ACUTE/UNTF NAVAJO HOUSE PLANS
Project ID: CEEn_2018CPST_003

by

B^4 Engineering:
Benjamin Arrington
Zachary Barnett
David Bell
David Blake

A Capstone Project Final Report

Submitted to

Paul Thorley - Acute Engineering
Tony Dayish - Utah Navajo Trust Fund

Department of Civil and Environmental Engineering
Brigham Young University

April 15, 2019

Executive Summary

PROJECT TITLE: ACUTE/UNTF NAVAJO HOUSE PLANS
PROJECT ID: CEEn_2018CPST_003
PROJECT SPONSOR: Paul Thorley
TEAM NAME: B^4 Engineering

The B^4 Engineering capstone group was assigned to the Acute-UNTF Navajo house plans project. The project consisted of updating the structural engineering on several housing plans for the Utah Navajo Trust Fund. Project deliverables include the following:

- Complete set of structural housing plans with structural details based on the provided architectural drawings
- Summary of structural calculations
- Detailed bill of materials for construction of each housing plan
- 3D-printed model of the structure.

Students conducted research to understand the history and the organization of the Utah Navajo Trust Fund (UNTF). Design criteria were gathered for eleven locations using accepted engineering practices. The worst-case criteria were applied to the three provided housing plans. Plans were analyzed using the 2015 International Building Code (IBC), including the Utah Statewide Amendments to the IBC, and compared with the prescriptive designs obtained from the 2015 International Residential Code (IRC). Recommendations were made based on the results of the analysis on which methodology to follow. Only structural elements were analyzed for the purposes of this project. Work was completed across the 2018-2019 academic year, with the final results being delivered on April 15, 2019.

It is the recommendation of this group that the design using the IBC methodology be used. For consistency, future updates to the engineering for other UNTF housing plans should be completed using the IBC methodology. Given that the 2018 editions of the IBC and the IRC and the 2016 edition of Minimum Design Loads for Buildings and Other Structures (ASCE 7-16) will be adopted beginning the summer of 2019, an updated design could be implemented in the future. Of particular note are the design snow loads that will be changed in the upcoming edition of the code. Using a different design snow load would impact header sizes, stud spacing, and footing sizes. Given that the worst-case design criteria were used for this analysis, a site-specific analysis could also be performed for different locations, particularly those outside of Monticello, which has the most stringent design constraints. A more in-depth cost analysis could be performed on specific structural elements, such as the foundation and footings, to further reduce the cost of the homes. This would be beneficial because the cost of materials greatly varies from location to location.

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Introduction

The B⁴ Engineering capstone group was assigned to the Acute-UNTF Navajo housing plans project. This project included completing a set of engineered plans based on architectural drawings and compiling a list of required materials for house construction. Students performed research to understand both the administrative processes of the Utah Navajo Trust Fund (UNTF) and how their funds are allocated. The objective of the project was to perform engineering on housing plans that meets code requirements and is the most economically efficient. Students analyzed the structural members of the house using the 2015 International Building Code (IBC) and the 2015 International Residential Code (IRC). A comparison of the results based on each code's specifications was performed. Additionally, the plans were engineered for optimal rates of construction. The project was completed during the Fall 2018 and Winter 2019 semesters. The deliverables for the final product include: structural plans including structural details, a summary of the structural calculations, a detailed bill of materials, and a 3D-printed model of the designed structure.

Schedule

Weekly Group Work Schedule:

- Group meetings were conducted every Monday, Tuesday, and Thursday for one hour to follow up on assigned tasks, complete assignments, and coordinate as a team with the sponsor about upcoming milestones.

- Each team member dedicated 4 hours of personal time per week to focus on tasks that they had been specifically assigned.

- Communication with the client for this project was completed through the sponsor. Weekly communication was established with Paul Thorley via phone calls, in-person meetings, and emails.

The project was divided into four stages of work, each representing a milestone in the project. Each stage was defined within the first week of work.

- Stage 1: Students worked with Paul to research the organization of the UNTF and to understand their expectations for the project, including design criteria for the various locations.
  - This stage was completed on November 12, 2018.

- Stage 2: Students developed the engineering for the housing plans.
  - Engineering was completed on February 4, 2019.

- Stage 3: Students prepared a bill of materials for the housing plans. Only structural items were included.
  - The bill of materials was completed on March 28, 2019.

- Stage 4: Students compiled a report consisting of the housing plans, structural details, all relevant calculations, and a bill of materials.
  - The final product was completed on April 15, 2019.

Project Timeline:

- September 24, 2018: Introductory meeting with Paul Thorley.
- October 1, 2018: Research begun to understand the history and organization of the UNTF.
- October 15, 2018: Research completed on the UNTF. Began researching locations where the homes will be built.
- October 25, 2018: Design locations finalized. Created a map of locations for reference.

- October 29, 2018: Research begun to gather design criteria for each location.
- November 5, 2018: Plans received for engineering.
- November 12, 2018: Design criteria established.
- December 3, 2018: Engineering completed using IBC methodology with Acute Tools.
- January 7, 2019: Engineering begun using IRC methodology.
- February 4, 2019: Engineering completed using IRC methodology.
- March 14, 2019: 3D Model completed.
- March 28, 2019: Bill of materials completed.
- April 15, 2019: Final product delivered.

Assumptions & Limitations

Design criteria were determined for a wide range of locations across Southern Utah and Northern Arizona. The worst-case scenarios were selected for each design variable (frost depth, snow load, etc.). The design criteria based on the worst cast Utah locations were applied to the Arizona locations. No specific site locations were identified as the scope of the project incorporates multiple localities. As a result, the engineering for specific locations could be reassessed based on site-specific criteria. The designs were completed according to the 2015 edition of the IBC, in accordance with the 2015 Utah Statewide Amendments to the IBC. This portion of the project was completed before the 2018 edition of the IBC was adopted by the state of Utah. It should be noted that updates in the most recent code have allowed for more accurate snow load calculations in some of the areas. Limited geotechnical data were available for the predefined areas outlined for this project, and assumptions were made in accordance with Section 11.4.2 of Minimum Design Loads for Buildings and Other Structures (ASCE 7-10).

The B^4 Engineering capstone group provided work for this capstone project “as is” using best practices and with best effort. Project results cannot be construed as work performed by licensed professionals and cannot be used as “stamped deliverables” without first being reviewed, approved, and stamped by a qualified and relevant licensed professional structural engineer.

Design, Analysis & Results

To begin the design process, the latitude and longitude coordinates were identified for each of the UNTF chapter locations involved in this project. For each chapter, the chapter headquarters was used as the location in question. A total of eleven chapters were identified for this project and are included on the map in Appendix B. The location information can be seen in Table 1. Using the 2015 Utah Statewide Amendments to the IBC, the ground snow loads were calculated and the values for frost depth were obtained. ASCE 7-10 was used to obtain the values for the design wind speed and the wind exposure category for each location. These values are given in Table 2.

Table 1. Utah Navajo Trust Fund Chapter Locations

Chapter	Latitude	Longitude	Elevation	County	Nearest City	Zip Code
Aneth	37d 15' 38.24"	-109d 18' 26.52"	4500	San Juan	Aneth	84534
Dennehotso	36d 50' 26"	-109d 51' 7.9"	5000	Apache (AZ)	Dennehotso	86535
Mexican Water	36d 58' 1"	-109d 38' 16"	5200	Apache (AZ)	NA	84531
Navajo Mountain	37d 1' 1"	-110d 47' 48"	6000	San Juan	Navajo Mountain	86044
Oljato	37d 0' 15"	-110d 10' 22.8"	5200	San Juan	NA	84536
Red Mesa	37d 3' 53.5"	-109d 21' 49.8"	5450	San Juan	NA	84534
Teec nos pos	36d 55' 16"	-109d 5' 8"	5250	Apache (AZ)	NA	86514
Blanding (BMDC)	37d 37' 24"	-109d 28' 44"	6100	San Juan	Blanding	84511
Monticello (BMDC)	37d 52' 9"	-109d 20' 31"	7100	San Juan	Monticello	84535
Bluff (BMDC)	37d 17' 1"	-109d 33' 10"	4300	San Juan	Bluff	84512
Westwater (BMDC)	37d 37' 24"	-109d 28' 46"	6100	San Juan	Blanding	84511

Table 2. Engineering Design Criteria

Chapter	Soil Classification	Roof Snow Load (psf)	Ground Snow Load (psf)	Frost Depth (in)	Wind Speed (mph)	Wind Exposure
Aneth	D	30	43	20	115	C
Dennehotso	D	30	43	20	115	C
Mexican Water	D	30	43	20	115	C
Navajo Mountain	D	30	43	20	115	C
Oljato	D	30	43	20	115	C
Red Mesa	D	30	43	20	115	C
Teec nos pos	D	30	43	20	115	C
Blanding (BMDC)	D	30	43	20	115	C
Monticello (BMDC)	D	35	50	20	115	C
Bluff (BMDC)	D	30	43	20	115	C
Westwater (BMDC)	D	30	43	20	115	C

Once the design criteria were established for all of the proposed locations, the architectural drawings for each of the three housing plans were analyzed to identify all of the structural elements. These elements were engineered according to the design parameters for the worst case location, which corresponded to the Monticello location. The structural engineering for these plans was completed using both the prescriptive approach from the IRC and the design process corresponding to the IBC, in accordance with the Utah Statewide Amendments to the IBC by using the Acute Process. For the IBC methodology, the structures were classified as risk category II. The results from both of these design methods were compared with the original callouts on the architectural drawings. These comparisons can be seen in Tables 3 and 4. 'T' and 'K' refer to trimmers and full-height king studs, respectively.

Table 3. Design Comparison I

	Acute Process/IBC		IRC		Original	
Location	Beam	Support (T/K)	Beam	Support (T/K)	Beam	Support (T/K)
Rear 3030	(2) 2X6	1/1	(2) 2X4	1/1	(2) 2X6	1/1
Rear Door	(2) 2X6	1/1	(2) 2X4	1/1	(2) 2X6	1/1
Rear 1640	(2) 2X6	1/1	(2) 2X4	1/1	(2) 2X6	1/1
Rear 4040	(2) 2X6	1/1	(2) 2X6	1/2	(2) 2X6	1/1
Left back 4040	(2) 2X6	1/1	(2) 2X6	1/2	(2) 2X6	1/1
Left front 4040	(2) 2X6	1/1	(2) 2X6	1/2	(2) 2X6	1/1
Front 5040	(3) 2X8	1/1	(2) 2X8	2/3	(3) 2X6	1/1
Front door	(2) 2X6	1/1	(2) 2X4	1/1	(2) 2X6	1/1
Front left 4040	(3) 2X6	1/1	(2) 2X6	1/2	(2) 2X6	1/1
Front right 4040	(3) 2X6	1/1	(2) 2X6	1/2	(2) 2X6	1/1
Right 3010	(2) 2X6	1/1	(2) 2X4	1/1	(2) 2X6	1/1
Front 8040	(2) 1.75X9.5 LVL	1/1	(2) 2X12	2/3	(2) 2X10	1/1
Front porch	(2) 2X8	4X4	(2) 2X6	(2) 2X4	(2) 2X8	Not Specified
Rear porch	(2) 2X8	4X4	(2) 2X6	(2) 2X4	(2) 2X8	Not Specified
Floor Beams	(3) 2X10	4X4	(3) 2X12	(2) 2X4	(2) 2X10	4X4

Table 4. Design Comparison II

Member	Acute Process/IBC	IRC	Original
Roof Sheathing	7/16" OSB	5/8" OSB	7/16" OSB
Roof Nailing	8d @ 12" O.C. field, 6" O.C. edge	8d @ 12" O.C. field, 6" O.C. edge	8d @ 8" O.C. field, 6" O.C. edge
CMU Fdn. Walls	8"X8"X16"	8"X8"X16"	8"X8"X16"
Footing	10"X20"	6"X20"	10"X20"
Rebar	24" O.C.	48" O.C.	24" O.C.
Grouted Cells	Fully grouted	48" O.C.	24" O.C.
Washers	--	3"X3" (slotted)	3"X3" (slotted)
Anchor Bolts	1/2"Ø @ 72" O.C.	1/2"Ø @ 72" O.C.	1/2"ØX10" @ 24" O.C.
Wall Studs	2x6 @ 24" O.C.	2x4 @ 24" O.C.	2x6 @ 24" O.C.
Rafters	2x4 @ 24" O.C.	2x4 @ 24" O.C.	2x4 @ 24" O.C.
J Bar	--	48" O.C.	24" O.C.
Slab	4"	3.5"	4"
Dowels to FW (slab)	--	--	#4 @ 24" O.C.
Floor Joists	2X10 @ 16" O.C.	2X10 @ 16" O.C.	9-1/2 TJI @ 16" O.C.
Footing Rebar	(2) #4	(1) #4	(2) #4, lap 30 bar Ø
Floor Sheathing	3/4" OSB	--	3/4" OSB
Floor Nailing	8d @ 12" O.C. field, 6" O.C. edge	8d @ 12" field, 6" O.C. edge	8d @ 8" O.C. field, 6" O.C. edge
Wall Sheathing	7/16" OSB	7/16" OSB	7/16" OSB
Wall Nailing	8d @ 6" O.C.	No. 8 screws @12" O.C. field, 4" O.C. edge	Not Specified

One design was selected in its entirety for recommendation to the UNTF. Although the IRC methodology resulted in a few structural members being more cost effective when compared to the same members engineered using the IBC methodology, there were several items that were deemed as nonconservative or impractical. The wall stud spacing given in the IRC was not permitted under calculated prescriptions of the IBC. Additionally, requiring screws for shear walls was considered more work than seemed reasonable for unskilled laborers. As such, the design results from the IBC are the recommendation for this project. The housing plans marked with the updated engineered structural members have been included in Appendix C. The structural calculations for each housing plan and the IRC code references for each of the elements are found in Appendices D and E, respectively. It is noted that both options for the Nizhoni house plan were included in the same structural report. The bill of materials for each plan has been included in Appendix F.

Lessons Learned

Inherent in the process of engineering comes the need to follow code. Understanding the various codes and how they interact with one another is necessary to be a successful engineer. This project is in a location where the local jurisdiction does not require the use of any specific codes. The governing body for these residential structures is not the state of Utah, the state of Arizona, or even the United States of America. This presented an interesting case for the students to determine how to design a structurally sound house when no governing body would need to approve the design. From an ethical standpoint, the structural members of the housing plans were nevertheless designed according to industry standard codes. Both the 2015 IBC and the 2015 IRC were used in analysis. A comparison of the resulting structural members, those designed using the IBC methodology and those designed using the IRC methodology, is included. This presented the team with a difficult question to answer: which code should be followed for these plans?

Both codes present methodologies of design considered valid in the state of Utah and produce acceptable results. Both are also used in the industry today. There are clear distinctions, however, between the two that make it helpful to understand their nuances. Following one code for a certain part of the structure and another code for another part of the structure is not a permissible practice, one code must be used to engineer the entire structure. This eliminates the option of selecting the most economical solutions from each methodology and combining them to create the most economical house plan.

A basic understanding of the difference between the two codes was necessary for the team to complete the capstone project. According to the International Code Council,

> "The *International Residential Code* was created to serve as a complete, comprehensive code regulating the construction of single-family houses, two-family houses and buildings consisting of three or more townhouse units. All buildings within the scope of the IRC are limited to three stories above grade plane… The benefits of devoting a separate code to residential construction include the fact that the user need not navigate through a multitude of code provisions that do not apply to residential construction in order to locate that which is applicable."[1]

The housing plans under consideration fulfil the criteria of the IRC, thus it is an allowable code to use as reference for engineering.

According to the International Code Council,

> "The *International Building Code* is a model code that provides minimum requirements to safeguard the public health, safety and general welfare of the occupants of new and existing buildings and structures… The IBC addresses structural strength… [and] applies to all occupancies, including one- and two-family dwellings and townhouses that are not within the scope of the IRC."[2]

The housing plans under consideration fulfil the criteria of the IBC, thus it is an allowable code to use as reference for engineering in addition to the IRC.

Of the two codes under consideration, the team chose to select the analysis performed using the IBC methodology. As the IBC is based on calculated values dependant upon material properties rather than prescriptive methods, the team's confidence in this method was greater than the results from the IRC. It was also noted that based on calculations, the structural members required by the IBC were larger than many of the members specified by the IRC. The students also note that in several instances, structural members that were specified by the IRC were found to be excessive and unreasonable when compared to the calculated results in the IBC.

The 3D model created for this project was modeled using Revit due to the collaborative abilities inherent in the program. A central file for modeling was created using the campus network drive to allow for multiple users to work simultaneously. The capstone group encountered many mapping and permission errors while attempting to access this, thus it was determined that one group member would be responsible for creating the model. Such technological issues are often encountered unexpectedly. Although a specific problem may be unforeseen, the fact that such roadblocks could arise should be anticipated whenever using computer software.

Conclusions

Many factors must be considered when engineering a structure, such as cost, ease of construction, and access to materials. Additionally, there are multiple codes that can be followed when performing the engineering. Both the 2015 IBC and the 2015 IRC are acceptable codes to use when engineering a house. It is not recommended by the capstone group that the structural designs are performed using specifications from both codes; the design should be completed based on either the IBC or the IRC.

When comparing the original callouts specified by the client to the results of the IBC and IRC methodologies, the students determined that the original design had several structural elements that were inadequate for the anticipated loads. The capstone group recommends a design using the 2015 IBC. This design specifies structural elements and components that have been calculated while incorporating material properties and worst-case design criteria. Calculations have been performed that can demonstrate the structural stability of elements that are easy to construct. This was the primary concern when evaluating the structural designs. For example, the IRC proscribes that shear walls be constructed using screws. Although this would produce a design that is structurally sound, it would not be practical for rapid construction. Beams and supports could also be designed so that the same lumber size could be used as often as possible, thus simplifying the construction. The IRC sizes structural members according to proscribed loading conditions and building dimensions. The IBC allows for the designs of structural elements to incorporate the actual loads that each individual member will be subjected to, producing a more accurate design when compared to the IRC. It was also noted that some structural elements specified by the IRC were smaller than those obtained using the calculations proscribed by the IBC. While both are valid methods to use and the IBC is potentially overly conservative in some instances, the capstone group decided to use the IBC methodology.

Recommendations

It is the recommendation of this capstone group that the design using the IBC methodology be used. For consistency, future updates to the engineering for other housing plans should be completed using the IBC methodology. Given that the 2018 editions of the IBC and the IRC and ASCE-16 will be adopted beginning the summer of 2019, a different design could be implemented in the future. Of particular note are the design snow loads that will be changed in the upcoming edition of the code. Using a different design snow load would impact header sizes, stud spacing, and footing sizes.

Given that the worst-case design criteria were used for this project, a site-specific analysis could be performed for each different location. This would be particularly useful for locations outside of Monticello, which has the most stringent design constraints. A more in-depth cost analysis could be performed on specific elements, such as the foundation, to further reduce the cost of the homes.

Appendix A: Team Member Resumes

Benjamin D. Arrington

98 Wymount Terrace Provo, UT 84604 | Phone: 407.508.8083 | Email: benarrington70@gmail.com

Skills

I am proficient in Microsoft Office, Autodesk AutoCAD & Revit, and troubleshooting computers. I am used to managing my time efficiently with little to no supervision, learn very quickly, problem solve, and work hard. I can collaborate clearly and kindly with coworkers, superiors, and clients.

Experience

~ **Construction Manager and Co-President for EERI BYU Student Chapter**

Provo, UT *January 2018 – Present*

- Counselled with group about seismic competition building design
- Helped implement construction design in time for competition in Los Angeles
- Modeled building design architecturally in Revit

~ **Building Modeler for BYU Physical Facilities - Planning Department**

Provo, UT *May 2017 – Present*

- Constructed models and plans of renovations to existing structures
- Entirely modeled buildings maintained and owned by BYU in coordination with their architects
- Managed working on multiple projects simultaneously
- Provided tech support to other modelers.

~ **CAD Technician for C M Arrington & Associates, INC.**

Kissimmee, FL *June 2015 – May 2017*

- Designed and put together construction plans for site development projects for the Professional Engineer and Surveyor using Autodesk AutoCAD software
- Worked under deadline constraints for multiple tedious projects simultaneously
- Worked with engineers and other technicians to complete assignments
- Managed my own schedule working remotely in Provo

~ **Drafting and CAD Teaching Assistant at Brigham Young University**

Provo, UT *September 2016 – May 2017*

- Taught students how to use AutoCAD and Revit software to complete assignments
- Shared insights into using the basic tools of the programs effectively and efficiently

~ **Construction Worker and Ticket operator for CKA LLC. Site Development**

Kissimmee, FL *October – November 2015*

- Assisted in laying sewer pipe and lift station
- Supervised the site for safety
- Assisted an excavator operator

Minot, ND & Kissimmee, FL *August – September 2012*

- Managed ticket distribution for truck drivers collecting material for construction sites
- Organized the information for billing in Excel

Major Accomplishments

~ Served 2 years in the Nevada Reno Mission of the Church of Jesus Christ of Latter-day Saints
~ Happily married since May of 2016
~ Eagle Scout

Education

Undergraduate Civil Engineering student with a structural emphasis at BYU since 2012; expected to graduate in April of 2020. Taken courses in structural analysis; elementary soil mechanics; elementary fluid mechanics; basic metals, woods, and composites; and basic concrete, masonry, and asphalt.

Zachary Barnett

zacbarnett12@gmail.com 566 Wymount Terrace Provo, Utah 84604 435-650-9479

Education:

Bachelor of Science in Civil Engineering — April 2019
Brigham Young University — *Provo, Utah*
- 3.87 Cumulative GPA

Associate of Science in General Studies — July 2015
Brigham Young University-Idaho — *Rexburg, Idaho*

Experience:

Student Engineer — April 2018-Present
Acute Engineering — *Orem, Utah*
- Perform accurate structural engineering on various light frame structures in accordance with the building codes adopted by the local jurisdiction
- Familiar with ASCE 7, NDS, and AISC structural design methods and specifications
- Perform structural engineering on plans that are in need of revisions during the construction phase

BYU Student Chapter Co-President — Jan. 2018-Aug. 2018
Earthquake Engineering Research Institute — *Provo, Utah*
- Direct 15 students in creating a skyscraper building design that can withstand simulated earthquake loads
- Coordinate with professors and local engineering firms to ensure reasonable design practices
- Prepare the BYU student chapter to qualify for and participate in 2018 national EERI competition

Teaching Assistant — Sep. 2016- April 2018
Brigham Young University Civil Engineering Department — *Provo, Utah*
- Tutor students on physics and engineering concepts
- Proper grading of homework in a timely manner
- Teach class lectures and test review sessions as necessary

Laboratory Technician — Aug. 2015-Dec. 2015
Horizon Laboratories — *Price, Utah*
- Demonstrate accuracy and precision in laboratory testing procedures and the recording of test data

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Skills:

Technical Computer Programs
- Proficient in Microsoft Excel and Word
- Proficient in Bluebeam, Forte, and MathCAD
- Experience with AutoCAD, SAP2000, RAM Steel, Revit, and RetainPro

Education

B.S. Civil Engineering, *Brigham Young University* Graduation: April 2019

- 3.90 GPA
- Coursework: Steel Design, Reinforced Concrete Design, Timber Design, Hydraulics Design, GIS

Skills/Certifications

Passed FE Exam

Computer Programs

- Proficient in ArcGIS Pro, ArcMap, AutoCAD, Forte, Revit, SAP2000, and WaterCAD
- Experienced coding in VBA and Python

Professional Organizations

- Earthquake Engineering Research Institute – Student Chapter Co-President
- Structural Engineers Association of Utah – Student Member
- American Society of Civil Engineers – Student Member

Work Experience

Student Engineer, *Acute Engineering* April 2017-Present

- Utilized software to engineer up to 10 projects a week Orem, UT
- Relied on engineering judgment to provide solutions for onsite problems
- Prepared structural reports and project addendums submitted for city review
- Reviewed submittals for trusses, hardware, and materials from third-party suppliers

Statics Teaching Assistant, *BYU Civil Engineering Department* January 2017-April 2017

- Assisted students in mastering the principles of statics Provo, UT
- Graded 35 homework assignments on a weekly basis

Engineering Intern, *JWO Engineering* April 2017-August 2017

- Modeled basic structures and sites in AutoCAD Orem, UT
- Compared site plans to update utility maps using GIS and WaterCAD
- Prepared technical write-ups for projects, including sections of city ordinances

Research Assistant, *BYU Civil Engineering Department* April 2017-December 2017

- Developed web applications in Python and HTML code for modeling groundwater flow in worldwide locations Provo, UT

GIS Teaching Assistant, *BYU Civil Engineering Department* January 2017-April 2017

- Assisted 45 students in data collection using GPS and surveying methods Provo, UT
- Helped students master the basics of digitalization and analysis of data using GIS software

Drafting Teaching Assistant, *BYU Civil Engineering Department* August 2016-January 2017

- Helped students to master the basics of AutoCAD and Revit Provo, UT
- Troubleshooted problems with the programs and grade 40 assignments a week on both programs

Leadership

Volunteers Coordinator, *2016 ASCE National Student Steel Bridge Competition*

Squad Leader, *BYU Marching Band*

D A V I D H. B L A K E

69 Wymount Terrace
Provo, UT 84604

dhblake73@gmail.com
774-285-4261

EDUCATION

Civil Engineering Student, Brigham Young University — Graduate: April 2019

- Structural engineering emphasis — *Provo, UT*
- Member of ASCE and EERI — 3.6 GPA

WORK EXPERIENCE

Student Structural Engineer, Acute Engineering — Present

- Engineer structural members for single and multi-family structures — *Orem, UT*
- Completed RFIs from clients covering a whole range of topics
- Designed many custom structural details for unusual architectural features

Teaching Assistant, Engineering Applications of GIS — Fall/Winter 2017

- Taught students ModelBuilder and Python scripting in ArcMap — *Provo, UT*
- Instructed 38 students two times per week on various topics
- Updated the class manual from ArcMap to ArcGIS Pro
- Conducted and graded 12 labs and other related assignments

Water Resources Intern, Central Utah Water Conservancy District — Summer 2017

- Conducted field visits to 20+ water facilities to catalog facility and asset information — *Orem, UT*
- Coordinated with managers and operators to develop standard operating procedures for District facilities
- Summarized technical data for over 1000 company assets
- Reviewed record drawings and submittals to compare asset details

Student Production Leader, BYU Concessions — 2016

- Lead 100+ volunteers to maintain, stock and run football concessions — *Provo, UT*
- Supervised events at the Marriot Center (seats 19,000 fans) including basketball
- Managed over $300,000 of product in the warehouse

Electrician's Apprentice, VMA Electric — Fall/Winter 2015

- Worked in a 2-man team to analyze and solve customer's issues — *Marlborough, MA*
- Learned proper skills and techniques conforming with local code
- Improved asset management for stock

SKILLS

- People Skills: Global-mindset, amiable, patient, communicator
- Leadership Skills: BYU ASCE Officer, EERI officer, Eagle Scout
- Computer Skills: Advanced Excel, ArcMap/ArcGIS Pro modelling and scripting, VBA coding, proficient Python scripting

VOLUNTARY SERVICE

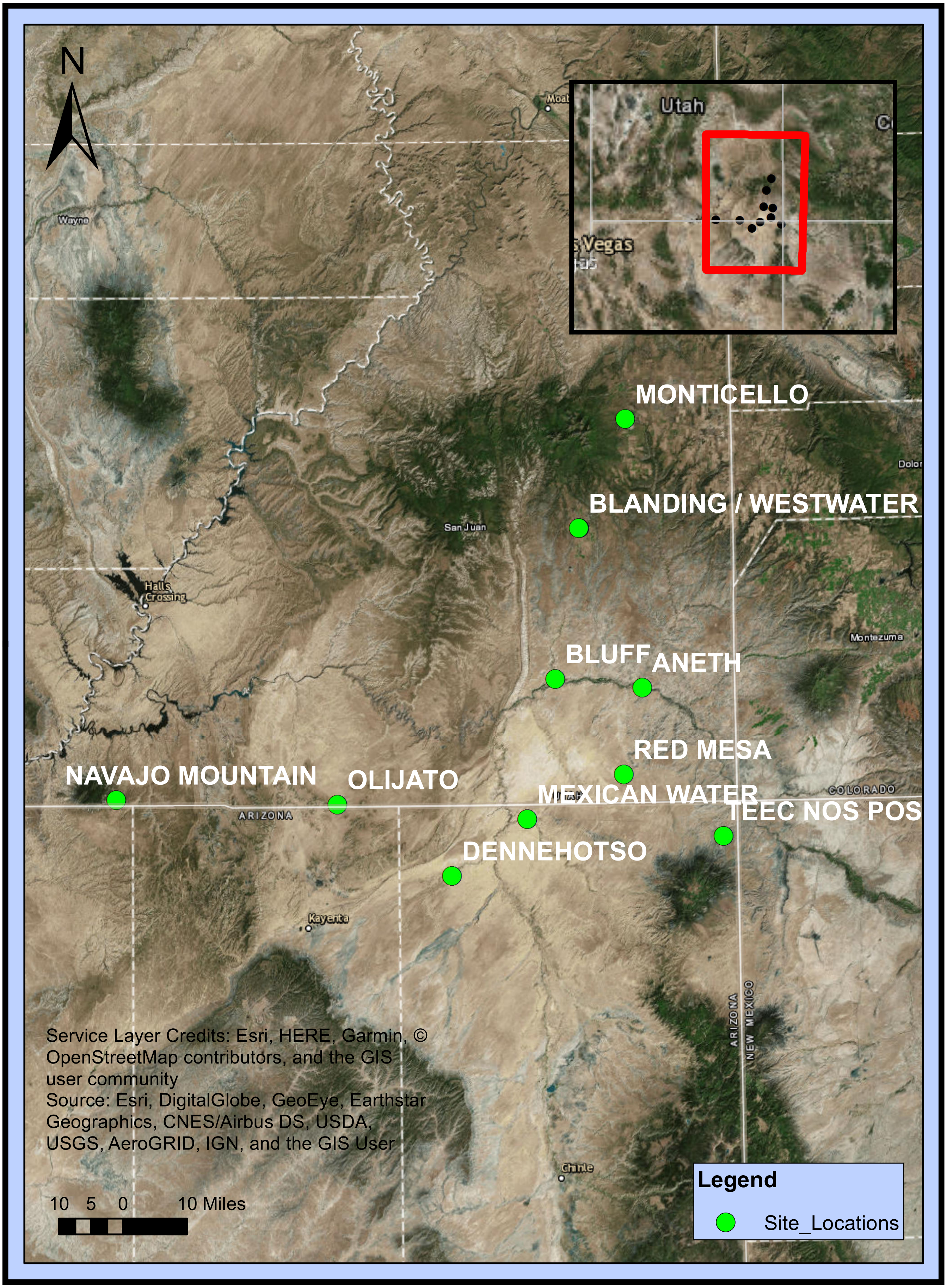
Full Time Volunteer, The Church of Jesus Christ of Latter-day Saints — 2013-2015

- Prepared and presented 90 trainings to groups of 5-20 volunteers — *New Zealand*
- Served community and individuals on a weekly basis

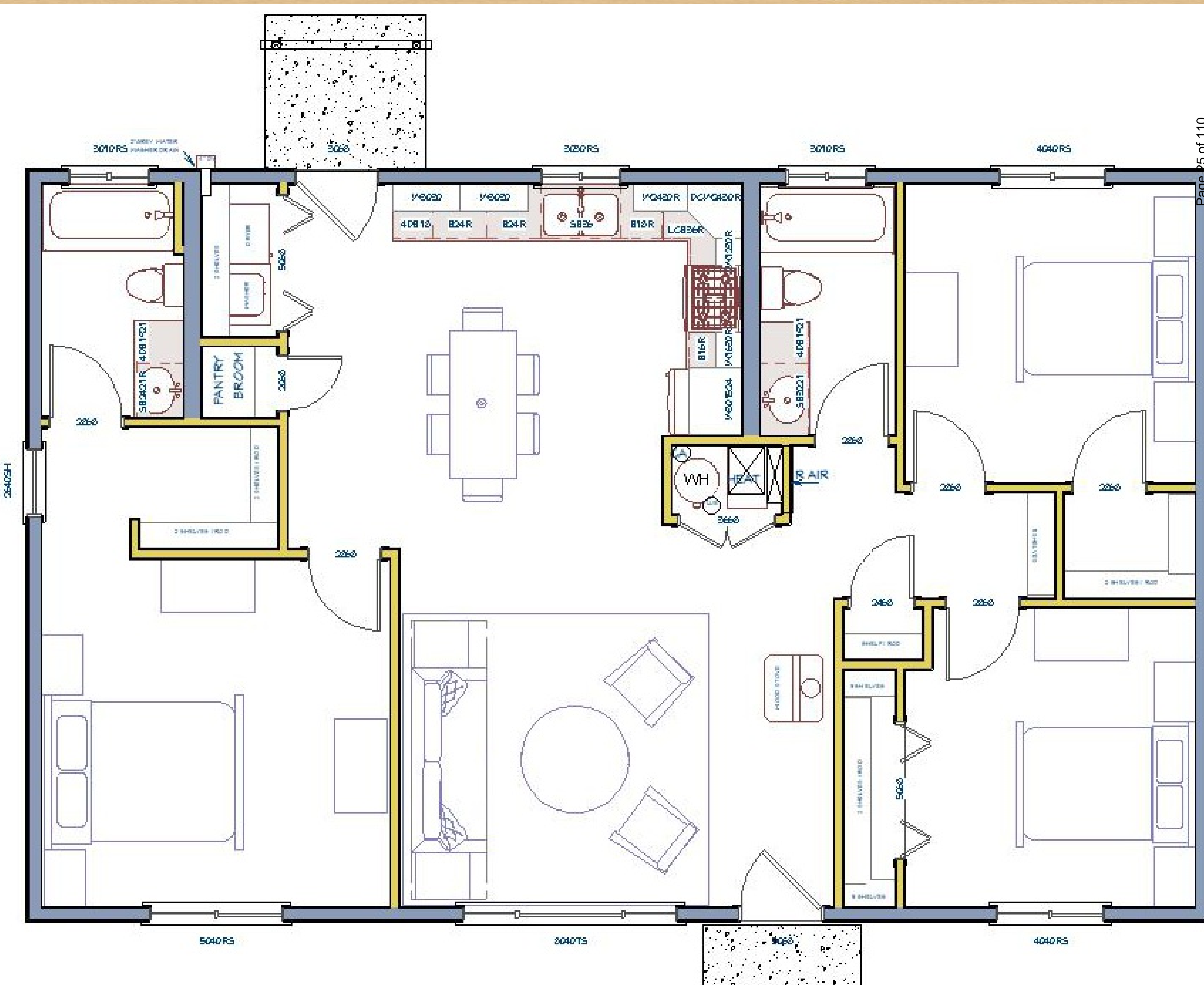
Community Service Projects

- Eagle Scout Project: Planned and organized 25 volunteers to build and replace 72-ft. of boardwalks on community trail
- Participated in BYU's Y-Serve club, Global Engineering Outreach club, volunteered for ASCE Concrete Canoe club, planned and prepared the trip to the 2018 Rocky Mountain Student Conference

Appendix B: UNTF Chapter Locations


N
Utah
MONTICELLO
BLANDING / WESTWATER
BLUFF
ANETH
RED MESA
NAVAJO MOUNTAIN
OLIJATO
MEXICAN WATER
TEEC NOS POS
DENNEHOTSO
Wayne
San Juan
Halls Crossing
Montezuma
COLORADO
ARIZONA
NEW MEXICO
Kayenta
Chinle
Service Layer Credits: Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User
10 5 0 10 Miles
Legend
Site_Locations

Appendix C: Structural Drawings



LIVING AREA 1232 S. FT.

