Rating form completed by:
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Text in green is to be part of UC Santa Cruz building database and may be part of UCOP database

UC Santa Cruz building seismic ratings

Stevenson College House 8, University of California Santa Cruz

CAAN #7142
547 Stevenson Service Road, Santa Cruz, CA 95064
UCSC Campus: Main Campus

REGISTERED PROFESSIONAL ENGINEER JOSEPH RICHARD MAFFEI No. 3694 STRUCTURAL STATE OF CALIFORNIA

DATE: 2018-12-31

Rating summary	Entry	Notes
UC Seismic Performance Level (rating)	IV (Fair)	
Rating basis	Tier 1	ASCE 41-17[1]
Date of rating	2018	
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	No previous rating reported
Further evaluation recommended?	No	

[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 UC Seismic Policy and Method B of Section 321 of the 2016 California Existing Building Code.

[2] Per Section 3.A.4.i of the Seismic Program Guidebook, 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

- Original construction drawings by Joseph Esherick and Associates (architect), "Residential College No. 2," dated 1965-1-20 (147 sheets with architectural, structural, MEP drawings). Structural drawings by Rutherford and Chekene (drawings for Stevenson College 8 on sheets S23-S28).
- University of California building database information, "Stevenson College 8," provided by Jose Sanchez (UCSC) on 2018-12-12.

Additional building information known to exist

- None

Scope for completing this form

We reviewed structural drawings for original construction and carried out ASCE 41-17 Tier 1 evaluation. We did not make site visit or evaluate non-structural life-safety hazards but we reviewed photos by UCSC staff.

Brief description of structure

Stevenson College 8 is one of a cluster of four similar buildings that are part of the residential component of Stevenson College (formerly College Two Women's Hall) at the campus. The complex was designed in 1965 by the architectural office of Joseph Esherick and Associates and the structural office of Rutherford and Chekene; construction was completed in 1966.

The building has an area of approximately 12,076 square feet and three stories above grade. There is a partial one-story basement at the southwest corner of the building. The floor plate is rectangular in plan, 50 feet north-south by 74 feet east-west.

Foundation System: The building is on a slightly sloping site, sloping downhill from north to south. The foundation of the building consists of 12" wide foundation walls located under the wood shear walls. A partial basement occurs at the southwest corner of the building, with concrete perimeter walls bearing on strip footings.

Structural system for vertical (gravity) load: Wood framing is provided at floor levels 1, 2, 3, and roof. Typical floors at levels 1, 2, 3 are framed using 2x12 joists at 16" spacing, spanning north-south and supported by wood walls. Floors are topped with 1-1/8" plywood sheathing. The roof is divided into a sloped asphalt-shingled roof area around the perimeter of the building, and a flat roof area at the center space of the roof. The sloped portions of the roof are framed with 5/16" plywood over 3" decking which spans between the exterior walls and a ring of interior walls, and the flat portion of the roof is framed with 3/8" plywood sheathing over 2x10 rafters at 16" spacing which span between the interior walls.

Structural system for lateral forces: Plywood sheathed wood-framed walls are provided in both the east-west and north-south directions, located around the building perimeter and around the stair/utility core at the center of the building. Some shear walls are not continuous from top to foundation. Where discontinuous walls occur, supplemental beams and/or posts are provided to resist the overturning moment of the discontinuous wall. Typical walls consist of 2x4 studs at 16" spacing with 3/8" plywood sheathing.

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

Identified seismic deficiencies of the building include the following:

- Discontinuous walls occur at Level 3 and Level 2. At Level 3, the interior rows of east-west walls that support one side of the sloped portions of the roof are discontinuous. To support these walls, the spacing of the floor joists was reduced to 12". At Level 2, approximately 12% of the north-south walls are discontinuous, most of them located at the east end of the building. Beams and posts were provided to support these discontinuous walls.
- No hold-downs (except at two specifically-called-out locations at the foundation) are indicated in the drawings, including at the ends of wall piers. Wall piers of short length occur at the interior walls, and these piers may uplift and rock at the foundation.

