Rating form completed by:

MAFFEI STRUCTURAL ENGINEERING
maffei-structure.com
Karl Telleen, Joe Maffei

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

Merrill College Academic Building

CAAN #7189
639 Merrill Road, Santa Cruz, CA 95064
UCSC Campus: Main Campus

DATE: 2019-06-30

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 for modification
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 not previously rated
Further evaluation recommended?	Tier 2	Focused on adequacy of perimeter wall piers, diaphragm continuity at offsets, steel moment frame connections

[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

- Architectural drawings by Campbell & Wong & Associates, "College No. 4, University of California at Santa Cruz," dated 6 July 1967, sheets Cover, A2, A10-A15. (The cover sheet and A2 include general notes and sheet index applicable to seven buildings in the Merrill College complex that were designed at the same time; Sheets A10-A15 address the Academic Building.)
- Structural drawings by Eric Elsesser & Associates, College No. 4, University of California at Santa Cruz," dated 6 July 1967, sheets S1, S2, S27-S35. (S1 and S2 include general notes and typical details applicable to seven buildings in the Merrill College complex that were designed at the same time; Sheets S27-35 address the Academic Building.)

Additional building information known to exist

- None

Scope for completing this form

We reviewed the structural drawings for the original construction and carried out a site visit to verify that the existing drawings matched the existing structure to the best of our knowledge. An ASCE 41-17 Tier 1 evaluation was completed. We did not perform an ASCE 41 Tier 1 nonstructural evaluation, but we looked for potentially hazardous nonstructural components during our site visit.

Brief description of structure

Merrill Academic Building is one of seven buildings in Merrill College (formerly College Four) that were designed in 1967 by the architectural firm Campbell & Wong & Associates and Structural Engineer Eric Elsesser & Associates.

The Academic Building is a two-story building, approximately 18,500 square feet. The building is L-shaped in plan, comprised of two rectangular wings. The site slopes downhill to the south. The elevation of the floor and roof levels of the south wing is approximately 5 feet lower than the north wing. At the north end of the north wing, the first story is partially below-grade. Some portions of the roof are flat, and other portions are sloped; flat portions of the roof are approximately 20 feet above ground floor level; sloped portions have low end approximately 20 feet above ground level and high end approximately 27 feet above ground level.

Identification of levels: Ground floor is at elevation 802.75' at the north wing and 797.63' at the south wing, 2nd floor, roof.

Foundation system: Foundations consist of reinforced concrete strip footings. The ground floor is a 4" slab-on-grade.

Structural system for vertical (gravity) load: The superstructure consists of wood framing. The 2nd floor consists of joists at 16" on center, sheathed with ¾" plywood, plus 1-5/8" lightweight concrete fill with 4x4-14/14 welded wire fabric. The roof consists of joists at 16" on center, sheathed with ½" plywood. Sloped portions of the roof have metal roofing; flat portions have built-up roofing. Joists span to wood stud bearing walls, and in some cases wood post columns.

Structural system for lateral forces: Perimeter walls, walls along the central longitudinal corridors of the wings, and some transverse walls consist of 2x6 studs at 16" on center with ½" plywood sheathing. These walls have 5/8" diameter anchor bolts to the foundation at 32" on center. Most of these walls (except those at the perimeter, where there is little length of wall between windows) are designed as shear walls having posts with tie-down anchors at the ends of the walls. Interior partition walls (non-bearing, transverse) consist of 2x4 studs.

At two locations, there are steel moment frames consisting of W12x31 columns with W12x40 beams at the 2nd Floor and W12x31 beams at the roof. Beam-column connections have full-penetration flange welds with reinforcing fillet, and continuity plates; webs have ¼" fillet each side.

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

- The roof has several portions (sloped portions and flat portions) with different elevations, such that the roof diaphragm is not continuous. Earthquake damage may occur at offsets between the diaphragm levels. However, each portion of the diaphragm has associated shear walls in each direction providing lateral resistance on 3 sides of the diaphragm, so damage at diaphragm offsets is not expected to cause instability.
- Floor levels of the two wings of the building have different elevations. Earthquake damage may occur at the stairway that links the two wings of the building.
- The moment frame beam-column connections for the moment frame at the lecture halls are designed as full penetration welds, which was typical for pre-Northridge connection. The column panel zones do not have adequate shear capacity to develop the strength of the beams. Strong column-weak beam requirements are not satisfied at Level 2. The location of one of the columns offsets at Level 2, such that the column from Level 2 to roof is supported on a cantilevered beam. Although this moment frame is noncompliant per the Tier 1 checks, we judge that the moment frame is backed-up by the wood walls which would prevent excessive drift.