Steve Perry's Design Solutions & Construction Inc.

COMB RIDGE PLAN

FLOOR PLAN
BACK- FRONT VIEW

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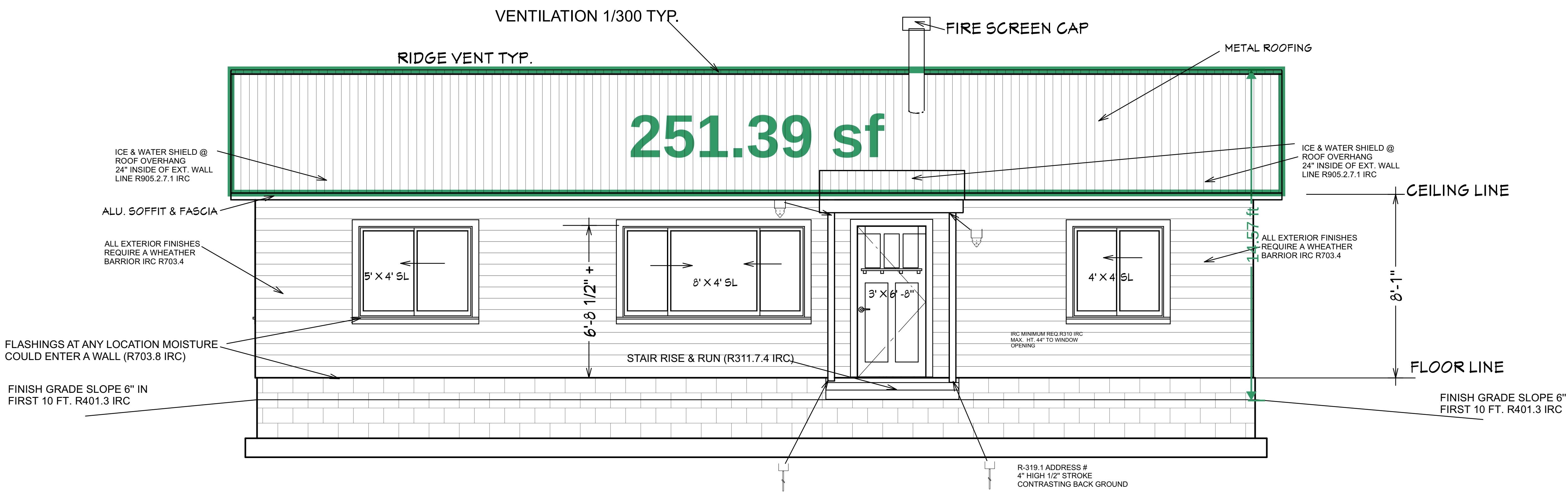
COMB RIDGE PLAN

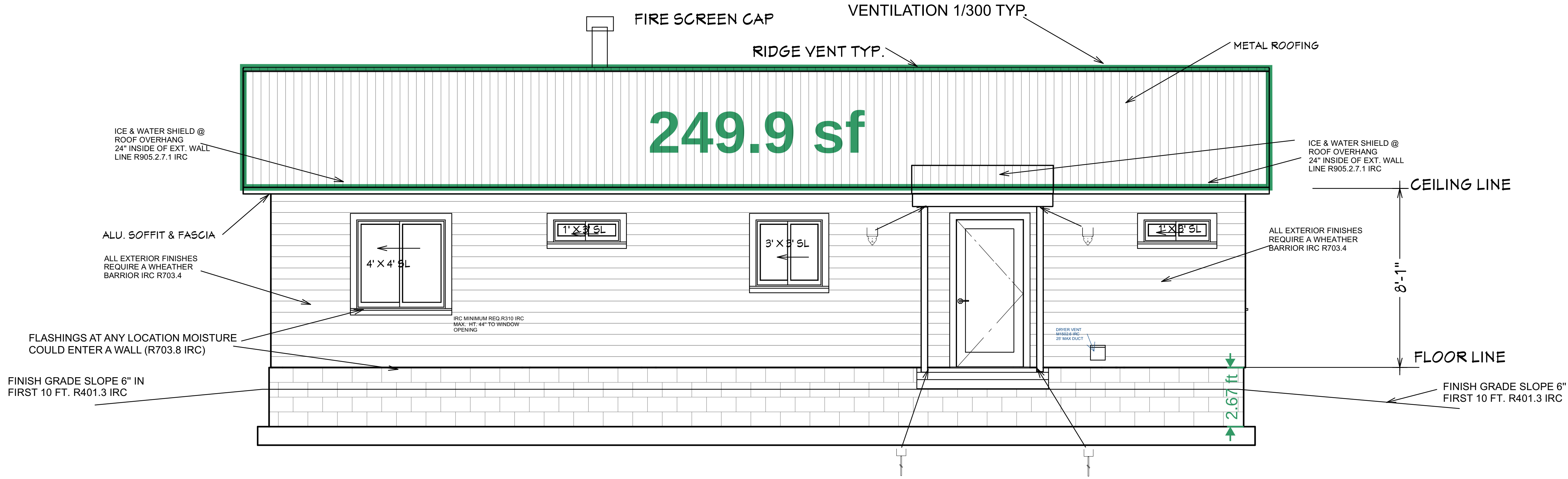
FRONT & BACK ELEVATIONS

4



FRONT ELEVATION

3/16" SCALE



BACK ELEVATION

3/16" SCALE

NOTE!

IT IS IMPORTANT FOR THE OWNER / BUILDER TO UNDERSTAND THAT THIS PLAN DOES NOT SHOW THE MANY CODE REQUIREMENTS FOR EACH ITEM SHOWN IN A PLAN! IT IS THEIR RESPONSIBILITY TO BE SURE THIS PROJECT IS CONSTRUCTED IN FULL COMPLIANCE WITH ALL STATE AND LOCAL CODES AND ORDINANCES. THESE PLANS ARE NOT ALL INCLUSIVE OF ALL THE MINIMUM CODES AND ORDINANCES. THIS FACT DOES NOT RELIEVE THE OWNER / BUILDER FROM FULL COMPLIANCE WITH ALL MINIMUM STANDARDS. NO OMISSION FROM THESE PLANS GIVES PERMISSION FOR VIOLATION OF ANY CODE OR ORDINANCE OR CAN BE USED AS A LIABILITY AGAINST THE PLAN DESIGNER. A PERMIT APPROVAL DOES NOT GRANT PERMISSION TO VIOLATE ANY CODE OR LOCAL ORDINANCE. THE 2010 BUILDING CODES ARE THE NEW 2009 EDITIONS OF THE IBC, IRC, IPC, IMC, IFGC, IECC, AND THE 2003 ANSI a117.1 AND NEC.

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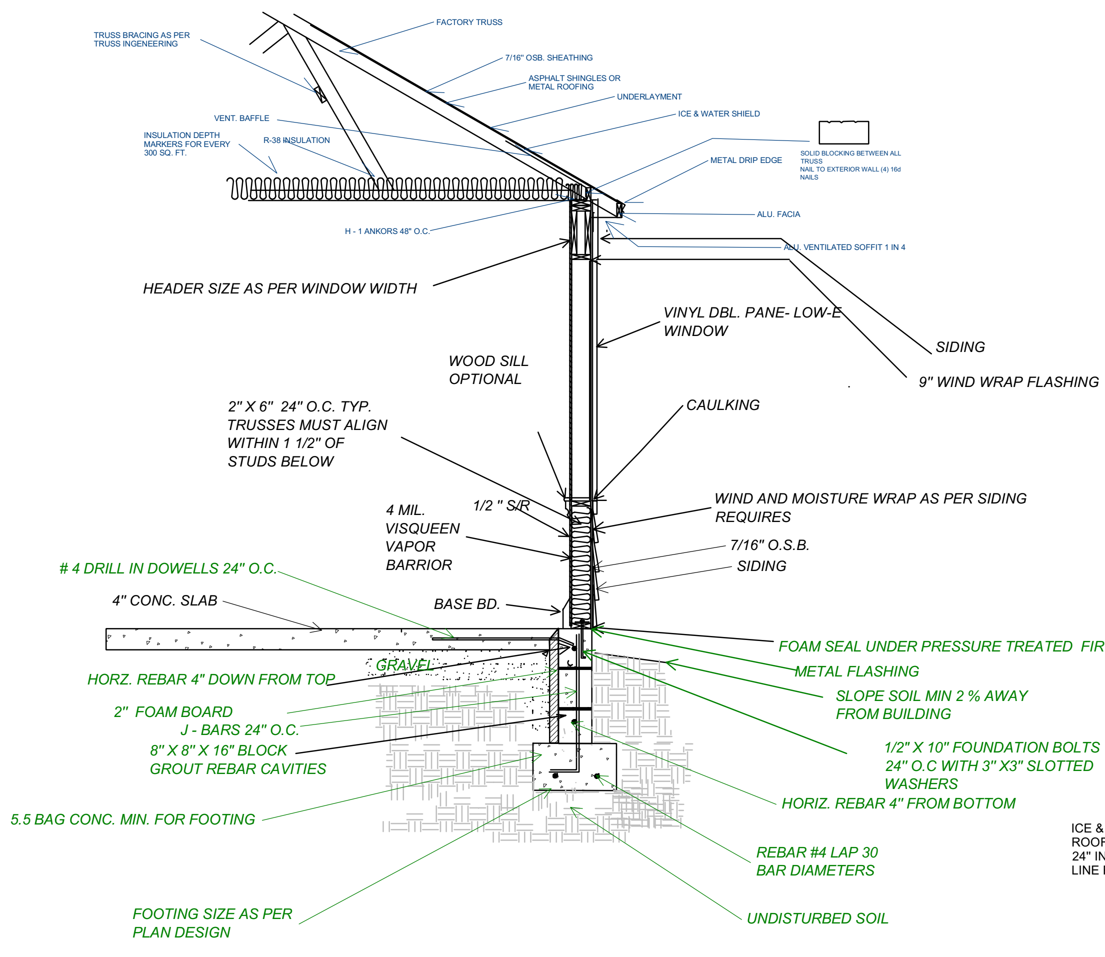
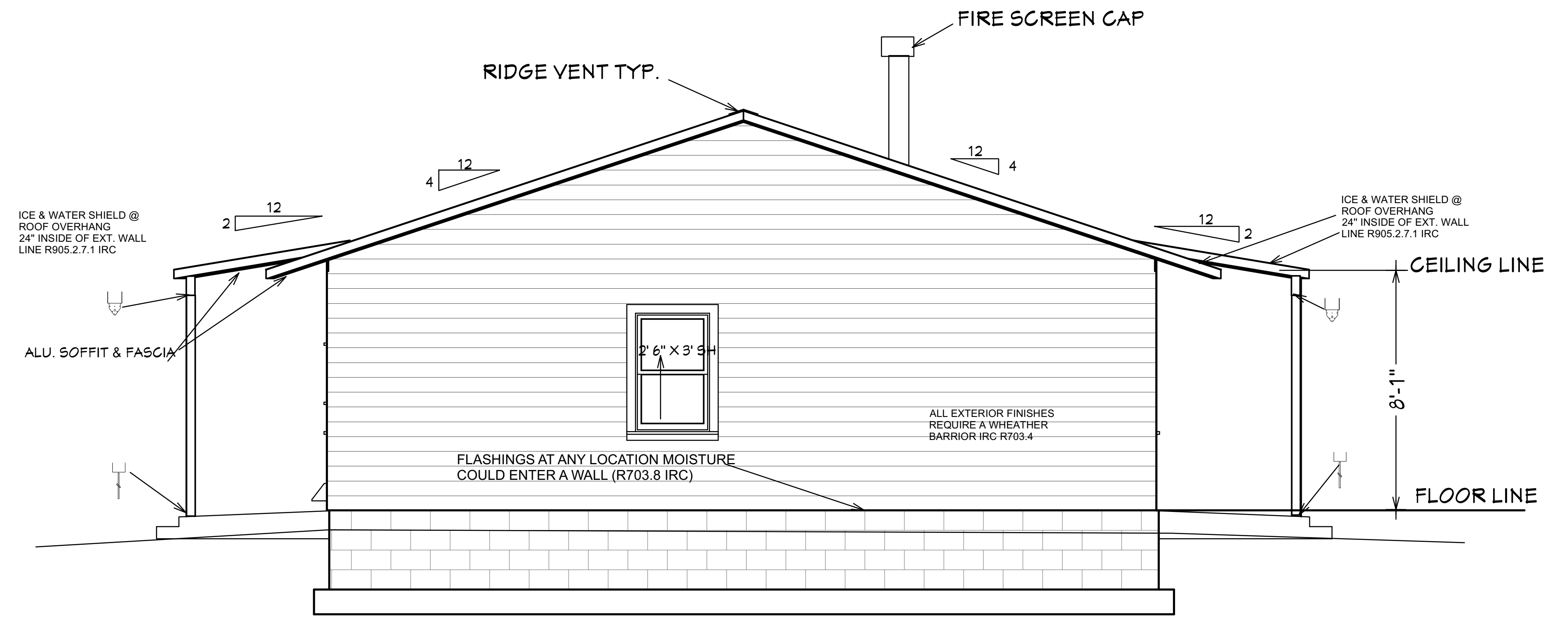
COMB RIDGE PLAN

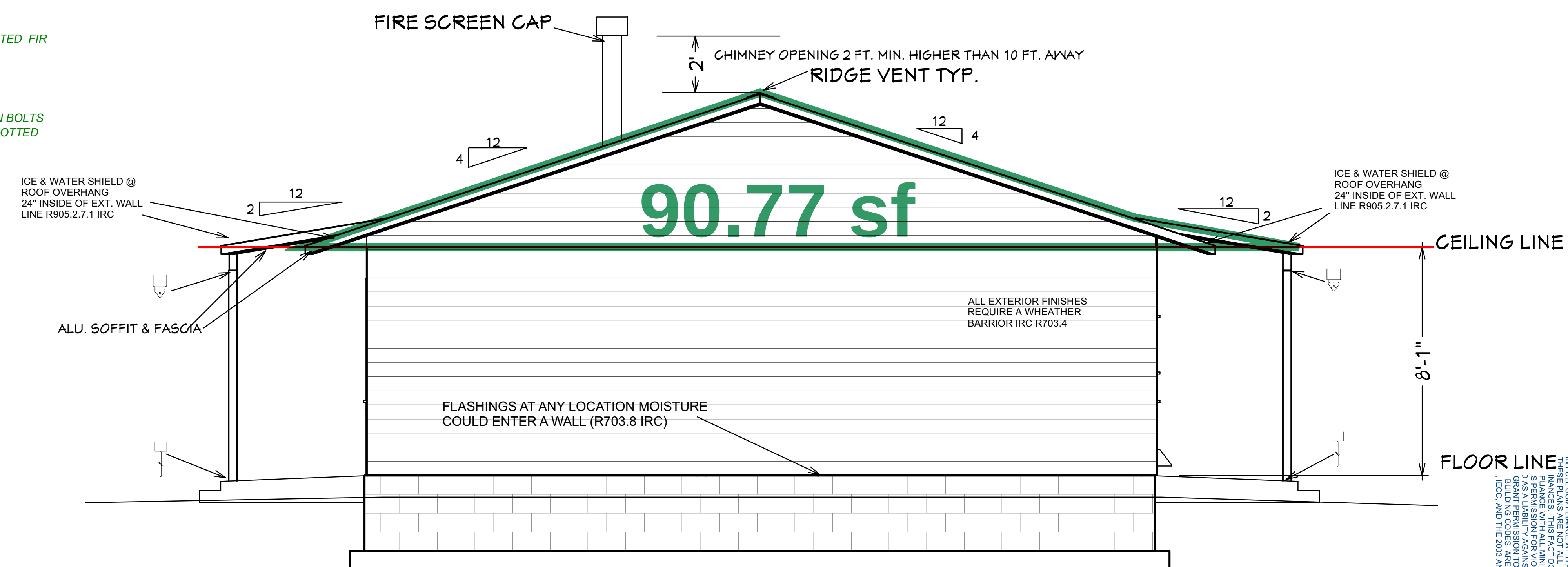


WALL - TRUSS DETAILS



LEFT ELEVATION

3/16" SCALE



RIGHT ELEVATION

3/16" SCALE

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END ELEVATIONS & WALL/ROOF DETAIL

5

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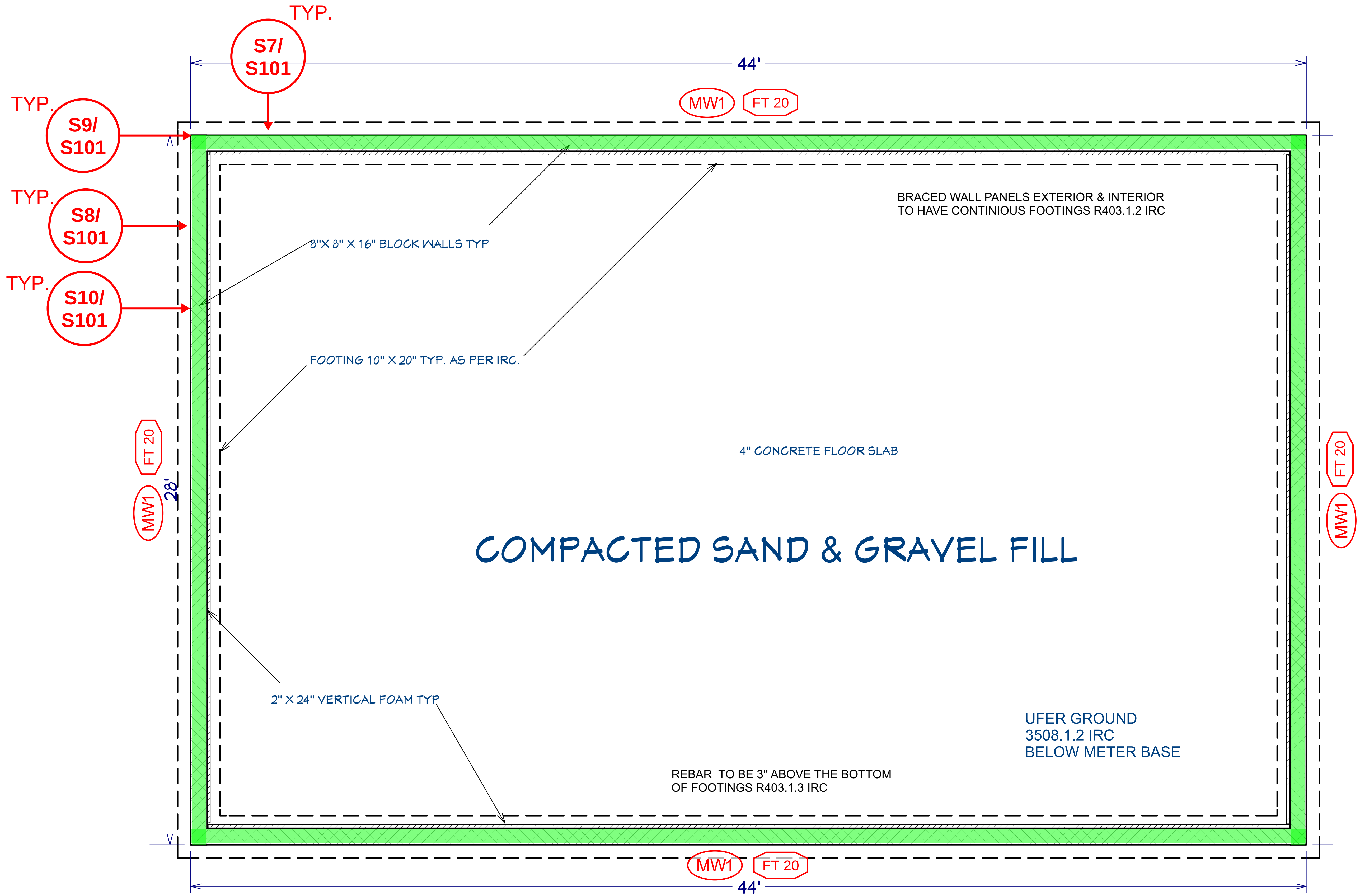
COMB RIDGE PLAN

FOOTING & WALLS
WALL 1/4" SCALE

2



FOOTING SCHEDULE

MARK	WIDTH	LENGTH	THICKNESS	REINFORCEMENT	
				TRANSVERSE	LENGTHWISE
FT20	20 "	CONT.	10 "	-	(2) #4

1. CONTINUOUS FOOTINGS SHALL BE CENTERED UNDER WALLS AND SPOT FOOTINGS SHALL BE CENTERED UNDER COLUMNS UNLESS NOTED OTHERWISE.
2. FOOTINGS AND FOUNDATIONS, EXCAVATIONS, GRADING, AND FILL SHALL COMPLY WITH THE PROVISIONS OF THE GEOTECHNICAL REPORT (SEE GSN)

MASONRY WALL SCHEDULE

MARK	TYPE	WIDTH	REINFORCEMENT			GROUT
			VERTICAL	HORIZONTAL	LAYER	
MW 1	CMU	8"	#4 @24" o.c.	(2)#4 @48" o.c.	CENTER	Solid

NOTE!

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COMB RIDGE PLAN

MAIN FLOOR
1/4" SCALE

3

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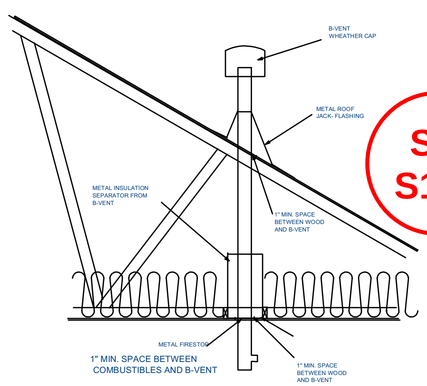
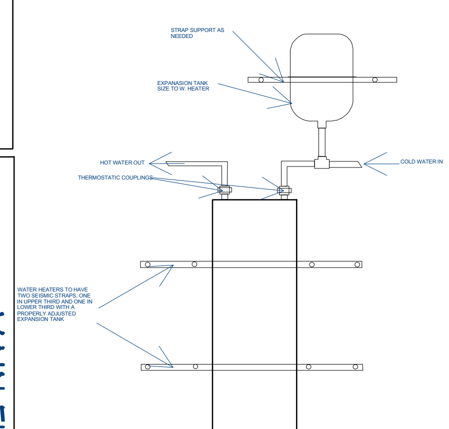
COMBUSTION AIR REQUIRED FOR ALL GAS FIRED APPLIANCES (G2407.5 & G2407.6 IRC) (R303.5IRC)



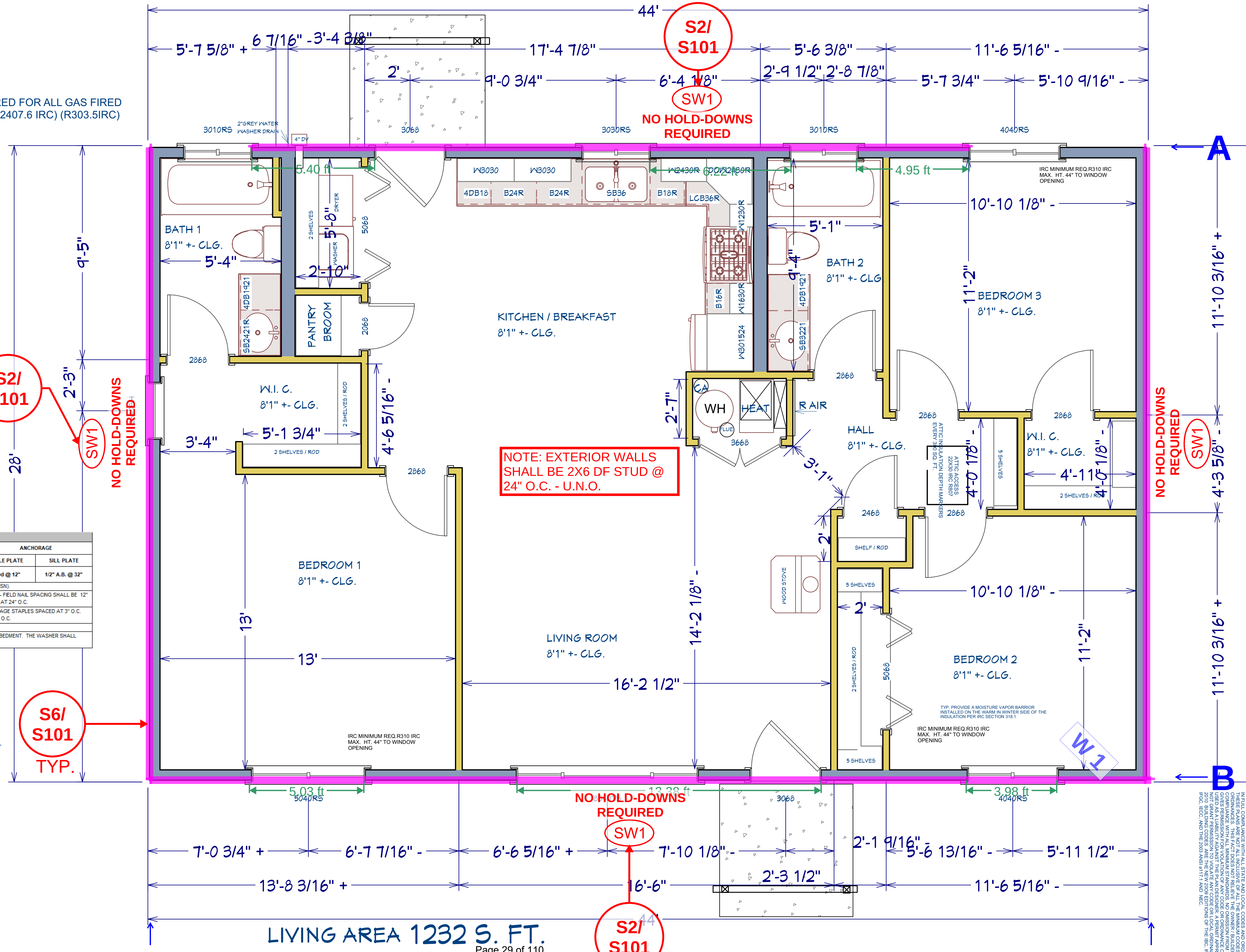
B-VENT DETAIL

SHEAR WALL SCHEDULE					
MARK	SHEATHING	EDGE NAILING	ABUTTING PANEL EDGE FRAMING	ANCHORAGE	
				SOLE PLATE	SILL PLATE
SW1	7/16"	8d @ 6"	2X	10d @ 12"	1/2" A.B. @ 32"

1. SHEATHING SHALL CONSIST OF WOOD STRUCTURAL PANELS (SEE GSN).
2. SHEATHING NAILS SHALL BE COMMON OR GALVANIZED BOX NAILS. - FIELD NAIL SPACING SHALL BE 12" FOR STUDS SPACED 16" O.C. OR LESS AND 6" O.C. FOR STUDS SPACED AT 24" O.C.
3. FOR SW1 ONLY, EDGE NAILS MAY BE SUBSTITUTED WITH 1-1/2" 16 GAGE STAPLES SPACED AT 3" O.C. AND FIELD NAILS MAY BE SUBSTITUTED WITH 16 GAGE STAPLES AT 12" O.C.
4. ANCHORAGE NAILS SHALL BE COMMON NAILS.
5. ANCHOR BOLTS SHALL HAVE A 3X3X0.229" WASHER AND 7" MIN EMBEDMENT. THE WASHER SHALL EXTEND TO WITHIN 1/2" FROM THE SHEATHING.



EXPANSION TANK & STRAP DETAIL



NOTE! IT IS IMPORTANT FOR THE OWNER / BUILDER TO UNDERSTAND THAT THIS PLAN DOES NOT SHOW THE REQUIREMENTS FOR LOCAL CODES AND ORDINANCES.

Steve Perry's Design Solutions & Construction Inc.

COMB RIDGE PLAN

ROOF TRUSS LAYOUT & NOTES

6

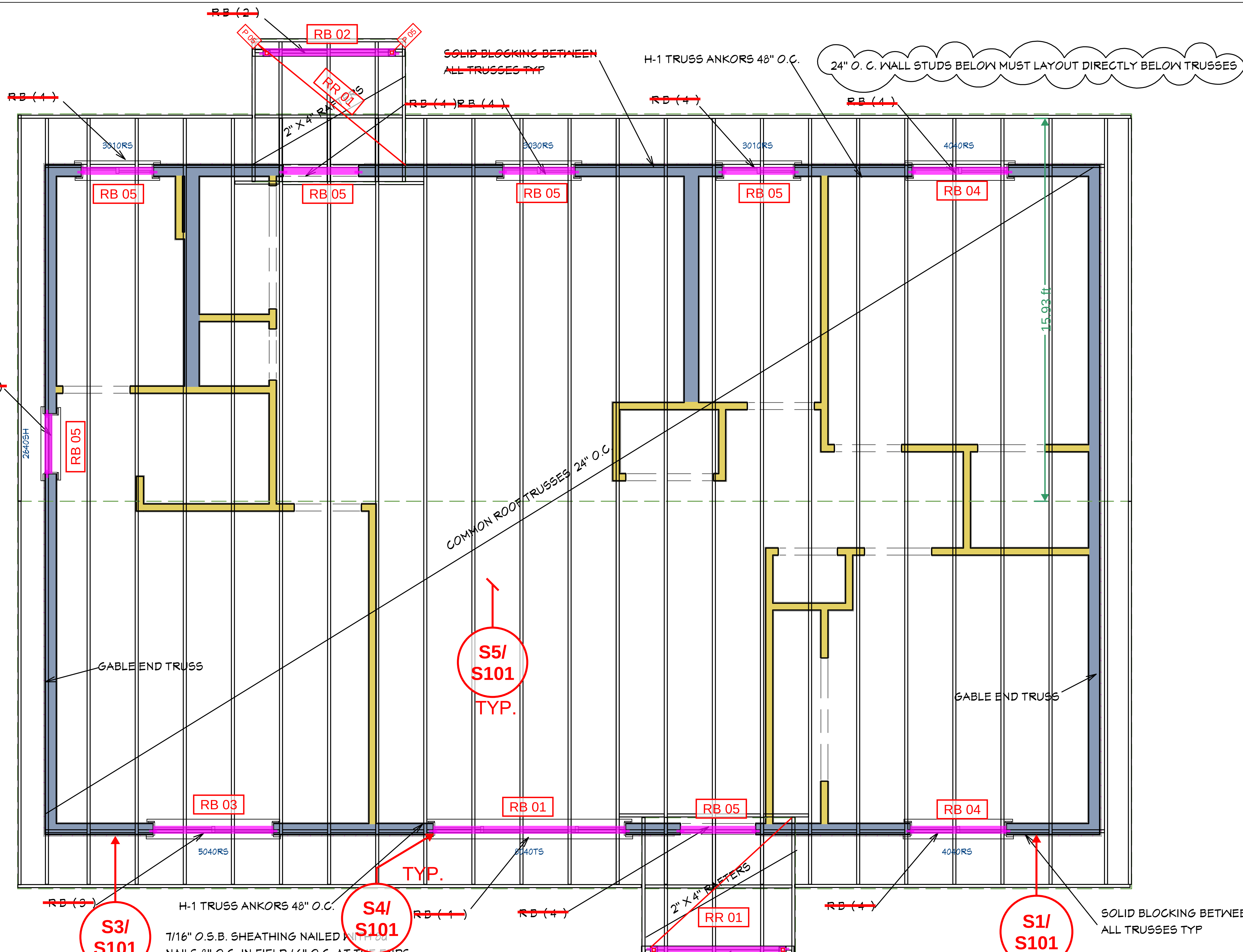
BEAM SCHEDULE	
MARK	TYPE
RB 01	(2) 1-3/4 X 9-1/2 LVL
RB 02	(2) 2 X 8
RB 03	(3) 2 X 8
RB 04	(3) 2 X 6
RB 05	(2) 2 X 6
1. DIMENSIONAL LUMBER DF#2 U.N.O.	
2. LAMINATED VENEER LUMBER (LVL) 2.0E	
3. GLUED-LAMINATED TIMBER (GLB) 24F-1.8E	
4. STEEL W-SHAPES A992-50	
5. SUFFIXES (A, B, ETC.) DENOTE ALTERNATIVES FOR THE SPECIFIED BEAM	

ROOF RAFTER SCHEDULE	
MARK	TYPE
RR 01	2 X 4 @ 24" O.C.
1. DIMENSIONAL LUMBER DF#2 U.N.O.	
2. SUFFIXES (A, B, ETC.) DENOTE ALTERNATIVES FOR THE SPECIFIED RAFTER	

SHEATHING SCHEDULE	
TYPE	THICKNESS
FLOOR	3/4" (48/24 SPAN RATING)
ROOF	7/16" (24/16 SPAN RATING)
1. SHEATHING PERPENDICULAR TO SUPPORTS.	
2. FLOOR SHEATHING NAILED & GLUED TO SUPPORT	
3. 8d COMMON NAILS 6" O.C. (EDGES) 12" O.C. (FIELD)	
4. NAILING NO CLOSER THAN 3/8" FROM PANEL EDGE	

WOOD TRUSS LOADS
GROUND SNOW LOAD, Pg = 57 PSF
FLAT ROOF SNOW LOAD = 35 PSF
TOP CHORD DEAD LOAD = 10 PSF
BOTTOM CHORD DEAD LOAD = 5 PSF
1. DESIGN SNOW LOADS SHALL BE IN ACCORDANCE WITH ASCE 7-10 CHAP.7 (2015 IBC 1608.1)

POST SCHEDULE	
MARK	TYPE
P 05	4 X 4 POST
1. PARALLEL STRAND LUMBER (PSL) 1.8E	
2. STEEL PIPE (PIPE STD) A53	
3. STEEL HOLLOW SECTION (HSS) A500	
4. STEEL COLUMNS REQUIRE BEARING PLATES	
5. CONTINUE POSTS TO FDN / STRUCT MEMBER	



TRUSS DESIGN DRAWINGS NEED TO BE ENGINEER REVIEWED TO VERIFY LOADING ON THE OTHER BUILDING COMPONENTS.THESE DRAWINGS MUST BE ON SITE FOR INSPECTION (R502.11.4 IRC, R802.10 IRC)

ROOF TRUSS LAYOUT

1/4" SCALE

NOTE!

