ADDENDUM NO. 2

Skagit County Public Works May 21, 2025

2025 Waste Storage Facility Construction

NOTICE TO PROSPECTIVE BIDDERS

NOTICE IS HEREY GIVEN that the Contract Provision and Plans have been modified as follows:

THE FOLLOWING CHANGES HAVE BEEN MADE TO THE CONTRACT PROVISIONS:

Appendix F – Vicinity Maps and Plans is supplemented to include template designs created by Peterson Structural Engineers that were shared with us from Skagit Conservation District to be used in supplement with the Fitzgerald WSF Roof Drainage and Concrete Apron Designs, produced by Skagit County. The supplemental documents include "Stock Agricultural Waste Storage Facility – Design Criteria Memorandum," "Fitzgerald 2024-02-09 Stock Agricultural WSF Stamped Structural Drawings," and stamped "Structural Design Calculations." Please note the structural drawings detail construction for up to four (4) storage bins, but our project will only entail two (2) storage bins. Documents attached.

PETERSON STRUCTURAL ENGINEERS

Tacoma Office
708 Broadway
Suite 110
Tacoma, WA 98402
253.830.2140

February 9, 2024

Emmett Wild
Skagit Conservation District
2021 E. College Way Suite 203
Mount Vernon, WA 98273
360.428.4313

Project #: 2302-0069

RE: **Stock Agricultural Waste Storage Facility – Design Criteria Memorandum**

To Whom it May Concern -

The following memorandum has been generated by Peterson Structural Engineers (PSE) to summarize the structural design criteria and loading considered for the 10-Foot Bin Waste Storage Facility (WSF) Stock Structure Standard Design. The following memorandum, in conjunction with the provided structural drawings and structural design calculations (dated February 9, 2024 and collectively referred to as the "design documents"), may be used by Skagit, Whatcom, Whidbey Island, and San Juan Island Conservation Districts to determine project design applicability in the subject counties.

The subject WSF structural design as detailed in the structural drawings shall only be constructed in regions where all of the criteria outlined herein are met. The structural design shall not be implemented where any of the criteria outlined herein are not met, unless otherwise reviewed and approved by a Professional Engineer licensed in Washington State. The structural design is a standard design that may require adaptation for a specific use or site. Any design alterations or deviations from the design documents shall be reviewed and approved by a Professional Engineer licensed in Washington State.

Appended to this memorandum are design criteria references as provided by the Skagit, Whatcom, Whidbey Island, and San Juan Island Counties as well as excerpts from the American Society of Civil Engineers Standard 7-16 (ASCE 7-16), *Minimum Design Loads for Buildings and Other Structures*. The provided excerpts may be used as an aid in determining project design applicability in the subject counties.

General Standards

All work shall be in strict conformance with the 2021 International Building Code (2021 IBC) as amended by the State of Washington as well as the applicable United States Department of Agriculture (USDA) National Resources Conservation Service (NRCS) Standards. The subject WSF structural design is only applicable under the 2021 IBC and is not permitted for use under future code adoption cycles without written approval by PSE. Following future building code adoption, PSE may be consulted to review, update, and reissue the design for use.

The subject WSF structural design is considered a Risk Category I structure per the 2021 IBC and ASCE 7-16. Per Section C1.5.1 of ASCE 7-16, "Risk Category I structures generally encompass buildings and structures that normally are unoccupied and that would result in negligible risk to the public should they fail." Uses and occupancies of the structure which conform to higher Risk Categories are not permitted.

Location

The subject WSF structural design shall only be applicable to regions within Skagit, Whatcom, Whidbey Island, and San Juan Island Counties in Washington State where in conformance with the criteria outlined herein.

Bin Types

Per the structural drawings, the owner/contractor are provided the following options for bin construction:

- Reinforced Concrete Walls
    - Height: 4’-0”
    - Thickness: 0’-6”
    - Reinforcing: See structural drawings
- Precast Ecology Block Walls
    - Height: 4’-0”
    - Block geometry:
        - Width: 2’-0”
        - Height: 2’-0”
        - Length: 4’-0” (full block) and 2’-0” (half block). Block types shall be as noted in the structural drawings.

General Requirements

Per the structural drawings, the owner/contractor are provided the option of using a 2-bin, 3-bin, or 4-bin configuration. This subject design is not applicable to layouts or bin configurations other than those detailed in the structural drawings. Summarized below are the primary geometric requirements for the structure:

- Internal bin size: 10’-0” x 10’-0” clear
- Retained exterior backfill height: Up to 3” below the top of wall
- Front beam soffit elevation (vertical entry clearance): 10’-0” above top of slab (6’-0” above top of wall)
- Roof slope: 2V:12H (approximately = 9.46°)
- Slab slope: 2% to back wall
- Foundation thickness:
    - At footing edges: 1’-0” minimum
    - Interior slab region: 0’-6” minimum
- Geometry: See structural drawings

Maintenance of Structure

Portions of the structure will be exposed to weather, contact with stored waste, and other conditions that promote material deterioration. The owner should routinely observe material conditions and perform maintenance as needed to ensure structural soundness. When material deterioration occurs, owner shall repair or replace impacted members. Furthermore, structural damages that result from storage operations or machinery should be reviewed by a Professional Engineer licensed in the State of Washington to determine repairs. Alternatively, the member may be replaced in kind and connected as detailed in the design documents. The owner or contractor is responsible for any shoring required to support the structure during member placement.

Live Loads

The subject WSF structural design shall only be applicable to the following live loads:

- Floor Distributed Load: Shall not exceed 250psf
- Flood Concentrated Load: Shall not exceed 8,000lb
- Retaining Wall Vertical Surcharge Load: Shall not exceed 250psf

Snow Loads

The subject WSF structural design shall only be applicable to regions that meet the following snow load criteria:

- Ground Snow Loads: Shall not exceed 40.0-psf
- Flat Roof Snow Loads: Shall not exceed 30.0-psf

Wind Loads

The subject WSF structural design shall only be applicable to regions that meet the following wind load criteria:

- Wind Exposure: Exposures B through D are acceptable
- Basic Wind Speed per ASCE 7-16: Shall not exceed 100-mph
- Topographic Factor: K_{zt} shall not exceed 1.5

Seismic Loads

The subject WSF structural design shall only be applicable to regions that meet the following seismic load criteria:

- Site Class: Class A through D are permitted. Structural design has assumed Site Class D. Design is not valid for Site Class E and Site Class F.
- Mapped Short Spectral Response, $S_S \leq 1.50g$
- Mapped Spectral Response at 1-second, $S_1 \leq 0.60g$
- Design Short Spectral Response, $S_{DS} \leq 1.30g$
- Design Spectral Response at 1-second, $S_{D1} \leq 0.8$
- Seismic Response Coefficient, $C_S \leq 0.80$

For more information on site-specific loading, refer to ASCE 7-16 and ATC Hazard Maps[1].

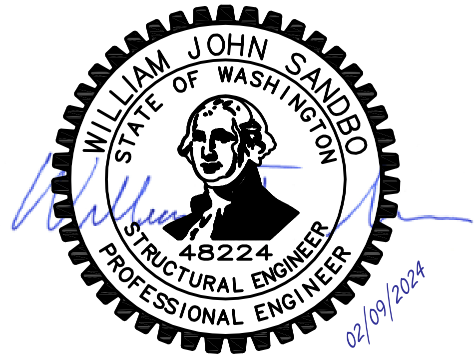
The design criteria outlined herein may not capture all load scenarios across the applicable regions. PSE is not responsible for the regulation or oversight of design implementation and construction for the subject WSF design. Applicability of the subject WSF structural design shall be regulated by the Conservation Districts in strict conformance with the provided design documents.

Site civil, architectural (including waterproofing and flashing), and any other nonstructural elements are outside of PSE's scope of work. All construction shall be in strict conformance with the 2021 IBC and USDA NRCS standards.

[1] https://hazards.atcouncil.org/

Please don’t hesitate to contact us if you have any questions.

Sincerely,



Bill Sandbo, PE, SE, LEED AP
Principal
Peterson Structural Engineers, Inc.

Sent via email to Emmett Wild on 2/9/2024 <emmett@skagitcd.org>

Appendix Table of Contents

Appendix A - County Provided Design Criteria

Skagit County

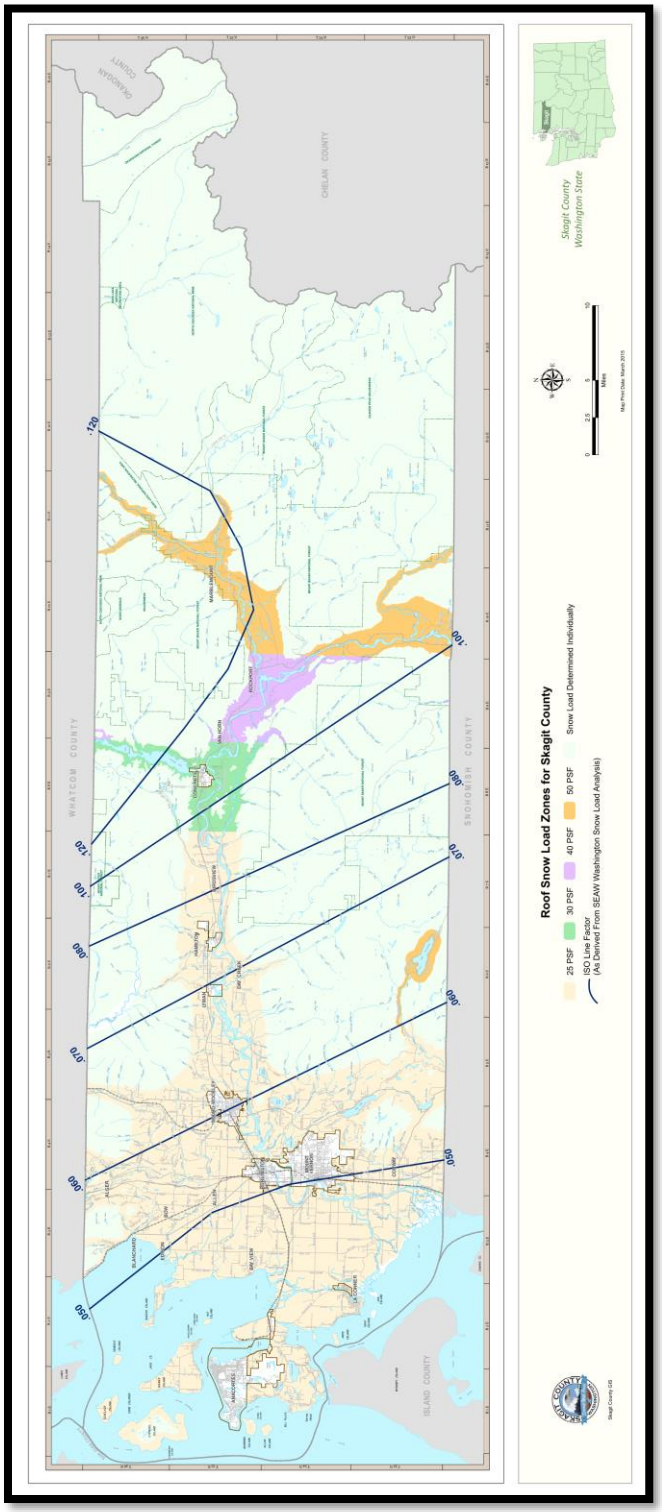


Figure 1: Skagit Roof Snow Load Map - URL: https://www.skagitcounty.net/Maps/iMap/?mapid=8fe801e1318643c9bfef288efb64c85f

Whatcom County

SNOW LOAD REVISION

Whatcom County	Approx. Average Elevation	Revised Ground Snow Load	Revised Roof Snow Load
Acme	310	22	25
Bellingham	100	15	25
Blaine	45	16	25
Deming	210	24	25
Diablo	910	100	100
Ferndale	60	20	25
Glacier	900	74	74
Lawrence	145	24	25
Lynden	103	24	25
Maple Falls	643	77	77
Mt. Baker Ski Area	4200	588	588
Newhalem	510	129	129
Nooksack	84	24	25
Sumas	36	24	25
Wickersham	310	28	28
Kendall	460		50
Paradise	460		50
Pt. Roberts	120		25

Essential facilities, Group A and other applicable occupancies, will require engineering.

Any proposal can challenge the above design load with engineer or architect stamped and signed calculations and criteria.

Buildings where the roof snow load exceeds 70 PSF will require engineering.

Recommendations are valid for the recognized central area of each regional designation. Building Services reserves the right to adjust the roof snow load based on building location and/or criteria per the currently adopted version of the IBC and/or the Snow Load Analysis for Washington.

Seismic Design Category D1.

Basic wind speed – 85 MPH (verify exposure rating with Building Services Division.)
Tax Parcel Number required.

Residential Permit Application Packet
Form PL4-72-001A

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Figure 2: Whatcom County Climatic and Geographic Design Criteria - URL: https://www.whatcomcounty.us/542/Snow-Loads

<u>Island County</u>

ISLAND COUNTY 2018 TABLE 301.2(1) CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA (effective Feb 1, 2021)

ROOF SNOW LOAD	WIND DESIGN				SEISMIC DESIGN CATEGORY	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP	ICE BARRIER UNDERLAYMENT REQUIRED	FLOOD HAZARDS	AIR FREEZING INDEX	MEAN ANNUAL TEMPERATURE
	SPEED (mph)	TOPOGRAPHIC EFFECTS	SPECIAL WIND REGION	WINDBORNE DEBRIS ZONE		WEATHER-ING	FROST LINE DEPTH	TERMITE					
25	110	YES	NO	NO	D2	MODERATE	12 INCHES	SLIGHT TO MODERATE	16°	NO	1982 / 2017	1500	49.7°

MANUAL J DESIGN CRITERIA

ELEVATION	LATITUDE	WINTER HEATING	SUMMER COOLING	ALTITUDE CORRECTION FACTOR	INDOOR DESIGN TEMPERATURE	DESIGN TEPERATURE COOLING	HEATING TEMPERATURE DIFFERENCE
46 FEET	48°	27°	70°	1.00	68°	74°	—
COOLING TEMPERATURE DIFFERENCE	WIND VELOCITY HEATING	WIND VELOCITY COOLING	COINCIDENT WET BULB	DAILY RANGE	WINTER HUMIDITY	SUMMER HUMIDITY	
—	15	7.5	61	L	—	—	

Figure 3: Island County 2018 Table 301.2(1) Climatic and Geographic Design Criteria – URL: https://www.islandcountywa.gov/547/Building-Codes

Figure notes:

1. Design criteria shown above is for the 2018 IBC and ASCE 7-16. Some design criteria may be updated under the 2021 IBC. PSE recommends contacting the local Building Department for more information.
2. Wind loads generated per the 2021 IBC and ASCE 7-16 are based on the basic wind speed. Ultimate wind speed as listed above is applicable to the 2021 International Residential Code (IRC). Subject design is based on the 2021 IBC/ASCE 7-16 design criteria and loads.

<u>San Juan Island County</u>

SAN JUAN COUNTY DEPARTMENT OF COMMUNITY DEVELOPMENT
135 Rhone Street, PO Box 947, Friday Harbor, WA 98250
(360) 378-2354 | (360) 378-2116
dcd@sanjuanco.com | www.sanjuanco.com

SAN JUAN COUNTY CONSTRUCTION REGULATIONS AND DESIGN CRITERIA

Regulations and Design Criteria:

• 2018 International Building Code
• 2018 International Fire Code
• 2018 International Residential Code (IRC)
• 2018 International Mechanical Code (IMC)
• 2018 Uniform Plumbing Code (UPC)
• 2018 WA State Energy Code (WSEC)
• RCW 19.27 & 70.92
• WAC Chapters 51-40; 42; & 44 – 47
• SJCC Title 15 (SJC Building Code)
• SJC Unified Development Code
• SJC Comprehensive Plan
• Local Design Criteria:
Seismic Zone: D1
Wind Load: 110 mph
Wind Exposure: site specific -DESIGNER TO VERIFY
• Frost Depth: 12 inches (BOTTOM OF FOOTINGS)
• Snow Load: 25 lb. LL
• Floor Load: <u>60 lb LL Exterior Decks</u>/40lb LL Interior/ 30lb LL Sleeping Room

• Setbacks: from slopes - UDC Tables 6.1 & 6.2 & Per IRC Figure R403.1.7.1

• Fire Hydrant Provisions: Residential Structures that contain 4000 sq/ft or more of living area must be serviced by approved fire hydrants or a fire suppression system installed in accordance with NFPA 13-R

• Special requirements: Critical area, Wetland, Archeology, or Geotechnical reports may be required in some areas, contact Planning dept of DCD.
• Assumed soil bearing capacity 1500, if engineering assumes a higher PSF, the soil bearing capacity must be verified by a Geologist, or Washington State licensed Engineer or Architect.

WHEN IS A BUILDING PERMIT NECESSARY?

A Building permit is required for each individual structure before construction is started if your project involves:

- **<u>Any structure for residential use, regardless of size</u>**.
- Any structure not specifically exempt by the San Juan County Code or IRC 105.2
- Remodeling, except painting, papering, and similar finish work.
- Placement of a manufactured or modular home, or a relocated structure.
- Where a building permit is not required, but where plumbing and mechanical work is being performed, separate plumbing and mechanical permits are required from CD&P.
- Where electrical work is being performed, separate electrical permits are required from the Department of Labor and Industries, at (360) 647-7333 or www.wa.gov/lni.

Figure 4: San Juan County Construction Regulations and Design Criteria - URL: https://www.sanjuancountywa.gov/DocumentCenter/View/11661/Construction-Regulations--Local-Design-Criteria---PDF?bidId=

Figure note: Wind loads generated per the 2021 IBC and ASCE 7-16 are based on the basic wind speed. Ultimate wind speed as listed above is applicable to the 2018 International Residential Code (IRC). Subject design is based on the 2021 IBC/ASCE 7-16 design criteria and loads.

Appendix B – ASCE 7-16 Design Criteria Excerpts

Wind Speed Map

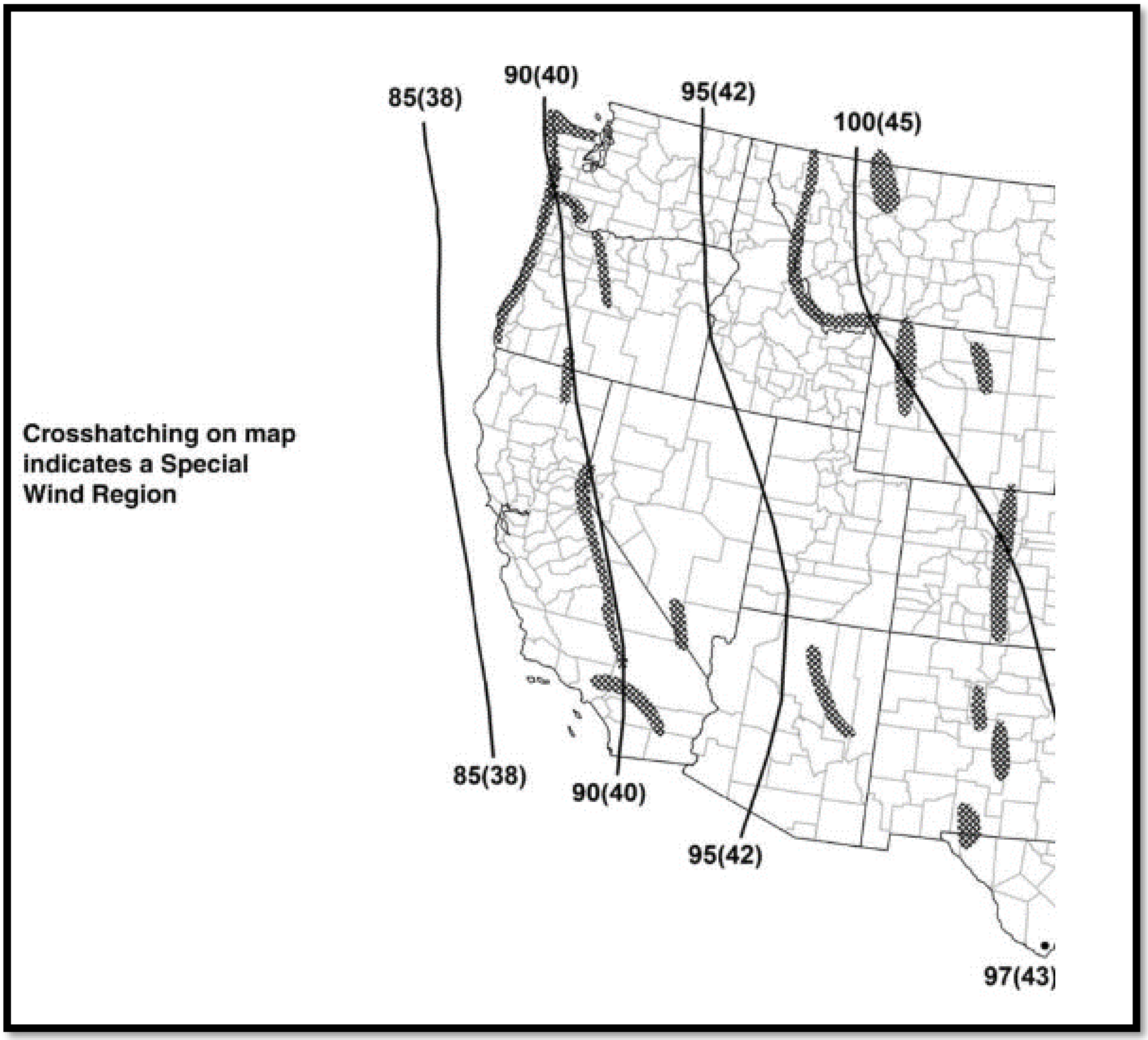


Figure 5: Basic Wind Speed Map for Risk Category I Buildings and Other Structures, Excerpt from Figure 26.5-1A of ASCE 7-16.

Ground Snow Loads

Table 1: Ground Snow Loads for Selected Locations in Washington, Excerpt from Table 7.2-5 of ASCE 7-16.

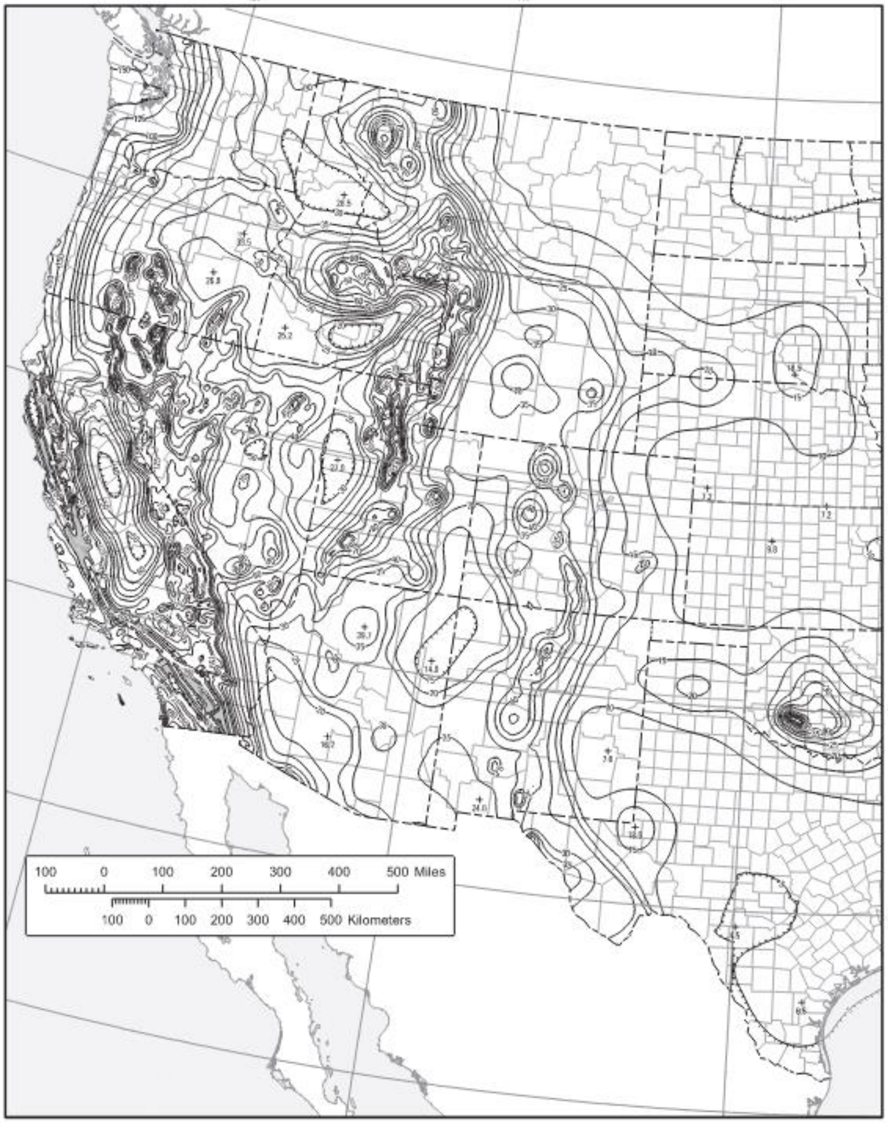
Table 7.2-5 Ground Snow Loads for Selected Locations in Washington

City/Town	County	Ground Snow Load (lb/ft^2)	Elevation (ft)
Arlington	Snohomish	17	120
Auburn	King	20	85
Bainbridge Island	Kitsap	15	100
Bellevue	King	20	100
Bellingham	Watcom	15	100
Bonney Lake	Pierce	18	40
Bothell	King	20	90
Bremerton	Kitsap	15	100
Burien	King	16	325
Covington	King	20	85
Crystal Mt.	Pierce	438	4,380
Des Moines	King	18	370
Edmonds	Snohomish	20	350
Ellensburg	Kittitas	34	1,540
Everett	Snohomish	15	110
Federal Way	King	20	85
Issaquah	King	20	100
Kenmore	King	20	90
Kennewick	Benton	15	400
Kent	King	20	50
Kirkland	King	20	180
Lacey	Thurston	15	200
Lake Stevens	Snohomish	15	250
Lakewood	Pierce	15	235
Longview	Cowlitz	18	21
Lynnwood	Snohomish	22	435
Maple Valley	King	23	440
Marysville	Snohomish	16	20
Mercer Island	King	16	320
Mt. Baker	Whatcom	588	4,200
Mt. Spokane	Spokane	151	5,800
Mt. Vernon	Skagit	15	180
Oak Harbor	Island	17	120
Olympia	Thurston	15	130
Pasco	Franklin	15	383
Pullman	Whitman	30	2,400
Puyallup	Pierce	18	40
Redmond	King	20	120
Renton	King	20	15
Richland	Benton	15	359
Sammamish	King	28	520
SeaTac	King	22	440
Seattle	King	20	350
Shoreline	King	22	450
Snoqualmie Pass	Kittitas	433	3,000
Spokane	Spokane	39	2,000
Spokane Valley	Spokane	39	2,000
Stevens Pass	Chelan	400	4,060
Tacoma	Pierce	21	380
Tukwila	King	16	325
Univ. Place	Pierce	20	400
Vancouver	Clark	20	150
Walla Walla	Walla Walla	18	1,000
Wenatchee	Chelan	22	780
White Pass	Yakima	244	4,720
Yakima	Yakima	19	1,066

Note: To convert lb/ft^2 to kN/m^2, multiply by 0.0479. To convert feet to meters, multiply by 0.3048.

1. Statutory requirements of the Authority Having Jurisdiction are not included in this state ground snow load table.
2. For locations where there is substantial change in altitude over the jurisdiction, the load applies at and below the cited elevation, with a tolerance of 100 ft (30 m).
3. For other locations in Washington, see Structural Engineers Association of Washington (1995). "Snow Load Analysis for Washington," Seattle, WA, www.seaw.org, for ground snow load values.

Seismic Ground Motions



Notes:

Maps prepared by United States Geological Survey (USGS) in collaboration with the Federal Emergency Management Agency (FEMA)-funded Building Seismic Safety Council (BSSC) and the American Society of Civil Engineers (ASCE). The basis is explained in commentaries prepared by BSSC and ASCE and in the references.

Ground motion values contoured on these maps incorporate:

- a target risk of structural collapse equal to 1% in 50 years based upon a generic structural fragility
- a factor of 1.1 to adjust from a geometric mean to the maximum response regardless of direction
- deterministic upper limits imposed near large, active faults, which are taken as 1.8 times the estimated median response to the characteristic earthquake for the governing fault (1.8 is used to represent the 84th percentile response), but not less than 150% g.

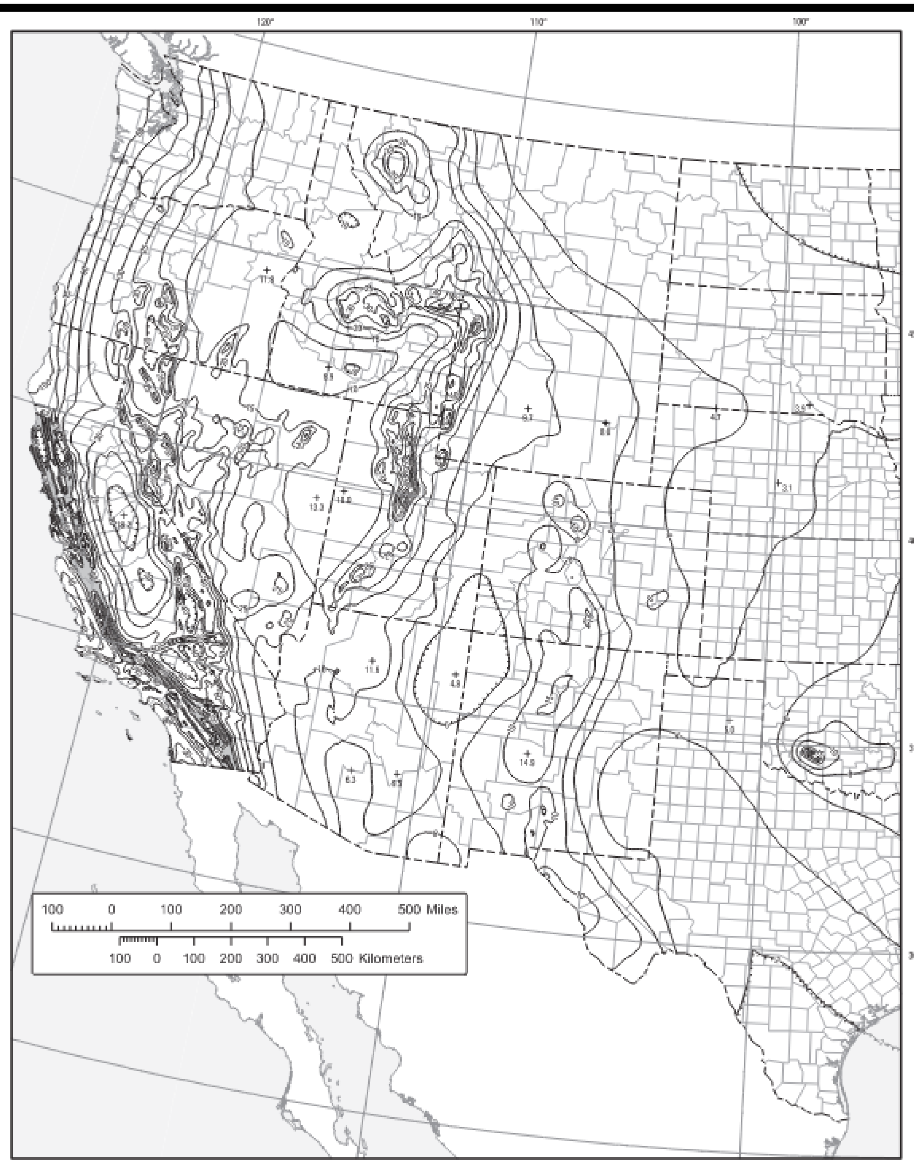
As such, the values are different from those on the uniform-hazard 2014 USGS National Seismic Hazard Maps posted at: https://doi.org/10.5066/F7HT2MHG.

Larger, more detailed versions of these maps are not provided because it is recommended that the corresponding USGS web tool (https://doi.org/10.5066/F7NK3C76) be used to determine the mapped value for a specified location.

FIGURE 22-1 S_S Risk-Targeted Maximum Considered Earthquake (MCE_R) Ground Motion Parameter for the Conterminous United States for 0.2-s Spectral Response Acceleration (5% of Critical Damping)

Sources: ASCE (2010); Building Seismic Safety Council (2009); Huang, Whittaker, and Luco (2008); Luco and colleagues (2007); Peterson and colleagues (2014).

Figure 6: S_S Risk Targeted Maximum Considered Earthquake (MCE_R) Ground Motion Parameter from the Conterminous United States for 0.2-s Spectral Response Acceleration (5% of Critical Damping), Excerpt from Figure 22-1 of ASCE 7-16



Notes:

Maps prepared by United States Geological Survey (USGS) in collaboration with the Federal Emergency Management Agency (FEMA)-funded Building Seismic Safety Council (BSSC) and the American Society of Civil Engineers (ASCE). The basis is explained in commentaries prepared by BSSC and ASCE and in the references.

Ground motion values contoured on these maps incorporate:

- a target risk of structural collapse equal to 1% in 50 years based upon a generic structural fragility
- a factor of 1.3 to adjust from a geometric mean to the maximum response regardless of direction
- deterministic upper limits imposed near large, active faults, which are taken as 1.8 times the estimated median response to the characteristic earthquake for the governing fault (1.8 is used to represent the 84th percentile response), but not less than 60% g.

As such, the values are different from those on the uniform-hazard 2014 USGS National Seismic Hazard Maps posted at: https://doi.org/10.5066/F7HT2MHG.

Larger, more detailed versions of these maps are not provided because it is recommended that the corresponding USGS web tool (https://doi.org/10.5066/F7NK3C76) be used to determine the mapped value for a specified location.

FIGURE 22-2 S_1 Risk-Targeted Maximum Considered Earthquake (MCE_R) Ground Motion Parameter for the Conterminous United States for 1.0-s Spectral Response Acceleration (5% of Critical Damping)

Sources: ASCE (2010); Building Seismic Safety Council (2009); Huang, Whittaker, and Luco (2008); Luco and colleagues (2007); Peterson and colleagues (2014).

Figure 7: S_1 Risk-Targeted Maximum Considered Earthquake (MCE_R) Ground Motion Parameters for the Conterminous United States for 1.0-s Spectral Response Acceleration (5% of Critical Damping), Excerpt from Figure 22-2 of ASCE 7-16.

STRUCTURAL SHEETS:

GENERAL STRUCTURAL NOTES:

1. THESE NOTES ARE GENERAL IN NATURE AND ARE INTENDED TO SET MINIMUM STANDARDS FOR CONSTRUCTION. THE CONTRACTOR SHALL BE COMPLETELY FAMILIAR WITH THE CONTRACT DOCUMENTS AND HAVE A COPY OF THEM ON SITE AT ALL TIMES.
2. FOR ANY PORTION OF THE CONSTRUCTION WHICH THE CONTRACTOR IS UNABLE TO ASCERTAIN THE REQUIRED CONSTRUCTION OR WHERE CONFLICTS EXIST, IT IS THE CONTRACTOR'S RESPONSIBILITY TO REQUEST ADDITIONAL INFORMATION (RFIs) AND/OR CLARIFICATIONS BEFORE CONSTRUCTION.
3. ALL WORK SHALL BE IN STRICT CONFORMANCE WITH THE 2021 INTERNATIONAL BUILDING CODE (IBC) WITH WASHINGTON STATE AMENDMENTS AS WELL AS APPLICABLE UNITED STATES DEPARTMENT OF AGRICULTURE NATIONAL RESOURCE CONSERVATION SERVICE (NRCS) STANDARDS WITH WASHINGTON STATE SUPPLEMENTS. ALL BUILDING ELEMENTS AND COMPONENTS NOT SPECIFICALLY DETAILED IN THESE STRUCTURAL CONSTRUCTION DOCUMENTS SHALL BE FABRICATED AND CONSTRUCTED IN ACCORDANCE WITH THE MINIMUM STANDARDS CONTAINED IN THE IBC.
4. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND ELEVATIONS BEFORE CONSTRUCTION. THE ENGINEER SHALL BE NOTIFIED OF ANY DISCREPANCIES OR INCONSISTENCIES.
5. THE CONTRACT STRUCTURAL DRAWINGS REPRESENT THE FINISHED STRUCTURE. METHODS, PROCEDURES, AND SEQUENCE OF CONSTRUCTION ARE THE RESPONSIBILITY OF THE CONTRACTOR. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO MAINTAIN AND ENSURE THE INTEGRITY OF THE STRUCTURE AT ALL STAGES OF CONSTRUCTION.
6. CONSTRUCTION LOADS SHALL NOT EXCEED THE DESIGN LIVE LOAD FOR THE STRUCTURE. PROVIDE SHORING AND/OR BRACING WHERE LOADS EXCEED DESIGN CAPACITY AND WHERE STRUCTURES HAVE NOT ATTAINED DESIGN STRENGTH.
7. CLADDING, WATERPROOFING, AND ARCHITECTURAL FEATURES ARE OUTSIDE THE STRUCTURAL SCOPE OF WORK. ANY DEPICTION OF SUCH FEATURES ON THE STRUCTURAL DRAWINGS ARE NOT INTENDED TO BE USED FOR CONSTRUCTION. REPRESENTATION OF SUCH FEATURES ON THESE DRAWINGS MAY OR MAY NOT BE ACCURATE.

DESIGN LOADS: PER 2021 IBC & NRCS WITH WASHINGTON AMENDMENTS

1603.1.1 – FLOOR LOADS:
- LIVE LOAD .... 250 PSF DISTRIBUTED, 8,000 LB CONCENTRATED
- RETAINING WALL SURCHARGE .... 250 PSF (VERTICAL, BEHIND WALL)

1603.1.2 – ROOF LOADS:
- DEAD LOAD .... 12 PSF
- LIVE LOAD .... SEE SNOW LOADS

1603.1.3 – SNOW LOADS:
- GROUND SNOW LOAD, Pg .... 40 PSF
- FLAT-ROOF SNOW LOAD, Pf .... 30 PSF
- SNOW EXPOSURE FACTOR, Ce 1.1
- SNOW LOAD IMPORTANCE FACTOR, Is .... 0.8, CATEGORY I
- THERMAL FACTOR, Ct 1.2
- FROST DEPTH .... 12 INCHES

1603.1.4 – WIND DESIGN CRITERIA:
- BASIC DESIGN WIND SPEED, V .... 100 MPH
- RISK CATEGORY I
- WIND EXPOSURE .... EXPOSURE D
- TOPOGRAPHIC EFFECTS, K_{zt} 1.5
- COMPONENTS & CLADDING: DESIGN WIND PRESSURES (+/–)
  - ROOF ELEMENTS (Atrib = 9 ft^2) .... 77.93 PSF (1.0W), 46.76 PSF (0.6W) & –114.72 PSF (1.0W), –68.83 PSF (0.6W)

1603.1.5 – EARTHQUAKE DESIGN CRITERIA:
- RISK CATEGORY I
- SEISMIC IMPORTANCE FACTOR, I_E 1.00
- SPECTRAL ACCELERATION, S_s .... 1.500 g
- SPECTRAL ACCELERATION, S_1 .... 0.600 g
- SITE CLASS .... D (DEFAULT)
- SPECTRAL RESPONSE COEFFICIENT, S_{DS} .... 1.3 g
- SPECTRAL RESPONSE COEFFICIENT, S_{D1} .... 0.800 g
- SEISMIC DESIGN CATEGORY .... CATEGORY D
- SEISMIC FORCE RESISTING SYSTEM(S) .... CANTILEVERED COLUMN SYSTEM – TIMBER FRAMES
- RESPONSE MODIFICATION FACTORS(S), R 1.5
- SEISMIC RESPONSE COEFFICIENTS(S), C_s 0.8

PROJECT APPLICABILITY NOTES:

THE SUBJECT WASTE STORAGE FACILITY STANDARD STRUCTURAL DESIGN AS DETAILED HEREIN SHALL ONLY BE CONSTRUCTED IN REGIONS WITHIN SKAGIT, WHATCOM, WHIDBEY ISLAND AND SAN JUAN ISLANDS CONSERVATION DISTRICTS WHERE ALL OF THE DESIGN CRITERIA OUTLINED ABOVE AND IN THE DESIGN CRITERIA MEMORANDUM PREPARED BY PSE ARE MET. THE STRUCTURAL DESIGN SHALL NOT BE IMPLEMENTED IN ANY LOCATION WHERE THE LIVE, SNOW, WIND, OR SEISMIC LOAD CRITERIA SUMMARIZED ABOVE ARE EXCEEDED.

THE STRUCTURAL DESIGN PRESENTED HEREIN IS A STANDARD DESIGN THAT MAY REQUIRE ADAPTATION FOR A SPECIFIC USE OR SITE. ANY DESIGN ADAPTATIONS SHALL BE REVIEWED AND APPROVED BY A PROFESSIONAL ENGINEER LICENSED IN THE STATE OF WASHINGTON.

PSE IS NOT RESPONSIBLE FOR THE REGULATION OR OVERSIGHT OF DESIGN IMPLEMENTATION.

CONCRETE:

1. ALL CONCRETE SHALL BE HARD ROCK CONCRETE MEETING REQUIREMENTS OF ACI-301, "SPECIFICATIONS FOR STRUCTURAL CONCRETE FOR BUILDINGS". MIX PROPORTIONS SHALL BE PER ACI-301, METHOD 2 OR THE ALTERNATE PROCEDURE.
2. STRUCTURAL CONCRETE SHALL ATTAIN THE FOLLOWING MINIMUM COMPRESSIVE STRENGTH AT 28 DAYS:

TYPE	f'c	SLUMP	w/c	AIR
ALL CONCRETE	4,000 psi	1–4"	0.45	6%

3. SPECIAL INSPECTION IS NOT REQUIRED. SEE EXCEPTIONS TO SPECIAL INSPECTION INCLUDED IN IBC SECTION 1705.3. 4,000 psi COMPRESSIVE STRENGTH IS SPECIFIED FOR WEATHERING PROTECTION. STRUCTURAL DESIGN OF CONCRETE BASED ON 2,500 psi COMPRESSIVE STRENGTH.
4. ALL CONCRETE EXPOSED TO WEATHER SHALL CONTAIN 6% (±) 1% AIR ENTRAINMENT BY VOLUME. AIR ENTRAINMENT SHALL BE IN CONFORMANCE WITH ASTM C260.
5. COLD WEATHER PLACEMENT SHALL CONFORM TO ACI-306. HOT WEATHER PLACEMENT SHALL CONFORM TO ACI-305. MECHANICALLY VIBRATE ALL FORMED CONCRETE. DO NOT OVER-VIBRATE. PLACE CONCRETE MONOLITHICALLY BETWEEN CONSTRUCTION OR CONTROL JOINTS. PROTECT ALL CONCRETE FROM PREMATURE DRYING.
6. CHAMFER ALL EXTERIOR CORNERS 1/2" UNLESS SHOWN OTHERWISE.
7. SLUMP LIMITS MAY BE INCREASED BY ADDITION OF ADMIXTURES PROVIDED THAT THE WATER/CEMENT RATIO OF THE ORIGINAL MIX DESIGN IS NOT EXCEEDED. WATER REDUCING ADMIXTURE SHALL BE IN CONFORMANCE WITH ASTM494, USED IN CONFORMANCE WITH MANUFACTURER'S INSTRUCTIONS. SUBMIT ADMIXTURES TO ENGINEER FOR REVIEW PRIOR TO CONSTRUCTION.
8. CEMENT SHALL BE TYPE I OR II IN CONFORMANCE WITH ASTM C150. AGGREGATES SHALL BE IN CONFORMANCE WITH ASTM C33 AND USE CRUSHED (NOT ROUND) GRAVEL OR STONE. COARSE AGGREGATES SHALL NOT EXCEED 3/4". WATER SHALL BE CLEAN AND POTABLE.
9. REINFORCING STEEL SHALL CONFORM TO ASTM A615, GRADE 60. GRADE 40 MAY BE USED FOR #3 AND SMALLER TIES AND STIRRUPS. DETAIL AND PLACE ACCORDING TO ACI MANUAL SP-66. BENDS SHALL BE MADE AROUND A PIN HAVING A DIAMETER NOT LESS THAN SIX TIMES THE MINIMUM THICKNESS OF THE BAR. REBENDING OR STRAIGHTENING OF REINFORCING OR BENDING OF REINFORCING STEEL CAST INTO CONCRETE IS NOT ALLOWED.
10. UNLESS OTHERWISE NOTED, MINIMUM COVER SHALL BE 1 1/2" FOR #5 AND SMALLER BARS, 2" FOR #6 AND LARGER BARS AND 3" WHEN POURED AGAINST EARTH. SUPPORT REINFORCEMENT WITH APPROVED CHAIRS, SPACERS, OR TIES.
11. UNLESS OTHERWISE NOTED, PROVIDE MINIMUM 48 BAR DIAMETERS AT SPLICES. NO MORE THAN 50% OF REINFORCING SHALL BE SPLICED AT ANY LOCATION. UNLESS OTHERWISE NOTED, BEND ALL HORIZONTAL REINFORCING A MINIMUM OF 2'-0" AT CORNERS AND WALL/FOOTING INTERSECTIONS WITH MIN. EMBEDMENT BEYOND INTERFACE PER DEVELOPMENT LENGTH SPECIFIED IN ACI 318.
12. FORMWORK SHALL BE IN ACCORDANCE WITH ACI-347 "GUIDE TO FORMWORK FOR CONCRETE". FORMS SHALL BE DESIGNED BY THE CONTRACTOR. BRACING SHALL BE PROVIDED AS REQUIRED OR UNTIL THE CONCRETE HAS REACHED ITS SPECIFIED 28-DAY STRENGTH. ALL SHORING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. FORMWORK, SUPPORTS, AND SHORING SHALL PROVIDE FINISHED CONCRETE SURFACES AT ALL FACES: LEVEL, PLUMB, AND TRUE TO DIMENSIONS AND ELEVATIONS SHOWN IN THE DRAWINGS.

FOUNDATIONS:

1. SOIL CHARACTERISTICS HAVE BEEN ASSUMED PER THE 2021 IBC WITH WASHINGTON AMENDMENTS SECTION 1806 PRESUMPTIVE LOAD-BEARING VALUES OF SOILS CONSISTENT WITH CLAY, SANDY CLAY, SILTY CLAY, CLAYEY SILT, SILT AND SANDY SILT (CL, ML, MH AND CH) SOIL TYPES. THE CONTRACTOR SHALL VERIFY THE PRESUMED SOIL TYPES PRIOR TO CONSTRUCTION AND NOTIFY THE ENGINEER AND ARCHITECT OF NON-CONFORMING IN-SITU CONDITIONS IF PRESENT BEFORE PROCEEDING.
2. ALL FOUNDATIONS TO BEAR ON UNDISTURBED NATIVE MATERIAL, OR GRANULAR COMPACTED FILL.
3. SOIL DESIGN CRITERIA, PER 2021 IBC SECTION 1806:
   - 3.1. SOIL BEARING – 1,500 PSF
   - 3.2. ⅓ INCREASE ALLOWED FOR SHORT TERM LOADS
   - 3.3. SOIL PROFILE – D
   - 3.4. FRICTION COEFFICIENT – 0.35 (GRANULAR COMPACTED SUBGRADE)
4. ALL EXCAVATIONS SHALL BE PROPERLY BACKFILLED. DO NOT PLACE BACKFILL BEHIND RETAINING WALLS UNTIL THE CONCRETE WALL HAS ATTAINED THE 80% DESIGN STRENGTH. WHERE A SLAB ON GRADE IS USED TO RESTRAIN THE BOTTOM OF A RETAINING WALL, DO NOT PLACE BACKFILL BEHIND THE WALL UNTIL THE SLAB(S) HAVE BEEN CAST AND ATTAINED FULL DESIGN STRENGTH.

POST-INSTALLED CONCRETE ANCHORS:

1. ADHESIVE:
   - 1.1. ADHESIVE ANCHORS SHALL BE INSTALLED BY QUALIFIED PERSONNEL TRAINED TO INSTALL ADHESIVE ANCHORS IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND WITH STRICT ADHERENCE TO THE PROVISIONS WITHIN THE MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS.
   - 1.2. AT THE TIME OF ANCHOR INSTALLATION, IN ACCORDANCE WITH ACI 318-19 SECTION 17.1.2, ADHESIVE ANCHORS SHALL BE INSTALLED IN CONCRETE HAVING A MINIMUM AGE OF 21 DAYS.
2. MECHANICAL:
   - 2.1. 2.1. MECHANICAL ANCHORS SHALL BE INSTALLED BY QUALIFIED PERSONNEL TRAINED TO INSTALL MECHANICAL ANCHORS IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND WITH STRICT ADHERENCE TO THE PROVISIONS WITHIN THE MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS.

SOLID SAWN LUMBER:

1. UNLESS NOTED OTHERWISE, STRUCTURAL LUMBER SHALL BE DOUGLAS FIR OR HEM FIR CONFORMING TO WWPA GRADING RULES.
2. MINIMUM GRADES ARE, EXCEPT AS NOTED OTHERWISE:
   - STRUCTURAL JOISTS & PLANKS – #2
   - BEAMS & STRINGERS – #2
   - POSTS & TIMBERS – #1
3. NOTCHING IS NOT PERMITTED IN JOISTS, RAFTERS, BEAMS, LINTELS, COLUMNS, TRUSSES, AND BRACING MEMBERS UNLESS NOTED OTHERWISE.
4. ALL LUMBER IN CONTACT WITH CONCRETE SHALL BE PRESSURE TREATED OR SUFFICIENTLY TREATED FOR EXTERIOR EXPOSURE. OWNER SHALL ROUTINELY OBSERVE MATERIAL CONDITIONS, AND MAINTAIN AS NEEDED. WHEN MATERIAL DETERIORATION OCCURS, MEMBERS SHOULD BE REPLACED.
5. PRESSURE TREATED LUMBER SHALL CONFORM TO THE AWPA AND SHALL BEAR THE QUALITY MARK OF AN ACCREDITED ALSC INSPECTION AGENCY. MINIMUM TREATING STANDARDS (RETENTION LBS./CU. FT) SHALL BE AS FOLLOWS:

APPLICATION	ACQ/ACZA	CA-B
ABOVE GROUND	0.25	0.10
GROUND CONTACT	0.40	0.21
FRESH WATER IMMERSION	0.40	0.21
IN GROUND (STRUCTURAL)	0.60	0.31
SILL PLATES	0.25	0.10

6. TREAT ALL CUT ENDS OF TREATED WOOD FOR EXTERIOR EXPOSURE.
7. NAILING SHALL BE IN CONFORMANCE WITH THE 2021 IBC AS AMENDED WITH WASHINGTON AMENDMENTS UNLESS NOTED OTHERWISE. FASTENERS FOR PRESERVATIVE-TREATED WOOD SHALL BE OF HOT-DIPPED ZINC-COATED GALVANIZED STEEL, STAINLESS STEEL, SILICON BRONZE OR COPPER. THE COATING WEIGHTS FOR ZINC-COATED FASTENERS SHALL BE IN ACCORDANCE WITH ASTM A-153. 5/8-INCH DIAMETER STEEL ANCHOR BOLTS & LARGER NEED NOT BE GALVANIZED, UNLESS NOTED OTHERWISE.
8. USE STANDARD WASHERS FOR ALL BOLT HEADS AND NUTS IN CONTACT WITH WOOD.

PREMANUFACTURED CONNECTION HARDWARE:

1. CONNECTION HARDWARE IS BY THE SIMPSON COMPANY OF SAN LEANDRO, CA. ALL STEEL CONNECTORS SHALL BE GALVANIZED OR BY SOME METHOD MADE CORROSION RESISTANT, UNLESS OTHERWISE INDICATED.
2. PROVIDE BOLTED OR NAILED CONNECTIONS FOR THE MAXIMUM CAPACITY UNLESS NOTED OTHERWISE.
3. CONNECTORS IN CONTACT WITH PRESSURE TREATED WOOD SHALL BE EITHER POST HOT-DIP GALVANIZED OR STAINLESS STEEL. FASTENERS SHALL BE OF THE SAME MATERIAL OR PROTECTIVE COATING AS THE CONNECTORS, DO NOT MIX DIFFERING METALS IN THE SAME CONNECTION.
4. ALL HARDWARE SHALL BE INSTALLED PER MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS, UNLESS NOTED OTHERWISE.

SHEATHING:

1. WOOD STRUCTURAL PANELS SHALL BE APA RATED EXPOSURE 1 PLYWOOD, AND COVERED IN DOC PS 1 AND PS 2, UNLESS NOTED OTHERWISE.
2. MINIMUM PANEL THICKNESS SHALL BE 19/32", OR AS INDICATED IN THESE PLANS. PARTICLEBOARD IS NOT PERMITTED.
3. MINIMUM NAILING IS 8d@6" AT PANEL EDGES AND 8d@12" IN THE FIELD. ALL NAILS SHALL BE COMMON OR GALVANIZED BOX NAILS. BLOCKING IS REQUIRED WHERE NOTED ON THE PLANS.

NOTE REGARDING BIN OPTIONS:

THE FOLLOWING DESIGN INCLUDES OPTIONS FOR CAST-IN-PLACE (CIP) BIN CONSTRUCTION AND ECOLOGY BLOCK BIN CONSTRUCTION. WHERE CIP BINS ARE BEING USED, SHEETS S1-S4 AND S8-S9 ARE APPLICABLE. WHERE ECOLOGY BLOCK BINS ARE BEING USED, SHEETS S1 AND S5-S9 ARE APPLICABLE. IT IS NOT PERMITTED TO INTERMIX CIP WALLS AND ECOLOGY BLOCK WALLS IN THE DESIGN.

AT OWNER/CONTRACTOR'S OPTION, THESE PLANS MAY BE USED FOR THE CONSTRUCTION OF EITHER A 2-BIN, 3-BIN, OR 4-BIN CONFIGURATION. OTHER CONFIGURATIONS ARE NOT INCLUDED AS PART OF THIS DESIGN.

