Scan 1

DCI ENGINEERS

# Structural Calculations

For:

Block 8L

60 NW Davis

**Structural Calculations Package**

**Revised Foundation Permit Response**

STRUCTURAL REGISTERED PROFESSIONAL ENGINEER
74858PE
OREGON
MARCH 23, 2011
SHIRLEY CHALUPA

EXPIRES: 12-31-2015

RECEIVED
DEC 23 2014
BDS
DOCUMENT SERVICES

14-211482-STR-01-CO

Prepared For:

Ankrom Moisan Architects, Inc.

6820 SW Macadam Ave, Ste 100

Portland, OR 98104

22-Dec-14

Job Number: 14031-0013

400 SW 6th Avenue, Suite 605 Portland, OR 97204 Phone: (503) 242.2448 Fax: (503) 242.2449

Seattle Spokane Everett Portland San Diego Austin

# Structural Checksheet Response

**Permit #:** **14-211482-STR-01-CO** **Date:** **12/22/14**

**Customer name and phone number:** **DCI Engineers 503-242-2448 (Mike Poulos)**

*Note:* *Please number each change in the '#' column. Use as many lines as necessary to describe your changes. Indicate which reviewer's checksheet you are responding to and the item your change addresses. If the item is not in response to a checksheet, write* **customer** *in the last column.*

| # | Description of changes, revisions, additions, etc. | Checksheet and item # |
|---|---|---|
| 1 | Neither the storefront or cold form framing require special inspections. The anchor will, but that is covered by our post-installed anchor section. | STR-01 Item #1 |
| 2 | Additional pages from RAM have been provided showing the units used for each load type. Also the loading plans have been included with additional descriptions of what each load is. | STR-01 Item #10 |
| 3 | Enlarged RAM printouts have been included. Also an additional detail at the drop bands has been added to the drawings. See detail 10/S4.04 | STR-01 Item #11 |
| 4 | A revised sheet L-5A has been included. The seismic base shear and distribution on this sheet is based on the ELF method. Three base shears are calculated. One for the approximate period, and one for each orthogonal direction using the Etabs period. These base shears were then used to determine the required scaling factors for the modal response analysis to reach 85% of the ELF base shear. See sheet L7-A | STR-01 Item #12 |
| 5 | Additional information has been added describing the difference between Core 1 for the moment and Core 1 thru 3 for the shear analysis. | STR-01 Item #13 |
| 6 | The original calculation section for the Columns has been attached. See sheets C1-C24. | STR-01 Item #14 |
| 7 | The require embedment of the drag struts has been added to the drawings. See sheet S2.02 | STR-01 Item #15 |
| 8 | More details have been added. See Sheet S4.04 | STR-01 Item #16 |
| 9 | This dimension is given in details 17, 18 and 19/S5.01. Detail 16/S5.01 will be updated. | STR-01 Item #17 |
| 10 | The 3" concrete topping is attached to each glu-lam per detail 12/S6.01. See attached Fp calculations. | STR-01 Item #18 |
| 11 | This was taken care of with the Grading and Geopier permit. | STR-01 Item #19 |
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| | | |

# Units

## Geometry Units

Item 10.1

Plan Dimensions: feet
Angles: degrees

Slab Thickness: inches
Elevations: inches

Support Dimensions: inches
Support Height: feet

## Loading and Reaction Unit

Point Force: Kips
- Report As Zero: 0 Kips

Point Moment: kip-ft
- Report As Zero: 0 kip-ft

Line Force: kips/ft
- Report As Zero: 0 kips/ft

Line Moment: Kips
- Report As Zero: 0 Kips

Area Force: psf
- Report As Zero: 0 psf

Area Moment: #/foot
- Report As Zero: 0 #/foot

## Spring and Stiffness Units

Point Force Spring: kips/in
Point Moment Spring: k-ft/°

Line Force Spring: ksi
Line Moment Spring: k/°

Area Force Spring: pci
Area Moment Spring: k/ft°

## Slab Analysis Units

Force: Kips
- Report As Zero: 0 Kips

Force Per Width: kips/ft
- Report As Zero: 0 kips/ft

Moment: kip-ft
- Report As Zero: 0 kip-ft

Moment Per Width: Kips
- Report As Zero: 0 Kips

Concrete Stress: psi
- Report As Zero: 0 psi

Deflection: inches
- Report As Zero: 0 inches

## Materials Units

Concrete Volume: $yd^3$
Reinforcement Weight: tons
PT Weight: pounds

Reinforcing Area: $in^2$
Tendon Profile: inches
Cover: inches

PT Force: Kips
Reinforcing Stress: ksi

## Miscellaneous Unit

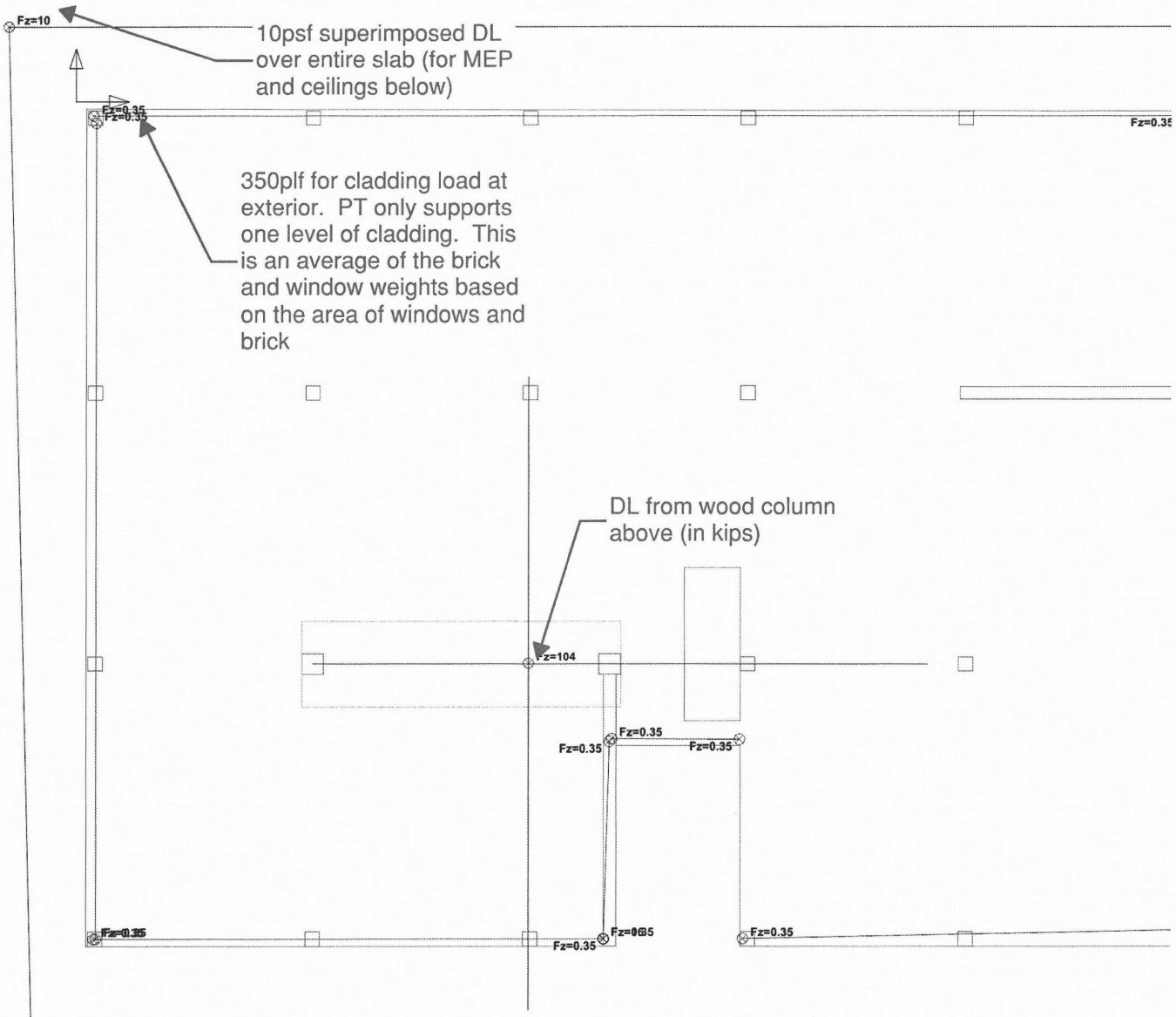
Floor Area: $ft^2$
Tendon Angles (for friction): radians

Density: pcf

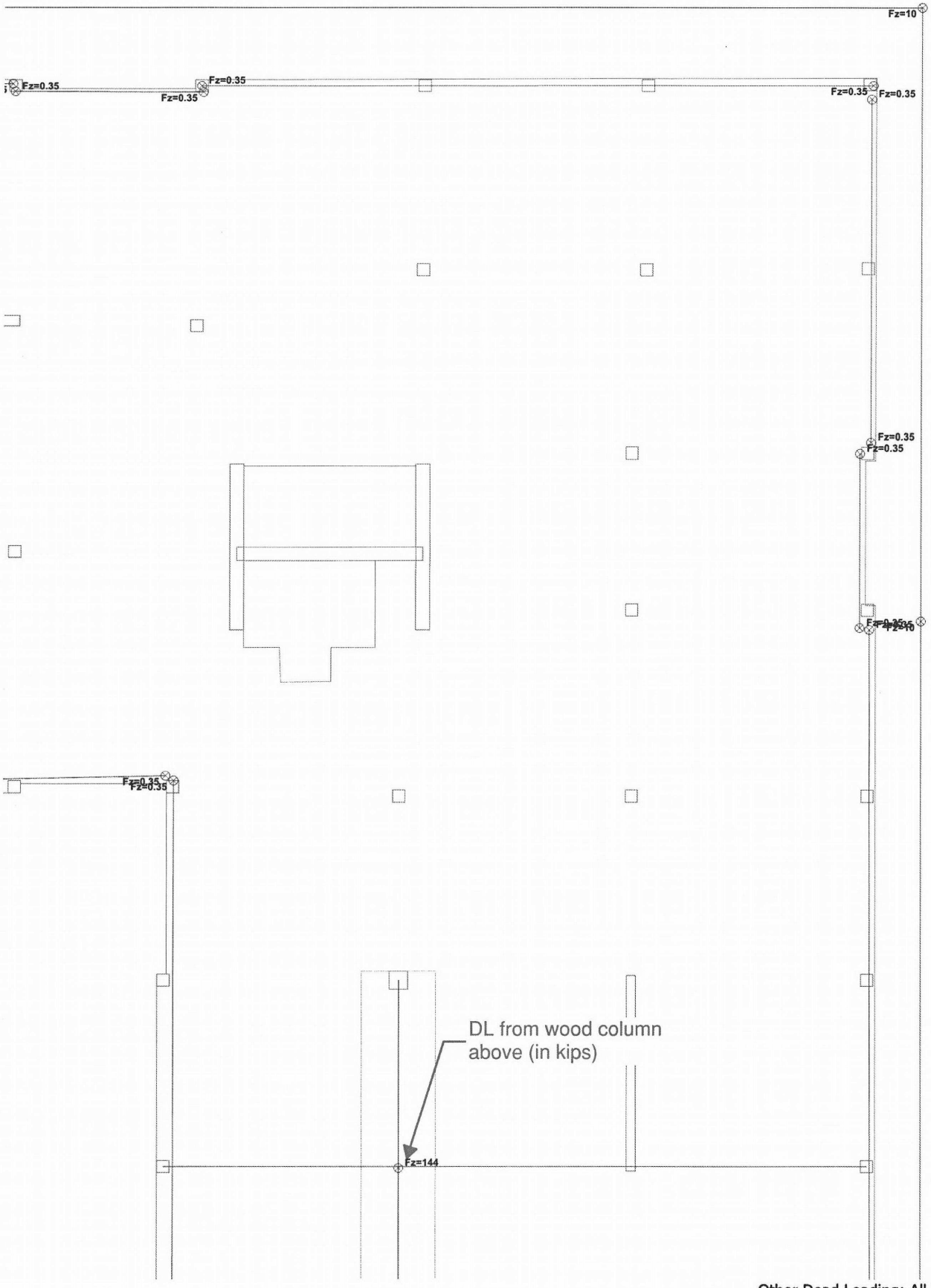
Elongations: inches

# Other Dead Loading: All Loads Plan

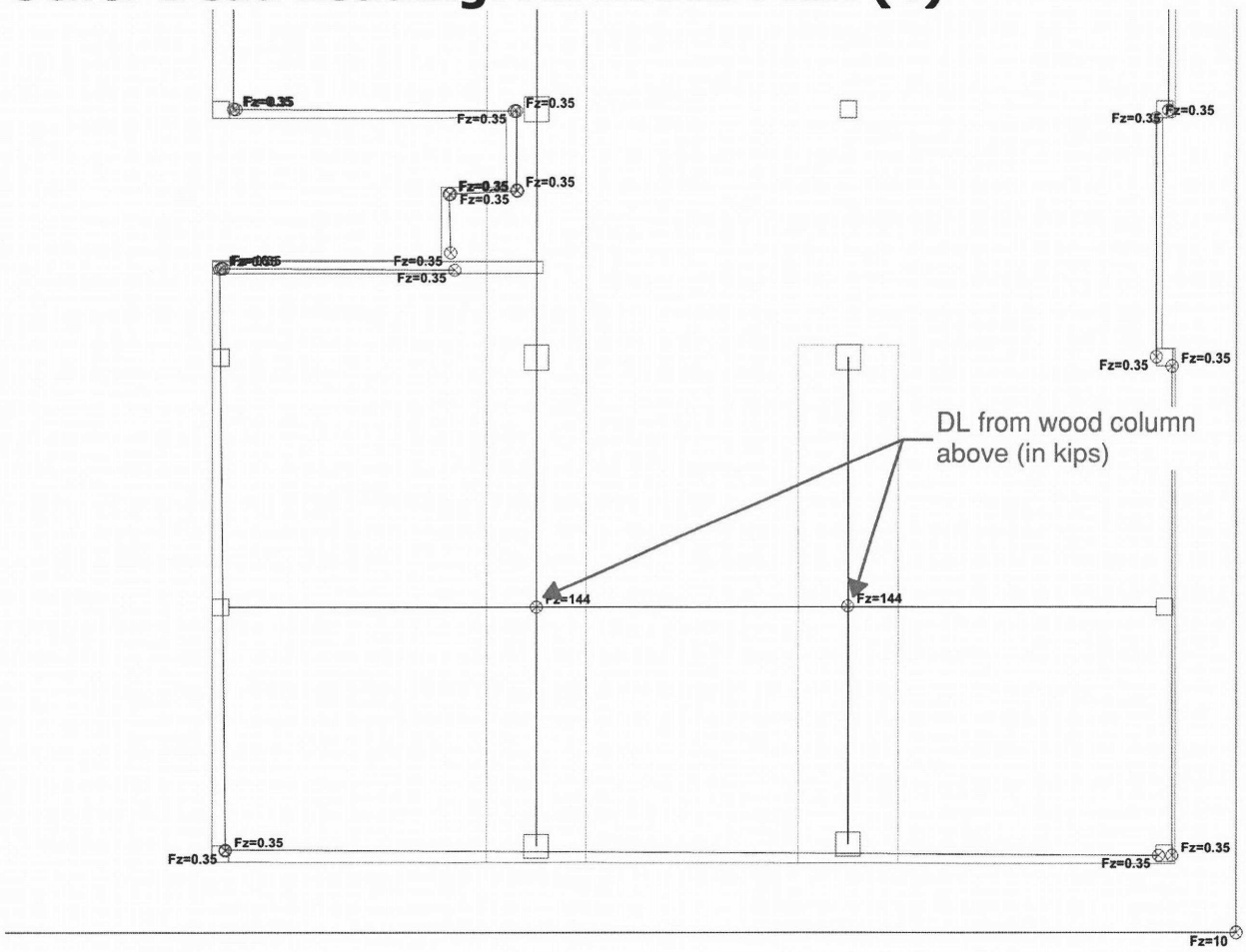
**Other Dead Loading: User Lines; User Notes; User Dimensions; Point Loads; Point Load Icons; Point Load Values; Line Loads; Line Load Icons; Line Load Values; Area Loads; Area Load Icons; Area Load Values;**
**Drawing Import: User Lines; User Notes; User Dimensions;**
**Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;**
**Scale = 1:185**



# Other Dead Loading: All Loads Plan (2)



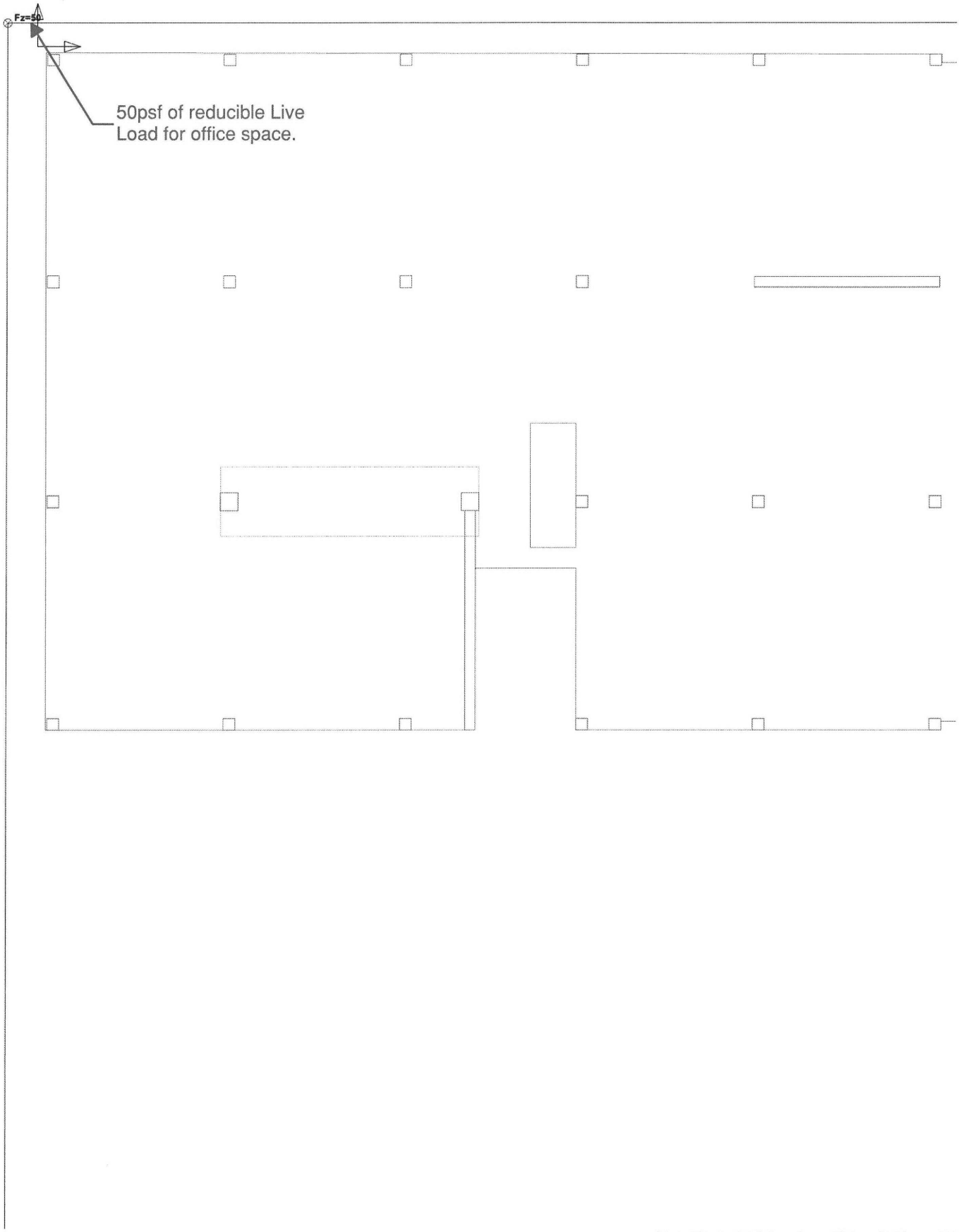
# Other Dead Loading: All Loads Plan (4)



