MACKENZIE.

DESIGN DRIVEN | CLIENT FOCUSED

West Side Fire Department - Station #2

Seismic Assessment

Prepared January 23, 2018

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WEST SIDE FIRE
Neighbor Helping Neighbor since 1948

Prepared for:

West Side Fire
Department
4250 Barrett Road
Hood River, OR 97031

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Project Number

2170545.00
January 23, 2018

83773PE
NOVEMBER 14, 2017
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EXPIRES: 12/31/18

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1. INTRODUCTION

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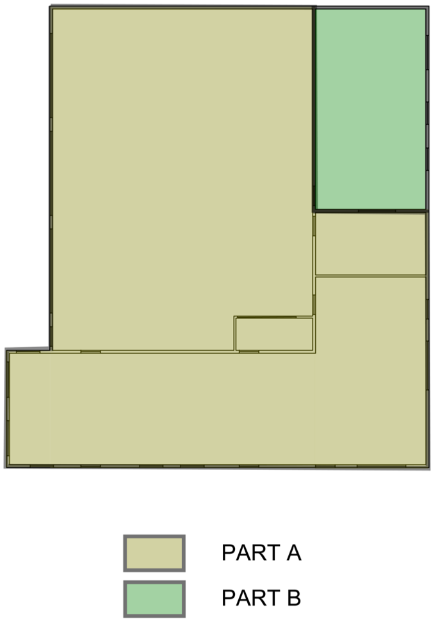
EXECUTIVE SUMMARY

An ASCE 41-13 Tier 1 seismic evaluation of the existing West Side Hood River Fire Station #2 was conducted for West Side Fire Department. As part of the review, a site visit was conducted on October 27th, 2017. The fire station has several significant deficiencies in the structure that do not meet the standards for a critical infrastructure building that provides a performance level of Operational after a seismic event. The primary deficiencies include an inadequate shear walls, drag connections from the shear walls to the diaphragms, and anchorage of the shear walls to the foundation. These deficiencies and the deficiencies identified in the checklists must be addressed and upgraded in order to meet Operational performance standards. A cost estimate was prepared for the proposed seismic upgrades with an anticipated total project cost as follows:

- Construction: $818.109
- Consultants: $335,500
- Owner: $71,500
- Total: $1,225,109 ($233.53/SF)



Project Summary Information						
Building Part	Building Part Name	Included in Retrofit	Year Built	Building Type***	Nonstructural Retrofits Included in Scope Y/N***	Previous Seismic Retrofit Y/N*** (Year if Yes)
A	Apparatus Bay & Office	Y	1972	W2	Y	N
C	Training Room	Y	2015	W2	Y	N
***Entries required ONLY for building parts included in proposed seismic retrofit.						
Nonstructural deficiencies posing life safety risk MUST be included in the scope of work and budget.						
Seismic fragility inputs for existing buildings with previous seismic retrofits MUST be adjusted to reflect previous seismic retrofit measures completed for a building part.						
Total Retrofit Cost ($)					$1,225,109	
Retrofit Square Feet (ft^2)					5,246	
Retrofit Cost Per Square Foot ($/ft^2)					$233.53	**Yes/No**
Is the station within a tsunami, FEMA flood zone or other high hazard area? If so provide documentation.						No

ASCE 41-13 ANALYSIS BACKGROUND

The seismic evaluation was conducted using ASCE 41-13 Seismic Evaluation and Retrofit of Existing Buildings. This document is not a code, but a nationally-recognized standard used by engineers to evaluate and retrofit existing buildings. Previously, there were two separate documents for the evaluation and retrofit of existing buildings: ASCE 31 and ASCE 41, respectively. Recently, these documents were combined into the updated version, ASCE 41-13, to help alleviate some of the inconsistencies that occurred when a

Figure 1
Building performance levels

building made the transition from seismic evaluation to the retrofit/upgrade process. New building codes include many provisions that require or encourage design and detailing practices that improve the seismic performance of a building, including regular building configuration, ductile detailing, and high quality materials. Most existing buildings will not meet these criteria that new construction would be designed and detailed for; however, it is recognized that these existing structural systems still have capacity that the new code doesn't recognize. The ASCE 41-13 includes guidelines and methods for evaluating the capacities of existing structural elements that might otherwise be insufficient when analyzed using the new building code provisions.

Within the ASCE 41-13 there are four building Performance Levels (lower to higher performance): Collapse Prevention (5-E), Life Safety (3-C), Immediate Occupancy (1-B), and Operational (1-A). Unless otherwise required by code (i.e., emergency response facilities, prisons, or other essential facilities), the majority of buildings are designed for the Performance Level of Life Safety (LS). The LS performance level is meant to ensure the safety of building occupants; however, buildings with this performance level will likely experience significant damage that may or may not be repaired or occupied after the earthquake. For critical facilities that need to retain full function immediately post-earthquake to provide emergency response to the community, such as a fire station, the building is evaluated to the higher standard of Operational. It should be noted that for structural evaluation the Operational and Immediate Occupancy criteria are the same. The difference in the two levels is that the support systems and equipment are operational; see Figure 1. Figure 2 includes a brief summary of each performance level and the anticipated damage for a building designed to each performance level.

ASCE 41-13 incorporates a multi-tier methodology for evaluating existing structures. Tier 1, which was chosen for this analysis, is a preliminary screening phase which utilizes a checklist approach to identify potential seismic hazards. It should be noted that at this stage, any identified risks are preliminary and may or may not be justifiable using a higher tier analysis. Tier 2 and Tier 3 are the evaluation and detailed evaluation phases, respectively, which were not conducted at this time. If a deficiency is identified in the Tier 1 screening phase, further Tier 2 or Tier 3 analysis can be used to

Figure 2

Damage Control and Building Performance Labels

	Target Building Performance Levels			
	Collapse Prevention Level (5-D)	**Life Safety Level (3-C)**	**Immediate Occupancy Level (1-B)**	**Operational Level (1-A)**
Overall damage	Severe	Moderate	Light	Very light
Structural components	Little residual stiffness and strength to resist lateral loads, but gravity load-bearing columns and walls function. Large permanent drifts. Some exits blocked. Building is near collapse in aftershocks and should not continue to be occupied.	Some residual strength and stiffness left in all stories. Gravity-load-bearing elements function. No out-of-plane failure of walls. Some permanent drift. Damage to partitions. Continued occupancy might not be likely before repair. Building might not be economical to repair.	No permanent drift. Structure substantially retains original strength and stiffness. Continued occupancy likely.	No permanent drift. Structure substantially retains original strength and stiffness. Minor cracking of facades, partitions, and ceilings as well as structural elements. All systems important to normal operation are functional. Continued occupancy and use highly likely.
Nonstructural components	Extensive damage. Infills and unbraced parapets failed or at incipient failure.	Falling hazards, such as parapets, mitigated, but many architectural, mechanical, and electrical systems are damaged.	Equipment and contents are generally secure but might not operate due to mechanical failure or lack of utilities. Some cracking of facades, partitions, and ceilings as well as structural elements. Elevators can be restarted. Fire protection operable.	Negligible damage occurs. Power and other utilities are available, possibly from standby sources.
Comparison with performance intended for typical buildings designed to codes or standards for new buildings, for the design earthquake	Significantly more damage and greater life safety risk.	Somewhat more damage and slightly higher life safety risk.	Less damage and low life safety risk.	Much less damage and very low life safety risk.

show the specific item is acceptable. After the seismic evaluation is completed, ASCE 41-13 may be used to complete a seismic retrofit design to address issues identified in the evaluation stage. As a part of the Tier 1 screening phases, various analyses or “Quick Checks” are to be performed where specifically required. Not all items that pass the quick check will necessarily meet more detailed checks nor are they guaranteed to meet current code requirements.

The Tier 1 analysis consists of a visual survey, which was conducted on October 27th, 2017. For each of the Tier 1 checklist items, an evaluation of Compliant (C), Non-compliant (NC), Not Applicable (N/A), or Unknown (U) is marked. NC does not necessarily mean that the issue cannot be justified with a higher tier evaluation phase; rather, only that it does not pass the Tier 1 screening criteria.

SCOPE AND LIMITATIONS

The Tier 1 analysis and retrofit scheme is based on site observations of only readily visible items and evaluation of available drawing documents listed herein. It should be noted that other deficiencies might exist that have not been identified by this screening phase and quick checks. In addition, no material or other testing was performed at this time for review. The Tier 1 quick check calculations have been performed and a more in-depth detailed analysis may be performed, though it is likely to have minimal impact on the results of this evaluation. The preliminary quick calculations of recommended retrofits were performed using ASCE 41-13 standards, which produce a conservative design for this evaluation.

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2. ASSESSMENT

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EXISTING BUILDING DESCRIPTION

The West Side Fire Station #2 is located at 1185 Tucker Rd in Hood River, Oregon. The building is wood framed with an upper roof made up of open-web joists (TJL) and a lower roof made up of engineered wood I-joists (TJI) that frame into wood stud walls. The original building consists of the apparatus bay, kitchen, board room, storage, and offices. There are three (3) overhead doors in the apparatus bay, all opening to the north side of the building. A subsequent addition was added onto the original building in 2015 to include the training room. It is assumed that the framing of this addition is similar to the framing of the low roof structure adjacent to it. There is also a separate garage structure south of the fire station that was built at an unknown date. This structure is not included in the scope of this report.

Building documents for the original building dated to 1977 were available for review. Building documents for any additions were not available. A geotechnical report was unavailable for review.

Figure 3
North elevation

Figure 4
North Elevation

Figure 5
West elevation

Figure 6
South elevation

Figure 7
South elevation

Figure 8
East elevation

MAIN STATION EVALUATION

Evaluation Criteria

This building was evaluated for a seismic event with a probability of exceedance of 10% in 50 years or a 500-year event (BSE-1N) for a Performance Level of Operational. This is the same design earthquake ground motion hazard to which new buildings are designed. The level of seismicity was determined at the site and compared to the ASCE 41-13 level definitions; see Figure 9. For this fire station, the design 1-second period acceleration is SX1=0.319 which classifies the site as an area of high seismicity.

Based on this seismicity definition and an Operational performance objective, the required checklists can be determined, as seen in Figure 10. The Basic Configuration, Immediate Occupancy Structural Checklists, and Position Retention Nonstructural checklists are required.

ASCE 41-13 has different checklists depending on the building construction type. This building type is classified as a W1, Wood Light Frames.

Figure 9
Level of Seismicity Definitions

Level of Seismicity[a]	S_{DS}	S_{D1}
Very low	<0.167 g	<0.067 g
Low	≥0.167 g <0.33 g	≥0.067 g <0.133 g
Moderate	≥0.33 g <0.50 g	≥0.133 g <0.20 g
High	≥ 0.50 g	≥0.20 g

[a] *The higher level of seismicity defined by S_{DS} or S_{D1} shall govern.*

Source: *Table 2-5, page 49; ASCE Standard – ASCE/SEI 41-13: American Society of Civil Engineers – Seismic Evaluation and Retrofit of Existing Buildings*

Summary of ASCE 41-13 Tier 1 Evaluation

The Tier 1 screening phase identified numerous structural and non-structural items as non-compliant. Non-compliant issues require further evaluation in order to determine their full impact on the seismic performance of the building, but these issues are a relatively good indicator of potential performance issues. A summary of some non compliant issues is presented below organized by each checklist. Copies of the Tier 1 checklists and calculations are included in this report in Appendices A and B. In an effort to clearly document the deficiencies and their associated retrofits each item has been numbered so the reader can identify the costs.

Figure 10
Checklists Required for a Tier 1 Screening

		Required Checklists[a]					
Level of Seismicity[b]	Level of Building Performance[c]	Very Low Seismicity Checklist (Sec 16.1.1)	Basic Configuration Checklist (Sec. 16.1.2)	Life Safety Checklist (Sec. 16.2LS through 16.15LS)	Immediate Occupancy Checklist (Sec. 16.2IO through 16.15IO)	Life Safety Nonstructural Checklist (Sec. 16.17)	Position Retention Nonstructural Checklist (Sec. 16.17)
Very low	LS	X					
Very low	IO		X		X		X
Low	LS		X	X		X	
Low	IO		X		X		X
Moderate	LS		X	X		X	
Moderate	IO		X		X		X
High	LS		X	X		X	
High	IO		X		X		X

[a] An X designates the checklist that must be completed for a Tier 1 screening as a function of the level of seismicity and level of performance.
[b] Defined in Section 2.5.
[c] LS = Life Safety Performance Level, and IO = Immediate Occupancy Performance Level (defined in Section 2.3.3).

Source: *Table 4-7, page 67; ASCE Standard – ASCE/SEI 41-13: American Society of Civil Engineers – Seismic Evaluation and Retrofit of Existing Buildings*

Immediate Occupancy Basic Configuration Checklist

Load Path – A clear lateral load path to transfer seismic forces from the walls, into the roof diaphragm, into the main lateral force resisting system, and then out into the foundations is required for compliance. The existing diaphragm is deficient, and there is no element to transfer seismic loads into the shear walls in most cases. The lateral force resisting system is deficient in several areas, particularly along the north wall in the apparatus bay which has several large openings for overhead doors. At this location, the existing footing is not large enough to resist overturning forces and exceeds the allowable seismic bearing pressure.

Immediate Occupancy Structural Checklist for Building Type W2

- **Shear Stress Check –** Existing shear walls are assumed to be unblocked, with either structural or non-structural sheathing, resulting in low capacities.
- **Narrow Wood Shear Walls/Openings –** North shear walls in apparatus bay have several openings for windows. Therefore the walls do not pass the quick check and have a height to width ratio greater than 1.5:1, which increases the likelihood of overturning.
- **Hold-Down Anchors –** It is assumed that shear walls do not have hold downs to resist overturning forces at each pier.
- **Diaphragm Continuity –** The building is composed of split-level roofs with no elements to provide shear transfer at the vertical offset of the diaphragm.
- **Roof Chord Continuity –** There do not appear to be any continuous chord elements throughout the building’s diaphragm.
- **Plan Irregularities** - At the lower roof, there are no drag elements at re-entrant corners to deliver the seismic forces into the lateral force resisting element.
- **Wood Sill Bolts –** Existing drawings indicate bolts at 5’-0” on center for the original building. It is assumed that the later addition is at this spacing or greater.

Non-Structural Checklist

- **Fire Suppression Piping –** Fire suppression piping should have proper lateral bracing and flexible couplings when necessary. It appeared some bracing was in place, but a further study may be necessary to determine if it is adequate.
- **Hazardous Materials and Shut-off Valves –** Gas cylinders and other hazardous materials should be tied down to prevent movement. It did appear that several were tied down, but other conditions were unknown. If any distribution systems carry hazardous materials, they should have shut-off valves.

- **Integrated Ceilings, Edge Clearance and Support –** Suspended ceilings in meeting room should have proper lateral restraints and allow for lateral movement.
- **Light Fixtures Lens Covers –** Light fixtures should have lens covers attached with safety devices to catch falling debris from the light fixture.
- **Panel Connections –** Panel fastening is unknown. Removal of siding and new panels will allow for the opportunity to properly attach panels to walls.
- **Tall Narrow Contents –** Several shelving units, storage units, and pieces of equipment appear to have a height-to-width ratio greater than 3:1 and are not anchored to the floor or walls. During a seismic event, these pose a falling hazard.
- **Fall Prone Contents -** Equipment or stored items weighing more than 20 lbs and located more than 4 ft above the floor should be braced or anchored to structure. A detailed survey of equipment/contents was not conducted, but some stored items appear to have met these criteria.
- **Suspended Contents/Equipment –** Equipment suspended without lateral bracing should be to swing from or move with the structure from which it is suspended without damaging other components.
- **Mechanical Doors –** It is unknown if the apparatus bay doors of this station are detailed to operate at a story drift ratio of 0.01, which could leave the doors inoperable after a seismic event.
- **Heavy Equipment –** Floor-supported equipment weighing more than 400 lbs should be anchored to the structure. It appeared that most of the equipment was properly anchored, but this should be investigated further.
- **Flexible Couplings –** Fluid and gas piping should have flexible couplings to accommodate any lateral movement. It appeared that flexible couplings were installed at a few locations, however more may be necessary at critical areas.
- **Piping –** Fluid and gas piping should be anchored and braced to the structure to limit spills or leaks. A detailed investigation was not conducted; however, only some piping was noted to meet this requirement.
- **Ducts –** Large ducts should be braced. The maximum unbraced span should not exceed 30 ft.

3. RECOMMENDATIONS

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RETROFIT RECOMMENDATIONS

Prior to retrofitting and design, material testing of key structural elements must be completed as required by ASCE 41-13 for a performance level greater than life safety.

The Tier 1 structural deficiencies listed will require further evaluation (ASCE 41-13 Tier 2 or 3 analyses) for the design of the seismic retrofits listed below. For a facility, such as a fire station, to meet the Operational Performance Level, each of these items will need to be further evaluated and brought up to meet current code requirements. The following narrative describes the approximate scope of one possible upgrade scheme to address the identified deficiencies. Plans and details of the upgrade scheme are provided in Appendix C.

Structural Retrofits:

Task 1: There is inadequate lateral support at the north side of the apparatus bay. Add two special moment frames at the existing bay doors. A continuous grade beam below the moment frame should be included to limit structure drift. Demolition of the existing slab as well as the existing building's foundations will need to occur to install the moment frame footings. Slab on grade to be replaced. Since there is some concern about the apparatus bay doors meeting the required thermal and seismic criteria, new apparatus bay doors are to be installed that will comply with current code criteria. See the Foundation/Roof Retrofit Plan for details and locations.

Task 2: Where walls have structural sheathing, wood shear walls should be blocked and re-nailed with smaller nail spacing. Where walls have non-structural sheathing, wood shear walls should be blocked, re-sheathed with structural sheathing, and re-nailed with smaller nail spacing. See the Foundation Retrofit Plan for details and locations. Hold-downs should be added on each side of wood shear wall piers. Hold-downs (Figure 11) should be a Simpson HTT5 or equivalent with epoxy anchorage into existing foundation. See the Foundation Retrofit Plan for details and locations. Additional sill anchors need to be added at wood shear walls to connect them to their foundations. The on-center spacing of sill bolts should be 3 feet on center or less. Provide strapping above and below windows so lateral forces can be properly transferred to adjacent wall piers. Remove existing roofing, and provide additional nailing @ 4" on center into the existing diaphragm. See the Roof Retrofit Plan for details.

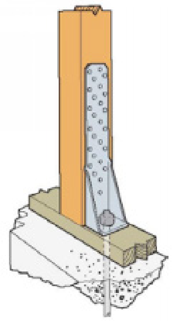

Figure 11
Simpson Hold Down

Task 3: There is no positive connection between the roof diaphragm and the shear walls. At the high roof, provide wood stud wall infill per SK3. At low roof, provide blocking infill per SK1 and SK2.

Task 4: Provide continuous chord elements at both the high roof and the low roof. See Roof Retrofit Plan for details and locations.

Task 5: Drag elements are required at the low roof at re-entrant corners. See Foundation/Roof Retrofit Plan for details & locations.

Non-Structural Retrofits:

Task 6: The purpose of this report and site visit was primarily a structural seismic assessment of the main station. If the decision is made to seismically retrofit and continue using the main station, a more detailed survey of non-structural components (ceilings, fire suppression systems, mechanical systems, light fixtures, etc.) should be made and any deficiencies should be addressed. The list below addresses some possible non-structural deficiencies and general solutions.Hazardous Materials: Gas cylinders and storage tanks should be restrained from lateral movement. It appeared that many of the gas cylinders were placed in cabinets; however, some hazardous material storage tanks may not be properly secured. Ensure shut-off valves are available for distributed hazardous materials (natural gas, gasoline, etc.) or are operational if present.

- Life Safety Systems: Emergency power to be anchored to slabs or supplement bracing added to prevent lateral movement. Emergency lighting should be properly anchored to walls or laterally braced to structure if hanging lights are present. Verify that fire suppression piping is properly braced.
- Hazardous Materials: Gas cylinders and storage tanks should be restrained from lateral movement. It appeared that many of the gas cylinders were placed in cabinets; however some hazardous material storage tanks may not be properly secured. Ensure shut-off valves are available for distributed hazardous materials (natural gas, gasoline, etc.) or are operational if present.Cladding: Provide proper attachment of exterior panels to structure. Ensure glazing with appropriate specifications is used.
- Ceilings: Supplemental attachments of gypsum board/ lath and plaster ceiling systems may be required. Add screws or nails as necessary. Provide edge distances and support for suspended ceilings, add lateral bracing if necessary.
- Light Fixtures: Add lens covers to light fixtures as required.
- Cladding: Provide proper attachment of exterior panels to structure. Ensure glazing with appropriate specifications is used.

- Contents & Furnishings: Use shelf lips on storage racks, bungee cords, wires, or anchorage to slab for contents that is likely to fall or tip in a seismic event.
- Mechanical & Electrical Equipment: Ensure proper slab anchorage for air compressor, water heater, and other mechanical equipment that is critical to station operations.
- Ducts/Piping: Mechanical ducts or fluid/gas piping should be properly braced to restrain lateral movement. Flexible couplings should be added to pipes at attachment to appliances or similar to allow movement.
- Architectural elements affected by the structural retrofit may have to be replaced due to demolition or access issues when applying the structural retrofit recommendations. This includes, but is not limited to, roofing, siding, and new paint.

Task Summary Table			**Drawings**	
Task #	Deficiency	Description	Keynote #	SK#
1	Load Path Narrow Wood Shear Walls Shear Stress Check	North side of high roof does not have a sufficient amount of shear wall to resist seismic forces. (2) bay moment frame required @ this location.	7, 8, 9, 10, 12	4
2	Shear Stress Check Hold Down Anchors Wood Sill Bolts	Existing wood shear walls & diaphragms do not have enough capacity to resist seismic loads. There is no hold-down anchorage to resist overturning. Wood sill bolts are not compliant.	1, 2, 3, 4, 5, 6, 15	-
3	Load Path Diaphragm Continuity	There is not sufficient blocking to tie the roof diaphragms to shear.	-	1, 2, 3
4	Roof Chord Continuity	There are no continuous chord elements.	16	3
5	Plan Irregularities	There are no drag elements @ re-entrant corners.	11, 13, 14	-
6	Life Safety Systems Hazardous Materials Ceilings Light Fixtures Cladding Furnishings Mechanical & Electrical Ducts & Piping	Non-structural components are not properly braced or restrained to prevent lateral movement during a seismic event.	-	-

CONCLUSIONS

The Tier 1 analysis has revealed that the building has multiple structural and non-structural seismic deficiencies which would not meet the current seismic design standards for an essential facility. Based on the site and the existing building information available at this time, the retrofit would address the deficiencies identified in the Tier 1 checklists to meet Operational standards. A thorough, Tier 2 analysis of the building in conjunction with materials testing and geotechnical investigation would need to be conducted to provide comprehensive upgrade design for the facility. The complete analysis and design development for those repairs is an effort that is beyond the scope of this investigation. Depending on the results of this additional analysis/investigation, there may be changes to the list of repairs above. Functionality and fire life safety deficiencies have not been addressed and are outside the scope of this report.

Once a complete analysis and design of a seismic upgrade has been submitted and construction has been completed, the West Side Fire Station #2 can expect to remain occupied and functional after a seismic event of the size expected in the region.

COST CONSIDERATIONS

Following completion of the seismic assessment, Mackenzie evaluated cost impacts of the rehabilitation scheme. The following cost summary projects a total development cost, including estimated construction costs, design costs, and owner costs.

Development costs of a project are not limited to construction costs alone and require consideration of other variables. These variables differ between new construction and renovation or expansion, and invariably change from one project to the next depending on site conditions, existing building conditions, building codes, seismic zones, and the environment of the construction industry. While differences arise depending on the design approach taken, the construction costs, design and engineering costs, and owner costs for furniture, fixtures and equipment are constants. New construction can often differ substantially due to the single variable of land acquisition.

Construction costs reflect the raw costs incurred by a general contractor for overhead and profit, bonding and insurance, securing of materials and general construction of the site and building. In addition to the identified construction costs, an escalation cost that reflects the expected start of construction has been added. Furthermore, a design contingency is recommended to ensure dollars are carried through construction for owner changes, design omissions, unforeseen conditions or jurisdictional requirements, among others.

Consultant costs reflect the costs incurred for project management and design of the project from conceptual design through construction administration. Though design fees can vary, these costs are generally factored using a fee based on the construction costs for the project. In addition to architectural and engineering services, costs include marketing materials and required services such as geotechnical analysis and special inspections. A contingency is provided for this category for any unforeseen or additionally requested design and/or engineering services throughout the project.

Owner costs reflect the costs generally incurred directly by the owner throughout the project. This includes all items the owner will likely need to contract separately from the general construction of the project. Additional owner-related costs include land costs, equipment and furnishing costs, relocation into the new facility, legal documentation and counsel for project documents and issuances, and jurisdictional fees associated with design review, building permits, and L&I fees. A contingency is provided in this category for any unforeseen or undefined costs not currently represented.

The following project development cost estimate examines the construction values of the programmed design concept based on the anticipated Construction, Consultant, and Owner Costs. Detailed break-out of the anticipated construction costs and permit costs have been provided in Appendix D to describe elements proposed.