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COMB RIDGE PLAN

ELECTRICAL

7

NOTE!

SMOKE DETECTORS IN EACH BEDROOM INTERWIRED. SMOKE-CARBON MONOXIDE DETECTORS IN A COMMON AREA AT EACH LEVEL INTERWIRED.

ARC FAULT PROTECTED CIRCUITS FOR ALL BEDROOM AREAS.

GROUND FAULT PROTECTED CIRCUITS OR OUTLETS IN ALL WET AREAS AND EXTERIOR LOCATIONS. EXTERIOR OUTLETS TO HAVE WEATHER PROOF COVERS.

2009 NEC 15-20 AMP BRANCH CIRCUITS TO BE PROTECTED BY A LISTED ARC-FAULT CIRCUIT INTERRUPTER-COMBINATION NEC 210.12

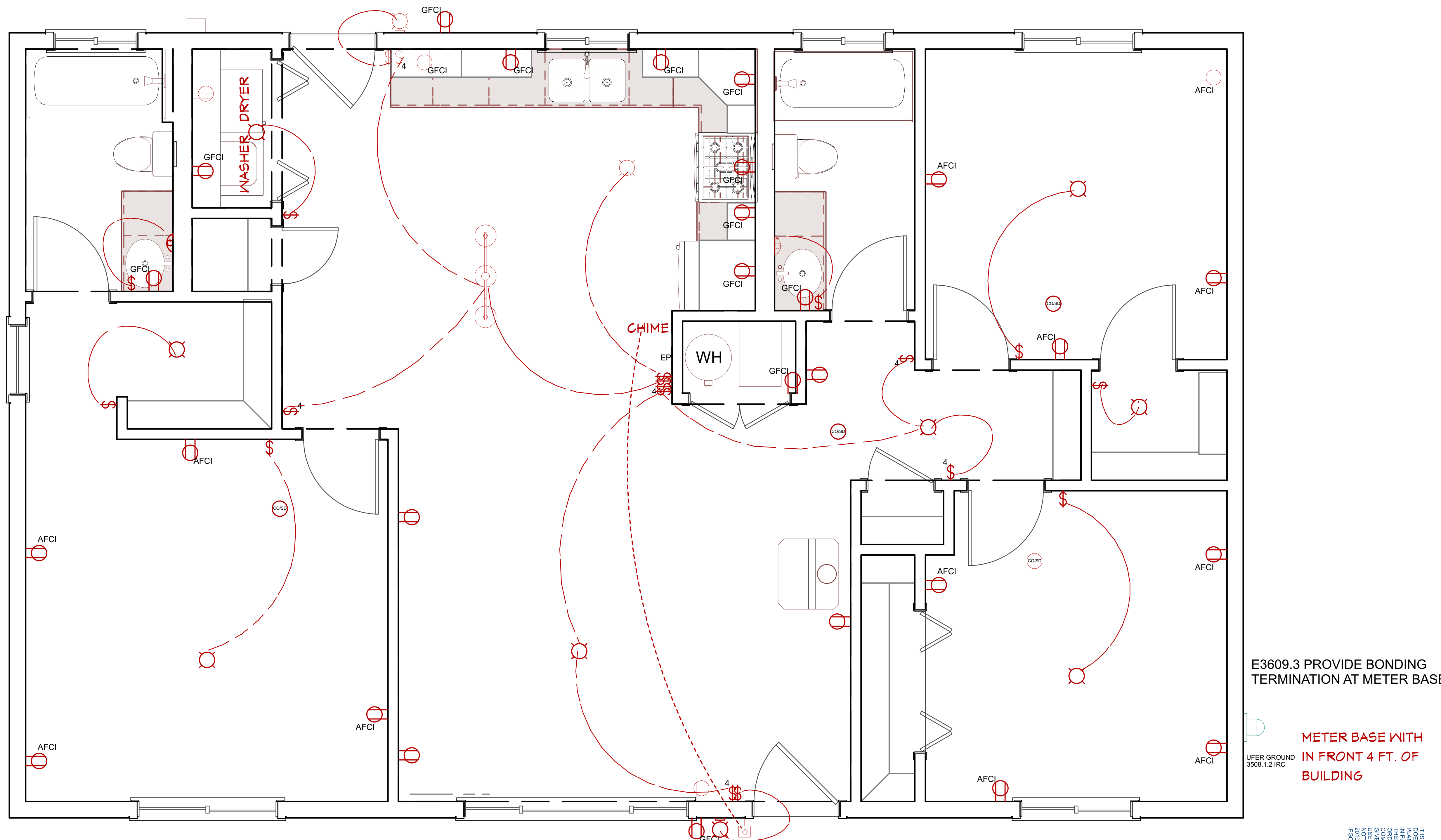
ELECT. CONDUCTORS PROTECTED WITH IN 6 FT. OF AN ATTIC ACCESS (E3802.2 IRC)

ELECT. PANEL CLEARANCES 30" X 36" OUT (E3609.4 IRC)

ELECT. CONDUCTORS PROTECTED WITH IN 6 FT. OF AN ATTIC ACCESS (E3802.2 IRC)

ALL RECEPTICALS MUST BE TAMPER RESISTANT

2009 NEC 15-20 AMP BRANCH CIRCUITS TO BE PROTECTED BY A LISTED ARC-FAULT CIRCUIT INTERRUPTER-COMBINATION NEC 210.12



ELECTRICAL

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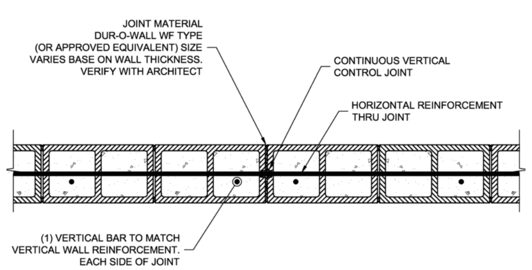
ENGINEERING

DATE:	04/11/2019
DRAWN BY:	BDA
DESIGNED BY:	BDA, DBB, DHB, ZDB
PROJECT NAME:	COMB RIDGE PLAN
PROJECT NUMBER:	CEEn_2018CPST_003
CLIENT:	UTAH NAVAJO TRUST FUND
SPONSOR:	ACUTE ENGINEERING

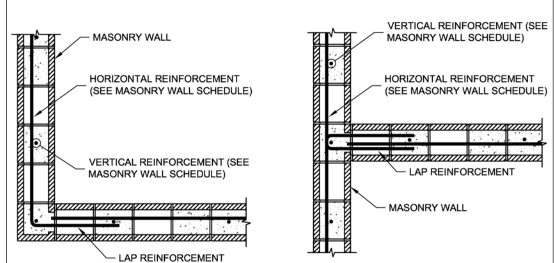
STRUCTURAL FRAMING DETAILS

S101



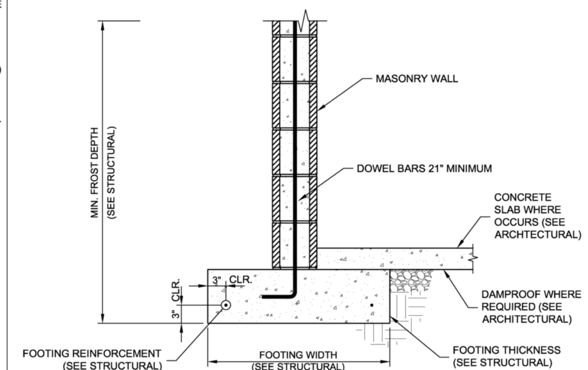
NOTE:
CONTROL JOINTS SHALL BE SPACED A MAXIMUM OF 30' O.C.
(SEE ARCHITECTURAL FOR LOCATIONS)

S10 — TYPICAL CONTROL JOINT FOR SINGLE REINFORCED MASONRY WALL (PLAN VIEW
SCALE: N.T.S.

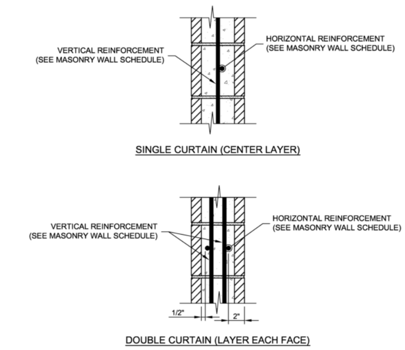


REQUIRED LAP LENGTH		
TYPE	CMU	MIN.
SPLICE	48 BAR DIA.	24"
HOOK	20 BAR DIA.	12"

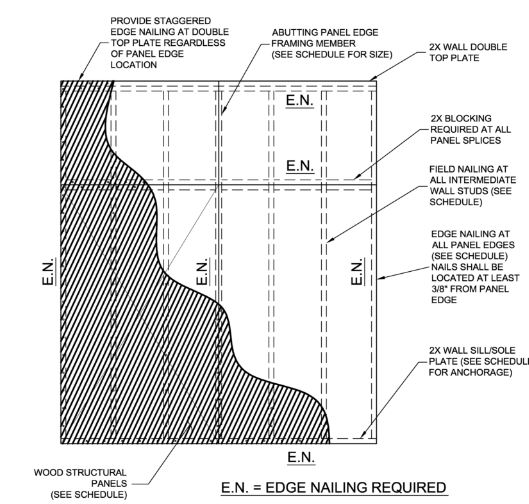
S9 — MASONRY WALL - CORNER AND INTERSECTION
SCALE: N.T.S.



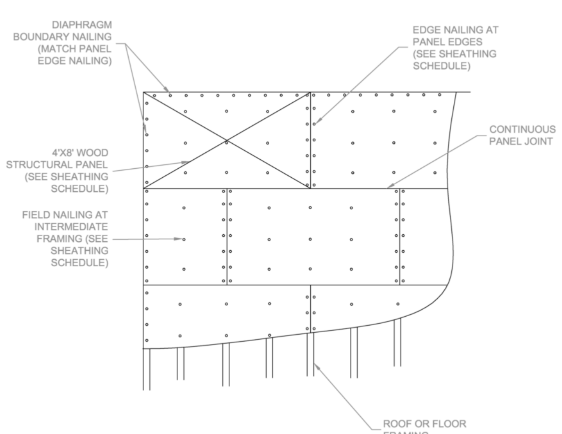
S8 — CONCRETE FOOTING - MASONRY WALL
SCALE: N.T.S.



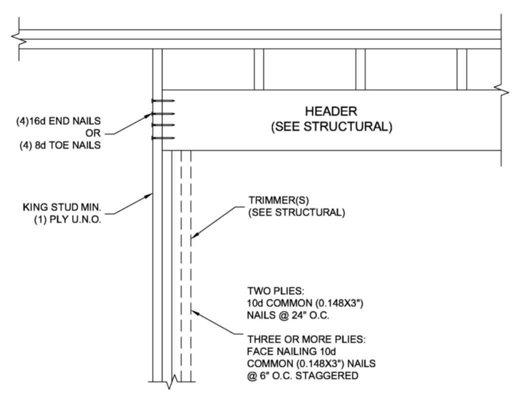
S7 — MASONRY WALL - REINFORCEMENT
SCALE: N.T.S.



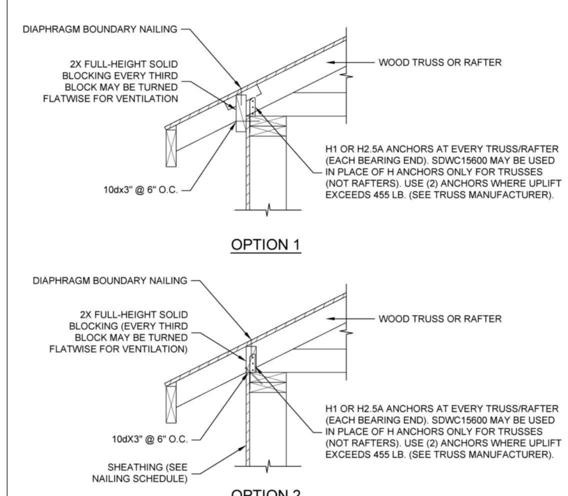
S6 — WOOD STRUCTURAL PANEL SHEAR WALL
SCALE: N.T.S.



S5 — WOOD STRUCTURAL PANEL DIAPHRAGM - UNBLOCKED
SCALE: N.T.S.

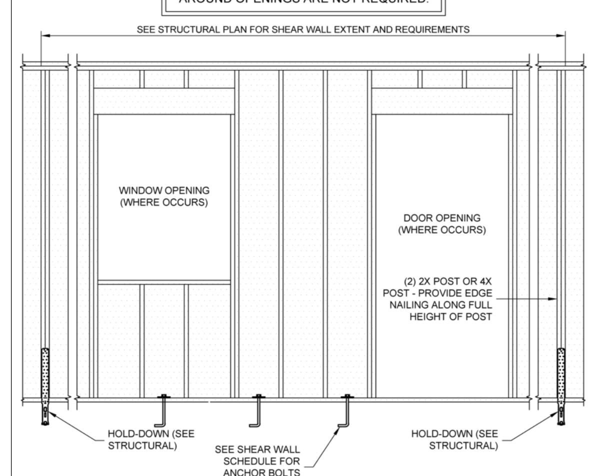


S4 — WOOD BEAM - WALL HEADER FRAMING
SCALE: N.T.S.



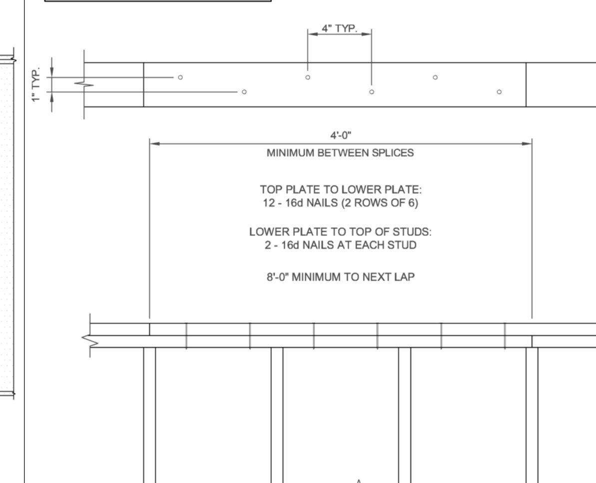
S3 — ROOF FRAMING - BLOCKING (150 PLF UNIT SHEAR)
SCALE: N.T.S.

ADDITIONAL STRAPPING AND BLOCKING AROUND OPENINGS ARE NOT REQUIRED.

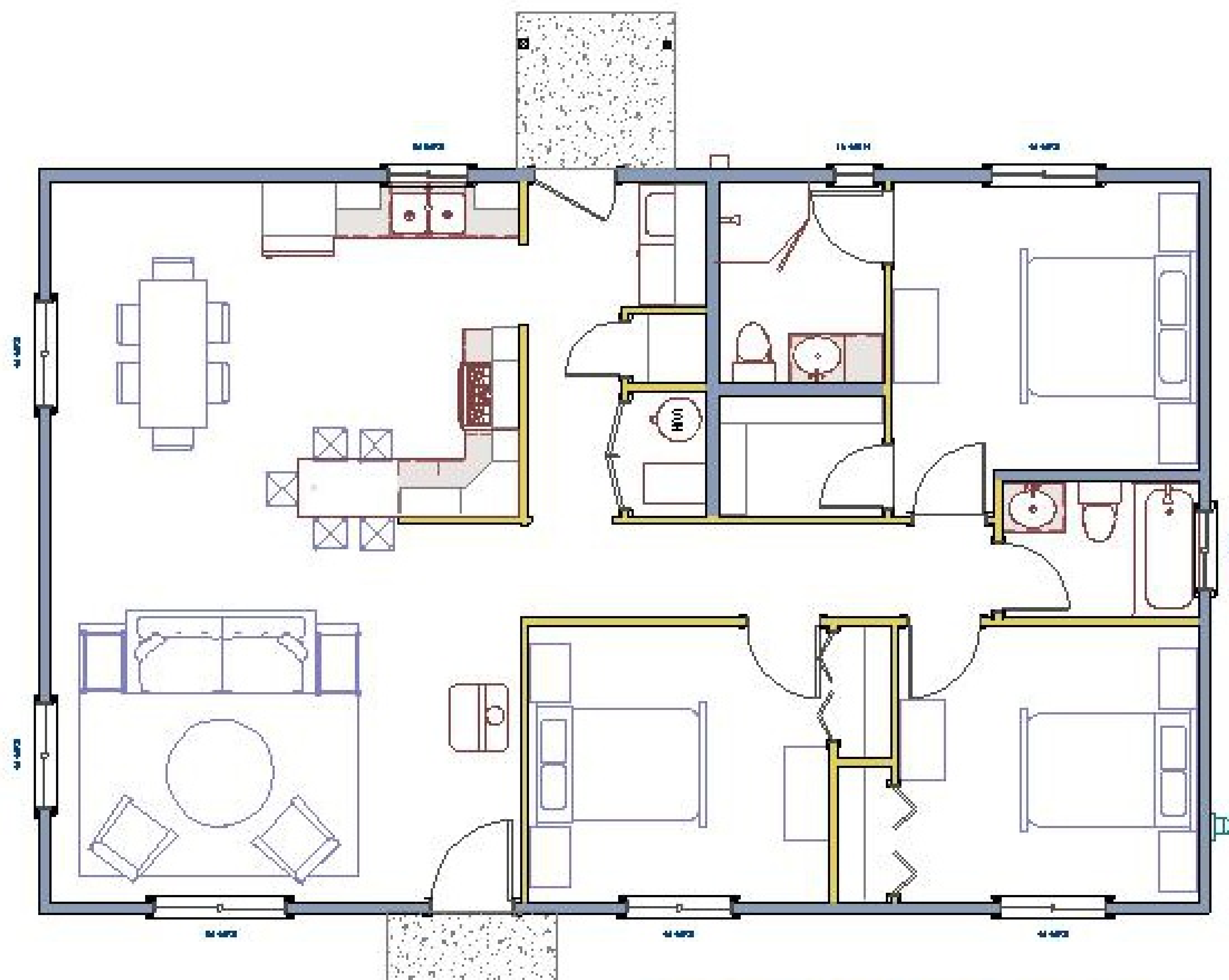


S2 — SHEAR WALL - PERFORATED
SCALE: N.T.S.

NOTE: WHERE DOUBLE TOP PLATE IS CUT DUE TO INTERSECTING BEAMS, WALLS, ETC. PROVIDE (2) CS16 STRAPS ACROSS CUT WITH 12" END LENGTHS



S1 — DIAPHRAGM - TOP PLATE SPLICE
SCALE: N.T.S.



NIZHONI LIVING SPACE 1232 S. FT.

Steve Perry's Design Solutions & Construction Inc.

NIZHONI ON SLAB PLAN

FLOOR PLAN
BACK- FRONT VIEW

1

NOTE!

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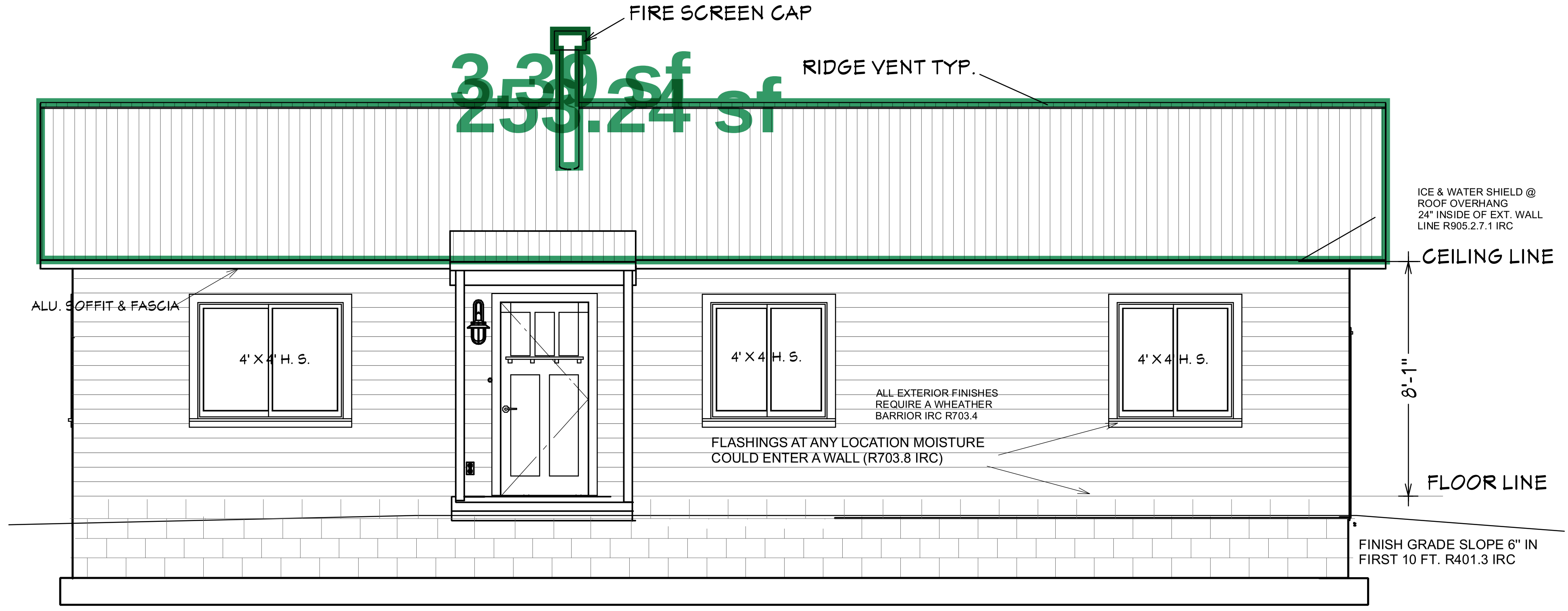
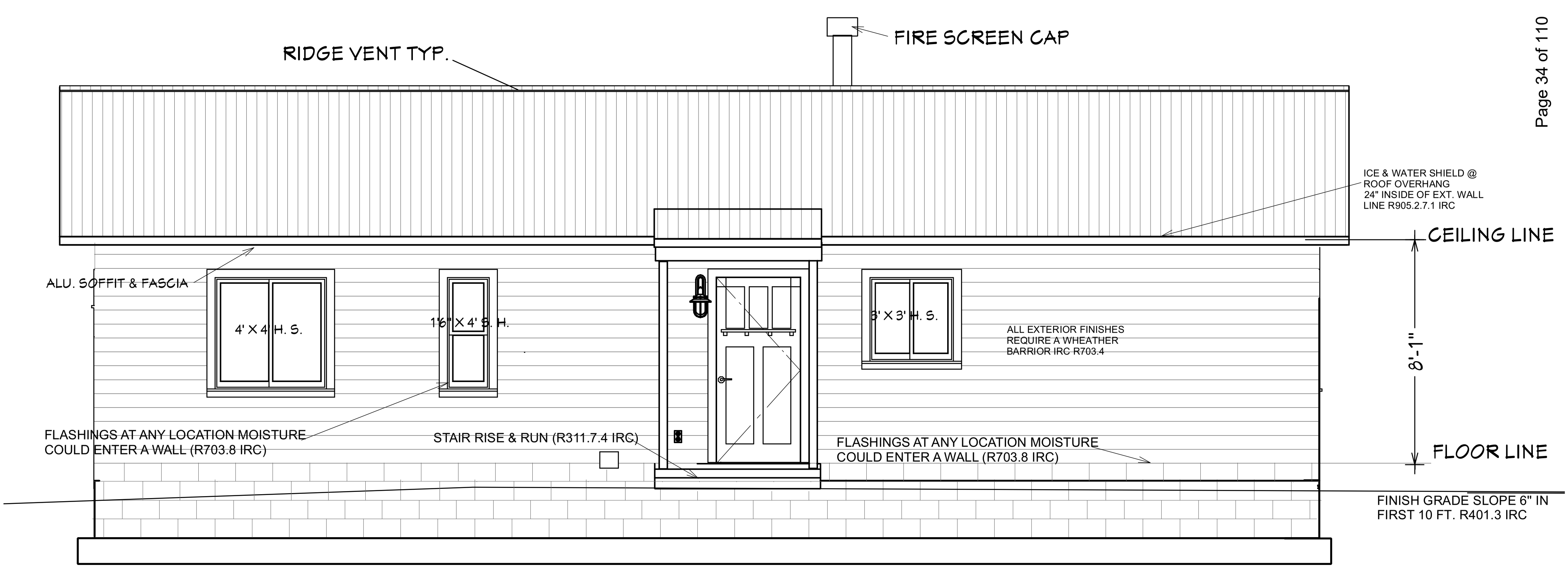


FRONT ELEVATION 3/16 SCALE



BACK ELEVATION 3/16" SCALE

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NIZHONI ON SLAB PLAN

FRONT & BACK ELEVATIONS

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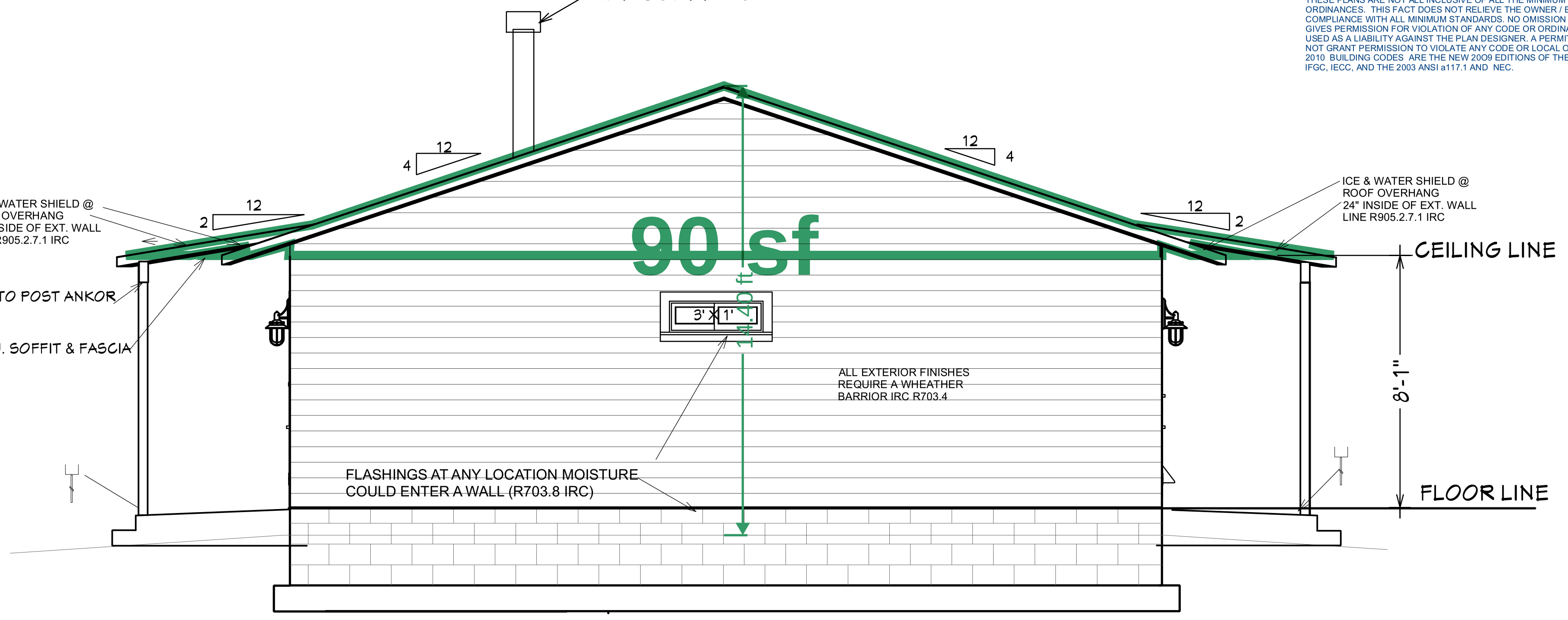
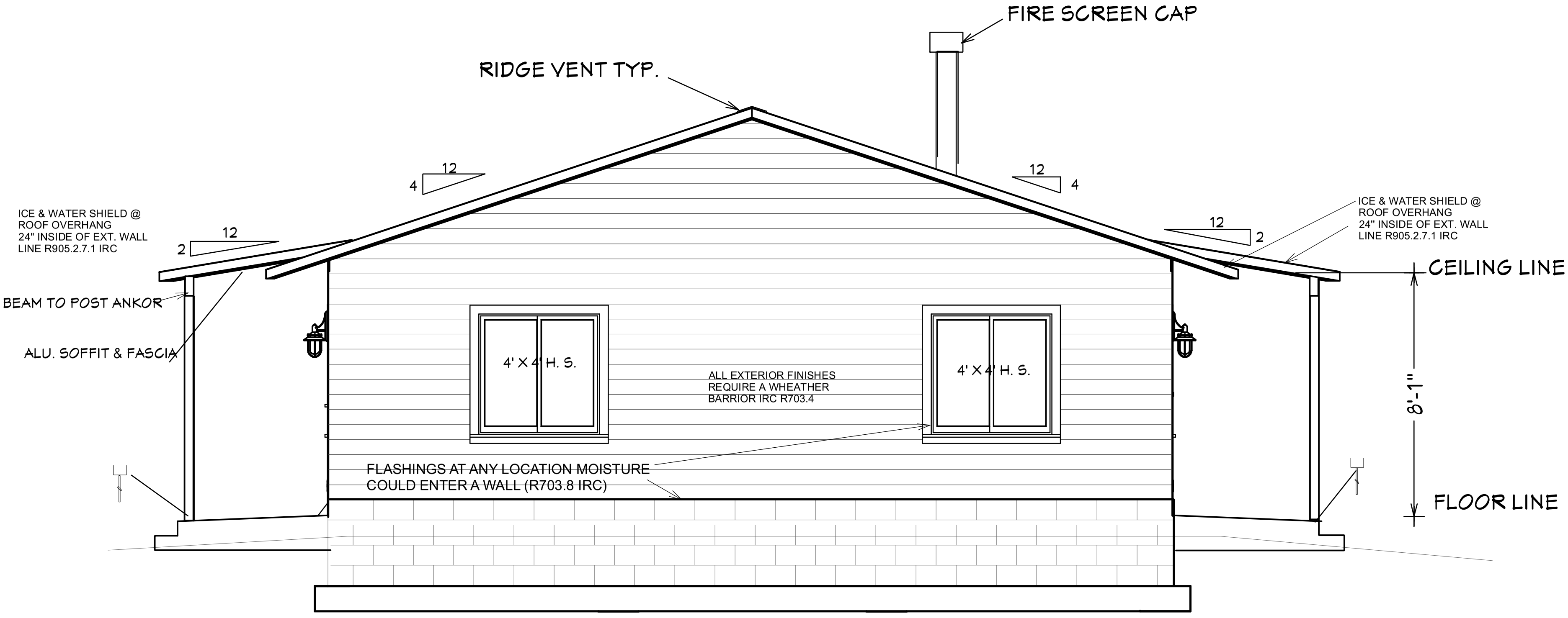


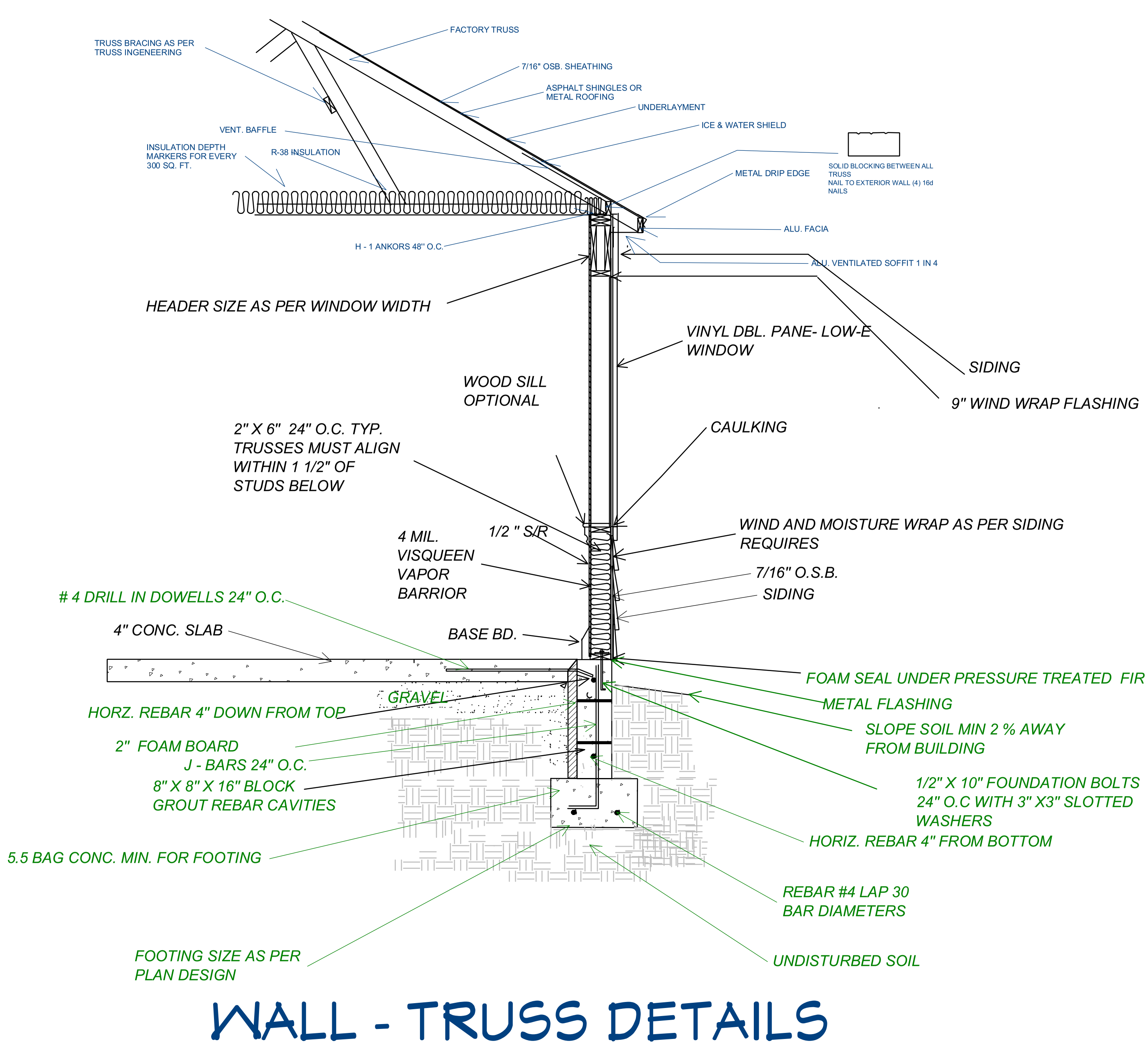
RIGHT ELEV.