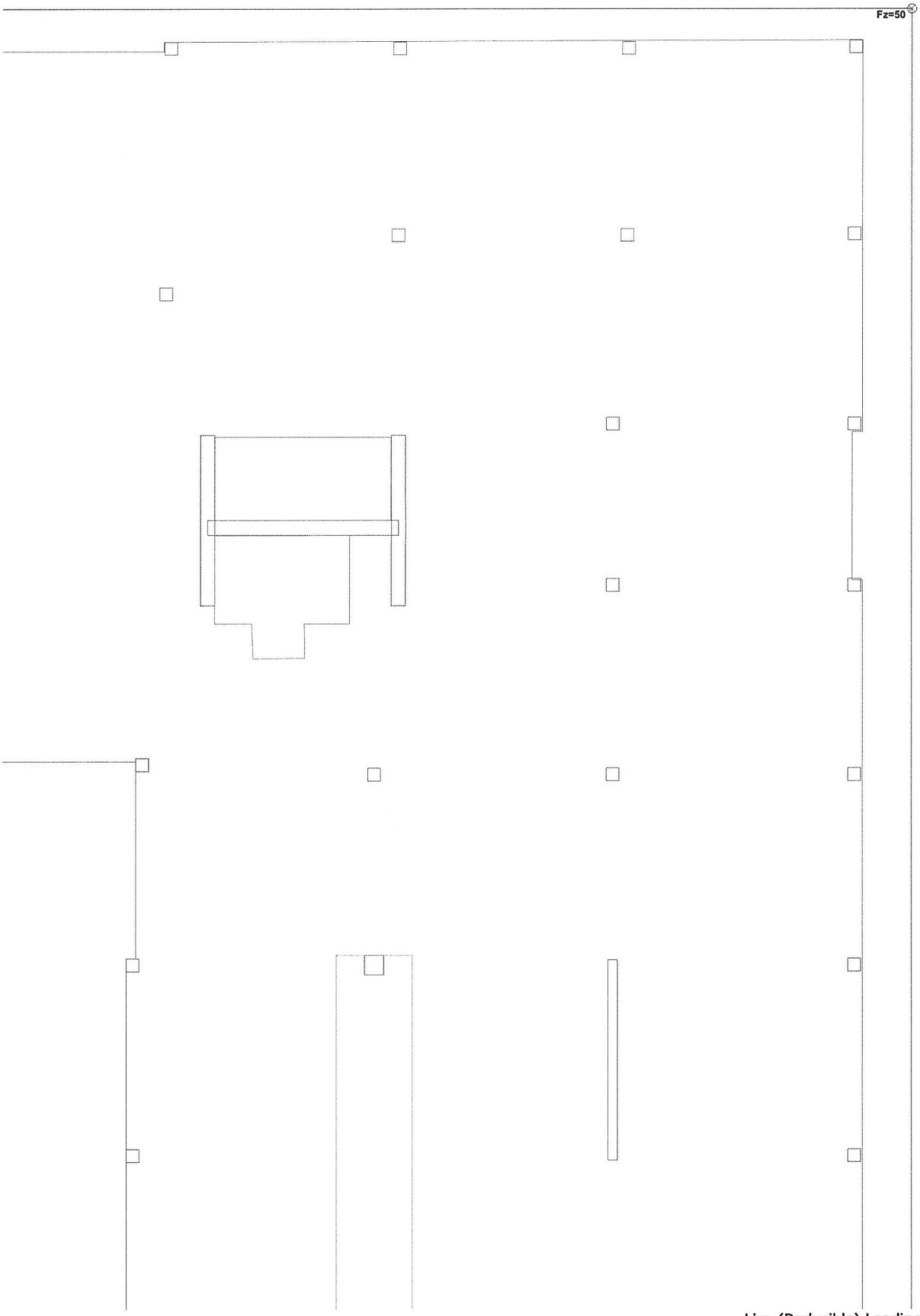
# Live (Reducible) Loading: All Loads Plan

Item 10.5

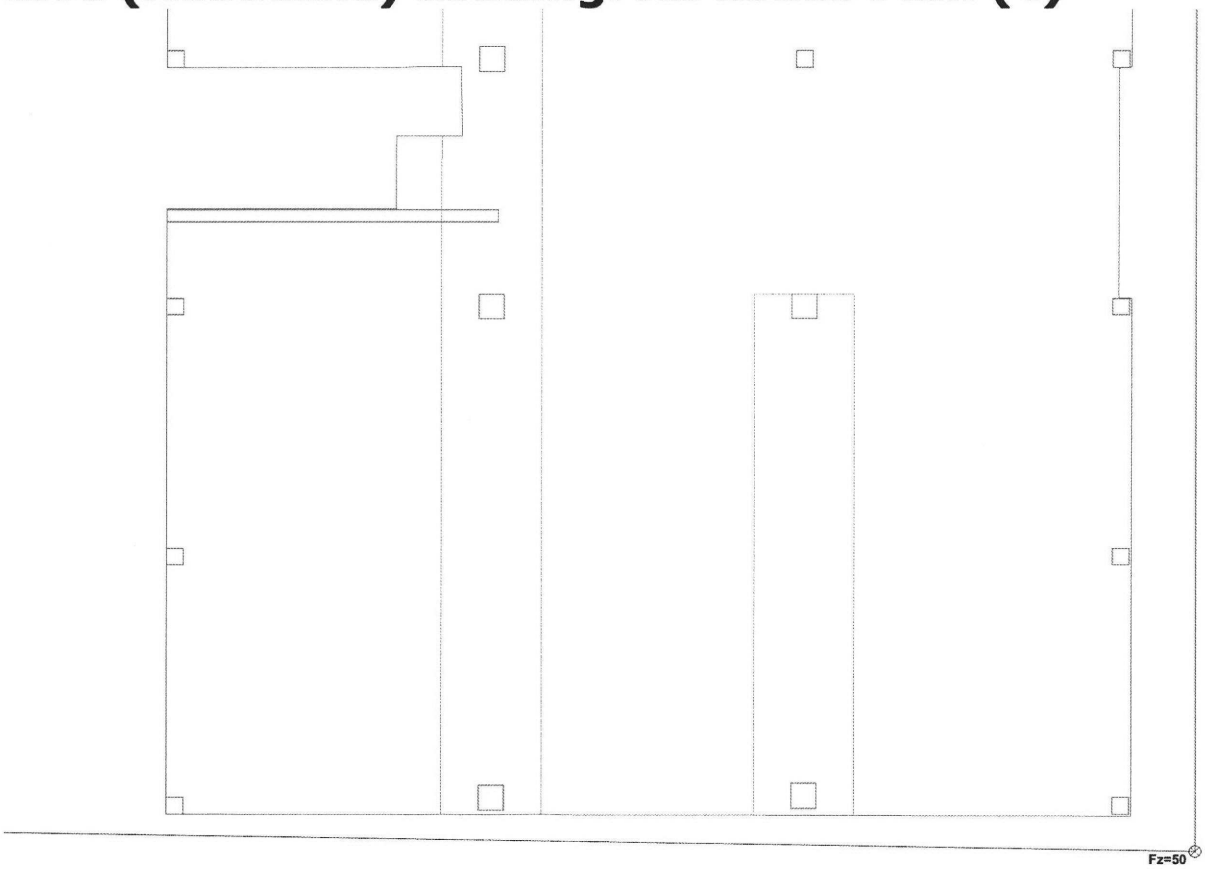
**Live (Reducible) Loading: User Lines; User Notes; User Dimensions; Point Loads; Point Load Icons; Point Load Values; Line Loads; Line Load Icons; Line Load Values; Area Loads; Area Load Icons; Area Load Values; Drawing Import: User Lines; User Notes; User Dimensions;**
**Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;**
**Scale = 1:185**



# Live (Reducible) Loading: All Loads Plan (2)



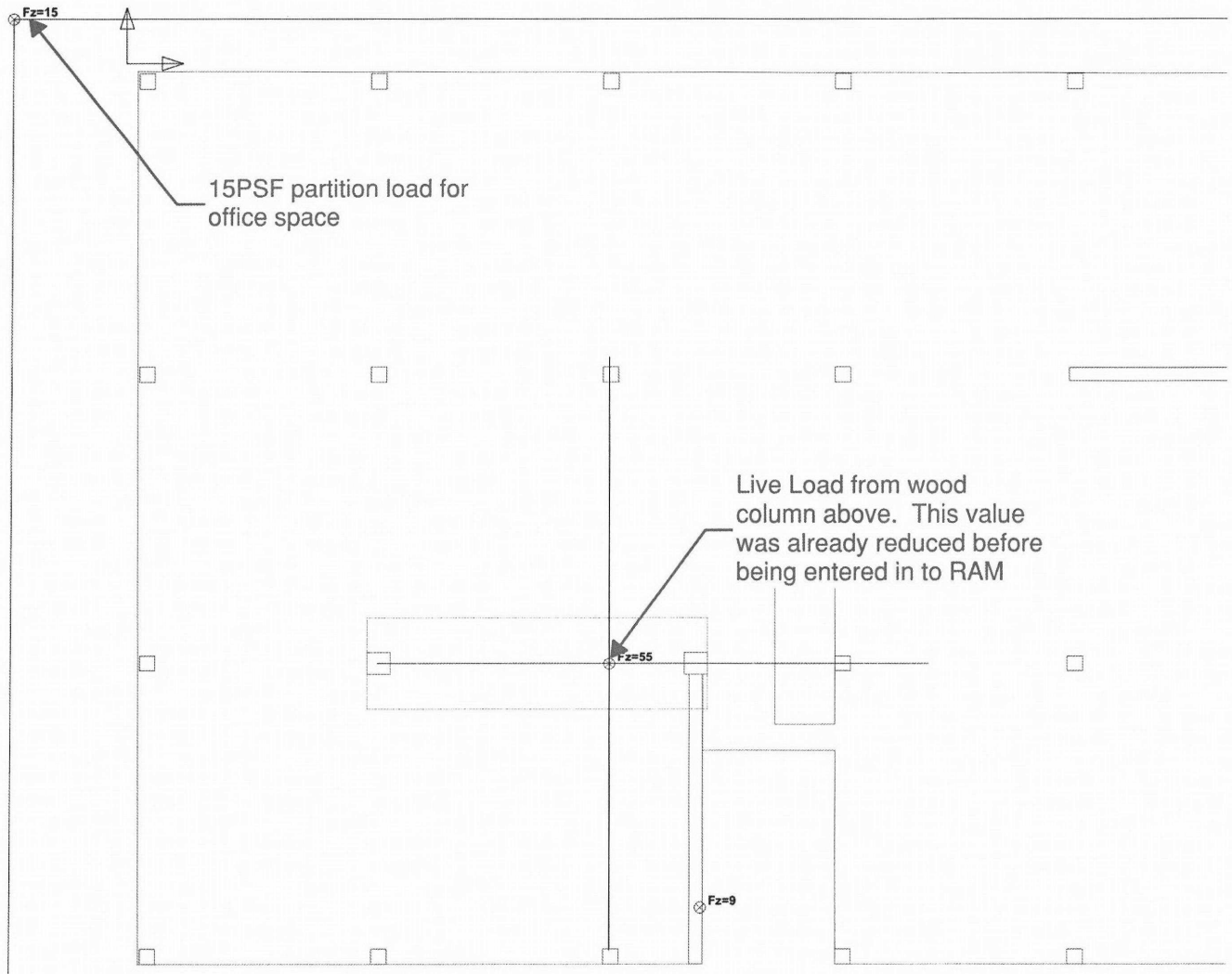
# Live (Reducible) Loading: All Loads Plan (4)



# Live (Unreducible) Loading: All Loads Plan

Item 10.8

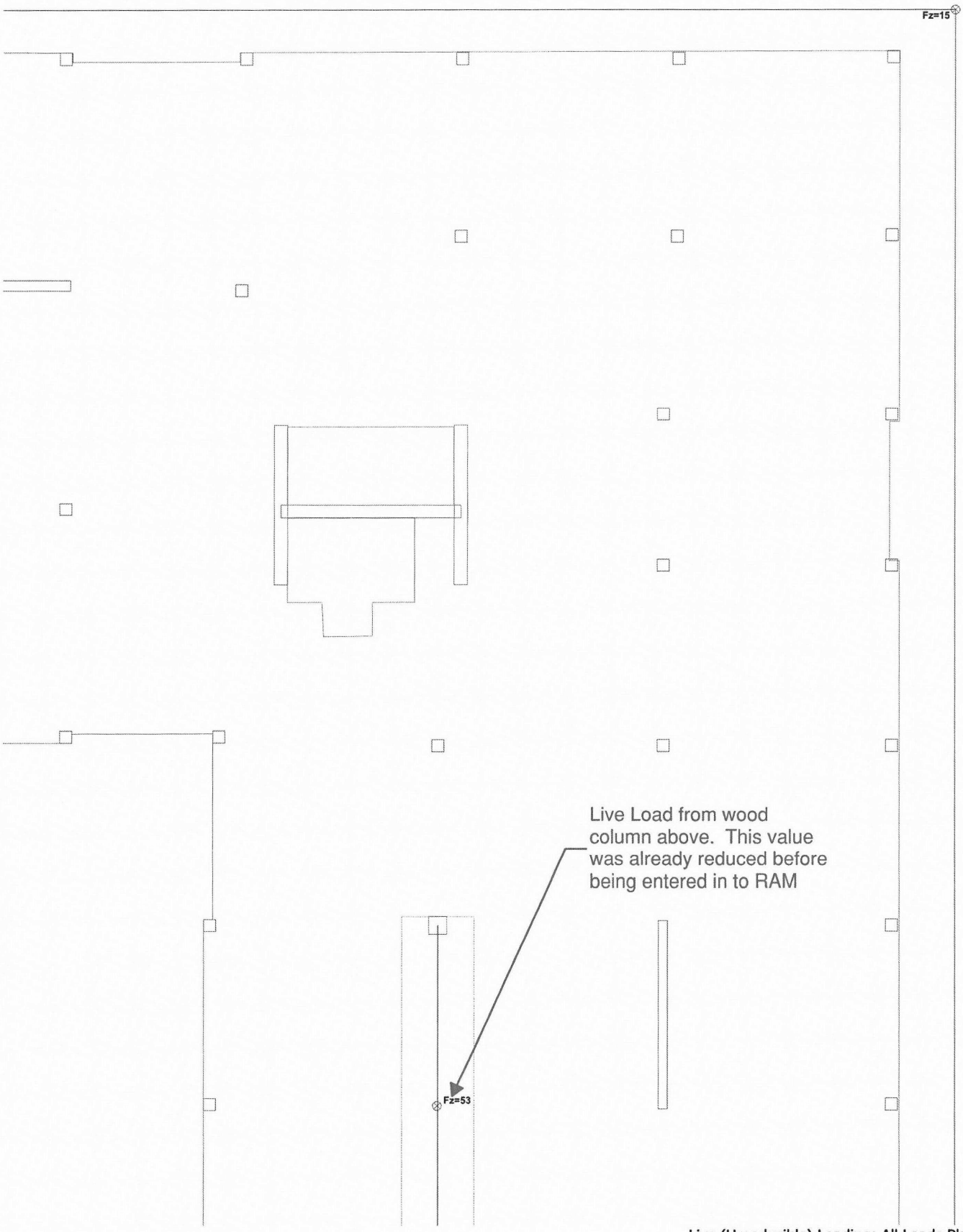
**Live (Unreducible) Loading: User Lines; User Notes; User Dimensions; Point Loads; Point Load Icons; Point Load Values; Line Loads; Line Load Icons; Line Load Values; Area Loads; Area Load Icons; Area Load Value**
**Drawing Import: User Lines; User Notes; User Dimensions;**
**Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;**
**Scale = 1:185**



# Live (Unreducible) Loading: All Loads Plan (2)

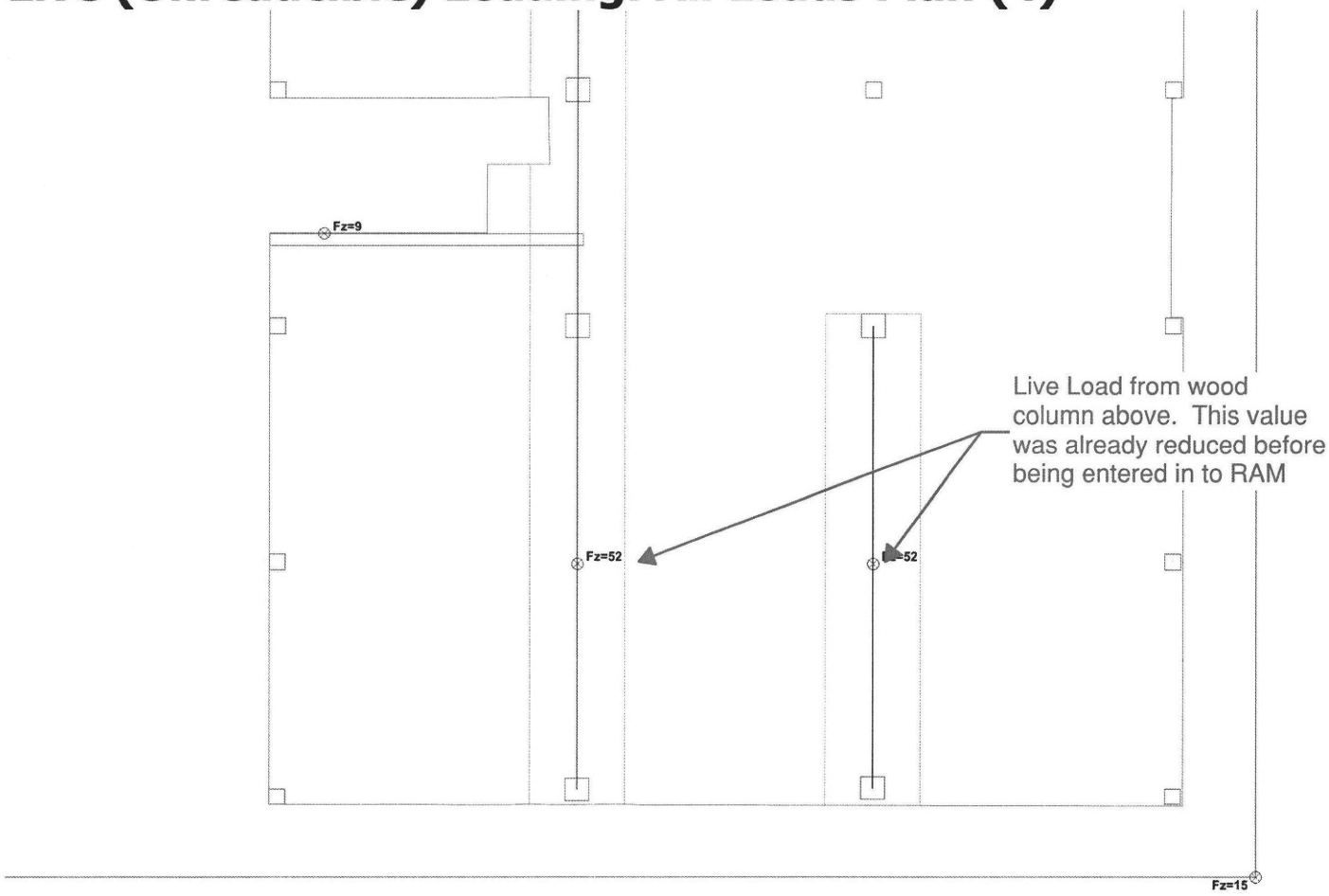
Item 10.9

s;



