# Makom Hillel: SLO Hillel Outdoor Event Space

By: Eli Greenberg
Project Advisor: Brent Nuttall

California Polytechnic State University
San Luis Obispo
Architectural Engineering Department

# Table of Contents

Abstract

This report details the design development for Makom Hillel, an outdoor event space dedicated to San Luis Obispo’s Hillel chapter. Hillel is an international organization working to connect Jewish students and community members with each other and their religion. The platform was designed as a service-learning senior project for the ARCE Department at Cal Poly SLO. The gravity and lateral systems were designed using the 2018 NDS, ASCE 7-16, and Simpson Strong Tie’s 2021 Wood Construction Connectors catalog. This project was conducted during Spring and Fall 2021 and supervised by Professor Brent Nuttall.

Background

During this unprecedented pandemic, SLO Hillel has provided strong programming, both virtual and socially distanced, to support and lift students' spirits through the fog of a campus shutdown. Using coffee shops, public parks and even the parking lot of Temple Ner Shalom, a local synagogue, has helped us navigate the constantly shifting rules and regulations.

Finding safe, open spaces has been a challenge for SLO Hillel, even before COVID-19. With no designated “house” or Center within the Cal Poly Campus, it is clear students would benefit from a safe gathering space to call their own while contributing to the larger community. There is optimism for a future beyond this pandemic, but some of the restrictions of COVID protocols will be with us for the near future, as more people wish to gather. SLO Hillel sees this moment as an opportunity to address the present and the future.

In concert with the strategic plan for the Laurate Property, Makom Hillel serves the following purposes for SLO Hillel and the larger community:

- Offers a safe gathering public space in the outdoors for events like campfires, shabbat services, and an in person Jewish Cal Poly Graduation ceremony
- Provides a longer-term model for students to see the space as an off-campus site of security and freedom to express their Jewish spirit in all its diversity
- As called for in the JCC strategic plan, we hope with the addition of camping yurts around the Makom we can invite families, other California Universities, and strategic partners to learn, celebrate and deepen our bonds within this new sacred space
- Provides a long-range opportunity to partner with the JCC and Jewish Federation in planning building, development and management

Makom Hillel is guided by the Cal Poly mantra of learning by doing, as the structure was designed as outlined in this report. In the future, the space will be used for student programming in collaboration with the JCC; most importantly the Festival of Jewish learning, but also experimental weekend experiential education and a way for students to be empowered by a space designated for their spiritual health.

The timing is right for SLO Hillel to grow with the strategic vision of the JCC. SLO Hillel is dedicated to the work necessary to make this dream a reality.

Interaction with Rabbi, Developer, and Contractor

During the course of this project, I worked closely with Rabbi Micah Hyman, the Executive Director of SLO Hillel, John Belsher, a local developer, and John King, a local contractor. The project was initially brought to me as a sophomore with the intent of building a house for Hillel somewhere close to campus. With Covid emerging, the project shifted from the initial concept to an outdoor event space where protocols and social distancing could be followed.

When the scope of the project changed, I was tasked with creating an architectural model based on the design specifications of Rabbi Hyman. Once I completed the model using Rhino, John Belsher was brought aboard to improve upon the initial design, providing guidance from his 30 years of experience. I communicated with John regularly to discuss the seating area in the center of the structure, the wind/shade screen design, the circulation path, and several other aspects of while I developed new Rhino models. His suggestions and advice lead to three more iterations until the final model was complete.

We presented the project to the Jewish Community Center’s Executive Board. Once we were granted permission to move forward, John King joined the team to break ground at Temple Ner Shalom. In partnership with John Belsher and John King, we developed a framing plan for the deck structure as well as typical details which I drafted using Revit.

When construction began, I met with the rest of the design team at the site once a week to check in on the progress of the structure and discuss any changes in the design. Through these weekly meetings, I learned a lot about the construction phase of a freestanding deck and was able to get some exposure to how a construction site operates. Construction was paused in July for budget concerns but will hopefully resume soon. I am still in contact with Rabbi Hyman regarding the future plans for the event space and will be in contact with John Belsher and John King should any additions be made to the deck.

Research of Similar Deck Structures

The information compiled below outlines good practices for the design and construction of a freestanding deck. This advice comes from a variety of sources, including the Journal of Light Construction, the Engineer Warehouse Blog, Greg Vancom, a YouTuber with 30 years of construction experience, and Simpson Strong Tie's "How to Build a Stronger Deck" video series.

- The biggest concern for a freestanding deck is how it will support itself without being attached to a house or another structure
- Racking and uplift must be considered for a freestanding deck which may not be the case when the deck is attached to a house or another structure
- Design the deck for potential future uses
- Use bolts, brackets, or screws wherever possible because nails can pull out overtime
- Use like metals for connectors and fasteners
- Consider the corrosiveness of the environment
- Double shear nailing can provide a strong connection with fewer fasteners
- Steel joist hangers provide bearing support and uplift resistance (Figure 5)
- Can provide *some* rotational resistance, though blocking might be needed (Figure 2)
- Pros for composite decking: Made of wood waste and plastic, low maintenance, weather resistant/durable, lighter in weight than solid wood
- Cons for composite decking: Prone to mildew, might need special fasteners
- Decking fastened through the boards into the joists (Figure 5)
- Deck should be braced parallel to the joists (Figure 3)
- Lateral motion can be resisted by:
    - Placing footings below grade – soil can help limit lateral displacement (Figure 3)
    - Burying posts into the earth
    - Large footings can provide significant resistance due to their mass (Figure 3)
    - Providing bracing between the post and beams (Figure 1)
        - Be sure to check braces against buckling and tension parallel to grain
    - Using the Simpson MPBZ (Moment Post Base) as the lateral system (Figure 4)

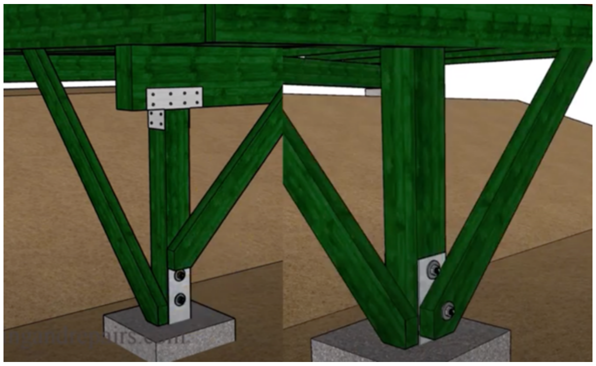


*Figure 1: Bracing can be Connected Directly to the Post or to the Post Anchor*

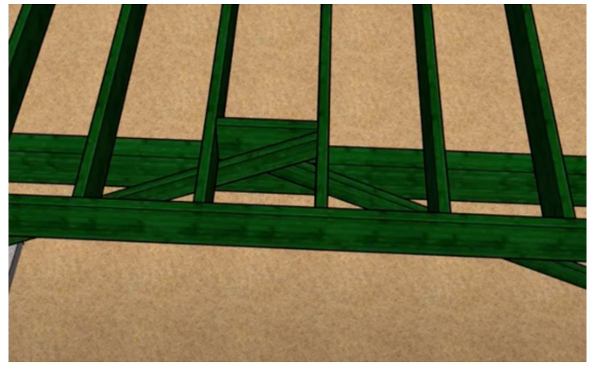


*Figure 2: Blocking to Connect Bracing and Prevent the Joists from Rotating*

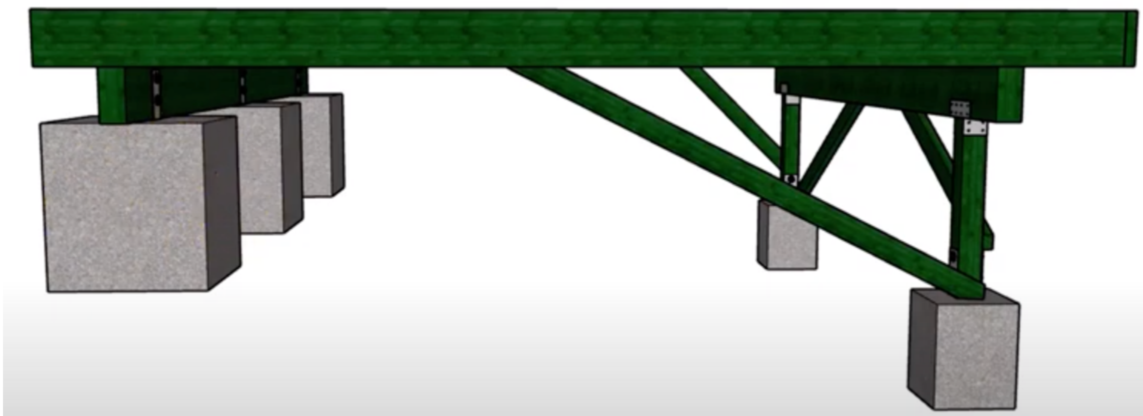


*Figure 3: Large Footings Resist Lateral Movement and Bracing Shown Parallel to Joists*

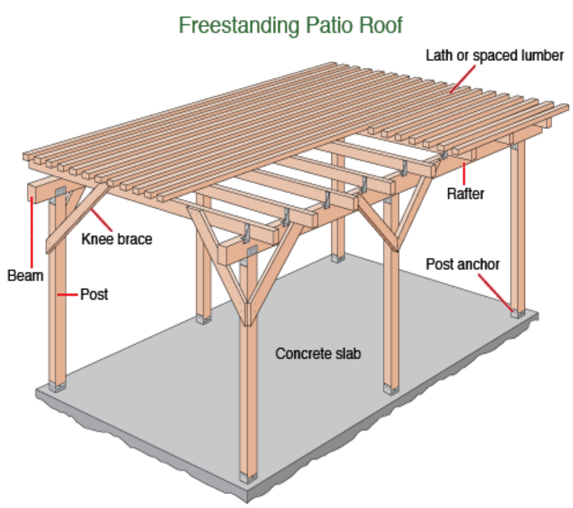



*Figure 4: Knee Bracing at Roof and Post Base Connection to Concrete*

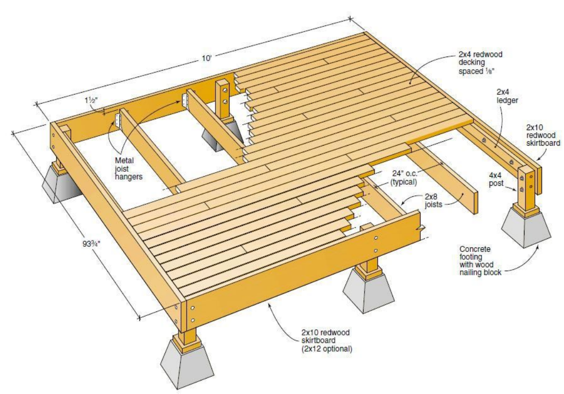



*Figure 5: Typical Deck Framing Showing Load Pattern; Joists to Beams to Girders to Posts into Concrete Foundations*

Inspiration of Design Components

Hillel wanted a space that allowed for an intimate interaction with the outdoor environment and could be used for a variety of events. The site has an unobstructed view of Bishop's Peak and the vast open area heading towards Los Osos. Having an elevated deck to get better views of the surrounding nature was important for the initial design.

A big inspiration for the design of the deck is the Meditation Platform at Camp Ramah in Ojai, California (Figure 6). Built at the top of a mountain overlooking the camp, the platform serves as a functional programmatic space and peaceful getaway for those looking to enjoy the views of the Ojai Valley. The deck is 24"- 48" off the ground to boost views of the surroundings and includes a metal truss shade structure to keep occupants cool during the summer months.

*Figure 6: Meditation Platform at Camp Ramah Including Steel Truss Shade Structure*

Another component that was essential to the deck was a sunken pit in the center to provide an amphitheater feeling during some of the events held at the space. This allows the deck to feel large and accommodating, but intimate and warm at the same time. The deck shown below (Figure 7) is a great example of what the design team tried to emulate by creating a welcoming inner space while maintaining the functionality of the rest of the deck.

*Figure 7: Sunken Fire Pit with Surrounding Functional Deck*

<u>Documentation of Design Iterations</u>

The first iteration of the design was designed to be a multipurpose event space and “glamping” ground with a central gathering area surrounded by six large tents (Figure 8). Shaped in plan like a Star of David, the structure was to serve as a reminder of each individual’s connection to Judaism (Figure 9). The central area was designed around a large, elevated fixture in which Jewish ceremonies could take place. Steps for access and seating were included as well as a large walkway around the fixture to allow dancing or gathering. The tents located at the six points of the star were meant to act as covered eating areas during Shabbat dinner events while also serving as a sleeping area for the community camping trips.