Structural deficiency	Affects rating?	Structural deficiency	Affects rating?
Lateral system stress check (wall shear, column shear or flexure, or brace axial as applicable)	Y	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)	N	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	Y		

Summary of review of non-structural life-safety concerns, including at exit routes.

We walked through all floors of the building and we looked for potentially hazardous nonstructural components during our site visit on 22 May 2019. As shown in the table below, no non-structural hazards were observed.

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 rating of IV (Fair) recognizes that the deficiencies described are not expected to be a collapse risk. In general, the building appears to be well-detailed for a two-story structure of this era of construction.

Recommendations for further evaluation or retrofit

Despite the rating of IV, if the University has plans to modify the building, we recommend a Tier 2 evaluation to consider whether a) diaphragm chords and/or perimeter wall piers should be strengthened and b) the steel moment frame connections should be improved.

Peer review of rating

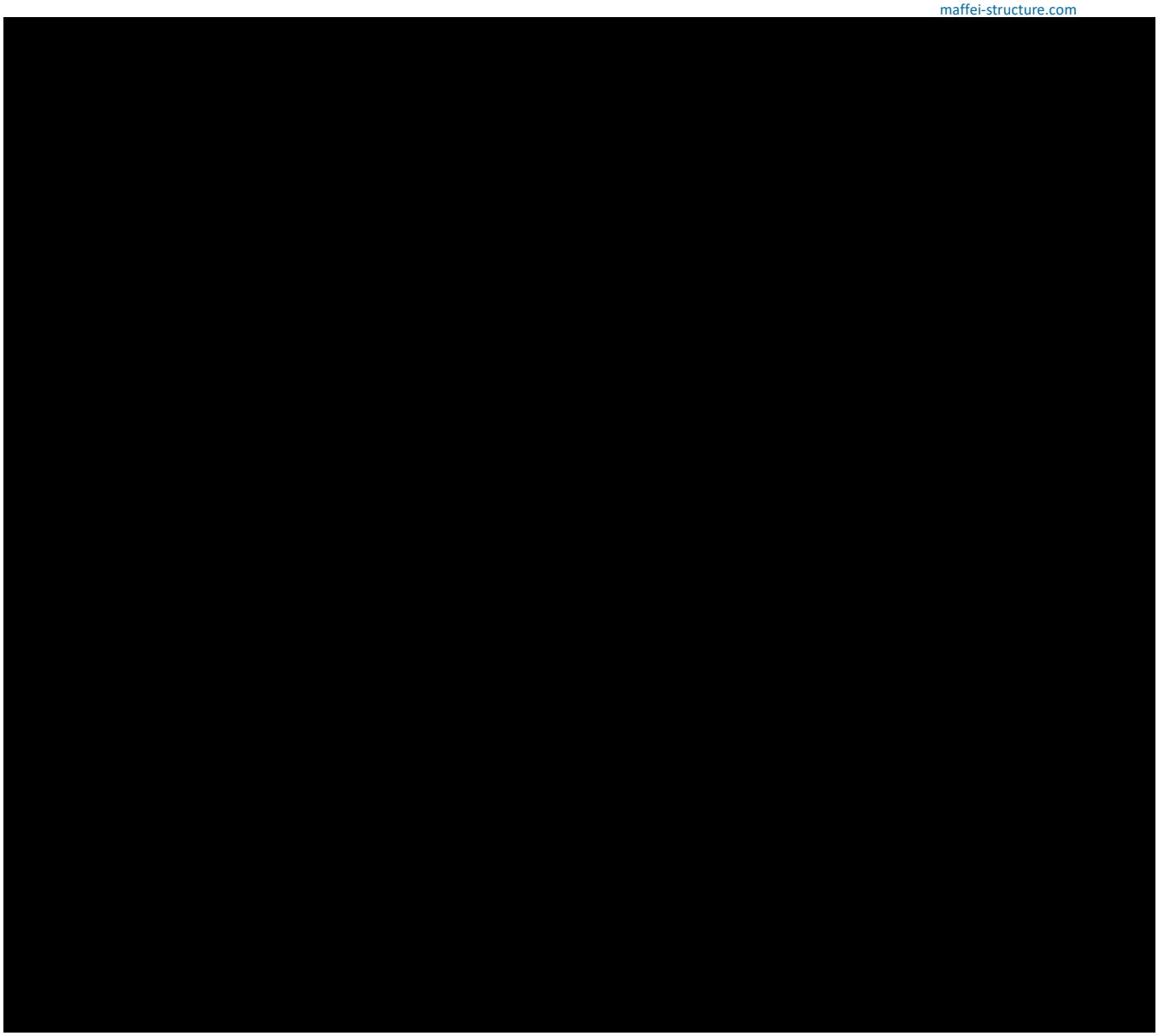
This seismic evaluation was discussed in a peer review meeting on 28 May 2019. Reviewers present were Bret Lizundia of R+C and Holly Razzano and Jay Yin of Degenkolb. Comments from the reviewers have been incorporated into this report. The reviewers agreed with the assigned rating.