NOTICE
0 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

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02/09/2024

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STOCK AGRICULTURAL WSF

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PROJECT SITE:
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WHATCOM CONSERVATION DISTRICT
WHIDBEY ISLAND CONSERVATION DISTRICT
SAN JUAN ISLANDS CONSERVATION DISTRICT

SHEET CONTENT
GENERAL NOTES

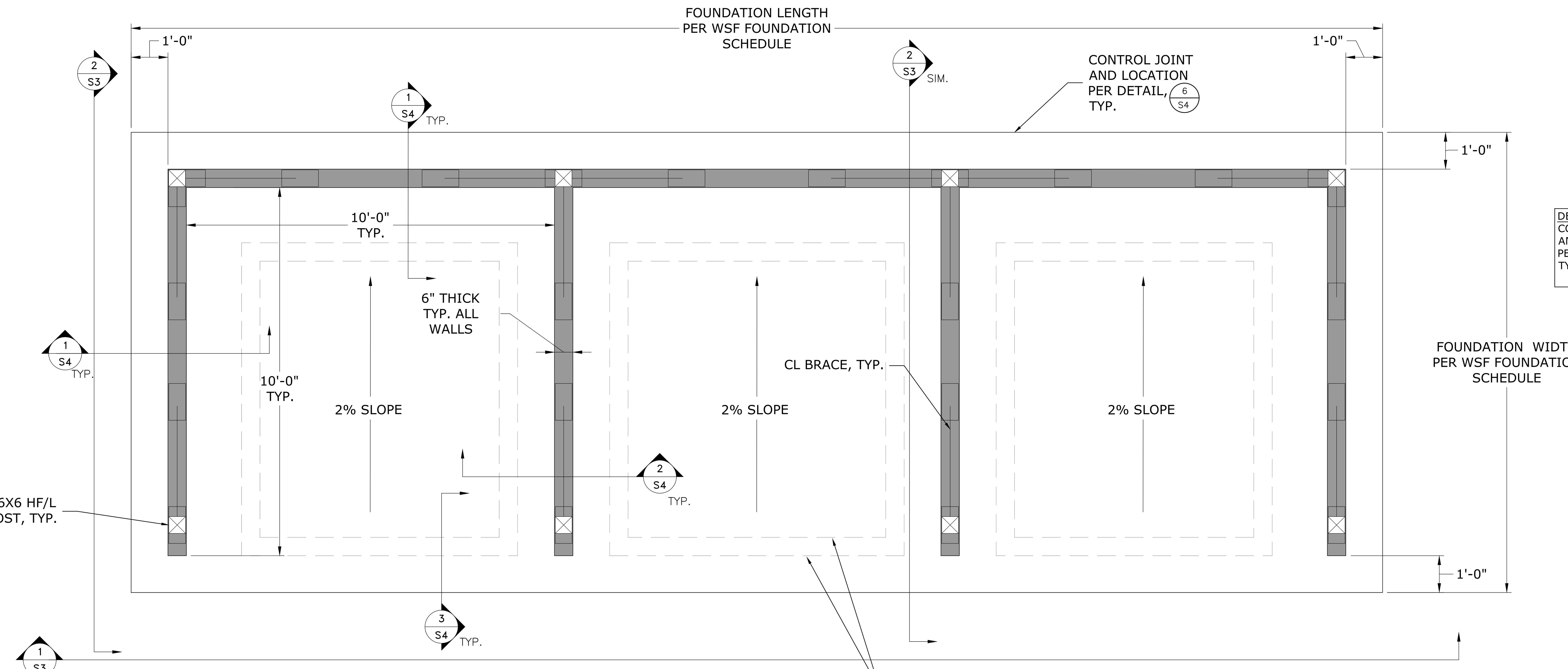
JOB No. 2302-0069

DRAWN RLKC
CHECKED NRW

DATE 2/9/24

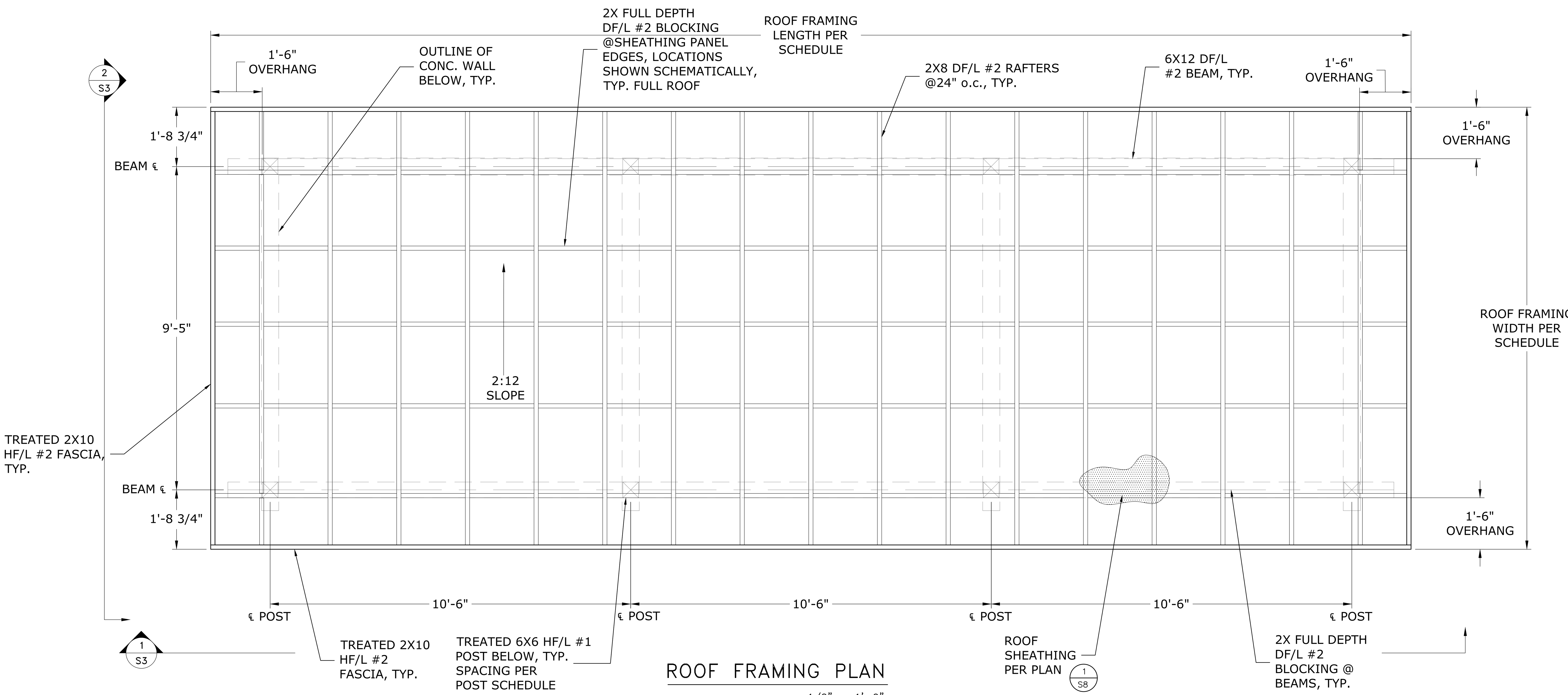
REVISIONS

SHEET



WALL/ FOUNDATION PLAN

1/2" = 1'-0"



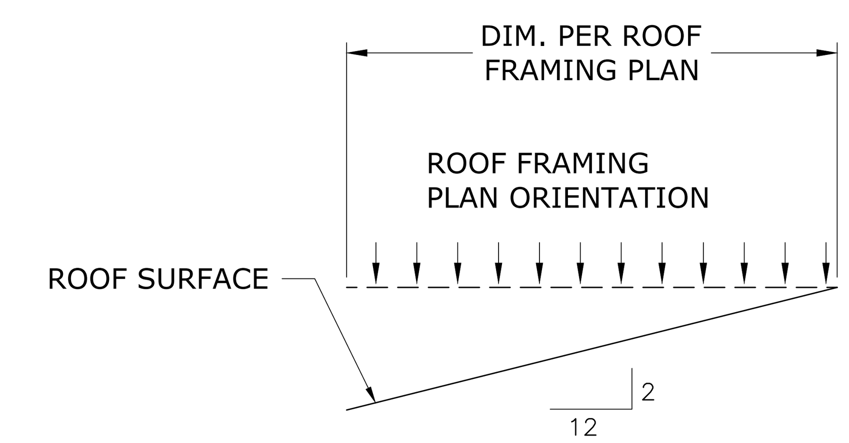
ROOF FRAMING PLAN

1/2" = 1'-0"

DETAIL NOTE:
CONTROL JOINT AND LOCATION PER DETAIL, 6/S4 TYP.

CIP WSF FOUNDATION SCHEDULE		
CIP BIN CONFIGURATION	TOTAL FOUNDATION LENGTH	TOTAL FOUNDATION WIDTH
CIP 2-BIN	23'-6"	12'-6"
CIP 3-BIN	34'-0"	12'-6"
CIP 4-BIN	44'-6"	12'-6"

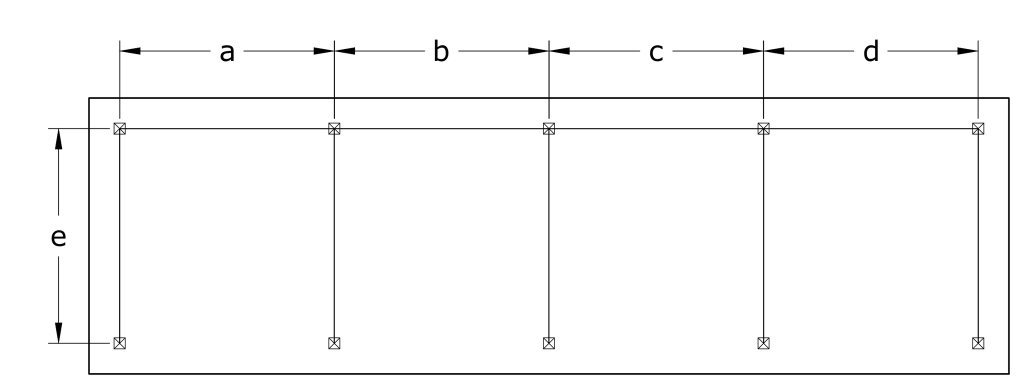
SHEET NOTES:
1. CONTRACTOR/OWNER'S OPTION TO USE 2-BIN, 3-BIN OR 4-BIN CONFIGURATION.
2. TREAT ALL CUT ENDS OF TREATED LUMBER FOR EXTERIOR EXPOSURE.
3. GUTTERS, DRIP EDGE, AND FLASHING BY OTHERS. NOT SHOWN FOR CLARITY.



ROOF FRAMING PLAN ORIENTATION

NOTE: DIMENSIONS TAKEN AS HORIZONTAL PROJECTIONS BASED ON ANGLE OF ROOF SURFACE

CIP ROOF FRAMING SCHEDULE		
CIP BIN CONFIGURATION	ROOF PLAN LENGTH	ROOF PLAN WIDTH
CIP 2-BIN	24'-5"1/2	12'-7"3/4
CIP 3-BIN	34'-11"1/2	12'-7"3/4
CIP 4-BIN	45'-5"1/2	12'-7"3/4



POST SPACING GEOMETRY

NTS

CIP POST SPACING SCHEDULE			
	CIP 2-BIN	CIP 3-BIN	CIP 4-BIN
a	10'-6"	10'-6"	10'-6"
b	10'-6"	10'-6"	10'-6"
c	-	10'-6"	10'-6"
d	-	-	10'-6"
e	9'-5"	9'-5"	9'-5"

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SHEET CONTENT
CIP BIN OPTION - FOUNDATION AND ROOF PLAN

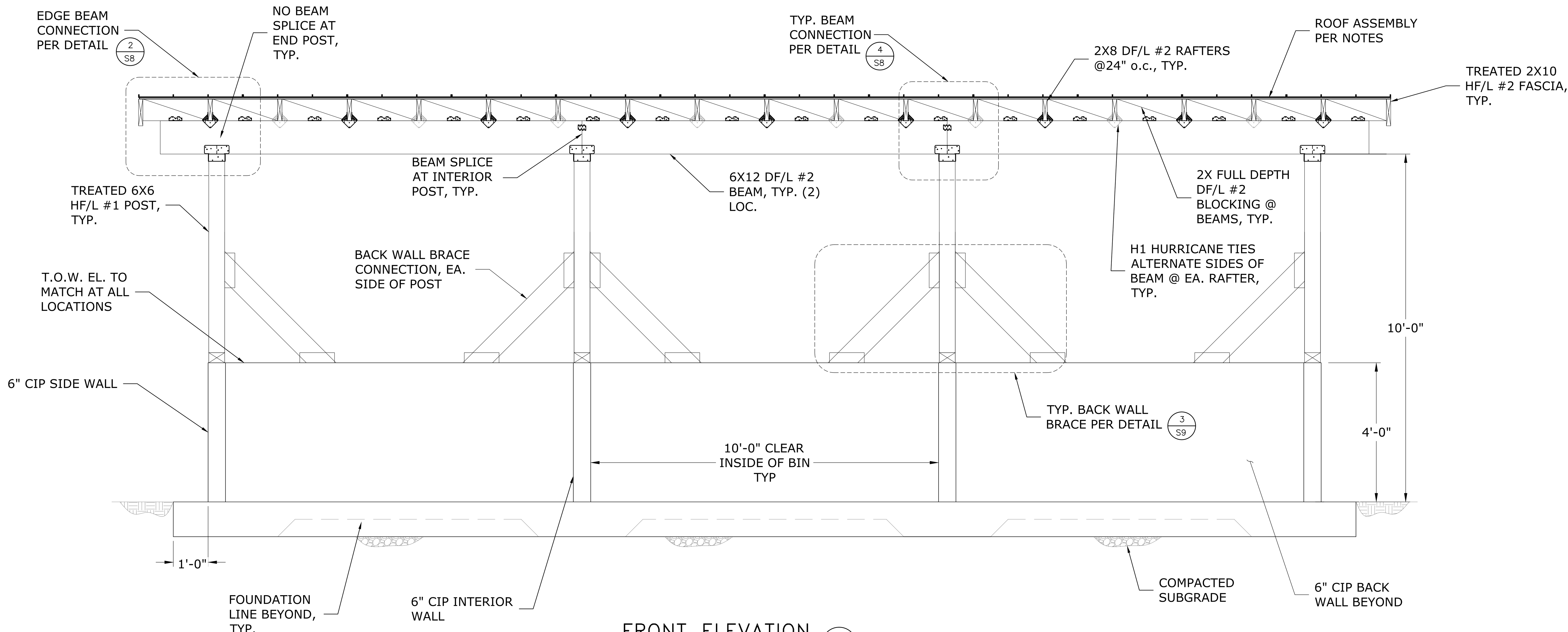
JOB No. 2302-0069

DRAWN RLKC CHECKED NRW

DATE 2/9/24

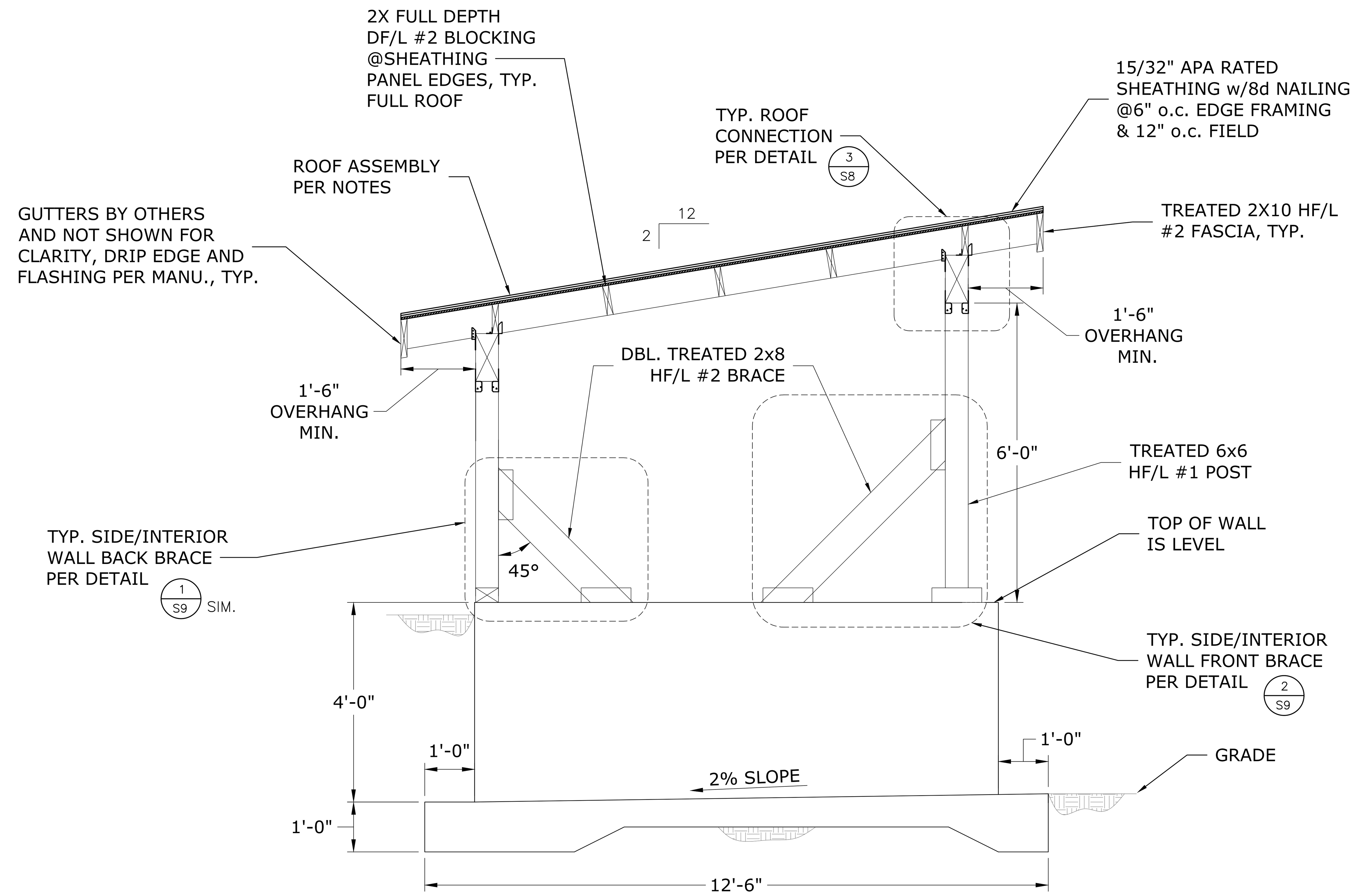
REVISIONS

SHEET S2 OF 9



FRONT ELEVATION 1/S3

1/2" = 1'-0"



WALL SECTION 2/S3

1/2" = 1'-0"

ROOF ASSEMBLY NOTES:
- ROOF ASSEMBLIES, UNDERLAYMENT, AND ATTACHMENT SHALL BE IN CONFORMANCE WITH CHAPTER 15 OF THE 2021 IBC WITH WASHINGTON AMMENDMENTS.
- ROOF ASSEMBLIES SHALL BE CAPABLE OF RESISTING THE DESIGN LOADS SUMMARIZED ON SHEET S1.
- CONTRACTOR/OWNER OPTION TO USE METAL ROOF PANELS OF COMPOSITE (SYNTHETIC) SHINGLES. UNDERLAYMENT, INSTALLATION, AND ATTACHMENT SHALL BE PER MANUFACTURE INSTALLATION INSTRUCTIONS

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SHEET CONTENT
CIP BIN OPTION - ELEVATIONS AND SECTIONS

JOB No.	2302-0069
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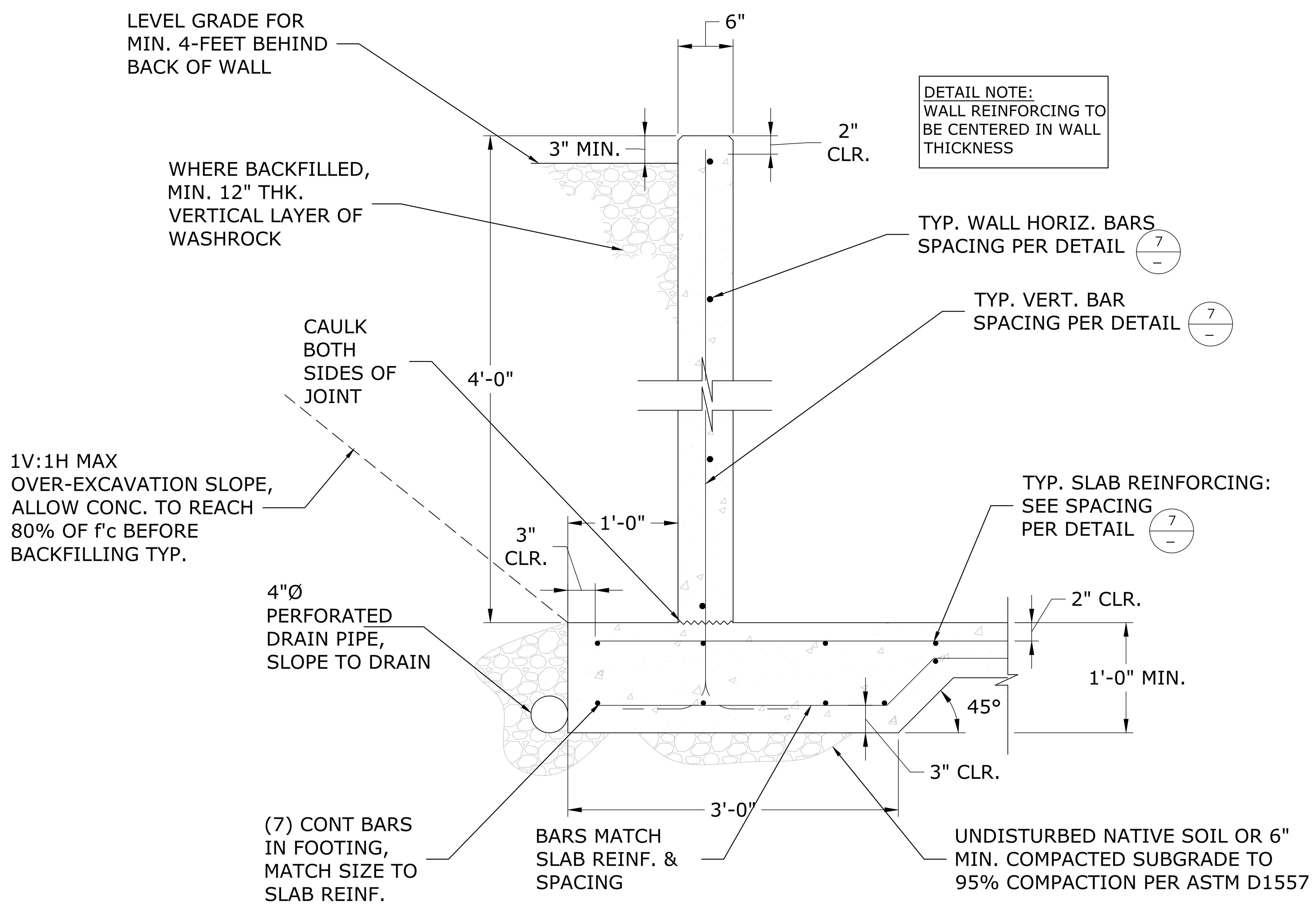
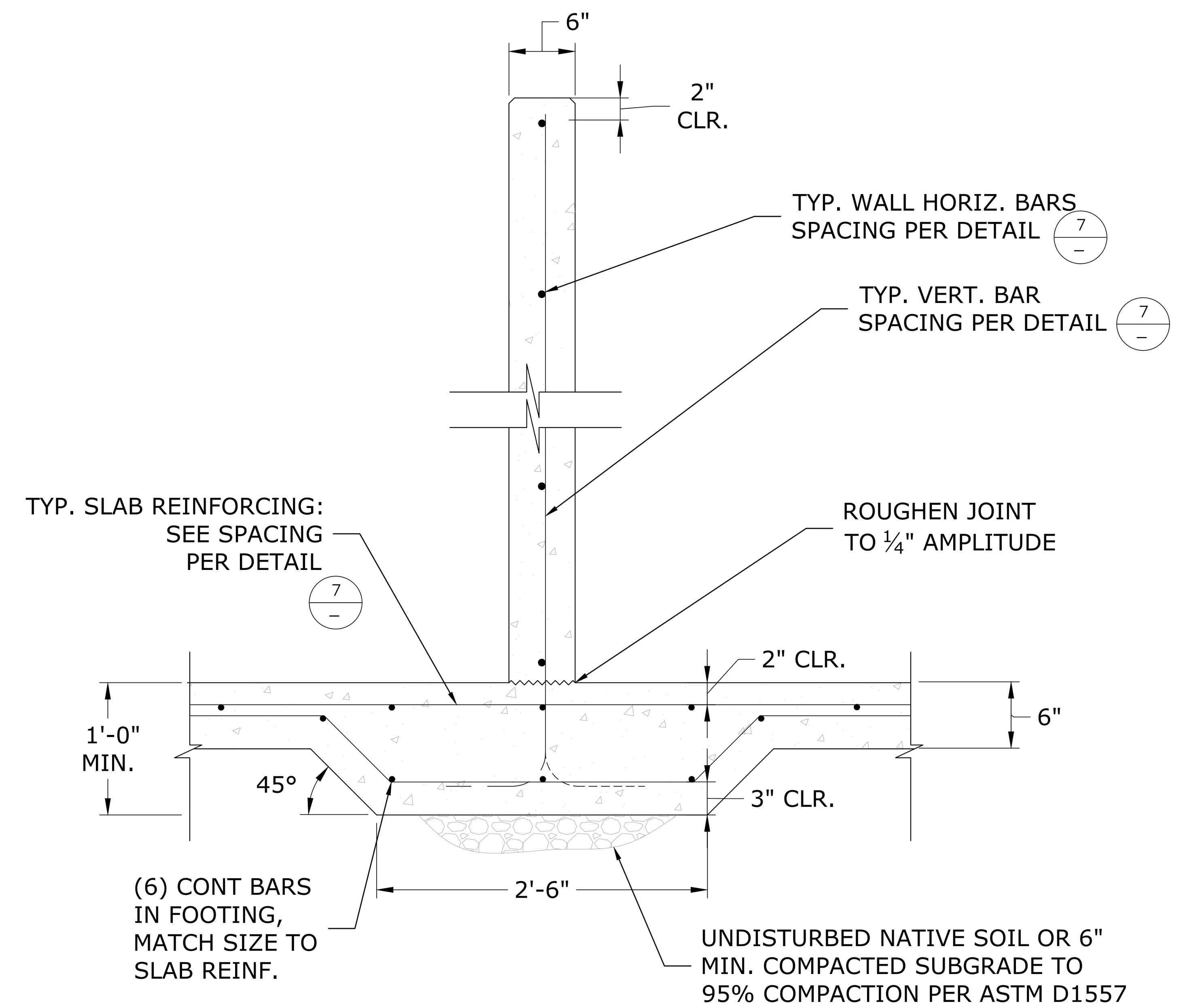
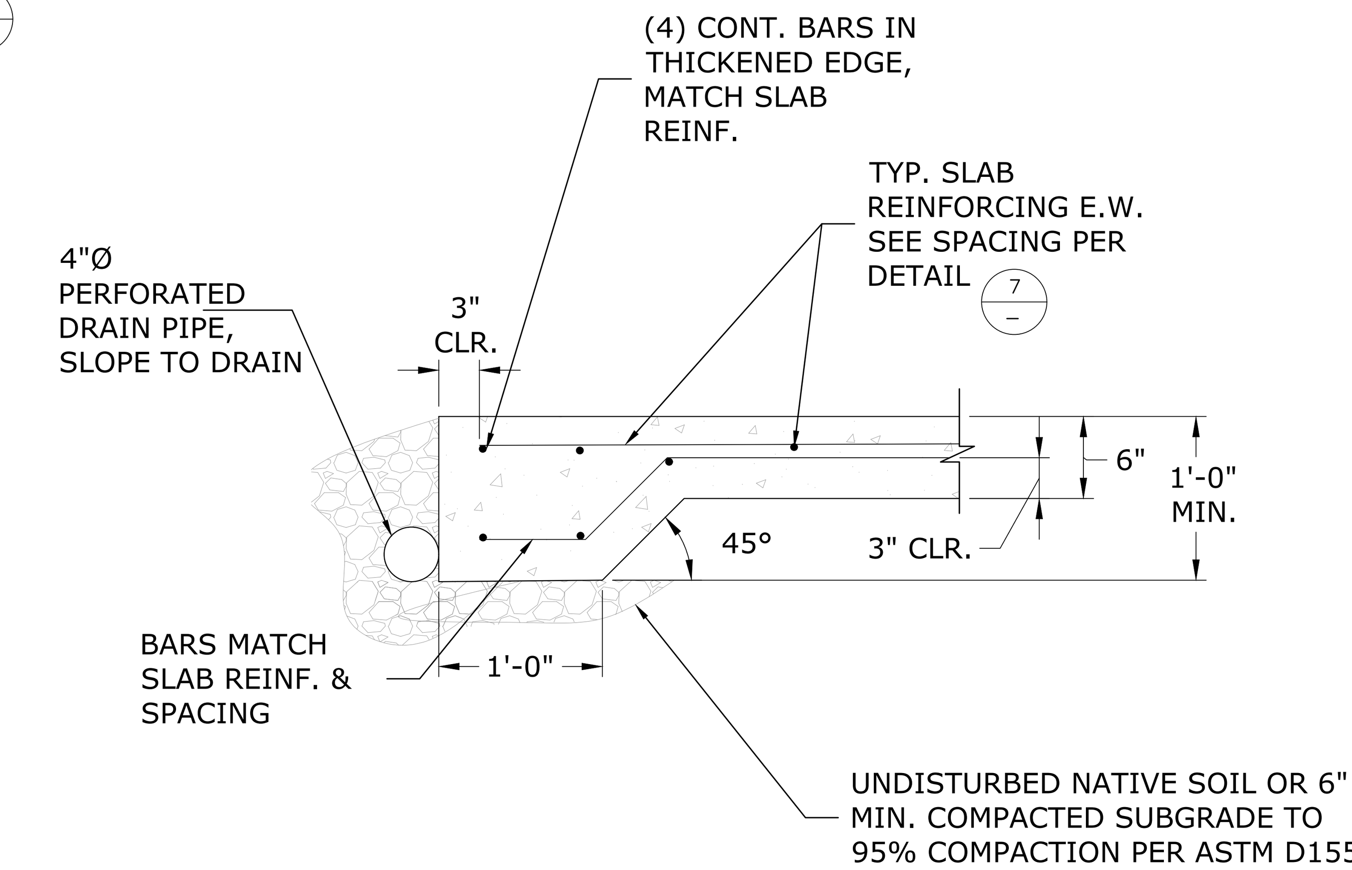
CHECKED	NRW
DATE	2/9/24
REVISIONS	
SHEET	S3 OF 9



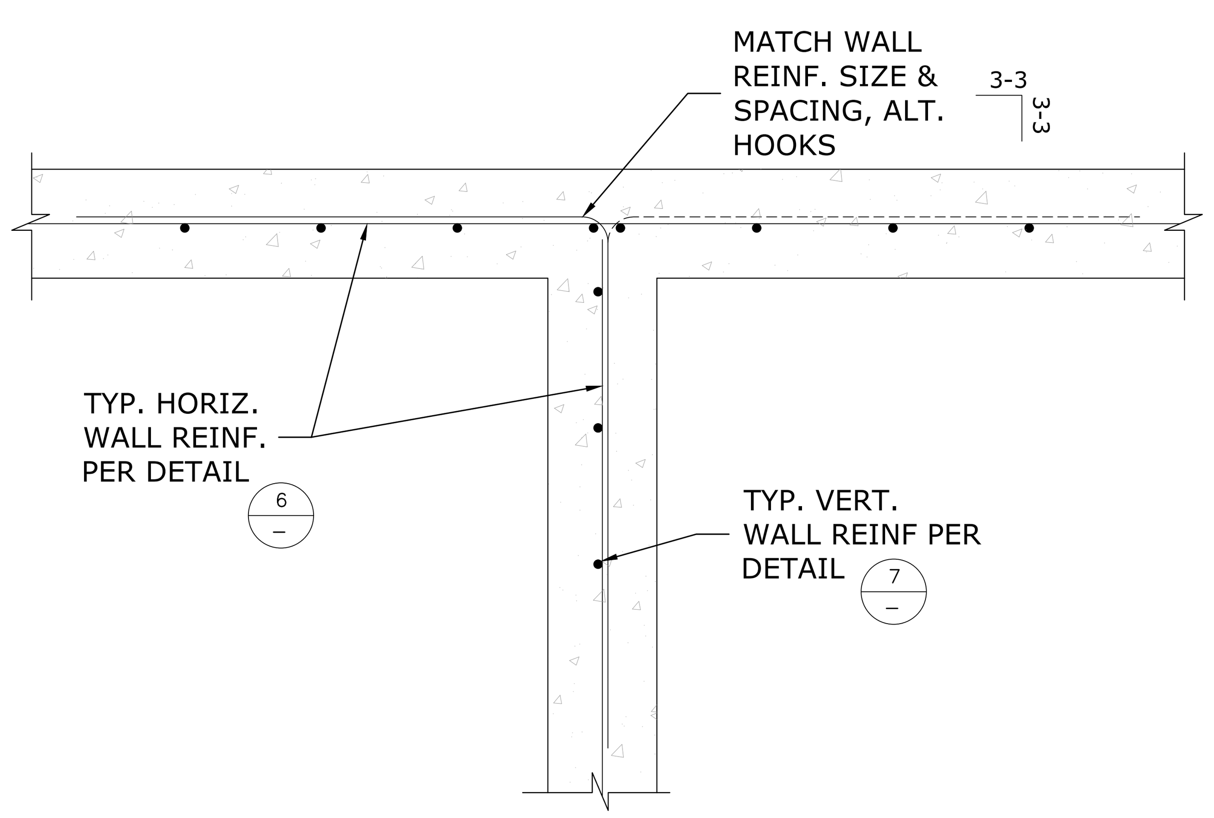
TYP. EXTERIOR CONC. WALL DETAIL 1/S4
1" = 1'-0"



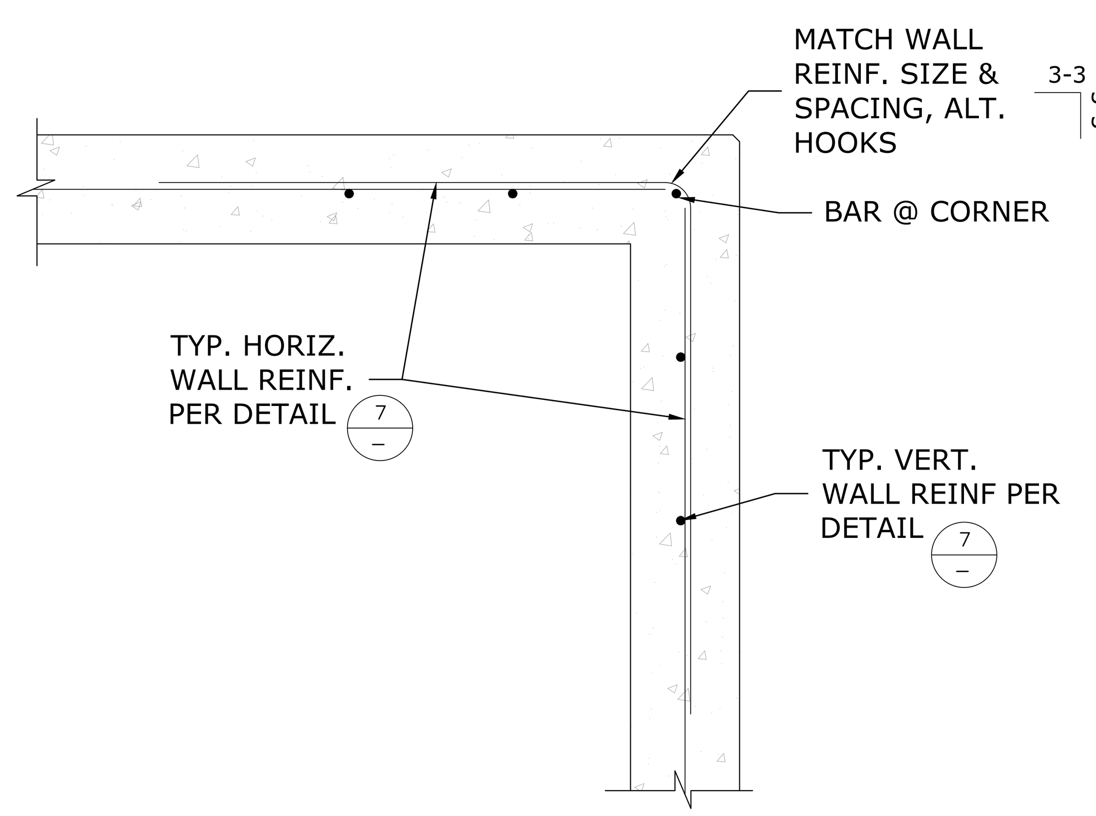
TYP. INTERIOR CONC. WALL DETAIL 2/S4
1" = 1'-0"



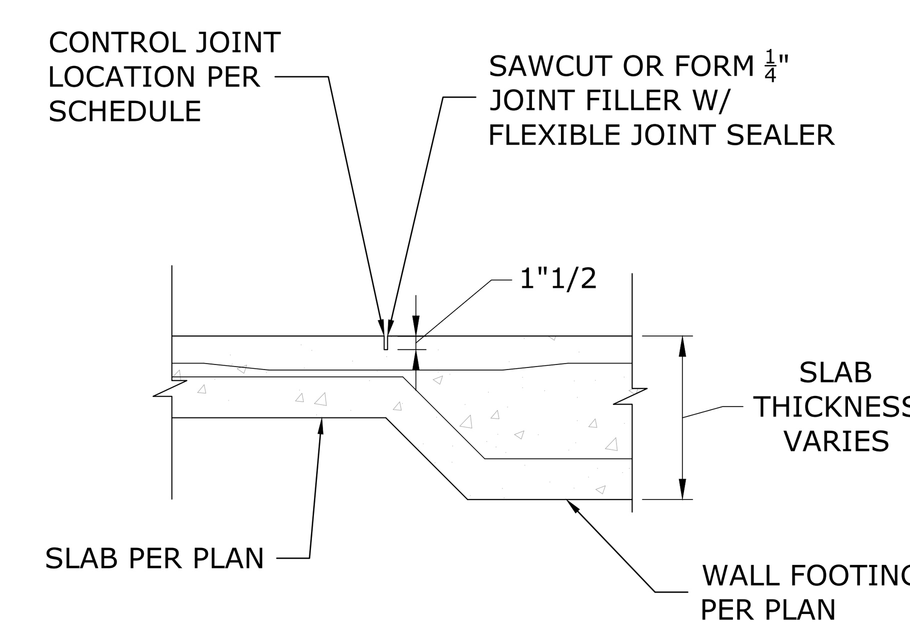
FRONT OF SLAB THICKENED EDGE DETAIL 3/S4
1" = 1'-0"



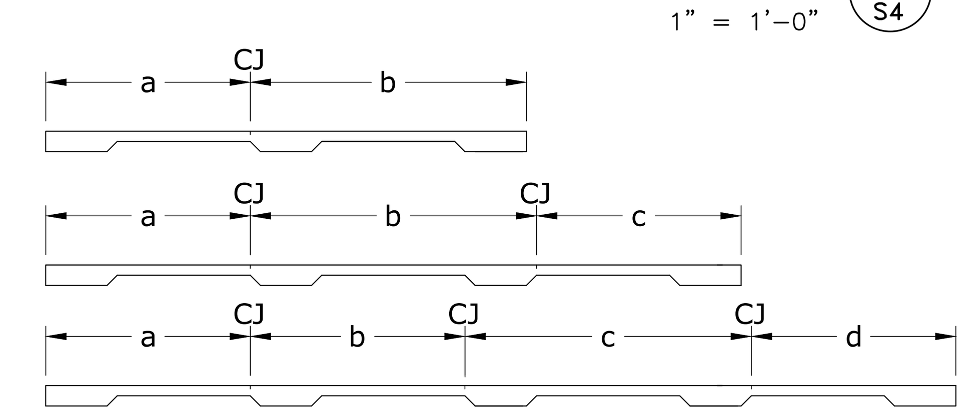
CONC. WALL INTERSECTION DETAIL 4/S4
1" = 1'-0"



CONC. WALL CORNER DETAIL 5/S4
1" = 1'-0"



SLAB CONTROL JOINT DETAIL 6/S4
1" = 1'-0"



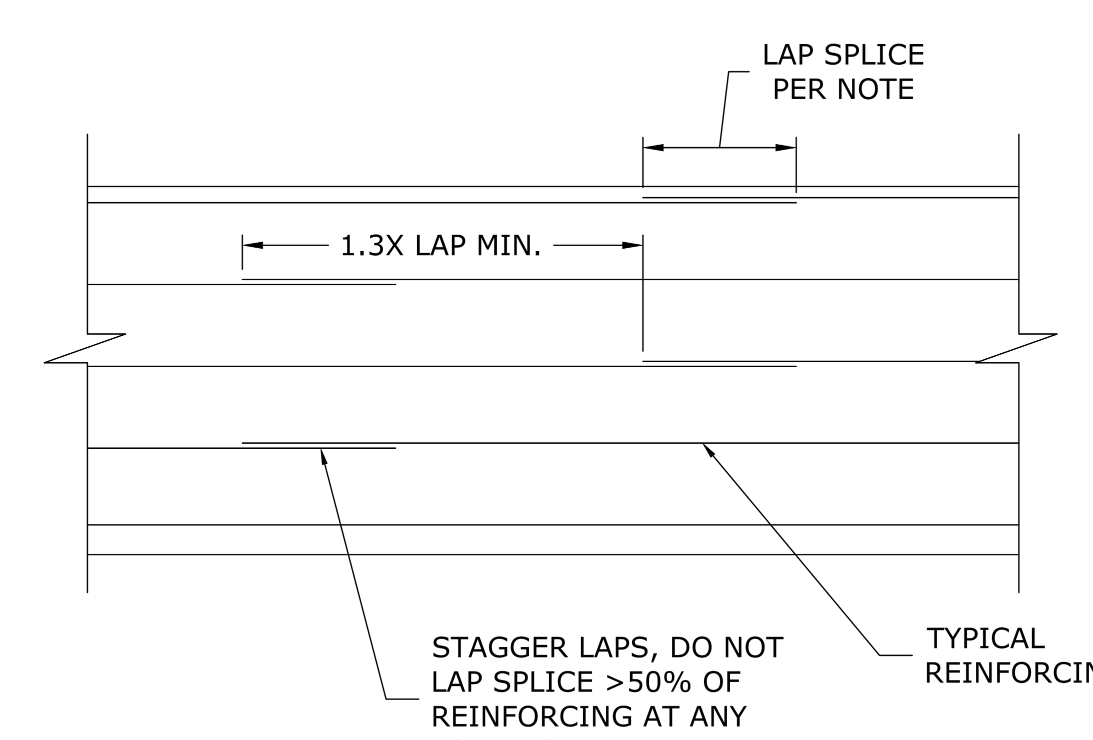
FOUNDATION CONTROL JOINT ELEVATION
NTS

CIP CONTROL JOINT LOCATION SCHEDULE			
	CIP 2-BIN	CIP 3-BIN	CIP 4-BIN
a	10'-0"	10'-0"	10'-0"
b	13'-6"	14'-0"	10'-6"
c	-	10'-0"	14'-0"
d	-	-	10'-0"

VERT. WALL REINF.	
#4 BARS	#5 BARS
@18" O.C.	@18" O.C.
HORZ. WALL REINF.	
#4 BARS	#5 BARS
@10" O.C.	@16" O.C.

SLAB REINF.	
#4 BARS	#5 BARS
@12" O.C.	@16" O.C.

TYPICAL REINFORCING SCHEDULE 7/S4
N.T.S



GENERAL LAP SPLICE DETAIL 8/S4
NTS

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SHEET CONTENT
CIP BIN OPTION - WALL AND FOUNDATION DETAILS

JOB No. 2302-0069
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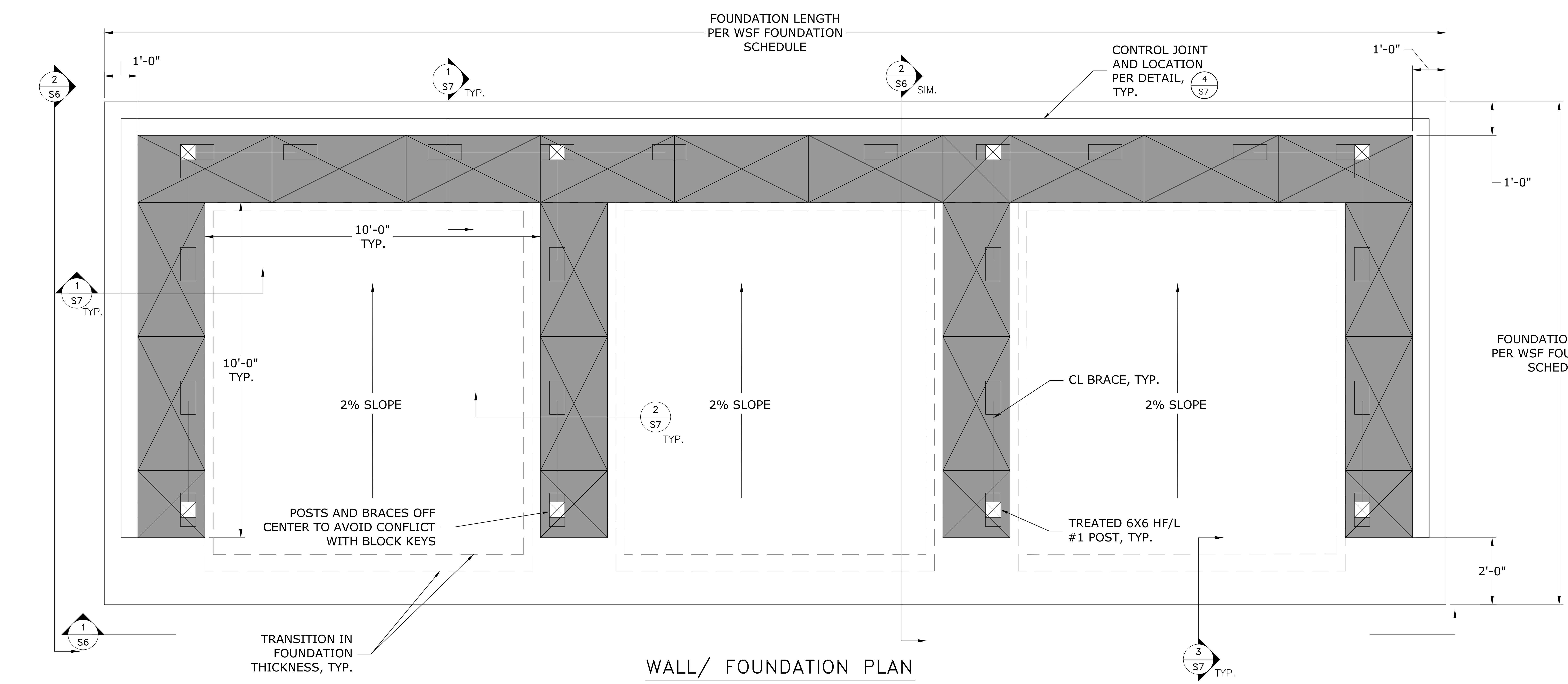
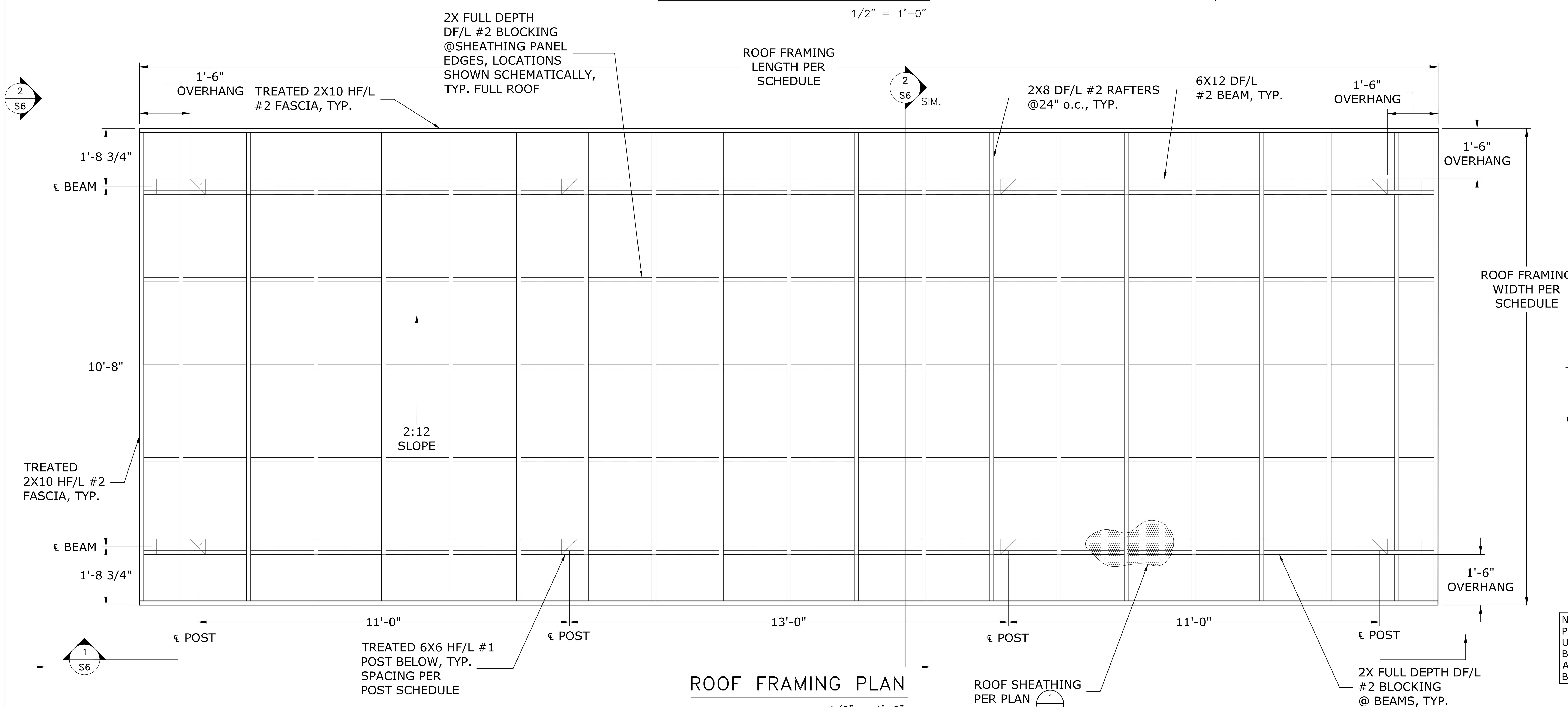
DATE 2/9/24
REVISIONS

SHEET S4 OF 9



WALL/ FOUNDATION PLAN

1/2" = 1'-0"



ROOF FRAMING PLAN

1/2" = 1'-0"

NOTE:
CONTRACTOR MAY USE A COMBINATION OF HALF BLOCKS (2'X2'X2') AND FULL BLOCKS (4'X2'X2') TO ACHIEVE THE BIN GEOMETRY SHOWN

NOTICE
0 1
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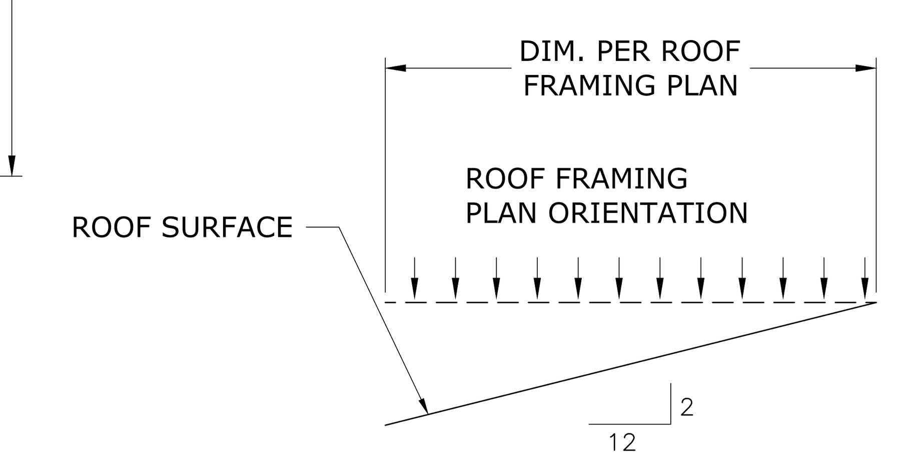
DETAIL NOTE:
CONTROL JOINT AND LOCATION PER DETAIL, 4 S7 TYP.

ECOLOGY BLOCK WSF FOUNDATION SCHEDULE		
ECOLOGY BLOCK BIN CONFIGURATION	TOTAL FOUNDATION LENGTH	TOTAL FOUNDATION WIDTH
EB 2-BIN	28'-0"	15'-0"
EB 3-BIN	40'-0"	15'-0"
EB 4-BIN	52'-0"	15'-0"

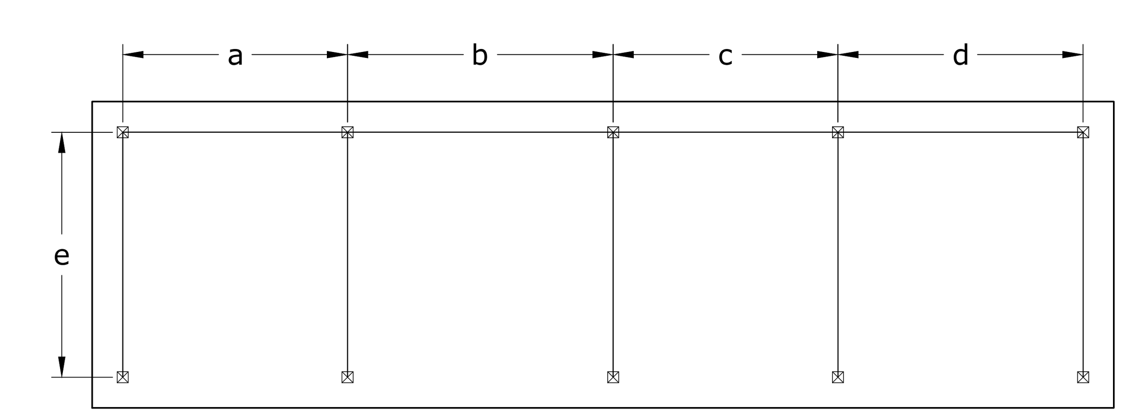
SHEET NOTES:
1. CONTRACTOR/OWNER'S OPTION TO USE 2-BIN, 3-BIN OR 4-BIN CONFIGURATION.
2. TREAT ALL CUT ENDS OF TREATED LUMBER FOR EXTERIOR EXPOSURE.
3. GUTTERS, DRIP EDGE, AND FLASHING BY OTHERS. NOT SHOWN FOR CLARITY.



