Ryan Skelly

Architecture 305b Portfolio

Final Project

General Description

The final project for Architecture 305b consists of the complete architectural and structural design of a two story commercial building, located in the greater Los Angeles area, which is left up to the students' discretion.

Architecturally, there is no limit to design or concept besides being within the project parameters, listed adjacent. My group decided to do an asymmetrical building shape, conceptualized as a brewery, a restaurant, and a bar deemed "The Hopperation." The building is characterized by a rustic and classic brewery design, utilizing materials such as brick for the walls and polished concrete for the flooring. One major highlight of the building is its encompassing usage and display of brewery equipment throughout the architecture, creating an interesting and unique place to dine and spend time.

Structurally, the commercial building is designed using wood, masonry, reinforced concrete, and steel. The flexible roof diaphragm was designed using plywood shear panels, wood GLBs, and steel columns. The rigid second floor diaphragm was designed using a reinforced concrete slab, reinforced CMU walls, steel beams and steel columns.

The final design package for the commercial building must include full structural engineering calculations, architectural plans, structural plans, renders, and structural details.

Parameters

Location: Arts District, Downtown Los Angeles, CA

Lot Size: Based on actual lot size (streets control usable area)

Usable Area: Approximately 200ft x 200ft (or more)

Number of Rooms: Based on architecture

Type of Roof and Floor Diaphragms: Roof - Flexible Diaphragm
2nd Floor - Rigid Diaphragm

Lateral Load Resisting Elements: Plywood Shear Panels for flexible roof diaphragm, and CMU piers for rigid 2nd floor diaphragm.

Location

Address: 216 S. Alameda St.
Los Angeles, CA 90012

Longitude: 118.23782 W

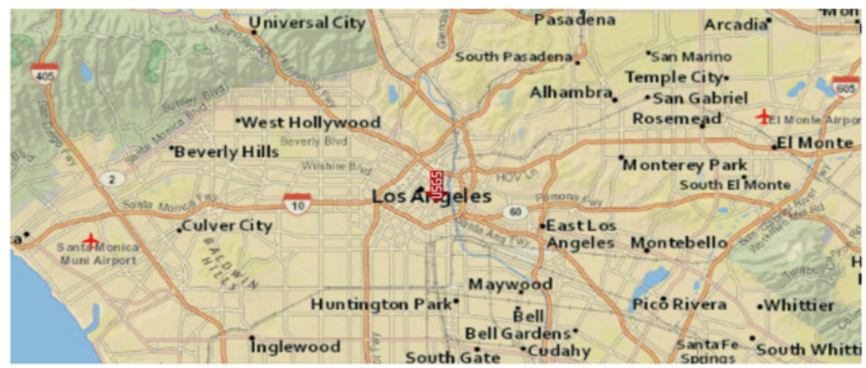
Latitude: 34.04661 N

USGS Design Maps Summary Report

View Detailed Report   Print

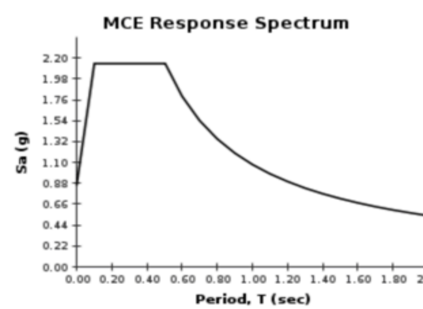
User–Specified Input

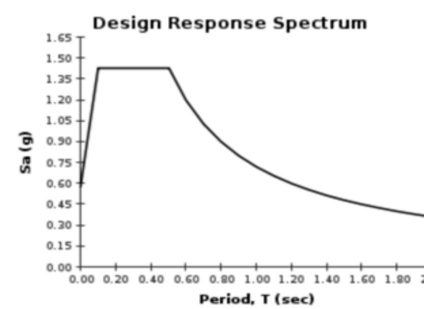
Report Title	216 S. Alameda St. Los Angeles, CA 90012 Sun February 14, 2016 23:03:06 UTC
Building Code Reference Document	ASCE 7-05 Standard (which utilizes USGS hazard data available in 2002)
Site Coordinates	34.04661°N, 118.23782°W
Site Soil Classification	Site Class D – "Stiff Soil"
Occupancy Category	I/II/III



USGS–Provided Output

S_S = 2.141 g	S_{MS} = 2.141 g	S_{DS} = 1.427 g
S_1 = 0.719 g	S_{M1} = 1.078 g	S_{D1} = 0.719 g





