$   
 $R_a = 1.8DL - 0.6E$

check beams for axial forces shown using load combos per section 12.4.3.1 (asd)

allowable stress permitted to be increased by 1.2

see following beam cal cs for load application



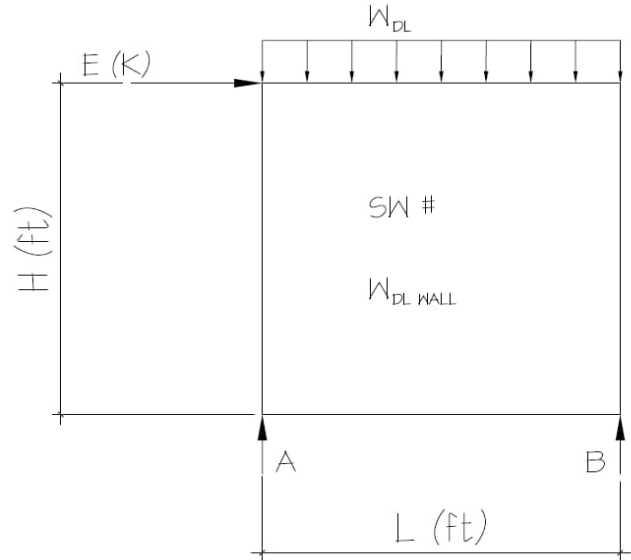
## Overstrength Cal cul ations

### Wall Description/SW #:

205

Parameters:

L = 16.8 ft  
H = 8.0 ft  
E = 1.85 k  
 $W_{DLWall}$  = 0.08 kl f  
 $W_{DL}$  = 0.071 kl f  
 $\Omega_0$  = 2.5 (ASCE TABLE 12.2.1 FOOTNOTE G)  
SDS = 0.928



analysis:

$E_{mh} = \Omega_0 * E = 4.63$  K       $E_v = 0.2 * SDS * DL = 0.472$  K  
 $E_m = E_{mh} + E_v = 5.097$  K  
 $E_m = E_{mh} - E_v = 4.153$  K

$E_m$  (max) =  $\sum M_A = 0 = 5.10(8.0) + 0.151(16.83)(8.415) - R_b(16.83)$        $R_b = 1.3DL + 2.4E$   
 $R_a = 1.3DL - 2.4E$   
 $E_m$  (min) =  $\sum M_A = 0 = 4.15(8.0) + 0.151(16.83)(8.415) - R_b(16.83)$        $R_b = 1.3DL + 2.0E$   
 $R_a = 1.3DL - 2.0E$

check beams for axial forces shown using load combos per section 12.4.3.1 (asd)

allowable stress permitted to be increased by 1.2

see following beam cal cs for load application



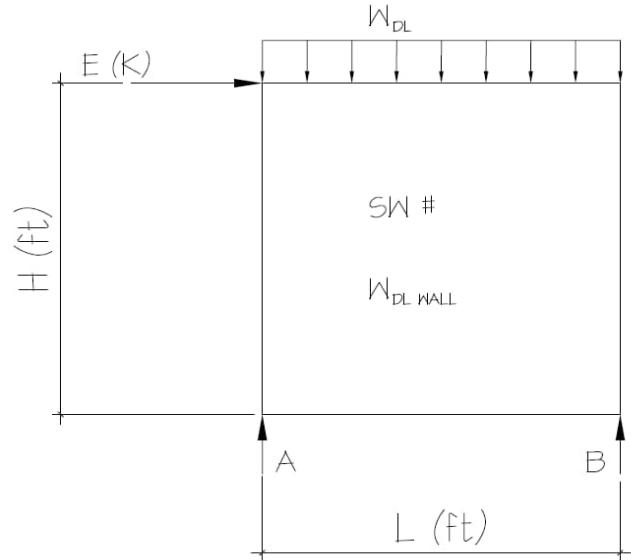
## Overstrength Cal cul ations

Wall Description/SW #:

107

Parameters:

L = 25.3 ft  
H = 9.5 ft  
E = 2.70 k  
W<sub>DLWall</sub> = 0.10 kl f  
W<sub>DL</sub> = 0.010 kl f  
Ω<sub>0</sub> = 2.5 (ASCE TABLE 12.2.1 FOOTNOTE G)  
SDS = 0.928



analysis:

$$E_{mh} = \Omega_0 * E = 6.75 \text{ K} \quad E_v = 0.2 * SDS * DL = 0.517 \text{ K}$$

$$E_m = E_{mh} + E_v = 7.267 \text{ K}$$

$$E_m = E_{mh} - E_v = 6.233 \text{ K}$$

$$E_m (\text{max}) = \sum M_A = 0 = 7.27(9.5) + 0.11(25.33)(12.665) - R_b(25.33) \quad R_b = 1.4DL + 2.7E$$

$$R_a = 1.4DL - 2.7E$$

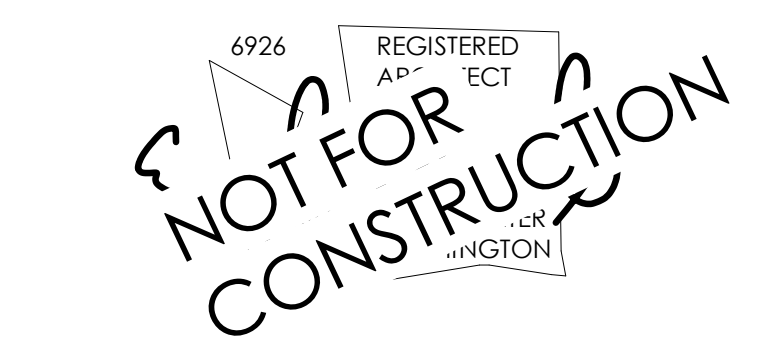
$$E_m (\text{min}) = \sum M_A = 0 = 6.23(9.5) + 0.11(25.33)(12.665) - R_b(25.33) \quad R_b = 1.4DL + 2.3E$$

$$R_a = 1.4DL - 2.3E$$

check beams for axial forces shown using load combos per section 12.4.3.1 (asd)

allowable stress permitted to be increased by 1.2

see following beam  
cal cs for load  
application

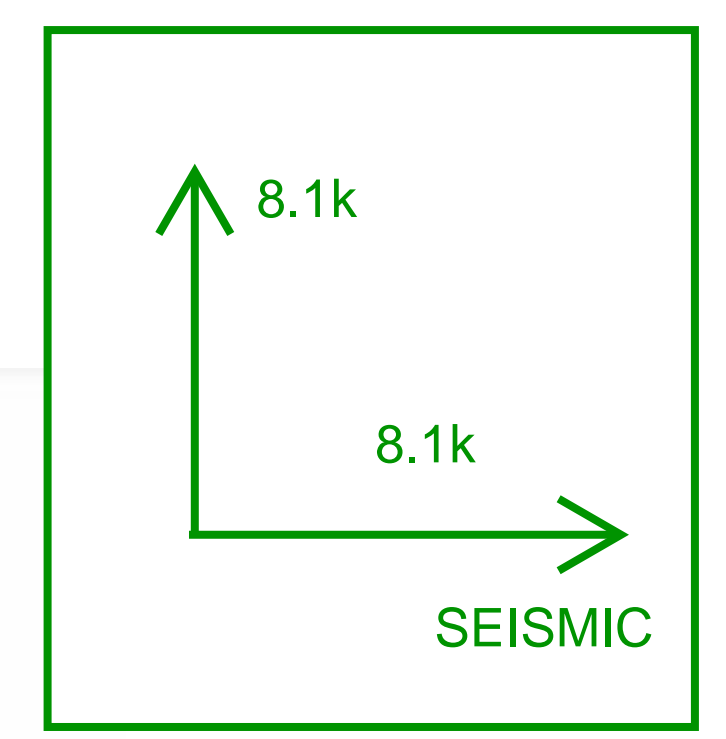


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**KEY NOTES**



**TABLE M1505.4.3(2) SYSTEM COEFFICIENT C<sub>system</sub>**

| SYSTEM TYPE  | DISTRIBUTED | NOT DISTRIBUTED |
|--------------|-------------|-----------------|
| Balanced     | 1.0         | 1.25            |
| Not balanced | 1.25        | 1.5             |

**TABLE M1505.4.3(3) INTERMITTENT OFF WHOLE-HOUSE MECHANICAL VENTILATION RATE FACTORS<sup>a,b</sup>**

| RUN-TIME % IN EACH 4-HOUR SEGMENT | 50% | 66% | 75% | 100% |
|-----------------------------------|-----|-----|-----|------|
| Factor <sup>a</sup>               | 2   | 1.5 | 1.3 | 1.0  |

**FOR REFERENCE ONLY  
 DELETE WHEN DONE**

For SI: 1 square foot = 0.0929 m<sup>2</sup>, 1 cubic foot per minute = 0.0004719 m<sup>3</sup>/s.

**HOUSE VENTILATION WITH HRV**

BALANCED WHOLE HOUSE VENTILATION REQUIREMENTS TO BE MET WITH A HEAT RECOVERY VENTILATION SYSTEM (HRV) PER M1505.4 AND WSEC ENERGY CREDIT OPTION 2.2/2.3/2.4. HRV TO HAVE MINIMUM SEPARATE HEAT RECOVERY EFFICIENCY OF 0.65/0.75/0.80. MINIMUM MECHANICAL VENTILATION AIRFLOW RATE TO BE 210 CFM (INTERMITTENT) - (4-5 BEDROOMS 400-6000 SF) TO OPERATE 50% OF TIME IN EACH 4-HOUR SEGMENT, PER TABLES M1505.4.3(1) AND M1505.4.3(3).

| SYMBOL | LOCATION      | MINIMUM FAN REQUIREMENTS   |
|--------|---------------|--|
| A      | BATH & POWDER | MINIMUM LOCAL EXHAUST RATE TO BE 50 CFM  |
| B      | KITCHEN       | MINIMUM LOCAL EXHAUST RATE TO BE 100 CFM PROVIDED BY RANGE HOOD OR DOWN DRAFT EXHAUST FAN, PER M1503.2<br>IF OVER 400 CFM, MAKEUP AIR IS REQUIRED IN THE SAME ROOM PER M1503.6** |
| C      | LAUNDRY ROOM  | MINIMUM LOCAL EXHAUST RATE TO BE 50 CFM  |

\*\* MAKEUP AIR IS NOT REQUIRED IF ALL GAS APPLIANCES IN THE HOUSE HAVE A DIRECT VENT OR MECHANICAL DRAFT VENT SYSTEM, PER MODIFICATION M1503.6.

**HOUSE VENTILATION NO HRV**

PROVIDE WHOLE HOUSE VENTILATION PER M1505.4 USING LAUNDRY ROOM EXHAUST FAN PER 1505.4.1.2 (WA) AND TABLE M1505.4.3(1), 8 (UPDATE). PROVIDE CONTROLS PER 1505.4.2. COMPLY WITH WSEC R403.6 (UPDATE).

| SYMBOL | LOCATION      | MINIMUM FAN REQUIREMENTS  |
|--------|---------------|---|
| A      | BATH & POWDER | MINIMUM LOCAL EXHAUST RATE TO BE 50 CFM (INTERMITTENT)  |
| B      | KITCHEN       | MINIMUM LOCAL EXHAUST RATE TO BE 100 CFM (INTERMITTENT) PROVIDED BY RANGE HOOD OR DOWN DRAFT EXHAUST FAN, PER M1503.2<br>IF OVER 400 CFM, MAKEUP AIR IS REQUIRED IN THE SAME ROOM PER M1503.6** |
| C      | LAUNDRY ROOM  | MIN. 210 CFM (INTERMITTENT) - TO FUNCTION AND BE LABELED AS WHOLE HOUSE FAN (4-5 BEDROOMS 400-6000 SF) TO OPERATE 50% OF TIME IN EACH 4-HOUR SEGMENT.   |

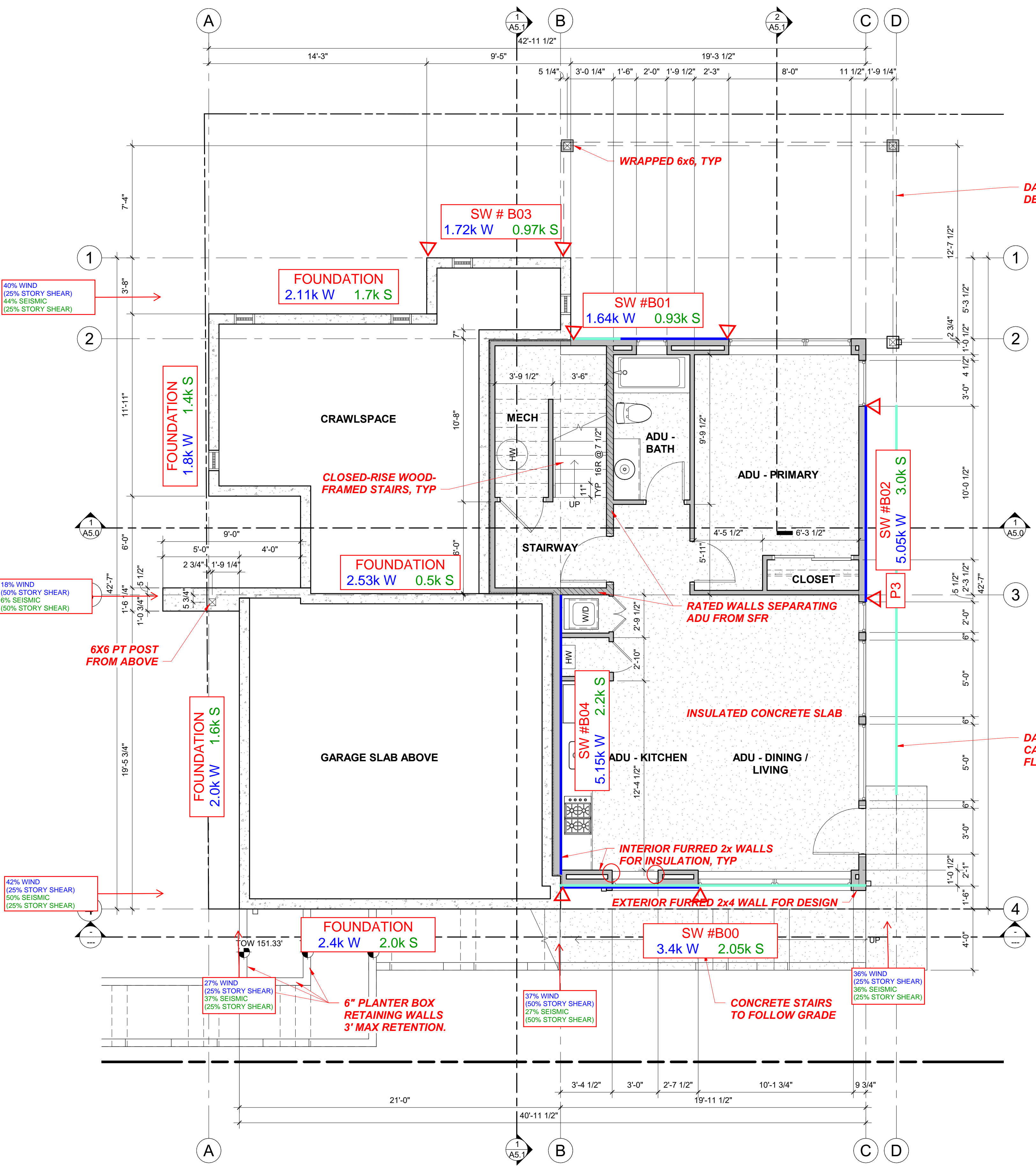
\*\* MAKEUP AIR IS NOT REQUIRED IF ALL GAS APPLIANCES IN THE HOUSE HAVE A DIRECT VENT OR MECHANICAL DRAFT VENT SYSTEM, PER MODIFICATION M1503.6.

**FLOOR PLAN NOTES**

- CONTRACTOR SHALL VERIFY ALL NOTES, DIMENSIONS & CONDITIONS PRIOR TO CONSTRUCTION.
- SEE STRUCTURAL DRAWINGS FOR ALL POSTS, BEAMS AND HEADERS.
- PROVIDE SOLID BLOCKING OVER SUPPORTS.
- PROVIDE FIRE BLOCKING @ ALL PLUMBING PENETRATIONS.
- WINDOWS & DOORS ARE SHOWN & NOTED AS NOMINAL SIZES.
- DOOR JAMB 4.5" FROM CORNER TYP., U.N.O.
- SEE SHEETS A0.3, A4.0 & A4.1 FOR WINDOW & DOOR HEADER HEIGHTS ABOVE FINISHED FLOOR.
- ALL WOOD IN CONTACT WITH CONCRETE TO BE PRESSURE TREATED.
- EXTERIOR WALLS @ 16" O.C., U.N.O.
- INSTALL SIMPSON CONC. TO WOOD HOLD-DOWNS PER STRUCTURAL DRAWINGS, ALSO SEE MANUFACTURER'S SPECS.
- SMOKE & CARBON MONOXIDE DETECTORS:  
 • SHALL BE 110V INTERCONNECTED W/ BATTERY BACKUP.  
 • SHALL SOUND AN ALARM AUDIBLE IN ALL SLEEPING ROOMS.  
 • SHALL BE INSTALLED ON EACH FLOOR AND IN ALL BEDROOMS.  
 • SHALL BE INSTALLED IN EACH LOCATION WHERE THERE IS A CEILING CHANGE OF GREATER THAN 24"
- FRESH AIR PROVIDED BY WHOLE-HOUSE EXHAUST FAN WITH FRESH AIR PORT (NET 4 SF IN MIN. OPENING) AT EACH HABITABLE ROOM. A TIMER OPERATES AN EXHAUST FAN WHICH PULLS OUTSIDE AIR THROUGH AIR INLETS LOCATED IN EACH HABITABLE ROOM.
- LIMITING DEVICE FOR TUBS TO PROVIDE MAX. 120°F HOT WATER TEMPERATURE.
- FOOTINGS SHALL BEAR ON SOLID UNDISTURBED EARTH (CONTROLLED, COMPACTED STRUCTURAL FILL OR BOTH). DEPTH OF FOOTINGS TO BE DETERMINED BY STRUCTURAL ENGINEER. FOUNDATION EXCAVATION, BACKFILL AND COMPACTION SHALL CONFORM TO SPECIFICATION REQUIREMENTS. THIS CONSTRUCTION WORK, INCLUDING DRAINAGE, SHORING AND SUCH OTHER RELATED WORK AS REQUIRED, SHALL BE CONDUCTED BY THE CONTRACTOR. STOP WORK IF RECOMMENDED EXCAVATION CUT OR BEARING SOIL CHANGES OCCUR IN EITHER HORIZONTAL OR VERTICAL DIRECTION AND NOTIFY IMMEDIATELY THE GEOTECHNICAL ENGINEER AND STRUCTURAL ENGINEER, AT WHICH POINT THE ENGINEERS SHALL DETERMINE CAUSE OF DISPLACEMENT AND DEVELOP AND IMPLEMENT REMEDIAL MEASURES.

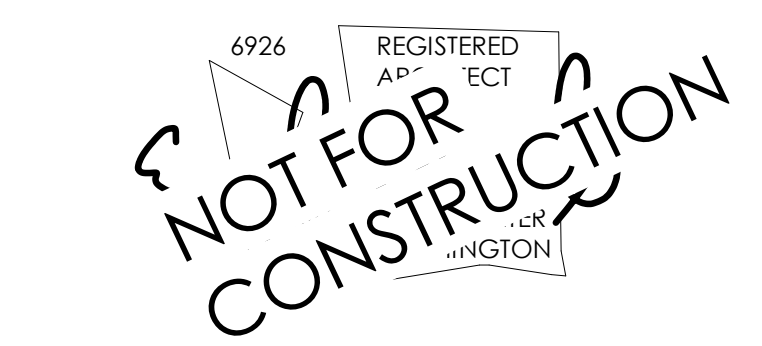
**SYMBOL LEGEND**

SEE TITLE SHEET A0.0 FOR COMPLETE SYMBOL INDEX.