# Live (Unreducible) Loading: All Loads Plan (4)

Item 10.10



# Snow Loading: All Loads Plan

**Snow Loading: User Lines; User Notes; User Dimensions; Point Loads; Point Load Icons; Point Load Values; Line Loads; Line Load Icons; Line Load Values; Area Loads; Area Load Icons; Area Load Values;**
**Drawing Import: User Lines; User Notes; User Dimensions;**
**Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;**
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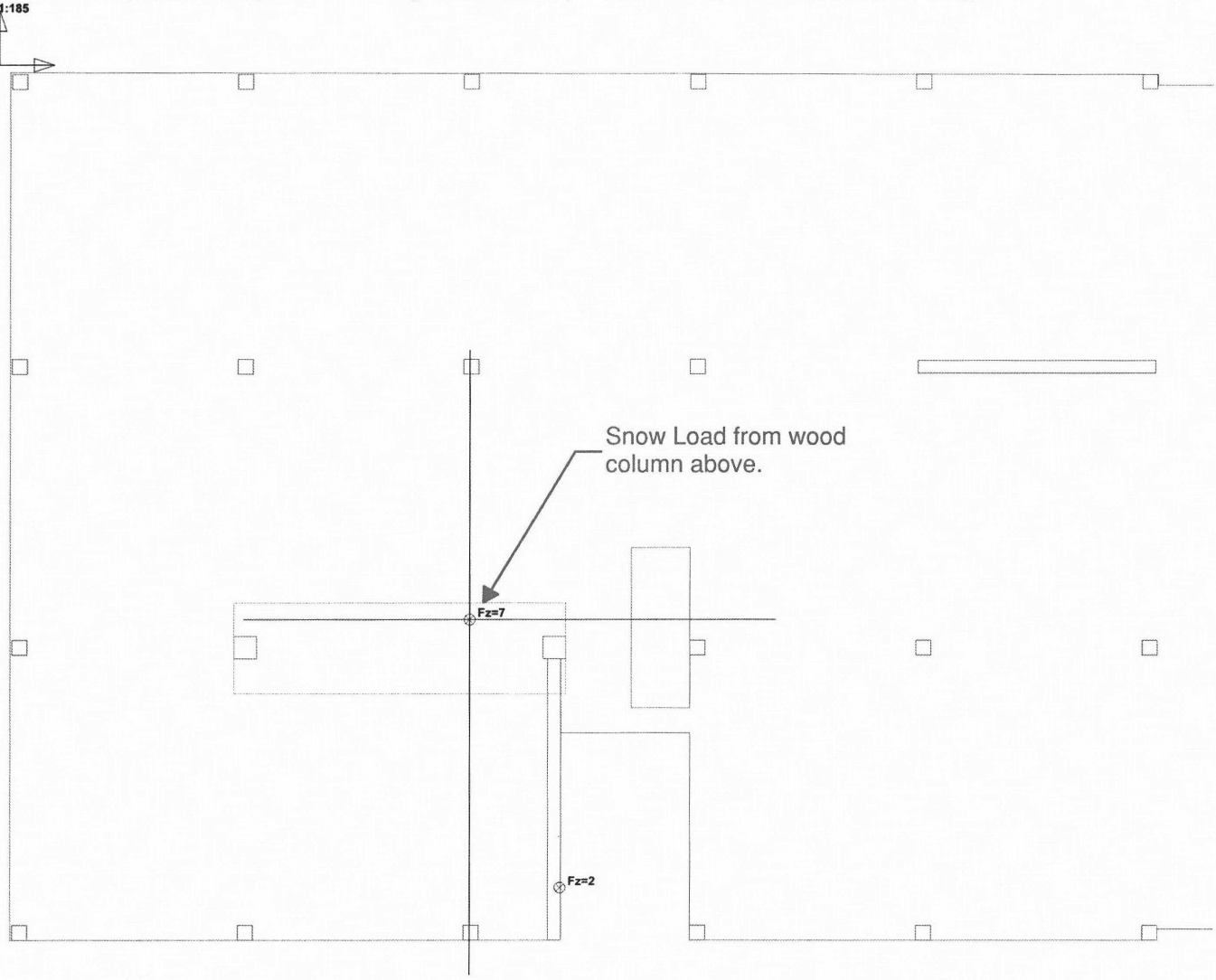
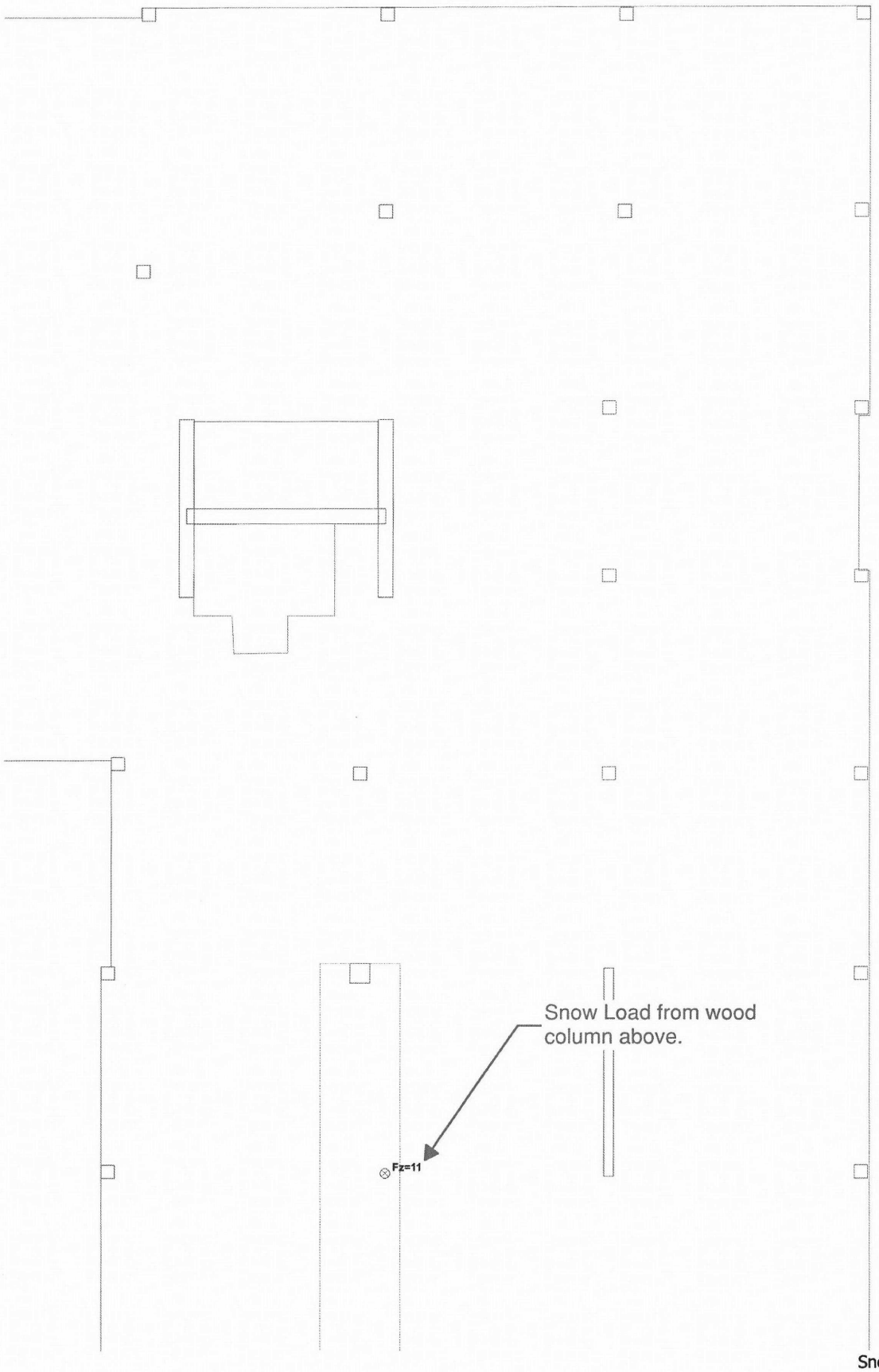
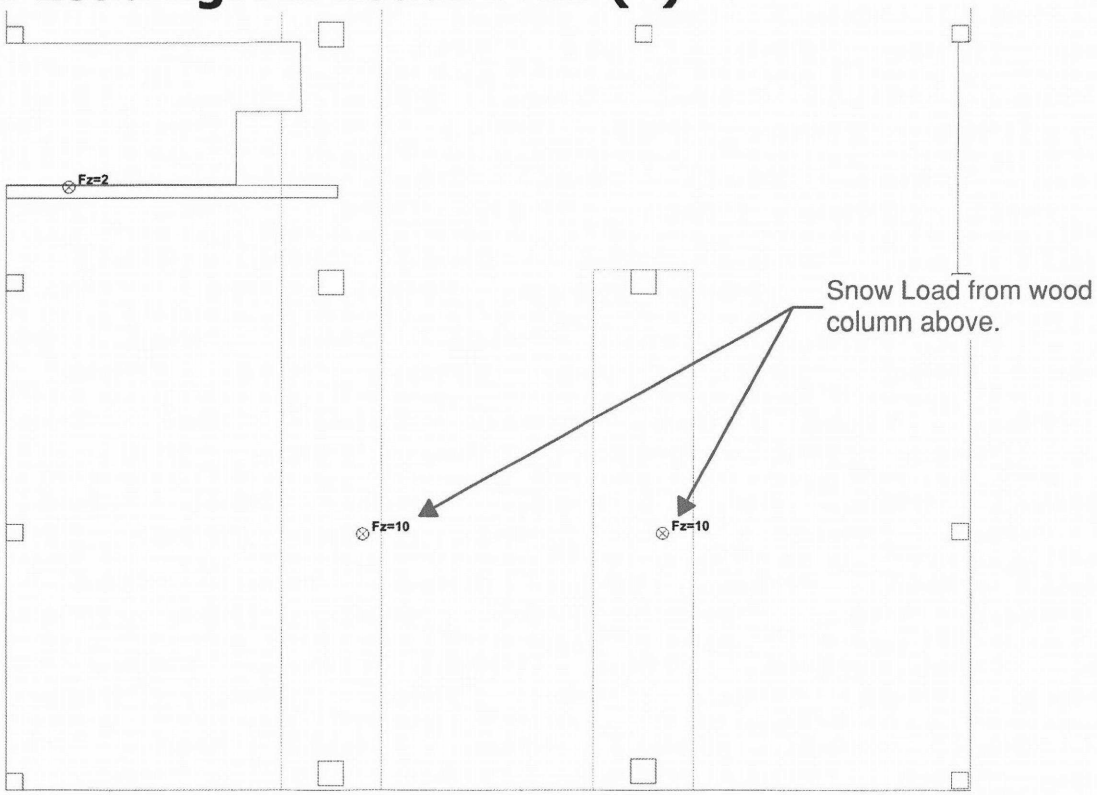


# Snow Loading: All Loads Plan (2)



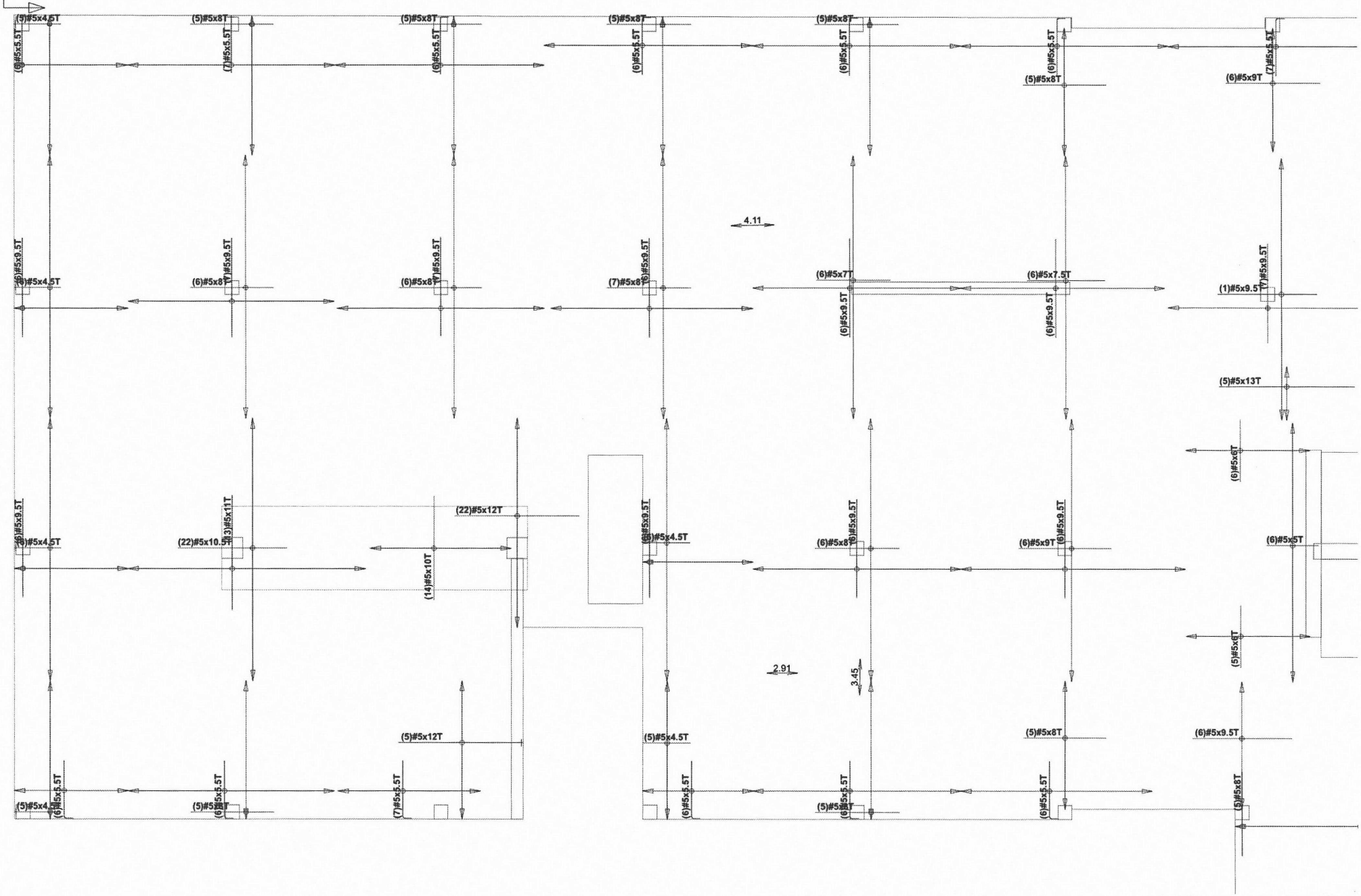
# Snow Loading: All Loads Plan (4)



# Reinforcement: Top Bars Plan

Reinforcement: User Lines; User Notes; User Dimensions; Latitude User Concentrated Reinf.; Latitude Program Concentrated Reinf.; Latitude User Distributed Reinf.; Latitude Program Distributed Reinf.; Longitude User Concentrated Reinf.; Longitude Program Concentrated Reinf.; Longitude User Distributed Reinf.; L
Drawing Import: User Lines; User Notes; User Dimensions;
Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;
Scale = 1:150

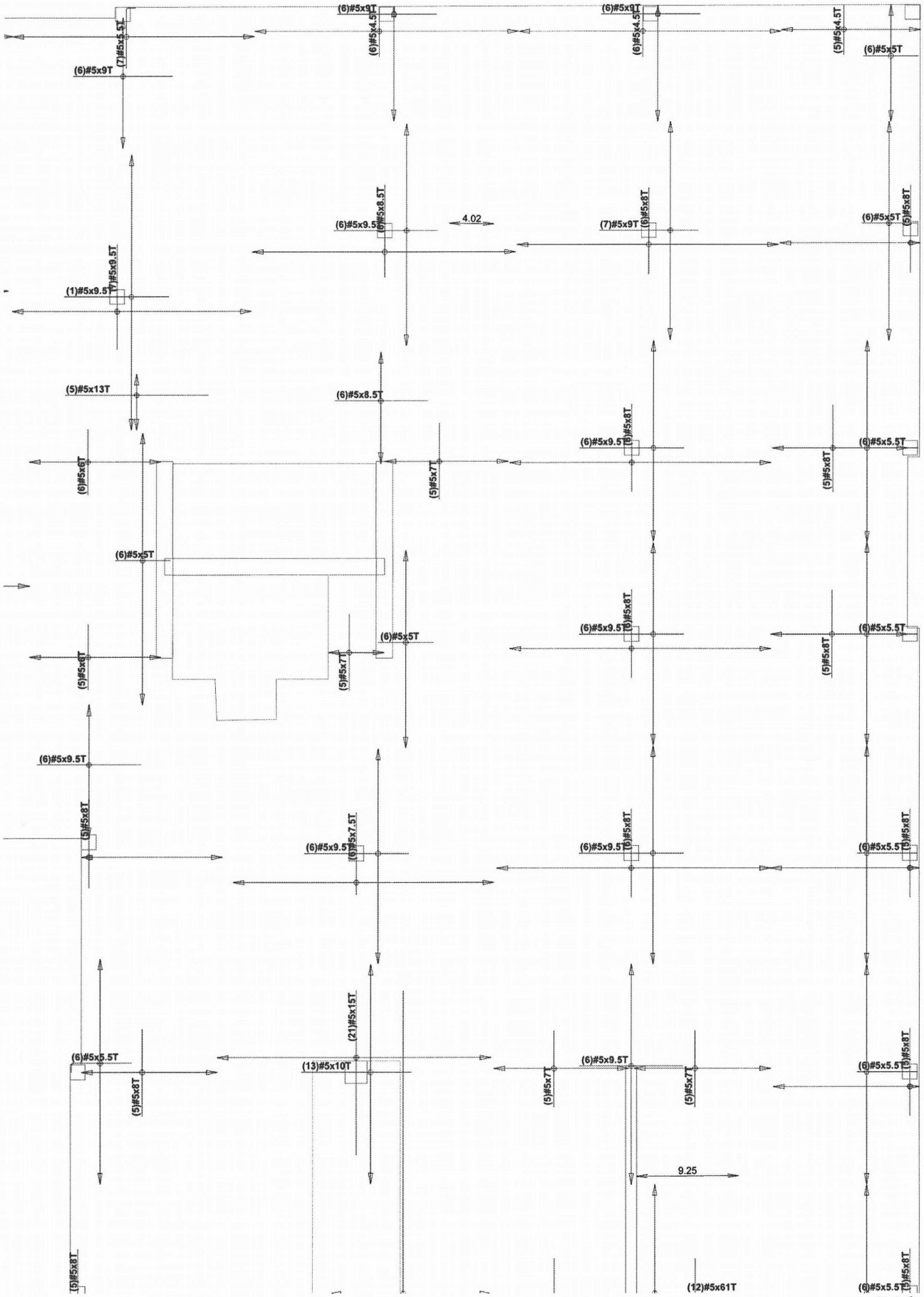
Item 11.1



# Reinforcement: Top Bars Plan

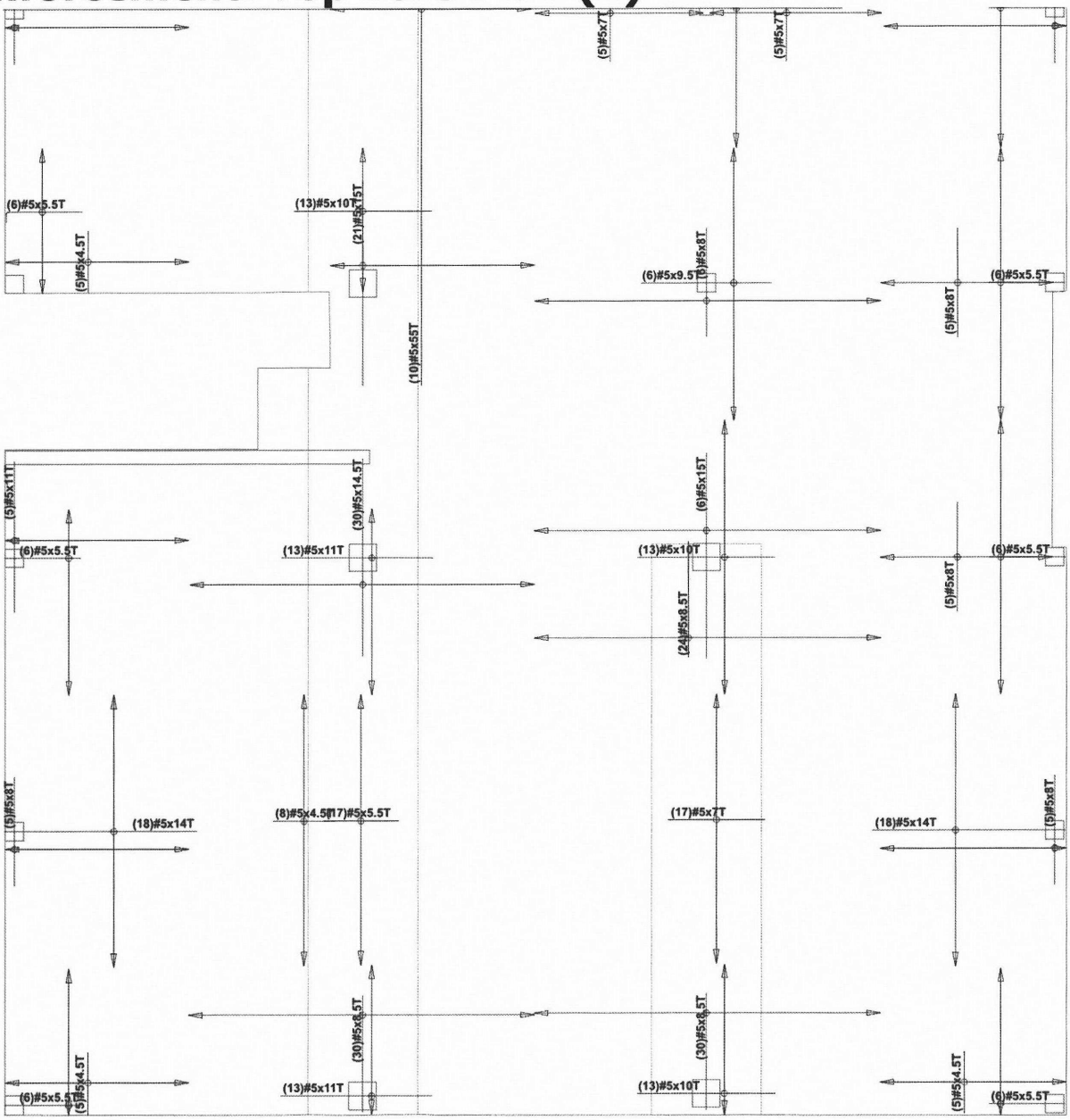
**Reinforcement: User Lines; User Notes; User Dimensions; Latitude User Concentrated Reinf.; Latitude Program Concentrated Reinf.; Latitude User Distributed Reinf.; Latitude Program Distributed Reinf.; Longitude User Concentrated Reinf.;**
**Drawing Import: User Lines; User Notes; User Dimensions;**
**Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;**
**Scale = 1:150**