ROOF FRAMING PLAN ORIENTATION

NOTE: DIMENSIONS TAKEN AS HORIZONTAL PROJECTIONS BASED ON ANGLE OF ROOF SURFACE

ECOLOGY BLOCK ROOF FRAMING SCHEDULE		
ECOLOGY BLOCK BIN CONFIGURATION	ROOF PLAN LENGTH	ROOF PLAN WIDTH
EB 2-BIN	26'-5"1/2	14'-1"1/2
EB 3-BIN	38'-5"1/2	14'-1"1/2
EB 4-BIN	50'-5"1/2	14'-1"1/2



POST SPACING GEOMETRY

NTS

NOTE:
POST SPACING IS NOT UNIFORM ON ECOLOGY BLOCK OPTION TO AVOID CONFLICT WITH BLOCK KEYS

ECOLOGY BLOCK POST SPACING SCHEDULE			
	EB 2-BIN	EB 3-BIN	EB 4-BIN
a	11'-0"	11'-0"	11'-0"
b	12'-0"	13'-0"	13'-0"
c	-	11'-0"	11'-0"
d	-	-	12'-0"
e	10'-8"	10'-8"	10'-8"

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SHEET CONTENT
ECOLOGY BLOCK OPTION - FOUNDATION AND ROOF PLAN

JOB No.
2302-0069

DRAWN RLKC
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DATE 2/9/24

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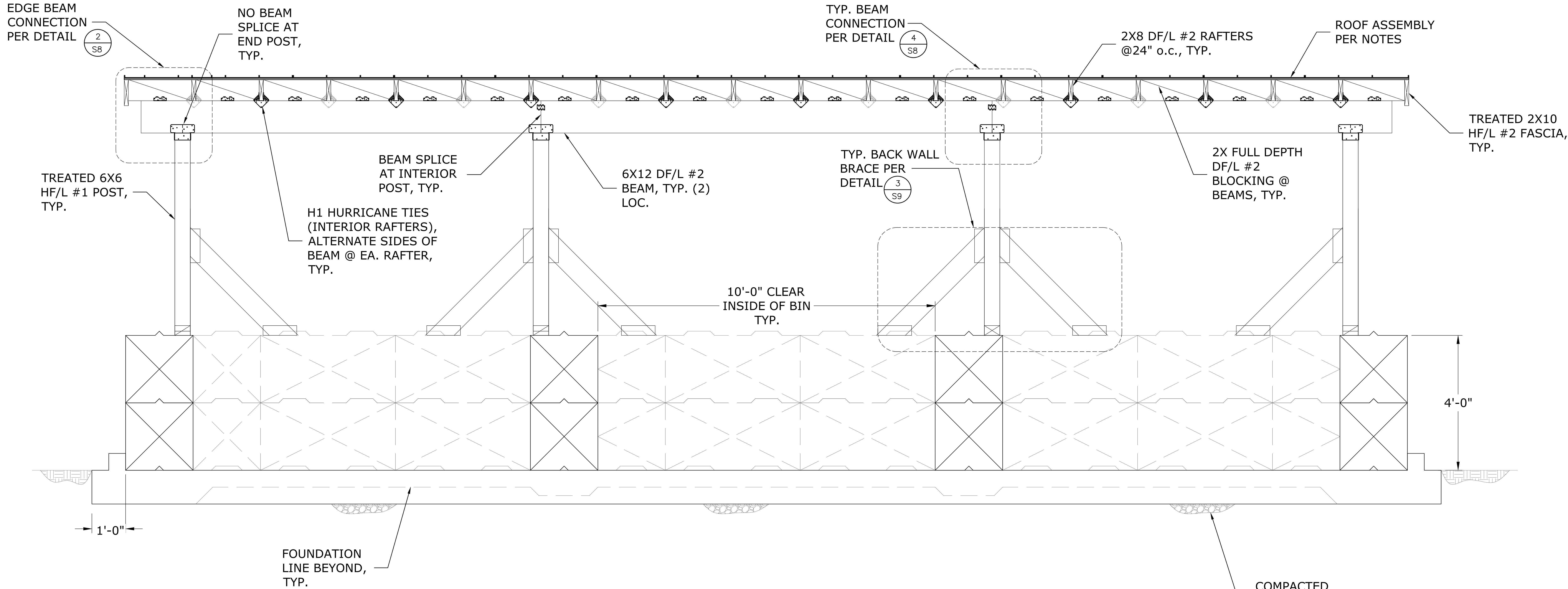
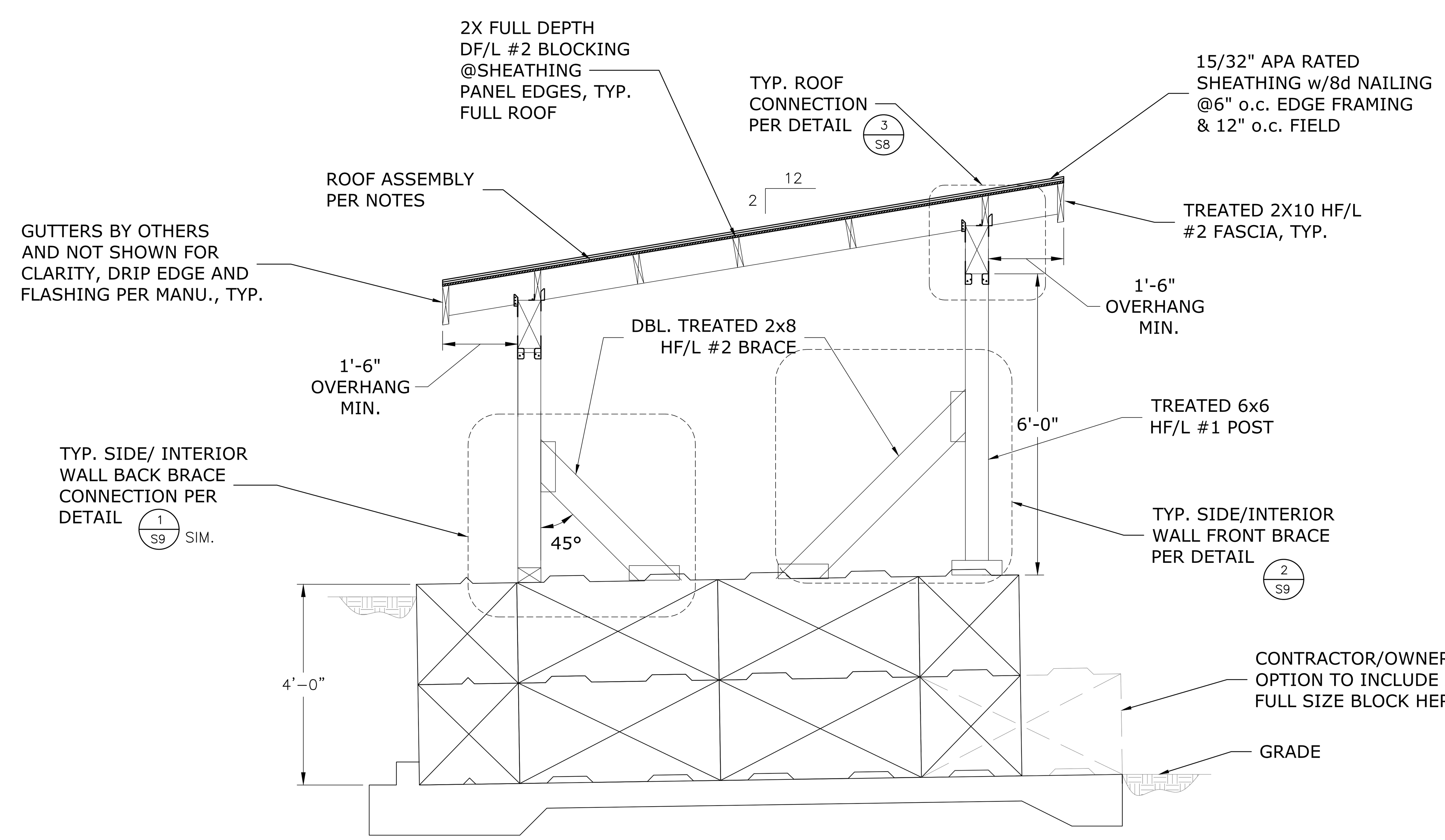
S5 OF 9



FRONT ELEVATION 1/S6
3/8" = 1'-0"



SECTION 2/S6
3/8" = 1'-0"

ROOF ASSEMBLY NOTES:
- ROOF ASSEMBLIES, UNDERLAYMENT, AND ATTACHMENT SHALL BE IN CONFORMANCE WITH CHAPTER 15 OF THE 2021 IBC WITH WASHINGTON AMMENDMENTS.
- ROOF ASSEMBLIES SHALL BE CAPABLE OF RESISTING THE DESIGN LOADS SUMMARIZED ON SHEET S1.
- CONTRACTOR/OWNER OPTION TO USE METAL ROOF PANELS OF COMPOSITE (SYNTHETIC) SHINGLES. UNDERLAYMENT, INSTALLATION, AND ATTACHMENT SHALL BE PER MANUFACTURE INSTALLATION INSTRUCTIONS

NOTICE
0 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

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02/09/2024

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(253)830 - 2140

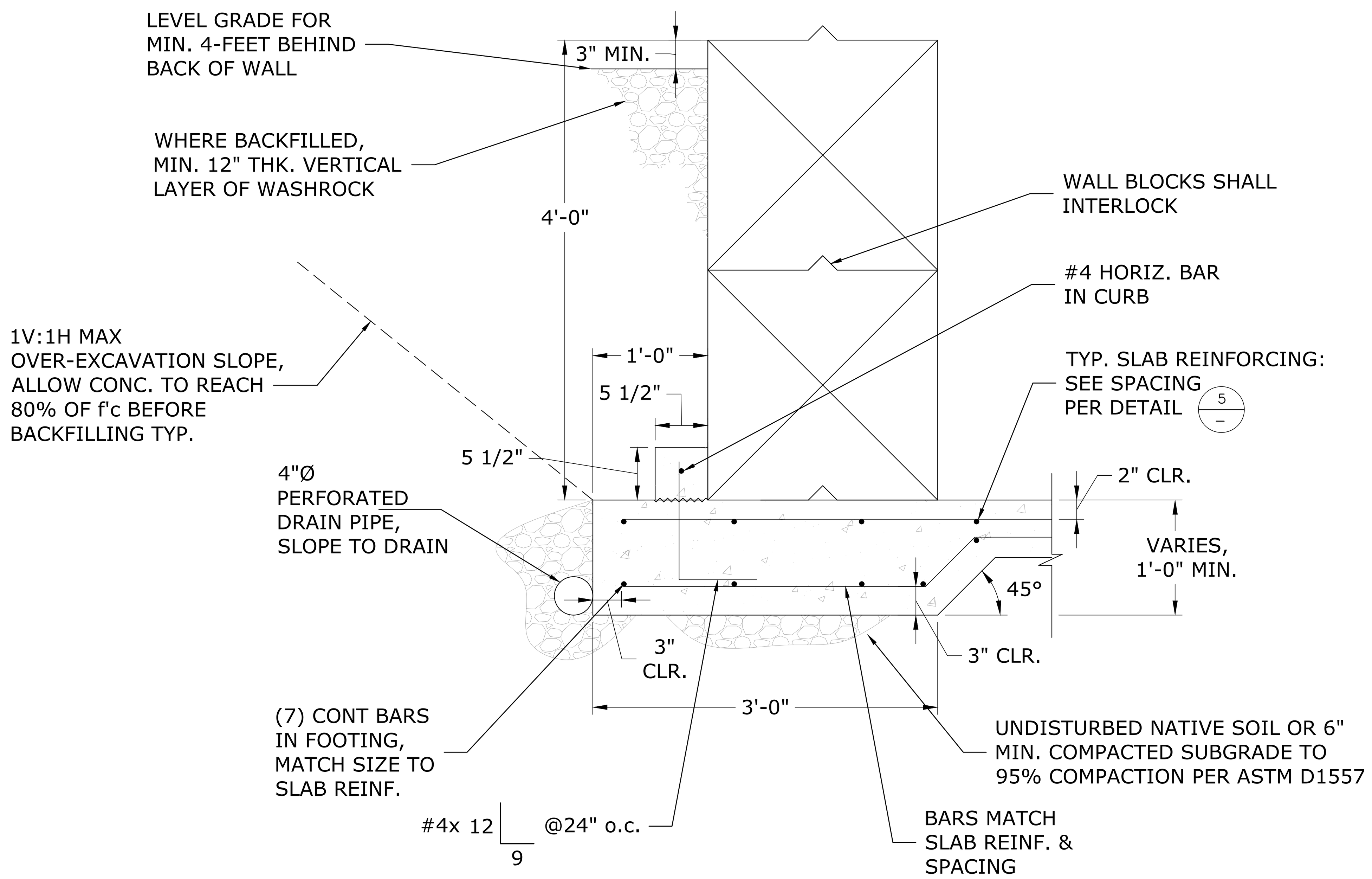
STOCK AGRICULTURAL WSF

CLIENT INFO:
SKAGIT CONSERVATION DISTRICT
2021 E. COLLEGE WAY, SUITE 203
MOUNT VERNON, WA 98273

PROJECT SITE:
SKAGIT CONSERVATION DISTRICT
WHATCOM CONSERVATION DISTRICT
WHIDBEY ISLAND CONSERVATION DISTRICT
SAN JUAN ISLANDS CONSERVATION DISTRICT

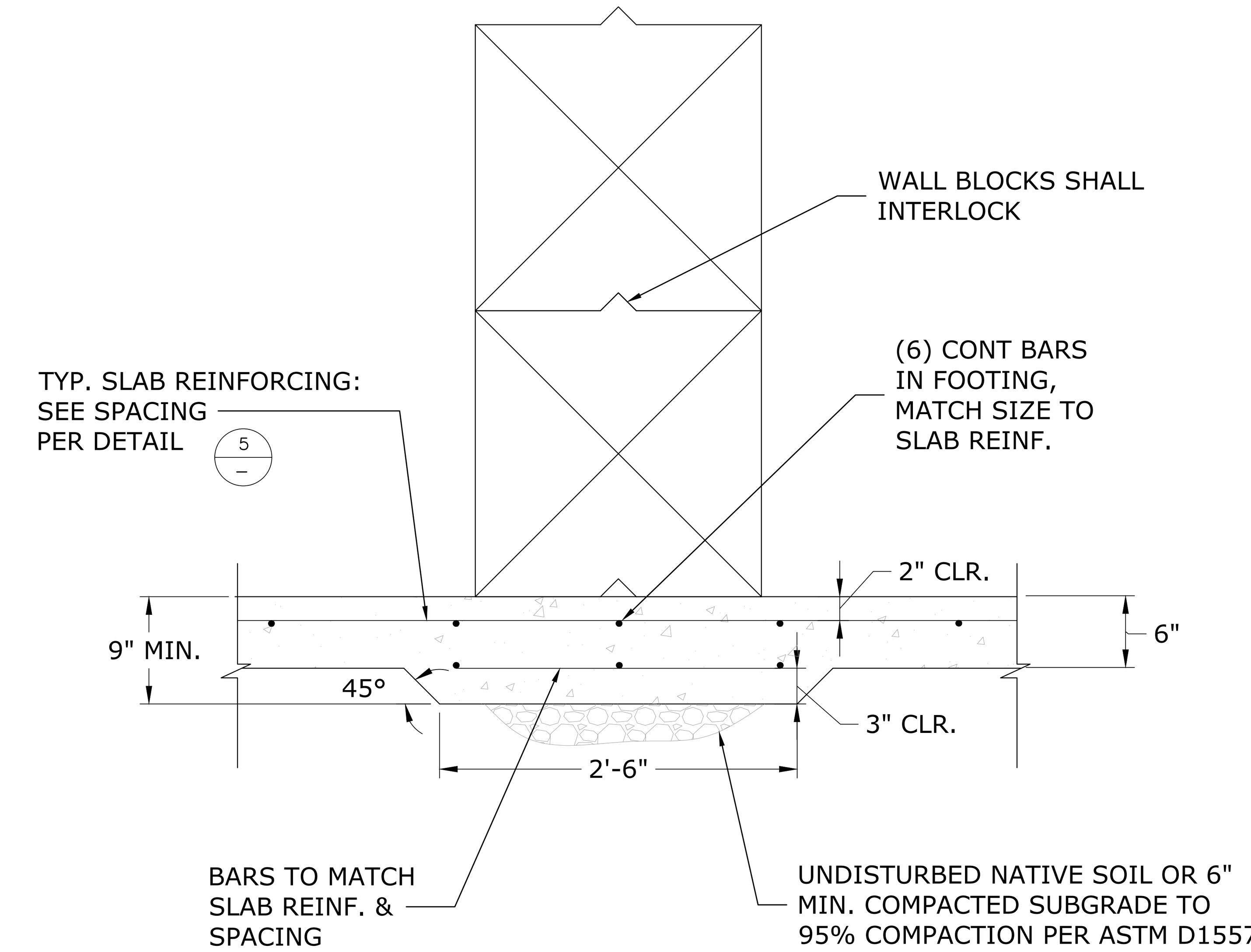
SHEET CONTENT
ECOLOGY BLOCK OPTION - ELEVATION AND SECTIONS

JOB No.	2302-0069
DRAWN	RLKC
CHECKED	NRW
DATE	2/9/24
REVISIONS	
SHEET	S6 OF 9



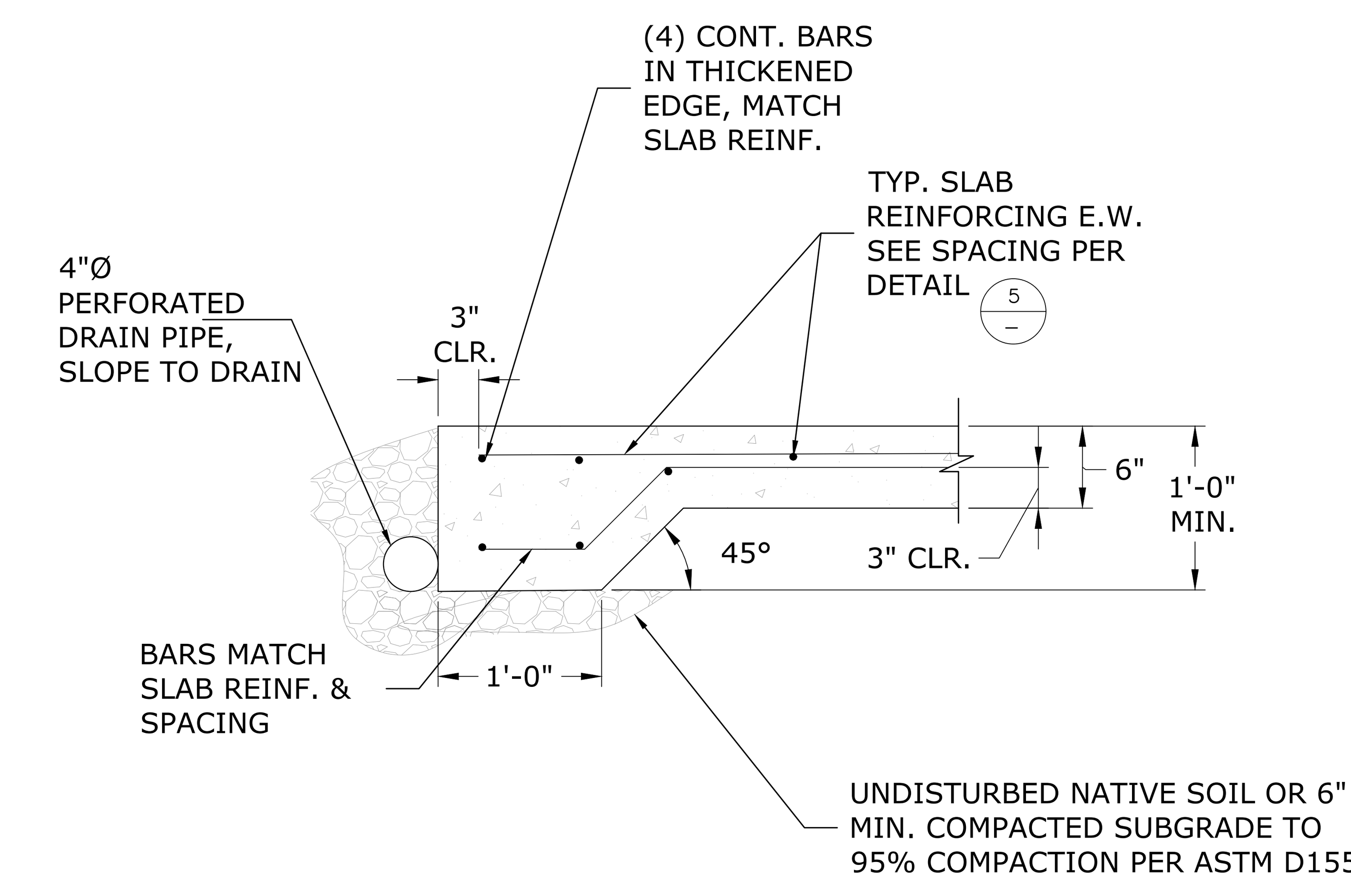
TYP. EXTERIOR ECO BLOCK WALL FOOTING DETAIL 1/S7

1" = 1'-0"



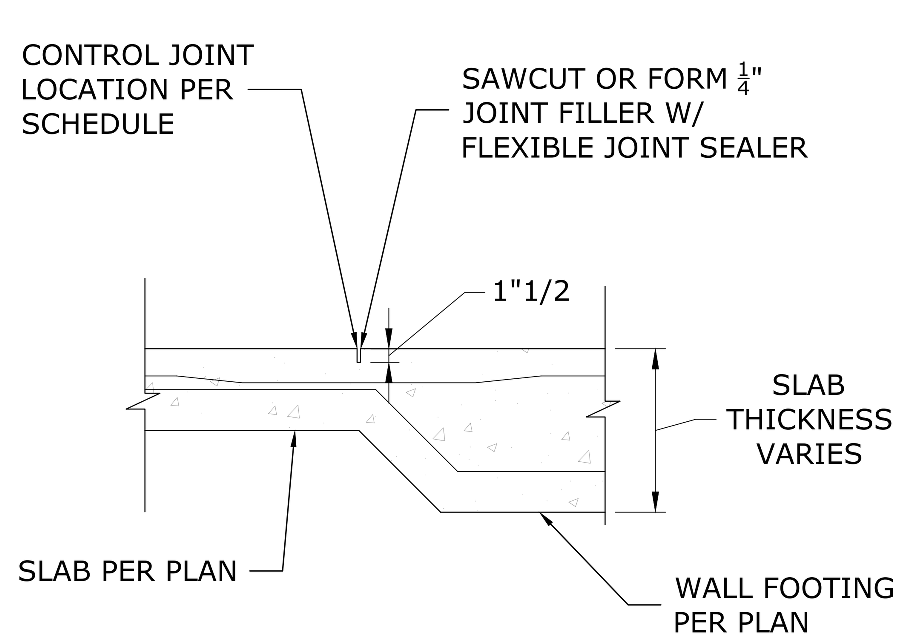
TYP. INTERIOR ECO BLOCK WALL FOOTING DETAIL 2/S7

1" = 1'-0"



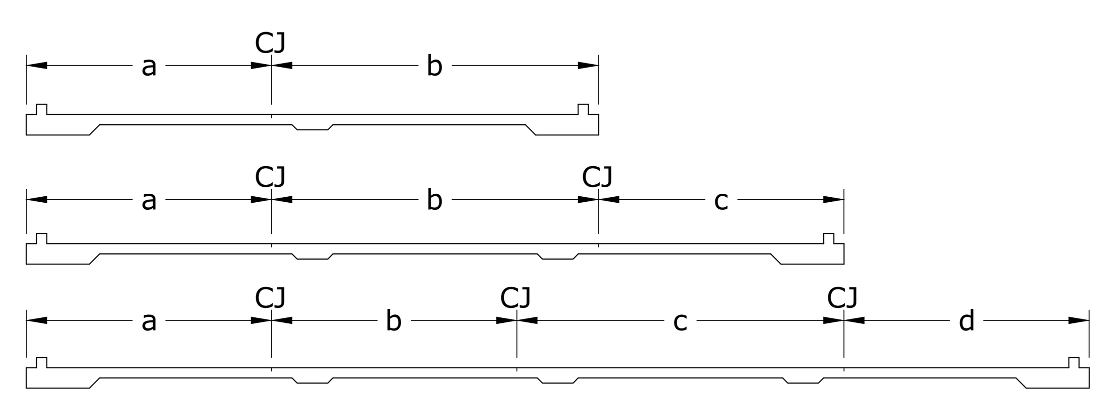
FRONT OF SLAB THICKENED EDGE DETAIL 3/S7

1" = 1'-0"



SLAB CONTROL JOINT DETAIL 4/S7

1" = 1'-0"



FOUNDATION CONTROL JOINT ELEVATION

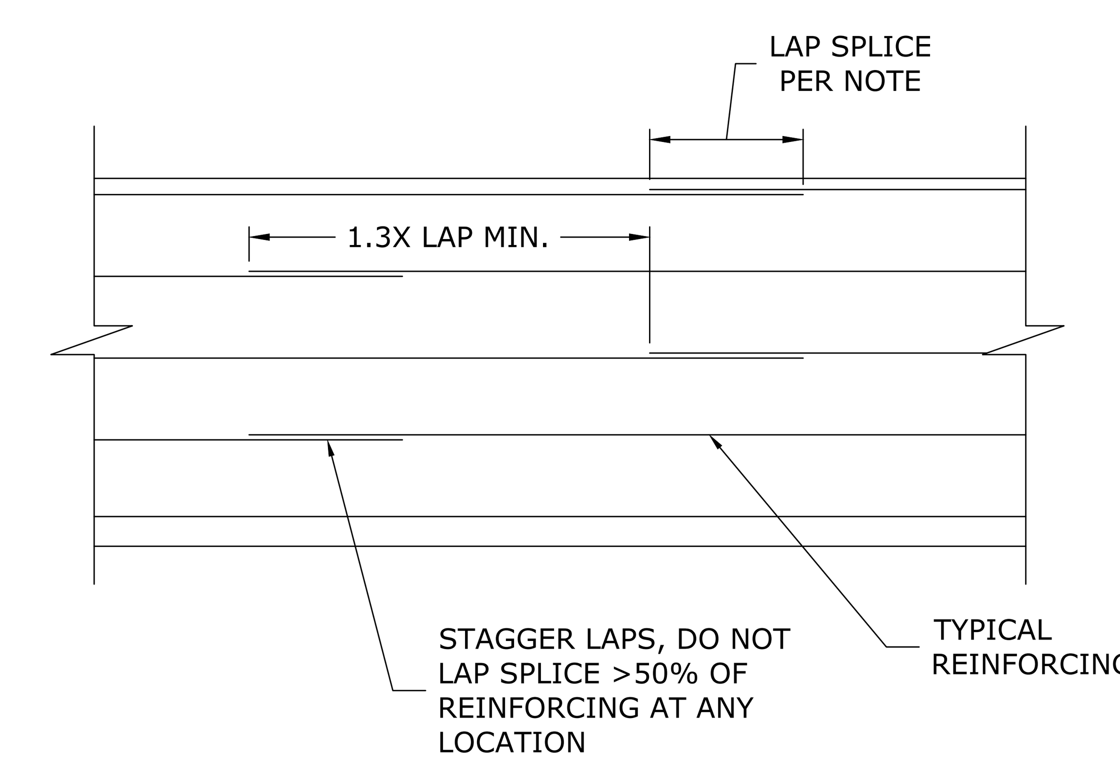
NTS

ECOLOGY BLOCK CONTROL JOINT LOCATION SCHEDULE			
	EB 2-BIN	EB 3-BIN	EB 4-BIN
a	12'-0"	12'-0"	12'-0"
b	16'-0"	16'-0"	12'-0"
c	-	12'-0"	16'-0"
d	-	-	12'-0"

SLAB REINF.	
#4 BARS	#5 BARS
@12" O.C.	@16" O.C.

TYPICAL REINFORCING SCHEDULE 5/S7

N.T.S



GENERAL LAP SPLICE DETAIL 8/S7

NTS

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STOCK AGRICULTURAL WSF

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MOUNT VERNON, WA 98273

SHEET CONTENT
ECOLOGY BLOCK OPTION -
WALL AND
FOUNDATION DETAILS

JOB No. 2302-0069

DRAWN RLKC CHECKED NRW

DATE 2/9/24

REVISIONS

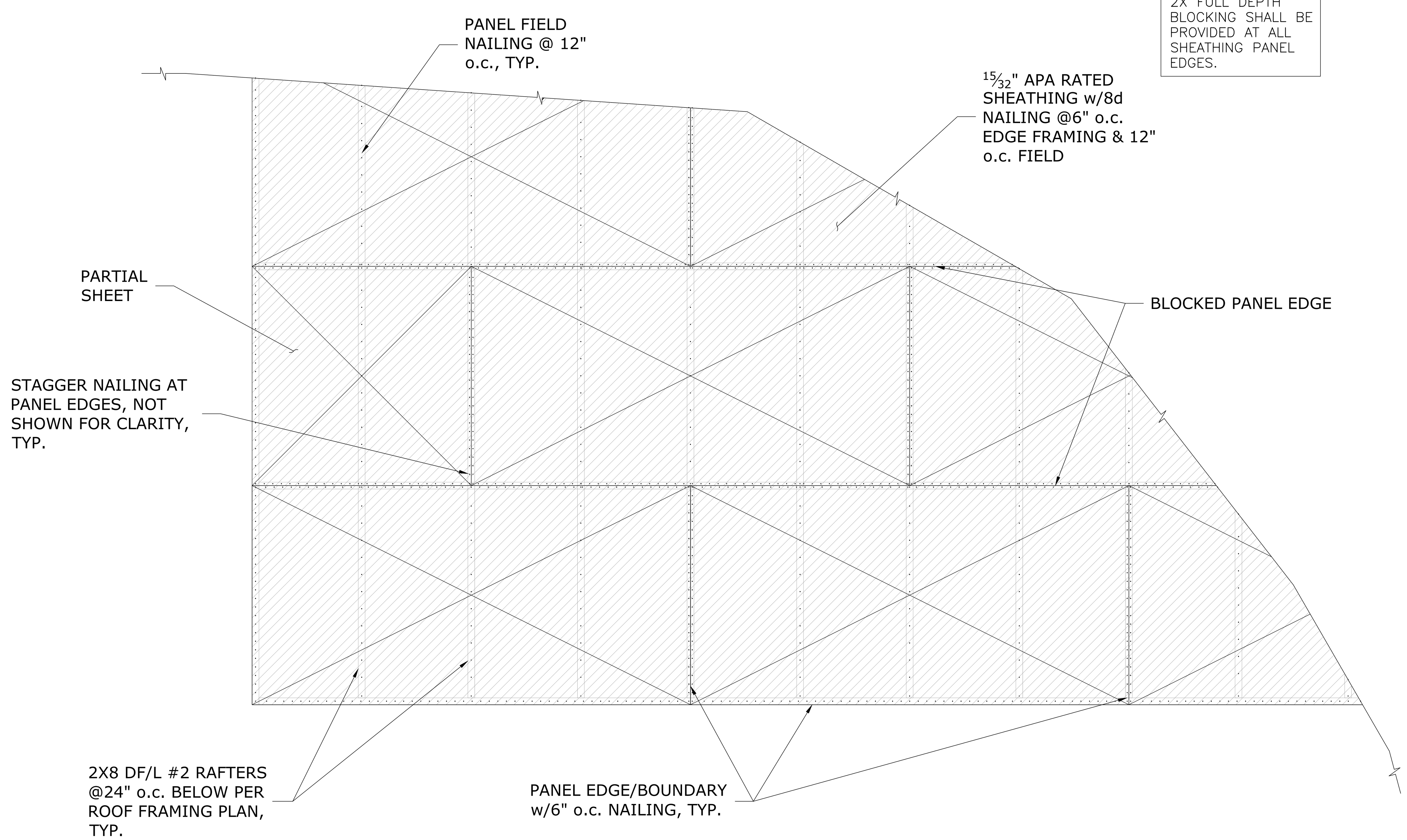
SHEET S7 OF 9

NOTICE

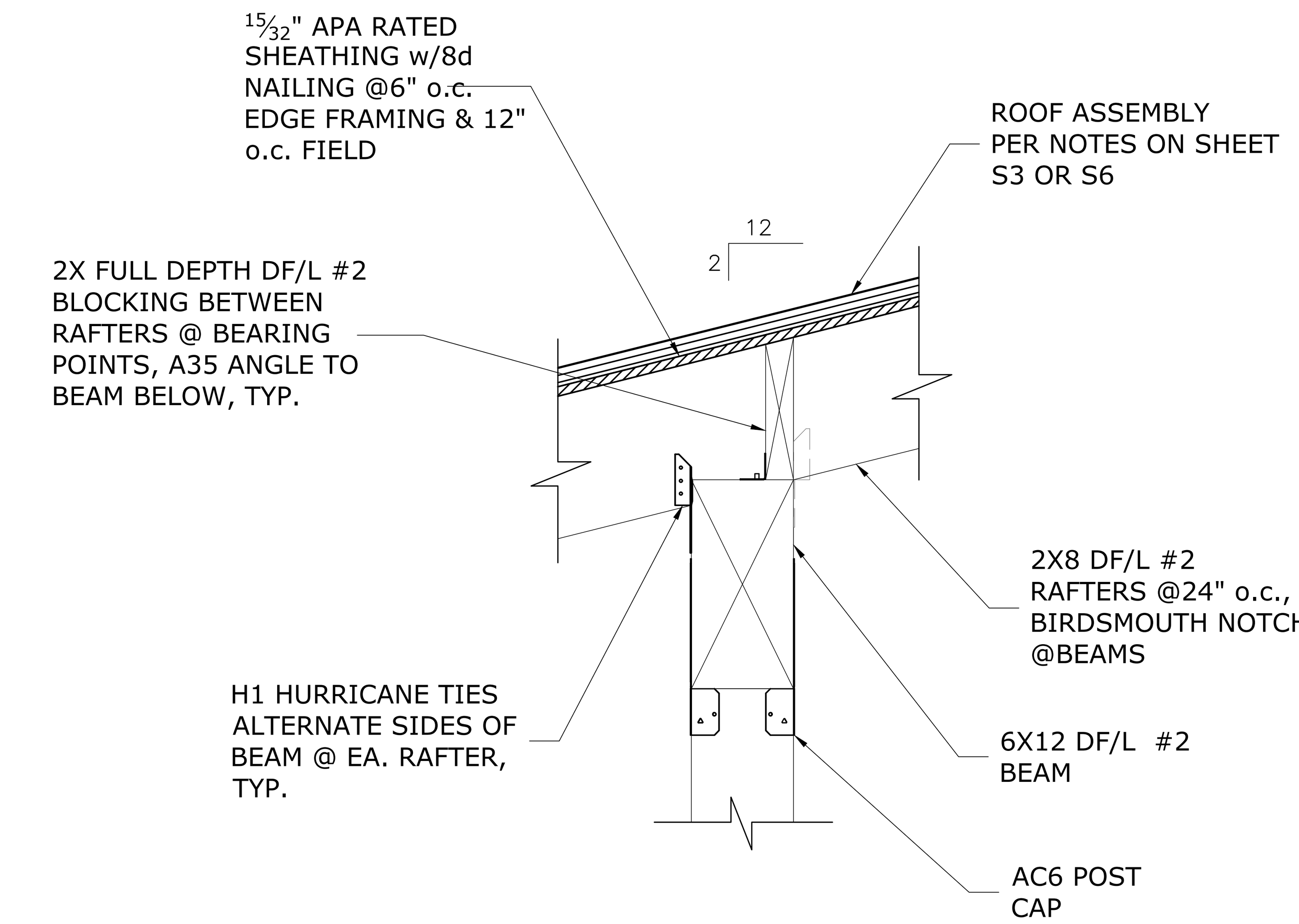
0 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DETAIL NOTES:
2X FULL DEPTH BLOCKING SHALL BE PROVIDED AT ALL SHEATHING PANEL EDGES.

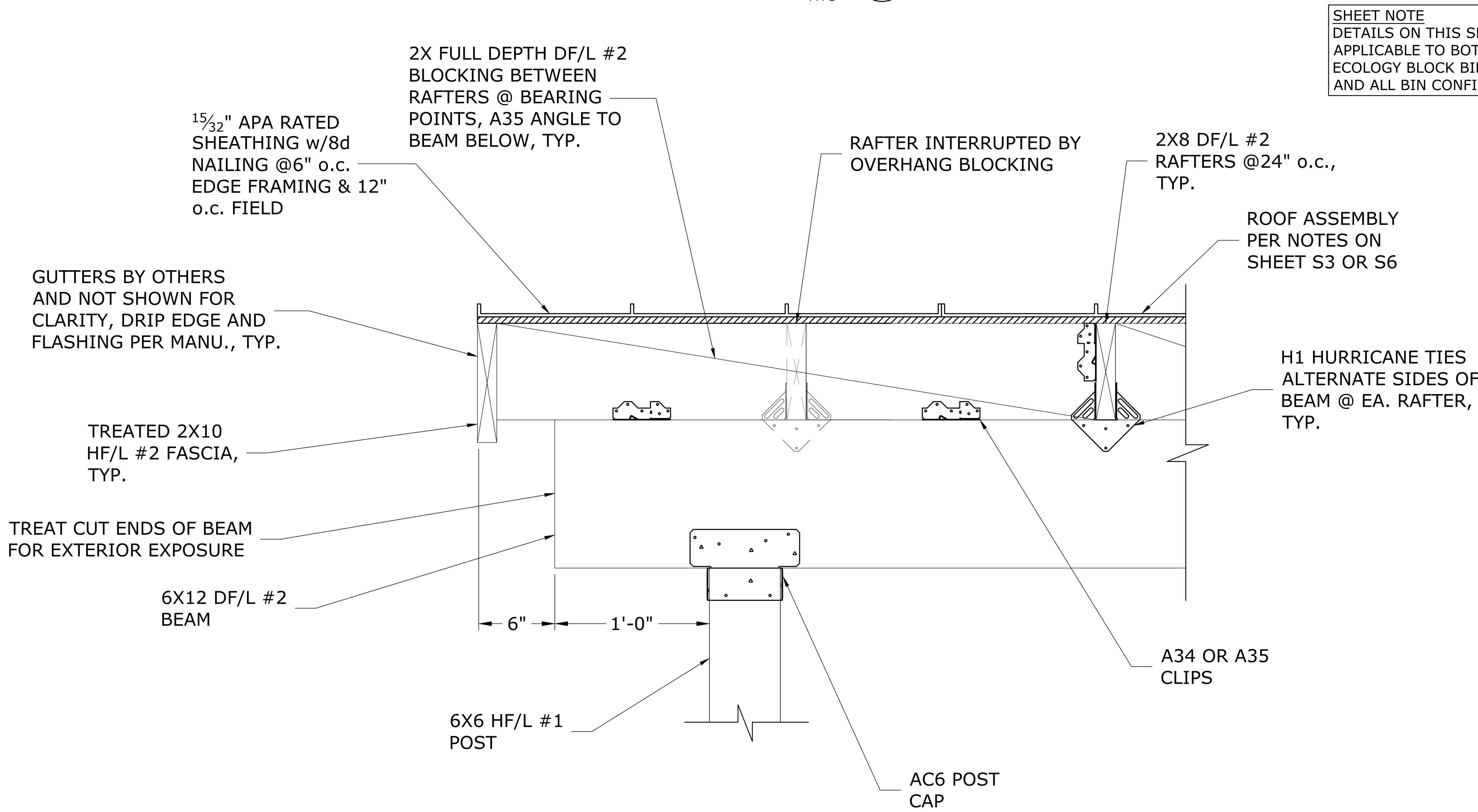


ROOF SHEATHING PLAN (1/S8)
NTS

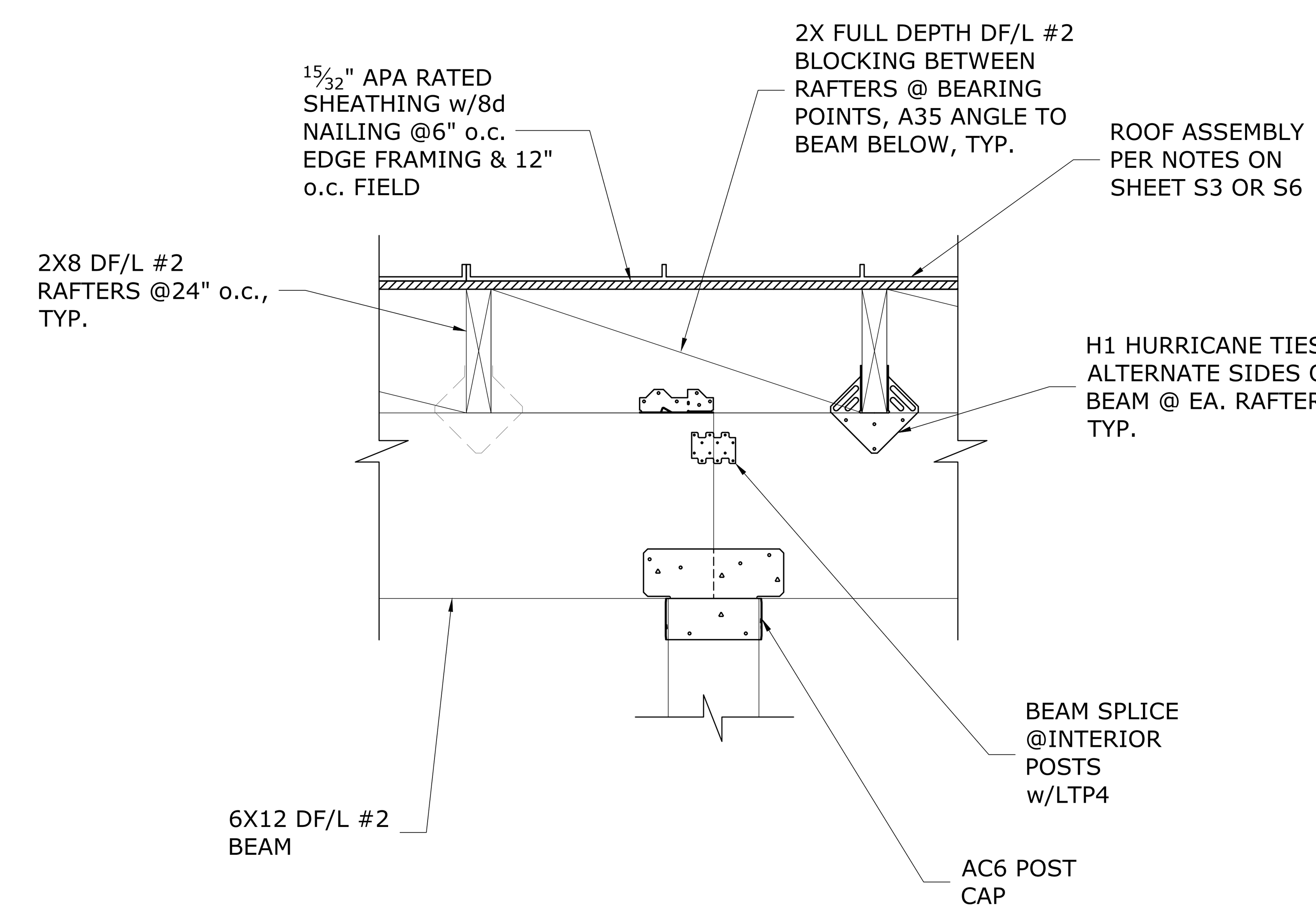


TYP. POST–BEAM CONNECTION (3/S8)
1"1/2 = 1'–0"

SHEET NOTE
DETAILS ON THIS SHEET ARE APPLICABLE TO BOTH CIP BIN AND ECOLOGY BLOCK BIN OPTIONS AND ALL BIN CONFIGURATIONS



TYP. EDGE–POST BEAM CONNECTION (2/S8)
1"1/2 = 1'–0"



INTERIOR POST–BEAM CONNECTION (4/S8)
1"1/2 = 1'–0"

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STOCK AGRICULTURAL WSF

CLIENT INFO:
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PROJECT SITE:
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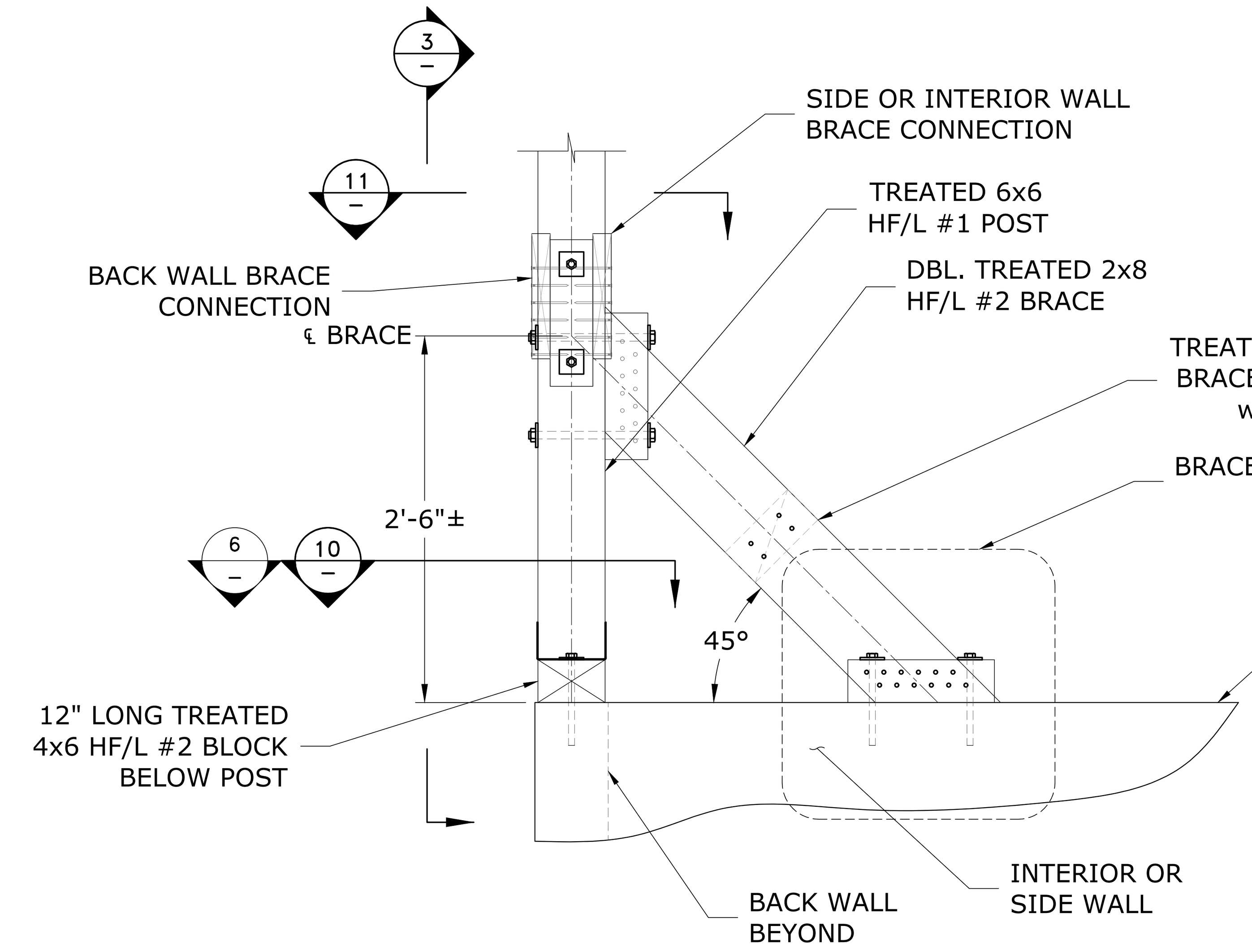
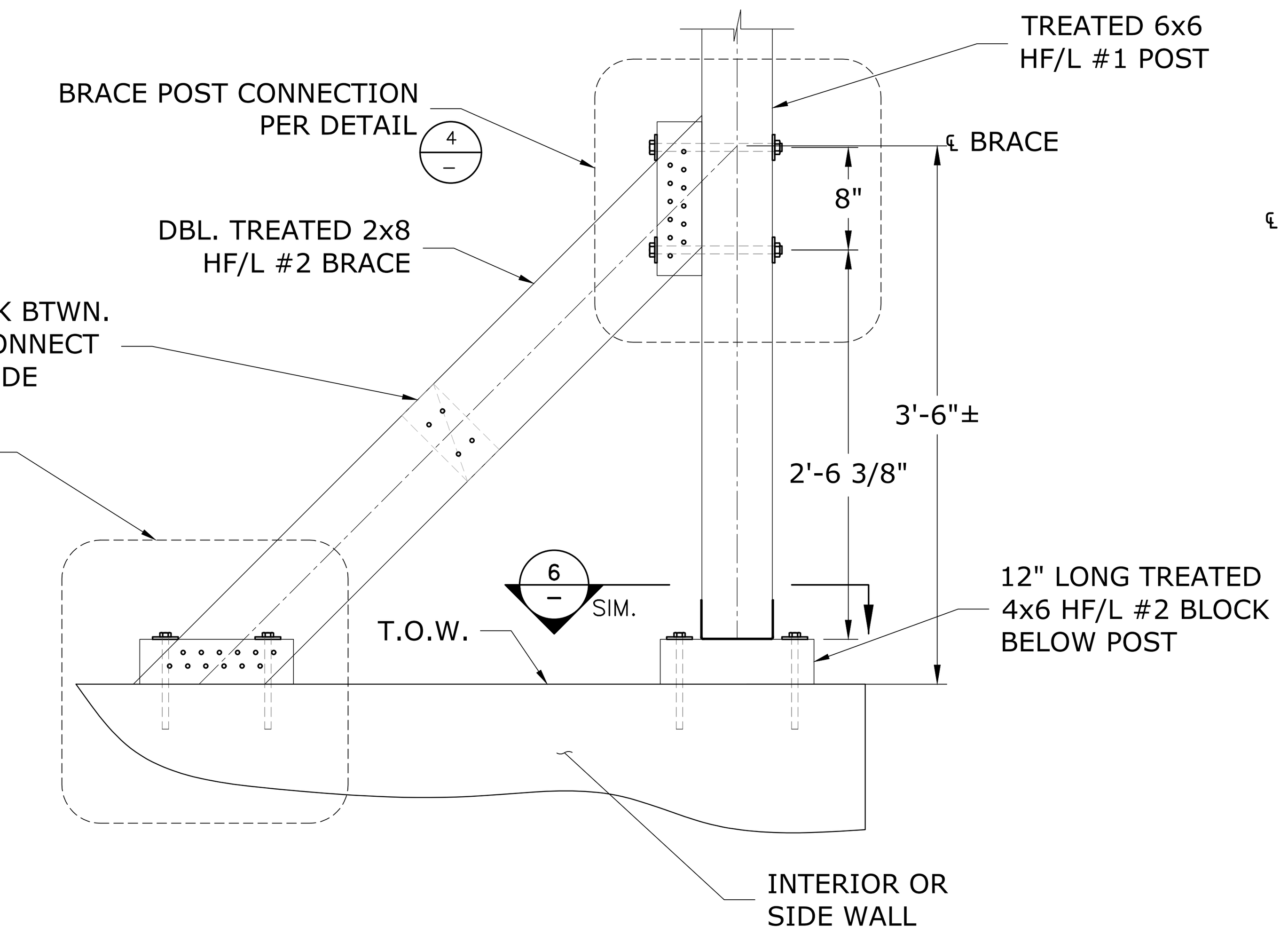
SHEET CONTENT
GENERAL DETAILS - ROOF FRAMING

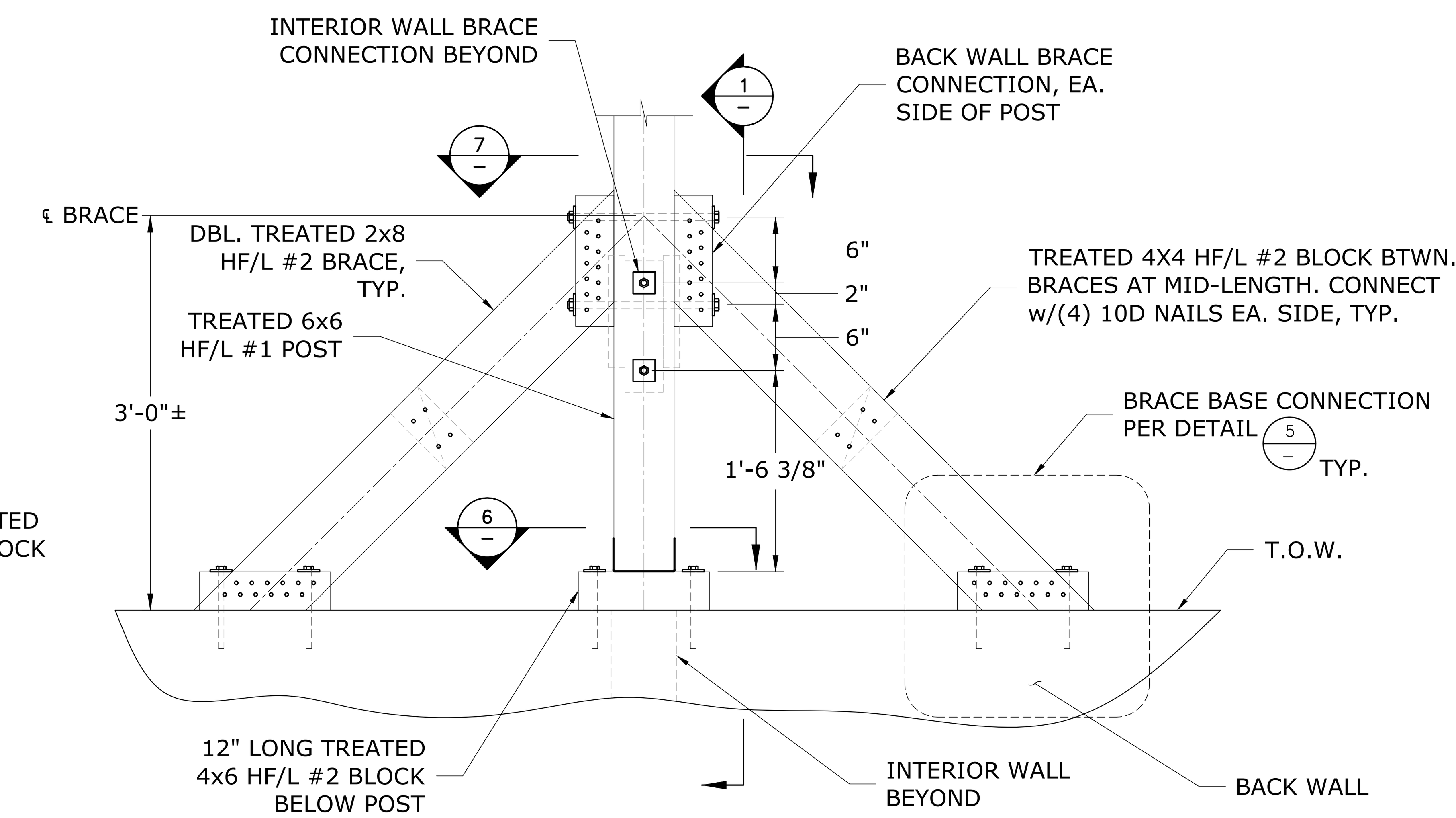
JOB No.	2302-0069
DRAWN	RLKC
CHECKED	NRW
DATE	2/9/24
REVISIONS	
SHEET	S8 OF 9



BACK BRACE SIDE ELEVATION 1/S9
1" = 1'-0"