**BASEMENT PLAN**  
 1/4" = 1'-0" 1



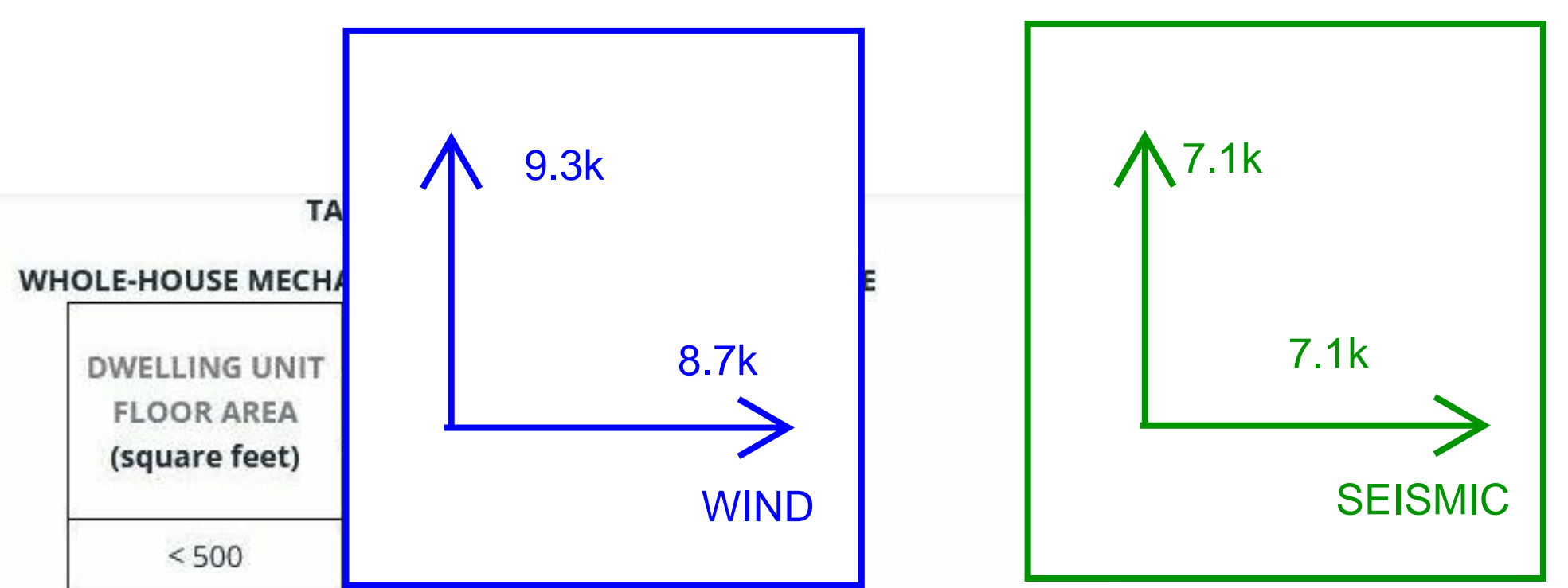


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**KEY NOTES**



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**WHOLE-HOUSE MECHANICAL**

| DWELLING UNIT FLOOR AREA (square feet) | 30 | 35 | 40 | 50 | 55 |
|--|----|----|----|----|----|
| < 500                                  |    |    |    |    |    |
| 501 - 1,000                            | 30 | 35 | 40 | 50 | 55 |
| 1,001 - 1,500                          | 30 | 40 | 45 | 55 |    |
| 1,501 - 2,000                          | 35 |    |    |    |    |
| 2,001 -                                |    |    |    |    |    |

|               | 75 | 80 |
|---------------|----|----|
| 4,001 - 4,500 | 60 | 70 |
| 4,501 - 5,000 | 65 | 75 |

For SI: 1 square foot = 0.0929 m<sup>2</sup>, 1 cubic foot per minute = 0.0004719 m<sup>3</sup>/s.

**TABLE M1505.4.3(2)**

**SYSTEM COEFFICIENT C<sub>system</sub>**

| SYSTEM TYPE  | DISTRIBUTED | NOT DISTRIBUTED |
|--------------|-------------|-----------------|
| Balanced     | 1.0         | 1.25            |
| Not balanced | 1.25        | 1.5             |

**TABLE M1505.4.3(3)**

**INTERMITTENT OFF WHOLE-HOUSE MECHANICAL VENTILATION RATE FACTORS<sup>a,b</sup>**

| RUN-TIME % IN EACH 4-HOUR SEGMENT | 50% | 66% | 75% | 100% |
|-----------------------------------|-----|-----|-----|------|
| Factor <sup>a</sup>               | 2   | 1.5 | 1.3 | 1.0  |

**HOUSE VENTILATION WITH HRV**

BALANCED WHOLE HOUSE VENTILATION REQUIREMENTS TO BE MET WITH A HEAT RECOVERY VENTILATION SYSTEM (HRV) PER M1505.4 AND WSEC ENERGY CREDIT OPTION 2.2/2.3/2.4. HRV TO HAVE MINIMUM SEVEN (7) HEAT RECOVERY EFFICIENCY OF 0.65/0.75/0.80. MINIMUM MECHANICAL VENTILATION AIRFLOW RATE TO BE 210 CFM (INTERMITTENT). (4-5 BEDROOMS 400-6000 SF) TO OPERATE 50% OF TIME IN EACH 4-HOUR SEGMENT, PER TABLES M1505.4.3(1) AND M1505.4.3(3).

| SYMBOL | LOCATION      | MINIMUM FAN REQUIREMENTS   |
|--------|---------------|--|
| A      | BATH & POWDER | MINIMUM LOCAL EXHAUST RATE TO BE 50 CFM  |
| B      | KITCHEN       | MINIMUM LOCAL EXHAUST RATE TO BE 100 CFM PROVIDED BY RANGE HOOD OR DOWN DRAFT EXHAUST FAN, PER M1503.2<br>IF OVER 400 CFM, MAKEUP AIR IS REQUIRED IN THE SAME ROOM PER M1503.6** |
| C      | LAUNDRY ROOM  | MINIMUM LOCAL EXHAUST RATE TO BE 50 CFM  |

\*\* MAKEUP AIR IS NOT REQUIRED IF ALL GAS APPLIANCES IN THE HOUSE HAVE A DIRECT VENT OR MECHANICAL DRAFT VENT SYSTEM, PER MODIFICATION M1503.6.

**HOUSE VENTILATION NO HRV**

PROVIDE WHOLE HOUSE VENTILATION PER M1505.4 USING LAUNDRY ROOM EXHAUST FAN PER 1505.4.1.2 (WA) AND TABLE 1505.4.3(1) & (2). PROVIDE CONTROLS PER 1505.4.2. COMPLY WITH WSEC R403.6.

| SYMBOL | LOCATION      | MINIMUM FAN REQUIREMENTS   |
|--------|---------------|--|
| A      | BATH & POWDER | MINIMUM LOCAL EXHAUST RATE TO BE 50 CFM (INTERMITTENT)   |
| B      | KITCHEN       | MINIMUM LOCAL EXHAUST RATE TO BE 100 CFM (INTERMITTENT) PROVIDED BY RANGE HOOD OR DOWN DRAFT EXHAUST FAN PER M1503.2<br>IF OVER 400 CFM, MAKEUP AIR IS REQUIRED IN THE SAME ROOM PER M1503.6** |
| C      | LAUNDRY ROOM  | MIN. 210 CFM (INTERMITTENT) - TO FUNCTION AND BE LABELED AS WHOLE HOUSE FAN (4-5 BEDROOMS 4501-6000 SF) TO OPERATE 50% OF TIME IN EACH 4-HOUR SEGMENT.   |

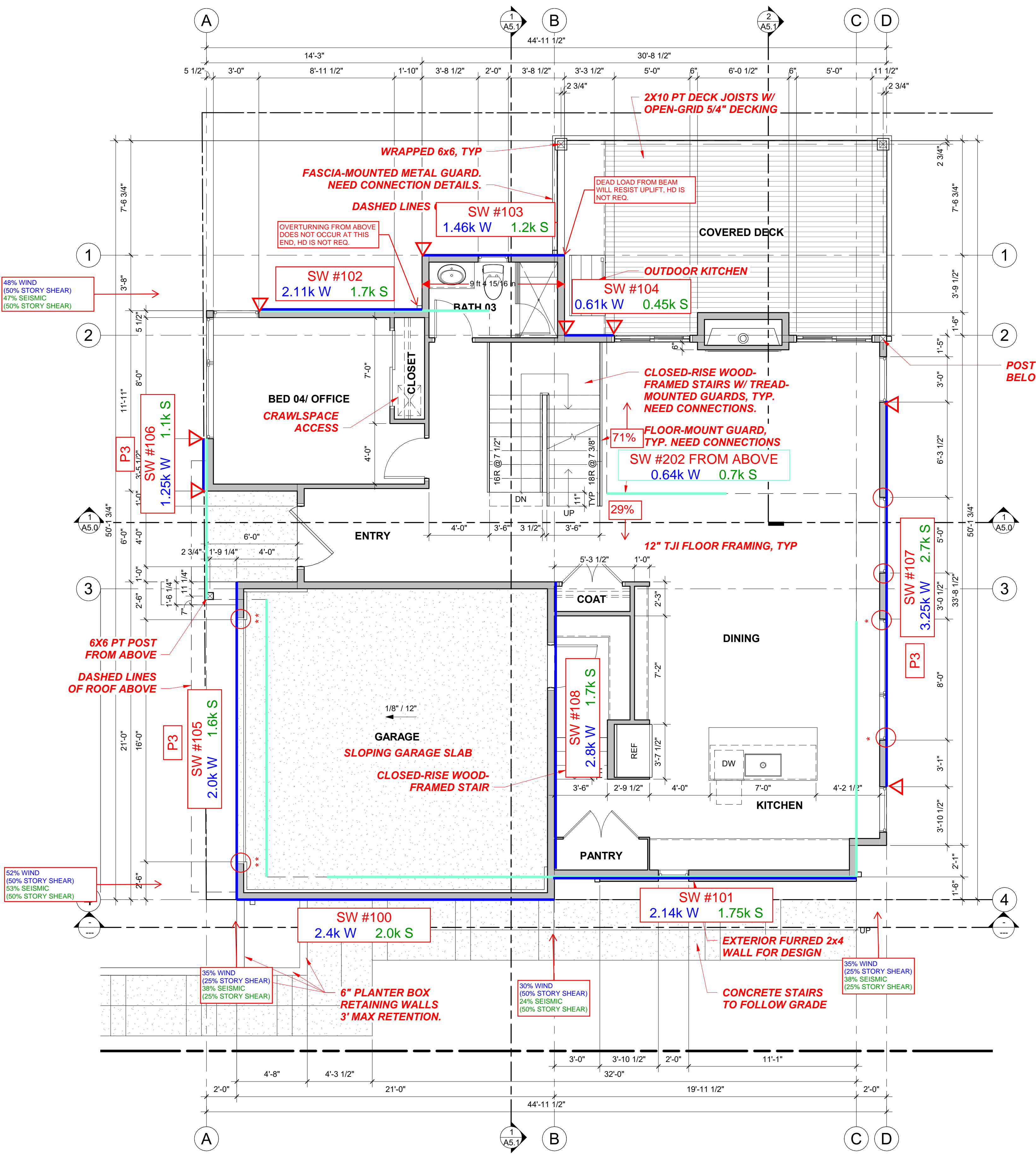
\*\* MAKEUP AIR IS NOT REQUIRED IF ALL GAS APPLIANCES IN THE HOUSE HAVE A DIRECT VENT OR MECHANICAL DRAFT VENT SYSTEM, PER MODIFICATION M1503.6.

**FLOOR PLAN NOTES**

- CONTRACTOR SHALL VERIFY ALL NOTES, DIMENSIONS & CONDITIONS PRIOR TO CONSTRUCTION.
- SEE STRUCTURAL DRAWINGS FOR ALL POSTS, BEAMS AND HEADERS.
- PROVIDE SOLID BLOCKING OVER SUPPORTS.
- PROVIDE FIRE BLOCKING @ ALL PLUMBING PENETRATIONS.
- WINDOWS & DOORS ARE SHOWN & NOTED AS NOMINAL SIZES.
- DOOR JAMB 4.5" FROM CORNER TYP., U.N.O.
- SEE SHEETS A0.3, A4.0 & A4.1 FOR WINDOW & DOOR HEADER HEIGHTS ABOVE FINISHED FLOOR.
- ALL WOOD IN CONTACT WITH CONCRETE TO BE PRESSURE TREATED.
- EXTERIOR WALLS TO BE 2x6 STUDS @ 16" O.C., U.N.O.
- INSTALL SIMPSON CONC. TO WOOD HOLD-DOWNS PER STRUCTURAL DRAWINGS, ALSO SEE MANUFACTURER'S SPECS.
- SMOKE & CARBON MONOXIDE DETECTORS:  
 • SHALL BE 110V INTERCONNECTED W/ BATTERY BACKUP.  
 • SHALL SOUND AN ALARM AUDIBLE IN ALL SLEEPING ROOMS.  
 • SHALL BE INSTALLED ON EACH FLOOR AND IN ALL BEDROOMS.  
 • SHALL BE INSTALLED IN EACH LOCATION WHERE THERE IS A CEILING CHANGE OF GREATER THAN 24".
- FRESH AIR PROVIDED BY WHOLE-HOUSE EXHAUST FAN WITH FRESH AIR PORT (NET 4 SF IN MIN. OPENING) AT EACH HABITABLE ROOM. A TIMER OPERATES AN EXHAUST FAN WHICH PULLS OUTSIDE AIR THROUGH AIR INLETS LOCATED IN EACH HABITABLE ROOM.
- LIMITING DEVICE FOR TUBS TO PROVIDE MAX. 120°F HOT WATER TEMPERATURE.
- FOOTINGS SHALL BEAR ON SOLID UNDISTURBED EARTH (CONTROLLED, COMPACTED STRUCTURAL FILL OR BOTH). DEPTH OF FOOTINGS TO BE DETERMINED BY STRUCTURAL ENGINEER. FOUNDATION EXCAVATION, BACKFILL AND COMPACTION SHALL CONFORM TO SPECIFICATION REQUIREMENTS. THIS CONSTRUCTION WORK, INCLUDING DRAINAGE, SHORING AND SUCH OTHER RELATED WORK AS REQUIRED, SHALL BE CONDUCTED BY THE CONTRACTOR. STOP WORK IF RECOMMENDED EXCAVATION CUT OR BEARING SOIL CHANGES OCCUR IN EITHER HORIZONTAL OR VERTICAL DIRECTION AND NOTIFY IMMEDIATELY THE GEOTECHNICAL ENGINEER AND STRUCTURAL ENGINEER, AT WHICH POINT THE ENGINEERS SHALL DETERMINE CAUSE OF DISPLACEMENT AND DEVELOP AND IMPLEMENT REMEDIAL MEASURES.

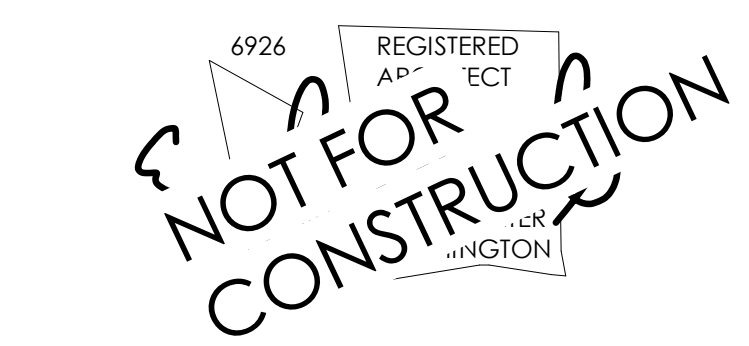
**SYMBOL LEGEND**

SEE TITLE SHEET A0.0 FOR COMPLETE SYMBOL INDEX.



**1ST FLOOR PLAN**  
 1/4" = 1'-0"

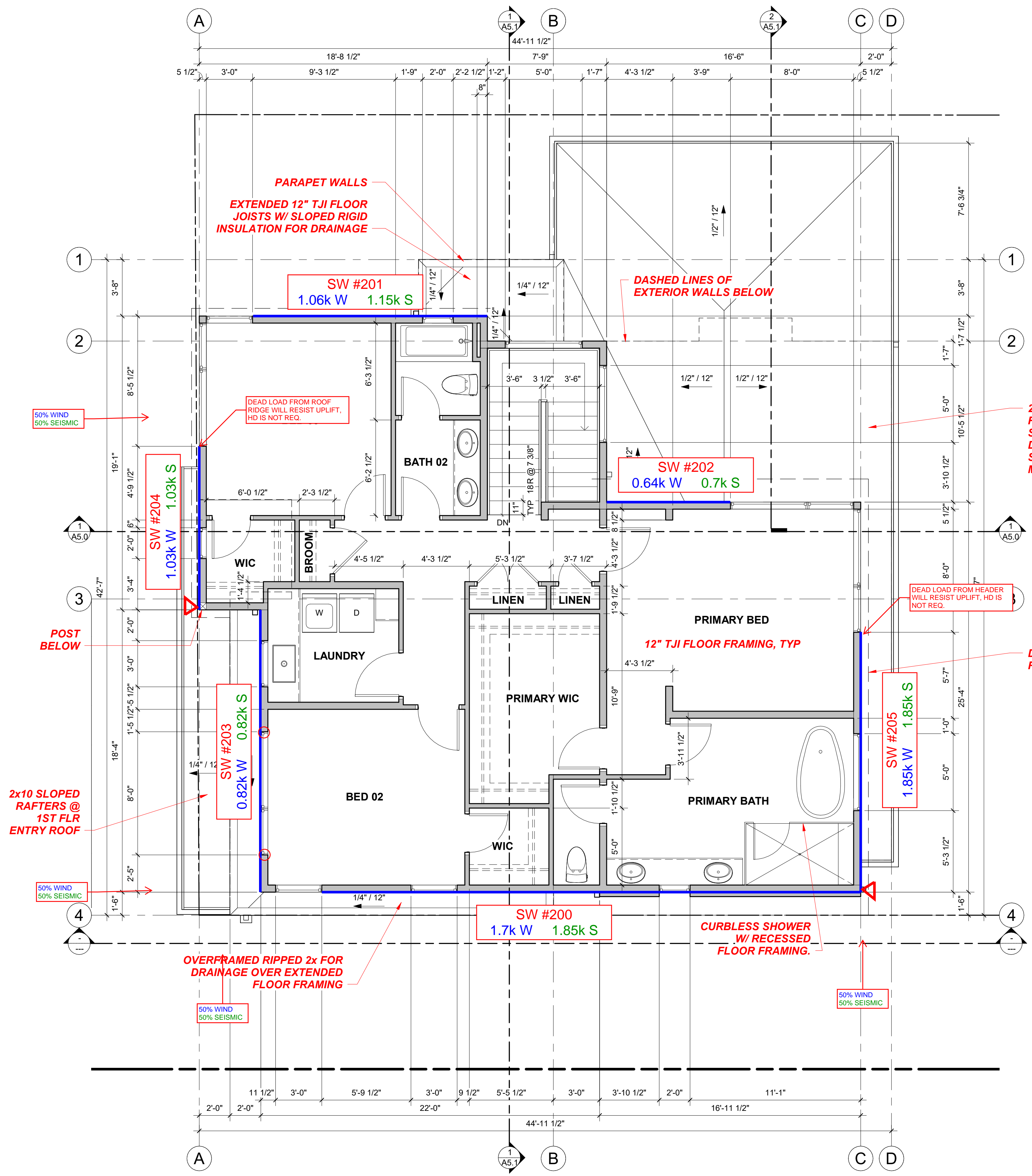
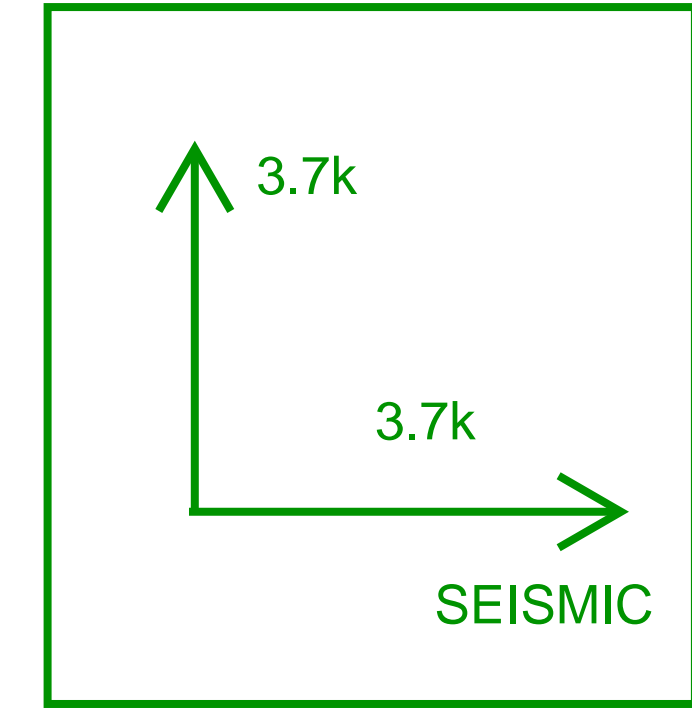
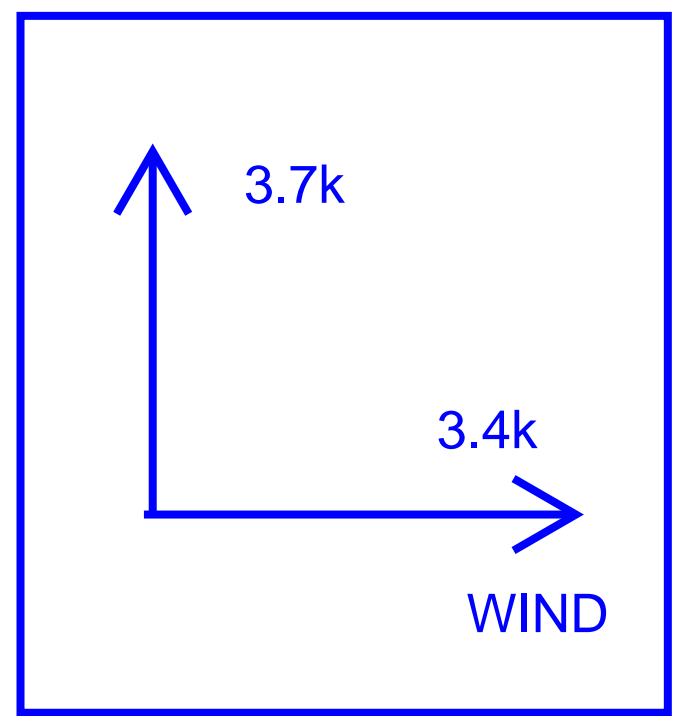




