Rating form completed by:

RUTHERFORD + CHEKENE
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Evaluator: MN/WAL/BL
Date: 06/28/2019

Text in green is to be part of UCSC building database and may be part of UCOP database.

DATE: 2019-06-28

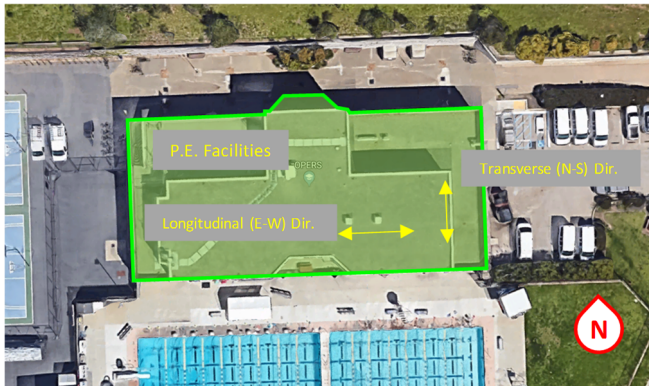
UC Santa Cruz Building Seismic Ratings

P.E. Facilities

CAAN #7743
451 East Field Service Road, Santa Cruz, CA 95064
UCSC Campus: Main Campus

South Elevation (Looking Northeast)

Plan



Rating summary	Entry	Notes
UC Seismic Performance Level (rating)	IV (Fair)	
Rating basis	Tier 1	ASCE 41-17[1]
Date of rating	2019	
Recommended list assignment (UC Santa Cruz category for retrofit)	None	Priority A =Retrofit ASAP Priority B=Retrofit at next permit application
Ballpark total construction cost to retrofit to IV rating[2]	None	See recommendations on further evaluation and retrofit.
Is 2018-2019 rating required by UCOP?	Yes	Building was previously rated as “Good” by R+C in 1998.
Further evaluation recommended?	Yes	To address non-structural hazards

[1] We translate this Tier 1 evaluation to a Seismic Performance Level rating using professional judgment. Non-compliant items in the Tier 1 evaluation do not automatically put a building into a particular rating category, but we evaluate such items along with the combination of building features and potential deficiencies, focused on the potential for collapse or serious damage to the gravity supporting structure that may threaten occupant safety. See Section III.B of the 19 May 2017 *UC Seismic Safety Policy* and Method B of Section 321 of the 2016 *California Building Code*.

[2] Per Section III.A.4.i of the 26 March 2019 *UC Seismic Program Guidebook, Version 1.3*, the cost includes all construction cost necessitated by the seismic retrofit, including restoration of finishes and any triggered work on utilities or accessibility. It does not include soft costs such as design fees or campus costs. The cost is in 2019 dollars.

Building information used in this evaluation

- Architectural drawings by Worley K. Wong, Ronald G. Brocchini & Associates, "P.E. Facilities 1987, East Facilities Expansion, University of California, Santa Cruz," dated 15 May 1987.
- Structural drawings by Vogel and Meyer Partnership Structural Engineers, "P.E. Facilities 1987, East Facilities Expansion, University of California, Santa Cruz," dated 15 May 1987.

Additional building information known to exist

None

Scope for completing this form

Reviewed structural drawings for original construction, made brief site visit on 16 May 2019, and carried out ASCE 41-17 Tier 1 evaluation.

Brief description of structure

The P.E. Facilities building was designed in 1987 by architects Worley K. Wong, Ronald G. Brocchini & Associates and by Vogel and Meyer Partnership Structural Engineers. The construction completion date is 1988. The first story has lockers and showers and is rectangular with an east-west dimension of 175'6" and a north-south dimension of 75'6". The second story contains offices and is "T"-shaped in plan with the stem of the "T" at the north end. The second story west and east walls of the flange of the "T" are set back 16'2-3/4" from the first story perimeter, and the west and east walls of the stem of the "T" are set back 63'9-3/4" from the first story perimeter. The setback areas create a low roof which is nominally aligned with the second floor elevation.

Building condition: During the site visit, we did not observe signs of deterioration of structural elements. Horizontal framing members at second floor and roof were not visible due to the presence of ceilings. The same applies to plywood shear walls at the second floor. CMU walls were mainly observable from the outside of the building. We noticed signs of aging/delamination of a limited section of linoleum tile at the second floor. The presence of rust on piping, appurtenances, and sporadically on equipment was observed in Rooms 118 and 119, where the pool solution tanks and filtration pumps are located.

Identification of levels: Two stories (first floor and second floor). The first floor aligns with the surrounding flat grade.

Foundation system: The superstructure is founded on shallow single footings located under reinforced concrete and steel columns and strip footings under CMU walls.

Structural system for vertical (gravity) load: The high roof over the second story is wood-framed with ½" plywood over TJIs and sawn lumber spanning to glulam beams and interior and exterior wood stud bearing walls. The stud walls are framed with 2x6s at 16" o.c. Glulam beams are supported by steel pipe columns and the wood bearing walls. The second floor/low roof is also wood-framed with ¾" plywood over TJIs and sawn lumber spanning to glulam beams and CMU bearing walls. The second story wood stud walls are typically bearing directly on the first story CMU bearing walls. The 3" X-strong steel pipe columns are typically embedded inside the 8" CMU walls. There are also freestanding 4x4x1/4" HSS tubes, 12" diameter concrete columns, and 14" diameter concrete columns. The first floor is a 5" reinforced concrete slab-on-grade. The low and high roofs are tar and gravel with crickets formed with tapered rigid insulation. The second floor finish consists of linoleum flooring over an estimated 1.5" thick gypcrete topping slab. The thickness of the gypcrete could not be verified against available drawings. However, the estimate seems reasonable and matches dead load estimate found on Sheet S5.

Structural system for lateral forces: At the second story, the plywood high roof diaphragm spans between the plywood sheathed shear walls. The high roof plywood panel edges are unblocked, have 8d@6" o.c. edge nailing, and had an allowable stress design (ASD) capacity of 240 plf per the structural drawings. The plywood shear walls have blocked panel edges, with edge nailing of 10d at 6" o.c. for typical panels, with heavier nailing of 10d at 4" o.c. for selected walls. At the first story, the plywood second floor/low roof diaphragm spans between the CMU walls. The plywood panel edges are blocked with 2x4 flat blocking, have 10d@4" o.c. edge nailing, and had an ASD capacity of 425 plf per the structural drawings. The CMU walls are fully grouted with #5 at 16" o.c. in both the horizontal and vertical directions.

Brief description of seismic deficiencies and expected seismic performance including mechanism of nonlinear response and structural behavior modes

Identified seismic features and deficiencies of the building include the following:

- The flexible wood-framed diaphragms—comprised of truss joists, sawn lumber, and glued laminated beams with plywood sheathing—are well anchored to well-distributed wood-framed walls and CMU walls in the second story and first story in both directions, respectively.
- Although there are setbacks in plan at the second story that exceed the 30% threshold in the Tier 1 checklist, the wood-frame second story walls bear directly on CMU walls below. See annotated plan at the end of this section. Given the significant increase in stiffness at the first story from the CMU walls, it is unlikely that there will be substantial higher mode effects in the wood-framed second story. Rather, it is likely that there will be a podium effect where the first story serves as a base and limits the amount of inertial weight from the first story that impacts the second story.
- The amounts of vertical and horizontal reinforcement provided in the CMU walls comply with ASCE 41-17 Tier 1 Quick Check. Well detailed diaphragm-wall connections will allow to transfer the loads from the second floor diaphragm and second story wood shear walls to the CMU walls. The calculated average shear stress in the CMU walls is well below the ASCE 41-17 limit, since the building has ample walls in both directions, with a demand-to-capacity ratio (D/C) = 0.16 in the N-S direction and D/C=0.18 in the E-W direction. At the north façade, there are a series of short CMU piers between clerestory windows along a large portion of the building length. The wall line has a D/C=0.55 using a tributary area assumption. The demand-to-capacity ratios at the second story plywood walls, while compliant with the Tier 1 Quick Check, are substantially higher than those of the CMU walls. The average D/C ratio is 0.99 for the N-S direction and 0.59 for the E-W direction.
- Given the relative D/C ratios, the nonlinear behavior of the structure is expected to be concentrated on inelastic response of wood-framed walls at the second story, with the potential for concentrated inelastic action at the piers next to clerestory windows on the north façade.