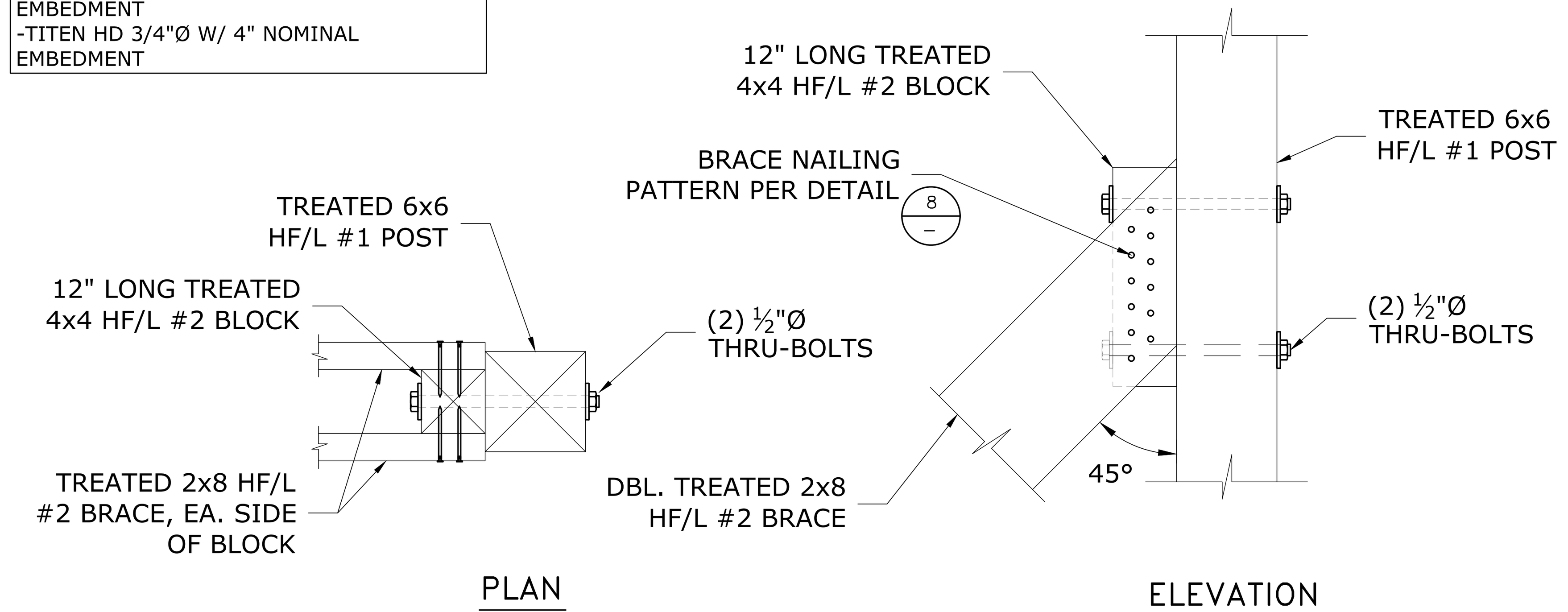
FRONT BRACE ELEVATION 2/S9
1" = 1'-0"



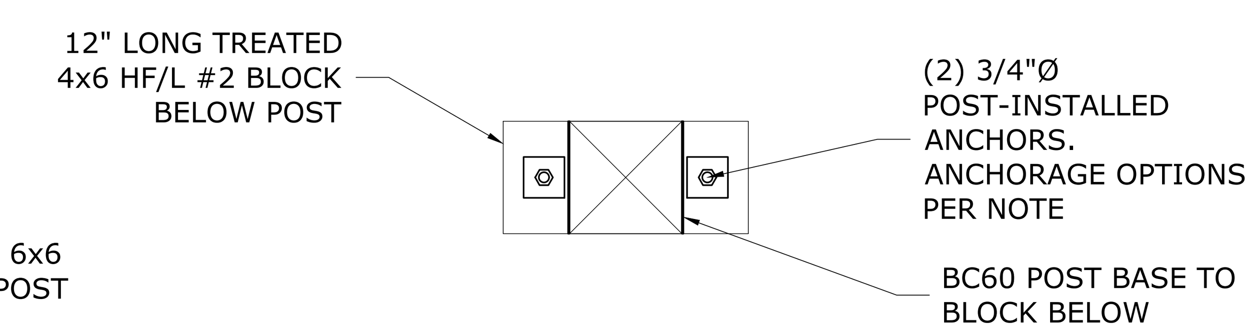
BACK BRACE REAR ELEVATION 3/S9
1" = 1'-0"

BRACE AND COLUMN ANCHORAGE OPTIONS:
EPOXY:
-HILTI HIT-RE 500 V3 3/4"Ø THREADED ROD ASTM F1554 GR36/A36 W/ 6" EMBEDMENT
-SIMPSON SET 3G 3/4"Ø THREADED ROD ASTM F1554 GR36 W/ 6" EMBEDMENT
-DEWALT PURE110+ 3/4"Ø THREADED ROD ASTM F1554 GR36/A36 W/ 6" EMBEDMENT

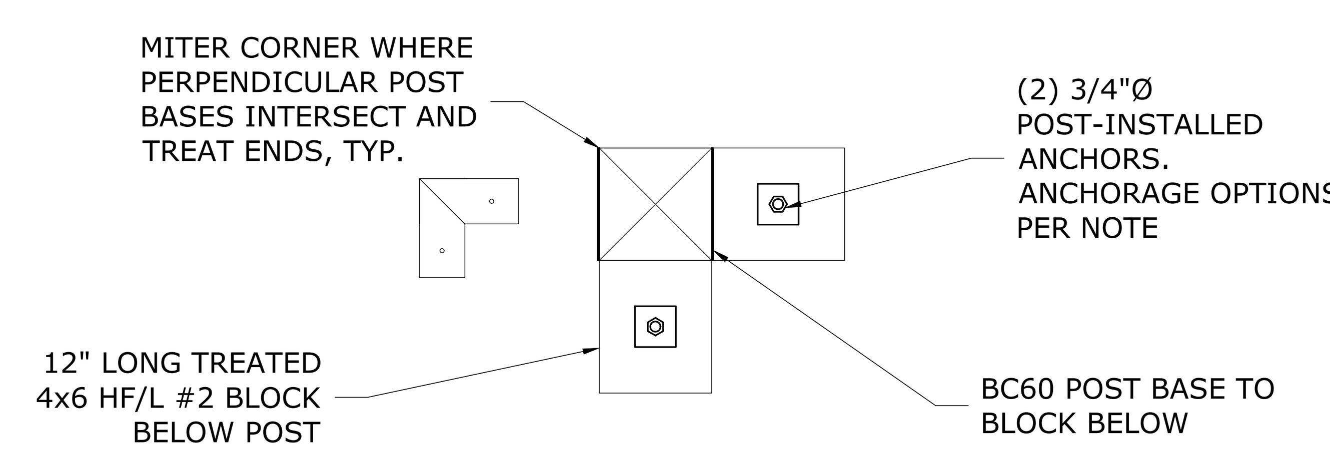
MECHANICAL:
-DEWALT SCREW-BOLT+ 3/4"Ø W/ 4.25" NOMINAL EMBEDMENT
-HILTI KH-EZ 3/4"Ø W/ 4" NOMINAL EMBEDMENT
-TITEN HD 3/4"Ø W/ 4" NOMINAL EMBEDMENT



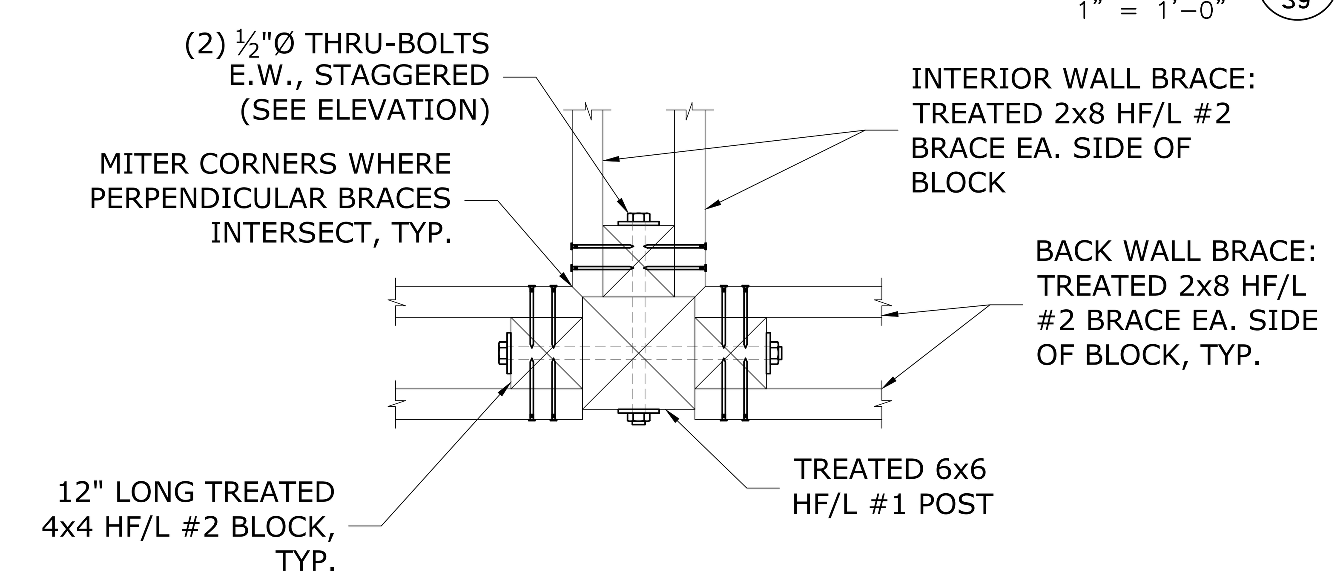
TYP. BRACE POST CONNECTION DETAIL 4/S9
1 1/2" = 1'-0"



TYP. POST BASE CONNECTION DETAIL 6/S9
1 1/2" = 1'-0"

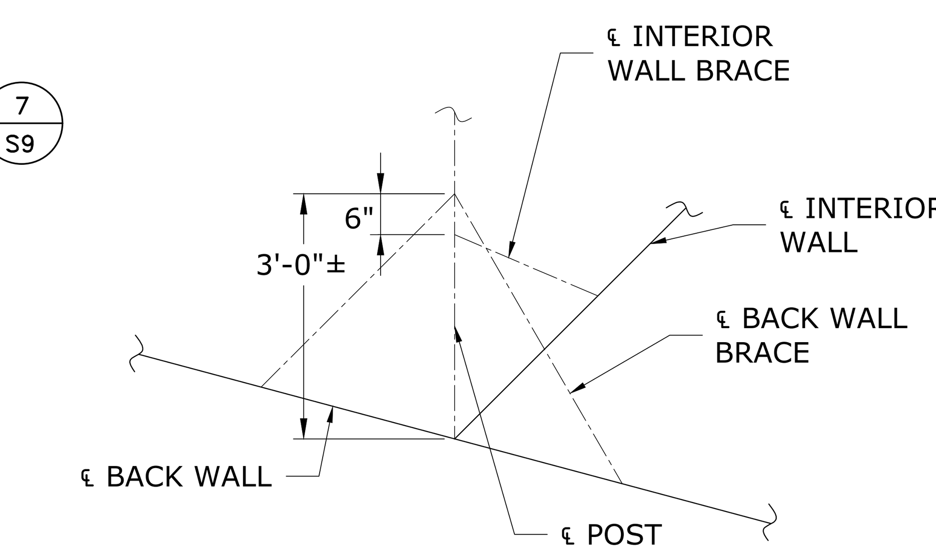


CORNER POST BASE CONNECTION DETAIL 10/S9
1 1/2" = 1'-0"

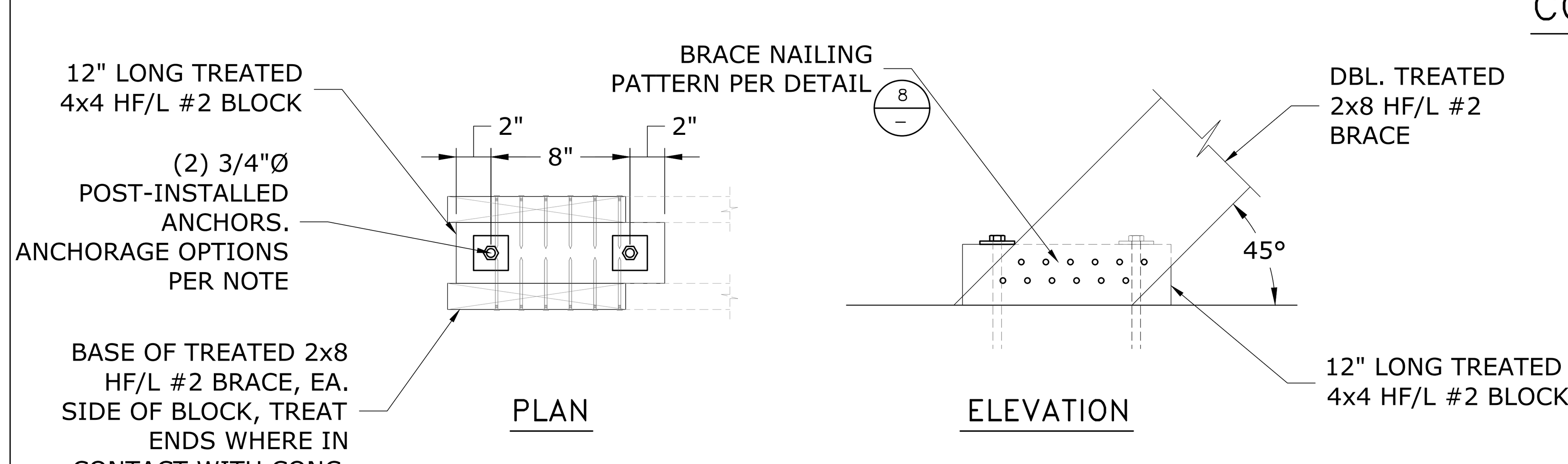


BACK MIDDLE POST DETAIL 7/S9
1 1/2" = 1'-0"

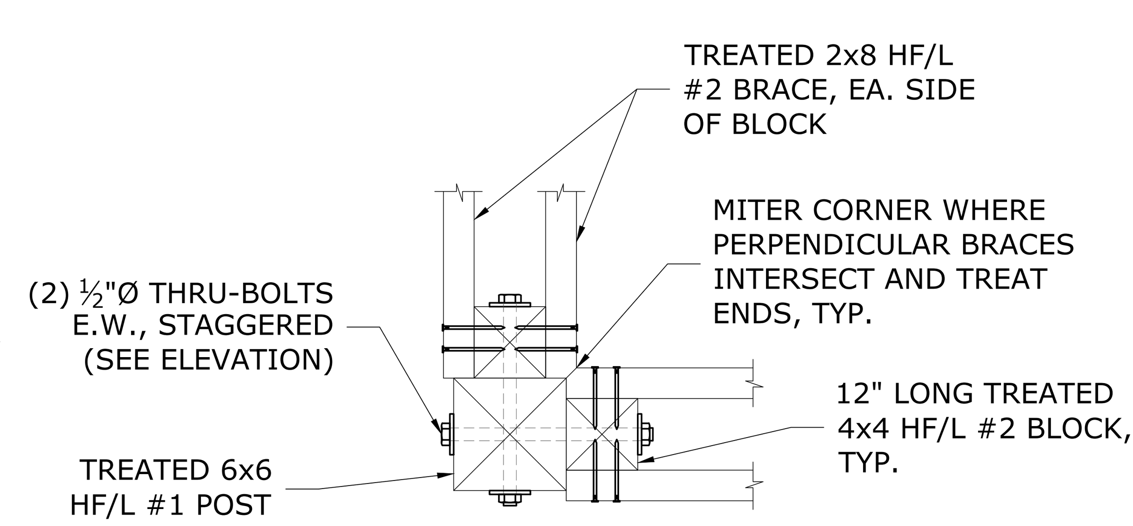
SHEET NOTE
DETAILS ON THIS SHEET ARE APPLICABLE TO BOTH CIP BIN AND ECOLOGY BLOCK BIN OPTIONS AND ALL BIN CONFIGURATIONS



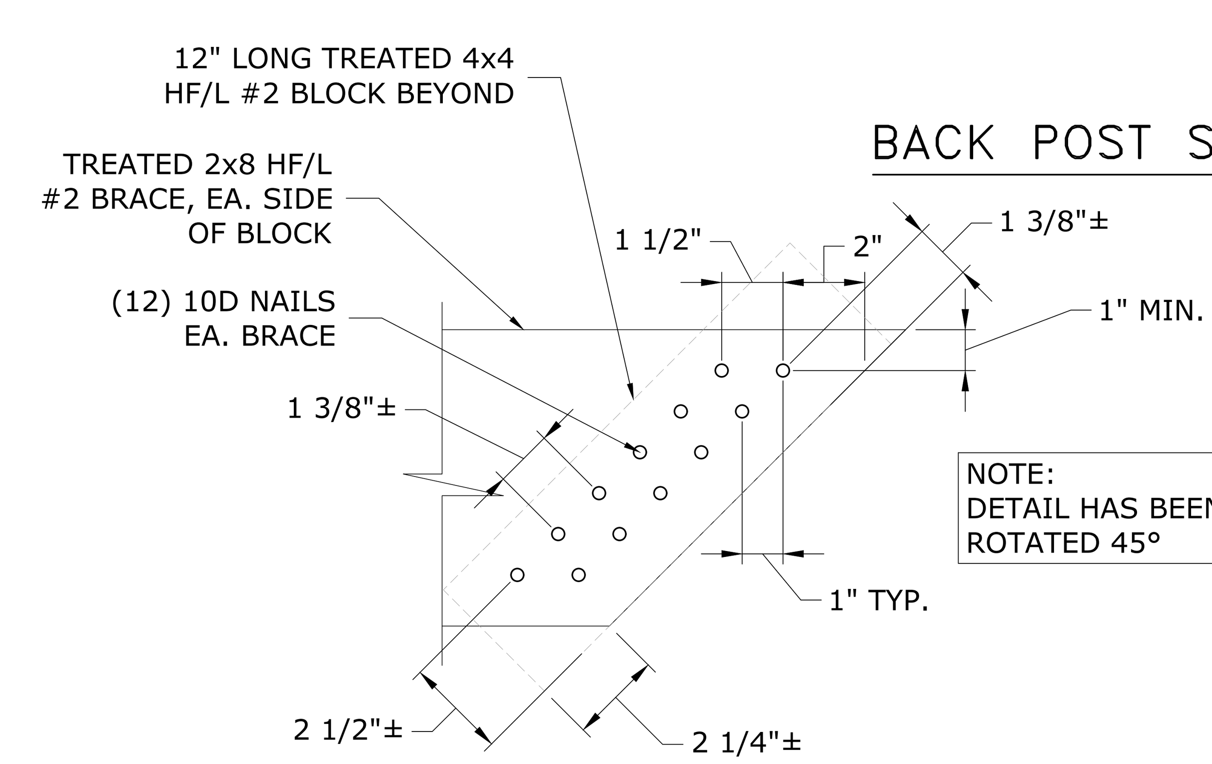
BACK POST SCHEMATIC ISOMETRIC 9/S9
1/2" = 1'-0"



TYP. BRACE BASE CONNECTION DETAIL 5/S9
1 1/2" = 1'-0"



BACK CORNER POST DETAIL 11/S9
1 1/2" = 1'-0"



TYP. BRACE NAILING PATTERN 8/S9
3" = 1'-0"

NOTICE
0 1
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STOCK AGRICULTURAL WSF

CLIENT INFO:
SKAGIT CONSERVATION DISTRICT
2021 E. COLLEGE WAY, SUITE 203
MOUNT VERNON, WA 98273

PROJECT SITE:
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SHEET CONTENT
GENERAL DETAILS - POST BRACING

JOB No. 2302-0069
DRAWN RLKC
CHECKED NRW
DATE 2/9/24
REVISIONS

SHEET S9 OF 9

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PETERSON STRUCTURAL ENGINEERS

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Structural Design Calculations

Stock Agricultural WSF
Whatcom County, Skagit County, Whidbey Island, and San Juan Island, WA

Client Information	Project Site
Emmett Wild	Whatcom County
Skagit Conservation District	Skagit County
2021 E. College Way Suite 203	Whidbey Island
Mount Vernon, WA 98273	San Juan Island
(360) 899-8761	

Prepared By	Endorsement
Peterson Structural Engineers	
February 9, 2024	
Project No. 2302-0069	

Scope

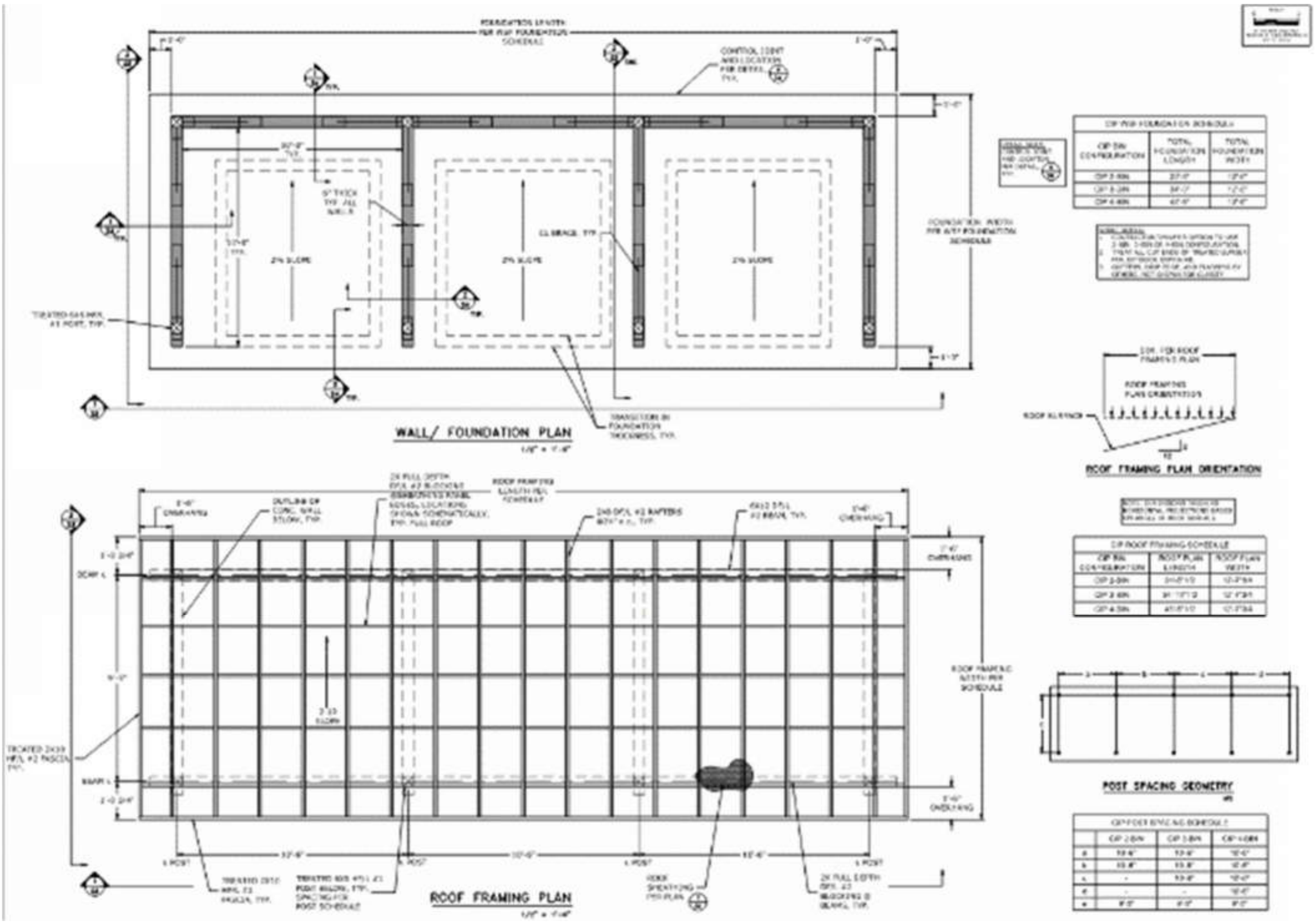
To provide structural calculations for a stock structure standard design waste storage facility (WSF) to be implemented at various locations within Whatcom County, Skagit County, Whidbey Island, and San Juan Island, WA. Elements under review include the foundation, retaining walls, and roof framing. Any other elements not specifically referenced in these calculations are outside the purview of these calculations and are designed by others.

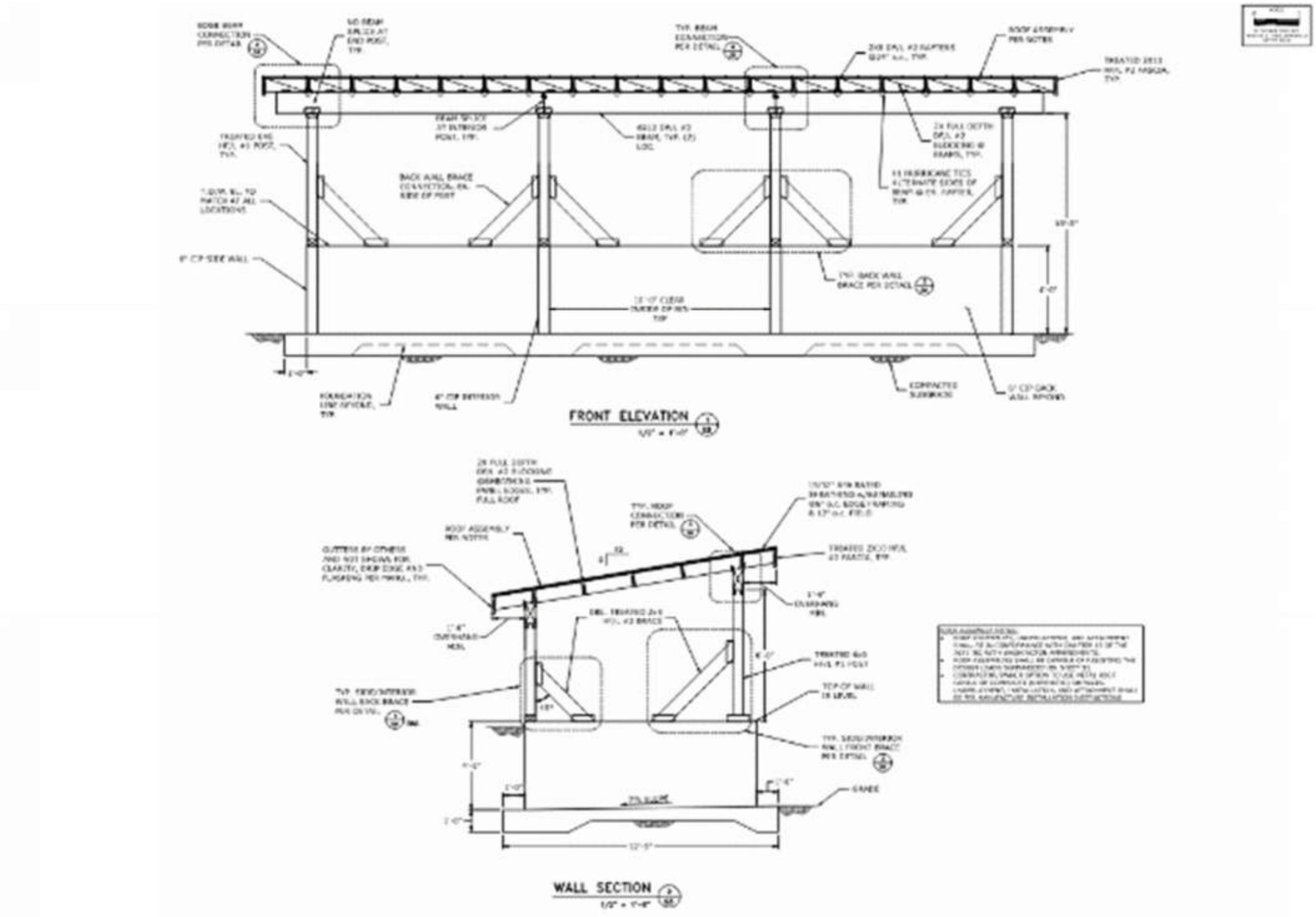
References

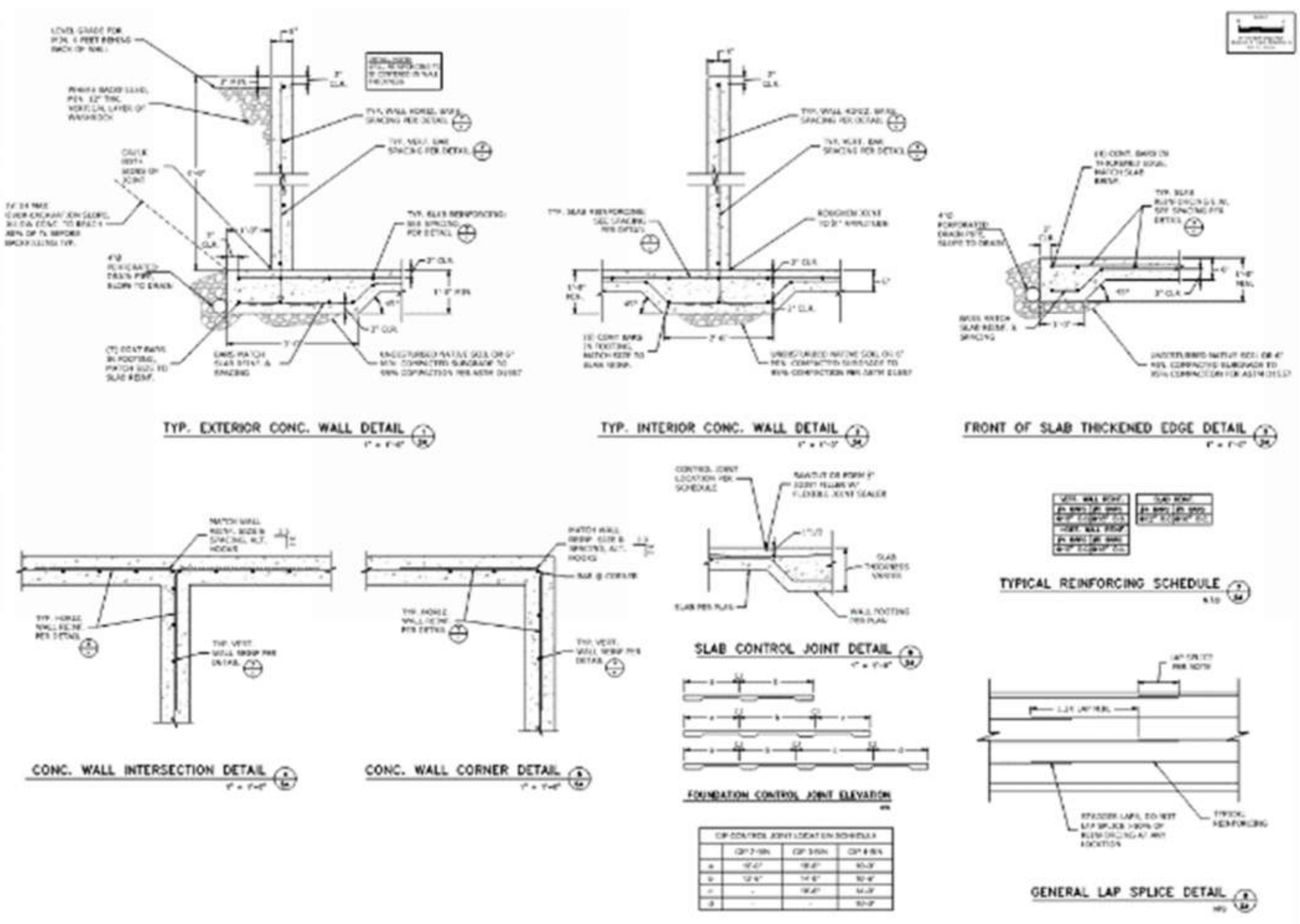
1. 2021 International Building Code with Washington Amendments (IBC)
2. United States Department of Agriculture National Resources Conservation Service, Conservation Practice Standard (NRCS CPS)
3. United States Department of Agriculture National Resource Conservation Service, National Engineering Manual with Washington State Supplements (NRCS NEM)
4. ASCE/SEI 7-16, Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers (ASCE)
5. 2019 Building Code Requirements for Structural Concrete, ACI 318-19, and Commentary (ACI)
6. 2018 National Design Specification for Wood Construction, ANSI/AWC (NDS)
7. 2015 Special Design Provisions for Wind and Seismic ANSI/AWC (SDPWS)
8. ATC Hazards Website, https://hazards.atcouncil.org/, (ATC)
9. Design Criteria as Provided by Whatcom County, Skagit County, Whidbey Island, and San Juan Island.

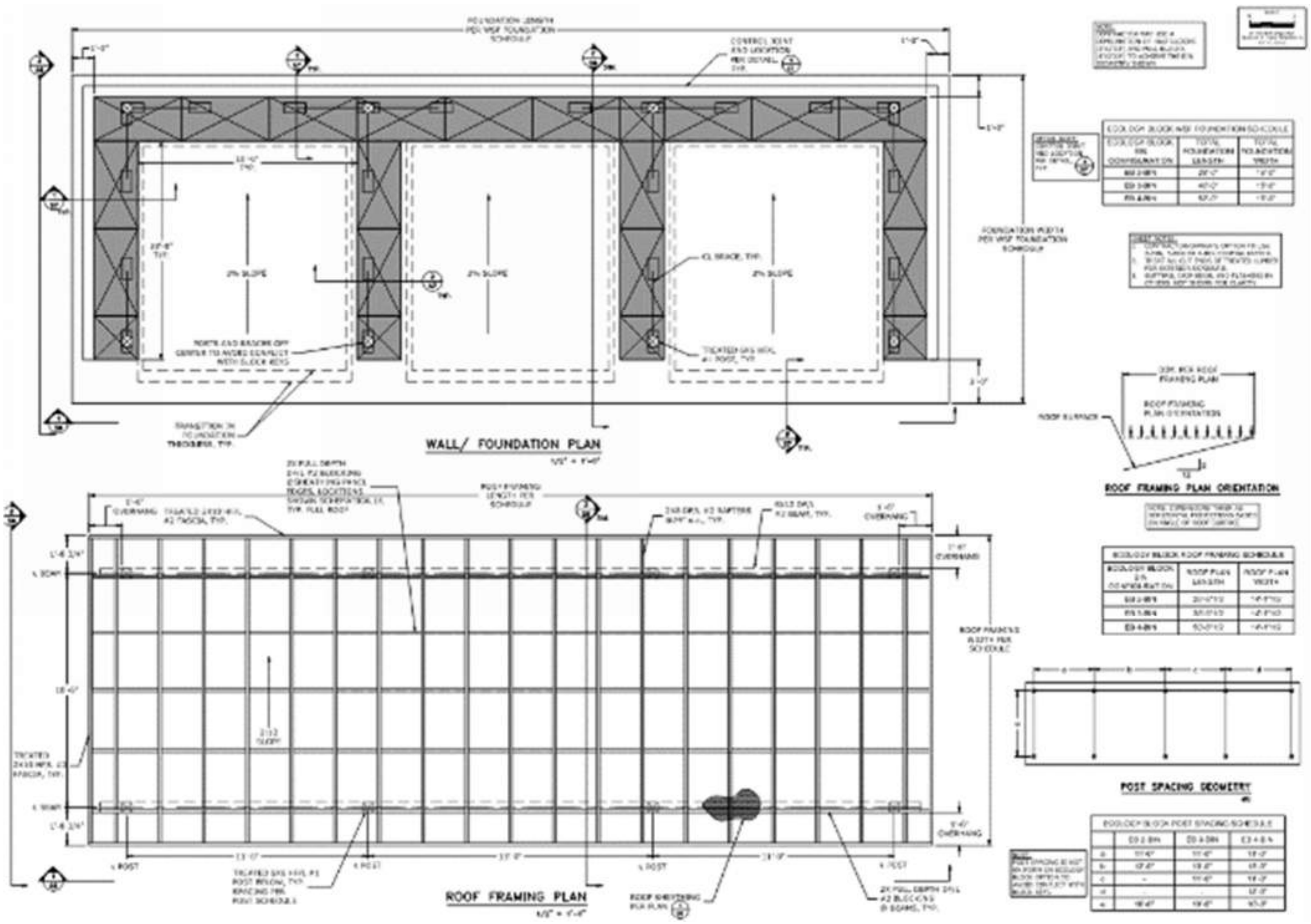
Table of Contents

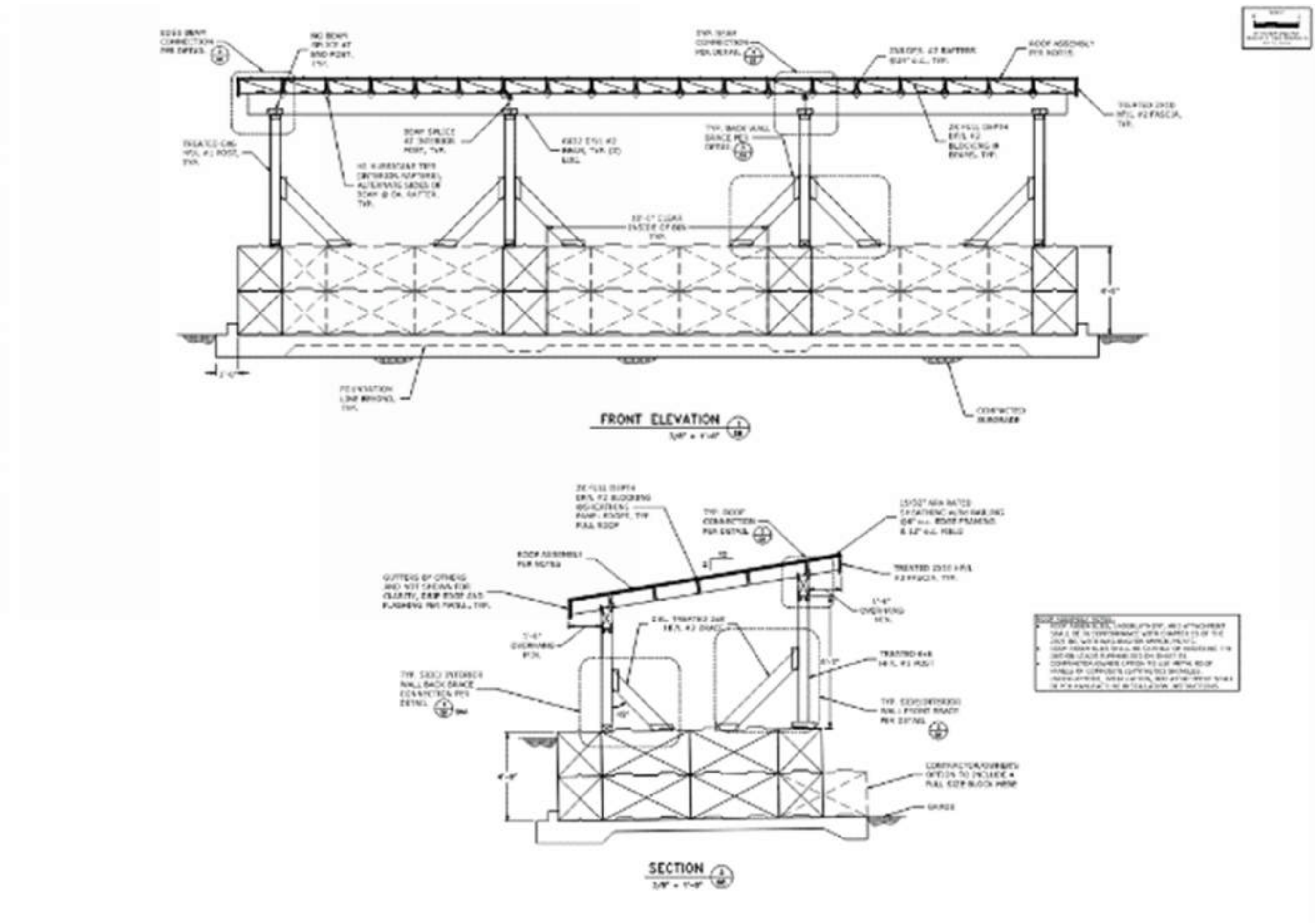
Drawings

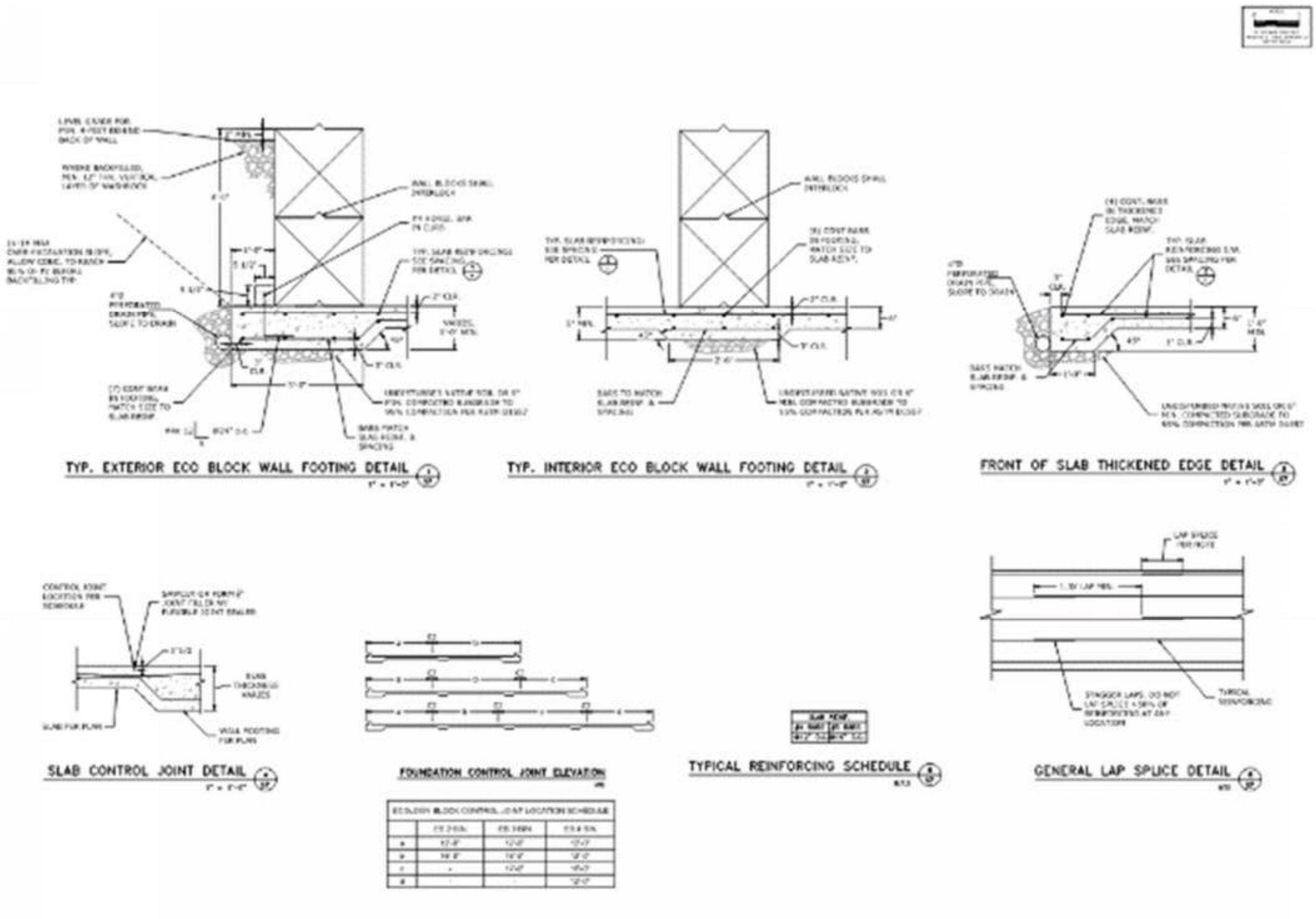

WALL/ FOUNDATION PLAN
ROOF FRAMING PLAN ORIENTATION
POST SPACING GEOMETRY
ROOF FRAMING PLAN

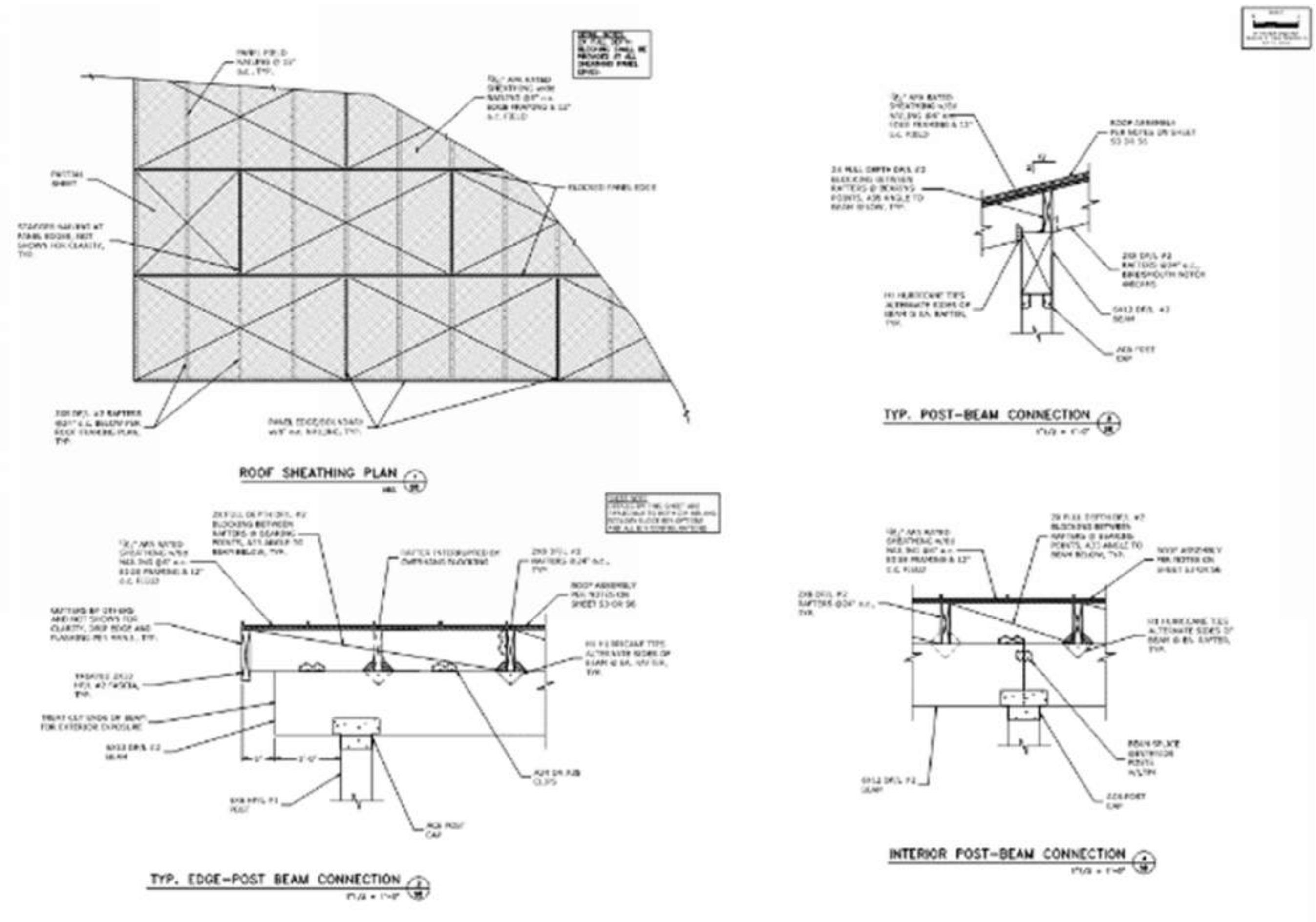

FRONT ELEVATION
WALL SECTION

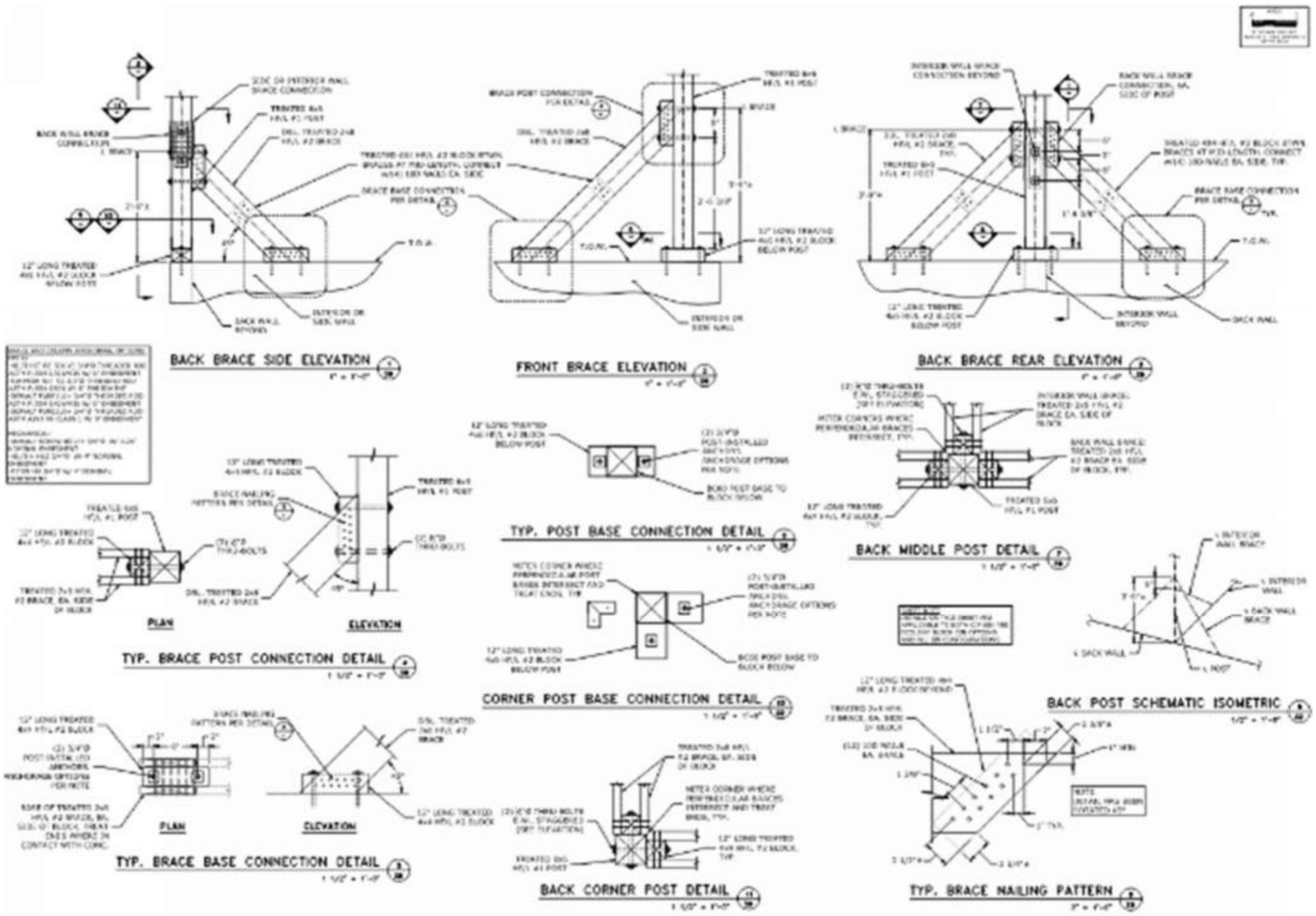

TYP. EXTERIOR CONC. WALL DETAIL
TYP. INTERIOR CONC. WALL DETAIL
FRONT OF SLAB THICKENED EDGE DETAIL
TYPICAL REINFORCING SCHEDULE
SLAB CONTROL JOINT DETAIL
CONC. WALL INTERSECTION DETAIL
CONC. WALL CORNER DETAIL
FOUNDATION CONTROL JOINT ELEVATION
GENERAL LAP SPLICE DETAIL


WALL/ FOUNDATION PLAN
ROOF FRAMING PLAN
ROOF FRAMING PLAN ORIENTATION
POST SPACING GEOMETRY


FRONT ELEVATION
SECTION


TYP. EXTERIOR ECO BLOCK WALL FOOTING DETAIL
TYP. INTERIOR ECO BLOCK WALL FOOTING DETAIL
FRONT OF SLAB THICKENED EDGE DETAIL
SLAB CONTROL JOINT DETAIL
FOUNDATION CONTROL JOINT ELEVATION
TYPICAL REINFORCING SCHEDULE
GENERAL LAP SPLICE DETAIL


ROOF SHEATHING PLAN
TYP. POST-BEAM CONNECTION
TYP. EDGE-POST BEAM CONNECTION
INTERIOR POST-BEAM CONNECTION



Note: sketches are schematic.

Design Criteria

Risk Category I

Importance Factors — Per ASCE 7-16, Table 1.5-2

Snow, $I_S = 0.8$

Seismic, $I_E = 1.00$

Geometry

Retaining Wall Height = 4’-0”

Eave Height = 10’-0” max (6’-0” above top of retaining wall)

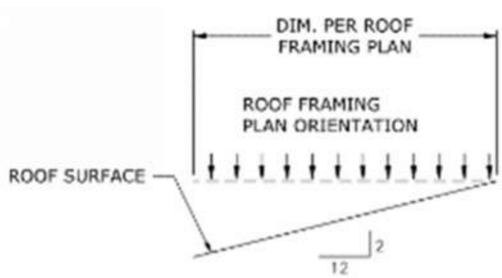
Foundation:

CIP WSF FOUNDATION SCHEDULE		
CIP BIN CONFIGURATION	TOTAL FOUNDATION LENGTH	TOTAL FOUNDATION WIDTH
CIP 2-BIN	23'-6"	12'-6"
CIP 3-BIN	34'-0"	12'-6"
CIP 4-BIN	44'-6"	12'-6"

ECOLOGY BLOCK WSF FOUNDATION SCHEDULE		
ECOLOGY BLOCK BIN CONFIGURATION	TOTAL FOUNDATION LENGTH	TOTAL FOUNDATION WIDTH
EB 2-BIN	28'-0"	15'-0"
EB 3-BIN	40'-0"	15'-0"
EB 4-BIN	52'-0"	15'-0"

Roof Framing:

Note: Roof dimensions taken as horizontal projections based on angle of roof surface



ROOF FRAMING PLAN ORIENTATION

CIP ROOF FRAMING SCHEDULE		
CIP BIN CONFIGURATION	ROOF PLAN LENGTH	ROOF PLAN WIDTH
CIP 2-BIN	24'-5"1/2	12'-7"3/4
CIP 3-BIN	34'-11"1/2	12'-7"3/4
CIP 4-BIN	45'-5"1/2	12'-7"3/4

ECOLOGY BLOCK ROOF FRAMING SCHEDULE		
ECOLOGY BLOCK BIN CONFIGURATION	ROOF PLAN LENGTH	ROOF PLAN WIDTH
EB 2-BIN	26'-5"1/2	14'-1"1/2
EB 3-BIN	38'-5"1/2	14'-1"1/2
EB 4-BIN	50'-5"1/2	14'-1"1/2

Deflection Criteria

Deflection criteria is per IBC Table 1604.3. The most stringent deflection between the span ratio and total deflection shown below shall be used.

