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

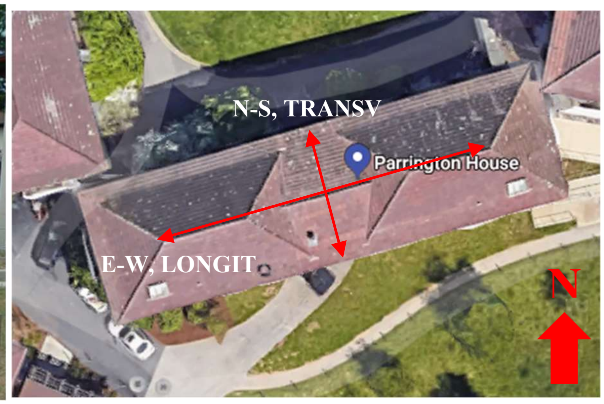
UC Santa Cruz building seismic ratings

Parrington House Residential Building, Cowell College

CAAN #7121
513 Cowell 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)	Poor (V)	
Rating basis	Tier 1	ASCE 41-17[1]
Date of rating	2018	
Recommended list assignment (UC Santa Cruz category for retrofit)	Priority B	Priority A=Retrofit ASAP Priority B=Retrofit at next permit application
Ballpark total construction cost to retrofit to IV rating[2]	Medium ($50 - $200/sf)	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 out-of-plane connections at end walls and stair fin walls

[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 Wurster, Bernardi, and Emmons, "Residential College Number One, University of California, Sant Cruz," as-built dated 12 Dec 1965 (signed 11 Sept 1964), sheets A1-A3 and A11-A13 pertinent to Unit 'A'.
- Structural drawings by Gilbert-Forsberg-Diekman-Schmidt, "Residential College Number One, Unit 'A' University of California, Sant Cruz," as-built dated 12 Dec 1965 (signed 11 Sept 1964), sheets S1, S3, S9 and S10 pertinent to Unit 'A'. Note that sheets S5 through S8, which contain framing plans for other units, also contain details pertinent to main stair and lobby roof at Unit 'A'. These sheets were not provided and subject details were not reviewed.
- University of California building database information, "Cowell College," provided by Jose Sanchez (UCSC) on 2018-11-20.

Additional building information known to exist

- None

Scope for completing this form

Reviewed structural drawings for original construction and carried out ASCE 41-17 Tier 1 evaluation. Did not make site visit or evaluate non-structural life-safety hazards.

Brief description of structure

Parrington is one of a cluster of seven similar buildings that forms the residential component of Cowell College (formerly College One) at the campus. The complex was designed in 1964 by the architectural office of Wurster, Bernardi and Emmons and the structural office of Gilbert-Forsberg-Diekman-Schmidt; construction was completed in late 1965.

The building is 3 story structure that contains approximately 11,500 square feet. In plan, the building is comprised of two rectangular residential wings, each measuring 54 feet wide by 30 feet deep. The wings are linked by a central lobby measuring 16'-6" wide by 20 feet deep that contains the main stair access to both wings. The structure measures 27 feet in height from the 1st floor to the top of perimeter walls at the eave of the roof and about 30 feet to the mid-height of the roof.

Each wing is constructed with cast-in-place reinforced concrete walls on 4 sides. The connecting lobby between the wings has an all glazed front façade and concrete wall at the rear façade that extend between the end walls of the wings. Floors at the wings are wood joist framing with plywood sheathing and a 1-5/8 inch nonstructural concrete topping, presumably for acoustic and fire purposes. The floor at the first level of the residential wings is wood framed with a short crawl space below; there is a slab on grade at the lobby. The roof is wood framed and consists of a hip roof over each wing with a gabled connecting roof over the lobby.

The stair treads and landings at the lobby are constructed with precast concrete on steel tube framing in a butterfly style. There are exterior exit stairs at the ends of each wing that are exposed to weather. The stair flights are constructed with precast treads on steel tube stringers in a butterfly style spanning to cast-in-place reinforced concrete landings (the condition of steel components exposed to weather and their connections was not observed as part of this review). Landings span between the concrete end wall and a fin wall at the outside face of the stair.