Item 11.2



# Reinforcement: Top Bars Plan (2)

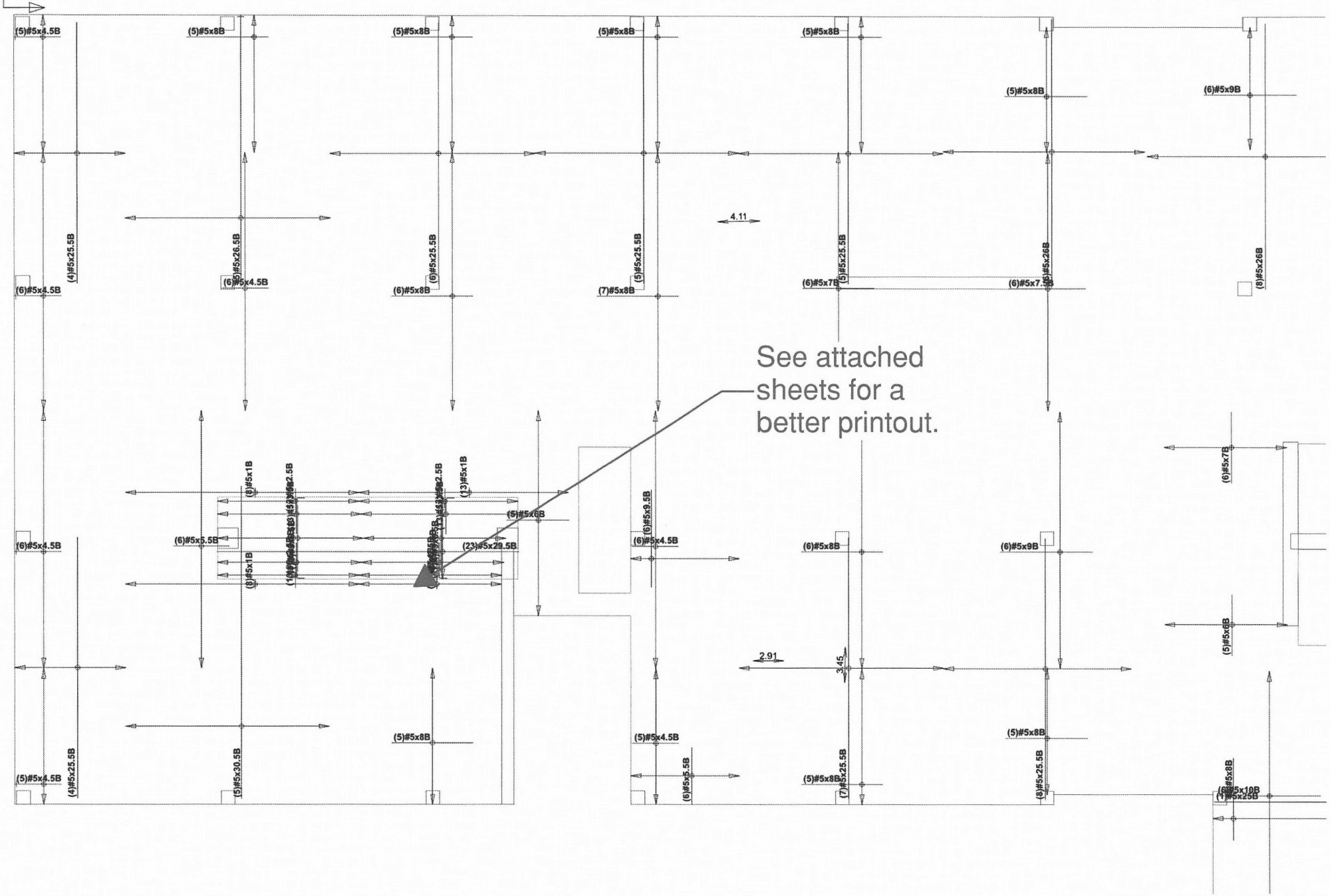
Item 11.3



# Reinforcement: Bottom Bars Plan

inforcement: User Lines; User Notes; User Dimensions; Latitude User Concentrated Reinf.; Latitude Program Concentrated Reinf.; Latitude User Distributed Reinf.; Latitude Program Distributed Reinf.; Longitude User Concentrated Reinf.; Longitude Program Concentrated Reinf.; Longitude User Distributed Reinf.; L
awing Import: User Lines; User Notes; User Dimensions;
ement: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;
ale = 1:150

Item 11.4



# Reinforcement: Bottom Bars Plan

**Reinforcement: User Lines; User Notes; User Dimensions; Latitude User Concentrated Reinf.; Latitude Program Concentrated Reinf.; Latitude User Distributed Reinf.; Latitude Program Distributed Reinf.; Longitude User Concentrated Reinf.; Drawing Import: User Lines; User Notes; User Dimensions;**
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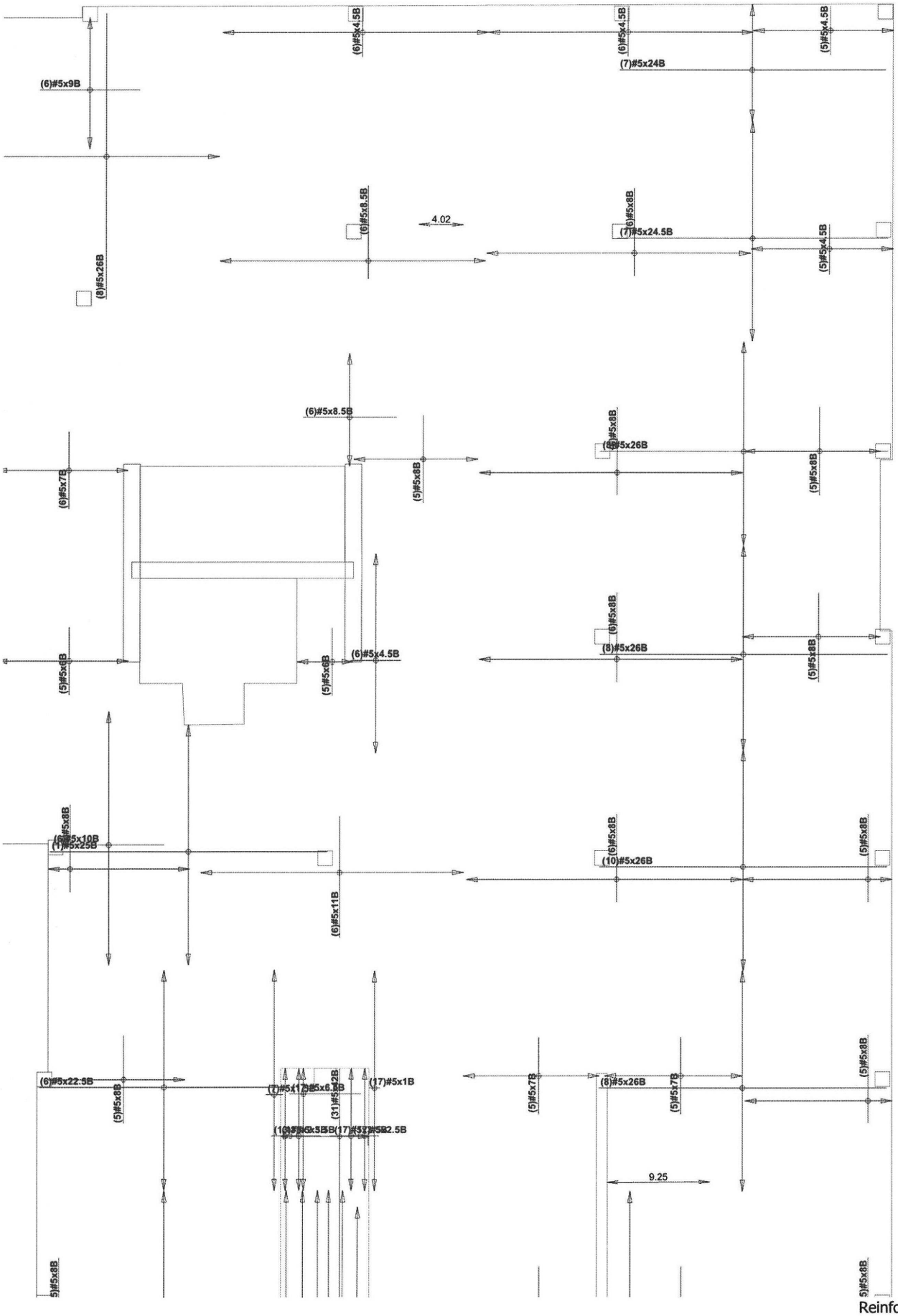
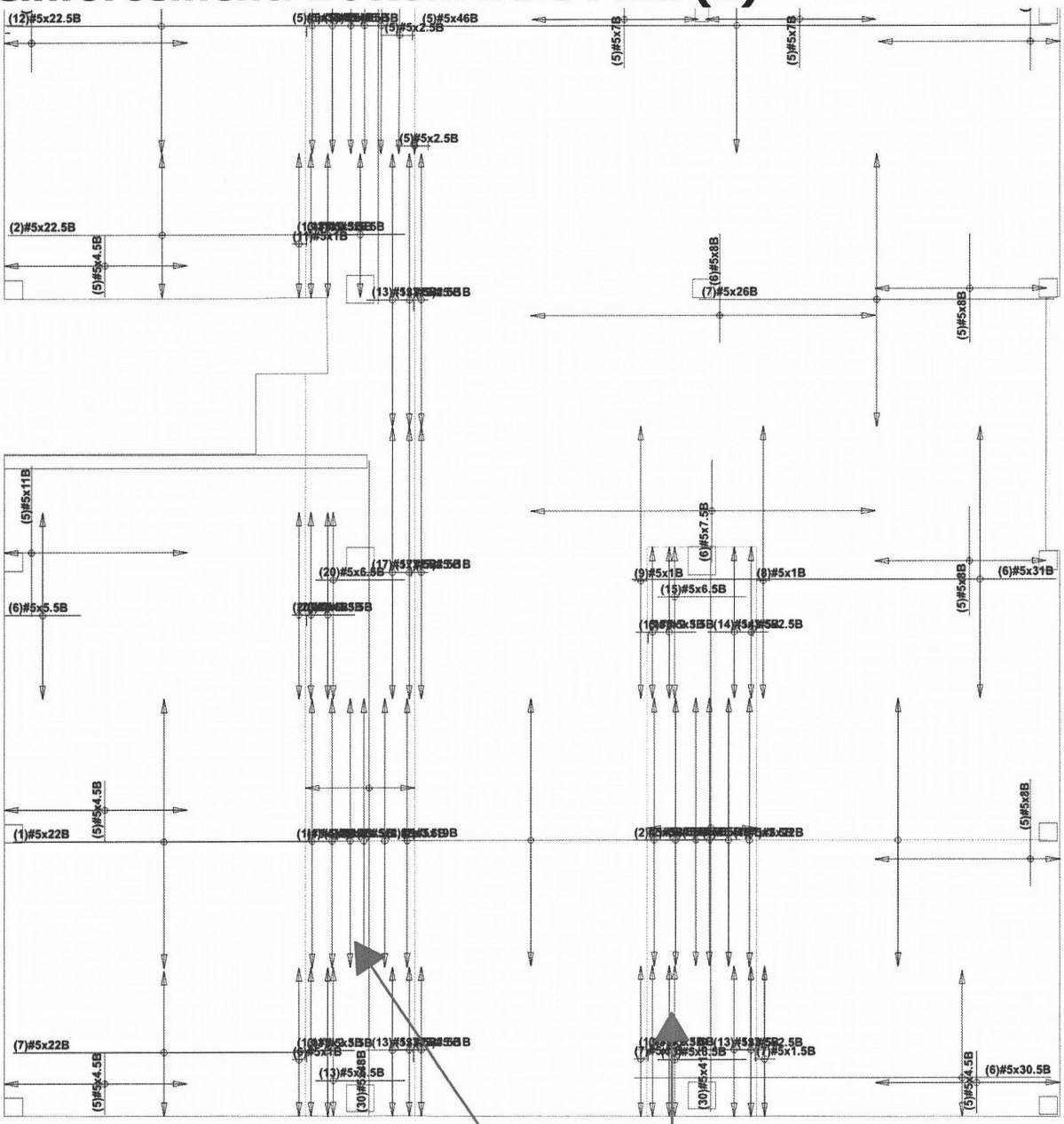
**Scale = 1:150**

Item 11.5



# Reinforcement: Bottom Bars Plan (2)

Item 11.6




See attached sheets for a better printout.

# Reinforcement: Bottom Bars Plan

**Reinforcement: User Lines; User Notes; User Dimensions; Latitude User Concentrated Reinf.; Latitu**
**Drawing Import: User Lines; User Notes; User Dimensions;**

Item 11.7

**Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements E**
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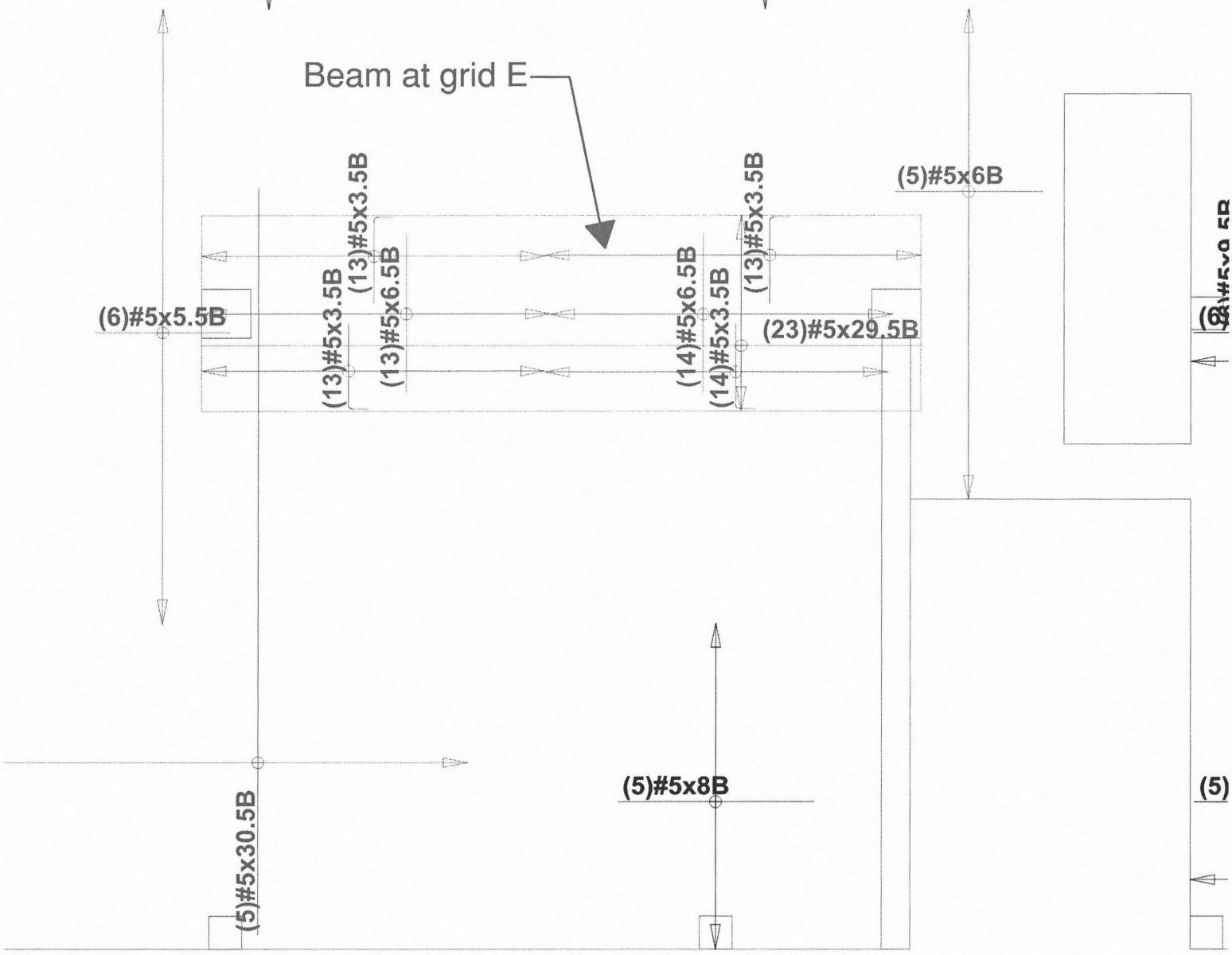