Project Cost Summary

West Side Fire Station 2 - Project Cost Summary

12/18/2017

		Comments	
Construction Cost of Facility			
General Contractor Construction Cost	**$434,823**	$82.89	per SF
Escalation Start of Construction - Fall 2019	$52,179	12%	6% per year
Construction Contingency	$146,100	30%	
General Conditions	$60,661	9%	
CMGC Process	$40,910	5%	
Profit & Overhead	$73,467	9%	
Bonds & Insurances	$9,968	1%	
Total Construction Costs	**$818,109**	$155.95	per SF
Consultants Costs			
A/E Design	$135,000	17%	of GCC Cost
Reimbursables	$13,500	10%	of A/E Design and Construction
As-builting building	$5,000	Allowance	
A/E LEED Design and Documentation	$0	Not required	
CM/GC Preconstruction Services	$35,000	Allowance	5k per month
Owner's Project Manager	$35,000	4%	of GC Cost
Topo and Boundary Survey	$3,500	Allowance	
ASCE 41 Materials Testing	$10,000	Allowance	
Special Inspections	$16,000	Estimate	
Geotechnical Services	$20,000	Estimate	
Environmental Services	$0	Not required	
Hazardous Material Survey/Testing/Mitigation Specs	$12,000	Estimate	
Abatement	$20,000	Estimate	
Subtotal - Consultants	**$305,000**		
Consultants Contingency	$30,500	10%	of Consultants Costs
Total Consultants Costs	**$335,500**	$63.95	per SF
Owner Costs			
Lawyer Contract Review	$7,500	Allowance	
Fixtures, Furniture & Equipment (FF&E)	$15,000	Estimated to replace	
Moving Allowance	$7,500	Move to temporary facility	
Temporary Facilities	$25,000	Tents for apparatus	
Permit Fees	$10,000	Estimate	
Subtotal - Owner Costs	**$65,000**		
Owner Contingency	$6,500	10%	of Owner Costs
Total Owner Costs	**$71,500**	$13.63	per SF
Total Project Cost	**$1,225,109**	**$233.53**	**per SF**

Building Size: 5,246 SF

Exclusions: Off-site improvements to public right-of-way or utilities

A. ASCE 41-13 CHECKLIST

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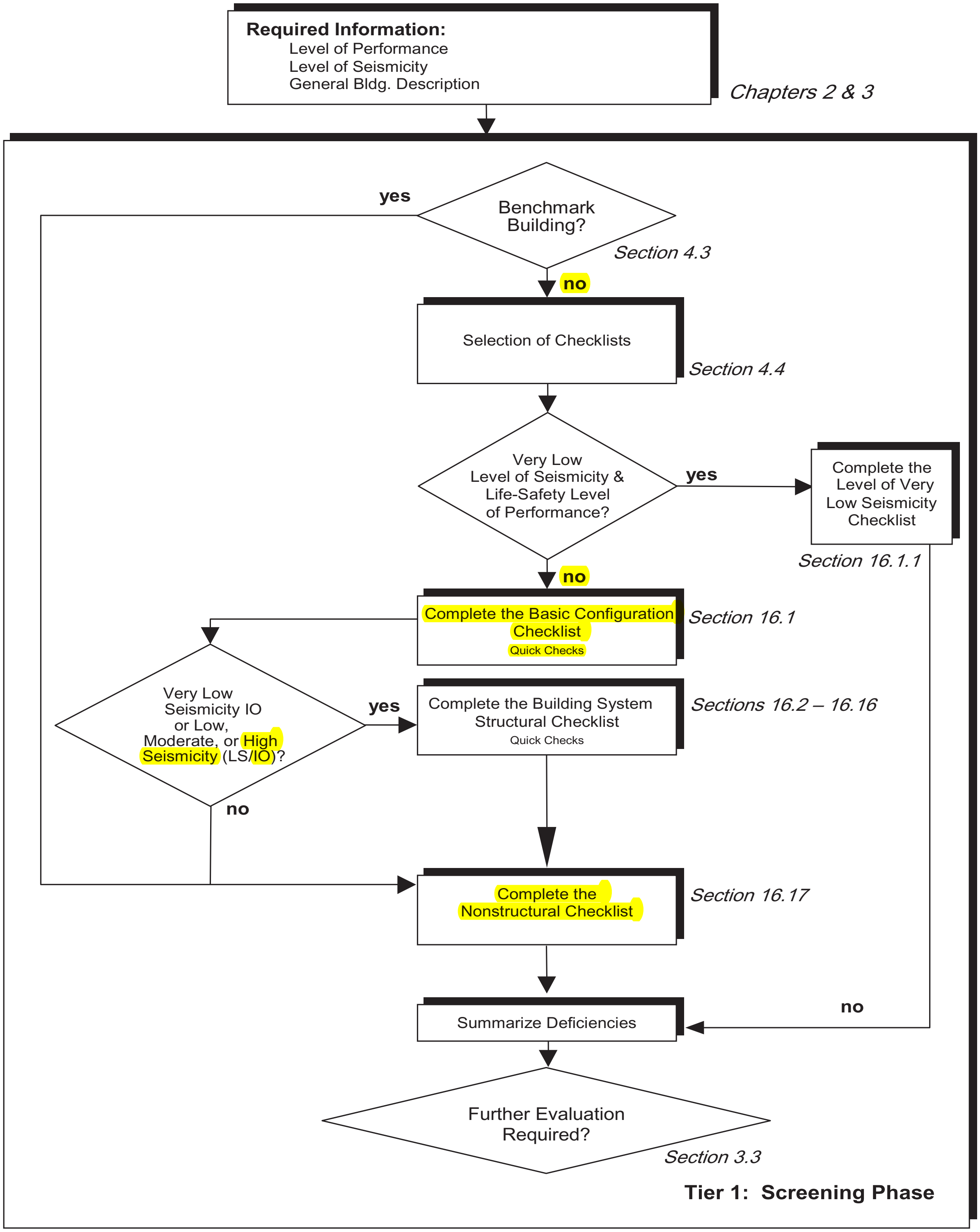

FIG. 4-1. Tier 1 Evaluation Process

Project: HOOD RIVER STATION 2

Location: 1185 TUCKER RD, HOOD RIVER OR 97031

Completed by: SIW

Date: NOVEMBER 8, 2017

16.1.2IO IMMEDIATE OCCUPANCY BASIC CONFIGURATION CHECKLIST

Very Low Seismicity

Building System

General

C [✓ NC] N/A U LOAD PATH: The structure shall contain a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation. (Commentary: Sec. A.2.1.1. Tier 2: Sec. 5.4.1.1)

[✓ C] NC N/A U ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building is greater than 4% of the height of the shorter building. This statement need not apply for the following building types: W1, W1a, and W2. (Commentary: Sec. A.2.1.2. Tier 2: Sec. 5.4.1.2)

C NC [✓ N/A] U MEZZANINES: Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure. (Commentary: Sec. A.2.1.3. Tier 2: Sec. 5.4.1.3)

Building Configuration

[✓ C] NC N/A U WEAK STORY: The sum of the shear strengths of the seismic-force-resisting system in any story in each direction shall not be less than 80% of the strength in the adjacent story above. (Commentary: Sec. A.2.2.2. Tier 2: Sec. 5.4.2.1)

[✓ C] NC N/A U SOFT STORY: The stiffness of the seismic-force-resisting system in any story shall not be less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffnessof the three stories above. (Commentary: Sec. A.2.2.3. Tier 2: Sec. 5.4.2.2)

[✓ C] NC N/A U VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation. (Commentary: Sec. A.2.2.4. Tier 2: Sec. 5.4.2.3)

[✓ C] NC N/A U GEOMETRY: There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines. (Commentary: Sec. A.2.2.5. Tier 2: Sec. 5.4.2.4)

[✓ C] NC N/A U MASS: There is no change in effective mass more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered. (Commentary: Sec. A.2.2.6. Tier 2: Sec. 5.4.2.5)

C NC [✓ N/A] U TORSION: The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension. (Commentary: Sec. A.2.2.7. Tier 2: Sec. 5.4.2.6)

Low Seismicity: Complete the Following Items in Additionto the Items for Very Low Seismicity.

Geologic Site Hazards

C NC N/A [✓ U] LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance shall not exist in the foundation soils at depths within 50 ft under the building. (Commentary: Sec. A.6.1.1. Tier 2: 5.4.3.1)

[✓ C] NC N/A U SLOPE FAILURE: The building site is sufficiently remote from potential earthquake-induced slope failures or rockfalls to be unaffected by such failures or is capable of accommodating any predicted movements without failure. (Commentary: Sec. A.6.1.2. Tier 2: 5.4.3.1)

C NC N/A [✓ U] SURFACE FAULT RUPTURE: Surface fault rupture and surface displacement at the building site are not anticipated. (Commentary: Sec. A.6.1.3. Tier 2: 5.4.3.1)

Moderate and High Seismicity: Complete the Following Items in Addition to the Items for Low Seismicity.

Foundation Configuration

[✓ C] NC N/A U OVERTURNING: The ratio of the least horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than 0.6S_a. (Commentary: Sec. A.6.2.1. Tier 2: Sec. 5.4.3.3)

C NC N/A [✓ U] TIES BETWEEN FOUNDATION ELEMENTS: The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C. (Commentary: Sec. A.6.2.2. Tier 2: Sec. 5.4.3.4)

Project: HOOD RIVER STATION 1

Location: 1185 TUCKER RD, HOOD RIVER OR 97031

Completed by: SIW

Date: NOVEMBER 8, 2017

16.3IO IMMEDIATE OCCUPANCY STRUCTURAL CHECKLIST FOR BUILDING TYPE W2: WOOD FRAMES, COMMERCIAL AND INDUSTRIAL

Very Low Seismicity

Seismic-Force-Resisting System

[✓ C] NC N/A U REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2. (Commentary: Sec. A.3.2.1.1. Tier 2: Sec. 5.5.1.1)

C [✓ NC] N/A U SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 4.5.3.3, is less than the following values (Commentary: Sec. A.3.2.7.1. Tier 2: Sec. 5.5.3.1.1):

Structural panel sheathing	1,000 lb/ft
Diagonal sheathing	700 lb/ft
Straight sheathing	100 lb/ft
All other conditions	100 lb/ft

C NC [✓ N/A] U STUCCO (EXTERIOR PLASTER) SHEAR WALLS: Multi-story buildings do not rely on exterior stucco walls as the primary seismic-force-resisting system. (Commentary: Sec. A.3.2.7.2. Tier 2: Sec. 5.5.3.6.1)

[✓ C] NC N/A U GYPSUM WALLBOARD OR PLASTER SHEAR WALLS: Interior plaster or gypsum wallboard is not used as shear walls on buildings more than one story high with the exception of the uppermost level of a multi-story building. (Commentary: Sec. A.3.2.7.3. Tier 2: Sec. 5.5.3.6.1)

C [✓ NC] N/A U NARROW WOOD SHEAR WALLS: Narrow wood shear walls with an aspect ratio greater than 2-to-1 are not used to resist seismic forces. (Commentary: Sec. A.3.2.7.4. Tier 2: Sec. 5.5.3.6.1)

C NC [✓ N/A] U WALLS CONNECTED THROUGH FLOORS: Shear walls have an interconnection between stories to transfer overturning and shear forces through the floor. (Commentary: Sec. A.3.2.7.5. Tier 2: Sec. 5.5.3.6.2)

C NC [✓ N/A] U HILLSIDE SITE: For structures that are taller on at least one side by more than one-half story because of a sloping site, all shear walls on the downhill slope have an aspect ratio less than 1-to-2. (Commentary: Sec. A.3.2.7.6. Tier 2: Sec. 5.5.3.6.3)

C NC [✓ N/A] U CRIPPLE WALLS: Cripple walls below first-floor-level shear walls are braced to the foundation with wood structural panels. (Commentary: Sec. A.3.2.7.7. Tier 2: Sec. 5.5.3.6.4)

C [✓ NC] N/A U OPENINGS: Walls with openings greater than 80% of the length are braced with wood structural panel shear walls with aspect ratios of not more than 1.5-to-1 or are supported by adjacent construction through positive ties capable of transferring the seismic forces. (Commentary: Sec. A.3.2.7.8. Tier 2: Sec. 5.5.3.6.5)

C [✓ NC] N/A U HOLD-DOWN ANCHORS: All shear walls have hold-down anchors, constructed per acceptable construction practices, attached to the end studs. (Commentary: Sec. A.3.2.7.9. Tier 2: Sec. 5.5.3.6.6)

Connections

[✓ C] NC N/A U WOOD POSTS: There is a positive connection of wood posts to the foundation. (Commentary: Sec. A.5.3.3. Tier 2: Sec. 5.7.3.3)

[✓ C] NC N/A U WOOD SILLS: All wood sills are bolted to the foundation. (Commentary: Sec. A.5.3.4. Tier 2: Sec. 5.7.3.3)

C NC [✓ N/A] U GIRDER/COLUMN CONNECTION: There is a positive connection using plates, connection hardware, or straps between the girder and the column support. (Commentary: Sec. A.5.4.1. Tier 2: Sec. 5.7.4.1)

Foundation System

C NC [✓ N/A] U DEEP FOUNDATIONS: Piles and piers are capable of transferring the lateral forces between the structure and the soil. (Commentary: Sec. A.6.2.3.)

[✓ C] NC N/A U SLOPING SITES: The difference in foundation embedment depth from one side of the building to another shall not exceed one story high. (Commentary: Sec. A.6.2.4)

Low, Moderate, and High Seismicity: Complete the Following Items in Addition to the Items for Very Low Seismicity.

Seismic-Force-Resisting System

C [✓ NC] N/A U NARROW WOOD SHEAR WALLS: Narrow wood shear walls with an aspect ratio greater than 1.5-to-1 are not used to resist seismic forces. (Commentary: Sec. A.3.2.7.4. Tier 2: Sec. 5.5.3.6.1)

Diaphragms

C [✓ NC] N/A U DIAPHRAGM CONTINUITY: The diaphragms are not composed of split-level floors and do not have expansion joints. (Commentary: Sec. A.4.1.1. Tier 2: Sec. 5.6.1.1)

C [✓ NC] N/A U ROOF CHORD CONTINUITY: All chord elements are continuous, regardless of changes in roof elevation. (Commentary: Sec. A.4.1.3. Tier 2: Sec. 5.6.1.1)

C [✓ NC] N/A U PLAN IRREGULARITIES: There is tensile capacity to develop the strength of the diaphragm at reentrant corners or other locations of plan irregularities. (Commentary: Sec. A.4.1.7. Tier 2: Sec. 5.6.1.4)

C NC [✓ N/A] U DIAPHRAGM REINFORCEMENT AT OPENINGS: There is reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. (Commentary: Sec. A.4.1.8. Tier 2: Sec. 5.6.1.5)

C NC [✓ N/A] U STRAIGHT SHEATHING: All straight sheathed diaphragms have aspect ratios less than 1-to-1 in the direction being considered. (Commentary: Sec. A.4.2.1. Tier 2: Sec. 5.6.2)

[✓ C] NC N/A U SPANS: All wood diaphragms with spans greater than 12 ft consist of wood structural panels or diagonal sheathing. Wood commercial and industrial buildings may have rod-braced systems. (Commentary: Sec. A.4.2.2. Tier 2: Sec. 5.6.2)

C NC [✓ N/A] U DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 30 ft and aspect ratios less than or equal to 3-to-1. (Commentary: Sec. A.4.2.3. Tier 2: Sec. 5.6.2)

[✓ C] NC N/A U OTHER DIAPHRAGMS: The diaphragm does not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Commentary: Sec. A.4.7.1. Tier 2: Sec. 5.6.5)

Connections

C [✓ NC] N/A U WOOD SILL BOLTS: Sill bolts are spaced at 4 ft or less, with proper edge and end distance provided for wood and concrete. (Commentary: Sec. A.5.3.7. Tier 2: Sec. 5.7.3.3)

Project: HOOD RIVER STATION 2

Location: 1185 TUCKER RD, HOOD RIVER OR 97031

Completed by: SIW

Date: NOVEMBER 8, 2017

16.17 NONSTRUCTURAL CHECKLIST

Life Safety Systems

C [✓ NC] N/A U LS-LMH; PR-LMH. FIRE SUPPRESSION PIPING: Fire suppression piping is anchored and braced in accordance with NFPA-13. (Commentary: Sec. A.7.13.1. Tier 2: Sec. 13.7.4)

C [✓ NC] N/A U LS-LMH; PR-LMH. FLEXIBLE COUPLINGS: Fire suppression piping has flexible couplings in accordance with NFPA-13. (Commentary: Sec. A.7.13.2. Tier 2: Sec. 13.7.4)

C NC N/A [✓ U] LS-LMH; PR-LMH. EMERGENCY POWER: Equipment used to power or control life safety systems is anchored or braced. (Commentary: Sec. A.7.12.1. Tier 2: Sec. 13.7.7)

C NC [✓ N/A] U LS-LMH; PR-LMH. STAIR AND SMOKE DUCTS: Stair pressurization and smoke control ducts are braced and have flexible connections at seismic joints. (Commentary: Sec. A.7.14.1. Tier 2: Sec. 13.7.6)

C NC N/A [✓ U] LS-MH; PR-MH. SPRINKLER CEILING CLEARANCE: Penetrations through panelized ceilings for fire suppression devices provide clearances in accordance with NFPA-13. (Commentary: Sec. A.7.13.3. Tier 2: Sec. 13.7.4)

C NC N/A [✓ U] LS-not required; PR-LMH. EMERGENCY LIGHTING: Emergency and egress lighting equipment is anchored or braced. (Commentary: Sec. A.7.3.1. Tier 2: Sec. 13.7.9)

Hazardous Materials

C NC N/A [✓ U] LS-LMH; PR-LMH. HAZARDOUS MATERIAL EQUIPMENT: Equipment mounted on vibration isolators and containing hazardous material is equipped with restraints or snubbers. (Commentary: Sec. A.7.12.2. Tier 2: 13.7.1)

[✓ C] NC N/A U LS-LMH; PR-LMH. HAZARDOUS MATERIAL STORAGE: Breakable containers that hold hazardous material, including gas cylinders, are restrained by latched doors, shelf lips, wires, or other methods. (Commentary: Sec. A.7.15.1. Tier 2: Sec. 13.8.4)

C NC N/A [✓ U] LS-MH; PR-MH. HAZARDOUS MATERIAL DISTRIBUTION: Piping or ductwork conveying hazardous materials is braced or otherwise protected from damage that would allow hazardous material release. (Commentary: Sec. A.7.13.4. Tier 2: Sec. 13.7.3 and 13.7.5)

C NC N/A [✓ U] LS-MH; PR-MH. SHUT-OFF VALVES: Piping containing hazardous material, including natural gas, has shut-off valves or other devices to limit spills or leaks. (Commentary: Sec. A.7.13.3. Tier 2: Sec. 13.7.3 and 13.7.5)

C [✓ NC] N/A U LS-LMH; PR-LMH. FLEXIBLE COUPLINGS: Hazardous material ductwork and piping, including natural gas piping, has flexible couplings. (Commentary: Sec. A.7.15.4, Tier 2: Sec.13.7.3 and 13.7.5)

C NC [✓ N/A] U LS-MH; PR-MH. PIPING OR DUCTS CROSSING SEISMIC JOINTS: Piping or ductwork carrying hazardous material that either crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements. (Commentary: Sec. A.7.13.6. Tier 2: Sec.13.7.3, 13.7.5, and 13.7.6)

Partitions

C NC [✓ N/A] U LS-LMH; PR-LMH. UNREINFORCED MASONRY: Unreinforced masonry or hollow-clay tile partitions are braced at a spacing of at most 10 ft in Low or Moderate Seismicity, or at most 6 ft in High Seismicity. (Commentary: Sec. A.7.1.1. Tier 2: Sec. 13.6.2)

C NC [✓ N/A] U LS-LMH; PR-LMH. HEAVY PARTITIONS SUPPORTED BY CEILINGS: The tops of masonry or hollow-clay tile partitions are not laterally supported by an integrated ceiling system. (Commentary: Sec. A.7.2.1. Tier 2: Sec. 13.6.2)

C NC [✓ N/A] U LS-MH; PR-MH. DRIFT: Rigid cementitious partitions are detailed to accommodate the following drift ratios: in steel moment frame, concrete moment frame, and wood frame buildings, 0.02; in other buildings, 0.005. (Commentary A.7.1.2 Tier 2: Sec. 13.6.2)

C NC [✓ N/A] U LS-not required; PR-MH. LIGHT PARTITIONS SUPPORTED BY CEILINGS: The tops of gypsum board partitions are not laterally supported by an integrated ceiling system. (Commentary: Sec. A.7.2.1. Tier 2: Sec. 13.6.2)

C NC [✓ N/A] U LS-not required; PR-MH. STRUCTURAL SEPARATIONS: Partitions that cross structural separations have seismic or control joints. (Commentary: Sec. A.7.1.3. Tier 2. Sec. 13.6.2)

C NC [✓ N/A] U LS-not required; PR-MH. TOPS: The tops of ceiling-high framed or panelized partitions have lateral bracing to the structure at a spacing equal to or less than 6 ft. (Commentary: Sec. A.7.1.4. Tier 2. Sec. 13.6.2)

Ceilings

C NC [✓ N/A] U LS-MH; PR-LMH. SUSPENDED LATH AND PLASTER: Suspended lath and plaster ceilings have attachments that resist seismic forces for every 12 ft^2 of area. (Commentary: Sec. A.7.2.3. Tier 2: Sec. 13.6.4)

C [✓ NC] N/A U LS-MH; PR-LMH. SUSPENDED GYPSUM BOARD: Suspended gypsum board ceilings have attachments that resist seismic forces for every 12 ft^2 of area. (Commentary: Sec. A.7.2.3. Tier 2: Sec. 13.6.4)

C [✓ NC] N/A U LS-not required; PR-MH. INTEGRATED CEILINGS: Integrated suspended ceilings with continuous areas greater than 144 ft^2, and ceilings of smaller areas that are not surrounded by restraining partitions, are laterally restrained at a spacing no greater than 12 ft with members attached to the structure above. Each restraint location has a minimum of four diagonal wires and compression struts, or diagonal members capable of resisting compression. (Commentary: Sec. A.7.2.2. Tier 2: Sec. 13.6.4)

C [✓ NC] N/A U LS-not required; PR-MH. EDGE CLEARANCE: The free edges of integrated suspended ceilings with continuous areas greater than 144 ft^2 have clearances from the enclosing wall or partition of at least the following: in Moderate Seismicity, 1/2 in.; in High Seismicity, 3/4 in. (Commentary: Sec. A.7.2.4. Tier 2: Sec. 13.6.4)

C NC [✓ N/A] U LS-not required; PR-MH. CONTINUITY ACROSS STRUCTURE JOINTS: The ceiling system does not cross any seismic joint and is not attached to multiple independent structures. (Commentary: Sec. A.7.2.5. Tier 2: Sec. 13.6.4)

C [✓ NC] N/A U LS-not required; PR-H. EDGE SUPPORT: The free edges of integrated suspended ceilings with continuous areas greater than 144 ft^2 are supported by closure angles or channels not less than 2 in. wide. (Commentary: Sec. A.7.2.6. Tier 2: Sec. 13.6.4)

C NC [✓ N/A] U LS-not required; PR-H. SEISMIC JOINTS: Acoustical tile or lay-in panel ceilings have seismic separation joints such that each continuous portion of the ceiling is no more than 2500 ft^2 and has a ratio of long-to-short dimension no more than 4-to-1. (Commentary: Sec. A.7.2.7. Tier 2: 13.6.4)

Light Fixtures

C [✓ NC] N/A U LS-MH; PR-MH. INDEPENDENT SUPPORT: Light fixtures that weigh more per square foot than the ceiling they penetrate are supported independent of the grid ceiling suspension system by a minimum of two wires at diagonally opposite corners of each fixture. (Commentary: Sec. A.7.3.2. Tier 2: Sec. 13.6.4 and 13.7.9)

C [✓ NC] N/A U LS-not required; PR-H. PENDANT SUPPORTS: Light fixtures on pendant supports are attached at a spacing equal to or less than 6 ft and, if rigidly supported, are free to move with the structure to which they are attached without damaging adjoining components. (Commentary: A.7.3.3. Tier 2: Sec. 13.7.9)

C [✓ NC] N/A U LS-not required; PR-H. LENS COVERS: Lens covers on light fixtures are attached with safety devices. (Commentary: Sec. A.7.3.4. Tier 2: Sec. 13.7.9)

Cladding and Glazing

C NC [✓ N/A] U LS-MH; PR-MH. CLADDING ANCHORS: Cladding components weighing more than 10 lb/ft^2 are mechanically anchored to the structure at a spacing equal to or less than the following: for Life Safety in Moderate Seismicity, 6 ft; for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 ft. (Commentary: Sec. A.7.4.1. Tier 2: Sec. 13.6.1)

C NC [✓ N/A] U LS-MH; PR-MH. CLADDING ISOLATION: For steel or concrete moment frame buildings, panel connections are detailed to accommodate a story drift ratio of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicity, 0.02. (Commentary: Sec. A.7.4.3. Tier 2: Section 13.6.1)

C NC [✓ N/A] U LS-MH; PR-MH. MULTI-STORY PANELS: For multi-story panels attached at more than one floor level, panel connections are detailed to accommodate a story drift ratio of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicty, 0.02. (Commentary: Sec. A.7.4.4. Tier 2: Sec. 13.6.1)

C NC N/A [✓ U] LS-MH; PR-MH. PANEL CONNECTIONS: Cladding panels are anchored out-of-plane with a minimum number of connections for each wall panel, as follows: for Life Safety in Moderate Seismicity, 2 connections; for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 connections. (Commentary: Sec. A.7.4.5. Tier 2: Sec. 13.6.1.4)

C NC N/A [✓ U] LS-MH; PR-MH. BEARING CONNECTIONS: Where bearing connections are used, there is a minimum of two bearing connections for each cladding panel. (Commentary: Sec. A.7.4.6. Tier 2: Sec. 13.6.1.4)

C NC [✓ N/A] U LS-MH; PR-MH. INSERTS: Where concrete cladding components use inserts, the inserts have positive anchorage or are anchored to reinforcing steel. (Commentary: Sec. A.7.4.7. Tier 2: Sec. 13.6.1.4)

C NC N/A [✓ U] LS-MH; PR-MH. OVERHEAD GLAZING: Glazing panes of any size in curtain walls and individual interior or exterior panes over 16 ft^2 in area are laminated annealed or laminated heat-strengthened glass and are detailed to remain in the frame when cracked. (Commentary: Sec. A.7.4.8: Tier 2: Sec. 13.6.1.5)

Masonry Veneer

C NC [✓ N/A] U LS-LMH; PR-LMH. TIES: Masonry veneer is connected to the backup with corrosion-resistant ties. There is a minimum of one tie for every 2-2/3 ft^2, and the ties have spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 36 in.; for Life Safety in High Seismicity and for Position Retention in any seismicity, 24 in. (Commentary: Sec. A.7.5.1. Tier 2: Sec. 13.6.1.2)

C NC [✓ N/A] U LS-LMH; PR-LMH. SHELF ANGLES: Masonry veneer is supported by shelf angles or other elements at each floor above the ground floor. (Commentary: Sec. A.7.5.2. Tier 2: Sec. 13.6.1.2)

C NC [✓ N/A] U LS-LMH; PR-LMH. WEAKENED PLANES: Masonry veneer is anchored to the backup adjacent to weakened planes, such as at the locations of flashing. (Commentary: Sec. A.7.5.3. Tier 2: Sec. 13.6.1.2)

C NC [✓ N/A] U LS-LMH; PR-LMH. UNREINFORCED MASONRY BACKUP: There is no unreinforced masonry backup. (Commentary: Sec. A.7.7.2. Tier 2: Section 13.6.1.1 and 13.6.1.2)

C NC [✓ N/A] U LS-MH; PR-MH. STUD TRACKS: For veneer with metal stud backup, stud tracks are fastened to the structure at a spacing equal to or less than 24 in. on center. (Commentary: Sec. A.7.6.1. Tier 2: Section 13.6.1.1 and 13.6.1.2)