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 non-structural life- safety concerns, including at exit routes.[3]

None known by those familiar with the building. We did not visit building interior.

UCOP non-structural checklist item	Life safety hazard?	UCOP non-structural 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	None observed
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

Discussion of rating

The building deficiencies include discontinuous walls and a lack of hold-downs at the ends of wall piers. Although overall shear demand-to-capacity ratios are low in the shear walls, these deficiencies could lead to damage in the walls especially at the first floor where shear demand-to-capacity is higher. We recommend a rating of IV (Fair). The rating may be raised to III (Good) with further evaluation.

Recommendations for further evaluation or retrofit

We recommend that the University perform a more detailed seismic evaluation to assess the supports under the discontinuous walls and to verify whether hold-downs should be provided at the ends of wall piers, especially at the connection to the foundation. We recommend a Tier 2 linear static analysis.

Peer review of rating

The key issues and expected seismic performance of this building are essentially the same as that for buildings 7139, 7140, and 7141. The peer review of these buildings, carried out 17 June 2019, applies to this building; reviewer present was Bret Lizundia of R+C.

[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 the type and location of potential non-structural hazards.

Additional building data	Entry	Notes
Latitude	36.997401	
Longitude	-122.05138	
Are there other structures besides this one under the same CAAN#	No	
Number of stories above lowest perimeter grade	3	
Number of stories (basements) below lowest perimeter grade	1	
Building occupiable area (OGSF)	12076	
Risk Category per 2016 CBC Table 1604.5	II	Residential occupancy (dormitory)
Estimated fundamental period	0.24 sec	Estimated using ASCE 41-17 equation 4-4 and 7-18
Building height, h_n	28 ft	Structural height defined per ASCE 7-16 Section 11.2
Coefficient for period, C_t	0.020	Defined per ASCE 41-17 equation 4-4 and 7-18
Coefficient for period, β	0.75	Defined per ASCE 41-17 equation 4-4 and 7-18
Site data		
975 yr hazard parameters S_s, S_1	1.286, 0.488	
Site class	D	
Site class basis[4]	Geotech	See footnote below
Site parameters F_a, F_v[5]	1, 1.81	
Ground motion parameters S_{cs}, S_{c1}	1.286, 0.885	
S_a at building period	1.29	
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

[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

[5] F_V factor used does not include the requirements of Section 11.4.8-3 of ASCE 7-16 that are applicable to Site Class D, and which per Exception 2 would result in an effective F_V factor of 2.72 (1.5 times larger). At the Santa Cruz main campus this only affects structures with T>0.69 seconds. We understand that the appropriateness of this requirement of Section 11.4.8 might be reviewed by UCOP.

Site-specific ground motion study?	No	
Applicable code		
Applicable code or approx. date of original construction	Built: 1965 Code: 1964 UBC	Code specified construction drawing General Notes
Applicable code for partial retrofit	None	No partial retrofit known
Applicable code for full retrofit	None	No full retrofit known
FEMA P-154 data		
Model building type North-South	W1 Wood wall	
Model building type East-West	W1 Wood wall	
FEMA P-154 score	N/A	Not included here, ASCE 41 Tier 1 evaluation performed.
Previous ratings		
Most recent rating	-	No known previous rating
Date of most recent rating	-	
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

Figure: Annotated floor plan (3rd floor shown)

Figure: Annotated floor plan (2nd floor shown)