# Reinforcement: Bottom Bars Plan

**Reinforcement: User Lines; User Notes; User Dimensions; Latitude User Concentrated Reinf.; Latitude Progra**
**Drawing Import: User Lines; User Notes; User Dimensions;**
**Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; C**
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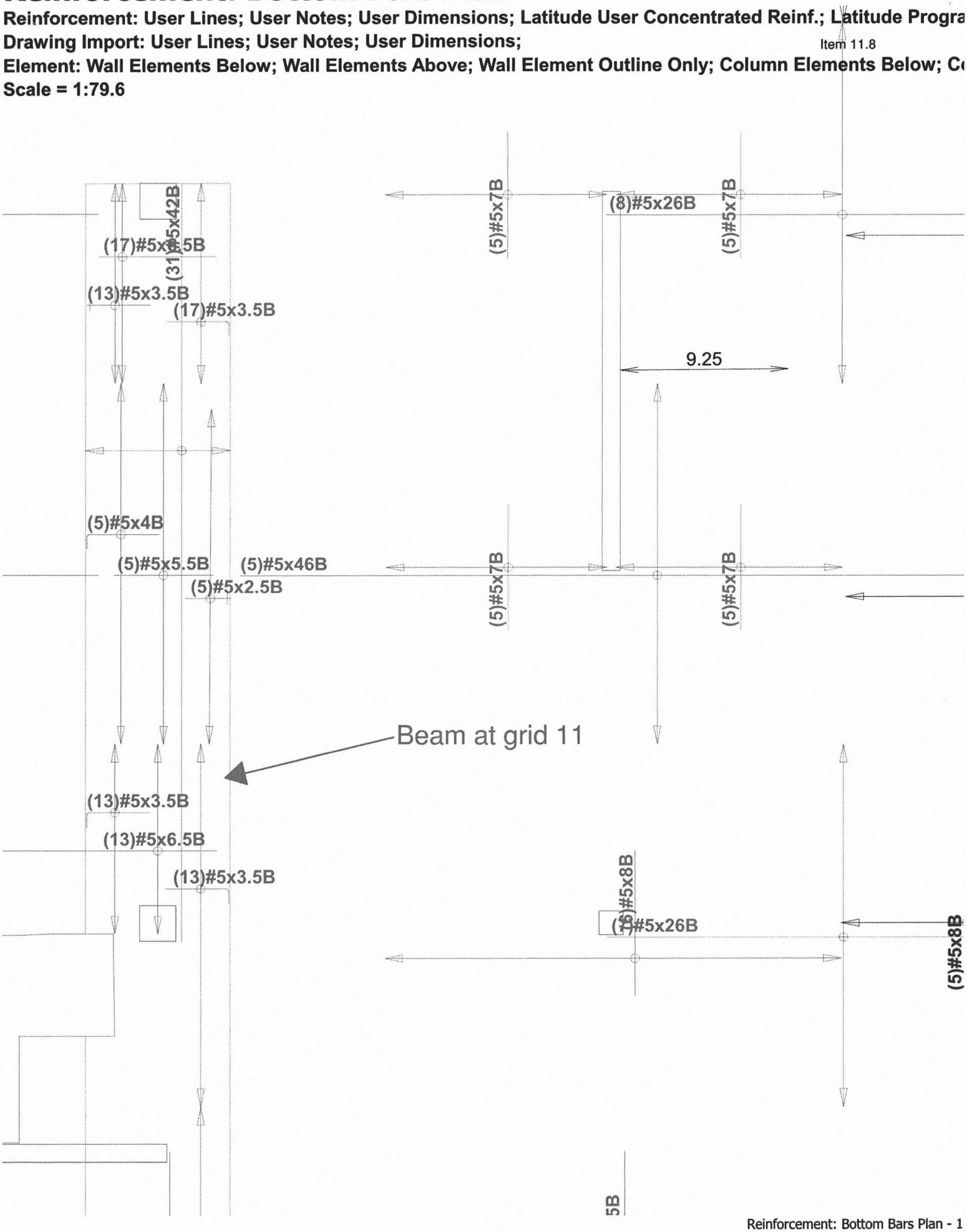
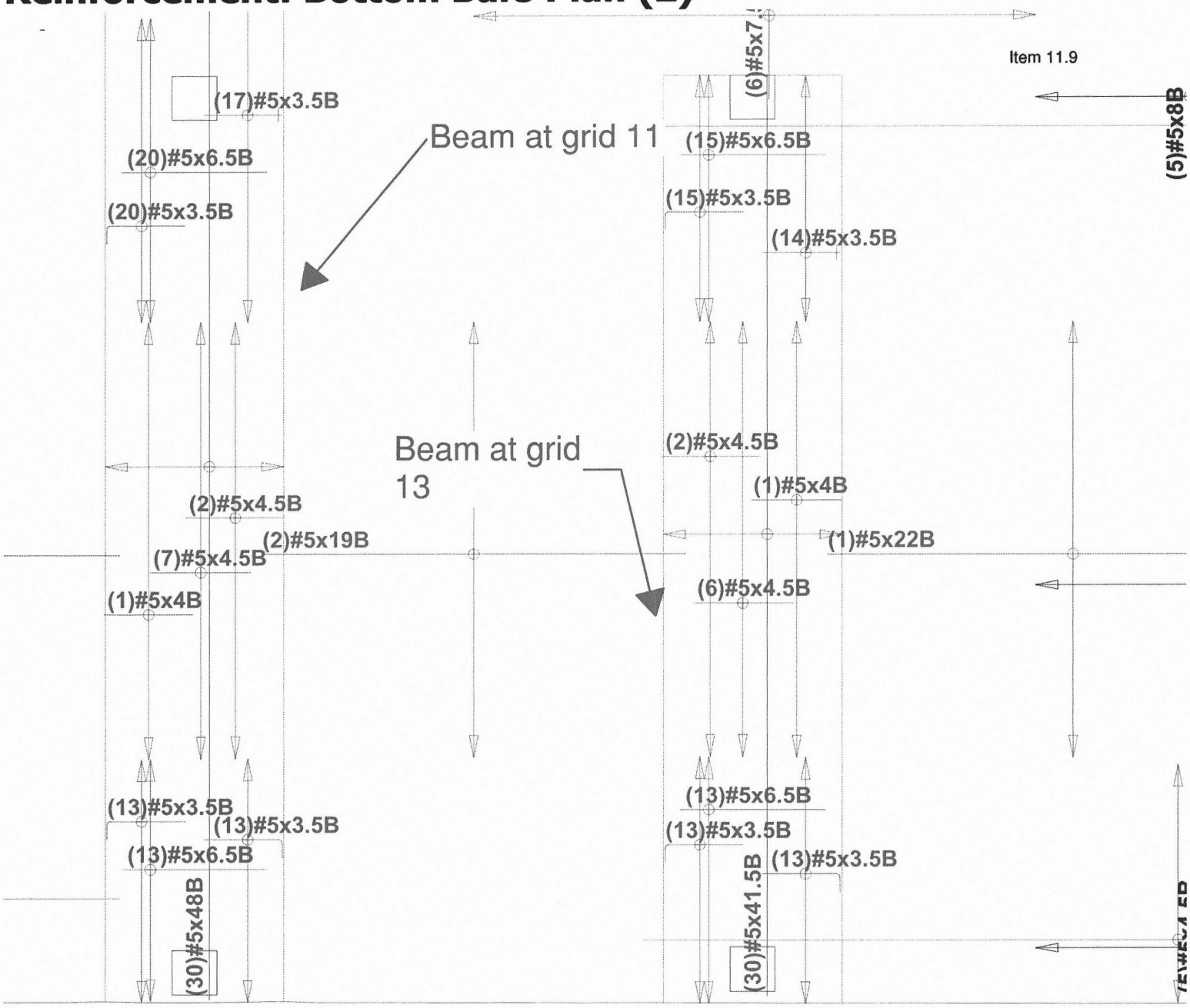


# Reinforcement: Bottom Bars Plan (2)



DCI ENGINEERS

Project # : 14031-0013 Page # : #N/A
Proj. Name : Block 8L
Engineer : MDP Date : 11/17/2014
Subject : Seismic Load Determination

This is Ta (eq. 12.8-7 from ASCE 7-10)
Ta generates a Cs = 0.121 (eq. 12.8.2 ASCE 7-10)

## Seismic Base Shear and Distribution

See sheet L14 (original calc package for Etabs print out with building period.

| | | |
|---|---|---|
| Seismic Coefficient | $C_s$ = | 0.121 |
| Period of Structure | $T_a$ = | 0.504 sec |
| Exponent due to period | k = | 1.0 |

Tx (from etabs) = 0.503
Tx generates a Cs = 0.121 (eq 12.8.2 and12.8.3)

Ty (from etabs) = 0.706
Ty generates a Cs = 0.105 (eq 12.8.2 and12.8.3)

| Level | Story | Height | Weight Description | Weight | | |
|---|---|---|---|---|---|---|
| ROOF | 5th | 72.0 ft | Roof | 1859.1 kip | <--- | See Detailed Breakdown |
| L6 | 4th | 60.0 ft | L6 Residential | 2239.6 kip | <--- | See Detailed Breakdown |
| L5 | 3rd | 48.0 ft | L5 Residential | 2536.9 kip | <--- | See Detailed Breakdown |
| L4 | 2nd | 36.0 ft | L4 Office | 2293.2 kip | <--- | See Detailed Breakdown |
| L3 | 3rd | 24.0 ft | L4 Office | 2293.2 kip | <--- | See Detailed Breakdown |
| L2 | 1st | 12.0 ft | L2 Office | 5013.3 kip | <--- | See Detailed Breakdown |
| | | | Seismic Weight of Building | W = 16235.4 kip | | |

| | | |
|---|---|---|
| V = | Seismic Base Shear $C_sW$ (Ta) | 1962.6 kip |
| Vx = | Using Etabs Periof | 1962.6 kip |
| Vy = | Using Etabs Periof | 1698.6 kip |

### ELF Distribution of Seismic Forces Per ASCE 7-05 12.8.3:

| | $A_i$ | $W_i$ | $h_i$ | $W_ih_i^k$ | $C_{vx}$ | $F_x$ | $\Sigma F_x$ |
|---|---|---|---|---|---|---|---|
| ROOF | 18844 ft² | 1859.1 k | 72.0 ft | 134,936 | 0.228 | 447.4 k | 447.4 k |
| L6 | 24375 ft² | 2239.6 k | 60.0 ft | 135,414 | 0.229 | 449.0 k | 896.4 k |
| L5 | 24375 ft² | 2536.9 k | 48.0 ft | 122,660 | 0.207 | 406.7 k | 1,303.1 k |
| L4 | 24375 ft² | 2293.2 k | 36.0 ft | 83,111 | 0.140 | 275.6 k | 1,578.7 k |
| L3 | 24375 ft² | 2293.2 k | 24.0 ft | 55,365 | 0.094 | 183.6 k | 1,762.2 k |
| L2 | 0 ft² | 5013.3 k | 12.0 ft | 60,441 | 0.102 | 200.4 k | 1,962.6 k |
| | | | $\Sigma W_ih_i^k$ = | 591,928 | | | |

*f'c = 5000 psi*
*3sqrt(f'c)= 212.1 psi*
*Conc SW req'd = 9252 in²*
*w/12" thick wall, length req'd = 64.25 ft*
(With an R of 6)

### Seismic Forces at Diaphragm Per ASCE 7-05 12.10.1.1:

| | | |
|---|---|---|
| Spectral Accel at 0.2 sec | $S_{DS}$ = | 0.73 |
| Seismic Importance | $I_E$ = | 1.0 |
| $F_{px\,max} = 0.4\,(S_{DS})\,I_E * w_p$ | | 0.290 * $w_p$ max |
| $F_{px\,min} = 0.2\,(S_{DS})\,I_E * w_p$ | | 0.145 * $w_p$ min |

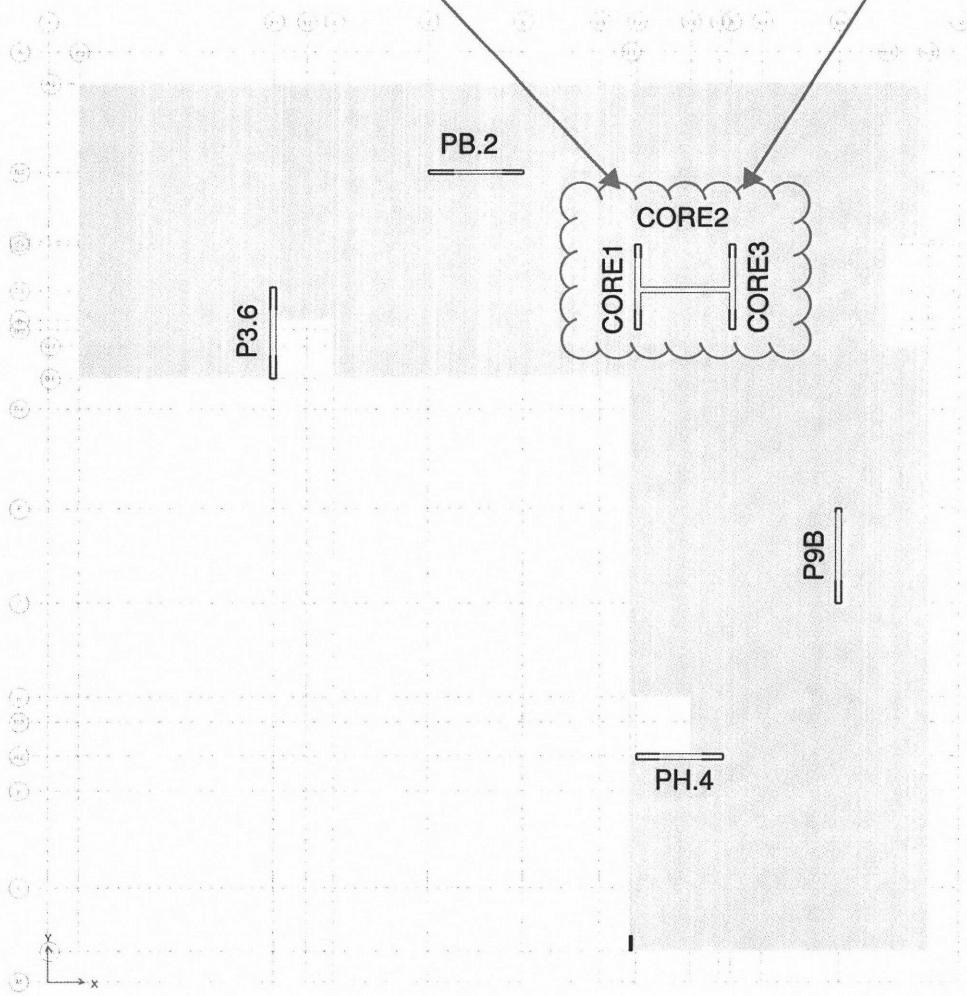
| | $F_i$ | $W_i$ | $\Sigma F_i / \Sigma W_i$ | governing | | $F_{px}$ | $\gamma = F_{px} / F_x$ |
|---|---|---|---|---|---|---|---|
| ROOF | 447.4 k | 1859.1 k | 0.241 | 0.241 | calc'd | 447.4 kip | 1.00 |
| L6 | 449.0 k | 2239.6 k | 0.219 | 0.219 | calc'd | 489.8 kip | 1.09 |
| L5 | 406.7 k | 2536.9 k | 0.196 | 0.196 | calc'd | 498.2 kip | 1.22 |
| L4 | 275.6 k | 2293.2 k | 0.177 | 0.177 | calc'd | 405.4 kip | 1.47 |
| L3 | 183.6 k | 2293.2 k | 0.157 | 0.157 | calc'd | 360.1 kip | 1.96 |
| L2 | 200.4 k | 5013.3 k | 0.121 | 0.145 | min | 727.3 kip | 3.63 |

ETABS 2013 13.1.5 11/17/2014

## ROOF PLAN

For the moment, since we want the H-shaped core to act as one piece, a separate model was created and the entire core is labeled Core1.

Core1, Core2 and Core3 are the names of each individual shear pier that was modeled in ETabs for the H-shaped core.




8L - Shear Model revised.EDB Plan View - ROOF - Z = 74 (ft)

| DCI ENGINEERS | Project No. 14031-013 | Sheet No. 1 |
|---|---|---|
| Project: BLOCK 8L | | Date: 8/27/14 |
| Subject: NON-SFRS COLUMN : GL 1 | | By: GM |

1/9 – 24x24

$P_D = 398^k$ $P_L = 171^k$ $P_S = 20^k$ $\delta_u = 0.41''$

$1.34D + 0.5L + 0.2S = 616.1^k$ $0.2 S_{DS} = 0.2 \times 0.724 = 0.14$

$0.76D = 298.7^k$

RISA OUTPUT: $M_g = 70.1^{kf}$ < SPCOL: $\phi M_n = 86.7^{kf}$

$V_g = 4.7^k$ $\phi V_n = 188^k$ *

• ACI 21.13.3 APPLIES

$A_g f'_c/10 = 24^2 \cdot 6000/10 = 345.6^k$ • ACI 21.13.3.2 APPLIES

$0.35 P_o = 1321^k$ $A_g f'_c/10 < P_u < 0.35 P_o$

• ACI 21.6.3.1

$A_{st} = 12 \times \#10 = 15.24 \text{ in}^2$

$A_g = 24^2 = 576 \text{ in}^2$

$\rho_g = 0.026$ , $0.01 < \rho_g < 0.06$

• ACI 21.6.4.2 , TIE SPACING < 14"

• ACI 21.6.5 – $M_{pr}$ CALC

SPCOL: $M_{pr} = 1175^{kf}$ w/ $\phi = 1.0$ + $1.25 f_y$

$V_{pr} = 2M_{pr}/h_c = 162^k$ $h_c = 14'6''$

$\phi V_c = \phi 2\sqrt{f'_c} bd = 0.75 \cdot 2\sqrt{6000} \cdot 24'' \cdot 21.4'' = 59.6^k$

$$s = \frac{\phi A_v f_y d}{V_{pr} - \phi V_c} = \frac{0.654 \cdot 0.2 \text{in}^2 \cdot 60 \cdot 21.4''}{162 - 59.6} = 6.63''$$

• ACI 21.6.5.2 –

b) $P_u = 298.7^k > A_g f'_c/20 = 172.8^k$

OK TO USE $V_c$

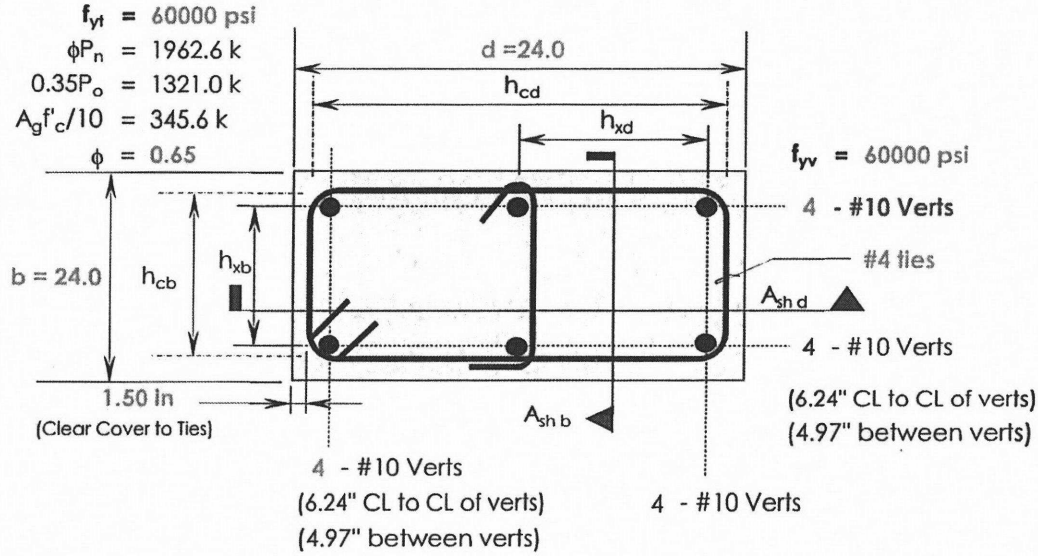
USE 4 LEGS #4 TIE @ 6" O.C – SEE SPREADSHEET

* $\phi V_n = \phi V_c + \phi V_s = 59.6 + 0.75 \cdot (4 \cdot 0.2) \cdot 60 \cdot 21.4''/6'' = 59.6 + 128.2 = 188^k$

| DCI ENGINEERS | Project No. 14031-013 | Sheet No. 2 (C-2) |
|---|---|---|
| Project: Block 8L | | Date: 8/27/14 |
| Subject: Non-SFRS Column: GL I/9 | | By: GM |

# 24" x 24" Column w/ 12-#10 Verts & #4 ties @ 6" oc

$f'_c$ = 6000 psi
$f_{yt}$ = 60000 psi
$\phi P_n$ = 1962.6 k
$0.35P_o$ = 1321.0 k
$A_g f'_c/10$ = 345.6 k
$\phi$ = 0.65




(Diagram Not to Scale)

$f_{yv}$ = 60000 psi

| 12-#10 Verts |
|---|
| #4 ties @ 6" oc |
| Vert. Rein = 2.65% |

Rein. per ft height.

| |
|---|
| 1.1 x Verts. = 56.8 plf |
| Ties = 23.3 plf |
| Total = 80.1 plf |

Assumed that
0.35Po > Pu > Agf'c/10

No. legs ($A_{sh\,b}$) = 4
No. legs ($A_{sh\,d}$) = 4

## ACI 318-11 Section 21.13.3.1

$s_{max}$ = d / 2

x-direction $s$ = 10.68 in  y-direction $s$ = 10.68 in

use $s$ = **10.68 in**

**Section Not Used**

~~Max spacing per ACI 21.13.3.1~~
~~s = 10.68 in~~

## ACI 318-11 Section 21.6.4.4 as amended by 21.13.3.3

(I) $$A_{sh} = 0.3\left(\frac{s\,b_c\,f'_c}{f_{yt}}\right)\left(\left(\frac{A_g}{A_{ch}}\right) - 1\right) \quad \text{Eq. (21-4)}$$

| Column Core Capacity |
|---|
| $0.3P_o$ = 925.7 k |
| $\phi P_n$ = 1604.6 k |

IF
$A_{sh\,b}$ = 0.80 sq in
$b_{cb}$ = 21.000 in
$f'_c$ = 6000 psi
$f_{yt}$ = 60000 psi
$A_g$ = 576 sq in
$A_{ch}$ = 441 sq in
THEN $s_b$ = **4.1 in**