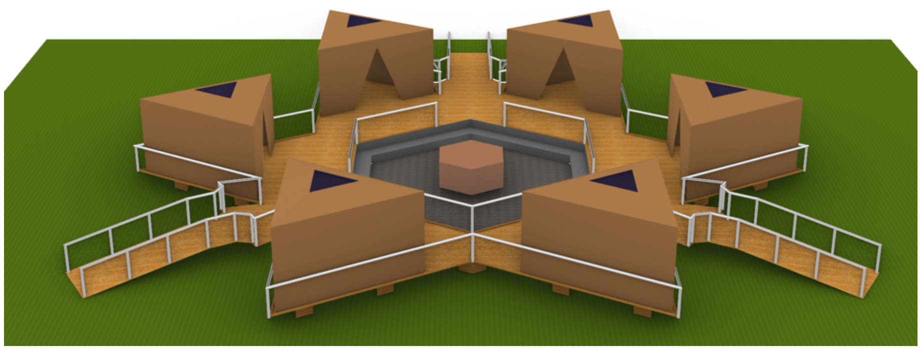


*Figure 8: A 3D View of the Six Tents Surrounding the Central Fixture*

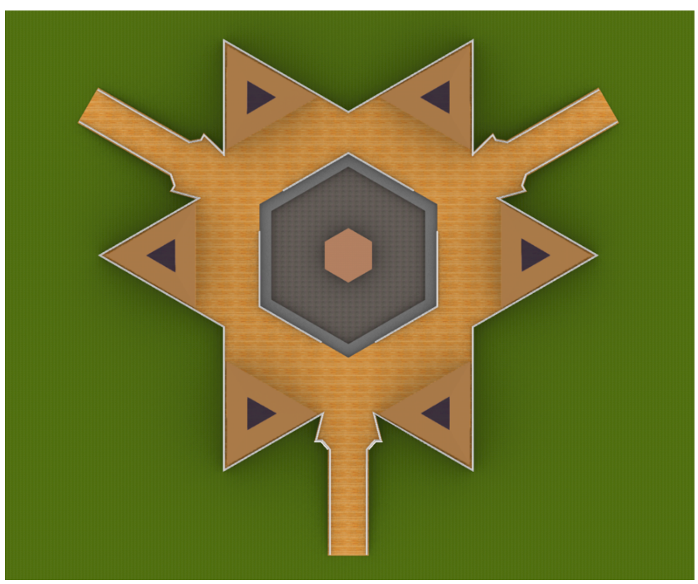


*Figure 9: Plan View Highlighting the Star of David Layout*

The second iteration transitioned away from the Star of David design to one that would have been more cost effective and quicker to build. While the Star of David component was still important to Hillel, it was more important not to overcomplicate the design. This design still places a heavy focus on the central gathering space, including more seating surrounding a central platform that could be used for prayer services and other community events (Figure 11). Without the six tents, wind and shade coverage needed to be addressed. This was solved by placing a canvas screen along five sides of the hexagon to catch the wind with awnings above to provide shade (Figure 10). This structure was also designed to be two feet taller than the initial design to offer better views of the surrounding nature and help induce the feeling that individuals were entering a holy space.

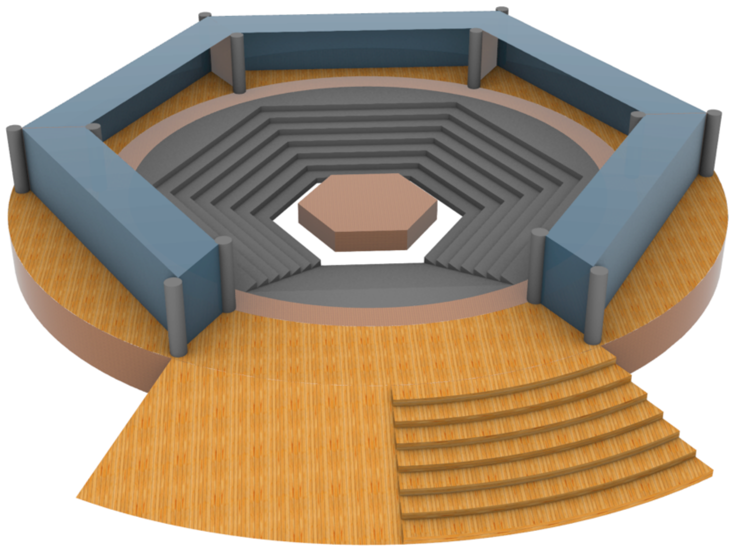


*Figure 10: 3D View of the Larger Inner Area and the Wind/Shade Screens Along the Exterior*

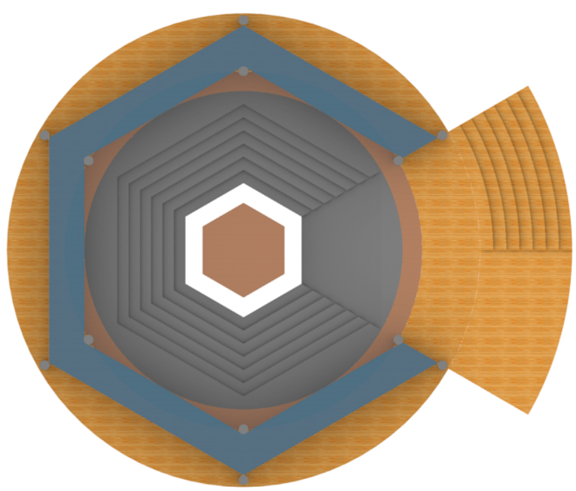


*Figure 11: Plan View of the Circular Design with a Hexagonal Interior*

The third iteration was created as an inverse of the second in that it has a circular interior space with a hexagonal exterior (Figure 13). This allowed for a more effective use of the deck while also improving constructability. The central area was downsized to create a more intimate setting which also increased the space in the other areas around the deck (Figure 12). This change increased the size of the wind screens to cover the larger surrounding area. In addition, the design introduced a ramp from the deck to the central platform to allow easy access.

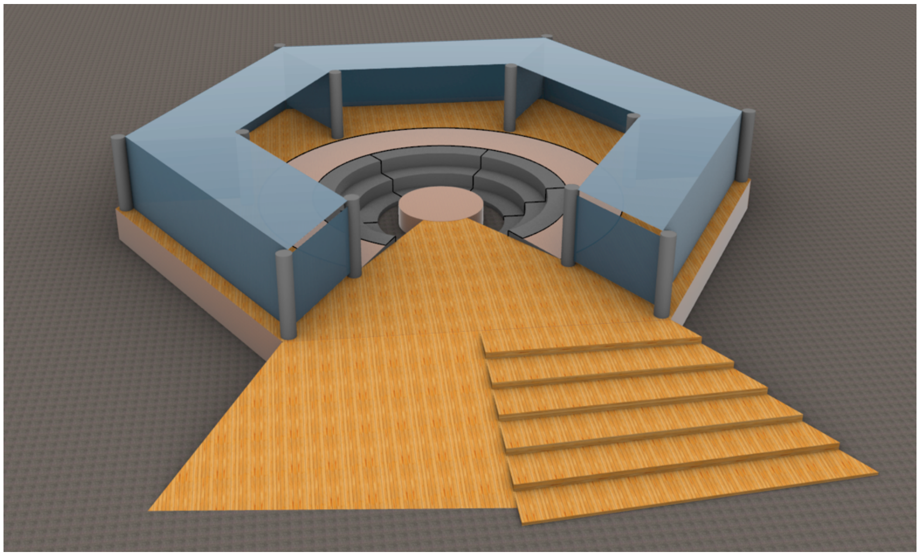


*Figure 12: 3D View of Intimate Circular Area with Ramp Attaching to Platform*

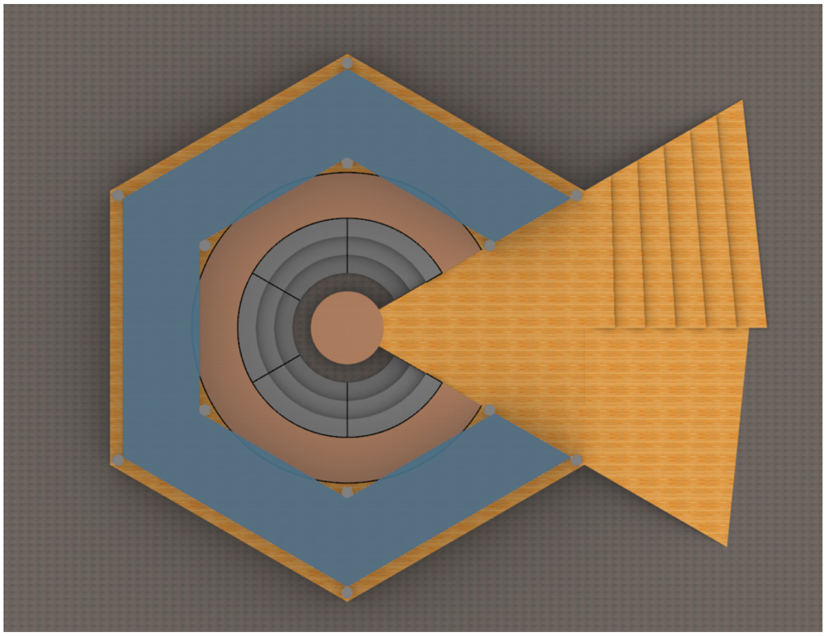


*Figure 13: Plan View Showing Hexagonal Perimeter and Circular Interior Space with Larger Wind/Shade Screens*

The final iteration maintained the outer hexagonal shape but changed the interior space to match (Figure 15). This improved constructability because none of the wood used for framing would have to be curved. The deck was lowered to be no more than 30” tall to avoid the need for a building permit which negated the need for multiple stairs in the entry. The smaller central gathering area was maintained to keep the intimate feeling and the ramp to access the platform was also kept (Figure 14).

Currently, windscreens have only been installed on the northeastern side of the structure since the wind blows in from Morro Bay. The rest of the windscreens may be installed later in construction. There is no plan to implement the speaker platform on top of the fire pit, which removes the need for ramp accessibility.

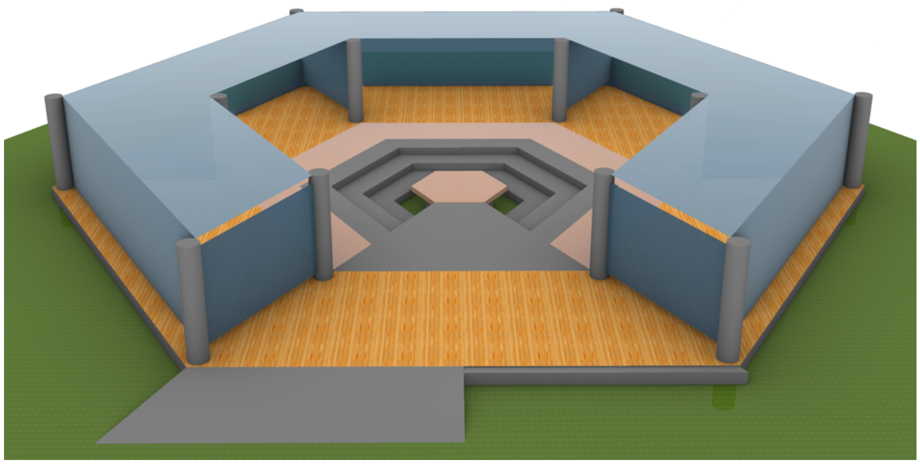


*Figure 14: 3D View Highlighting Shorter Ramp and Hexagonal Central Area*

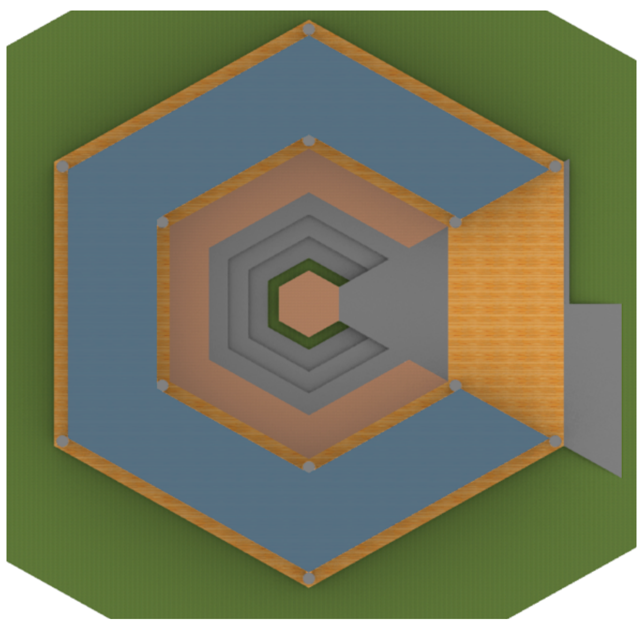


*Figure 15: Plan View of the Final Proposed Structure*

Proposed Site Location

The project is proposed to be at Temple Ner Shalom, located three and a half miles south of Cal Poly's campus, on the other side of Bishop Mountain (Figure 16). Within the Temple Ner Shalom Property, the project is proposed for the North East corner, a spot that has an unobstructed view of Bishop Mountain and fully immerses the users in the surrounding nature (Figure 17).