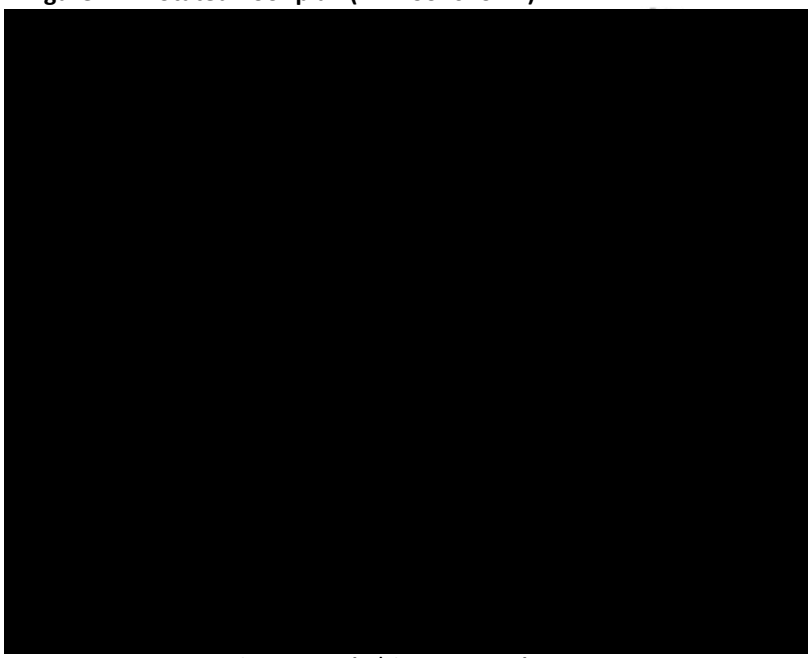

Figure: Annotated floor plan (1st floor shown)

UC Campus:	University of California Santa Cruz			Date:	12/19/2018		
Building CAAN:	7142	Auxiliary CAAN:	-	By Firm:	Maffei Structural Engineering		
Building Name:	Stevenson College House 8			Initials:	*NY*	Checked:	*JRM*
Building Address:	547 Stevenson Service Road, Santa Cruz CA 95064			Page:	1	of	3

ASCE 41-17
Collapse Prevention Basic Configuration Checklist

LOW SEISMICITY

BUILDING SYSTEMS - *GENERAL*

C	NC	N/A	U	Description
○	○	○	○	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: C**
○	○	○	○	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: C –** no adjacent buildings
○	○	○	○	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: N/A –** no mezzanine

BUILDING SYSTEMS - *BUILDING CONFIGURATION*

C	NC	N/A	U	Description
○	○	○	○	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: C**
○	○	○	○	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: C**

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

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Building Name:	Stevenson College House 8			Initials:	*NY*	Checked:	*JRM*
Building Address:	547 Stevenson Service Road, Santa Cruz CA 95064			Page:	2	of	3

ASCE 41-17
Collapse Prevention Basic Configuration Checklist

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: NC –** discontinuous walls occur at Level 3 and 2. At Level 3, joists are increased to 2x12 under discontinuous walls. At Level 2, beams and posts are provided under discontinuous walls.
○	○	○	○	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: C**
○	○	○	○	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: C**
○	○	○	○	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: C**

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

GEOLOGIC SITE HAZARD

		Description
C NC N/A U	○ ○ ○ ○	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: C**
C NC N/A U	○ ○ ○ ○	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: C**

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

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Building Address:	547 Stevenson Service Road, Santa Cruz CA 95064			Page:	3	of	3

ASCE 41-17
Collapse Prevention Basic Configuration Checklist

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

GEOLOGIC SITE HAZARD

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) **Comments: C**

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

FOUNDATION CONFIGURATION

C	NC	N/A	U	Description
○	○	○	○	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: NC –** least horizontal dimension occurs at core wall north-south wall, L=16' and h= 28'. L/h = 0.57 < 0.6Sa = 0.6*1.55 = 0.93. Stem wall provided perpendicular to wall and may serve to distribute soil bearing pressure over a longer effective width.
○	○	○	○	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: C –** majority of foundation is tied together by foundation walls. Remainder is restrained by soil Site Class C.