3/16" SCALE



LEFT ELEVATION

3/16" SCALE



WALL - TRUSS DETAILS

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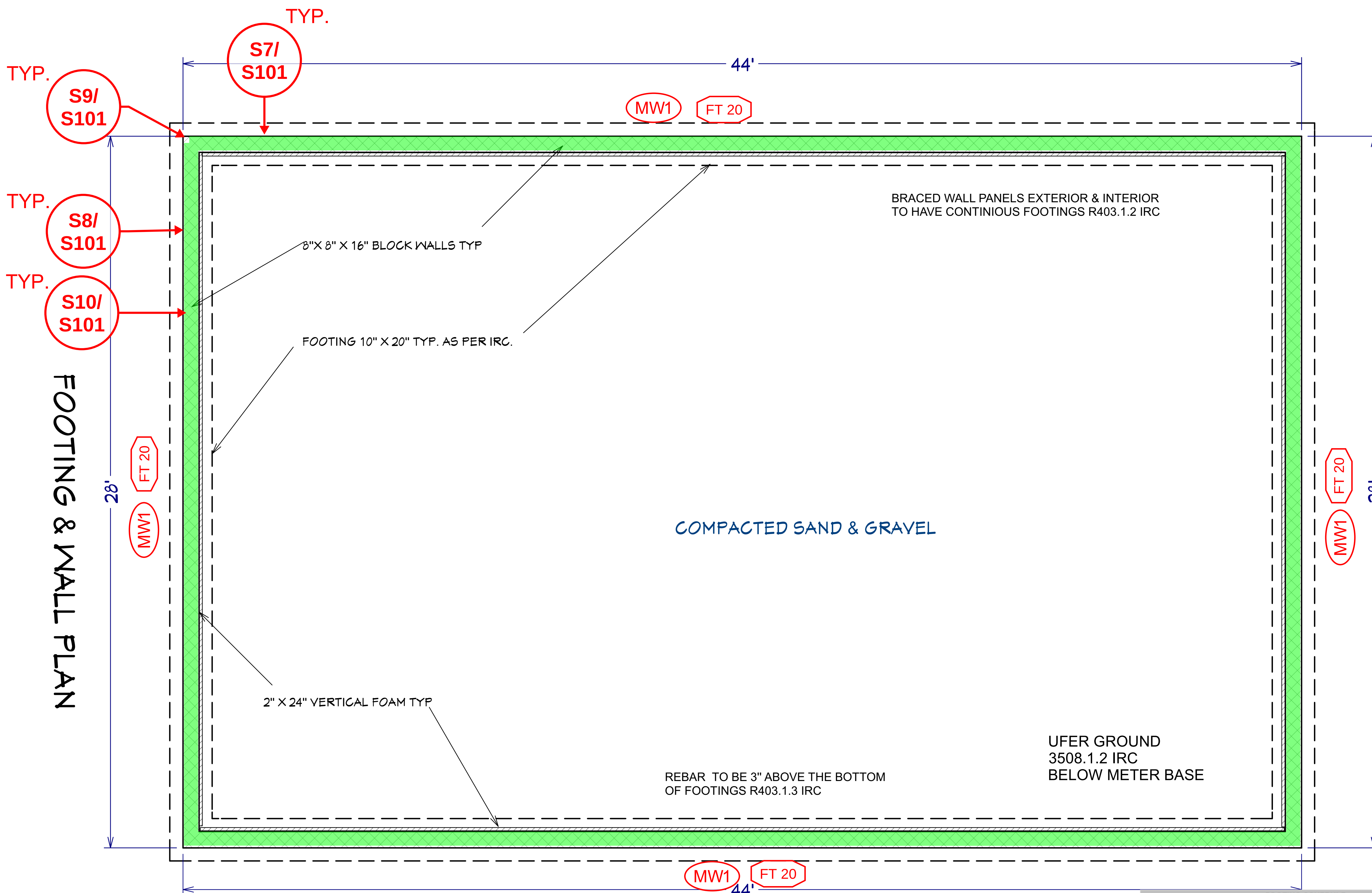
NIZHONI ON SLAB PLAN

END ELEVATIONS & WALL/ROOF DETAIL

5

FOOTING & WALL PLAN



MASONRY WALL SCHEDULE

MARK	TYPE	WIDTH	REINFORCEMENT			GROUT
			VERTICAL	HORIZONTAL	LAYER	
MW 1	CMU	8"	#4 @24" o.c.	(2)#4 @48" o.c.	CENTER	Solid

FOOTING SCHEDULE

MARK	WIDTH	LENGTH	THICKNESS	REINFORCEMENT	
				TRANSVERSE	LENGTHWISE
FT20	20 "	CONT.	10 "	-	(2) #4

1. CONTINUOUS FOOTINGS SHALL BE CENTERED UNDER WALLS AND SPOT FOOTINGS SHALL BE CENTERED UNDER COLUMNS UNLESS NOTED OTHERWISE.

2. FOOTINGS AND FOUNDATIONS, EXCAVATIONS, GRADING, AND FILL SHALL COMPLY WITH THE PROVISIONS OF THE GEOTECHNICAL REPORT (SEE GSN)

NOTE!

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NIZHONI ON SLAB PLAN

FOOTING & WALLS
WALL 1/4" SCALE

STEVE PERRY'S DESIGN SOLUTIONS

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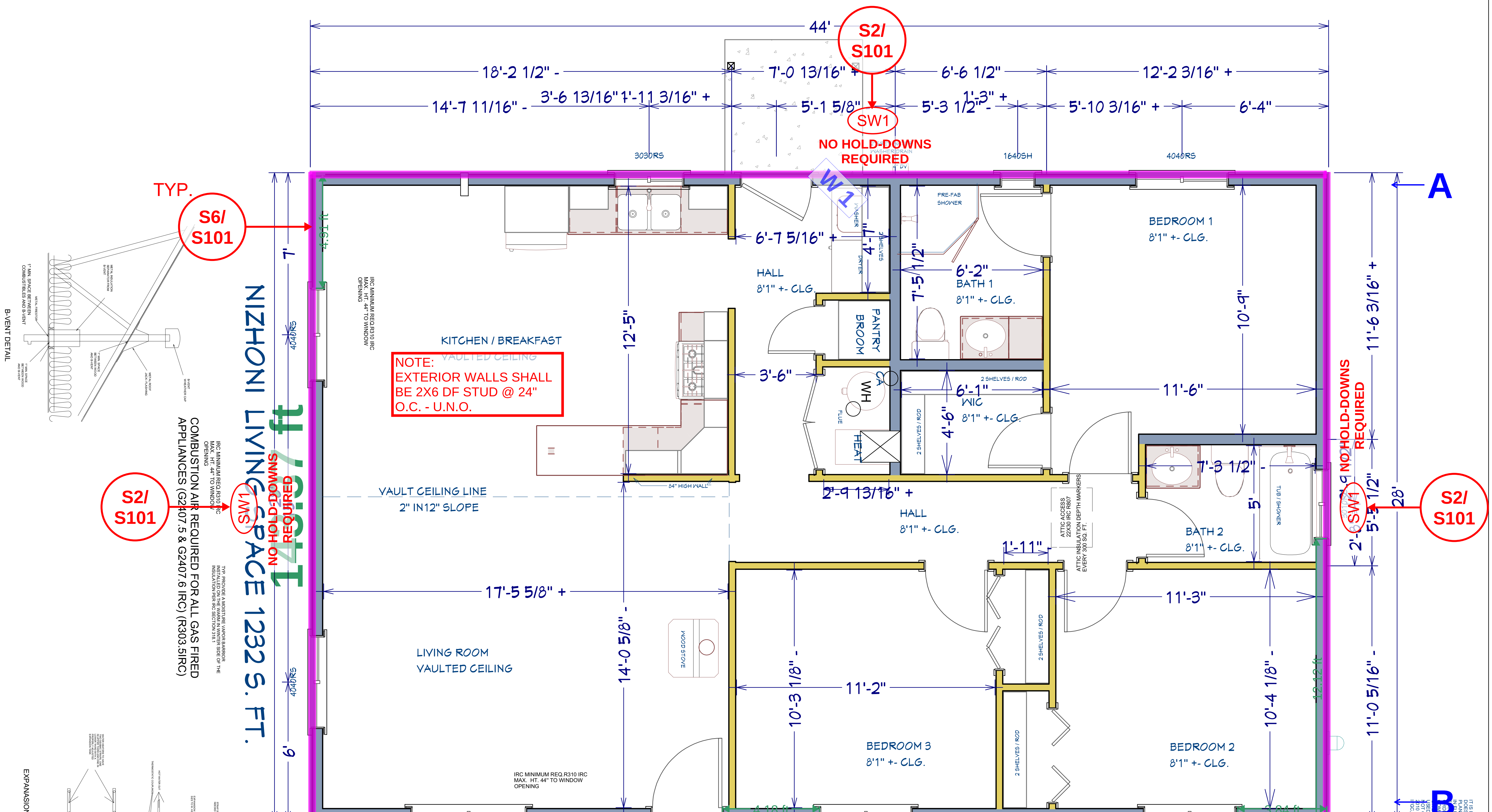
NIZHONI ON SLAB PLAN



M
1/4" SCALE

SHEAR WALL SCHEDULE					
MARK	SHEATHING	EDGE NAILING	ABUTTING PANEL EDGE FRAMING	ANCHORAGE	
				SOLE PLATE	SILL PLATE
SW1	7/16"	8d @ 6"	2X	10d @ 12"	1/2" A.B. @ 72"

1. SHEATHING SHALL CONSIST OF WOOD STRUCTURAL PANELS (SEE GSN).
2. SHEATHING NAILS SHALL BE COMMON OR GALVANIZED BOX NAILS. - FIELD NAIL SPACING SHALL BE 12" FOR STUDS SPACED 16" O.C. OR LESS AND 6" O.C. FOR STUDS SPACED AT 24" O.C.
3. FOR SW1 ONLY, EDGE NAILS MAY BE SUBSTITUTED WITH 1-1/2" 16 GAGE STAPLES SPACED AT 3" O.C. AND FIELD NAILS MAY BE SUBSTITUTED WITH 16 GAGE STAPLES AT 12" O.C.
4. ANCHORAGE NAILS SHALL BE COMMON NAILS.
5. ANCHOR BOLTS SHALL HAVE A 3X3X0.229" WASHER AND 7" MIN EMBEDMENT. THE WASHER SHALL EXTEND TO WITHIN 1/2" FROM THE SHEATHING.

3

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NIZHONI ON SLAB PLAN

ROOF TRUSS LAYOUT

BEAM SCHEDULE	
MARK	TYPE
RB 01	(2) 2 X 6
RB 02	(2) 2 X 6
RB 03	(3) 2 X 6
RB 04	(3) 2 X 8
RB 05	(2) 2 X 8

1. DIMENSIONAL LUMBER DF#2 U.N.O.
2. LAMINATED VENEER LUMBER (LVL) 2.0E
3. GLUED-LAMINATED TIMBER (GLB) 24F-1.8E
4. STEEL W-SHAPES A992-50
5. SUFFIXES (A, B, ETC.) DENOTE ALTERNATIVES FOR THE SPECIFIED BEAM

ROOF RAFTER SCHEDULE	
MARK	TYPE
RR 01	2 X 4 @ 24" O.C.

1. DIMENSIONAL LUMBER DF#2 U.N.O.
2. SUFFIXES (A, B, ETC.) DENOTE ALTERNATIVES FOR THE SPECIFIED RAFTER

SHEATHING SCHEDULE	
TYPE	THICKNESS
FLOOR	3/4" (48/24 SPAN RATING)
ROOF	7/16" (24/16 SPAN RATING)

1. SHEATHING PERPENDICULAR TO SUPPORTS.
2. FLOOR SHEATHING NAILED & GLUED TO SUPPORT
3. 8d COMMON NAILS 6" O.C. (EDGES) 12" O.C. (FIELD)
4. NAILING NO CLOSER THAN 3/8" FROM PANEL EDGE

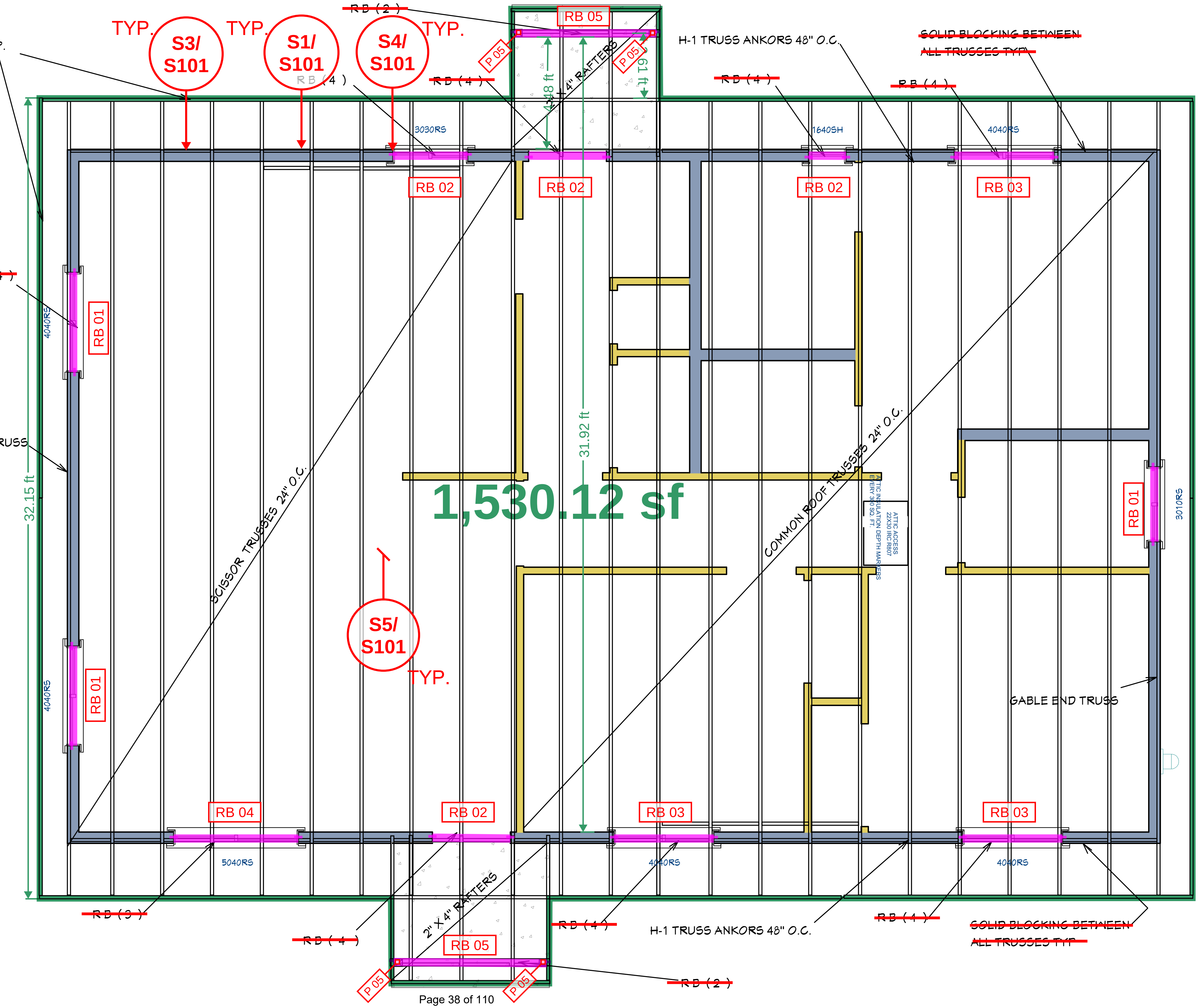
WOOD TRUSS LOADS
GROUND SNOW LOAD, Pg = 57 PSF
FLAT ROOF SNOW LOAD = 35 PSF
TOP CHORD DEAD LOAD = 10 PSF
BOTTOM CHORD DEAD LOAD = 5 PSF

1. DESIGN SNOW LOADS SHALL BE IN ACCORDANCE WITH ASCE 7-10 CHAP.7 (2015 IBC 1608.1)

POST SCHEDULE	
MARK	TYPE
P 02	(2) 2X POST
P 05	4 X 4 POST

1. PARALLEL STRAND LUMBER (PSL) 1.8E
2. STEEL PIPE (PIPE STD) A53
3. STEEL HOLLOW SECTION (HSS) A500
4. STEEL COLUMNS REQUIRE BEARING PLATES
5. CONTINUE POSTS TO FDN / STRUCT MEMBER

WITH 8d
T THE ENDS
ER REVIEWED TO
MPONENTS.THESE
(R502.11.4 IRC, R802.10 IRC)



NOTE!

TRUSS LAYOUT

6

E3609.3 PROVIDE BONDING
TERMINATION AT METER BASE

METER BASE WITH
IN FRONT 4 FT. OF
BUILDING

NOTE!

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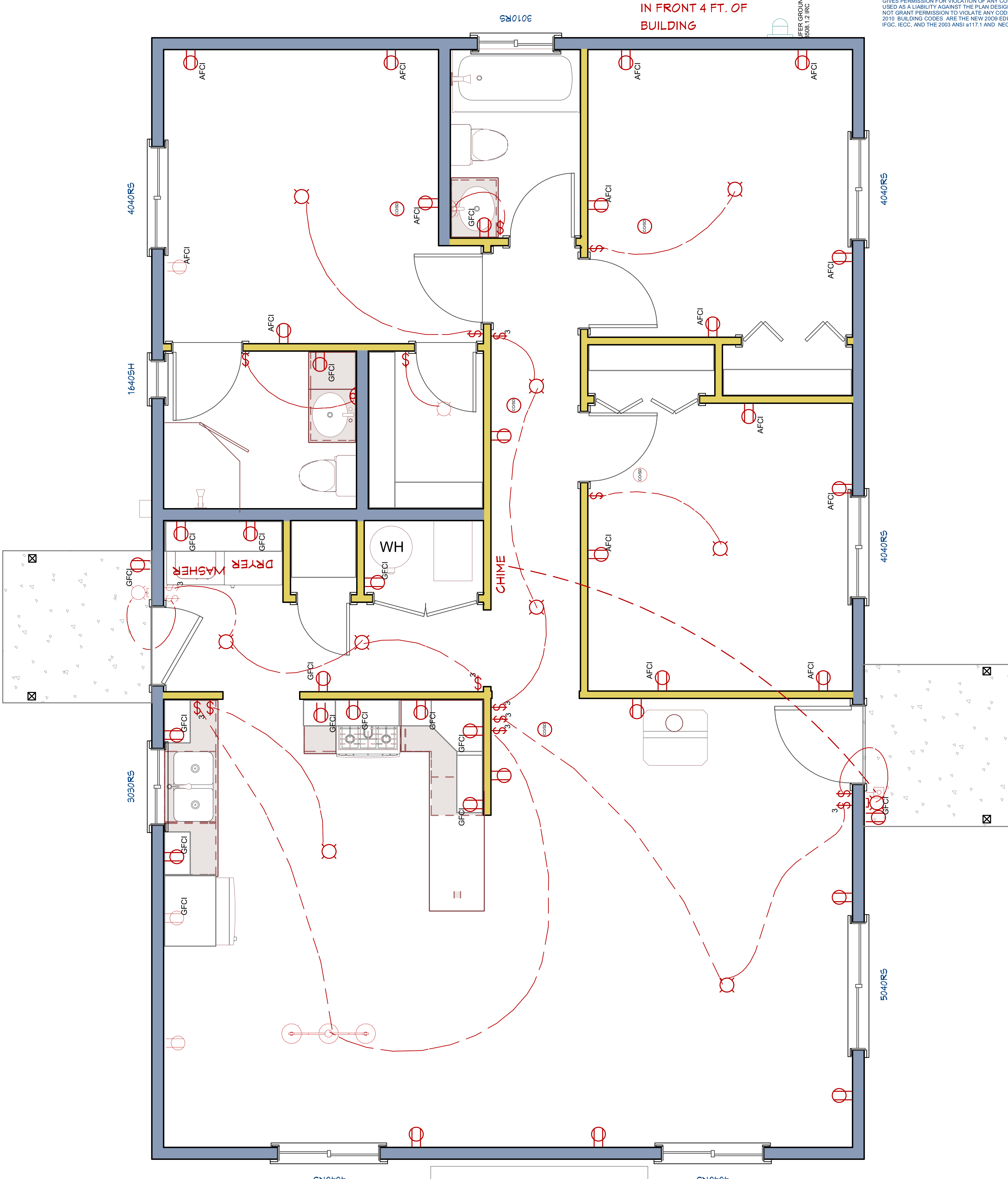


ELECTRICAL

ELECT. CONDUCTORS PROTECTED WITH IN 6 FT. OF AN ATTIC ACCESS (E3802.2 IRC)

ELECT. PANEL CLEARANCES 30" X 36" OUT (E3609.4 IRC)

ELECT. CONDUCTORS PROTECTED WITH IN 6 FT. OF AN ATTIC ACCESS (E3802.2 IRC)

ALL RECEPTICALS MUST BE TAMPER RESISTANT

2009 NEC 15-20 AMP BRANCH CIRCUITS TO BE PROTECTED BY A LISTED ARC-FAULT CIRCUIT INTERRUPTER-COMBINATION NEC 210.12

NOTE!

SMOKE DETECTORS IN EACH BEDROOM INTERWIRED. SMOKE-CARBON MONOXIDE DETECTORS IN A COMMON AREA AT EACH LEVEL INTERWIRED.

ARC FAULT PROTECTED CIRCUITS FOR ALL BEDROOM AREAS.

GROUND FAULT PROTECTED CIRCUITS OR OUTLETS IN ALL WET AREAS AND EXTERIOR LOCATIONS. EXTERIOR OUTLETS TO HAVE WEATHER PROOF COVERS.

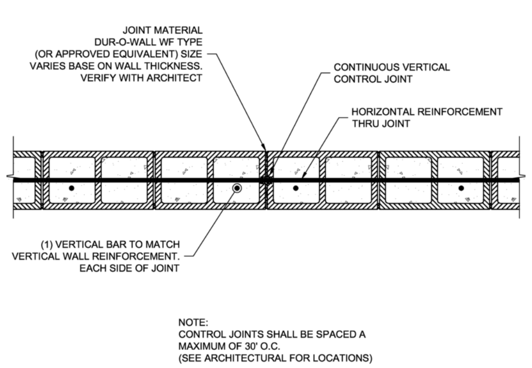
2009 NEC 15-20 AMP BRANCH CIRCUITS TO BE PROTECTED BY A LISTED ARC-FAULT CIRCUIT INTERRUPTER-COMBINATION NEC 210.12

Steve Perry's Design Solutions & Construction Inc.

NIZHONI ON SLAB PLAN

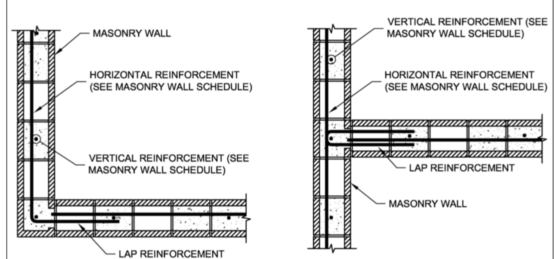
ELECTRICAL

7



S10 — TYPICAL CONTROL JOINT FOR SINGLE REINFORCED MASONRY WALL (PLAN VIEW

SCALE: N.T.S.

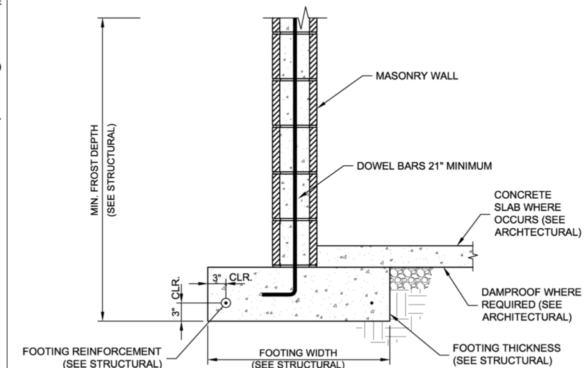


REQUIRED LAP LENGTH

TYPE	CMU	MIN.
SPLICE	48 BAR DIA.	24"
HOOK	20 BAR DIA.	12"

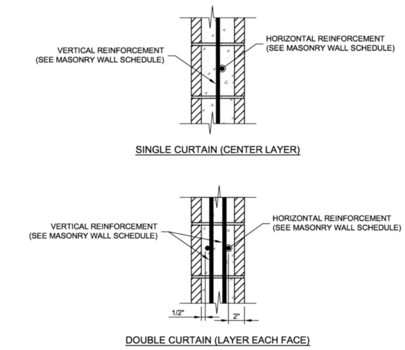
S9 — MASONRY WALL - CORNER AND INTERSECTION

SCALE: N.T.S.



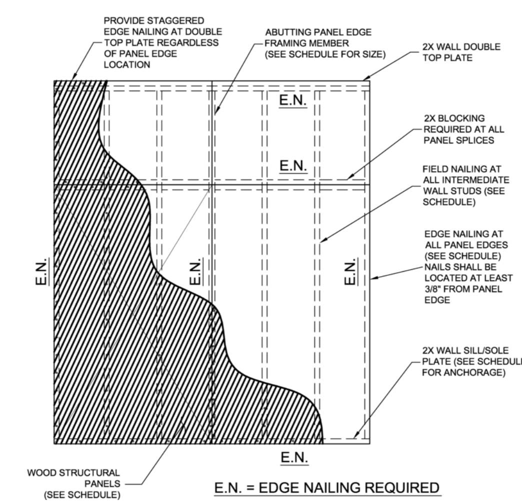
S8 — CONCRETE FOOTING - MASONRY WALL

SCALE: N.T.S.



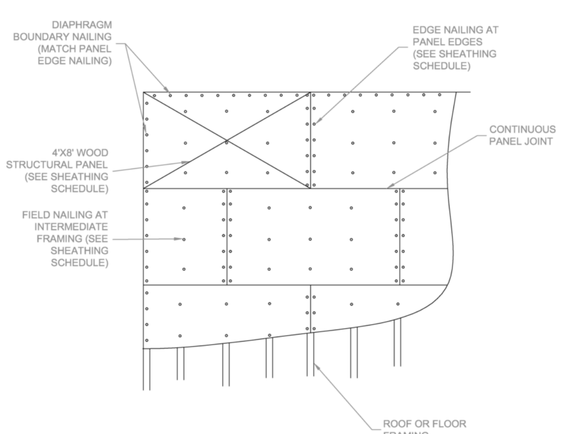
S7 — MASONRY WALL - REINFORCEMENT

SCALE: N.T.S.



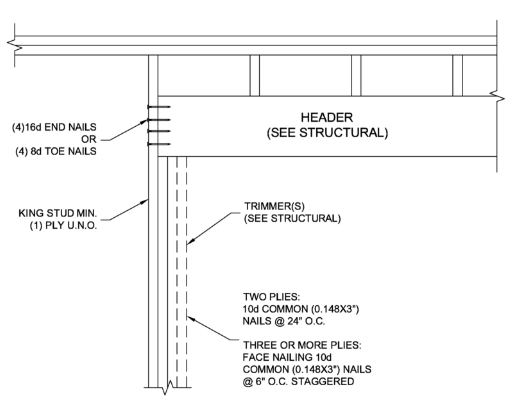
S6 — WOOD STRUCTURAL PANEL SHEAR WALL

SCALE: N.T.S.



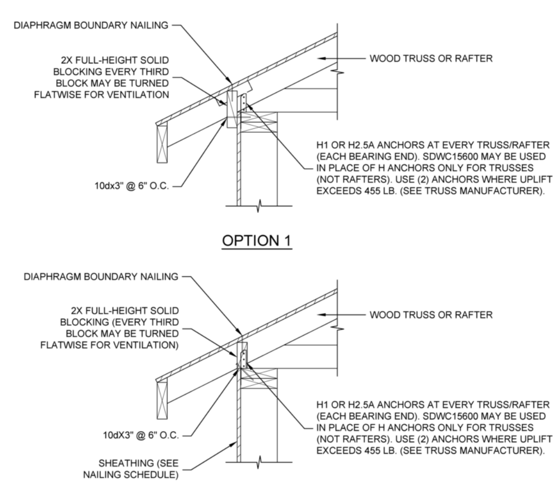
S5 — WOOD STRUCTURAL PANEL DIAPHRAGM - UNBLOCKED

SCALE: N.T.S.



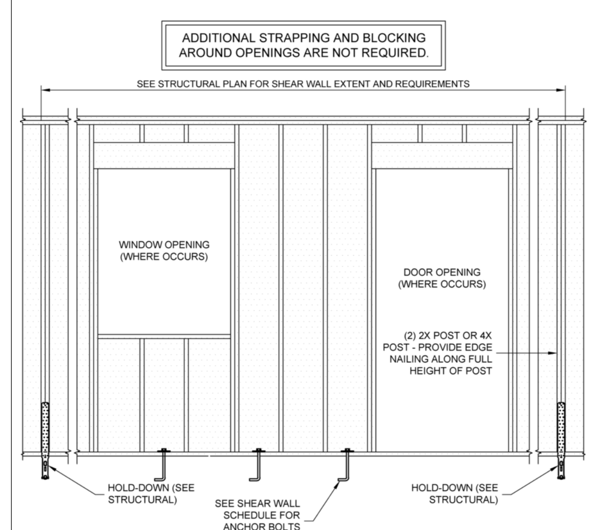
S4 — WOOD BEAM - WALL HEADER FRAMING

SCALE: N.T.S.



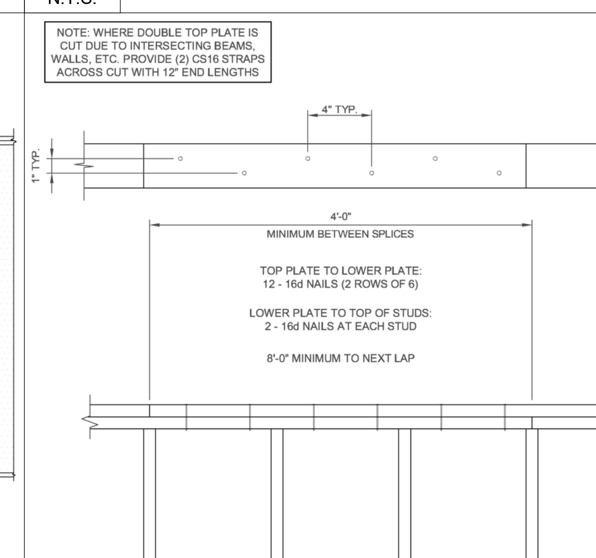
S3 — ROOF FRAMING - BLOCKING (150 PLF UNIT SHEAR)

SCALE: N.T.S.



S2 — SHEAR WALL - PERFORATED

SCALE: N.T.S.