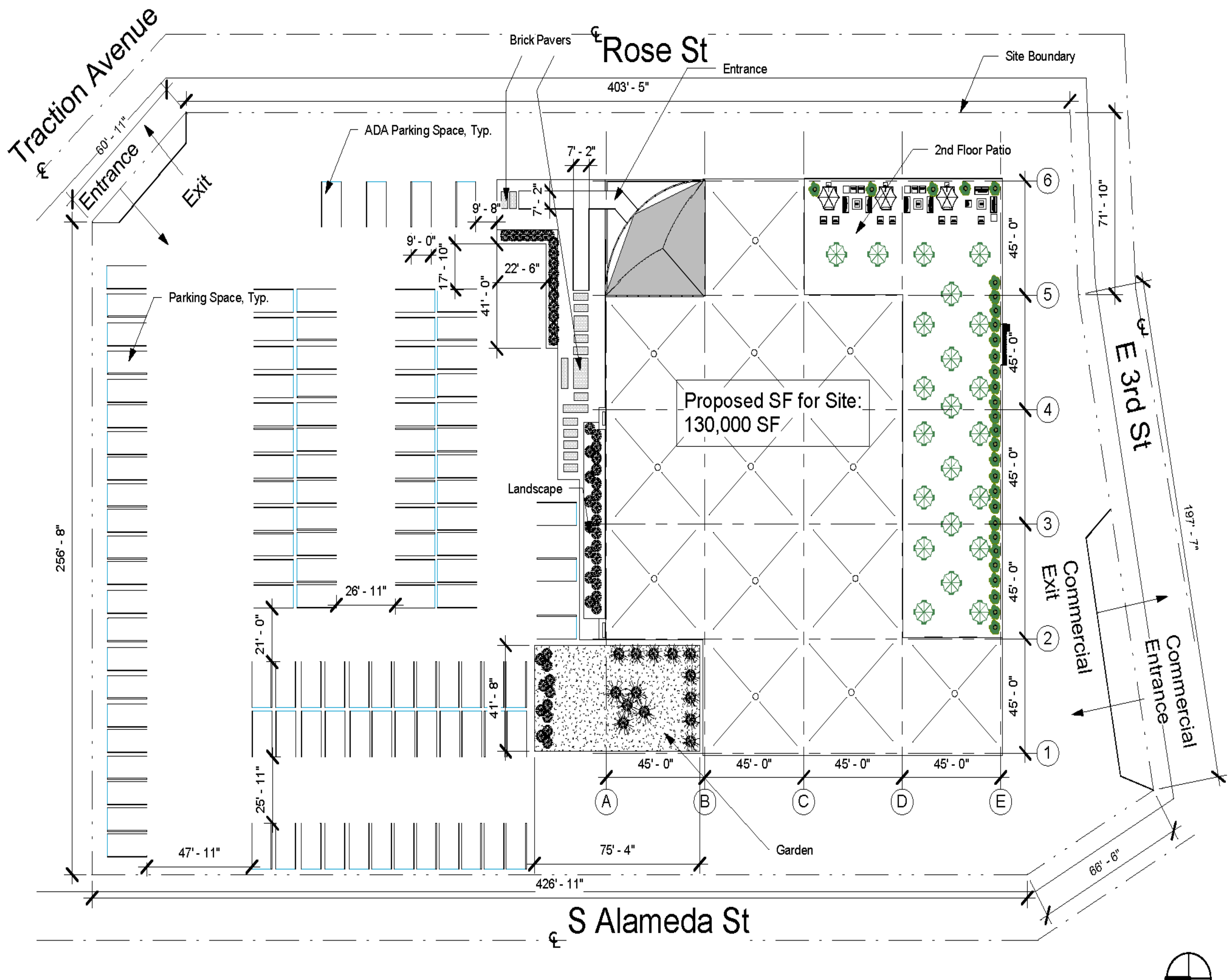
Renders


KPMG
CBRE
CALIFORNIA BANK & TRUST
THE HOPPERATION


THE HOPPERATION


Kegs
& Egg

Architectural Plans



1 Site
1" = 40'-0"

The Hopperation Brewery

Participants:
Isabela Arce
Keith Leonard
Christina Nour
Ryan Skelly

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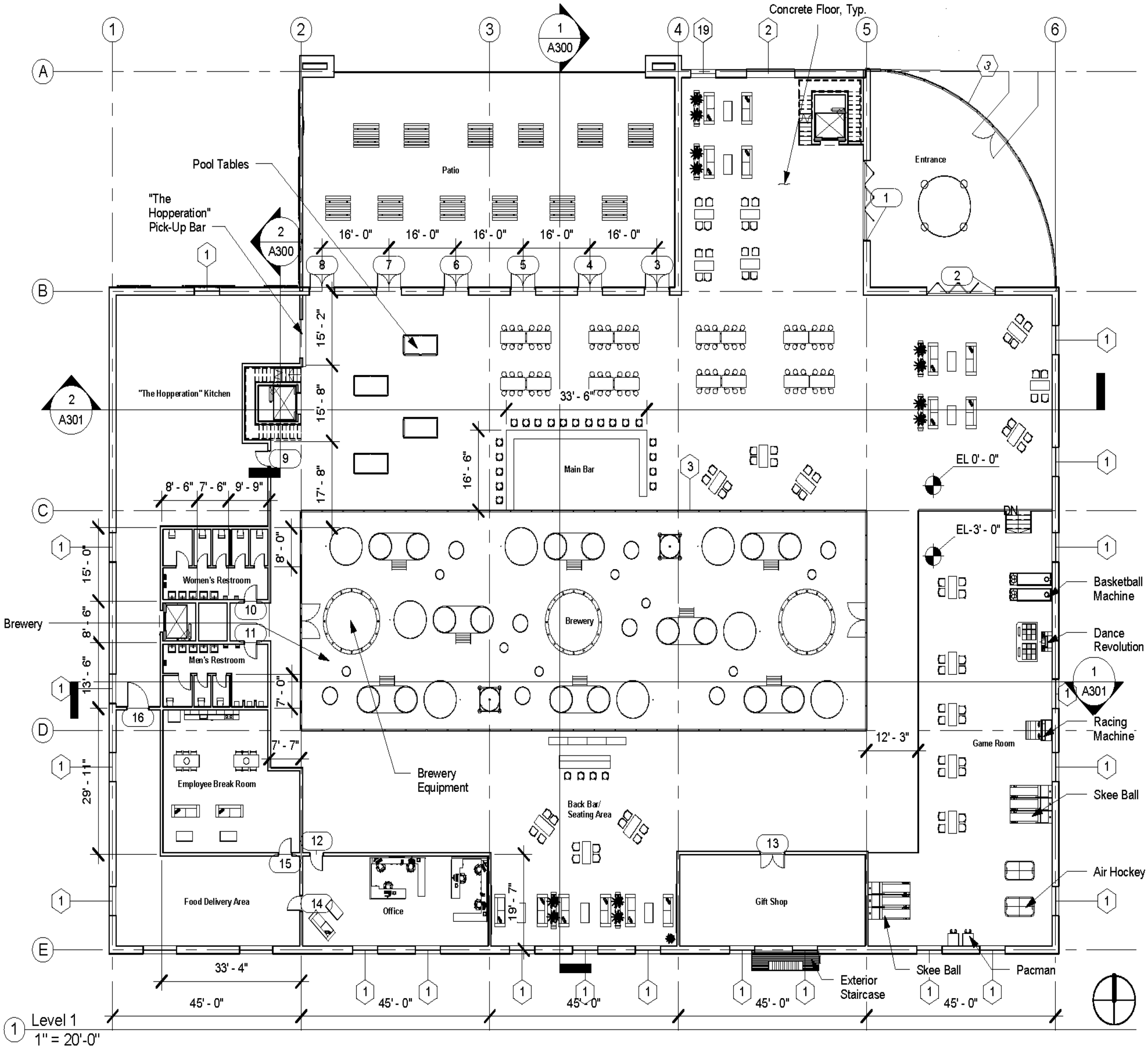
Spring 2016
Professor Tigran

Description:	Date:

Site Plan

A002

Scale 1" = 40'-0"



The Hopperation Brewery

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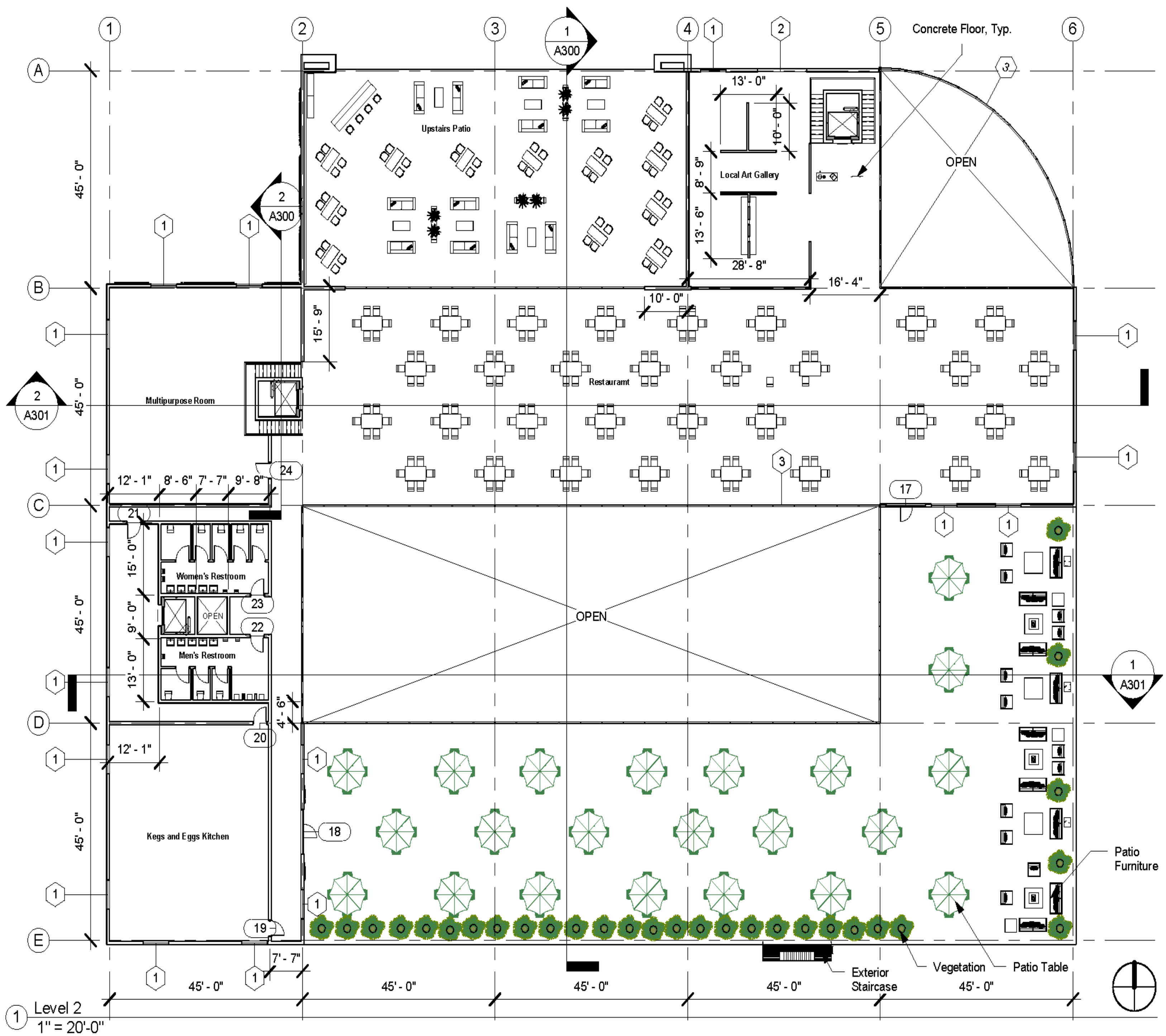
Description:	Date:

Floor Plan - 1st Floor

A100

Scale 1" = 20'-0"



The Hopperation Brewery

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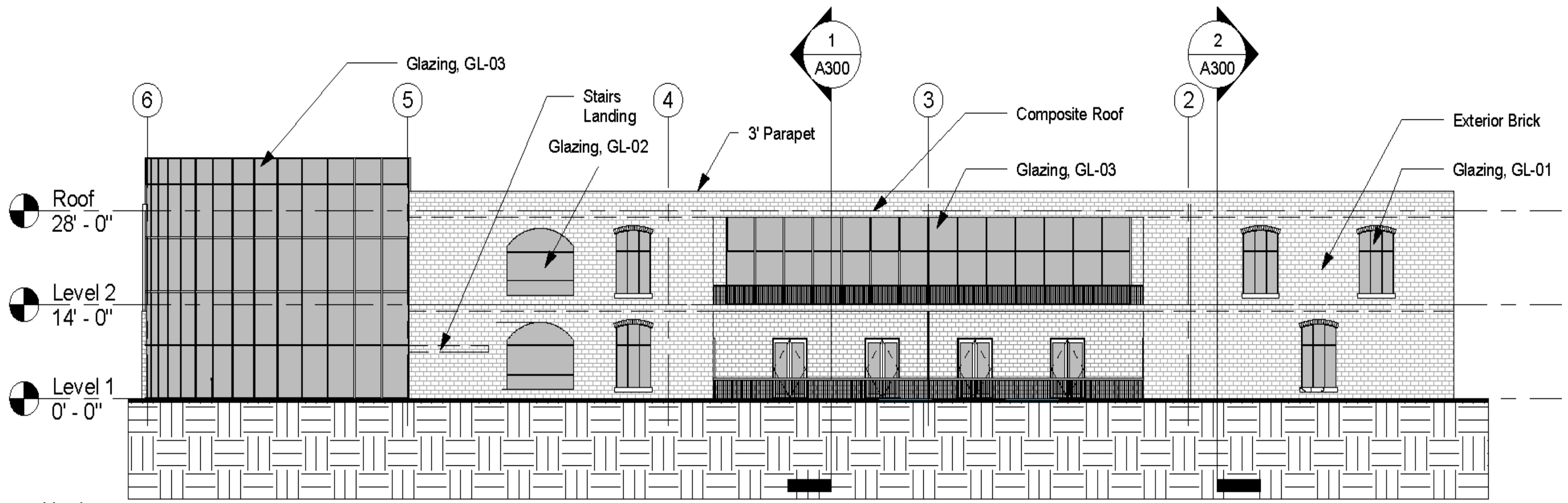
Description:	Date:

Floor Plan - 2nd Floor

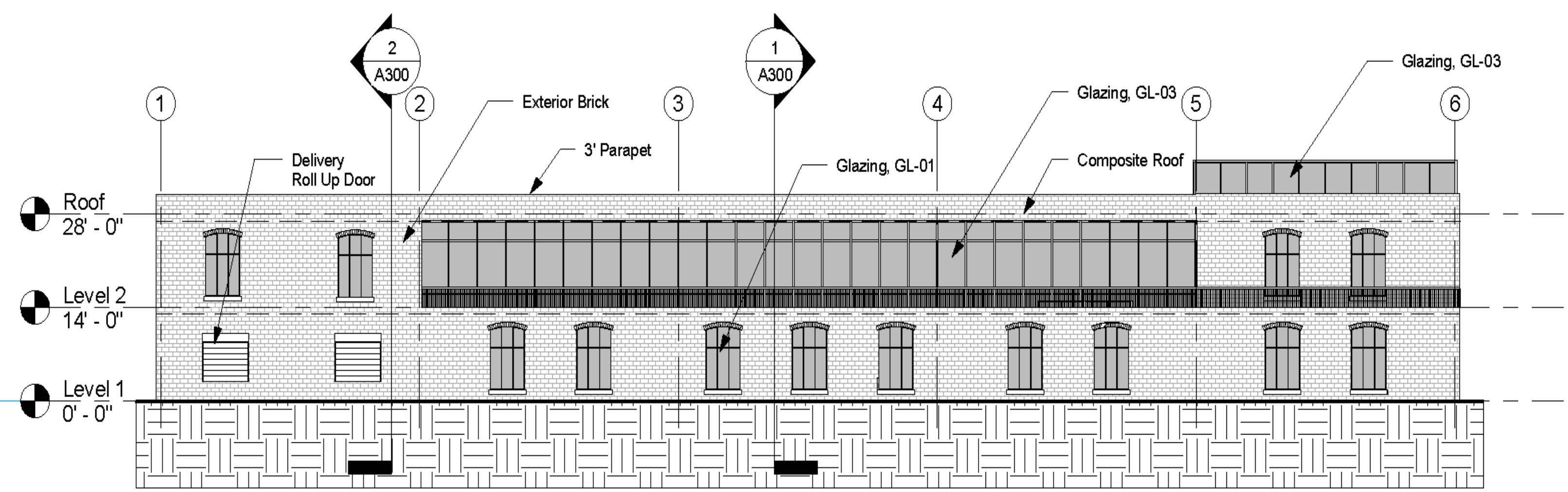
A101

Scale 1" = 20'-0"

