Ryan Skelly

Architecture 305a Portfolio

Final Project

General Description

The final project for Architecture 305a consists of complete architectural and structural designs of a two story residence or studio, which is left up to the students' discretion. Architecturally, designs are limited to rectangular shapes or a triangular shape, all with different orientations to the Malibu coastline. Structurally, the house or studio is designed using wood construction with plywood shear panels in combination with steel cantilever columns for lateral support. In the final design package, there must be full structural engineering calculations, architectural plans, structural plans, renders, and structural details.

My group decided to do a rectangular shape, with the longest side of the house facing the Malibu oceanfront to take advantage of the stunning views. We also chose our client to be a chef, which caused our design to provide a modern and relaxing getaway with plenty of open space, garden areas, and a large kitchen to work on his or her craft.

Parameters

Location: Malibu, CA (oceanfront property)

Lot Size: 60ft x 150ft

Living Area: Approximately 1,500 sq. ft.

Number of Rooms: (2) Bedrooms, (2-3) Bathrooms, (1) Living/Studio with two story high ceiling, Kitchen, etc.

Type of Roof and Floor Diaphragms: Flexible Diaphragms

Lateral Load Resisting Elements: Plywood Shear Panels and Steel Cantilever Columns

Location

Address: 11768 Ellice St.
Malibu, CA 90265

Longitude: -118.96

Latitude: 34.05

USGS Design Maps Summary Report

View Detailed Report Print

User–Specified Input

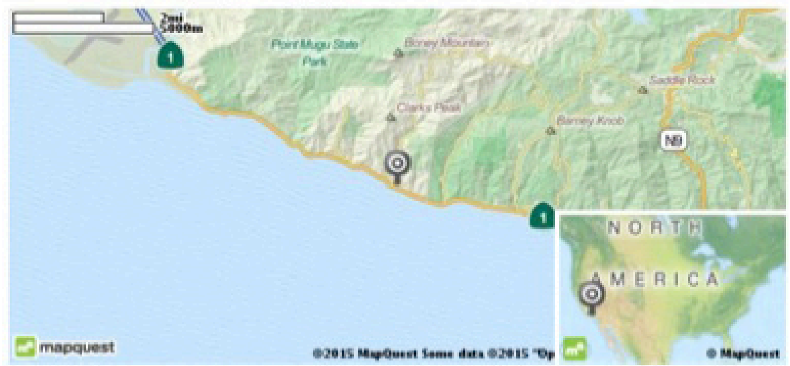
Report Title 11768 Ellice St.
Sun September 13, 2015 21:39:18 UTC

Building Code Reference Document ASCE 7-05 Standard
(which utilizes USGS hazard data available in 2002)

Site Coordinates 34.05281°N, 118.95983°W

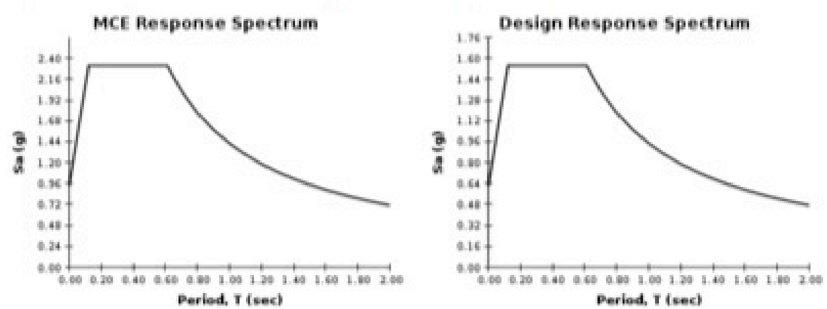
Site Soil Classification Site Class D – "Stiff Soil"

Occupancy Category I/II/III

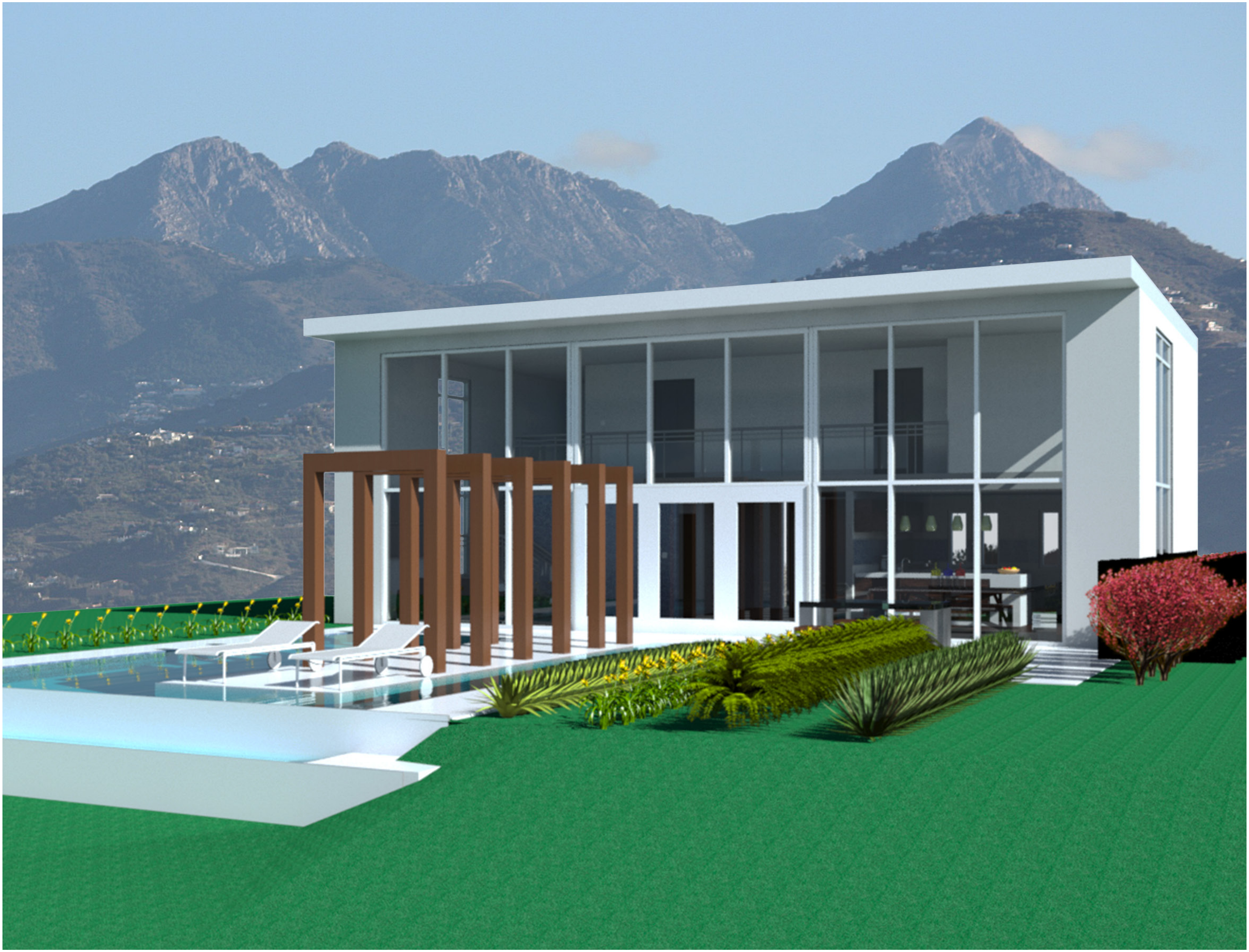


USGS–Provided Output

S_S =	2.314 g	S_{MS} =	2.314 g	S_{DS} =	1.543 g
S_1 =	0.946 g	S_{M1} =	1.419 g	S_{D1} =	0.946 g