S1 — DIAPHRAGM - TOP PLATE SPLICE

SCALE: N.T.S.

4 ENGINEERING

DATE: 04/11/2019

DRAWN BY: BDA

DESIGNED BY: BDA, DBB, DHB, ZDB

PROJECT NAME: NIZHONI SLAB PLAN

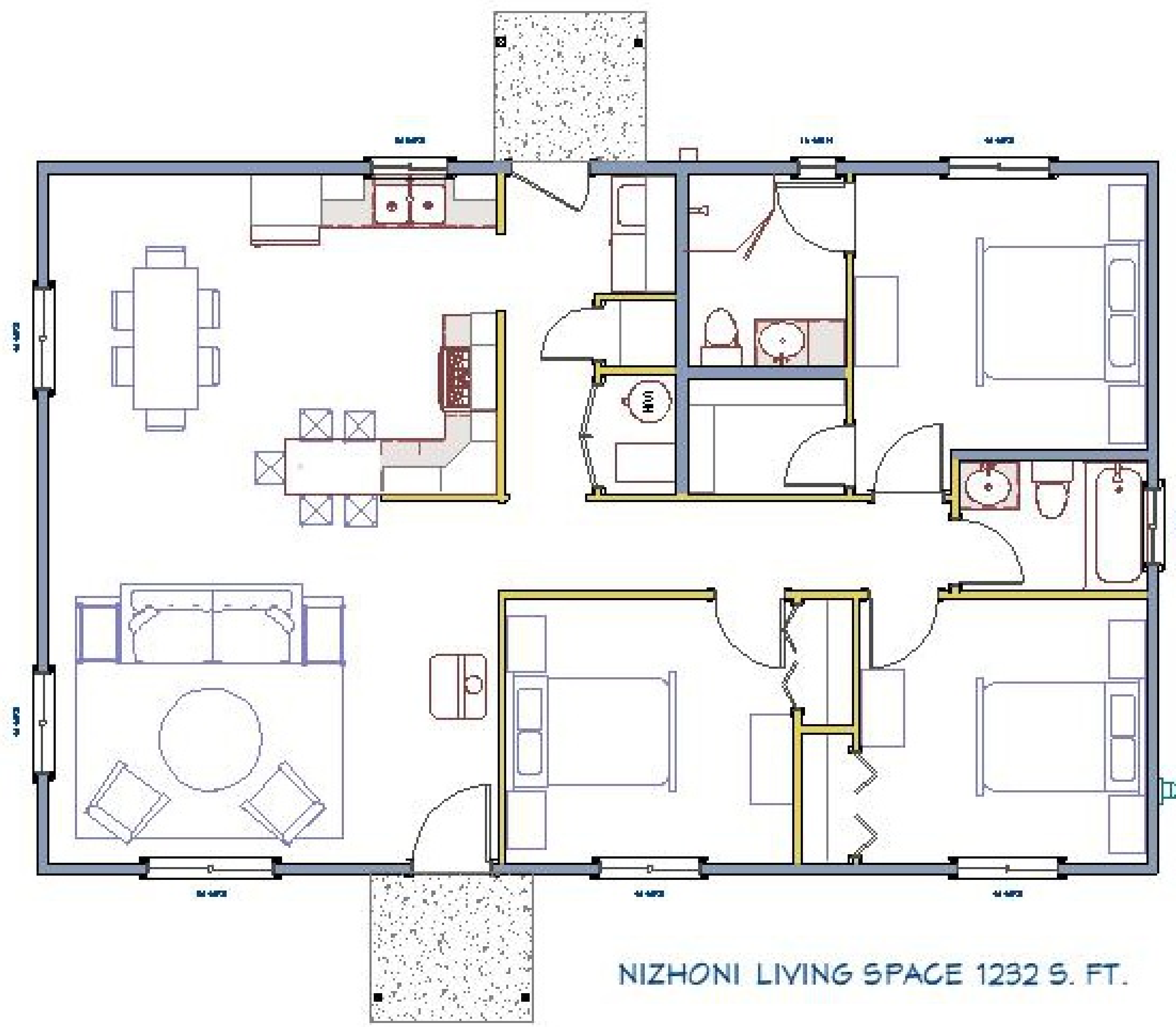
PROJECT NUMBER: CEEn_2018CPST_003

CLIENT: UTAH NAVAJO TRUST FUND

SPONSOR: ACUTE ENGINEERING

STRUCTURAL FRAMING DETAILS

S101



NIZHONI LIVING SPACE 1232 S. FT.

NIZHONI ON SLAB PLAN

FLOOR PLAN
BACK- FRONT VIEW

1

NOTE!

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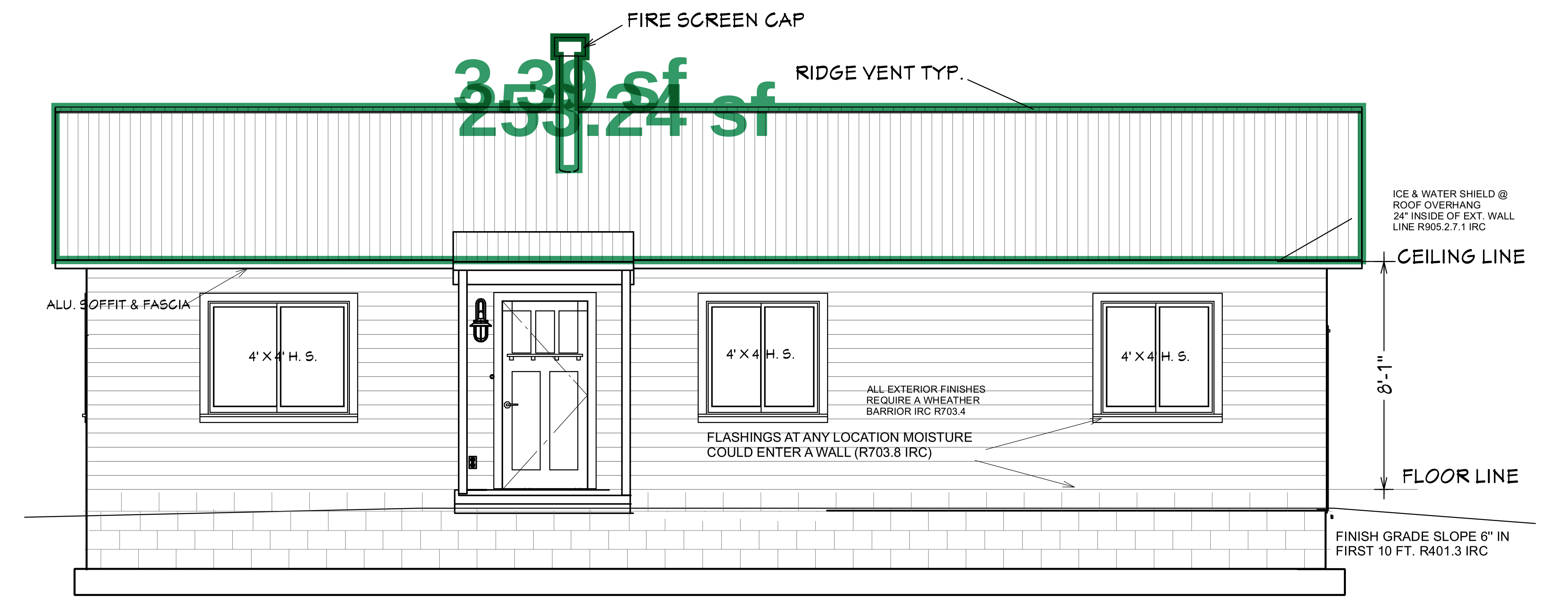
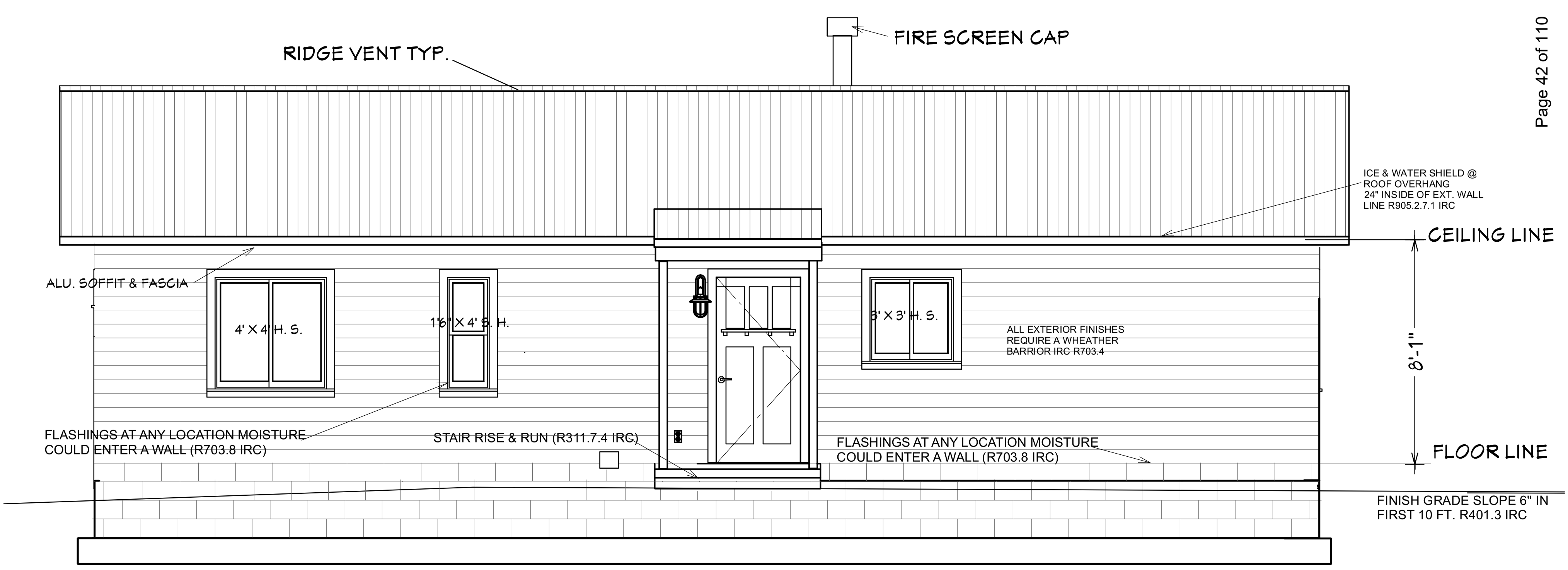


FRONT ELEVATION 3/16 SCALE



BACK ELEVATION 3/16" SCALE

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NIZHONI ON SLAB PLAN

FRONT & BACK ELEVATIONS

4

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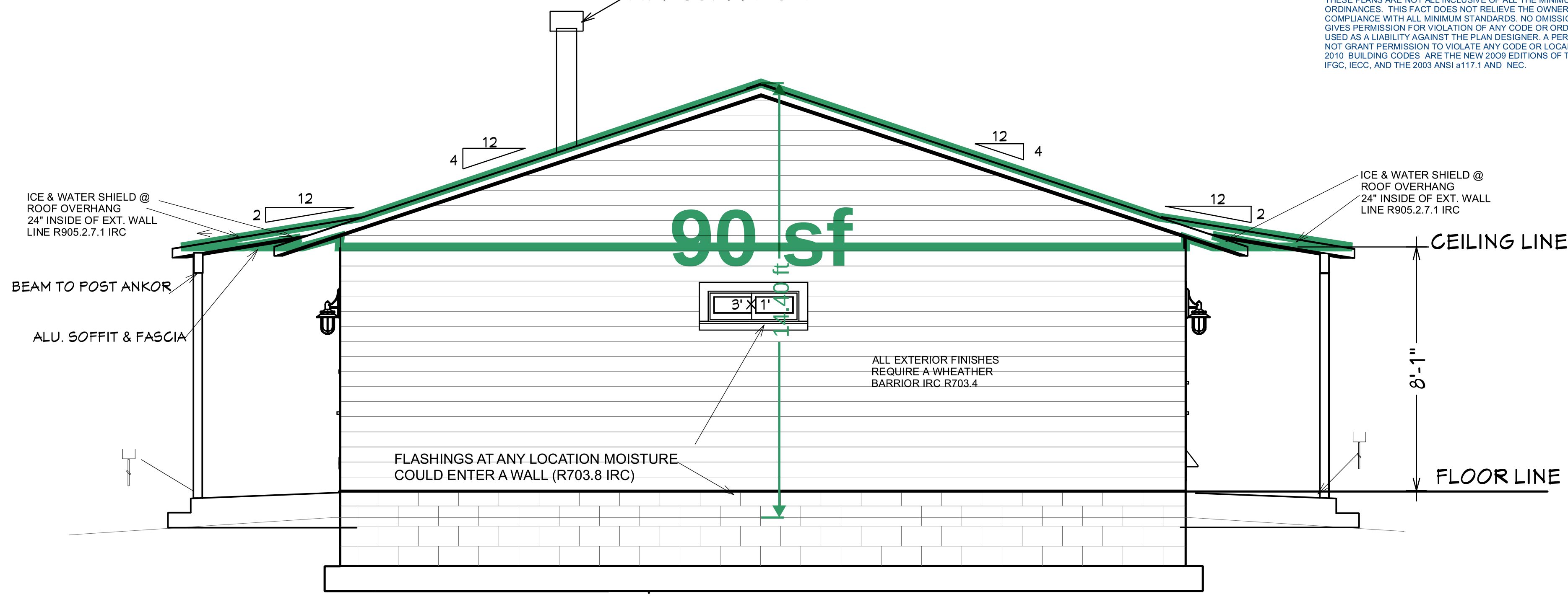
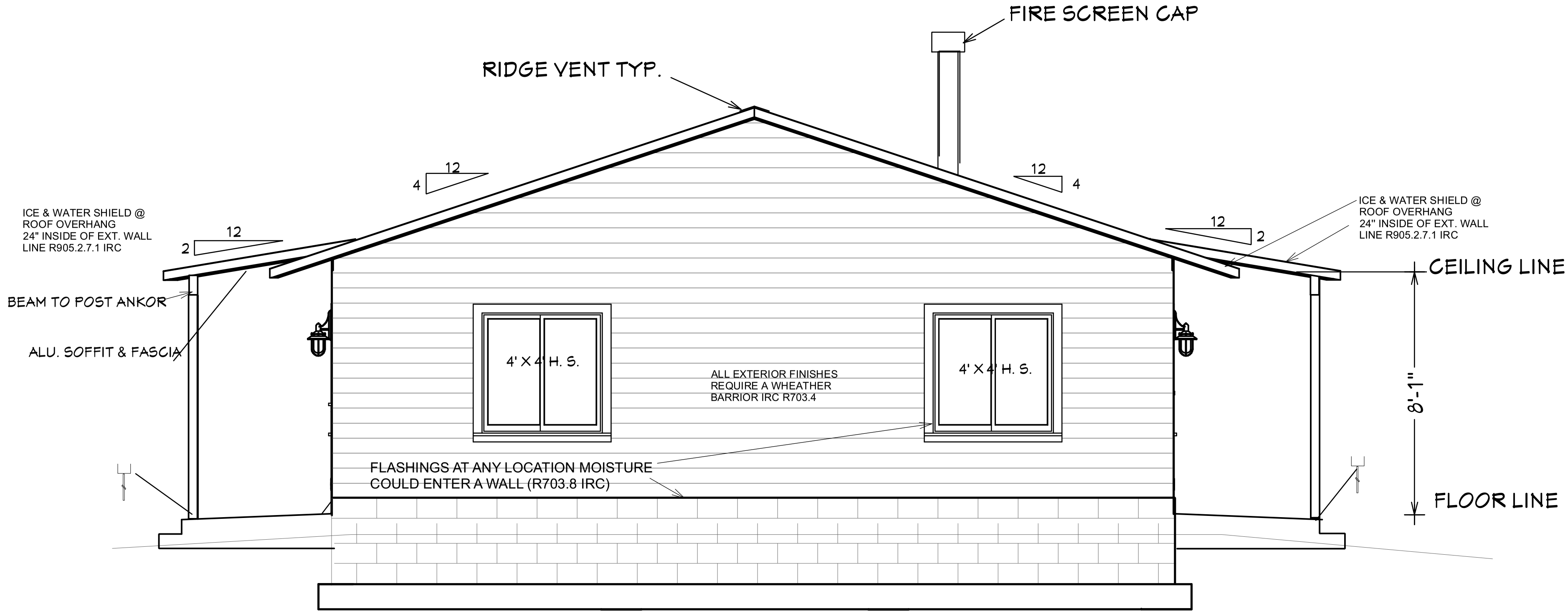


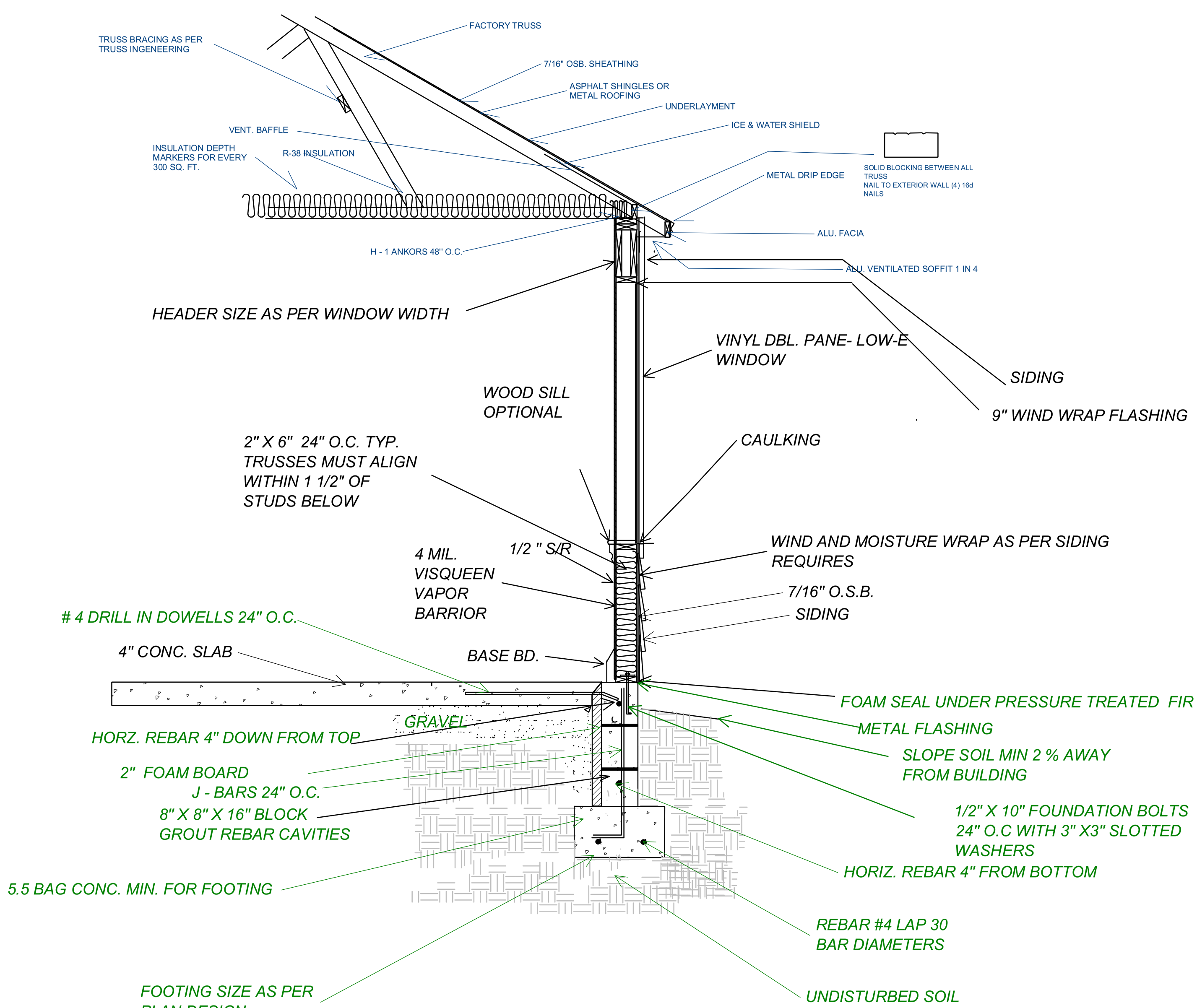
RIGHT ELEV.

3/16" SCALE



LEFT ELEVATION

3/16" SCALE



WALL - TRUSS DETAILS

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NIZHONI ON SLAB PLAN

END ELEVATIONS & WALL/ROOF DETAIL

5

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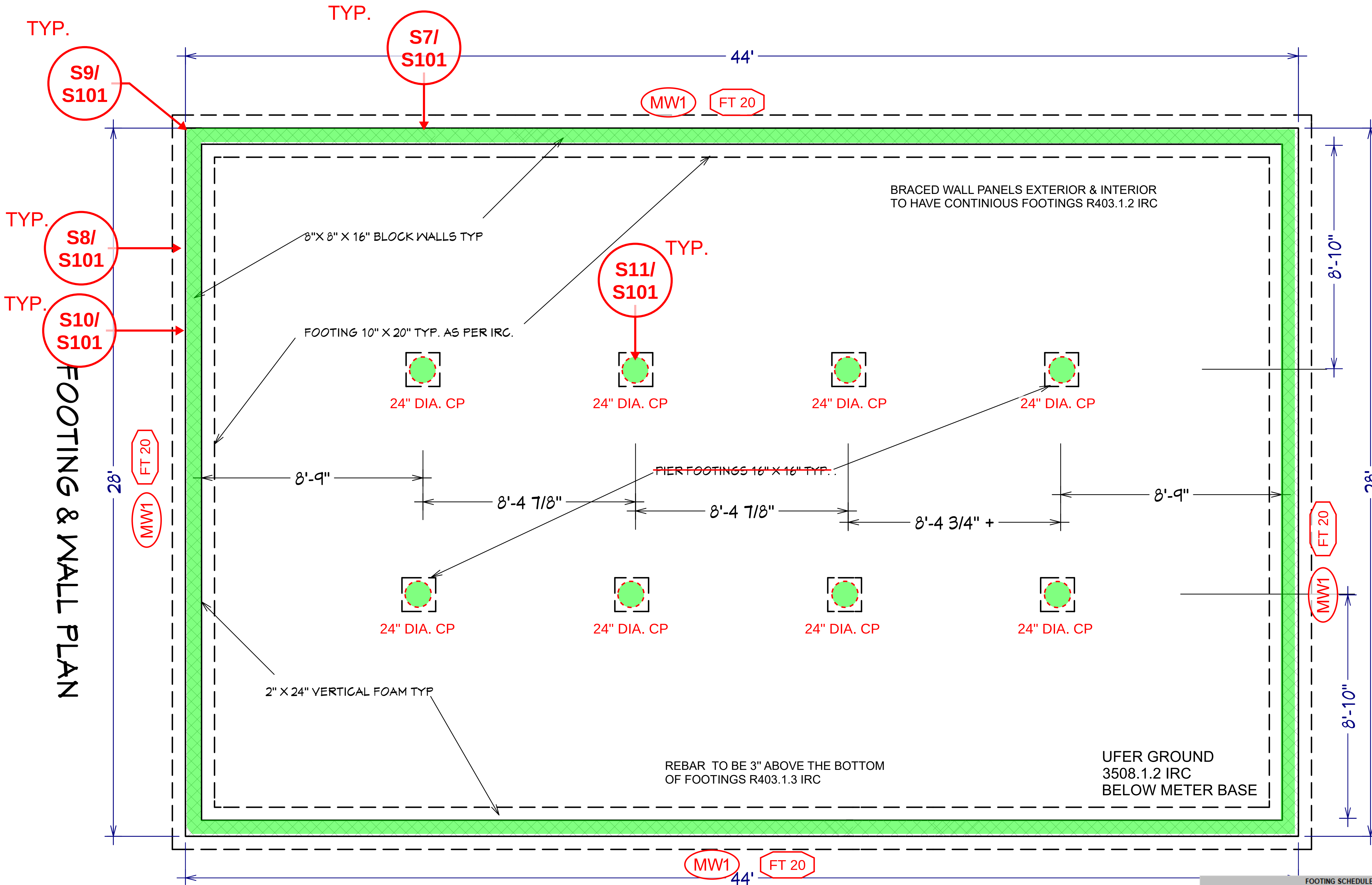
NIZHONI C.S. PLAN

FOOTING & WALL PLAN



MASONRY WALL SCHEDULE							
			REINFORCEMENT				
MARK	TYPE	WIDTH	VERTICAL	HORIZONTAL	LAYER	GROUT
MW 1	CMU	8"	#4 @24" o.c.	(2)#4 @48" o.c.	CENTER	Solid

FOOTING SCHEDULE					
MARK	WIDTH	LENGTH	THICKNESS	REINFORCEMENT	
				TRANSVERSE	LENGTHWISE
FT20	20 "	CONT.	10 "	-	(2) #4

1. CONTINUOUS FOOTINGS SHALL BE CENTERED UNDER WALLS AND SPOT FOOTINGS SHALL BE CENTERED UNDER COLUMNS UNLESS NOTED OTHERWISE.

2. FOOTINGS AND FOUNDATIONS, EXCAVATIONS, GRADING, AND FILL SHALL COMPLY WITH THE PROVISIONS OF THE GEOTECHNICAL REPORT (SEE GSN)

NOTE!

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FOOTING & WALLS
WALL 1/4" SCALE

2

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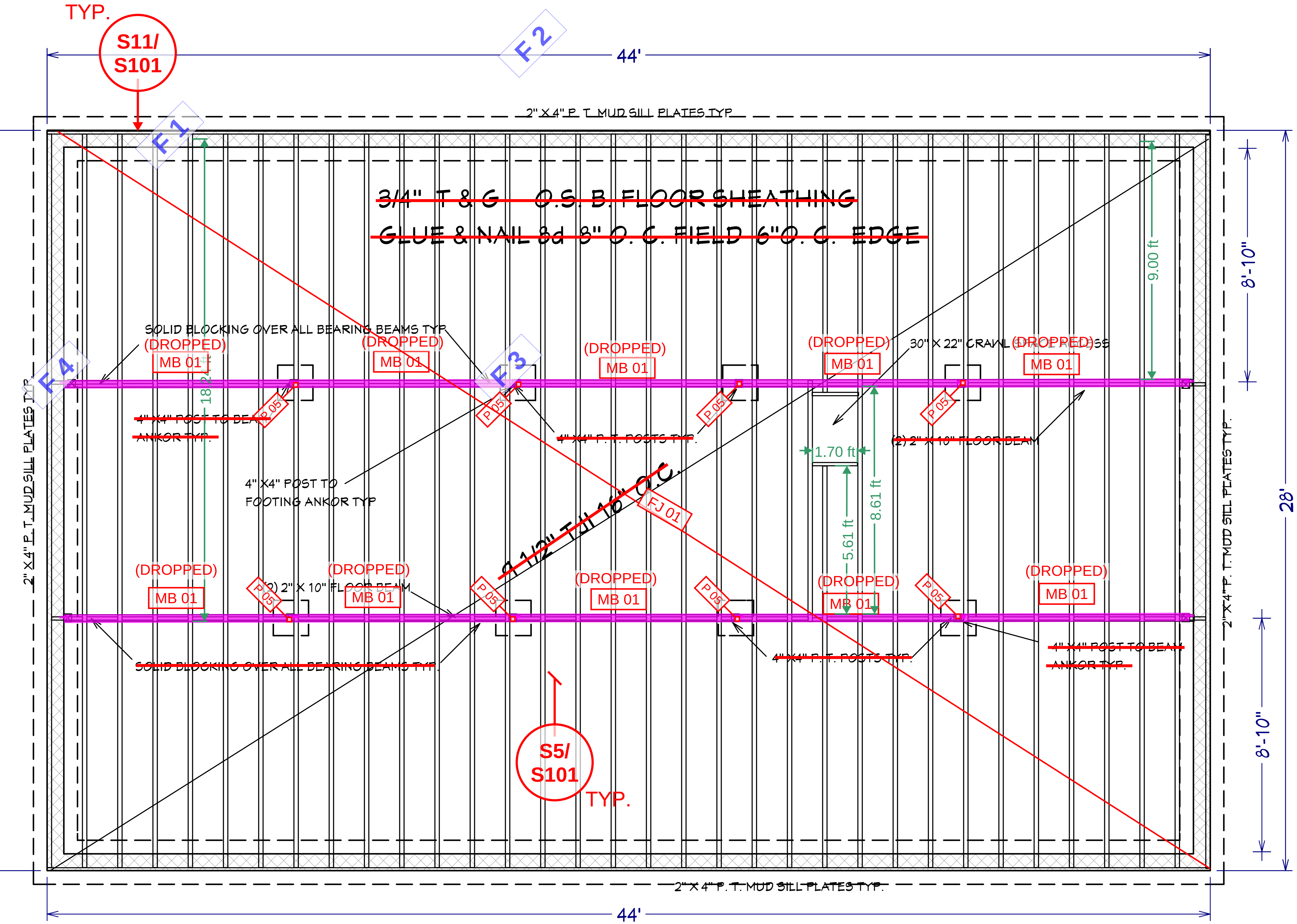
NIZHONI C.S. PLAN

BEAM SCHEDULE	
MARK	TYPE
MB 01 A	(3) 2 X 10
MB 01 B	1-3/4 X 9-1/2 LVL
1. DIMENSIONAL LUMBER DF#2 U.N.O.	
2. LAMINATED VENEER LUMBER (LVL) 2.0E	
3. GLUED-LAMINATED TIMBER (GLB) 24F-1.8E	
4. STEEL W-SHAPES A992-50	
5. SUFFIXES (A, B, ETC.) DENOTE ALTERNATIVES FOR THE SPECIFIED BEAM	

FLOOR JOIST SCHEDULE	
MARK	TYPE
FJ 01	2 X 10 @ 16" O.C.
1. DIMENSIONAL LUMBER DF#2 U.N.O.	
2. SUFFIXES (A, B, ETC.) DENOTE ALTERNATIVES FOR THE SPECIFIED JOIST	

SHEATHING SCHEDULE	
TYPE	THICKNESS
FLOOR	3/4" (48/24 SPAN RATING)
ROOF	7/16" (24/16 SPAN RATING)
1. SHEATHING PERPENDICULAR TO SUPPORTS.	
2. FLOOR SHEATHING NAILED & GLUED TO SUPPORT	
3. 8d COMMON NAILS 6" O.C. (EDGES) 12" O.C. (FIELD)	
4. NAILING NO CLOSER THAN 3/8" FROM PANEL EDGE	

POST SCHEDULE	
MARK	TYPE
P 02	(2) 2X POST
P 05	4 X 4 POST
1. PARALLEL STRAND LUMBER (PSL) 1.8E	
2. STEEL PIPE (PIPE STD) A53	
3. STEEL HOLLOW SECTION (HSS) A500	
4. STEEL COLUMNS REQUIRE BEARING PLATES	
5. CONTINUE POSTS TO FDN / STRUCT MEMBER	



NOTE!

FLOOR JOIST LAYOUT

3

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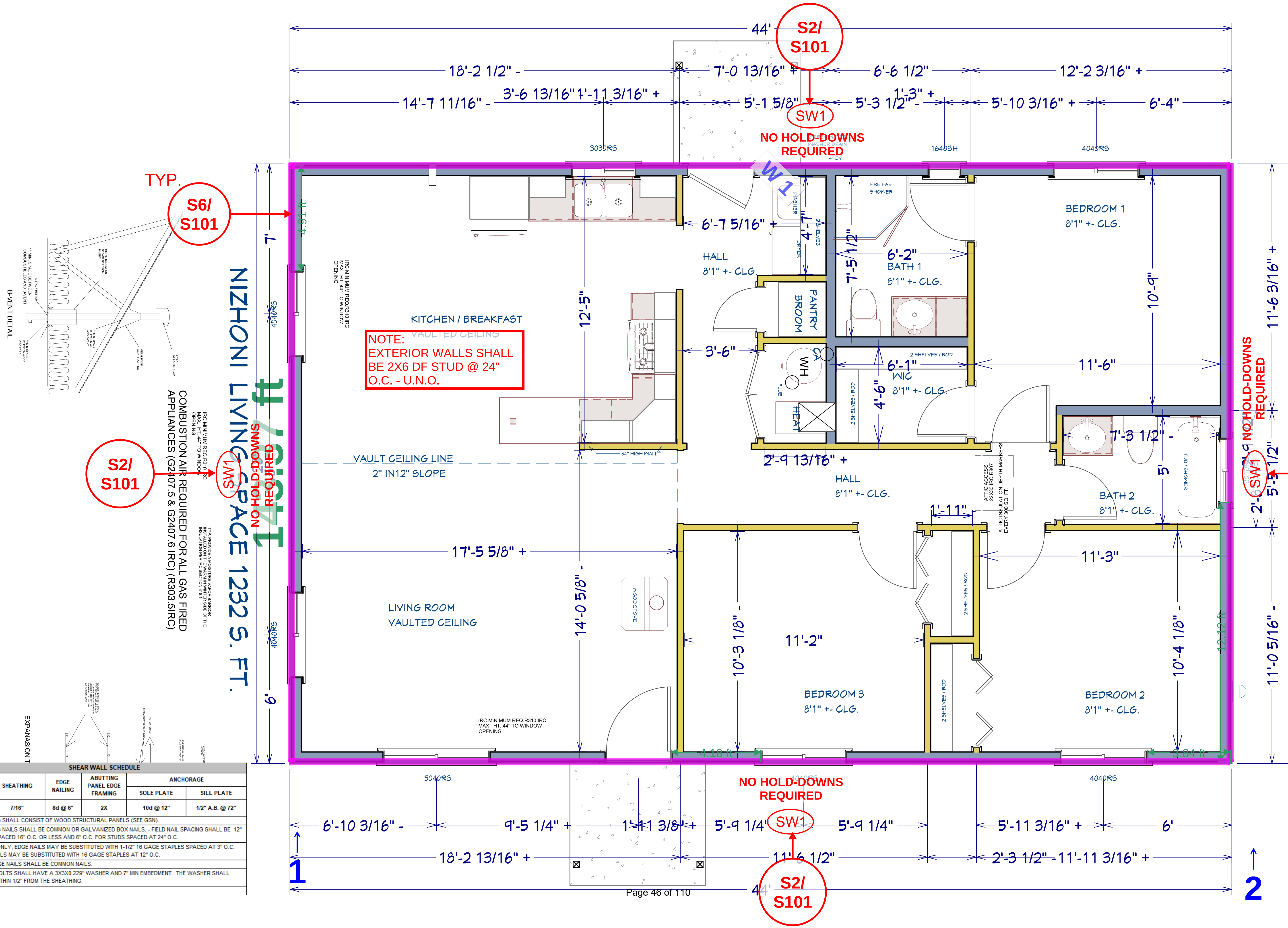
NIZHONI ON SLAB PLAN



SHEAR WALL SCHEDULE					
MARK	SHEATHING	EDGE NAILING	ABUTTING PANEL EDGE FRAMING	ANCHORAGE	
				SOLE PLATE	SILL PLATE
SW1	7/16"	8d @ 6"	2X	10d @ 12"	1/2" A.B. @ 72"

1. SHEATHING SHALL CONSIST OF WOOD STRUCTURAL PANELS (SEE GSN).
2. SHEATHING NAILS SHALL BE COMMON OR GALVANIZED BOX NAILS. - FIELD NAIL SPACING SHALL BE 12" FOR STUDS SPACED 16" O.C. OR LESS AND 6" O.C. FOR STUDS SPACED AT 24" O.C.
3. FOR SW1 ONLY, EDGE NAILS MAY BE SUBSTITUTED WITH 1-1/2" 16 GAGE STAPLES SPACED AT 3" O.C. AND FIELD NAILS MAY BE SUBSTITUTED WITH 16 GAGE STAPLES AT 12" O.C.
4. ANCHORAGE NAILS SHALL BE COMMON NAILS.
5. ANCHOR BOLTS SHALL HAVE A 3X3X0.229" WASHER AND 7" MIN EMBEDMENT. THE WASHER SHALL EXTEND TO WITHIN 1/2" FROM THE SHEATHING.