	L or L_r	**S & W**	**D + L**
Roof Members	L/360 in	L/360 in	L/240 in

Gravity Loading

Dead Load

Roof Dead Load;	q_{DLr} = 12 psf;	
Exterior Conc. Wall Dead Load;	q_{DLew} = 100 psf;	Concrete wall in elevation
Partition Wall Dead load;	q_{DLpw} = 100 psf;	Concrete wall in elevation

See Soil Design Values for stored waste loads.

Live Load

Roof Live Load (area);	q_{LLr} = 20 psf;	per IBC Table 1607.1
Roof Live Load (concentrated);	P_{LLr} = 300 lb;	per IBC Table 1607.1
Floor Vehicle Live Load (area);	q_{LLf} = 250 psf;	per IBC Table 1607.1
Floor Vehicle Live Load (concentrated);	P_{LLr} = 8,000 lb;	per IBC Table 1607.1

Backfill Surcharge Load → See retaining wall design

Snow Load

Snow Importance Factor;	I_s = 0.8; per ASCE Table 1.5-2	
Snow Exposure Factor;	C_e = 1.1; cat. C, sheltered	conservative per ASCE Table 7.3-1
Snow Thermal Factor;	C_t = 1.20; unheated	per ASCE Table 7.3-2
Snow Slope Factor;	C_{sl} = 1.0;	per ASCE 7.4.1 – 7.4.4, & Figure 7.4-1
Minimum Roof Snow Load;	P_{min} = (25 psf) $\times$ I_s = 20 psf;	per ASCE Section 7.3.4
Ground Snow Load;	p_g = 40.0 psf;	maximum in considered regions
Balanced Snow Load;	p_B = 29.6psf;	See following page for balanced snow loads.

ASCE 7-16 Chapter 7 - SNOW LOADS

FLAT ROOF SNOW LOAD

Flat-roof snow load, p_f =	$0.7C_eC_tI_sp_g$		Eq. 7.3-1
Exposure factor, C_e =	1.10		Table 7.3-1
Thermal factor, C_t =	1.20		Table 7.3-2
Flat-roof snow load, p_f =	29.57	psf	
Min p_f (ASCE 7) =	16.00	psf	
Calculated p_f =	29.57	psf	

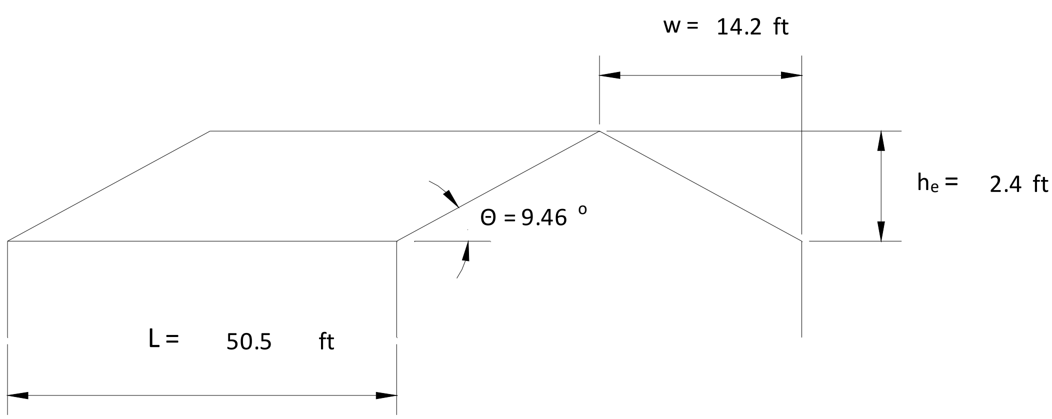
SLOPE ROOF SNOW LOAD

p_s =	C_sp_f		Eq. 7.4-1
Design p_f =	29.57	psf	
Slope Θ =	9.46	°	
C_t =	1.20		
Slope factor C_s =	1.00		7.4-1, 7.4.2, 7.4.3 Figure 7-2a, 7-2b and 7-2c
Calculated p_s =	29.57	psf	
p_{sBD} =	25.00	psf	Building Dept. Minimum

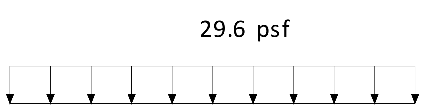
PARTIAL LOADING

UNBALANCED SNOW LOADS

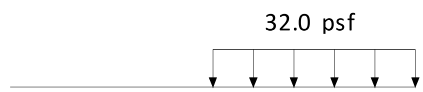
Balanced and Unbalanced Snow Load for Hip and Gable Roof (Fig. 7-5)



BALANCED



UNBALANCED W ≤ 20 ft



<u>Note:</u> Per ASCE 7-16 Section 12.7.2, snow loads do not need to be included in the effective seismic weight since flat roof snow loads < 30psf.

<u>Note:</u> Structure geometry is shown for 1 example configuration. Snow loads are the same for the other design configurations included as well.

Soil Design Values (Assumed)

Backfill Soil Active Lateral Pressure;	γ_{ab} = 45 psf/ft;	per IBC Table 1610.1, NRCS CPS Code 313
Infill Waste Active Lateral Pressure;	γ_{ai} = 60 psf/ft;	Conservative, accounts for stored waste

Coefficient of Sliding Friction; μ_s = 0.35;
per IBC Table 1806.2, NRCS CPS Code 313, Assumes GW/GP prepped subgrade

Allowable Soil Bearing; $P_{b,a}$ = 1,500 psf; per IBC Table 1806.2, NRCS CPS Code 313

Wind Loading

Wind Exposure C

Basic Wind Speed;	V = 100; mph	Per ASCE 7
Topographic Factor,	K_{zt} = 1.5;	Conservative
Ground Elevation;	0ft	Conservative
Component and Cladding Trib. Area;	Typical: 9ft^2	Conservative
	Roof Beams: 31.5ft^2	Controlling trib. area

See following pages for wind load generation.

Roof Loads

Main Wind Force Resisting System (MWFRS) Loading

MWFRS is defined as an assembly of structural elements assigned to provide support and stability to the overall system.

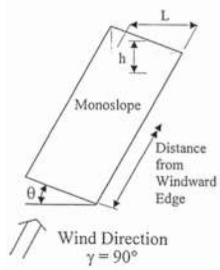
ASCE 7-16 Chapter 27: Wind Forces on Monoslope Free Roofs - Directional Method

Per ASCE 7-16 §27.3.2

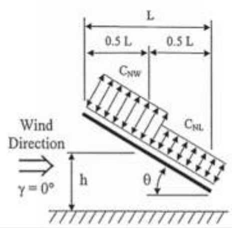
Risk Category	I		
Basic wind speed (3 sec gust), V =	100	MPH	OK
Exposure	C		
Roof Angle, θ =	9.46	°	OK
Mean Roof Height, h =	10.9	ft	
Horizontal Dimension of Roof, L=	14.2	ft	
h/L=	0.91		OK
Exposure Coefficient, K_z =	0.85		Section 26.10.1
Topographic Factor, K_{zt} =	1.50		Section 26.8.2
Wind Directionality Factor, K_d =	0.85		Section 26.6
Ground Elevation Factor, K_e =	1.00		Section 26.9
Velocity Pressure, q_h =	27.74	psf	$0.00256K_zK_{zt}K_dK_eV^2$ (Eqn. 26.10-1)
Gust-Effect Factor, G =	0.85		Section 26.11
Net Design Pressure, P_N =	q_hGC_N		Eqn. 27.3-2

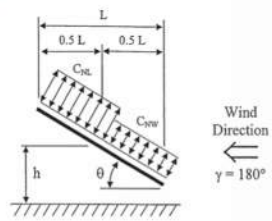
Net Pressure Coefficients, C_N for γ = 90°

Horz. Distance from Windward Edge	Load Case	Clear Wind Flow		Obstr. Wind Flow	
		C_N	**P_N** (psf)	C_N	**P_N** (psf)
<h	A	-0.8	-18.9	-1.2	-28.3
	B	0.8	18.9	0.5	11.8
>h, ≤2h	A	-0.6	-14.1	-0.9	-21.2
	B	0.5	11.8	0.5	11.8
>2h	A	-0.3	-7.1	-0.6	-14.1
	B	0.3	7.1	0.3	7.1



Note: For monoslope roofs with θ less than 5°, C_N values shown apply for cases where γ=0° and 0.05≤ *h/L* ≤ 0.25. See Fig 27.3-4 for other *h/L* values.





Notation

L = Horizontal dimension of roof , measured in the along-wind direction, ft.

h = Mean roof height, ft.

γ = Direction of wind, degrees.

θ = Angle of plane of roof from horizontal, degrees.

Net Pressure Coefficients, C_N

Roof Angle (Deg.)	Load Case	Wind Direction, γ = 0°				Wind Direction, γ = 180°			
		Clear Wind Flow		Obstr. Wind Flow		Clear Wind Flow		Obstr. Wind Flow	
		C_{NW}	C_{NL}	C_{NW}	C_{NL}	C_{NW}	C_{NL}	C_{NW}	C_{NL}
9.46	A	-0.7	-1.1	-1.0	-1.5	1.0	1.5	0.0	-1.2
	B	-1.5	0.0	-1.8	-0.7	1.7	0.4	0.9	-0.3

Net Design Pressures (psf)

Roof Angle (Deg.)	Load Case	Wind Direction, γ = 0°				Wind Direction, γ = 180°			
		Clear Wind Flow		Obstr. Wind Flow		Clear Wind Flow		Obstr. Wind Flow	
		P_{NW}	**P_{NL}**	**P_{NW}**	**P_{NL}**	**P_{NW}**	**P_{NL}**	**P_{NW}**	**P_{NL}**
9.46	A	-16.0	-25.4	-24.2	-35.4	23.7	36.0	-1.0	-27.7
	B	-36.1	0.0	-42.6	-17.6	39.0	8.9	21.3	-7.1

Notes (ASCE 7-16):

1. C_{NW} and C_{NL} denote net pressures (contributions from top and bottom surfaces) for windward and leeward half of roof surfaces, respectively.
2. Clear wind flow denotes relatively unobstructed wind flow with blockage less than or equal to 50%. Obstructed wind flow denotes objects below roof inhibiting wind flow (> 50% blockage).
3. For values of θ between 7.5° and 45°, linear interpolation is permitted. For values of θ less than 7.5°, use load coefficients for 0°.
4. Plus and minus signs signify pressures acting toward and away from the top roof surface, respectively.
5. All load cases shown for each roof angle shall be investigated.
6. Figures per ASCE 7-16

Components & Cladding (C&C) Loading

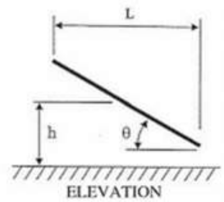
Components and Cladding wind loads shall be used for structural items that are not a part of the MWFRS. Roof rafters, sheathing, roof joists, wall studs, wall headers, and their connection to the structure shall be designed for C&C loading.

<u>Typical C&C</u>

ASCE 7-16 Chapter 30: Wind Forces on Monoslope Free Roofs - Components and Cladding

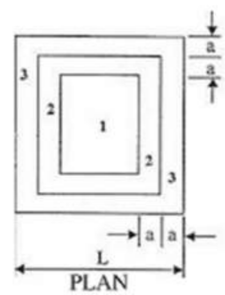
Per ASCE 7-16 §30.7

Risk Category	I		
Basic wind speed (3 sec gust), V =	100	MPH	
Exposure	C		
Roof Angle, θ =	9.46	°	OK
Mean Roof Height, h =	10.90	ft	
Horizontal Dimension of Roof, L=	14.2	ft	
h/L=	0.91		OK
Exposure Coefficient, K_z =	0.85		Section 26.10.1
Topographic Factor, K_{zt} =	1.50		Section 26.8.2
Wind Directionality Factor, K_d =	0.85		Section 26.6
Ground Elevation Factor, K_e =	1.00		Section 26.9
Velocity Pressure, q_h =	27.74	psf	$0.00256K_zK_{zt}K_dK_eV^2$ (Eqn. 26.10-1)
Gust-Effect Factor, G =	0.85		Section 26.11
Net Design Pressure, P_N =	q_hGC_N		Eqn. 30.7-1
a =	3	ft	Per Fig. 30.7-1, a = 10% of least horiz. Dimension or 0.4h, whichever
Effective Wind Area (EWA) =	9	ft^2	is smaller but not less than 4% of least horizontal dimension or 3ft.
Min. C&C Preesure =	16	psf	§30.2.2



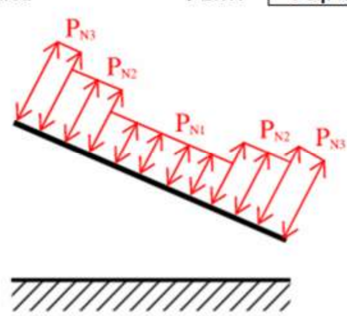
Net Pressure Coefficients - Figure 30.7-1 (0.25 ≤ h ≤ 1.0, θ ≤ 45°)

Net Pressure Coefficients, C_N					
Effective Wind Area (ft^2)			$\leq a^2$	$>a^2, \leq 4.0a^2$	$>4a^2$
Clear Wind Flow	Zone 3	Towards	3.30	2.48	1.65
		Away	-4.10	-2.31	-1.53
	Zone 2	Towards	2.48	2.48	1.65
		Away	-2.31	-2.31	-1.53
	Zone 1	Towards	1.65	1.65	1.65
		Away	-1.53	-1.53	-1.53
Obstructed Wind Flow	Zone 3	Towards	1.81	1.36	0.90
		Away	-4.86	-2.76	-1.80
	Zone 2	Towards	1.36	1.36	0.90
		Away	-2.76	-2.76	-1.80
	Zone 1	Towards	0.90	0.90	0.90
		Away	-1.80	-1.80	-1.80



Net C&C Wind Pressures for Select Effective Wind Area ——→EWA = 9 sq. ft. <a^2

			C_N	P_N (psf)
Clear Wind Flow	Zone 3	Towards	3.30	77.93
		Away	-4.10	-96.58
	Zone 2	Towards	2.48	58.45
		Away	-2.31	-54.45
	Zone 1	Towards	1.65	38.96
		Away	-1.53	-36.10
Obstructed Wind Flow	Zone 3	Towards	1.81	42.66
		Away	-4.86	-114.72
	Zone 2	Towards	1.36	32.00
		Away	-2.76	-65.01
	Zone 1	Towards	0.90	21.33
		Away	-1.80	-42.56



Notes (ASCE 7-16):

1. C_N denotes net pressures (contributions from top and bottom surfaces).
2. Clear wind flow denotes relatively unobstructed wind flow with blockage less than or equal to 50%. Obstructed wind flow denotes objects below roof inhibiting wind flow (> 50% blockage).
3. For values of θ other than those shown in Figure 30.7-1, linear interpolation is permitted.
4. Plus and minus signs signify pressures acting toward and away from the top roof surface, respectively.
5. All load cases shown for each roof angle shall be investigated.
6. Figures per ASCE 7-16

The above wind loads are applicable to all C&C members other than the beams.

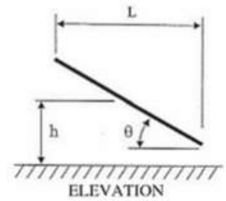
Beam C&C Loads

The following component and cladding loads are applicable to only the roof beams.

ASCE 7-16 Chapter 30: Wind Forces on Monoslope Free Roofs - Components and Cladding

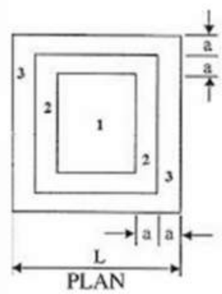
Per ASCE 7-16 §30.7

Risk Category	I		
Basic wind speed (3 sec gust), V =	100	MPH	
Exposure	C		
Roof Angle, θ =	9.46	°	OK
Mean Roof Height, h =	10.90	ft	
Horizontal Dimension of Roof, L=	14.2	ft	
h/L=	0.91		OK
Exposure Coefficient, K_z =	0.85		Section 26.10.1
Topographic Factor, K_{zt} =	1.50		Section 26.8.2
Wind Directionality Factor, K_d =	0.85		Section 26.6
Ground Elevation Factor, K_e =	1.00		Section 26.9
Velocity Pressure, q_h =	27.74	psf	$0.00256K_zK_{zt}K_dK_eV^2$ (Eqn. 26.10-1)
Gust-Effect Factor, G =	0.85		Section 26.11
Net Design Pressure, P_N =	q_hGC_N		Eqn. 30.7-1
a =	3	ft	Per Fig. 30.7-1, a = 10% of least horiz. Dimension or 0.4h, whichever
Effective Wind Area (EWA) =	31.5	ft^2	is smaller but not less than 4% of least horizontal dimension or 3ft.
Min. C&C Preesure =	16	psf	§30.2.2



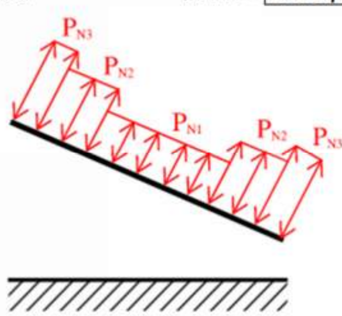
Net Pressure Coefficients - Figure 30.7-1 (0.25 ≤ h ≤ 1.0, θ ≤ 45°)

Net Pressure Coefficients, C_N					
Effective Wind Area (ft^2)			$\leq a^2$	$>a^2, \leq 4.0a^2$	$>4a^2$
Clear Wind Flow	Zone 3	Towards	3.30	2.48	1.65
		Away	-4.10	-2.31	-1.53
	Zone 2	Towards	2.48	2.48	1.65
		Away	-2.31	-2.31	-1.53
	Zone 1	Towards	1.65	1.65	1.65
		Away	-1.53	-1.53	-1.53
Obstructed Wind Flow	Zone 3	Towards	1.81	1.36	0.90
		Away	-4.86	-2.76	-1.80
	Zone 2	Towards	1.36	1.36	0.90
		Away	-2.76	-2.76	-1.80
	Zone 1	Towards	0.90	0.90	0.90
		Away	-1.80	-1.80	-1.80



Net C&C Wind Pressures for Select Effective Wind Area → EWA = 31.5 sq. ft. >a^2,≤4.0a^2

			C_N	P_N (psf)
Clear Wind Flow	Zone 3	Towards	2.48	58.45
		Away	-2.31	-54.45
	Zone 2	Towards	2.48	58.45
		Away	-2.31	-54.45
	Zone 1	Towards	1.65	38.96
		Away	-1.53	-36.10
Obstructed Wind Flow	Zone 3	Towards	1.36	32.00
		Away	-2.76	-65.01
	Zone 2	Towards	1.36	32.00
		Away	-2.76	-65.01
	Zone 1	Towards	0.90	21.33
		Away	-1.80	-42.56



Notes (ASCE 7-16):

1. C_N denotes net pressures (contributions from top and bottom surfaces).
2. Clear wind flow denotes relatively unobstructed wind flow with blockage less than or equal to 50%. Obstructed wind flow denotes objects below roof inhibiting wind flow (> 50% blockage).
3. For values of θ other than those shown in Figure 30.7-1, linear interpolation is permitted.
4. Plus and minus signs signify pressures acting toward and away from the top roof surface, respectively.
5. All load cases shown for each roof angle shall be investigated.
6. Figures per ASCE 7-16

Seismic Loading

Seismic Importance Factor;	I_e = 1.0;	per ASCE 7 Table 1.5-2
Soil Class D – Default		assumed
Seismic Design Category D		per ASCE 7 Table 11.6-1 and 11.6-2
Spectral Response (short);	S_s = 1.50; g	per ASCE 7 Figure 22-1
Spectral Response (1s);	S_1 = 0.600; g	per ASCE 7 Figure 22-2
Spectral Acceleration (short);	S_{DS} = 1.3; g	See following pages
Spectral Acceleration (1s);	S_{D1} = 0.800; g	See following pages

Seismic Force Resisting System: Cantilevered Column Systems Detailed to Conform to the Requirements for Timber Frames

Seismic Response Coefficient;	C_s = 0.8;	See following pages
Vertical Seismic Coefficient;	$0.2 \times S_{DS}$ =0.16	

Building Code Information		
Risk Category =	I	
S_s =	1.500	Fig. 22-1, 22-3,& 22-5 to 22-8
S_1 =	0.600	Fig. 22-2, 22-4, & 22-5 to 22-8
Long Transition Period, T_L =	16	Fig. 22-14 to 22-17
Soil Site Class =	D (default)	See Section 11.4.4 for mininmum Fa

Design Spectral Acceleration Parameters - ASCE 7-16 Chapter 11		
;hort-Period Site Coefficient, F_a =	1.2	Tbl. 11.4-1, min. of 1.2 per 11.4.4
Long-Period Site Coefficient, F_v =	1.7	Table 11.4-2
S_{MS} =	1.800	$S_{MS} = F_a \cdot S_S$, Eq. 11.4-1
S_{M1} =	1.020	$S_{M1} = F_v \cdot S_1$, Eq. 11.4-2
S_{DS} =	1.200	$S_{DS} = 2/3 \cdot S_{MS}$, Eq. 11.4-3
S_{D1} =	0.680	$S_{D1} = 2/3 \cdot S_{M1}$, Eq. 11.4-4
T_s =	0.567	$T_s = S_{D1}/S_{DS}$, Sect. 11.4.6

Seismic Design Category - ASCE 7-16 Chapter 11		
Seismic Design Category for S_{DS} =	D	Table 11.6-1
Seismic Design Category for S_{D1} =	D	Table 11.6-2
Seismic Design Category =	D	Most critical of the cases above

Exception 2 of section 11.4.8 is applicable

Seismic Base Shear - Building Structures - ASCE 7-16 Chapter 12		
Importance Factor, I_e =	1.00	Table 1.5-2
Structure Height, h_n =	12.90	ft
Seismic Force Resisting System =	G. Timber frames	
Response Modification Coef., R =	1.5	Table. 12.2-1
Overstrength Factor, Ω_o =	1.5	Table. 12.2-1
Deflection Amplification Fact., C_d =	1.5	Table 12.2-1
Building Height Limit =	35	Table 12.2-1

Building Height Okay for Seismic Force Resisting System

Fundamental Period		
Actual Calc'd Period, T_c =		from analysis (calculated if blank)
Period Coefficient, C_T =	0.020	Table 12.8-2
Period Exponent, x =	0.75	Table. 12.8-2
Approximate Period, T_a =	0.14	sec., $T_a = C_t \cdot h_n^x$, Eq. 12.8-7
Upper Limit Coefficient, C_u =	1.40	Table. 12.8-1
Max Period, T_{max} =	0.19	sec., $T_{max} = C_u \cdot T_a$, Section 12.8.2
Fundamental Period, T =	0.14	sec.

Horizontal Component - Seismic Design Coefficients		
C_s =	0.800	Cs = SDS/(R/Ie), Eqn. 12.8-2 per 11.4.8 Exception 2
$C_{s,max}$ =	3.330	Cs,max = SD1/(T·R/Ie), Eq. 12.8-3
$C_{s,min}$ =	0.200	Cs,min = 0.5·S1/(R/Ie), Eq. 12.8-6

Seismic Coefficients		
Base Shear Coeff., $C_{s,design}$ =	0.800	g's $E_h = C_s W$
Vert. Seismic Coeff., $0.2 \cdot S_{DS}$ =	0.240	g's $E_v = 0.2 S_{DS} W$

Gravity Design

Design Result Summary (Controlling Actions Shown)

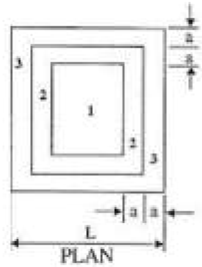
Member	Utilization
Roof Sheathing	DCR = 0.75
Rafters	DCR = 0.86
Girder Beams	DCR = 0.87
Slab on Grade	FS = 11.59

Note: By inspection, there is a reserve capacity in the gravity force resisting system to resist 30psf design snow loads (calculations included considered 29.6psf)

Roof Design

Demands:

- Dead = 8-12psf
- Live = 20psf
- Snow = 29.6psf
- Wind:
  - MWFRS:
    - Applicable to elements not considered components and cladding.
    - Controlling Downward = 42.66psf
    - Controlling Uplift = 21.33psf
  - C&C:
    - Applicable to roof sheathing, and rafters
      - Controlling Downward: Clear Wind Flow
        - Zone 1 = 38.96psf
        - Zone 2 = 58.45psf
        - Zone 3 = 77.93psf
      - Controlling Uplift: Obstructed Wind Flow
        - Zone 1 = 21.33psf
        - Zone 2 =32.00sf
        - Zone 3 = 42.66psf
    - Applicable to roof girder beams
      - Controlling Downward: Clear Wind Flow
        - Zone 1 = 38.96psf
        - Zone 2 = 58.45psf
        - Zone 3 = 58.45psf
      - Controlling Uplift: Obstructed Wind Flow
        - Zone 1 = 21.33psf
        - Zone 2 =32.00psf
        - Zone 3 = 32.00psf



Sheathing

Evaluate the roof sheathing for out-of-plane load effects.

Try 15/32 sheathing with 32/16 span rating.

Sheathing spans 24” (rafter spacing)

Demands:

- Dead = 1.6psf (sheathing weight)
- Live = 20psf
- Snow = 29.6psf
- Wind: C&C
  - Down = 77.93psf
  - Up = -114.72psf
- By inspection, $0.6D+0.6W_{UP}$ controls
- Demand, P = 0.6*(1.6) + 0.6*(-114.72)psf = 69.79psf (up)

Capacity:

- Nominal out-of-plane capacity, P_n = 155psf (SDPWS Table 3.2.2)
- ASD reduction factor, Ω = 1.67
- ΩP_n = 92.81psf > P ✓

<u>15/32 APA rated sheathing with 32/16 span rating is adequate (DCR = 0.29)</u>

<u>Rafters: 2x8 DF/L #2 @24” o.c.</u>

Spans:

- Span 1 ≈ 2’ (cantilever end)
- Span 2 ≈ 10.67’ (interior)
- Span 3 ≈ 2’ (cantilever end)

Spacing = 2’-0” o.c.

Demands:

- Dead = 8psf
- Live = 20psf
- Snow = 29.6psf
  - Note, additional partial snow load cases were considered per ASCE 7 section 7.5.1 and are included in the Enercalc calculations appended to this report.
- Wind (Zone 3) = 77.93psf (downward)

<u>Per Enercalc (see appendix) 2x8 DF/L #2 @24” o.c. rafters are adequate (DCR = 0.86)</u>

Girder Beams: 6x12 DF/L #2
By inspection, the front beam line controls since it has the greatest tributary width.
Spans:

- Span 1 = 2'-0" (cantilever overhang)
- Span 2 ≈ 13'-0" (largest span in Ecology Block)

Demands:

- Tributary Width ≈ 8'-0"
- Dead = 12psf
- Live = 20psf
- Snow = 29.6psf
- Wind (Zone 2&3) = 32.00psf (downward)

Per Enercalc (see appendix) 6x12 DF/L #2 beams are adequate (DCR = 0.87)

Slab on Grade Design
Evaluate the slab on grade for vehicular concentrated loads.
Concrete compressive strength, f'_c = 2,500psi
Assumed soil modulus of subgrade reaction = 50pci (conservative)

Per Enercalc (see appendix) a 12" thick slab on grade is adequate (FS = 11.59)

Lateral Design

Design Result Summary (Controlling Actions Shown)

Member	Utilization
Post	DCR = 0.72
Corner Post Anchorage	Varies (All DCR <1.0, see design)
Brace	DCR = 0.7
Wall Sill Plate	DCR = 0.43
Wall Sill Plate Anchorage	Varies (All DCR <1.0, see design)
Retaining Wall	Varies (All DCR <1.0, see design)

Assumptions:

- The primary lateral force resisting system are the braced cantilevered posts supporting the roof framing.
- Evaluate the structure for horizontal seismic load effects in the two orthogonal principal directions: transverse and longitudinal (per ASCE 7, Section 12.14.4.2.1).
- In the transverse direction, the diaphragm will have flexible behavior.
- In the longitudinal direction, the diaphragm will behave as a cantilever/3-sided diaphragm and is idealized as rigid in the analysis.
- Because there are not vertical elements of the lateral force resisting system on both sides in the longitudinal direction (i.e. cantilever/3-sided diaphragm), a redundancy factor of 1.3 is used per ASCE 7 Section 12.3.4.2.
- Flat roof snow load is less than 30 psf (see snow load generation). As such, roof snow loads do not need to be considered in the effective seismic weight of the structure per Section 12.7.2 of ASCE 7-16.

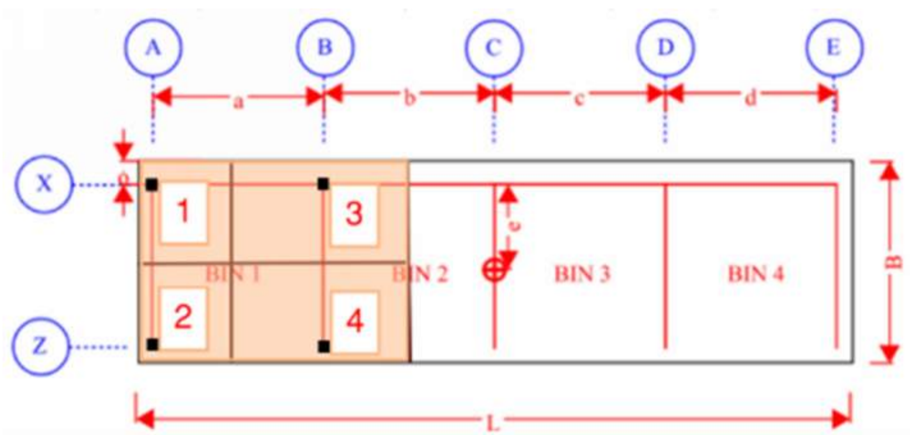
Load Generation

Generate gravity and lateral seismic demands for each post. By inspection, seismic demands control over wind. By inspection, the ecology block option will control over the CIP option because the thicker walls result in greater tributary widths. Also, by inspection, the 3 or 4-bin option will control because of the staggering of columns. For example, Bin 2 has the largest width to accommodate the offset post base from the interlocking notch in the middle of the ecology block. Thus, the posts on the ecology block layout are furthest apart and support a larger tributary area and load which will govern the post design.

Gravity Demands

Post Mark	Description	Trib Area (ft^2)	Dead (kip)	Live Roof (kip)	Snow (kip)
1	Side Back	41.25	0.495	0.825	1.221
2	Side Front	41.25	0.495	0.825	1.221
3	Interior Back	90	1.08	1.8	2.664
4	Interior Front	90	1.08	1.8	2.664

Note: Tributary areas are approximate.



Geometry

	2-Bin	3-Bin	4-Bin	units
o	1.5	1.5	1.5	ft
B	15	15	15	ft
L	27	39	51	ft
a	11	11	11	ft
b	12	13	13	ft
c	0	11	11	ft
d	0	0	12	ft
e	6.75	6.75	6.75	ft

Example Calculations: Post Mark 1

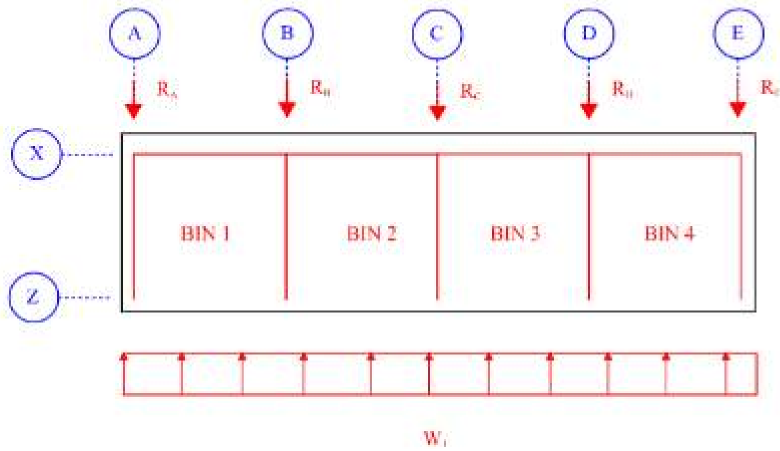
- Tributary Width, W = 5.5’ (estimated from CAD, all posts support gravity loads)
- Tributary Length, L = 7.5’ (estimated from CAD, all posts support gravity loads)
- Tributary Area, A = W*L = 41.25ft^2
- Dead Load = D*A = 12psf*41.25ft^2= 0.495kip
- Live Roof = L_r*A = 20psf*41.25ft^2= 0.825kip
- Snow Load = S*A = 29.6psf*41.25ft^2= 1.221kip

Seismic Demands

Inputs

Roof Dead	12	psf
ρC_S	1.04	-
Bin Width	10	ft
Bin Length	10	ft
Wall Thickness	2	ft
Overhang, o	1.5	ft

Case 1 – Transverse Seismic Loading



Diaphragm Forces

	2-Bin	3-Bin	4-Bin	units
W_1	187	187	187	plf
R_A	1310	1310	1310	lb
R_B	2153	2246	2246	lb
R_C	1310	2246	2246	lb
R_D	0	1310	2153	lb
R_E	0	0	1404	lb
Max Diaphragm Shear	**144**	**150**	**150**	**plf**

Example Calculations: R_A

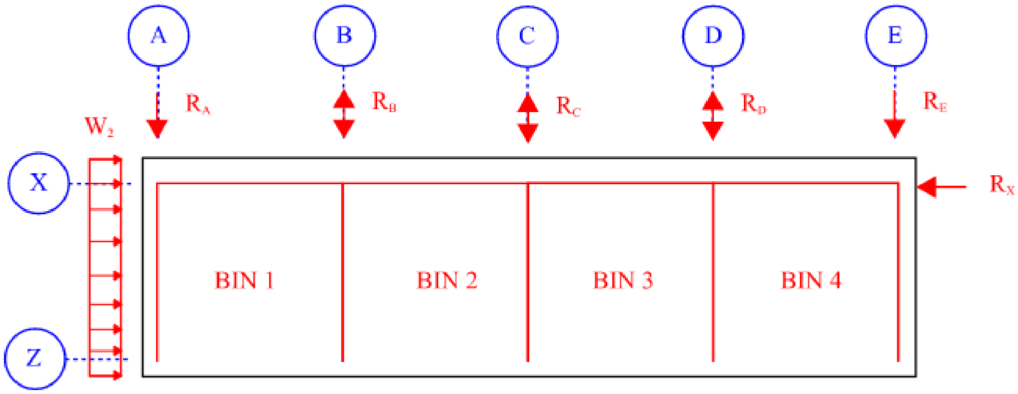
- Transverse seismic loading, $W_1 = DL*\rho C_s*B$ = 12psf*1.04*15ft = 187plf
- Force along line $R_A = W_1*((a)+o)$ = 187plf*((11ft)+1.5ft) = 1,310lbs

Transverse Seismic Load Imposed on Braces and Posts per reactions R_A through R_E

Reactions	2-Bin	3-Bin	4-Bin	units
R_{AX}	655	655	655	lb
R_{AZ}	655	655	655	lb
R_{BX}	1076	1123	1123	lb
R_{BZ}	1076	1123	1123	lb
R_{CX}	655	1123	1123	lb
R_{CZ}	655	1123	1123	lb
R_{DX}	0	655	1076	lb
R_{DZ}	0	655	1076	lb
R_{EX}	0	0	702	lb
R_{EZ}	0	0	702	lb
Controlling Back Post/Brace Demand	**1076**	**1123**	**1123**	**lb**
Controlling Front Post/Brace Demand	**1076**	**1123**	**1123**	**lb**

Case 2 – Transverse Seismic Loading

Note: Reactions A-E are calculated assuming cantilever diaphragm behavior. These braces are responsible for resisting torsional effects. Demands along interior brace lines are expected to effectively cancel out within each bin zone due to positive and negative contributions from each adjacent bin zone (slight differences in bin geometry produce a non-zero reaction value). Exterior brace lines develop the reactions required to resist the torsional demands within the subject bin zone.



Diaphragm Forces

	2-Bin	3-Bin	4-Bin	units
W_2	306	437	568	plf
W_2/No. Bins	153	146	142	plf
R_A	87	83	81	lb
R_B	0	0	0	lb
R_C	87	0	0	lb
R_D	0	83	0	lb
R_E	0	0	81	lb
R_X	4128	5897	7666	lb
Max Diaphragm Shear	**168**	**168**	**168**	**plf**

Reactions	2-Bin	3-Bin	4-Bin	units
R_{AX}	52	50	49	lb
R_{AZ}	52	50	49	lb
R_{BX}	4	8	8	lb
R_{BZ}	4	8	8	lb
R_{CX}	47	-8	-8	lb
R_{CZ}	47	-8	-8	lb
R_{DX}	0	50	4	lb
R_{DZ}	0	50	4	lb
R_{EX}	0	0	45	lb
R_{EZ}	0	0	45	lb
R_{XA}	1264	1217	1193	lb
R_{XB}	1264	1217	1193	lb
R_{XC}	1264	1217	1193	lb
R_{XD}	1264	1217	1193	lb
R_{XE}	1264	1217	1193	lb
Controlling Back Post/Brace Demand	**1264**	**1217**	**1193**	**lb**
Controlling Front Post/Brace Demand	**52**	**50**	**49**	**lb**

Demand Summary

Controlling Back Longitudinal Demand	**1264**	**lb**
Controlling Back Transverse Demand	**1123**	**lb**
Controlling Front Demand	**1123**	**lb**

Interior Back Post and Longitudinal Brace

Maximum height above wall = 4’-3”
Intermediate bracing at 3’-0” above base

Gravity Demands:

- Dead = 1.08 kip
- Live Roof = 1.8 kip
- Snow = 2.664 kip

Lateral Demands:

- Seismic = 1.264kip

Per RISA (see appendix) P.T. 6x6 HF/L #1 posts are adequate (DCR = 0.41)
Per RISA (see appendix) DBL P.T. 2x6 HF/L #2 braces are adequate (DCR = 0.48)

Interior Back Post and Transverse Brace

Maximum height above wall = 4'-3"

Intermediate bracing at 2'-6" above base

Gravity Demands:

- Dead = 1.08 kip
- Live Roof = 1.8 kip
- Snow = 2.664 kip

Lateral Demands:

- Seismic = 1.123kip

Per RISA (see appendix) P.T. 6x6 HF/L #1 posts are adequate (DCR = 0.46)

Per RISA (see appendix) DBL P.T. 2x6 HF/L #2 braces are adequate (DCR = 0.36)

Interior Front Post and Transverse Brace

Maximum height above wall = 6'-0"

Intermediate bracing at 3'-6" above base

Gravity Demands:

- Dead = 1.08 kip
- Live Roof = 1.8 kip
- Snow = 2.664 kip

Lateral Demands:

- Seismic = 1.123kip

Per RISA (see appendix) P.T. 6x6 HF/L #1 posts are adequate (DCR = 0.72) - Governs

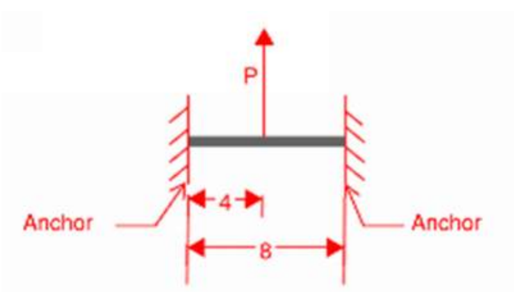
Per RISA (see appendix) DBL P.T. 2x6 HF/L #2 braces are adequate (DCR = 0.7) - Governs

Sill Plate Design

Evaluate the sill plate for the maximum tension reaction from the brace.

Total Double Brace Axial Load = 2.72kip (1.0E)

Vertical component of demand per RISA output, P = 1,930lb



Per Enercalc (see appendix) a P.T. 4x4 HF/L #2 sill plate in weak axis bending is adequate (DCR = 0.43)

Knee Brace Nailing Design

Evaluate the Nailing on the brace to sill plate connection for the maximum axial force in the brace. Per RISA Front Post brace RISA model, the maximum brace reaction for a single Brace Axial Load in Single Shear= 1.36 kip (1.0E). See Appendix A for brace demand forces.

American Wood Council Connection Results – Capacity for (12) 10D Nails = 2.09 kip

<u>(12) 10D Nails on each Brace/ Sill Plate Connection is adequate (DCR = 0.65)</u>

Design Method	Load & Resistance Factor Design (LRFD)
Connection Type	Lateral loading
Fastener Type	Nail
Loading Scenario	Single Shear
	Submit Initial Values

Main Member Type	Hem-Fir
Main Member Thickness	3.5 in.
Side Member Type	Hem-Fir
Side Member Thickness	1.5 in.
Nail Type	Box
Nail Size	10d (D = 0.128 in.; L = 3 in.)
Time Effect Factor	= 1.0
Wet Service Factor	C_M = 1.0
End Grain Factor	C_eg = 1.0
Temperature Factor	C_t = 1.0
Diaphragm Factor	C_di = 1.0

Calculate Connection Capacity

Connection Yield Mode Descriptions | Limits of Use

Diaphragm Factor Help | Load Duration Factor Help | Technical Help

Show Printable View

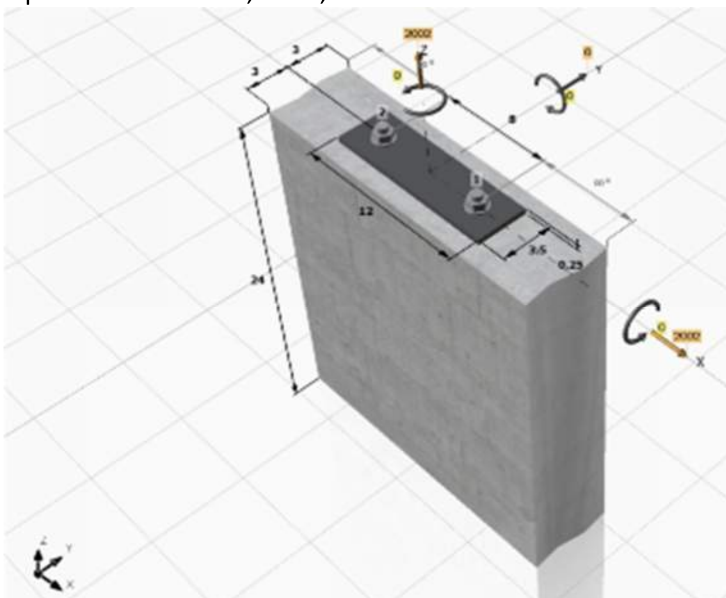
Connection Yield Modes

Im	660 lbs.
Is	660 lbs.
II	273 lbs.
IIIm	242 lbs.
IIIs	242 lbs.
IV	174 lbs.

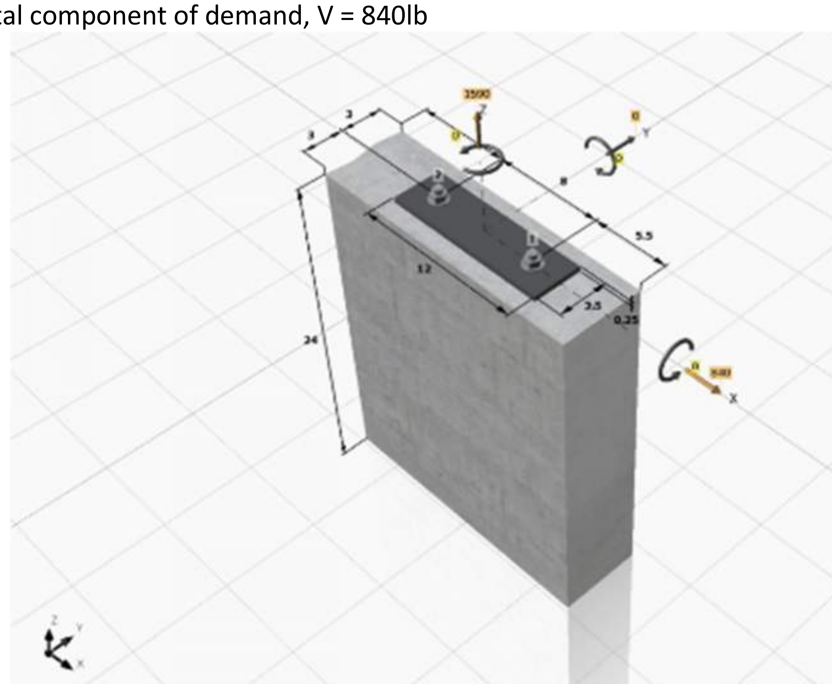
Adjusted LRFD Capacity	174 lbs.

Sill Plate Anchorage Design

Case 1:
Evaluate the sill plate anchorage for the lateral and vertical reaction from the brace.
Demands per RISA output for load combination [(0.9-0.2S_{DS})D+Ω_0E]
Vertical component of demand, P = 2,002lb
Horizontal component of demand, V = 2,002lb



Case 2
Evaluate the sill plate anchorage for the lateral and vertical reaction at the base of the front post.
Edge condition – Anchor is 5.5” from front of wall
Demands per RISA output for load combination [(0.9-0.2S_{DS})D+Ω_0E]
Vertical component of demand, P = 1590lb
Horizontal component of demand, V = 840lb



Provide anchorage designs compatible with either hot dipped galvanized threaded rods or 304/316SS threaded rods. By inspection, HDG Gr 36 threaded rods will control.

Provide anchorage designs for the following epoxy options:

- Hilti HIT-RE 500 V3
- Simpson SET-3G
- Dewalt Pure 110+

Provide anchorage designs for the following mechanical options:

- Hilti KH-EZ
- Titen HD
- Dewalt Screw Bolt+

Per Dewalt Design Assist Anchorage Software and Simpson Anchorage Software, the following anchors are adequate to resist tension loads

BRACE AND COLUMN ANCHORAGE OPTIONS:
EPOXY:
-HILTI HIT-RE 500 V3 3/4"Ø THREADED ROD ASTM F1554 GR36/A36 W/ 6" EMBEDMENT
-SIMPSON SET 3G 3/4"Ø THREADED ROD ASTM F1554 GR36 W/ 6" EMBEDMENT
-DEWALT PURE110+ 3/4"Ø THREADED ROD ASTM F1554 GR36/A36 W/ 6" EMBEDMENT

MECHANICAL:
-DEWALT SCREW-BOLT+ 3/4"Ø W/ 4.25" NOMINAL EMBEDMENT
-HILTI KH-EZ 3/4"Ø W/ 4" NOMINAL EMBEDMENT
-TITEN HD 3/4"Ø W/ 4" NOMINAL EMBEDMENT

Retaining Wall Design

CIP Wall Properties:

- Wall Thickness = 6”
- Wall Height = 4’-0” (max)
- Retained backfill height = Wall height - 3”
- Retained infill height = Wall Height
- Concrete Compressive Strength, f'_c = 2,500psi
- Reinforcing Info:
  - Vertical Reinforcing = #5@16” o.c. OR #4 @ 12” o.c.
  - Horizontal Reinforcing = #5@16” o.c. OR #4 @ 10” o.c.
  - Reinforcing Yield, f_y = 60,000psi

Footing Properties:

- Footing Thickness = 12”
- Footing width = Enercalc calculation considers the whole footing width, including the tapered portion. Note that the analysis is inherently conservative as it idealizes the wall as a cantilevered condition, though it is also supported on the side by the back wall. Further, the soil backfill is tapered to the front of the bins, so average demands are less than approximated by Enercalc.
- Reinforcing Info:
  - Rebars size and spacing match slab reinforcing

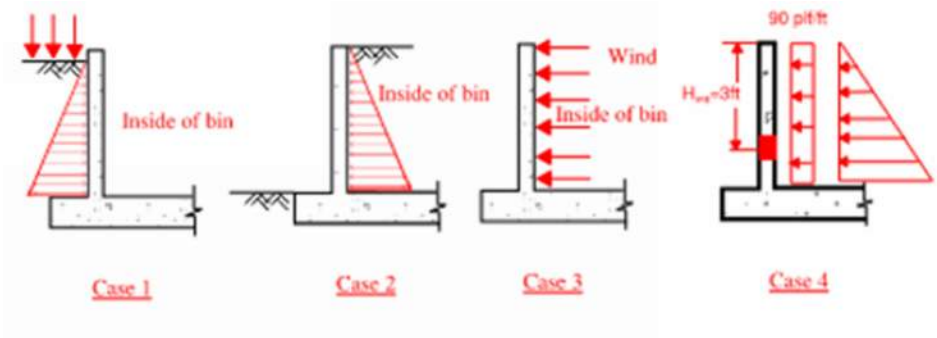
Ecology Block Properties:

- Ecology Block Wall Thickness = 2’-0”
- Ecology Block Wall Height = 2’-0” (max)
- Retained backfill height = Wall height - 3”
- Retained infill height = Wall Height

Surcharge Loads: NRCS does not prescribe surcharge design loads for agricultural storage structures. As such, this design conservatively assumes the following: For wall strength checks: Design for a 250psf surcharge load. Note that this is conservative and is representative of if a heavy vehicle load was placed behind a portion of the wall. The intent of this check is to evaluate the strength of the wall for high localized demands as a result of heavy vehicular loads.

Design Cases:

- Case 1 (Wall Design): Backfill + Surcharge with Empty Bin – **Governs Design by Inspection**
- Case 2 (Wall Design): Infill without Backfill
- Case 3 (Wall Design): Wind on an Empty Bin Without Backfill
- Case 4 (Beam Design): Back Wall Horizontally Spanning



Case 1: Backfill + Surcharge with Empty Bin

Demands:

- Active Backfill = 45psf/ft
- Backfill Surcharge = 250psf

Per Enercalc (See Appendix), the 6” retaining wall is adequate with #5 Verts. @16” o.c. and #5 Horiz. Bars @16” o.c. OR with #4 Verts. @12” o.c. and #4 Horiz. Bars @10” o.c.

Case 2: Infill Without Backfill

Demands:

- Active Infill = 60psf/ft

Only active infill considered in case. By inspection, case 1 governs the design.

Case 3: Wind with Empty Bin Without Backfill

Demands:

- Wind = 54.43 psf (see bin wall wind load generation)

Only wind loads considered in case. By inspection, case 1 governs the design.

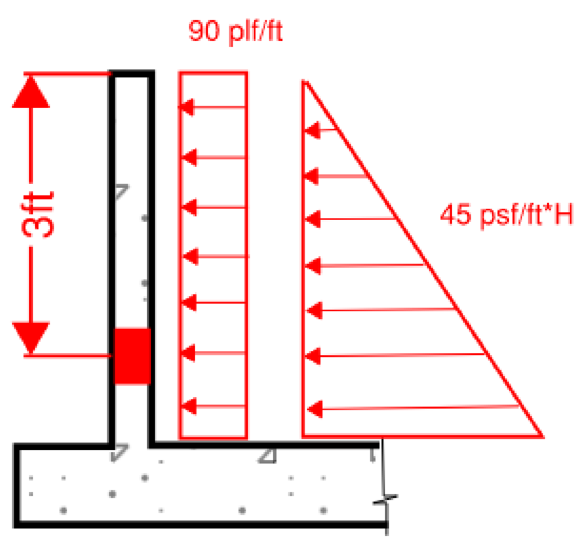
Case 4: Back Wall Horizontally Spanning

Idealize the back wall as horizontally spanning. Is assumed as a simple support beam supported at the interior and side walls. Analysis assumes the lowest 12" of the wall is effectively fixed by the footing below rather than horizontally spanning. Evaluate the region directly above as horizontally spanning. Note that the analysis is inherently conservative.

Demands:

- By inspection, stem demands for Case 1 controls.
- Active Pressure Demands:
  - Active Pressure, p_a = 45psf/ft
  - Average Depth H_1 = 3 ft
  - Uniform Load = p_a * H_1 = 135 plf/ft
  - In Enercalc, consider active pressures as dead loads since they have the same load factor

- Backfill Surcharge = 250psf
  - Soil Density = 12 pcf
  - Surcharge pressure width H_2 = 250psf /125pcf = 2 ft of additional surcharge
  - Uniform Load = p_a * H_2 = 90 plf/ft
  - In Enercalc, consider surcharge pressures as a live load

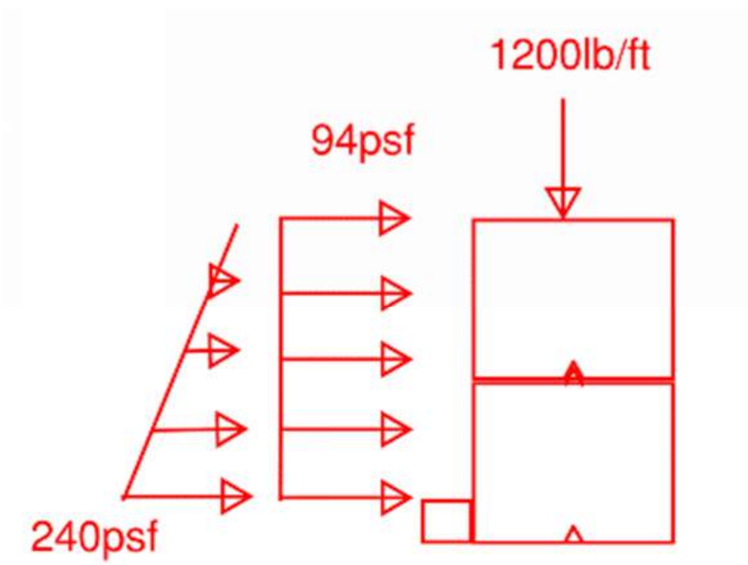


By inspection, case 1 governs the design.

Ecology Block Overturning and Sliding Check

Backfill Surcharge	250	psf
Soil Density	120	pcf
Active Soil Pressure	45	psf/ft
Surcharge OT Load Height Above Wall	2.08	ft
Surcharge OT Load at Top of Wall	93.75	psf
Surcharge OT Load at Bot of Wall	304.69	psf
Triangular OT Load at Bot of Wall	240	psf
Backfill Height	3.25	ft
OT Moment	752.58	lb*ft/ft
Conc Density	150	pcf
Ecology Block width	2	ft
Ecology Block height	4	ft
Ecology Block Wt.	1200	lb/ft
Resist Moment	1200	lb*ft/ft
Overturning Safety Factor	1.59	

coeff. Friction	0.7	
Sliding Resistance	840	lb/ft
Sliding Force	542.34	lb/ft
Sliding Safety Factor	1.55	



Appendix A – Enercalc and RISA Calculations

Multiple Simple Beam — Project File: Roof Girder and Rafter 2302-0069.ec6

LIC# : KW-06014167, Build:20.23.08.01 — PETERSON STRUCTURAL ENGINEERS — (c) ENERCALC INC 1983-2023

Description : 2x8 Rafter DF/L #2 @ 24" o.c.