C NC [✓ N/A] U LS-MH; PR-MH. ANCHORAGE: For veneer with concrete block or masonry backup, the backup is positively anchored to the structure at a horizontal spacing equal to or less than 4 ft along the floors and roof. (Commentary: Sec. A.7.7.1. Tier 2: Section 13.6.1.1 and 13.6.1.2)

C NC [✓ N/A] U LS-not required; PR-MH. WEEP HOLES: In veneer anchored to stud walls, the veneer has functioning weep holes and base flashing. (Commentary: Sec. A.7.5.6. Tier 2: Section 13.6.1.2)

C NC [✓ N/A] U LS-not required; PR-MH. OPENINGS: For veneer with metal stud backup, steel studs frame window and door openings. (Commentary: Sec. A.7.6.2. Tier 2: Sec. 13.6.1.1 and 13.6.1.2)

Parapets, Cornices, Ornamentation, and Appendages

C NC [✓ N/A] U LS-LMH; PR-LMH. URM PARAPETS OR CORNICES: Laterally unsupported unreinforced masonry parapets or cornices have height-to-thickness ratios no greater than the following: for Life Safety in Low or Moderate Seismicity, 2.5; for Life Safety in High Seismicity and for Position Retention in any seismicity, 1.5. (Commentary: Sec. A.7.8.1. Tier 2: Sec. 13.6.5)

C NC [✓ N/A] U LS-LMH; PR-LMH. CANOPIES: Canopies at building exits are anchored to the structure at a spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 10 ft; for Life Safety in High Seismicity and for Position Retention in any seismicity, 6 ft. (Commentary: Sec. A.7.8.2. Tier 2: Sec. 13.6.6)

C NC [✓ N/A] U LS-MH; PR-LMH. CONCRETE PARAPETS: Concrete parapets with height-to-thickness ratios greater than 2.5 have vertical reinforcement. (Commentary: Sec. A.7.8.3. Tier 2: Sec. 13.6.5)

C NC [✓ N/A] U LS-MH; PR-LMH. APPENDAGES: Cornices, parapets, signs, and other ornamentation or appendages that extend above the highest point of anchorage to the structure or cantilever from components are reinforced and anchored to the structural system at a spacing equal to or less than 6 ft. This checklist item does not apply to parapets or cornices covered by other checklist items. (Commentary: Sec. A.7.8.4. Tier 2: Sec. 13.6.6)

Masonry Chimneys

C NC [✓ N/A] U LS-LMH; PR-LMH. URM CHIMNEYS: Unreinforced masonry chimneys extend above the roof surface no more than the following: for Life Safety in Low or Moderate Seismicity, 3 times the least dimension of the chimney; for Life Safety in High Seismicity and for Position Retention in any seismicity, 2 times the least dimension of the chimney. (Commentary: Sec. A.7.9.1. Tier 2: 13.6.7)

C NC [✓ N/A] U LS-LMH; PR-LMH. ANCHORAGE: Masonry chimneys are anchored at each floor level, at the topmost ceiling level, and at the roof. (Commentary: Sec. A.7.9.2. Tier 2: 13.6.7)

Stairs

C NC [✓ N/A] U LS-LMH; PR-LMH. STAIR ENCLOSURES: Hollow-clay tile or unreinforced masonry walls around stair enclosures are restrained out-of-plane and have height-to-thickness ratios not greater than the following: for Life Safety in Low or Moderate Seismicity, 15-to-1; for Life Safety in High Seismicity and for Position Retention in any seismicity, 12-to-1. (Commentary: Sec. A.7.10.1. Tier 2: Sec. 13.6.2 and 13.6.8)

C NC [✓ N/A] U LS-LMH; PR-LMH. STAIR DETAILS: In moment frame structures, the connection between the stairs and the structure does not rely on shallow anchors in concrete. Alternatively, the stair details are capable of accommodating the drift calculated using the Quick Check procedure of Section 4.5.3.1 without including any lateral stiffness contribution from the stairs. (Commentary: Sec. A.7.10.2. Tier 2: 13.6.8)

Contents and Furnishings

C NC [✓ N/A] U LS-MH; PR-MH. INDUSTRIAL STORAGE RACKS: Industrial storage racks or pallet racks more than 12 ft high meet the requirements of ANSI/MH 16.1 as modified by ASCE 7 Chapter 15. (Commentary: Sec. A.7.11.1. Tier 2: Sec. 13.8.1)

C [✓ NC] N/A U LS-H; PR-MH. TALL NARROW CONTENTS: Contents more than 6 ft high with a height-to-depth or height-to-width ratio greater than 3-to-1 are anchored to the structure or to each other. (Commentary: Sec. A.7.11.2. Tier 2: Sec. 13.8.2)

C [✓ NC] N/A U LS-H; PR-H. FALL-PRONE CONTENTS: Equipment, stored items, or other contents weighing more than 20 lb whose center of mass is more than 4 ft above the adjacent floor level are braced or otherwise restrained. (Commentary: Sec. A.7.11.3. Tier 2: Sec. 13.8.2)

C NC [✓ N/A] U LS-not required; PR-MH. ACCESS FLOORS: Access floors more than 9 in. high are braced. (Commentary: Sec. A.7.11.4. Tier 2: Sec. 13.8.3)

C NC [✓ N/A] U LS-not required; PR-MH. EQUIPMENT ON ACCESS FLOORS: Equipment and other contents supported by access floor systems are anchored or braced to the structure independent of the access floor. (Commentary: Sec. A.7.11.5. Tier 2: Sec. 13.7.7 and 13.8.3)

C [✓ NC] N/A U LS-not required; PR-H. SUSPENDED CONTENTS: Items suspended without lateral bracing are free to swing from or move with the structure from which they are suspended without damaging themselves or adjoining components. (Commentary. A.7.11.6. Tier 2: Sec. 13.8.2)

Mechanical and Electrical Equipment

C [✓ NC] N/A U LS-H; PR-H. FALL-PRONE EQUIPMENT: Equipment weighing more than 20 lb whose center of mass is more than 4 ft above the adjacent floor level, and which is not in-line equipment, is braced. (Commentary: A.7.12.4. Tier 2: 13.7.1 and 13.7.7)

C [✓ NC] N/A U LS-H; PR-H. IN-LINE EQUIPMENT: Equipment installed in-line with a duct or piping system, with an operating weight more than 75 lb, is supported and laterally braced independent of the duct or piping system. (Commentary: Sec. A.7.12.5. Tier 2: Sec. 13.7.1)

C [✓ NC] N/A U LS-H; PR-MH. TALL NARROW EQUIPMENT: Equipment more than 6 ft high with a height-to-depth or height-to-width ratio greater than 3-to-1 is anchored to the floor slab or adjacent structural walls. (Commentary: Sec. A.7.12.6. Tier 2: Sec. 13.7.1 and 13.7.7)

C NC N/A [✓ U] LS-not required; PR-MH. MECHANICAL DOORS: Mechanically operated doors are detailed to operate at a story drift ratio of 0.01. (Commentary: Sec. A.7.12.7. Tier 2: Sec. 13.6.9)

C [✓ NC] N/A U LS-not required; PR-H. SUSPENDED EQUIPMENT: Equipment suspended without lateral bracing is free to swing from or move with the structure from which it is suspended without damaging itself or adjoining components. (Commentary: Sec. A.7.12.8. Tier 2: Sec. 13.7.1 and 13.7.7)

C NC [✓ N/A] U LS-not required; PR-H. VIBRATION ISOLATORS: Equipment mounted on vibration isolators is equipped with horizontal restraints or snubbers and with vertical restraints to resist overturning. (Commentary: Sec. A.7.12.9. Tier 2: Sec. 13.7.1)

C [✓ NC] N/A U LS-not required; PR-H. HEAVY EQUIPMENT: Floor-supported or platform-supported equipment weighing more than 400 lb is anchored to the structure. (Commentary: Sec. A.7.12.10. Tier 2: 13.7.1 and 13.7.7)

C NC N/A [✓ U] LS-not required; PR-H. ELECTRICAL EQUIPMENT: Electrical equipment is laterally braced to the structure. (Commentary: Sec. A.7.12.11. Tier 2: 13.7.7)

C NC N/A [✓ U] LS-not required; PR-H. CONDUIT COUPLINGS: Conduit greater than 2.5 in. trade size that is attached to panels, cabinets, or other equipment and is subject to relative seismic displacement has flexible couplings or connections. (Commentary: Sec. A.7.12.12. Tier 2: 13.7.8)

Piping

C [✓ NC] N/A U LS-not required; PR-H. FLEXIBLE COUPLINGS: Fluid and gas piping has flexible couplings. (Commentary: Sec. A.7.13.2. Tier 2: Sec. 13.7.3 and 13.7.5)

C [✓ NC] N/A U LS-not required; PR-H. FLUID AND GAS PIPING: Fluid and gas piping is anchored and braced to the structure to limit spills or leaks. (Commentary: Sec. A.7.13.4. Tier 2: Sec. 13.7.3 and 13.7.5)

C NC [✓ N/A] U LS-not required; PR-H. C-CLAMPS: One-sided C-clamps that support piping larger than 2.5 in. in diameter are restrained. (Commentary: Sec. A.7.13.5. Tier 2: Sec. 13.7.3 and 13.7.5)

C NC [✓ N/A] U LS-not required; PR-H. PIPING CROSSING SEISMIC JOINTS: Piping that crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements. (Commentary: Sec. A7.13.6. Tier 2: Sec.13.7.3 and Sec. 13.7.5)

Ducts

C NC [✓ N/A] U LS-not required; PR-H. DUCT BRACING: Rectangular ductwork larger than 6 ft^2 in cross-sectional area and round ducts larger than 28 in. in diameter are braced. The maximum spacing of transverse bracing does not exceed 30 ft. The maximum spacing of longitudinal bracing does not exceed 60 ft. (Commentary: Sec. A.7.14.2. Tier 2: Sec. 13.7.6)

C NC N/A [✓ U] LS-not required; PR-H. DUCT SUPPORT: Ducts are not supported by piping or electrical conduit. (Commentary: Sec. A.7.14.3. Tier 2: Sec. 13.7.6)

C NC [✓ N/A] U LS-not required; PR-H. DUCTS CROSSING SEISMIC JOINTS: Ducts that cross seismic joints or isolation planes or are connected to independent structures have couplings or other details to accommodate the relative seismic displacements. (Commentary: Sec. A.7.14.5. Tier 2: Sec. 13.7.6)

Elevators

C NC [✓ N/A] U LS-H; PR-H. RETAINER GUARDS: Sheaves and drums have cable retainer guards. (Commentary: Sec. A.7.16.1. Tier 2: 13.8.6)

C NC [✓ N/A] U LS-H; PR-H. RETAINER PLATE: A retainer plate is present at the top and bottom of both car and counterweight. (Commentary: Sec. A.7.16.2. Tier 2: 13.8.6)

C NC [✓ N/A] U LS-not required; PR-H. ELEVATOR EQUIPMENT: Equipment, piping, and other components that are part of the elevator system are anchored. (Commentary: Sec. A.7.16.3. Tier 2: 13.8.6)

C NC [✓ N/A] U LS-not required; PR-H. SEISMIC SWITCH: Elevators capable of operating at speeds of 150 ft/min or faster are equipped with seismic switches that meet the requirements of ASME A17.1 or have trigger levels set to 20% of the acceleration of gravity at the base of the structure and 50% of the acceleration of gravity in other locations. (Commentary: Sec. A.7.16.4. Tier 2: 13.8.6)

C NC [✓ N/A] U LS-not required; PR-H. SHAFT WALLS: Elevator shaft walls are anchored and reinforced to prevent toppling into the shaft during strong shaking. (Commentary: Sec. A.7.16.5. Tier 2: 13.8.6)

C NC [✓ N/A] U LS-not required; PR-H. COUNTERWEIGHT RAILS: All counterweight rails and divider beams are sized in accordance with ASME A17.1. (Commentary: Sec. A.7.16.6. Tier 2: 13.8.6)

C NC [✓ N/A] U LS-not required; PR-H. BRACKETS: The brackets that tie the car rails and the counterweight rail to the structure are sized in accordance with ASME A17.1. (Commentary: Sec. A.7.16.7. Tier 2: 13.8.6)

C NC [✓ N/A] U LS-not required; PR-H. SPREADER BRACKET: Spreader brackets are not used to resist seismic forces. (Commentary: Sec. A.7.16.8. Tier 2: 13.8.6)

C NC [✓ N/A] U LS-not required; PR-H. GO-SLOW ELEVATORS: The building has a go-slow elevator system. (Commentary: Sec. A.7.16.9. Tier 2: 13.8.6)

B. ASCE 41-13 CALCULATIONS

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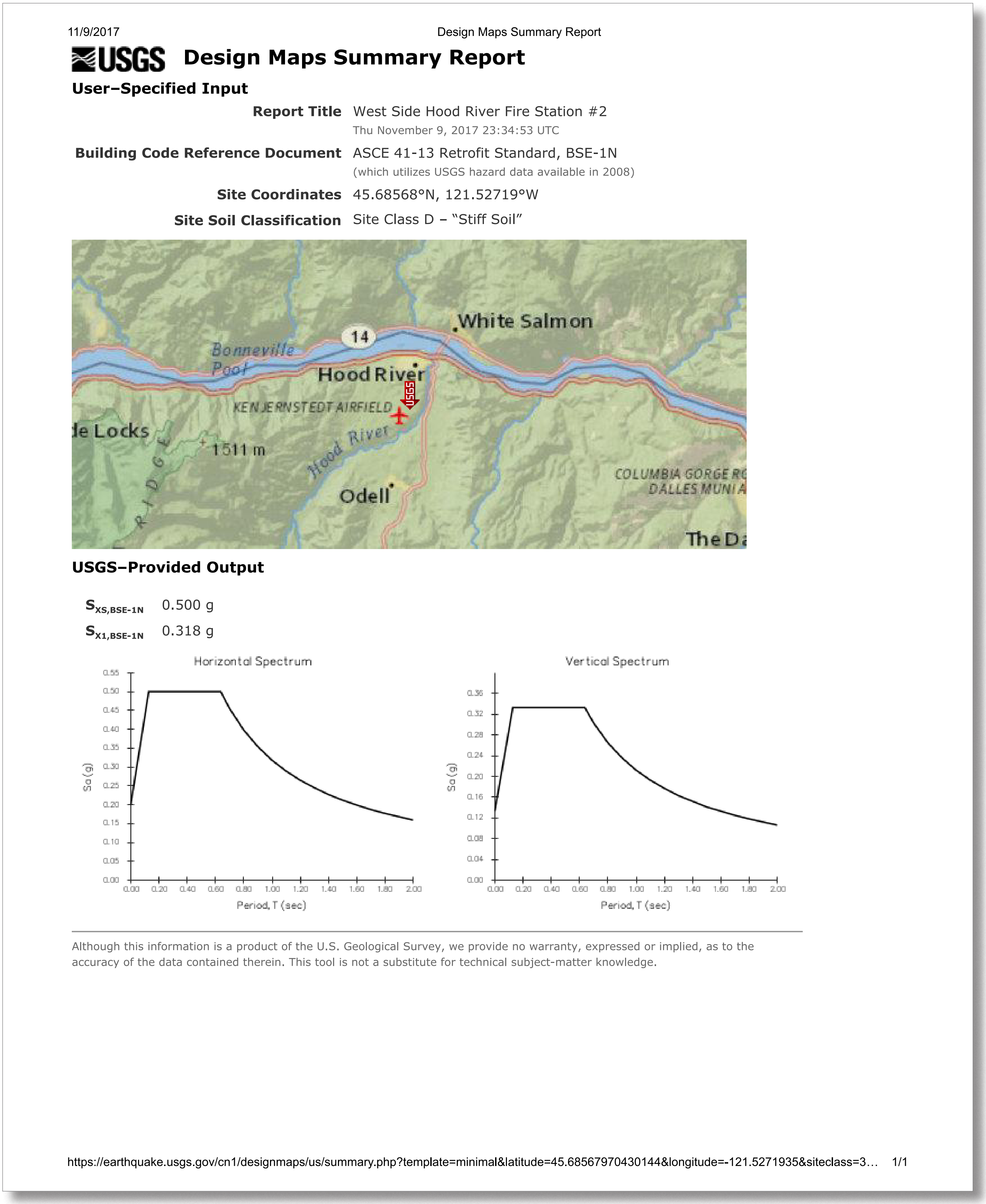

11/9/2017 Design Maps Summary Report

Design Maps Summary Report

User–Specified Input

Report Title	West Side Hood River Fire Station #2 Thu November 9, 2017 23:34:53 UTC
Building Code Reference Document	ASCE 41-13 Retrofit Standard, BSE-1N (which utilizes USGS hazard data available in 2008)
Site Coordinates	45.68568°N, 121.52719°W
Site Soil Classification	Site Class D – “Stiff Soil”

USGS–Provided Output

$S_{XS,BSE-1N}$ 0.500 g

$S_{X1,BSE-1N}$ 0.318 g

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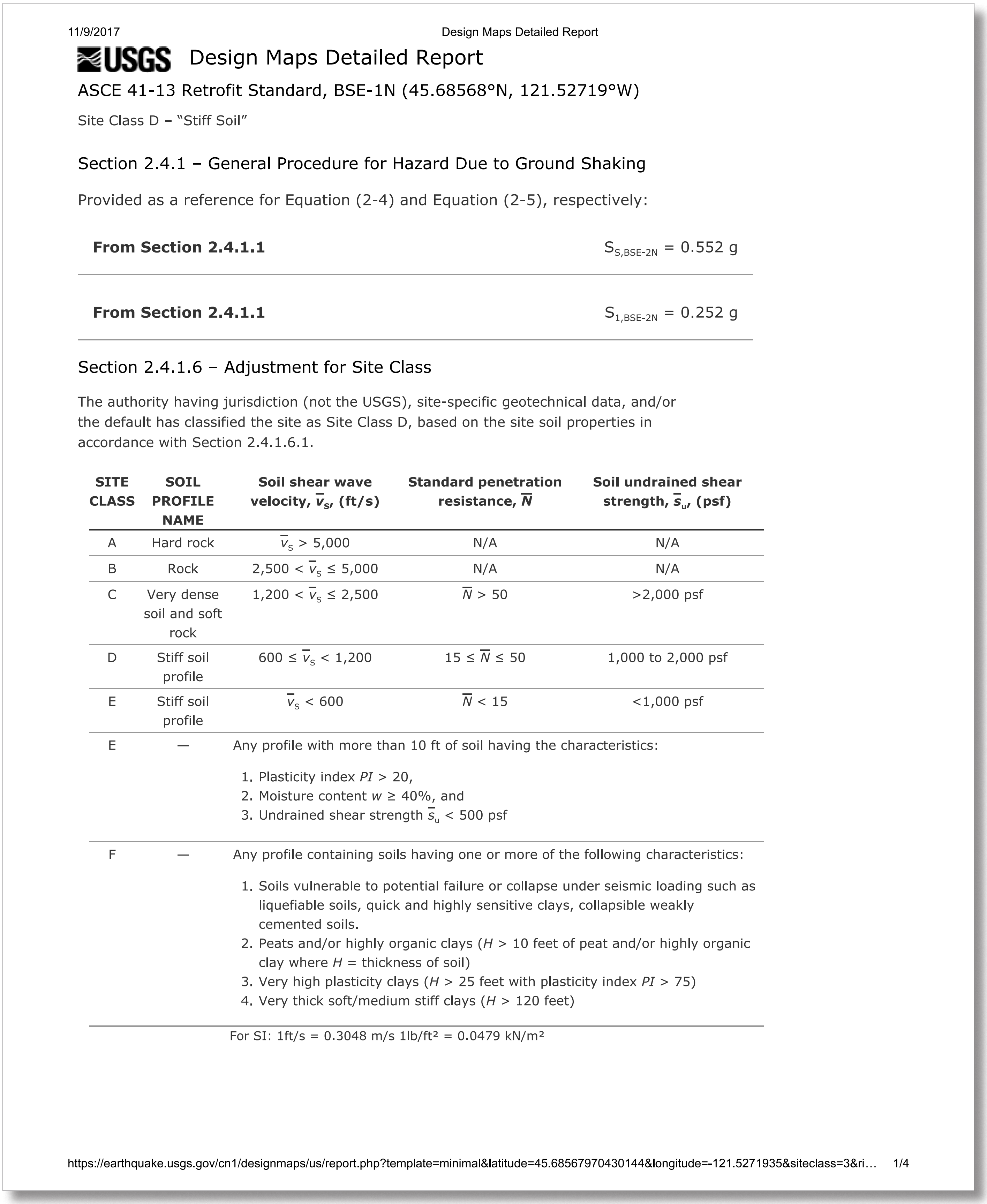

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USGS Design Maps Detailed Report

ASCE 41-13 Retrofit Standard, BSE-1N (45.68568°N, 121.52719°W)

Site Class D – “Stiff Soil”

Section 2.4.1 – General Procedure for Hazard Due to Ground Shaking

Provided as a reference for Equation (2-4) and Equation (2-5), respectively:

From Section 2.4.1.1 $S_{S,BSE-2N}$ = 0.552 g

From Section 2.4.1.1 $S_{1,BSE-2N}$ = 0.252 g

Section 2.4.1.6 – Adjustment for Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Section 2.4.1.6.1.

SITE CLASS	**SOIL PROFILE NAME**	**Soil shear wave velocity, $\overline{v}_s$, (ft/s)**	**Standard penetration resistance, $\overline{N}$**	**Soil undrained shear strength, $\overline{s}_u$, (psf)**
A	Hard rock	$\overline{v}_S > 5{,}000$	N/A	N/A
B	Rock	$2{,}500 < \overline{v}_S \le 5{,}000$	N/A	N/A
C	Very dense soil and soft rock	$1{,}200 < \overline{v}_S \le 2{,}500$	$\overline{N} > 50$	>2,000 psf
D	Stiff soil profile	$600 \le \overline{v}_S < 1{,}200$	$15 \le \overline{N} \le 50$	1,000 to 2,000 psf
E	Stiff soil profile	$\overline{v}_S < 600$	$\overline{N} < 15$	<1,000 psf
E	—	Any profile with more than 10 ft of soil having the characteristics: 1. Plasticity index $PI > 20$, 2. Moisture content $w \ge 40\%$, and 3. Undrained shear strength $\overline{s}_u < 500$ psf		
F	—	Any profile containing soils having one or more of the following characteristics: 1. Soils vulnerable to potential failure or collapse under seismic loading such as liquefiable soils, quick and highly sensitive clays, collapsible weakly cemented soils. 2. Peats and/or highly organic clays ($H > 10$ feet of peat and/or highly organic clay where H = thickness of soil) 3. Very high plasticity clays ($H > 25$ feet with plasticity index $PI > 75$) 4. Very thick soft/medium stiff clays ($H > 120$ feet)		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

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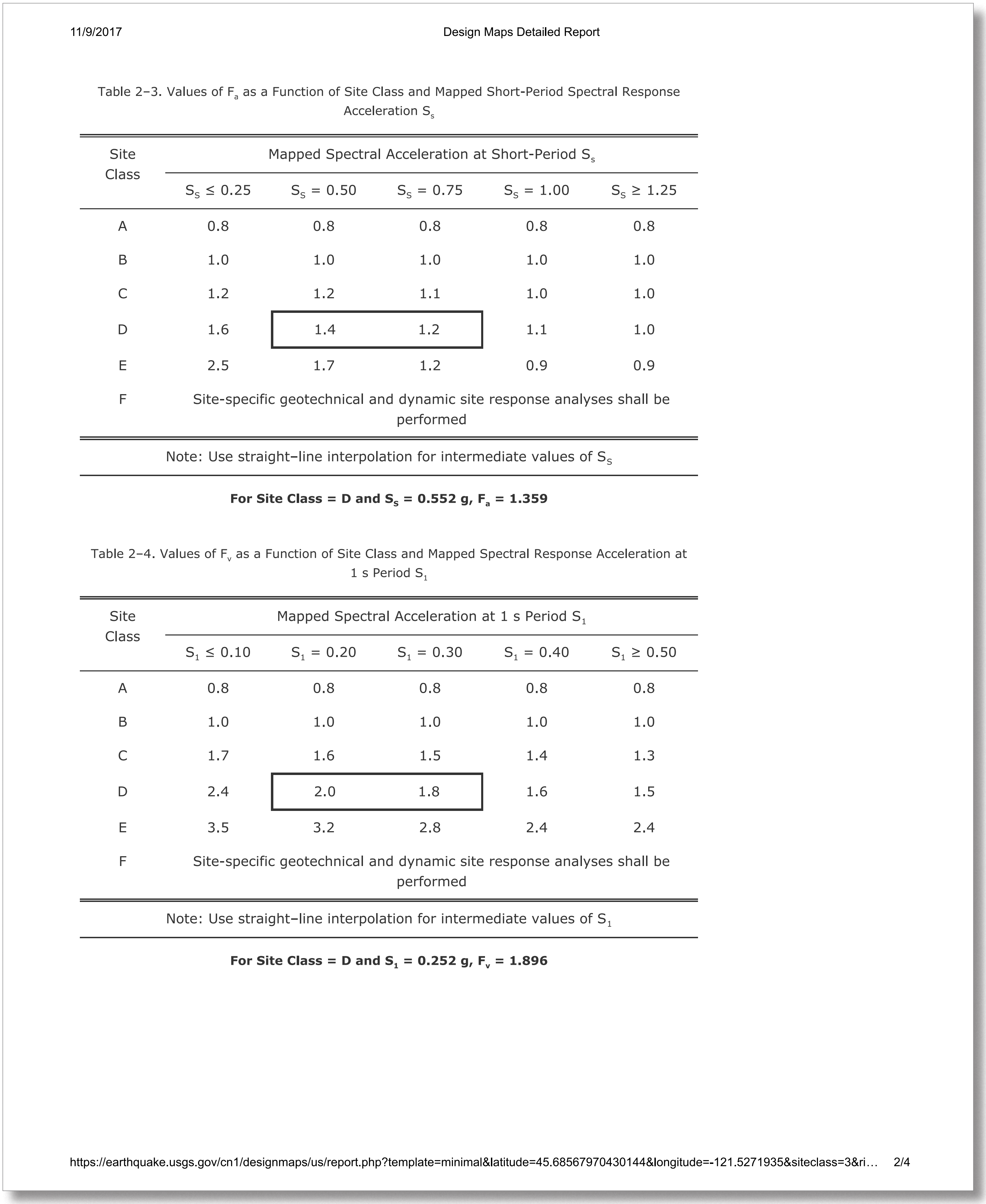

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Table 2–3. Values of F_a as a Function of Site Class and Mapped Short-Period Spectral Response Acceleration S_s

Site Class	Mapped Spectral Acceleration at Short-Period S_s				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	Site-specific geotechnical and dynamic site response analyses shall be performed				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = D and S_S = 0.552 g, F_a = 1.359