Elevations



1 North
1" = 20'-0"



2 South
1" = 20'-0"

The Hopperation Brewery

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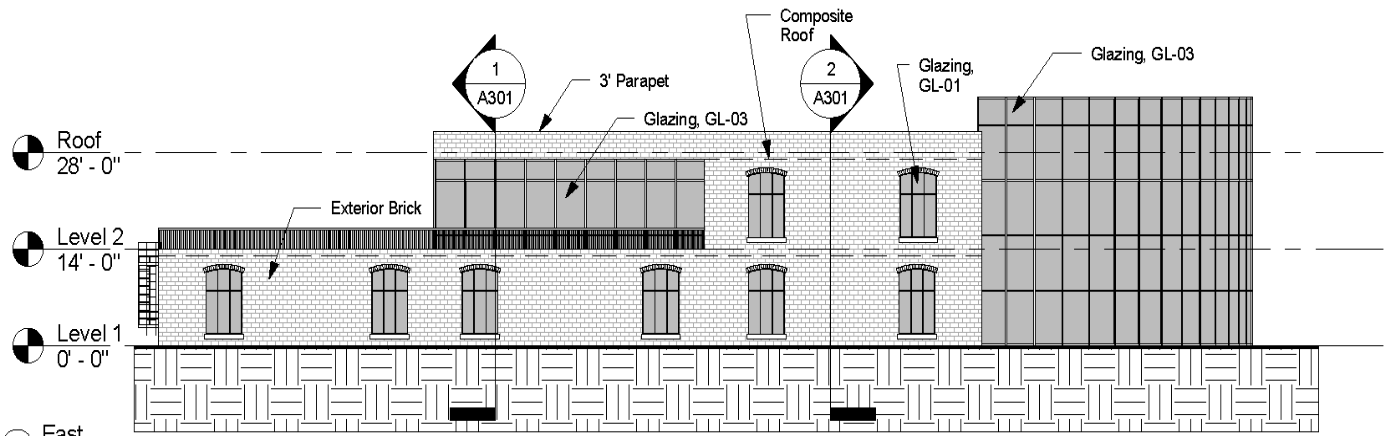
Description:	Date:

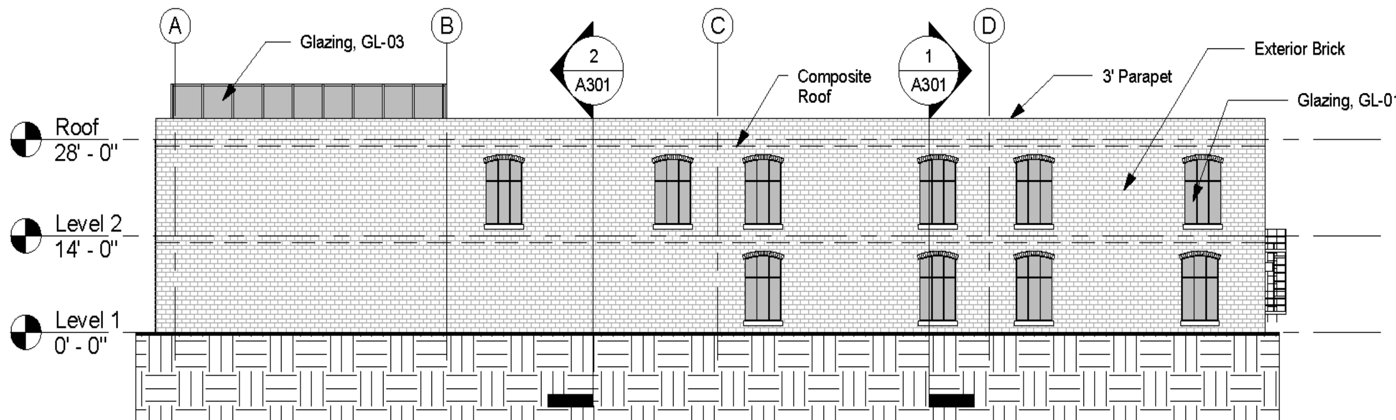
Elevation - N & S

A200

Scale 1" = 20'-0"



1 East
1" = 20'-0"



2 West
1" = 20'-0"

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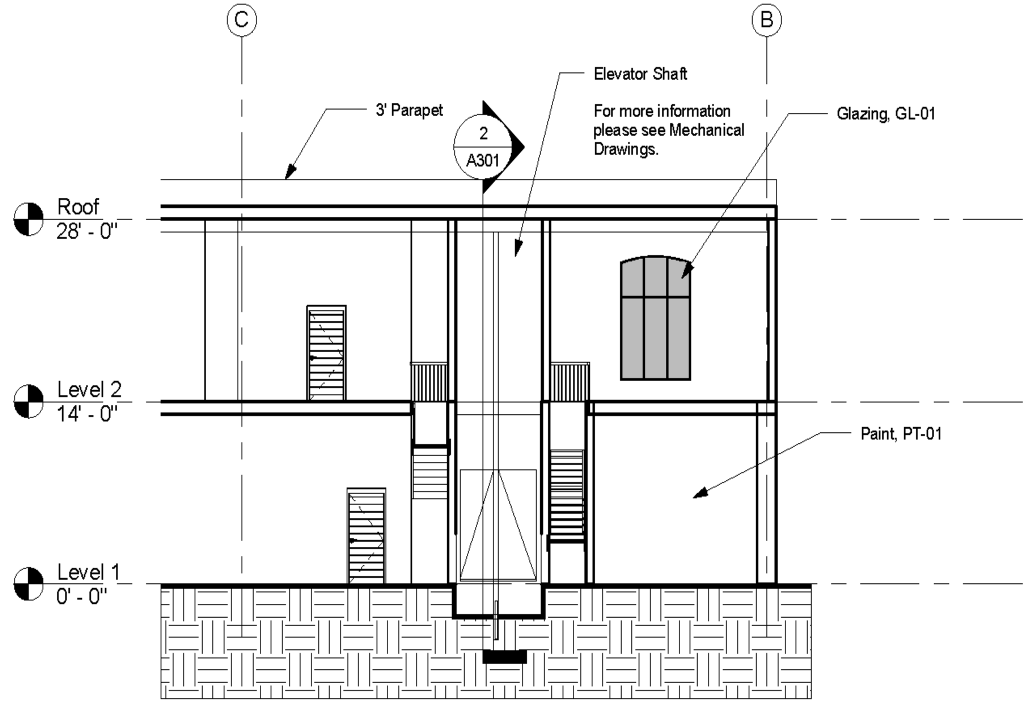
Elevation - E & W

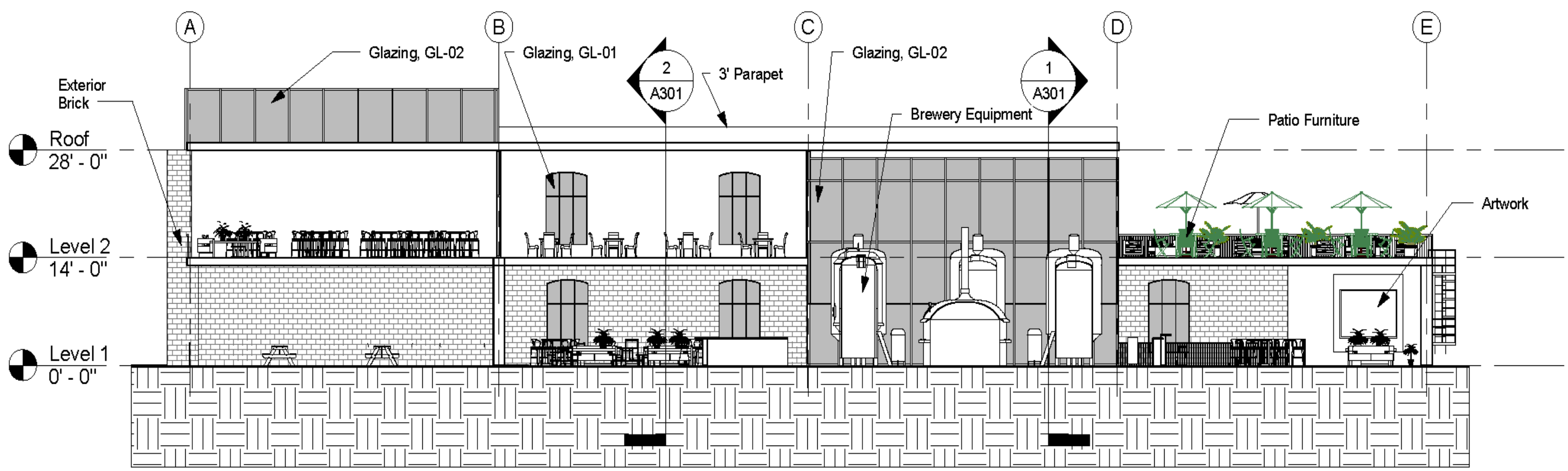
A201

Scale 1" = 20'-0"