Wood Beam Design : 2x8 Rafter DF/L #2

Calculations per NDS 2018, IBC 2021, ASCE 7-16

BEAM Size : **2x8, Sawn, Fully Braced**
Using Allowable Stress Design with ASCE 7-16 Load Combinations, Major Axis Bending

Wood Species : Douglas Fir-Larch — Wood Grade : No.2

Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.210 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Wood Beam Design : 2x8 Rafter DF/L #2

Calculations per NDS 2018, IBC 2021, ASCE 7-16

BEAM Size : **2x8, Sawn, Fully Braced**
Using Allowable Stress Design with ASCE 7-16 Load Combinations, Major Axis Bending

Wood Species : Douglas Fir-Larch — Wood Grade : No.2

Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.210 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

Beam self weight calculated and added to loads
Unif Load: D = 0.0080, Lr = 0.0250, S = 0.030, W = 0.07790 k/ft, Trib= 2.0 ft

Design Summary

Max fb/Fb Ratio = **0.863** : 1
fb : Actual : 1,490.75 psi at 5.335 ft in Span # 2
Fb : Allowable : 1,728.00 psi
Load Comb : +D+0.750S+0.450W

Max fv/FvRatio = **0.341** : 1
fv : Actual : 98.21 psi at 10.670 ft in Span # 2
Fv : Allowable : 288.00 psi
Load Comb : +D+0.750S+0.450W

Max Reactions (k)	D	Lr	L	S	W	E	H
Left Support	0.13	0.37		0.44	1.14		
Right Support	0.13	0.37		0.44	1.14		

Max Deflections

Transient Downward	0.501 in	Total Downward	0.429 in
Ratio	255 <0	Ratio	298
	LC: W Only		LC: +D+0.750S+0.450W
Transient Upward	-0.275 in	Total Upward	-0.236 in
Ratio	174 <0	Ratio	202
	LC: W Only		LC: +D+0.750S+0.450W

Description : 6x12 Roof Girder DF/L #2

Wood Beam Design : Roof Girder DF/L #2

Calculations per NDS 2018, IBC 2021, ASCE 7-16

BEAM Size : **6x12, Sawn, Defined Brace Spacing, 1st at ft and spaced at 2.0 ft**
Using Allowable Stress Design with ASCE 7-16 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir-Larch			Wood Grade : No.2					
Fb - Tension	875.0 psi	Fc - Prll	600.0 psi	Fv	170.0 psi	Ebend- xx	1,300.0 ksi	Density	31.210 pcf
Fb - Compr	875.0 psi	Fc - Perp	625.0 psi	Ft	425.0 psi	Eminbend - xx	470.0 ksi		

Wood Beam Design : Roof Girder DF/L #2

Calculations per NDS 2018, IBC 2021, ASCE 7-16

BEAM Size : **6x12, Sawn, Defined Brace Spacing, 1st at ft and spaced at 2.0 ft**
Using Allowable Stress Design with ASCE 7-16 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir-Larch			Wood Grade : No.2					
Fb - Tension	875.0 psi	Fc - Prll	600.0 psi	Fv	170.0 psi	Ebend- xx	1,300.0 ksi	Density	31.210 pcf
Fb - Compr	875.0 psi	Fc - Perp	625.0 psi	Ft	425.0 psi	Eminbend - xx	470.0 ksi		

Applied Loads

Beam self weight calculated and added to loads
Unif Load: D = 0.0120, Lr = 0.0250, S = 0.030, W = 0.0320 k/ft, Trib= 8.0 ft

Design Summary

Max fb/Fb Ratio = **0.867** : 1
fb : Actual : 697.05 psi at 6.630 ft in Span # 2
Fb : Allowable : 803.60 psi
Load Comb : +D+S

Max fv/FvRatio = **0.305** : 1
fv : Actual : 47.64 psi at 2.000 ft in Span # 1
Fv : Allowable : 156.40 psi
Load Comb : +D+S

Max Reactions (k)	D	Lr	L	S	W	E	H
Left Support	0.95	1.73		2.08	2.22		
Right Support	0.70	1.27		1.52	1.62		

Max Deflections

Transient Downward	0.173 in	Total Downward	0.273 in
Ratio	904	Ratio	571
	LC: W Only		LC: +D+0.750S+0.450W
Transient Upward	-0.080 in	Total Upward	-0.126 in
Ratio	600	Ratio	378
	LC: W Only		LC: +D+0.750S+0.450W

DESCRIPTION: Slab on Grade

Code References

Calculations per IBC 2021, ASCE 7-16
Load Combinations Used : ASCE 7-16

Analytical Values

d - Slab Thickness	6.0 in	Ks - Soil Modulus of Subgrade Reac	50.0 pci
FS - Req'd Factor of Safety	5.0 : 1	Ec - Concrete Elastic Modulus	2,850.0 ksi
		f'c - Concrete Compressive Strength	2.50 ksi
		μ - Poisson's Ratio	0.150
		Min. Adjacent Load Distance	48.012 in

Analysis Formulas

Pn = 1.72 [(Ks R1 / Ec) 10,000 + 3.6] Fr d'
Ks = Soil modulus of subgrade reaction
R1 = 50% plate average dimension = sqrt(PlWid * PlLer
Ec = Concrete elastic modulus
Fr - Concrete modulus of rupture = 7.5 * sqrt(f'c)
d - Slab Thickness

Min Adjacent Column Distance = 1.5 * ([Ec d^3 / (12 * (1- u^2) Ks] ^ 1
Ec = Concrete elastic modulus
d - Slab Thickness
u - Poisson's ratio
Ks = Soil modulus of subgrade reaction

Load & Capacity Table

Load ID	Plate (in) Wid	Len	R1 (in)	Applied Concentrated Load on Plate - (kip) D	Lr	L	S	W	E	Governing Ld Comb	Pu (kip)	Pn (kip)	Check
Point Loac	4.50	4.50	2.25			8.00				L Only	8.0	92.8	Pass, FS=11.59 >= 5

Back Longitudinal Post and Brace

Node Coordinates

	Label	X [ft]	Y [ft]	Z [ft]	Detach From Diaphragm
1	N1	0	0	0	
2	N2	0	4.22	0	
3	N3	0	3	0	
4	N4	3	0	0	

Wood Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	Post	6X6	Column	Rectangular	HF/L #1	Typical	30.25	76.26	76.26	128.87
2	Brace	6X6	Column	Rectangular	HF/L #2	Typical	30.25	76.26	76.26	128.87
3	Brace Alt	2X6	Column	Rectangular	HF/L #2	Typical	8.25	1.55	20.8	5.12

Member Primary Data

	Label	I Node	J Node	Section/Shape	Type	Design List	Material	Design Rule
1	M1	N1	N2	Post	Column	Rectangular	HF/L #1	Typical
2	M2	N3	N4	Brace Alt	Column	Rectangular	HF/L #2	Typical
3	M3	N3	N4	Brace Alt	Column	Rectangular	HF/L #2	Typical

Node Loads and Enforced Displacements (BLC 1 : Dead)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	Y	-1.08

Node Loads and Enforced Displacements (BLC 2 : Live Roof)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	Y	-1.8

Node Loads and Enforced Displacements (BLC 3 : Snow)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	Y	-2.66

Node Loads and Enforced Displacements (BLC 4 : Seismic Horiz)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	X	1.26

Load Combinations

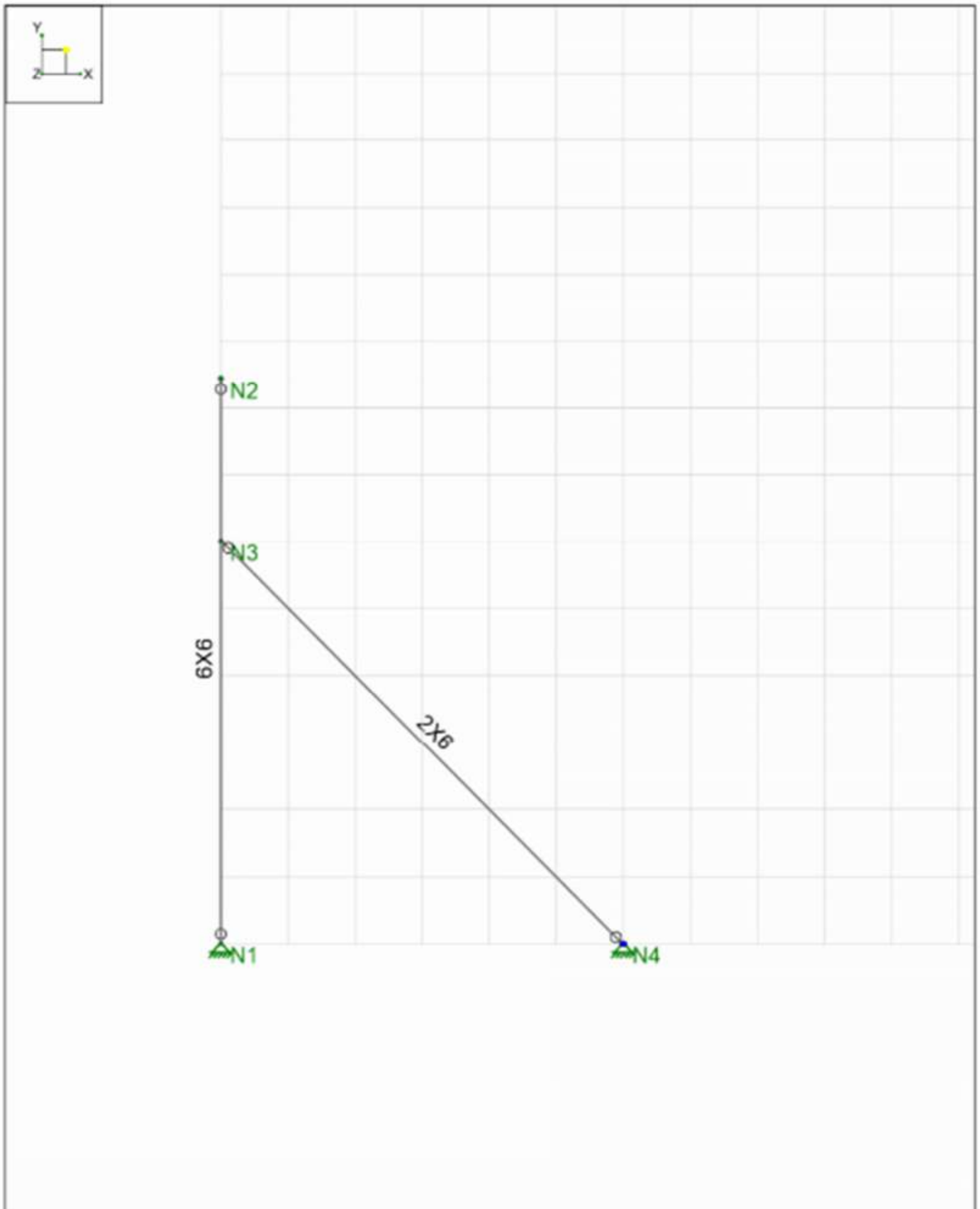
	Description	Solve	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	D	Yes	DL	1	NL	1				
2	D+Lr	Yes	DL	1	RLL	1				
3	D+S	Yes	DL	1	SL	1				
4	D+0.7Ev+0.7Eh	Yes	DL	1	Sds*DL	0.17	EL	0.7		
5	D+0.7Ev-0.7Eh	Yes	DL	1	Sds*DL	0.17	EL	-0.7		
6	D+0.7Ev+(0.7OmEh)	Yes	DL	1	Sds*DL	0.17	Om*EL	0.7		
7	D+0.7Ev-(0.7OmEh)	Yes	DL	1	Sds*DL	0.17	Om*EL	-0.7		
8	D+0.525Ev+0.525Eh+0.1S	Yes	DL	1	Sds*DL	0.13	EL	0.53	SL	0.1
9	D+0.525Ev-0.525Eh+0.1S	Yes	DL	1	Sds*DL	0.13	EL	-0.53	SL	0.1
10	D+0.525Ev+0.525(OmEh)+0.1S	Yes	DL	1	Sds*DL	0.13	Om*EL	0.53	SL	0.1
11	D+0.525Ev-0.525(OmEh)+0.1S	Yes	DL	1	Sds*DL	0.13	Om*EL	-0.53	SL	0.1
12	0.6D-0.7Ev+0.7Eh	Yes	DL	0.6	Sds*DL	-0.17	EL	0.7		
13	0.6D-0.7Ev-0.7Eh	Yes	DL	0.6	Sds*DL	-0.17	EL	-0.7		
14	0.6D-0.7Ev+0.7(OmEh)	Yes	DL	0.6	Sds*DL	-0.17	Om*EL	0.7		
15	0.6D-0.7Ev-0.7(OmEh)	Yes	DL	0.6	Sds*DL	-0.17	Om*EL	-0.7		

Envelope Node Reactions

	Node Label		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
0	N3	max	0	13	0	13	0	13	0	13	0	13	0	13
1		min	0	1	0	1	0	1	0	1	0	1	0	1
2	N4	max	1.24	5	1.24	4	0	13	0	13	0	13	0	13
3		min	-1.24	4	-1.24	13	0	1	0	1	0	1	0	1
4	N1	max	0.36	4	3.74	3	0	13	0	13	0	13	0	13
5		min	-0.36	5	-0.81	12	0	1	0	1	0	1	0	1
6	Totals:	max	0.88	5	3.74	3	0	13						
7		min	-0.88	4	0.43	12	0	1						

Envelope Node Reactions - Overstrength or Capacity Limit

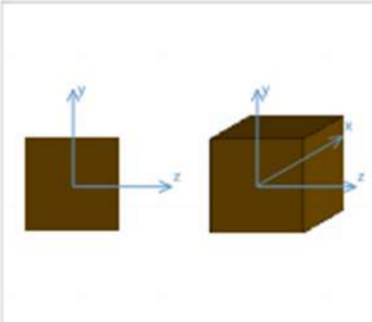
	Node Label		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
0	N3	max	0	15*	0	15*	0	15*	0	15*	0	15*	0	15*
1		min	0	6*	0	6*	0	6*	0	6*	0	6*	0	6*
2	N4	max	1.87	15*	1.87	14*	0	15*	0	15*	0	15*	0	15*
3		min	-1.87	6*	-1.87	7*	0	6*	0	6*	0	6*	0	6*
4	N1	max	0.54	6*	3.16	7*	0	15*	0	15*	0	15*	0	15*
5		min	-0.54	7*	-1.44	14*	0	6*	0	6*	0	6*	0	6*
6	Totals:	max	1.33	15*	1.51	10*	0	15*						
7		min	-1.33	6*	0.43	15*	0	6*						



RISA	<Licensed Company>	WSF Back Longitudinal Knee Brace	SK-6
	NickWelling		Jan 09, 2024 at 04:44 PM
	2302-0069		2023_11_28 Back Longitudi...

Detail Report: M1

Load Combination: Envelope **Code check:** 0.405 (LC 12)



Input Data

Shape:	6X6 (nominal)	**I Node:**	N1
Member Type:	Column	**J Node:**	N2
Length (ft):	4.22	**I Release:**	Fixed
Material Type:	Wood	**J Release:**	Fixed
Design Rule:	Typical	**I Offset:**	N/A
Internal Sections:	97	**J Offset:**	N/A
Design Code:	AWC NDS-18 / SDPWS-15 ASD	**T/C Only:**	Both Way

Material Properties

Material:	HF/L #1	**Grade:**	No.1	**Nu:**	0.3
Type:	Solid Sawn	**Cm:**	Yes	**Alpha ($1e^{5}$ $°F^{-1}$):**	0.3
Database:	Visually Graded	**Ci:**	Yes	**Density (k/ft^3):**	0.04
Species:	Hem-Fir	**Emod:**	1		

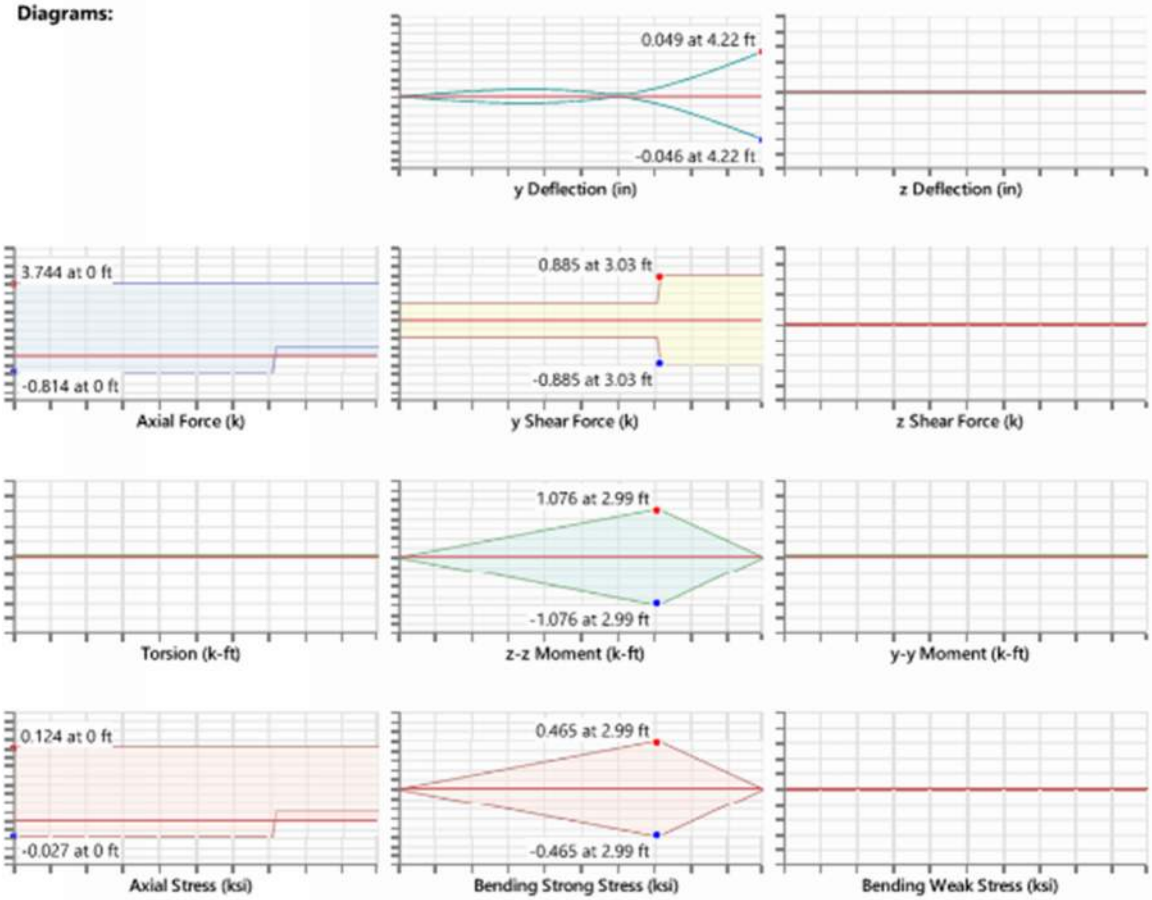
Shape Properties

F_b (ksi):	0.98	**E (ksi):**	1300	**b (actual) (in):**	5.5
F_t (ksi):	0.65	**Emod:**	1	**d (actual) (in):**	5.5
F_v (ksi):	0.14	**COV_E (Table F1):**	0.25		
F_c (ksi):	0.85	**E_{min} (ksi):**	474.9		

Design Properties

le2 (ft):	4.22	**y sway:**	No	**C_{fu}:**	1
le1 (ft):	4.22	**z sway:**	No	**C_P:**	0.93
le-bend top:	Lbyy	**C_D:**	1.6	**Max Defl Ratio:**	L/1041
le-bend bot (ft):	4.22	**R_B:**	3.03	**Max Defl Location:**	4.22
K_{y-y}:	1	**C_L:**	1	**Span:**	N/A
K_{z-z}:	1	**C_r:**	1		

Diagrams:

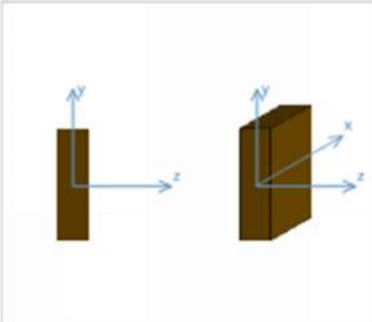


AWC NDS-18 / SDPWS-15 ASD Code Check

Limit State	Gov. LC	Required	Available	Unity Check	Result
Applied Loading - Bending/Axial	12	-	-	-	-
Applied Loading - Shear + Torsion	5	-	-	-	-
Axial Compression Analysis	-	0 ksi	0.92 ksi	-	-
Axial Tension Analysis	-	-0.03 ksi	0.83 ksi	-	-
Flexural Analysis, Fb1'	-	0.47 ksi	1.25 ksi	-	-
Flexural Analysis, Fb2'	-	0 ksi	1.25 ksi	-	-
Bending & Axial Compression Analysis	-	-	-	**0.37**	PASS
Bending & Axial Tension Analysis	-	-	-	**0.41**	PASS
Shear Analysis	-	0.04 ksi	0.18 ksi	**0.24**	PASS

Detail Report: M2

Load Combination: Envelope **Code check:** 0.477 (LC 4)



Input Data

Shape:	2X6 (nominal)	**I Node:**	N3
Member Type:	Column	**J Node:**	N4
Length (ft):	4.24	**I Release:**	BenPIN
Material Type:	Wood	**J Release:**	Fixed
Design Rule:	Typical	**I Offset:**	N/A
Internal Sections:	97	**J Offset:**	N/A
Design Code:	AWC NDS-18 / SDPWS-15 ASD	**T/C Only:**	Both Way

Material Properties

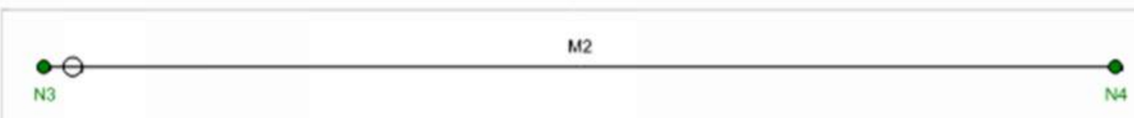
Material:	HF/L #2	**Grade:**	No.2	**Nu:**	0.3
Type:	Solid Sawn	**Cm:**	Yes	**Alpha ($1e^{5}$ $^{o}F^{-1}$):**	0.3
Database:	Visually Graded	**Ci:**	Yes	**Density (k/ft^3):**	0.04
Species:	Hem-Fir	**Emod:**	1		

Shape Properties

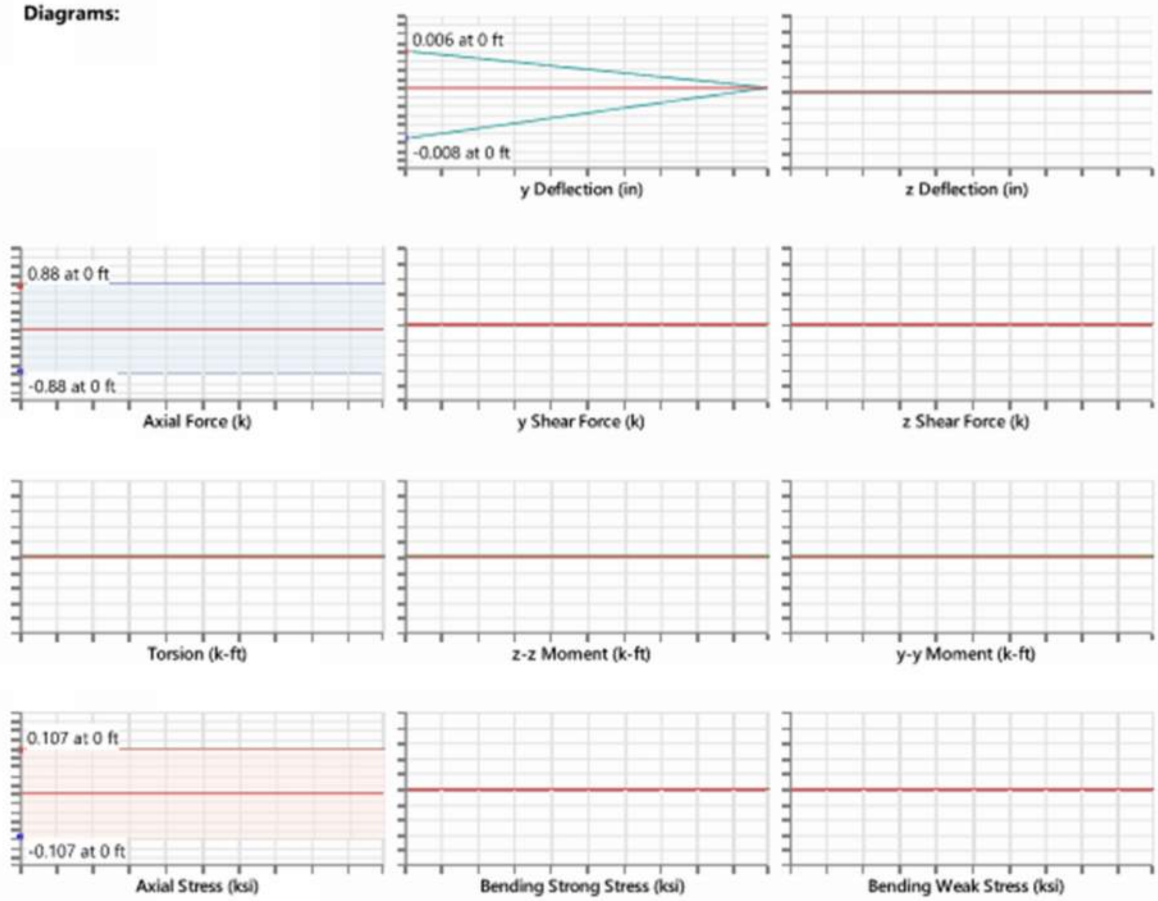
F_b (ksi):	0.85	**E (ksi):**	1300	**b (actual) (in):**	1.5
F_t (ksi):	0.52	**Emod:**	1	**d (actual) (in):**	5.5
F_v (ksi):	0.15	**COV_E (Table F1):**	0.25		
F_c (ksi):	1.3	**E_{min} (ksi):**	474.9		

Design Properties

le2 (ft):	4.24	**y sway:**	No	**C_{fu}:**	1
le1 (ft):	4.24	**z sway:**	No	**C_P:**	0.15
le-bend top:	Lbyy	**C_D:**	1.6	**Max Defl Ratio:**	L/10000
le-bend bot (ft):	4.24	**R_B:**	11.16	**Max Defl Location:**	0
$K_{y\text{-}y}$:	1	**C_L:**	0.96	**Span:**	N/A
$K_{z\text{-}z}$:	1	**C_r:**	1		



Diagrams:

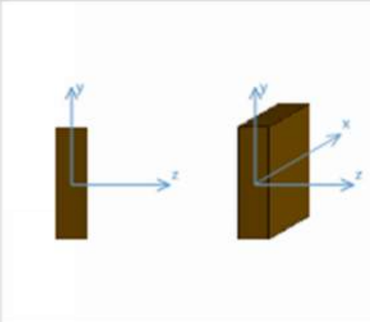


AWC NDS-18 / SDPWS-15 ASD Code Check

Limit State	Gov. LC	Required	Available	Unity Check	Result
Applied Loading - Bending/Axial	4	-	-	-	-
Applied Loading - Shear + Torsion	13	-	-	-	-
Axial Compression Analysis	-	0.11 ksi	0.22 ksi	-	-
Axial Tension Analysis	-	0 ksi	0.87 ksi	-	-
Flexural Analysis, Fb1'	-	0 ksi	1.36 ksi	-	-
Flexural Analysis, Fb2'	-	0 ksi	1.41 ksi	-	-
Bending & Axial Compression Analysis	-	-	-	0.48	PASS
Bending & Axial Tension Analysis	-	-	-	0	PASS
Shear Analysis	-	0 ksi	0.19 ksi	0	PASS

Detail Report: M3

Load Combination: Envelope **Code check:** 0.477 (LC 4)



Input Data

Shape:	2X6 (nominal)	**I Node:**	N3
Member Type:	Column	**J Node:**	N4
Length (ft):	4.24	**I Release:**	BenPIN
Material Type:	Wood	**J Release:**	Fixed
Design Rule:	Typical	**I Offset:**	N/A
Internal Sections:	97	**J Offset:**	N/A
Design Code:	AWC NDS-18 / SDPWS-15 ASD	**T/C Only:**	Both Way

Material Properties

Material:	HF/L #2	**Grade:**	No.2	**Nu:**	0.3
Type:	Solid Sawn	**Cm:**	Yes	**Alpha ($1e^{5}$ $°F^{-1}$):**	0.3
Database:	Visually Graded	**Ci:**	Yes	**Density (k/ft^3):**	0.04
Species:	Hem-Fir	**Emod:**	1		

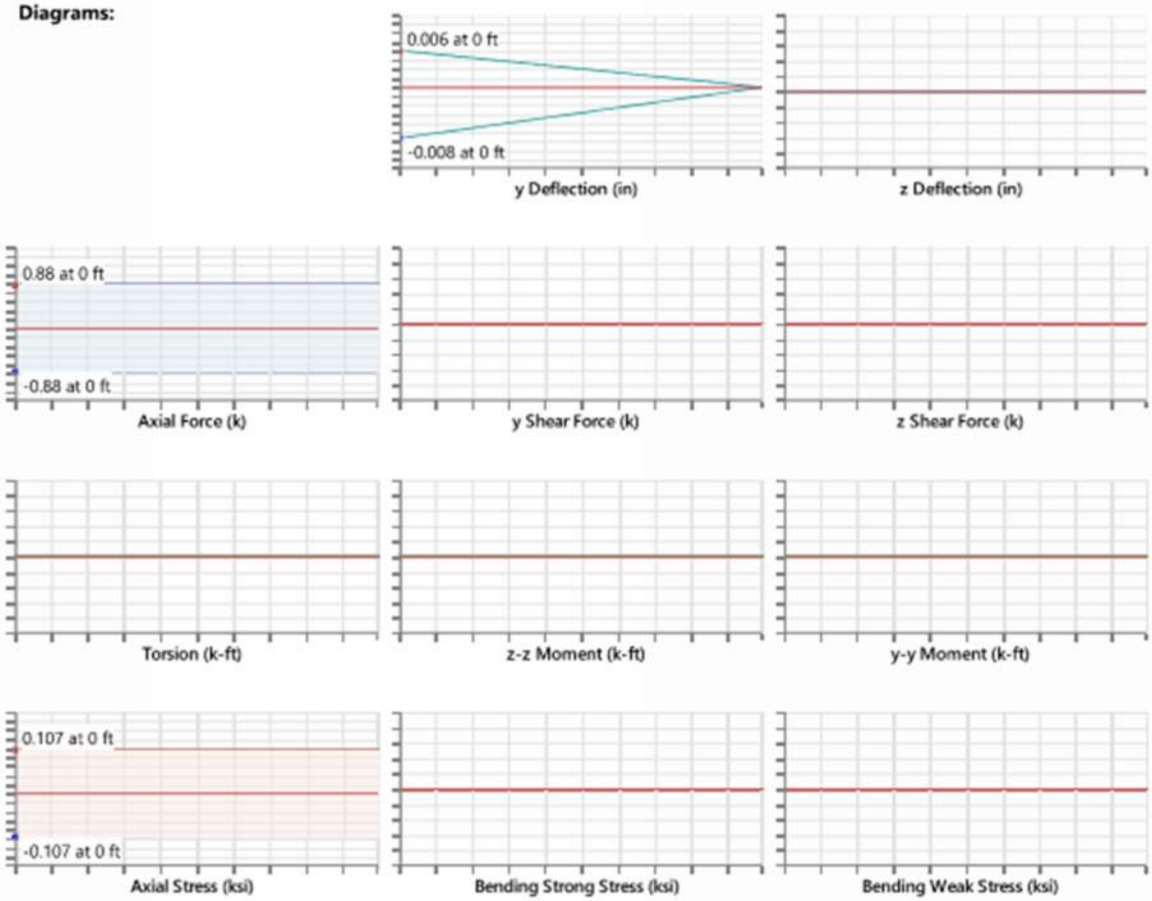
Shape Properties

F_b (ksi):	0.85	**E (ksi):**	1300	**b (actual) (in):**	1.5
F_t (ksi):	0.52	**Emod:**	1	**d (actual) (in):**	5.5
F_v (ksi):	0.15	**COV_E (Table F1):**	0.25		
F_c (ksi):	1.3	**E_{min} (ksi):**	474.9		

Design Properties

le2 (ft):	4.24	**y sway:**	No	**C_{fu}:**	1
le1 (ft):	4.24	**z sway:**	No	**C_P:**	0.15
le-bend top:	Lbyy	**C_D:**	1.6	**Max Defl Ratio:**	L/10000
le-bend bot (ft):	4.24	**R_B:**	11.16	**Max Defl Location:**	0
$K_{y\text{-}y}$:	1	**C_L:**	0.96	**Span:**	N/A
$K_{z\text{-}z}$:	1	**C_r:**	1		

Diagrams:



AWC NDS-18 / SDPWS-15 ASD Code Check

Limit State	Gov. LC	Required	Available	Unity Check	Result
Applied Loading - Bending/Axial	4	-	-	-	-
Applied Loading - Shear + Torsion	13	-	-	-	-
Axial Compression Analysis	-	0.11 ksi	0.22 ksi	-	-
Axial Tension Analysis	-	0 ksi	0.87 ksi	-	-
Flexural Analysis, Fb1'	-	0 ksi	1.36 ksi	-	-
Flexural Analysis, Fb2'	-	0 ksi	1.41 ksi	-	-
Bending & Axial Compression Analysis	-	-	-	**0.48**	PASS
Bending & Axial Tension Analysis	-	-	-	**0**	PASS
Shear Analysis	-	0 ksi	0.19 ksi	**0**	PASS

Back Transverse Post and Brace

Node Coordinates

	Label	X [ft]	Y [ft]	Z [ft]	Detach From Diaphragm
1	N1	0	0	0	
2	N2	0	4.22	0	
3	N3	0	2.5	0	
4	N4	2.5	0	0	

Wood Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	Post	6X6	Column	Rectangular	HF/L #1	Typical	30.25	76.26	76.26	128.87
2	Brace	6X6	Column	Rectangular	HF/L #2	Typical	30.25	76.26	76.26	128.87
3	Brace Alt	2X6	Column	Rectangular	HF/L #2	Typical	8.25	1.55	20.8	5.12

Member Primary Data

	Label	I Node	J Node	Section/Shape	Type	Design List	Material	Design Rule
1	M1	N1	N2	Post	Column	Rectangular	HF/L #1	Typical
2	M2	N3	N4	Brace Alt	Column	Rectangular	HF/L #2	Typical
3	M3	N3	N4	Brace Alt	Column	Rectangular	HF/L #2	Typical

Node Loads and Enforced Displacements (BLC 1 : Dead)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	Y	-1.08

Node Loads and Enforced Displacements (BLC 2 : Live Roof)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	Y	-1.8

Node Loads and Enforced Displacements (BLC 3 : Snow)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	Y	-2.66

Node Loads and Enforced Displacements (BLC 4 : Seismic Horiz)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	X	1.12

Load Combinations

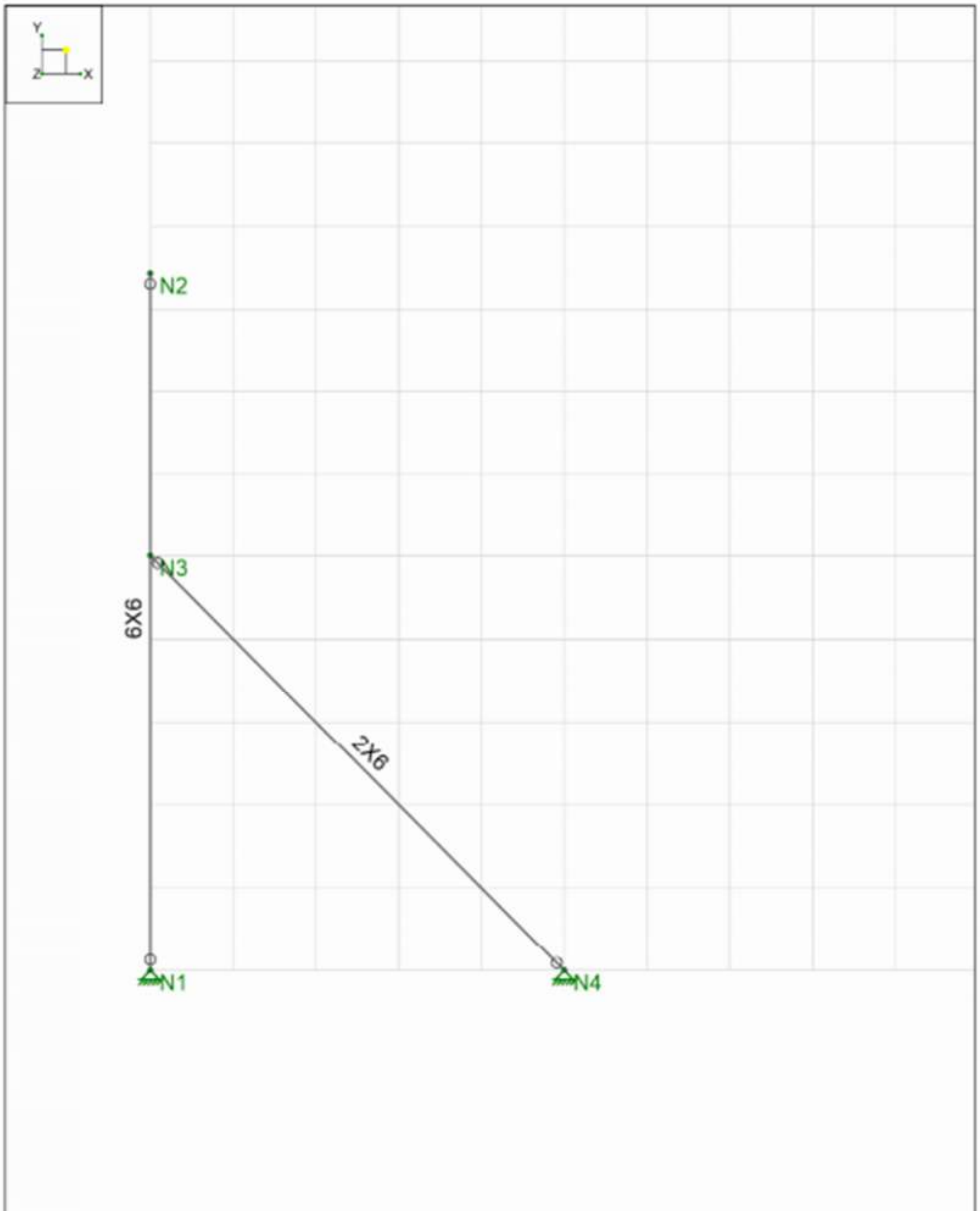
	Description	Solve	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	D	Yes	DL	1	NL	1				
2	D+Lr	Yes	DL	1	RLL	1				
3	D+S	Yes	DL	1	SL	1				
4	D+0.7Ev+0.7Eh	Yes	DL	1	Sds*DL	0.17	EL	0.7		
5	D+0.7Ev-0.7Eh	Yes	DL	1	Sds*DL	0.17	EL	-0.7		
6	D+0.7Ev+(0.7OmEh)	Yes	DL	1	Sds*DL	0.17	Om*EL	0.7		
7	D+0.7Ev-(0.7OmEh)	Yes	DL	1	Sds*DL	0.17	Om*EL	-0.7		
8	D+0.525Ev+0.525Eh+0.1S	Yes	DL	1	Sds*DL	0.13	EL	0.53	SL	0.1
9	D+0.525Ev-0.525Eh+0.1S	Yes	DL	1	Sds*DL	0.13	EL	-0.53	SL	0.1
10	D+0.525Ev+0.525(OmEh)+0.1S	Yes	DL	1	Sds*DL	0.13	Om*EL	0.53	SL	0.1
11	D+0.525Ev-0.525(OmEh)+0.1S	Yes	DL	1	Sds*DL	0.13	Om*EL	-0.53	SL	0.1
12	0.6D-0.7Ev+0.7Eh	Yes	DL	0.6	Sds*DL	-0.17	EL	0.7		
13	0.6D-0.7Ev-0.7Eh	Yes	DL	0.6	Sds*DL	-0.17	EL	-0.7		
14	0.6D-0.7Ev+0.7(OmEh)	Yes	DL	0.6	Sds*DL	-0.17	Om*EL	0.7		
15	0.6D-0.7Ev-0.7(OmEh)	Yes	DL	0.6	Sds*DL	-0.17	Om*EL	-0.7		

Envelope Node Reactions

	Node Label		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
0	N4	max	1.33	13	1.33	12	0	13	0	13	LOCKED		0	13
1		min	-1.33	4	-1.33	5	0	1	0	1	LOCKED		0	1
2	N1	max	0.54	12	3.74	3	0	13	0	13	0	13	0	13
3		min	-0.54	5	-0.9	12	0	1	0	1	0	1	0	1
4	N3	max	NC		NC		NC		LOCKED		NC		NC	
5		min	NC		NC		NC		LOCKED		NC		NC	
6	Totals:	max	0.79	13	3.74	3	0	13						
7		min	-0.79	4	0.43	13	0	1						

Envelope Node Reactions - Overstrength or Capacity Limit

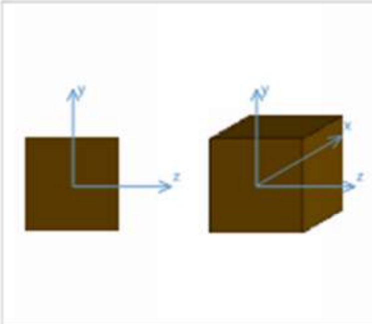
	Node Label		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
0	N4	max	1.99	15*	1.99	6*	0	15*	0	15*	LOCKED		0	15*
1		min	-1.99	14*	-1.99	15*	0	6*	0	6*	LOCKED		0	6*
2	N1	max	0.81	14*	3.29	7*	0	15*	0	15*	0	15*	0	15*
3		min	-0.81	7*	-1.56	14*	0	6*	0	6*	0	6*	0	6*
4	N3	max	NC		NC		NC		LOCKED		NC		NC	
5		min	NC		NC		NC		LOCKED		NC		NC	
6	Totals:	max	1.18	15*	1.51	11*	0	15*						
7		min	-1.18	6*	0.43	15*	0	6*						



RISA	<Licensed Company>	WSF Back Transverse Knee Brace	SK-1
	NickWelling		Jan 09, 2024 at 04:39 PM
	2302-0069		2023_11_28 Back Transver...

Detail Report: M1

Load Combination: Envelope **Code check:** 0.497 (LC 12)



Input Data

Shape:	6X6 (nominal)	**I Node:**	N1
Member Type:	Column	**J Node:**	N2
Length (ft):	4.22	**I Release:**	Fixed
Material Type:	Wood	**J Release:**	Fixed
Design Rule:	Typical	**I Offset:**	N/A
Internal Sections:	97	**J Offset:**	N/A
Design Code:	AWC NDS-18 / SDPWS-15 ASD	**T/C Only:**	Both Way

Material Properties

Material:	HF/L #1	**Grade:**	No.1	**Nu:**	0.3
Type:	Solid Sawn	**Cm:**	Yes	**Alpha ($1e^{5o}F^{-1}$):**	0.3
Database:	Visually Graded	**Ci:**	Yes	**Density (k/ft^3):**	0.04
Species:	Hem-Fir	**Emod:**	1		

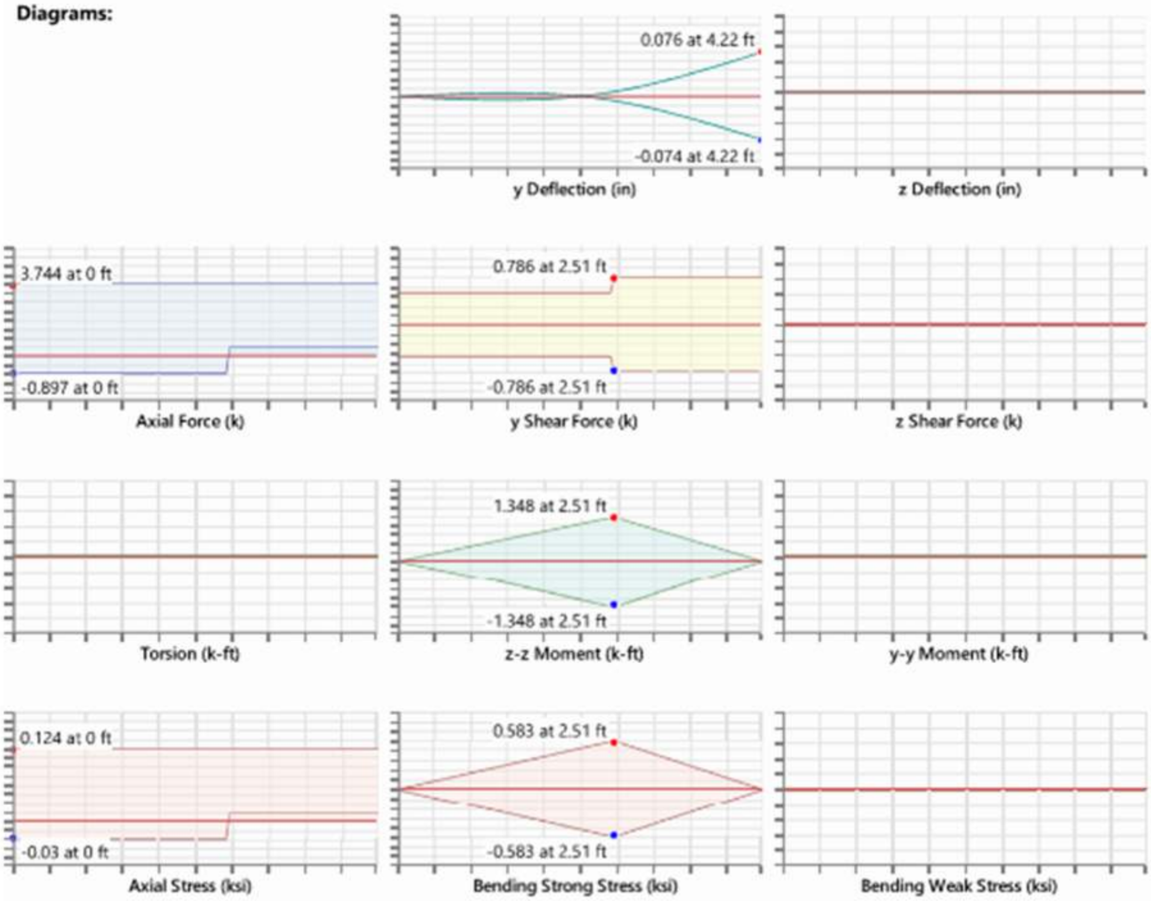
Shape Properties

F_b (ksi):	0.98	**E (ksi):**	1300	**b (actual) (in):**	5.5
F_t (ksi):	0.65	**Emod:**	1	**d (actual) (in):**	5.5
F_v (ksi):	0.14	**COV_E (Table F1):**	0.25		
F_c (ksi):	0.85	**E_{min} (ksi):**	474.9		

Design Properties

le2 (ft):	4.22	**y sway:**	No	**C_{fu}:**	1
le1 (ft):	4.22	**z sway:**	No	**C_P:**	0.93
le-bend top:	Lbyy	**C_D:**	1.6	**Max Defl Ratio:**	L/664
le-bend bot (ft):	4.22	**R_B:**	3.03	**Max Defl Location:**	4.22
K_{y-y}:	1	**C_L:**	1	**Span:**	N/A
K_{z-z}:	1	**C_r:**	1		

Diagrams:

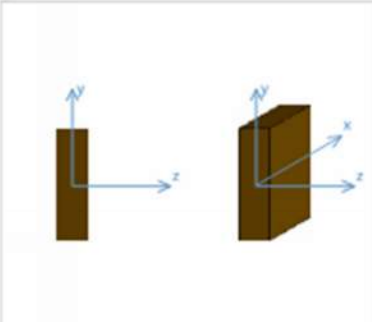


AWC NDS-18 / SDPWS-15 ASD Code Check

Limit State	Gov. LC	Required	Available	Unity Check	Result
Applied Loading - Bending/Axial	12	-	-	-	-
Applied Loading - Shear + Torsion	12	-	-	-	-
Axial Compression Analysis	-	0 ksi	0.92 ksi	-	-
Axial Tension Analysis	-	-0.03 ksi	0.83 ksi	-	-
Flexural Analysis, Fb1'	-	0.58 ksi	1.25 ksi	-	-
Flexural Analysis, Fb2'	-	0 ksi	1.25 ksi	-	-
Bending & Axial Compression Analysis	-	-	-	0.46	PASS
Bending & Axial Tension Analysis	-	-	-	0.5	PASS
Shear Analysis	-	0.04 ksi	0.18 ksi	0.22	PASS

Detail Report: M2

Load Combination: Envelope **Code check:** 0.360 (LC 12)



Input Data

Shape:	2X6 (nominal)	**I Node:**	N3
Member Type:	Column	**J Node:**	N4
Length (ft):	3.54	**I Release:**	BenPIN
Material Type:	Wood	**J Release:**	Fixed
Design Rule:	Typical	**I Offset:**	N/A
Internal Sections:	97	**J Offset:**	N/A
Design Code:	AWC NDS-18 / SDPWS-15 ASD	**T/C Only:**	Both Way

Material Properties

Material:	HF/L #2	**Grade:**	No.2	**Nu:**	0.3
Type:	Solid Sawn	**Cm:**	Yes	**Alpha ($1e^{5}$°F^{-1}):**	0.3
Database:	Visually Graded	**Ci:**	Yes	**Density (k/ft^3):**	0.04
Species:	Hem-Fir	**Emod:**	1		

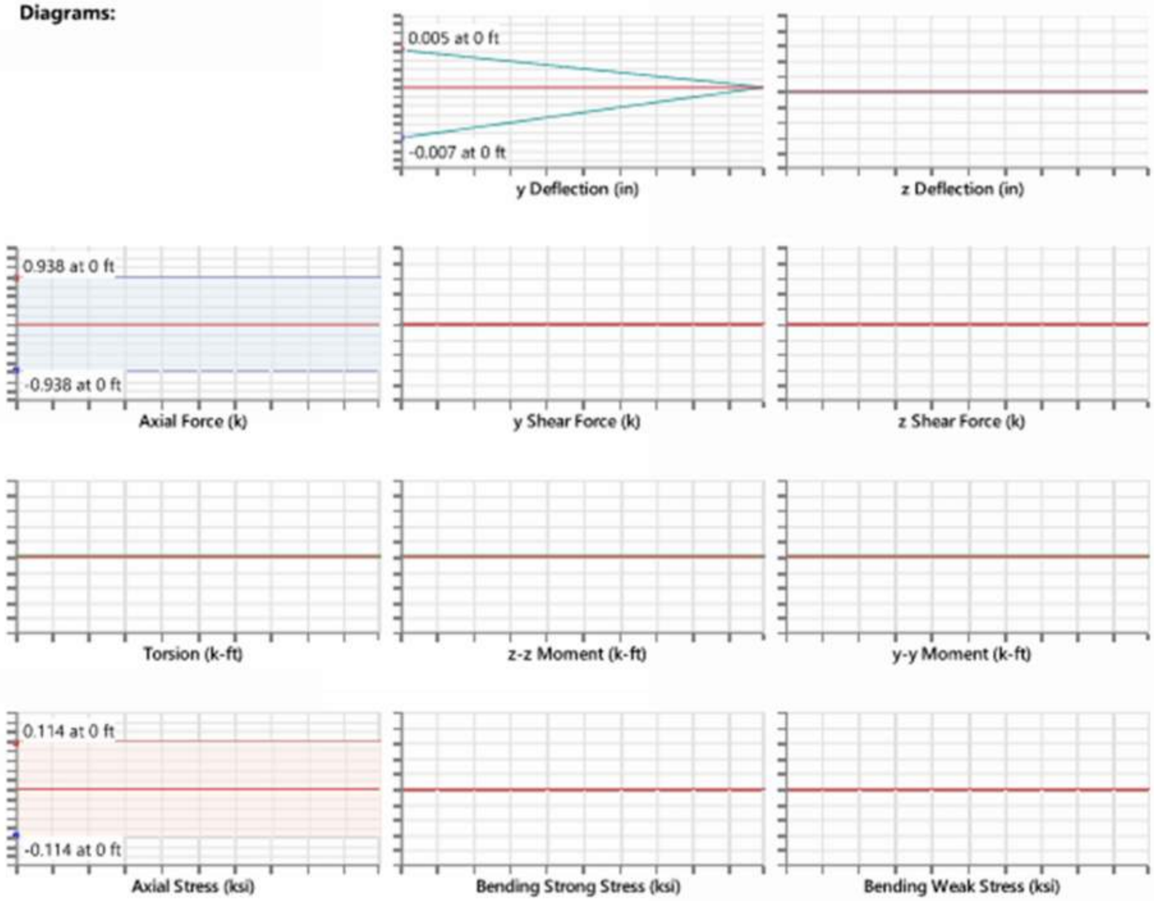
Shape Properties

F_b (ksi):	0.85	**E (ksi):**	1300	**b (actual) (in):**	1.5
F_t (ksi):	0.52	**Emod:**	1	**d (actual) (in):**	5.5
F_v (ksi):	0.15	**COV_E (Table F1):**	0.25		
F_c (ksi):	1.3	**E_{min} (ksi):**	474.9		

Design Properties

le2 (ft):	3.54	**y sway:**	No	**C_{fu}:**	1
le1 (ft):	3.54	**z sway:**	No	**C_P:**	0.22
le-bend top:	Lbyy	**C_D:**	1.6	**Max Defl Ratio:**	L/10000
le-bend bot (ft):	3.54	**R_B:**	10.18	**Max Defl Location:**	0
K_{y-y}:	1	**C_L:**	0.97	**Span:**	N/A
K_{z-z}:	1	**C_r:**	1		

Diagrams:

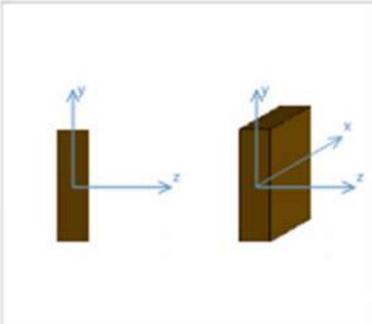


AWC NDS-18 / SDPWS-15 ASD Code Check

Limit State	Gov. LC	Required	Available	Unity Check	Result
Applied Loading - Bending/Axial	12	-	-	-	-
Applied Loading - Shear + Torsion	4	-	-	-	-
Axial Compression Analysis	-	0.11 ksi	0.32 ksi	-	-
Axial Tension Analysis	-	0 ksi	0.87 ksi	-	-
Flexural Analysis, Fb1'	-	0 ksi	1.37 ksi	-	-
Flexural Analysis, Fb2'	-	0 ksi	1.41 ksi	-	-
Bending & Axial Compression Analysis	-	-	-	**0.36**	**PASS**
Bending & Axial Tension Analysis	-	-	-	**0**	**PASS**
Shear Analysis	-	0 ksi	0.19 ksi	**0**	**PASS**