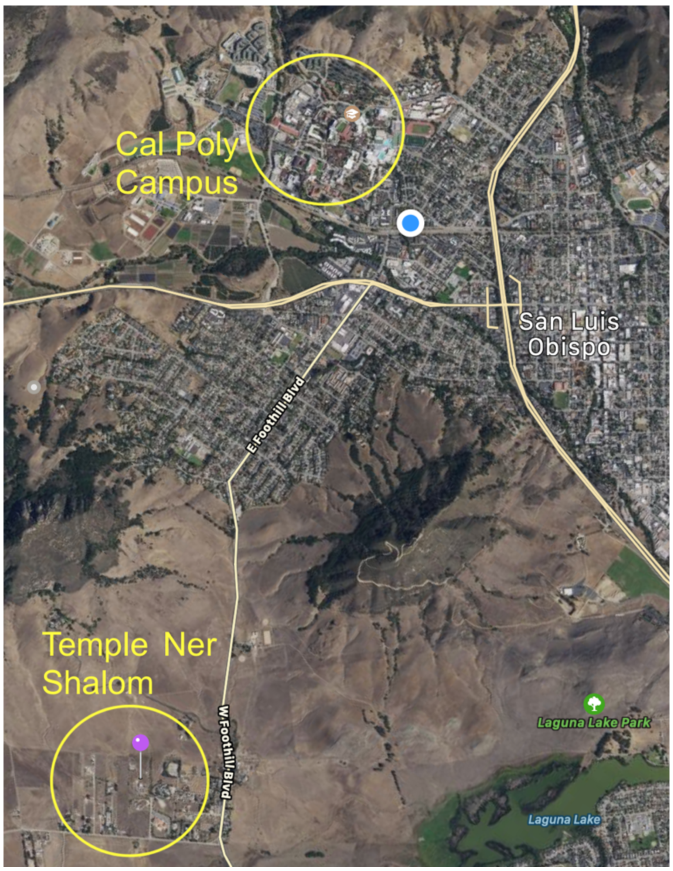



*Figure 16: Temple Ner Shalom is Located 3.5 Miles South of Cal Poly, Directly Off of Foothill Blvd*


*Figure 17: Project Location Shown in the North East Corner of the Temple's Property*

Electrical Drawings

To accommodate the use of the space for community events, lighting and access to electricity are essential. Even though the site is far away from the existing building and getting electricity to the structure will be difficult, I partnered with Rabbi Hyman and John Belsher to come up with an electrical and lighting plan (Figure 18). The outlets, LED strips, sconces, and light fixtures along the pathway were incorporated into the final 3D model (Figure 19, Figure 20). The listed specifications for the lighting and electrical components were put together by John King and John Belsher. In professional practice, electrical drawings include symbols that represent the different components of an electrical system such as the outlets, switches, and circuits (Figure 21, Figure 22). For the purposes of this project, the individual components were distinguished using different colors.

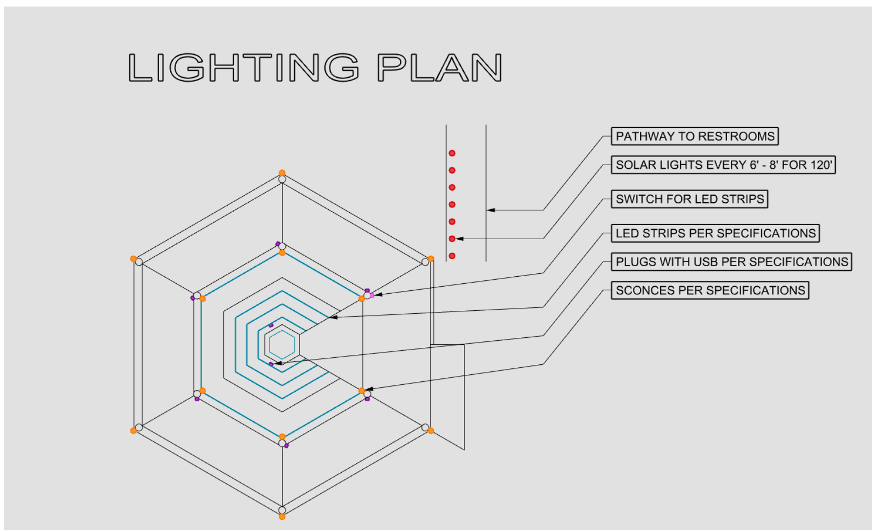



*Figure 18: Proposed Lighting Plan*

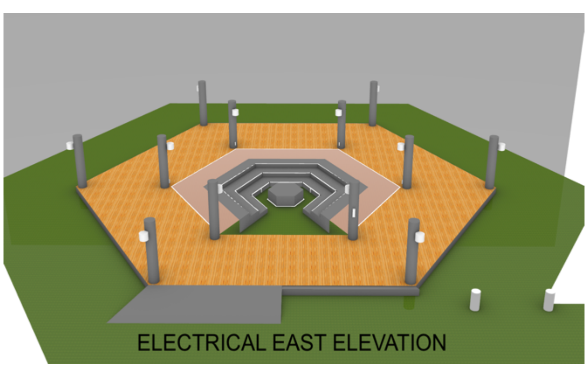



*Figure 19: East Elevation of Electrical Components*

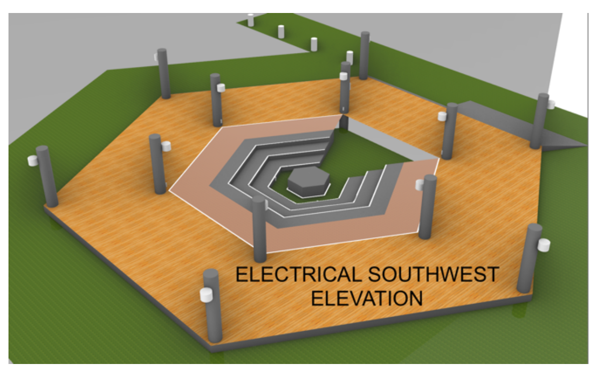



*Figure 20: Southwest Elevation of Electrical Components*

WIRING/ELECTRIC SPECIFICATIONS

A) WIRE SPECIFICATIONS
    a. TANK BREAKER BOX TO BATHROOM – 180 FT.
        i. 6 AWG 3-WIRE COPPER (4% MAX VOLTAGE DROP AT 195 FT.)
        ii. 2 IN. SCHED. 90 PVC CONDUIT
    b. BATHROOM BREAKER BOX TO PLATFORM – 150 FT.
        i. 6 AWG 3-WIRE COPPER
        ii. 2 IN. SCHED. 90 PVC CONDUIT
B) BREAKER BOXES
    a. (2) 50-AMP BOXES (BATHROOM AND PLATFORM)
        i. WEATHERPROOF STRUCTURES FOR EACH
        ii. HOMELINE 50-AMP
C) LED STRIP LIGHTING
    a. 64 FT. TOTAL COMMERCIAL ELECTRIC
    b. (3) 32 FT. STRIPS
D) (9) SCONCES
    a. 100-WATT LED EQUIVALENT PROGRESS LIGHTING
E) DIMMER SWTICH (FOR HOME LIGHTS/SCONCES)
    a. WEATHER-PROOF COVER TOGGLE SWITCH
F) (~10) WEATHER-FROOF JUNCTION BOXES
    a. 4X4X4 PVC
G) (6-PACK) ELECTRICAL OUTLETS WITH USB
    a. 4 AMP USB WITH 20 AMP OUTLET
H) (2) ELECTRICAL GFCI OUTLETS
I) WEATHERPROOF COVERS FOR ELECTRICAL OUTLETS
    a. HOME DEPOT – BOX COVERS
J) EXTERIOR WIRE CABLE TO SWITCHES
    a. 3-WIRE
    b. 100 FT.
    c. DIRECT BURIAL
K) 20 AMP CIRCUIT BREAKERS
    a. (2) FOR PLATFORM
    b. (2) FOR BATHROOM
    c. SQUARE D
L) EXTERIOR SWITCH FOR LED LIGHTS
    a. SEE ABOVE COVER FOR HOUSE DIMMER SWITCH
M) EXTERIOR PATH AND RAMP SOLAR LIGHTS
    a. 150 FT. @ 10 FT. O.C.
    b. (3) 6-PACK HAMPTON BAY

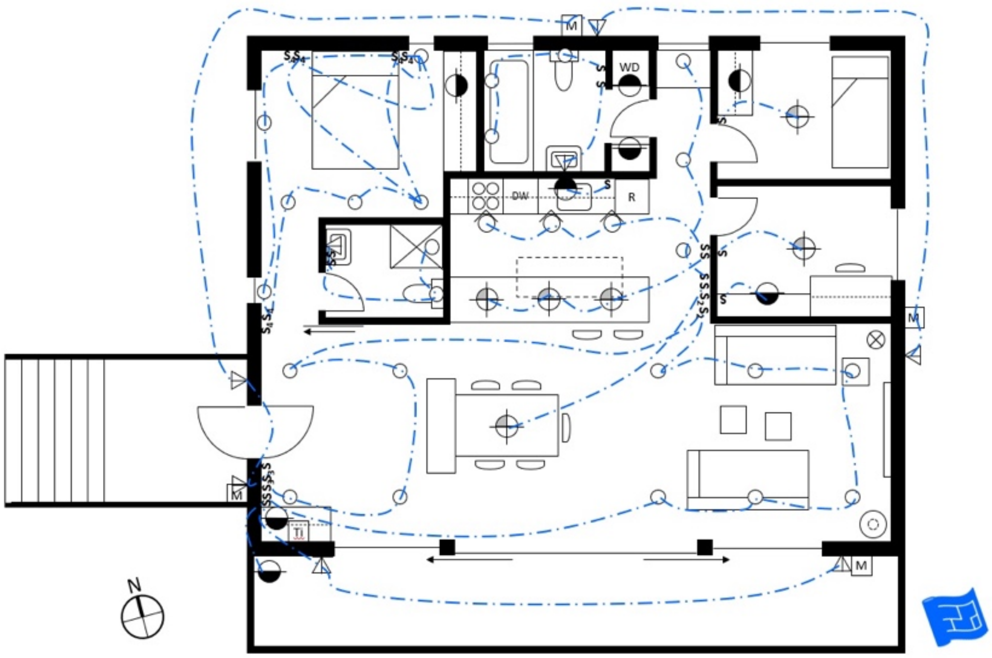


*Figure 21: Plan with All Electrical Components Shown*

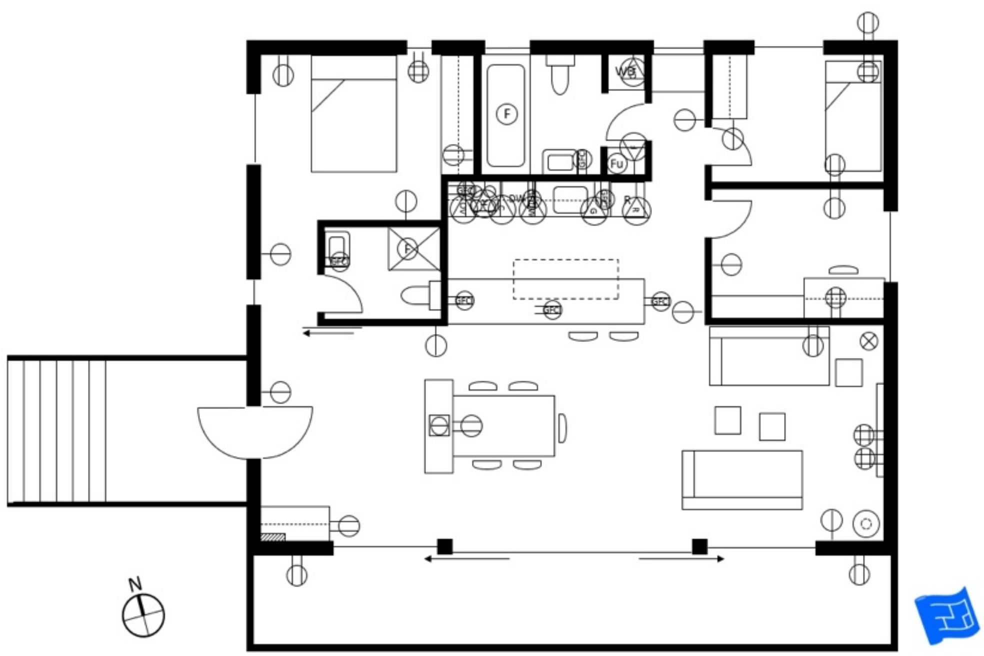


*Figure 22: Plan with All Outlet Locations Shown*

Architectural Drawings

The following are pictures of the final architectural model including a plan view (Figure 23), 3D views, (Figure 2, Figure 3, Figure 4), an elevation (Figure 5), and dimensions for the stairs and ramps (Figure 6, Figure 7). Per the IBC, stairs must be 36” wide minimum, with a 4” – 7” riser, and an 11” tread depth. The inner stairs were designed to be 58” wide with 7” risers and a 24” tread to ensure comfortable seating. Per the IBC, tamps must not exceed a slope ratio of 1:12. The slope of the entrance ramp is 1:7.2 while the ramp to the speaker platform is flat.