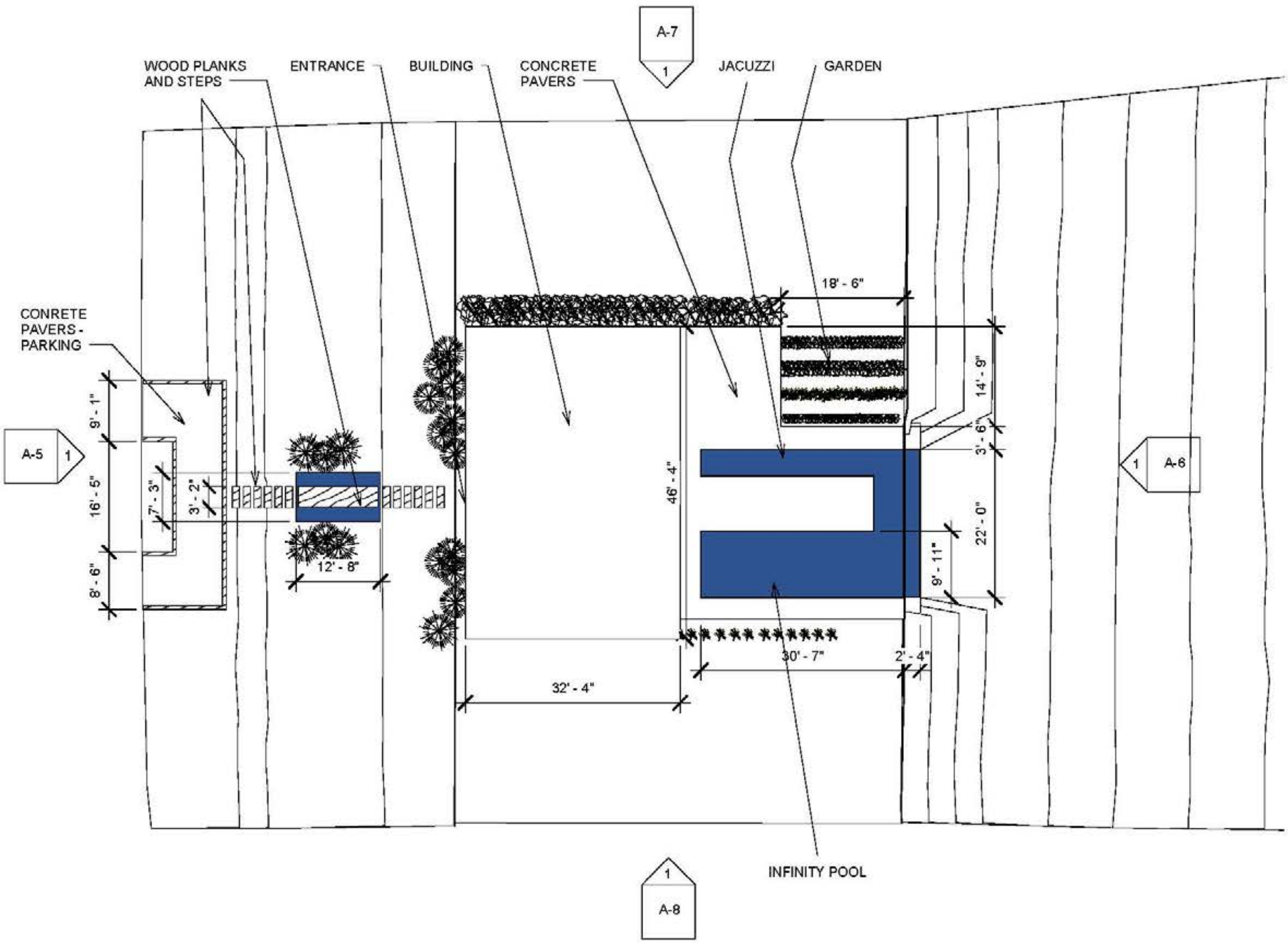


Renders






Architectural Plans



1 Site
1/16" = 1'-0"

LOCATION:
11768 ELLICE STREET,
MALIBU, CA 90265

SQ FOOT
HOUSE: 1,890 SF
PROPERTY: 9,000 SF

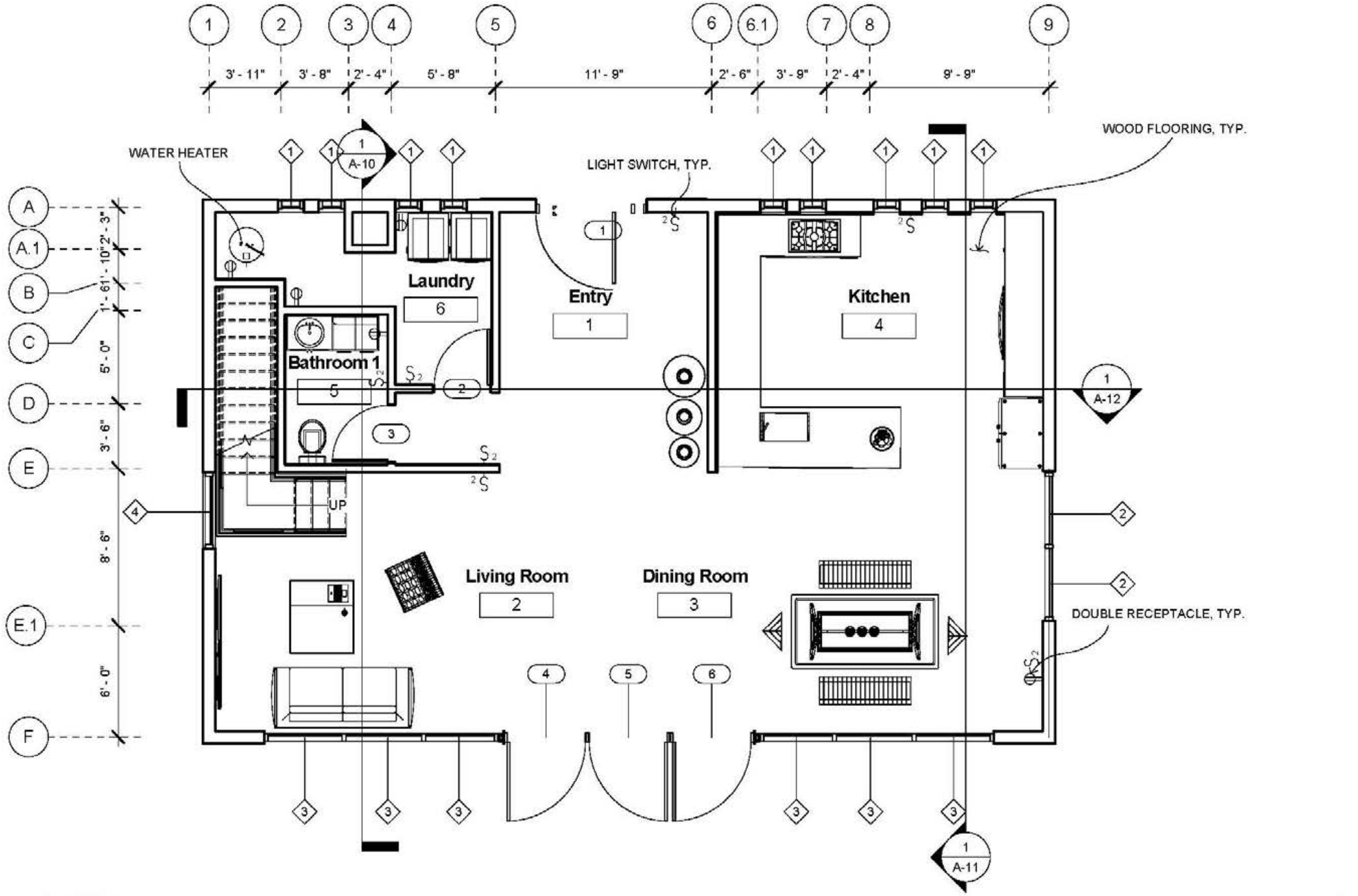
SCOPE OF WORK:
BRAND NEW RESIDENTIAL HOUSE WITH HIGH END FINISHES.