1/4" SCALE

3

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NIZHONI ON SLAB PLAN

TRUSS LAYOUT

6

BEAM SCHEDULE	
MARK	TYPE
RB 01	(2) 2 X 6
RB 02	(2) 2 X 6
RB 03	(3) 2 X 6
RB 04	(3) 2 X 8
RB 05	(2) 2 X 8

1. DIMENSIONAL LUMBER DF#2 U.N.O.
2. LAMINATED VENEER LUMBER (LVL) 2.0E
3. GLUED-LAMINATED TIMBER (GLB) 24F-1.8E
4. STEEL W-SHAPES A992-50
5. SUFFIXES (A, B, ETC.) DENOTE ALTERNATIVES FOR THE SPECIFIED BEAM

ROOF RAFTER SCHEDULE	
MARK	TYPE
RR 01	2 X 4 @ 24" O.C.

1. DIMENSIONAL LUMBER DF#2 U.N.O.
2. SUFFIXES (A, B, ETC.) DENOTE ALTERNATIVES FOR THE SPECIFIED RAFTER

SHEATHING SCHEDULE	
TYPE	THICKNESS
FLOOR	3/4" (48/24 SPAN RATING)
ROOF	7/16" (24/16 SPAN RATING)

1. SHEATHING PERPENDICULAR TO SUPPORTS.
2. FLOOR SHEATHING NAILED & GLUED TO SUPPORT
3. 8d COMMON NAILS 6" O.C. (EDGES) 12" O.C. (FIELD)
4. NAILING NO CLOSER THAN 3/8" FROM PANEL EDGE

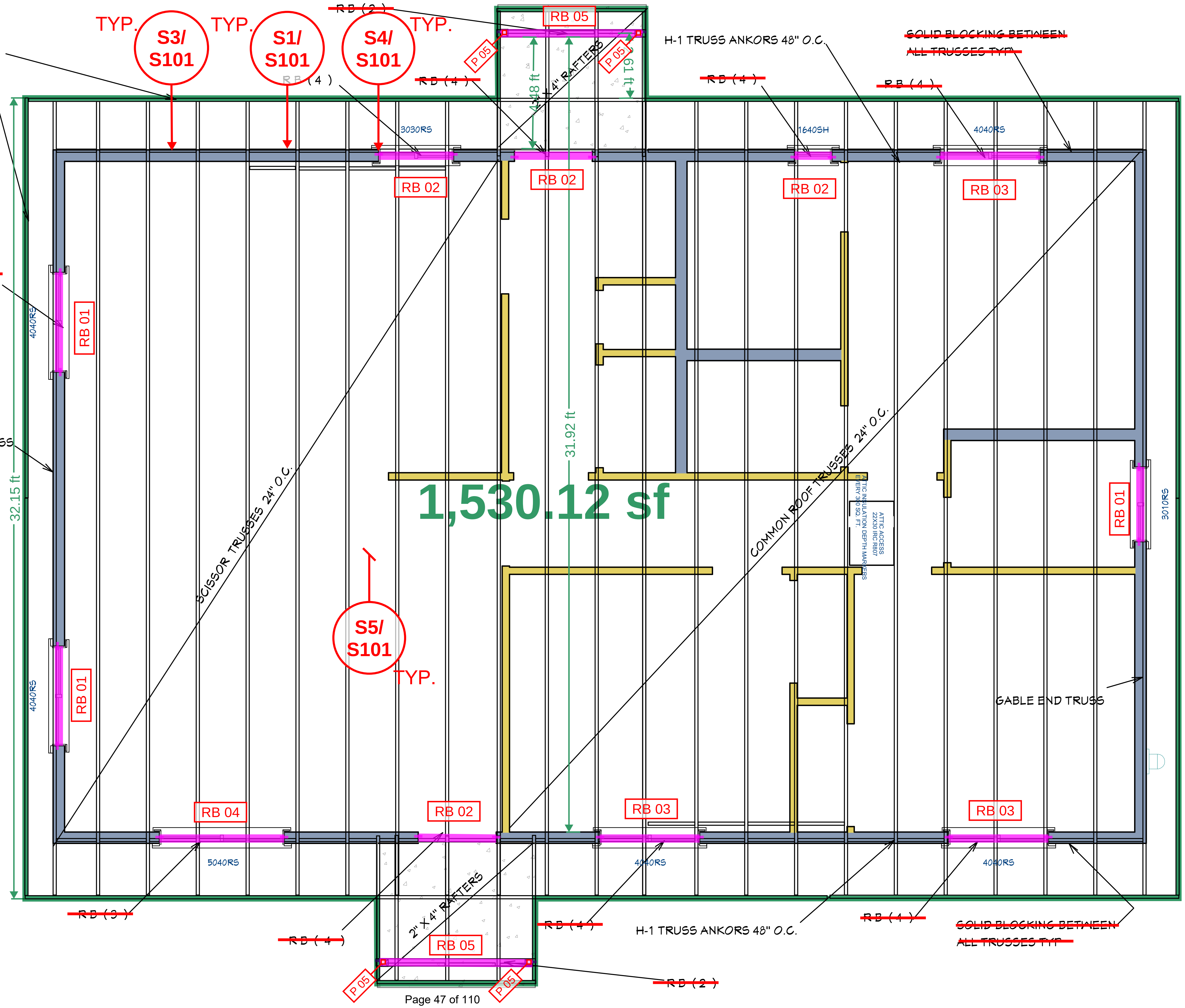
WOOD TRUSS LOADS
GROUND SNOW LOAD, Pg = 57 PSF
FLAT ROOF SNOW LOAD = 35 PSF
TOP CHORD DEAD LOAD = 10 PSF
BOTTOM CHORD DEAD LOAD = 5 PSF

1. DESIGN SNOW LOADS SHALL BE IN ACCORDANCE WITH ASCE 7-10 CHAP.7 (2015 IBC 1608.1)

POST SCHEDULE	
MARK	TYPE
P 02	(2) 2X POST
P 05	4 X 4 POST

1. PARALLEL STRAND LUMBER (PSL) 1.8E
2. STEEL PIPE (PIPE STD) A53
3. STEEL HOLLOW SECTION (HSS) A500
4. STEEL COLUMNS REQUIRE BEARING PLATES
5. CONTINUE POSTS TO FDN / STRUCT MEMBER

ROOF TRUSS LAYOUT

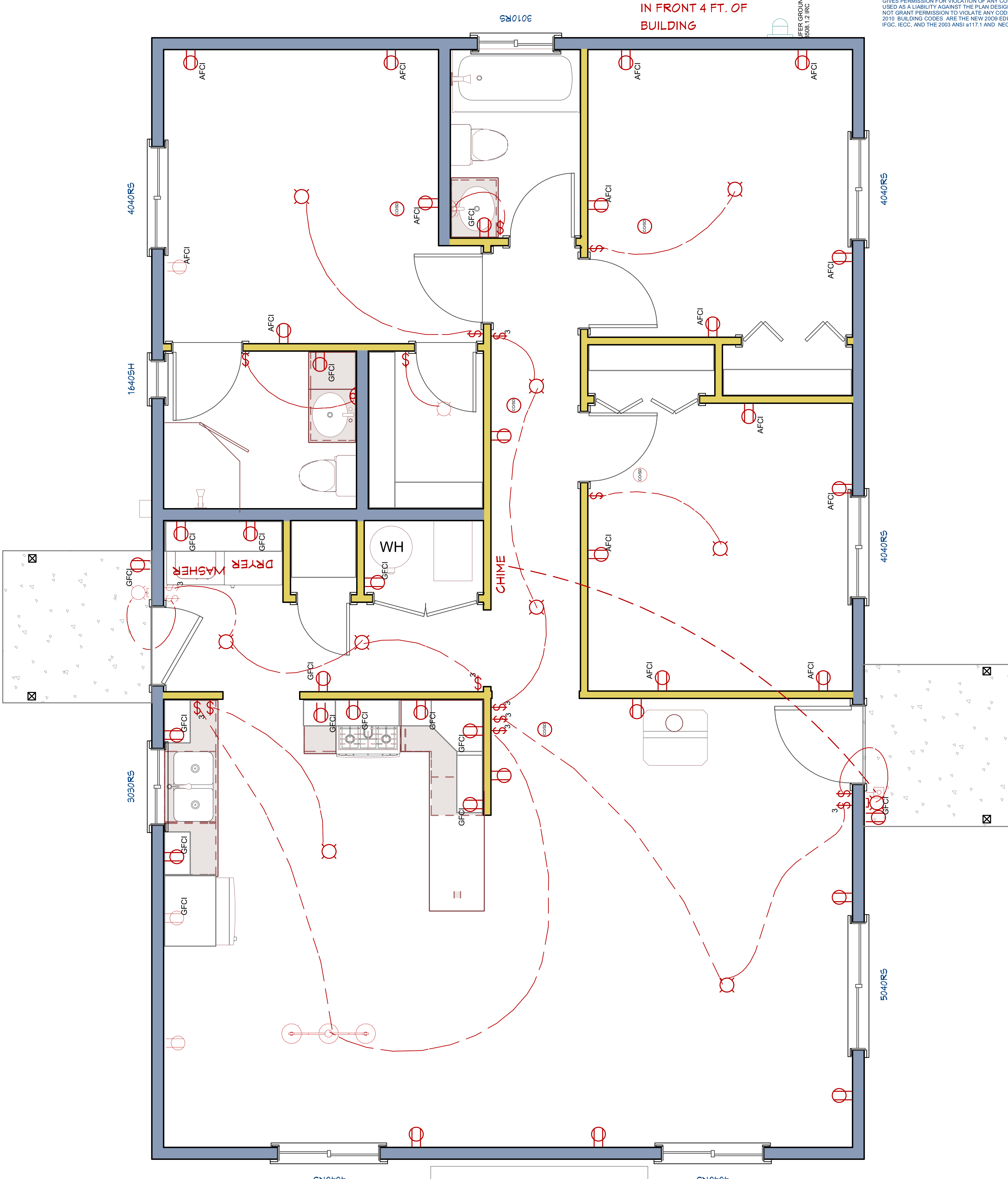


E3609.3 PROVIDE BONDING
TERMINATION AT METER BASE

METER BASE WITH
IN FRONT 4 FT. OF
BUILDING

NOTE!

IT IS IMPORTANT FOR THE OWNER / BUILDER TO UNDERSTAND THAT THIS PLAN DOES NOT SHOW THE MANY CODE REQUIREMENTS FOR EACH ITEM SHOWN IN A PLAN! IT IS THEIR RESPONSIBILITY TO BE SURE THIS PROJECT IS CONSTRUCTED IN FULL COMPLIANCE WITH ALL STATE AND LOCAL CODES AND ORDINANCES. THESE PLANS ARE NOT ALL INCLUSIVE OF ALL THE MINIMUM CODES AND ORDINANCES. THIS FACT DOES NOT RELIEVE THE OWNER / BUILDER FROM FULL COMPLIANCE WITH ALL MINIMUM STANDARDS. NO OMISSION FROM THESE PLANS GIVES PERMISSION FOR VIOLATION OF ANY CODE OR ORDINANCE OR CAN BE USED AS A LIABILITY AGAINST THE PLAN DESIGNER. A PERMIT APPROVAL DOES NOT GRANT PERMISSION TO VIOLATE ANY CODE OR LOCAL ORDINANCE. THE 2010 BUILDING CODES ARE THE NEW 2009 EDITIONS OF THE IBC, IRC, IPC, IMC, IFGC, IECC, AND THE 2003 ANSI a117.1 AND NEC.



ELECTRICAL

ELECT. CONDUCTORS PROTECTED WITH IN 6 FT. OF AN ATTIC ACCESS (E3802.2 IRC)

ELECT. PANEL CLEARANCES 30" X 36" OUT (E3609.4 IRC)

ELECT. CONDUCTORS PROTECTED WITH IN 6 FT. OF AN ATTIC ACCESS (E3802.2 IRC)

ALL RECEPTICALS MUST BE TAMPER RESISTANT

2009 NEC 15-20 AMP BRANCH CIRCUITS TO BE PROTECTED BY A LISTED ARC-FAULT CIRCUIT INTERRUPTER-COMBINATION NEC 210.12

NOTE!

SMOKE DETECTORS IN EACH BEDROOM INTERWIRED.
SMOKE-CARBON MONOXIDE DETECTORS IN A COMMON AREA AT EACH LEVEL INTERWIRED.

ARC FAULT PROTECTED CIRCUITS FOR ALL BEDROOM AREAS.

GROUND FAULT PROTECTED CIRCUITS OR OUTLETS IN ALL WET AREAS AND EXTERIOR LOCATIONS. EXTERIOR OUTLETS TO HAVE WEATHER PROOF COVERS.

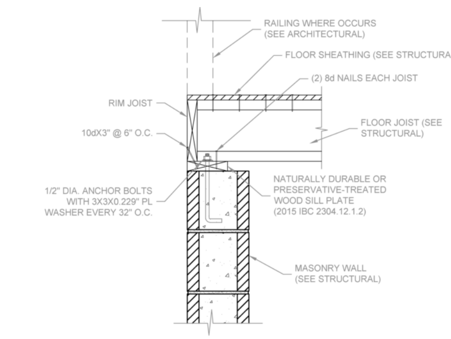
2009 NEC 15-20 AMP BRANCH CIRCUITS TO BE PROTECTED BY A LISTED ARC-FAULT CIRCUIT INTERRUPTER-COMBINATION NEC 210.12

Steve Perry's Design Solutions & Construction Inc.

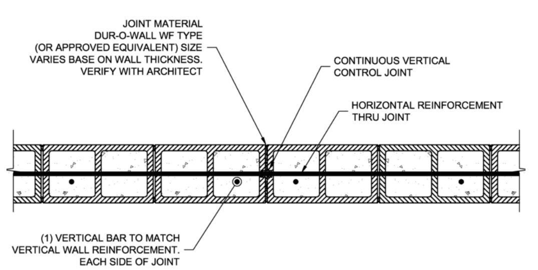
NIZHONI ON SLAB PLAN

ELECTRICAL

7

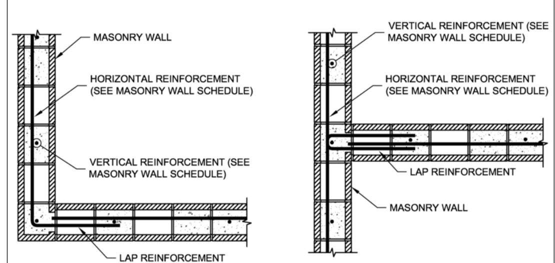


S11 MASONRY WALL - WOOD FLOOR (ABOVE)
SCALE: N.T.S.



NOTE:
CONTROL JOINTS SHALL BE SPACED A MAXIMUM OF 30' O.C. (SEE ARCHITECTURAL FOR LOCATIONS)

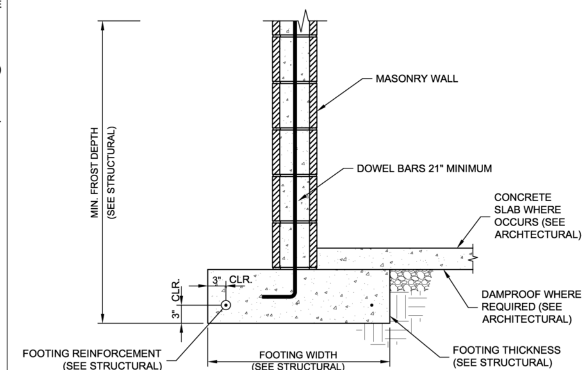
S10 TYPICAL CONTROL JOINT FOR SINGLE REINFORCED MASONRY WALL (PLAN VIEW
SCALE: N.T.S.



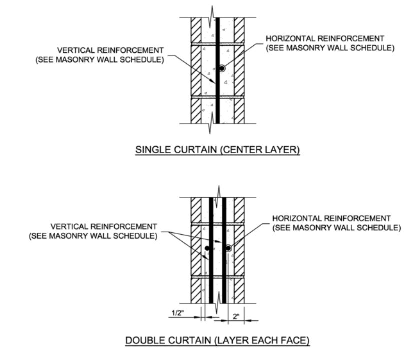
REQUIRED LAP LENGTH

TYPE	CMU	MIN.
SPLICE	48 BAR DIA.	24"
HOOK	20 BAR DIA.	12"

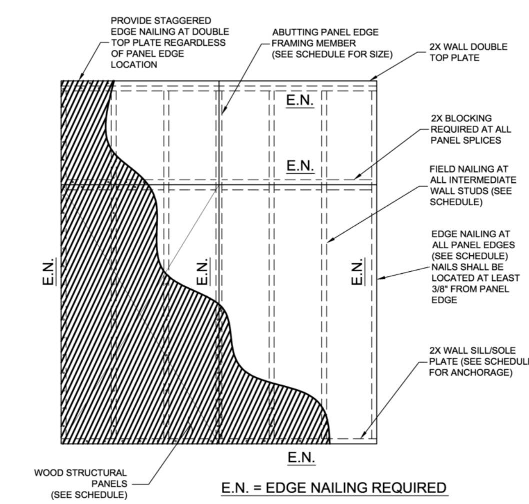
S9 MASONRY WALL - CORNER AND INTERSECTION
SCALE: N.T.S.



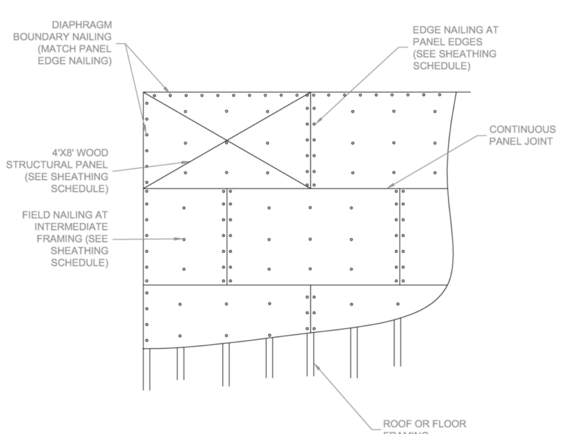
S8 CONCRETE FOOTING - MASONRY WALL
SCALE: N.T.S.



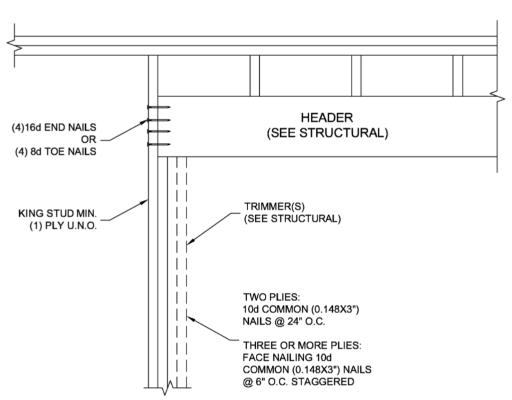
S7 MASONRY WALL - REINFORCEMENT
SCALE: N.T.S.



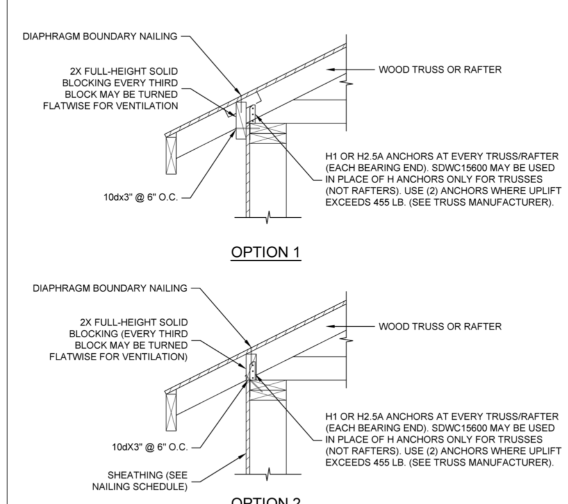
S6 WOOD STRUCTURAL PANEL SHEAR WALL
SCALE: N.T.S.



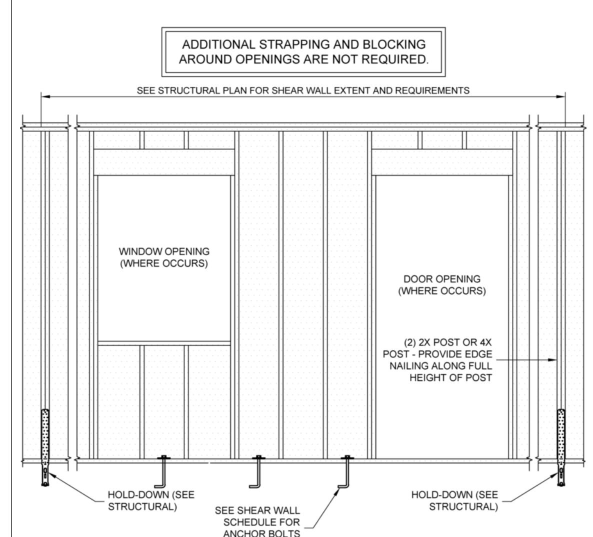
S5 WOOD STRUCTURAL PANEL DIAPHRAGM - UNBLOCKED
SCALE: N.T.S.



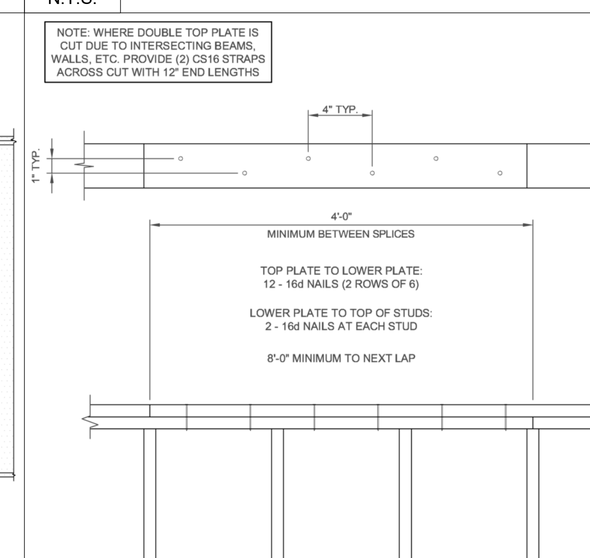
S4 WOOD BEAM - WALL HEADER FRAMING
SCALE: N.T.S.



S3 ROOF FRAMING - BLOCKING (150 PLF UNIT SHEAR)
SCALE: N.T.S.



S2 SHEAR WALL - PERFORATED
SCALE: N.T.S.



S1 DIAPHRAGM - TOP PLATE SPLICE
SCALE: N.T.S.

ENGINEERING

DATE: 04/11/2019
DRAWN BY: BDA
DESIGNED BY: BDA, DBB, DHB, ZDB

PROJECT NAME: NIZHONI CRAWL SPACE PLAN
PROJECT NUMBER: CEEn_2018CPST_003
CLIENT: UTAH NAVAJO TRUST FUND
SPONSOR: ACUTE ENGINEERING

STRUCTURAL FRAMING DETAILS

S101

Appendix D: Structural Reports

ACUTE ENGINEERING
1429 South State St.
Orem, Utah 84097
Phone 801.229.9020
Fax 801.224.0050
info@acuteengineering.com

Structural Calculations

Project Name:	**UNTF Comb Ridge V12-2018 (Base) 281218**
Project Location:	**AN,BL, BF, MW, MO, NM, OL, RM,WE**
	Utah
Project Number:	**281218**
Date:	**3/22/2019**

Valid Wet Stamp In Red

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1. Design Criteria

Project information

Address / location *	=	AN,BL, BF, MW, MO, NM, OL, RM,WE
Area / subdivision		
Area / subdiv. No. 1	=	San Juan - Aneth (AN)
Area / subdiv. No. 2	=	San Juan - Mexican Water (MW)
Area / subdiv. No. 3	=	San Juan - Navajo Mountain (NM)
Area / subdiv. No. 4	=	San Juan - Oljato (OL)
Area / subdiv. No. 5	=	San Juan - Red Mesa (RM)
Area / subdiv. No. 6	=	San Juan - Blanding (BMDC) (BL)
Area / subdiv. No. 7	=	San Juan - Monticello (BMDC) (MO)
Area / subdiv. No. 8	=	San Juan - Bluff (BMDC) (BF)
Area / subdiv. No. 9	=	San Juan - Westwater (BMDC) (WE)
State	=	Utah

* The structural calculations report and corresponding construction documents are valid for a single use at the project location and shall not be reused, copied, or reproduced without written consent.

Jurisdiction / occupancy information

Jurisdiction	=	Utah	
Building code	=	Utah Code, Title 15A	
Model building code	=	2015 IRC	2015 IBC 101.2 & IRC R301.1.3
Use and occupancy classification	=	Residential - 1-unit dwelling (R)	
Risk category	=	Not occupancy categories I, III, IV (II)	

** Building code compliance of non-structural issues is not addressed. Refer to the architect or designer for compliance.

Deferred submittals

Prefabricated metal plate wood trusses - roof (truss manufacturer)

Area / Subdiv. Comparison

Area / Subdiv.			Wind parameters		Snow	Frost	Mapped periods	
No.	City	Elev. (ft)	V (mph)	Exposure	Pf (psf)	(in.)	Ss	S1
1	San Juan County	4,500	115	3	30	20	0.1376	0.0488
2	San Juan County	5,200	115	3	30	20	0.128	0.0463
3	San Juan County	6,000	115	3	30	20	0.2318	0.0714
4	Oljeto	5,200	115	3	30	20	0.1856	0.0554
5	San Juan County	5,450	115	3	30	20	0.1342	0.0473
6	Blanding	6,100	115	3	30	20	0.1509	0.0524
7	Monticello	7,100	115	3	35	20	0.1557	0.0542
8	Bluff	4,300	115	3	30	20	0.1463	0.0498
9	San Juan County	6,100	115	3	30	20	0.1509	0.0524
Design		**7,100**	**115**	**3**	**35**	**20**	**0.2318**	**0.0714**

	Soil				Lateral earth p (psf)		Allow soil	Minimum footing width	
No.	Site class	Fa	Fv	SDS	Active	At-rest	p (psf)	FT (in.)	SF (in.)
1	D	1.60	2.40	0.15	30	60	1,500	18	20
2	D	1.60	2.40	0.14	30	60	1,500	18	20
3	D	1.60	2.40	0.25	30	60	1,500	18	20
4	D	1.60	2.40	0.20	30	60	1,500	18	20
5	D	1.60	2.40	0.14	30	60	1,500	18	20
6	D	1.60	2.40	0.16	30	60	1,500	18	20
7	D	1.60	2.40	0.17	30	60	1,500	18	20
8	D	1.60	2.40	0.16	30	60	1,500	18	20
9	D	1.60	2.40	0.16	30	60	1,500	18	20
Design	**D**	**1.60**	**2.40**	**0.25**	**30**	**60**	**1,500**	**18**	**20**

Environmental load parameters

Earthquake

Mapped short period	Ss =	0.2318	2015 IBC Figure 1613.3.1(1)
Mapped 1-sec. period	S1 =	0.0714	2015 IBC Figure 1613.3.1(2)

Wind

Ult. design wind speed	Vult =	115 mph	2015 IBC Figure 1609.3(1), 1609.3(2), 1609.3(3)
Exposure category	=	C	2015 IBC 1609.4.3

Soil

Geotechnical design basis †

Area / subdiv. No. 1	=	Presumptive values, 2015 IBC Table 1806.2	
Area / subdiv. No. 2	=	Presumptive values, 2015 IBC Table 1806.2	
Area / subdiv. No. 3	=	Presumptive values, 2015 IBC Table 1806.2	
Area / subdiv. No. 4	=	Presumptive values, 2015 IBC Table 1806.2	
Area / subdiv. No. 5	=	Presumptive values, 2015 IBC Table 1806.2	
Area / subdiv. No. 6	=	Presumptive values, 2015 IBC Table 1806.2	
Area / subdiv. No. 7	=	Presumptive values, 2015 IBC Table 1806.2	
Area / subdiv. No. 8	=	Presumptive values, 2015 IBC Table 1806.2	
Area / subdiv. No. 9	=	Presumptive values, 2015 IBC Table 1806.2	
Minimum frost cover	=	20 in.	2015 IBC 1809.5
Site class	=	D	
Special requirements	=	None	

Lateral active press.	=	30 psf
Lateral at-rest press.	=	60 psf
Lateral passive press.	=	150 psf
Coeff. of friction	=	0.25
Allow. vert. bearing	Qa =	1500 psf
Min. cont. footing	=	18 in.
Min. spot footing	=	20 in.

† It is recommended that a geotechnical investigation be conducted unless satisfactory data from adjacent areas is available that demonstrates an investigation is not necessary for any of the conditions in 2015 IBC 1803.5.1-12. The structural calculations report and corresponding construction documents are only valid for the soil parameters listed herin. The design professional in responsible charge shall be notified if observations or field conditions differ.