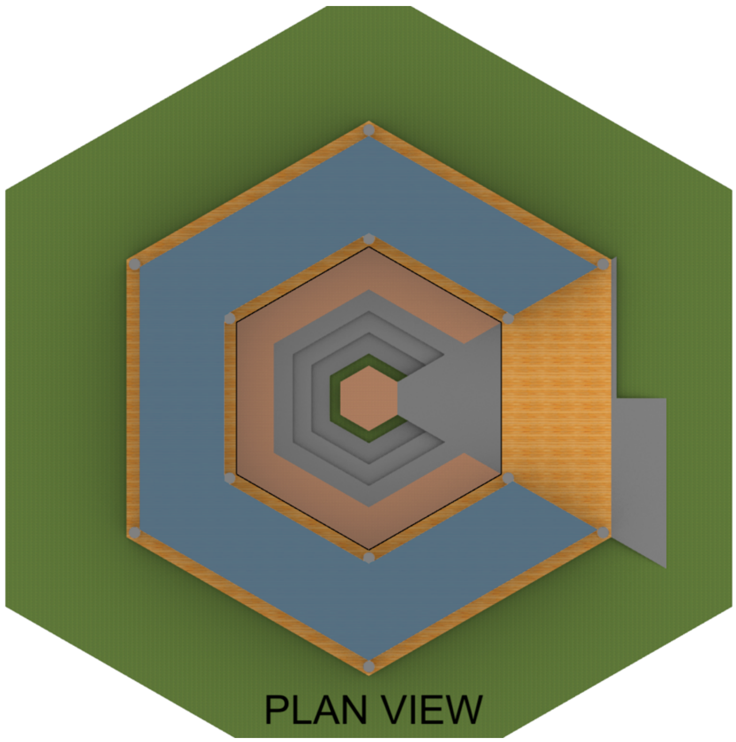



*Figure 23: Plan View of Architectural Model*

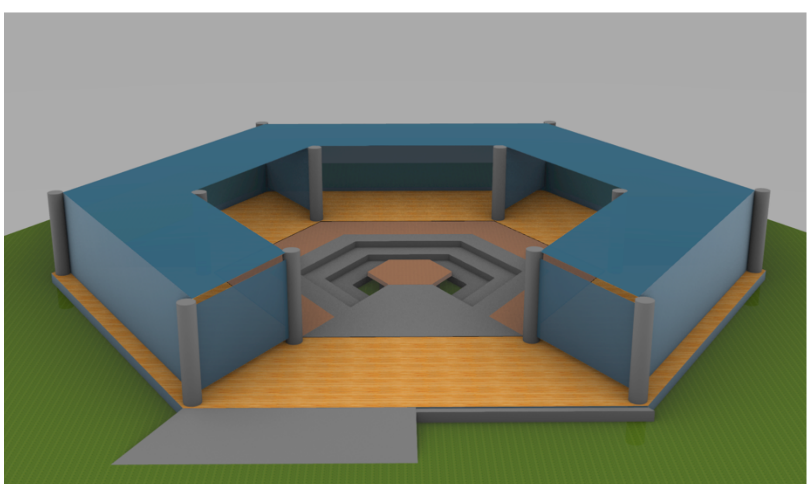


*Figure 24: Perspective Photo Looking South West*

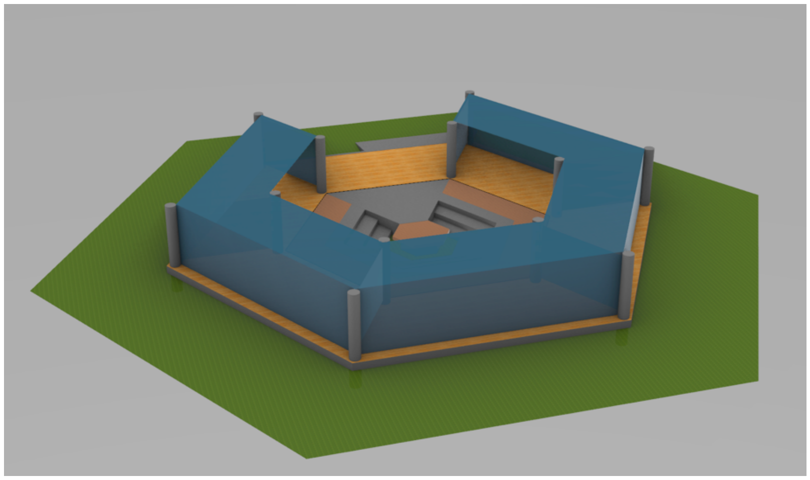


*Figure 25: Perspective Photo Looking North East*

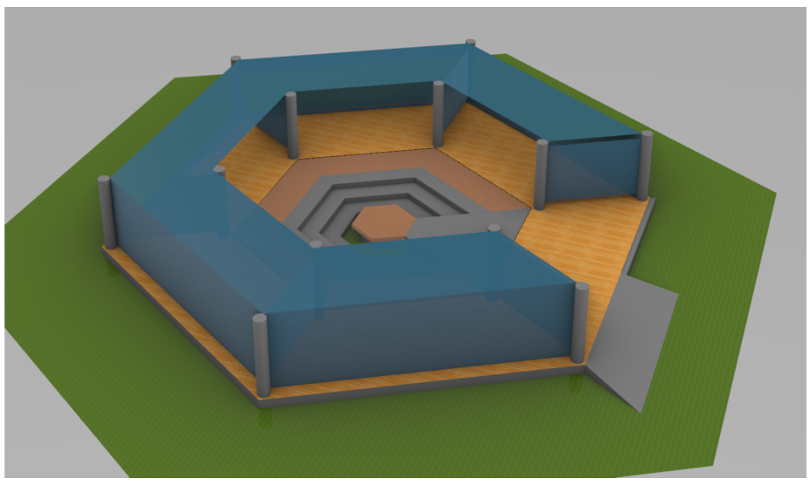


*Figure 26: Perspective Photo Looking North*

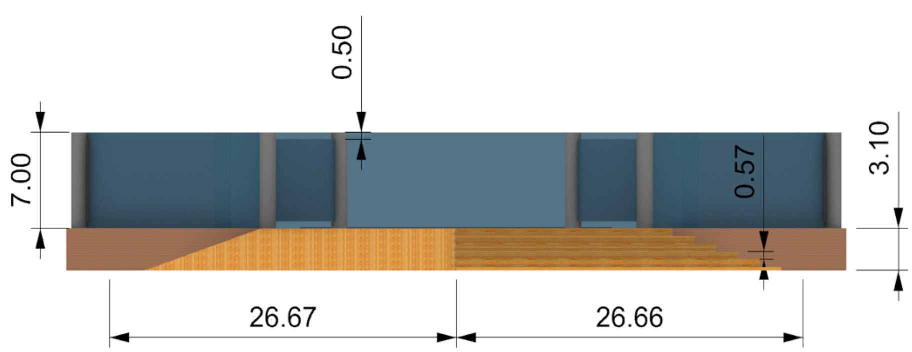



*Figure 27: Elevation Including Some Critical Dimensions (Units: ft.)*

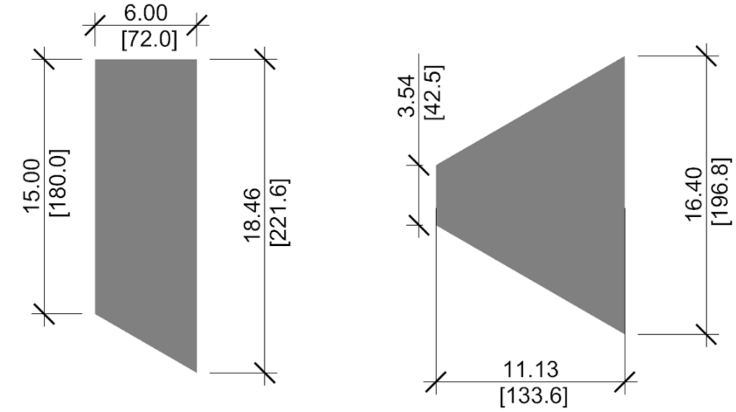



*Figure 28: Plan and Dimensions of Entrance Ramp and Ramp to Center Platform*

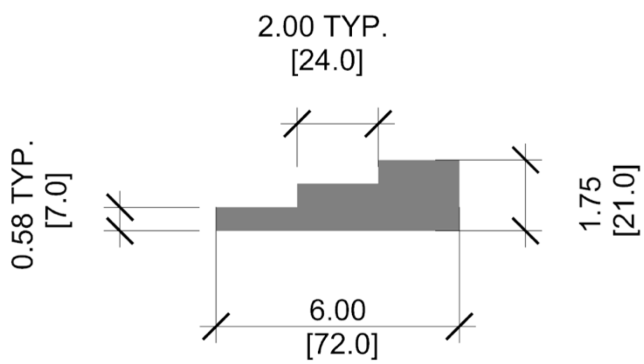



*Figure 29: Section of Stairs into Center Pit with Dimensions*

<u>Construction Progress Photos</u>

The photos shown below document the construction process of the deck and show the weekly progress accomplished by the construction team.

*Figure 30: The construction team has poured the footings and is laying out the girders. Some of the posts have also been connected to the footings.*

*Figure 31: Formwork and crack control rebar for the small slab underneath the firepit*

*Figure 32: Most of the structural members have been framed*

*Figure 33: Decking installed on top of structural framing. Wind screens installed on the northeastern side*

*Figure 34: Construction of firepit is complete using CMU blocks, as well as the deck boards used for the inner ring of seating*

*Figure 35: Decking fully complete and wind screens have been installed. Ramp and stair to access deck fully constructed*

## Load Takeoff:

| | Item | Calcs | Unit Weight (PSF) |
|---|---|---|---|
| 1.5" | Trex Deck | $60pcf(1.5in)\left(\frac{1ft}{12in}\right)$ | 7.5psf |
| 2x6 | Joists | $35pcf\left(\frac{1.5in \times 5.5in}{144in^2/ft^2}\right)\left(\frac{12in/ft}{16in}\right)$ | 1.5psf |
| | Misc. | – | 1.0 psf |
| | Total to Joists | | 10psf |
| 4x6 | Beams | $35pcf\left(\frac{3.5in \times 5.5in}{144in^2/ft^2}\right)\left(\frac{12in/ft}{150in}\right)$ | 0.37psf |
| | Total to Beams | | 10.37psf |
| 6x6 | Girders | $35pcf\left(\frac{5.5in \times 5.5in}{144in^2/ft^2}\right)\left(\frac{12in/ft}{242.5in}\right)$ | 0.37psf |
| | Total to Girders | | 10.75psf |
| 4x10 | Posts | $35pcf\left(\frac{3.5in \times 9.25in}{144in^2/ft^2}\right)\left(\frac{12in/ft}{174in}\right)$ | 0.54 psf |
| | Total to Posts | | 11.3 psf |
| | Live Load = | | 40 psf |

## Seismic Weight:

Total Area = Large Hexagon − Small Hexagon

$$= \frac{3\sqrt{3}}{2}(34.66ft)^2 - \frac{3\sqrt{3}}{2}(5.75ft)^2$$

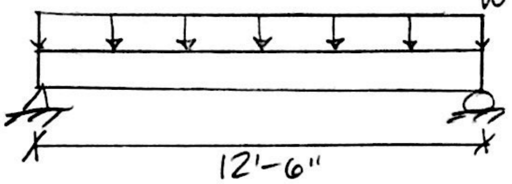
Total Area = $3036.41 \, ft^2$

$W = 11.3 \, psf \, (3036.41 \, ft^2)$

$W = 34311.45^{\#}$

$\underline{\underline{W = 34.31^{K}}}$

Typ. Joist Design!