Table 2–4. Values of F_v as a Function of Site Class and Mapped Spectral Response Acceleration at 1 s Period S_1

Site Class	Mapped Spectral Acceleration at 1 s Period S_1				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	Site-specific geotechnical and dynamic site response analyses shall be performed				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.252 g, F_v = 1.896

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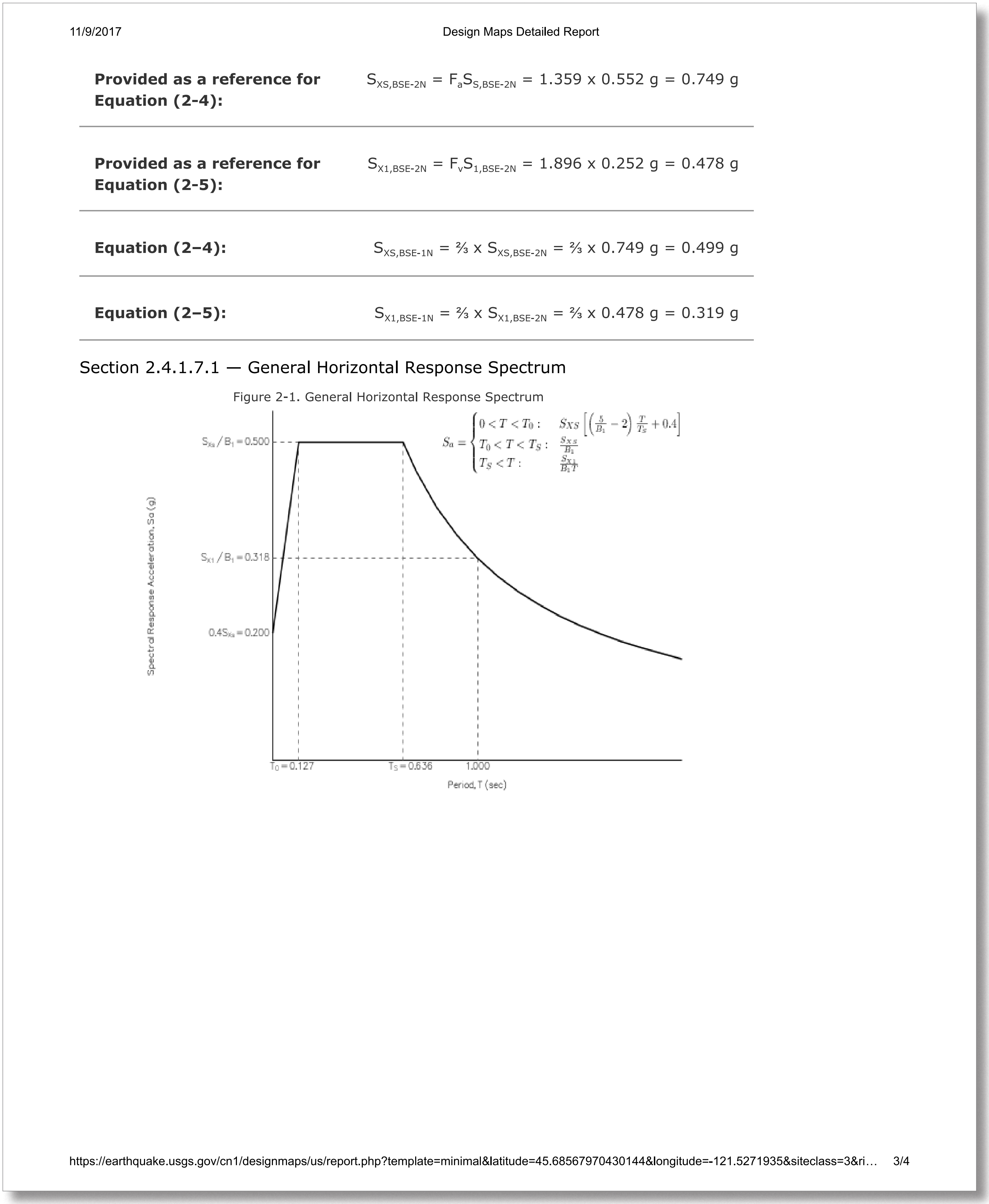


Provided as a reference for Equation (2-4): $S_{XS,BSE\text{-}2N} = F_a S_{S,BSE\text{-}2N} = 1.359 \text{ x } 0.552 \text{ g} = 0.749 \text{ g}$

Provided as a reference for Equation (2-5): $S_{X1,BSE\text{-}2N} = F_v S_{1,BSE\text{-}2N} = 1.896 \text{ x } 0.252 \text{ g} = 0.478 \text{ g}$

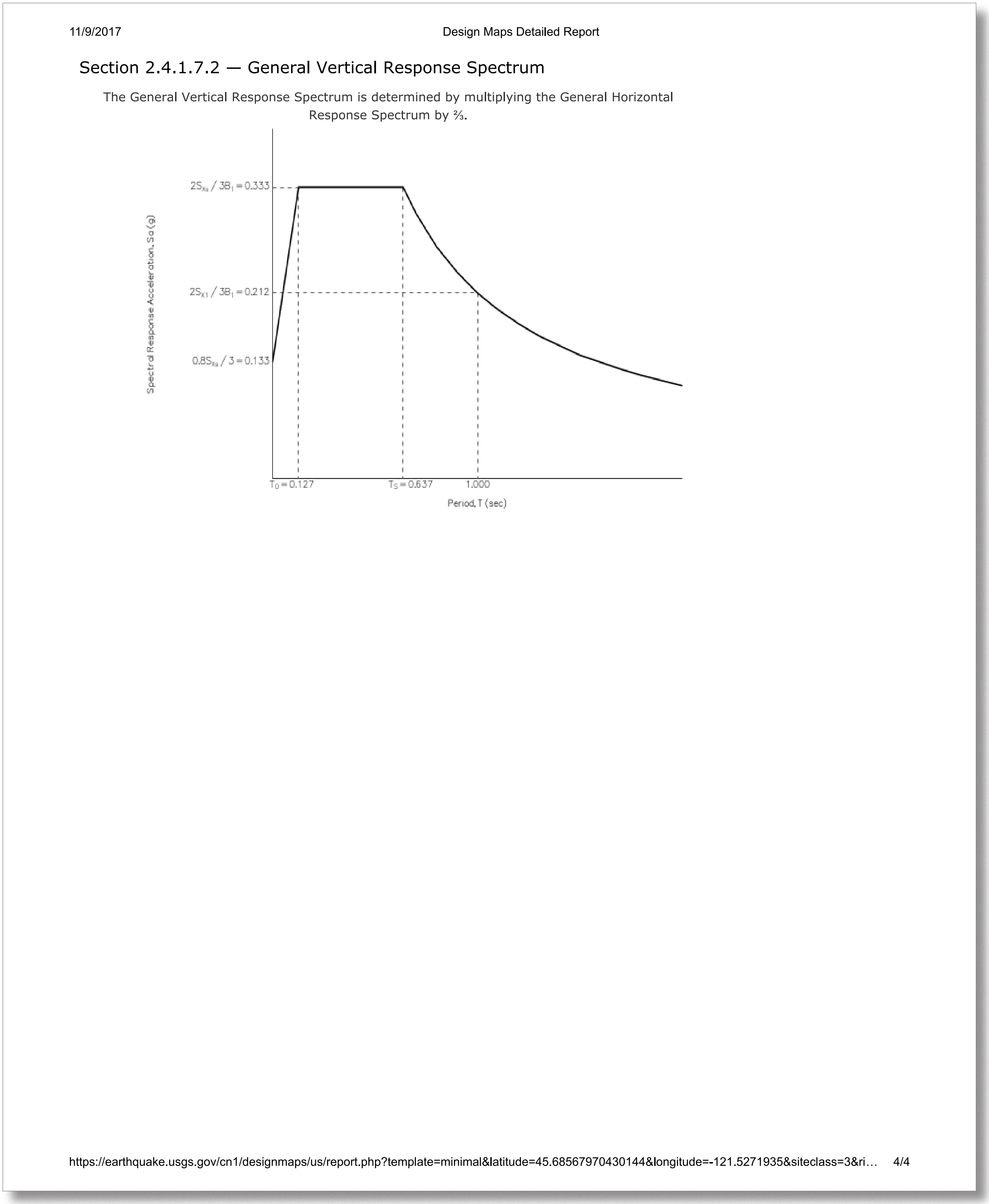
Equation (2–4): $S_{XS,BSE\text{-}1N} = ⅔ \text{ x } S_{XS,BSE\text{-}2N} = ⅔ \text{ x } 0.749 \text{ g} = 0.499 \text{ g}$

Equation (2–5): $S_{X1,BSE\text{-}1N} = ⅔ \text{ x } S_{X1,BSE\text{-}2N} = ⅔ \text{ x } 0.478 \text{ g} = 0.319 \text{ g}$

Section 2.4.1.7.1 — General Horizontal Response Spectrum

Figure 2-1. General Horizontal Response Spectrum

$$S_a = \begin{cases} 0 < T < T_0 : & S_{XS}\left[\left(\frac{5}{B_1} - 2\right)\frac{T}{T_S} + 0.4\right] \\ T_0 < T < T_S : & \frac{S_{XS}}{B_1} \\ T_S < T : & \frac{S_{X1}}{B_1 T} \end{cases}$$



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Section 2.4.1.7.2 — General Vertical Response Spectrum

The General Vertical Response Spectrum is determined by multiplying the General Horizontal Response Spectrum by ⅔.

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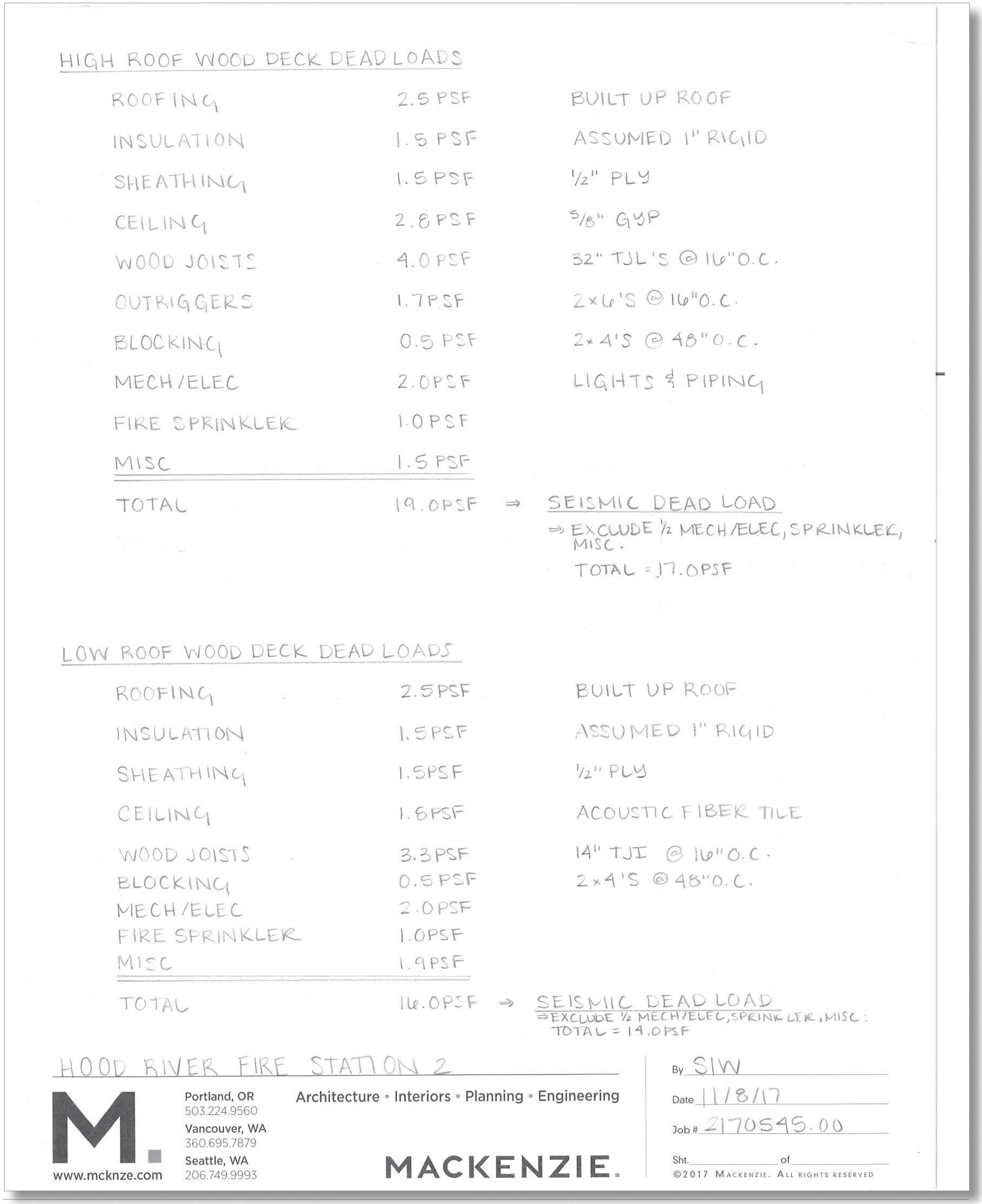

HIGH ROOF WOOD DECK DEAD LOADS

ROOFING	2.5 PSF	BUILT UP ROOF
INSULATION	1.5 PSF	ASSUMED 1" RIGID
SHEATHING	1.5 PSF	½" PLY
CEILING	2.8 PSF	5/8" GYP
WOOD JOISTS	4.0 PSF	32" TJL'S @ 16" O.C.
OUTRIGGERS	1.7 PSF	2×6'S @ 16" O.C.
BLOCKING	0.5 PSF	2×4'S @ 48" O.C.
MECH/ELEC	2.0 PSF	LIGHTS & PIPING
FIRE SPRINKLER	1.0 PSF	
MISC	1.5 PSF	
TOTAL	19.0 PSF	⇒ SEISMIC DEAD LOAD

⇒ EXCLUDE ½ MECH/ELEC, SPRINKLER, MISC.

TOTAL = 17.0 PSF

LOW ROOF WOOD DECK DEAD LOADS

ROOFING	2.5 PSF	BUILT UP ROOF
INSULATION	1.5 PSF	ASSUMED 1" RIGID
SHEATHING	1.5 PSF	½" PLY
CEILING	1.8 PSF	ACOUSTIC FIBER TILE
WOOD JOISTS	3.3 PSF	14" TJI @ 16" O.C.
BLOCKING	0.5 PSF	2×4'S @ 48" O.C.
MECH/ELEC	2.0 PSF	
FIRE SPRINKLER	1.0 PSF	
MISC	1.9 PSF	
TOTAL	16.0 PSF	⇒ SEISMIC DEAD LOAD

⇒ EXCLUDE ½ MECH/ELEC, SPRINKLER, MISC:

TOTAL = 14.0 PSF

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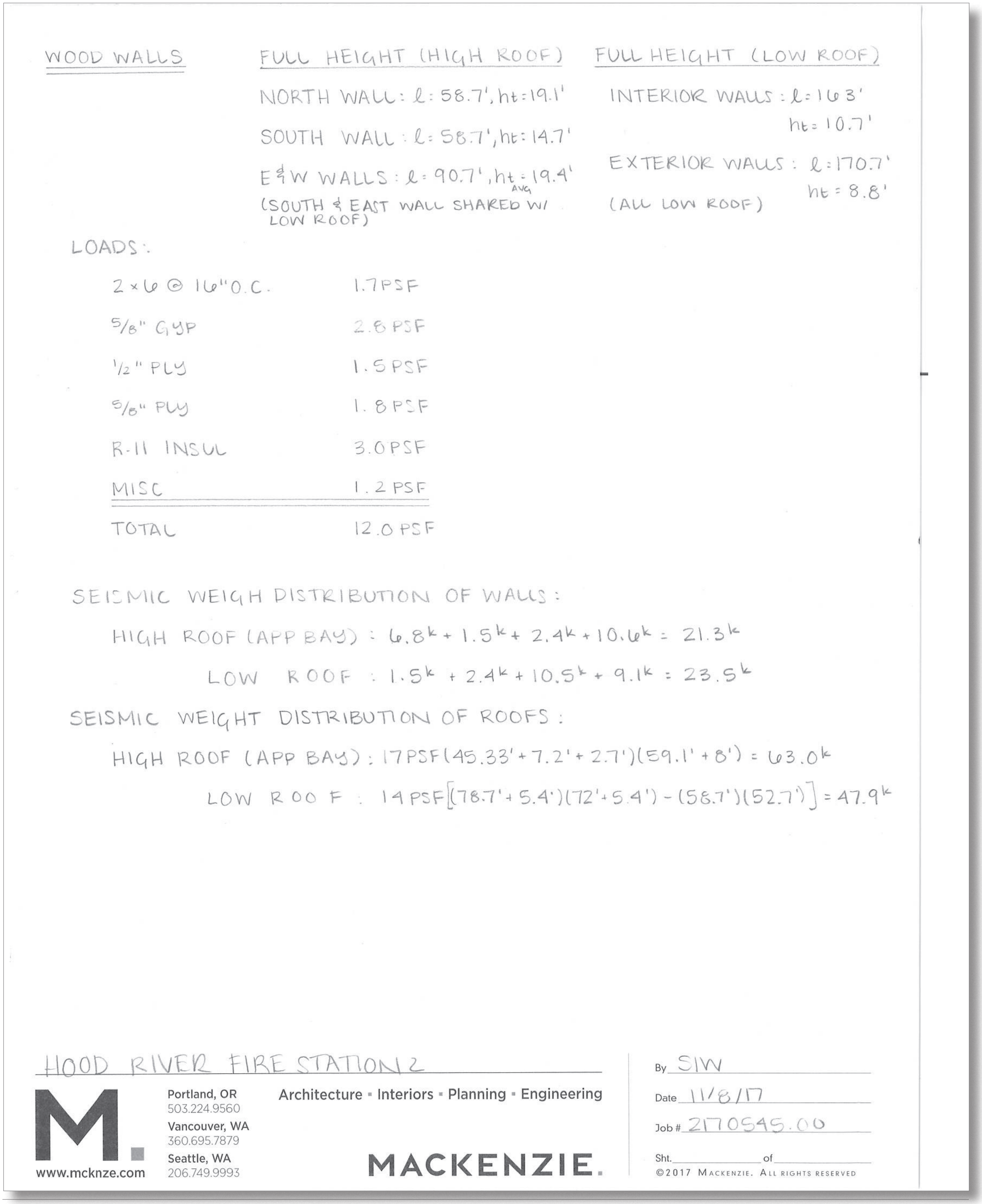

WOOD WALLS

FULL HEIGHT (HIGH ROOF)

NORTH WALL: ℓ: 58.7', ht: 19.1'

SOUTH WALL: ℓ: 58.7', ht: 14.7'

E & W WALLS: ℓ: 90.7', ht_{AVG}: 19.4'

(SOUTH & EAST WALL SHARED W/ LOW ROOF)

FULL HEIGHT (LOW ROOF)

INTERIOR WALLS: ℓ: 163'
ht: 10.7'

EXTERIOR WALLS: ℓ: 170.7'
ht: 8.8'

(ALL LOW ROOF)

LOADS:

2×6 @ 16" O.C.	1.7 PSF
5/8" GYP	2.8 PSF
1/2" PLY	1.5 PSF
5/8" PLY	1.8 PSF
R-11 INSUL	3.0 PSF
MISC	1.2 PSF
TOTAL	12.0 PSF

SEISMIC WEIGH DISTRIBUTION OF WALLS:

HIGH ROOF (APP BAY): $6.8^k + 1.5^k + 2.4^k + 10.6^k = 21.3^k$

LOW ROOF: $1.5^k + 2.4^k + 10.5^k + 9.1^k = 23.5^k$

SEISMIC WEIGHT DISTRIBUTION OF ROOFS:

HIGH ROOF (APP BAY): 17 PSF $(45.33' + 7.2' + 2.7')(59.1' + 8') = 63.0^k$

LOW ROOF: 14 PSF $[(78.7' + 5.4')(72' + 5.4') - (58.7')(52.7')] = 47.9^k$

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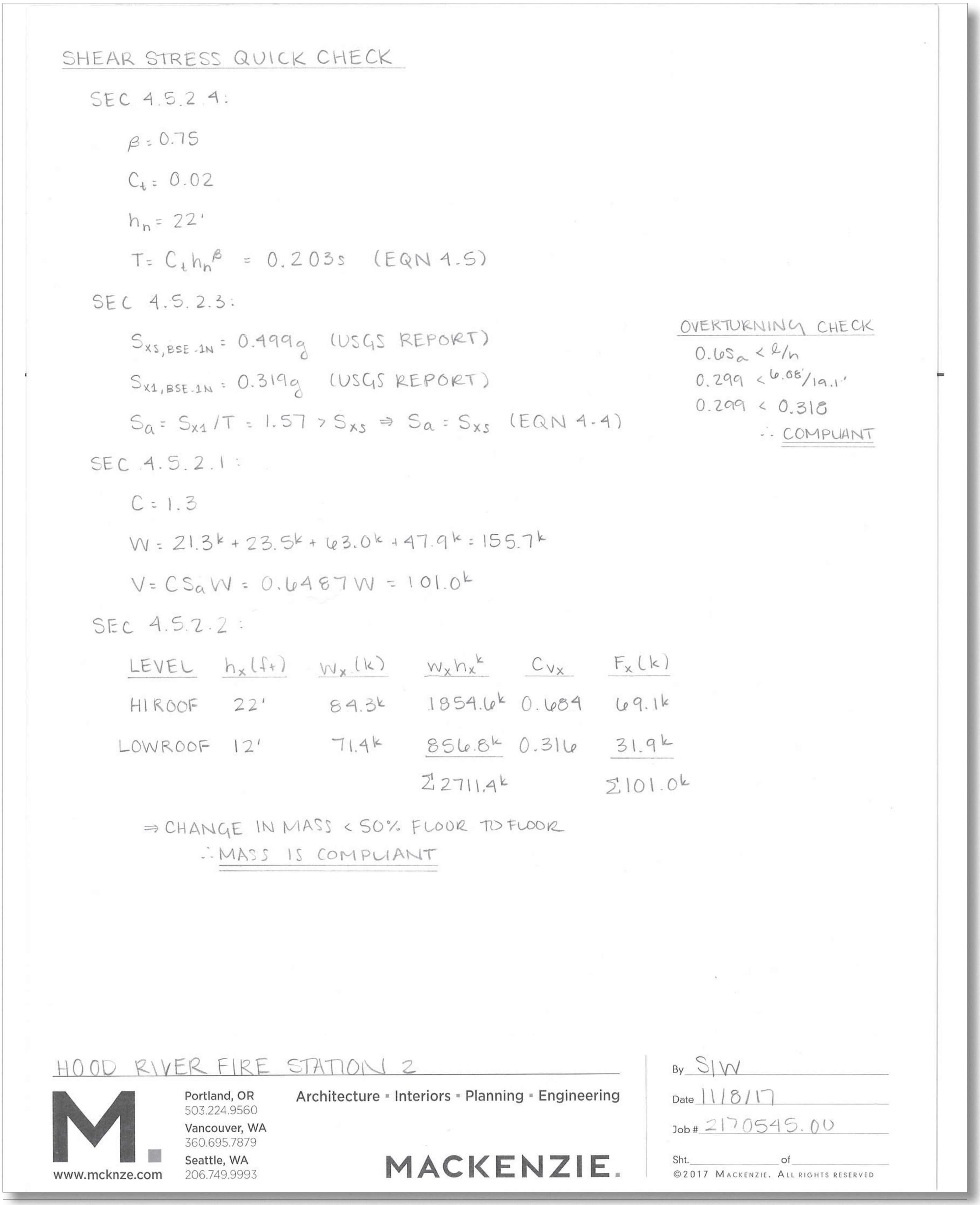

SHEAR STRESS QUICK CHECK

SEC 4.5.2.4:

$\beta = 0.75$

$C_t = 0.02$

$h_n = 22'$

$T = C_t h_n^{\beta} = 0.203s$ (EQN 4.5)

SEC 4.5.2.3:

$S_{XS,BSE-1N} = 0.499g$ (USGS REPORT)

$S_{X1,BSE-1N} = 0.319g$ (USGS REPORT)

$S_a = S_{X1}/T = 1.57 > S_{XS} \Rightarrow S_a = S_{XS}$ (EQN 4-4)

OVERTURNING CHECK

$0.6S_a < \ell/h$

$0.299 < 6.08'/19.1'$

$0.299 < 0.318$

∴ COMPLIANT

SEC 4.5.2.1:

$C = 1.3$

$W = 21.3^k + 23.5^k + 63.0^k + 47.9^k = 155.7^k$

$V = CS_aW = 0.6487W = 101.0^k$

SEC 4.5.2.2:

LEVEL	h_x (ft)	W_x (k)	$W_x h_x^k$	C_{vx}	F_x (k)
HI ROOF	22'	84.3^k	1854.6^k	0.684	69.1^k
LOW ROOF	12'	71.4^k	856.8^k	0.316	31.9^k
			$\Sigma 2711.4^k$		$\Sigma 101.0^k$

⇒ CHANGE IN MASS < 50% FLOOR TO FLOOR

∴ MASS IS COMPLIANT

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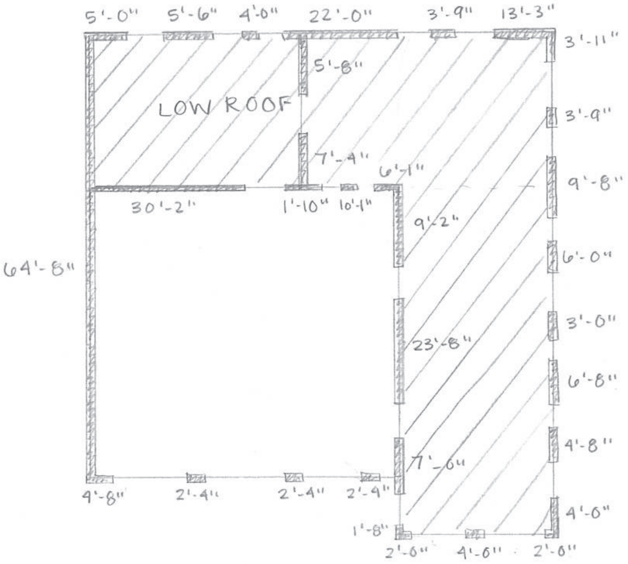
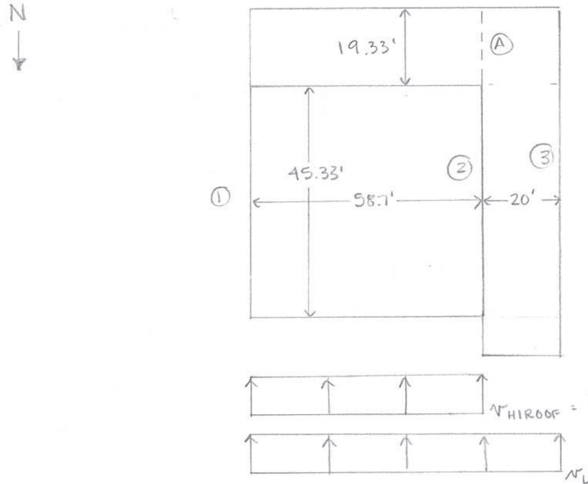
SHEAR STRESS QUICK CHECK (CONT'D)