Structural deficiency	Affects rating?	Structural deficiency	Affects rating?
Lateral system stress check (wall shear, column shear or flexure, or brace axial as applicable)	N	Openings at shear walls (concrete or masonry)	N
Load path	N	Liquefaction	N
Adjacent buildings	N	Slope failure	N
Weak story	N	Surface fault rupture	N
Soft story	N	Masonry or concrete wall anchorage at flexible diaphragm	N
Geometry (vertical irregularities)	Y	URM wall height-to-thickness ratio	N
Torsion	N	URM parapets or cornices	N
Mass – vertical irregularity	N	URM chimney	N
Cripple walls	N	Heavy partitions braced by ceilings	N
Wood sills (bolting)	N	Appendages	N
Diaphragm continuity	N		

Summary of review of nonstructural life-safety concerns, including at exit routes.[3]

We did not observe any falling hazard that pose a life-safety concern. We did observe two nonstructural deficiencies where we recommend further action beyond that associated with a Tier 1 assessment.

- In Rooms 118 and 119, there are tanks holding pool filtration chemicals that are unrestrained. We recommend properly restraining any hazardous materials as that can be done independently of any structural or architectural work and has a high return in terms of risk reduction vs dollars spent.

[3] For these Tier 1 evaluations, we do not visit all spaces of the building; we rely on campus staff to report to us their understanding of if and where nonstructural hazards may occur.

- Unbraced piping was observed in Room 134, the cogeneration room. It is acknowledged that the presence of unbraced piping is not an indication of non-compliance with current provisions. For that reason, we recommend that further evaluation of the utility bracing in Room 134 be conducted to properly assess any risk that may exist and suggest ways of mitigating said risk.

UCOP nonstructural checklist item	Life safety hazard?	UCOP nonstructural checklist item	Life safety hazard?
Heavy ceilings, feature or ornamentation above large lecture halls, auditoriums, lobbies or other areas where large numbers of people congregate	None observed	Unrestrained hazardous materials storage	Yes
Heavy masonry or stone veneer above exit ways and public access areas	None observed	Masonry chimneys	None observed
Unbraced masonry parapets, cornices or other ornamentation above exit ways and public access areas	None observed	Unrestrained natural gas-fueled equipment such as water heaters, boilers, emergency generators, etc.	None observed

Basis of rating

We assign a Seismic Performance Level rating of IV (Fair) to this building because no major seismic deficiencies were identified in the ASCE 41-17 Tier 1 evaluation process.

Recommendations for further evaluation or retrofit

From a structural standpoint, we do not recommend any further evaluations or retrofit. From a nonstructural standpoint, we recommend restraining of tanks in Rooms 118 and 119, and a more focused evaluation of utility bracing in Room 134.

Peer review of rating

This seismic evaluation was discussed in a peer review meeting on 17 June 2019. Reviewers present were Joe Maffei of Maffei Structural Engineering and Robert Graff of Degenkolb Engineers. Comments from the reviewers have been incorporated into this report. The reviewers agreed with the assigned rating.

Additional building data	Entry	Notes
Latitude	36.995029	
Longitude	-122.054086	
Are there other structures besides this one under the same CAAN#	No	
Number of stories above lowest perimeter grade	2	
Number of stories (basements) below lowest perimeter grade	0	
Building occupiable area (OGSF)	19,043	
Risk Category per 2016 CBC Table 1604.5	II	
Building structural height, h_n	26.58 ft	Structural height defined per ASCE 7-16 Section 11.2
Coefficient for period, C_t	0.020	Estimated using ASCE 41-17 equation 4-4 and 7-18
Coefficient for period, β	0.75	Estimated using ASCE 41-17 equation 4-4 and 7-18
Estimated fundamental period	0.23 sec	Estimated using ASCE 41-17 equation 4-4 and 7-18
Site data		
975-year hazard parameters S_s, S_1	1.285, 0.487	From OSHPD/SEAOC website

Site class	D	
Site class basis	Geotech[4]	See footnote below
Site parameters F_a, F_v	1.0, 1.813	From OSHPD/SEAOC website
Ground motion parameters S_{cs}, S_{c1}	1.285, 0.883	From OSHPD/SEAOC website
S_a at building period	1.28	
Site V_{s30}	900 ft/s	
V_{s30} basis	Estimated	Estimated based on site classification of D.
Liquefaction potential	Low	
Liquefaction assessment basis	County map	See footnote below
Landslide potential	Low	
Landslide assessment basis	County map	See footnote below
Active fault rupture identified at site	No	
Fault rupture assessment basis	County map	See footnote below
Site-specific ground motion study?	No	
Applicable code		
Applicable code or approx. date of original construction	Built: 1988 Code: UBC 1982	Per structural drawings, Sheet S1
Applicable code for partial retrofit	None	No partial retrofit
Applicable code for full retrofit	None	No full retrofit
FEMA P-154 data		
Model building type North-South	RM1-Masonry shear wall and W2-Wood Frames	
Model building type East-West	RM1-Masonry shear wall and W2-Wood Frames	
FEMA P-154 score	N/A	Not included here because we performed ASCE 41 Tier 1 evaluation.
Previous ratings		
Most recent rating	Good	Building was previously rated as “Good” by R+C.
Date of most recent rating	1998	

[4] Determination of site class and assessment of geotechnical hazards are based on correspondence with Pacific Crest Geotechnical Engineers and Nolan, Zinn, and Associates Geologists. [*Revised Geology and Geologic Hazards, Santa Cruz Campus, University of California*, Job # 04003-SC 13 May 2005]. Site class is taken as D throughout the main campus of UC Santa Cruz. The following links provide hazard maps for liquefaction, landslide, and fault rupture:
https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/LiquifactionMap2009.pdf
https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/LandslideMap2009.pdf
https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/FaultZoneMap2009.pdf

2nd most recent rating	-	
Date of 2nd most recent rating	-	
3rd most recent rating	-	
Date of 3rd most recent rating	-	
Appendices		
ASCE 41 Tier 1 checklist included here?	Yes	Refer to attached checklist file

Rating form completed by:

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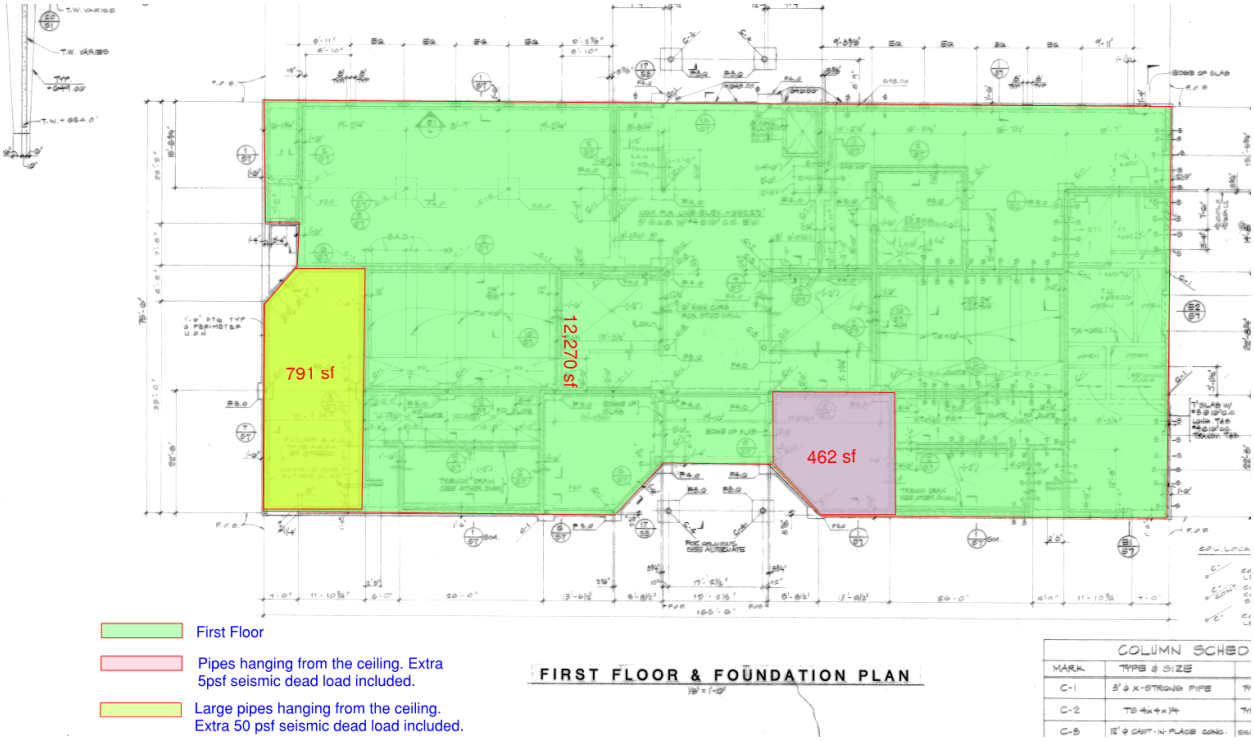
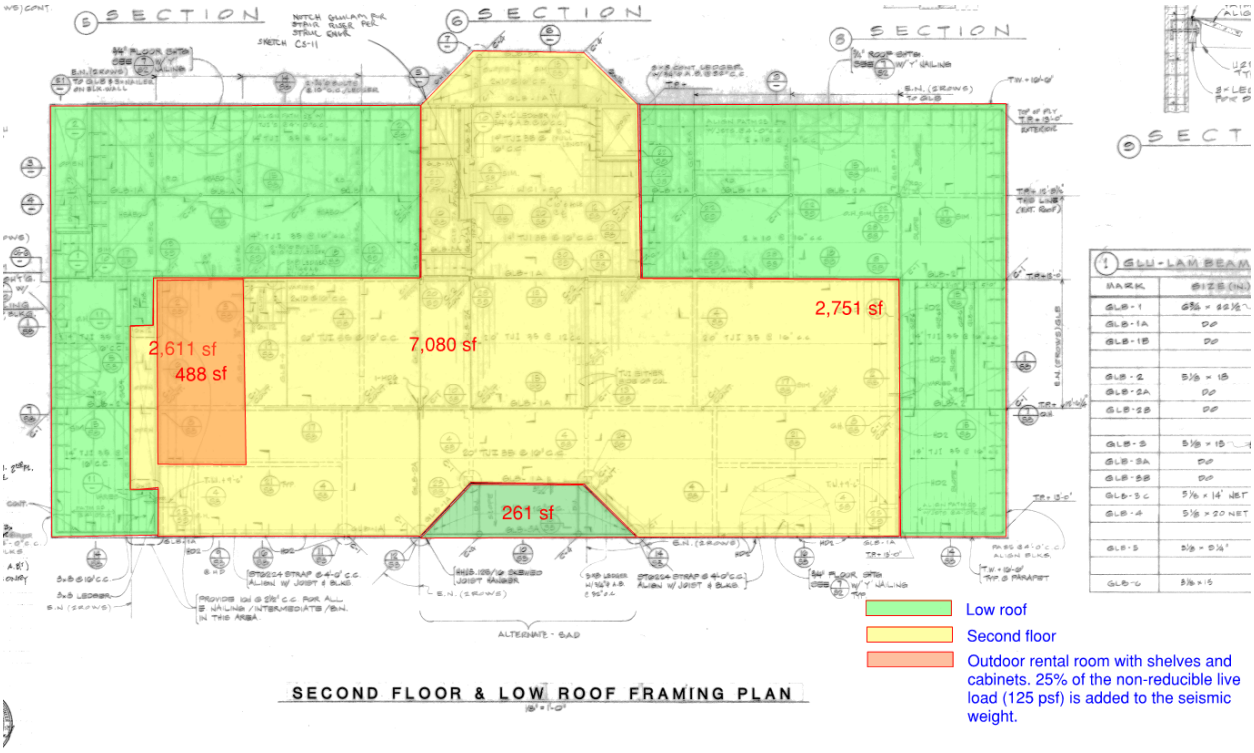
Evaluator: MN/WAL/BL
Date: 06/28/2019

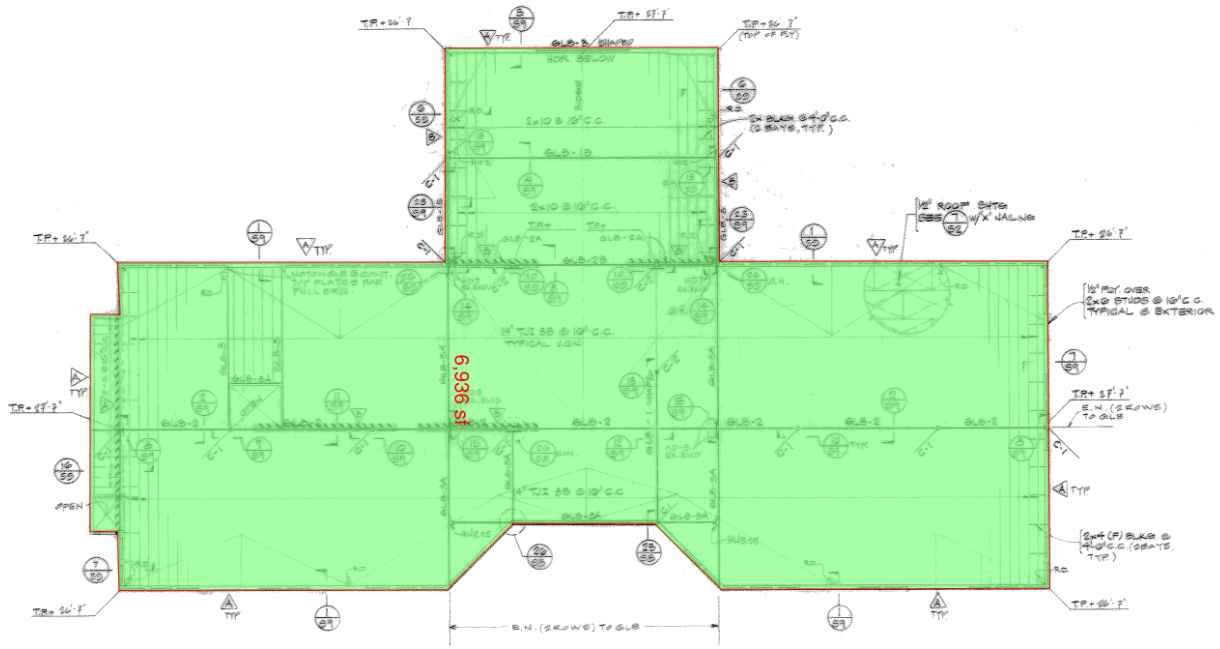
Color Coded Floor Plans:



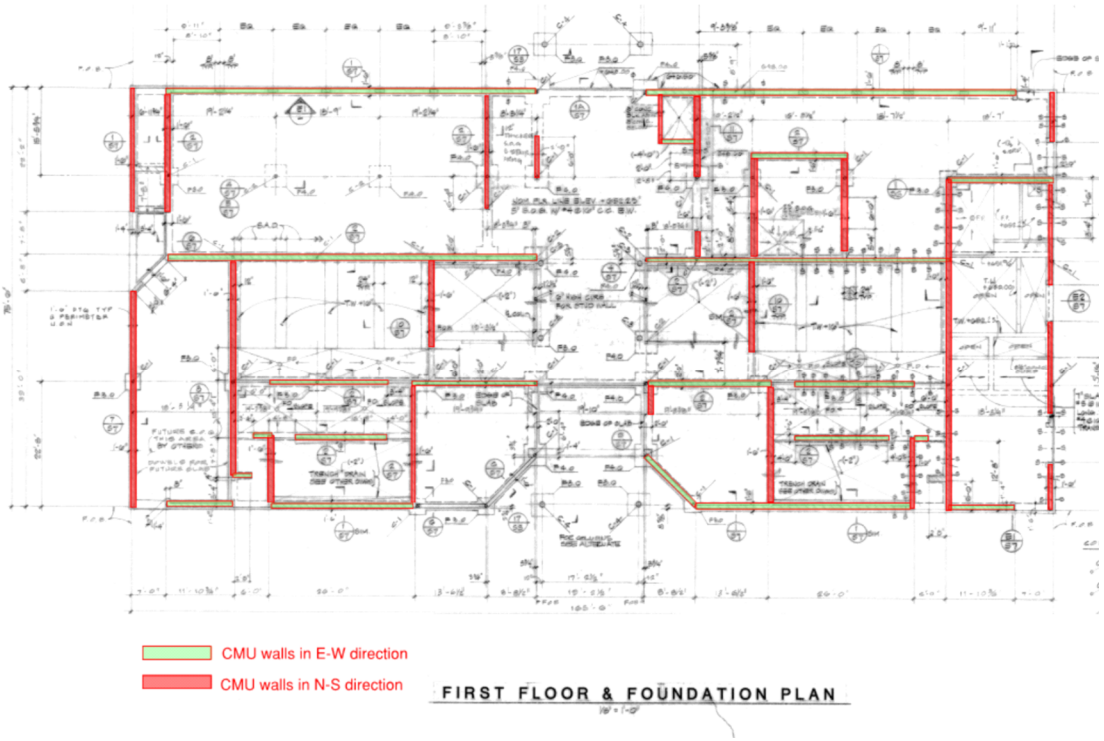
First Floor (Ground) Plan



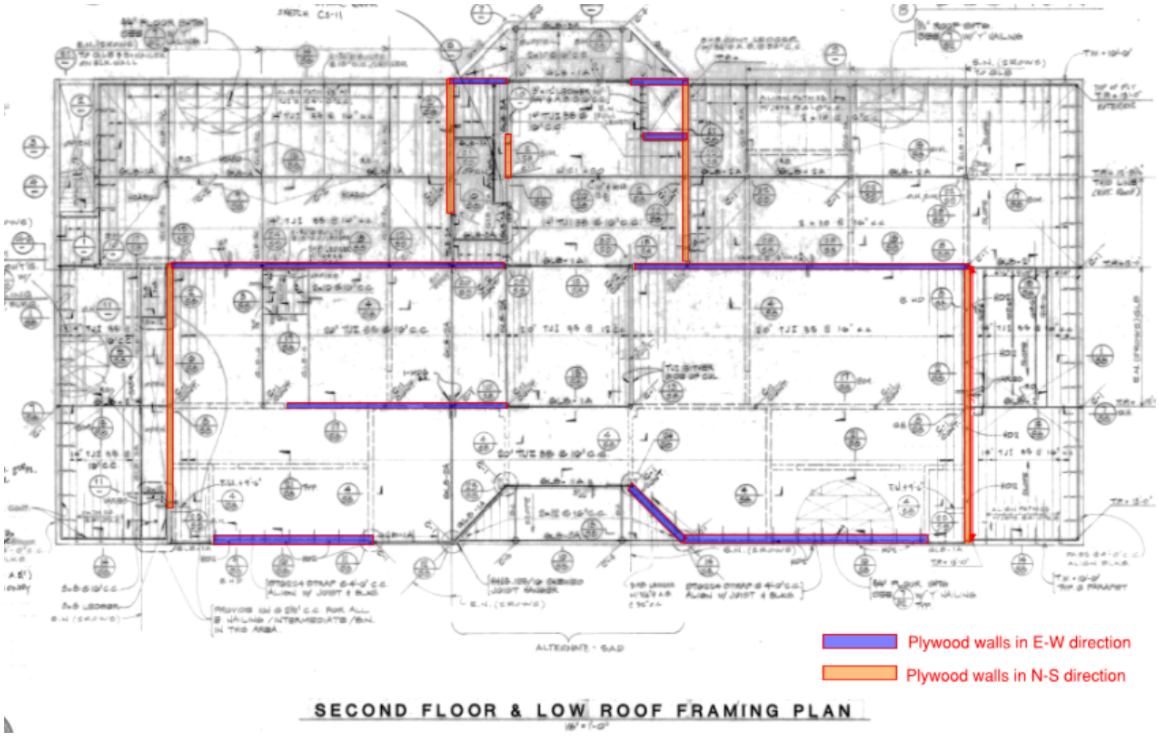
Second Floor and Low Roof Plan



High Roof Plan



Annotated CMU walls at first floor



Annotated Plywood Walls at Second Floor

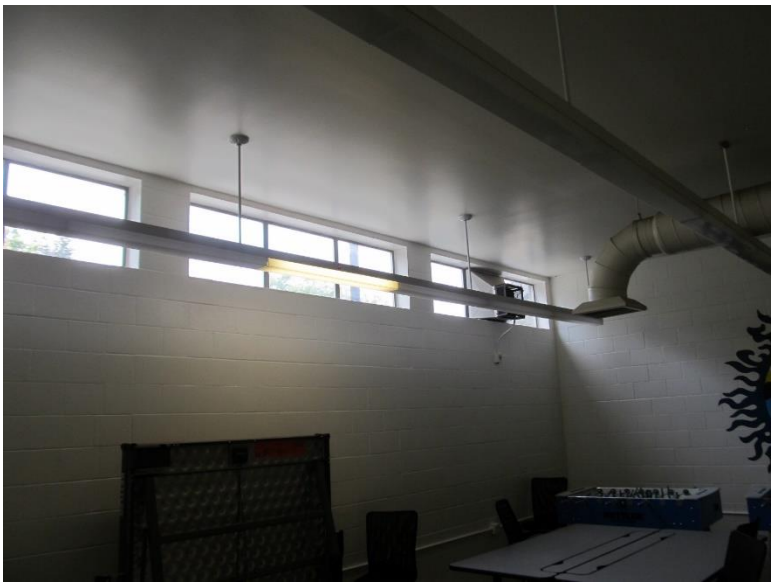
APPENDIX A

Additional Photos

Northeast corner (looking southwest)

Entrance (north elevation)

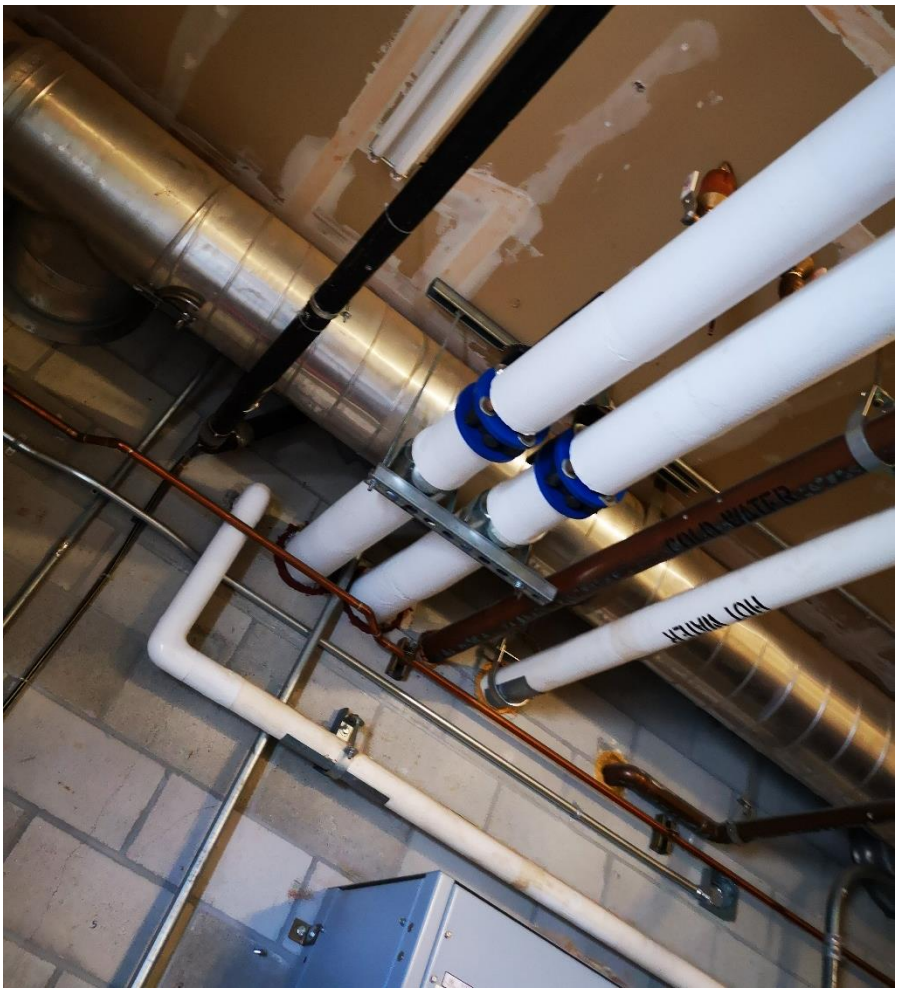
Northwest corner (looking southeast)