PREPARED BY:
Isabela Arce
Keith Leonard
Ryan Skelly
Christina Nour

USC University of Southern California

Site Plan

A-1



1 Level 1
3/16" = 1'-0"

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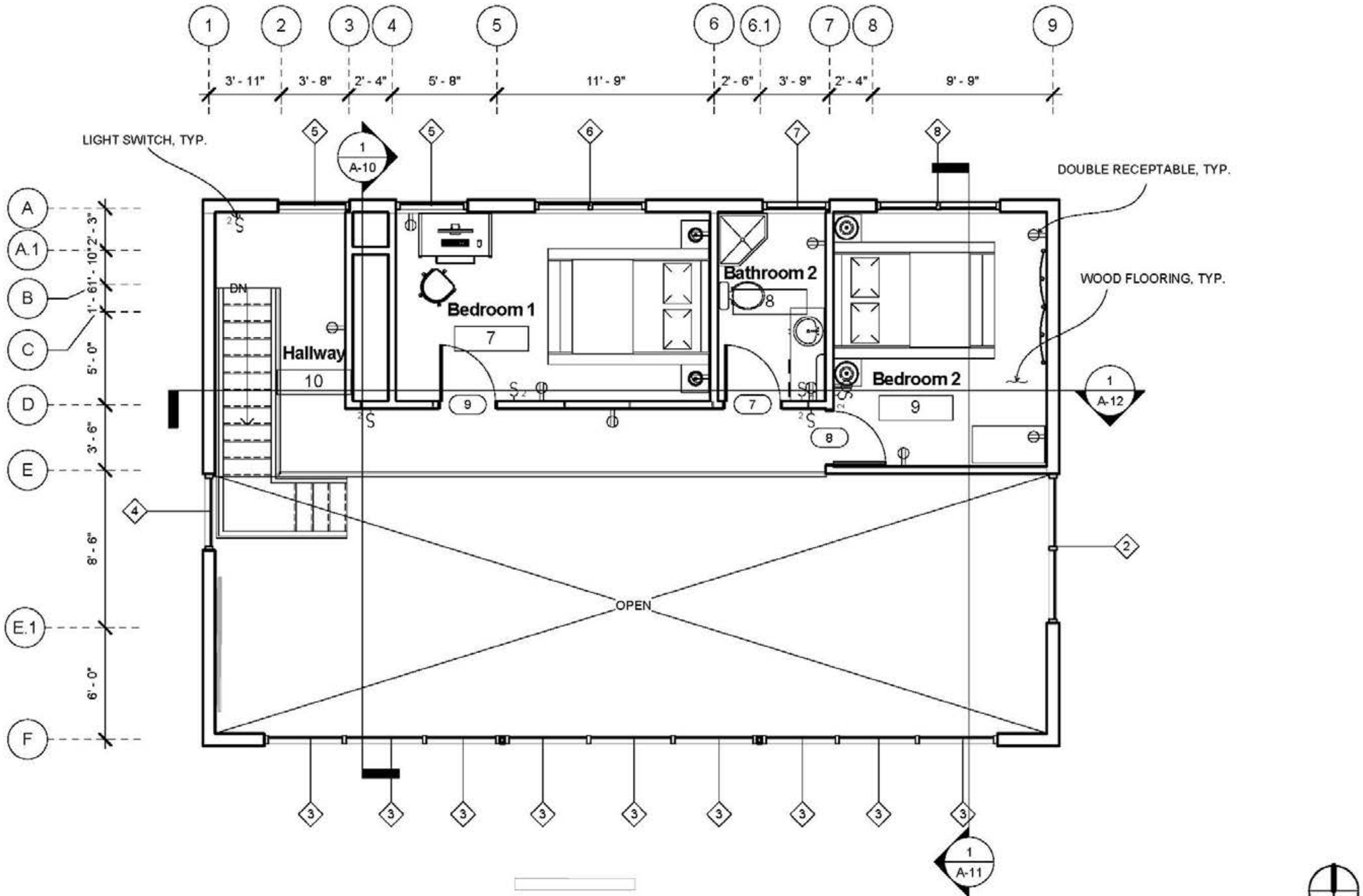
Plan - First Floor

A-2



REVISIONS | BY

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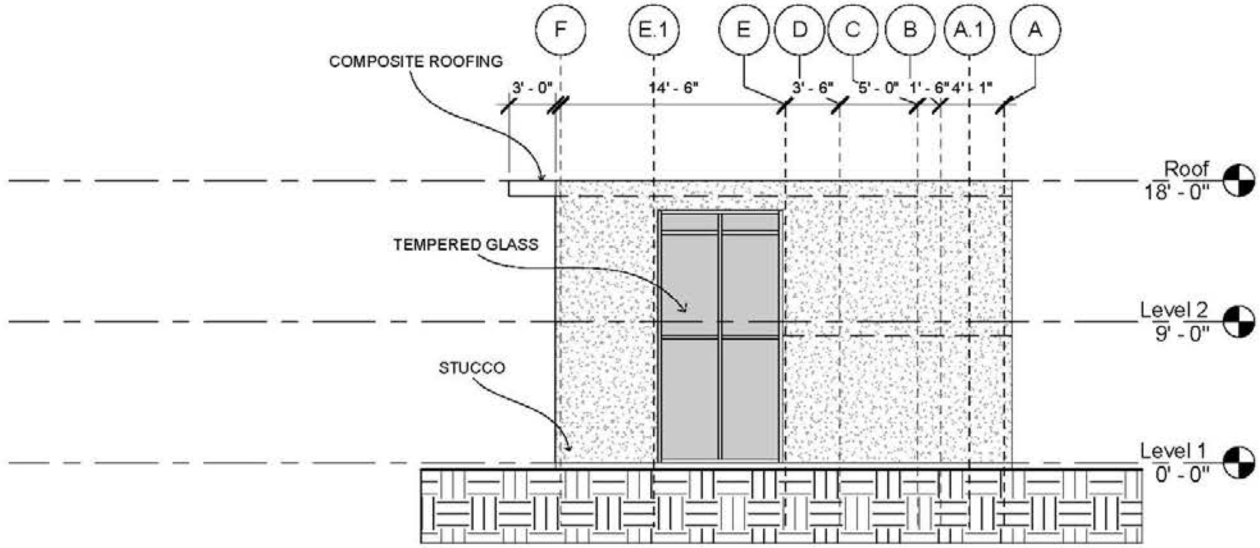
Plan - Second Floor

FOR PRICING
10/20/2015
3/16" = 1'-0"
JOB NO. 15-3028-2
SHEET
A-3

Elevations



1 East Elevation
1/8" = 1'-0"

VEGETATION
NOT SHOWN
FOR CLARITY

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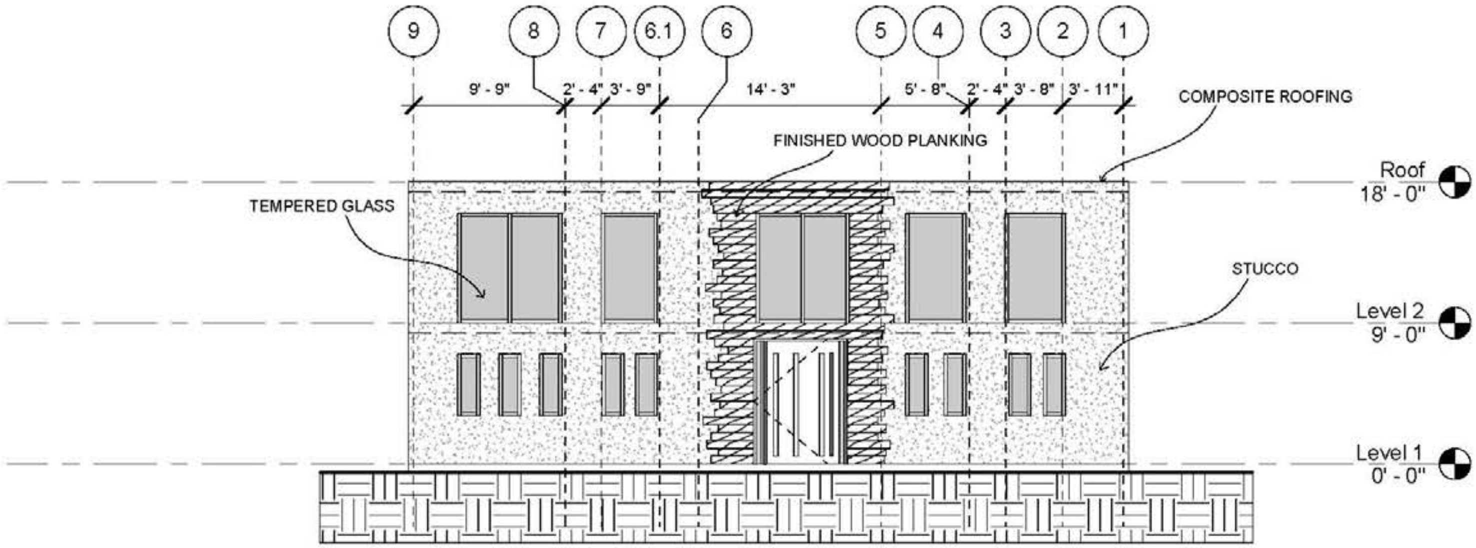
Elevation - East