Detail Report: M3

Load Combination: Envelope **Code check:** 0.360 (LC 12)



Input Data

Shape:	2X6 (nominal)	**I Node:**	N3
Member Type:	Column	**J Node:**	N4
Length (ft):	3.54	**I Release:**	BenPIN
Material Type:	Wood	**J Release:**	Fixed
Design Rule:	Typical	**I Offset:**	N/A
Internal Sections:	97	**J Offset:**	N/A
Design Code:	AWC NDS-18 / SDPWS-15 ASD	**T/C Only:**	Both Way

Material Properties

Material:	HF/L #2	**Grade:**	No.2	**Nu:**	0.3
Type:	Solid Sawn	**Cm:**	Yes	**Alpha ($1e^{5o}F^{-1}$):**	0.3
Database:	Visually Graded	**Ci:**	Yes	**Density (k/ft^3):**	0.04
Species:	Hem-Fir	**Emod:**	1		

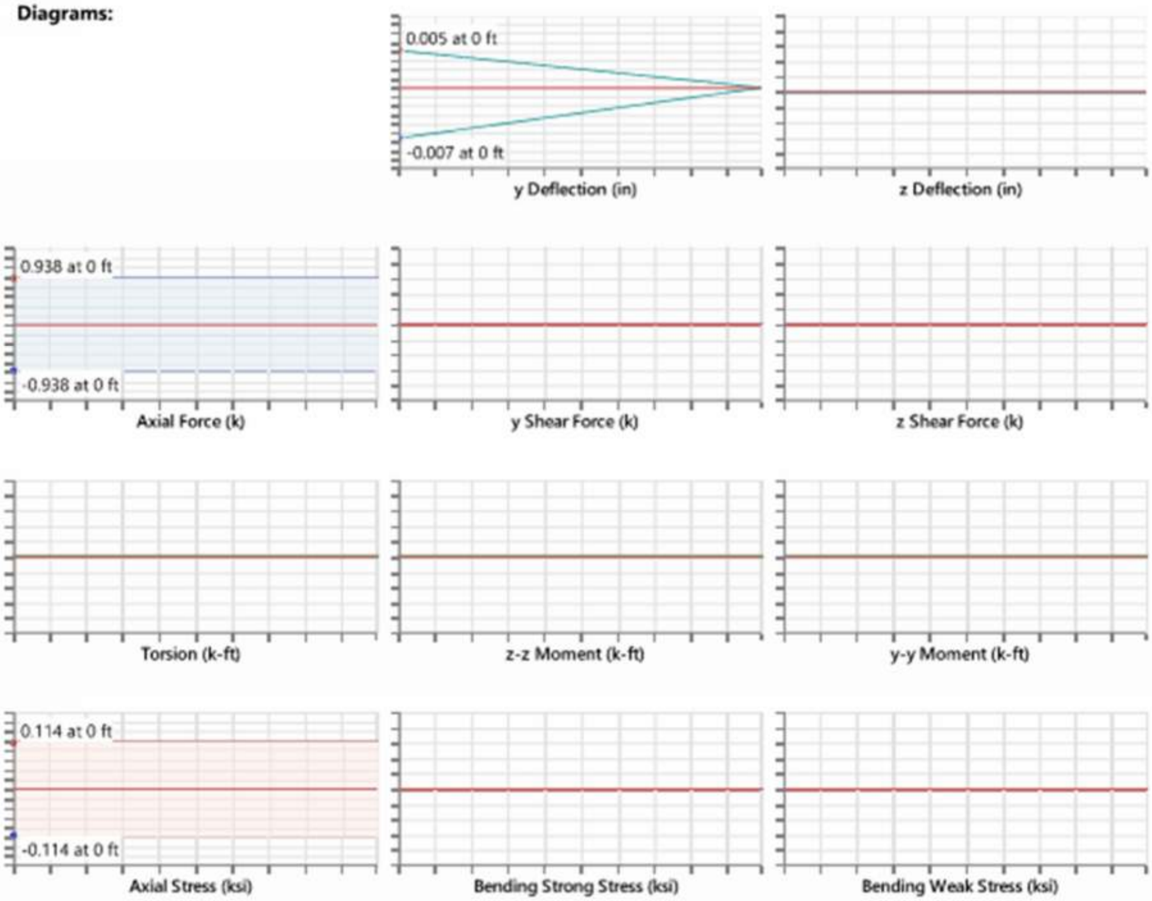
Shape Properties

F_b (ksi):	0.85	**E (ksi):**	1300	**b (actual) (in):**	1.5
F_t (ksi):	0.52	**Emod:**	1	**d (actual) (in):**	5.5
F_v (ksi):	0.15	**COV_E (Table F1):**	0.25		
F_c (ksi):	1.3	**E_{min} (ksi):**	474.9		

Design Properties

le2 (ft):	3.54	**y sway:**	No	**C_{fu}:**	1
le1 (ft):	3.54	**z sway:**	No	**C_P:**	0.22
le-bend top:	Lbyy	**C_D:**	1.6	**Max Defl Ratio:**	L/10000
le-bend bot (ft):	3.54	**R_B:**	10.18	**Max Defl Location:**	0
K_{y-y}:	1	**C_L:**	0.97	**Span:**	N/A
K_{z-z}:	1	**C_r:**	1		

Diagrams:



AWC NDS-18 / SDPWS-15 ASD Code Check

Limit State	Gov. LC	Required	Available	Unity Check	Result
Applied Loading - Bending/Axial	12	-	-	-	-
Applied Loading - Shear + Torsion	4	-	-	-	-
Axial Compression Analysis	-	0.11 ksi	0.32 ksi	-	-
Axial Tension Analysis	-	0 ksi	0.87 ksi	-	-
Flexural Analysis, Fb1'	-	0 ksi	1.37 ksi	-	-
Flexural Analysis, Fb2'	-	0 ksi	1.41 ksi	-	-
Bending & Axial Compression Analysis	-	-	-	**0.36**	**PASS**
Bending & Axial Tension Analysis	-	-	-	**0**	**PASS**
Shear Analysis	-	0 ksi	0.19 ksi	**0**	**PASS**

Front Post and Transverse Brace

Node Coordinates

	Label	X [ft]	Y [ft]	Z [ft]	Detach From Diaphragm
1	N1	0	0	0	
2	N2	0	6	0	
3	N3	0	3.5	0	
4	N4	3.5	0	0	

Wood Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	Post	6X6	Column	Rectangular	HF/L #1	Typical	30.25	76.26	76.26	128.87
2	Brace	6X6	Column	Rectangular	HF/L #2	Typical	30.25	76.26	76.26	128.87
3	Brace Alt	2X6	Column	Rectangular	HF/L #2	Typical	8.25	1.55	20.8	5.12

Member Primary Data

	Label	I Node	J Node	Section/Shape	Type	Design List	Material	Design Rule
1	M1	N1	N2	Post	Column	Rectangular	HF/L #1	Typical
2	M2	N3	N4	Brace Alt	Column	Rectangular	HF/L #2	Typical
3	M3	N3	N4	Brace Alt	Column	Rectangular	HF/L #2	Typical

Node Loads and Enforced Displacements (BLC 1 : Dead)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	Y	-1.08

Node Loads and Enforced Displacements (BLC 2 : Live Roof)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	Y	-1.8

Node Loads and Enforced Displacements (BLC 3 : Snow)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	Y	-2.66

Node Loads and Enforced Displacements (BLC 4 : Seismic Horiz)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	X	1.12

Load Combinations

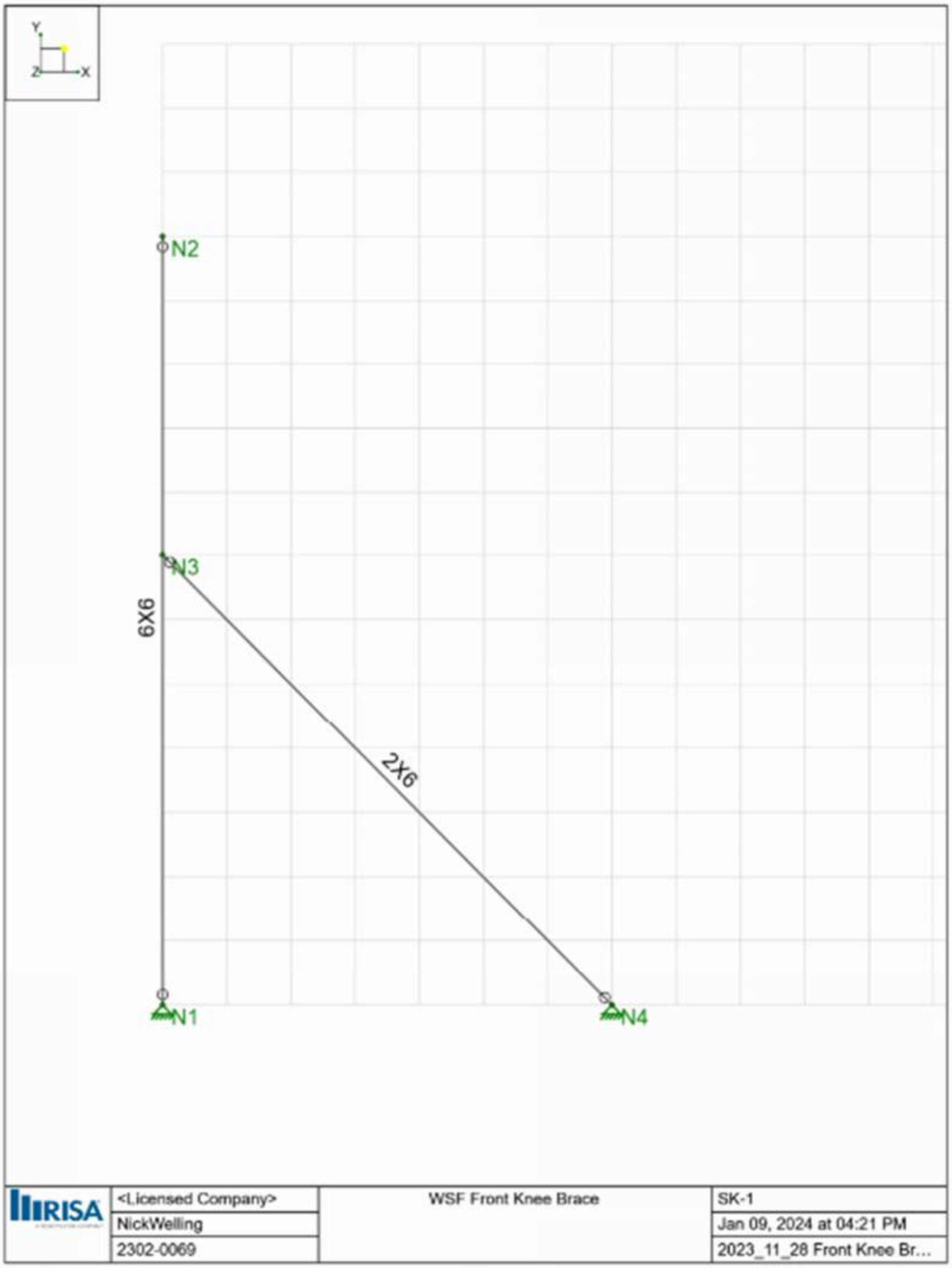
	Description	Solve	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	D	Yes	DL	1	NL	1				
2	D+Lr	Yes	DL	1	RLL	1				
3	D+S	Yes	DL	1	SL	1				
4	D+0.7Ev+0.7Eh	Yes	DL	1	Sds*DL	0.17	EL	0.7		
5	D+0.7Ev-0.7Eh	Yes	DL	1	Sds*DL	0.17	EL	-0.7		
6	D+0.7Ev+(0.7OmEh)	Yes	DL	1	Sds*DL	0.17	Om*EL	0.7		
7	D+0.7Ev-(0.7OmEh)	Yes	DL	1	Sds*DL	0.17	Om*EL	-0.7		
8	D+0.525Ev+0.525Eh+0.1S	Yes	DL	1	Sds*DL	0.13	EL	0.53	SL	0.1
9	D+0.525Ev-0.525Eh+0.1S	Yes	DL	1	Sds*DL	0.13	EL	-0.53	SL	0.1
10	D+0.525Ev+0.525(OmEh)+0.1S	Yes	DL	1	Sds*DL	0.13	Om*EL	0.53	SL	0.1
11	D+0.525Ev-0.525(OmEh)+0.1S	Yes	DL	1	Sds*DL	0.13	Om*EL	-0.53	SL	0.1
12	0.6D-0.7Ev+0.7Eh	Yes	DL	0.6	Sds*DL	-0.17	EL	0.7		
13	0.6D-0.7Ev-0.7Eh	Yes	DL	0.6	Sds*DL	-0.17	EL	-0.7		
14	0.6D-0.7Ev+0.7(OmEh)	Yes	DL	0.6	Sds*DL	-0.17	Om*EL	0.7		
15	0.6D-0.7Ev-0.7(OmEh)	Yes	DL	0.6	Sds*DL	-0.17	Om*EL	-0.7		

Envelope Node Reactions

	Node Label		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
0	N4	max	1.35	13	1.35	12	0	13	0	13	LOCKED		0	13
1		min	-1.35	4	-1.35	13	0	1	0	1	LOCKED		0	1
2	N1	max	0.56	12	3.74	3	0	13	0	13	0	13	0	13
3		min	-0.56	13	-0.92	12	0	1	0	1	0	1	0	1
4	N3	max	NC		NC		NC		LOCKED		NC		NC	
5		min	NC		NC		NC		LOCKED		NC		NC	
6	Totals:	max	0.79	5	3.74	3	0	13						
7		min	-0.79	4	0.43	12	0	1						

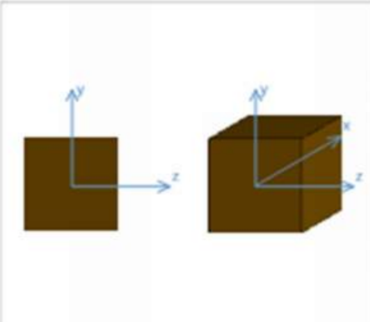
Envelope Node Reactions - Overstrength or Capacity Limit

	Node Label		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
0	N4	max	2.02	7*	2.02	14*	0	15*	0	15*	LOCKED		0	15*
1		min	-2.02	14*	-2.02	7*	0	6*	0	6*	LOCKED		0	6*
2	N1	max	0.84	6*	3.32	7*	0	15*	0	15*	0	15*	0	15*
3		min	-0.84	7*	-1.59	14*	0	6*	0	6*	0	6*	0	6*
4	N3	max	NC		NC		NC		LOCKED		NC		NC	
5		min	NC		NC		NC		LOCKED		NC		NC	
6	Totals:	max	1.18	7*	1.51	11*	0	15*						
7		min	-1.18	14*	0.43	14*	0	6*						



Detail Report: M1

Load Combination: Envelope **Code check:** 0.718 (LC 12)



Input Data

Shape:	6X6 (nominal)	**I Node:**	N1
Member Type:	Column	**J Node:**	N2
Length (ft):	6	**I Release:**	Fixed
Material Type:	Wood	**J Release:**	Fixed
Design Rule:	Typical	**I Offset:**	N/A
Internal Sections:	97	**J Offset:**	N/A
Design Code:	AWC NDS-18 / SDPWS-15 ASD	**T/C Only:**	Both Way

Material Properties

Material:	HF/L #1	**Grade:**	No.1	**Nu:**	0.3
Type:	Solid Sawn	**Cm:**	Yes	**Alpha ($1e^{5o}F^{-1}$):**	0.3
Database:	Visually Graded	**Ci:**	Yes	**Density (k/ft^3):**	0.04
Species:	Hem-Fir	**Emod:**	1		

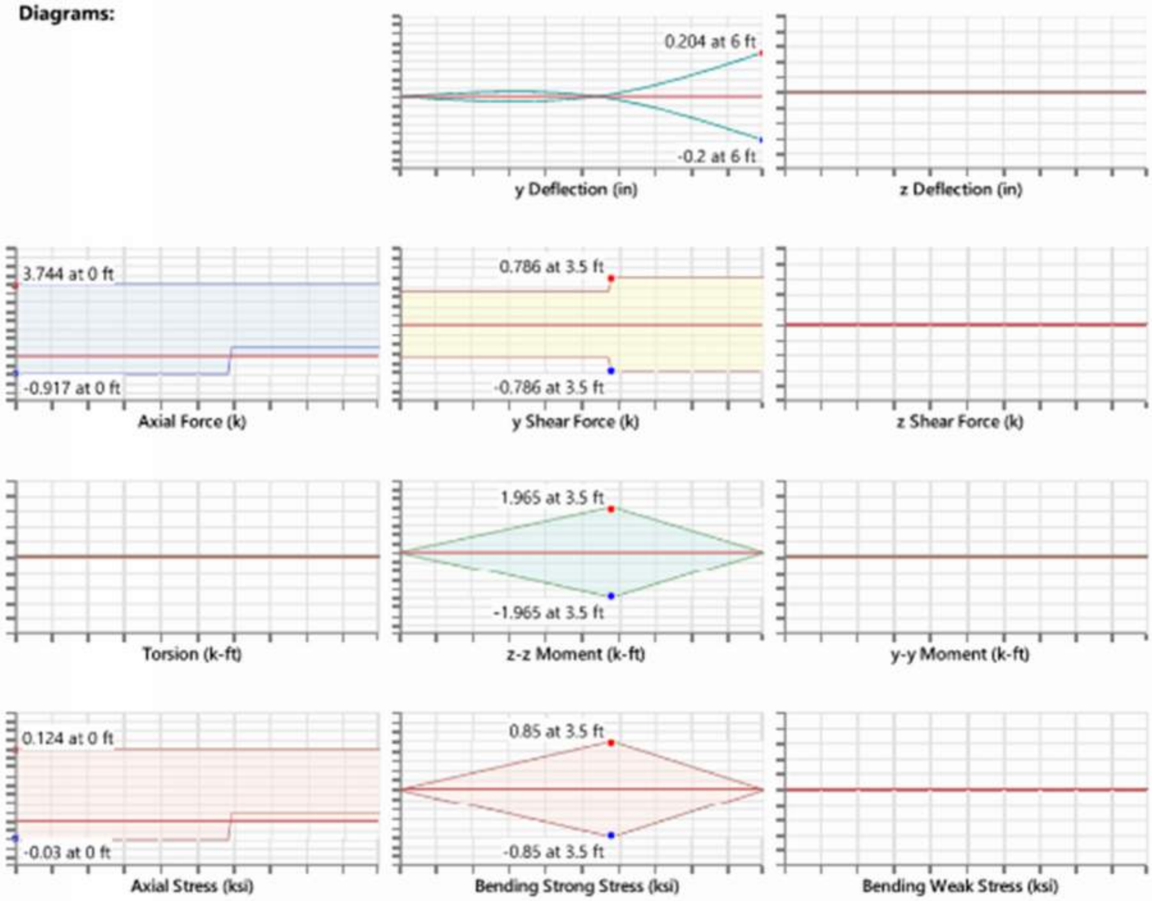
Shape Properties

F_b (ksi):	0.98	**E (ksi):**	1300	**b (actual) (in):**	5.5
F_t (ksi):	0.65	**Emod:**	1	**d (actual) (in):**	5.5
F_v (ksi):	0.14	**COV_E (Table F1):**	0.25		
F_c (ksi):	0.85	**E_{min} (ksi):**	474.9		

Design Properties

le2 (ft):	6	**y sway:**	No	**C_{fu}:**	1
le1 (ft):	3.5	**z sway:**	No	**C_P:**	0.84
le-bend top:	Lbyy	**C_D:**	1.6	**Max Defl Ratio:**	L/353
le-bend bot (ft):	6	**R_B:**	3.62	**Max Defl Location:**	6
K_{y-y}:	1	**C_L:**	1	**Span:**	N/A
K_{z-z}:	1	**C_r:**	1		

Diagrams:

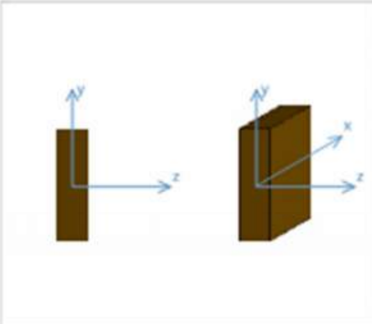


AWC NDS-18 / SDPWS-15 ASD Code Check

Limit State	Gov. LC	Required	Available	Unity Check	Result
Applied Loading - Bending/Axial	12	-	-	-	-
Applied Loading - Shear + Torsion	5	-	-	-	-
Axial Compression Analysis	-	0 ksi	0.83 ksi	-	-
Axial Tension Analysis	-	-0.03 ksi	0.83 ksi	-	-
Flexural Analysis, Fb1'	-	0.85 ksi	1.25 ksi	-	-
Flexural Analysis, Fb2'	-	0 ksi	1.25 ksi	-	-
Bending & Axial Compression Analysis	-	-	-	**0.68**	**PASS**
Bending & Axial Tension Analysis	-	-	-	**0.72**	**PASS**
Shear Analysis	-	0.04 ksi	0.18 ksi	**0.22**	**PASS**

Detail Report: M2

Load Combination: Envelope **Code check:** 0.696 (LC 12)



Input Data

Shape:	2X6 (nominal)	**I Node:**	N3
Member Type:	Column	**J Node:**	N4
Length (ft):	4.95	**I Release:**	BenPIN
Material Type:	Wood	**J Release:**	Fixed
Design Rule:	Typical	**I Offset:**	N/A
Internal Sections:	97	**J Offset:**	N/A
Design Code:	AWC NDS-18 / SDPWS-15 ASD	**T/C Only:**	Both Way

Material Properties

Material:	HF/L #2	**Grade:**	No.2	**Nu:**	0.3
Type:	Solid Sawn	**Cm:**	Yes	**Alpha ($1e^{5}$ °F^{-1}):**	0.3
Database:	Visually Graded	**Ci:**	Yes	**Density (k/ft^3):**	0.04
Species:	Hem-Fir	**Emod:**	1		

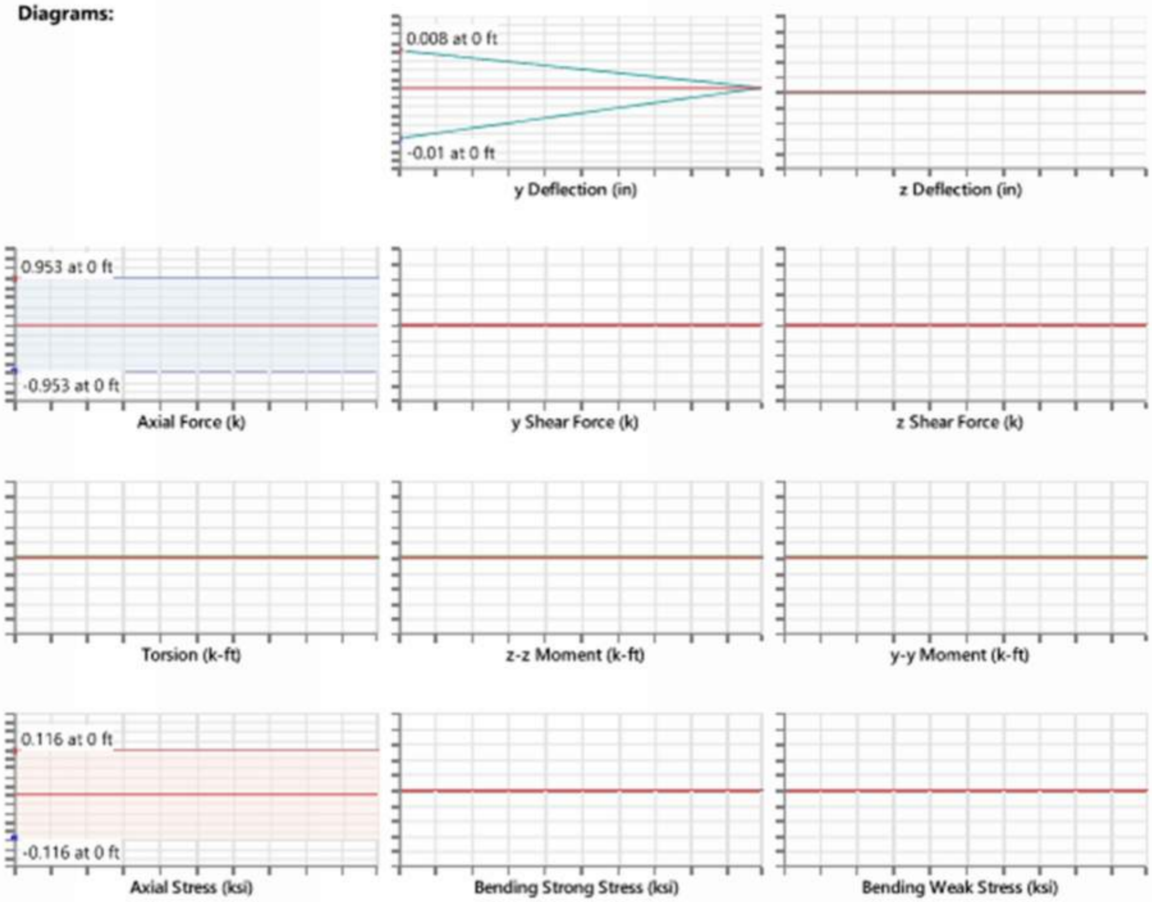
Shape Properties

F_b (ksi):	0.85	**E (ksi):**	1300	**b (actual) (in):**	1.5
F_t (ksi):	0.52	**Emod:**	1	**d (actual) (in):**	5.5
F_v (ksi):	0.15	**COV_E (Table F1):**	0.25		
F_c (ksi):	1.3	**E_{min} (ksi):**	474.9		

Design Properties

le2 (ft):	4.95	**y sway:**	No	**C_{fu}:**	1
le1 (ft):	4.95	**z sway:**	No	**C_P:**	0.11
le-bend top:	Lbyy	**C_D:**	1.6	**Max Defl Ratio:**	L/10000
le-bend bot (ft):	4.95	**R_B:**	12.05	**Max Defl Location:**	0
K_{y-y}:	1	**C_L:**	0.95	**Span:**	N/A
K_{z-z}:	1	**C_r:**	1		

Diagrams:

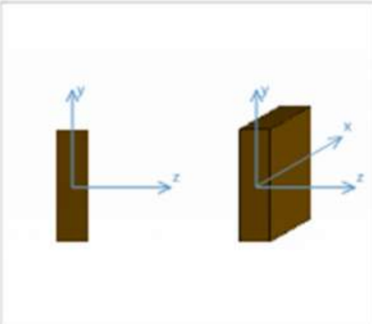


AWC NDS-18 / SDPWS-15 ASD Code Check

Limit State	Gov. LC	Required	Available	Unity Check	Result
Applied Loading - Bending/Axial	12	-	-	-	-
Applied Loading - Shear + Torsion	13	-	-	-	-
Axial Compression Analysis	-	0.12 ksi	0.17 ksi	-	-
Axial Tension Analysis	-	0 ksi	0.87 ksi	-	-
Flexural Analysis, Fb1'	-	0 ksi	1.35 ksi	-	-
Flexural Analysis, Fb2'	-	0 ksi	1.41 ksi	-	-
Bending & Axial Compression Analysis	-	-	-	0.7	PASS
Bending & Axial Tension Analysis	-	-	-	0	PASS
Shear Analysis	-	0 ksi	0.19 ksi	0	PASS

Detail Report: M3

Load Combination: Envelope **Code check:** 0.696 (LC 12)



Input Data

Shape:	2X6 (nominal)	**I Node:**	N3
Member Type:	Column	**J Node:**	N4
Length (ft):	4.95	**I Release:**	BenPIN
Material Type:	Wood	**J Release:**	Fixed
Design Rule:	Typical	**I Offset:**	N/A
Internal Sections:	97	**J Offset:**	N/A
Design Code:	AWC NDS-18 / SDPWS-15 ASD	**T/C Only:**	Both Way

Material Properties

Material:	HF/L #2	**Grade:**	No.2	**Nu:**	0.3
Type:	Solid Sawn	**Cm:**	Yes	**Alpha ($1e^{5}$ °F^{-1}):**	0.3
Database:	Visually Graded	**Ci:**	Yes	**Density (k/ft^3):**	0.04
Species:	Hem-Fir	**Emod:**	1		

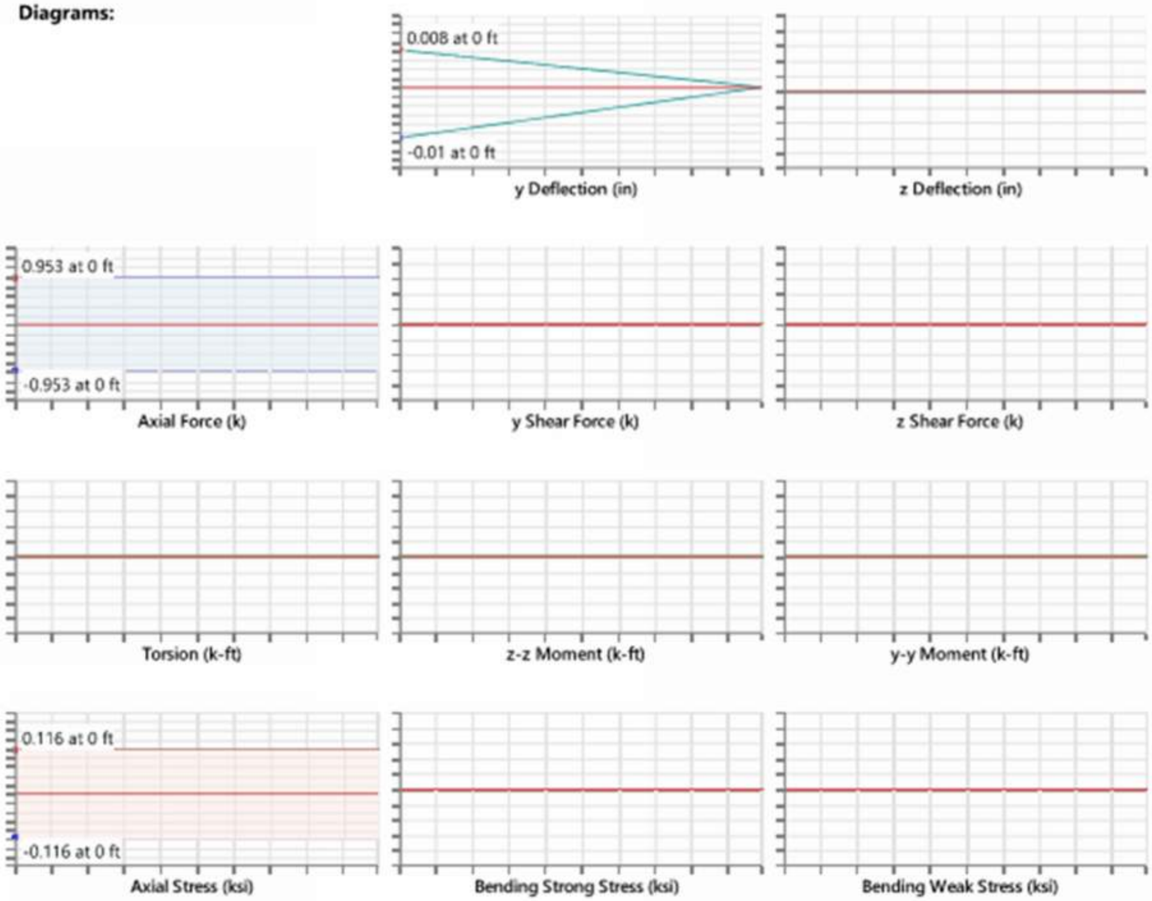
Shape Properties

F_b (ksi):	0.85	**E (ksi):**	1300	**b (actual) (in):**	1.5
F_t (ksi):	0.52	**Emod:**	1	**d (actual) (in):**	5.5
F_v (ksi):	0.15	**COV_E (Table F1):**	0.25		
F_c (ksi):	1.3	**E_{min} (ksi):**	474.9		

Design Properties

le2 (ft):	4.95	**y sway:**	No	**C_{fu}:**	1
le1 (ft):	4.95	**z sway:**	No	**C_P:**	0.11
le-bend top:	Lbyy	**C_D:**	1.6	**Max Defl Ratio:**	L/10000
le-bend bot (ft):	4.95	**R_B:**	12.05	**Max Defl Location:**	0
K_{y-y}:	1	**C_L:**	0.95	**Span:**	N/A
K_{z-z}:	1	**C_r:**	1		

Diagrams:



AWC NDS-18 / SDPWS-15 ASD Code Check

Limit State	Gov. LC	Required	Available	Unity Check	Result
Applied Loading - Bending/Axial	12	-	-	-	-
Applied Loading - Shear + Torsion	13	-	-	-	-
Axial Compression Analysis	-	0.12 ksi	0.17 ksi	-	-
Axial Tension Analysis	-	0 ksi	0.87 ksi	-	-
Flexural Analysis, Fb1'	-	0 ksi	1.35 ksi	-	-
Flexural Analysis, Fb2'	-	0 ksi	1.41 ksi	-	-
Bending & Axial Compression Analysis	-	-	-	**0.7**	PASS
Bending & Axial Tension Analysis	-	-	-	**0**	PASS
Shear Analysis	-	0 ksi	0.19 ksi	**0**	PASS

Wood Beam

Project File: Sill Plate.ec6

LIC# : KW-06014167, Build:20.23.08.01 PETERSON STRUCTURAL ENGINEERS (c) ENERCALC INC 1983-2023

DESCRIPTION: Sill Plate Weak Axis Bending

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.967	0.963
Max Upward from Load Cases	0.967	0.963
E Only * 0.70	0.677	0.674
E Only * 0.5250	0.507	0.506
E Only	0.967	0.963

Wood Beam

Project File: Sill Plate.ec6

LIC# : KW-06014167, Build:20.23.08.01 PETERSON STRUCTURAL ENGINEERS (c) ENERCALC INC 1983-2023

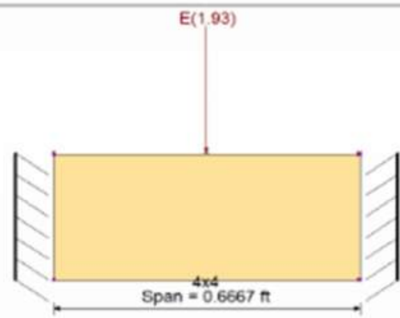
DESCRIPTION: Sill Plate Weak Axis Bending

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	850.0 psi	*E : Modulus of Elasticity*	
Load Combination :	IBC 2021	Fb -	850.0 psi	Ebend- xx	1,300.0 ksi
		Fc - Prll	1,300.0 psi	Eminbend - xx	470.0 ksi
Wood Species :	Hem-Fir	Fc - Perp	405.0 psi		
Wood Grade :	No.2	Fv	150.0 psi		
		Ft	525.0 psi	Density	26.840 pcf
Beam Bracing :	Completely Unbraced				



Applied Loads

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

Beam self weight NOT internally calculated and added
Point Load : E = 1.930 k @ 0.3330 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.116 : 1	Maximum Shear Stress Ratio	=	0.431 : 1
Section used for this span		**4x4**	Section used for this span		**4x4**
fb: Actual	=	189.27 psi	fv: Actual	=	82.84 psi
F'b	=	1,632.00 psi	F'v	=	192.00 psi
Load Combination		E Only * 0.70	Load Combination		E Only * 0.70
Location of maximum on span	=	0.000 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0 in	Ratio =	0 <120	n/a
Max Upward Transient Deflection	0 in	Ratio =	0 <120	n/a
Max Downward Total Deflection	0.000 in	Ratio =	34291 >=120	Span: 1 : E Only * 0.70
Max Upward Total Deflection	0 in	Ratio =	0 <120	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios										Moment Values			Shear Values		
Segment Length	Span #	M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	M	fb	F'b	V	fv	F'v
														0.0	0.00	0.0	0.0
Length = 0.6667 ft	1			0.90	1.00	1.00	1.00	1.500	1.00	0.80	1.00			918.0	0.00	0.0	108.0
E Only * 0.70					1.00	1.00	1.00	1.500	1.00	0.80	1.00			0.0	0.00	0.0	0.0
Length = 0.6667 ft	1	0.116	0.431	1.60	1.00	1.00	1.00	1.500	1.00	0.80	1.00	0.11	189.3	1,632.0	0.68	82.8	192.0
E Only * 0.5250					1.00	1.00	1.00	1.500	1.00	0.80	1.00			0.0	0.00	0.0	0.0
Length = 0.6667 ft	1	0.087	0.324	1.60	1.00	1.00	1.00	1.500	1.00	0.80	1.00	0.08	142.0	1,632.0	0.51	62.1	192.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
E Only	1	0.0003	0.333		0.0000	0.000

Cantilevered Retaining Wall

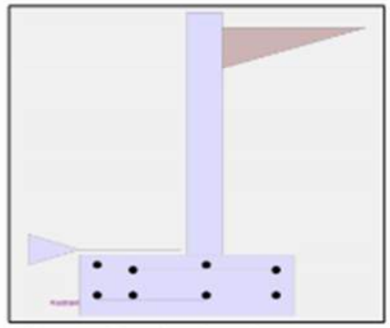
Project File: Cantilevered Wall.ec6

LIC# : KW-06014167, Build:20.23.08.01 PETERSON STRUCTURAL ENGINEERS (c) ENERCALC INC 1983-2023

DESCRIPTION: Retaining Wall - Case 1 UPDATE (Wall Design): Backfill+Surcharge with Empty Tank

Code Reference:

Calculations per IBC 2021 1807.3, ASCE 7-16



Criteria

Retained Height	=	3.75 ft
Wall height above soil	=	0.25 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	0.00 in
Water table above bottom of footing	=	0.0 ft

Soil Data

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	45.0 psf/ft
	=	
Passive Pressure	=	200.0 psf/ft
Soil Density, Heel	=	125.00 pcf
Soil Density, Toe	=	125.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in

Surcharge Loads

Surcharge Over Heel	=	250.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT Used for Sliding & Overturning		

Axial Load Applied to Stem

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

DESCRIPTION: Retaining Wall - Case 1 UPDATE (Wall Design): Backfill+Surcharge with Empty Tank

Design Summary

Wall Stability Ratios

Overturning	=	1.65	OK
Slab Resists All Sliding !			
Global Stability	=	1.65	
Total Bearing Load	=	1,469 lbs	
...resultant ecc.	=	8.38 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	1,221 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	1,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,710 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	9.7 psi	OK
Footing Shear @ Heel	=	10.6 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	935.2 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

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

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	6.00		
Rebar Size	=	# 5		
Rebar Spacing	=	16.00		
Rebar Placed at	=	3.3 in		
Design Data				
fb/FB + fa/Fa	=	**0.519**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	1,046.3		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	1,645.3		
Moment.....Allowable	=	3,165.6		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	26.4		
Shear.....Allowable	psi =	54.1		
Anet (Masonry)	in2 =			
Wall Weight	psf =	75.0		
Rebar Depth 'd'	in =	3.30		
Masonry Data				
f'm	psi =			
Fs	psi =			
Solid Grouting	=			
Modular Ratio 'n'	=			
Equiv. Solid Thick.	=			
Masonry Block Type	=			
Masonry Design Method	=	ASD		
Concrete Data				
f'c	psi =	2,500.0		
Fy	psi =	60,000.0		

DESCRIPTION: Retaining Wall - Case 1 UPDATE (Wall Design): Backfill+Surcharge with Empty Tank

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1226 in2/ft		
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.1296 in2/ft	#4@ 18.52 in	#4@ 37.04 in
Provided Area :	0.2325 in2/ft	#5@ 28.70 in	#5@ 57.41 in
Maximum Area :	0.447 in2/ft	#6@ 40.74 in	#6@ 81.48 in

Footing Data

Toe Width	=	1.50 ft
Heel Width	=	1.50
Total Footing Width	=	3.00
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f'c = 2,500 psi	Fy =	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top 3.00	@ Btm.=	3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	1,710	0 psf	
Mu' : Upward	=	1,523	8 ft-#	
Mu' : Downward	=	203	571 ft-#	
Mu: Design	=	1,321 OK	563 ft-#	OK
phiMn	=	11,610	11,610 ft-#	
Actual 1-Way Shear	=	9.69	10.63 psi	
Allow 1-Way Shear	=	75.00	75.00 psi	
Toe Reinforcing	=	# 5 @ 12.00 in		
Heel Reinforcing	=	# 5 @ 12.00 in		
Key Reinforcing	=	None Spec'd		
Footing Torsion, Tu	=		0.00 ft-lbs	
Footing Allow. Torsion, phi Tu	=		0.00 ft-lbs	

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Heel: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Key: No key defined

Min footing T&S reinf Area	0.78	in2
Min footing T&S reinf Area per foot	0.26	in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 9.26 in	#4@ 18.52 in
#5@ 14.35 in	#5@ 28.70 in
#6@ 20.37 in	#6@ 40.74 in

Cantilevered Retaining Wall

Project File: Cantilevered Wall.ec6

LIC# : KW-06014167, Build:20.23.08.01 PETERSON STRUCTURAL ENGINEERS (c) ENERCALC INC 1983-2023

DESCRIPTION: Retaining Wall - Case 1 UPDATE (Wall Design): Backfill+Surcharge with Empty Tank

Summary of Overturning & Resisting Forces & Moments

.....OVERTURNING.....

Item		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		507.7	1.58	803.8
HL Act Pres (be water tbl)				
Hydrostatic Force				
Buoyant Force	=			
Surcharge over Heel	=	427.5	2.38	1,015.3
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=			
Load @ Stem Above Soil	=			
	=			
Total	=	935.2	**O.T.M.** =	1,819.1

Resisting/Overturning Ratio = **1.65**

Vertical Loads used for Soil Pressure = 1,468.8 lbs

.....RESISTING.....

		Force lbs	Distance ft	Moment ft-#
Soil Over HL (ab. water tbl)		468.8	2.50	1,171.9
Soil Over HL (bel. water tbl)			2.50	1,171.9
Water Table				
Sloped Soil Over Heel	=			
Surcharge Over Heel	=	250.0	2.50	625.0
Adjacent Footing Load	=			
Axial Dead Load on Stem	=			
* Axial Live Load on Stem	=			
Soil Over Toe	=			
Surcharge Over Toe	=			
Stem Weight(s)	=	300.0	1.75	525.0
Earth @ Stem Transitions	=			
Footing Weight	=	450.0	1.50	675.0
Key Weight	=			
Vert. Component	=			
Total =		1,468.8 lbs	**R.M.=**	2,996.9

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 100.0 pci

Horizontal Defl @ Top of Wall (approximate only) 0.113 in

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

Cantilevered Retaining Wall

Project File: Cantilevered Wall.ec6

LIC# : KW-06014167, Build:20.23.08.01 PETERSON STRUCTURAL ENGINEERS (c) ENERCALC INC 1983-2023

DESCRIPTION: Retaining Wall - Case 1 UPDATE (Wall Design): Backfill+Surcharge with Empty Tank

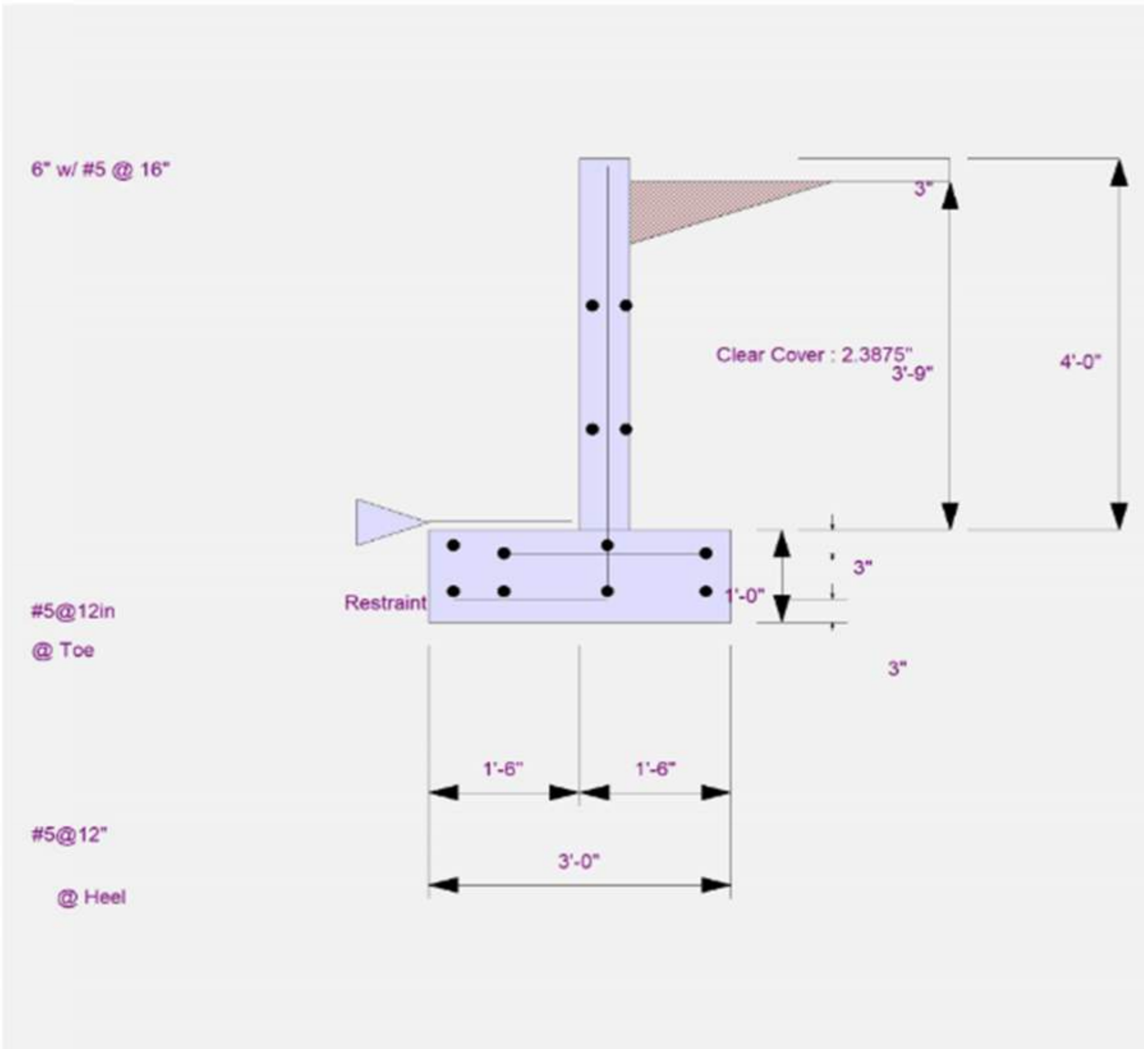
Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

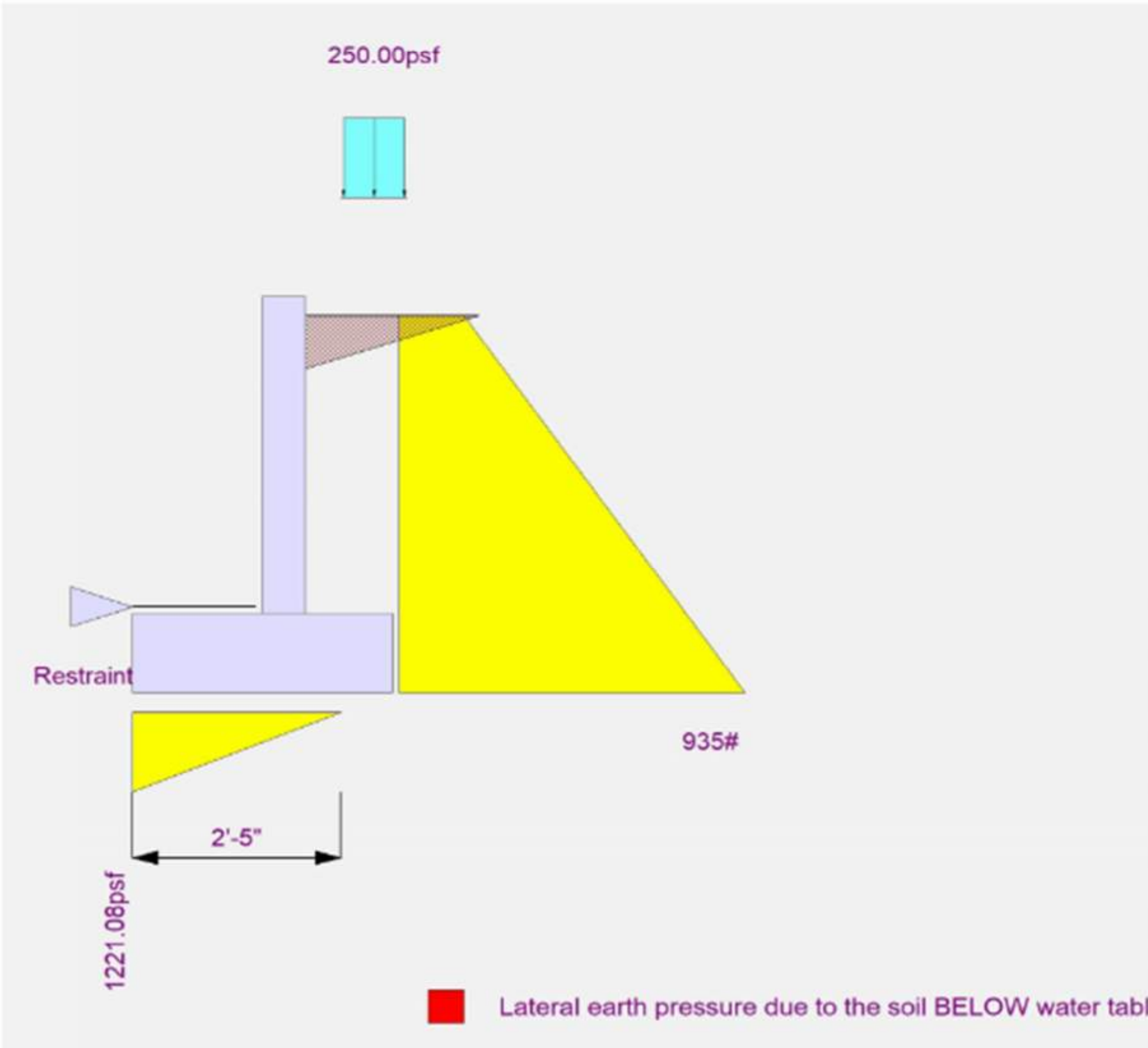
Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #5 bar specified in this stem design segment (25.4.2.4a) =	23.40 in
Development length for #5 bar specified in this stem design segment =	18.00 in
Hooked embedment length into footing for #5 bar specified in this stem design segment =	10.50 in
As Provided =	0.2325 in2/ft
As Required =	0.1320 in2/ft

DESCRIPTION: Retaining Wall - Case 1 UPDATE (Wall Design): Backfill+Surcharge with Empty Tank



DESCRIPTION: Retaining Wall - Case 1 UPDATE (Wall Design): Backfill+Surcharge with Empty Tank



Appendix B – Anchorage Calculations

Dewalt Design Assist Anchorage Design Software

DEWALT DESIGN ASSIST 1.7.0.0 Page 1

2024_01_26 Post Anchorage 2302-0069

1/26/2024

1.Project Information

Company:	
Project Engineer:	- -
Address:	- - - Oregon 97201
Phone:	M: - P: -
Email:	rachelle.child@psengineers.com
Project Name:	Untitled
Project Address:	Untitled
Notes:	

2.Selected Anchor Information

Selected Anchor :	Pure110+
Brand:	DEWALT
Material:	3/4" Ø Threaded Rod ASTM F1554 GR36/A36
Embedment:	h_{ef} 6.00 in h_{nom} 6 in
Approval:	ICC-ES ESR-3298
Issued/Revision:	Jul.2023 -
Drill method:	Hammer Drilled

3.Design Principles

Design Method:	ACI 318-19	
Load Combinations:	Section 5.3	User Defined Loads

4.Base Material Information

Concrete:

Type:	Cracked	Normal Weight Concrete		
Strength	2500 psi			

Reinforcement:

Edge Reinforcement	None or < #4 Rebar			
Spacing	Tension	No (Condition B)	Shear	No (Condition B)
Controls Breakout	Tension	False	Shear	False

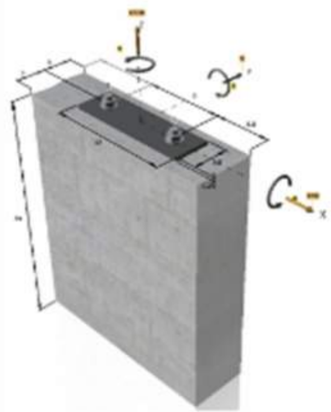
Base Plate:

Sizing	Thickness 0.25 in Length 3.5 in Width 12 in
Standoff	None Height 0 in
Strength	36000 psi

Profile:	None
Hole Condition:	Dry Hole
Max. Service Temperature:	Long Term: 110 °F Short Term: 130 °F

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

5.Geometric Conditions



h_{slab}	24	in	h_{min}	7.750	in
Edge Cx-	∞	in	c_{min}	1.750	in
Edge Cx+	5.5	in	c_{ac}	8.772	in
Edge Cy-	3	in	s_{min}	3.750	in
Edge Cy+	3	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength:	795.00	14551.00	0.055	OK	
Concrete Breakout Strength:	1590.00	3156.00	0.504	OK	Controls
Bond Strength	1590.00	3629.00	0.438	OK	

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	420.00	7566.00	0.056	OK	
Concrete Breakout Strength:	840.00	1723.00	0.488	OK	Controls
Pryout Strength	840.00	6798.00	0.124	OK	

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

7.Warnings and Remarks

ANCHOR DESIGN CRITERIA IS SATISFIED

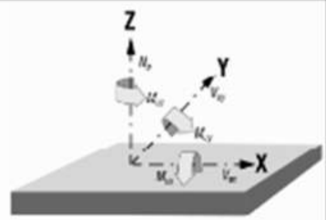
- The results of the calculations carried out by means of the DDA Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an design professional/engineer, particularly with regard to compliance with applicable standards, norms and permits, prior to using them for your specific project. The DDA Software serves only as an aid to interpret standards, norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.