Additional building data	Entry	Notes
Latitude	36.999660	
Longitude	-122.053592	
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)	18509	
Risk Category per 2016 CBC Table 1604.5	III	Offices and classrooms. Assumes occupant load greater than 500 with education occupancy (above 12th grade. University to confirm.
Estimated fundamental period	0.21 sec	Estimated using ASCE 41-17 equation 4-4 and 7-18
Building structural height, h_n	23.5 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
Site data		
Ground motion parameters S_{cs}, S_{c1}	1.286, 0.488	
Site class	D	
Site class basis[3]	Geotech	See footnote below
Site parameters F_a, F_v[4]	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	

[3] 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

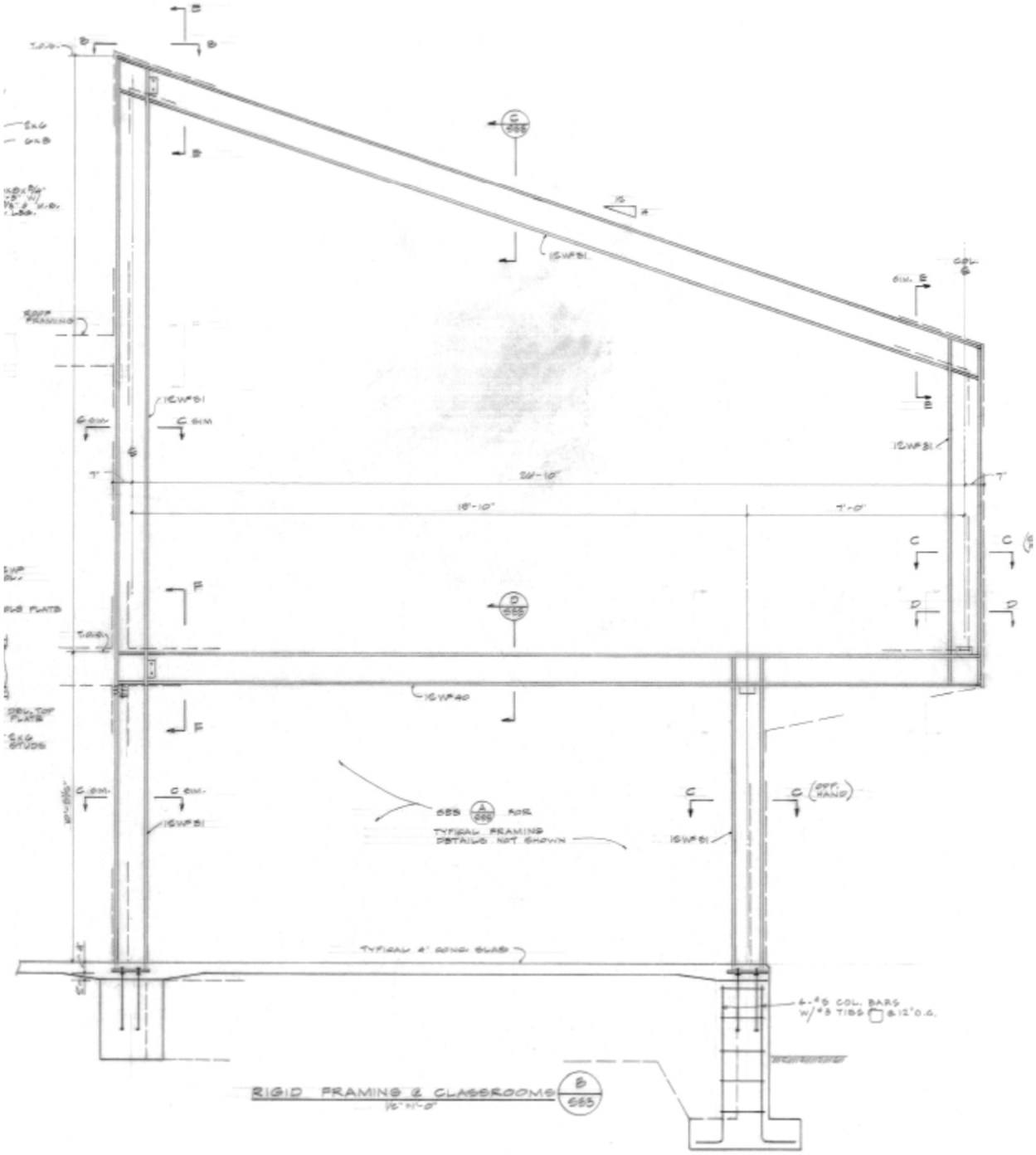
[4] F_V factor used does not include the requirements of Section 11.4.8-3 of ASCE 7-16 that are applicable to Site Class D, and which per Exception 2 would result in an effective F_V factor of 2.72 (1.5 times larger). At the Santa Cruz main campus this only affects structures with T>0.69 seconds. We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