Snow

Elevation (max)	=	7100 ft	
Flat roof snow load	Pf =	35 psf	Jurisdiction

2.1 Loads - Snow

Ground snow loads
(ASCE 7-10 Chap. 7.2)

Basis	=	Utah amend. 2015 IBC 1608.1.2	
County	=	San Juan	
Elevation	=	7100 ft	
Ground snow load	Pg =	57 psf	

Flat roof snow loads
(ASCE 7-10 Chap. 7.3)

Basis	=	Jurisdiction	
Roof exposure definition	=	Not fully exposed or sheltered (ASCE 7-10 Table 7-2, Notes a and b).	
Roof exposure	=	Partial	ASCE 7-10 Table 7-2 (notes a,b)
Terrain category (wind)	=	C	
Exposure factor	Ce =	1	ASCE 7-10 Table 7-2
Roof thermal condition	=	Not unheated nor a continuously heated greenhouse (ASCE 7-10 Table 7-3).	
Thermal factor	Ct =	1	ASCE 7-10 Table 7-3
Risk category	=	II	
Snow importance factor	Is =	1	ASCE 7-10 Table 1.5-2
Flat roof snow load	Pf =	35 psf	Jurisdiction

Sloped roof snow loads
(ASCE 7-10 Chap. 7.4)

Basis	=	Jurisdiction	
Roof surface	=	Non-slippery (asphalt shingles, wood shingles, or shakes).	
Roof slope	=	18 deg.	
Roof slope factor	Cs =	1	ASCE 7-10 Chap. C7.4
Eave snow load	Peave =	35 psf	Utah amend. 2015 IBC 1608.1.1
Balanced snow load	Ps =	35 psf	Jurisdiction

Unbalanced roof snow loads
(ASCE 7-10 Chap. 7.6)

Hip and gable roofs

Eave to ridge distance	W =	16 ft	
Roof system	=	Truss	
Snow density	gamma =	21 pcf	ASCE 7-10 Equation 7.7-1
Height of balanced snow	Hb =	2 ft	ASCE 7-10 Chap. 7.7.1
Unbalanced snow load	Ps =	35 psf	ASCE 7-10 Chap. 7.6.1

2.2 Loads - Dead / Live

Roof dead loads
(2015 IBC 1606, ASCE 7-10 Table C3-1)

Asphalt shingles	=	2 psf	ASCE 7-10 Table C3-1
Felt or ready roofing, roof sheathing	=	3 psf	ASCE 7-10 Table C3-1
Wood trusses, misc	=	5 psf	Estimated
Insulation, gypsum sheathing	=	5 psf	ASCE 7-10 Table C3-1
Roof DL No. 1	**Total =**	**15 psf**	

Floor dead loads
(2015 IBC 1606, ASCE 7-10 Table C3-1)

Floor sheathing	=	2 psf	ASCE 7-10 Table C3-1
Wood joists/trusses, MEP, misc	=	6 psf	ASCE 7-10 Table C3-1
Gypsum sheathing	=	2 psf	ASCE 7-10 Table C3-1
Interior Walls	=	2 psf	Estimated
Floor DL No. 1	**Total =**	**12 psf**	
6" composite suspended concrete slab	=	75 psf	Estimated
Floor DL No. 2	**Total =**	**75 psf**	

Wall dead loads
(2015 IBC 1606, ASCE 7-10 Table C3-1)

Interior stud walls	=	10 psf	ASCE 7-10 12.14.8.1
Exterior 2x6@16"o.c.,5/8" gyp, insul., 7/16" sheatl	=	12 psf	ASCE 7-10 Table C3-1

Roof live loads
(2015 IBC 1607)

Occupancy or use		Unif. (psf)	Conc. (lb)	Ref.
Roofs (ordinary construction)	=	20	300	2015 IBC Table 1607.1 No. 26

Floor live loads
(2015 IBC 1607)

Occupancy or use		Unif. (psf)	Conc. (lb)	Ref.
Residential (1-2 unit dwelling)	=	40	0	2015 IBC Table 1607.1 No. 25
Stairs and exits (residential 1-2 unit dwelling)	=	40	300	2015 IBC Table 1607.1 No. 30

Load sets

Live load (occupancy or use)	(psf)	Dead load	(psf)	Abbrev.
Flat roof snow load	35	Roof DL No. 1	15	S 35 15
Residential (1-2 unit dwelling)	40	Floor DL No. 1	12	L 40 12
Stairs and exits (residential 1-2 unit dwelling)	40	Floor DL No. 1	12	Ex 40 12
Residential (1-2 unit dwelling)	40	Floor DL No. 2	75	C 40 75

Deflection limits (L/limit)

(2015 IBC 1604.3.1)

Construction		L	S or W	D+L
Roof members (supporting plaster ceiling)	=	360	360	240
Floor members (joists)	=	360		240
Floor members (beams/headers)	=	360		240
Exterior walls and interior partitions (with other brit	=		240	

2.3 Loads - Earthquake

Seismic Design Criteria
(2015 IBC 1613.3, ASCE 7-10 Chap. 11)

Mapped acceleration parameters					
MCE short period	Ss =	0.232 g			
MCE 1.0 sec. period	S1 =	0.071 g			
Design acceleration parameters					
Site class	=	D			
Site coefficient	Fa =	1.6			
Site coefficient	Fv =	2.4			
Adjusted short period	SMS =	0.37	Design short period	SDS =	0.25
Adjusted 1.0 sec. period	SM1 =	0.17	Design 1.0 sec. period	SD1 =	0.11
Risk category	=	II			
IRC Seismic design category	=	B			

Dead loads
(2015 IBC 1606; ASCE 7-10 Chap. 12.7.2, Table C3-1)

Effective seismic snow weight	=	9 psf	Utah Amend. 2015 IBC 1613.1.1
Roof DL No. 1	=	15 psf	
Floor DL No. 1	=	12 psf	
Interior stud walls	=	10 psf	
Exterior 2x6@16"o.c.,5/8" gyp, insul., 7/16" sheatl	=	12 psf	

Equivalent Lateral Force Procedure
(ASCE 7-10 Chap. 12.8)

		Primary LFRS	
Basic structural system	=	Bearing wall systems	
Seismic force-resisting system	=	Light-frame wood walls (wood sheath	
Structural design parameters			
Response modification factor	R =	6.5	ASCE 7-10 Table 12.2-1 No. A15
System overstrength factor	Omega =	3	ASCE 7-10 Table 12.2-1 No. A15
Deflection amplification factor	Cd =	4	ASCE 7-10 Table 12.2-1 No. A15
Building height limit	=	999 ft	ASCE 7-10 Table 12.2-1 No. A15
Fundamental period			
Structure type	=	All other	
Approximate period parameter	Ct =	0.02	ASCE 7-10 Table 12.8-2
Approximate period parameter	x =	0.75	ASCE 7-10 Table 12.8-2
Height above base	=	9.33 ft	
Approximate fundamental period	Ta =	0.107 sec.	ASCE 7-10 Equation 12.8-7
Approximate fundamental freq.	n =	9.36 hz	
Long period transition period	TL =	8 sec.	ASCE 7-10 Figure 22-12
Seismic base shear			
Seismic importance factor	Ie =	1.00	ASCE 7-10 Table 1.5-2
Seismic response coefficient	Csmin =	0.011	ASCE 7-10 Equations 12.8-5,6
Seismic response coefficient	Csmax =	0.165	ASCE 7-10 Equations 12.8-3,4
Seismic response coefficient	Cs =	0.04	ASCE 7-10 Equation 12.8-2
Seismic base shear (LRFD)	V =	1670 lb	ASCE 7-10 Equation 12.8-1

Weight Parameters

	Exterior Wall			Roof		Floor + Int Wall		Total
		Permtr 1	Permtr 2	Area	Weight	Area	Weight	Weight
	Trib.	(ft)	(ft)	(sf)	(psf)	(sf)	(psf)	(lb)
1	4	144	0	1,526	24	0	12	43,896
Total								43,896

Seismic Lateral Loads
(ASCE 7-10 Chap. 12.8.3)

						Vx (Shear walls)	
			Hx		Fx	LRFD	ASD
Level	Height (ft)	Floor (in)	(ft)	Cvx	(lb)	(lb)	(lb)
1	8.0	10	9.33	1.0	1,670	1,670	1,169

2.4 Loads - Wind

Design wind pressure
(2015 IBC 1609, ASCE 7-10 Chap.2 6)

Terrain exposure				
Surface roughness (upwind)		=	Open terrain with scattered obstructions having heights generally less than 30 ft.	
Exposure category		=	C	2015 IBC 1609.4.3
Terrain exp. constant	alpha	=	9.5	ASCE 7-10 Table 26.9-1
Terrain exp. constant	Zg	=	900	ASCE 7-10 Table 26.9-1
Terrain exp. constant	Zmin	=	15 ft	ASCE 7-10 Table 26.9-1
Topographic factor	Kzt	=	1	ASCE 7-10 Chap. 26.8.2
Basic wind pressure				
Ultimate design wind speed	Vult	=	115 mph	2015 IBC Figure 1609.3(1), 1609.3(2)
Structure type		=	Buildings - MWFRS	
Wind directionality factor	Kd	=	0.85	ASCE 7-10 Table 26.6-1
Risk category		=	II	2015 IBC Table 1604.5
Approx. fundamental freq.		=	9.36 hz	
Structure type		=	Rigid	ASCE 7-10 Chap. 26.2
Gust effect factor	G	=	0.85	ASCE 7-10 Chap. 26.9.1
Enclosure		=	Enclosed (A building that is not open or partially enclosed.)	
Roof pitch		=	4:12	
Internal pressure coeff.	GCpi	=	0.18	ASCE 7-10 Chap. 26.11.1, Table 26.1
Basic velocity pressure	q	=	28.78 psf	ASCE 7-10 Equation 27.3-1

Directional Procedure: Components and cladding
(ASCE 7-10 Chap. 30.4)

Roof mean height	h	=	12 ft	ASCE 7-10 Chap. 26.2
Effective wind area (component)	Aeff	=	20 sf	
Velocity press. exp. coeff.	Kz	=	0.85	ASCE 7-10 Table 30.3-1 Note 1.
Velocity pressure	qh	=	24.43 psf	ASCE 7-10 Equation 30.3-1

Pressure coefficient		End	Interior		
Positve	GCp =	0.95	0.95		ASCE 7-10 Figure 30.4-1
Negative	GCp =	-1.29	-1.05		ASCE 7-10 Figure 30.4-1
Maximum pressure	max p =	36.00	29.97	psf	ASCE 7-10 Equation 30.4-1

Elevation Geometry

Level	Trib. Height (ft)	Horiz. dim. (ft) Front	Side	Max roof Elev. (ft)	Front Proj. A (sf) Gable	Sloped	Side Proj. A (sf) Gable	Sloped
1	4.2	43.85	27.9	14.6	0	252	91	0

Directional Procedure: MWFRS external pressure coefficients
(ASCE 7-10 Chap. 27.3, Figure 27.4-1 weighted Cp for sloped / gabled area)

Level	Front, Cp				Side, Cp			
Roof	Windward		Leeward		Windward		Leeward	
Level	Max Cp	Min Cp	Max Cp	Min Cp	Max Cp	Min Cp	Max Cp	Min Cp
1	-0.06	-0.51	-0.57	-0.57	0.80	0.80	-0.39	-0.39
	Windward	Leeward	Side		Windward	Leeward	Side	
Walls	0.80	-0.50	-0.70		0.80	-0.39	-0.70	

Directional Procedure: MWFRS wind pressures
(ASCE 7-10 Chap. 27.3.1, Table 27.3-1))

Level	Elev. (ft)	Kz	qz (psf)	Front pressure (psf) +GCpi	-GCpi	Total	Side pressure (psf) +GCpi	-GCpi	Total
Walls - Leeward									
Max h	9.33	0.85	24.43	-14.78	-5.99		-12.41	-3.61	
Walls - Windward									
1	9.33	0.85	24.43	12.21	21.01	26.99	12.21	21.01	24.62
Roofs - Leeward									
1	14.60	0.85	24.43	-16.24	-7.44		-12.41	-3.61	
Roofs - Windward									
1	14.60	0.85	24.43	-14.94	-5.69	1.76	12.21	12.21	24.62

Directional Procedure: Wind Lateral Loads
(ASCE 7-10 Chap. 27.2-27.4)

	Front				Side			
	Walls	Roof	Fx (ASD)	Vx (ASD)	Walls	Roof	Fx (ASD)	Vx (ASD)
Level	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)
1	2,989	265	3,254	3,254	1,734	1,344	3,079	3,079

3.1 LFRS - Wood Sheathing / Diaphragms

Sheathing analysis

APA Engineered Wood Construciton Guide, Form No. E30W Tables 12, 30 (2016 APA)

	Applied loads (OOP)			Sheathing			Allow	
Location	Label	LL (psf)	DL (psf)	Size	Rating	Support spacing (in.)	LL (psf)	Result
Roof	S 35 15	35	15	7/16"	24/16	24	40	OK 13%
Floor	L 40 12	40	12	3/4"	48/24	16	238	OK 83%

Diaphragm parameters

		Transverse (front)		Longitudinal (side)					
	Seismic	Wind	Horz.	Wind	Horz.	Sheathing		Diaphragm	
Level	Fpx	MWFRS	dim. (ft)	MWFRS	dim. (ft)	Mark	Panel	Nailing	Blocking
1	1,519	3,254	43.85	3,079	27.9	RS 1	7/16"	8d @ 6"o.c.	Unblocked

Diaphragm analysis

	Max	Reaction Load (lb)			Diaphragm	Wind		Seismic	
Level	Span (ft)	Wind	Seismic	Line L (ft)	Layout	v (plf)	Allow (plf)	v (plf)	Allow (plf)
Transverse (front) direction									
1	43.85	1,627	760	27.9	Case 1	58	322	27	230
Longitudinal (side) direction									
1	27.9	1,539	760	43.85	Case 3	35	238	17	170

Chord Analysis

	Max		% Total	Chord		
Level	Span (ft)	Depth (ft)	Load	Force (lb)	Collector Type	Allow (lb)
Transverse (front) direction			on Diaph.			
1	43.85	28	100%	639	TP Splice (12) 16d	2,700
Longitudinal (side) direction						
1	27.9	44	100%	245	TP Splice (12) 16d	2,700

Strut Analysis

	Line	Strut	% Total	Strut		
Level	Length (ft)	Length (ft)	Load	Force (lb)	Collector Type	Allow (lb)
Transverse (front) direction						
1	27.9	14	50%	814	TP Splice (12) 16d	2,700
Longitudinal (side) direction			0			
1	43.85	22	50%	770	TP Splice (12) 16d	2,700

3.2 LFRS - Wood Shear Walls

Level 1 - Transverse LFRS (2015 IBC 2305)

Wind lateral load (ASD)	=	3,254	lb
Seismic lateral load (ASD)	=	1,169	lb

Line	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
W =	1,627	1,627													
E =	584	584													

Wall segment			Opening (ft)		LFRS						Anchorage	Hold-down	
Line	L (ft)	h (ft)	b total	h max	Type	Wind	Allow	Seismic	Allow	D (in.)	Type	T (lb)	Type
1	27.84	8	2.5	4	SW1	64	349	23	249	0.07	1/2" A.B. @ 72'	0	
2	27.84	8	0	0	SW1	58	365	21	260	0.06	1/2" A.B. @ 72'	0	

Level 1 - Longitudinal LFRS (2015 IBC 2305)

Wind lateral load (ASD)	=	3,079	lb
Seismic lateral load (ASD)	=	1,169	lb

Line	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
W =	1,539	1,539													
E =	584	584													

Wall segment			Opening (ft)		LFRS						Anchorage	Hold-down	
Line	L (ft)	h (ft)	b total	h max	Type	Wind	Allow	Seismic	Allow	D (in.)	Type	T (lb)	Type
A	31.5	8	13	6.67	SW1	83	225	32	161	0.16	1/2" A.B. @ 72'	0	
B	44	8	22.5	6.67	SW1	72	206	27	147	0.15	1/2" A.B. @ 72'	0	

4.1 VFRS - Wood Bearing Walls

Wall 1	**2 X 6 DF Stud @ 24 in. o.c.**

Wall

Section	=	1
Level	=	Main
Height	=	7.71 ft
Label	=	2 X 6 DF Stud @ 24 in. o.c.
Result	=	OK Combo 5: D + (0.6W)

Vertical Load

Label	LL (psf)	DL (psf)	Trib (ft)	Line DL (plf)	Vertical Load (plf) Total	Vertical Load (plf) Capacity
S 35 15	35	15	16	50	859	2,578
L 40 12	40	12	0			

Lateral out-of-plane (OOP) pressure

Seismic	=	1.2 psf			
H	=	7.71 ft	Stud Fac. 2015 SDPWS Table 3.1.1.1	=	1.35
s	=	24 in. o.c.	Wind zone	=	End
Aeff	=	15.4 sf	Lateral out-of-plane (OOP) pressure	=	36 psf
Kz	=	0.84	Combined axial / bending stress factor (CSF)	=	0.36
qz	=	24.43 psf	Lateral out-of-plane deflection (L/Defl.)	=	1,514

Geometric Properties

Width	=	1.5 in.
Depth	=	5.5 in.
S	=	7.56 in.3
Area	=	8.25 in.2
I	=	20.8 in.4
Weight	=	17.7 lb
Slenderness Ratio Ratio		
x-x axis	=	16.8
y-y axis	=	0.0

Column Stability

CF (Fc)	=	1.00
Cd	=	1
Fc	=	850 psi
c	=	0.8
FcEx	=	1482 psi
FcEy	=	0 psi
Fc*	=	850 psi
Cp	=	0.84
F'c	=	716 psi
fc	=	208 psi

Combined Axial & Bending

Cd	=	1.60	
CF (Fb)	=	1.00	
Fc*	=	1360 psi	
Cp	=	0.71	
F'c	=	979 psi	
fc	=	72 psi	Combo 5
fc	=	174 psi	Combo 6

Wind Forces Govern Design

Cr	=	1.35	
M (ASD)	=	321 lb-ft	
F'b	=	1512 psi	
fb	=	509 psi	
CSF	=	0.36	Combo 5
CSF	=	0.32	Combo 6
CSF	=	0.04	Combo 7

Wind Deflection

Deflection	=	0.06 in.

4.2 VFRS - Wood Joists

RR 01	2 X 4 @ 24" O.C.

Summary

Mark	=	RR 01
Center span	=	5 ft
Section	=	2 X 4 @ 24" O.C.
Result	=	Section adequate by 20%.

Uniform Load

				Partition DL (psf)	
Label	Class	LL (psf)	DL (psf)	Center	Cantilever
S 35 15	Roof	35	15	0	0

Beam Adjustment Factors

Cd	=	1
CF / CV	=	1.5
Cr	=	1

Reference Allowable Loads

Moment	=	396 lb-ft
Shear	=	630 lb
R1	=	1640.625 lb
R2	=	1640.625 lb

Support

	Left	Right
Left (in.)	1.75	1.75
Web stiffener	No WS	No WS

Section and Material Properties

Flange		
d	=	0 in.
b	=	0 in.
Web		
h	=	0 in.
Panel		
t	=	0 in.
C. Factor	=	0

Reactions

	Left	Right
Roof LL (lb)	175	175
Floor LL (lb)	0	0
DL (lb)	79	79
Total load (lb)	**254**	**254**

Uplift

	Left
Roof LL (lb)	0
Floor LL (lb)	0
DL (lb)	0
Total uplift (lb)	**0**

Joist Properties

Joist K	=	738.46154
Joist EI	=	0 in.2-lb
Comp. EI	=	0 in.2-lb
Effec. EI	=	8575000 in.2-lb

4.3 VFRS - Beams / Posts

Summary	**RB 01**	**(2) 1-3/4 X 9-1/2 LVL [LVL (2.0E)]**

Mark	=	RB 01
Section	=	(2) 1-3/4 X 9-1/2 LVL [LVL (2.0E)]
Span	=	8.5 ft
Result	=	Section adequate by 35 % - Load Combo. No.3 DL + RLL - Flexure

Distributed Loads

			Load Start		Load End	
Class	LL (psf)	DL (psf)	Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	35	15	16.00	0.00	16.00	8.50

Dead Loads

Self Weight	BSW =	10 plf
Cont. Dead Load	W =	25 plf

Allowable Stress

Shear Stress	Fv =	285 psi
Bending Stress	Fb =	2600 psi

Beam Adjustment Factors

Load Duration	Cd =	1.00
Form	CF =	1.00
Repetative	Cr / Cv =	1.00

Load Reduction Factors

Live Load	LLRF =	1.00

Beam Section Properties

Width	b =	3.5 in.
Depth	d =	9.5 in.
Area	A =	33 in.2
Shear Area	As =	22 in.2
Moment of Inertia	I =	250 in.4
Section Modulus	S =	53 in.3

Beam Material Properties

Modulus of Elasticity	E =	2000000 psi
Flexure Stiffness	EI =	500000000 lb-in.2

Req'd bearing length = 1.37"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.07	0.13	54 %	0.20	53 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	2,932	6,318	54 %
Moment (lb-ft)	7,656	11,775	35 %

Support Reactions

	Left	Right
RLL (lb)	2,380	2,380
FLL (lb)	0	0
DL (lb)	1,223	1,223
Total (lb)	3,603	3,603

	Post	Capacity
Left:	2 X 6 (1) K	5128 lb

RB 02	(2) 2 X 8 [DF #2]

Summary

Mark	=	RB 02
Section	=	(2) 2 X 8 [DF #2]
Center Span	=	6 ft
Result	=	Section adequate by 80 % - Load Combo. No.3 DL + RLL - Flexure

Distributed Loads

			Load Start		Load End	
Class	LL (psf)	DL (psf)	Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	35	15	2.00	0.00	2.00	7.00

Dead Loads

Self Weight	BSW =	5 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.00
Form	CF =	1.20
Repetative	Cr / Cv =	1.00

Load Reduction Factors

Live Load	LLRF =	1.00

Beam Section Properties

Width	b =	3 in.
Depth	d =	7.25 in.
Area	A =	22 in.2
Shear Area	As =	15 in.2
Moment of Inertia	I =	95 in.4
Section Modulus	S =	26 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	152000000 lb-in.2

Req'd bearing length =   0.2"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.07	0.01	93 %	0.02	93 %
Cantilever		0.00	89 %	0.00	89 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	257	2,610	90 %
Moment (lb-ft)	476	2,365	80 %

Support Reactions

	Left	Right
RLL (lb)	246	246
FLL (lb)	0	0
DL (lb)	129	129
Total (lb)	375	375

	Post	Capacity
Left:	4 X 4	6948 lb

RB 03	(3) 2 X 8 [DF #2]

Summary

Mark	=	RB 03
Section	=	(3) 2 X 8 [DF #2]
Span	=	5.5 ft
Result	=	Section adequate by 22 % - Load Combo. No.3 DL + RLL - Flexure

Distributed Loads

			Load Start		Load End	
Class	LL (psf)	DL (psf)	Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	35	15	16.00	0.00	16.00	5.50

Dead Loads

Self Weight	BSW =	8 plf
Cont. Dead Load	W =	25 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.00
Form	CF =	1.20
Repetative	Cr / Cv =	1.15

Load Reduction Factors

Live Load	LLRF =	1.00

Beam Section Properties

Width	b =	4.5 in.
Depth	d =	7.25 in.
Area	A =	33 in.2
Shear Area	As =	22 in.2
Moment of Inertia	I =	143 in.4
Section Modulus	S =	39 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	229000000 lb-in.2

Req'd bearing length = 0.83"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.07	0.05	72 %	0.08	72 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	1,815	3,915	54 %
Moment (lb-ft)	3,198	4,080	22 %

Support Reactions

		Left	Right
	RLL (lb)	1,540	1,540
	FLL (lb)	0	0
	DL (lb)	786	786
	Total (lb)	2,326	2,326
	Post		Capacity
Left:	2 X 6 (1) K		5127 lb

RB 04	(3) 2 X 6 [DF #2]

Summary

Mark	=	RB 04
Section	=	(3) 2 X 6 [DF #2]
Span	=	4.5 ft
Result	=	Section adequate by 16 % - Load Combo. No.3 DL + RLL - Flexure

Distributed Loads

			Load Start		Load End	
Class	LL (psf)	DL (psf)	Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	35	15	16.00	0.00	16.00	4.50

Dead Loads

Self Weight	BSW =	6 plf
Cont. Dead Load	W =	25 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.00
Form	CF =	1.30
Repetative	Cr / Cv =	1.15

Load Reduction Factors

Live Load	LLRF =	1.00

Beam Section Properties

Width	b =	4.5 in.
Depth	d =	5.5 in.
Area	A =	25 in.2
Shear Area	As =	17 in.2
Moment of Inertia	I =	62 in.4
Section Modulus	S =	23 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	100000000 lb-in.2

Req'd bearing length = 0.68"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.07	0.05	65 %	0.08	65 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	1,512	2,970	49 %
Moment (lb-ft)	2,136	2,544	16 %

Support Reactions

		Left	Right
	RLL (lb)	1,260	1,260
	FLL (lb)	0	0
	DL (lb)	639	639
	Total (lb)	1,899	1,899
	Post		Capacity
Left:	2 X 6 (1) K		5127 lb

Summary | **RB 05** | **(2) 2 X 6 [DF #2]**

Mark	=	RB 05
Section	=	(2) 2 X 6 [DF #2]
Span	=	3.5 ft
Result	=	Section adequate by 15 % - Load Combo. No.3 DL + RLL - Flexure

Distributed Loads

			Load Start		Load End	
Class	LL (psf)	DL (psf)	Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	35	15	16.00	0.00	16.00	3.50

Dead Loads

Self Weight	BSW =	4 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.00
Form	CF =	1.30
Repetative	Cr / Cv =	1.00

Load Reduction Factors

Live Load	LLRF =	1.00

Beam Section Properties

Width	b =	3 in.
Depth	d =	5.5 in.
Area	A =	17 in.2
Shear Area	As =	11 in.2
Moment of Inertia	I =	42 in.4
Section Modulus	S =	15 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	67000000 lb-in.2

Req'd bearing length = 0.76"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.07	0.03	76 %	0.04	76 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	1,055	1,980	47 %
Moment (lb-ft)	1,251	1,475	15 %

Support Reactions

	Left	Right
RLL (lb)	980	980
FLL (lb)	0	0
DL (lb)	450	450
Total (lb)	1,430	1,430

	Post	Capacity
Left:	2 X 6 (1) K	5127 lb

5.1 Foundation - Concrete Walls / Footings

Foundation Walls and Footings

ACI 318-14 Section 14 and Utah Amendment to IBC Table 1807.1.6.4

Foundation Wall				Line Loads			Point Loads			Continuous Footing			Spot Footing		
		Soil		RLL	FLL	DL	RLL	FLL	DL		Brg. Press.			Brg. Press.	
Section	Mark	(ft)	Result	(plf)	(plf)	(plf)	(plf)	(plf)	(plf)	Mark	(psf)	Result	Mark	(psf)	Result
1				560	0	740	0	0	0	FT20	780	48%			

5.2 Foundation - Masonry Walls

In-Plane Analysis					
Flexure Strength					
phi		=	0.9		
phi-Mn		=	**70.7**	k-ft	
Result			**OK**	**15%**	
Minimum Flexure Reinforcement					
Tensile stress		=	Perp		
fr-partial		=	0.163	ksi	
Mcr		=	54.1	k-ft	
1.3Mcr		=	70.4	k-ft	
Result			**OK**	**0%**	
Maximum Flexure Reinforcement					
epsilon-st		=	0.03991	in./in.	
alpha		=	4		
alpha*epsilon-y		=	0.008276	in./in.	
Result			**OK**	**79%**	
Shear Strength					
Masonry Shear Strength					
dv		=	56	in.	
Mu/(Vu*dv)		=	1		
An		=	427	in.2	
Vm		=	41.9	k	
phi-Vm		=	33.5	k	
Shear reinforceme		=	Not Required		
Minimum Shear Reinforcement					
s-max		=	None	in. o.c.	
Av		=	0.05	in.2	
Av-min		=	0.2989	in.2	
Result			**OK**	**0%**	
Reinforcement Shear Strength					
Vs		=	7.0	k	
Nominal Shear Strength					
Vn-max		=	74.4	k	
phi		=	0.8		
Vn		=	48.9	k	
phi-Vn		=	**39.1**	k	
Result			**OK**	**86%**	
1.25*Mn Level Loads					
Factor		=	**1.64**		
Error		=	**0.00**		
Mu		=	**98.21**	k-ft	
Vu		=	**8.93**	k	
Minimuim Shear Strength					
V(1.25Mn)		=	8.9	k	
2*Vu		=	10.9	k	
Vn-min		=	8.9	k	
Result			**OK**	**77%**	

ACUTE ENGINEERING
1429 South State St.
Orem, Utah 84097
Phone 801.229.9020
Fax 801.224.0050
info@acuteengineering.com

Structural Calculations

Project Name:	**UNTF Nizhoni V12-2018 (Base) 291218**
Project Location:	**AN,BL, BF, MW, MO, NM, OL, RM,WE**
	Utah
Project Number:	**291218**
Date:	**3/22/2019**

Valid Wet Stamp In Red

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1. Design Criteria

Project information

Address / location *	=	AN,BL, BF, MW, MO, NM, OL, RM,WE
Area / subdivision		
Area / subdiv. No. 1	=	San Juan - Aneth (AN)
Area / subdiv. No. 2	=	San Juan - Mexican Water (MW)
Area / subdiv. No. 3	=	San Juan - Navajo Mountain (NM)
Area / subdiv. No. 4	=	San Juan - Oljato (OL)
Area / subdiv. No. 5	=	San Juan - Red Mesa (RM)
Area / subdiv. No. 6	=	San Juan - Blanding (BMDC) (BL)
Area / subdiv. No. 7	=	San Juan - Monticello (BMDC) (MO)
Area / subdiv. No. 8	=	San Juan - Bluff (BMDC) (BF)
Area / subdiv. No. 9	=	San Juan - Westwater (BMDC) (WE)
State	=	Utah

* The structural calculations report and corresponding construction documents are valid for a single use at the project location and shall not be reused, copied, or reproduced without written consent.

Jurisdiction / occupancy information

Jurisdiction	=	Utah	
Building code	=	Utah Code, Title 15A	
Model building code	=	2015 IRC	2015 IBC 101.2 & IRC R301.1.3
Use and occupancy classification	=	Residential - 1-unit dwelling (R)	
Risk category	=	Not occupancy categories I, III, IV (II)	

** Building code compliance of non-structural issues is not addressed. Refer to the architect or designer for compliance.

Deferred submittals

Prefabricated metal plate wood trusses - roof (truss manufacturer)

Area / Subdiv. Comparison

Area / Subdiv.			Wind parameters		Snow	Frost	Mapped periods	
No.	City	Elev. (ft)	V (mph)	Exposure	Pf (psf)	(in.)	Ss	S1
1	San Juan County	4,500	115	3	30	20	0.1376	0.0488
2	San Juan County	5,200	115	3	30	20	0.128	0.0463
3	San Juan County	6,000	115	3	30	20	0.2318	0.0714
4	Oljeto	5,200	115	3	30	20	0.1856	0.0554
5	San Juan County	5,450	115	3	30	20	0.1342	0.0473
6	Blanding	6,100	115	3	30	20	0.1509	0.0524
7	Monticello	7,100	115	3	35	20	0.1557	0.0542
8	Bluff	4,300	115	3	30	20	0.1463	0.0498
9	San Juan County	6,100	115	3	30	20	0.1509	0.0524
Design		**7,100**	**115**	**3**	**35**	**20**	**0.2318**	**0.0714**

	Soil				Lateral earth p (psf)		Allow soil	Minimum footing width	
No.	Site class	Fa	Fv	SDS	Active	At-rest	p (psf)	FT (in.)	SF (in.)
1	D	1.60	2.40	0.15	30	60	1,500	18	20
2	D	1.60	2.40	0.14	30	60	1,500	18	20
3	D	1.60	2.40	0.25	30	60	1,500	18	20
4	D	1.60	2.40	0.20	30	60	1,500	18	20
5	D	1.60	2.40	0.14	30	60	1,500	18	20
6	D	1.60	2.40	0.16	30	60	1,500	18	20
7	D	1.60	2.40	0.17	30	60	1,500	18	20
8	D	1.60	2.40	0.16	30	60	1,500	18	20
9	D	1.60	2.40	0.16	30	60	1,500	18	20
Design	**D**	**1.60**	**2.40**	**0.25**	**30**	**60**	**1,500**	**18**	**20**

Environmental load parameters

Earthquake

Mapped short period	Ss =	0.2318	2015 IBC Figure 1613.3.1(1)
Mapped 1-sec. period	S1 =	0.0714	2015 IBC Figure 1613.3.1(2)

Wind

Ult. design wind speed	Vult =	115 mph	2015 IBC Figure 1609.3(1), 1609.3(2), 1609.3(3)
Exposure category	=	C	2015 IBC 1609.4.3

Soil

Geotechnical design basis †

Area / subdiv. No. 1	=	Presumptive values, 2015 IBC Table 1806.2	
Area / subdiv. No. 2	=	Presumptive values, 2015 IBC Table 1806.2	
Area / subdiv. No. 3	=	Presumptive values, 2015 IBC Table 1806.2	
Area / subdiv. No. 4	=	Presumptive values, 2015 IBC Table 1806.2	
Area / subdiv. No. 5	=	Presumptive values, 2015 IBC Table 1806.2	
Area / subdiv. No. 6	=	Presumptive values, 2015 IBC Table 1806.2	
Area / subdiv. No. 7	=	Presumptive values, 2015 IBC Table 1806.2	
Area / subdiv. No. 8	=	Presumptive values, 2015 IBC Table 1806.2	
Area / subdiv. No. 9	=	Presumptive values, 2015 IBC Table 1806.2	
Minimum frost cover	=	20 in.	2015 IBC 1809.5
Site class	=	D	
Special requirements	=	None	
Lateral active press.	=	30 psf	
Lateral at-rest press.	=	60 psf	
Lateral passive press.	=	150 psf	
Coeff. of friction	=	0.25	
Allow. vert. bearing	Qa =	1500 psf	
Min. cont. footing	=	18 in.	
Min. spot footing	=	20 in.	

† It is recommended that a geotechnical investigation be conducted unless satisfactory data from adjacent areas is available that demonstrates an investigation is not necessary for any of the conditions in 2015 IBC 1803.5.1-12. The structural calculations report and corresponding construction documents are only valid for the soil parameters listed herin. The design professional in responsible charge shall be notified if observations or field conditions differ.