CMU wall at first story

Unrestrained tank of filtration chemicals

Unrestrained tanks of filtration chemicals



Pipes in Room 134 (cogeneration room)

Pipes in Room 134 (cogeneration room)

APPENDIX B

ASCE 41-17 Tier 1 Checklists (Structural)

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7743	Auxiliary CAAN:		By Firm:	RUTHERFORD + CHEKENE		
Building Name:	P.E. Facilities			Initials:	MN	Checked:	WAL/BL
Building Address:	451 East Field Service Road, Santa Cruz, CA 95064			Page:	1	of	4

ASCE 41-17
Collapse Prevention Basic Configuration Checklist

LOW SEISMICITY

BUILDING SYSTEMS - *GENERAL*

	Description
C ◉ NC ○ N/A ○ U ○	LOAD PATH: The structure contains 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) **Comments:** Plywood diaphragms deliver loads to plywood shear walls at the high roof and 8" reinforced concrete masonry unit (CMU) walls at second floor and isolated columns (steel, reinforced concrete, wood posts). The CMU walls and columns are founded on strip and spread footings, respectively.
C ○ NC ○ N/A ◉ U ○	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building is greater than 0.25% of the height of the shorter building in low seismicity, 0.5% in moderate seismicity, and 1.5% in high seismicity. (Commentary: Sec. A.2.1.2. Tier 2: Sec. 5.4.1.2) **Comments:** There are no adjacent structures.
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) **Comments:** There are no mezzanines.

BUILDING SYSTEMS - *BUILDING CONFIGURATION*

	Description

Note: **C =** Compliant **NC =** Noncompliant **N/A =** Not Applicable **U =** Unknown

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ASCE 41-17
Collapse Prevention Basic Configuration Checklist

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 is not less than 80% of the strength in the adjacent story above. (Commentary: Sec. A2.2.2. Tier 2: Sec. 5.4.2.1) **Comments:** The shear strengths of the seismic force-resisting system increases in each principal direction from top to bottom. • Wood-framed wall (2nd story): - Allowable shear stress (ASCE 41-17): fs = 1,000 lb/ft - Total wall length in each principal direction: L_{N-S} = 140 ft, L_{E-W} = 232 ft - Total shear capacity in N-S direction: $C^2_{N-S} = fs^* L_{N-S}$ = 140 kips - Total shear capacity in E-W direction: $C^2_{E-W} = fs^* L_{E-W}$ = 232 kips - • Reinforced CMU wall (1st story): - Allowable shear stress (ASCE 41-17): fs = 70 psi - Total wall area in each principal direction: A_{N-S} = 44,664 in^2, A_{E-W} = 51,256 in^2 - Total shear capacity in N-S direction: $C^1_{N-S} = fs^* A_{N-S}$ = 3,126 kips - Total shear capacity in E-W direction: $C^1_{E-W} = fs^* A_{E-W}$ = 3,588 kips ➢ C^1_{N-S} / C^2_{N-S} = 22 ➢ C^1_{E-W} / C^2_{E-W} = 15
C	NC	N/A	U	
◉	○	○	○	SOFT STORY: The stiffness of the seismic-force-resisting system in any story is not 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 stiffness of the three stories above. (Commentary: Sec. A.2.2.3. Tier 2: Sec. 5.4.2.2) **Comments:** - The stiffness of the seismic force-resisting system increases from top to the bottom over the height. - Story heights are approximately the same from floor to floor.
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) **Comments:** The seismic force-resisting system changes from plywood shear walls at the second story to 8” CMU walls at the first story. The second story footprint has setbacks from the first story perimeter footprint. However, the plywood shear walls stack on top of the CMU walls.
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) **Comments:** On the north façade, due to the setback in the plans at the NW and NE corners, the east-west length of plywood shear walls at the second story is less than 70% of the length of the CMU wall line at the first story.

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ASCE 41-17
Collapse Prevention Basic Configuration Checklist

C	NC	N/A	U	
○	○	◉	○	MASS: There is no change in effective mass of 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) **Comments:** Two story building with light roof.
◉	○	○	○	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) **Comments:** Flexible diaphragm.

MODERATE SEISMICITY (COMPLETE THE FOLLOWING ITEMS IN ADDITION TO THE ITEMS FOR LOW SEISMICITY)

GEOLOGIC SITE HAZARD

C	NC	N/A	U	Description
◉	○	○	○	LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance do not exist in the foundation soils at depths within 50 ft (15.2m) under the building. (Commentary: Sec. A.6.1.1. Tier 2: 5.4.3.1) **Comments:** **Per 2009 County map at** https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/LiquifactionMap2009.pdf
◉	○	○	○	SLOPE FAILURE: The building site is located away from potential earthquake-induced slope failures or rockfalls so that it is 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) **Comments:** **Per 2009 County map at** https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/LandslideMap2009.pdf
◉	○	○	○	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) **Comments:** **Per 2009 County map at** https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/FaultZoneMap2009.pdf

HIGH SEISMICITY (COMPLETE THE FOLLOWING ITEMS IN ADDITION TO THE ITEMS FOR MODERATE SEISMICITY)

FOUNDATION CONFIGURATION

	Description

Note: **C =** Compliant **NC =** Noncompliant **N/A =** Not Applicable **U =** Unknown

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ASCE 41-17
Collapse Prevention Basic Configuration Checklist

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) **Comments:** Least horizontal dimension of the seismic-force resisting system: B = 75'-6", Building Height: H = 26'-7", B/H = 2.84 Sa = 1.285g per SEAOC/OSHPD at BSE-2E 0.6x Sa = 0.77 B/H > 0.6 Sa → OK
◉	○	○	○	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) **Comments:** Site Class D is assumed. The slab at the foundation level is doweled to and restrains the spread and strip footings.

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ASCE 41-17
Collapse Prevention Structural Checklist For Building Type RM1-RM2

LOW AND MODERATE SEISMICITY

SEISMIC-FORCE-RESISTING SYSTEM

C	NC	N/A	U	Description
●	○	○	○	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) **Comments:** The number of lines of shear walls in each principal direction exceeds 4.
●	○	○	○	SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than 70 lb/in.^{2} (0.48 MPa). (Commentary: Sec. A.3.2.4.1. Tier 2: Sec. 5.5.3.1.1) **Comments:** The calculated average shear stress in the reinforced masonry shear walls is 11.0 and 12.6 psi in the E-W and N-S direction, respectively. The calculated average shear stress in short wall piers at top of the CMU walls on the north exterior wall of the building is 38.5 psi.
●	○	○	○	REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls is greater than 0.002 of the wall with the minimum of 0.0007 in either of the two directions; the spacing of reinforcing steel is less than 48 in. (1220 mm), and all vertical bars extend to the top of the walls. (Commentary: Sec. A.3.2.4.2. Tier 2: Sec. 5.5.3.1.3) **Comments:** Per the masonry reinforcing steel information given in structural drawings, Sheet S3, Details 2-4: horizontal reinforcing steel ratio = 0.0024 > 0.0007 → OK vertical reinforcing steel ratio = 0.0024 > 0.0007 → OK Total reinforcing steel ratio = 0.0048 > 0.002 → OK Horizontal and vertical spacing = 16” < 48” → OK

STIFF DIAPHRAGMS

C	NC	N/A	U	Description
○	○	●	○	TOPPING SLAB: Precast concrete diaphragm elements are interconnected by a continuous reinforced concrete topping slab. (Commentary: Sec. A.4.5.1. Tier 2: Sec. 5.6.4) **Comments:** Flexible diaphragm.