Sections



2 Section 2
1" = 10'-0"



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

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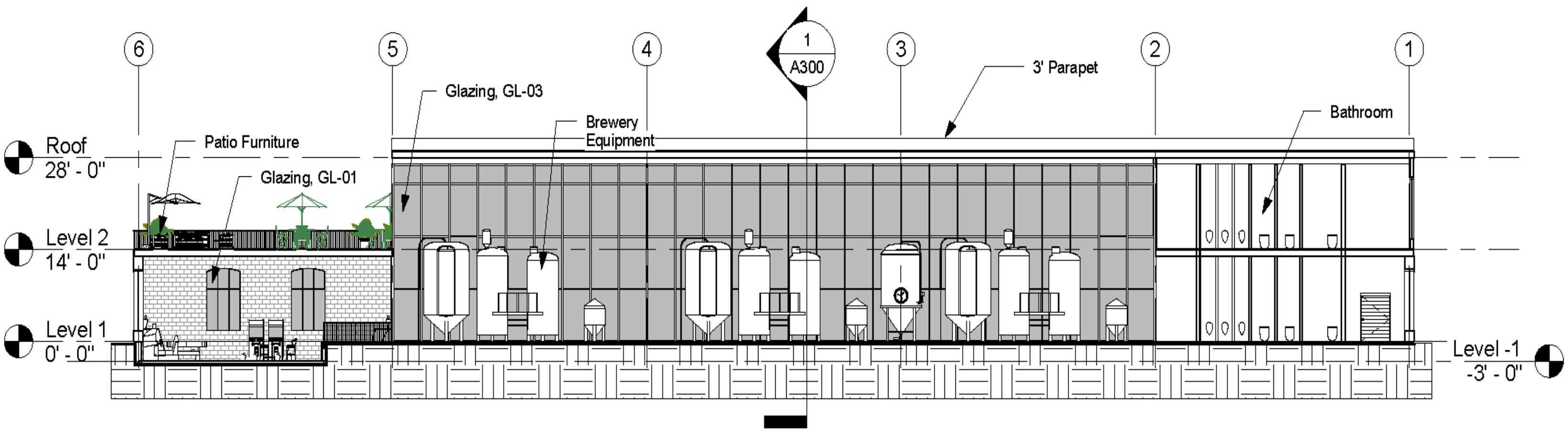
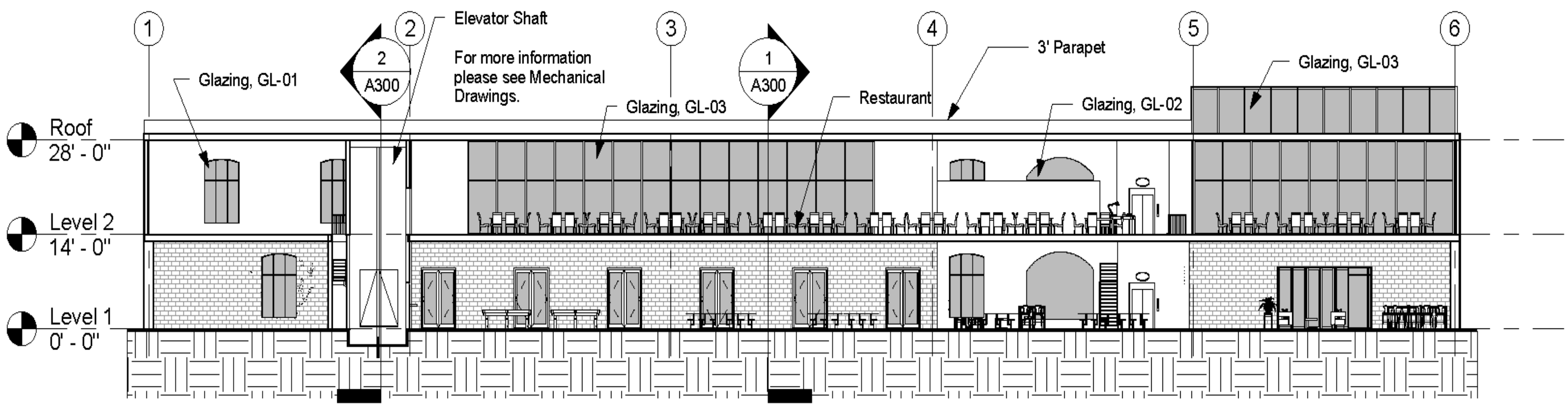
Sections

A300

Scale As indicated



1 Section 4
1" = 20'-0"



2 Section 3
1" = 20'-0"

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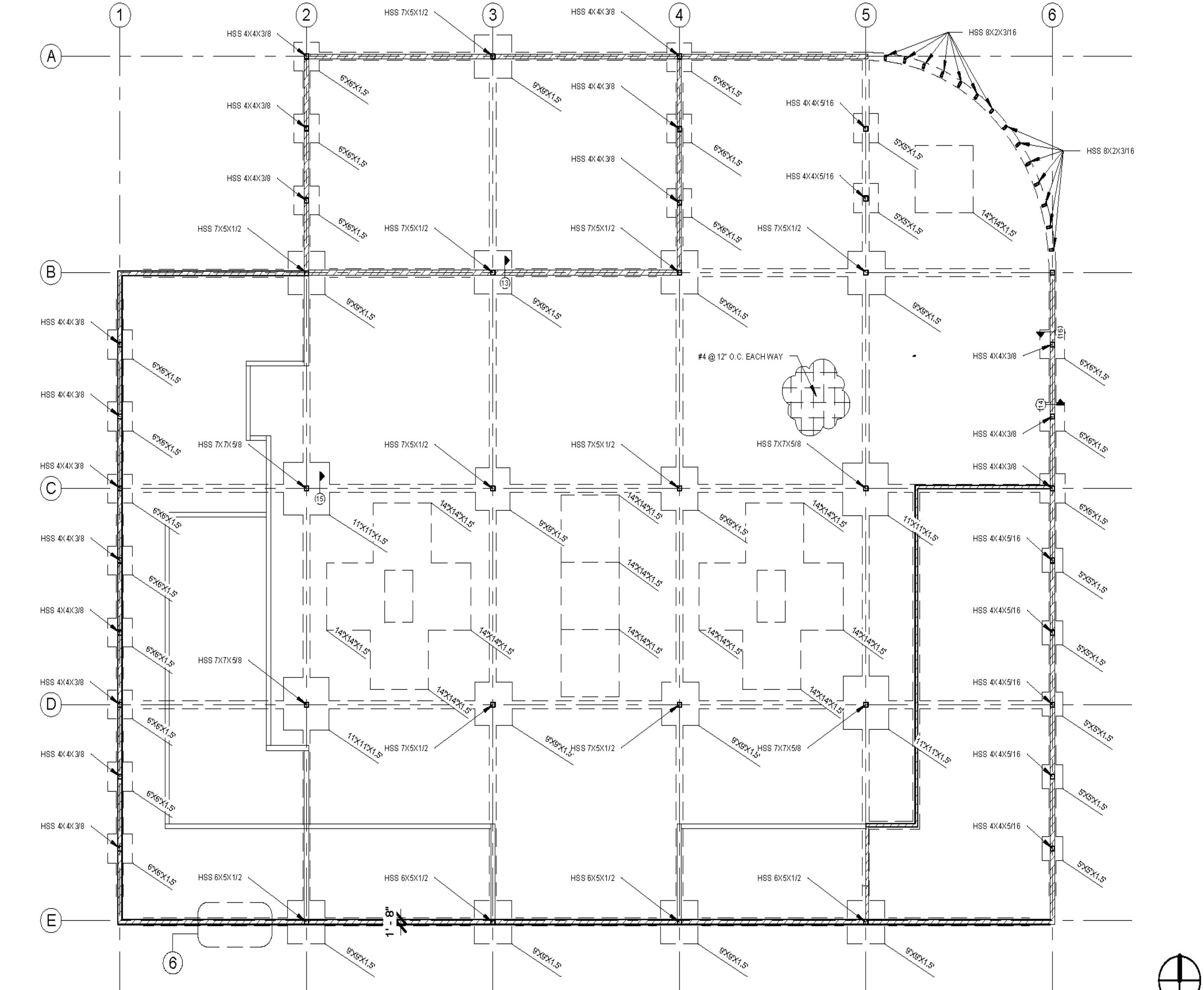
Description:	Date:

Sections

A301

Scale 1" = 20'-0"

Structural Plans



1 Foundation
1" = 20'-0"

The Hopperation Brewery

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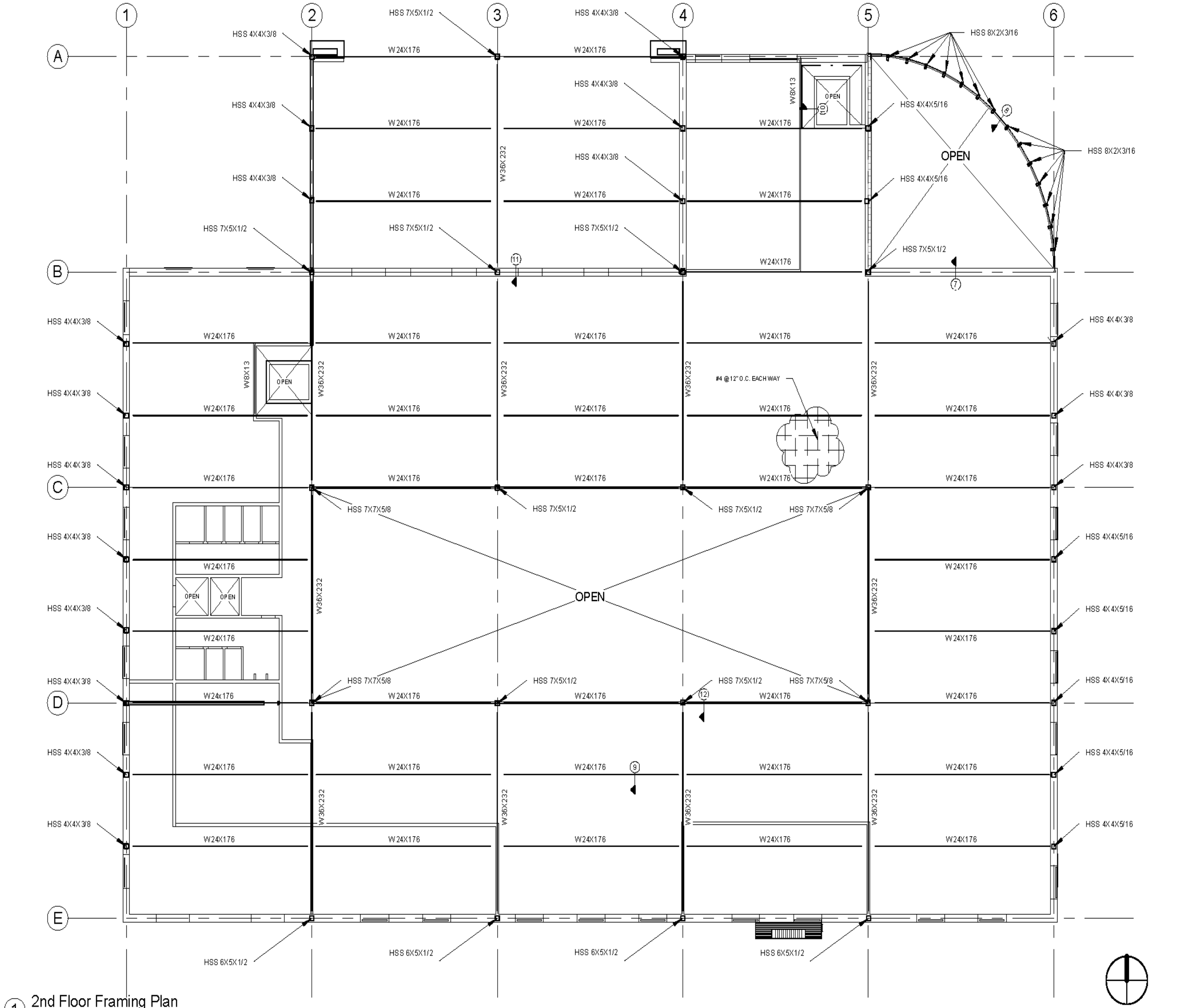
Description:	Date:

Foundation Plan

S100

Scale 1" = 20'-0"



1 2nd Floor Framing Plan
1" = 20'-0"