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**KEY NOTES**



**2ND FLOOR PLAN**  
 1/4" = 1'-0"

**HOUSE VENTILATION WITH HRV**

BALANCED WHOLE HOUSE VENTILATION REQUIREMENTS TO BE MET WITH A HEAT RECOVERY VENTILATION SYSTEM (HRV) PER M1505.4 AND WSEC ENERGY CREDIT OPTION 2.2/2.3/2.4. HRV TO HAVE MINIMUM SENSIBLE HEAT RECOVERY EFFICIENCY OF 0.65/0.75/0.80. MINIMUM MECHANICAL VENTILATION AIRFLOW RATE TO BE 210 CFM (INTERMITTENT) - (4-5 BEDROOMS 4500-6000 SF) TO OPERATE 50% OF TIME IN EACH 4-HOUR SEGMENT, PER TABLES M1505.4.3(1) AND M1505.4.3(3).

| SYMBOL | LOCATION      | MINIMUM FAN REQUIREMENTS   |
|--------|---------------|--|
| A      | BATH & POWDER | MINIMUM LOCAL EXHAUST RATE TO BE 50 CFM  |
| B      | KITCHEN       | MINIMUM LOCAL EXHAUST RATE TO BE 100 CFM PROVIDED BY RANGE HOOD OR DOWN DRAFT EXHAUST FAN, PER M1503.2<br>IF OVER 400 CFM, MAKEUP AIR IS REQUIRED IN THE SAME ROOM PER M1503.6** |
| C      | LAUNDRY ROOM  | MINIMUM LOCAL EXHAUST RATE TO BE 50 CFM  |

\*\* MAKEUP AIR IS NOT REQUIRED IF ALL GAS APPLIANCES IN THE HOUSE HAVE A DIRECT VENT OR MECHANICAL DRAFT VENT SYSTEM, PER MODIFICATION M1503.6.

**HOUSE VENTILATION NO HRV**

PROVIDE WHOLE HOUSE VENTILATION PER M1505.4 USING LAUNDRY ROOM EXHAUST FAN PER 1505.4.1.2 (WA) AND TABLE 1505.4.3(1) & (2), PROVIDE CONTROLS PER 1505.4.2. COMPLY WITH WSEC R403.6

| SYMBOL | LOCATION      | MINIMUM FAN REQUIREMENTS   |
|--------|---------------|--|
| A      | BATH & POWDER | MINIMUM LOCAL EXHAUST RATE TO BE 50 CFM (INTERMITTENT)   |
| B      | KITCHEN       | MINIMUM LOCAL EXHAUST RATE TO BE 100 CFM (INTERMITTENT) PROVIDED BY RANGE HOOD OR DOWN DRAFT EXHAUST FAN PER M1503.2<br>IF OVER 400 CFM, MAKEUP AIR IS REQUIRED IN THE SAME ROOM PER M1503.6** |
| C      | LAUNDRY ROOM  | MIN. 210 CFM (INTERMITTENT) - TO FUNCTION AND BE LABELED AS WHOLE HOUSE FAN (4-5 BEDROOMS 4501-6000 SF) TO OPERATE 50% OF TIME IN EACH 4-HOUR SEGMENT.   |

\*\* MAKEUP AIR IS NOT REQUIRED IF ALL GAS APPLIANCES IN THE HOUSE HAVE A DIRECT VENT OR MECHANICAL DRAFT VENT SYSTEM, PER MODIFICATION M1503.6.

**FLOOR PLAN NOTES**

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- PROVIDE FIRE BLOCKING @ ALL PLUMBING PENETRATIONS.
- WINDOWS & DOORS ARE SHOWN & NOTED AS NOMINAL SIZES.
- DOOR JAMB 4.5" FROM CORNER TYP., U.N.O.
- SEE SHEETS A0.3, A4.0 & A4.1 FOR WINDOW & DOOR HEADER HEIGHTS ABOVE FINISHED FLOOR.
- ALL WOOD IN CONTACT WITH CONCRETE TO BE PRESSURE TREATED.
- EXTERIOR WALLS TO BE 2x6 STUDS @ 16" O.C., U.N.O.
- INSTALL SIMPSON CONC. TO WOOD HOLD-DOWNS PER STRUCTURAL DRAWINGS, ALSO SEE MANUFACTURER'S SPECS.
- SMOKE & CARBON MONOXIDE DETECTORS:  
 • SHALL BE 110V INTERCONNECTED W/ BATTERY BACKUP.  
 • SHALL SOUND AN ALARM AUDIBLE IN ALL SLEEPING ROOMS.  
 • SHALL BE INSTALLED ON EACH FLOOR AND IN ALL BEDROOMS.  
 • SHALL BE INSTALLED IN EACH LOCATION WHERE THERE IS A CEILING CHANGE OF GREATER THAN 24".
- FRESH AIR PROVIDED BY WHOLE-HOUSE EXHAUST FAN WITH FRESH AIR PORT (NET 4 SF IN MIN. OPENING) AT EACH HABITABLE ROOM. A TIMER OPERATES AN EXHAUST FAN WHICH PULLS OUTSIDE AIR THROUGH AIR INLETS LOCATED IN EACH HABITABLE ROOM.
- LIMITING DEVICE FOR TUBS TO PROVIDE MAX. 120°F HOT WATER TEMPERATURE.
- FOOTINGS SHALL BEAR ON SOLID UNDISTURBED EARTH (CONTROLLED, COMPACTED STRUCTURAL FILL OR BOTH). DEPTH OF FOOTINGS TO BE DETERMINED BY STRUCTURAL ENGINEER. FOUNDATION EXCAVATION, BACKFILL AND COMPACTION SHALL CONFORM TO SPECIFICATION REQUIREMENTS. THIS CONSTRUCTION WORK, INCLUDING DRAINAGE, SHORING AND SUCH OTHER RELATED WORK AS REQUIRED, SHALL BE CONDUCTED BY THE CONTRACTOR. STOP WORK IF RECOMMENDED EXCAVATION CUT OR BEARING SOIL CHANGES OCCUR IN EITHER HORIZONTAL OR VERTICAL DIRECTION AND NOTIFY IMMEDIATELY THE GEOTECHNICAL ENGINEER AND STRUCTURAL ENGINEER, AT WHICH POINT THE ENGINEERS SHALL DETERMINE CAUSE OF DISPLACEMENT AND DEVELOP AND IMPLEMENT REMEDIAL MEASURES.

**SYMBOL LEGEND**

SEE TITLE SHEET A0.0 FOR COMPLETE SYMBOL INDEX.

LNL Buil ds  
2430 74th Ave SE

Mercer Isl and

Seismic Shear Wall Calculations

*Reviewed By: NJM*

*December 9, 2022*

*Parameters:*

*Single Family Home*

*Design Wind Speed: 100 MPH*

*wind Exposure Category: B*

*Seismic Design Category: D*

*Code & Design Standard: 2018 IBC Ch. 1613, ASCE 7-16 Ch. 26-30*



**MULHERN+KULP**  
RESIDENTIAL STRUCTURAL ENGINEERING

**SEISMIC CALCULATION - ASCE 7-16**

**Seismic Design Category:**

User Inputs:

|  |       |
|--|-------|
| Site Class   | D     |
| Spectral Response Accel. 0.2 sec, <b>S<sub>s</sub></b> | 1.392 |
| Spectral Response Accel. 1.0 sec, <b>S<sub>1</sub></b> | 0.485 |
| Occupancy Category                                     | II    |

Variables:

|                                  |      |
|----------------------------------|------|
| Site coefficient, F <sub>a</sub> | 1.00 |
| Site coefficient, F <sub>v</sub> | 1.82 |

Calculated Values:

|   |       |
|---|-------|
| Maximum spectral response acceleration, <b>S<sub>ms</sub></b> | 1.392 |
| Maximum spectral response acceleration, <b>S<sub>m1</sub></b> | 0.880 |
| Design spectral response acceleration, <b>S<sub>ds</sub></b>  | 0.928 |
| Design spectral response acceleration, <b>S<sub>d1</sub></b>  | 0.587 |
| Seismic Design Category (short term)                          | D     |
| Seismic Design Category (1.0 second term)                     | D     |

**Building period Determination:**

User Inputs:

|  |       |
|--|-------|
| Building period coefficient, <b>C<sub>t</sub></b>    | 0.020 |
| Long-Period Trans Period, <b>T<sub>L</sub></b> (sec) | 6     |
| Ht. abv base to highest level, h <sub>n</sub>        | 29    |

Calculated Values:

|  |       |
|--|-------|
| Approximate Fundamental Period, T <sub>a</sub> | 0.250 |
| T <sub>0</sub>                                 | 0.126 |
| T <sub>s</sub>                                 | 0.632 |
| Spectral Response Acc., S <sub>a</sub> (g)     | 0.928 |

**Site Class Assumption**

|    |  |
|----|--|
| No | Per ASCE 7-16 Section 11.4.3 the Site Class may be assumed to be D |
|----|--|

**Equivalent Lateral force procedure**

Dead Load Calculation:

| Level | Story Ht. (ft.) | Area (ft <sup>2</sup> ) | Dead Load (psf) | DL of ext wall trib. to level (kips) | Total Level DL |
|-------|-----------------|-------------------------|-----------------|--------------------------------------|----------------|
| 1     | 10.0            | 1470                    | 10              | 6.1                                  | 21 k           |
| 2     | 11.0            | 1928                    | 13              | 7.9                                  | 34 k           |
| 3     | 8.0             | 1541                    | 15              | 3.4                                  | 27 k           |
| 4     | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |
| 5     | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |
| 6     | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |
| 7     | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |
| 8     | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |
| 9     | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |
| 10    | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |
| 11    | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |
| 12    | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |
| 13    | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |
| 14    | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |
| 15    | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |
| 16    | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |
| 17    | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |
| 18    | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |
| 19    | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |
| 20    | 0.0             | 0                       | 0               | 0.0                                  | 0 k            |

**Total Dead Load Of Structure** = 81 Kips

Seismic Response Coefficient:

|  | Transverse | Longitudinal |
|--|------------|--------------|
| Response modification factor, <b>R</b>             | 6.5        | 6.5          |
| Occupancy Importance Factor, <b>I<sub>E</sub></b>  | 1.00       | 1.00         |
| Seismic Response Coefficient, <b>C<sub>s</sub></b> | 0.143      | 0.143        |

Base Shears:

**Ultimate Loads**

| Transverse | Longitudinal |
|------------|--------------|
| 12 k       | 12 k         |

x 0.7 =

**Allowable Loads**

| Transverse | Longitudinal |
|------------|--------------|
| 8.1 k      | 8.1 k        |

Story Shear Calculation:

Distribution exponent, 1.00

**Ultimate Loads**

| Level | Vert. Dist. Factor, <b>C<sub>vk</sub></b> | Transverse                  |               | Longitudinal                |               |
|-------|---|-----------------------------|---------------|-----------------------------|---------------|
|       |   | Story Shear, F <sub>x</sub> | Σ Story Shear | Story Shear, F <sub>x</sub> | Σ Story Shear |
| 1     | 0.124                                     | 1.4 k                       | 1.4 k         | 1.4 k                       | 1.4 k         |
| 2     | 0.419                                     | 4.8 k                       | 4.8 k         | 4.8 k                       | 4.8 k         |
| 3     | 0.458                                     | 5.3 k                       | 5.3 k         | 5.3 k                       | 5.3 k         |
| 4     | 0.000                                     | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 5     | 0.00                                      | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 6     | 0.00                                      | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 7     | 0.00                                      | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 8     | 0.00                                      | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 9     | 0.00                                      | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 10    | 0.00                                      | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 11    | 0.00                                      | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 12    | 0.00                                      | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 13    | 0.00                                      | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 14    | 0.00                                      | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 15    | 0.00                                      | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 16    | 0.00                                      | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 17    | 0.00                                      | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 18    | 0.00                                      | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 19    | 0.00                                      | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 20    | 0.00                                      | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |

x 0.7 =

**Allowable Loads**

| Level | Transverse                  |               | Longitudinal                |               |
|-------|-----------------------------|---------------|-----------------------------|---------------|
|       | Story Shear, F <sub>x</sub> | Σ Story Shear | Story Shear, F <sub>x</sub> | Σ Story Shear |
| 1     | 1.0 k                       | 1.0 k         | 1.0 k                       | 1.0 k         |
| 2     | 3.4 k                       | 3.4 k         | 3.4 k                       | 3.4 k         |
| 3     | 3.7 k                       | 3.7 k         | 3.7 k                       | 3.7 k         |
| 4     | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 5     | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 6     | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 7     | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 8     | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 9     | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 10    | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 11    | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 12    | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 13    | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 14    | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 15    | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 16    | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 17    | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 18    | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 19    | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |
| 20    | 0.0 k                       | 0.0 k         | 0.0 k                       | 0.0 k         |



***Shearwall Design Summary***

**Shearwall 200:** 2nd - Side Ext. Wall @ Bed 2/Primary Ba

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**No Hold down Required**

**Shearwall 201:** 2nd - Side Ext. Wall @ Bed 3

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**No Hold down Required**



**Shearwall Design Summary**

**Shearwall 202:** 2nd - Side Ext. Wall @ Primary

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

Shearwall Assembly Specification

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

Overturning Evaluation:

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

Hold-down Specification

**No Hold down Required**

**Shearwall 203:** 2nd - Front Ext. Wall @ Bed 2

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

Shearwall Assembly Specification

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

Overturning Evaluation:

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

Hold-down Specification

**No Hold down Required**



**Shearwall Design Summary**

**Shearwall 204:** 2nd - Front Ext. Wall @ Bed 3

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

Shearwall Assembly Specification

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

Overturning Evaluation:

Resistive DL  plf Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

Hold-down Specification

**SIMPSON CS16 STRAP TIE (14" END LENGTH)**

**Shearwall 205:** 2nd - Back Ext. Wall @ Primary

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

Shearwall Assembly Specification

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

Overturning Evaluation:

Resistive DL  plf Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

Hold-down Specification

**SIMPSON CS16 STRAP TIE (14" END LENGTH)**



***Shearwall Design Summary***

**Shearwall** xxx: - Not Used

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs **####** Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

PO - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - UNBLOCKED  
**#DIV/O!**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**No Hold down Required**

**Shearwall** xxx: - Not Used

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs **####** Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

PO - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - UNBLOCKED  
**#DIV/O!**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**No Hold down Required**





*Shearwall Design Summary*

**Shearwall 100:** 1st - Side Ext. Wall @ Garage

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

Shearwall Assembly Specification

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

Overturning Evaluation:

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

Hold-down Specification

**No Hold down Required**

**Shearwall 101:** 1st - Side Ext. Wall @ Kitchen

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

Shearwall Assembly Specification

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

Overturning Evaluation:

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

Hold-down Specification

**No Hold down Required**



**Shearwall Design Summary**

**Shearwall 102:** 1st - Side Ext. Wall @ Bed 4

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

Shearwall Assembly Specification

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

Overturning Evaluation:

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

Hold-down Specification

**SIMPSON STHD14RJ HOLDOWN**

**Shearwall 103:** 1st - Side Ext. Wall @ Bath 3

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

Shearwall Assembly Specification

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

Overturning Evaluation:

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

Hold-down Specification

**SIMPSON STHD14RJ HOLDOWN**



***Shearwall Design Summary***

**Shearwall 104:** 1st - Side Ext. Wall @ Dining

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**SIMPSON CS16 STRAP TIE (14" END LENGTH)**

**Shearwall 105:** 1st - Front Ext. Wall @ Garage

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P3 - 1-side 7/16" OSB  
fastened w/ 8d nails at 3"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**No Hold down Required**



***Shearwall Design Summary***

**Shearwall 106:** 1st - Front Ext. Wall @ Bed 4

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P3 - 1-side 7/16" OSB  
fastened w/ 8d nails at 3"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  plf Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**SIMPSON STHD14RJ HOLDOWN**

**Shearwall 107:** 1st - Back Ext. Wall @ Dining

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P3 - 1-side 7/16" OSB  
fastened w/ 8d nails at 3"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  plf Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**SIMPSON CS16 STRAP TIE (14" END LENGTH)**



Shearwall Design Summary

**Shearwall 108:** 1st - Int. Wall @ Garage

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

Shearwall Assembly Specification

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

Overturning Evaluation:

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

Hold-down Specification

**No Hold down Required**

**Shearwall xxx:** - Not Used

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs ####! Allowable Shearwall Capacity  lbs

Shearwall Assembly Specification

PO - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - UNBLOCKED  
**#DIV/O!**

Overturning Evaluation:

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

Hold-down Specification

**No Hold down Required**



***Shearwall Design Summary***

**Shearwall BOO:** - Side Ext. Wall @ ADU Dining

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P3 - 1-side 7/16" OSB  
fastened w/ 8d nails at 3"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**SIMPSON STHD14RJ HOLDOWN**

**Shearwall BO1:** - Side Ext. Wall @ ADU Bath

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**SIMPSON STHD14RJ HOLDOWN**



***Shearwall Design Summary***

**Shearwall B02:** - Back Ext. Wall @ ADU Primary

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P3 - 1-side 7/16" OSB  
fastened w/ 8d nails at 3"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**SIMPSON STHD14RJ HOLDOWN**

**Shearwall B03:** - Side Ext. Wall @ Crawl

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**No Hold down Required**



***Shearwall Design Summary***

**Shearwall B04:** - Int. Wall @ ADU Kitchen

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

PO - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - UNBLOCKED  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**No Hold down Required**

**Shearwall XXX:** - Not Used

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs ### Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