FOR PRICING
10/20/2015
1/8" = 1'-0"
JOB NO. 15-3058-2
SHEET
A-7



VEGETATION NOT SHOWN FOR CLARITY

1 North Elevation
1/8" = 1'-0"

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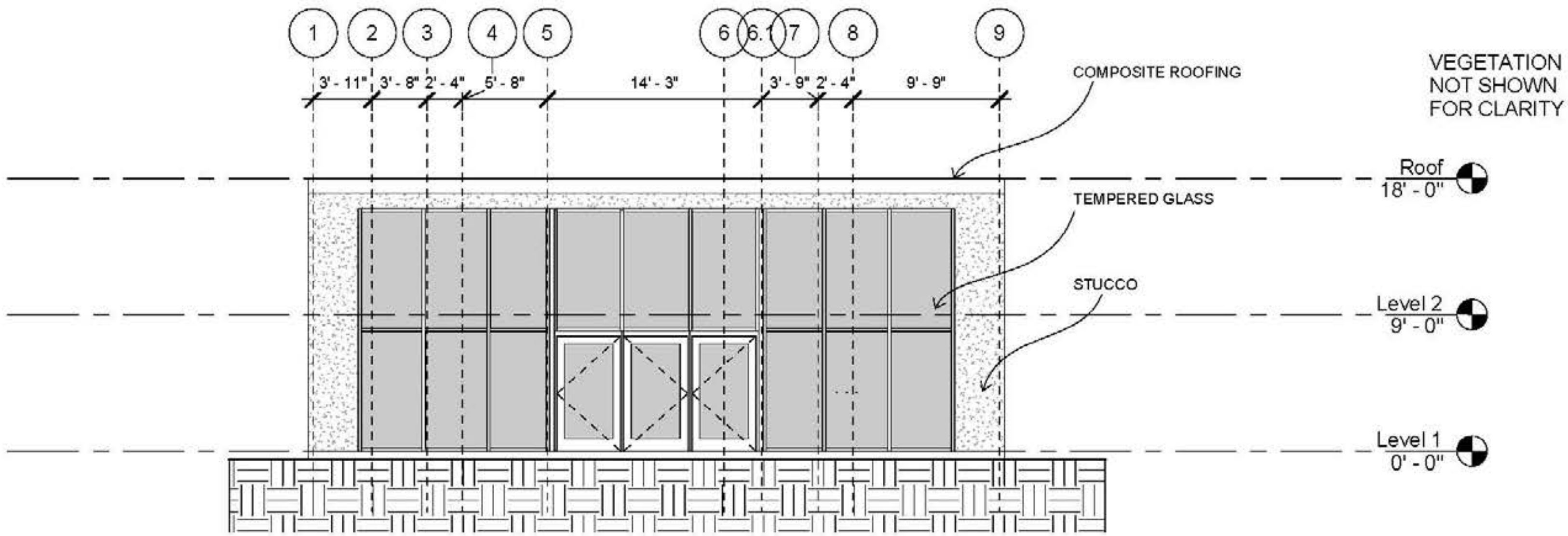
Elevation - North

FOR PRICING
10/20/2015
1/8" = 1'-0"
SHEET
A-5



1 South Elevation
1/8" = 1'-0"

REVISIONS | BY

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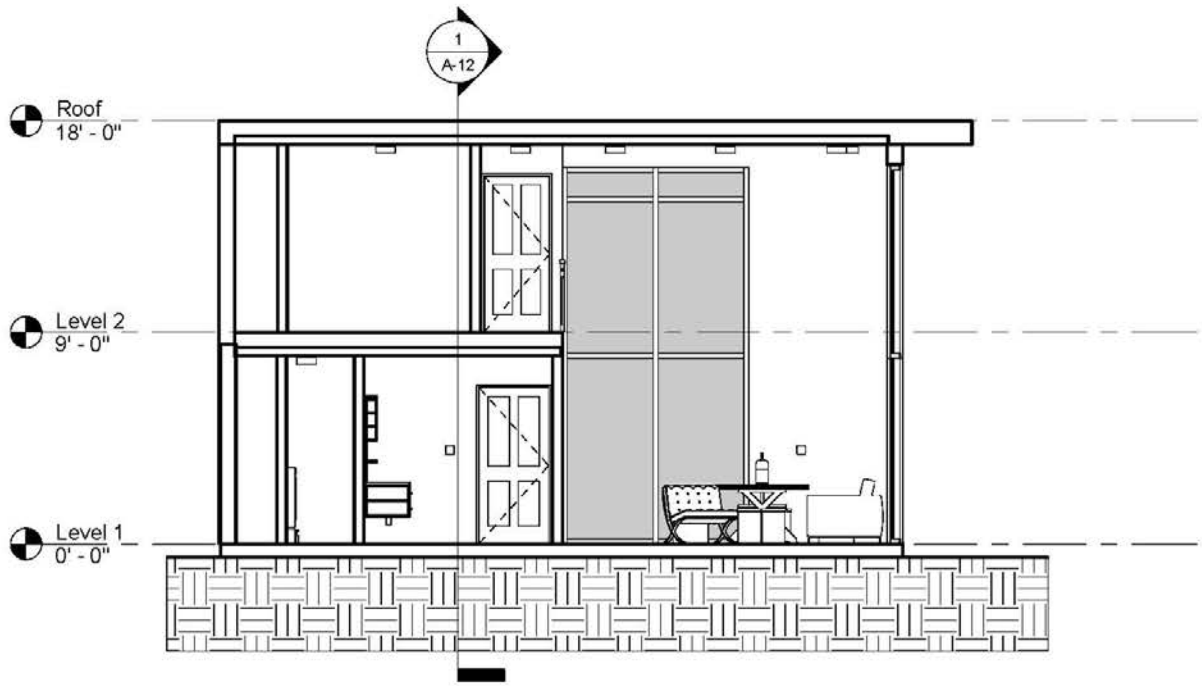
Elevation - South

FOR PRICING

SHEET

A-6

Sections



1 Section 1
3/16" = 1'-0"

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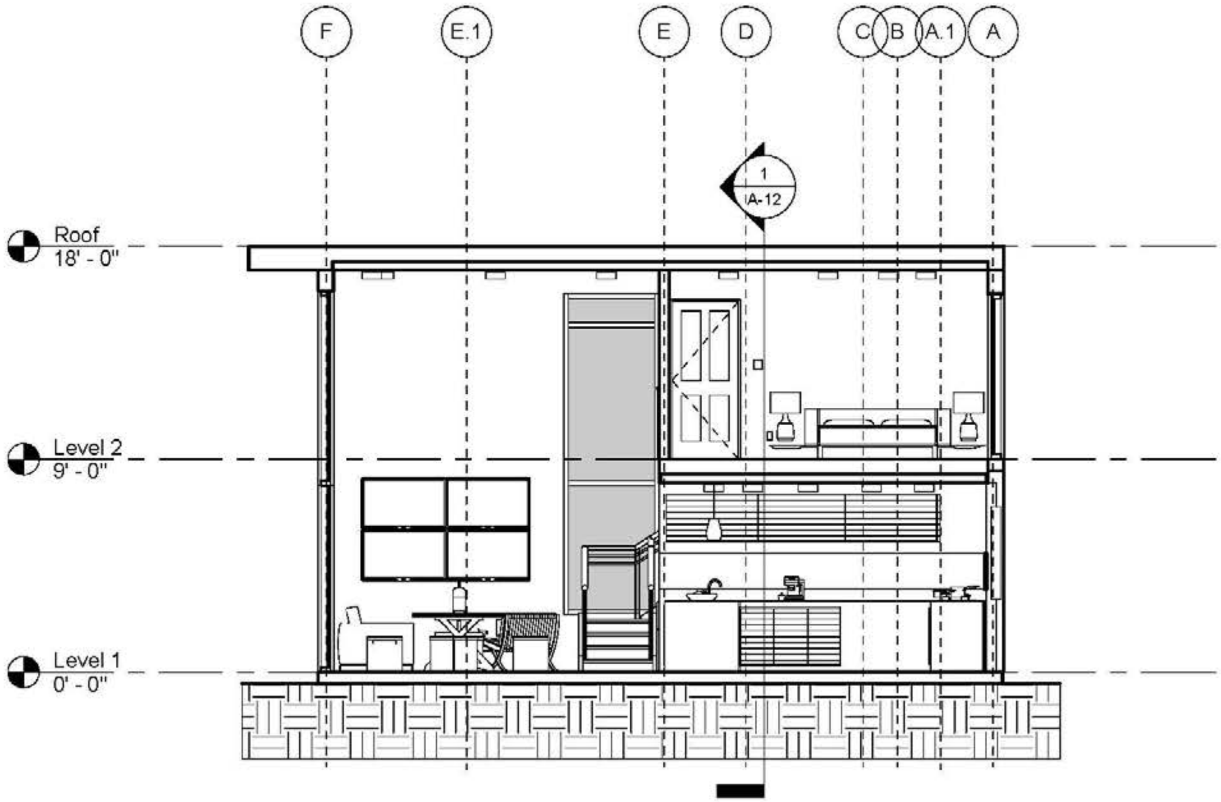
Section 1