The Hopperation Brewery

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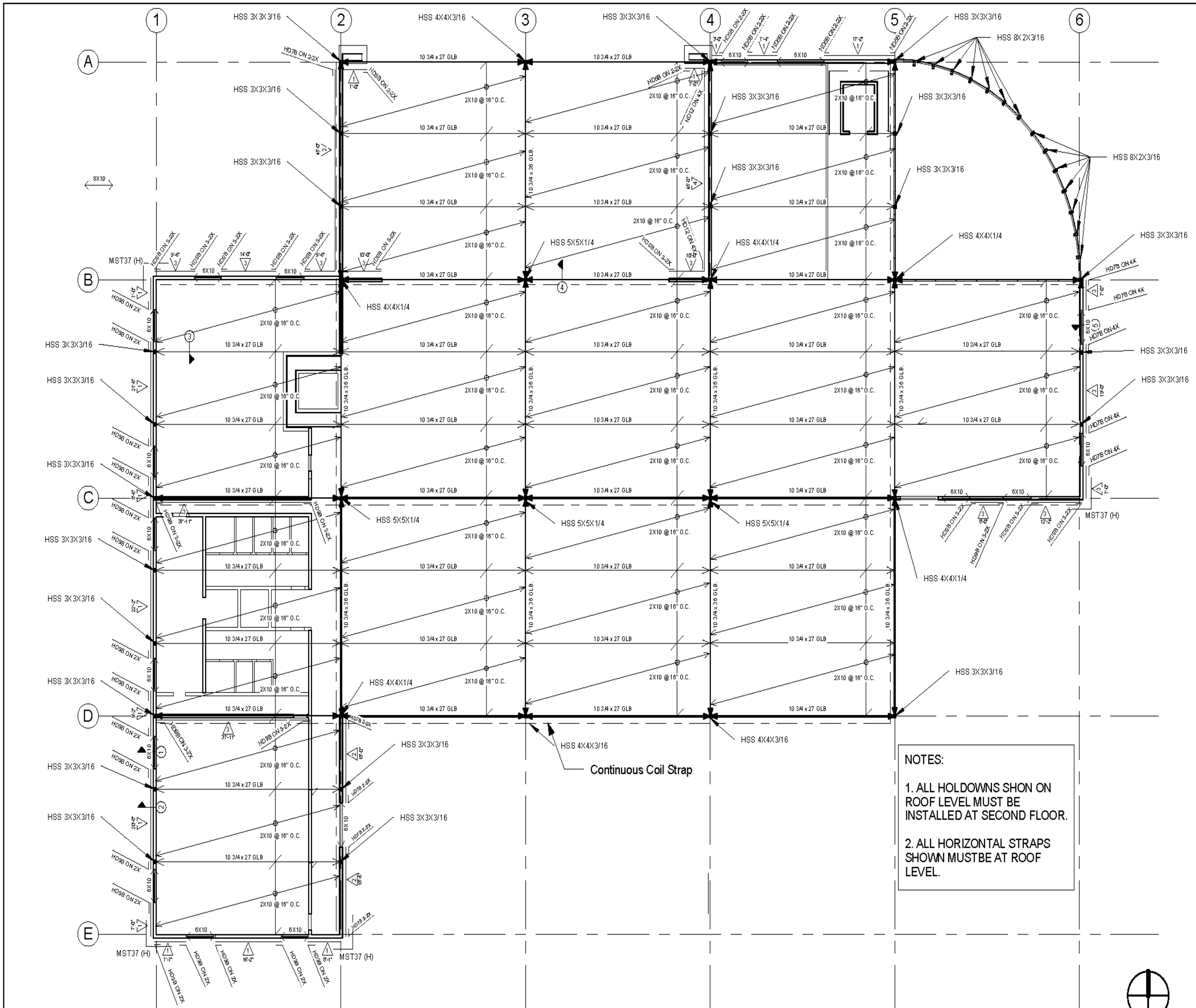
Description:	Date:

Framing Plan 2nd Floor

S101

Scale 1" = 20'-0"



NOTES:

1. ALL HOLDOWNS SHON ON ROOF LEVEL MUST BE INSTALLED AT SECOND FLOOR.

2. ALL HORIZONTAL STRAPS SHOWN MUSTBE AT ROOF LEVEL.

1 Roof Framing Plan
1" = 20'-0"

The Hopperation Brewery

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Description:	Date:

Framing Plan Roof

S102

Scale 1" = 20'-0"

Calculations

Wind Design – 2^{ND} Wood Framing

Wind = 20 psf

$F_C' = 1650[0.98011 - \{(0.98011)^2 - 0.71023\}^{1/2}] = 791.529$ psi

$P_a = 16.0$ psf x 1.33 ft x 45 ft = 957.6 lb

$P_{all} = F_C' \times A = 791.529$ psi x 8.25 in^2 = 6,530.11 lb

→ 957.60 lb < 6,530.11 lb (2 x 6) ✓ O.K

W= 20 psf x 1.33 ft = 26.6 plf

$M = WL^2/8 = 26.6(11)^2/8 = 402.325$ lb-ft

→ 402.325 lb-ft < 1030 lb-ft (2 x 6) ✓ O.K

$P_a/P_{all} + M/M_{all} < 1.33$

(957.6/6,530.11) + (402.325/1030) = 0.537

→ 0.537 < 1.33 (2 x 6 O.K.)

→ **2 x 6 @ 16" O.C. is adequate**

Wind Design: Glass Curtain Wall (Entrance)

Parameters:

$C = 2\pi r \rightarrow \frac{1}{4}C = \frac{1}{2}\pi r$

$r = 45'$

$\frac{1}{4}C = \frac{1}{2}\pi r = \frac{1}{2}\pi(45') = 70.6858$ ft

Say $C = 70'$

Use segment length $= 5' \rightarrow \frac{70}{5} = 14$ segments of glass

$WL = (20 \text{ psf})(5 \text{ ft}) = 100$ plf

$L = 36'$

$F_y = 46$ ksi (HSS RECT.)

$E = 29{,}000$ ksi

$$M = \frac{WL^2}{8} = \frac{(100 \text{ plf})(36 \text{ ft})^2}{8} = 16.2 \text{ k} - \text{ft}$$

$$V = \frac{WL}{2} = \frac{(100 \text{ plf})(36 \text{ ft})}{2} = 1.8 \text{ k}$$

Try HSS $8x2x\frac{3}{16} \rightarrow M = 17.2$ k – ft (Table 3 – 12)

Self wt: 0.0010235 k/in

$I = 22.4 \text{ in}^4$

$$\Delta = \frac{5WL^4}{384EI} = \frac{(5)\left(\frac{0.000833 \text{ k}}{\text{in}}\right)(36 \text{ ft x } 12 \text{ in})^4}{(384)(29000 \text{ ksi})(22.4 \text{ in}^4)} =$$

$$= 0.582 \text{ in} < \frac{L}{240} = \frac{(36 \text{ ft x}12 \text{ in})}{240} = 1.8 \text{ in} \rightarrow \text{OK}$$

Use HSS 8x2x$\frac{3}{16}$ for Steel Columns in Glass Curtain Wall

Steel-Concrete Stair Design

Dimensions:

Landing:
L = 14′5″ = 14.4167′
w = 3′
Stair Runs (Each run is equivalent in dimension):
L = 11′1″ = 11.0833′
w = 3′
h = 7′

Design Stair Runs:

LL = 100 psf

$$DL = \frac{\left(\frac{1}{8}"\right)(490\text{ psf})}{(12")} + \frac{(3")(150\text{ psf})}{(12")} = 42.6042\text{ psf}$$

$$w = DL + LL = (42.6042\text{ psf} + 100\text{ psf})\left(\frac{3}{2}\right) = 213.9063\text{ plf}$$

$$M = \frac{wl^2}{8} = \frac{(213.9063\text{ plf})(11.0833')^2}{8} = 3{,}284.5181\text{ ft} - \text{lb} = 3.285\text{ k} - \text{ft}$$

$$V = \frac{WL}{2} = \frac{(213.9063\text{ plf})(11.0833\text{ FT})}{2} = 790.3180\text{ lb} = 0.7903\text{ k}$$

Try C12x20.7

$$\Delta = \frac{5WL^4}{384EI} = \frac{(5)\left(\frac{0.01783\text{ k}}{\text{in}}\right)(11.0833\text{ ft x }12\text{ in})^4}{(384)(29000\text{ ksi})(129\text{ in}^4)} =$$
$$= 0.0194\text{ in} < \frac{L}{240} = \frac{(11.0833\text{ ft x}12\text{ in})}{240} = 0.554\text{ in} \rightarrow \text{OK}$$