IF
$A_{sh\,d}$ = 0.80 sq in
$b_{cd}$ = 21.000 in
$f'_c$ = 6000 psi
$f_{yt}$ = 60000 psi
$A_g$ = 576 sq in
$A_{ch}$ = 441 sq in
THEN $s_d$ = **4.1 in**

**Section Not Used**

~~Half of Trans. Reinf. Req'd per 21.13.3.3, if $P_u > 0.35\,P_o$~~
~~2s = 8.30 in~~

(II) $$A_{sh} = 0.09\left(\frac{s\,b_c\,f'_c}{f'_{yt}}\right) \quad \text{Eq. (21-5)}$$

IF
$A_{sh\,b}$ = 0.80 sq in
$b_{cb}$ = 21.000 in
$f'_c$ = 6000 psi
$f_{yt}$ = 60000 psi
THEN $s_b$ = **4.2 in**

IF
$A_{sh\,d}$ = 0.80 sq in
$b_{cd}$ = 21.000 in
$f'_c$ = 6000 psi
$f_{yt}$ = 60000 psi
THEN $s_d$ = **4.2 in**

**Section Not Used**

~~Half of Trans. Reinf. Req'd per 21.13.3.3, if $P_u > 0.35\,P_o$~~
~~2s = 8.47 in~~

## ACI 318-08 Section 21.13.3.2

(a) $s_{max}$ = 6 x 1.270 in = 7.62 in
use $s$ = **7.62 in**

(b) $s_{max}$ = **6.0 in**

**Min per ACI 21.13.3.2**
~~s = 6.00 in~~

C-3

General Information:
==========

File Name: P:\2014 Portland Jobs\14031-0013 Block 8L\Calculations\GM Calcs\SPcol\8L - col i 9.col
Project: Block 8L
Column: I/7 Engineer: GM
Code: ACI 318-11 Units: English

Run Option: Investigation Slenderness: Not considered
Run Axis: X-axis Column Type: Structural

Material Properties:
==========

f'c = 6 ksi fy = 60 ksi
Ec = 4415.21 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.75

Section:
==========

Rectangular: Width = 24 in Depth = 24 in

Gross section area, Ag = 576 in^2
Ix = 27648 in^4 Iy = 27648 in^4
rx = 6.9282 in ry = 6.9282 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========

Bar Set: ASTM A615

| Size | Diam (in) | Area (in^2) | Size | Diam (in) | Area (in^2) | Size | Diam (in) | Area (in^2) |
|---|---|---|---|---|---|---|---|---|
| # 3 | 0.38 | 0.11 | # 4 | 0.50 | 0.20 | # 5 | 0.63 | 0.31 |
| # 6 | 0.75 | 0.44 | # 7 | 0.88 | 0.60 | # 8 | 1.00 | 0.79 |
| # 9 | 1.13 | 1.00 | # 10 | 1.27 | 1.27 | # 11 | 1.41 | 1.56 |
| # 14 | 1.69 | 2.25 | # 18 | 2.26 | 4.00 | | | |

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 15.24 in^2 at rho = 2.65%
Minimum clear spacing = 5.06 in

12 #10 Cover = 1.5 in

Service Loads:
==========

| No. | Load Case | Axial Load kip | Mx @ Top k-ft | Mx @ Bot k-ft | My @ Top k-ft | My @ Bot k-ft |
|---|---|---|---|---|---|---|
| 1 | Dead | 393.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Live | 171.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Wind | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | EQ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Snow | 20.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Sustained Load Factors:
==========

| Load Case | Factor (%) |
|---|---|
| Dead | 100 |
| Live | 0 |
| Wind | 0 |
| EQ | 0 |
| Snow | 0 |

Load Combinations:
==========

U1 = 1.340*Dead + 0.500*Live + 0.000*Wind + 0.000*EarthQuake + 0.200*Snow
U2 = 0.760*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U3 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

C-4

Factored Loads and Moments with Corresponding Capacities:

NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

| No. | Load Combo | Pu kip | Mux k-ft | PhiMnx k-ft | PhiMn/Mu | NA depth in | Dt depth in | eps_t | Phi |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 U1 | 616.12 | 0.00 | 867.41 | 999.999 | 9.99 | 21.49 | 0.00345 | 0.768 |
| 2 | | 616.12 | 0.00 | 867.41 | 999.999 | 9.99 | 21.49 | 0.00345 | 0.768 |
| 3 | 1 U2 | 298.68 | 0.00 | 849.47 | 999.999 | 6.66 | 21.49 | 0.00668 | 0.900 |
| 4 | | 298.68 | 0.00 | 849.47 | 999.999 | 6.66 | 21.49 | 0.00668 | 0.900 |
| 5 | 1 U3 | 755.20 | 0.00 | 773.07 | 999.999 | 12.76 | 21.49 | 0.00205 | 0.650 |
| 6 | | 755.20 | 0.00 | 773.07 | 999.999 | 12.76 | 21.49 | 0.00205 | 0.650 |

*** End of output ***

C-5

General Information:
==========

File Name: P:\2014 Portland Jobs\14031-0013 Block 8L\Calculations\GM Calcs\S...\8L - col i 9 Mpr.col
Project: Block 8L
Column: I/7 Engineer: GM
Code: ACI 318-11 Units: English

Run Option: Investigation Slenderness: Not considered
Run Axis: X-axis Column Type: Structural

Material Properties:
==========

f'c = 6 ksi fy = 75 ksi
Ec = 4415.21 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.75

Section:
==========

Rectangular: Width = 24 in Depth = 24 in

Gross section area, Ag = 576 in^2
Ix = 27648 in^4 Iy = 27648 in^4
rx = 6.9282 in ry = 6.9282 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========

Bar Set: ASTM A615

| Size | Diam (in) | Area (in^2) | Size | Diam (in) | Area (in^2) | Size | Diam (in) | Area (in^2) |
|---|---|---|---|---|---|---|---|---|
| # 3 | 0.38 | 0.11 | # 4 | 0.50 | 0.20 | # 5 | 0.63 | 0.31 |
| # 6 | 0.75 | 0.44 | # 7 | 0.88 | 0.60 | # 8 | 1.00 | 0.79 |
| # 9 | 1.13 | 1.00 | # 10 | 1.27 | 1.27 | # 11 | 1.41 | 1.56 |
| # 14 | 1.69 | 2.25 | # 18 | 2.26 | 4.00 | | | |

Confinement: Other; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 1, phi(b) = 1, phi(c) = 1

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 15.24 in^2 at rho = 2.65%
Minimum clear spacing = 5.06 in

12 #10 Cover = 1.5 in

Service Loads:
==========

| No. | Load Case | Axial Load kip | Mx @ Top k-ft | Mx @ Bot k-ft | My @ Top k-ft | My @ Bot k-ft |
|---|---|---|---|---|---|---|
| 1 | Dead | 393.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Live | 171.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Wind | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | EQ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Snow | 20.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Sustained Load Factors:
==========

| Load Case | Factor (%) |
|---|---|
| Dead | 100 |
| Live | 0 |
| Wind | 0 |
| EQ | 0 |
| Snow | 0 |

Load Combinations:
==========

U1 = 1.340*Dead + 0.500*Live + 0.000*Wind + 0.000*EarthQuake + 0.200*Snow
U2 = 0.760*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow

C-6

Factored Loads and Moments with Corresponding Capacities:

NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

| No. | Load Combo | Pu kip | Mux k-ft | PhiMnx k-ft | PhiMn/Mu | NA depth in | Dt depth in | eps_t | Phi |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 U1 | 616.12 | 0.00 | 1174.53 | 999.999 | 9.15 | 21.49 | 0.00405 | 1.000 |
| 2 | | 616.12 | 0.00 | 1174.53 | 999.999 | 9.15 | 21.49 | 0.00405 | 1.000 |
| 3 | 1 U2 | 298.68 | 0.00 | 1056.43 | 999.999 | 7.18 | 21.49 | 0.00597 | 1.000 |
| 4 | | 298.68 | 0.00 | 1056.43 | 999.999 | 7.18 | 21.49 | 0.00597 | 1.000 |

*** End of output ***

| DCI ENGINEERS | Project No. 14031-013 | Sheet No. 1 |
|---|---|---|
| Project: BLOCK 8L | | Date: 8/27/14 |
| Subject: NON-SFRS COL ; GL I | | By: GM |

1/7 - 16x16

$P_D = 72^k$ $P_L = 37^k$ $P_S = 3^k$ $\delta_u = 0.41''$

$1.34D + 0.5L + 0.2S = 116.3^k$

$0.76D = 54.7^k$

RISA OUTPUT: $M_8 = 41.7^k$ < SPCOL: $\phi M_n = 228^{kf}$

$V_8 = 2.8^k$ $\phi V_n = 53^k$

• ACI 21.13.3 APPLIES

$\phi V_n = \phi V_c + \phi V_s$

$= 0.65(2\sqrt{6000} \cdot 16 \cdot 13.5 + (2 \cdot 0.2) \cdot 60 \cdot 13.5/6)$

$= 0.65(21.75 + 31.2)$

$= 53^k$

$A_g f'_c/10 = 16^2 \cdot 6000/10 = 153.6^k > P_u$

• ACI 21.13.3.1 APPLIES

• ACI 21.5.2.1

$\rho = A_{st}/bd = (3 \cdot 0.79)/16 \cdot 13.5 = 0.011 < 0.025$

$A_{s,min} = \frac{3\sqrt{f'_c}}{f_y} bwd = 0.837 in^2$

$200\, bwd/f_y = 0.72$

$3.79 = 2.37 in^2$ PROVIDED.

PROVIDE 2 LEGS #4 TIE @ 6"

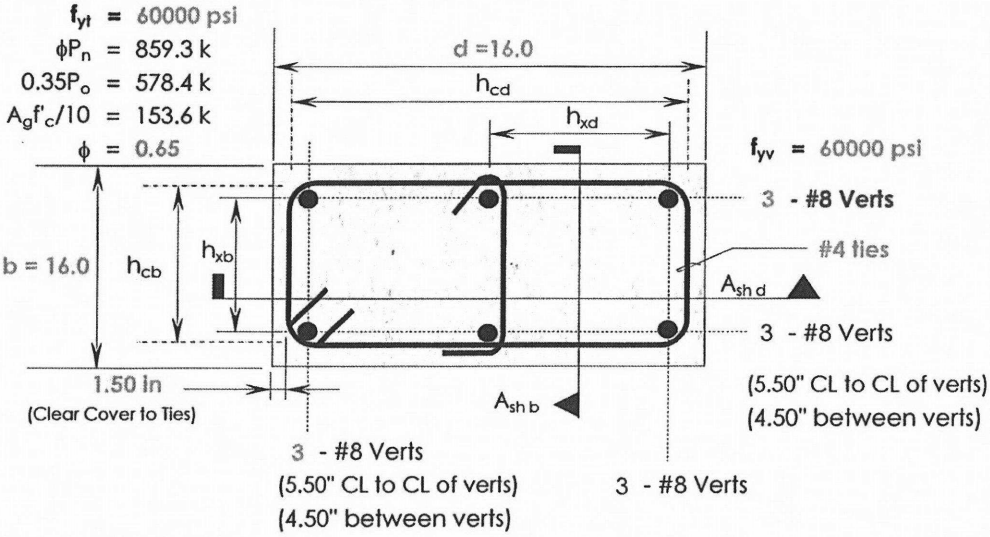
C-8

DCI ENGINEERS

| Project No. | Sheet No. |
|---|---|
| 14031-013 | 2 |
| **Project** | **Date** |
| BLOCK 8L | 8/27/14 |
| **Subject** | **By** |
| ACI 318-11 Column - GL 1/7 | GM |

# 16" x 16" Column w/ 8-#8 Verts & #4 ties @ 6.75" oc

$f'_c$ = 6000 psi
$f_{yt}$ = 60000 psi
$\phi P_n$ = 859.3 k
$0.35P_o$ = 578.4 k
$A_g f'_c/10$ = 153.6 k
$\phi$ = 0.65




(Diagram Not to Scale)

**8-#8 Verts**
**#4 ties @ 6.75" oc**
Vert. Rein = 2.47%

Rein. per ft height.
1.1 x Verts. = 23.5 plf
Ties = 5.8 plf
Total = 29.3 plf

Assumed that
Pu < Agf'c/10

No. legs ($A_{sh\,b}$) = 2
No. legs ($A_{sh\,d}$) = 2

## ACI 318-11 Section 21.13.3.1

$s_{max}$ = d / 2

x-direction s = 6.75 in  y-direction s = 6.75 in

use **s = 6.75 in**

**Max spacing per ACI 21.13.3.1**
**s = 6.75 in**

## ACI 318-11 Section 21.6.4.4 as amended by 21.13.3.3

(I) $A_{sh} = 0.3\left(\frac{s\,b_c\,f'_c}{f_{yt}}\right)\left(\left(\frac{A_g}{A_{ch}}\right) - 1\right)$ Eq. (21-4)

| Column Core Capacity | |
|---|---|
| $0.3P_o$ | = 362.7 k |
| $\phi P_n$ | = 628.6 k |

IF
$A_{sh\,b}$ = 0.40 sq in
$b_{cb}$ = 13.000 in
$f'_c$ = 6000 psi
$f_{yt}$ = 60000 psi
$A_g$ = 256 sq in
$A_{ch}$ = 169 sq in
THEN **$s_b$ = 2.0 in**

IF
$A_{sh\,d}$ = 0.40 sq in
$b_{cd}$ = 13.000 in
$f'_c$ = 6000 psi
$f_{yt}$ = 60000 psi
$A_g$ = 256 sq in
$A_{ch}$ = 169 sq in
THEN **$s_d$ = 2.0 in**

**Section Not Used**

~~Half of Trans. Reinf. Req'd per 21.13.3.3, if $P_u$ > 0.35 $P_o$~~
~~2s = 3.98 in~~

(II) $A_{sh} = 0.09\left(\frac{s\,b_c\,f'_c}{f'_{yt}}\right)$ Eq. (21-5)

IF
$A_{sh\,b}$ = 0.40 sq in
$b_{cb}$ = 13.000 in
$f'_c$ = 6000 psi
$f_{yt}$ = 60000 psi
THEN **$s_b$ = 3.4 in**

IF
$A_{sh\,d}$ = 0.40 sq in
$b_{cd}$ = 13.000 in
$f'_c$ = 6000 psi
$f_{yt}$ = 60000 psi
THEN **$s_d$ = 3.4 in**

**Section Not Used**

~~Half of Trans. Reinf. Req'd per 21.13.3.3, if $P_u$ > 0.35 $P_o$~~
~~2s = 6.84 in~~

## ACI 318-08 Section 21.13.3.2

(a) $s_{max}$ = 6 x 1.000 in = 6.00 in

use **s = 6.00 in**

**Section Not Used**

(b) $s_{max}$ = **6.0 in**

~~Min per ACI 21.13.3.2~~
~~s = 6.00 in~~

C-9

General Information:
==========

File Name: P:\2014 Portland Jobs\14031-0013 Block 8L\Calculations\GM Calcs\SPcol\8L - col i 7.col
Project: Block 8L
Column: I/7 Engineer: GM
Code: ACI 318-11 Units: English

Run Option: Investigation Slenderness: Not considered
Run Axis: X-axis Column Type: Structural

Material Properties:
==========

f'c = 6 ksi fy = 60 ksi
Ec = 4415.21 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.75

Section:
==========

Rectangular: Width = 16 in Depth = 16 in

Gross section area, Ag = 256 in^2
Ix = 5461.33 in^4 Iy = 5461.33 in^4
rx = 4.6188 in ry = 4.6188 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========

Bar Set: ASTM A615

| Size | Diam (in) | Area (in^2) | Size | Diam (in) | Area (in^2) | Size | Diam (in) | Area (in^2) |
|---|---|---|---|---|---|---|---|---|
| # 3 | 0.38 | 0.11 | # 4 | 0.50 | 0.20 | # 5 | 0.63 | 0.31 |
| # 6 | 0.75 | 0.44 | # 7 | 0.88 | 0.60 | # 8 | 1.00 | 0.79 |
| # 9 | 1.13 | 1.00 | # 10 | 1.27 | 1.27 | # 11 | 1.41 | 1.56 |
| # 14 | 1.69 | 2.25 | # 18 | 2.26 | 4.00 | | | |

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 6.32 in^2 at rho = 2.47%
Minimum clear spacing = 4.63 in

8 #8 Cover = 1.5 in

Service Loads:
==========

| No. | Load Case | Axial Load kip | Mx @ Top k-ft | Mx @ Bot k-ft | My @ Top k-ft | My @ Bot k-ft |
|---|---|---|---|---|---|---|
| 1 | Dead | 72.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Live | 37.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Wind | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | EQ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Snow | 3.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Sustained Load Factors:
==========

| Load Case | Factor (%) |
|---|---|
| Dead | 100 |
| Live | 0 |
| Wind | 0 |
| EQ | 0 |
| Snow | 0 |

Load Combinations:
==========

U1 = 1.340*Dead + 0.500*Live + 0.000*Wind + 1.000*EarthQuake + 0.200*Snow
U2 = 0.760*Dead + 0.000*Live + 0.000*Wind + 1.000*EarthQuake + 0.000*Snow
U3 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

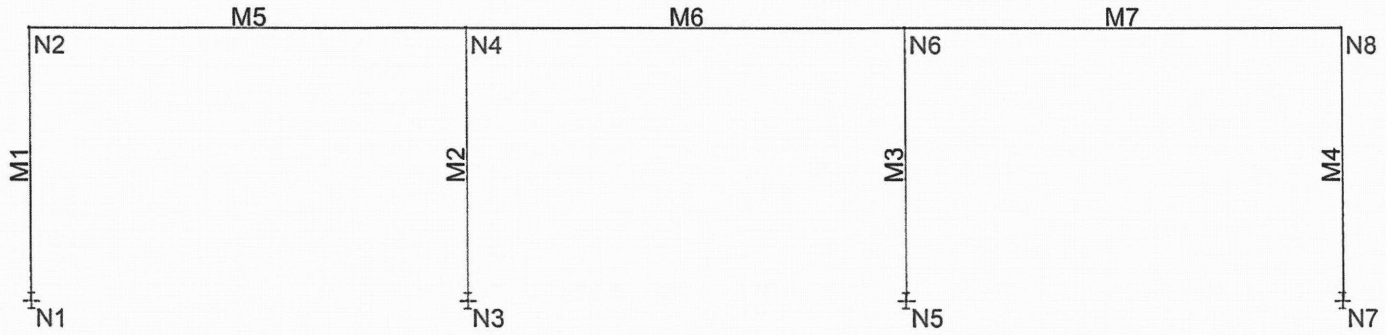
C-1C

Factored Loads and Moments with Corresponding Capacities:

NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

| No. | Load Combo | Pu kip | Mux k-ft | PhiMnx k-ft | PhiMn/Mu | NA depth in | Dt depth in | eps_t | Phi |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 U1 | 115.58 | 0.00 | 228.07 | 999.999 | 4.56 | 13.63 | 0.00597 | 0.900 |
| 2 | | 115.58 | 0.00 | 228.07 | 999.999 | 4.56 | 13.63 | 0.00597 | 0.900 |
| 3 | 1 U2 | 54.72 | 0.00 | 202.20 | 999.999 | 3.80 | 13.63 | 0.00776 | 0.900 |
| 4 | | 54.72 | 0.00 | 202.20 | 999.999 | 3.80 | 13.63 | 0.00776 | 0.900 |
| 5 | 1 U3 | 147.10 | 0.00 | 238.00 | 999.999 | 4.89 | 13.63 | 0.00536 | 0.900 |
| 6 | | 147.10 | 0.00 | 238.00 | 999.999 | 4.89 | 13.63 | 0.00536 | 0.900 |

*** End of output ***




Results for LC 1, Induced Moments 1

| | | |
|---|---|---|
| DCI Engineers | Block 8L - Line I | SK - 1 |
| GM | | Sept 9, 2014 at 4:30 PM |
| 14031-0013 | | Block 8L - non SFRS col, line i.r3d |

RISA TECHNOLOGIES

Company : DCI Engineers
Designer : GM
Job Number : 14031-0013
Model Name : Block 8L - Line I

Sept 5, 2014

Checked By:_____

## Concrete Properties

| | Label | E [ksi] | G [ksi] | Nu | Therm (\1E... | Density[k/ft... | f'c[ksi] | Lambda | Flex Steel[... | Shear Stee... |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Conc6000NW | 4415 | 1920 | .15 | .6 | .145 | 6 | 1 | 60 | 60 |