PO - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - UNBLOCKED  
**#DIV/O!**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**No Hold down Required**



LNL Buil ds  
2430 74th Ave SE

Mercer Isl and

Wind Shear Wall Cal cul ations

*Reviewed By: NJM*

*December 9, 2022*

*Parameters:*

*Single Family Home*

*Design Wind Speed: 100 MPH*

*wind Exposure Category: B*

*Seismic Design Category: D*

*Code & Design Standard: 2018 IBC Ch. 1609, ASCE 7-16 Ch. 26-30*



**MULHERN+KULP**  
RESIDENTIAL STRUCTURAL ENGINEERING

### Wind Design Summary per ASCE 7-16

| Parameters:                         |      |      | Roof Geometry:      |       |     | Building Geometry: |    |    |
|-------------------------------------|------|------|---------------------|-------|-----|--------------------|----|----|
| Wind Speed                          | 100  |      | Trans. Roof Pitch   | 4.0   | :12 | length             | 45 | ft |
| Exposure Category                   | B    |      | Long. Roof Pitch    | 4.0   | :12 | Width              | 43 | ft |
| Risk Category                       | II   |      | Mean Roof Height, H | 33.67 | ft  | Number of stories  | 3  |    |
| Wind Directionality Factor, $K_d$   | 0.85 |      |                     |       |     |                    |    |    |
| Topographic Factor, $K_{zt}$        | 1.30 |      |                     |       |     |                    |    |    |
| Gust Factor, G                      | 0.85 |      |                     |       |     |                    |    |    |
| Ground El. ev. Above Sea Level [ft] | 0    |      |                     |       |     |                    |    |    |
| Design Type                         | ASD  | 0.60 |                     |       |     |                    |    |    |

| <b>Transverse Direction (Perpendicular to Main Ridge Line)</b> |                       |              |                         |           |           |             |                                |             |           |       |      |      |
|--|-----------------------|--------------|-------------------------|-----------|-----------|-------------|--------------------------------|-------------|-----------|-------|------|------|
| Diaphragm Level  | Floor-to-Floor Height |              | Tributary Design Areas: |           |           | Diagram     | Tributary Design Loads: (0.6W) |             |           |       |      |      |
|  |                       |              | Section A               | Section O | Section B |             | Section A                      | Section O   | Section B |       |      |      |
| 3  | 8                     | ft           | Roof Surface            | 0         | 110       | 0           | sq ft                          | Story Shear | 0.00      | 3.38  | 0.00 | kips |
|  |                       | Wall surface | 0                       | 205       | 0         | sq ft       |                                | Total Shear | 0.00      | 3.38  | 0.00 |      |
| 3.38 kips  |                       |              |                         |           |           |             |                                |             |           |       |      |      |
| 2  | 11                    | ft           | Roof Surface            | 0         | 0         | 0           | sq ft                          | Story Shear | 0.00      | 5.26  | 0.00 | kips |
|  |                       | Wall surface | 0                       | 420       | 0         | sq ft       |                                | Total Shear | 0.00      | 8.64  | 0.00 |      |
| 8.64 kips  |                       |              |                         |           |           |             |                                |             |           |       |      |      |
| 1  | 10                    | ft           | Roof Surface            | 0         | 0         | 0           | sq ft                          | Story Shear | 0.00      | 5.11  | 0.00 | kips |
|  |                       | Wall surface | 0                       | 431       | 0         | sq ft       |                                | Total Shear | 0.00      | 13.75 | 0.00 |      |
| 13.75 kips   |                       |              |                         |           |           |             |                                |             |           |       |      |      |
| FND  |                       |              | Roof Surface            | 0         | 0         | 0           | sq ft                          | Story Shear | 0.00      | 0.00  | 0.00 | kips |
|  | Wall surface          | 0            | 0                       | 0         | sq ft     | Total Shear |                                | 0.00        | 13.75     | 0.00  | kips |      |
| 13.75 kips   |                       |              |                         |           |           |             |                                |             |           |       |      |      |

| <b>Longitudinal Direction (Parallel to Main Ridge Line)</b> |                       |              |                         |           |           |             |                                |             |           |       |      |      |
|---|-----------------------|--------------|-------------------------|-----------|-----------|-------------|--------------------------------|-------------|-----------|-------|------|------|
| Diaphragm Level   | Floor-to-Floor Height |              | Tributary Design Areas: |           |           | Diagram     | Tributary Design Loads: (0.6W) |             |           |       |      |      |
|   |                       |              | Section A               | Section O | Section B |             | Section A                      | Section O   | Section B |       |      |      |
| 3   | 8                     | ft           | Roof Surface            | 0         | 66        | 0           | sq ft                          | Story Shear | 0.00      | 3.68  | 0.00 | kips |
|   |                       | Wall surface | 0                       | 250       | 0         | sq ft       |                                | Total Shear | 0.00      | 3.68  | 0.00 |      |
| 3.68 kips   |                       |              |                         |           |           |             |                                |             |           |       |      |      |
| 2   | 11                    | ft           | Roof Surface            | 0         | 0         | 0           | sq ft                          | Story Shear | 0.00      | 5.58  | 0.00 | kips |
|   |                       | Wall surface | 0                       | 450       | 0         | sq ft       |                                | Total Shear | 0.00      | 9.26  | 0.00 |      |
| 9.26 kips   |                       |              |                         |           |           |             |                                |             |           |       |      |      |
| 1   | 10                    | ft           | Roof Surface            | 0         | 0         | 0           | sq ft                          | Story Shear | 0.00      | 4.76  | 0.00 | kips |
|   |                       | Wall surface | 0                       | 406       | 0         | sq ft       |                                | Total Shear | 0.00      | 14.02 | 0.00 |      |
| 14.02 kips  |                       |              |                         |           |           |             |                                |             |           |       |      |      |
| FND   |                       |              | Roof Surface            | 0         | 0         | 0           | sq ft                          | Story Shear | 0.00      | 0.00  | 0.00 | kips |
|   | Wall surface          | 0            | 0                       | 0         | sq ft     | Total Shear |                                | 0.00        | 14.02     | 0.00  | kips |      |
| 14.02 kips  |                       |              |                         |           |           |             |                                |             |           |       |      |      |



***Shearwall Design Summary***

**Shearwall 200:** 2nd - Side Ext. Wall @ Bed 2/Primary Ba

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**No Hold down Required**

**Shearwall 201:** 2nd - Side Ext. Wall @ Bed 3

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**No Hold down Required**



***Shearwall Design Summary***

**Shearwall 202:** 2nd - Side Ext. Wall @ Primary

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**No Hold down Required**

**Shearwall 203:** 2nd - Front Ext. Wall @ Bed 2

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**No Hold down Required**



***Shearwall Design Summary***

**Shearwall 204:** 2nd - Front Ext. Wall @ Bed 3

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**SIMPSON CS16 STRAP TIE (14" END LENGTH)**

**Shearwall 205:** 2nd - Back Ext. Wall @ Primary

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**No Hold down Required**



Shearwall Design Summary

Shearwall XXX: - Not Used

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs      Allowable Shearwall Capacity  lbs  
#####

Shearwall Assembly Specification

PO - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - UNBLOCKED  
#DIV/O!

Overturning Evaluation:

Resistive DL  pl f      Overturning Moment  k-ft      Hold Down Design Load  lbs  
DL at ends of wall  lbs      Resistive Moment  k-ft      Hold down Capacity  lbs

Hold-down Specification

No Hold down Required

Shearwall XXX: - Not Used

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs      Allowable Shearwall Capacity  lbs  
#####

Shearwall Assembly Specification

PO - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - UNBLOCKED  
#DIV/O!

Overturning Evaluation:

Resistive DL  pl f      Overturning Moment  k-ft      Hold Down Design Load  lbs  
DL at ends of wall  lbs      Resistive Moment  k-ft      Hold down Capacity  lbs

Hold-down Specification

No Hold down Required



***Shearwall Design Summary***

**Shearwall 100:** 1st - Side Ext. Wall @ Garage

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**No Hold down Required**

**Shearwall 101:** 1st - Side Ext. Wall @ Kitchen

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**No Hold down Required**



*Shearwall Design Summary*

**Shearwall 102:** 1st - Side Ext. Wall @ Bed 4

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

Shearwall Assembly Specification

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

Overturning Evaluation:

Resistive DL  plf Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

Hold-down Specification

**SIMPSON STHD14RJ HOLDOWN**

**Shearwall 103:** 1st - Side Ext. Wall @ Bath 3

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

Shearwall Assembly Specification

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

Overturning Evaluation:

Resistive DL  plf Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

Hold-down Specification

**SIMPSON STHD14RJ HOLDOWN**





***Shearwall Design Summary***

**Shearwall 104:** 1st - Side Ext. Wall @ Dining

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**SIMPSON CS16 STRAP TIE (14" END LENGTH)**

**Shearwall 105:** 1st - Front Ext. Wall @ Garage

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P3 - 1-side 7/16" OSB  
fastened w/ 8d nails at 3"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**No Hold down Required**



***Shearwall Design Summary***

**Shearwall 106:** 1st - Front Ext. Wall @ Bed 4

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P3 - 1-side 7/16" OSB  
fastened w/ 8d nails at 3"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  plf Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**SIMPSON STHD14RJ HOLDOWN**

**Shearwall 107:** 1st - Back Ext. Wall @ Dining

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P3 - 1-side 7/16" OSB  
fastened w/ 8d nails at 3"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  plf Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**SIMPSON CS16 STRAP TIE (14" END LENGTH)**



Shearwall Design Summary

**Shearwall 108:** 1st - Int. Wall @ Garage

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

Shearwall Assembly Specification

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

Overturning Evaluation:

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

Hold-down Specification

**No Hold down Required**

**Shearwall xxx:** - Not Used

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs ### Allowable Shearwall Capacity  lbs

Shearwall Assembly Specification

PO - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - UNBLOCKED  
**#DIV/O!**

Overturning Evaluation:

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

Hold-down Specification

**No Hold down Required**



***Shearwall Design Summary***

**Shearwall BOO:** - Side Ext. Wall @ ADU Dining

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P3 - 1-side 7/16" OSB  
fastened w/ 8d nails at 3"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**SIMPSON STHD14RJ HOLDOWN**

**Shearwall BO1:** - Side Ext. Wall @ ADU Bath

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**SIMPSON STHD14RJ HOLDOWN**



***Shearwall Design Summary***

**Shearwall B02:** - Back Ext. Wall @ ADU Primary

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P3 - 1-side 7/16" OSB  
fastened w/ 8d nails at 3"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**SIMPSON STHD14RJ HOLDOWN**

**Shearwall B03:** - Side Ext. Wall @ Crawl

**Shearwall Properties:**

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

**Capacity Evaluation:**

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

**Shearwall Assembly Specification**

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

**Overturning Evaluation:**

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

**Hold-down Specification**

**SIMPSON STHD14RJ HOLDOWN**



Shearwall Design Summary

**Shearwall B04:** - Int. Wall @ ADU Kitchen

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs < Allowable Shearwall Capacity  lbs

Shearwall Assembly Specification

P1 - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - edges blocked  
**ADEQUATE**

Overturning Evaluation:

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

Hold-down Specification

**No Hold down Required**

**Shearwall XXX:** - Not Used

Shearwall Properties:

Wall height, H  ft. Max wall opening ht, H<sub>c</sub>  ft.  
Wall Length, L  ft. Qualifying Wall Length, L  ft. Shearwall Assembly

Capacity Evaluation:

Total Shear Load on Wall  lbs ####! Allowable Shearwall Capacity  lbs

Shearwall Assembly Specification

PO - 1-side 7/16" OSB  
fastened w/ 8d nails at 6"o.c. panel edges & 12"o.c. panel field - UNBLOCKED  
**#DIV/O!**

Overturning Evaluation:

Resistive DL  pl f Overturning Moment  k-ft Hold Down Design Load  lbs  
DL at ends of wall  lbs Resistive Moment  k-ft Hold down Capacity  lbs

Hold-down Specification

**No Hold down Required**



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Project Title:  
 Engineer:  
 Project ID:  
 Project Descr:

## Cantilevered Retaining Wall

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

(c) ENERCALC INC 1983-2022

**DESCRIPTION:** Cant'd Retaining Wall @ Garage (Detail 7)

### Code Reference

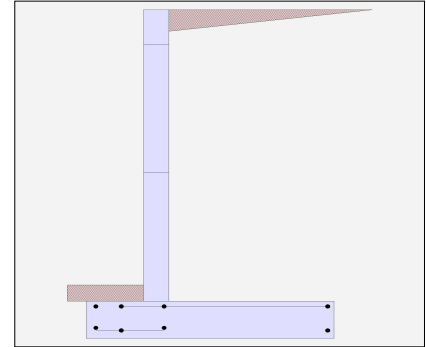
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

#### Criteria

|                         |   |         |
|-------------------------|---|---------|
| Retained Height         | = | 9.08 ft |
| Wall height above soil  | = | 0.00 ft |
| Slope Behind Wall       | = | 0.00    |
| Height of Soil over Toe | = | 6.00 in |
| Water height over heel  | = | 0.0 ft  |

#### Soil Data

|  |   |              |
|--|---|--------------|
| Allow Soil Bearing                         | = | 5,333.0 psf  |
| Equivalent Fluid Pressure Method           |   |              |
| Active Heel Pressure                       | = | 35.0 psf/ft  |
| Passive Pressure                           | = | 350.0 psf/ft |
| Soil Density, Heel                         | = | 110.00 pcf   |
| Soil Density, Toe                          | = | 110.00 pcf   |
| Footing  Soil Friction                     | = | 0.350        |
| Soil height to ignore for passive pressure | = | 12.00 in     |



#### Surcharge Loads

|                                      |   |         |
|--------------------------------------|---|---------|
| Surcharge Over Heel                  | = | 0.0 psf |
| Used To Resist Sliding & Overturning |   |         |
| Surcharge Over Toe                   | = | 0.0 psf |
| Used for Sliding & Overturning       |   |         |

#### Axial Load Applied to Stem

|                         |   |         |
|-------------------------|---|---------|
| Axial Dead Load         | = | 0.0 lbs |
| Axial Live Load         | = | 0.0 lbs |
| Axial Load Eccentricity | = | 0.0 in  |

#### Earth Pressure Seismic Load

|                                   |   |         |
|-----------------------------------|---|---------|
| Method                            | : | Uniform |
| Multiplier Used                   | = | 8.000   |
| (Multiplier used on soil density) |   |         |

#### Lateral Load Applied to Stem

|                      |   |                             |
|----------------------|---|-----------------------------|
| Lateral Load         | = | 0.0 #/ft                    |
| ...Height to Top     | = | 0.00 ft                     |
| ...Height to Bottom  | = | 0.00 ft                     |
| Load Type            | = | Wind (W)<br>(Service Level) |
| Wind on Exposed Stem | = | 0.0 psf<br>(Strength Level) |

|                       |   |         |
|-----------------------|---|---------|
| Uniform Seismic Force | = | 81.997  |
| Total Seismic Force   | = | 840.445 |

#### Adjacent Footing Load

|                                       |   |                |
|---------------------------------------|---|----------------|
| Adjacent Footing Load                 | = | 0.0 lbs        |
| Footing Width                         | = | 0.00 ft        |
| Eccentricity                          | = | 0.00 in        |
| Wall to Ftg CL Dist                   | = | 0.00 ft        |
| Footing Type                          | = | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft         |
| Poisson's Ratio                       | = | 0.300          |



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## Cantilevered Retaining Wall

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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### DESCRIPTION: Cant'd Retaining Wall @ Garage (Detail 7)

| Design Summary   |                     | Stem Construction              |        | 3rd             | 2nd             | Bottom              |    |    |
|--|---------------------|--------------------------------|--------|-----------------|-----------------|---------------------|----|----|
| <b>Wall Stability Ratios</b>   |                     | <b>Design Height Above Ftg</b> | ft =   | Stem OK<br>8.00 | Stem OK<br>4.00 | Ratio > 1.0<br>0.00 |    |    |
| Overturning  | = 3.17 OK           | Wall Material Above "Ht"       | =      | Concrete        | Concrete        | Concrete            | SD | SD |
| Sliding  | = 1.18 Ratio < 1.5! | Design Method                  | =      | SD              | SD              | SD                  |    |    |
| Global Stability   | = 2.15              | Thickness                      | =      | 8.00            | 8.00            | 8.00                |    |    |
| Total Bearing Load   | = 7,269 lbs         | Rebar Size                     | =      | # 5             | # 5             | # 5                 |    |    |
| ...resultant ecc.  | = 1.53 in           | Rebar Spacing                  | =      | 12.00           | 12.00           | 12.00               |    |    |
| Soil Pressure @ Toe  | = 1,111 psf OK      | Rebar Placed at                | =      | 6.5 in          | 6.5 in          | 6.5 in              |    |    |
| Soil Pressure @ Heel   | = 877 psf OK        | <b>Design Data</b>             |        |                 |                 |                     |    |    |
| Allowable  | = 5,333 psf         | fb/FB + fa/Fa                  | =      | <b>0.007</b>    | <b>0.267</b>    | <b>1.212</b>        |    |    |
| <b>Soil Pressure Less Than Allowable</b>   |                     | <b>Total Force @ Section</b>   |        |                 |                 |                     |    |    |
| ACI Factored @ Toe   | = 1,555 psf         | Service Level                  | lbs =  |                 |                 |                     |    |    |
| ACI Factored @ Heel  | = 1,227 psf         | Strength Level                 | lbs =  | 121.6           | 1,140.2         | 3,054.8             |    |    |
| Footing Shear @ Toe  | = 6.2 psi OK        | <b>Moment....Actual</b>        |        |                 |                 |                     |    |    |
| Footing Shear @ Heel   | = 53.7 psi OK       | Service Level                  | ft-# = |                 |                 |                     |    |    |
| Allowable  | = 75.0 psi          | Strength Level                 | ft-# = | 59.9            | 2,285.0         | 10,376.4            |    |    |
| <b>Sliding Calcs</b>   |                     | Moment.....Allowable           | ft-# = | 8,557.2         | 8,557.2         | 8,557.2             |    |    |
| Lateral Sliding Force  | = 2,426.8 lbs       | <b>Shear.....Actual</b>        |        |                 |                 |                     |    |    |
| less 100% Passive Force  | = - 311.1 lbs       | Service Level                  | psi =  |                 |                 |                     |    |    |
| less 100% Friction Force   | = - 2,544.3 lbs     | Strength Level                 | psi =  | 1.6             | 14.6            | 39.2                |    |    |
| Added Force Req'd  | = 0.0 lbs OK        | Shear.....Allowable            | psi =  | 75.0            | 75.0            | 75.0                |    |    |
| ...for 1.5 Stability   | = 784.8 lbs NG      | Anet (Masonry)                 | in2 =  |                 |                 |                     |    |    |
| Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures. |                     | Rebar Depth 'd'                | in =   | 6.50            | 6.50            | 6.50                |    |    |
| <b>Load Factors</b>  |                     | <b>Masonry Data</b>            |        |                 |                 |                     |    |    |
| Building Code  |                     | f'm                            | psi =  |                 |                 |                     |    |    |
| Dead Load  | 1.200               | Fs                             | psi =  |                 |                 |                     |    |    |
| Live Load  | 1.600               | Solid Grouting                 | =      |                 |                 |                     |    |    |
| Earth, H   | 1.600               | Modular Ratio 'n'              | =      |                 |                 |                     |    |    |
| Wind, W  | 1.600               | Wall Weight                    | psf =  | 100.0           | 100.0           | 100.0               |    |    |
| Seismic, E   | 1.000               | Short Term Factor              | =      |                 |                 |                     |    |    |
|  |                     | Equiv. Solid Thick.            | =      |                 |                 |                     |    |    |
|  |                     | Masonry Block Type             | =      |                 |                 |                     |    |    |
|  |                     | Masonry Design Method          | =      | ASD             |                 |                     |    |    |
|  |                     | <b>Concrete Data</b>           |        |                 |                 |                     |    |    |
|  |                     | f'c                            | psi =  | 2,500.0         | 2,500.0         | 2,500.0             |    |    |
|  |                     | Fy                             | psi =  | 60,000.0        | 60,000.0        | 60,000.0            |    |    |