8.Load Condition

Design Loads / Actions

Nu	1590	lb	Vux	840	lb	Vuy	0	lb
Muz	0	in-lb	Mux	0	in-lb	Muy	0	in-lb

Consider Load Reversal X Direction 100% Y Direction 100%



DEWALT

DEWALT DESIGN ASSIST 1.7.0.0

2024_01_26 Knee Brace Anchorage 2302-0069

1/26/2024

1.Project Information

Company:	
Project Engineer:	- -
Address:	- - - Oregon 97201
Phone:	M: - P: -
Email:	rachelle.child@psengineers.com
Project Name:	Untitled
Project Address:	Untitled
Notes:	

2.Selected Anchor Information

Selected Anchor :	Pure110+					
Brand:	DEWALT					
Material:	3/4" Ø Threaded Rod ASTM F1554 GR36/A36					
Embedment:	h_{ef}	6.00	in	h_{nom}	6	in
Approval:	ICC-ES ESR-3298					
Issued/Revision:	Jul.2023	-				
Drill method:	Hammer Drilled					

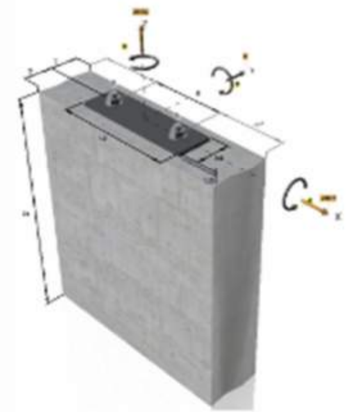
3.Design Principles

Design Method:	ACI 318-19	
Load Combinations:	Section 5.3	User Defined Loads

4.Base Material Information

Concrete:									
Type:	Cracked		Normal Weight Concrete						
Strength	2500	psi							
Reinforcement:									
Edge Reinforcement	None or < #4 Rebar								
Spacing	Tension	No (Condition B)		Shear	No (Condition B)				
Controls Breakout	Tension	False		Shear	False				
Base Plate:									
Sizing	Thickness	0.25	in	Length	3.5	in	Width	12	in
Standoff	None			Height	0	in			
Strength	36000	psi							
Profile:	None								
Hole Condition:	Dry Hole								
Max. Service Temperature:	Long Term: 110	°F		Short Term: 130	°F				

5.Geometric Conditions



h_{slab}	24	in	h_{min}	7.750	in
Edge Cx-	∞	in	c_{min}	1.750	in
Edge Cx+	∞	in	c_{ac}	8.772	in
Edge Cy-	3	in	s_{min}	3.750	in
Edge Cy+	3	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength:	1001.00	14551.00	0.069	OK	
Concrete Breakout Strength:	2002.00	3128.00	0.640	OK	Controls
Bond Strength	2002.00	4206.00	0.476	OK	

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	1001.00	7566.00	0.132	OK	
Concrete Breakout Strength:	2002.00	6183.00	0.324	OK	Controls
Pryout Strength	2002.00	6737.00	0.297	OK	

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

7.Warnings and Remarks

ANCHOR DESIGN CRITERIA IS SATISFIED

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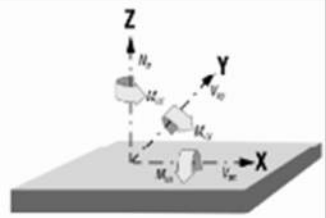
8.Load Condition

Design Loads / Actions

Nu	2002	lb	Vux	2002	lb	Vuy	0	lb
Muz	0	in-lb	Mux	0	in-lb	Muy	0	in-lb

Consider Load Reversal X Direction 100% Y Direction 100%



1.Project Information

Company:	
Project Engineer:	- -
Address:	- - - Oregon 97201
Phone:	M: - P: -
Email:	rachelle.child@psengineers.com
Project Name:	Untitled
Project Address:	Untitled
Notes:	

2.Selected Anchor Information

Selected Anchor :	HIT-RE 500 V3				
Brand:	Hilti®				
Material:	3/4" Ø Threaded Rod ASTM F1554 GR36/A36				
Embedment:	h_{ef} 6.00	in	h_{nom}	6	in
Approval:	ICC-ES ESR-3814				
Issued/Revision:	Jan,2023	Mar,2023			
Drill method:	Hammer Drilled				

3.Design Principles

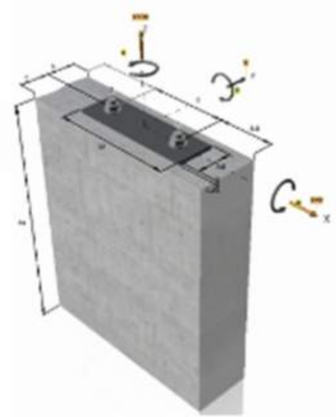
Design Method:	ACI 318-19	
Load Combinations:	Section 5.3	User Defined Loads

4.Base Material Information

Concrete:								
Type:	Cracked		Normal Weight Concrete					
Strength	2500	psi						
Reinforcement:								
Edge Reinforcement	None or < #4 Rebar							
Spacing	Tension	No (Condition B)	Shear	No (Condition B)				
Controls Breakout	Tension	False	Shear	False				
Base Plate:								
Sizing	Thickness	0.25	in	Length 3.5	in	Width	12	in
Standoff	None		Height	0	in			
Strength	36000	psi						
Profile:	None							
Hole Condition:	Dry Hole							
Max. Service Temperature:	Long Term: 110	°F	Short Term: 130	°F				

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

5.Geometric Conditions



h_{slab}	24	in	h_{min}	7.750	in
Edge Cx-	∞	in	c_{min}	1.750	in
Edge Cx+	5.5	in	c_{ac}	8.772	in
Edge Cy-	3	in	s_{min}	3.750	in
Edge Cy+	3	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength:	795.00	14551.00	0.055	OK	
Concrete Breakout Strength:	1590.00	3156.00	0.504	OK	
Bond Strength	1590.00	2977.00	0.534	OK	Controls

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	420.00	7566.00	0.056	OK	
Concrete Breakout Strength:	840.00	1723.00	0.488	OK	Controls
Pryout Strength	840.00	6412.00	0.131	OK	

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

7.Warnings and Remarks

ANCHOR DESIGN CRITERIA IS SATISFIED

- The results of the calculations carried out by means of the DDA Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an design professional/engineer, particularly with regard to compliance with applicable standards, norms and permits, prior to using them for your specific project. The DDA Software serves only as an aid to interpret standards, norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
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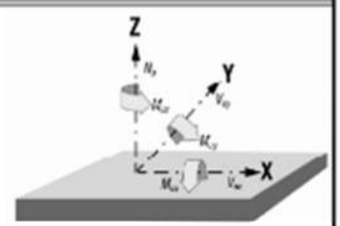
8.Load Condition

Design Loads / Actions

Nu	1590	lb	Vux	840	lb	Vuy	0	lb
Muz	0	in-lb	Mux	0	in-lb	Muy	0	in-lb

Consider Load Reversal X Direction 100% Y Direction 100%



2024_01_26 Knee Brace Anchorage 2302-0069

1/26/2024

1.Project Information

Company:	
Project Engineer:	- -
Address:	- - - Oregon 97201
Phone:	M: - P: -
Email:	rachelle.child@psengineers.com
Project Name:	Untitled
Project Address:	Untitled
Notes:	

2.Selected Anchor Information

Selected Anchor :	HIT-RE 500 V3
Brand:	Hilti®
Material:	3/4" Ø Threaded Rod ASTM F1554 GR36/A36
Embedment:	h_{ef} 6.00 in h_{nom} 6 in
Approval:	ICC-ES ESR-3814
Issued/Revision:	Jan,2023 Mar,2023
Drill method:	Hammer Drilled

3.Design Principles

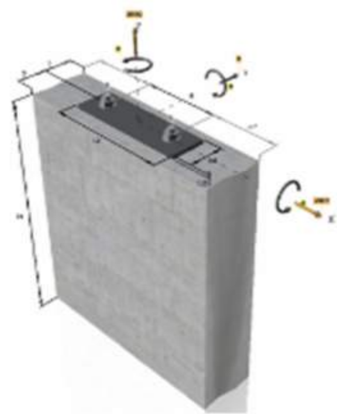
Design Method:	ACI 318-19	
Load Combinations:	Section 5.3	User Defined Loads

4.Base Material Information

Concrete:									
Type:	Cracked		Normal Weight Concrete						
Strength	2500	psi							
Reinforcement:									
Edge Reinforcement	None or < #4 Rebar								
Spacing	Tension	No (Condition B)	Shear	No (Condition B)					
Controls Breakout	Tension	False	Shear	False					
Base Plate:									
Sizing	Thickness	0.25	in	Length	3.5	in	Width	12	in
Standoff	None			Height	0	in			
Strength	36000	psi							
Profile:	None								
Hole Condition:	Dry Hole								
Max. Service Temperature:	Long Term: 110	°F		Short Term: 130	°F				

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

5.Geometric Conditions



h_{slab}	24	in	h_{min}	7.750	in
Edge Cx-	∞	in	c_{min}	1.750	in
Edge Cx+	∞	in	c_{ac}	8.772	in
Edge Cy-	3	in	s_{min}	3.750	in
Edge Cy+	3	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength:	1001.00	14551.00	0.069	OK	
Concrete Breakout Strength:	2002.00	3128.00	0.640	OK	Controls
Bond Strength	2002.00	3591.00	0.558	OK	

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	1001.00	7566.00	0.132	OK	
Concrete Breakout Strength:	2002.00	6183.00	0.324	OK	Controls
Pryout Strength	2002.00	6737.00	0.297	OK	

7.Warnings and Remarks

ANCHOR DESIGN CRITERIA IS SATISFIED

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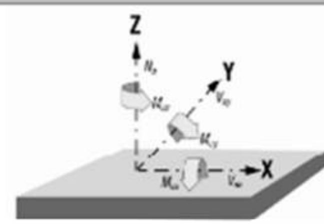
8.Load Condition

Design Loads / Actions

Nu	2002	lb	Vux	2002	lb	Vuy	0	lb
Muz	0	in-lb	Mux	0	in-lb	Muy	0	in-lb

Consider Load Reversal X Direction 100% Y Direction 100%



1.Project Information

Company:	
Project Engineer:	- -
Address:	- - - Oregon 97201
Phone:	M: - P: -
Email:	rachelle.child@psengineers.com
Project Name:	Untitled
Project Address:	Untitled
Notes:	

2.Selected Anchor Information

Selected Anchor :	KH-EZ
Brand:	Hilti®
Material:	3/4" Ø Medium Carbon Steel
Embedment:	h_{ef} 2.92 in h_{nom} 4 in
Approval:	ICC-ES ESR-3027
Issued/Revision:	Dec,2021 Apr,2022
Drill method:	Hammer Drilled

3.Design Principles

Design Method:	ACI 318-19	
Load Combinations:	Section 5.3	User Defined Loads

4.Base Material Information

Concrete:

Type:	Cracked	Normal Weight Concrete		
Strength	2500 psi			

Reinforcement:

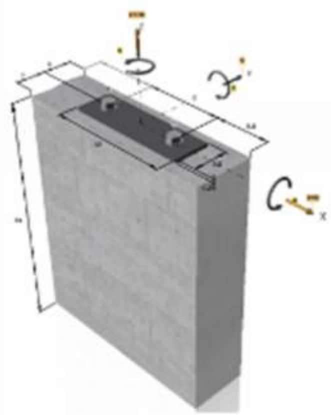
Edge Reinforcement	None or < #4 Rebar			
Spacing	Tension	No (Condition B)	Shear	No (Condition B)
Controls Breakout	Tension	False	Shear	False

Base Plate:

Sizing	Thickness 0.25 in	Length 3.5 in	Width 12 in	
Standoff	None	Height 0 in		
Strength	36000 psi			

Profile: None

5.Geometric Conditions



h_{slab}	24	in	h_{min}	6.000	in
Edge Cx-	∞	in	c_{min}	1.750	in
Edge Cx+	5.5	in	c_{ac}	4.410	in
Edge Cy-	3	in	s_{min}	3.000	in
Edge Cy+	3	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength:	795.00	20810.00	0.038	OK	
Concrete Breakout Strength:	1590.00	3271.00	0.486	OK	Controls

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	420.00	9996.00	0.042	OK	
Concrete Breakout Strength:	840.00	1523.00	0.551	OK	Controls
Pryout Strength	840.00	7046.00	0.119	OK	

7.Warnings and Remarks

ANCHOR DESIGN CRITERIA IS SATISFIED

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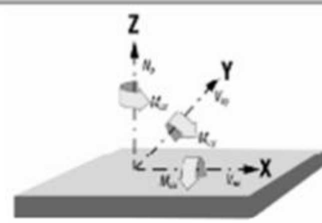
8.Load Condition

Design Loads / Actions

Nu	1590	lb	Vux	840	lb	Vuy	0	lb
Muz	0	in-lb	Mux	0	in-lb	Muy	0	in-lb

Consider Load Reversal X Direction 100% Y Direction 100%



1.Project Information

Company:	
Project Engineer:	- -
Address:	- - - Oregon 97201
Phone:	M: - P: -
Email:	rachelle.child@psengineers.com
Project Name:	Untitled
Project Address:	Untitled
Notes:	

2.Selected Anchor Information

Selected Anchor :	KH-EZ				
Brand:	Hilti®				
Material:	3/4" Ø Medium Carbon Steel				
Embedment:	h_{ef} 2.92	in	h_{nom}	4	in
Approval:	ICC-ES ESR-3027				
Issued/Revision:	Dec,2021	Apr,2022			
Drill method:	Hammer Drilled				

3.Design Principles

Design Method:	ACI 318-19	
Load Combinations:	Section 5.3	User Defined Loads

4.Base Material Information

Concrete:

Type:	Cracked		Normal Weight Concrete					
Strength	2500	psi						

Reinforcement:

Edge Reinforcement	None or < #4 Rebar			
Spacing	Tension	No (Condition B)	Shear	No (Condition B)
Controls Breakout	Tension	False	Shear	False

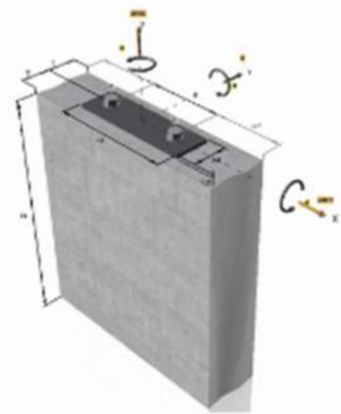
Base Plate:

Sizing	Thickness	0.25	in	Length	3.5	in	Width	12	in
Standoff	None			Height	0	in			
Strength	36000	psi							

Profile: None

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

5.Geometric Conditions



h_{slab}	24	in	h_{min}	6.000	in
Edge Cx-	∞	in	c_{min}	1.750	in
Edge Cx+	∞	in	c_{ac}	4.410	in
Edge Cy-	3	in	s_{min}	3.000	in
Edge Cy+	3	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength:	1001.00	20810.00	0.048	OK	
Concrete Breakout Strength:	2002.00	3271.00	0.612	OK	Controls

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	1001.00	9996.00	0.100	OK	
Concrete Breakout Strength:	2002.00	5466.00	0.366	OK	Controls
Pryout Strength	2002.00	7046.00	0.284	OK	

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

7.Warnings and Remarks

ANCHOR DESIGN CRITERIA IS SATISFIED

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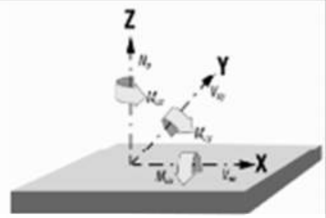
8.Load Condition

Design Loads / Actions

Nu	2002	lb	Vux	2002	lb	Vuy	0	lb
Muz	0	in-lb	Mux	0	in-lb	Muy	0	in-lb

Consider Load Reversal X Direction 100% Y Direction 100%



DEWALT

DEWALT DESIGN ASSIST 1.7.0.0

Page 1

2024_01_26 Post Anchorage 2302-0069

1/26/2024

1.Project Information

Company:	
Project Engineer:	- -
Address:	- - - Oregon 97201
Phone:	M: - P: -
Email:	rachelle.child@psengineers.com
Project Name:	Untitled
Project Address:	Untitled
Notes:	

2.Selected Anchor Information

Selected Anchor :	Screw-Bolt+				
Brand:	DEWALT				
Material:	3/4" Ø				
Embedment:	h_{ef} 2.92	in	h_{nom}	4	in
Approval:	ICC-ES ESR-3889				
Issued/Revision:	Nov,2023	-			
Drill method:	Hammer Drilled				

3.Design Principles

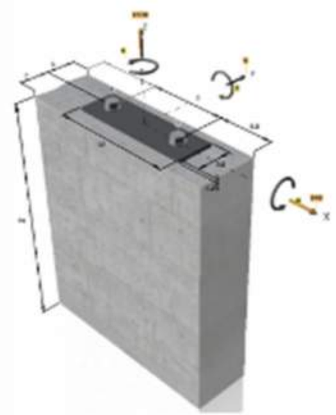
Design Method:	ACI 318-19	
Load Combinations:	Section 5.3	User Defined Loads

4.Base Material Information

Concrete:								
Type:	Cracked		Normal Weight Concrete					
Strength	2500	psi						
Reinforcement:								
Edge Reinforcement	None or < #4 Rebar							
Spacing	Tension	No (Condition B)	Shear	No (Condition B)				
Controls Breakout	Tension	False	Shear	False				
Base Plate:								
Sizing	Thickness	0.25 in	Length	3.5	in	Width	12	in
Standoff	None		Height	0	in			
Strength	36000	psi						
Profile:	None							

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

5.Geometric Conditions



h_{slab}	24	in	h_{min}	6.000	in
Edge Cx-	∞	in	c_{min}	1.750	in
Edge Cx+	5.5	in	c_{ac}	10.900	in
Edge Cy-	3	in	s_{min}	3.000	in
Edge Cy+	3	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength:	795.00	24807.00	0.032	OK	
Concrete Breakout Strength:	1590.00	3271.00	0.486	OK	

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	420.00	11556.00	0.036	OK	
Concrete Breakout Strength:	840.00	1540.00	0.546	OK	
Pryout Strength	840.00	7046.00	0.119	OK	

7.Warnings and Remarks

ANCHOR DESIGN CRITERIA IS SATISFIED

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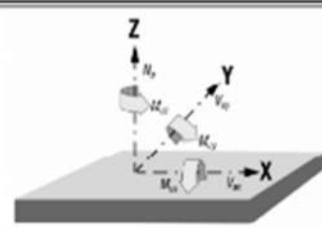
8.Load Condition

Design Loads / Actions

Nu	1590	lb	Vux	840	lb	Vuy	0	lb
Muz	0	in-lb	Mux	0	in-lb	Muy	0	in-lb

Consider Load Reversal X Direction 100% Y Direction 100%



1.Project Information

Company:	
Project Engineer:	- -
Address:	- - - Oregon 97201
Phone:	M: - P: -
Email:	rachelle.child@psengineers.com
Project Name:	Untitled
Project Address:	Untitled
Notes:	

2.Selected Anchor Information

Selected Anchor :	Screw-Bolt+
Brand:	DEWALT
Material:	3/4" Ø
Embedment:	h_{ef} 2.92 in h_{nom} 4 in
Approval:	ICC-ES ESR-3889
Issued/Revision:	Nov,2023 -
Drill method:	Hammer Drilled

3.Design Principles

Design Method:	ACI 318-19	
Load Combinations:	Section 5.3	User Defined Loads

4.Base Material Information

Concrete:

Type:	Cracked	Normal Weight Concrete		
Strength	2500 psi			

Reinforcement:

Edge Reinforcement	None or < #4 Rebar			
Spacing	Tension	No (Condition B)	Shear	No (Condition B)
Controls Breakout	Tension	False	Shear	False

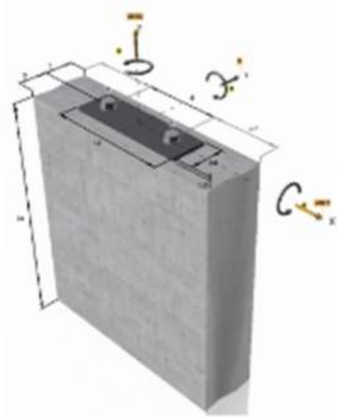
Base Plate:

Sizing	Thickness	0.25	in	Length	3.5	in	Width	12 in
Standoff	None			Height	0	in		
Strength	36000	psi						

Profile: None

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

5.Geometric Conditions



h_{slab}	24	in	h_{min}	6.000	in
Edge Cx-	∞	in	c_{min}	1.750	in
Edge Cx+	∞	in	c_{ac}	10.900	in
Edge Cy-	3	in	s_{min}	3.000	in
Edge Cy+	3	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength:	1001.00	24807.00	0.040	OK	
Concrete Breakout Strength:	2002.00	3271.00	0.612	OK	

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	1001.00	11556.00	0.087	OK	
Concrete Breakout Strength:	2002.00	5525.00	0.362	OK	
Pryout Strength	2002.00	7046.00	0.284	OK	

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

7.Warnings and Remarks

ANCHOR DESIGN CRITERIA IS SATISFIED

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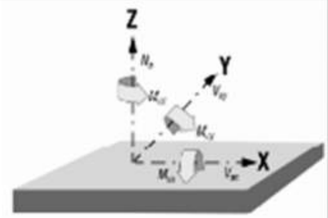
8.Load Condition

Design Loads / Actions

Nu	2002	lb	Vux	2002	lb	Vuy	0	lb
Muz	0	in-lb	Mux	0	in-lb	Muy	0	in-lb

Consider Load Reversal X Direction 100% Y Direction 100%



<u>Simpson Strong Tie Anchorage Design Software</u>

SIMPSON Strong-Tie Anchor Designer™ Software
Version 3.1.2209.3

Company:		Date:	9/8/2022
Engineer:		Page:	1/6
Project:			
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-19
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: F1554 Grade 36
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-4057
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 7.75
c_{ac} (inch): 8.77
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 48.00
State: Uncracked
Compressive strength, f'_c (psi): 2500
$\Psi_{c,V}$: 1.4
Reinforcement condition: Supplementary reinforcement not present
Supplemental edge reinforcement: No
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Continuous
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 3.50 x 12.00 x 0.25

Recommended Anchor
Anchor Name: SET-3G - SET-3G w/ 3/4"Ø F1554 Gr. 36
Code Report: ICC-ES ESR-4057

SIMPSON Strong-Tie

Anchor Designer™
Software
Version 3.1.2209.3

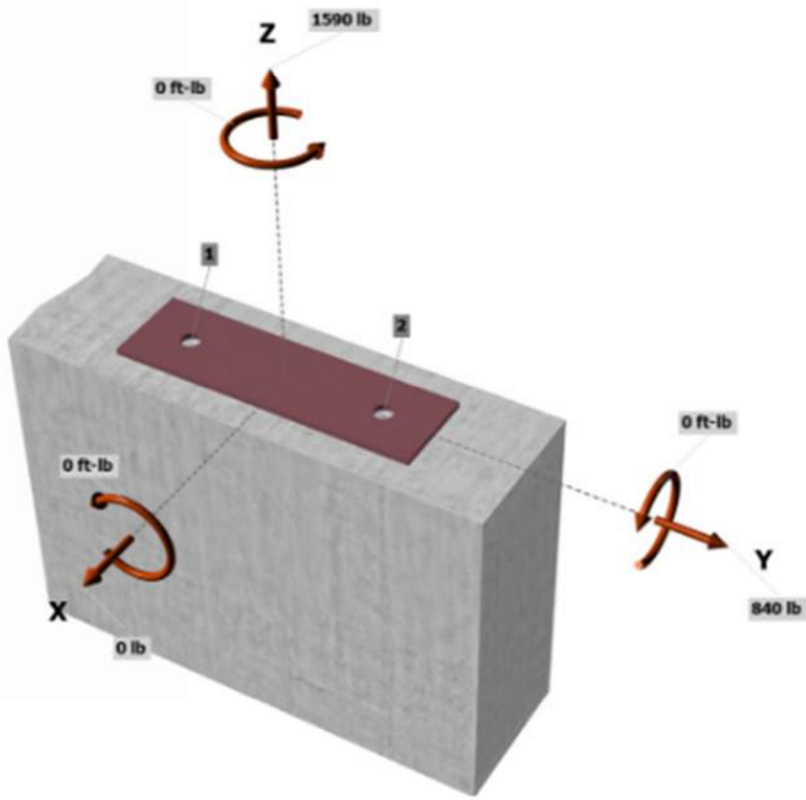
Company:		Date:	9/8/2022
Engineer:		Page:	2/6
Project:			
Address:			
Phone:			
E-mail:			

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

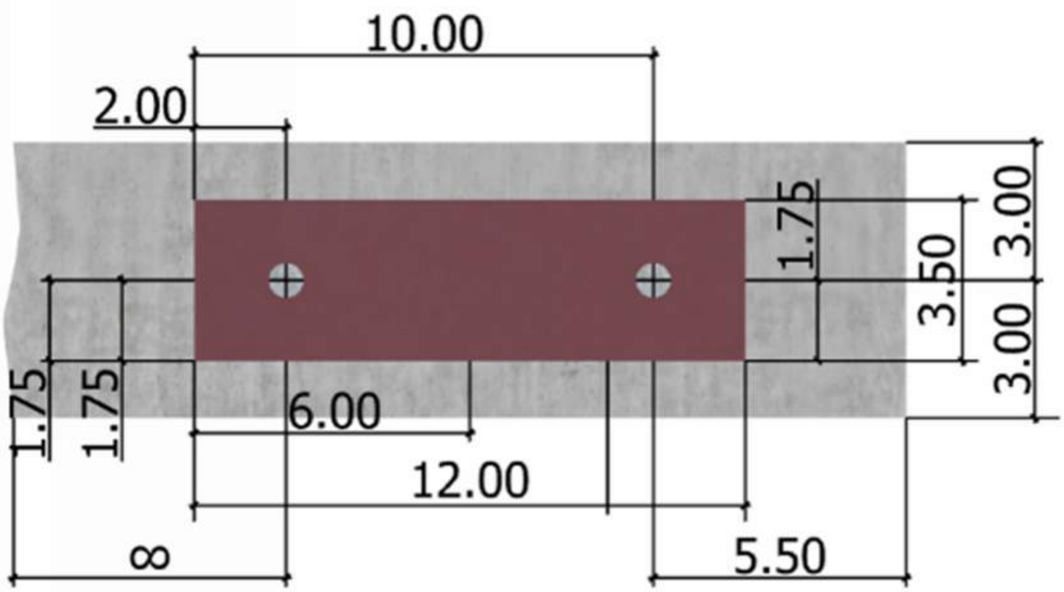
N_{ua} [lb]: 1590
V_{uax} [lb]: 0
V_{uay} [lb]: 840
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



Company:		Date:	9/8/2022
Engineer:		Page:	3/6
Project:			
Address:			
Phone:			
E-mail:			

<Figure 2>

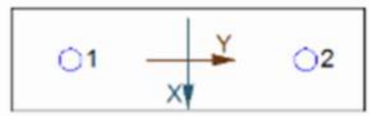


3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	795.0	0.0	420.0	420.0
2	795.0	0.0	420.0	420.0
Sum	1590.0	0.0	840.0	840.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 1590
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.6.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
19370	0.75	14528

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.6.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.6.2.2.1)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
24.0	1.00	2500	3.667	8425

$\phi N_{cbg} = \phi (A_{Nc} / A_{Nco}) \Psi_{ec,N} \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b$ (Sec. 17.5.1.2 & Eq. 17.6.2.1a)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
114.00	121.00	3.00	1.000	0.864	1.00	1.000	8425	0.65	4456

6. Adhesive Strength of Anchor in Tension (Sec. 17.6.5)

$\tau_{k,uncr} = \tau_{k,uncr} f_{short-term} K_{sat} (f'_c / 2{,}500)^n$

$\tau_{k,uncr}$ (psi)	$f_{short-term}$	K_{sat}	f'_c (psi)	n	$\tau_{k,uncr}$ (psi)
2064	1.00	1.00	2500	0.35	2064

$N_{ba} = \lambda_a \tau_{uncr} \pi d_a h_{ef}$ (Eq. 17.6.5.2.1)

λ_a	τ_{uncr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	2064	0.75	6.000	29179

$\phi N_{ag} = \phi (A_{Na} / A_{Na0}) \Psi_{ec,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba}$ (Sec. 17.5.1.2 & Eq. 17.6.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	ϕN_{ag} (lb)
142.64	422.18	10.27	3.00	1.000	0.788	1.000	29179	0.65	5047

8. Steel Strength of Anchor in Shear (Sec. 17.7.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11625	1.0	0.65	7556

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.7.2)

Shear perpendicular to edge in y-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	2500	13.50	22321

$\phi V_{cby} = \phi(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.5.1.2 & Eq. 17.7.2.1a)

A_{Vc} (in²)	A_{Vco} (in²)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cby} (lb)
121.50	820.13	0.744	1.400	1.000	22321	0.70	2413

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	2500	3.00	2338

$\phi V_{cbgx} = \phi(2)(A_{Vc}/A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.5.1.2, 17.7.2.1(c) & Eq. 17.7.2.1b)

A_{Vc} (in²)	A_{Vco} (in²)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgx} (lb)
76.50	40.50	1.000	1.000	1.400	1.000	2338	0.70	8657

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.7.3)

$\phi V_{cpg} = \phi\min|k_{cp}N_{ag}; k_{cp}N_{cbg}| = \phi\min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}; k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.5.1.2 & Eq. 17.7.3.1b)

k_{cp}	A_{Na} (in²)	A_{Na0} (in²)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	142.64	422.18	0.788	1.000	1.000	29179	7765

A_{Nc} (in²)	A_{Nco} (in²)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
114.00	121.00	1.000	0.864	1.000	1.000	8425	6855	0.70

ϕV_{cpg} (lb)
9598

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.8)

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	795	14528	0.05	Pass
Concrete breakout	**1590**	**4456**	**0.36**	**Pass (Governs)**
Adhesive	1590	5047	0.32	Pass

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	420	7556	0.06	Pass
T Concrete breakout y+	**840**	**2413**	**0.35**	**Pass (Governs)**

|| Concrete breakout x-	**840**	**8657**	**0.10**	**Pass (Governs)**
Pryout	840	9598	0.09	Pass

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.8.1	0.36	0.00	35.7%	1.0	Pass

SET-3G w/ 3/4"Ø F1554 Gr. 36 with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- Designer must exercise own judgement to determine if this design is suitable.
- Refer to manufacturer's product literature for hole cleaning and installation instructions.

SIMPSON Strong-Tie Anchor Designer™ Software
Version 3.1.2209.3

Company:		Date:	9/8/2022
Engineer:		Page:	1/6
Project:			
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-19
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: F1554 Grade 36
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-4057
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 7.75
c_{ac} (inch): 8.77
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 48.00
State: Uncracked
Compressive strength, f'_c (psi): 2500
$\Psi_{c,V}$: 1.4
Reinforcement condition: Supplementary reinforcement not present
Supplemental edge reinforcement: No
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Continuous
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 3.50 x 12.00 x 0.25

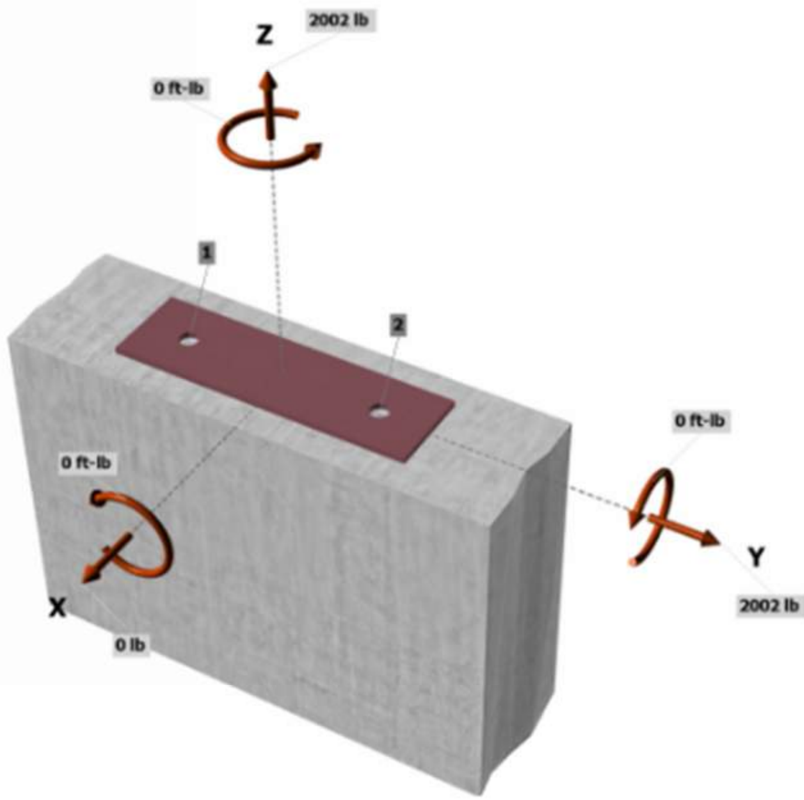
Recommended Anchor
Anchor Name: SET-3G - SET-3G w/ 3/4"Ø F1554 Gr. 36
Code Report: ICC-ES ESR-4057

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

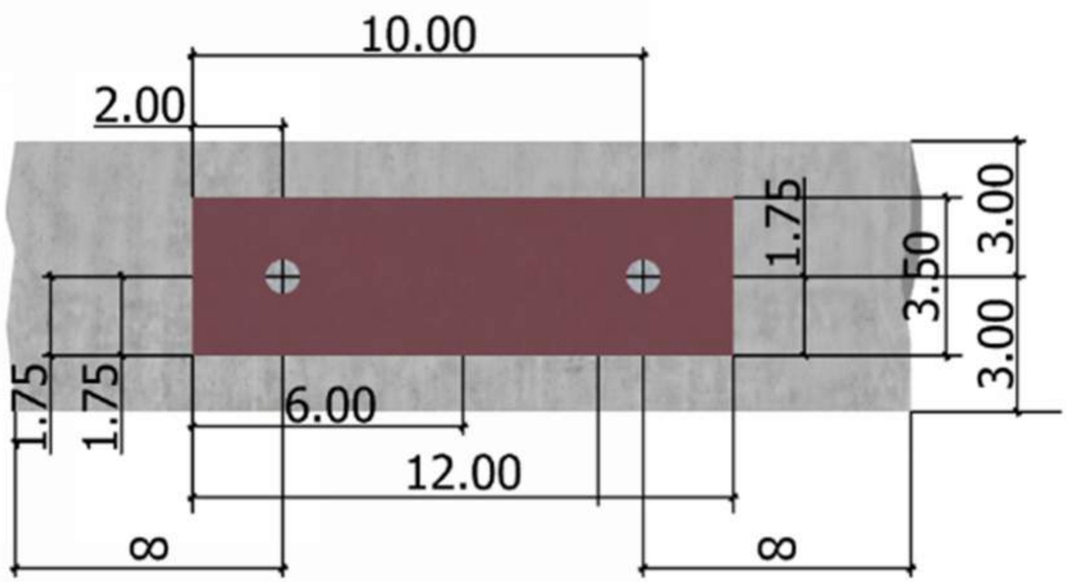
Strength level loads:

N_{ua} [lb]: 2002
V_{uax} [lb]: 0
V_{uay} [lb]: 2002
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



<Figure 2>

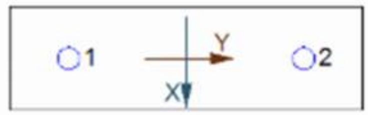


3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	1001.0	0.0	1001.0	1001.0
2	1001.0	0.0	1001.0	1001.0
Sum	2002.0	0.0	2002.0	2002.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 2002
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.6.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
19370	0.75	14528

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.6.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.6.2.2.1)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
24.0	1.00	2500	6.000	17636

$\phi N_{cbg} = \phi (A_{Nc} / A_{Nco}) \Psi_{ec,N} \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b$ (Sec. 17.5.1.2 & Eq. 17.6.2.1a)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
156.00	324.00	3.00	1.000	0.800	1.00	1.000	17636	0.65	4416

6. Adhesive Strength of Anchor in Tension (Sec. 17.6.5)

$\tau_{k,uncr} = \tau_{k,uncr} f_{short-term} K_{sat} (f'_c / 2{,}500)^n$

$\tau_{k,uncr}$ (psi)	$f_{short-term}$	K_{sat}	f'_c (psi)	n	$\tau_{k,uncr}$ (psi)
2064	1.00	1.00	2500	0.35	2064

$N_{ba} = \lambda_a \tau_{uncr} \pi d_a h_{ef}$ (Eq. 17.6.5.2.1)

λ_a	τ_{uncr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	2064	0.75	6.000	29179

$\phi N_{ag} = \phi (A_{Na} / A_{Na0}) \Psi_{ec,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba}$ (Sec. 17.5.1.2 & Eq. 17.6.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	ϕ	ϕN_{ag} (lb)
171.28	422.18	10.27	3.00	1.000	0.788	1.000	29179	0.65	6060

8. Steel Strength of Anchor in Shear (Sec. 17.7.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11625	1.0	0.65	7556

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.7.2)

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	2500	3.00	2338

$\phi V_{cbgx} = \phi\,(2)(A_{Vc}/A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.5.1.2, 17.7.2.1(c) & Eq. 17.7.2.1b)

A_{Vc} (in²)	A_{Vco} (in²)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgx} (lb)
76.50	40.50	1.000	1.000	1.400	1.000	2338	0.70	8657

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.7.3)

$\phi V_{cpg} = \phi\min|k_{cp}N_{ag}; k_{cp}N_{cbg}| = \phi\min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}; k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.5.1.2 & Eq. 17.7.3.1b)

k_{cp}	A_{Na} (in²)	A_{Na0} (in²)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	171.28	422.18	0.788	1.000	1.000	29179	9324

A_{Nc} (in²)	A_{Nco} (in²)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
156.00	324.00	1.000	0.800	1.000	1.000	17636	6793	0.70

ϕV_{cpg} (lb)
9511

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.8)

Tension	Factored Load, N_{ua} (lb)	Design Strength, øN_n (lb)	Ratio	Status
Steel	1001	14528	0.07	Pass
Concrete breakout	**2002**	**4416**	**0.45**	**Pass (Governs)**
Adhesive	2002	6060	0.33	Pass

Shear	Factored Load, V_{ua} (lb)	Design Strength, øV_n (lb)	Ratio	Status
Steel	1001	7556	0.13	Pass
|| Concrete breakout x-	**2002**	**8657**	**0.23**	**Pass (Governs)**
Pryout	2002	9511	0.21	Pass

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.8.1	0.45	0.00	45.3%	1.0	Pass

SET-3G w/ 3/4"Ø F1554 Gr. 36 with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

SIMPSON Strong-Tie

Anchor Designer™ Software
Version 3.1.2209.3

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Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-19
Units: Imperial units

Anchor Information:
Anchor type: Concrete screw
Material: Carbon Steel
Diameter (inch): 0.750
Nominal Embedment depth (inch): 4.000
Effective Embedment depth, h_{ef} (inch): 2.940
Code report: ICC-ES ESR-2713
Anchor category: 1
Anchor ductility: No
h_{min} (inch): 6.00
c_{ac} (inch): 6.00
C_{min} (inch): 1.75
S_{min} (inch): 2.75

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 48.00
State: Uncracked
Compressive strength, f'_c (psi): 2500
$\Psi_{c,V}$: 1.4
Reinforcement condition: Supplementary reinforcement not present
Supplemental edge reinforcement: No
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 3.50 x 12.00 x 0.25

Recommended Anchor
Anchor Name: Titen HD® - 3/4"Ø Titen HD, hnom:4" (102mm)
Code Report: ICC-ES ESR-2713

Input data and results must be checked for agreement with the existing circumstances, the standards and guidelines must be checked for plausibility.

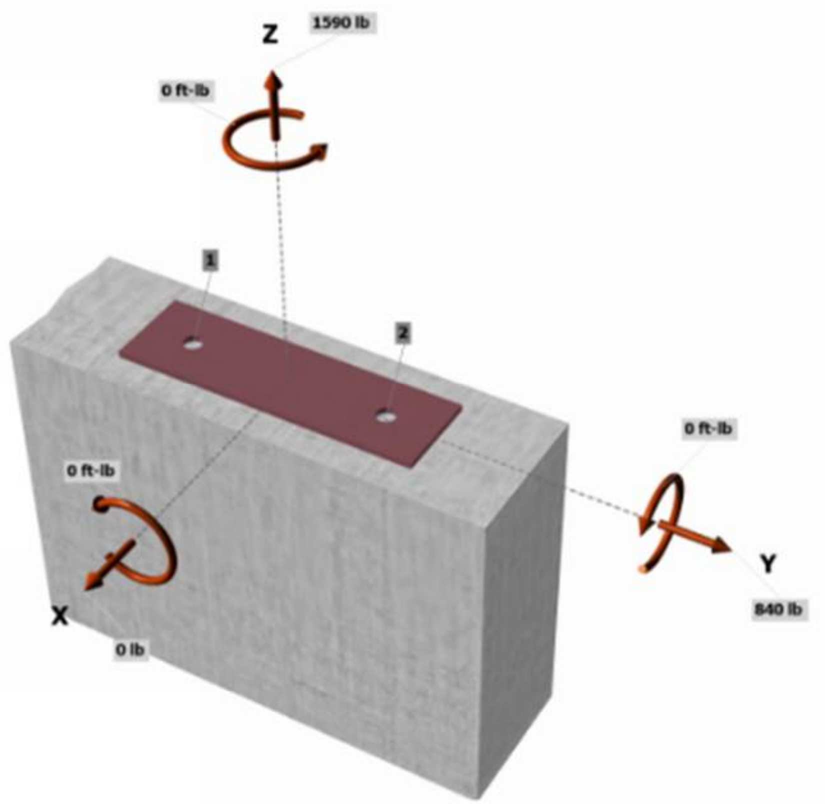
Simpson Strong-Tie Company Inc. 5956 W. Las Positas Boulevard Pleasanton, CA 94588 Phone: 925.560.9000 Fax: 925.847.3871 www.strongtie.com

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: Not applicable
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 1590
V_{uax} [lb]: 0
V_{uay} [lb]: 840
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



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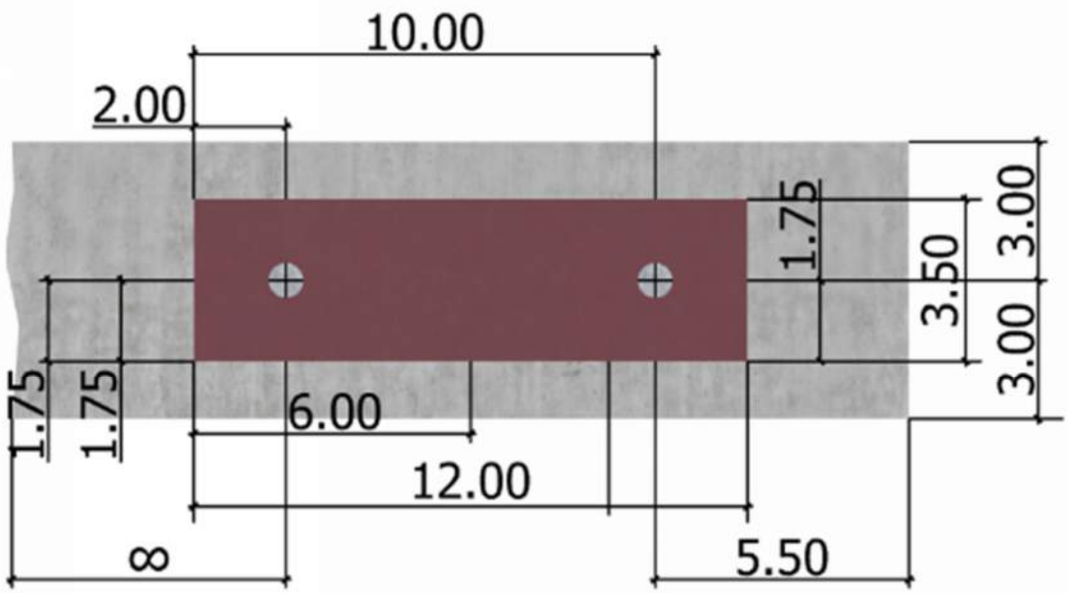
Address:			
Phone:			
E-mail:			

<Figure 2>



SIMPSON Strong-Tie

Anchor Designer™ Software
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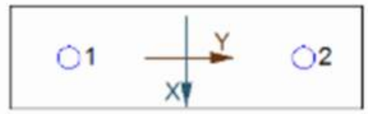
3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	795.0	0.0	420.0	420.0
2	795.0	0.0	420.0	420.0
Sum	1590.0	0.0	840.0	840.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 1590
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.6.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
45540	0.65	29601

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.6.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.6.2.2.1)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
27.0	1.00	2500	2.940	6805

$\phi N_{cbg} = \phi (A_{Nc} / A_{Nco}) \Psi_{ec,N} \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b$ (Sec. 17.5.1.2 & Eq. 17.6.2.1a)

A_{Nc} (in²)	A_{Nco} (in²)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
100.92	77.79	3.00	1.000	0.904	1.00	0.735	6805	0.65	3813

8. Steel Strength of Anchor in Shear (Sec. 17.7.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout} \phi V_{sa}$ (lb)
14950	1.0	0.60	8970

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.7.2)

Shear perpendicular to edge in y-direction:

$V_{by} = \min|7(l_e / d_a)^{0.2} \sqrt{d_a} \lambda_a \sqrt{f'_c} c_{a1}^{1.5}; 9 \lambda_a \sqrt{f'_c} c_{a1}^{1.5}|$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
2.94	0.750	1.00	2500	13.50	19759

$\phi V_{cby} = \phi (A_{Vc} / A_{Vco}) \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} V_{by}$ (Sec. 17.5.1.2 & Eq. 17.7.2.1a)

A_{Vc} (in²)	A_{Vco} (in²)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cby} (lb)
121.50	820.13	0.744	1.400	1.000	19759	0.70	2136

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e / d_a)^{0.2} \sqrt{d_a} \lambda_a \sqrt{f'_c} c_{a1}^{1.5}; 9 \lambda_a \sqrt{f'_c} c_{a1}^{1.5}|$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
2.94	0.750	1.00	2500	3.00	2070

$\phi V_{cbgx} = \phi\,(2)(A_{Vc} / A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.5.1.2, 17.7.2.1(c) & Eq. 17.7.2.1b)

A_{Vc} (in²)	A_{Vco} (in²)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgx} (lb)
76.50	40.50	1.000	1.000	1.400	1.000	2070	0.70	7663

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.7.3)

$\phi V_{cpg} = \phi k_{cp}N_{cbg} = \phi k_{cp}(A_{Nc} / A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.5.1.2 & Eq. 17.7.3.1b)

k_{cp}	A_{Nc} (in²)	A_{Nco} (in²)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕV_{cpg} (lb)
2.0	100.92	77.79	1.000	0.904	1.000	0.735	6805	0.70	8213

11. Results

Interaction of Tensile and Shear Forces (Sec. R17.8)

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	795	29601	0.03	Pass
Concrete breakout	**1590**	**3813**	**0.42**	**Pass (Governs)**

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	420	8970	0.05	Pass
T Concrete breakout y+	**840**	**2136**	**0.39**	**Pass (Governs)**
|| Concrete breakout x-	**840**	**7663**	**0.11**	**Pass (Governs)**
Pryout	840	8213	0.10	Pass

Interaction check	$(N_{ua}/\phi N_{n})^{5/3}$	$(V_{ua}/\phi V_{n})^{5/3}$	Combined Ratio	Permissible	Status
Sec. R17.8	0.23	0.21	44.4%	1.0	Pass

3/4"Ø Titen HD, hnom:4" (102mm) meets the selected design criteria.

12. Warnings

- Designer must exercise own judgement to determine if this design is suitable.
- Refer to manufacturer's product literature for hole cleaning and installation instructions.

SIMPSON Strong-Tie	Anchor Designer™ Software Version 3.1.2209.3

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Engineer:		Page:	1/5
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Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-19
Units: Imperial units

Anchor Information:
Anchor type: Concrete screw
Material: Carbon Steel
Diameter (inch): 0.750
Nominal Embedment depth (inch): 4.000
Effective Embedment depth, h_{ef} (inch): 2.940
Code report: ICC-ES ESR-2713
Anchor category: 1
Anchor ductility: No
h_{min} (inch): 6.00
c_{ac} (inch): 6.00
C_{min} (inch): 1.75
S_{min} (inch): 2.75

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 48.00
State: Uncracked
Compressive strength, f'c (psi): 2500
$\Psi_{c,V}$: 1.4
Reinforcement condition: Supplementary reinforcement not present
Supplemental edge reinforcement: No
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 3.50 x 12.00 x 0.25

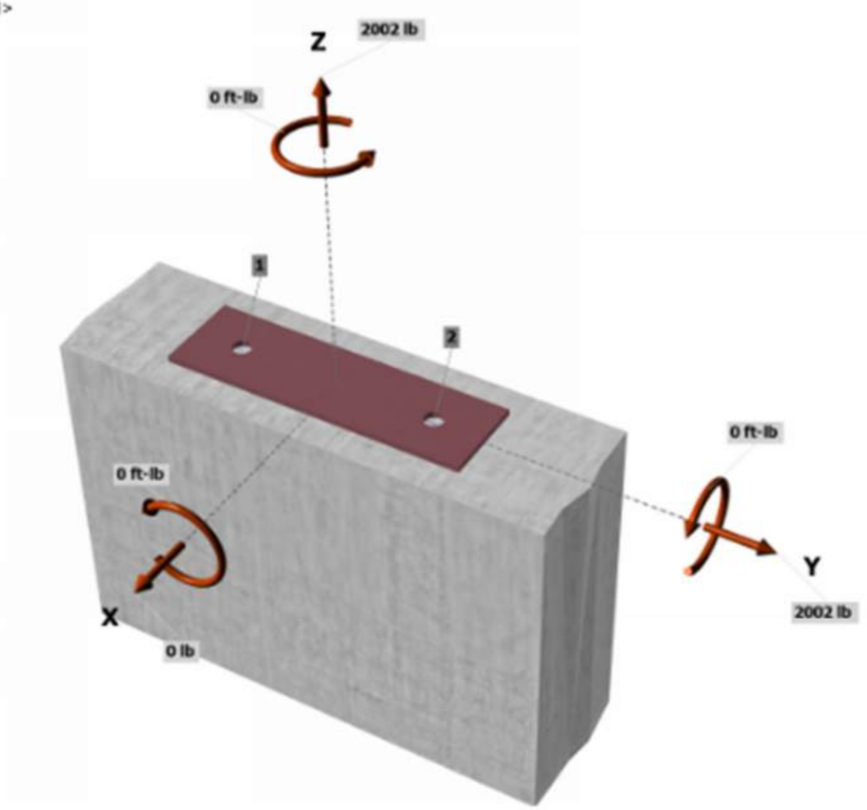
Recommended Anchor
Anchor Name: Titen HD® - 3/4"Ø Titen HD, hnom:4" (102mm)
Code Report: ICC-ES ESR-2713

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: Not applicable
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

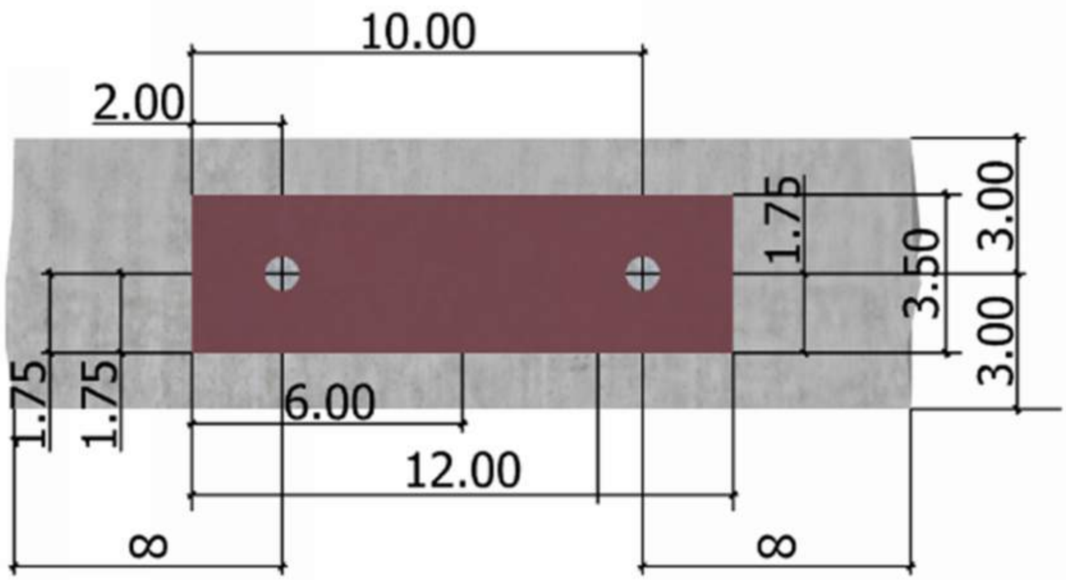
N_{ua} [lb]: 2002
V_{uax} [lb]: 0
V_{uay} [lb]: 2002
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



Company:		Date:	9/8/2022
Engineer:		Page:	3/5
Project:			
Address:			
Phone:			
E-mail:			

<Figure 2>



3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	1001.0	0.0	1001.0	1001.0
2	1001.0	0.0	1001.0	1001.0
Sum	2002.0	0.0	2002.0	2002.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 2002
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>

4. Steel Strength of Anchor in Tension (Sec. 17.6.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
45540	0.65	29601

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.6.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.6.2.2.1)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
27.0	1.00	2500	2.940	6805

$\phi N_{cbg} = \phi\,(A_{Nc} / A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.5.1.2 & Eq. 17.6.2.1a)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
100.92	77.79	3.00	1.000	0.904	1.00	0.735	6805	0.65	3813

8. Steel Strength of Anchor in Shear (Sec. 17.7.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
14950	1.0	0.60	8970

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.7.2)

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
2.94	0.750	1.00	2500	3.00	2070

$\phi V_{cbgx} = \phi\,(2)(A_{Vc} / A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.5.1.2, 17.7.2.1(c) & Eq. 17.7.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgx} (lb)
76.50	40.50	1.000	1.000	1.400	1.000	2070	0.70	7663

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.7.3)

$\phi V_{cpg} = \phi k_{cp} N_{cbg} = \phi k_{cp}(A_{Nc} / A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.5.1.2 & Eq. 17.7.3.1b)

k_{cp}	A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕV_{cpg} (lb)
2.0	100.92	77.79	1.000	0.904	1.000	0.735	6805	0.70	8213

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.8)

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	1001	29601	0.03	Pass
Concrete breakout	**2002**	**3813**	**0.53**	**Pass (Governs)**

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	1001	8970	0.11	Pass
|| Concrete breakout x-	**2002**	**7663**	**0.26**	**Pass (Governs)**
Pryout	2002	8213	0.24	Pass

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.8.1	0.53	0.00	52.5%	1.0	Pass

3/4"Ø Titen HD, hnom:4" (102mm) meets the selected design criteria.

12. Warnings

- Designer must exercise own judgement to determine if this design is suitable.
- Refer to manufacturer's product literature for hole cleaning and installation instructions.

END OF ADDENDUM NO. 2

Receipt of Addendum No. 2 must be acknowledged on page 4 of the "Proposal for Bidding Purposes" where indicated.

DATE OF BID OPENING REMAINS THE SAME: Wednesday, May 28, 2025, at 4:00 p.m., or soon thereafter

Leanne Ingman
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Leanne Ingman
Natural Resources Technician