N-S EVENT



$v_{HIROOF} = 69.1^k / 58.7' = 1.18^k/ft$

$v_{LO\ ROOF} = 31.9^k / 78.7' = 0.4^k/ft$

REACTIONS: ① 46.4 k ② 50.4 k ③ 4 k

DRAG FORCE @ Ⓐ : $19.33' / 64.66' \, (50.4^k) = 15.07^k$

WOOD DIAPHRAGM DEMAND : $50.4^k / 45.33' = 1112$ PLF

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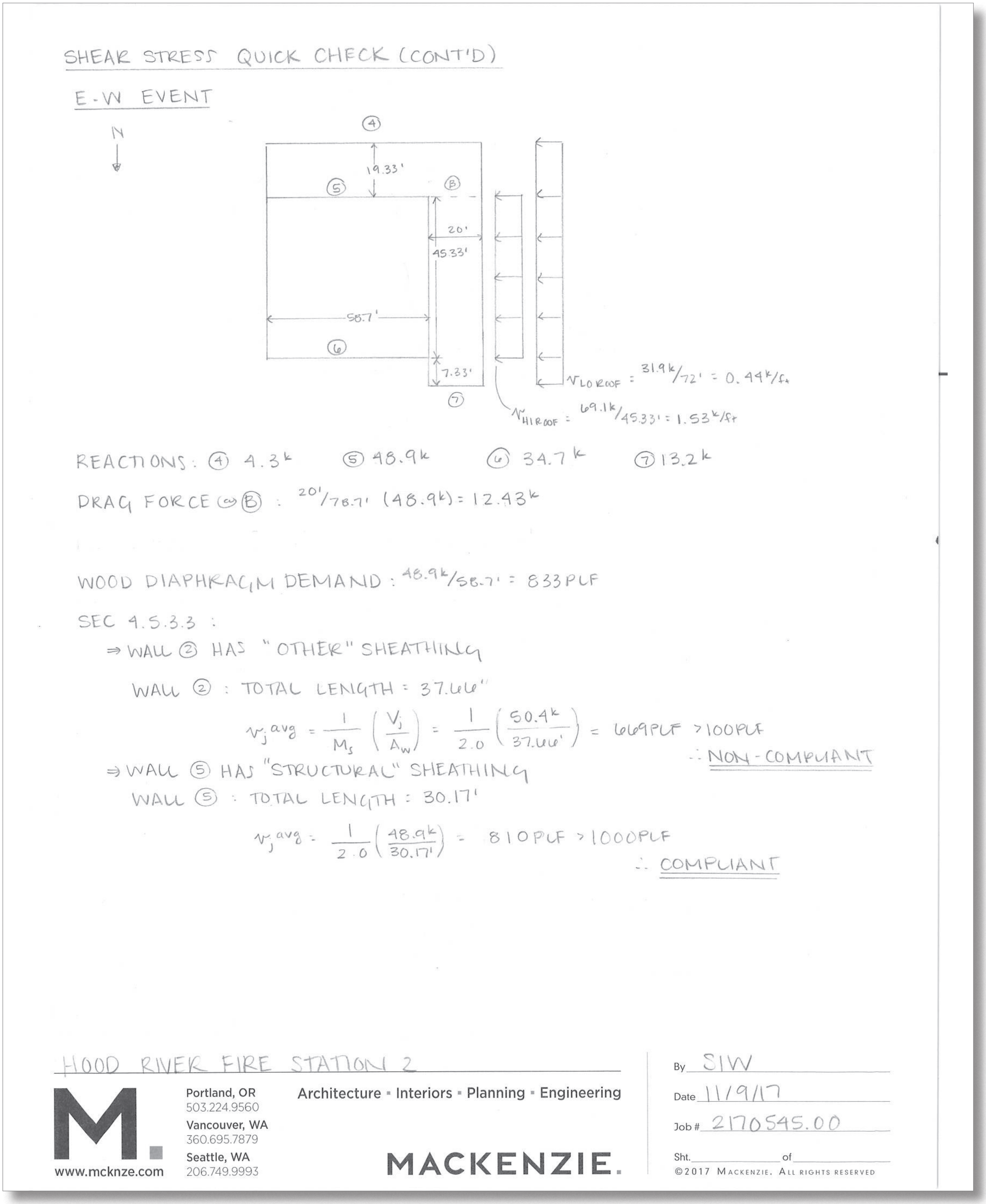

SHEAR STRESS QUICK CHECK (CONT'D)

E-W EVENT

N

④
19.33'
⑤
Ⓑ
20'
45.33'
58.7'
⑥
7.33'
⑦

$v_{LO\ ROOF} = 31.9^k/72' = 0.44^k/ft$

$v_{HI\ ROOF} = 69.1^k/45.33' = 1.53^k/ft$

REACTIONS: ④ 4.3^k ⑤ 48.9^k ⑥ 34.7^k ⑦ 13.2^k

DRAG FORCE @ Ⓑ : $20'/78.7' (48.9^k) = 12.43^k$

WOOD DIAPHRAGM DEMAND: $48.9^k/58.7' = 833$ PLF

SEC 4.5.3.3 :

⇒ WALL ② HAS "OTHER" SHEATHING

WALL ② : TOTAL LENGTH = 37.66"

$$v_j^{avg} = \frac{1}{M_s}\left(\frac{V_j}{A_w}\right) = \frac{1}{2.0}\left(\frac{50.4^k}{37.66'}\right) = 669 \text{ PLF} > 100 \text{ PLF}$$

∴ NON-COMPLIANT

⇒ WALL ⑤ HAS "STRUCTURAL" SHEATHING

WALL ⑤ : TOTAL LENGTH = 30.17'

$$v_j^{avg} = \frac{1}{2.0}\left(\frac{48.9^k}{30.17'}\right) = 810 \text{ PLF} > 1000 \text{ PLF}$$

∴ COMPLIANT

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WOOD SHEAR WALL CHECKS

⇒ WALL ② $(m = 1.7, k = 1.0)$

$Q_u = 50.4^k / 32.83' = 1.54^k/ft = 1540\,PLF$

$mkQ_c = 1.7(140PLF) = 238PLF < Q_u$ ∴ WOOD SHEAR WALLS DEFICIENT W/ ASSUMED PROPERTIES

UNBLOCKED WALL, 8" NAILING, #6 TYPE S OR W DRYWALL SCREWS OVER 5/8" GYPSUM WALLBOARD

⇒ RE-SHEATH, ADD NAILING & BLOCKING TO WALL ②

$Q_u = 1540PLF$

$mkQ_c = 1.7(1020PLF) = 1734PLF > Q_u$ ∴ 19/32" PLY SHTG W/10d NAILS @ 4" O.C. BLOCKED

⇒ WALL ⑤ $(m = 1.7, k = 1.0)$

$Q_u = 48.9^k / 30.17' = 1.621^k/ft = 1621\,PLF$

$mkQ_cC_{ub} = 1.7(520PLF)(0.6) = 530.4PLF < Q_u$ ∴ WOOD SHEAR WALLS DEFICIENT W/ ASSUMED PROPERTIES

UNBLOCKED WALL, 8d NAILS @ 6" O.C. OVER 1/2" PLYWOOD SHEATHING

⇒ RE-NAIL, ADD BLOCKING TO WALL ⑤

$Q_u = 1621PLF$

$mkQ_c = 1.7(980\,PLF) = 1666PLF > Q_u$ ∴ 1/2" PLY SHTG W/ 8d NAILS @ 3" O.C., BLOCKED

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Eccentrically Loaded Footing

PROJECT NAME: WEST SIDE HOOD RIVER STATION 2
PROJECT NO.: 2170545.00
DESIGNER: SIW
DATE: 11/28/17

▶ Unit Definitions

▶

▼ SOUTH SIDE OF HIGH ROOF

Dead Load: $P_{dl} := 17 \cdot psf \cdot \left(\frac{45.33 \cdot ft}{2}\right) \cdot 30.17 \cdot ft = 11.625 \cdot k$

Live Load: $P_{ll} := 0 \cdot k$

Total Load: $P_t := P_{dl} + P_{ll}$

$P_t = 11.625 \cdot k$

Ultimate Load: $P_u := 1.2 \cdot P_{dl} + 1.6 \cdot P_{ll}$

$P_u = 13.95 \cdot k$

Applied Moment: $M_t := 48.9 \cdot k \cdot 21.7 \cdot ft = 1.061 \times 10^3 \cdot k \cdot ft$

Soil Bearing: $q_{all} := 1500 \cdot psf \cdot 1.33$

Wt. of Conc. $\gamma_{conc} := 150 \cdot pcf$

Footing Width: $W := 2 \cdot ft$ (Out of plane)

Length: $L := 32.17 \cdot ft$

Thickness: $t := 8 \cdot in$

Eccentricity of col. to center line of Ftg $e_{ftg} := 0 \cdot ft$

Concrete Strength: $f_c := 3 \cdot ksi$

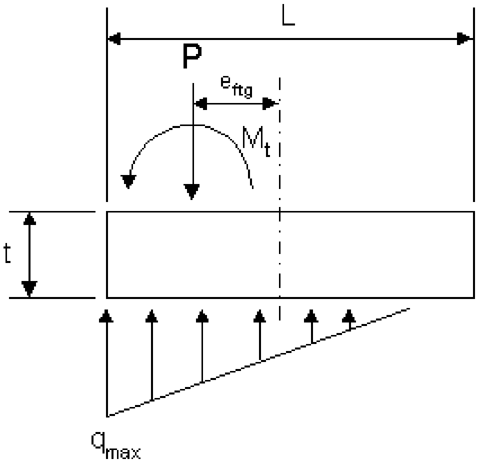
Steel $f_y := 60 \cdot ksi$

Steel Depth: $d := t - 3 \cdot in - .75 \cdot in \cdot 1.5$

$d = 3.875 \cdot in$

Column Size $c := 6 \cdot in$

Overturning



$CC_{12} := 1.1$ $\quad m_{ftg} := 1.5$ $\quad \mu_{ot} := 4.0$

$M_{ot} := M_t$ $\quad M_{ot} = 1.061 \times 10^{3} \cdot k \cdot ft$

$P_{conc} := (W \cdot L \cdot t) \cdot \gamma_{conc}$ $\quad P_{conc} = 6.434 \cdot k$

$$M_{res} := P_t \cdot \left(\frac{L}{2} - e_{ftg}\right) + P_{conc} \cdot \left(\frac{L}{2}\right)$$

$M_{res} = 290.473 \cdot k \cdot ft$

$$DCR_{ot} := \frac{M_{ot}}{0.9 \cdot M_{res} \cdot (CC_{12} \cdot \mu_{ot})} \qquad DCR_{ot} = 0.923$$

$check_{ot} := if(DCR_{ot} \le 1.0, "OK", "NG")$ $\quad check_{ot} = "OK"$

Soil Bearing

$P_{tot} := P_t + P_{conc}$

$$e := \frac{L}{2} - \frac{M_{res} \cdot CC_{12} \cdot \mu_{ot} - M_{ot}}{P_{tot}} \qquad e = 4.071 \text{ ft} \qquad K := \left(\frac{\frac{L}{2} - e}{L}\right) \cdot 3 \qquad K = 1.12$$

$$q_{max} := \frac{P_{tot} \cdot 2}{K \cdot W \cdot L \cdot m_{ftg}} \qquad q_{max} = 0.334 \cdot ksf \qquad q_{all} = 1.995 \cdot ksf \qquad \frac{q_{max}}{q_{all}} = 0.167$$

$check_{sb} := if(q_{all} \ge q_{max}, "OK", "NG")$ $\quad check_{sb} = "OK"$

Punching Shear

ACI 318-11 R11.11.1.2, 11.11.2.1c, eqn 11-33

ACI 318-14 22.6.4, Table 22.6.5.2(a)

$P_{utot} := P_u + P_{conc} \cdot 1.2$ $\quad q_u := q_{max} \cdot 1.6$ $\quad 1$

$V_u := P_u - (c + d)^2 \cdot q_u$ $\quad V_u = 13.588 \cdot k$

$b_o := (c + d) \cdot 4$

$$\phi V_c := .75 \cdot \left(4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d\right) \qquad \phi V_c = 25.151 \cdot k \qquad \frac{V_u}{\phi V_c} = 0.54$$

$check_{pv} := if(\phi V_c \ge V_u, "OK", "NG")$ $\quad check_{pv} = "OK"$

Beam Shear

(per 1' width)

ACI 318-11 R11.11.1.1, 11.2.1.1, eqn 11-3

ACI 318-14 8.4.3, 22.5.5.1, eqn 22.5.5.1

$$V_u := \left(\frac{W - c}{2} - d\right) \cdot q_u \cdot 1 \cdot ft \qquad V_u = 0.228 \cdot k$$

at "d" from column face

$$\phi V_c := .75 \cdot \left(2 \cdot \sqrt{f_c \cdot psi} \cdot d\right) \cdot 1 \cdot ft \qquad \phi V_c = 3.82 \cdot k \qquad \frac{V_u}{\phi V_c} = 0.06$$

$check_{bv} := if(\phi V_c \ge V_u, "OK", "NG")$ $\quad check_{bv} = "OK"$

Flexure (per 1' width)

ACI 318-11 15.4.1, 15.4.2a

ACI 318-14 13.2.6.4, 13.2.7.1

$M_u := q_u \cdot \left(\frac{W - c}{2}\right)^2 \cdot \frac{1}{2} \cdot 1 \cdot ft$ $M_u = 0.15 \cdot lk$

Find As_{req} : $f(A_{sreq}) := A_{sreq} \cdot f_y \cdot \left[d - \frac{A_{sreq} \cdot f_y}{.85 \cdot f_c \cdot (1 \cdot ft) \cdot 2}\right] \cdot .9 - M_u$

Given $f(p) = 0$ $g(p) := Find(p)$ $A_{sreq} := g(1 \cdot in^2)$

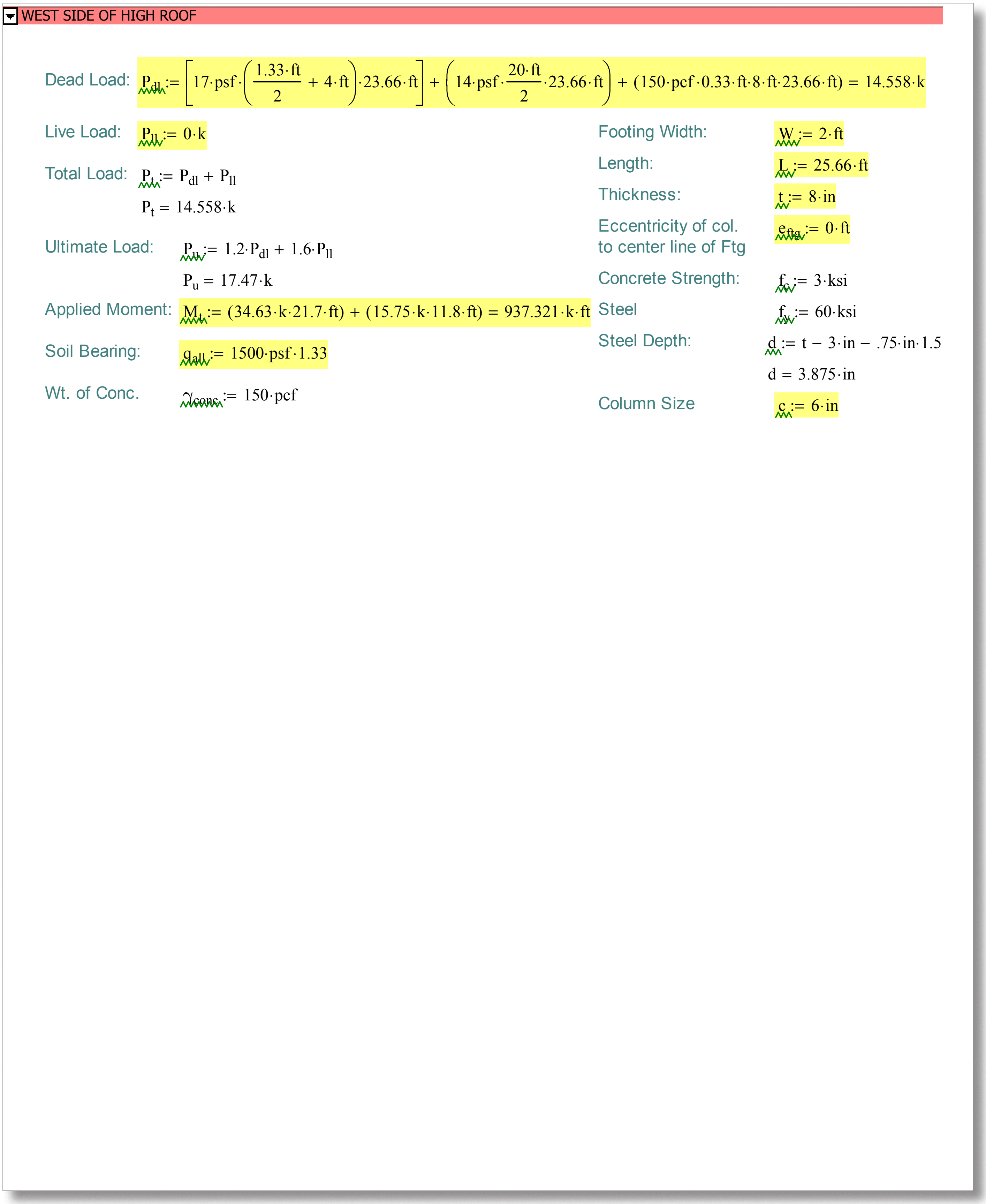
Use #5's @ 12" oc $A_s := .31 \cdot in^2$ $A_{sreq} = 8.639 \times 10^{-3} \cdot in^2$ $\frac{A_{sreq}}{A_s} = 0.028$

$check_f := if(A_s \geq A_{sreq}, "OK", "NG")$ $check_f = "OK"$

$\rho := \frac{A_s}{(1 \cdot ft) \cdot d}$ $\rho = 0.0067$ $\rho_{min} := .0018$ ACI 318-11 eqn (10-3)
ACI 318-14 9.6.1.2

$check_\rho := if(\rho \geq \rho_{min}, "OK", "NG")$ $check_\rho = "OK"$

SOUTH SIDE OF HIGH ROOF



WEST SIDE OF HIGH ROOF

Dead Load: $P_{dl} := \left[17\cdot psf\cdot\left(\frac{1.33\cdot ft}{2} + 4\cdot ft\right)\cdot 23.66\cdot ft\right] + \left(14\cdot psf\cdot\frac{20\cdot ft}{2}\cdot 23.66\cdot ft\right) + (150\cdot pcf\cdot 0.33\cdot ft\cdot 8\cdot ft\cdot 23.66\cdot ft) = 14.558\cdot k$

Live Load: $P_{ll} := 0\cdot k$

Total Load: $P_t := P_{dl} + P_{ll}$

$P_t = 14.558\cdot k$

Ultimate Load: $P_u := 1.2\cdot P_{dl} + 1.6\cdot P_{ll}$

$P_u = 17.47\cdot k$

Applied Moment: $M_t := (34.63\cdot k\cdot 21.7\cdot ft) + (15.75\cdot k\cdot 11.8\cdot ft) = 937.321\cdot k\cdot ft$

Soil Bearing: $q_{all} := 1500\cdot psf\cdot 1.33$

Wt. of Conc. $\gamma_{conc} := 150\cdot pcf$

Footing Width: $W := 2\cdot ft$

Length: $L := 25.66\cdot ft$

Thickness: $t := 8\cdot in$

Eccentricity of col.
to center line of Ftg $e_{ftg} := 0\cdot ft$

Concrete Strength: $f_c := 3\cdot ksi$

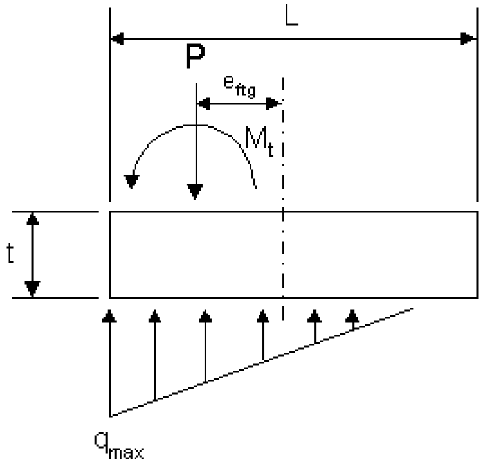
Steel $f_y := 60\cdot ksi$

Steel Depth: $d := t - 3\cdot in - .75\cdot in\cdot 1.5$

$d = 3.875\cdot in$

Column Size $c := 6\cdot in$

Overturning



$CC_{12} := 1.1$ $m_{ftg} := 1.5$ $\mu_{ot} := 4.0$

$M_{ot} := M_t$ $M_{ot} = 937.321 \cdot k \cdot ft$

$P_{conc} := (W \cdot L \cdot t) \cdot \gamma_{conc}$ $P_{conc} = 5.132 \cdot k$

$$M_{res} := P_t \cdot \left(\frac{L}{2} - e_{ftg} \right) + P_{conc} \cdot \left(\frac{L}{2} \right)$$

$M_{res} = 252.624 \cdot k \cdot ft$

$$DCR_{ot} := \frac{M_{ot}}{0.9 \cdot M_{res} \cdot \left(CC_{12} \cdot \mu_{ot} \right)} \qquad DCR_{ot} = 0.937$$

$check_{ot} := if\left(DCR_{ot} \le 1.0, \text{"OK"}, \text{"NG"} \right)$ $check_{ot} = \text{"OK"}$

Soil Bearing

$P_{tot} := P_t + P_{conc}$

$$e := \frac{L}{2} - \frac{M_{res} \cdot CC_{12} \cdot \mu_{ot} - M_{ot}}{P_{tot}} \qquad e = 3.982 \ ft \qquad K := \left(\frac{\frac{L}{2} - e}{L} \right) \cdot 3 \qquad K = 1.034$$

$$q_{max} := \frac{P_{tot} \cdot 2}{K \cdot W \cdot L \cdot m_{ftg}} \qquad q_{max} = 0.495 \cdot ksf \qquad q_{all} = 1.995 \cdot ksf \qquad \frac{q_{max}}{q_{all}} = 0.248$$

$check_{sb} := if\left(q_{all} \ge q_{max}, \text{"OK"}, \text{"NG"} \right)$ $check_{sb} = \text{"OK"}$

Punching Shear

ACI 318-11 R11.11.1.2, 11.11.2.1c, eqn 11-33

ACI 318-14 22.6.4, Table 22.6.5.2(a)

1

$P_{utot} := P_u + P_{conc} \cdot 1.2$ $q_u := q_{max} \cdot 1.6$

$V_u := P_u - (c + d)^2 \cdot q_u$ $V_u = 16.934 \cdot k$

$b_o := (c + d) \cdot 4$

$$\phi V_c := .75 \cdot \left(4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d \right) \qquad \phi V_c = 25.151 \cdot k \qquad \frac{V_u}{\phi V_c} = 0.673$$

$check_{pv} := if\left(\phi V_c \ge V_u, \text{"OK"}, \text{"NG"} \right)$ $check_{pv} = \text{"OK"}$

Beam Shear

(per 1' width)

ACI 318-11 R11.11.1.1, 11.2.1.1, eqn 11-3

ACI 318-14 8.4.3, 22.5.5.1, eqn 22.5.5.1

$$V_u := \left(\frac{W - c}{2} - d \right) \cdot q_u \cdot 1 \cdot ft \qquad V_u = 0.338 \cdot k$$

at "d" from column face

$$\phi V_c := .75 \cdot \left(2 \cdot \sqrt{f_c \cdot psi} \cdot d \right) \cdot 1 \cdot ft \qquad \phi V_c = 3.82 \cdot k \qquad \frac{V_u}{\phi V_c} = 0.088$$

$check_{bv} := if\left(\phi V_c \ge V_u, \text{"OK"}, \text{"NG"} \right)$ $check_{bv} = \text{"OK"}$

Flexure (per 1' width)

ACI 318-11 15.4.1, 15.4.2a

ACI 318-14 13.2.6.4, 13.2.7.1

$M_u := q_u \cdot \left(\frac{W - c}{2}\right)^2 \cdot \frac{1}{2} \cdot 1 \cdot ft$ $M_u = 0.223 \cdot lk$

Find As$_{req}$: $f(A_{sreq}) := A_{sreq} \cdot f_y \cdot \left[d - \frac{A_{sreq} \cdot f_y}{.85 \cdot f_c \cdot (1 \cdot ft) \cdot 2}\right] \cdot .9 - M_u$

Given $f(p) = 0$ $g(p) := Find(p)$ $A_{sreq} := g\left(1 \cdot in^2\right)$

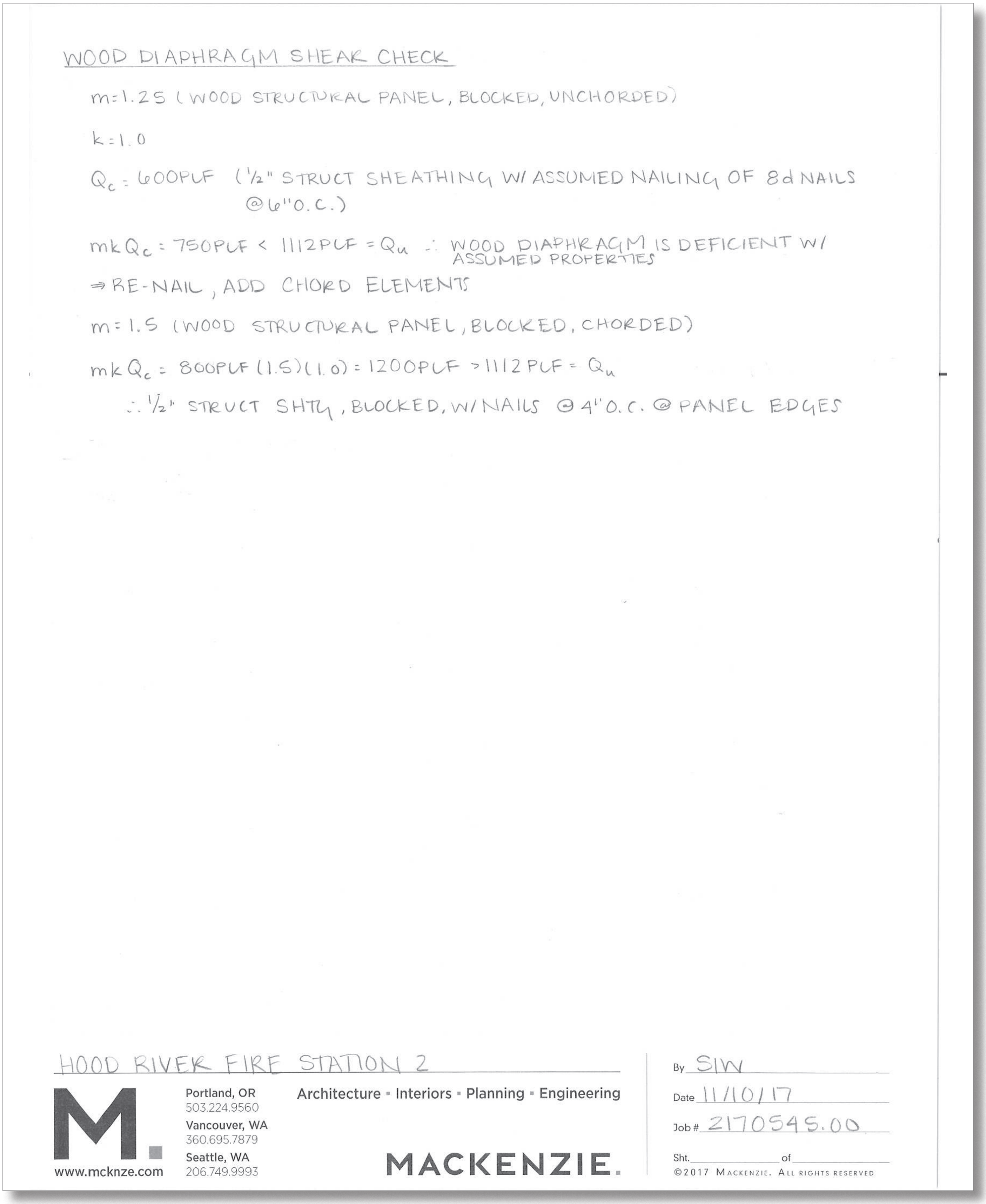
Use #5's @ 12" oc $A_s := .31 \cdot in^2$ $A_{sreq} = 0.013 \cdot in^2$ $\frac{A_{sreq}}{A_s} = 0.041$

$check_f := if\left(A_s \ge A_{sreq}, \text{"OK"}, \text{"NG"}\right)$ $check_f = \text{"OK"}$

$\rho := \frac{A_s}{(1 \cdot ft) \cdot d}$ $\rho = 0.0067$ $\rho_{min} := .0018$ ACI 318-11 eqn (10-3)
ACI 318-14 9.6.1.2

$check_\rho := if\left(\rho \ge \rho_{min}, \text{"OK"}, \text{"NG"}\right)$ $check_\rho = \text{"OK"}$

WEST SIDE OF HIGH ROOF



WOOD DIAPHRAGM SHEAR CHECK

$m = 1.25$ (WOOD STRUCTURAL PANEL, BLOCKED, UNCHORDED)

$k = 1.0$

$Q_c = 600$PLF (½" STRUCT SHEATHING W/ ASSUMED NAILING OF 8d NAILS @6" O.C.)