USE C12x20.7 for Stair Stringer

Design Landing:

$$M = \frac{wl^2}{8} = \frac{(213.9063\text{ plf})(14.4167')^2}{8} = 5557.3188\text{ ft} - \text{lb} = 5.557\text{ k} - \text{ft}$$

$$V = \frac{WL}{2} = \frac{(213.9063\text{ plf})(14.4167\text{ ft})}{2} = 1{,}541.9115\text{ lb} = 1.542\text{ k}$$

Try C12x20.7

$$\Delta = \frac{5WL^4}{384EI} = \frac{(5)\left(\frac{0.01783\text{ k}}{\text{in}}\right)(14.4167\text{ ft x }12\text{ in})^4}{(384)(29000\text{ ksi})(129\text{ in}^4)} =$$
$$= 0.0556\text{ in} < \frac{L}{240} = \frac{(14.4167\text{ ft x }12\text{ in})}{240} = 0.7208\text{ in} \rightarrow \text{OK}$$

USE C12x20.7 for Landing Stringer

Design Railing Post:

$P_{max} = 200\ \text{lb}$
$H = 36\ \text{in}$

$M = PH = (200\ \text{lb})(36\ \text{in}) = 7200\ \text{in} - \text{lb}$
$w = 50\ \text{plf}$

Try HSS1.660x0.140

$$\Delta = \frac{5WL^4}{384EI} = \frac{(5)\left(\frac{0.004167\ \text{k}}{\text{in}}\right)(3\ \text{ft x}\ 12\ \text{in})^4}{(384)(29000\ \text{ksi})(0.910\ \text{in}^4)} =$$
$$= 0.0171\ \text{in} < \frac{L}{240} = \frac{(3\ \text{ft x}12\ \text{in})}{240} = 0.15\ \text{in} \rightarrow \text{OK}$$

USE HSS 1.660 x 0.140 for Railing Post

Design Stair Columns:

$w = DL + LL = (42.6042\ \text{psf} + 100\ \text{psf})(3) = 427.8126\ \text{plf}$
$H = 7'$

$$P = \frac{1}{2}(w_{stair}) + \frac{1}{2}(w_{landing}) = \frac{1}{2}(4741.575\ \text{lb}) + \frac{1}{2}(6167.646\ \text{lb}) = 5{,}454.61$$
Try HSS $2\text{x}2\text{x}\frac{3}{16} \rightarrow P_{allow} = 13.5\ \text{k}$

$P < P_{allow} \rightarrow= 5.455\ \text{k} < 13.5\ \text{k} \rightarrow \text{OK}$

USE (2) HSS 2x2x$\frac{3}{16}$ columns attatched to landing

Slab Design

Assume 6” reinforced concrete slab

DL = 94 psf

LL = 100 psf

$f'_c = 3{,}000$ psi

$f_y = 60{,}000$ psi

For Deflection:

$w = 94\text{ psf} + 100\text{ psf} = 194\text{ psf}$

$$\Delta = \frac{WL^4}{185EI} < \frac{L}{240}$$

$$\Delta = \frac{(194\text{ psf})L^4\left(\frac{1\text{ k}}{1000\text{ lb}}\right)\left(\frac{1'}{12"}\right)}{185(3122\text{ ksi})(216\text{ in}^4)} < \frac{L}{240}$$

$L < 26.5'$

For Moment:

$w = (1.2)(94\text{ psf}) + (1.6)(100\text{ psf}) = 272.8\text{ plf}$

$$M_u = \frac{(272.8\text{ plf})(15\text{ ft})^2}{8} = 7.673\text{ k} - \text{ft}$$

Steel:

$$F = \frac{bd^2}{12000} = \frac{(12\text{ in})(5\text{ in})^2}{12000} = 0.025$$

$$K_n = \frac{M_u}{F} = \frac{7.673}{0.025} = 306.9 \rightarrow \rho = 0.0062$$

$A_s = bd\rho = (12\text{ in})(5\text{ in})(0.0062) = 0.372\text{ in}^2$

Choose #4 reinforcement

$(0.2)(12) = (?)(.372)$

$? = 6.5"$ o. c for #4 bars

USE #4 @ 6" O. C. for L = 15′

Brewery Tank Design

Parameters:

h = 15’ 2” = 15.1667’
r = 4’

Determine weight of holding tank (when full):

$V_{cyl} = \pi r^2 h = \pi(4')^2(15.1667') = 762.3615\text{ ft}^3$

Density of beer $= \rho_{beer} = 1060\,\frac{kg}{m^3}$

$$\gamma_{beer} = \left(1060\,\frac{kg}{m^3}\right)\left(\frac{1\text{ m}}{3.28084\text{ ft}}\right)^3\left(\frac{2.20462\text{ lb}}{1\text{ kg}}\right) = 66.17355\,\frac{lb}{ft^3}$$

$$W_{tank} = W_{beer}V_{cyl} = \left(66.17355\,\frac{lb}{ft^3}\right)(762.3615\text{ ft}^3)\left(\frac{1k}{1000lb}\right) = 50.4482\text{ k}$$

Determine Seismic Force acting on the cylindrical holding tank:

Use criterion for boilers, water heaters, and atmospheric tanks:

$a_p = 1.0$

$R_p = 2.5$

Use criteria for a standard manufacturing facility:

$I_p = 1.0$

Holding tank is on ground level:

$z = 0$

Other Parameters:

$h = 28'$

$S_{DS} = 1.427$

$W_p = 50.4482\ k$

Compute Horizontal Seismic Design Force:

$$F_p = \frac{0.4a_pS_{DS}W_p}{\left(\frac{R_p}{I_p}\right)}\left(1+2\left(\frac{z}{h}\right)\right) = \frac{0.4(1.0)(1.427)(50.4482\ k)}{\left(\frac{2.5}{1.0}\right)}\left(1+2\left(\frac{0}{28'}\right)\right)$$

$F_p = 11.5183\ k$

$F_p \le 1.6S_{DS}I_PW_p = (1.6)(1.427)(1.0)(50.4482) = 115.1833\ k$

$11.5183\ k \le 115.1833\ k \rightarrow \text{o.k.}$

$F_p \ge 0.3S_{DS}I_pW_p = (0.3)(1.427)(1.0)(50.4482) = 21.5969\ k$

$11.5183\ k \ge 21.5969\ k \rightarrow \text{No, use } F_p = 21.5969\ k$

$\therefore F_p = 21.5969\ k\ (LRFD)$

$$\therefore F_p = \frac{21.5969\ k}{1.4} = 15.4263\ k\ (ASD)$$

Design Foundation for cylindrical holding tank:

Assume foundation is 1.5' deep:

$$d = \frac{h}{2} + 2' = \frac{15.1667'}{2} + 1.5' = 9.0834'$$

Overturning:

$M_0 = F_pd = (15.4263\ k)(9.0834') = 140.1225\ k-ft$

$$M_R = DL\left(\frac{L}{2}\right) = 50.4482\ k\left(\frac{14'}{2}\right) = 353.1374\ k-ft$$

$$S.F. = \frac{M_R}{M_0} = \frac{353.1374\ k-ft}{140.1225\ k-ft} = 2.52 > 1.5 \rightarrow OK$$

Sliding:

$$S.F. = \frac{(130\ psf)(A_F)}{F_p} = \frac{(130\ psf)(14')^2}{15{,}426.3\ lb} = 1.652 > 1.5 \rightarrow o.k.$$

Use 14'x14'x1.5'FTG for cylindrical brewing tank
Use #5@12" O.C.


THE
HOPPERATION