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Building Name:	Stevenson College 8			Initials:	NY	Checked:	JRM
Building Address:	547 Stevenson Service Road, Santa Cruz, CA 95064			Page:	1	of	3

ASCE 41-17
Collapse Prevention Structural Checklist For Building Type W1-W1A

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: C**
●	○	○	○	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 (14.6 kN/m) Diagonal sheathing: 700 lb/ft (10.2 kN/m) Straight sheathing: 100 lb/ft (1.5 kN/m) All other conditions: 100 lb/ft (1.5 kN/m) **Comments: C –** At Level 1, avg. v,north-south walls = 745 #/ft < 1000 #/ft, OK At Level 1, avg. v, east-west walls = 805 #/ft < 1000#/ft, 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: C**
○	○	○	○	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: C**
○	○	○	○	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: C –** At full-height interior core wall, h = 28', L = 16', h/L = 1.75 < 2 OK At story-height interior wall piers, h = 9.17', L= 6', h/L = 1.5 < 2.0 OK

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Building Address:	547 Stevenson Service Road, Santa Cruz, CA 95064			Page:	2	of	3

ASCE 41-17
Collapse Prevention Structural Checklist For Building Type W1-W1A

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) **Comments: NC** – Hold-downs do not appear to be provided at the ends of wall piers between the floors. Hold-downs are not provided typically at the foundation except at approximately 4 locations.
○	○	○	○	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: N/A**
○	○	○	○	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: C** – cripple walls occur at south and west perimeter walls, plywood sheathing is provided.
○	○	○	○	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: C –** walls do not have openings greater than 80% of their length

CONNECTIONS

				Description
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) **Comments: C**
○	○	○	○	WOOD SILLS: All wood sills are bolted to the foundation. (Commentary: Sec. A.5.3.4. Tier 2: Sec. 5.7.3.3) **Comments: C –** bolts provided at 32” o.c. minimum
○	○	○	○	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: C**

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Building Address:	547 Stevenson Service Road, Santa Cruz, CA 95064			Page:	3	of	3

ASCE 41-17
Collapse Prevention Structural Checklist For Building Type W1-W1A

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

CONNECTIONS

	Description
C NC N/A U	WOOD SILL BOLTS: Sill bolts are spaced at 6 ft or less with acceptable edge and end distance provided for wood and concrete. (Commentary: Sec. A.5.3.7. Tier 2: Sec. 5.7.3.3) **Comments: C –** bolts provided at 32" o.c. minimum

DIAPHRAGMS

	Description
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) **Comments: C**
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) **Comments: C**
C NC N/A U	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: N/A** – plywood sheathed roof diaphragm
C NC N/A U	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: C** – plywood sheathed roof diaphragm
C NC N/A U	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12 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: C –** roof diaphragm is blocked plywood sheathing
C NC N/A U	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: C**

SEISMIC EVALUATION OF EXISTING BUILDINGS - TIER 1 SCREENING

ASCE 41-17 Chapter 4

General

			Reference
Building	Stevenson College 8 (CAAN 7142)		
Architect	Joseph Esherick and Associates		(UCSC database)
Structural Engineer	Rutherford and Chekene		(UCSC database)
Location	547 Stevenson Service Road, Santa Cruz CA 95064		(UCSC database)
Design date	1965		(Construction dwgs dated 7/26/68)
Latitude	36.997401		(Google Earth)
Longitude	-122.05138	Dorm	"
Stories above grade	3		

Seismic parameters

*MSE rule for establishing occupant load for risk category as follows. Assume 50 gross sf/person per 2016 CBC table 1004.1.2 for "Dormitory" function. Therefore, 7308 sf/50 = 146. Assume 146 occupants, less than 5000, '

Risk Category	II*	2016 CBC Table 1604A.5		
Site Class	C	https://earthquake.usgs.gov/hazards/urban/sfbay/soilt		(ASCE 41-17 2.4.1.6, ASCE 7-16 Chapter 20)
Liquefaction hazard	Low	http://data-sccgis.opendata.arcgis.com/datasets/77d38		(ASCE 41-17 3.3.4)
Landslide hazard	Low	http://data-sccgis.opendata.arcgis.com/datasets/7984aabd55ec4a4794ae33d7919bd9c7_133		
S_{DS}	1.312	https://hazards.atcour	Based on ASCE 7-16 DE, used to determine "Level of Seismicity"	(ASCE 41-17 Eq 2-4)
S_{D1}	0.588	https://hazards.atcouncil.org/	Based on ASCE 7-16 DE, used to determine "Level of Seismicity"	(ASCE 41-17 Eq 2-5)
S_{XS}	1.286	For BSE-2E hazard level		(ASCE 41-17 Table 2-2)
S_{X1}	0.885	For BSE-2E hazard level		(ASCE 41-17 Table 2-2)