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**Cantilevered Retaining Wall**

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

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**DESCRIPTION: Cant'd Retaining Wall @ Garage (Detail 7)**

**Concrete Stem Rebar Area Details**

| 3rd Stem                        | Vertical Reinforcing | Horizontal Reinforcing                                       |
|---------------------------------|----------------------|--|
| As (based on applied moment) :  | 0.0022 in2/ft        |  |
| (4/3) * As :                    | 0.0029 in2/ft        | Min Stem T&S Reinf Area 0.208 in2                            |
| 200bd/fy : 200(12)(6.5)/60000 : | 0.26 in2/ft          | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft |
| 0.0018bh : 0.0018(12)(8) :      | 0.1728 in2/ft        | Horizontal Reinforcing Options :                             |
|                                 | =====                | One layer of :      Two layers of :                          |
| Required Area :                 | 0.1728 in2/ft        | #4@ 12.50 in      #4@ 25.00 in                               |
| Provided Area :                 | 0.31 in2/ft          | #5@ 19.38 in      #5@ 38.75 in                               |
| Maximum Area :                  | 0.8805 in2/ft        | #6@ 27.50 in      #6@ 55.00 in                               |

| 2nd Stem                        | Vertical Reinforcing | Horizontal Reinforcing                                       |
|---------------------------------|----------------------|--|
| As (based on applied moment) :  | 0.0821 in2/ft        |  |
| (4/3) * As :                    | 0.1095 in2/ft        | Min Stem T&S Reinf Area 0.768 in2                            |
| 200bd/fy : 200(12)(6.5)/60000 : | 0.26 in2/ft          | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft |
| 0.0018bh : 0.0018(12)(8) :      | 0.1728 in2/ft        | Horizontal Reinforcing Options :                             |
|                                 | =====                | One layer of :      Two layers of :                          |
| Required Area :                 | 0.1728 in2/ft        | #4@ 12.50 in      #4@ 25.00 in                               |
| Provided Area :                 | 0.31 in2/ft          | #5@ 19.38 in      #5@ 38.75 in                               |
| Maximum Area :                  | 0.8805 in2/ft        | #6@ 27.50 in      #6@ 55.00 in                               |

| Bottom Stem                     | Vertical Reinforcing | Horizontal Reinforcing                                       |
|---------------------------------|----------------------|--|
| As (based on applied moment) :  | 0.373 in2/ft         |  |
| (4/3) * As :                    | 0.4974 in2/ft        | Min Stem T&S Reinf Area 0.768 in2                            |
| 200bd/fy : 200(12)(6.5)/60000 : | 0.26 in2/ft          | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft |
| 0.0018bh : 0.0018(12)(8) :      | 0.1728 in2/ft        | Horizontal Reinforcing Options :                             |
|                                 | =====                | One layer of :      Two layers of :                          |
| Required Area :                 | 0.373 in2/ft         | #4@ 12.50 in      #4@ 25.00 in                               |
| Provided Area :                 | 0.31 in2/ft          | #5@ 19.38 in      #5@ 38.75 in                               |
| Maximum Area :                  | 0.8805 in2/ft        | #6@ 27.50 in      #6@ 55.00 in                               |



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## Cantilevered Retaining Wall

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

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### DESCRIPTION: Cant'd Retaining Wall @ Garage (Detail 7)

#### Footing Data

|                          |       |         |             |
|--------------------------|-------|---------|-------------|
| Toe Width                | =     | 1.50    | ft          |
| Heel Width               | =     | 5.00    |             |
| Total Footing Width      | =     | 6.50    |             |
| Footing Thickness        | =     | 14.00   | in          |
| Key Width                | =     | 0.00    | in          |
| Key Depth                | =     | 0.00    | in          |
| Key Distance from Toe    | =     | 0.00    | ft          |
| f'c =                    | 2,500 | psi     | Fy = 60,000 |
| Footing Concrete Density | =     | 150.00  | pcf         |
| Min. As %                | =     | 0.0018  |             |
| Cover @ Top              | 2.00  | @ Btm.= | 3.00 in     |

#### Footing Design Results

|                                | Toe              | Heel        |
|--------------------------------|------------------|-------------|
| Factored Pressure              | = 1,555          | 1,227 psf   |
| Mu' : Upward                   | = 1,721          | 0 ft-#      |
| Mu' : Downward                 | = 311            | 18,855 ft-# |
| Mu: Design                     | = 1,410          | 18,855 ft-# |
| phiMn                          | = 14,400         | 23,311 ft-# |
| Actual 1-Way Shear             | = 6.16           | 53.65 psi   |
| Allow 1-Way Shear              | = 75.00          | 75.00 psi   |
| Toe Reinforcing                | = # 5 @ 12.00 in |             |
| Heel Reinforcing               | = # 5 @ 8.00 in  |             |
| Key Reinforcing                | = None Spec'd    |             |
| Footing Torsion, Tu            | =                | 0.00 ft-lbs |
| Footing Allow. Torsion, phi Tu | =                | 0.00 ft-lbs |

**If torsion exceeds allowable, provide supplemental design for footing torsion.**

#### Other Acceptable Sizes & Spacings

Toe:  
 Heel:  
 Key:

|                                     |                                   |         |
|-------------------------------------|-----------------------------------|---------|
| Min footing T&S reinf Area          | 1.97                              | in2     |
| Min footing T&S reinf Area per foot | 0.30                              | in2 /ft |
| If one layer of horizontal bars:    | If two layers of horizontal bars: |         |
| #4 @ 7.94 in                        | #4 @ 15.87 in                     |         |
| #5 @ 12.30 in                       | #5 @ 24.60 in                     |         |
| #6 @ 17.46 in                       | #6 @ 34.92 in                     |         |

### Summary of Overturning & Resisting Forces & Moments

| Item                                    | .....OVERTURNING..... |               |             | .....RESISTING.....           |                |             |                       |
|---|-----------------------|---------------|-------------|-------------------------------|----------------|-------------|-----------------------|
|   | Force lbs             | Distance ft   | Moment ft-# | Force lbs                     | Distance ft    | Moment ft-# |                       |
| HL Act Pres (ab water tbl)              | 1,838.5               | 3.42          | 6,281.2     | Soil Over HL (ab. water tbl)  | 4,329.6        | 4.33        | 18,761.4              |
| HL Act Pres (be water tbl)              |                       |               |             | Soil Over HL (bel. water tbl) |                | 4.33        | 18,761.4              |
| Hydrostatic Force                       |                       |               |             | Watre Table                   |                |             |                       |
| Buoyant Force                           | =                     |               |             | Sloped Soil Over Heel         | =              |             |                       |
| Surcharge over Heel                     | =                     |               |             | Surcharge Over Heel           | =              |             |                       |
| Surcharge Over Toe                      | =                     |               |             | Adjacent Footing Load         | =              |             |                       |
| Adjacent Footing Load                   | =                     |               |             | Axial Dead Load on Stem       | =              |             |                       |
| Added Lateral Load                      | =                     |               |             | * Axial Live Load on Stem     | =              |             |                       |
| Load @ Stem Above Soil                  | =                     |               |             | Soil Over Toe                 | = 82.5         | 0.75        | 61.9                  |
| Seismic Earth Load                      | = 588.3               | 5.12          | 3,015.0     | Surcharge Over Toe            | =              |             |                       |
|   | =                     |               |             | Stem Weight(s)                | = 908.3        | 1.83        | 1,665.2               |
|   | =                     |               |             | Earth @ Stem Transitions      | =              |             |                       |
| <b>Total</b>                            | = 2,426.8             | <b>O.T.M.</b> | = 9,296.2   | Footing Weight                | = 1,137.5      | 3.25        | 3,696.9               |
|   |                       |               |             | Key Weight                    | =              |             |                       |
| <b>Resisting/Overturning Ratio</b>      |                       | =             | <b>3.17</b> | Vert. Component               | = 811.5        | 6.50        | 5,275.0               |
| Vertical Loads used for Soil Pressure = |                       | 7,269.4       | lbs         | <b>Total =</b>                | <b>7,269.4</b> | <b>lbs</b>  | <b>R.M.= 29,460.4</b> |

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS considered in the calculation of Overturning Resistance.



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## Cantilevered Retaining Wall

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION:** Cant'd Retaining Wall @ Garage (Detail 7)

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci

Horizontal Defl @ Top of Wall (approximate only) 0.043 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

## Cantilevered Retaining Wall

Project File: Beams.ec6

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**DESCRIPTION:** Cant'd Retaining Wall @ Garage (Detail 8)

### Code Reference

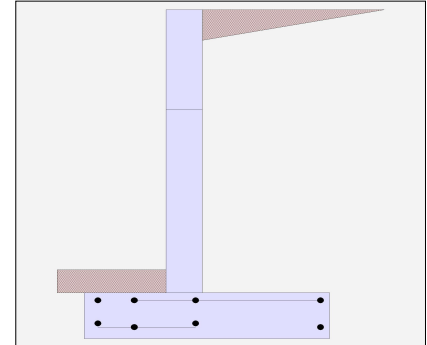
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

#### Criteria

|                         |   |         |
|-------------------------|---|---------|
| Retained Height         | = | 6.17 ft |
| Wall height above soil  | = | 0.00 ft |
| Slope Behind Wall       | = | 0.00    |
| Height of Soil over Toe | = | 6.00 in |
| Water height over heel  | = | 0.0 ft  |

#### Soil Data

|   |   |              |
|---|---|--------------|
| Allow Soil Bearing                            | = | 5,333.0 psf  |
| Equivalent Fluid Pressure Method              |   |              |
| Active Heel Pressure                          | = | 35.0 psf/ft  |
|   | = |              |
| Passive Pressure                              | = | 350.0 psf/ft |
| Soil Density, Heel                            | = | 110.00 pcf   |
| Soil Density, Toe                             | = | 110.00 pcf   |
| Footing  Soil Friction                        | = | 0.350        |
| Soil height to ignore<br>for passive pressure | = | 12.00 in     |



#### Surcharge Loads

|                                      |   |         |
|--------------------------------------|---|---------|
| Surcharge Over Heel                  | = | 0.0 psf |
| Used To Resist Sliding & Overturning |   |         |
| Surcharge Over Toe                   | = | 0.0 psf |
| Used for Sliding & Overturning       |   |         |

#### Axial Load Applied to Stem

|                         |   |         |
|-------------------------|---|---------|
| Axial Dead Load         | = | 0.0 lbs |
| Axial Live Load         | = | 0.0 lbs |
| Axial Load Eccentricity | = | 0.0 in  |

#### Earth Pressure Seismic Load

|                                   |   |         |
|-----------------------------------|---|---------|
| Method                            | : | Uniform |
| Multiplier Used                   | = | 8.000   |
| (Multiplier used on soil density) |   |         |

#### Lateral Load Applied to Stem

|                      |   |                             |
|----------------------|---|-----------------------------|
| Lateral Load         | = | 0.0 #/ft                    |
| ...Height to Top     | = | 0.00 ft                     |
| ...Height to Bottom  | = | 0.00 ft                     |
| Load Type            | = | Wind (W)<br>(Service Level) |
| Wind on Exposed Stem | = | 0.0 psf<br>(Strength Level) |

|                       |   |         |
|-----------------------|---|---------|
| Uniform Seismic Force | = | 57.360  |
| Total Seismic Force   | = | 411.271 |

#### Adjacent Footing Load

|  |   |                |
|--|---|----------------|
| Adjacent Footing Load                    | = | 0.0 lbs        |
| Footing Width                            | = | 0.00 ft        |
| Eccentricity                             | = | 0.00 in        |
| Wall to Ftg CL Dist                      | = | 0.00 ft        |
| Footing Type                             | = | Spread Footing |
| Base Above/Below Soil<br>at Back of Wall | = | 0.0 ft         |
| Poisson's Ratio                          | = | 0.300          |



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 Project ID:  
 Project Descr:

## Cantilevered Retaining Wall

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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### DESCRIPTION: Cant'd Retaining Wall @ Garage (Detail 8)

| Design Summary   |                     | Stem Construction              |        | 3rd             | 2nd             | Bottom          |    |    |
|--|---------------------|--------------------------------|--------|-----------------|-----------------|-----------------|----|----|
| <b>Wall Stability Ratios</b>   |                     | <b>Design Height Above Ftg</b> | ft =   | Stem OK<br>6.17 | Stem OK<br>4.00 | Stem OK<br>0.00 |    |    |
| Overturning  | = 3.07 OK           | Wall Material Above "Ht"       | =      | Concrete        | Concrete        | Concrete        |    |    |
| Sliding  | = 1.17 Ratio < 1.5! | Design Method                  | =      | SD              | SD              | SD              | SD | SD |
| Global Stability   | = 2.24              | Thickness                      | =      | 8.00            | 8.00            | 8.00            |    |    |
|  |                     | Rebar Size                     | =      | # 4             | # 4             | # 4             |    |    |
|  |                     | Rebar Spacing                  | =      | 12.00           | 12.00           | 12.00           |    |    |
|  |                     | Rebar Placed at                | =      | 6.5 in          | 6.5 in          | 6.5 in          |    |    |
| Total Bearing Load   | = 3,355 lbs         | <b>Design Data</b>             |        |                 |                 |                 |    |    |
| ...resultant ecc.  | = 0.25 in           | fb/FB + fa/Fa                  | =      | <b>0.000</b>    | <b>0.040</b>    | <b>0.582</b>    |    |    |
| Soil Pressure @ Toe  | = 675 psf OK        | <b>Total Force @ Section</b>   |        |                 |                 |                 |    |    |
| Soil Pressure @ Heel   | = 639 psf OK        | Service Level                  | lbs =  |                 |                 |                 |    |    |
| Allowable  | = 5,333 psf         | Strength Level                 | lbs =  |                 | 256.3           | 1,419.8         |    |    |
| <b>Soil Pressure Less Than Allowable</b>   |                     | <b>Moment....Actual</b>        |        |                 |                 |                 |    |    |
| ACI Factored @ Toe   | = 945 psf           | Service Level                  | ft-# = |                 |                 |                 |    |    |
| ACI Factored @ Heel  | = 895 psf           | Strength Level                 | ft-# = |                 | 230.4           | 3,284.1         |    |    |
| Footing Shear @ Toe  | = 5.2 psi OK        | Moment.....Allowable           | ft-# = | 5,637.6         | 5,637.6         | 5,637.6         |    |    |
| Footing Shear @ Heel   | = 25.9 psi OK       | <b>Shear.....Actual</b>        |        |                 |                 |                 |    |    |
| Allowable  | = 82.2 psi          | Service Level                  | psi =  |                 |                 |                 |    |    |
|  |                     | Strength Level                 | psi =  |                 | 3.3             | 18.2            |    |    |
| <b>Sliding Calcs</b>   |                     | Shear.....Allowable            | psi =  | 75.0            | 75.0            | 75.0            |    |    |
| Lateral Sliding Force  | = 1,187.5 lbs       | Anet (Masonry)                 | in2 =  |                 |                 |                 |    |    |
| less 100% Passive Force  | = - 218.8 lbs       | Rebar Depth 'd'                | in =   | 6.50            | 6.50            | 6.50            |    |    |
| less 100% Friction Force   | = - 1,174.3 lbs     | <b>Masonry Data</b>            |        |                 |                 |                 |    |    |
| Added Force Req'd  | = 0.0 lbs OK        | f'm                            | psi =  |                 |                 |                 |    |    |
| ...for 1.5 Stability   | = 388.2 lbs NG      | Fs                             | psi =  |                 |                 |                 |    |    |
|  |                     | Solid Grouting                 | =      |                 |                 |                 |    |    |
|  |                     | Modular Ratio 'n'              | =      |                 |                 |                 |    |    |
|  |                     | Wall Weight                    | psf =  | 100.0           | 100.0           | 100.0           |    |    |
|  |                     | Short Term Factor              | =      |                 |                 |                 |    |    |
|  |                     | Equiv. Solid Thick.            | =      |                 |                 |                 |    |    |
|  |                     | Masonry Block Type             | =      |                 |                 |                 |    |    |
|  |                     | Masonry Design Method          | =      | ASD             |                 |                 |    |    |
|  |                     | <b>Concrete Data</b>           |        |                 |                 |                 |    |    |
|  |                     | f'c                            | psi =  | 2,500.0         | 2,500.0         | 2,500.0         |    |    |
|  |                     | Fy                             | psi =  | 60,000.0        | 60,000.0        | 60,000.0        |    |    |
| Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures. |                     |                                |        |                 |                 |                 |    |    |
| <b>Load Factors</b>  |                     |                                |        |                 |                 |                 |    |    |
| Building Code  |                     |                                |        |                 |                 |                 |    |    |
| Dead Load  | 1.200               |                                |        |                 |                 |                 |    |    |
| Live Load  | 1.600               |                                |        |                 |                 |                 |    |    |
| Earth, H   | 1.600               |                                |        |                 |                 |                 |    |    |
| Wind, W  | 1.600               |                                |        |                 |                 |                 |    |    |
| Seismic, E   | 1.000               |                                |        |                 |                 |                 |    |    |



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**Cantilevered Retaining Wall**

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION: Cant'd Retaining Wall @ Garage (Detail 8)**

**Concrete Stem Rebar Area Details**

| 3rd Stem                        | Vertical Reinforcing | Horizontal Reinforcing                                       |
|---------------------------------|----------------------|--|
| As (based on applied moment) :  | 0 in2/ft             |  |
| (4/3) * As :                    | 0 in2/ft             | Min Stem T&S Reinf Area 0.000 in2                            |
| 200bd/fy : 200(12)(6.5)/60000 : | 0.26 in2/ft          | Min Stem T&S Reinf Area per ft of stem Height : 0.000 in2/ft |
| 0.0018bh : 0.0018(12)(8) :      | 0.1728 in2/ft        | Horizontal Reinforcing Options :                             |
|                                 | =====                | One layer of :      Two layers of :                          |
| Required Area :                 | 0.1728 in2/ft        | #4@ 0.00 in      #4@ 0.00 in                                 |
| Provided Area :                 | 0.2 in2/ft           | #5@ 0.00 in      #5@ 0.00 in                                 |
| Maximum Area :                  | 0.8805 in2/ft        | #6@ 0.00 in      #6@ 0.00 in                                 |
| <hr/>                           |                      |  |
| 2nd Stem                        | Vertical Reinforcing | Horizontal Reinforcing                                       |
| As (based on applied moment) :  | 0.0083 in2/ft        |  |
| (4/3) * As :                    | 0.011 in2/ft         | Min Stem T&S Reinf Area 0.417 in2                            |
| 200bd/fy : 200(12)(6.5)/60000 : | 0.26 in2/ft          | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft |
| 0.0018bh : 0.0018(12)(8) :      | 0.1728 in2/ft        | Horizontal Reinforcing Options :                             |
|                                 | =====                | One layer of :      Two layers of :                          |
| Required Area :                 | 0.1728 in2/ft        | #4@ 12.50 in      #4@ 25.00 in                               |
| Provided Area :                 | 0.2 in2/ft           | #5@ 19.38 in      #5@ 38.75 in                               |
| Maximum Area :                  | 0.8805 in2/ft        | #6@ 27.50 in      #6@ 55.00 in                               |
| <hr/>                           |                      |  |
| Bottom Stem                     | Vertical Reinforcing | Horizontal Reinforcing                                       |
| As (based on applied moment) :  | 0.1181 in2/ft        |  |
| (4/3) * As :                    | 0.1574 in2/ft        | Min Stem T&S Reinf Area 0.768 in2                            |
| 200bd/fy : 200(12)(6.5)/60000 : | 0.26 in2/ft          | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft |
| 0.0018bh : 0.0018(12)(8) :      | 0.1728 in2/ft        | Horizontal Reinforcing Options :                             |
|                                 | =====                | One layer of :      Two layers of :                          |
| Required Area :                 | 0.1728 in2/ft        | #4@ 12.50 in      #4@ 25.00 in                               |
| Provided Area :                 | 0.2 in2/ft           | #5@ 19.38 in      #5@ 38.75 in                               |
| Maximum Area :                  | 0.8805 in2/ft        | #6@ 27.50 in      #6@ 55.00 in                               |