CONNECTIONS

C	NC	N/A	U	Description

Note: **C** = Compliant **NC** = Noncompliant **N/A** = Not Applicable **U** = Unknown

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Collapse Prevention Structural Checklist For Building Type RM1-RM2

C	NC	N/A	U	
◉	○	○	○	WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7. (Commentary: Sec. A.5.1.1. Tier 2: Sec. 5.7.1.1) **Comments:** - Per Detail 16 in structural drawings, Sheet S8: The bottom flange of truss joists are nailed to ST 6224 strap ties at 4'-0" c.c. w/ 8-10d @ minimum spacing 3" o.c.. The strap ties are nailed to 3x nailer w/ 8-10d. The 3x nailer is anchored to the CMU wall w/ ¾" Φ anchor bolts at 32" o.c. - Per Detail 14 in structural drawings, Sheet S8: 3x8 ledgers are anchored to the CMU wall with ¾" Φ anchor bolts at 16" and 8" o.c. The filler plates on both sides of the truss joist in the vicinity of the connection are nailed to the PATM 25 at 4'-0" o.c. anchored to the wall. - Per Detail 9 in structural drawings, Sheet S3: The truss joist is positively anchored to the CMU wall with HD rods. - Per Detail 7 in structural drawings, Sheet S8: The GLB is bolted to the ECCO column cap which is welded to the pipe column with one-sided 3/16" fillet weld. The steel pipe column is embedded in the CMU wall. - Per Detail 1 in structural drawings, Sheet S8: the diaphragm is positively anchored to the CMU walls with PA 35 anchors at 4'-00" o.c. in 3" Φ holes in blocks. - Per Detail 9 in structural drawings, Sheet S5: The truss joists in the vicinity of the connection are bolted to the PATM 25 at 4'-0" o.c. w/ 3-1/2" machine bolts. PATM 25 ties are anchored to the wall.
C	NC	N/A	U	
◉	○	○	○	WOOD LEDGERS: The connection between the wall panels and the diaphragm does not induce cross-grain bending or tension in the wood ledgers. (Commentary: Sec. A.5.1.2. Tier 2: Sec. 5.7.1.3) **Comments:** Per details below, the connection between the wall panels and the diaphragm does not induce cross-grain bending or tension in the wood ledgers: - Detail 16 in structural drawings, Sheet S8: The bottom flange of truss joists are nailed to ST 6224 strap ties at 4'-00" c.c. w/ 8-10d @ minimum spacing 3" o.c.. The strap ties are nailed to 3x nailer w/ 8-10d. The 3x nailer is anchored to the CMU wall w/ ¾" Φ anchor bolts at 32" o.c. - Detail 14 in structural drawings, Sheet S8: 3x8 ledgers are anchored to the CMU wall with ¾" Φ anchor bolts at 16" and 8" o.c. The filler plates on both sides of the truss joist in the vicinity of the connection are nailed to the PATM 25 at 4'-00" o.c. anchored to the wall. - Detail 9 in structural drawings, Sheet S3: The truss joist is positively anchored to the CMU wall with HD rods. - Detail 7 in structural drawings, Sheet S8: The GLB is bolted to the ECCO column cap which is welded to the pipe column with one-sided 3/16" fillet weld. The steel pipe column is embedded in the CMU wall. - Detail 1 in structural drawings, Sheet S8: the diaphragm is positively anchored to the CMU walls with PA 35 anchors at 4'-0" o.c. in 3" Φ holes in blocks. - Per detail 9 in structural drawings, Sheet S5: The truss joists in the vicinity of the connection are bolted to the PATM 25 at 4'-0" o.c. w/ 3-1/2" machine bolts. PATM 25 ties are anchored to the wall.

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C	NC	N/A	U	
◉	○	○	○	TRANSFER TO SHEAR WALLS: Diaphragms are connected for transfer of seismic forces to the shear walls. (Commentary: Sec. A.5.2.1. Tier 2: Sec. 5.7.2) **Comments:** Per details shown in structural drawings, Sheets S3, S5, and S8.
○	○	◉	○	TOPPING SLAB TO WALLS OR FRAMES: Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements are doweled for transfer of forces into the shear wall or frame elements. (Commentary: Sec. A.5.2.3. Tier 2: Sec. 5.7.2) **Comments:** No topping slab.
◉	○	○	○	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation. (Commentary: Sec. A.5.3.5. Tier 2: Sec. 5.7.3.4) **Comments:** Wall reinforcement is doweled into the foundation per the masonry reinforcing steel information given in structural drawings, Sheet S3, Details 3, 4.
◉	○	○	○	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) **Comments:** - Structural steel angle w/ 7/8" dia. through bolts are used to connect girder and column per Detail 11 on Sheet S-8. - Per Detail 7 in structural drawings, Sheet S8: The GLB is bolted to the ECCO column cap which is welded to the pipe column with one-sided 8/16" fillet weld. The steel pipe column is embedded in the CMU wall.

HIGH SEISMICITY (COMPLETE THE FOLLOWING ITEMS IN ADDITION TO THE ITEMS FOR LOW AND MODERATE SEISMICITY)

STIFF DIAPHRAGMS

				Description
C	NC	N/A	U	
○	○	◉	○	OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls are less than 25% of the wall length. (Commentary: Sec. A.4.1.4. Tier 2: Sec. 5.6.1.3) **Comments:** Flexible diaphragm.
○	○	◉	○	OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls are not greater than 8 ft (2.4 m) long. (Commentary: Sec. A.4.1.6. Tier 2: Sec. 5.6.1.3) **Comments:** Flexible diaphragm.

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FLEXIBLE DIAPHRAGMS

C	NC	N/A	U	Description
●	○	○	○	CROSS TIES: There are continuous cross ties between diaphragm chords. (Commentary: Sec. A.4.1.2. Tier 2: Sec. 5.6.1.2) **Comments:** There are continuous cross ties between diaphragm chords.
●	○	○	○	OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls are less than 25% of the wall length. (Commentary: Sec. A.4.1.4. Tier 2: Sec. 5.6.1.3) **Comments:** No large diaphragm openings adjacent to the shear walls.
●	○	○	○	OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls are not greater than 8 ft (2.4 m) long. (Commentary: Sec. A.4.1.6. Tier 2: Sec. 5.6.1.3) **Comments:** No large diaphragm openings adjacent to exterior masonry shear walls.
○	○	●	○	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 2-to-1 in the direction being considered. (Commentary: Sec. A.4.2.1. Tier 2: Sec. 5.6.2) **Comments:** 1/2” and 3/4” plywood per Detail 3 in Sheet S-2.
●	○	○	○	SPANS: All wood diaphragms with spans greater than 24 ft (7.3 m) consist of wood structural panels or diagonal sheathing. (Commentary: Sec. A.4.2.2. Tier 2: Sec. 5.6.2) **Comments:** 1/2” and 3/4” plywood per detail 3 in Sheet S-2.
●	○	○	○	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12.2 m) and aspect ratios less than or equal to 4-to-1. (Commentary: Sec. A.4.2.3. Tier 2: Sec. 5.6.2) **Comments:** Unblocked diaphragms at the higher roof have horizontal spans less than 40 ft and aspect ratios less than 4:1.
●	○	○	○	OTHER DIAPHRAGMS: Diaphragms do 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) **Comments:** 1/2” and 3/4” plywood per Detail 3 in Sheet S-2.