FOR PRICING
10/20/2015
3/16" = 1'-0"
JOB NO. 15-3028-2
SHEET
A-10



1 Section 2
3/16" = 1'-0"

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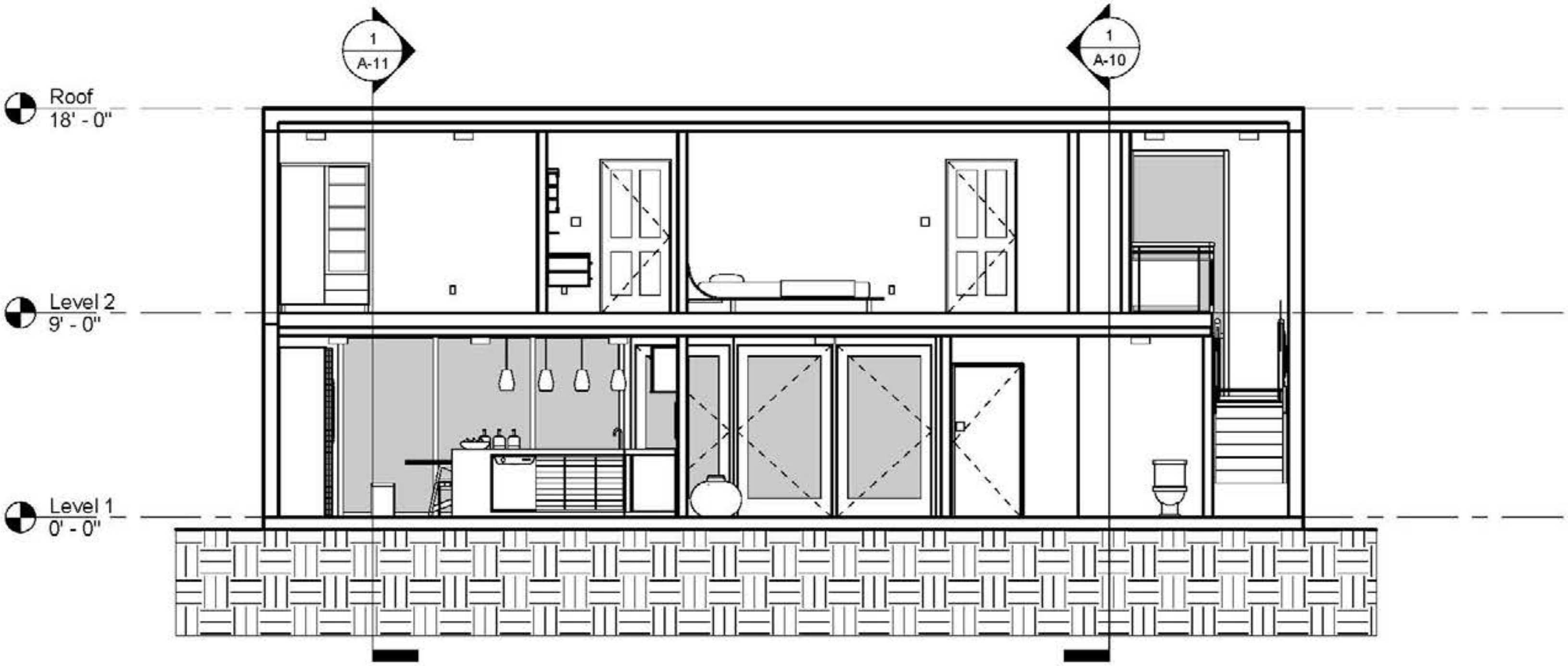
Section 2

FOR PRICING
10/20/2015
3/16" = 1'-0"
JOB NO. 13-3008-2
SHEET
A-11



1 Section 3
3/16" = 1'-0"

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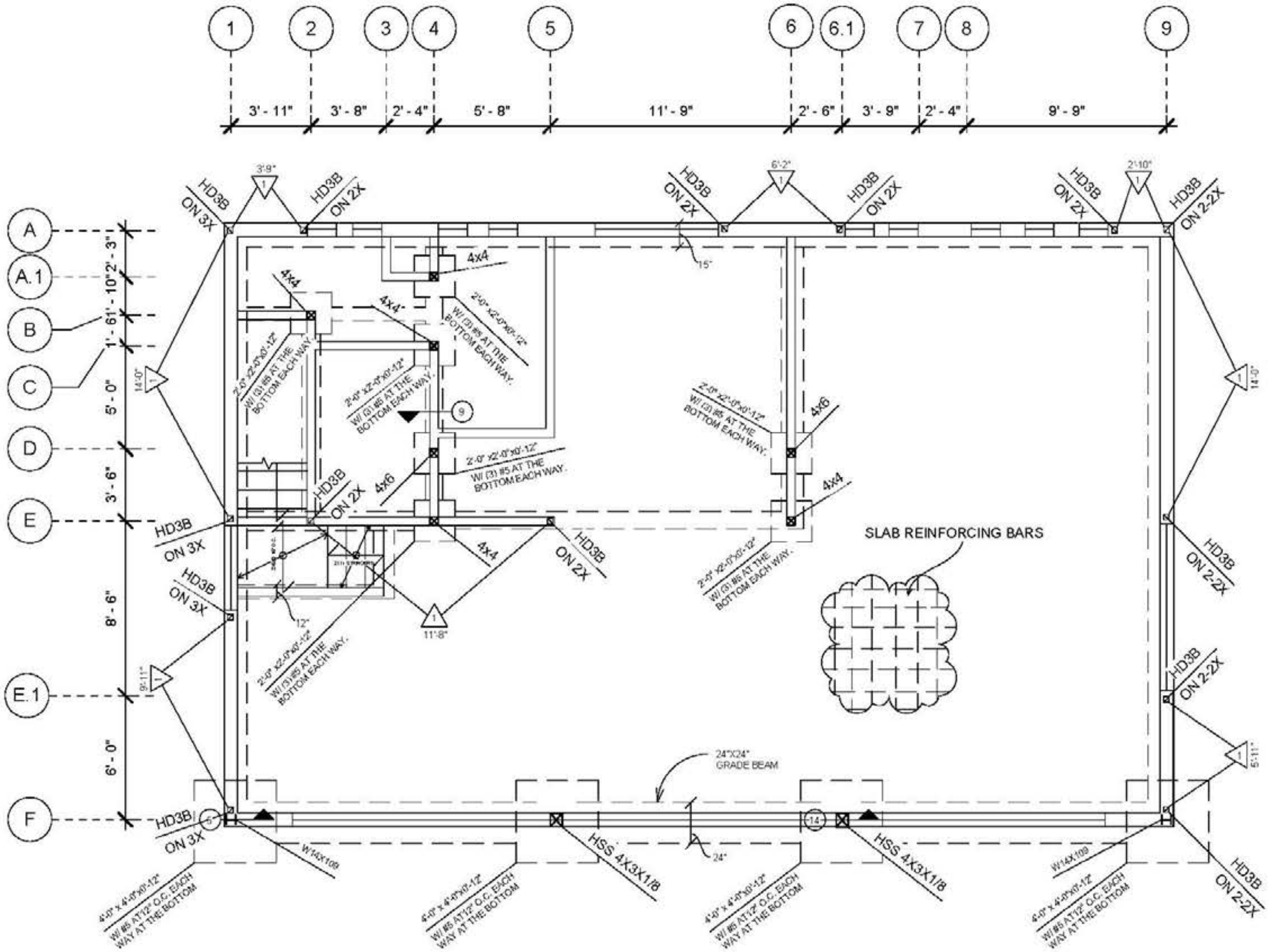
Section 3