$W = W_D + W_L$
$= (10\,psf + 40\,psf)(1.33\,ft)$

$W = 66.66\,plf$

$V = \frac{wL}{2} = \frac{(66.66\,plf)(12.5\,ft)}{2}$

$V = 416.67\#$

$M = \frac{wL^2}{8} = \frac{(66.66\,plf)(12.5\,ft)^2}{8}$

$M = 1302.08\,\#ft$ $\qquad (M = 15625\,\#in)$

$F'b = F_b C_D C_m C_t C_L C_F C_{fu} C_i C_r$
$= 1200\,psi(1.0)(1.0)(1.0)(1.0)(1.2)(1.0)(0.8)(1.15)$

$F'b = 1324.8\,psi$

$S_{req'd} = \frac{M}{F'b} = \frac{15625\,\#in}{1324.8\,psi} = 11.79\,in^3$

$F'v = F_v C_D C_m C_t C_i$
$= 180\,psi\,(1.0)(1.0)(1.0)(0.8)$

$F'v = 144\,psi$

$A_{req'd} = \frac{1.5V}{F'v} = \frac{1.5(416.67\#)}{144\,psi} = 4.34\,in^2$

$\Delta_{allow} = \frac{l}{240} = \frac{150\,in}{240} = 0.625\,in$

$I_{req'd} = \frac{5wL^4}{384E\Delta}$

$E' = E\,C_m C_t C_i$
$= 1800000\,psi\,(1.0)(1.0)(0.8)$
$E' = 1710000\,psi$

$I_{req'd} = \frac{5(66.67\,plf)(12.5\,ft)^4(12\,in/ft)^3}{384(1710000\,psi)(0.625\,in)} = 34.27\,in^4$

Try 2x8 Joists:

$A = 10.88 in^2$
$S = 13.14 in^3$
$I = 47.63 in^4$

$$f_b = \frac{M}{S} = \frac{15625 \#in}{13.14 in^3} = 1189.12 psi$$

$$f_v = \frac{1.5V}{A} = \frac{1.5(416.67\#)}{10.88 in^2} = 57.44 psi$$

$$\Delta = \frac{5wL^4}{384EI} = \frac{5(66.67\#/ft)(12.5ft)^4(12in/ft)^3}{384(1710000psi)(47.63in^4)} = 0.45 in$$

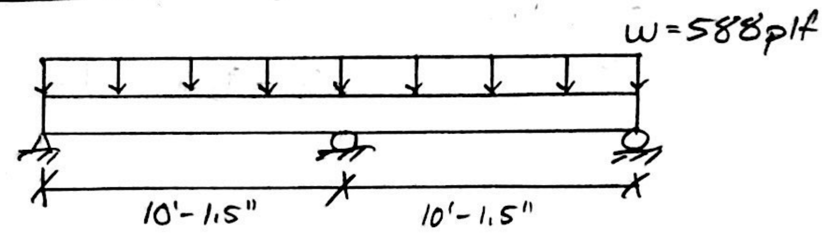
$F'_b = 1324.8 psi > f_b = 1189.12 psi$ OKAY ✓

$F'_v = 144 psi > f_v = 57.44 psi$ OKAY ✓

$\Delta_{allow} = 0.625 in > \Delta_{actual} = 0.45 in$ OKAY ✓

$$\boxed{\text{USE 2x8 Joists @ 16 in. o.c.}}$$

Typical Beam Design:




$W = W_D + W_L$

Live Load Reduction:

$L = L_0\left(0.25 + \frac{15}{\sqrt{K_{LL} A_T}}\right)$ (ASCE-7 §4.7.2)

$K_{LL} = 2$ (Interior Beam, Table 4.7-1)

$A_T = \frac{a+b}{2}h = \frac{(13ft + 27.5ft)}{2}(12.5ft) = 253.13 ft^2$

$L = 40psf\left(0.25 + \frac{15}{\sqrt{2(253.13ft^2)}}\right)$

$L = 36.67 psf$

$w = (10.37psf + 36.67psf)(12.5ft) = 588 plf$

$V_{max}$ @ center support $= \frac{5wL}{8} = \frac{5(588plf)(10.125ft)}{8}$

$V_{max} = 3720.94\#$

$M_{max} = \frac{wL^2}{8} = \frac{588plf(10.125ft)^2}{8}$

$M_{max} = 7534.9 \#ft$ $(M = 90418.78 \# in)$

$F'b = F_b C_D C_m C_t C_L C_{fu} C_F C_i C_r$
$= 1200psi (1.0)(1.0)(1.0)(1.0)(1.0)(1.1)(0.8)(1.0)$

$F'b = 1056 psi$

$S_{req'd} = \frac{M}{F'b} = \frac{90418.78 \# in}{1056 psi} = 85.62 in^3$

$F'v = F_v C_D C_m C_t C_i$
$= 180 psi (1.0)(1.0)(1.0)(0.8)$

$F'v = 144 psi$

$A_{req'd} = \frac{1.5V}{F'v} = \frac{1.5(3720.94\#)}{144psi} = 38.76 in^2$

$$\Delta allow = \frac{l}{240} = \frac{121.5in}{240} = \underline{0.51in}$$

$$I_{req'd} = \frac{5wL^4}{384E\Delta} = \frac{5(588plf)(10.125ft)^4(12in/ft)^3}{384(1710000psi)(0.51in)}$$

$$I_{req'd} = 159.43in^4$$

<u>Try 4x14 Beams:</u>

$A = 46.38in^2$
$S = 102.41in^3$
$I = 678.5in^4$

$$f_b = \frac{M}{S} = \frac{90418.78\#in}{102.41in^3} = 882.91psi$$

$$f_v = \frac{1.5V}{A} = \frac{1.5(3720.94\#)}{46.38in^2} = 120.34psi$$

$$\Delta actual = \frac{5wL^4}{384EI} = \frac{5(588plf)(10.125ft)^4(12in/ft)^3}{384(1710000psi)(678.5in^4)} = 0.12in$$

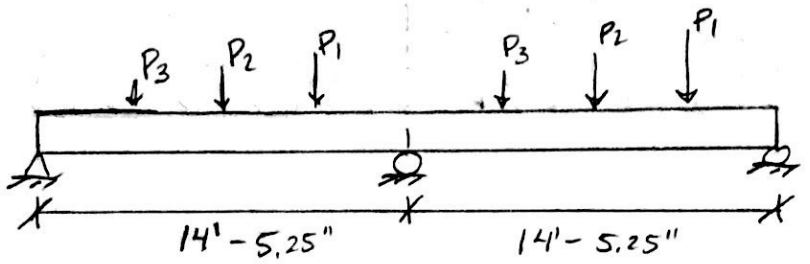
$F'b = 1056psi > f_b = 882.91psi$ OKAY ✓

$F'v = 144psi > f_v = 120.34psi$ OKAY ✓

$\Delta allow = 0.51in > \Delta actual = 0.12in$ OKAY ✓

$$\boxed{\text{USE 4x14 Beams}}$$

Typical Girder Design:




$P_1 = (10.75\text{ psf} + 40\text{ psf})(1.33\text{ft})(9.25\text{ft}/2)(2)$

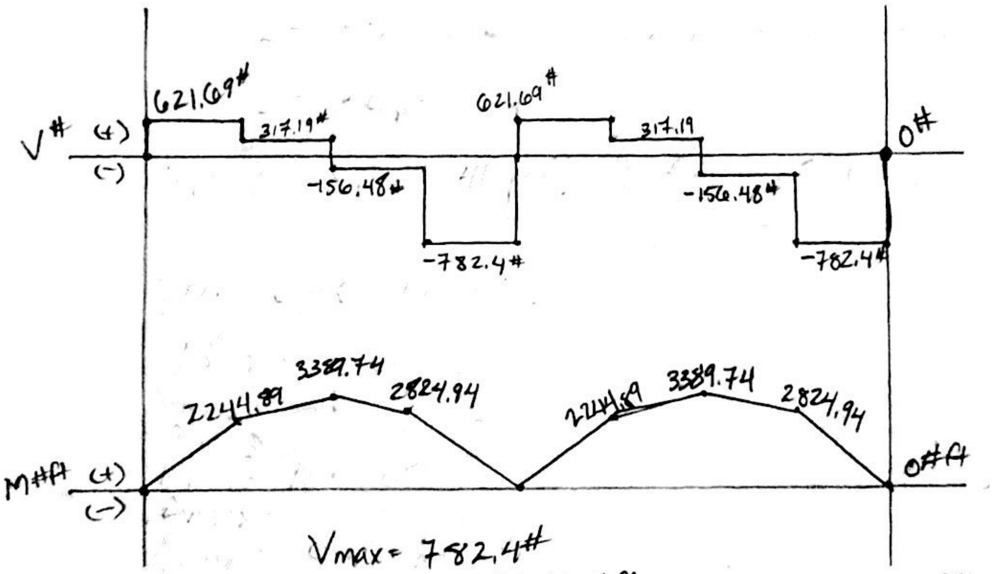
$P_1 = 625.92\#$

$P_2 = (10.75\text{ psf} + 40\text{ psf})(1.33\text{ft})(7\text{ft}/2)(2)$

$P_2 = 473.67\#$

$P_3 = (10.75\text{ psf} + 40\text{ psf})(1.33\text{ft})(4.5\text{ft}/2)(2)$

$P_3 = 304.5\#$




$V_{max} = 782.4\#$

$M_{max} = 3389.74\ \#ft$ $(M = 40676.83\ \#in)$

$F'_b = F_b\, C_D C_M C_t C_L C_F C_{fu} C_i C_r$

$= 1350\text{ psi}(1.0)(1.0)(1.0)(1.0)(1.0)(1.0)(0.8)(1.0)$

$F'_b = 1080\text{ psi}$

$S_{req'd} = \dfrac{M}{F'_b} = \dfrac{40676.83\#in}{1080\text{psi}} = 37.66\ in^3$

$F'v = Fv\, C_D C_M C_t C_i$
$= 170\,psi\,(1.0)(1.0)(1.0)(0.8)$

$F'v = 136\ psi$

$A_{req'd} = \frac{1.5V}{F'v} = \frac{1.5(782.94^{\#})}{136psi} = 8.63\ in^2$

$\Delta allow = \frac{l}{240} = \frac{173.25in}{240} = 0.722in$

From ENERCALC: $\Delta actual = 0.413in$

Try 6X8 Girders:

$A = 41.25\ in^2$
$S = 51.56in^3$
$I = 193.4\ in^4$

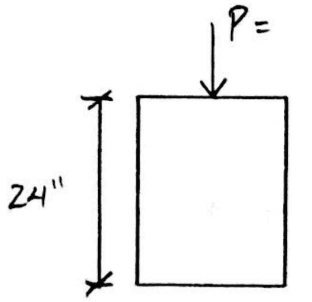
$f_b = \frac{M}{S} = \frac{40676.83\#in}{51.56in^3} = 788.92psi$

$f_v = \frac{1.5V}{A} = \frac{1.5(782.4^{\#})}{41.25in^2} = 28.45\ psi$

$F'b = 1080\,psi > f_b = 788.92psi$ OKAY ✓
$F'v = 136psi > f_v = 28.45psi$ OKAY ✓
$\Delta allow = 0.722in > \Delta actual = 0.413in$ OKAY ✓

$\boxed{\text{USE 6X8 Girders}}$

## Worst-Case Post Design:




$$P = (D + L)A_T$$

Live Load Reduction:

$$L = L_o\left(0.25 + \frac{15}{\sqrt{K_{LL}A_T}}\right) \qquad \text{(ASCE-7 § 4.7.2)}$$

$$K_{LL} = 4$$

$$A_T = \left(\frac{a+b}{2}\right)h\,(2) = \frac{(6.5\,ft + 13.75\,ft)}{2}(12.5\,ft)(2)$$

$$A_T = 253.125\ ft^2$$

$$L = 40\,psf\left(0.25 + \frac{15}{\sqrt{4(253.125\,ft^2)}}\right) =$$

$$L = 28.86\ psf$$

$$P = (11.3\,psf + 28.86\,psf)(253.125\,ft^2)$$

$$P = 10165.5\ \#$$

Post is so short, crushing will govern.

$$F'c = F_c C_D C_m C_t C_F C_i C_p$$
$$= 1500\,psi\,(1.0)(1.0)(1.0)(1.0)(0.8)\,C_p$$

Assume pin-pin $(K = 1.0)$

$$l_e = 1.0(24")$$
$$l_e = 24\,in$$

$$\frac{l_{e1}}{d_1} = \frac{24\,in}{6\,in} = 4 \qquad \frac{l_{e2}}{d_2} = \frac{24\,in}{4\,in} = 6$$

$$F_{cE} = \frac{0.822\,E'_{min}}{(l_e/d)^2}$$

$$E'_{min} = E_{min} C_M C_t C_i C_T$$
$$= 620000\ psi (1.0)(1.0)(0.8)(1.0)$$

$$E'_{min} = 496000\ psi$$

$$F_{CE} = \frac{0.822(496000\ psi)}{(6)^2} = 11325.33\ psi$$

$$F_c^* = 800\ psi$$

$$C_p = \frac{1 + F_{CE}/F_c^*}{2c} - \sqrt{\left(\frac{1+F_{CE}/F_c^*}{2c}\right)^2 - \frac{F_{CE}/F_c^*}{c}}$$

$$= \frac{1 + \frac{11325.33 psi}{1200 psi}}{2(0.8)} - \sqrt{\left(\frac{1+\frac{11325.33 psi}{1200 psi}}{2(0.8)}\right)^2 - \frac{\left(\frac{11325.33 psi}{1200 psi}\right)}{0.8}}$$

$$C_p = 0.977$$

$$F'_c = 1500 psi (0.8)(0.977)$$

$$\underline{F'_c = 1172.90\ psi}$$

$$A_{req'd} = \frac{P}{F'_c} = \frac{10165.5\#}{1172.90 psi}$$

$$A_{req'd} = 8.67 in^2$$

Try 4x6 Post:

$$f_c = P/A = 10165.5\# / 19.25 in^2$$

$$f_c = 528.08\ psi$$

$F'_c > f_c$ OKAY ✓

$$\boxed{\text{USE 4x6 Posts}}$$

Worst-Case Footing Design:

No soils report → use IBC Table 1806.2

$q_{allow} = 1500\,psf$

Assume $f'c = 3000\,psi$

$A_{FTG} = \frac{P}{q_{allow}} = \frac{10165.5^{\#}}{1500\,psf}$

$A_{FTG} = 6.78\,ft^2$

$B_{req'd} = 2.6\,ft$

Try $3' \times 3' \times 24''$ Square Ftg

$q = \frac{P}{A}$

$P = 10165.5^{\#} + 150\,pcf\,(3ft)^2(1.5ft)$

$P = 12190.5^{\#}$

$q = 12190.5^{\#} / 9ft^2$

$q = 1354.5\,psf < 1500\,psf$ OKAY ✓

$\boxed{\text{USE } 3' \times 3' \times 18'' \text{ Square FTGs}}$

Wind ELFP: USING ASCE 7-16 Table 29.1-1

Step 1: Risk Category II (Table 1.5-1)

Step 2: Basic Wind Speed, V

$V = 92\ mph$

Step 3: Determine wind load parameters

$K_d = 0.85$ (Table 26.6-1)

Exposure category: C (§ 26.7.3)

$K_{zt} = 1.0$ (§ 26.8.2)

$K_e = 1.0$ (§ 26.9)

$G = 1.0$

Step 4: Determine pressure exposure coefficients

$K_z = 0.85$

Step 5: Determine velocity pressure

$q_z = 0.00256\, K_z K_{zt} K_d K_e V^2$

$= 0.00256(0.85)(1.0)(0.85)(1.0)(92)^2$

$q_z = 15.66\ psf$

Step 6: Determine force coefficient

$C_f = 1.8$

Step 7: Calculate Wind Force, F or pressure, p

$F = q_z G C_f A_f$

$= (15.66\ psf)(1.0)(1.8)(171\ ft^2)$

$F = 4818.6^{\#}$

Seismic ELFP: USING ASCE 7-16 §15.1.3 & §12.8

Address: 875 Laureate Ln, San Luis Obispo, CA 93405

Latitude: 35.2883 Longitude: -120.7069

$S_s = 1.012$ $S_1 = 0.375$

$S_{ms} = 1.215$ $S_{m1} = (1.925)(0.375) = 0.7219$

$S_{DS} = 0.81$ $S_{D1} = (2/3)S_{m1} = 0.481$

Response Modification Factor:

$R = 1.25$ (Table 15.4-2)

Importance Factor:

$I_e = 1.0$

Approximate Period:

$T_a = C_t h_n^x = 0.02(2.5)^{0.75}$

$T_a = 0.04$ sec

Calculate $C_s$:

$C_s = \frac{S_{DS}}{(R/I)} = \frac{0.81}{(1.25/1.0)} = \underline{\underline{0.648}}$

$C_s = \frac{S_{D1}}{T(R/I)} = \frac{0.481}{0.04(1.25)} = 9.62$ (max)

$C_s = 0.044 S_{DS} I_e \geq 0.01$
$= 0.044(0.81)(1.0) = 0.036$ (min)

Calculate W:

From Load Takeoff:

$W = 34.31^k$

$V = 0.648(34.31^k)$

$\underline{\underline{V = 22.23^k}}$

Joist - Beam Connection:

$V_{max} = 416.67^{\#}$

Try LUS26 Face Mount Hanger

Capacity = $865^{\#} > 416.67^{\#}$ OKAY ✓

$\boxed{\text{USE LUS26 Face Mount Hangers}}$

Joist - Girder Connection

$V_{max} = 416.67^{\#}$

Try A35 clips

Capacity = $590^{\#} > 416.67^{\#}$

$\boxed{\text{USE A35 Straps @ 150° skew}}$

Beam - Post Connection:

Beam does not carry axial loads

Gravity only, no uplift

Check member capacity for $F'_{c\perp}$, see S

$\boxed{\text{USE AC4 Post Caps}}$

## Girder-Post Connection:

Girder does not carry axial loads, only gravity

Check: member capacity for $F'c_{\perp}$, see S

$\boxed{\text{USE AC6 Post Caps}}$

## Post-Base Connection:

$P_{max} = 10165.5^{\#}$

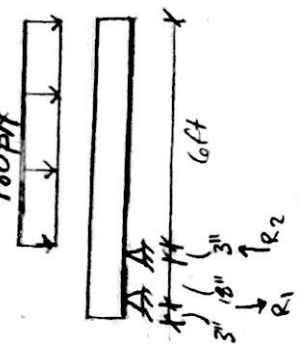
Try CBSQ46-SDS2

Check Post Base shear capacity, see S

Capacity = $14420^{\#} > 10165.5^{\#}$ OKAY ✓

$\boxed{\text{USE CBSQ46-SDS2 Column Base}}$

## Wind Screen Base Connection:




$w = 15.66\ psf(11.5ft)$

$w = 180plf$

$\circlearrowleft \Sigma M_{R1} = 0$

$180plf(6ft)(4.75ft) + R_2(1.5ft) = 0$

$R_2 = 3420^{\#} \leftarrow$

$\rightarrow \Sigma F_x = 0$

$180plf(6ft) - 3420^{\#} - R_1 = 0$

$R_1 = 2340^{\#} \rightarrow$

Try 5/8" A307 ABs

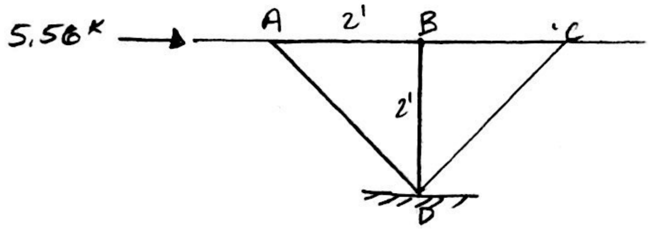
Capacity = $10400^{\#} > 3420^{\#}$

$\boxed{\text{USE 5/8" } \phi \text{ A307 Anchor Bolts}}$

N-S Knee Brace Design:

Assume 25% to Line 1, Line 5
50% to Line 3

Line 1 & Line 5:




$L_{Brace} = \sqrt{2^2+2^2}$

$L_{Brace} = 2.83\ ft$

$$F_{Brace} = \frac{2.83}{2}(5.56^K) = 7.86^K$$

$$F'_t = F_t C_D C_m C_t C_F C_i$$
$$= 675\,psi(1.6)(1.0)(1.0)(1.5)(0.8)$$

$$F'_t = 1296\,psi$$

$$F'_c = F_c C_D C_m C_t C_F C_i C_P$$
$$= 1500\,psi(1.6)(1.0)(1.0)(1.05)(1.0)\,C_P$$

$$C_P = \frac{1+(F_{cE}/F_c^*)}{2c} - \sqrt{\left(\frac{1+(F_{cE}/F_c^*)}{2c}\right)^2 - \frac{F_{cE}/F_c^*}{c}}$$

$$F_{cE} = \frac{0.822\,E'_{min}}{(l_e/d)^2}$$

$$E'_{min} = E_{min} C_m C_t C_i C_T$$
$$= 620{,}000\,psi(1.0)(1.0)(0.95)(1.0)$$

$$E'_{min} = 589{,}000\,psi$$

$$\frac{l_{e_1}}{d_1} = \frac{33.94\,in}{1.5\,in} = 22.63$$

$$F_{cE} = \frac{0.822(589000\,psi)}{(22.63)^2}$$

$$F_{cE} = 945.62\,psi$$

$$F_c^* = 2520\,psi$$

$$C_P = \frac{1+(945.62\,psi/2520\,psi)}{2(0.8)} - \sqrt{\left(\frac{1+(945.62\,psi/2520\,psi)}{2(0.8)}\right)^2 - \left(\frac{945.62\,psi/2520\,psi}{0.8}\right)}$$

$$C_P = 0.340$$

$F'c = 1500psi\,(1.6)(1.05)(0.340)$

$F'c = 857.23\,psi$ (governs)

$Areq'd = P/F'c = 7860\#/857.23psi$

$Areq'd = 9.17in^2$

Try 2x8 Knee Brace:

$A = 10.88in^2$

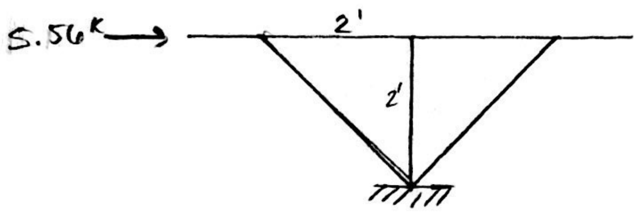
$f_c = 7860\#/10.875in^2$

$f_c = 722.76\,psi$

$f_c < F'c$ OKAY ✓

$\boxed{\text{USE 2x8 Knee Braces}}$

Line 3: 2 braces in Line - 1/2 $F_{Line}$ to each




$L_{Brace} = \sqrt{2^2+2^2}$

$L_{Brace} = 2.83\,ft$

$F_{Brace} = \frac{2.83ft}{2ft}(5.56^K) = 7.86^K$

$F'c = F_c C_D C_m C_t C_F C_i C_p$
$= 1500\,psi\,(1.6)(1.0)(1.0)(1.05)(1.0)\,C_p$

$C_p = \frac{1+(F_{cE}/F_c^*)}{2c} - \sqrt{\left(\frac{1+F_{cE}/F_c^*}{2c}\right)^2 - \frac{F_{cE}/F_c^*}{c}}$

$F_{cE} = \frac{0.822E'min}{(l_e/d)^2}$

$E'min = E_{min}\,C_m C_t C_i C_T$
$= 620000psi\,(1.0)(1.0)(0.95)(1.0)$

$E'min = 589{,}000psi$

$$le/d = \frac{33.94in}{1.5in} = 22.63$$

$$F_{cE} = \frac{0.822\,(589{,}000psi)}{(22.63)^2}$$

$F_{cE} = 945.62\ psi$

$F_c^* = 2520\ psi$

$$C_p = \frac{1 + 945.62psi/2520psi}{2(0.8)} - \sqrt{\left(\frac{1 + 945.62psi/2520psi}{2(0.8)}\right)^2 - \frac{945.62psi/2520psi}{0.8}}$$

$C_p = 0.340$

$F'_c = 1500psi\,(1.6)(1.05)(0.340)$

$F'_c = 857.23psi$

$A_{req'd} = P/F'_c = 7860^{\#}/857.23\ psi$

$A_{req'd} = 9.17\ in^2$

Try 2x8 Knee Brace:

$A = 10.88\ in^2$

$f_c = 7860^{\#}/10.88in^2$

$f_c = 722.76\ psi$

$f_c < F'_c$ OKAY ✓

| USE 2x8 Knee Braces |
|---|

Note: Structure is symmetrical;

use 2x8 Braces around perimeter

use (2) 2x8 Braces @ every girder line

Check Beam for $F'_{c\perp}$:

$F'_{c\perp} = F_{c\perp} C_m C_t C_i C_b$

$C_b = \frac{l_b + 0.375}{l_b} = \frac{5.5in + 0.375}{5.5in}$

$C_b = 1.068$

$= 625psi(1.0)(1.0)(1.0)(1.068)$

$F'_{c\perp} = 667.61psi$

$f_{c\perp} = P/A = 10165.5^{\#}/(3.5in)(5.5in)$

$f_{c\perp} = 528.08 psi$

$f_{c\perp} = 528.08 psi < F'_{c\perp} = 667.61 psi$ OKAY ✓

Check Girder for $F_{c\perp}$:

$F'_{c\perp} = F_{c\perp} C_m C_t C_i C_b$

$C_b = \frac{l_b + 0.375}{l_b} = \frac{3.5in + 0.375}{3.5in}$

$C_b = 1.107$

$= 625psi(1.0)(1.0)(1.0)(1.107)$

$F'_{c\perp} = 691.96 psi$

$f_{c\perp} = P/A = 1404.09^{\#}/(3.5in)(5.5in)$

$f_{c\perp} = 72.94 psi$

$f_{c\perp} = 72.94 psi < F'_{c\perp} = 691.96 psi$ OKAY ✓

Post Base Shear Capacity:

$V_{req'd} = 1064.5\#$

Base uses (14) 1/4" x 2" Strong Drive Screws

Per Simpson, Allowable Shear = 290#

Capacity = 14(290#) = 4060#

$V_{req'd} = 1064.5\# < \text{Capacity} = 4060\#$ OKAY ✓

Knee Brace Bolt Design:

Beam-Brace Bolts:

Main member: $t_m = 3.5"$
Side member: $t_m = 1.5"$
Bolt Diameter: $\phi = 7/8"$

$Z_{11} = 1590\#$

From AWC Connection Calculator:

ASD capacity = 2544 #/bolt

Demand = 7860#

# bolts = 7860#/2544 #/bolt

= 3.09 bolts ⇒ use 4 bolts

Capacity = 4(2544#) = 10176# OKAY ✓

End dist: 2D = 2(7/8") = 1.75"

Edge dist: 1.5D = 1.5(7/8") = 1.3"

Row spacing: 3D = 3(7/8") = 2.68"

Space between Rows: 1.5D = 1.3"

$\boxed{\text{USE (4) 7/8"}\ \phi\ \text{A307 bolts}}$

## Beam - Post Bolts: (Double Shear)

Main Member: $t_m = 3.5''$
Side member: $t_m = 1.5''$
Bolt Diameter: $\phi = 7/8''$

$Z_{11} = 3180\#$

From AWC Connection Calculator:

ASD Capacity = 5089#/bolt

Demand = 15720#

# bolts = 15720# / 5089#/bolt

= 3.09 bolts ⇒ use 4 bolts

Capacity = 4(5089#) = 20356# OKAY ✓

End dist: 2D = 2(7/8") = 1.75"

Edge dist: 1.5D = 1.5(7/8") = 1.31"

Row Spacing: 3D = 3(7/8") = 2.63"

Spacing Between Rows: 1.5D = 1.31"

$\boxed{\text{USE (4) 7/8" } \phi \text{ A307 Bolts}}$

## Girder - Brace Bolts:

Main Member: $t_m = 5.5''$
Side Member: $t_m = 1.5''$
Bolt Diameter: $\phi = 7/8''$

$Z_{11} = 1590\#$

From AWC Connection Calculator:

ASD Capacity = 2544#/bolt

Demand = 78600#

#bolts = 7860# / 2544 #/bolts

= 3.09 bolts ⇒ use 4 bolts

Capacity = 4(2544#) = 10176#  OKAY ✓

End dist: 2D = 2(7/8") = 1.75"

Edge dist: 1.5D = 1.5(7/8") = 1.31"

Row spacing: 3D = 3(7/8") = 2.63"

Spacing between rows: 1.5D = 1.31"

$\boxed{\text{USE (4) 7/8"}\phi\text{ A307 Bolts}}$

Girder-Post Bolts: (Double Shear)

Main Member: tm = 5.5"
Side member: tm = 1.5"
Bolt Diameter: $\phi$ = 7/8"

$Z_{II}$ = 1590#

From AWC Connection Calculator:

ASD Capacity = 5089#/bolt

Demand = 15720#

#bolts = 15720# / 5089#/bolt

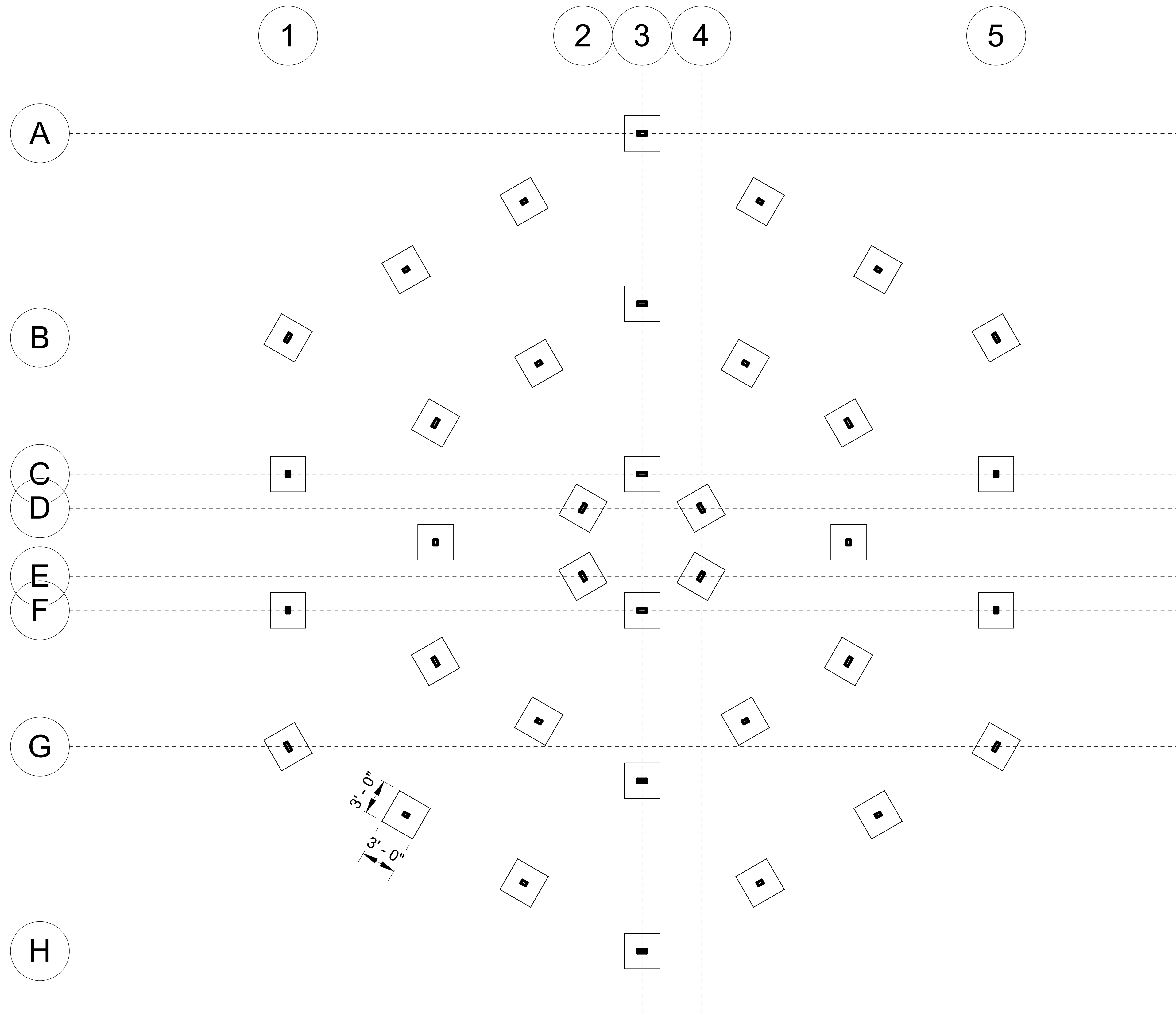
= 3.09 bolts → use 4 bolts

Capacity = 4(5089#) = 20356#  OKAY ✓

End dist = 1.75"  Edge dist = 1.31"

Row spacing = 2.63"  Spacing between rows: 1.31"

$\boxed{\text{USE (4) 7/8"}\phi\text{ A307 Bolts}}$




1 FOUNDATION PLAN
1" = 10'-0"

HILLEL OF
SAN LUIS OBISPO

PROJECT:

MAKOM HILLEL

SITE:
875 LAUREATE LN
SAN LUIS OBISPO,
CA 93405

REVISIONS:

| DESCR. | DATE |
|---|---|
| | |
| | |
| | |

DRAWN BY: EJG

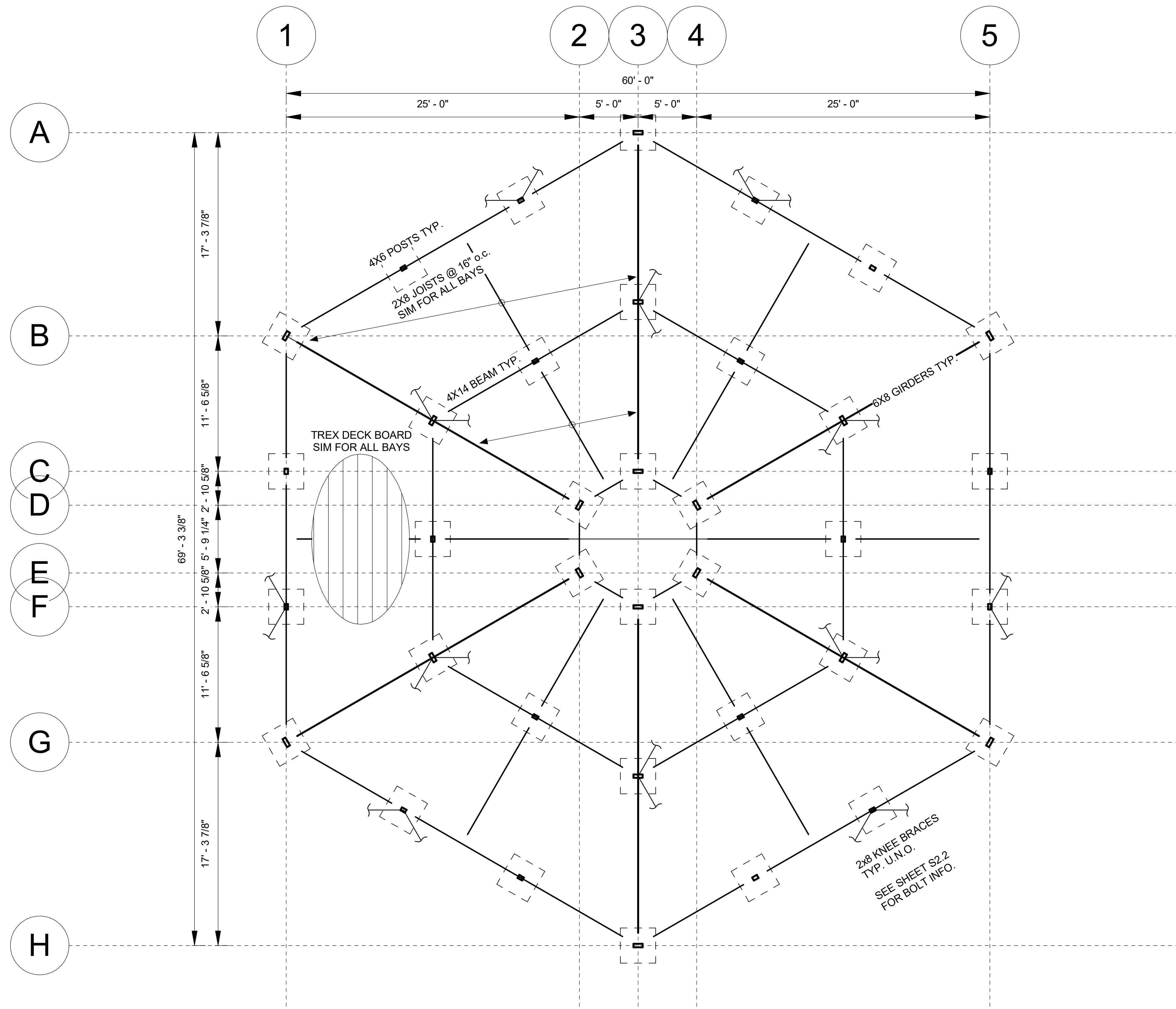
SHEET NAME:

FOUNDATION PLAN

SCALE: 1" = 10'-0"

SHEET NO.:

S2.0




1 DECK PLAN
1" = 10'-0"

HILLEL OF
SAN LUIS OBISPO

PROJECT:

MAKOM HILLEL

SITE:
875 LAUREATE LN
SAN LUIS OBISPO,
CA 93405

REVISIONS:

| DESCR. | DATE |
|---|---|
| FRAMING PLAN | 4/28/21 |
| UPDATED LABELING | 10/25/21 |
| DRAW IN BRACES | 12/2/21 |

DRAWN BY: EJG

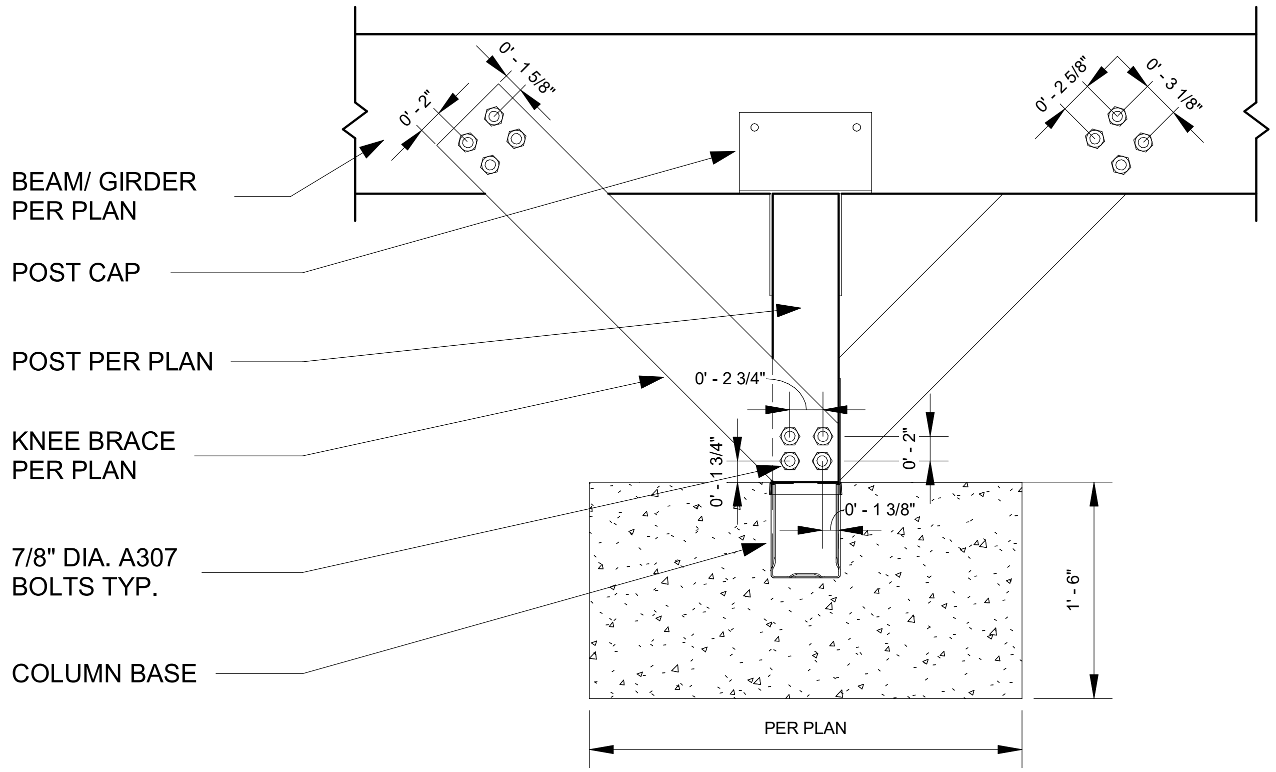
SHEET NAME:

DECK
FRAMING PLAN

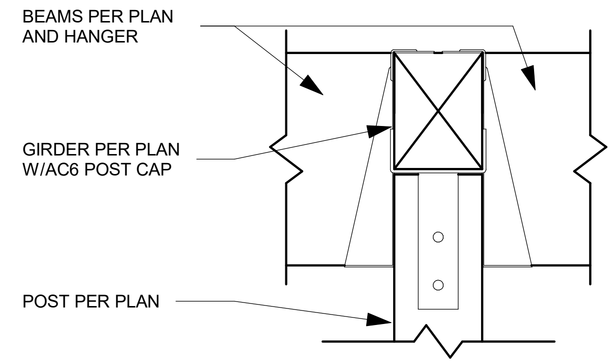
SCALE: 1" = 10'-0"

SHEET NO.:

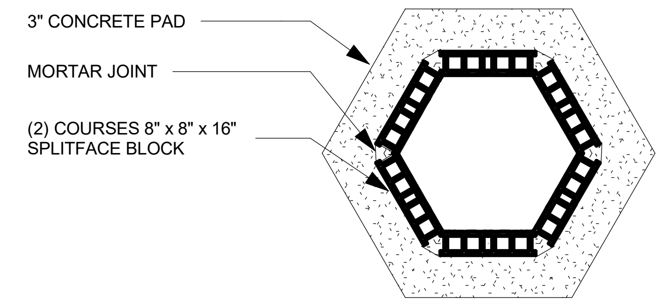
S2.1



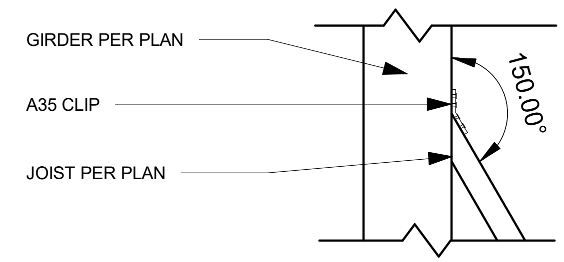

8 KNEE BRACE CONNECTION
3/4" = 1'-0"



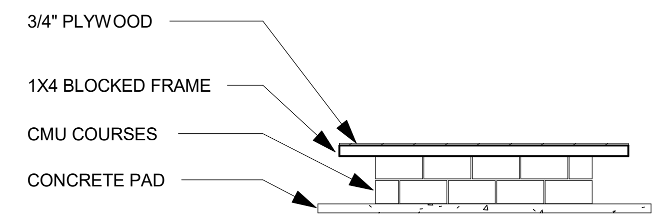

5 BEAM GIRDER POST CONNECTION
1" = 1'-0"



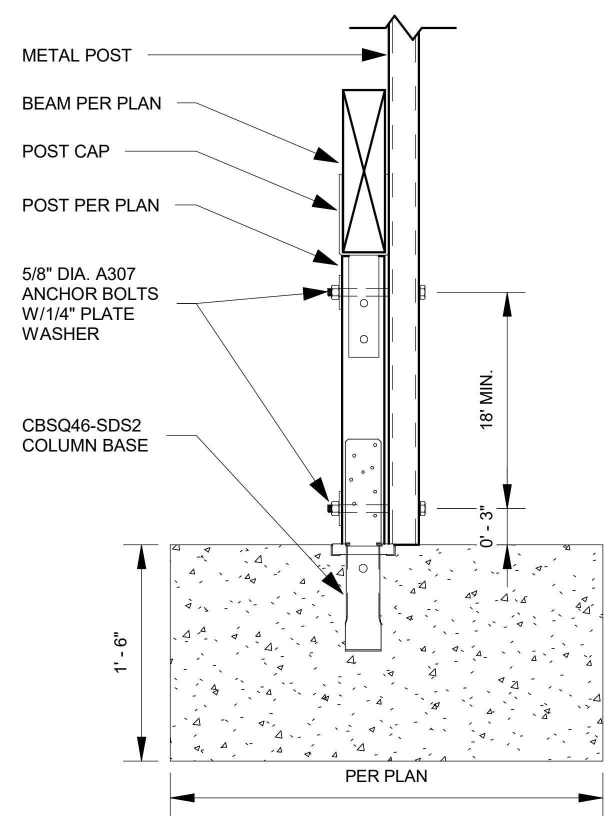

1 FIRE PIT PLAN
3/16" = 1'-0"



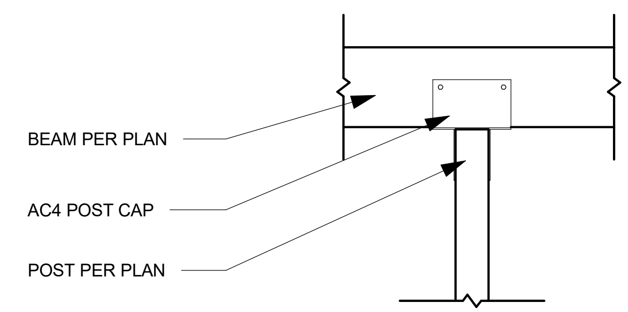

6 JOIST GIRDER CONNECTION
1" = 1'-0"



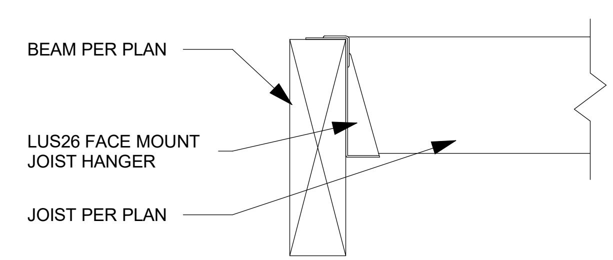

2 FIRE PIT ELEVATION
3/16" = 1'-0"




7 WIND SCREEN CONNECTION
3/4" = 1'-0"




3 BEAM POST CONNECTION
3/8" = 1'-0"




4 JOIST BEAM CONNECTION
1" = 1'-0"

SLO Hillel

HILLEL OF SAN LUIS OBISPO

PROJECT:
MAKOM HILLEL

SITE:
875 LAUREATE LN
SAN LUIS OBISPO, CA 93405

REVISIONS:

| DESCR. | DATE |
|---|---|
| DETAILS 1-5 | 4/28/21 |
| DETAILS 6-8 | 11/14/21 |
| | |

DRAWN BY: EJG

SHEET NAME:
DETAILS

SCALE: AS SHOWN

SHEET NO.:
S2.2

Global, Political, Economic, Environmental, and Societal Impacts

It's difficult to predict what kind of impact a small structure like this could have on the global and political climate. While I do not believe any large scale change will be produced from the design of this event space, my hope is that it strengthens the Cal Poly and San Luis Obispo Jewish communities, and perhaps even the California Jewish community, and allows Jews to feel comfortable gathering in a space they get to call their own.

The economic impact of this project can be tied to all of the donors who contributed to the fundraising. I believe that many of the kind donors will want to see the space in person and will encourage them to continue donating when they can after seeing first-hand the impact of their generosity.

Since the deck is on the smaller end of the spectrum, it was easy to use wood, a more sustainable material. The incising on the wood, while involved chemicals that harm the environment, will prevent the structural members from rotting and needing to be replaced. In the long run, this will require less wood and allows the structure to thrive for a long time. In addition, there was minimal concrete used throughout the construction process, creating as little carbon emission as possible.

As for the societal implications this project will have, I hope that other students and even industry professionals can look at this senior project as a reminder of the importance to give back to the communities that have given so much to us. It's very easy to get caught up in doing things for ourselves and focusing on what we need. That's extremely important, but we must also take some time to recognize what our communities need and use the tools we have to help improve the lives of those who have improved ours.

Takeaways from My Senior Project

Over the course of the two quarters I spent designing Makom Hillel, I feel like I was able to learn a lot about myself, the real-world interactions between designer and client, as well as the code we use to design.

I realized that designing actual structures that will have a real impact on people and their lives is far more rewarding than I ever imagined -- certainly more rewarding than turning in a submittal with calculations and drawings all based on hypothetical building requirements. This is a space that will be part of the future of Hillel and the san Luis obispo community and I am incredible proud of myself for being part of the team that made this vision a reality.

I found out the hard way that the client doesn't always know what they're looking for until you present them with a design. A lot of the time, cost and time are what govern the decisions the client makes. Going through four different iterations of design until we finally got the perfect one was difficult, frustrating, and as the architect, a little sad that I had to change my vision of the space to make things easier on Hillel. Although it was hard work, I think it made me appreciate what architects do and the difficulties they face when altering their designs to fit the client's needs.

On top of that, I became extremely familiar with the NDS and was able to explore ASCE 7-16 code more than what is typically taught in our ARCE classes. I used the same ELFP procedure to come up with the earthquake forces and design the lateral system for the deck which included 2x8 knee braces and 7/8" diameter bolts. Since we only briefly discussed bolted connections in our Timber Design lecture, I had to review the different failure modes in order to correctly design the knee brace connection. I also explored the wind related chapters in ASCE 7-16 since the deck is a free-standing structure and requires a slightly different approach for the wind design.

Overall, I appreciate the opportunity to design something that will be used by Jewish Cal Poly students and SLO residents. I am grateful for all of the professors who have helped me get to this point and have taught me so much throughout my years in the ARCE program. I am proud of the work I have done and all of the things I have learned.

References

Breyer, Matt. "Freestanding Decks." *JLC Online*, 3 Aug. 2012, https://www.jlconline.com/deck-builder/freestanding-decks_o

Santos, Fagjun. "Building a Freestanding Deck: What Should You Expect? (Updated 2021)." *Engineer Warehouse*, 20 Jan. 2021, https://engineerwarehouse.com/blogs/engineering-project-ideas/building-a-freestanding-deck

Vancom, Greg, director. *Structural Bracing Ideas for Small Decks Built On Sloping Hillside*. *YouTube*, YouTube, 28 Nov. 2020, https://www.youtube.com/watch?v=OGbl91y1zYg

Simpson Strong-Tie, director. *How to Build a Stronger Deck*. *Simpson Strong-Tie Site*, 1 June 2020, https://www.strongtie.com/solutions/deckcenter/get-ready-for-deck-season

Showalter, John, and Loren Ross. "Residential Wood Deck Design." Apr. 2017, https://awc.org/pdf/codes-standards/publications/dca/StructureMag-DCA62012-StructuralSpecifications-1704.pdf

*NDS®, National Design Specification® for Wood Construction with Commentary*. American Wood Council, 2018.

*Minimum Design Loads and Associated Criteria for Buildings and Other Structures: ASCE/SEI 7-16*. American Society of Civil Engineers, 2017.

Staff, KSBY. "Jewish Student Group 'SLO Hillel' Opens New Pavilion." *KSBY*, 12 June 2021, https://www.ksby.com/news/local-news/jewish-student-group-slo-hillel-opens-new-pavilion.