Note: **C** = Compliant **NC** = Noncompliant **N/A** = Not Applicable **U** = Unknown

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CONNECTIONS

C	NC	N/A	U	Description
◉	○	○	○	STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements are installed taut and are stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 in. (3 mm) before engagement of the anchors. (Commentary: Sec. A.5.1.4. Tier 2: Sec. 5.7.1.2) **Comments:** Per details below, the anchors of CMU walls to wood diaphragms are expected to be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 in. before engagement of the anchors. - Detail 16 in structural drawings, Sheet S8: The bottom flange of truss joists are nailed to ST 6224 strap ties at 4'-00" c.c. w/ 8-10d @ minimum spacing 3" o.c. The strap ties are nailed to 3x nailer w/ 8-10d. The 3x nailer is anchored to the CMU wall w/ ¾" Φ anchor bolts at 32" o.c. - Detail 14 in structural drawings, Sheet S8: 3x8 ledgers are anchored to the CMU wall with ¾" Φ anchor bolts at 16" and 8" o.c. The filler plates on both sides of the truss joist in the vicinity of the connection are nailed to the PATM 25 at 4'-0" o.c. anchored to the wall. - Detail 9 in structural drawings, Sheet S3: The truss joist is positively anchored to the CMU wall with HD rods. - Detail 7 in structural drawings, Sheet S8: The GLB is bolted to the ECCO column cap which is welded to the pipe column with one-sided 8/16" fillet weld. The steel pipe column is embedded in the CMU wall. - Detail 1 in structural drawings, Sheet S8: the diaphragm is positively anchored to the CMU walls with PA 35 anchors at 4'-0" o.c. in 3" Φ holes in blocks. - Per Detail 9 in structural drawings, Sheet S5: The truss joists in the vicinity of the connection are bolted to the PATM 25 at 4'-0" o.c. w/ 3-1/2" machine bolts. PATM 25 ties are anchored to the wall.

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Collapse Prevention Structural Checklist For Building Type W2

LOW AND MODERATE SEISMICITY

SEISMIC-FORCE-RESISTING SYSTEM

C	NC	N/A	U	Description
◉	○	○	○	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) **Comments:** The number of shear wall lines in each principal direction equals 4.
◉	○	○	○	SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, 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 **Comments:** - Average shear stress in N-S direction: 993 plf < 1000 plf → OK - Average shear stress in E-W direction: 596 plf < 1000 plf → OK
○	○	◉	○	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) **Comments:** One-story shear walls.
◉	○	○	○	GYPSUM WALLBOARD OR PLASTER SHEAR WALLS: Interior plaster or gypsum wallboard is not used for 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) **Comments:** Plywood is used for shear walls.
◉	○	○	○	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) **Comments:** No narrow wood shear walls.
◉	○	○	○	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) **Comments:** Overturning is transferred from wood walls to CMU walls via Simpson HD holdowns at shear wall ends.

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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-1. (Commentary: Sec. A.3.2.7.6. Tier 2: Sec. 5.5.3.6.3) **Comments:** No sloping site.
○	○	◉	○	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) **Comments**: No cripple walls.
◉	○	○	○	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) **Comments:** No large openings observed in wood shear walls.

CONNECTIONS

C	NC	N/A	U	Description
◉	○	○	○	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) **Comments:** PB post bases are used for column base connection to concrete foundation per Detail 10 on Sheet S-2.
○	○	◉	○	WOOD SILLS: All wood sills are bolted to the foundation. (Commentary: Sec. A.5.3.4. Tier 2: Sec. 5.7.3.3) **Comments:** No wood sills at foundation level.
◉	○	○	○	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) **Comments:** Structural steel angles w/ 7/8" dia. through bolts are used to connect girder and column per Detail 11 on Sheet S-8.

HIGH SEISMICITY (COMPLETE THE FOLLOWING ITEMS IN ADDITION TO THE ITEMS FOR LOW AND MODERATE SEISMICITY)

CONNECTIONS

C	NC	N/A	U	Description
◉	○	○	○	WOOD SILL BOLTS: Sill bolts are spaced at 6 ft (1.8 m) or less with acceptable edge and end distance provided for wood and concrete. (Commentary: A.5.3.7. Tier 2: Sec. 5.7.3.3) **Comments:** Sill bolt spacing is less than 6 ft for the will below second floor framing and on top of the CMU. Details are shown on Sheet S8.

Note: **C** = Compliant **NC** = Noncompliant **N/A** = Not Applicable **U** = Unknown

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DIAPHRAGMS

C	NC	N/A	U	Description
●	○	○	○	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) **Comments:** The diaphragm is continuous.
●	○	○	○	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) **Comments:** Roof chords are continuous.
○	○	●	○	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) **Comments:** No large opening observed in the roof diaphragm.
○	○	●	○	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 2-to-1 in the direction being considered. (Commentary: Sec. A.4.2.1. Tier 2: Sec. 5.6.2) **Comments:** 1/2” and 3/4” plywood per Detail 3 in Sheet S-2.
●	○	○	○	SPANS: All wood diaphragms with spans greater than 24 ft (7.3 m) consist of wood structural panels or diagonal sheathing. (Commentary: Sec. A.4.2.2. Tier 2: Sec. 5.6.2) **Comments:** 1/2” and 3/4” plywood per Detail 3 in Sheet S-2.
○	○	●	○	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12.2 m) and have aspect ratios less than or equal to 4-to-1. (Commentary: Sec. A.4.2.3. Tier 2: Sec. 5.6.2) **Comments:** 1/2” and 3/4” plywood per Detail 3 in Sheet S-2.
●	○	○	○	OTHER DIAPHRAGMS: The diaphragms do 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) **Comments:** 1/2” and 3/4” plywood per Detail 3 in Sheet S-2.

APPENDIX C

UCOP Seismic Safety Policy Falling Hazards Assessment Summary

UC Campus:	Santa Cruz			Date:	06/28/2019		
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UCOP SEISMIC SAFETY POLICY
Falling Hazard Assessment Summary

	Description
P ☐ N/A ☒	**Heavy ceilings, features or ornamentation above large lecture halls, auditoriums, lobbies, or other areas where large numbers of people congregate (50 ppl or more)** **Comments:** There are no heavy ceilings, features, or ornamentation in this building.
P ☐ N/A ☒	**Heavy masonry or stone veneer above exit ways or public access areas** **Comments:** The egress path goes through the exterior reinforced CMU walls; however, exterior CMU walls are reinforced and do not represent a falling hazard.
P ☐ N/A ☒	**Unbraced masonry parapets, cornices, or other ornamentation above exit ways or public access areas** **Comments:** Masonry parapets are reinforced and positively braced by floor beams.
P ☒ N/A ☐	**Unrestrained hazardous material storage** **Comments:** Chemicals stored in rooms 118 and 119 are used in the pool filtration system; existing drawings do not specify if those chemicals are classified as hazardous. A cursory review of those rooms identified that tanks storing those chemicals are not restrained. Facilities personnel indicated that this room is scheduled to undergo remodeling. If that occurs, we recommend that all containers holding hazardous materials are identified and restrained to current provisions.
P ☐ N/A ☒	**Masonry chimneys** **Comments:** There are no masonry chimneys.
P ☐ N/A ☒	**Unrestrained natural gas-fueled equipment such as water heaters, boilers, emergency generators, etc.** **Comments:** Visual observation of equipment in Room 134 showed that most (if not all) feature anchors to the floor. Switchgear equipment and other electrical panels are anchored to a CMU wall.
P ☒ N/A ☐	**Other:** Unbraced Piping in Room 134 **Comments:** Room 134 is the cogen room, and as such it contains substantial equipment, associated piping, and conduit. It appears that some piping was not restrained as would be required under current provisions. There are many exceptions under which the piping/conduit is exempt from provisions depending on its size, its service, distance to adjacent obstacles, distance to support above, etc. A cursory Tier 1 evaluation can only identify the possibility of a deficiency. A more focused, detailed MEP distribution system evaluation of the cogen room would be necessary to rule out the presence of a deficiency and its associated life-safety hazard.

Falling Hazards Risk: Low.

Unrestrained Hazardous Materials Risk: Moderate-High.