SHEET
A-12

Structural Plans



1 Foundation
3/16" = 1'-0"

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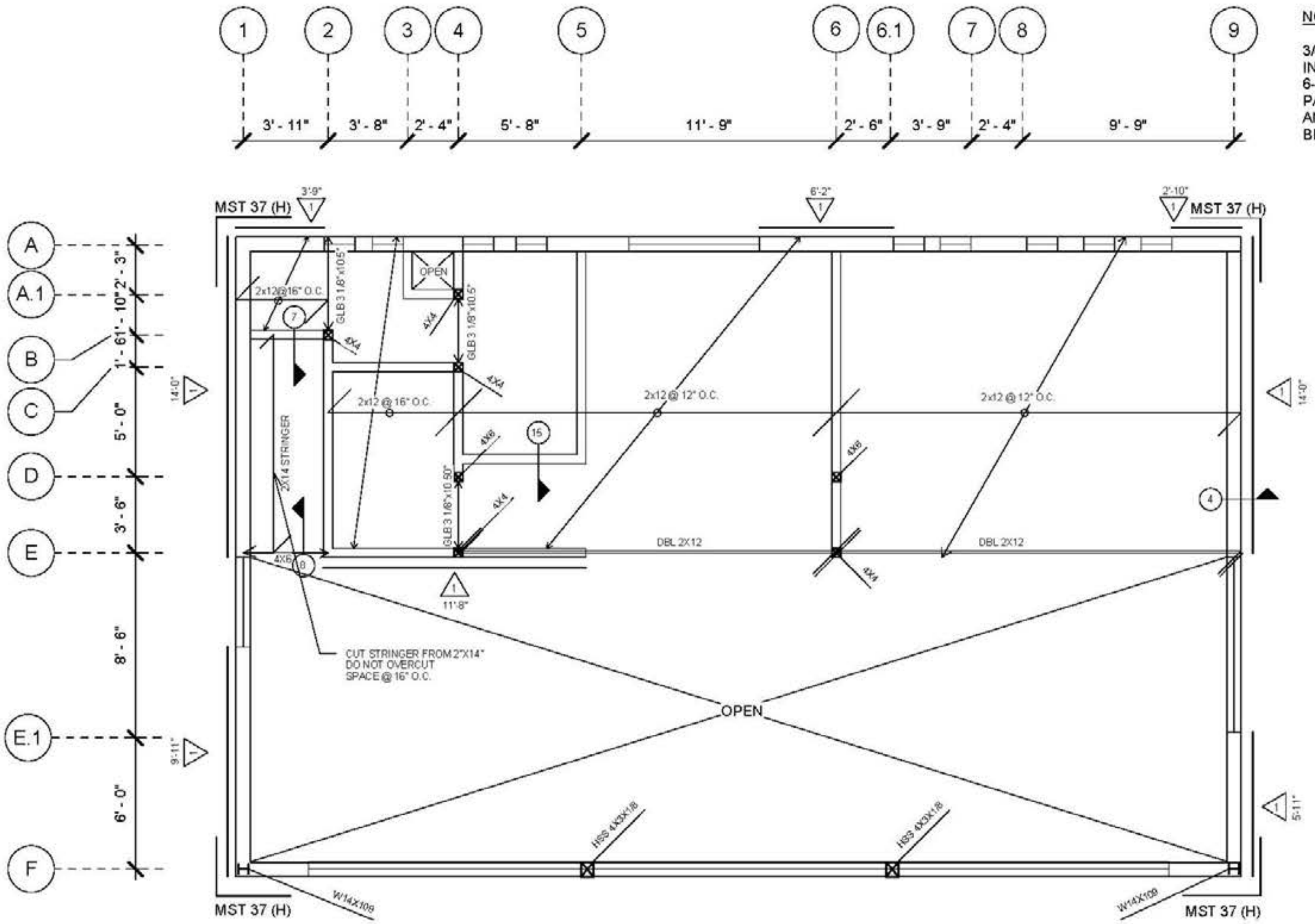
Foundation Plan

FOR PRICING
10/20/2015
3/16" = 1'-0"
JOB NO. 15-302B-2
SHEET
S-1



NOTE:

3/4" CDX PLY. PANEL, INDEX 40/20 w/ 10d @ 6-6-12, U.O.N. PANELS GLUE AND NAILED. BLOCK ALL EDGES.

1 Framing - 2nd Floor
3/16" = 1'-0"

REVISIONS | BY

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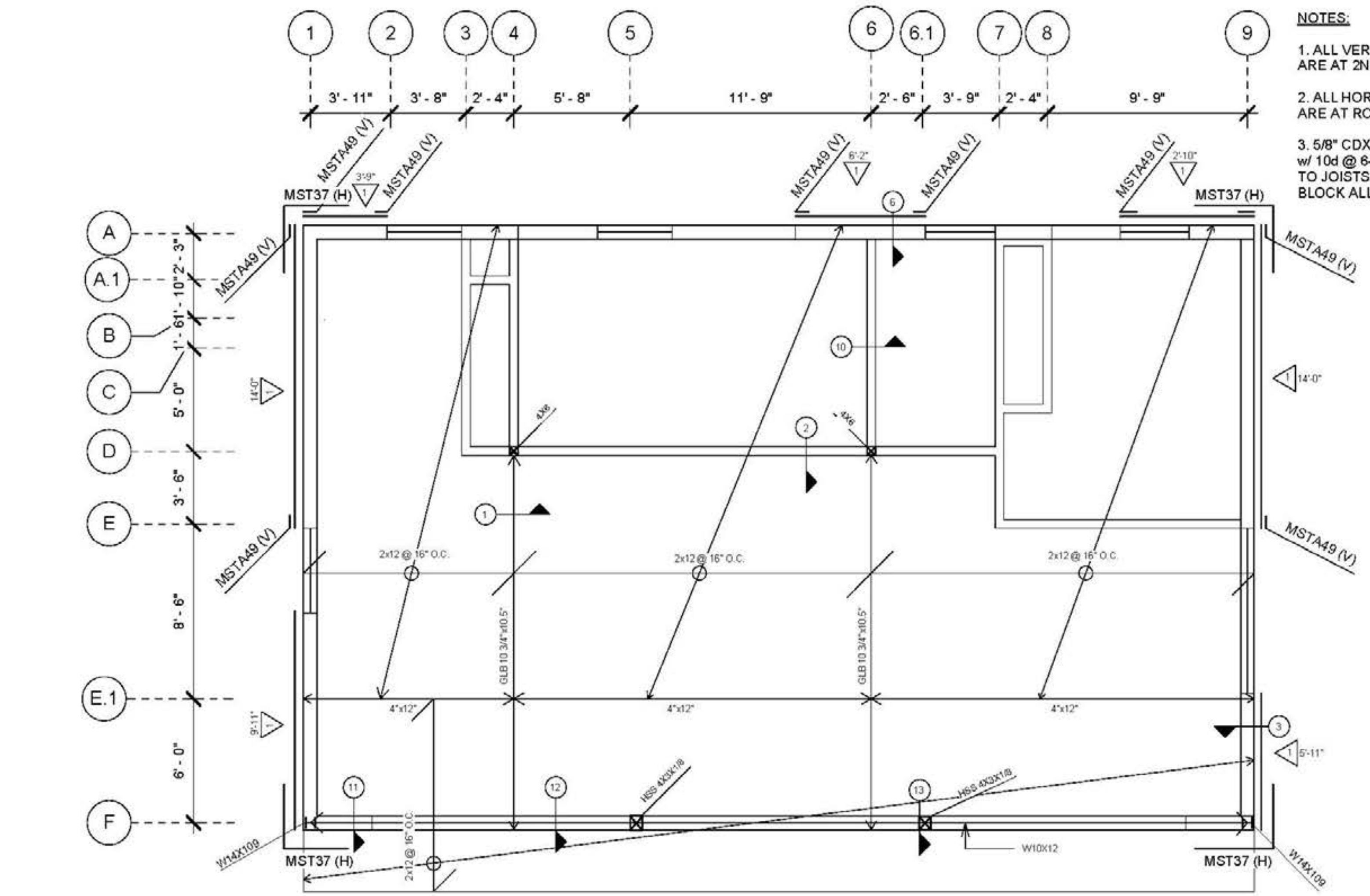
Framing Plan - Second Floor

FOR PRICING

3/16" = 1'-0"

SHEET

S-2



NOTES:

1. ALL VERTICAL STRAPS SHOWN ARE AT 2ND FLOOR LEVEL

2. ALL HORIZONTAL STRAPS SHOWN ARE AT ROOF LEVEL.

3. 5/8" CDX PLY. PANEL, INDEX 32/16 w/ 10d @ 6-6-12. GLUED PLYWOOD TO JOISTS IN ADDITION TO NAILING. BLOCK ALL EDGES.