$mkQ_c = 750$PLF $<$ 1112PLF $= Q_u$ ∴ WOOD DIAPHRAGM IS DEFICIENT W/ ASSUMED PROPERTIES

⇒ RE-NAIL, ADD CHORD ELEMENTS

$m = 1.5$ (WOOD STRUCTURAL PANEL, BLOCKED, CHORDED)

$mkQ_c = 800$PLF $(1.5)(1.0) = 1200$PLF > 1112 PLF $= Q_u$

∴ ½" STRUCT SHTG, BLOCKED, W/ NAILS @ 4" O.C. @ PANEL EDGES

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HOLD-DOWN ANCHORAGE

@ WALL ⑦

$0.9M_{ST} > M_{OT}/(C_1 C_2 \mu_{OT})$

$M_{ST} = [12PSF(12')(8.66') + 14PSF(0.66')(12')](6') = 8148^{\#\text{-}ft} = 8.15^{k\text{-}ft}$

$M_{OT} = 13.2^k(12') = 158^{k\text{-}ft}$

$C_1 C_2 = 1.1$

$\mu_{OT} = 4.0$

$0.9M_{ST} = 7.34^{k\text{-}ft}$

$M_{OT}/(C_1 C_2 \mu_{OT}) = 35.9^{k\text{-}ft} > 7.34^{k\text{-}ft}$ ∴ OVERTURNING, HOLDOWNS REQ'D

@ WALL ①

$M_{ST} = [12PSF(19.4')(45.33') + 17PSF(0.66' + 4')(45.33')](45.33'/2) = 320{,}570^{\#\text{-}ft} = 320.57^{k\text{-}ft}$

$M_{OT} = 46.4^k(21.6') = 1002.3^{k\text{-}ft}$

$0.9M_{ST} = 288.5^{k\text{-}ft}$

$M_{OT}/(C_1 C_2 \mu_{OT}) = 228^{k\text{-}ft} < 288.5^{k\text{-}ft}$ ∴ NO OVERTURNING

@ WALL ⑤

$M_{ST} = [12PSF(14.7')(30.17') + 17PSF(45.33'/2)(30.17') + 14PSF(19.33'/2)(30.17')](30.17'/2)$

$= 317{,}221^{\#\text{-}ft} = 317.22^{k\text{-}ft}$

$M_{OT} = 48.9^k(17.2') = 841.1^{k\text{-}ft}$

$0.9M_{ST} = 285.5^{k\text{-}ft}$

$M_{OT}/(C_1 C_2 \mu_{OT}) = 191.2^{k\text{-}ft} < 285.5^{k\text{-}ft}$ ∴ NO OVERTURNING

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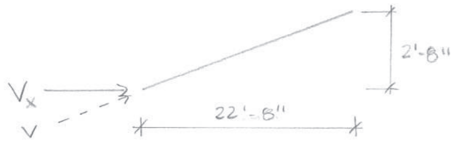
WORST CASE DRAG



$V_x = 15.07^k \Omega = 15.07^k (2.5) = 37.7^k$

$V = 37.7^k (22.8'/22.66') = 38^k$

TRY 4×12 DF-L #1

$F_c = 1500 psi$

$K_F = 2.4$

$C_F = 1.1$

C_P : $E_{min}' = 620{,}000 psi (1.76) = 1{,}091{,}200 psi$

$F_{CE} = 0.822(1{,}091{,}200 psi) / (274"/3.5")= 11{,}464.3 psi$

$F_c^* = F_c K_F C_F = 3960 psi$

$C_P = 3.9/1.6 - \sqrt{(3.9/1.6)^2 - 2.9/0.8} = 0.91$

$F_c' = F_c^* C_P = 3604 psi$

$f_c = 38{,}000\# / (3.5")(11.25") = 965 psi < F_c'$

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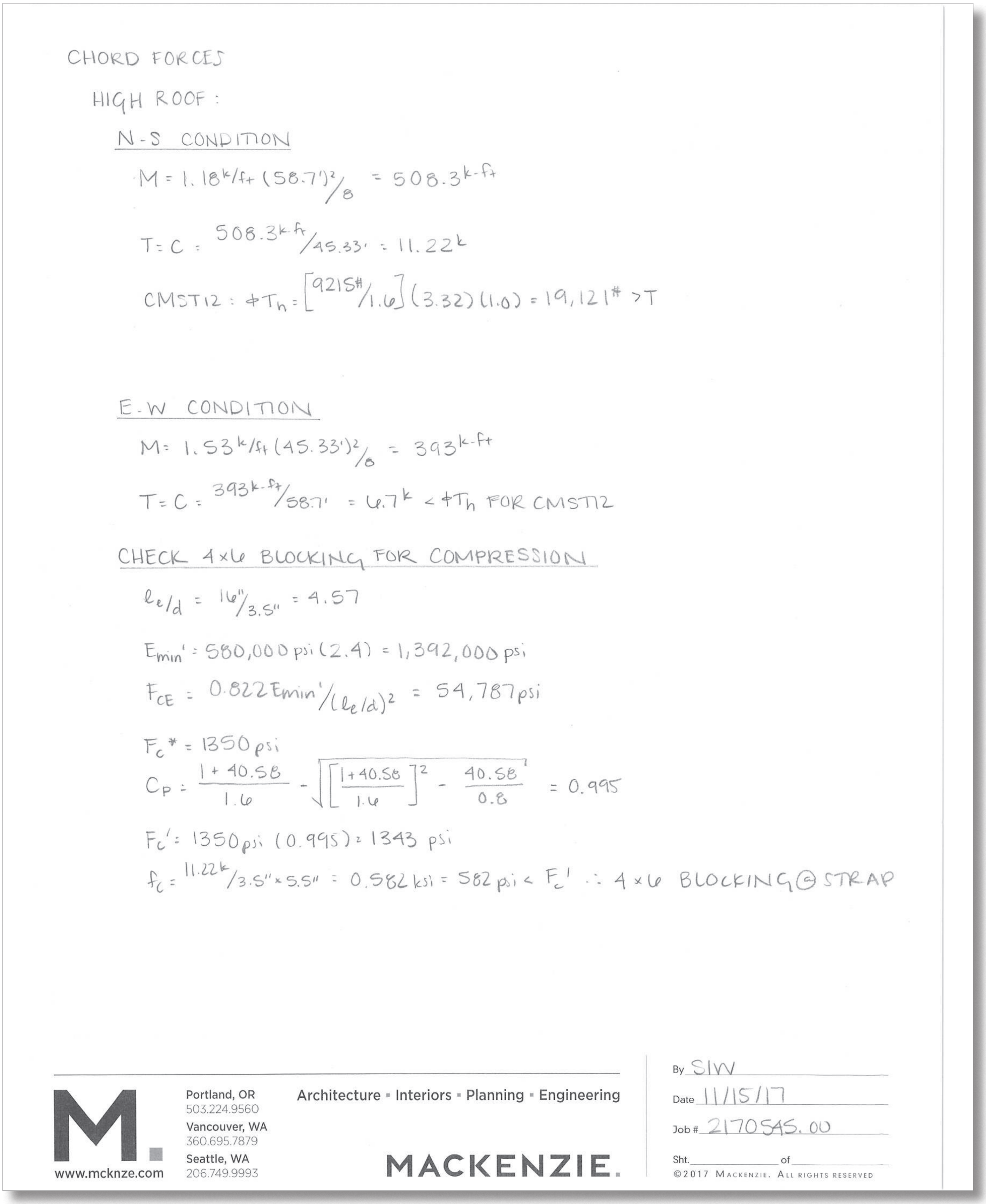

CHORD FORCES

HIGH ROOF :

N-S CONDITION

$M = 1.18^{k}/ft\,(58.7')^2/8 = 508.3^{k\text{-}ft}$

$T = C = 508.3^{k\text{-}ft}/45.33' = 11.22^{k}$

$CMST12 : \phi T_n = \left[9215^{\#}/1.6\right](3.32)(1.0) = 19{,}121^{\#} > T$

E-W CONDITION

$M = 1.53^{k}/ft\,(45.33')^2/8 = 393^{k\text{-}ft}$

$T = C = 393^{k\text{-}ft}/58.7' = 6.7^{k} < \phi T_n$ FOR CMST12

CHECK 4x6 BLOCKING FOR COMPRESSION

$\ell_e/d = 16''/3.5'' = 4.57$

$E_{min}' = 580{,}000\,psi\,(2.4) = 1{,}392{,}000\,psi$

$F_{cE} = 0.822\,E_{min}'/(\ell_e/d)^2 = 54{,}787\,psi$

$F_c^* = 1350\,psi$

$$C_P = \frac{1 + 40.58}{1.6} - \sqrt{\left[\frac{1 + 40.58}{1.6}\right]^2 - \frac{40.58}{0.8}} = 0.995$$

$F_c' = 1350\,psi\,(0.995) = 1343\,psi$

$f_c = 11.22^{k}/3.5'' \times 5.5'' = 0.582\,ksi = 582\,psi < F_c'$ ∴ 4x6 BLOCKING @ STRAP

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CHORD FORCES

LOWER ROOF:

N-S CONDITION

$M = 0.4^{k}/ft\,(78.7')^2/8 = 309.68^{k\text{-}ft}$

$T = C = 309.7^{k'}/19.33' = 16.02^{k} < \phi T_n$ FOR CMST12

E-W CONDITION

$M = 0.44^{k}/ft\,(72')^2/8 = 285.12^{k\text{-}ft}$

$T = C = 285.12^{k\text{-}ft}/20' = 14.3^{k} < \phi T_n$ FOR CMST12

CHECK 4×6 BLOCKING FOR COMPRESSION

$f_c = 16.02^{k}/(3.5")(5.5") = 832\text{ psi} < F_c'$ ∴ 4×6 BLOCKING @ STRAP

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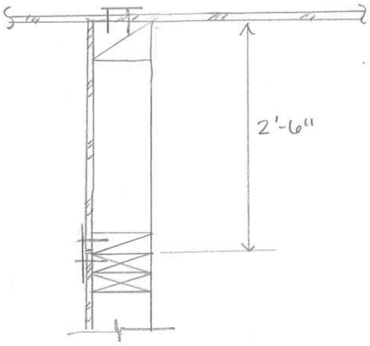
WALL INFILL



$v_{MAX} = 1621 PLF$

SIMPSON LTP 5 @ 9" O.C. : $V = 1621^{\#}(9"/12") = 1216^{\#}$

$\phi V_n = (620^{\#}/1.6)(3.32)(1.0) = 1287^{\#} > V$

OOP LOADS (ASCE 7-10 SEC 12.11):

$F_P = 0.4 S_{DS} k_a I_e W_p = 0.4(0.5)(2.0)(1.5) W_p = 0.6 W_p = 0.6(12 PSF) = 7.2^{PLF/FT}$

@ MAX HEIGHT:

$F_p \cdot \frac{ht}{2}$ $7.2^{PLF}/FT\,(21.7'/2) = 78.1^{\#}/FT$

$M = 78.1^{\#}/FT\,(5')^{2}/8 = 244^{\#\text{-}ft} = 2929^{\#\text{-}in}$

$V = 78.1^{\#}/FT\,(5')/2 = 195.3^{\#}$

$F_b' = 900 psi (2.54)(1.5)(1.1) = 3772 psi$

$S_{REQ'D} = M/F_b' = 0.777 in^3 < S_{2\times6} = 7.56 in^3$

$A_{REQ'D} = 1.5V/180 psi = 1.63 in^2 < A_{2\times6} = 8.25 in^2$

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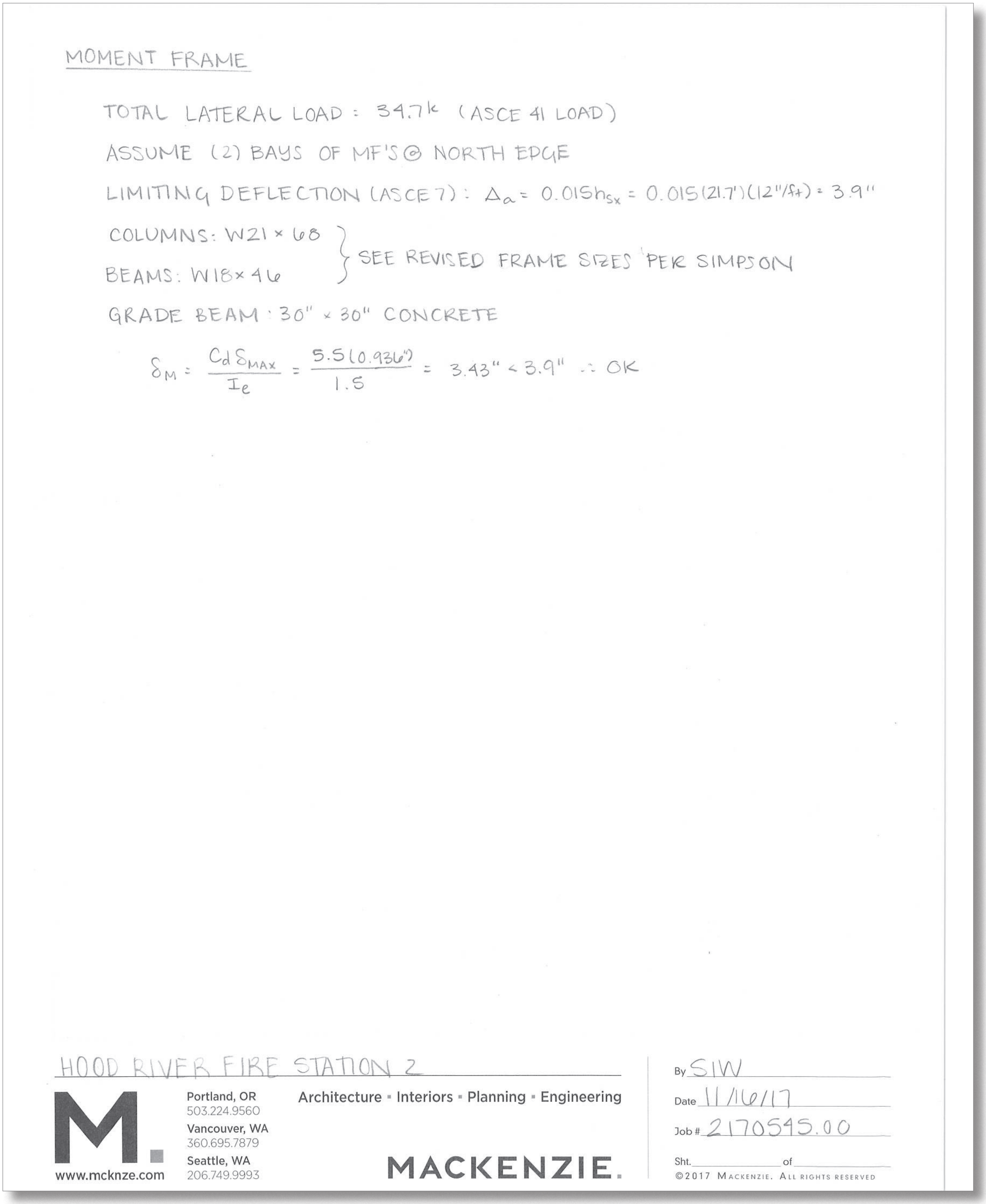


MOMENT FRAME

TOTAL LATERAL LOAD: 34.7^{k} (ASCE 41 LOAD)

ASSUME (2) BAYS OF MF'S @ NORTH EDGE

LIMITING DEFLECTION (ASCE 7): $\Delta_a = 0.015h_{sx} = 0.015(21.7')(12''/ft) = 3.9''$

COLUMNS: W21 × 68 } SEE REVISED FRAME SIZES PER SIMPSON

BEAMS: W18 × 46

GRADE BEAM: 30" × 30" CONCRETE

$$\delta_M = \frac{C_d \delta_{MAX}}{I_e} = \frac{5.5(0.936'')}{1.5} = 3.43'' < 3.9'' \therefore OK$$

HOOD RIVER FIRE STATION 2

Portland, OR
503.224.9560
Vancouver, WA
360.695.7879
Seattle, WA
206.749.9993

www.mcknze.com

Architecture ▪ Interiors ▪ Planning ▪ Engineering

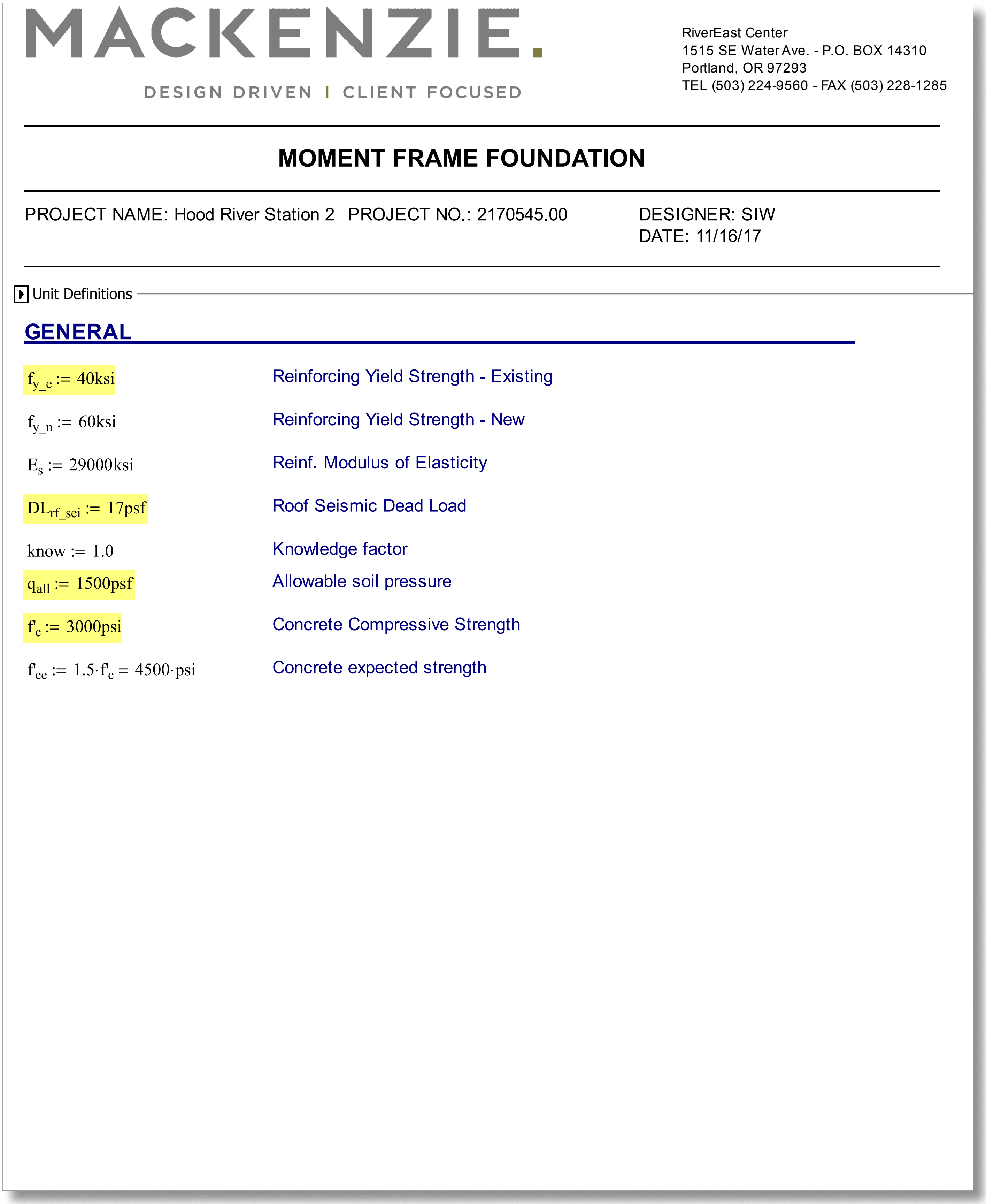
MACKENZIE.

By SIW

Date 11/16/17

Job # 2170545.00

Sht. _____ of _____



MACKENZIE.
DESIGN DRIVEN I CLIENT FOCUSED

RiverEast Center
1515 SE Water Ave. - P.O. BOX 14310
Portland, OR 97293
TEL (503) 224-9560 - FAX (503) 228-1285

MOMENT FRAME FOUNDATION

PROJECT NAME: Hood River Station 2 PROJECT NO.: 2170545.00

DESIGNER: SIW
DATE: 11/16/17

▶ Unit Definitions

GENERAL

$f_{y\_e} := 40ksi$	Reinforcing Yield Strength - Existing
$f_{y\_n} := 60ksi$	Reinforcing Yield Strength - New
$E_s := 29000ksi$	Reinf. Modulus of Elasticity
$DL_{rf\_sei} := 17psf$	Roof Seismic Dead Load
$know := 1.0$	Knowledge factor
$q_{all} := 1500psf$	Allowable soil pressure
$f'_c := 3000psi$	Concrete Compressive Strength
$f'_{ce} := 1.5 \cdot f'_c = 4500 \cdot psi$	Concrete expected strength

▼ Moment Frame At North Side

1) Overturning Analysis

$ht_{rf} := 21.7ft$ Roof Height

$w_s := 16.66 \cdot ft$ Width of Moment Frame

$V_{rf} := 17.35k$ Ultimate Shear @ Roof

$V_{tot} := V_{rf}$ $V_{tot} = 17.35 \cdot k$ Total Base Shear

$M_{ot} := V_{rf} \cdot ht_{rf}$ $M_{ot} = 376.5 \cdot k \cdot ft$ Overturning Moment

$P_D := DL_{rf\_sei} \cdot \left(\frac{45.33 \cdot ft}{2} \cdot w_s \right)$ $P_D = 6.419 \cdot k$

$P_L := 0$ $P_L = 0 \cdot k$

$P_S := P_D \cdot \frac{25psf}{DL_{rf\_sei}}$ $P_S = 9.44 \cdot k$

$P_E := \frac{M_{ot}}{w_s}$ $P_E = 22.599 \cdot k$

$P_{slab} := 6in \cdot 0.15kcf \cdot 5ft \cdot 0.5 \cdot w_s$ $P_{slab} = 3.124 \cdot k$ Additional overturning resistance from slab

Gravity Footing Calcs

$A_{grav} := \frac{P_D + P_L + P_S}{q_{all}}$ $A_{grav} = 10.573 \ ft^2$

Seismic Footing Calcs - Footing @ ea Column

$CC_{12} := 1.1$ Table 7-3

$\mu_{ot} := 4$ pg 99 (10.0 = Collapse, 8.0 = Life Safety, 4.0 = I.O.)