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: 1967 Code: 1964 UBC	Code inferred based on design year
Applicable code for partial retrofit	None	No retrofit
Applicable code for full retrofit	None	No retrofit
FEMA P-154 data		
Model building type North-South	W1a – Wood light frame (more than 3000 sf)	
Model building type East-West	W1a – Wood light frame (more than 3000 sf)	
FEMA P-154 score	N/A	Not included here. Tier 1 evaluation.
Previous ratings		
Most recent rating	None	
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



Ground floor plan. Blue indicates wood shear walls with tie-downs at ends. Red indicates steel moment frames.

2nd Floor plan. Blue indicates wood shear walls with tie-downs at ends. Red indicates steel moment frames.



Steel moment frame

East side

West side

Junction between north and south wings, looking south-west

Bell Tower, looking south

UC Campus:	Santa Cruz			Date:	6/30/2019		
Building CAAN:	7189	Auxiliary CAAN:		By Firm:	Maffei Structural Engineering		
Building Name:	Merrill College Academic Building			Initials:	*KCT*	Checked:	*JRM*
Building Address:	639 Merrill Road, Santa Cruz, CA 95064			Page:	1	of	3

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:**
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:** The north end of the north wing abuts the Commons Building. Structural drawings indicate 2 inches clear between the two structures. 2 inches is more than 1.5% of the height because the roof of the Commons Building is only about 10 feet above grade at this location.
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:**

BUILDING SYSTEMS - *BUILDING CONFIGURATION*

	Description
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:**
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:**

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

UC Campus:	Santa Cruz			Date:	6/30/2019		
Building CAAN:	7189	Auxiliary CAAN:		By Firm:	Maffei Structural Engineering		
Building Name:	Merrill College Academic Building			Initials:	KCT	Checked:	JRM
Building Address:	639 Merrill 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:**
○	○	○	○	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:**
○	○	○	○	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:**
○	○	○	○	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:**

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

GEOLOGIC SITE HAZARD

				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:**
○	○	○	○	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:**

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UC Campus:	Santa Cruz			Date:	6/30/2019		
Building CAAN:	7189	Auxiliary CAAN:		By Firm:	Maffei Structural Engineering		
Building Name:	Merrill College Academic Building			Initials:	*KCT*	Checked:	*JRM*
Building Address:	639 Merrill 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:**

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:** 0.6Sa = 0.92. Width of each wing is about 40 feet, height 23.5 feet average. 23.5/40 = 0.59.
○	○	○	○	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:**

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Building CAAN:	7189	Auxiliary CAAN:		By Firm:	Maffei Structural Engineering		
Building Name:	Merrill College Academic Building			Initials:	*KCT*	Checked:	*JRM*
Building Address:	639 Merrill Road, Santa Cruz, CA 95064			Page:	1	of	4

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

LOW AND MODERATE SEISMICITY

SEISMIC-FORCE-RESISTING SYSTEM

	Description
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) **Comments:**
C NC N/A U ○ ○ ○ ○	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:** Sheathing is ½" plywood. D/C ratio is 1.2 assuming Risk Category III (M-factor halfway between Life Safety and Collapse Prevention for BSE-2), or 1.0 assuming Risk Category II.
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) **Comments:**
C NC N/A U ○ ○ ○ ○	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 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) **Comments:**

UC Campus:	Santa Cruz			Date:	6/30/2019		
Building CAAN:	7189	Auxiliary CAAN:		By Firm:	Maffei Structural Engineering		
Building Name:	Merrill College Academic Building			Initials:	*KCT*	Checked:	*JRM*
Building Address:	639 Merrill Road, Santa Cruz, CA 95064			Page:	2	of	4

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:**
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:**
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) **Comments:**
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) **Comments:** Exterior walls have window openings with narrow wall piers between.