Scope

Performance level	Collapse Prevention	(ASCE 41-17 Table 2-2)
Seismic hazard level	BSE-2E	(ASCE 41-17 Table 2-2)
Level of seismicity	High	(ASCE 41-17 Table 2-4)
Building type	W1: Wood Light Frames	(ASCE 41-17 Table 3-1)

Material properties

				Notes	
Concrete	f'_c	3	psi	Detault per ASCE 41 Table 4-2	(ASCE 41-17 Table 10-4)
Reinf.	f_y	40	ksi	Detault per ASCE 41 Table 4-3	(ASCE 41-17 Table 10-4)
Wood	F_y	unknown	ksi	No specifications in dwgs	(ASCE 41-17 Table 10-4)
Steel	F_y	N/A	ksi	N/A	(ASCE 41-17 Table 9-1)

Checklists

Benchmark building	No	(ASCE 41-17 Table 3-2)
Checklist(s) req'd	17.1.2 Basic Configuration	(ASCE 41-17 Table 4-6)
	17.12 Structural Checklist for Building Types W1	(ASCE 41-17 Table 4-6)
	~~17.19 Nonstructural Checklist~~ (not performed)	(ASCE 41-17 Table 4-6)

Seismic forces

V	471	kip	$V = Cs_a W$	= 1.29W	(ASCE 41-17 Eq 4-1)
W	367	kip	building weight		(ASCE 41-17 4.4.2.1)
C	1.0		Convert linear elastic to inelastic disp.		(ASCE 41-17 Table 4-7)
S_a	1.29	g	$S_a = S_{x1}/T \le S_{XS}$		(ASCE 41-17 Eq 4-3)
T	0.24	sec	$T = C_t h_n^{\beta}$		(ASCE 41-17 Eq 4-4)
C_t	0.020				(ASCE 41-17 Eq 4-4)
β	0.75				(ASCE 41-17 Eq 4-4)
h_n	28.0	ft	building height		(ASCE 41-17 Eq 4-4)

Story Forces (ASCE 41-17 4-2a) (ASCE 41-17 4-2b)

Story	w	story ht	h	wh^k	F_{story}	F_{story}	V_{story}
	kip	ft	ft			kip	kip
Roof	107.1		28	2999	0.46	215	
3	129.8	9.7	18	2380	0.36	171	215
2	129.8	9.2	9	1190	0.18	85	386
1		9.2	0	0	0.00	0	471
Total	367	28		6569	1	471	

k 1.00 k = 1.0 for T < 0.5, 2.0 for T > 2.5, linear interpolation between

$F_{story} = V(wh^k)/(\Sigma wh^k)$ (ASCE 41-17 4-2a)

$V_{story} = \Sigma_{above} F_{story}$ (ASCE 41-17 4-2b)

Shear stress in shear walls (ASCE 41-17 4-8) (ASCE 41-17 4-8)

Story	$L_{w\,N\text{-}S}$	$L_{w\,E\text{-}W}$	v_{NS}^{avg}	v_{EW}^{avg}	D/C_{NS}	D/C_{EW}
	lf	lf	#/lf	#/lf		
Roof						
3	204	152	234	315	0.2	0.3
2	192	160	448	538	0.4	0.5
1	169	157	620	669	0.6	0.7
Total						

M_s 4.50 (ASCE 41-17 Table 4-8)

v_{limit} 1000 #/ft plywood sheathing

$v^{avg} = (1/M_s)(V_{story}/A_w)$ (ASCE 41-17 Eq 4-8)