$m_{ftg} := 1.5$ Section 8.4.2.3.2.1

$w_{ftg} := 2.5ft$ Footing Width

$d_{ftg} := 30in$ Footing Depth

$l_{ftg} := 3ft$ Footing Length

$P_{ftg} := l_{ftg} \cdot d_{ftg} \cdot w_{ftg} \cdot 150pcf$ $P_{ftg} = 2.8 \cdot k$ Footing Weight

$P_{tot} := (1.1P_D + 1.1P_{ftg} + P_E)$ $P_{tot} = 32.75 \cdot k$

$M_{res} := (P_D + P_{slab}) \cdot \frac{w_s}{2} + (P_{ftg} \cdot w_s)$ $M_{res} = 126.349 \cdot k \cdot ft$ Overturning Resistive Moment

$DCR_{OT} := \frac{M_{ot}}{0.9M_{res} \cdot (CC_{12} \cdot \mu_{ot})}$ $DCR_{OT} = 0.752$ EQ 7-6

$OT := if(1.0 \geq DCR_{OT}, \text{"OK"}, \text{"NO GOOD"})$ $OT = \text{"OK"}$ Overturning check

$q := \frac{P_{tot}}{l_{ftg} \cdot w_{ftg}}$ $q = 4367 \cdot psf$

Soil Pressure, Resultant Inside Central Kern

$DCR_{FTG} := \frac{q}{m_{ftg} \cdot 3 q_{all}}$ $DCR_{FTG} = 0.647$

$BEARING := if\left(DCR_{FTG} \le 1.0, \text{"OK"}, \text{"NG!!!"}\right)$ $BEARING = \text{"OK"}$

Check Temporary Load Soil Pressure

Design Footing Reinforcement (ACI 318-08)

Factor Soil Bearing Pressure (cons) By 1.4 to Bring to Ultimate

$q_u := q$ $q_u = 4367.1 \cdot psf$

$d_b := 0.625 in$ Diameter of Reinforcing Bar

$d := d_{ftg} - 3in - \frac{3 \cdot d_b}{2}$ $d = 26.1 \cdot in$ Depth to Reinforcing

Beam Shear

$\phi_{vc} := 1.0$ $\phi_b := 1.0$

$V_u := q_u \cdot max\left(l_{ftg}, w_{ftg}\right) \cdot 1ft$ $V_u = 13.101 \cdot k$

Ultimate Shear per Foot of Overhang Width (can take at d from face of support if needed!)

$V_c := 2 \cdot \sqrt{\frac{f_{ce}}{psi}} \cdot d \cdot 1ft \cdot psi$ $V_c = 41.96 \cdot k$

Shear Strength of Concrete per Foot - 11.2.1.1, p. 158

$\phi V_c := \phi_{vc} \cdot V_c$ $\phi V_c = 41.96 \cdot k$

$SHEAR := if\left(\phi V_c > V_u, \text{"OK"}, \text{"NG!!!"}\right)$ $SHEAR = \text{"OK"}$

Flexure

$$\beta_1 := \left| \begin{array}{ll} 0.65 \text{ if } f'_c \ge 8000psi \\ 0.85 \text{ if } f'_c \le 4000psi \\ 0.85 - \frac{.05 \cdot \left(\frac{f'_c}{psi} - 4000\right)}{1000} & \text{otherwise} \end{array} \right.$$

$\beta_1 = 0.85$

Beta,10.2.7.3, p. 131

$M_u := q_u \cdot \frac{max\left(l_{ftg}, w_{ftg}\right)^2}{2} \cdot 1ft$ $M_u = 19.652 \cdot k \cdot ft$

Ulitimate Moment per Foot of Overhang Width

Function to Solve RC Beam Area of Steel Required - 10.2, p. 129

$$f\left(A_s\right) := A_s \cdot f_{y\_n} \cdot \left(d - \frac{A_s \cdot f_{y\_n}}{0.85 \cdot f'_c \cdot 1ft \cdot 2}\right) \cdot \phi_b \cdot m_{ftg} - M_u$$

Given $f(p) = 0$ $g(p) := Find(p)$ $A_s := g\left(1in^2\right)$ $A_s = 0.101 \cdot in^2$

Area of Steel Required for Strength per Foot

$s := 12in$

Bar Spacing - 10.5.4, p. 135 (max spacing is 18" or $3d_{ftg}$)

$A_{bar} := 0.44in^2$

Use #6 at 12" o.c. Each Way Top and Bottom!

$A_{s\_ftg} := A_{bar} \cdot \frac{12in}{s}$ $A_{s\_ftg} = 0.44 \cdot in^2$ Area of Steel Provided per Foot

$REINF := if\left(A_{s\_ftg} \geq A_s, "OK", "NG!!!"\right)$ $REINF = "OK"$

$c := \frac{A_{s\_ftg} \cdot f_{y\_n}}{0.85 \cdot f'_c \cdot \beta_1 \cdot 1ft}$ $c = 1.015 \cdot in$ Neutral Axis Location

$flag := if\left(\frac{c}{d} < 0.375, "Tension Controlled", if\left(\frac{c}{d} > 0.6, "Compression Controlled", "Transition"\right)\right)$

$flag = "Tension Controlled"$

$$\phi_b := \begin{cases} 0.9 & if\ \frac{c}{d} < 0.375 \\ 0.65 & if\ \frac{c}{d} > 0.6 \\ 0.23 + \frac{0.25}{\frac{c}{d}} & otherwise \end{cases}$$

$\phi_b = 0.9$ Strength Reduction Factor - R9.3.2.2, p. 118

$M_n := A_{s\_ftg} \cdot f_{y\_n} \cdot \left(d - \frac{c \cdot \beta_1}{2}\right)$ $M_n = 56.388 \cdot k \cdot ft$ Nominal Moment Capacity per Foot

$\phi M_n := m_{ftg} \cdot \phi_b \cdot M_n$ $\phi M_n = 76.12 \cdot k \cdot ft$ Moment Capacity per Foot

$FLEXURE := if\left(\phi M_n > M_u, "OK", "NG!!!"\right)$ $FLEXURE = "OK"$

Grade Beam

$m_{ftg} := 1.5$ Section 8.4.2.3.2.1

$w_{bm} := 30in$ GB Width

$d_{bm} := 30in$ GB Depth

$M_u := 122.71k \cdot ft$ FROM RISA

$V_u := 12.52k$

Design Footing Reinforcement (ACI 318-08)

$d_b := 0.625in$ Diameter of Reinforcing Bar

$d := d_{ftg} - 3in - 0.5in - \frac{d_b}{2}$ $d = 26.2 \cdot in$ Depth to Reinforcing

Beam Shear

$\phi_{vc} := 1.0$ $\phi_b := 1.0$

$V_c := 2 \cdot \sqrt{\frac{f_{ce}}{psi}} \cdot d \cdot 1ft \cdot psi$ $V_c = 42.161 \cdot k$ Shear Strength of Concrete per Foot - 11.2.1.1, p. 158

$s_v := 6in$

$A_{sv} := 2 \cdot \left(0.2in^2\right)$

$V_s := A_{sv} \cdot f_{y\_n} \cdot \frac{d}{s_v}$ $V_s = 104.75 \cdot k$

$\phi V_c := \phi_{vc} \cdot \left(V_c + V_s\right)$ $\phi V_c = 146.911 \cdot k$

$SHEAR := if\left(\phi V_c > V_u, "OK", "NG!!!"\right)$ $SHEAR = "OK"$

Flexure

$$\beta_1 := \begin{cases} 0.65 & \text{if } f'_c \geq 8000\text{psi} \\ 0.85 & \text{if } f'_c \leq 4000\text{psi} \\ 0.85 - \dfrac{.05 \cdot \left(\dfrac{f'_c}{\text{psi}} - 4000\right)}{1000} & \text{otherwise} \end{cases}$$

$\beta_1 = 0.85$

Beta,10.2.7.3, p. 131

Function to Solve RC Beam Area of Steel Required - 10.2, p. 129

$$f(A_s) := A_s \cdot f_{y\_n} \cdot \left(d - \frac{A_s \cdot f_{y\_n}}{0.85 \cdot f'_c \cdot w_{bm} \cdot 2}\right) \cdot \phi_b \cdot m_{ftg} - M_u$$

Given $\quad f(p) = 0 \quad g(p) := \text{Find}(p) \quad A_s := g\left(1\text{in}^2\right)$

$A_s = 0.631 \cdot \text{in}^2$

Area of Steel Required for Strength per Foot

$A_{s\_ftg} := 0.44\text{in}^2 \cdot (8)$

$A_{s\_ftg} = 3.52 \cdot \text{in}^2$

Area of Steel Provided per Foot

$\text{REINF} := \text{if}\left(A_{s\_ftg} \geq A_s, \text{"OK"}, \text{"NG!!!"}\right)$

$\text{REINF} = \text{"OK"}$

$$c := \frac{A_{s\_ftg} \cdot f_{y\_n}}{0.85 \cdot f'_c \cdot \beta_1 \cdot w_{bm}}$$

$c = 3.248 \cdot \text{in}$

Neutral Axis Location

$$\text{flag} := \text{if}\left(\frac{c}{d} < 0.375, \text{"Tension Controlled"}, \text{if}\left(\frac{c}{d} > 0.6, \text{"Compression Controlled"}, \text{"Transition"}\right)\right)$$

$\text{flag} = \text{"Tension Controlled"}$

$$\phi_b := \begin{cases} 0.9 & \text{if } \dfrac{c}{d} < 0.375 \\ 0.65 & \text{if } \dfrac{c}{d} > 0.6 \\ 0.23 + \dfrac{0.25}{\dfrac{c}{d}} & \text{otherwise} \end{cases}$$

$\phi_b = 0.9$

Strength Reduction Factor - R9.3.2.2, p. 118

$$M_n := A_{s\_ftg} \cdot f_{y\_n} \cdot \left(d - \frac{c \cdot \beta_1}{2}\right)$$

$M_n = 436.605 \cdot k \cdot ft$

Nominal Moment Capacity per Foot

$\phi M_n := m_{ftg} \cdot \phi_b \cdot M_n$

$\phi M_n = 589.42 \cdot k \cdot ft$

Moment Capacity per Foot

$\text{FLEXURE} := \text{if}\left(\phi M_n > M_u, \text{"OK"}, \text{"NG!!!"}\right)$

$\text{FLEXURE} = \text{"OK"}$

▲ Moment Frame At North Side

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C. UPGRADE SCHEME

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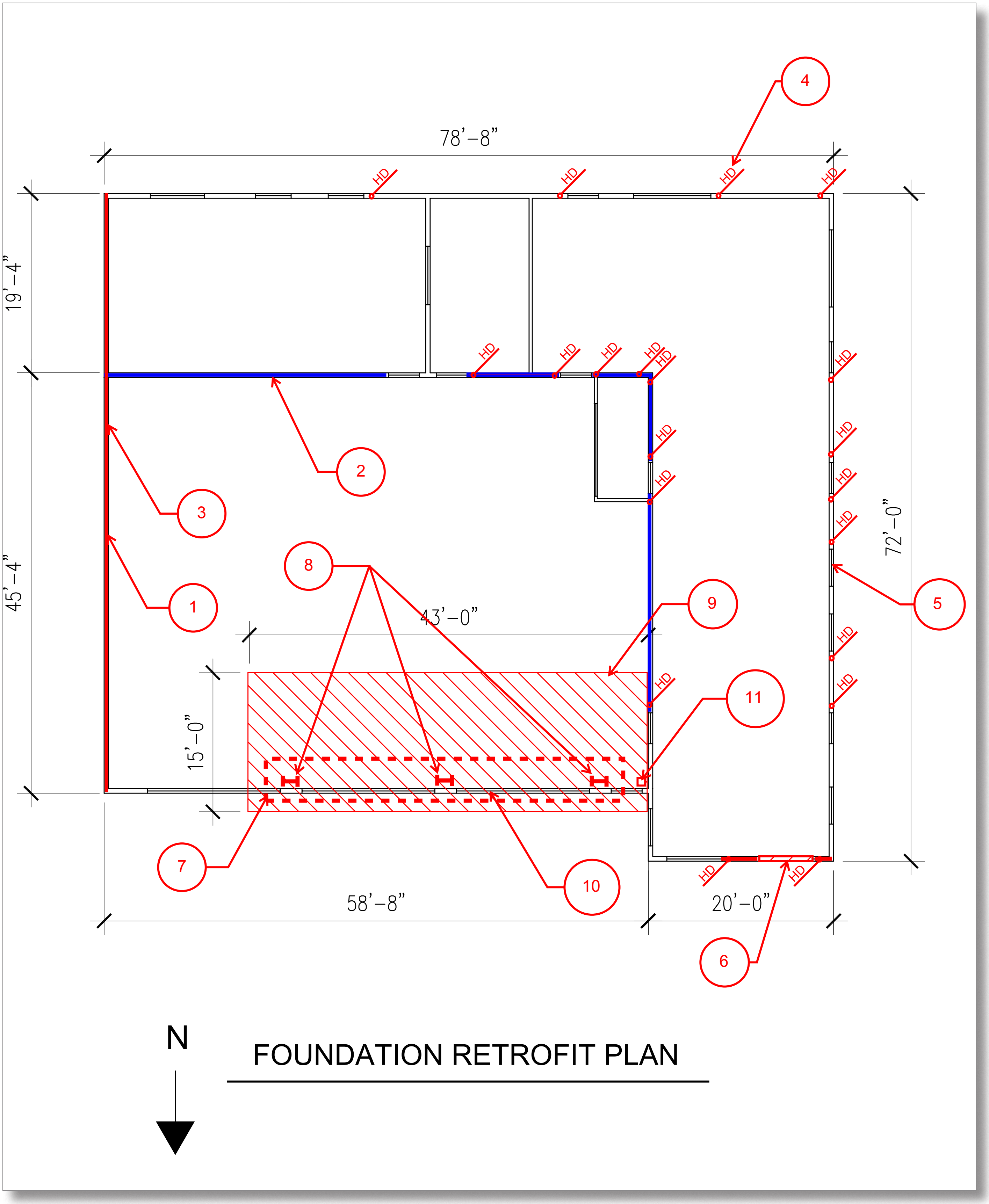
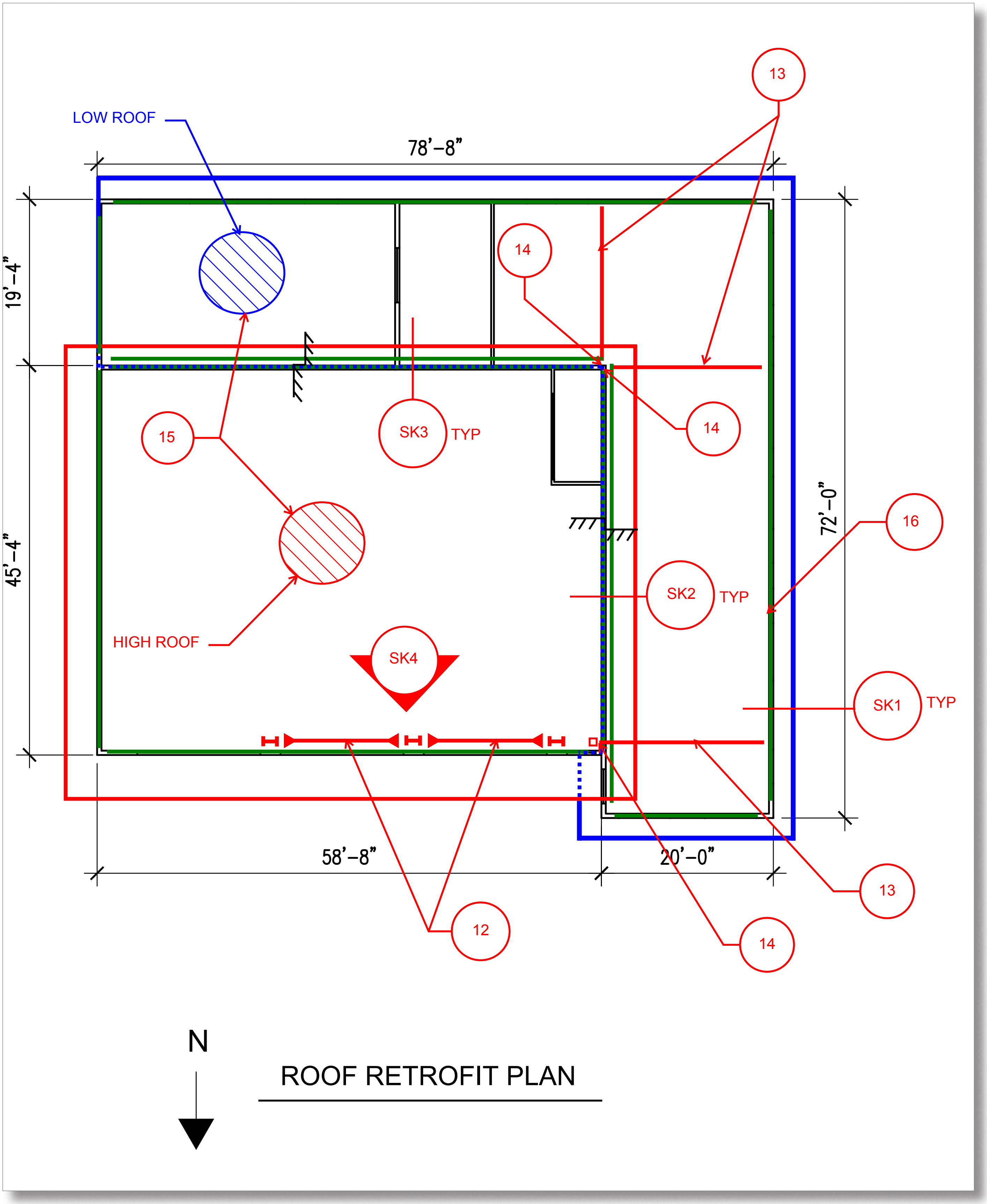


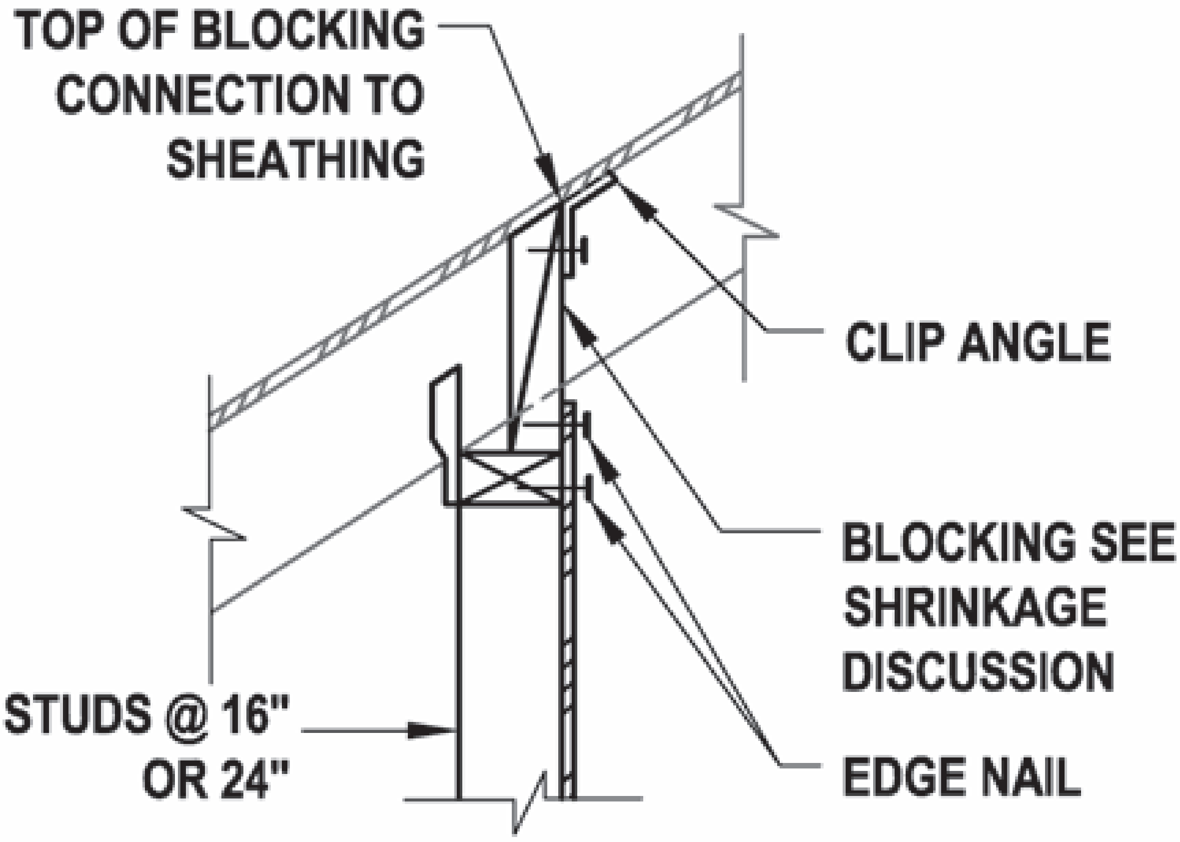
FOUNDATION RETROFIT PLAN



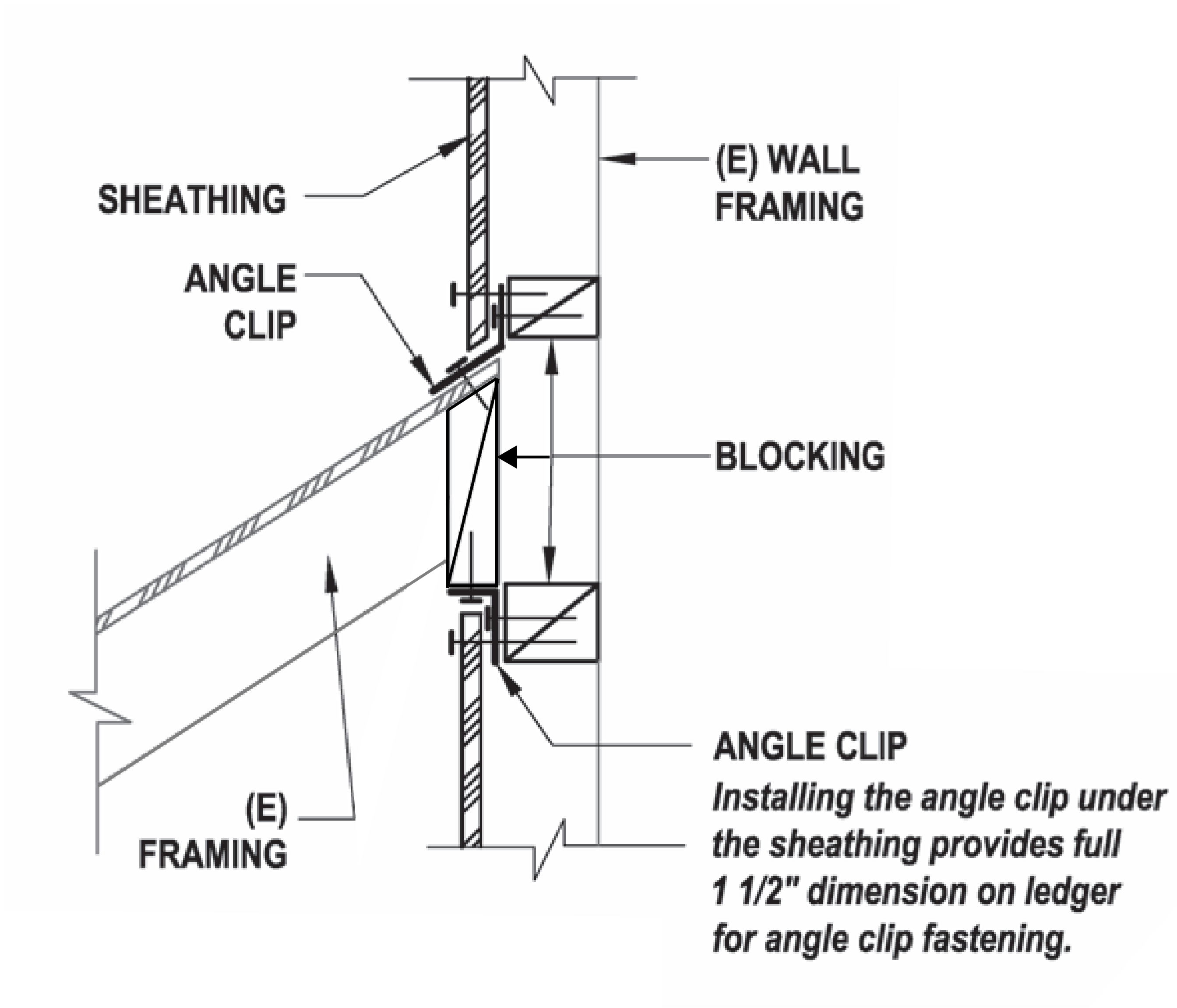
ROOF RETROFIT PLAN

Keynotes	
#	Description
1	REMOVE SIDING, ADD BLOCKING AS REQUIRED & RENAIL SHEATHING @ 3" O.C. AT WOOD SHEAR WALLS HIGHLIGHTED IN RED.
2	REMOVE EXISTING SHEATHING. ADD BLOCKING, REPLACE SHEATHING W/ 19/32" PLYWOOD SHEATHING W/ 10D NAILS @ 4" O.C. AT WOOD SHEAR WALLS HIGHLIGHTED IN BLUE.
3	ADD SILL ANCHORS AT HIGHLIGHTED SHEAR WALLS FROM KEYNOTES 1 &2. ASSUME 1/2" DIA SIMPSON TITEN HD @ 3'-0" O.C.
4	PROVIDE HOLDOWNS AT EA END OF WALL PIERS WHERE SHOWN, ASSUME SIMPSON HDU5-SDS2.5 W/ 5/8" DIA EPOXY ANCHOR AND 12" EMBEDMENT.
5	PROVIDE STRAPPING @ WINDOWS, TYP. ASSUME SIMPSON LSTA24 EA CORNER.
6	DEMO (E) WINDOW, INFILL WITH WOOD STUD WALL & SHEATHING TO MATCH ADJACENT WALLS. PROVIDE STRAPPING, ASSUME SIMPSON LSTA24 EA CORNER.
7	4'-0" WIDE x 2'-6" THICK GRADE BEAM W/ (8) #6 LONGITUDINAL TOP & BOT & #4 TIES @6" O.C. DEMO EXISTING FOOTING TO INSTALL MOMENT FRAME. EXISTING WOOD TRUSSES MAY HAVE TO BE SHORED.
8	SEE SIMPSON MOMENT FRAME (SK4) FOR PRELIMINARY COLUMN SIZES AND BASE CONNECTION.
9	DEMO EXISTING SLAB & REPLACE SLAB W/ 6" SOG.
10	REPLACE EXISTING APP BAY DOORS (3) TOTAL.
11	FULL HEIGHT HSS 8x8x5/16 COLUMN @ DRAG BEAM.
12	W12x45 MOMENT FRAME BEAMS, TYP. SEE ATTACHED SIMPSON MOMENT FRAME (SK4).
13	4x12 DF-L #1 DRAG BEAM @ RE-ENTRANT CORNER.
14	DRAG BEAM CONNECTION @ WOOD STUD WALL OR HSS COLUMN WHERE OCCURS.
15	REMOVE EXISTING ROOFING, ADD 8d NAILS @ 4" O.C. @ PANEL EDGES
16	CONTINUOUS SIMPSON CMST12 STRAP @ LOCATIONS HIGHLIGHTED IN GREEN, TYP. PROVIDE MIN 4x BLOCKING (JOISTS PERPENDICULAR) OR ATTACH TO EXISTING DOUBLE TOP PLATE (JOISTS PARALLEL).