1 Framing - Roof
3/16" = 1'-0"

REVISIONS	BY

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Christina Nour

USC University of Southern California

Framing Plan - Roof

FOR PRICING

S-3

Calculations

Seismic Design

Roof Diaphragm Walls N-S (q_{RF} = 5.54 psf)

H_1 = 5.54 psf x 28.67’ x 22.83’ = 3,626.13 lb
H_1/ft = 3,626.13 lb/24.5’ = 148.01 plf — △1 (340 plf)
$F_{1\ Half}$ = 148.01 plf x 8’ = 1,184.04 lb — Use MSTA49 (2020 lb)
$F_{1\ Full}$ = 148.01 plf x 16’ = 2,368.08 lb — Use HD3B on 3x (2525 lb)

H_9 = 5.54 psf x 28.67’ x 22.83’ = 3,626.13 lb
H_9/ft = 3,626.13 lb/20.5’ = 176.88 plf — △1 (340 plf)
$F_{9\ Half}$ = 176.88 plf x 8’ = 1,415.08 lb — Use MSTA49 (2020 lb)
$F_{9\ Full}$ = 176.88 plf x 16’ = 2,830.15 lb — Use HD3B on 2- 2x (3130 lb)

Roof Diaphragm Walls E-W (q_{RF} = 5.54 psf)

H_A = 5.54 psf x 45.67’ x 14.0’ = 3,542.17 lb
H_A/ft = 3,542.17 lb/18.75’ = 188.92 plf — △1 (340 plf)
$F_{A\ Half}$ = 188.92 plf x 8’ = 1,511.32 lb — Use MSTA49 (2020 lb)

H_F = 5.54 psf x 45.67’ x 14.0’ = 3,542.17 lb (ASD)
H_F’ = 3,542.17 x (6.5/2.5) = 9,209.64 (ASD)
Along this line, lateral load resisting systems are cantilever columns
See calculation for cantilever column below

2nd Diaphragm Walls N-S (q_{2nd} = 3.19 psf)

H_1 = [3.19 psf x 28.67’ x 22.83’] + $H_{1(RF)}$ = 4,160.11 lb
H_1/ft = 4,160.11 lb/14.0’ = 297.15 plf — △1 (340 plf)
$F_{1\ Half}$ = 297.15 plf x 8’ = 2,377.21 lb — Use HD3B on 3x (2525 lb)

H_9 = [3.19 psf x 28.67’ x 22.83’] + $H_{9(RF)}$ = 4,564.29 lb
H_9/ft = 4,564.29 lb/14.0’ = 326.02 plf — △1 (340 plf)
$F_{9\ Half}$ = 326.02 plf x 8’ = 2,608.17 lb — Use HD3B on 2-2x (3130 lb)

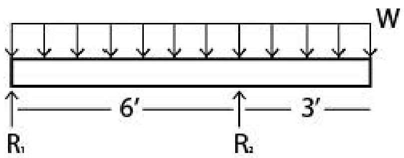
2nd Diaphragm Walls E-W (q_{2nd} = 3.19 psf)

H_A = [3.19 psf x 45.67’ x 7.0’] +$H_{A(RF)}$ = 6,200 lb
H_A/ft = 6,200 lb/12.75’ = 486.27 plf — △2 (510 plf)
$F_{A\ Half}$ = 486.27 plf x 8’ = 3,890.2 lb — Use HD3B on 2-2x (4505 lb)

H_E = [3.19 psf x 45.67’ x 7.0’] = 1,019.81 lb
H_E/ft = 1,019.81 lb /11.67’ = 87.39 plf — △1 (340 plf)
$F_{E\ Half}$ = 87.39 plf x 8’ = 699.10 lb — Use HD3B on 2x (1895 lb)

Cantilever Column Design

$H_S = H_F'/2 = 9{,}209.64/2 = 4604.82$ lb



$w = (14 \text{ psf} + 20 \text{ psf}) \times 1' = 34$ plf
$R_2 = [(34 \text{ plf} \times (9)^2)/2]/6 = 229.5 \text{ plf} = w'$
$w'' = 229.5 + 70 = 299.5$ plf
$M_{STL} = wL^2/8 = 299.5(13)^2/8 = 6{,}326.94$ lb –ft
$V_{DL} = [229.5(14/34) + 70] \times (14.67/2) = 1{,}206.61$ lb
$V_{LL} = [229.5(20/34)] \times (14.67/2) = 990.23$ lb

$H_S = 4{,}604.82$ lb (ASD; Per each column)
$P_{DL} = 1{,}206.61$ lb (Beam Reaction)
$P_{LL} = 990.23$ lb (Beam Reaction)

1) Find Allowable δ_{XE}:

For Steel Column:

$h_s = 17'$; $C_d = 2.5$; $R = 2.5$; $\Omega_O = 1.25$
$\delta_X \leq 0.025h_s = 0.025(17' \times 12) = 5.1$
$\delta_X = C_d(\delta_{XE})/I = 2.5(\delta_{XE})/(1.0) = 2.5\ \delta_{XE}$
→ $2.5\ \delta_{XE} \leq 5.1$
→ $\delta_{XE} \leq 2.04''$

For Plywood Shear Wall:

$h_s = 17'$; $C_d = 4$; $R = 6.5$
$\delta_X \leq 0.025h_s = 0.025(17' \times 12) = 5.1$
$\delta_X = C_d(\delta_{XE})/I = 4(\delta_{XE})/(1.0) = 4\ \delta_{XE}$
→ $4\ \delta_{XE} \leq 5.1$
→ $\delta_{XE} \leq 1.275''$ (Governs)

2) Design Steel Column:

Limit $\delta_{XE\ STL}$ to 68% of δ_{XE}:

$\delta_{XE\ STL} = \delta_{XE} \times (0.68) = PL^3/3EI$
1.275" x 0.68 = (4.61 k/ 0.7)(17' x 12)^3/(3 x 29,000)(I)
I = 741.23 in^4 → W14 x 109 (I = 1240 in^4) (Table 1-1)

Check Bending:

M = (4.61 k/0.7) x 17' = 111.96 k –ft
$\phi_b M_{px}$ = 720 k-ft > 111.96 k-ft ✓ (Table 3-2)

Check Compression:

P_a = 1.2(1.21 k) + 1.6(1 k) = 3.05 k
For W14 x 109 → KL/r_X =2.1(17' x 12)/ 6.22" =68.87
$\phi_c F_{CR}$ = 31.8 ksi (Table 4-22)
$\phi P_n = \phi_c F_{CR}(A)$ = 31.8 ksi x 32.0 in^2 = 1,017.6 k

Check Combine Loading:

$P_a / \phi P_n$ = 3.05/1,017.6 = 0.00230 < 0.2 (H1 – 1b)
3.05/2(1,017.6) + 111.96/720 = 0.157 < 1.0. ✓

Check Local Buckling:

$b/t \le 0.33(E/F_y)^{1/2}$ → $b_f/2t_f$ = 8.49 < 0.33(29,000/50)$^{1/2}$ = 9.15 O.K. ✓ (Table B4.1)
$h/t_W \le 1.49(E/F_y)^{1/2}$ → h/t_W = 21.7 < 1.49(29,000/50)$^{1/2}$ = 35.9 O.K. ✓ (Table B4.1)

3) Check δ_{XE}:

$\delta_{XE\ STL} = PL^3/3EI$ = (4.61 k/ 0.7)(17' x 12)^3/(3 x 29,000)(1240) = 0.518"
24" x 24" G.B. → I = 24 x24^3/12 =27,648 in^4
I_{CR} = 27,648 in^4/2 = 13,824 in^4
E_C = 57(3000 psi)$^{1/2}$ = 3122 ksi
H_S = P = 4.61 k/0.7 = 6.59 k
F = 6.59 k x 17'/22' = 5.09 k
$\delta_{XE\ G.B.} = (FL^3/3EI)(17'/22')$
= [(5.09 k)(22' x 12)^3/(3 x 3122 x 13824)](17'/22') = 0.559"
δ_{XE} = 0.518" + 0.559" = 1.077" < 1.275" O.K. ✓

Check P-Delta Effect:

$\Theta = P\Delta/V(h_x)(C_d)$ = (1.21 k+1 k) x 1.077"/(6.59 k x 17'x12 x 2.5) = 0.000708 < 0.10
→ P- Delta Effect is not required to be considered.