Note: P= Present, N/A = Not Applicable

APPENDIX D

Quick Check Calculations

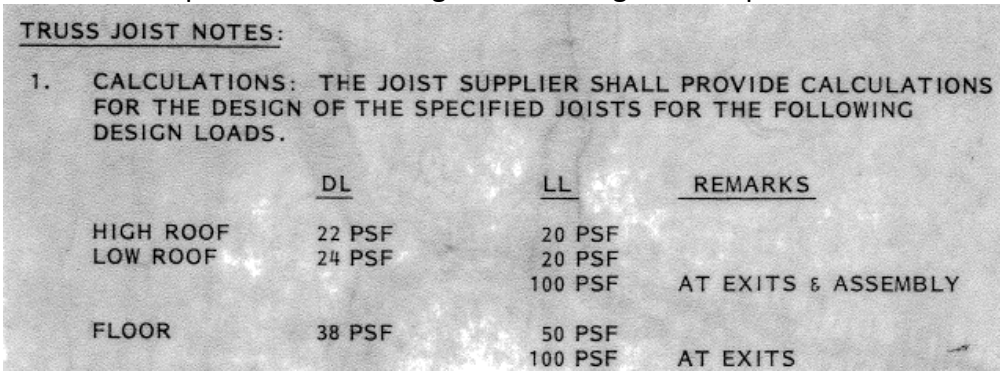
Unit Weights:

	Seismic Weight	Dead Load	
High Roof	**psf**	**psf**	**Remarks**
Roofing	6	6	Built-up Roof, 4-Ply, Gravel-Surfaced
Sheathing Board	1.5	1.5	1/2" plywood
Joists	2.5	2.5	14" TJI 35@16"
Ceiling	2	2	typ. gypboard ceiling panels
MEP	5	5	
Lighting and misc.	3	3	
Columns	0.161	0.161	
Partition+Plywood shear walls	7.5	0.0	Half of 15 psf
Parapet	2.0	0.0	
Total	30	20	

	Seismic Weight	Dead Load	
Low Roof	**psf**	**psf**	**Remarks**
Roofing	6	6	Built-up Roof, 4-Ply, Gravel-Surfaced
Sheathing Board	2.1	2.1	3/4" plywood
Joists	2.5	2.5	14" TJI 35@16"
Ceiling	2	2	typ. gypboard ceiling panels
MEP	3	3	
Lighting and misc.	5	5	
Columns	0.880	0.880	
Partition	5	0	Half of 10 psf
Parapet	15.7	0.0	CMU wall
Total	42	21	

	Seismic Weight	Dead Load	
2nd Floor	**psf**	**psf**	**Remarks**
Finishing	1	1	linoleum tiles
Gypcrete	13	13	1 1/2"
Sheathing Board	2.1	2.1	3/4" plywood
Joists	3.0	3.0	20" TJI 35@16"
Ceiling	2	2	typ. gypboard ceiling panels
MEP	3	3	
Lighting and misc.	5	5	
Partition+Plywood shear walls	12.5	12.5	Half of 15 psf+Half of 10 psf
Columns	0.880	0.880	
Total	43	43	

Below is a snapshot of S5 showing that our weight assumptions are reasonable:



TRUSS JOIST NOTES:

1. CALCULATIONS: THE JOIST SUPPLIER SHALL PROVIDE CALCULATIONS FOR THE DESIGN OF THE SPECIFIED JOISTS FOR THE FOLLOWING DESIGN LOADS.

	DL	LL	REMARKS
HIGH ROOF	22 PSF	20 PSF	
LOW ROOF	24 PSF	20 PSF	
		100 PSF	AT EXITS & ASSEMBLY
FLOOR	38 PSF	50 PSF	
		100 PSF	AT EXITS

Story Weights

W_CMU= 84 psf
w_CMU= 126 pcf
Wall Opening factor 0.9

Floor Levels	Floor Area (ft2)	Floor Weight (psf)	Wall Weight [1,2,3]					Additional Weight (kips) [4]	Total Seismic Weight (kips)
			Wall height below floor level (ft)	Wall height tributary to each floor level (ft)	Wall Area below (ft^2)	Wall Weight below (kips)	Wall Seismic Weight (kips)		
High Roof	6,936	30		0.00					206
Low Roof	5,623	42							237
2nd Floor	7,080	43	13.50	6.75	666	1,133	510	57.1	868
							Total Weight (kips) =		1,311

Notes:
1 - Seismic base is set at the 1st floor. Soil-structure interaction is ignored for ASCE 41-17 Tier 1.
2 - Wall weight includes area of exterior and interior concrete masonry walls.
3 - Wall weight is caculated for solid grouted 8" wall with normal weight CMUs (135 pcf) and grout weight of 140 pcf.
4 - 25% of the non-reducible live load (125 psf) is added to the seismic weight of the outdoor rental room with 488 sf area.
- 5 psf extra seismic dead load is considered for the pipes hanging from the ceiling in room 115 at ground level.
- 50 psf extra seismic dead load is considered for the large pipes hanging from the ceiling in room 134 at ground level.

Period

C_t=	0.02
h_n (ft)=	26.58
B=	0.75

T=	0.23	sec

Notes:
1- The period calculated per ASCE 41-17 Equation 4-4.

$$T = C_t \cdot h_n^{B}$$

2- Ct and B are for "all other framing system" per ASCE 41-17 Section 4.4.2.4.
3- The building height is taken from the 1st floor to the roof.

BSE-2E Response Spectrum

OSHPD

7743

Latitude, Longitude: 36.995029, -122.054086

Date	5/31/2019, 9:28:31 AM
Design Code Reference Document	ASCE41-17
Custom Probability	
Site Class	D - Stiff Soil

Type	Description	Value
Hazard Level		BSE-2E
S_S	spectral response (0.2 s)	1.285
S_1	spectral response (1.0 s)	0.487
S_{XS}	site-modified spectral response (0.2 s)	1.285
S_{X1}	site-modified spectral response (1.0 s)	0.883
f_a	site amplification factor (0.2 s)	1
f_v	site amplification factor (1.0 s)	1.813

Story Shears

Sa=	1.285	
W=	1,311	kips
C=	1.2	Per ASCE 41-17 Table 4-7 [1]

1 - Modification Factor, C, per ASCE 41-17, Table 4-7 for RM shear wall is used. The shear stress in wood-framed walls at the second story is adjusted by a factor of 1.1/1.2.

V=	2,021	kips

k=	1.00	

Floor Levels	Story Height (ft)	Total Height, H (ft)	Weight, W (kips)	W x H^k	coeff	Fx (kips)	Story Shear, V (kips)
High Roof	13.08	26.58	206	5,464	0.27	542	542
2nd Floor	13.50	13.50	1,105	14,921	0.73	1,479	2,021
			Σ=	20,385	1	2,021	

Notes:
1- The base of building is assumed to be at the 1st floor.

Average Stress in CMU wall:

Average Stresses

Ms =	4.5

Second floor

Direction	Story Shear	Wall Area	Opening ratio	Average Shear Stress	Tier 1 Shear Stress Limit	Wall OK?
	(kips)	(in^2)		(psi)	(psi)	
E-W direction	2,021	51,256	0.80	11.0	70	OK
N-S direction	2,021	44,664	0.80	12.6	70	OK

Second floor

Direction	Effective Wall Area	Tributary Area	Story Shear	Wall Shear[1]	Average Shear Stress	Tier 1 Shear Stress Limit	Wall OK?
	(in^2)	(ft^2)	(kips)	(kips)	(psi)	(psi)	
E-W direction: walls on the north side with openings on top	1,600	1,740	2,021	277	38.5	70	OK

1 -Flexible diaphragm: diaphragm load is distributed to shear walls by the tributary area.

Average Stress in Wood-framed Wall (Connected to CMU walls):

Average Stresses

Ms =	4.5

Direction	Story Shear	Wall Length	Opening ratio	Average Shear Stress	Tier 1 Shear Stress Limit	Wall OK?
	(kips)	(ft)		(plf)	(plf)	
E-W direction	542	232	0.80	595.9	1000	OK
N-S direction	542	139	0.80	993.1	1000	OK