<u>Foundation System:</u> The site is moderately sloping. The superstructure is founded on shallow strip footings located under the concrete exterior walls and the wood bearing wall that runs along the hallway at the center of each wing.

<u>Structural system for vertical (gravity) load:</u> Floors are framed with 2x10 wood joist framing and 5/8 inch plywood sheathing. Joists are supported at the exterior by 3x wood ledgers bolted to the 8-inch thick reinforced concrete walls that are the perimeter structure and the façade. The joists are supported at the interior by a wood-stud bearing wall running along one side of the central corridor.

A wood-framed hip roof is constructed over each wing. Beams that frame the roof are spaced at 8 foot centers and supported at the perimeter atop the exterior concrete walls, and by posts at the interior that spring from upturned beams at the ceiling level.

Structural system for lateral forces: Plywood sheathed floor and roof diaphragms transfer out-of-plane forces from concrete walls and lateral inertial forces from floors (and roof) to concrete walls in-plane, which occur at the perimeter of each wing. Floor-to-wall connections were seismically retrofitted in 1985 to reduce the likelihood of splitting of the ledgers in cross grain bending under out-of-plane earthquake forces. The 8-inch thick concrete walls that surround the wings have substantial strength and stiffness to resist in-plane earthquake forces.

Cast-in-place concrete landings at exterior stairs brace fin walls at exterior of stair back to building. Connections between building end walls and floor diaphragms are required to transfer loads from fin wall and stair to floor diaphragm in addition to out-of-plane load from end wall.

Stair landings at the lobby span between the concrete end walls of the wings for lateral as well as vertical loads.

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:

- Connections of the floor and roof diaphragms to the concrete exterior walls for out-of-plane forces were identified as a deficiency in the original design and were retrofitted in 1985. The retrofit is for substantially lower strength than would be required by post 1994 building codes.
    - Floor-to-wall connections at end walls that run parallel to floor joist framing lack substantial development into floor diaphragm (i.e. sub-diaphragm). Demand on connections is increased by need to brace exit stairs and supporting fin wall for out-of plane forces.
    - Floor-to-wall connections may not be capable of preventing splitting of ledgers in cross-grain bending in a major earthquake. However, in the reviewer's opinion there is not an appreciable risk that loss of vertical support will occur.

Nonlinear behavior is expected to be limited to floor and roof diaphragms. Concrete wall elements have substantial overstrength and are expected to remain essentially elastic.

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	Y
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	N		

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

None known to reviewer; we did not visit building. Review of details of construction of glazed wall at entry lobby and condition of connections of steel tube stringers to landings at exterior exit stairs would be suggested focus of further review for nonstructural hazards.

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 assumes that the exterior stairs and end walls are connected to the structure in a reasonably adequate way, such that they are not a collapse risk in the BSE-C earthquake level. The rating falls below III (Good) because the 1985 retrofit of floor-to-wall connections is for lower forces than would be required by today's standards.

Recommendations for further evaluation or retrofit

Although we rate the building as IV (Fair), we recommend that the Campus perform a more detailed review of floor-to-wall connections at end walls, considering whether ties near center of building should be strengthened and carried back further into the floor diaphragms. The campus should also check the condition of exterior stairs. We put the building on List 2, as the above items should be done if there are any plans for modifying the building.

Peer review of rating

The key issues and expected seismic performance of this building are essentially the same as that for building 7124. The peer review of that building, carried out 17 June 2019, applies to this building; reviewer present was Bret Lizundia of R+C.

Additional building data	Entry	Notes
Latitude	36.9964	
Longitude	-122.0541525	
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	0	Unoccupied Crawl Space is not considered a story
Building occupiable area (OGSF)	11502	
Risk Category per 2016 CBC Table 1604.5	II	Residential occupancy (dormitory).

[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.