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MULHERN & KULP STRUCTURAL ENGINEERING INC

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### DESCRIPTION: Cant'd Retaining Wall @ Garage (Detail 8)

#### Footing Data

|                          |       |         |                 |
|--------------------------|-------|---------|-----------------|
| Toe Width                | =     | 1.50    | ft              |
| Heel Width               | =     | 3.00    |                 |
| Total Footing Width      | =     | 4.50    |                 |
| Footing Thickness        | =     | 12.00   | in              |
| Key Width                | =     | 0.00    | in              |
| Key Depth                | =     | 0.00    | in              |
| Key Distance from Toe    | =     | 0.00    | ft              |
| f'c =                    | 3,000 | psi     | Fy = 60,000 psi |
| Footing Concrete Density | =     | 150.00  | pcf             |
| Min. As %                | =     | 0.0018  |                 |
| Cover @ Top              | 2.00  | @ Btm.= | 3.00 in         |

#### Footing Design Results

|                                |   | <u>Toe</u>     | <u>Heel</u> |
|--------------------------------|---|----------------|-------------|
| Factored Pressure              | = | 945            | 895 psf     |
| Mu' : Upward                   | = | 1,057          | 0 ft-#      |
| Mu' : Downward                 | = | 277            | 4,190 ft-#  |
| Mu: Design                     | = | 781            | 4,190 ft-#  |
| phiMn                          | = | 9,837          | 11,003 ft-# |
| Actual 1-Way Shear             | = | 5.22           | 25.93 psi   |
| Allow 1-Way Shear              | = | 82.16          | 82.16 psi   |
| Toe Reinforcing                | = | # 5 @ 14.35 in |             |
| Heel Reinforcing               | = | # 5 @ 14.35 in |             |
| Key Reinforcing                | = | None Spec'd    |             |
| Footing Torsion, Tu            | = |                | 0.00 ft-lbs |
| Footing Allow. Torsion, phi Tu | = |                | 0.00 ft-lbs |

**If torsion exceeds allowable, provide supplemental design for footing torsion.**

#### Other Acceptable Sizes & Spacings

Toe:  
 Heel:  
 Key:

|                                     |      |                                   |
|-------------------------------------|------|-----------------------------------|
| Min footing T&S reinf Area          | 1.17 | in2                               |
| Min footing T&S reinf Area per foot | 0.26 | in2 /ft                           |
| If one layer of horizontal bars:    |      | If two layers of horizontal bars: |
| #4 @ 9.26 in                        |      | #4 @ 18.52 in                     |
| #5 @ 14.35 in                       |      | #5 @ 28.70 in                     |
| #6 @ 20.37 in                       |      | #6 @ 40.74 in                     |

### Summary of Overturning & Resisting Forces & Moments

| Item                                    | .....OVERTURNING..... |             |                         | .....RESISTING.....           |                    |              |                |
|---|-----------------------|-------------|-------------------------|-------------------------------|--------------------|--------------|----------------|
|   | Force lbs             | Distance ft | Moment ft-#             | Force lbs                     | Distance ft        | Moment ft-#  |                |
| HL Act Pres (ab water tbl)              | 899.7                 | 2.39        | 2,150.2                 | Soil Over HL (ab. water tbl)  | 1,583.6            | 3.33         | 5,278.8        |
| HL Act Pres (be water tbl)              |                       |             |                         | Soil Over HL (bel. water tbl) |                    | 3.33         | 5,278.8        |
| Hydrostatic Force                       |                       |             |                         | Watre Table                   |                    |              |                |
| Buoyant Force                           | =                     |             |                         | Sloped Soil Over Heel         | =                  |              |                |
| Surcharge over Heel                     | =                     |             |                         | Surcharge Over Heel           | =                  |              |                |
| Surcharge Over Toe                      | =                     |             |                         | Adjacent Footing Load         | =                  |              |                |
| Adjacent Footing Load                   | =                     |             |                         | Axial Dead Load on Stem       | =                  |              |                |
| Added Lateral Load                      | =                     |             |                         | * Axial Live Load on Stem     | =                  |              |                |
| Load @ Stem Above Soil                  | =                     |             |                         | Soil Over Toe                 | =                  | 82.5         | 61.9           |
| Seismic Earth Load                      | =                     | 287.9       | 3.59                    | 1,032.1                       | Surcharge Over Toe | =            |                |
|   | =                     |             |                         | Stem Weight(s)                | =                  | 617.0        | 1,131.2        |
|   | =                     |             |                         | Earth @ Stem Transitions      | =                  |              |                |
| <b>Total</b>                            | =                     | 1,187.5     | <b>O.T.M. = 3,182.3</b> | Footing Weight                | =                  | 675.0        | 1,518.8        |
|   |                       |             |                         | Key Weight                    | =                  |              |                |
| <b>Resisting/Overturning Ratio</b>      |                       |             | = <b>3.07</b>           | Vert. Component               | =                  | 397.1        | 1,787.1        |
| Vertical Loads used for Soil Pressure = |                       |             | 3,355.3 lbs             | <b>Total =</b>                | <b>3,355.3 lbs</b> | <b>R.M.=</b> | <b>9,777.6</b> |

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS considered in the calculation of Overturning Resistance.



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**DESCRIPTION:** Cant'd Retaining Wall @ Garage (Detail 8)

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

|                              |           |
|------------------------------|-----------|
| Soil Spring Reaction Modulus | 250.0 pci |
|------------------------------|-----------|

|  |          |
|--|----------|
| Horizontal Defl @ Top of Wall (approximate only) | 0.026 in |
|--|----------|

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.





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MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION:** Cant'd Retaining Wall @ Garage W/ Basement Slab (Detail 9)

### Code Reference

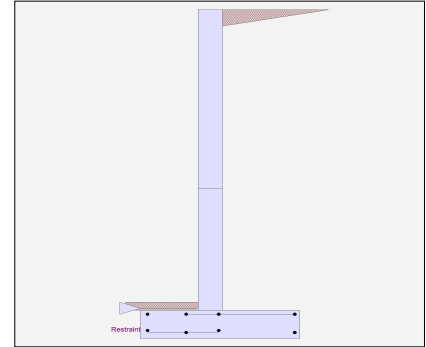
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

#### Criteria

|                         |   |          |
|-------------------------|---|----------|
| Retained Height         | = | 12.33 ft |
| Wall height above soil  | = | 0.00 ft  |
| Slope Behind Wall       | = | 0.00     |
| Height of Soil over Toe | = | 4.00 in  |
| Water height over heel  | = | 0.0 ft   |

#### Soil Data

|  |   |              |
|--|---|--------------|
| Allow Soil Bearing                         | = | 5,333.0 psf  |
| Equivalent Fluid Pressure Method           |   |              |
| Active Heel Pressure                       | = | 35.0 psf/ft  |
| Passive Pressure                           | = | 350.0 psf/ft |
| Soil Density, Heel                         | = | 110.00 pcf   |
| Soil Density, Toe                          | = | 110.00 pcf   |
| Footing  Soil Friction                     | = | 0.350        |
| Soil height to ignore for passive pressure | = | 12.00 in     |



#### Surcharge Loads

|                                      |   |         |
|--------------------------------------|---|---------|
| Surcharge Over Heel                  | = | 0.0 psf |
| Used To Resist Sliding & Overturning |   |         |
| Surcharge Over Toe                   | = | 0.0 psf |
| Used for Sliding & Overturning       |   |         |

#### Axial Load Applied to Stem

|                         |   |         |
|-------------------------|---|---------|
| Axial Dead Load         | = | 0.0 lbs |
| Axial Live Load         | = | 0.0 lbs |
| Axial Load Eccentricity | = | 0.0 in  |

#### Earth Pressure Seismic Load

|                                   |   |         |
|-----------------------------------|---|---------|
| Method                            | : | Uniform |
| Multiplier Used                   | = | 8.000   |
| (Multiplier used on soil density) |   |         |

#### Lateral Load Applied to Stem

|                      |   |                             |
|----------------------|---|-----------------------------|
| Lateral Load         | = | 0.0 #/ft                    |
| ...Height to Top     | = | 0.00 ft                     |
| ...Height to Bottom  | = | 0.00 ft                     |
| Load Type            | = | Wind (W)<br>(Service Level) |
| Wind on Exposed Stem | = | 0.0 psf<br>(Strength Level) |

|                       |   |           |
|-----------------------|---|-----------|
| Uniform Seismic Force | = | 107.973   |
| Total Seismic Force   | = | 1,457.280 |

#### Adjacent Footing Load

|                                       |   |                |
|---------------------------------------|---|----------------|
| Adjacent Footing Load                 | = | 0.0 lbs        |
| Footing Width                         | = | 0.00 ft        |
| Eccentricity                          | = | 0.00 in        |
| Wall to Ftg CL Dist                   | = | 0.00 ft        |
| Footing Type                          | = | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft         |
| Poisson's Ratio                       | = | 0.300          |



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### DESCRIPTION: Cant'd Retaining Wall @ Garage W/ Basement Slab (Detail 9)

| Design Summary                    |                     | Stem Construction              |        | 3rd              | 2nd             | Bottom          |    |    |  |
|-----------------------------------|---------------------|--------------------------------|--------|------------------|-----------------|-----------------|----|----|--|
| <b>Wall Stability Ratios</b>      |                     | <b>Design Height Above Ftg</b> | ft =   | Stem OK<br>12.33 | Stem OK<br>5.00 | Stem OK<br>0.00 |    |    |  |
| Overturning                       | = 1.38 Ratio < 1.5! | Wall Material Above "Ht"       | =      | Concrete         | Concrete        | Concrete        | SD | SD |  |
| Slab Resists All Sliding !        |                     | Design Method                  | =      | SD               | SD              | SD              |    |    |  |
| Global Stability                  | = 1.45              | Thickness                      | =      | 10.00            | 10.00           | 10.00           |    |    |  |
| Total Bearing Load                | = 7,601 lbs         | Rebar Size                     | =      | # 5              | # 5             | # 6             |    |    |  |
| ...resultant ecc.                 | = 17.45 in          | Rebar Spacing                  | =      | 12.00            | 12.00           | 6.00            |    |    |  |
| Soil Pressure @ Toe               | = 3,186 psf OK      | Rebar Placed at                | =      | 8.5 in           | 8.5 in          | 8.5 in          |    |    |  |
| Soil Pressure @ Heel              | = 0 psf OK          | <b>Design Data</b>             |        |                  |                 |                 |    |    |  |
| Allowable                         | = 5,333 psf         | fb/FB + fa/Fa                  | =      | <b>0.000</b>     | <b>0.579</b>    | <b>0.869</b>    |    |    |  |
| Soil Pressure Less Than Allowable |                     | <b>Total Force @ Section</b>   |        |                  |                 |                 |    |    |  |
| ACI Factored @ Toe                | = 4,460 psf         | Service Level                  | lbs =  |                  |                 |                 |    |    |  |
| ACI Factored @ Heel               | = 0 psf             | Strength Level                 | lbs =  | 2,295.9          |                 | 5,588.1         |    |    |  |
| Footing Shear @ Toe               | = 31.7 psi OK       | <b>Moment....Actual</b>        |        |                  |                 |                 |    |    |  |
| Footing Shear @ Heel              | = 51.8 psi OK       | Service Level                  | ft-# = |                  |                 |                 |    |    |  |
| Allowable                         | = 75.0 psi          | Strength Level                 | ft-# = | 6,576.4          |                 | 25,703.0        |    |    |  |
| <b>Sliding Calcs</b>              |                     | Moment.....Allowable           | ft-# = | 11,347.2         | 11,347.2        | 29,547.9        |    |    |  |
| Lateral Sliding Force             | = 4,207.9 lbs       | <b>Shear.....Actual</b>        |        |                  |                 |                 |    |    |  |
|                                   |                     | Service Level                  | psi =  |                  |                 |                 |    |    |  |
|                                   |                     | Strength Level                 | psi =  | 22.5             |                 | 54.8            |    |    |  |
|                                   |                     | Shear.....Allowable            | psi =  | 75.0             | 75.0            | 75.0            |    |    |  |
|                                   |                     | Anet (Masonry)                 | in2 =  |                  |                 |                 |    |    |  |
|                                   |                     | Rebar Depth 'd'                | in =   | 8.50             | 8.50            | 8.50            |    |    |  |
|                                   |                     | <b>Masonry Data</b>            |        |                  |                 |                 |    |    |  |
|                                   |                     | f'm                            | psi =  |                  |                 |                 |    |    |  |
|                                   |                     | Fs                             | psi =  |                  |                 |                 |    |    |  |
|                                   |                     | Solid Grouting                 | =      |                  |                 |                 |    |    |  |
|                                   |                     | Modular Ratio 'n'              | =      |                  |                 |                 |    |    |  |
|                                   |                     | Wall Weight                    | psf =  | 125.0            | 125.0           | 125.0           |    |    |  |
|                                   |                     | Short Term Factor              | =      |                  |                 |                 |    |    |  |
|                                   |                     | Equiv. Solid Thick.            | =      |                  |                 |                 |    |    |  |
|                                   |                     | Masonry Block Type             | =      |                  |                 |                 |    |    |  |
|                                   |                     | Masonry Design Method          | =      | ASD              |                 |                 |    |    |  |
|                                   |                     | <b>Concrete Data</b>           |        |                  |                 |                 |    |    |  |
|                                   |                     | f'c                            | psi =  | 2,500.0          | 2,500.0         | 2,500.0         |    |    |  |
|                                   |                     | Fy                             | psi =  | 60,000.0         | 60,000.0        | 60,000.0        |    |    |  |

Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures.

#### Load Factors

|               |       |
|---------------|-------|
| Building Code |       |
| Dead Load     | 1.200 |
| Live Load     | 1.600 |
| Earth, H      | 1.600 |
| Wind, W       | 1.600 |
| Seismic, E    | 1.000 |



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**DESCRIPTION: Cant'd Retaining Wall @ Garage W/ Basement Slab (Detail 9)**

**Concrete Stem Rebar Area Details**

| 3rd Stem                        | Vertical Reinforcing | Horizontal Reinforcing                                       |
|---------------------------------|----------------------|--|
| As (based on applied moment) :  | 0 in2/ft             |  |
| (4/3) * As :                    | 0 in2/ft             | Min Stem T&S Reinf Area 0.000 in2                            |
| 200bd/fy : 200(12)(8.5)/60000 : | 0.34 in2/ft          | Min Stem T&S Reinf Area per ft of stem Height : 0.000 in2/ft |
| 0.0018bh : 0.0018(12)(10) :     | 0.216 in2/ft         | Horizontal Reinforcing Options :                             |
|                                 | =====                | One layer of :      Two layers of :                          |
| Required Area :                 | 0.216 in2/ft         | #4@ 0.00 in      #4@ 0.00 in                                 |
| Provided Area :                 | 0.31 in2/ft          | #5@ 0.00 in      #5@ 0.00 in                                 |
| Maximum Area :                  | 1.1515 in2/ft        | #6@ 0.00 in      #6@ 0.00 in                                 |

| 2nd Stem                        | Vertical Reinforcing | Horizontal Reinforcing                                       |
|---------------------------------|----------------------|--|
| As (based on applied moment) :  | 0.1786 in2/ft        |  |
| (4/3) * As :                    | 0.2382 in2/ft        | Min Stem T&S Reinf Area 1.759 in2                            |
| 200bd/fy : 200(12)(8.5)/60000 : | 0.34 in2/ft          | Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft |
| 0.0018bh : 0.0018(12)(10) :     | 0.216 in2/ft         | Horizontal Reinforcing Options :                             |
|                                 | =====                | One layer of :      Two layers of :                          |
| Required Area :                 | 0.2382 in2/ft        | #4@ 10.00 in      #4@ 20.00 in                               |
| Provided Area :                 | 0.31 in2/ft          | #5@ 15.50 in      #5@ 31.00 in                               |
| Maximum Area :                  | 1.1515 in2/ft        | #6@ 22.00 in      #6@ 44.00 in                               |

| Bottom Stem                     | Vertical Reinforcing | Horizontal Reinforcing                                       |
|---------------------------------|----------------------|--|
| As (based on applied moment) :  | 0.6982 in2/ft        |  |
| (4/3) * As :                    | 0.9309 in2/ft        | Min Stem T&S Reinf Area 1.200 in2                            |
| 200bd/fy : 200(12)(8.5)/60000 : | 0.34 in2/ft          | Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft |
| 0.0018bh : 0.0018(12)(10) :     | 0.216 in2/ft         | Horizontal Reinforcing Options :                             |
|                                 | =====                | One layer of :      Two layers of :                          |
| Required Area :                 | 0.6982 in2/ft        | #4@ 10.00 in      #4@ 20.00 in                               |
| Provided Area :                 | 0.88 in2/ft          | #5@ 15.50 in      #5@ 31.00 in                               |
| Maximum Area :                  | 1.1515 in2/ft        | #6@ 22.00 in      #6@ 44.00 in                               |



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Project Title:  
 Engineer:  
 Project ID:  
 Project Descr:

## Cantilevered Retaining Wall

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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### DESCRIPTION: Cant'd Retaining Wall @ Garage W/ Basement Slab (Detail 9)

#### Footing Data

|                          |       |         |                 |
|--------------------------|-------|---------|-----------------|
| Toe Width                | =     | 2.00    | ft              |
| Heel Width               | =     | 3.50    |                 |
| Total Footing Width      | =     | 5.50    |                 |
| Footing Thickness        | =     | 14.00   | in              |
| Key Width                | =     | 0.00    | in              |
| Key Depth                | =     | 0.00    | in              |
| Key Distance from Toe    | =     | 0.00    | ft              |
| f'c =                    | 2,500 | psi     | Fy = 60,000 psi |
| Footing Concrete Density | =     | 150.00  | pcf             |
| Min. As %                | =     | 0.0018  |                 |
| Cover @ Top              | 2.00  | @ Btm.= | 3.00 in         |

#### Footing Design Results

|                                |   | <u>Toe</u>     | <u>Heel</u> |
|--------------------------------|---|----------------|-------------|
| Factored Pressure              | = | 4,460          | 0 psf       |
| Mu' : Upward                   | = | 7,390          | 0 ft-#      |
| Mu' : Downward                 | = | 508            | 12,537 ft-# |
| Mu: Design                     | = | 6,882          | 12,537 ft-# |
| phiMn                          | = | 14,059         | 16,897 ft-# |
| Actual 1-Way Shear             | = | 31.66          | 51.82 psi   |
| Allow 1-Way Shear              | = | 75.00          | 75.00 psi   |
| Toe Reinforcing                | = | # 5 @ 12.30 in |             |
| Heel Reinforcing               | = | # 5 @ 11.19 in |             |
| Key Reinforcing                | = | None Spec'd    |             |
| Footing Torsion, Tu            | = |                | 0.00 ft-lbs |
| Footing Allow. Torsion, phi Tu | = |                | 0.00 ft-lbs |

**If torsion exceeds allowable, provide supplemental design for footing torsion.**

#### Other Acceptable Sizes & Spacings

Toe:  
 Heel:  
 Key:

|                                     |      |                                   |
|-------------------------------------|------|-----------------------------------|
| Min footing T&S reinf Area          | 1.66 | in <sup>2</sup>                   |
| Min footing T&S reinf Area per foot | 0.30 | in <sup>2</sup> /ft               |
| If one layer of horizontal bars:    |      | If two layers of horizontal bars: |
| #4 @ 7.94 in                        |      | #4 @ 15.87 in                     |
| #5 @ 12.30 in                       |      | #5 @ 24.60 in                     |
| #6 @ 17.46 in                       |      | #6 @ 34.92 in                     |

### Summary of Overturning & Resisting Forces & Moments

| Item                                    | .....OVERTURNING..... |             |                 | .....RESISTING.....           |                    |             |          |              |          |
|---|-----------------------|-------------|-----------------|-------------------------------|--------------------|-------------|----------|--------------|----------|
|   | Force lbs             | Distance ft | Moment ft-#     | Force lbs                     | Distance ft        | Moment ft-# |          |              |          |
| HL Act Pres (ab water tbl)              | 3,187.8               | 4.50        | 14,341.6        | Soil Over HL (ab. water tbl)  | 3,616.8            | 4.17        | 15,070.0 |              |          |
| HL Act Pres (be water tbl)              |                       |             |                 | Soil Over HL (bel. water tbl) |                    | 4.17        | 15,070.0 |              |          |
| Hydrostatic Force                       |                       |             |                 | Watre Table                   |                    |             |          |              |          |
| Buoyant Force                           | =                     |             |                 | Sloped Soil Over Heel         | =                  |             |          |              |          |
| Surcharge over Heel                     | =                     |             |                 | Surcharge Over Heel           | =                  |             |          |              |          |
| Surcharge Over Toe                      | =                     |             |                 | Adjacent Footing Load         | =                  |             |          |              |          |
| Adjacent Footing Load                   | =                     |             |                 | Axial Dead Load on Stem       | =                  |             |          |              |          |
| Added Lateral Load                      | =                     |             |                 | * Axial Live Load on Stem     | =                  |             |          |              |          |
| Load @ Stem Above Soil                  | =                     |             |                 | Soil Over Toe                 | =                  | 73.3        | 1.00     | 73.3         |          |
| Seismic Earth Load                      | =                     | 1,020.1     | 6.75            | 6,883.9                       | Surcharge Over Toe | =           |          |              |          |
|   | =                     |             |                 | Stem Weight(s)                | =                  | 1,541.3     | 2.42     | 3,724.7      |          |
|   | =                     |             |                 | Earth @ Stem Transitions      | =                  |             |          |              |          |
| <b>Total</b>                            | =                     | 4,207.9     | <b>O.T.M. =</b> | 21,225.5                      | Footing Weight     | =           | 962.5    | 2.75         | 2,646.9  |
|   |                       |             |                 |                               | Key Weight         | =           |          |              |          |
| <b>Resisting/Overturning Ratio</b>      |                       |             | =               | <b>1.38</b>                   | Vert. Component    | =           | 1,407.2  | 5.50         | 7,739.3  |
| Vertical Loads used for Soil Pressure = |                       | 7,601.0     | lbs             |                               | <b>Total =</b>     | 7,601.0     | lbs      | <b>R.M.=</b> | 29,254.2 |

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS considered in the calculation of Overturning Resistance.