## Joint Coordinates and Temperatures

| | Label | X [ft] | Y [ft] | Z [ft] | Temp [F] | Detach From Diap... |
|---|---|---|---|---|---|---|
| 1 | N1 | 0 | 0 | 0 | 0 | |
| 2 | N2 | 0 | 15 | 0 | 0 | |
| 3 | N7 | 72 | 0 | 0 | 0 | |
| 4 | N8 | 72 | 15 | 0 | 0 | |
| 5 | N3 | 24 | 0 | 0 | 0 | |
| 6 | N4 | 24 | 15 | 0 | 0 | |
| 7 | N5 | 48 | 0 | 0 | 0 | |
| 8 | N6 | 48 | 15 | 0 | 0 | |

## Concrete Beam Design Parameters

| | Label | Shape | Length[ft] | B-eff Left[in] | B-eff Right[in] | Slab Thic... | Slab Thic... | Icr Factor | Flexural L... | Shear Lay... |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | M5 | CRECT8X64 | 24 | | | | | .8 | Use Desi... | Use Desi... |
| 2 | M6 | CRECT8X128 | 24 | | | | | .8 | Use Desi... | Use Desi... |
| 3 | M7 | CRECT8X64 | 24 | | | | | .8 | Use Desi... | Use Desi... |

## Concrete Column Design Parameters

| | Label | Shape | Length[ft] | Lu-yy[ft] | Lu-zz[ft] | Cm-yy | Cm-zz | Kyy | Kzz | y sway | z sway | Icr Fa... | Flexural Lay... | Shear Layout |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | M1 | CRECT... | 15 | | | | | | | | | .5 | Use Design ... | Use Design Ru... |
| 2 | M2 | CRECT... | 15 | | | | | | | | | .5 | Use Design ... | Use Design Ru... |
| 3 | M3 | CRECT... | 15 | | | | | | | | | .5 | Use Design ... | Use Design Ru... |
| 4 | M4 | CRECT... | 15 | | | | | | | | | .5 | Use Design ... | Use Design Ru... |

## Joint Loads and Enforced Displacements (BLC 1 : DL)

| | Joint Label | L,D,M | Direction | Magnitude[(k,k-ft), (in,rad), (k*s^2/ft... |
|---|---|---|---|---|
| 1 | N2 | L | Y | -72 |
| 2 | N8 | L | Y | -94 |
| 3 | N4 | L | Y | -316 |
| 4 | N6 | L | Y | -393 |

## Joint Loads and Enforced Displacements (BLC 2 : LL)

| | Joint Label | L,D,M | Direction | Magnitude[(k,k-ft), (in,rad), (k*s^2/ft... |
|---|---|---|---|---|
| 1 | N2 | L | Y | -37 |
| 2 | N8 | L | Y | -49 |
| 3 | N6 | L | Y | -171 |
| 4 | N4 | L | Y | -133 |

## Joint Loads and Enforced Displacements (BLC 3 : EQ)

| | Joint Label | L,D,M | Direction | Magnitude[(k,k-ft), (in,rad), (k*s^2/ft... |
|---|---|---|---|---|
| 1 | N2 | D | X | .41 |

## Joint Loads and Enforced Displacements (BLC 4 : SL)

| | Joint Label | L,D,M | Direction | Magnitude[(k,k-ft), (in,rad), (k*s^2/ft... |
|---|---|---|---|---|
| 1 | N6 | L | Y | -20 |
| 2 | N4 | L | Y | -14 |

## Joint Loads and Enforced Displacements (BLC 4 : SL) (Continued)

| | Joint Label | L,D,M | Direction | Magnitude[(k,k-ft), (in,rad), (k*s^2/ft... |
|---|---|---|---|---|
| 3 | N2 | L | Y | -3 |
| 4 | N8 | L | Y | -5 |

## Basic Load Cases

| | BLC Description | Category | X Gravity | Y Gravity | Z Gravity | Joint | Point | Distributed | Area(Me... | Surface(... |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | DL | DL | | | | 4 | | | | |
| 2 | LL | LL | | | | 4 | | | | |
| 3 | EQ | EL | | | | 1 | | | | |
| 4 | SL | SL | | | | 4 | | | | |

## Load Combinations

| | Description | Solve | PD... | SR... | BLC | Factor | BLC | Factor | BLC | Factor | BLC | Factor | BLC | Factor | BLC | Factor | BLC | Factor | BLC | Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Induced Mo... | Yes | Y | | DL | 1.34 | EL | 1 | LL | .5 | SL | 1 | | | | | | | | |
| 2 | Induced Mo... | Yes | Y | | DL | .76 | EL | 1 | | | | | | | | | | | | |

## Member Section Forces

| | LC | Member Label | Sec | Axial[k] | y Shear[k] | z Shear[k] | Torque[k-ft] | y-y Moment[k-... | z-z Moment[k-... |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | M1 | 1 | 116.274 | 1.3 | 0 | 0 | 0 | 0 |
| 2 | | | 2 | 116.274 | 1.3 | 0 | 0 | 0 | -4.874 |
| 3 | | | 3 | 116.274 | 1.3 | 0 | 0 | 0 | -9.748 |
| 4 | | | 4 | 116.274 | 1.3 | 0 | 0 | 0 | -14.622 |
| 5 | | | 5 | 116.274 | 1.3 | 0 | 0 | 0 | -19.496 |
| 6 | 1 | M2 | 1 | 501.705 | 4.587 | 0 | 0 | 0 | 0 |
| 7 | | | 2 | 501.705 | 4.587 | 0 | 0 | 0 | -17.202 |
| 8 | | | 3 | 501.705 | 4.587 | 0 | 0 | 0 | -34.405 |
| 9 | | | 4 | 501.705 | 4.587 | 0 | 0 | 0 | -51.607 |
| 10 | | | 5 | 501.705 | 4.587 | 0 | 0 | 0 | -68.81 |
| 11 | 1 | M3 | 1 | 634.244 | 4.675 | 0 | 0 | 0 | 0 |
| 12 | | | 2 | 634.244 | 4.675 | 0 | 0 | 0 | -17.533 |
| 13 | | | 3 | 634.244 | 4.675 | 0 | 0 | 0 | -35.065 |
| 14 | | | 4 | 634.244 | 4.675 | 0 | 0 | 0 | -52.598 |
| 15 | | | 5 | 634.244 | 4.675 | 0 | 0 | 0 | -70.13 |
| 16 | 1 | M4 | 1 | 157.277 | 1.378 | 0 | 0 | 0 | 0 |
| 17 | | | 2 | 157.277 | 1.378 | 0 | 0 | 0 | -5.167 |
| 18 | | | 3 | 157.277 | 1.378 | 0 | 0 | 0 | -10.335 |
| 19 | | | 4 | 157.277 | 1.378 | 0 | 0 | 0 | -15.502 |
| 20 | | | 5 | 157.277 | 1.378 | 0 | 0 | 0 | -20.67 |
| 21 | 1 | M5 | 1 | 7.707 | -1.705 | 0 | 0 | 0 | -19.496 |
| 22 | | | 2 | 7.707 | -1.705 | 0 | 0 | 0 | -9.266 |
| 23 | | | 3 | 7.707 | -1.705 | 0 | 0 | 0 | .964 |
| 24 | | | 4 | 7.707 | -1.705 | 0 | 0 | 0 | 11.194 |
| 25 | | | 5 | 7.707 | -1.705 | 0 | 0 | 0 | 21.424 |
| 26 | 1 | M6 | 1 | 4.258 | -3.941 | 0 | 0 | 0 | -47.386 |
| 27 | | | 2 | 4.258 | -3.941 | 0 | 0 | 0 | -23.741 |
| 28 | | | 3 | 4.258 | -3.941 | 0 | 0 | 0 | -.096 |
| 29 | | | 4 | 4.258 | -3.941 | 0 | 0 | 0 | 23.549 |
| 30 | | | 5 | 4.258 | -3.941 | 0 | 0 | 0 | 47.194 |
| 31 | 1 | M7 | 1 | 1.021 | -1.817 | 0 | 0 | 0 | -22.936 |
| 32 | | | 2 | 1.021 | -1.817 | 0 | 0 | 0 | -12.035 |
| 33 | | | 3 | 1.021 | -1.817 | 0 | 0 | 0 | -1.133 |
| 34 | | | 4 | 1.021 | -1.817 | 0 | 0 | 0 | 9.768 |
| 35 | | | 5 | 1.021 | -1.817 | 0 | 0 | 0 | 20.67 |

## Member Section Forces (Continued)

| | LC | Member Label | Sec | Axial[k] | y Shear[k] | z Shear[k] | Torque[k-ft] | y-y Moment[k-... | z-z Moment[k-... |
|---|---|---|---|---|---|---|---|---|---|
| 36 | 2 | M1 | 1 | 52.991 | 1.318 | 0 | 0 | 0 | 0 |
| 37 | | | 2 | 52.991 | 1.318 | 0 | 0 | 0 | -4.941 |
| 38 | | | 3 | 52.991 | 1.318 | 0 | 0 | 0 | -9.883 |
| 39 | | | 4 | 52.991 | 1.318 | 0 | 0 | 0 | -14.824 |
| 40 | | | 5 | 52.991 | 1.318 | 0 | 0 | 0 | -19.765 |
| 41 | 2 | M2 | 1 | 237.915 | 4.632 | 0 | 0 | 0 | 0 |
| 42 | | | 2 | 237.915 | 4.632 | 0 | 0 | 0 | -17.369 |
| 43 | | | 3 | 237.915 | 4.632 | 0 | 0 | 0 | -34.739 |
| 44 | | | 4 | 237.915 | 4.632 | 0 | 0 | 0 | -52.108 |
| 45 | | | 5 | 237.915 | 4.632 | 0 | 0 | 0 | -69.477 |
| 46 | 2 | M3 | 1 | 300.873 | 4.673 | 0 | 0 | 0 | 0 |
| 47 | | | 2 | 300.873 | 4.673 | 0 | 0 | 0 | -17.523 |
| 48 | | | 3 | 300.873 | 4.673 | 0 | 0 | 0 | -35.045 |
| 49 | | | 4 | 300.873 | 4.673 | 0 | 0 | 0 | -52.568 |
| 50 | | | 5 | 300.873 | 4.673 | 0 | 0 | 0 | -70.091 |
| 51 | 2 | M4 | 1 | 73.221 | 1.353 | 0 | 0 | 0 | 0 |
| 52 | | | 2 | 73.221 | 1.353 | 0 | 0 | 0 | -5.075 |
| 53 | | | 3 | 73.221 | 1.353 | 0 | 0 | 0 | -10.15 |
| 54 | | | 4 | 73.221 | 1.353 | 0 | 0 | 0 | -15.226 |
| 55 | | | 5 | 73.221 | 1.353 | 0 | 0 | 0 | -20.301 |
| 56 | 2 | M5 | 1 | 9.269 | -1.729 | 0 | 0 | 0 | -19.765 |
| 57 | | | 2 | 9.269 | -1.729 | 0 | 0 | 0 | -9.391 |
| 58 | | | 3 | 9.269 | -1.729 | 0 | 0 | 0 | .984 |
| 59 | | | 4 | 9.269 | -1.729 | 0 | 0 | 0 | 11.358 |
| 60 | | | 5 | 9.269 | -1.729 | 0 | 0 | 0 | 21.732 |
| 61 | 2 | M6 | 1 | 5.178 | -3.975 | 0 | 0 | 0 | -47.745 |
| 62 | | | 2 | 5.178 | -3.975 | 0 | 0 | 0 | -23.898 |
| 63 | | | 3 | 5.178 | -3.975 | 0 | 0 | 0 | -.051 |
| 64 | | | 4 | 5.178 | -3.975 | 0 | 0 | 0 | 23.796 |
| 65 | | | 5 | 5.178 | -3.975 | 0 | 0 | 0 | 47.643 |
| 66 | 2 | M7 | 1 | 1.187 | -1.781 | 0 | 0 | 0 | -22.448 |
| 67 | | | 2 | 1.187 | -1.781 | 0 | 0 | 0 | -11.76 |
| 68 | | | 3 | 1.187 | -1.781 | 0 | 0 | 0 | -1.073 |
| 69 | | | 4 | 1.187 | -1.781 | 0 | 0 | 0 | 9.614 |
| 70 | | | 5 | 1.187 | -1.781 | 0 | 0 | 0 | 20.301 |

| DCI ENGINEERS | Project No. 14031-013 | Sheet No. 1 |
|---|---|---|
| Project: BLOCK 8L | | Date: 8/27/14 |
| Subject: NON-SFRS COL: GL2 | | By: GM |

B2/2 - 16x16

$P_D = 224^k$ $P_L = 110^k$ $P_S = 13^k$ $\delta_u = 0.47''$

$1.34D + 0.5L + 0.2S = 360^k$

$0.76D = 170.2^k$

RISA OUTPUT: $M_8 = 34.1^{kf}$ < SPCOL: $\phi M_n = 210^{kf}$

$V_8 = 2.3^k$ $\phi V_n = 57^k$

• ACI 21.13.3 APPLIES

$\phi V_n = \phi V_c + \phi V_s$

$= 0.65(2\cdot\sqrt{6000}\cdot 16\cdot 13.5 + (2\cdot 0.2)\cdot 60\cdot 13.5/16)$

$= 57^k$

$A_g f'_c/10 = 16^2\cdot 6000/10 = 153.6^k > P_u$ • ACI 21.13.3.2 APPLIES

$0.35P_o = 518.4^k > P_u$

• ACI 21.6.3.1

$A_{st}/A_g = 8\cdot 0.79/16^2 = 0.0247$ , $0.01 < \rho_g < 0.06$

• ACI 21.6.4.2, TIE SPACING < 14"

• ACI 21.6.5 - $M_{pr}$ CALC

SPCOL: $M_{pr} = 330^k$ w/ $\phi = 1.0$ + $1.25f_y$

$V_{pr} = 2M_{pr}/h_c = 45.5^k$ , $h_c = 14'6''$

$\phi V_c = 21.75^k$

$s = \dfrac{\phi A_v f_y d}{V_{pr} - \phi V_c} = \dfrac{0.65\cdot(2\cdot 0.2)\cdot 60\cdot 13.5}{45.5 - 21.75^k} = 8.9''$

• ACI 21.6.5.2

b) $P_u = 170.2^k > A_g f'_c/20 = 76.8^k$

OK TO USE $V_c$

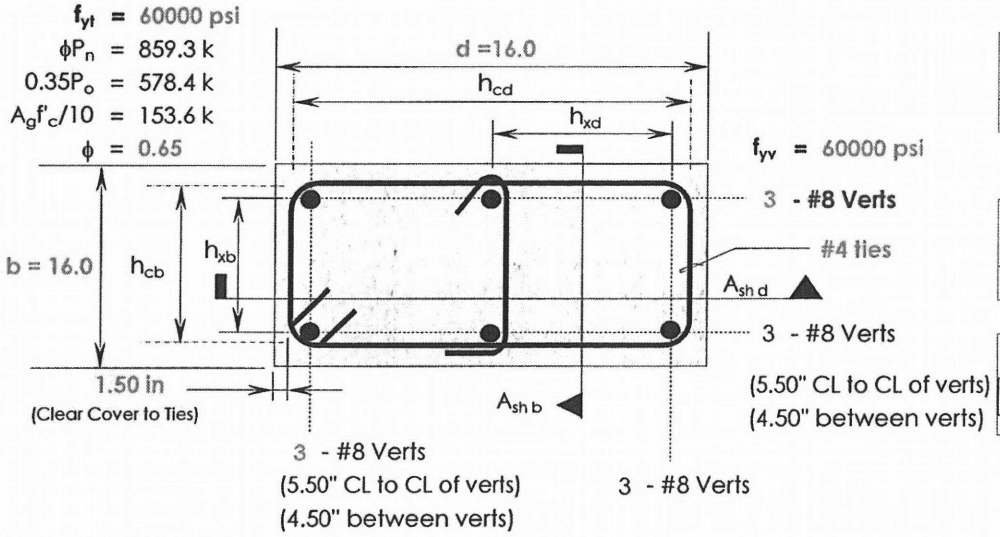
USE 2 LEGS #4 TIE @ 6" O.C. - SEE SPREADSHEET

DCI ENGINEERS

| Project No. | Sheet No. |
|---|---|
| 14031-013 | 2 |
| **Project** | **Date** |
| Block 8L | 8/27/14 |
| **Subject** | **By** |
| Non-SFRS Column GL B.2/2 | GM |

# 16" x 16" Column w/ 8-#8 Verts & #4 ties @ 6" oc

$f'_c$ = 6000 psi
$f_{yt}$ = 60000 psi
$\phi P_n$ = 859.3 k
$0.35P_o$ = 578.4 k
$A_g f'_c/10$ = 153.6 k
$\phi$ = 0.65




(Diagram Not to Scale)

| |
|---|
| **8-#8 Verts** |
| **#4 ties @ 6" oc** |
| Vert. Rein = 2.47% |

Rein. per ft height.

| |
|---|
| 1.1 x Verts. = 23.5 plf |
| Ties = 6.6 plf |
| Total = 30.1 plf |

Assumed that

0.35Po > Pu > Agf'c/10

No. legs ($A_{sh\,b}$) = 2
No. legs ($A_{sh\,d}$) = 2

## ACI 318-11 Section 21.13.3.1

$s_{max}$ = d / 2

x-direction s = 6.75 in  y-direction s = 6.75 in

use **s = 6.75 in**

**Section Not Used**

~~Max spacing per ACI 21.13.3.1~~

~~s = 6.75 in~~

## ACI 318-11 Section 21.6.4.4 as amended by 21.13.3.3

(I) $A_{sh} = 0.3\left(\frac{s\,b_c\,f'_c}{f_{yt}}\right)\left(\left(\frac{A_g}{A_{ch}}\right) - 1\right)$ Eq. (21-4)

| Column Core Capacity | |
|---|---|
| $0.3P_o$ = | 362.7 k |
| $\phi P_n$ = | 628.6 k |

IF $A_{sh\,b}$ = 0.40 sq in
$b_{cb}$ = 13.000 in
$f'_c$ = 6000 psi
$f_{yt}$ = 60000 psi
$A_g$ = 256 sq in
$A_{ch}$ = 169 sq in
THEN **$s_b$ = 2.0 in**

IF $A_{sh\,d}$ = 0.40 sq in
$b_{cd}$ = 13.000 in
$f'_c$ = 6000 psi
$f_{yt}$ = 60000 psi
$A_g$ = 256 sq in
$A_{ch}$ = 169 sq in
THEN **$s_d$ = 2.0 in**

**Section Not Used**

~~Half of Trans. Reinf. Req'd per 21.13.3.3, if $P_u > 0.35\,P_o$~~

~~2s = 3.98 in~~

(II) $A_{sh} = 0.09\left(\frac{s\,b_c\,f'_c}{f'_{yt}}\right)$ Eq. (21-5)

IF $A_{sh\,b}$ = 0.40 sq in
$b_{cb}$ = 13.000 in
$f'_c$ = 6000 psi
$f_{yt}$ = 60000 psi
THEN **$s_b$ = 3.4 in**

IF $A_{sh\,d}$ = 0.40 sq in
$b_{cd}$ = 13.000 in
$f'_c$ = 6000 psi
$f_{yt}$ = 60000 psi
THEN **$s_d$ = 3.4 in**

**Section Not Used**

~~Half of Trans. Reinf. Req'd per 21.13.3.3, if $P_u > 0.35\,P_o$~~

~~2s = 6.84 in~~

## ACI 318-08 Section 21.13.3.2

(a) $s_{max}$ = 6 x 1.000 in = 6.00 in

use **s = 6.00 in**

(b) $s_{max}$ = **6.0 in**

**Min per ACI 21.13.3.2**

s = 6.00 in

C-17

General Information:
==========

File Name: P:\2014 Portland Jobs\14031-0013 Block 8L\Calculations\GM Calcs\SPcol\8L - col b.2 2.col
Project: Block 8L
Column: I/7 Engineer: GM
Code: ACI 318-11 Units: English

Run Option: Investigation Slenderness: Not considered
Run Axis: X-axis Column Type: Structural

Material Properties:
==========

f'c = 6 ksi fy = 60 ksi
Ec = 4415.21 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.75

Section:
==========

Rectangular: Width = 16 in Depth = 16 in

Gross section area, Ag = 256 in^2
Ix = 5461.33 in^4 Iy = 5461.33 in^4
rx = 4.6188 in ry = 4.6188 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========