Estimated fundamental period	0.25 sec	Estimated using ASCE 41-17 equation 4-4 and 7-18
Building structural height, h_n	30 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		
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
Site-specific ground motion study?	No	
Applicable code		
Applicable code or approx. date of original construction	Built: 1965 Code: 1964 UBC	Code inferred based on design year
Applicable code for partial retrofit	1985 UBC	Wood floor to concrete wall out-of-plane anchors only
Applicable code for full retrofit	None	No full retrofit
FEMA P-154 data		
Model building type North-South	C2a - Conc. wall (Flexible Diaphragm)	
Model building type East-West	C2a - Conc. wall (Flexible Diaphragm)	

[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.

FEMA P-154 score	N/A	Not included here because we performed ASCE 41 Tier 1 evaluation.
Previous ratings		
Most recent rating	III (Good)	
Date of most recent rating	Unknown	Indicated on spreadsheet
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

[redacted]

Annotated floor plan (3rd floor shown)

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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:**
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:**
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:**

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

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 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 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:**

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Collapse Prevention Basic Configuration Checklist

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

FOUNDATION CONFIGURATION

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

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ASCE 41-17
Collapse Prevention Structural Checklist For Building Type C2-C2A

Low And Moderate Seismicity

Seismic-Force-Resisting System

C NC N/A U	Description
C: ☐ NC: ☐ N/A: ☒ U: ☐	COMPLETE FRAMES: Steel or concrete frames classified as secondary components form a complete vertical-load-carrying system. (Commentary: Sec. A.3.1.6.1. Tier 2: Sec. 5.5.2.5.1) **Comments:**
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 concrete shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the greater of 100 lb/in.^{2} (0.69 MPa) or $2\sqrt{f'_c}$. (Commentary: Sec. A.3.2.2.1. Tier 2: Sec. 5.5.3.1.1) **Comments:**
C: ☒ NC: ☐ N/A: ☐ U: ☐	REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area is not less than 0.0012 in the vertical direction and 0.0020 in the horizontal direction. (Commentary: Sec. A.3.2.2.2. Tier 2: Sec. 5.5.3.1.3) **Comments:**

Connections

C NC N/A U	Description
C: ☐ NC: ☒ N/A: ☐ U: ☐	WALL ANCHORAGE AT FLEXIBLE DIAPHRAGMS: Exterior concrete or masonry walls that are dependent on flexible diaphragms 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:** *Building was retrofit for this deficiency in 1985. Connections appear to be lighter than would be mandated today, but may be okay considering low story height. Connections at east and west ends of concern, since also brace stairs. These end wall connections are not adequately developed into diaphragm.*
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:**

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Collapse Prevention Structural Checklist For Building Type C2-C2A

C NC N/A U	
C [X] NC [ ] N/A [ ] U [ ]	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation with vertical bars equal in size and spacing to the vertical wall reinforcing directly above the foundation. (Commentary: Sec. A.5.3.5. Tier 2: Sec. 5.7.3.4) **Comments:**

High Seismicity (Complete The Following Items In Addition To The Items For Low And Moderate Seismicity)

Seismic-Force-Resisting System

	Description
C [X] NC [ ] N/A [ ] U [ ]	DEFLECTION COMPATIBILITY: Secondary components have the shear capacity to develop the flexural strength of the components. (Commentary: Sec. A.3.1.6.2. Tier 2: Sec. 5.5.2.5.2) **Comments:**
C [ ] NC [ ] N/A [X] U [ ]	FLAT SLABS: Flat slabs or plates not part of the seismic-force-resisting system have continuous bottom steel through the column joints. (Commentary: Sec. A.3.1.6.3. Tier 2: Sec. 5.5.2.5.3) **Comments:**
C [ ] NC [ ] N/A [X] U [ ]	COUPLING BEAMS: The ends of both walls to which the coupling beam is attached are supported at each end to resist vertical loads caused by overturning. (Commentary: Sec. A.3.2.2.3. Tier 2: Sec. 5.5.3.2.1) **Comments:**

Diaphragms (Stiff Or Flexible)

	Description
C [X] 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 [X] 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:**

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Flexible Diaphragms

C NC N/A U	Description
C ☐ NC ☒ N/A ☐ U ☐	CROSS TIES: There are continuous cross ties between diaphragm chords. (Commentary: Sec. A.4.1.2. Tier 2: Sec. 5.6.1.2) **Comments:** *Does not comply in direction perpendicular to floor joists, but not a concern based on 30 foot building dimension.*
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:**
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 (12.2 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:**
C ☒ NC ☐ N/A ☐ U ☐	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:**