Snow

Elevation (max)	=	7100 ft	
Flat roof snow load	Pf =	35 psf	Jurisdiction

2.1 Loads - Snow

Ground snow loads
(ASCE 7-10 Chap. 7.2)

Basis	=	Utah amend. 2015 IBC 1608.1.2	
County	=	San Juan	
Elevation	=	7100 ft	
Ground snow load	Pg =	57 psf	

Flat roof snow loads
(ASCE 7-10 Chap. 7.3)

Basis	=	Jurisdiction	
Roof exposure definition	=	Not fully exposed or sheltered (ASCE 7-10 Table 7-2, Notes a and b).	
Roof exposure	=	Partial	ASCE 7-10 Table 7-2 (notes a,b)
Terrain category (wind)	=	C	
Exposure factor	Ce =	1	ASCE 7-10 Table 7-2
Roof thermal condition	=	Not unheated nor a continuously heated greenhouse (ASCE 7-10 Table 7-3).	
Thermal factor	Ct =	1	ASCE 7-10 Table 7-3
Risk category	=	II	
Snow importance factor	Is =	1	ASCE 7-10 Table 1.5-2
Flat roof snow load	Pf =	35 psf	Jurisdiction

Sloped roof snow loads
(ASCE 7-10 Chap. 7.4)

Basis	=	Jurisdiction	
Roof surface	=	Non-slippery (asphalt shingles, wood shingles, or shakes).	
Roof slope	=	18 deg.	
Roof slope factor	Cs =	1	ASCE 7-10 Chap. C7.4
Eave snow load	Peave =	35 psf	Utah amend. 2015 IBC 1608.1.1
Balanced snow load	Ps =	35 psf	Jurisdiction

Unbalanced roof snow loads
(ASCE 7-10 Chap. 7.6)

Hip and gable roofs

Eave to ridge distance	W =	16 ft	
Roof system	=	Truss	
Snow density	gamma =	21 pcf	ASCE 7-10 Equation 7.7-1
Height of balanced snow	Hb =	2 ft	ASCE 7-10 Chap. 7.7.1
Unbalanced snow load	Ps =	35 psf	ASCE 7-10 Chap. 7.6.1

2.2 Loads - Dead / Live

Roof dead loads
(2015 IBC 1606, ASCE 7-10 Table C3-1)

Asphalt shingles	=	2 psf	ASCE 7-10 Table C3-1
Felt or ready roofing, roof sheathing	=	3 psf	ASCE 7-10 Table C3-1
Wood trusses, misc	=	5 psf	Estimated
Insulation, gypsum sheathing	=	5 psf	ASCE 7-10 Table C3-1
Roof DL No. 1	**Total =**	**15 psf**	

Floor dead loads
(2015 IBC 1606, ASCE 7-10 Table C3-1)

Floor sheathing	=	2 psf	ASCE 7-10 Table C3-1
Wood joists/trusses, MEP, misc	=	6 psf	ASCE 7-10 Table C3-1
Gypsum sheathing	=	2 psf	ASCE 7-10 Table C3-1
Interior Walls	=	2 psf	Estimated
Floor DL No. 1	**Total =**	**12 psf**	

Wall dead loads
(2015 IBC 1606, ASCE 7-10 Table C3-1)

Interior stud walls	=	10 psf	ASCE 7-10 12.14.8.1
Exterior 2x4@16"o.c.,5/8" gyp, insul., 7/16" sheatl	=	11 psf	ASCE 7-10 Table C3-1

Roof live loads
(2015 IBC 1607)

Occupancy or use		Unif. (psf)	Conc. (lb)	Ref.
Roofs (ordinary construction)	=	20	300	2015 IBC Table 1607.1 No. 26

Floor live loads
(2015 IBC 1607)

Occupancy or use		Unif. (psf)	Conc. (lb)	Ref.
Residential (1-2 unit dwelling)	=	40	0	2015 IBC Table 1607.1 No. 25
Stairs and exits (residential 1-2 unit dwelling)	=	40	300	2015 IBC Table 1607.1 No. 30

Load sets

Live load (occupancy or use)	(psf)	Dead load	(psf)	Abbrev.
Flat roof snow load	35	Roof DL No. 1	15	S 35 15
Residential (1-2 unit dwelling)	40	Floor DL No. 1	12	L 40 12
Stairs and exits (residential 1-2 unit dwelling)	40	Floor DL No. 1	12	Ex 40 12

Deflection limits (L/limit)

(2015 IBC 1604.3.1)

Construction		L	S or W	D+L
Roof members (supporting plaster ceiling)	=	360	360	240
Floor members (joists)	=	360		240
Floor members (beams/headers)	=	360		240
Exterior walls and interior partitions (with other brit	=		240	

2.3 Loads - Earthquake

Seismic Design Criteria
(2015 IBC 1613.3, ASCE 7-10 Chap. 11)

Mapped acceleration parameters					
MCE short period	Ss =	0.232 g			
MCE 1.0 sec. period	S1 =	0.071 g			
Design acceleration parameters					
Site class	=	D			
Site coefficient	Fa =	1.6			
Site coefficient	Fv =	2.4			
Adjusted short period	SMS =	0.37	Design short period	SDS =	0.25
Adjusted 1.0 sec. period	SM1 =	0.17	Design 1.0 sec. period	SD1 =	0.11
Risk category	=	II			
IRC Seismic design category	=	B			

Dead loads
(2015 IBC 1606; ASCE 7-10 Chap. 12.7.2, Table C3-1)

Effective seismic snow weight	=	9 psf	Utah Amend. 2015 IBC 1613.1.1
Roof DL No. 1	=	15 psf	
Floor DL No. 1	=	12 psf	
Interior stud walls	=	10 psf	
Exterior 2x4@16"o.c.,5/8" gyp, insul., 7/16" sheatl	=	11 psf	

Equivalent Lateral Force Procedure
(ASCE 7-10 Chap. 12.8)

		Primary LFRS	
Basic structural system	=	Bearing wall systems	
Seismic force-resisting system	=	Light-frame wood walls (wood sheath	
Structural design parameters			
Response modification factor	R =	6.5	ASCE 7-10 Table 12.2-1 No. A15
System overstrength factor	Omega =	3	ASCE 7-10 Table 12.2-1 No. A15
Deflection amplification factor	Cd =	4	ASCE 7-10 Table 12.2-1 No. A15
Building height limit	=	999 ft	ASCE 7-10 Table 12.2-1 No. A15
Fundamental period			
Structure type	=	All other	
Approximate period parameter	Ct =	0.02	ASCE 7-10 Table 12.8-2
Approximate period parameter	x =	0.75	ASCE 7-10 Table 12.8-2
Height above base	=	9.33 ft	
Approximate fundamental period	Ta =	0.107 sec.	ASCE 7-10 Equation 12.8-7
Approximate fundamental freq.	n =	9.36 hz	
Long period transition period	TL =	8 sec.	ASCE 7-10 Figure 22-12
Seismic base shear			
Seismic importance factor	Ie =	1.00	ASCE 7-10 Table 1.5-2
Seismic response coefficient	Csmin =	0.011	ASCE 7-10 Equations 12.8-5,6
Seismic response coefficient	Csmax =	0.165	ASCE 7-10 Equations 12.8-3,4
Seismic response coefficient	Cs =	0.04	ASCE 7-10 Equation 12.8-2
Seismic base shear (LRFD)	V =	1650 lb	ASCE 7-10 Equation 12.8-1

Weight Parameters

	Exterior Wall			Roof		Floor + Int Wall		Total
		Permtr 1	Permtr 2	Area	Weight	Area	Weight	Weight
	Trib.	(ft)	(ft)	(sf)	(psf)	(sf)	(psf)	(lb)
1	4	144	0	1,530	24	0	12	43,386
Total								43,386

Seismic Lateral Loads
(ASCE 7-10 Chap. 12.8.3)

						Vx (Shear walls)	
			Hx		Fx	LRFD	ASD
Level	Height (ft)	Floor (in)	(ft)	Cvx	(lb)	(lb)	(lb)
1	8.0	10	9.33	1.0	1,650	1,650	1,155

2.4 Loads - Wind

Design wind pressure
(2015 IBC 1609, ASCE 7-10 Chap.2 6)

Terrain exposure			
Surface roughness (upwind)	=	Open terrain with scattered obstructions having heights generally less than 30 ft.	
Exposure category	=	C	2015 IBC 1609.4.3
Terrain exp. constant	alpha =	9.5	ASCE 7-10 Table 26.9-1
Terrain exp. constant	Zg =	900	ASCE 7-10 Table 26.9-1
Terrain exp. constant	Zmin =	15 ft	ASCE 7-10 Table 26.9-1
Topographic factor	Kzt =	1	ASCE 7-10 Chap. 26.8.2
Basic wind pressure			
Ultimate design wind speed	Vult =	115 mph	2015 IBC Figure 1609.3(1), 1609.3(2)
Structure type	=	Buildings - MWFRS	
Wind directionality factor	Kd =	0.85	ASCE 7-10 Table 26.6-1
Risk category	=	II	2015 IBC Table 1604.5
Approx. fundamental freq.	=	9.36 hz	
Structure type	=	Rigid	ASCE 7-10 Chap. 26.2
Gust effect factor	G =	0.85	ASCE 7-10 Chap. 26.9.1
Enclosure	=	Enclosed (A building that is not open or partially enclosed.)	
Roof pitch	=	4:12	
Internal pressure coeff.	GCpi =	0.18	ASCE 7-10 Chap. 26.11.1, Table 26.1
Basic velocity pressure	q =	28.78 psf	ASCE 7-10 Equation 27.3-1

Directional Procedure: Components and cladding
(ASCE 7-10 Chap. 30.4)

Roof mean height	h =	11.9 ft	ASCE 7-10 Chap. 26.2
Effective wind area (component)	Aeff =	20 sf	
Velocity press. exp. coeff.	Kz =	0.85	ASCE 7-10 Table 30.3-1 Note 1.
Velocity pressure	qh =	24.43 psf	ASCE 7-10 Equation 30.3-1

Pressure coefficient		End	Interior		
Positve	GCp =	0.95	0.95		ASCE 7-10 Figure 30.4-1
Negative	GCp =	-1.29	-1.05		ASCE 7-10 Figure 30.4-1
Maximum pressure	max p =	36.00	29.97	psf	ASCE 7-10 Equation 30.4-1

Elevation Geometry

	Trib.	Horiz. dim. (ft)		Max roof	Front Proj. A (sf)		Side Proj. A (sf)	
Level	Height (ft)	Front	Side	Elev. (ft)	Gable	Sloped	Gable	Sloped
1	4.2	44	28	14.4	3	253	90	0

Directional Procedure: MWFRS external pressure coefficients

(ASCE 7-10 Chap. 27.3, Figure 27.4-1 weighted Cp for sloped / gabled area)

Level	Front, Cp				Side, Cp			
Roof	Windward		Leeward		Windward		Leeward	
Level	Max Cp	Min Cp	Max Cp	Min Cp	Max Cp	Min Cp	Max Cp	Min Cp
1	-0.05	-0.49	-0.57	-0.57	0.80	0.80	-0.39	-0.39
	Windward	Leeward	Side		Windward	Leeward	Side	
Walls	0.80	-0.50	-0.70		0.80	-0.39	-0.70	

Directional Procedure: MWFRS wind pressures

(ASCE 7-10 Chap. 27.3.1, Table 27.3-1))

				Front pressure (psf)			Side pressure (psf)		
Level	Elev. (ft)	Kz	qz (psf)	+GCpi	-GCpi	Total	+GCpi	-GCpi	Total
Walls - Leeward									
Max h	9.33	0.85	24.43	-14.78	-5.99		-12.41	-3.61	
Walls - Windward									
1	9.33	0.85	24.43	12.21	21.01	26.99	12.21	21.01	24.62
Roofs - Leeward									
1	14.40	0.85	24.43	-16.21	-7.41		-12.41	-3.61	
Roofs - Windward									
1	14.40	0.85	24.43	-14.51	-5.43	1.98	12.21	12.21	24.62

Directional Procedure: Wind Lateral Loads

(ASCE 7-10 Chap. 27.2-27.4)

	Front				Side			
	Walls	Roof	Fx (ASD)	Vx (ASD)	Walls	Roof	Fx (ASD)	Vx (ASD)
Level	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)
1	2,999	304	3,303	3,303	1,741	1,330	3,070	3,070

3.1 LFRS - Wood Sheathing / Diaphragms

Sheathing analysis

APA Engineered Wood Construciton Guide, Form No. E30W Tables 12, 30 (2016 APA)

	Applied loads (OOP)			Sheathing			Allow	
Location	Label	LL (psf)	DL (psf)	Size	Rating	Support spacing (in.)	LL (psf)	Result
Roof	S 35 15	35	15	7/16"	24/16	24	40	OK 13%
Floor	L 40 12	40	12	3/4"	48/24	16	238	OK 83%

Diaphragm parameters

		Transverse (front)		Longitudinal (side)					
	Seismic	Wind	Horz.	Wind	Horz.	Sheathing		Diaphragm	
Level	Fpx	MWFRS	dim. (ft)	MWFRS	dim. (ft)	Mark	Panel	Nailing	Blocking
1	1,502	3,303	44	3,070	28	RS 1	7/16"	8d @ 6"o.c.	Unblocked

Diaphragm analysis

	Max	Reaction Load (lb)			Diaphragm	Wind		Seismic	
Level	Span (ft)	Wind	Seismic	Line L (ft)	Layout	v (plf)	Allow (plf)	v (plf)	Allow (plf)
Transverse (front) direction									
1	44	1,652	751	28	Case 1	59	322	27	230
Longitudinal (side) direction									
1	28	1,535	751	44	Case 3	35	238	17	170

Chord Analysis

	Max		% Total	Chord		
Level	Span (ft)	Depth (ft)	Load	Force (lb)	Collector Type	Allow (lb)
Transverse (front) direction			on Diaph.			
1	44	28	100%	649	TP Splice (12) 16d	2,700
Longitudinal (side) direction						
1	28	44	100%	244	TP Splice (12) 16d	2,700

Strut Analysis

	Line	Strut	% Total	Strut		
Level	Length (ft)	Length (ft)	Load	Force (lb)	Collector Type	Allow (lb)
Transverse (front) direction						
1	28	14	50%	826	TP Splice (12) 16d	2,700
Longitudinal (side) direction			0			
1	44	22	50%	768	TP Splice (12) 16d	2,700

3.2 LFRS - Wood Shear Walls

Level 1 - Transverse LFRS (2015 IBC 2305)

Wind lateral load (ASD)	=	3,303	lb
Seismic lateral load (ASD)	=	1,155	lb

Line	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
W =	1,652	1,652													
E =	578	578													

Wall segment			Opening (ft)		LFRS						Anchorage		Hold-down
Line	L (ft)	h (ft)	b total	h max	Type	Wind	Allow	Seismic	Allow	D (in.)	Type	T (lb)	Type
1	28	8	8	4	SW1	83	319	29	228	0.10	1/2" A.B. @ 72'	0	
2	28	8	3	1	SW1	66	365	23	260	0.07	1/2" A.B. @ 72'	0	

Level 1 - Longitudinal LFRS (2015 IBC 2305)

Wind lateral load (ASD)	=	3,070	lb
Seismic lateral load (ASD)	=	1,155	lb

Line	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
W =	1,535	1,535													
E =	578	578													

Wall segment			Opening (ft)		LFRS						Anchorage		Hold-down
Line	L (ft)	h (ft)	b total	h max	Type	Wind	Allow	Seismic	Allow	D (in.)	Type	T (lb)	Type
A	44	8	11.5	6.67	SW1	47	164	18	117	0.08	1/2" A.B. @ 72'	0	
B	44	8	16	6.67	SW1	55	226	21	161	0.10	1/2" A.B. @ 72'	0	

4.1 VFRS - Wood Bearing Walls

Wall 1	2 X 6 DF Stud @ 24 in. o.c.

Wall

Section	=	1
Level	=	Main
Height	=	7.71 ft
Label	=	2 X 6 DF Stud @ 24 in. o.c.
Result	=	OK Combo 5: D + (0.6W)

Vertical Load

					Vertical Load (plf)	
Label	LL (psf)	DL (psf)	Trib (ft)	Line DL (plf)	Total	Capacity
S 35 15	35	15	16	50	859	2,578
L 40 12	40	12	0			

Lateral out-of-plane (OOP) pressure

Seismic	=	1.1 psf			
H	=	7.71 ft	Stud Fac. 2015 SDPWS Table 3.1.1.1	=	1.35
s	=	24 in. o.c.	Wind zone	=	End
Aeff	=	15.4 sf	Lateral out-of-plane (OOP) pressure	=	36 psf
Kz	=	0.84	Combined axial / bending stress factor (CSF)	=	0.36
qz	=	24.43 psf	Lateral out-of-plane deflection (L/Defl.)	=	1,514

Geometric Properties

Width	=	1.5 in.
Depth	=	5.5 in.
S	=	7.56 in.3
Area	=	8.25 in.2
I	=	20.8 in.4
Weight	=	17.7 lb
Slenderness Ratio Ratio		
x-x axis	=	16.8
y-y axis	=	0.0

Column Stability

CF (Fc)	=	1.00
Cd	=	1
Fc	=	850 psi
c	=	0.8
FcEx	=	1482 psi
FcEy	=	0 psi
Fc*	=	850 psi
Cp	=	0.84
F'c	=	716 psi
fc	=	208 psi

Combined Axial & Bending

Cd	=	1.60	
CF (Fb)	=	1.00	
Fc*	=	1360 psi	
Cp	=	0.71	
F'c	=	979 psi	
fc	=	72 psi	Combo 5
fc	=	174 psi	Combo 6

Wind Forces Govern Design

Cr	=	1.35	
M (ASD)	=	321 lb-ft	
F'b	=	1512 psi	
fb	=	509 psi	
CSF	=	0.36	Combo 5
CSF	=	0.32	Combo 6
CSF	=	0.04	Combo 7

Wind Deflection

Deflection	=	0.06 in.

4.2 VFRS - Wood Joists

FJ 01	**2 X 10 @ 16" O.C.**

Summary

Mark	=	FJ 01
Center span	=	9 ft
Section	=	2 X 10 @ 16" O.C.
Result	=	Section adequate by 65%.

Uniform Load

				Partition DL (psf)	
Label	Class	LL (psf)	DL (psf)	Center	Cantilever
L 40 12	Floor	40	0	0	0

Beam Adjustment Factors

Cd	=	1
CF / CV	=	1.1
Cr	=	1

Reference Allowable Loads

Moment	=	2029 lb-ft
Shear	=	1665 lb
R1	=	1640.625 lb
R2	=	1640.625 lb

Support

	Left	Right
Left (in.)	1.75	1.75
Web stiffener	No WS	No WS

Section and Material Properties

Flange		
d	=	0 in.
b	=	0 in.
Web		
h	=	0 in.
Panel		
t	=	0.75 in.
C. Factor	=	0.45

Reactions

	Left	Right
Roof LL (lb)	0	0
Floor LL (lb)	240	240
DL (lb)	72	72
Total load (lb)	**312**	**312**

Uplift

	Left
Roof LL (lb)	0
Floor LL (lb)	0
DL (lb)	0
Total uplift (lb)	**0**

Joist Properties

Joist K	=	738.46154
Joist EI	=	189724418 in.2-lb
Comp. EI	=	290846338 in.2-lb
Effec. EI	=	217940696 in.2-lb

RR 01	2 X 4 @ 24" O.C.

Summary

Mark	=	RR 01
Center span	=	4.5 ft
Section	=	2 X 4 @ 24" O.C.
Result	=	Section adequate by 35%.

Uniform Load

				Partition DL (psf)	
Label	Class	LL (psf)	DL (psf)	Center	Cantilever
S 35 15	Roof	35	12	0	0

Beam Adjustment Factors

Cd	=	1
CF / CV	=	1.5
Cr	=	1

Reference Allowable Loads

Moment	=	396 lb-ft
Shear	=	630 lb
R1	=	1640.625 lb
R2	=	1640.625 lb

Support

	Left	Right
Left (in.)	1.75	1.75
Web stiffener	No WS	No WS

Section and Material Properties

Flange		
d	=	0 in.
b	=	0 in.
Web		
h	=	0 in.
Panel		
t	=	0 in.
C. Factor	=	0

Reactions

	Left	Right
Roof LL (lb)	158	158
Floor LL (lb)	0	0
DL (lb)	71	71
Total load (lb)	**229**	**229**

Uplift

	Left
Roof LL (lb)	0
Floor LL (lb)	0
DL (lb)	0
Total uplift (lb)	**0**

Joist Properties

Joist K	=	738.46154
Joist EI	=	0 in.2-lb
Comp. EI	=	0 in.2-lb
Effec. EI	=	8575000 in.2-lb

4.3 VFRS - Beams / Posts

RB 01	**(2) 2 X 6 [DF #2]**

Summary

Mark	=	RB 01
Section	=	(2) 2 X 6 [DF #2]
Span	=	4.5 ft
Result	=	Section adequate by 73 % - Load Combo. No.3 DL + RLL - Flexure

Distributed Loads

			Load Start		Load End	
Class	LL (psf)	DL (psf)	Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	35	15	2.00	0.00	2.00	4.50

Dead Loads

Self Weight	BSW =	4 plf
Cont. Dead Load	W =	50 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.00
Form	CF =	1.30
Repetative	Cr / Cv =	1.00

Load Reduction Factors

Live Load	LLRF =	1.00

Beam Section Properties

Width	b =	3 in.
Depth	d =	5.5 in.
Area	A =	17 in.2
Shear Area	As =	11 in.2
Moment of Inertia	I =	42 in.4
Section Modulus	S =	15 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	67000000 lb-in.2

Req'd bearing length = 0.19"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.01	0.01	94 %	0.02	90 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	279	1,980	86 %
Moment (lb-ft)	394	1,475	73 %

Support Reactions

	Left	Right
RLL (lb)	158	158
FLL (lb)	0	0
DL (lb)	192	192
Total (lb)	350	350

	Post	Capacity
Left:	2 X 6 (1) K	5127 lb

Summary | **RB 02** | **(2) 2 X 6 [DF #2]**

Mark	=	RB 02
Section	=	(2) 2 X 6 [DF #2]
Span	=	3.5 ft
Result	=	Section adequate by 13 % - Load Combo. No.3 DL + RLL - Flexure

Distributed Loads

			Load Start		Load End	
Class	LL (psf)	DL (psf)	Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	35	15	16.00	0.00	16.00	3.50

Dead Loads

Self Weight	BSW =	4 plf
Cont. Dead Load	W =	25 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.00
Form	CF =	1.30
Repetative	Cr / Cv =	1.00

Load Reduction Factors

Live Load	LLRF =	1.00

Beam Section Properties

Width	b =	3 in.
Depth	d =	5.5 in.
Area	A =	17 in.2
Shear Area	As =	11 in.2
Moment of Inertia	I =	42 in.4
Section Modulus	S =	15 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	67000000 lb-in.2

Req'd bearing length = 0.79"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.01	0.03	76 %	0.04	76 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	1,087	1,980	45 %
Moment (lb-ft)	1,289	1,475	13 %

Support Reactions

	Left	Right
RLL (lb)	980	980
FLL (lb)	0	0
DL (lb)	493	493
Total (lb)	1,473	1,473

	Post	Capacity
Left:	2 X 6 (1) K	5127 lb

Summary		RB 03	(3) 2 X 6 [DF #2]

Mark	=	RB 03
Section	=	(3) 2 X 6 [DF #2]
Span	=	4.5 ft
Result	=	Section adequate by 16 % - Load Combo. No.3 DL + RLL - Flexure

Distributed Loads

			Load Start		Load End	
Class	LL (psf)	DL (psf)	Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	35	15	16.00	0.00	16.00	4.50

Dead Loads

Self Weight	BSW =	6 plf
Cont. Dead Load	W =	25 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.00
Form	CF =	1.30
Repetative	Cr / Cv =	1.15

Load Reduction Factors

Live Load	LLRF =	1.00

Beam Section Properties

Width	b =	4.5 in.
Depth	d =	5.5 in.
Area	A =	25 in.2
Shear Area	As =	17 in.2
Moment of Inertia	I =	62 in.4
Section Modulus	S =	23 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	100000000 lb-in.2

Req'd bearing length = 0.68"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.01	0.05	65 %	0.08	65 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	1,512	2,970	49 %
Moment (lb-ft)	2,136	2,544	16 %

Support Reactions

		Left	Right
	RLL (lb)	1,260	1,260
	FLL (lb)	0	0
	DL (lb)	639	639
	Total (lb)	1,899	1,899
	Post		Capacity
Left:	2 X 6 (1) K		5127 lb

RB 04	(3) 2 X 8 [DF #2]

Summary

Mark	=	RB 04
Section	=	(3) 2 X 8 [DF #2]
Span	=	5.5 ft
Result	=	Section adequate by 22 % - Load Combo. No.3 DL + RLL - Flexure

Distributed Loads

			Load Start		Load End	
Class	LL (psf)	DL (psf)	Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	35	15	16.00	0.00	16.00	5.50

Dead Loads

Self Weight	BSW =	8 plf
Cont. Dead Load	W =	25 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.00
Form	CF =	1.20
Repetative	Cr / Cv =	1.15

Load Reduction Factors

Live Load	LLRF =	1.00

Beam Section Properties

Width	b =	4.5 in.
Depth	d =	7.25 in.
Area	A =	33 in.2
Shear Area	As =	22 in.2
Moment of Inertia	I =	143 in.4
Section Modulus	S =	39 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	229000000 lb-in.2

Req'd bearing length = 0.83"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.01	0.05	72 %	0.08	72 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	1,815	3,915	54 %
Moment (lb-ft)	3,198	4,080	22 %

Support Reactions

	Left	Right
RLL (lb)	1,540	1,540
FLL (lb)	0	0
DL (lb)	786	786
Total (lb)	2,326	2,326

	Post	Capacity
Left:	2 X 6 (1) K	5127 lb

RB 05	(2) 2 X 8 [DF #2]

Summary

Mark	=	RB 05
Section	=	(2) 2 X 8 [DF #2]
Span	=	6 ft
Result	=	Section adequate by 75 % - Load Combo. No.3 DL + RLL - Flexure

Distributed Loads

			Load Start		Load End	
Class	LL (psf)	DL (psf)	Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	35	15	2.50	0.00	2.50	6.00

Dead Loads

Self Weight	BSW =	5 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.00
Form	CF =	1.20
Repetative	Cr / Cv =	1.00

Load Reduction Factors

Live Load	LLRF =	1.00

Beam Section Properties

Width	b =	3 in.
Depth	d =	7.25 in.
Area	A =	22 in.2
Shear Area	As =	15 in.2
Moment of Inertia	I =	95 in.4
Section Modulus	S =	26 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	152000000 lb-in.2

Req'd bearing length =   0.21"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.01	0.02	92 %	0.03	92 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	317	2,610	88 %
Moment (lb-ft)	595	2,365	75 %

Support Reactions

		Left	Right
	RLL (lb)	263	263
	FLL (lb)	0	0
	DL (lb)	134	134
	Total (lb)	397	397
	Post		Capacity
Left:	4 X 4		6948 lb

Summary | **MB 01 A** | **(3) 2 X 10 [DF #2]**

Mark	=	MB 01 A
Section	=	(3) 2 X 10 [DF #2]
Span	=	9 ft
Result	=	Section adequate by 21 % - Load Combo. No.2 DL + FLL - Flexure

Distributed Loads

			Load Start		Load End	
Class	LL (psf)	DL (psf)	Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Floor	40	12	9.00	0.00	9.00	9.00

Dead Loads

Self Weight	BSW =	10 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.00
Form	CF =	1.10
Repetative	Cr / Cv =	1.15

Load Reduction Factors

Live Load	LLRF =	1.00

Beam Section Properties

Width	b =	4.5 in.
Depth	d =	9.25 in.
Area	A =	42 in.2
Shear Area	As =	28 in.2
Moment of Inertia	I =	297 in.4
Section Modulus	S =	64 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	475000000 lb-in.2

Req'd bearing length = 0.76" 0.76"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.04	0.11	63 %	0.15	67 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	1,782	4,995	64 %
Moment (lb-ft)	4,839	6,088	21 %

Support Reactions

	Left	Right
RLL (lb)	0	0
FLL (lb)	1,620	3,240
DL (lb)	530	1,061
Total (lb)	2,150	4,301

	Post	Capacity
Left:	4 X 4	7645 lb
Right:	4 X 4	7645 lb

Summary			MB 01 B	1-3/4 X 9-1/2 LVL [LVL (2.0E)]

Summary

Mark	=	MB 01 B
Section	=	1-3/4 X 9-1/2 LVL [LVL (2.0E)]
Span	=	9 ft
Result	=	Section adequate by 19 % - Load Combo. No.2 DL + FLL - Flexure

Distributed Loads

			Load Start		Load End	
Class	LL (psf)	DL (psf)	Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Floor	40	12	9.00	0.00	9.00	9.00

Dead Loads

Self Weight	BSW =	5 plf

Allowable Stress

Shear Stress	Fv =	285 psi
Bending Stress	Fb =	2600 psi

Beam Adjustment Factors

Load Duration	Cd =	1.00
Form	CF =	1.00
Repetative	Cr / Cv =	1.00

Load Reduction Factors

Live Load	LLRF =	1.00

Beam Section Properties

Width	b =	1.75 in.
Depth	d =	9.5 in.
Area	A =	17 in.2
Shear Area	As =	11 in.2
Moment of Inertia	I =	125 in.4
Section Modulus	S =	26 in.3

Beam Material Properties

Modulus of Elasticity	E =	2000000 psi
Flexure Stiffness	EI =	250000000 lb-in.2

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.04	0.21	29 %	0.28	38 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	1,753	3,159	44 %
Moment (lb-ft)	4,788	5,887	19 %

Req'd bearing length = 1.62" 1.62"

Support Reactions

		Left	Right
	RLL (lb)	0	0
	FLL (lb)	1,620	3,240
	DL (lb)	508	1,016
	Total (lb)	2,128	4,256
	Post		Capacity
Left:	4 X 4		6948 lb
Right:	4 X 4		6948 lb

5.1 Foundation - Concrete Walls / Footings

Foundation Walls and Footings

ACI 318-14 Section 14 and Utah Amendment to IBC Table 1807.1.6.4

Foundation Wall				Line Loads			Point Loads			Continuous Footing			Spot Footing		
		Soil		RLL	FLL	DL	RLL	FLL	DL	Brg. Press.			Brg. Press.		
Section	Mark	(ft)	Result	(plf)	(plf)	(plf)	(plf)	(plf)	(plf)	Mark	(psf)	Result	Mark	(psf)	Result
1				560	180	794	0	0	0	FT20	812	46%			
3				0	0	0	0	972	318				24" DIA	1,369	9%
4				70	0	530	0	486	159	FT20	705	53%			

5.2 Foundation - Masonry Walls

In-Plane Analysis					
Flexure Strength					
phi		=	0.9		
phi-Mn		=	**70.7**	k-ft	
Result			**OK**	**15%**	
Minimum Flexure Reinforcement					
Tensile stress		=	Perp		
fr-partial		=	0.163	ksi	
Mcr		=	54.1	k-ft	
1.3Mcr		=	70.4	k-ft	
Result			**OK**	**0%**	
Maximum Flexure Reinforcement					
epsilon-st		=	0.03991	in./in.	
alpha		=	4		
alpha*epsilon-y		=	0.008276	in./in.	
Result			**OK**	**79%**	
Shear Strength					
Masonry Shear Strength					
dv		=	56	in.	
Mu/(Vu*dv)		=	1		
An		=	427	in.2	
Vm		=	41.9	k	
phi-Vm		=	33.5	k	
Shear reinforceme		=	Not Required		
Minimum Shear Reinforcement					
s-max		=	None	in. o.c.	
Av		=	0.05	in.2	
Av-min		=	0.2989	in.2	
Result			**OK**	**0%**	
Reinforcement Shear Strength					
Vs		=	7.0	k	
Nominal Shear Strength					
Vn-max		=	74.4	k	
phi		=	0.8		
Vn		=	48.9	k	
phi-Vn		=	**39.1**	k	
Result			**OK**	**86%**	
1.25*Mn Level Loads					
Factor		=	**1.64**		
Error		=	**0.00**		
Mu		=	**98.21**	k-ft	
Vu		=	**8.93**	k	
Minimuim Shear Strength					
V(1.25Mn)		=	8.9	k	
2*Vu		=	10.9	k	
Vn-min		=	8.9	k	
Result			**OK**	**77%**	

<u>Appendix E: IRC References</u>

IRC References	
Beam	Table R602.7(2)
Supports	Table R602.7(2)
Roof Sheathing	Table R803.1
Roof Nailing	Table R602.3(1)
CMU Fdn. Walls	Section R404.1.4.1
Footing	Table R403.1(1)
Rebar	Section R403.1.3.2
Grouted Cells	Section R403.1.3.2
Washers	Section R602.11.1
Anchor Bolts	Section R403.1.6
Wall Studs	Table R602.3(5)
Rafters	Table R802.5.1(5)
J Bar	Section R403.1.3.2
Slab	Section R506.1
Floor Joists	Table R502.3.1(2)
Footing Rebar	Section R403.1.3.2
Floor Nailing	Table R602.3(1)
Wall Sheathing	Section R603.9.1
Wall Nailing	Table R603.3.2(1)

Appendix F: Bill of Materials

COMB RIDGE BILL OF MATERIALS

Item	Quantity	Dimensions
#4 Rebar	65	20 ft
1/2" Anchor Bolt	28	N/A
2X4	160	8 ft
2X4 (Pressure Treated)	22	8 ft
2X6	200	8 ft
2X8	10	8 ft
4X4 Post	4	8 ft
4X4 Post Base	4	N/A
4X4 Post Cap	4	N/A
7/16" OSB	160	4 ft X 8 ft
CMU	450	8 in X 8 in X 16 in
Concrete	900 ft^3	N/A
H1 Truss Anchor	42	N/A
LVL	2	10 ft

NIZHONI (SLAB ON GRADE) BILL OF MATERIALS

Item	Quantity	Dimensions
#4 Rebar	65	20 ft
1/2" Anchor Bolt	28	N/A
2X4	155	8 ft
2X4 (Pressure Treated)	22	8 ft
2X6	200	8 ft
2X8	10	8 ft
4X4 Post	4	8 ft
4X4 Post Base	4	N/A
4X4 Post Cap	4	N/A
7/16" OSB	160	4 ft X 8 ft
CMU	450	8 in X 8 in X 16 in
Concrete	900 ft^3	N/A
H1 Truss Anchor	42	N/A

NIZHONI (CRAWL SPACE) BILL OF MATERIALS

Item	Quantity	Dimensions
#3 Rebar	20	20 ft
#4 Rebar	78	20 ft
1/2" Anchor Bolt	28	N/A
23/32" OSB	55	4 ft X 8 ft
2X10	150	8 ft
2X4	155	8 ft
2X4 (Pressure Treated)	22	8 ft
2X6	200	8 ft
2X8	10	8 ft
4X4 Post	9	8 ft
4X4 Post Base	12	N/A
4X4 Post Cap	12	N/A
7/16" OSB	160	4 ft X 8 ft
CMU	450	8 in X 8 in X 16 in
Concrete	450 ft^3	N/A
H1 Truss Anchor	42	N/A

Appendix G: References

1. “EFFECTIVE USE OF THE INTERNATIONAL RESIDENTIAL CODE.” *EFFECTIVE USE OF THE INTERNATIONAL RESIDENTIAL CODE | 2018 International Residential Code for One- and Two-Family Dwellings | ICC premiumACCESS*, <https://codes.iccsafe.org/content/IRC2018/effective-use-of-the-international-residential-code> (Mar. 28, 2019).

2. “EFFECTIVE USE OF THE INTERNATIONAL BUILDING CODE.” *EFFECTIVE USE OF THE INTERNATIONAL BUILDING CODE | 2018 International Building Code | ICC premiumACCESS*, <https://codes.iccsafe.org/content/IBC2018/effective-use-of-the-international-building-code> (Mar. 28, 2019).