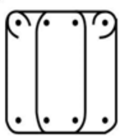
4) Design Grade Beam:

M = (4.61/0.7) x 17' = 112.03 k-ft
Ω_0(M) = 1.25(112.03) = 140.04
F = 24 x 21^2/12,000 = 0.882
K_n = 140.04/0.882 = 158.77
→ ρ = 0.00306 < 0.0033 → Use 0.0033
A_S = 21" x 24" x 0.0033 = 1.66 in^2
→ 4 #6 (1.76 in^2)

Design Spacing For Ties (Per ACI-318, Sec. 11.4.5.1):

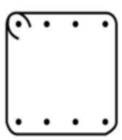
a) d/4 = 21"/4 = 5.25"
b) d_{bar}(8) = (6/8)"(8) = 6"
c) d_{hoop}(24) = (4/8)"(24) = 12"
d) 12"

→ Use min. = 5.25", say 5"

→ #4 Ties @ 5" O.C.  (For distance of min. 2d = 42" from both ends)

At Mid Portion of G.B. (Per ACI-318, Sec. 11.4.5.1):

d/2 = 21"/2 = 10.5", say 10" O.C.

→ #4 Ties @ 10" O.C.  at Mid Portion of G.B. Beam

5) Check Soil Bearing for the Footing:

H_S = 4,604.82 lb (ASD)
P_{DL} = 1,206.61 lb (ASD)
P_{LL} = 990.23 lb (ASD)

Size of Pad Ftg = $[(1,206.61+990.23)/1,500 \text{ psf}]^{1/2}$ = 1.21' say 4' Sq.
P = 2'x 2'x (44+(2' x 2)) x 150 pcf + 2 x 1,206.61 = 28,800+2,413.22 =31,213.22 lb

Overturning:

M_{OT} = (4,604.82 x 2) x (17' + 2' + 1') = 184,193 lb-ft
M_R = 31,213.22 lb x (48'/2) = 749,117.28 lb –ft
M_R/M_{OT} = 749,117.28/184,193 = 4.07 > 1.5 O.K. ✓
→ Overturning is O.K.

Sliding:

130 psf x [$(4')^2$ x 2 + 40' x 2']/(4604.82 lb x 2) = 1.58 > 1.5 O.K. ✓
→ Sliding is O.K.

Soil Bearing:

e = M_{OT}/P_{Total} = 184,193/(31,213.22+ 2 x 990.23) = 5.55 < 48/6 = 8'
→ Full bearing under the footing
q = P/BL(1 ± 6e/L) = [33,193.68/(2 x 48')](1 ± 6(5.55)/48')
q_{min} = 345.77 psf – 239.9 psf = 105.9 psf < 1500 psf x 1.33 = 1995 psf O.K. ✓
q_{max} = 345.77 psf + 239.9 psf = 585.7 psf < 1500 psf x 1.33 = 1995 psf O.K. ✓

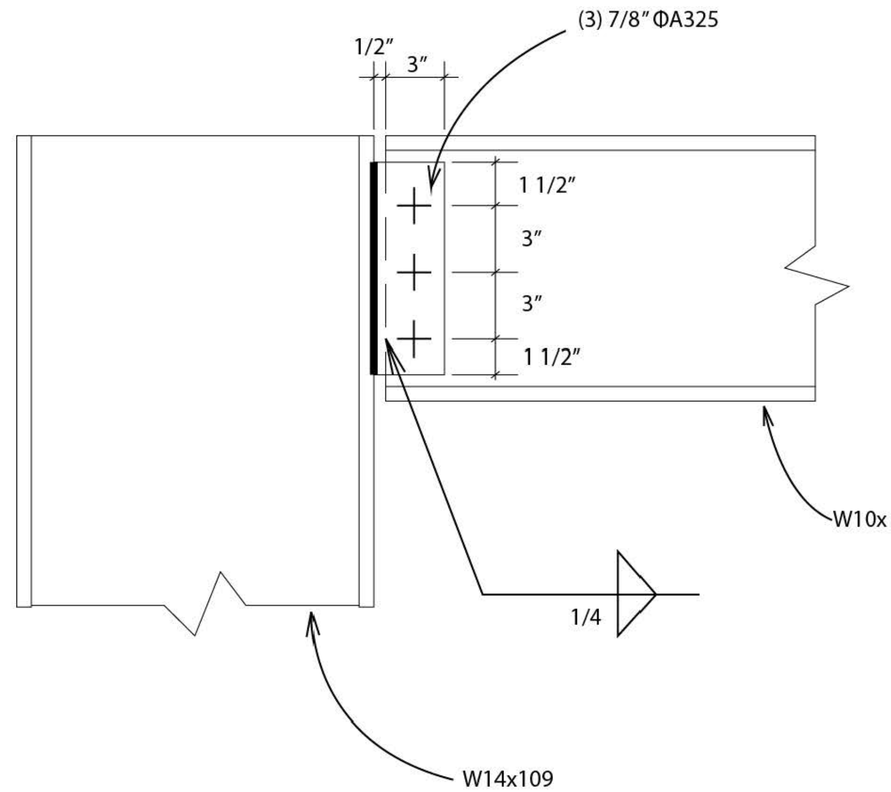
→ Soil Bearing O.K.

6) Design Sq. Ftg. Pads:

See Section 5 above.
Ftg. Size = $(1{,}206.61+990.23/1500)^{1/2}$ = 1.21', say 4' Sq. by 12" deep
→ Use 4' Sq. by 12" deep Pad Ftg w/ #5 @ 12" Each Way @ Bottom

7) Design Column To Beam Connection:

$V_{D+L} = 1.2(1.21) + 1.6(1) = 3.05$ k
$V_S = (4.61/0.7) \times 1.25 = 8.24$ k
$V_{Total} = [(3.05)^2 + (8.24)^2]^{1/2} = 8.79$ k /3 = 2.93 k < 13.1 k (7/8 "ΦA325)
→ Use 3 (7/8)" ΦA325 Bolts



Stair Design

Stringer

LL = 100 psf, DL = 13 psf
T.W. = 1.33 ft
$L_{projected}$ = 9.973 ft

W = (100 psf +13 psf) x 1.33 ft = 150.29 plf
M = $WL^2/8$ = $(150.29)(9.973)^2/8$ = 1,868.5 lb-ft < 1,973 lb-ft (2 x10) ✓ O.K
V = WL/2 = (150.29)(9.973)/2 = 749.4 lb < 879 (2 x 10) ✓ O.K
DEF. = $5WL^4/384EI$ = 5(0.00942 K/in)$(9.973 \times 12)^4$/384(1,600)(98.93) = 0.15 in
L/240 = (9.973 x 12)/240 =0.498 in
0.15 in < 0.498 in (2x10) ✓ O.K.

→ Use 2 x 14 @ 16" O.C. (2 x 10 is equivalent to 2 x 14 after cutting)

Landing

LL = 100 psf, DL = 13 psf
T.W. = 1.33 ft
L = 3 ft

W = (100 psf +13 psf) x 1.33 ft = 150.29 plf
M = $WL^2/8$ = $(150.29)(3)^2/8$ = 169.08 lb-ft < 1030 lb-ft (2 x 6) ✓ O.K
V = WL/2 = (150.29)(3)/2 = 225.44 lb < 653 (2 x 6) ✓ O.K
DEF. = $5WL^4/384EI$ = 5(0.00942 K/in)$(3\times 12)^4$/384(1,600)(20.80) = 0.0062 in
L/240 = (3 x 12)/240 =0.15 in
0.0062 in < 0.15 in (2 x 6) ✓ O.K.

→ Use 2 x 6 @ 16" O.C.