Task Summary Table			Drawings	
Task #	Deficiency	Description	Keynote #	SK#
1	Load Path , Narrow Wood, Shear Walls, Shear Stress Check	North side of high roof does not have a sufficient amount of shear wall to resist seismic forces. (2) bay moment frame required @ this location.	7, 8, 9, 10, 12	4
2	Shear Stress Check, Hold Down Anchors, Wood Sill Bolts	Existing wood shear walls & diaphragms do not have enough capacity to resist seismic loads. There is no hold-down anchorage to resist overturning. Wood sill bolts are not compliant.	1, 2, 3, 4, 5, 6, 15	-
3	Load Path, Diaphragm Continuity	There is not sufficient blocking to tie the roof diaphragms to shear.	-	1, 2, 3
4	Roof Chord Continuity	There are no continuous chord elements.	16	3
5	Plan Irregularities	There are no drag elements @ re-entrant corners.	11, 13, 14	-
6	Life Safety Systems, Hazardous Materials, Ceilings, Light Fixtures, Cladding, Furnishings, Mechanical & Electrical, Ducts & Piping	Non-structural components are not properly braced or restrained to prevent lateral movement during a seismic event.	-	-

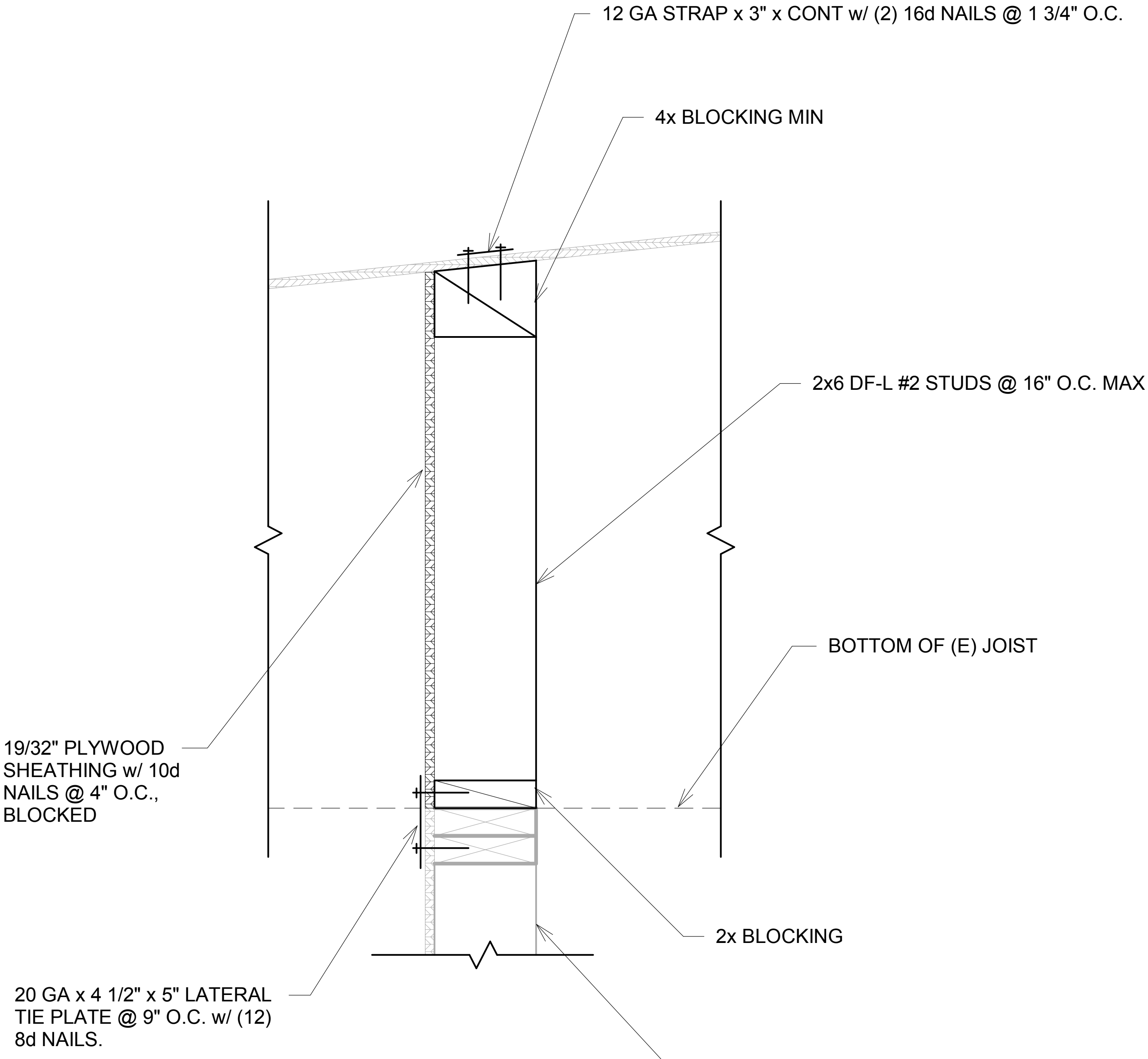


SK1 DIAPHRAGM TO SHEAR WALL CONNECTION

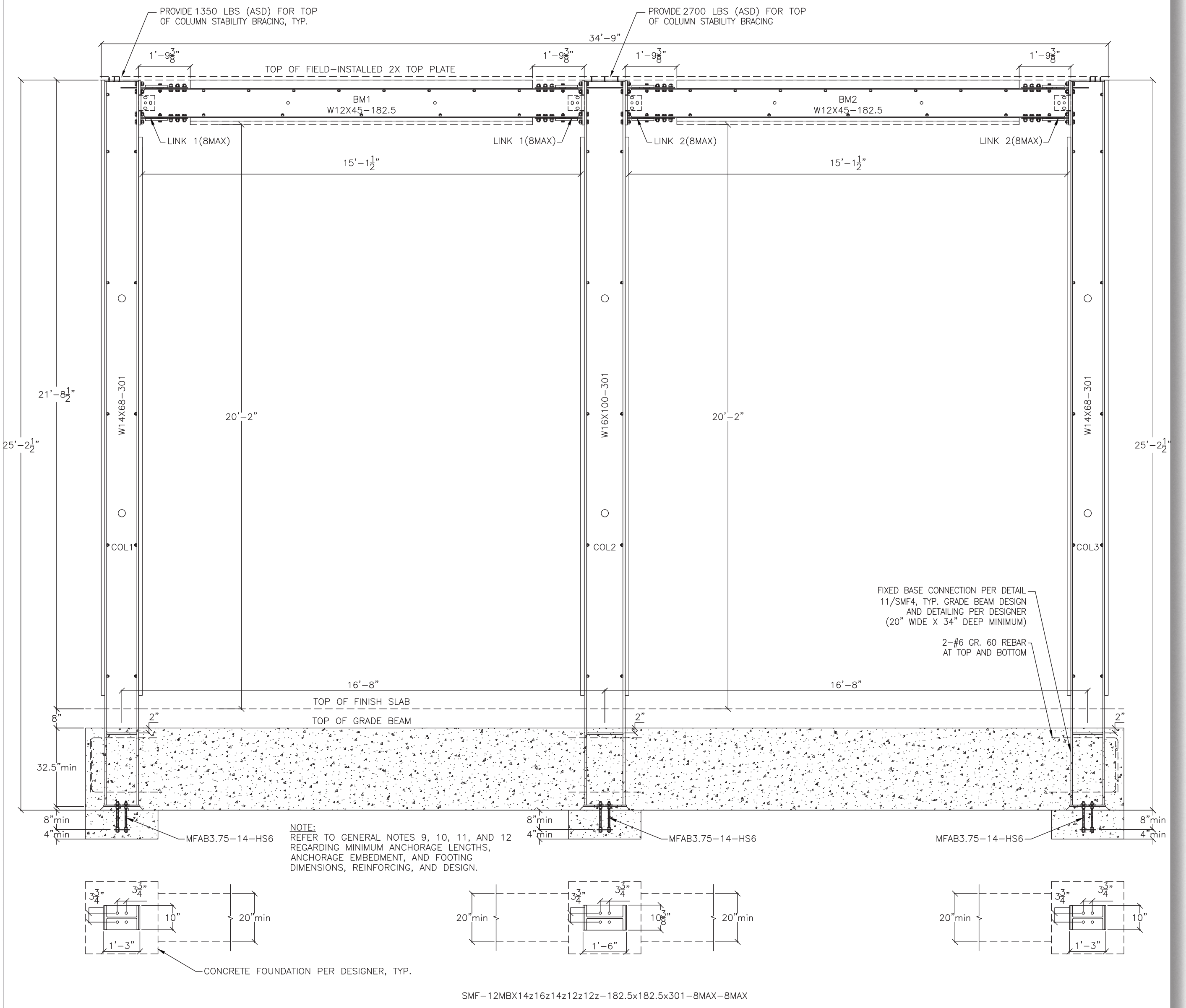


Installing the angle clip under the sheathing provides full 1 1/2" dimension on ledger for angle clip fastening.

SK2 DIAPHRAGM TO SHEAR WALL CONNECTION



SK3 DIAPHRAGM TO SHEAR WALL CONNECTION



FRAME ELEVATION

SCALE:1/2" = 1'-0"

SK4 SIMPSON MOMENT FRAME ELEVATION

D. COST ESTIMATE

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Construction FOCUS

Integrated Project Solutions

December 18, 2017
Revision #1

WEST SIDE FIRE DEPARTMENT
FIRE STATION #2 SEISMIC UPGRADES

STATEMENT OF PROBABLE COST

Prepared for:
Mackenzie
Portland, OR

Prepared by:
Steve Gunn

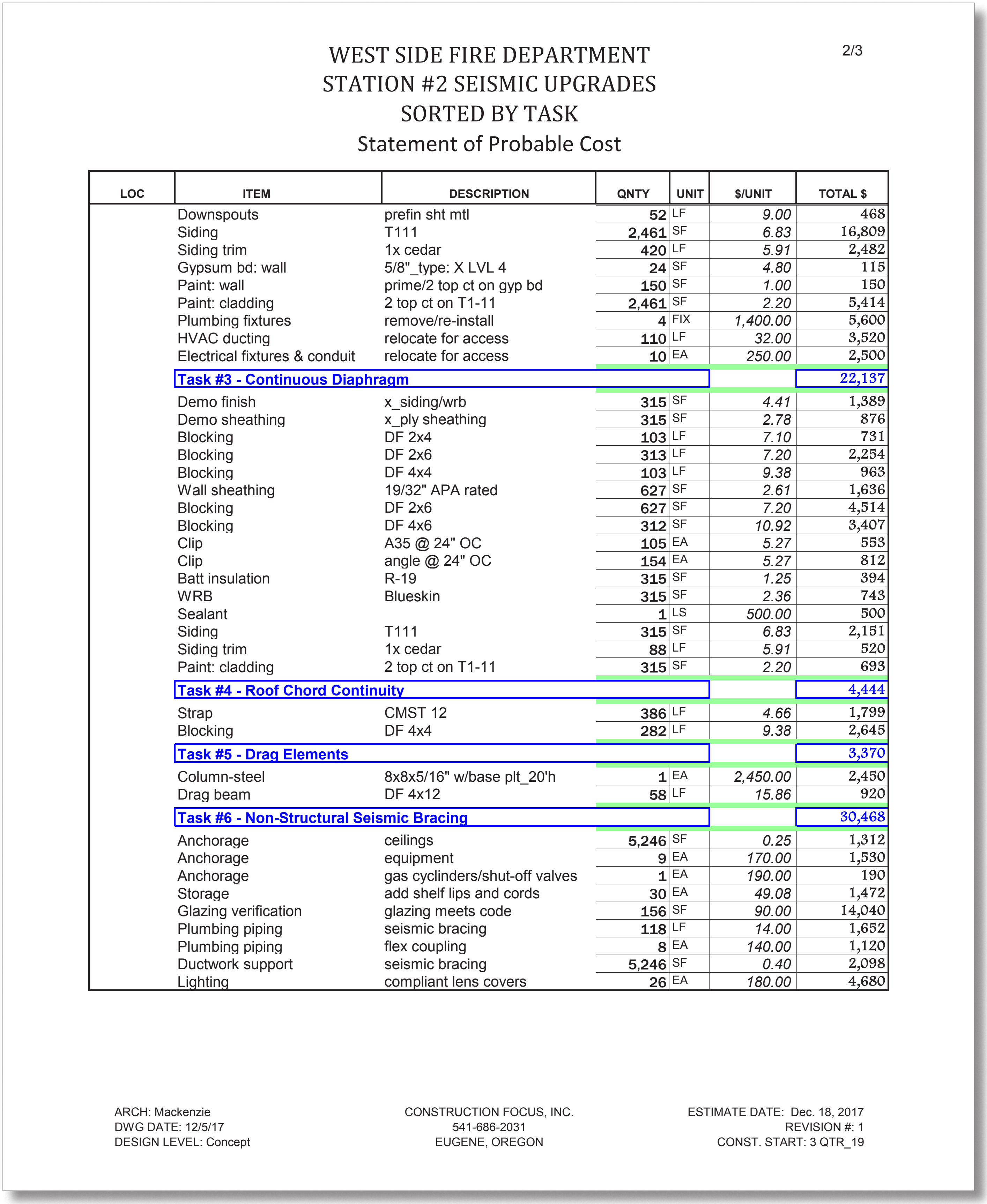
Steve Gunn

President
Construction Focus, Inc.

WEST SIDE FIRE DEPARTMENT
STATION #2 SEISMIC UPGRADES
SORTED BY TASK
Statement of Probable Cost

LOC	ITEM	DESCRIPTION	QNTY	UNIT	$/UNIT	TOTAL $
	SEISMIC UPGRADES					
		Building Gross Area	5,246	SF		
	Task #1 - Moment Frames					102,534
	Demo door	x_overhead door	**3**	EA	*900.00*	2,700
	Demo footing	x_cont ftg	**39**	LF	*200.00*	7,800
	Sawcut & demo slab	x_6"_conc for new ftg	**645**	SF	*12.00*	7,740
	Excavation	dig & haul	**18**	BCY	*75.00*	1,367
	Backfill	crushed rock	**12**	TN	*70.00*	863
	Grade beam	gb_4'w x 2'd	**39**	LF	*60.00*	2,340
	SOG patch	6"t conc w/ reinf&dowels	**645**	SF	*11.00*	7,095
	Simpson Strong Frame	supply & erect	**1**	EA	*30,071.14*	30,071
	Wall sheathing	19/32" APA rated	**24**	SF	*2.61*	63
	Shoring	for moment frame install	**39**	LF	*60.00*	2,340
	Overhead door	steel_hm frm_1/2 glz_14'x14'	**3**	EA	*12,740.00*	38,220
	Flooring	conc sealer	**645**	SF	*3.00*	1,935
	Task #2 - Shear Walls and Roof					271,870
	Demo finish	x_siding/wrb	**2,232**	SF	*4.41*	9,843
	Demo sheathing	x_ply sheathing	**1,853**	SF	*2.78*	5,151
	Salvage storage	r/r_lockers	**8**	EA	*136.32*	1,091
	Salvage storage	r/r_appliances	**6**	EA	*272.63*	1,636
	Demo roofing	x_mtl roofing/wrb	**5,675**	SF	*2.14*	12,145
	Salvage roof equip.	r/r_roof mt equip.	**1**	LS	*2,500.00*	2,500
	Demo window & frame	x_ext window/frm	**2**	EA	*272.63*	545
	Salvage casework	r/r_casework	**10**	LF	*34.08*	341
	Salvage equip.	r/r_elec pnls/meter/switch	**1**	EA	*4,500.00*	4,500
	Salvage equip.	r/r_wall ductwork/piping	**1**	LS	*800.00*	800
	Salvage equip.	r/r_wall-mount HVAC unit	**1**	EA	*900.00*	900
	Miscellaneous blocking and bracing		**320**	LF	*7.20*	2,304
	Nailing: wall	renail existing ply sheathing	**2,534**	SF	*1.18*	2,990
	Wall sheathing	19/32" APA rated	**1,757**	SF	*2.61*	4,586
	Blocking @ roof	DF 2x6	**727**	LF	*7.20*	5,232
	Nailing: roof	renail existing ply sheathing	**5,675**	SF	*1.18*	6,697
	Strap	simp LSTA24	**60**	EA	*4.66*	280
	Parapet wall framing	2x4 @ 16o.c.	**229**	SF	*11.00*	2,519
	Infill wall framing	2x6 @ 16o.c.	**24**	SF	*4.95*	119
	Holdown	simp HD5-SDS2.5 w/5/8" epox	**20**	EA	*143.16*	2,863
	Sill anchor	1/2" simp titen HD @ 36" OC	**26**	EA	*12.58*	327
	Finish carpentry	casings & trims	**162**	LF	*12.02*	1,947
	Batt insulation	R-19	**349**	SF	*1.25*	436
	WRB	Blueskin	**2,485**	SF	*2.36*	5,865
	Sealant		**1**	LS	*500.00*	500
	Roofing	tpo/cvr bd/4" rigid ins	**5,904**	SF	*26.00*	153,504
	Flashing	prefin sht mtl	**334**	LF	*8.00*	2,672
	Gutters	prefin sht mtl	**210**	LF	*12.00*	2,520

ARCH: Mackenzie	CONSTRUCTION FOCUS, INC.	ESTIMATE DATE: Dec. 18, 2017
DWG DATE: 12/5/17	541-686-2031	REVISION #: 1
DESIGN LEVEL: Concept	EUGENE, OREGON	CONST. START: 3 QTR_19



2/3

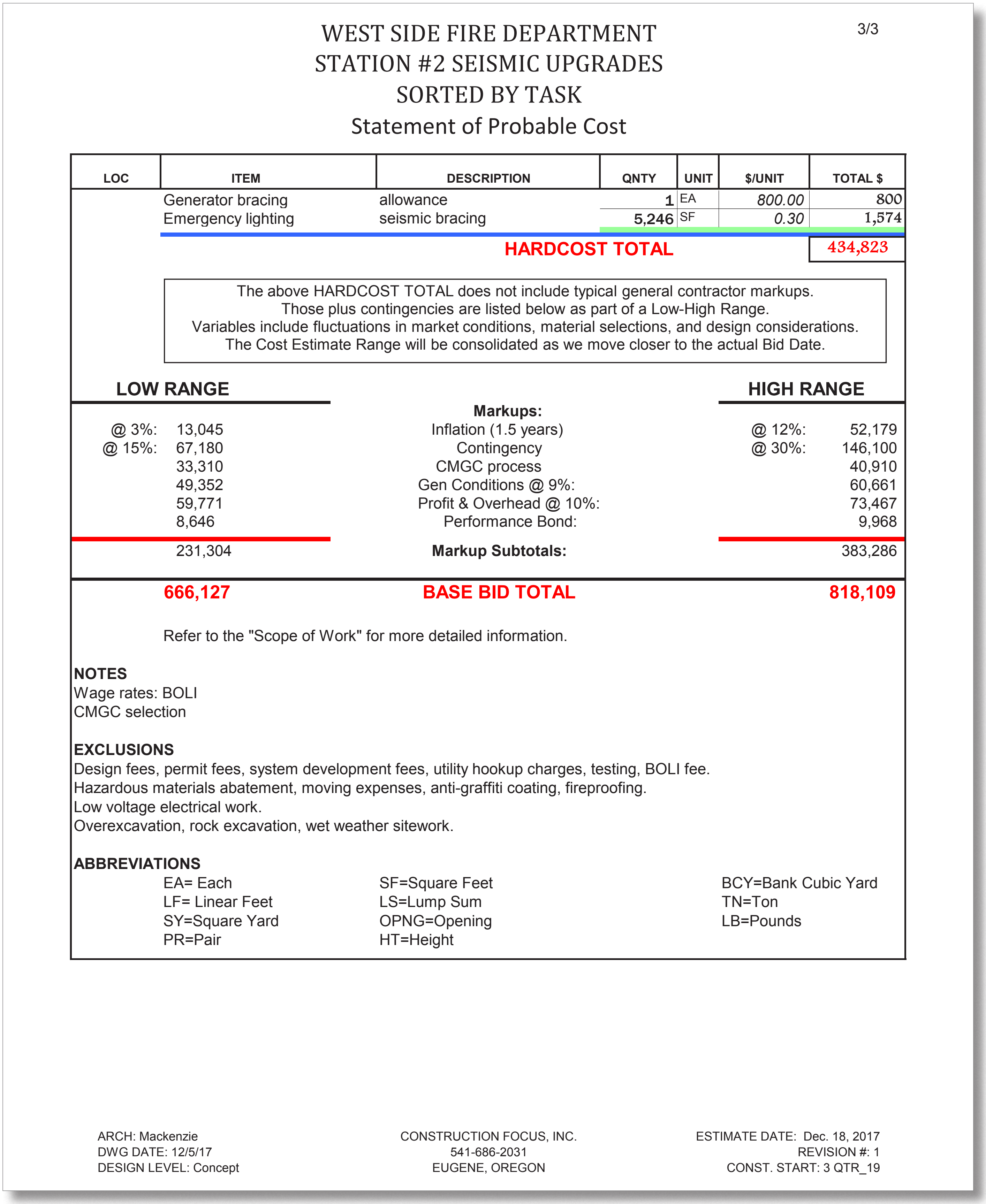
WEST SIDE FIRE DEPARTMENT
STATION #2 SEISMIC UPGRADES
SORTED BY TASK
Statement of Probable Cost

LOC	ITEM	DESCRIPTION	QNTY	UNIT	$/UNIT	TOTAL $
	Downspouts	prefin sht mtl	52	LF	9.00	468
	Siding	T111	2,461	SF	6.83	16,809
	Siding trim	1x cedar	420	LF	5.91	2,482
	Gypsum bd: wall	5/8"_type: X LVL 4	24	SF	4.80	115
	Paint: wall	prime/2 top ct on gyp bd	150	SF	1.00	150
	Paint: cladding	2 top ct on T1-11	2,461	SF	2.20	5,414
	Plumbing fixtures	remove/re-install	4	FIX	1,400.00	5,600
	HVAC ducting	relocate for access	110	LF	32.00	3,520
	Electrical fixtures & conduit	relocate for access	10	EA	250.00	2,500
	Task #3 - Continuous Diaphragm					22,137
	Demo finish	x_siding/wrb	315	SF	4.41	1,389
	Demo sheathing	x_ply sheathing	315	SF	2.78	876
	Blocking	DF 2x4	103	LF	7.10	731
	Blocking	DF 2x6	313	LF	7.20	2,254
	Blocking	DF 4x4	103	LF	9.38	963
	Wall sheathing	19/32" APA rated	627	SF	2.61	1,636
	Blocking	DF 2x6	627	SF	7.20	4,514
	Blocking	DF 4x6	312	SF	10.92	3,407
	Clip	A35 @ 24" OC	105	EA	5.27	553
	Clip	angle @ 24" OC	154	EA	5.27	812
	Batt insulation	R-19	315	SF	1.25	394
	WRB	Blueskin	315	SF	2.36	743
	Sealant		1	LS	500.00	500
	Siding	T111	315	SF	6.83	2,151
	Siding trim	1x cedar	88	LF	5.91	520
	Paint: cladding	2 top ct on T1-11	315	SF	2.20	693
	Task #4 - Roof Chord Continuity					4,444
	Strap	CMST 12	386	LF	4.66	1,799
	Blocking	DF 4x4	282	LF	9.38	2,645
	Task #5 - Drag Elements					3,370
	Column-steel	8x8x5/16" w/base plt_20'h	1	EA	2,450.00	2,450
	Drag beam	DF 4x12	58	LF	15.86	920
	Task #6 - Non-Structural Seismic Bracing					30,468
	Anchorage	ceilings	5,246	SF	0.25	1,312
	Anchorage	equipment	9	EA	170.00	1,530
	Anchorage	gas cyclinders/shut-off valves	1	EA	190.00	190
	Storage	add shelf lips and cords	30	EA	49.08	1,472
	Glazing verification	glazing meets code	156	SF	90.00	14,040
	Plumbing piping	seismic bracing	118	LF	14.00	1,652
	Plumbing piping	flex coupling	8	EA	140.00	1,120
	Ductwork support	seismic bracing	5,246	SF	0.40	2,098
	Lighting	compliant lens covers	26	EA	180.00	4,680

ARCH: Mackenzie
DWG DATE: 12/5/17
DESIGN LEVEL: Concept

CONSTRUCTION FOCUS, INC.
541-686-2031
EUGENE, OREGON

ESTIMATE DATE: Dec. 18, 2017
REVISION #: 1
CONST. START: 3 QTR_19



3/3

WEST SIDE FIRE DEPARTMENT
STATION #2 SEISMIC UPGRADES
SORTED BY TASK
Statement of Probable Cost

LOC	ITEM	DESCRIPTION	QNTY	UNIT	$/UNIT	TOTAL $
	Generator bracing	allowance	1	EA	*800.00*	800
	Emergency lighting	seismic bracing	5,246	SF	*0.30*	1,574

HARDCOST TOTAL 434,823

The above HARDCOST TOTAL does not include typical general contractor markups.
Those plus contingencies are listed below as part of a Low-High Range.
Variables include fluctuations in market conditions, material selections, and design considerations.
The Cost Estimate Range will be consolidated as we move closer to the actual Bid Date.

LOW RANGE			HIGH RANGE	
		Markups:		
@ 3%:	13,045	Inflation (1.5 years)	@ 12%:	52,179
@ 15%:	67,180	Contingency	@ 30%:	146,100
	33,310	CMGC process		40,910
	49,352	Gen Conditions @ 9%:		60,661
	59,771	Profit & Overhead @ 10%:		73,467
	8,646	Performance Bond:		9,968
	231,304	**Markup Subtotals:**		383,286
	666,127	**BASE BID TOTAL**		**818,109**

Refer to the "Scope of Work" for more detailed information.

NOTES
Wage rates: BOLI
CMGC selection

EXCLUSIONS
Design fees, permit fees, system development fees, utility hookup charges, testing, BOLI fee.
Hazardous materials abatement, moving expenses, anti-graffiti coating, fireproofing.
Low voltage electrical work.
Overexcavation, rock excavation, wet weather sitework.

ABBREVIATIONS
EA= Each
LF= Linear Feet
SY=Square Yard
PR=Pair
SF=Square Feet
LS=Lump Sum
OPNG=Opening
HT=Height
BCY=Bank Cubic Yard
TN=Ton
LB=Pounds

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