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## Cantilevered Retaining Wall

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION:** Cant'd Retaining Wall @ Garage W/ Basement Slab (Detail 9)

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus                                  250.0    pci

Horizontal Defl @ Top of Wall (approximate only)            0.198    in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,  
because the wall would then tend to rotate into the retained soil.

## Cantilevered Retaining Wall

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MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION:** Cant'd Retaining Wall @ Garage W/ Crawl (Detail 10)

### Code Reference

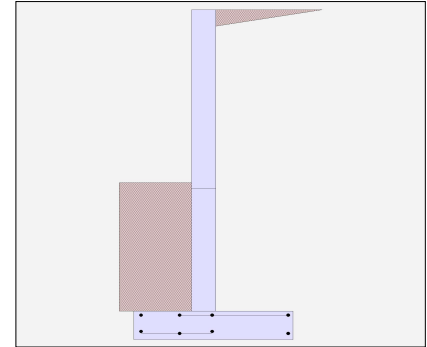
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

#### Criteria

|                         |   |          |
|-------------------------|---|----------|
| Retained Height         | = | 12.33 ft |
| Wall height above soil  | = | 0.00 ft  |
| Slope Behind Wall       | = | 0.00     |
| Height of Soil over Toe | = | 63.00 in |
| Water height over heel  | = | 0.0 ft   |

#### Soil Data

|  |   |              |
|--|---|--------------|
| Allow Soil Bearing                         | = | 5,333.0 psf  |
| Equivalent Fluid Pressure Method           |   |              |
| Active Heel Pressure                       | = | 35.0 psf/ft  |
|  | = |              |
| Passive Pressure                           | = | 350.0 psf/ft |
| Soil Density, Heel                         | = | 110.00 pcf   |
| Soil Density, Toe                          | = | 110.00 pcf   |
| Footing  Soil Friction                     | = | 0.350        |
| Soil height to ignore for passive pressure | = | 12.00 in     |



#### Surcharge Loads

|                                      |   |         |
|--------------------------------------|---|---------|
| Surcharge Over Heel                  | = | 0.0 psf |
| Used To Resist Sliding & Overturning |   |         |
| Surcharge Over Toe                   | = | 0.0 psf |
| Used for Sliding & Overturning       |   |         |

#### Axial Load Applied to Stem

|                         |   |         |
|-------------------------|---|---------|
| Axial Dead Load         | = | 0.0 lbs |
| Axial Live Load         | = | 0.0 lbs |
| Axial Load Eccentricity | = | 0.0 in  |

#### Earth Pressure Seismic Load

|                                   |           |
|-----------------------------------|-----------|
| Method                            | : Uniform |
| Multiplier Used                   | = 8.000   |
| (Multiplier used on soil density) |           |

#### Lateral Load Applied to Stem

|                      |   |                  |
|----------------------|---|------------------|
| Lateral Load         | = | 0.0 #/ft         |
| ...Height to Top     | = | 0.00 ft          |
| ...Height to Bottom  | = | 0.00 ft          |
| Load Type            | = | Wind (W)         |
|                      |   | (Service Level)  |
| Wind on Exposed Stem | = | 0.0 psf          |
|                      |   | (Strength Level) |

|                       |   |           |
|-----------------------|---|-----------|
| Uniform Seismic Force | = | 107.973   |
| Total Seismic Force   | = | 1,457.280 |

#### Adjacent Footing Load

|                                       |   |                |
|---------------------------------------|---|----------------|
| Adjacent Footing Load                 | = | 0.0 lbs        |
| Footing Width                         | = | 0.00 ft        |
| Eccentricity                          | = | 0.00 in        |
| Wall to Ftg CL Dist                   | = | 0.00 ft        |
| Footing Type                          | = | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft         |
| Poisson's Ratio                       | = | 0.300          |



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**Cantilevered Retaining Wall**

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION: Cant'd Retaining Wall @ Garage W/ Crawl (Detail 10)**

| <b>Design Summary</b>  |     |                   | <b>Stem Construction</b>       |        |              | <b>3rd</b>   | <b>2nd</b>   | <b>Bottom</b> |    |  |
|--|-----|-------------------|--------------------------------|--------|--------------|--------------|--------------|---------------|----|--|
| <b>Wall Stability Ratios</b>   |     |                   | <b>Design Height Above Ftg</b> | ft =   | Stem OK      | Stem OK      | Stem OK      |               |    |  |
| Overturning  | =   | 1.43 Ratio < 1.5! | Wall Material Above "Ht"       | =      | 12.33        | 5.00         | 0.00         |               |    |  |
| Sliding  | =   | 2.39 OK           | Design Method                  | =      | Concrete     | Concrete     | Concrete     | SD            | SD |  |
| Global Stability   | =   | 2.44              | Thickness                      | =      | 10.00        | 10.00        | 10.00        |               |    |  |
| Total Bearing Load = 8,683 lbs   |     |                   | Rebar Size                     | =      | # 5          | # 5          | # 6          |               |    |  |
| ...resultant ecc. = 17.97 in   |     |                   | Rebar Spacing                  | =      | 12.00        | 12.00        | 6.00         |               |    |  |
| Soil Pressure @ Toe = 3,873 psf OK   |     |                   | Rebar Placed at                | =      | 8.5 in       | 8.5 in       | 8.5 in       |               |    |  |
| Soil Pressure @ Heel = 0 psf OK  |     |                   | <b>Design Data</b>             | -----  |              |              |              |               |    |  |
| Allowable = 5,333 psf  |     |                   | fb/FB + fa/Fa                  | =      | <b>0.000</b> | <b>0.579</b> | <b>0.869</b> |               |    |  |
| <b>Soil Pressure Less Than Allowable</b>   |     |                   | <b>Total Force @ Section</b>   | -----  |              |              |              |               |    |  |
| ACI Factored @ Toe = 5,423 psf   |     |                   | Service Level                  | lbs =  |              |              |              |               |    |  |
| ACI Factored @ Heel = 0 psf  |     |                   | Strength Level                 | lbs =  |              |              | 2,295.9      | 5,588.1       |    |  |
| Footing Shear @ Toe = 31.0 psi OK  |     |                   | <b>Moment....Actual</b>        | -----  |              |              |              |               |    |  |
| Footing Shear @ Heel = 51.8 psi OK   |     |                   | Service Level                  | ft-# = |              |              |              |               |    |  |
| Allowable = 75.0 psi   |     |                   | Strength Level                 | ft-# = |              |              | 6,576.4      | 25,703.0      |    |  |
| <b>Sliding Calcs</b>   |     |                   | Moment.....Allowable           | ft-# = | 11,347.2     | 11,347.2     | 29,547.9     |               |    |  |
| Lateral Sliding Force  | =   | 4,207.9 lbs       | <b>Shear.....Actual</b>        | -----  |              |              |              |               |    |  |
| less 100% Passive Force  | -   | 7,030.4 lbs       | Service Level                  | psi =  |              |              |              |               |    |  |
| less 100% Friction Force   | ≡ - | 3,038.9 lbs       | Strength Level                 | psi =  |              |              | 22.5         | 54.8          |    |  |
| Added Force Req'd  | =   | 0.0 lbs OK        | Shear.....Allowable            | psi =  | 75.0         | 75.0         | 75.0         |               |    |  |
| ....for 1.5 Stability  | =   | 0.0 lbs OK        | Anet (Masonry)                 | in2 =  |              |              |              |               |    |  |
|  |     |                   | Rebar Depth 'd'                | in =   | 8.50         | 8.50         | 8.50         |               |    |  |
| Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures. |     |                   | <b>Masonry Data</b>            | -----  |              |              |              |               |    |  |
| <b>Load Factors</b>  |     |                   | f'm                            | psi =  |              |              |              |               |    |  |
| Building Code  |     |                   | Fs                             | psi =  |              |              |              |               |    |  |
| Dead Load  |     | 1.200             | Solid Grouting                 | =      |              |              |              |               |    |  |
| Live Load  |     | 1.600             | Modular Ratio 'n'              | =      |              |              |              |               |    |  |
| Earth, H   |     | 1.600             | Wall Weight                    | psf =  | 125.0        | 125.0        | 125.0        |               |    |  |
| Wind, W  |     | 1.600             | Short Term Factor              | =      |              |              |              |               |    |  |
| Seismic, E   |     | 1.000             | Equiv. Solid Thick.            | =      |              |              |              |               |    |  |
|  |     |                   | Masonry Block Type             | =      |              |              |              |               |    |  |
|  |     |                   | Masonry Design Method          | =      | ASD          |              |              |               |    |  |
|  |     |                   | <b>Concrete Data</b>           | -----  |              |              |              |               |    |  |
|  |     |                   | f'c                            | psi =  | 2,500.0      | 2,500.0      | 2,500.0      |               |    |  |
|  |     |                   | Fy                             | psi =  | 60,000.0     | 60,000.0     | 60,000.0     |               |    |  |



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Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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### DESCRIPTION: Cant'd Retaining Wall @ Garage W/ Crawl (Detail 10)

#### Concrete Stem Rebar Area Details

| 3rd Stem                        | Vertical Reinforcing | Horizontal Reinforcing                                       |
|---------------------------------|----------------------|--|
| As (based on applied moment) :  | 0 in2/ft             |  |
| (4/3) * As :                    | 0 in2/ft             | Min Stem T&S Reinf Area 0.000 in2                            |
| 200bd/fy : 200(12)(8.5)/60000 : | 0.34 in2/ft          | Min Stem T&S Reinf Area per ft of stem Height : 0.000 in2/ft |
| 0.0018bh : 0.0018(12)(10) :     | 0.216 in2/ft         | Horizontal Reinforcing Options :                             |
|                                 | =====                | One layer of :      Two layers of :                          |
| Required Area :                 | 0.216 in2/ft         | #4@ 0.00 in      #4@ 0.00 in                                 |
| Provided Area :                 | 0.31 in2/ft          | #5@ 0.00 in      #5@ 0.00 in                                 |
| Maximum Area :                  | 1.1515 in2/ft        | #6@ 0.00 in      #6@ 0.00 in                                 |

| 2nd Stem                        | Vertical Reinforcing | Horizontal Reinforcing                                       |
|---------------------------------|----------------------|--|
| As (based on applied moment) :  | 0.1786 in2/ft        |  |
| (4/3) * As :                    | 0.2382 in2/ft        | Min Stem T&S Reinf Area 1.759 in2                            |
| 200bd/fy : 200(12)(8.5)/60000 : | 0.34 in2/ft          | Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft |
| 0.0018bh : 0.0018(12)(10) :     | 0.216 in2/ft         | Horizontal Reinforcing Options :                             |
|                                 | =====                | One layer of :      Two layers of :                          |
| Required Area :                 | 0.2382 in2/ft        | #4@ 10.00 in      #4@ 20.00 in                               |
| Provided Area :                 | 0.31 in2/ft          | #5@ 15.50 in      #5@ 31.00 in                               |
| Maximum Area :                  | 1.1515 in2/ft        | #6@ 22.00 in      #6@ 44.00 in                               |

| Bottom Stem                     | Vertical Reinforcing | Horizontal Reinforcing                                       |
|---------------------------------|----------------------|--|
| As (based on applied moment) :  | 0.6982 in2/ft        |  |
| (4/3) * As :                    | 0.9309 in2/ft        | Min Stem T&S Reinf Area 1.200 in2                            |
| 200bd/fy : 200(12)(8.5)/60000 : | 0.34 in2/ft          | Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft |
| 0.0018bh : 0.0018(12)(10) :     | 0.216 in2/ft         | Horizontal Reinforcing Options :                             |
|                                 | =====                | One layer of :      Two layers of :                          |
| Required Area :                 | 0.6982 in2/ft        | #4@ 10.00 in      #4@ 20.00 in                               |
| Provided Area :                 | 0.88 in2/ft          | #5@ 15.50 in      #5@ 31.00 in                               |
| Maximum Area :                  | 1.1515 in2/ft        | #6@ 22.00 in      #6@ 44.00 in                               |





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### DESCRIPTION: Cant'd Retaining Wall @ Garage W/ Crawl (Detail 10)

#### Footing Data

|                          |       |         |                 |
|--------------------------|-------|---------|-----------------|
| Toe Width                | =     | 2.00    | ft              |
| Heel Width               | =     | 3.50    |                 |
| Total Footing Width      | =     | 5.50    |                 |
| Footing Thickness        | =     | 14.00   | in              |
| Key Width                | =     | 0.00    | in              |
| Key Depth                | =     | 0.00    | in              |
| Key Distance from Toe    | =     | 0.00    | ft              |
| f'c =                    | 2,500 | psi     | Fy = 60,000 psi |
| Footing Concrete Density | =     | 150.00  | pcf             |
| Min. As %                | =     | 0.0018  |                 |
| Cover @ Top              | 2.00  | @ Btm.= | 3.00 in         |

#### Footing Design Results

|                                |   | <u>Toe</u>     | <u>Heel</u> |
|--------------------------------|---|----------------|-------------|
| Factored Pressure              | = | 5,423          | 0 psf       |
| Mu' : Upward                   | = | 8,921          | 0 ft-#      |
| Mu' : Downward                 | = | 1,806          | 12,537 ft-# |
| Mu: Design                     | = | 7,115          | 12,537 ft-# |
| phiMn                          | = | 14,059         | 16,897 ft-# |
| Actual 1-Way Shear             | = | 31.04          | 51.82 psi   |
| Allow 1-Way Shear              | = | 75.00          | 75.00 psi   |
| Toe Reinforcing                | = | # 5 @ 12.30 in |             |
| Heel Reinforcing               | = | # 5 @ 11.19 in |             |
| Key Reinforcing                | = | None Spec'd    |             |
| Footing Torsion, Tu            | = |                | 0.00 ft-lbs |
| Footing Allow. Torsion, phi Tu | = |                | 0.00 ft-lbs |

**If torsion exceeds allowable, provide supplemental design for footing torsion.**

#### Other Acceptable Sizes & Spacings

Toe:  
 Heel:  
 Key:

|                                     |      |                                   |
|-------------------------------------|------|-----------------------------------|
| Min footing T&S reinf Area          | 1.66 | in2                               |
| Min footing T&S reinf Area per foot | 0.30 | in2 /ft                           |
| If one layer of horizontal bars:    |      | If two layers of horizontal bars: |
| #4@ 7.94 in                         |      | #4@ 15.87 in                      |
| #5@ 12.30 in                        |      | #5@ 24.60 in                      |
| #6@ 17.46 in                        |      | #6@ 34.92 in                      |

### Summary of Overturning & Resisting Forces & Moments

| Item                                    | .....OVERTURNING..... |             |                 | .....RESISTING.....           |                    |             |              |          |         |
|---|-----------------------|-------------|-----------------|-------------------------------|--------------------|-------------|--------------|----------|---------|
|   | Force lbs             | Distance ft | Moment ft-#     | Force lbs                     | Distance ft        | Moment ft-# |              |          |         |
| HL Act Pres (ab water tbl)              | 3,187.8               | 4.50        | 14,341.6        | Soil Over HL (ab. water tbl)  | 3,616.8            | 4.17        | 15,070.0     |          |         |
| HL Act Pres (be water tbl)              |                       |             |                 | Soil Over HL (bel. water tbl) |                    | 4.17        | 15,070.0     |          |         |
| Hydrostatic Force                       |                       |             |                 | Watre Table                   |                    |             |              |          |         |
| Buoyant Force                           | =                     |             |                 | Sloped Soil Over Heel         | =                  |             |              |          |         |
| Surcharge over Heel                     | =                     |             |                 | Surcharge Over Heel           | =                  |             |              |          |         |
| Surcharge Over Toe                      | =                     |             |                 | Adjacent Footing Load         | =                  |             |              |          |         |
| Adjacent Footing Load                   | =                     |             |                 | Axial Dead Load on Stem       | =                  |             |              |          |         |
| Added Lateral Load                      | =                     |             |                 | * Axial Live Load on Stem     | =                  |             |              |          |         |
| Load @ Stem Above Soil                  | =                     |             |                 | Soil Over Toe                 | =                  | 1,155.0     | 1,155.0      |          |         |
| Seismic Earth Load                      | =                     | 1,020.1     | 6.75            | 6,883.9                       | Surcharge Over Toe | =           |              |          |         |
|   | =                     |             |                 | Stem Weight(s)                | =                  | 1,541.3     | 3,724.7      |          |         |
|   | =                     |             |                 | Earth @ Stem Transitions      | =                  |             |              |          |         |
| <b>Total</b>                            | =                     | 4,207.9     | <b>O.T.M. =</b> | 21,225.5                      | Footing Weight     | =           | 962.5        | 2,646.9  |         |
|   |                       |             |                 | Key Weight                    | =                  |             |              |          |         |
| <b>Resisting/Overturning Ratio</b>      |                       |             | =               | <b>1.43</b>                   | Vert. Component    | =           | 1,407.2      | 5.50     | 7,739.3 |
| Vertical Loads used for Soil Pressure = |                       |             |                 | 8,682.7 lbs                   | <b>Total =</b>     | 8,682.7 lbs | <b>R.M.=</b> | 30,335.9 |         |

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS considered in the calculation of Overturning Resistance.