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 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) **Comments:**
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) **Comments:**

UC Campus:	Santa Cruz			Date:	6/30/2019		
Building CAAN:	7189	Auxiliary CAAN:		By Firm:	Maffei Structural Engineering		
Building Name:	Merrill College Academic Building			Initials:	*KCT*	Checked:	*JRM*
Building Address:	639 Merrill Road, Santa Cruz, CA 95064			Page:	3	of	4

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:**

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** The two wings of the buildings have different elevations. Also, within each wing, the roof is composed of flat portions and raised sloping portions. Each portion of diaphragm has associated shear walls in each direction providing lateral resistance on 3 sides of the diaphragm.
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:** Roof chords are not continuous at offsets between sloping portions of the roof and flat portions.
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:**
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:**

UC Campus:	Santa Cruz			Date:	6/30/2019		
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Building Name:	Merrill College Academic Building			Initials:	*KCT*	Checked:	*JRM*
Building Address:	639 Merrill Road, Santa Cruz, CA 95064			Page:	4	of	4

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

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:**
○	○	○	○	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:**

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SEISMIC EVALUATION OF EXISTING BUILDINGS - TIER 1 SCREENING

ASCE 41-17 Chapter 4

General

			Reference
Building	Merrill College Academic Building (CAAN 7189)		
Architect	Campbell & Wong & Associates		(UCSC database)
Structural Engineer	Eric Elsesser & Associates		(UCSC database)
Location	639 Merrill Road, Santa Cruz 95064		(UCSC database)
Design date	1967		(Construction dwgs dated 7/26/68)
Latitude	36.99966		(Google Earth)
Longitude	-122.05359		"
Stories above grade	2		

Seismic parameters

Risk category assumption is based on the assumption that occupant load is greater than 500. Estimate occupant load as 555. Based on assumption of 20 net sf/person per 2016 CBC table 1004.1.2 for "Educational, classroom" and assume 0.6Gross square feet = Net square feet. (0.6)(18,500 sf)/20 = 555.

Risk Category	III*	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}	1.31	https://hazards.atcour	Based on ASCE 7-16 DE, used to determine "Level of Seismicity"	(ASCE 41-17 Eq 2-4)
S_{D1}	0.59	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	W1a: Wood Light Frames, more than 3000 sf	(ASCE 41-17 Table 3-1)

Material properties

				Notes	
Concrete	f'_c	3	psi	Drawings sheet S1	(ASCE 41-17 Table 10-4)
Reinf.	f_y	40	ksi	Drawings sheet S1	(ASCE 41-17 Table 10-4)
					(ASCE 41-17 Table 10-4)
Steel	F_y	36	ksi	Drawings sheet S1	(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	1106	kip	$V = Cs_a W$	= 1.41W	(ASCE 41-17 Eq 4-1)
W	782	kip	building weight		(ASCE 41-17 4.4.2.1)
C	1.1		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	0.21	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	23.5	ft	building height		(ASCE 41-17 Eq 4-4)

Story Forces - overall (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	323		23.5	7591	0.62	683	
2	459	13.25	10.25	4705	0.38	423	683
1		10.25	0	0	0.00	0	1106
Total	782	23.5		12295	1	1106	

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 - overall (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						
2	301	302	605	603	0.6	0.6
1	301	302	980	977	1.0	1.0
Total						

M_s	3.75		(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)

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Subject:_____
By:_____
Date:_____

Story Forces - north wing (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	108		23.5	2538	0.62	228	
2	153	13.25	10.25	1568	0.38	141	228
1		10.25	0	0	0.00	0	369
Total	261	23.5		4106	1	369	

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 - north wing (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						
2	121	102	503	597	0.5	0.6
1	121	102	814	965	0.8	1.0
Total						

M_s 3.75 (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)

Story Forces - south wing (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	215		23.5	5053	0.62	455	
2	306	13.25	10.25	3137	0.38	282	455
1		10.25	0	0	0.00	0	737
Total	521	23.5		8189	1	737	

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 - south wing (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						
2	180	200	561	505	0.6	0.5
1	180	200	910	819	0.9	0.8
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)