Connections

C NC N/A U	Description
C ☐ NC ☐ N/A ☒ U ☐	UPLIFT AT PILE CAPS: Pile caps have top reinforcement, and piles are anchored to the pile caps. (Commentary: Sec. A.5.3.8. Tier 2: Sec. 5.7.3.5) **Comments:**

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By:__________________
Date:__________________

SEISMIC EVALUATION OF EXISTING BUILDINGS - TIER 1 SCREENING

ASCE 41-17 Chapter 4

General				**Reference**
Building	Cowell Parrington House			
Architect	Wurster, Bernardi, and Emmons			
Structural Engineer	Gilbert-Forsberg-Diekman-Schmidt			
Location	513 Cowell Service Road, Santa Cruz, CA 95064			
Design date	1970			
Latitude	36.99640		,	https://hazards.atcouncil.org/
Longitude	-122.05415			"
Stories above grade	3	Plus Unoccupied Crawl Space		

Seismic parameters

Risk Category	II	2016 CBC Table 1604.5		
Site Class	B	https://earthquake.usgs.gov/hazards/urban/sfbay/soiltype/		(ASCE 41-17 2.4.1.6, ASCE 7-16 Chapter 20)
Liquefaction hazard	Low	http://data-sccgis.opendata.arcgis.com/datasets/77d380d355934b38a44894154377e28d_62		(ASCE 41-17 3.3.4)
Landslide hazard	Low	http://data-sccgis.opendata.arcgis.com/datasets/7984aabd55ec4a4794ae33d7919bd9c7_133		
S_{DS}	0.982	https://hazards.atcouncil.org/	Based on ASCE 7-16 DE, used to determine "Level of Seismicity"	(ASCE 41-17 Eq 2-4)
S_{D1}	0.335	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	https://hazards.atcouncil.org/	(ASCE 41-17 Table 2-2)
S_{X1}	0.89	For BSE-2E hazard level	https://hazards.atcouncil.org/	(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	C2a: Concrete shear walls with flexible diaphragms	(ASCE 41-17 Table 3-1)

Material properties				Notes	
Concrete	f'_c	3000	psi	Specified on drawings, NWC	(ASCE 41-17 Table 10-4)
Reinf.	f_y	40	ksi	Not specified on Drawings	(ASCE 41-17 Table 10-4)
Steel	F_y	N/A	ksi	N/A	(ASCE 41-17 Table 9-1)

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Checklists

Benchmark building	No	Retrofit also pre-benchmark	(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 C2a		(ASCE 41-17 Table 4-6)
	~~17.19 Nonstructural Checklist~~	(not performed)	(ASCE 41-17 Table 4-6)

Seismic forces

V	787	kip	$V = Cs_a W$	= 1.54W	(ASCE 41-17 Eq 4-1)
W	510	kip	building weight		(ASCE 41-17 4.4.2.1)
C	1.2		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	0.22	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	25	ft	building height		(ASCE 41-17 Eq 4-4)

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

Note: The followings computation is for each of two wings separately

	Flat Load
roof	70680
floor	72900

Story	w	story ht	h	wh^k	F_{story}	F_{story}	V_{story}
	kip	ft	ft			kip	kip
Roof	124		29	3596	0.39	308	
3	193	10.0	19	3667	0.40	314	308
2	193	9.0	10	1930	0.21	165	622
1		10.0	0				787
Total	510			9193	1.0	787	
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	$A_{w\,N\text{-}S}$ in^2	$A_{w\,E\text{-}W}$ in^2	v_{NS}^{avg} psi	v_{EW}^{avg} psi	D/C_{NS}	D/C_{EW}
Roof						
3	5184	6720	16	12	0.1	0.1
2	5184	5520	32	30	0.3	0.3
1	5184	5520	40	38	0.4	0.3
Total						

M_s 3.75 (ASCE 41-17 Table 4-8)

v_{limit} 110 psi $v_{limit} = 2\sqrt{f_c'} \geq 100$ psi

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