Bar Set: ASTM A615

| Size | Diam (in) | Area (in^2) | Size | Diam (in) | Area (in^2) | Size | Diam (in) | Area (in^2) |
|---|---|---|---|---|---|---|---|---|
| # 3 | 0.38 | 0.11 | # 4 | 0.50 | 0.20 | # 5 | 0.63 | 0.31 |
| # 6 | 0.75 | 0.44 | # 7 | 0.88 | 0.60 | # 8 | 1.00 | 0.79 |
| # 9 | 1.13 | 1.00 | # 10 | 1.27 | 1.27 | # 11 | 1.41 | 1.56 |
| # 14 | 1.69 | 2.25 | # 18 | 2.26 | 4.00 | | | |

Confinement: Tied; #4 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 6.32 in^2 at rho = 2.47%
Minimum clear spacing = 4.50 in

8 #8 Cover = 1.5 in

Service Loads:
==========

| No. | Load Case | Axial Load kip | Mx @ Top k-ft | Mx @ Bot k-ft | My @ Top k-ft | My @ Bot k-ft |
|---|---|---|---|---|---|---|
| 1 | Dead | 224.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Live | 110.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Wind | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | EQ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Snow | 13.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Sustained Load Factors:
==========

| Load Case | Factor (%) |
|---|---|
| Dead | 100 |
| Live | 0 |
| Wind | 0 |
| EQ | 0 |
| Snow | 0 |

Load Combinations:
==========

U1 = 1.340*Dead + 0.500*Live + 0.000*Wind + 1.000*EarthQuake + 0.200*Snow
U2 = 0.760*Dead + 0.000*Live + 0.000*Wind + 1.000*EarthQuake + 0.000*Snow
U3 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

C-11

Factored Loads and Moments with Corresponding Capacities:

NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

| No. | Load Combo | Pu kip | Mux k-ft | PhiMnx k-ft | PhiMn/Mu | NA depth in | Dt depth in | eps_t | Phi |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 U1 | 357.76 | 0.00 | 209.79 | 999.999 | 8.62 | 13.50 | 0.00170 | 0.650 |
| 2 | | 357.76 | 0.00 | 209.79 | 999.999 | 8.62 | 13.50 | 0.00170 | 0.650 |
| 3 | 1 U2 | 170.24 | 0.00 | 237.73 | 999.999 | 5.16 | 13.50 | 0.00485 | 0.887 |
| 4 | | 170.24 | 0.00 | 237.73 | 999.999 | 5.16 | 13.50 | 0.00485 | 0.887 |
| 5 | 1 U3 | 451.30 | 0.00 | 201.35 | 999.999 | 9.97 | 13.50 | 0.00106 | 0.650 |
| 6 | | 451.30 | 0.00 | 201.35 | 999.999 | 9.97 | 13.50 | 0.00106 | 0.650 |

*** End of output ***

C-19

General Information:
==========

File Name: P:\2014 Portland Jobs\14031-0013 Block 8L\Calculations\GM Calcs...\8L - col b.2 2 Mpr.col
Project: Block 8L
Column: I/7 Engineer: GM
Code: ACI 318-11 Units: English

Run Option: Investigation Slenderness: Not considered
Run Axis: X-axis Column Type: Structural

Material Properties:
==========

f'c = 6 ksi fy = 75 ksi
Ec = 4415.21 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.75

Section:
==========

Rectangular: Width = 16 in Depth = 16 in

Gross section area, Ag = 256 in^2
Ix = 5461.33 in^4 Iy = 5461.33 in^4
rx = 4.6188 in ry = 4.6188 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========

Bar Set: ASTM A615

| Size | Diam (in) | Area (in^2) | Size | Diam (in) | Area (in^2) | Size | Diam (in) | Area (in^2) |
|---|---|---|---|---|---|---|---|---|
| # 3 | 0.38 | 0.11 | # 4 | 0.50 | 0.20 | # 5 | 0.63 | 0.31 |
| # 6 | 0.75 | 0.44 | # 7 | 0.88 | 0.60 | # 8 | 1.00 | 0.79 |
| # 9 | 1.13 | 1.00 | # 10 | 1.27 | 1.27 | # 11 | 1.41 | 1.56 |
| # 14 | 1.69 | 2.25 | # 18 | 2.26 | 4.00 | | | |

Confinement: Other; #4 ties with #10 bars, #4 with larger bars.
phi(a) = 1, phi(b) = 1, phi(c) = 1

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 6.32 in^2 at rho = 2.47%
Minimum clear spacing = 4.50 in

8 #8 Cover = 1.5 in

Service Loads:
==========

| No. | Load Case | Axial Load kip | Mx @ Top k-ft | Mx @ Bot k-ft | My @ Top k-ft | My @ Bot k-ft |
|---|---|---|---|---|---|---|
| 1 | Dead | 224.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Live | 110.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Wind | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | EQ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Snow | 13.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Sustained Load Factors:
==========

| Load Case | Factor (%) |
|---|---|
| Dead | 100 |
| Live | 0 |
| Wind | 0 |
| EQ | 0 |
| Snow | 0 |

Load Combinations:
==========

U1 = 1.340*Dead + 0.500*Live + 0.000*Wind + 1.000*EarthQuake + 0.200*Snow
U2 = 0.760*Dead + 0.000*Live + 0.000*Wind + 1.000*EarthQuake + 0.000*Snow

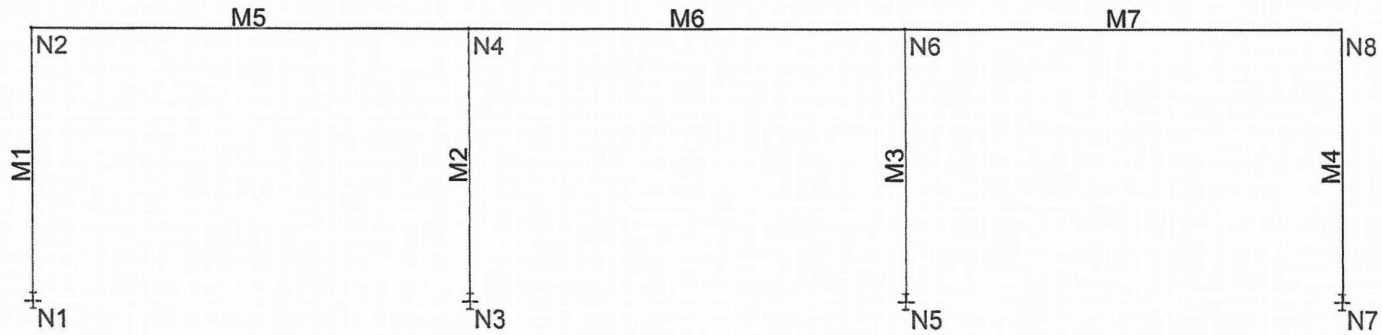
C-2C

Factored Loads and Moments with Corresponding Capacities:

NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

| No. | Load Combo | Pu kip | Mux k-ft | PhiMnx k-ft | PhiMn/Mu | NA depth in | Dt depth in | eps_t | Phi |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 U1 | 357.76 | 0.00 | 329.82 | 999.999 | 7.07 | 13.50 | 0.00273 | 1.000 |
| 2 | | 357.76 | 0.00 | 329.82 | 999.999 | 7.07 | 13.50 | 0.00273 | 1.000 |
| 3 | 1 U2 | 170.24 | 0.00 | 287.60 | 999.999 | 5.27 | 13.50 | 0.00468 | 1.000 |
| 4 | | 170.24 | 0.00 | 287.60 | 999.999 | 5.27 | 13.50 | 0.00468 | 1.000 |

*** End of output ***




Results for LC 1, Induced Moments_1

| | | |
|---|---|---|
| DCI Engineers | Block 8L - Line 2 | SK - 1 |
| GM | | Sept 9, 2014 at 4:31 PM |
| 14031-0013 | | Block 8L - non SFRS col, line 2.r3d |

C-21

## Concrete Properties

| | Label | E [ksi] | G [ksi] | Nu | Therm (\1E... | Density[k/ft... | f'c[ksi] | Lambda | Flex Steel[... | Shear Stee... |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Conc6000NW | 4415 | 1920 | .15 | .6 | .145 | 6 | 1 | 60 | 60 |

## Joint Coordinates and Temperatures

| | Label | X [ft] | Y [ft] | Z [ft] | Temp [F] | Detach From Diap... |
|---|---|---|---|---|---|---|
| 1 | N1 | 0 | 0 | 0 | 0 | |
| 2 | N2 | 0 | 15 | 0 | 0 | |
| 3 | N7 | 72 | 0 | 0 | 0 | |
| 4 | N8 | 72 | 15 | 0 | 0 | |
| 5 | N3 | 24 | 0 | 0 | 0 | |
| 6 | N4 | 24 | 15 | 0 | 0 | |
| 7 | N5 | 48 | 0 | 0 | 0 | |
| 8 | N6 | 48 | 15 | 0 | 0 | |

## Concrete Beam Design Parameters

| | Label | Shape | Length[ft] | B-eff Left[in] | B-eff Right[in] | Slab Thic... | Slab Thic... | Icr Factor | Flexural L... | Shear Lay... |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | M5 | CRECT8X64 | 24 | | | | | .8 | Use Desi... | Use Desi... |
| 2 | M6 | CRECT8X128 | 24 | | | | | .8 | Use Desi... | Use Desi... |
| 3 | M7 | CRECT8X64 | 24 | | | | | .8 | Use Desi... | Use Desi... |

## Concrete Column Design Parameters

| | Label | Shape | Length[ft] | Lu-yy[ft] | Lu-zz[ft] | Cm-yy | Cm-zz | Kyy | Kzz | y sway | z sway | Icr Fac... | Flexur... | Shear ... |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | M1 | CRECT1... | 15 | | | | | | | | | .5 | Use D... | Use D... |
| 2 | M2 | CRECT1... | 15 | | | | | | | | | .5 | Use D... | Use D... |
| 3 | M3 | CRECT1... | 15 | | | | | | | | | .5 | Use D... | Use D... |
| 4 | M4 | CRECT1... | 15 | | | | | | | | | .5 | Use D... | Use D... |

## Joint Loads and Enforced Displacements (BLC 1 : DL)

| | Joint Label | L,D,M | Direction | Magnitude[(k,k-ft), (in,rad), (k*s^2/ft... |
|---|---|---|---|---|
| 1 | N2 | L | Y | -101 |
| 2 | N4 | L | Y | -215 |
| 3 | N6 | L | Y | -224 |
| 4 | N8 | L | Y | -92 |

## Joint Loads and Enforced Displacements (BLC 2 : LL)

| | Joint Label | L,D,M | Direction | Magnitude[(k,k-ft), (in,rad), (k*s^2/ft... |
|---|---|---|---|---|
| 1 | N2 | L | Y | -51 |
| 2 | N4 | L | Y | -110 |
| 3 | N6 | L | Y | -110 |
| 4 | N8 | L | Y | -45 |

## Joint Loads and Enforced Displacements (BLC 3 : EQ)

| | Joint Label | L,D,M | Direction | Magnitude[(k,k-ft), (in,rad), (k*s^2/ft... |
|---|---|---|---|---|
| 1 | N2 | D | X | .47 |

## Joint Loads and Enforced Displacements (BLC 4 : SL)

| | Joint Label | L,D,M | Direction | Magnitude[(k,k-ft), (in,rad), (k*s^2/ft... |
|---|---|---|---|---|
| 1 | N2 | L | Y | -5 |
| 2 | N4 | L | Y | -11 |

## Joint Loads and Enforced Displacements (BLC 4 : SL) (Continued)

| | Joint Label | L,D,M | Direction | Magnitude[(k,k-ft), (in,rad), (k*s^2/ft... |
|---|---|---|---|---|
| 3 | N6 | L | Y | -13 |
| 4 | N8 | L | Y | -5 |

## Basic Load Cases

| | BLC Description | Category | X Gravity | Y Gravity | Z Gravity | Joint | Point | Distributed | Area(Me... | Surface(... |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | DL | DL | | | | 4 | | | | |
| 2 | LL | LL | | | | 4 | | | | |
| 3 | EQ | EL | | | | 1 | | | | |
| 4 | SL | SL | | | | 4 | | | | |

## Load Combinations

| | Description | Solve | PD... | SR... | BLC | Factor | BLC | Factor | BLC | Factor | BLC | Factor | BLC | Factor | BLC | Factor | BLC | Factor | BLC | Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Induced Mo... | Yes | Y | | DL | 1.34 | EL | 1 | LL | .5 | SL | 1 | | | | | | | | |
| 2 | Induced Mo... | Yes | Y | | DL | .76 | EL | 1 | | | | | | | | | | | | |

## Member Section Forces

| | LC | Member Label | Sec | Axial[k] | y Shear[k] | z Shear[k] | Torque[k-ft] | y-y Moment[k-... | z-z Moment[k-... |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | M1 | 1 | 164.505 | 1.232 | 0 | 0 | 0 | 0 |
| 2 | | | 2 | 164.505 | 1.232 | 0 | 0 | 0 | -4.62 |
| 3 | | | 3 | 164.505 | 1.232 | 0 | 0 | 0 | -9.241 |
| 4 | | | 4 | 164.505 | 1.232 | 0 | 0 | 0 | -13.861 |
| 5 | | | 5 | 164.505 | 1.232 | 0 | 0 | 0 | -18.482 |
| 6 | 1 | M2 | 1 | 353.836 | 2.212 | 0 | 0 | 0 | 0 |
| 7 | | | 2 | 353.836 | 2.212 | 0 | 0 | 0 | -8.296 |
| 8 | | | 3 | 353.836 | 2.212 | 0 | 0 | 0 | -16.592 |
| 9 | | | 4 | 353.836 | 2.212 | 0 | 0 | 0 | -24.887 |
| 10 | | | 5 | 353.836 | 2.212 | 0 | 0 | 0 | -33.183 |
| 11 | 1 | M3 | 1 | 368.252 | 2.299 | 0 | 0 | 0 | 0 |
| 12 | | | 2 | 368.252 | 2.299 | 0 | 0 | 0 | -8.623 |
| 13 | | | 3 | 368.252 | 2.299 | 0 | 0 | 0 | -17.245 |
| 14 | | | 4 | 368.252 | 2.299 | 0 | 0 | 0 | -25.868 |
| 15 | | | 5 | 368.252 | 2.299 | 0 | 0 | 0 | -34.491 |
| 16 | 1 | M4 | 1 | 152.287 | 1.362 | 0 | 0 | 0 | 0 |
| 17 | | | 2 | 152.287 | 1.362 | 0 | 0 | 0 | -5.109 |
| 18 | | | 3 | 152.287 | 1.362 | 0 | 0 | 0 | -10.219 |
| 19 | | | 4 | 152.287 | 1.362 | 0 | 0 | 0 | -15.328 |
| 20 | | | 5 | 152.287 | 1.362 | 0 | 0 | 0 | -20.437 |
| 21 | 1 | M5 | 1 | 3.595 | -1.335 | 0 | 0 | 0 | -18.482 |
| 22 | | | 2 | 3.595 | -1.335 | 0 | 0 | 0 | -10.473 |
| 23 | | | 3 | 3.595 | -1.335 | 0 | 0 | 0 | -2.464 |
| 24 | | | 4 | 3.595 | -1.335 | 0 | 0 | 0 | 5.545 |
| 25 | | | 5 | 3.595 | -1.335 | 0 | 0 | 0 | 13.554 |
| 26 | 1 | M6 | 1 | 2.306 | -1.599 | 0 | 0 | 0 | -19.63 |
| 27 | | | 2 | 2.306 | -1.599 | 0 | 0 | 0 | -10.035 |
| 28 | | | 3 | 2.306 | -1.599 | 0 | 0 | 0 | -.441 |
| 29 | | | 4 | 2.306 | -1.599 | 0 | 0 | 0 | 9.153 |
| 30 | | | 5 | 2.306 | -1.599 | 0 | 0 | 0 | 18.747 |
| 31 | 1 | M7 | 1 | .966 | -1.508 | 0 | 0 | 0 | -15.744 |
| 32 | | | 2 | .966 | -1.508 | 0 | 0 | 0 | -6.699 |
| 33 | | | 3 | .966 | -1.508 | 0 | 0 | 0 | 2.347 |
| 34 | | | 4 | .966 | -1.508 | 0 | 0 | 0 | 11.392 |
| 35 | | | 5 | .966 | -1.508 | 0 | 0 | 0 | 20.437 |

## Member Section Forces (Continued)

| | LC | Member Label | Sec | Axial[k] | y Shear[k] | z Shear[k] | Torque[k-ft] | y-y Moment[k-... | z-z Moment[k-... |
|---|---|---|---|---|---|---|---|---|---|
| 36 | 2 | M1 | 1 | 75.383 | 1.265 | 0 | 0 | 0 | 0 |
| 37 | | | 2 | 75.383 | 1.265 | 0 | 0 | 0 | -4.742 |
| 38 | | | 3 | 75.383 | 1.265 | 0 | 0 | 0 | -9.484 |
| 39 | | | 4 | 75.383 | 1.265 | 0 | 0 | 0 | -14.226 |
| 40 | | | 5 | 75.383 | 1.265 | 0 | 0 | 0 | -18.968 |
| 41 | 2 | M2 | 1 | 163.171 | 2.237 | 0 | 0 | 0 | 0 |
| 42 | | | 2 | 163.171 | 2.237 | 0 | 0 | 0 | -8.388 |
| 43 | | | 3 | 163.171 | 2.237 | 0 | 0 | 0 | -16.775 |
| 44 | | | 4 | 163.171 | 2.237 | 0 | 0 | 0 | -25.163 |
| 45 | | | 5 | 163.171 | 2.237 | 0 | 0 | 0 | -33.55 |
| 46 | 2 | M3 | 1 | 170.391 | 2.276 | 0 | 0 | 0 | 0 |
| 47 | | | 2 | 170.391 | 2.276 | 0 | 0 | 0 | -8.535 |
| 48 | | | 3 | 170.391 | 2.276 | 0 | 0 | 0 | -17.071 |
| 49 | | | 4 | 170.391 | 2.276 | 0 | 0 | 0 | -25.606 |
| 50 | | | 5 | 170.391 | 2.276 | 0 | 0 | 0 | -34.142 |
| 51 | 2 | M4 | 1 | 71.375 | 1.323 | 0 | 0 | 0 | 0 |
| 52 | | | 2 | 71.375 | 1.323 | 0 | 0 | 0 | -4.962 |
| 53 | | | 3 | 71.375 | 1.323 | 0 | 0 | 0 | -9.924 |
| 54 | | | 4 | 71.375 | 1.323 | 0 | 0 | 0 | -14.885 |
| 55 | | | 5 | 71.375 | 1.323 | 0 | 0 | 0 | -19.847 |
| 56 | 2 | M5 | 1 | 4.781 | -1.377 | 0 | 0 | 0 | -18.968 |
| 57 | | | 2 | 4.781 | -1.377 | 0 | 0 | 0 | -10.707 |
| 58 | | | 3 | 4.781 | -1.377 | 0 | 0 | 0 | -2.446 |
| 59 | | | 4 | 4.781 | -1.377 | 0 | 0 | 0 | 5.815 |
| 60 | | | 5 | 4.781 | -1.377 | 0 | 0 | 0 | 14.076 |
| 61 | 2 | M6 | 1 | 2.969 | -1.606 | 0 | 0 | 0 | -19.475 |
| 62 | | | 2 | 2.969 | -1.606 | 0 | 0 | 0 | -9.839 |
| 63 | | | 3 | 2.969 | -1.606 | 0 | 0 | 0 | -.203 |
| 64 | | | 4 | 2.969 | -1.606 | 0 | 0 | 0 | 9.432 |
| 65 | | | 5 | 2.969 | -1.606 | 0 | 0 | 0 | 19.068 |
| 66 | 2 | M7 | 1 | 1.137 | -1.455 | 0 | 0 | 0 | -15.074 |
| 67 | | | 2 | 1.137 | -1.455 | 0 | 0 | 0 | -6.344 |
| 68 | | | 3 | 1.137 | -1.455 | 0 | 0 | 0 | 2.387 |
| 69 | | | 4 | 1.137 | -1.455 | 0 | 0 | 0 | 11.117 |
| 70 | | | 5 | 1.137 | -1.455 | 0 | 0 | 0 | 19.847 |