STEVENSON COLLEGE 8

Seismic weight table

	W (psf)
ROOF	
◦ Sloped roof -	
Asphalt shingle	2
5/16" plywood	1
3x deck	8.5
1/2" gyp board ceil.	2
Insulation, MEP, misc	5
	18.5 psf, say 19 psf
◦ Flat roof -	
Built-up roof	6
1/2" plywood	1.6
2x10 @ 16" oc	4
1/2" gyp ceiling	2
Insulation, MEP, misc	5
	18.6 psf, say 19 psf
FLOOR	
1 1/8" plywood	3.5
2x10 @ 16" oc (2x12 @ L3)	5
1/2" gyp ceiling	2
Insulation, MEP, misc	5
	15.5 psf, say 16 psf

WALLS

Perimeter walls - 3x4 studs (2x4 above L2) @ 16" oc + insulation + 1/2" gyp board interior + 3/8" plywood + stucco = 13 psf

Interior partitions - assume 10 psf over floor area

STEVENSON COLLEGE 8 (cont)

Weight of building

$A_{floor} = A_{roof} = (50.2')(75.7') = 3800 ft^2$

$Perimeter = 2(50.2') + 2(75.7') = 252 ft$

	Weight
R	$3800 ft^2 (19^{psf}_{roof} + 5^{psf}_{partit.}) + 252'(\frac{9.7'}{2})(13 psf)$ 91200 + 15889 = 107.1 K
3	$3800 (16^{psf}_{floor} + 10^{psf}_{partit.}) + 252'(\frac{18.9'}{2})(13^{psf})$ 98800 + 30958 = 129.8 K
2	= 129.8 K
	W = 366.7 K

Length of walls

E-W	North elevation + north int.	South elevation + south int
R-3rd	75'-5'-7(3') + 41'-8.5'-3'-3' = 75.5' (neglects discontinuous walls)	75'-5'-5'(3)-4.5(3') + 41'-3'(2) = 76.5' (neglects discontinuous walls)
3rd-2nd	75'-3'-5'-7(3') + 41'-8.5'-3'-3' = 72.5'	75'-5'-7(3') + 41'-3' = 87'
2nd-1ST	75'-2(5')-5.5(3') + 41'-8.5'-3'-3' = 76'	75'-7.5'-6(3')-4' + 41'-3'-3' = 80.5'

N-S	East elevation + east int. walls	West elevation + west int. walls
R-3rd	50'-6(3') + 50'-3(3') + 16'-3'+16' = 102'	50'-6(3') + 50'-3(3') + 16'-3'+16' = 102'
3rd-2nd	50'-6(3') + 50'-3(3') + 16'-3'+16' = 102'	50'-17'-3.5(3') + 50'-3(3') + 16'-3'+16' = 89.5'
2nd-1ST	50'-5'-3'-2(1.5') + 10' + 6'+16' = 71'	50'-6(3') + 50'-3(3') + 9'+16' = 98'

Distribute lateral load to piers

Assume distributed in inverse proportion to height (neglect end piers)

	h	1/h	1/h / Σ1/h × 51k
P0	6'	.17	0.40
P1	34'	.029	0.07
P2	44'	.023	0.05
P3	26'	.038	0.09
P4	6'	.17	0.40
	176	0.43	1.0

← controls for brace design

Assume distributed by trib. width

P	L	L/ΣL
P0	36'	0.19
P1	40'	0.21
P2	40'	0.21
P3	40'	0.21
P4	36'	0.19
	192'	

} controls for brace design + vertical design

For V = 67k, for brace design, check end pier and tall pier,

At P0, $T = C = 0.4(67)(\frac{1}{2})(\frac{\sqrt{4^2+6^2}}{4})$

$= 23.7^k$

At P1, $T = C = 0.21(67)(\frac{\sqrt{8.83^2+8^2}}{8.83})$

$= 21.0^k$ << capacity of brace

for vertical design, check tallest tower

At P2, $T = C = 0.21(67)(\frac{44'}{8'}) = 78^k$