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Project Title:  
Engineer:  
Project ID:  
Project Descr:

## Cantilevered Retaining Wall

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.3.16

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION:** Cant'd Retaining Wall @ Garage W/ Crawl (Detail 10)

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci

Horizontal Defl @ Top of Wall (approximate only) 0.241 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

## Concrete Beam

Project File: Beams.ec6

LIC# : KW-06017913, Build:20.22.8.17

MULHERN & KULP STRUCTURAL ENGINEERING INC

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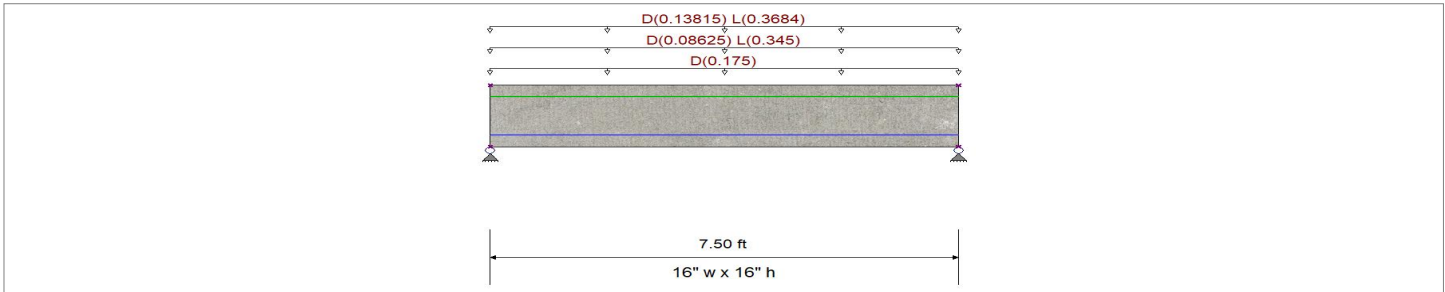
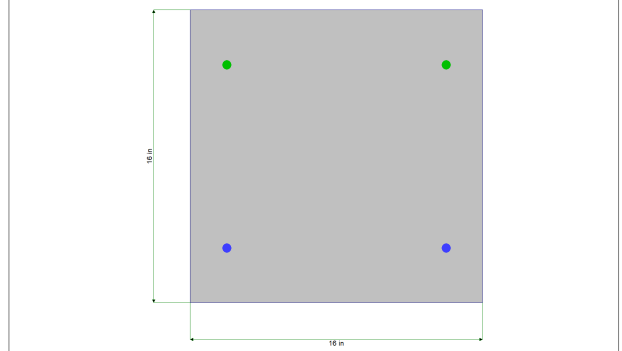
**DESCRIPTION:** Typ. Grade Beam

### CODE REFERENCES

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

### Material Properties

|                               |   |              |                                      |           |              |
|-------------------------------|---|--------------|--------------------------------------|-----------|--------------|
| $f'_c$                        | = | 2.50 ksi     | $\phi$ Phi Values                    | Flexure : | 0.90         |
| $f_r = f'_c^{1/2} \cdot 7.50$ | = | 375.0 psi    |                                      | Shear :   | 0.750        |
| $\psi$ Density                | = | 145.0 pcf    | $\beta_1$                            | =         | 0.850        |
| $\lambda$ LtWt Factor         | = | 1.0          |                                      |           |              |
| Elastic Modulus               | = | 3,122.0 ksi  | $F_y$ - Stirrups                     | =         | 40.0 ksi     |
| $f_y$ - Main Rebar            | = | 60.0 ksi     | E - Stirrups                         | =         | 29,000.0 ksi |
| E - Main Rebar                | = | 29,000.0 ksi | Stirrup Bar Size #                   | =         | 3            |
|                               |   |              | Number of Resisting Legs Per Stirrup | =         | 2            |



### Cross Section & Reinforcing Details

Rectangular Section, Width = 16.0 in, Height = 16.0 in

Span #1 Reinforcing....

2-#4 at 3.0 in from Bottom, from 0.0 to 7.50 ft in this span

2-#4 at 3.0 in from Top, from 0.0 to 7.50 ft in this span

### Beam self weight calculated and added to loads

#### Load for Span Number 1

Uniform Load : D = 0.010 ksf, Tributary Width = 17.50 ft, (Wall)

Uniform Load : D = 0.010, L = 0.040 ksf, Tributary Width = 8.625 ft, (Main Floor)

Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 9.210 ft, (Upper Floor)

### DESIGN SUMMARY

Design OK

|                                |                        |      |  |
|--------------------------------|------------------------|------|--|
| Maximum Bending Stress Ratio = | <b>0.517 : 1</b>       |      |  |
| Section used for this span     | <b>Typical Section</b> |      |  |
| Mu : Applied                   | 13.571                 | k-ft |  |
| Mn * Phi : Allowable           | 26.259                 | k-ft |  |
| Location of maximum on span    | 3.743                  | ft   |  |
| Span # where maximum occurs    | Span # 1               |      |  |

#### Maximum Deflection

|                                   |          |         |       |         |                |
|-----------------------------------|----------|---------|-------|---------|----------------|
| Max Downward Transient Deflection | 0.003 in | Ratio = | 30224 | >=360.0 | L Only         |
| Max Upward Transient Deflection   | 0.000 in | Ratio = | 0     | <360.0  | L Only         |
| Max Downward Total Deflection     | 0.006 in | Ratio = | 15731 | >=180.0 | Span: 1 : +D+L |
| Max Upward Total Deflection       | 0.000 in | Ratio = | 0     | <180.0  | Span: 1 : +D+L |

### Vertical Reactions

Support notation : Far left is #1

| Load Combination | Support 1 | Support 2 |
|------------------|-----------|-----------|
| Overall MAXimum  | 5.140     | 5.140     |
| Overall MINimum  | 1.479     | 1.479     |
| D Only           | 2.464     | 2.464     |
| +D+L             | 5.140     | 5.140     |
| +D+0.750L        | 4.471     | 4.471     |

### Concrete Beam

### DESCRIPTION: Typ. Grade Beam

### Vertical Reactions

Support notation : Far left is #1

| Load Combination | Support 1 | Support 2 |
|------------------|-----------|-----------|
| +0.60D           | 1.479     | 1.479     |
| L Only           | 2.675     | 2.675     |

### Detailed Shear Information

| Load Combination | Span Number | Distance 'd' |       | Vu (k) |        | Mu (k-ft) | d*Vu/Mu | Phi*Vc (k) | Comment      | Phi*Vs (k) | Phi*Vn (k) | Spacing (in) |         |
|------------------|-------------|--------------|-------|--------|--------|-----------|---------|------------|--------------|------------|------------|--------------|---------|
|                  |             | (ft)         | (in)  | Actual | Design |           |         |            |              |            |            | Req'd        | Suggest |
| +1.20D+1.60L     | 1           | 0.00         | 13.00 | 7.24   | 7.24   | 0.00      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 0.08         | 13.00 | 7.08   | 7.08   | 0.59      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 0.16         | 13.00 | 6.92   | 6.92   | 1.16      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 0.25         | 13.00 | 6.76   | 6.76   | 1.72      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 0.33         | 13.00 | 6.60   | 6.60   | 2.27      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 0.41         | 13.00 | 6.45   | 6.45   | 2.80      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 0.49         | 13.00 | 6.29   | 6.29   | 3.33      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 0.57         | 13.00 | 6.13   | 6.13   | 3.84      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 0.66         | 13.00 | 5.97   | 5.97   | 4.33      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 0.74         | 13.00 | 5.81   | 5.81   | 4.81      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 0.82         | 13.00 | 5.66   | 5.66   | 5.28      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 0.90         | 13.00 | 5.50   | 5.50   | 5.74      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 0.98         | 13.00 | 5.34   | 5.34   | 6.19      | 0.94    | 15.52      | Vu < PhiVc/2 | 15.5       | 15.5       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 1.07         | 13.00 | 5.18   | 5.18   | 6.62      | 0.85    | 15.46      | Vu < PhiVc/2 | 15.5       | 15.5       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 1.15         | 13.00 | 5.02   | 5.02   | 7.03      | 0.77    | 15.40      | Vu < PhiVc/2 | 15.4       | 15.4       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 1.23         | 13.00 | 4.86   | 4.86   | 7.44      | 0.71    | 15.35      | Vu < PhiVc/2 | 15.4       | 15.4       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 1.31         | 13.00 | 4.71   | 4.71   | 7.83      | 0.65    | 15.31      | Vu < PhiVc/2 | 15.3       | 15.3       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 1.39         | 13.00 | 4.55   | 4.55   | 8.21      | 0.60    | 15.27      | Vu < PhiVc/2 | 15.3       | 15.3       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 1.48         | 13.00 | 4.39   | 4.39   | 8.58      | 0.55    | 15.24      | Vu < PhiVc/2 | 15.2       | 15.2       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 1.56         | 13.00 | 4.23   | 4.23   | 8.93      | 0.51    | 15.20      | Vu < PhiVc/2 | 15.2       | 15.2       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 1.64         | 13.00 | 4.07   | 4.07   | 9.27      | 0.48    | 15.18      | Vu < PhiVc/2 | 15.2       | 15.2       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 1.72         | 13.00 | 3.92   | 3.92   | 9.60      | 0.44    | 15.15      | Vu < PhiVc/2 | 15.2       | 15.2       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 1.80         | 13.00 | 3.76   | 3.76   | 9.91      | 0.41    | 15.13      | Vu < PhiVc/2 | 15.1       | 15.1       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 1.89         | 13.00 | 3.60   | 3.60   | 10.21     | 0.38    | 15.11      | Vu < PhiVc/2 | 15.1       | 15.1       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 1.97         | 13.00 | 3.44   | 3.44   | 10.50     | 0.35    | 15.09      | Vu < PhiVc/2 | 15.1       | 15.1       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 2.05         | 13.00 | 3.28   | 3.28   | 10.78     | 0.33    | 15.07      | Vu < PhiVc/2 | 15.1       | 15.1       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 2.13         | 13.00 | 3.12   | 3.12   | 11.04     | 0.31    | 15.05      | Vu < PhiVc/2 | 15.0       | 15.0       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 2.21         | 13.00 | 2.97   | 2.97   | 11.29     | 0.28    | 15.03      | Vu < PhiVc/2 | 15.0       | 15.0       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 2.30         | 13.00 | 2.81   | 2.81   | 11.53     | 0.26    | 15.02      | Vu < PhiVc/2 | 15.0       | 15.0       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 2.38         | 13.00 | 2.65   | 2.65   | 11.75     | 0.24    | 15.00      | Vu < PhiVc/2 | 15.0       | 15.0       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 2.46         | 13.00 | 2.49   | 2.49   | 11.96     | 0.23    | 14.99      | Vu < PhiVc/2 | 15.0       | 15.0       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 2.54         | 13.00 | 2.33   | 2.33   | 12.16     | 0.21    | 14.98      | Vu < PhiVc/2 | 15.0       | 15.0       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 2.62         | 13.00 | 2.18   | 2.18   | 12.34     | 0.19    | 14.96      | Vu < PhiVc/2 | 15.0       | 15.0       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 2.70         | 13.00 | 2.02   | 2.02   | 12.52     | 0.17    | 14.95      | Vu < PhiVc/2 | 15.0       | 15.0       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 2.79         | 13.00 | 1.86   | 1.86   | 12.68     | 0.16    | 14.94      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 2.87         | 13.00 | 1.70   | 1.70   | 12.82     | 0.14    | 14.93      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 2.95         | 13.00 | 1.54   | 1.54   | 12.95     | 0.13    | 14.92      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 3.03         | 13.00 | 1.38   | 1.38   | 13.07     | 0.11    | 14.91      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 3.11         | 13.00 | 1.23   | 1.23   | 13.18     | 0.10    | 14.90      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 3.20         | 13.00 | 1.07   | 1.07   | 13.28     | 0.09    | 14.89      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 3.28         | 13.00 | 0.91   | 0.91   | 13.36     | 0.07    | 14.88      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 3.36         | 13.00 | 0.75   | 0.75   | 13.42     | 0.06    | 14.87      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 3.44         | 13.00 | 0.59   | 0.59   | 13.48     | 0.05    | 14.86      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 3.52         | 13.00 | 0.44   | 0.44   | 13.52     | 0.03    | 14.85      | Vu < PhiVc/2 | 14.8       | 14.8       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 3.61         | 13.00 | 0.28   | 0.28   | 13.55     | 0.02    | 14.84      | Vu < PhiVc/2 | 14.8       | 14.8       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 3.69         | 13.00 | 0.12   | 0.12   | 13.57     | 0.01    | 14.83      | Vu < PhiVc/2 | 14.8       | 14.8       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 3.77         | 13.00 | -0.04  | 0.04   | 13.57     | 0.00    | 14.82      | Vu < PhiVc/2 | 14.8       | 14.8       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 3.85         | 13.00 | -0.20  | 0.20   | 13.56     | 0.02    | 14.83      | Vu < PhiVc/2 | 14.8       | 14.8       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 3.93         | 13.00 | -0.36  | 0.36   | 13.54     | 0.03    | 14.84      | Vu < PhiVc/2 | 14.8       | 14.8       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 4.02         | 13.00 | -0.51  | 0.51   | 13.50     | 0.04    | 14.85      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 4.10         | 13.00 | -0.67  | 0.67   | 13.45     | 0.05    | 14.86      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 4.18         | 13.00 | -0.83  | 0.83   | 13.39     | 0.07    | 14.87      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 4.26         | 13.00 | -0.99  | 0.99   | 13.32     | 0.08    | 14.88      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |

**Concrete Beam**

Project File: Beams.ec6

LIC#: KW-06017913, Build:20.22.8.17

MULHERN & KULP STRUCTURAL ENGINEERING INC

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**DESCRIPTION: Typ. Grade Beam**

**Detailed Shear Information**

| Load Combination | Span Number | Distance 'd' |       | Vu (k) |        | Mu (k-ft) | d*Vu/Mu | Phi*Vc (k) | Comment      | Phi*Vs (k) | Phi*Vn (k) | Spacing (in) |         |
|------------------|-------------|--------------|-------|--------|--------|-----------|---------|------------|--------------|------------|------------|--------------|---------|
|                  |             | (ft)         | (in)  | Actual | Design |           |         |            |              |            |            | Req'd        | Suggest |
| +1.20D+1.60L     | 1           | 4.34         | 13.00 | -1.15  | 1.15   | 13.23     | 0.09    | 14.89      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 4.43         | 13.00 | -1.31  | 1.31   | 13.13     | 0.11    | 14.90      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 4.51         | 13.00 | -1.46  | 1.46   | 13.02     | 0.12    | 14.91      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 4.59         | 13.00 | -1.62  | 1.62   | 12.89     | 0.14    | 14.92      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 4.67         | 13.00 | -1.78  | 1.78   | 12.75     | 0.15    | 14.93      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 4.75         | 13.00 | -1.94  | 1.94   | 12.60     | 0.17    | 14.94      | Vu < PhiVc/2 | 14.9       | 14.9       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 4.84         | 13.00 | -2.10  | 2.10   | 12.43     | 0.18    | 14.96      | Vu < PhiVc/2 | 15.0       | 15.0       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 4.92         | 13.00 | -2.25  | 2.25   | 12.25     | 0.20    | 14.97      | Vu < PhiVc/2 | 15.0       | 15.0       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 5.00         | 13.00 | -2.41  | 2.41   | 12.06     | 0.22    | 14.98      | Vu < PhiVc/2 | 15.0       | 15.0       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 5.08         | 13.00 | -2.57  | 2.57   | 11.86     | 0.23    | 15.00      | Vu < PhiVc/2 | 15.0       | 15.0       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 5.16         | 13.00 | -2.73  | 2.73   | 11.64     | 0.25    | 15.01      | Vu < PhiVc/2 | 15.0       | 15.0       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 5.25         | 13.00 | -2.89  | 2.89   | 11.41     | 0.27    | 15.03      | Vu < PhiVc/2 | 15.0       | 15.0       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 5.33         | 13.00 | -3.05  | 3.05   | 11.17     | 0.30    | 15.04      | Vu < PhiVc/2 | 15.0       | 15.0       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 5.41         | 13.00 | -3.20  | 3.20   | 10.91     | 0.32    | 15.06      | Vu < PhiVc/2 | 15.1       | 15.1       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 5.49         | 13.00 | -3.36  | 3.36   | 10.64     | 0.34    | 15.08      | Vu < PhiVc/2 | 15.1       | 15.1       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 5.57         | 13.00 | -3.52  | 3.52   | 10.36     | 0.37    | 15.10      | Vu < PhiVc/2 | 15.1       | 15.1       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 5.66         | 13.00 | -3.68  | 3.68   | 10.07     | 0.40    | 15.12      | Vu < PhiVc/2 | 15.1       | 15.1       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 5.74         | 13.00 | -3.84  | 3.84   | 9.76      | 0.43    | 15.14      | Vu < PhiVc/2 | 15.1       | 15.1       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 5.82         | 13.00 | -3.99  | 3.99   | 9.44      | 0.46    | 15.16      | Vu < PhiVc/2 | 15.2       | 15.2       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 5.90         | 13.00 | -4.15  | 4.15   | 9.10      | 0.49    | 15.19      | Vu < PhiVc/2 | 15.2       | 15.2       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 5.98         | 13.00 | -4.31  | 4.31   | 8.76      | 0.53    | 15.22      | Vu < PhiVc/2 | 15.2       | 15.2       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 6.07         | 13.00 | -4.47  | 4.47   | 8.40      | 0.58    | 15.25      | Vu < PhiVc/2 | 15.3       | 15.3       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 6.15         | 13.00 | -4.63  | 4.63   | 8.02      | 0.62    | 15.29      | Vu < PhiVc/2 | 15.3       | 15.3       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 6.23         | 13.00 | -4.79  | 4.79   | 7.64      | 0.68    | 15.33      | Vu < PhiVc/2 | 15.3       | 15.3       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 6.31         | 13.00 | -4.94  | 4.94   | 7.24      | 0.74    | 15.37      | Vu < PhiVc/2 | 15.4       | 15.4       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 6.39         | 13.00 | -5.10  | 5.10   | 6.83      | 0.81    | 15.43      | Vu < PhiVc/2 | 15.4       | 15.4       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 6.48         | 13.00 | -5.26  | 5.26   | 6.40      | 0.89    | 15.49      | Vu < PhiVc/2 | 15.5       | 15.5       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 6.56         | 13.00 | -5.42  | 5.42   | 5.96      | 0.98    | 15.56      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 6.64         | 13.00 | -5.58  | 5.58   | 5.51      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 6.72         | 13.00 | -5.73  | 5.73   | 5.05      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 6.80         | 13.00 | -5.89  | 5.89   | 4.57      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 6.89         | 13.00 | -6.05  | 6.05   | 4.08      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 6.97         | 13.00 | -6.21  | 6.21   | 3.58      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 7.05         | 13.00 | -6.37  | 6.37   | 3.07      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 7.13         | 13.00 | -6.53  | 6.53   | 2.54      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 7.21         | 13.00 | -6.68  | 6.68   | 2.00      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 7.30         | 13.00 | -6.84  | 6.84   | 1.44      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 7.38         | 13.00 | -7.00  | 7.00   | 0.88      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |
| +1.20D+1.60L     | 1           | 7.46         | 13.00 | -7.16  | 7.16   | 0.30      | 1.00    | 15.57      | Vu < PhiVc/2 | 15.6       | 15.6       | 0.0          | 0.0     |

**Maximum Forces & Stresses for Load Combinations**

| Load Combination         | Segment  | Span # | Location (ft) along Beam | Bending Stress Results (k-ft) |         |              |
|--------------------------|----------|--------|--------------------------|-------------------------------|---------|--------------|
|                          |          |        |                          | Mu : Max                      | Phi*Mnx | Stress Ratio |
| MAXimum BENDING Envelope |          |        |                          |                               |         |              |
| +1.40D                   | Span # 1 | 1      | 7.500                    | 13.57                         | 26.26   | 0.52         |
| +1.20D+1.60L             | Span # 1 | 1      | 7.500                    | 6.47                          | 26.26   | 0.25         |
| +1.20D+L                 | Span # 1 | 1      | 7.500                    | 13.57                         | 26.26   | 0.52         |
| +1.20D                   | Span # 1 | 1      | 7.500                    | 10.56                         | 26.26   | 0.40         |
| +0.90D                   | Span # 1 | 1      | 7.500                    | 5.54                          | 26.26   | 0.21         |
|                          | Span # 1 | 1      | 7.500                    | 4.16                          | 26.26   | 0.16         |

**Overall Maximum Deflections**

| Load Combination | Span | Max. "-" Defl (in) | Location in Span (ft) | Load Combination | Max. "+" Defl (in) | Location in Span (ft) |
|------------------|------|--------------------|-----------------------|------------------|--------------------|-----------------------|
| +D+L             | 1    | 0.0057             | 3.750                 |                  | 0.0000             | 0.000                 |