Rating form completed by:
MAFFEI STRUCTURAL ENGINEERING
maffei-structure.com
Jason Armes (TSE), Noelle Yuen

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

Oakes College Residence A13-15

CAAN #7408
220 Oakes Road, Santa Cruz, CA 95064
UCSC Campus: Main Campus

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

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 UC Santa Cruz priority 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]	None	
Is 2018-2019 rating required by UCOP?	Yes	
Further evaluation recommended?	Yes	Focused on walkway and stair 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 life-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

- Structural drawings by Forell Elsesser, "College 7, University of California Santa Cruz" as-built date 15 July 1974.
- Architectural drawings by McCue Boone Tomsick Architects, "College 7, University of California Santa Cruz" as-built date 15 July 1974.
- Structural walkway repair drawings by Wildman & Morris Engineers – Architects, "Repair Damaged Construction, Oakes College, University of California, Santa Cruz" dated 23 February 1989.

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, but non-structural life-safety hazards were not evaluated.

Brief description of structure

The Oakes Residence complex consists of four groupings of buildings (designated as Oakes A, B, C, D) at the Oakes College (formerly College 7) at the UC Santa Cruz campus. The complex was designed in 1974 by the architectural office of McCue, Boone and Tomsick and the structural office of Forell Elsesser.

The Oakes Residence A13-15 is a 3-story L-shaped structure. An adjacent one-story structure of similar construction appears to be included under this CAAN number, and together these structures contain approximately 11,500 square feet. The buildings are in the Oakes A cluster of buildings (designated as the "Northwest Cluster" in the original structural drawings). In plan, the cluster is comprised of four rectangular residential pods, each measuring 34 feet wide by 34 feet deep. Each pod is constructed as an independent building with their own lateral system and diaphragm. The pods are assembled into various configurations; for example, in this building, three pods are assembled into an L-shape. The pods are linked by exterior walkways and stairs. The structures measure 27 feet in height from the 1st floor to the top of perimeter walls at the flat roof.

Each pod is constructed with plywood sheathing over wood joists at the floors and roof, and wood shear/bearing walls. At select locations steel posts are used for gravity support. The foundation consists of cast-in-place concrete grade beams with a slab on grade and select small retaining walls because of the sloping site. The roof is flat with a parapet around the perimeter.

As a result of weather and rot, the exterior walkways were repaired in 1989. The walkways are a similar construction of wood supported by wood walls, wood post, and select steel post. The stair treads are constructed with precast concrete on steel tube framing.

Identification of levels Three levels. 1st Floor at grade with top of slab on grade elevation = 595.0', 2nd Floor, 3rd Floor, Roof.

Foundation system: The foundation consists of grade beams supporting the bearing/shear wall lines of framing with an infill slab on grade. The site is moderately sloping and at some locations small retaining walls are required at the level 1 slab.

Structural system for vertical (gravity) load: Floors are framed with x10 wood joist framing and 5/8 inch plywood sheathing. Joists are supported at the exterior and interior (1/3 points) by 4x wood walls.

The walkway is supported by the exterior wall rim joist and by added steel posts and wood bearing walls.

Structural system for lateral forces: Plywood sheathed floor and roof diaphragms transfer lateral inertial forces from floors (and roof) to plywood sheathed wood stud walls in-plane, which occur mostly at the perimeter of each pod. The shear walls have ties downs for overturning and a well detailed load path for shear transfer down into the foundations. As stated above, since each pod has adequate wall to independently resist its own seismic demands. the structures are very regular in plan. When pods are assembled into a single building, and where plywood sheathed

walls from one pod are adjacent to walls from another pod, the plywood floor and roof is continuous between the walls, making the diaphragm continuous.

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:

- The shear wall hold-downs do not have a shrinkage compensating device and additional deflections would be expected from slack connections.
- The shear wall aspect ratios do not meet the Tier 1 checklist requirements, but the stress check and structural detail of these walls appear adequate.
- The seismic gaps between the building units at the walkways are small and some pounding is expected in a seismic event.
- The stair connections do not have any deformation capability because of their rigid connection top and bottom. We expect that the walkway structure will experience damage/non-linear behavior in a seismic event because of this.

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	Y	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	N		

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

We observed no clear concerns. The stair connections at the exterior walkway is rigid at both ends and may present drift compatibility issues in a seismic event.

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 has a well-defined force path and is well-detailed, and we assign this building a rating of IV (Fair). This rating assumes that the exterior stairs are connected to the structure in a reasonably adequate way, such that they are not a collapse risk in the BSE-C earthquake level.

[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.

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 stair connections, for both a condition assessment and adequacy of the connections for a seismic event. We put the building on Priority Category B, as the above items should be done if there are any plans for modifying the building.

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.

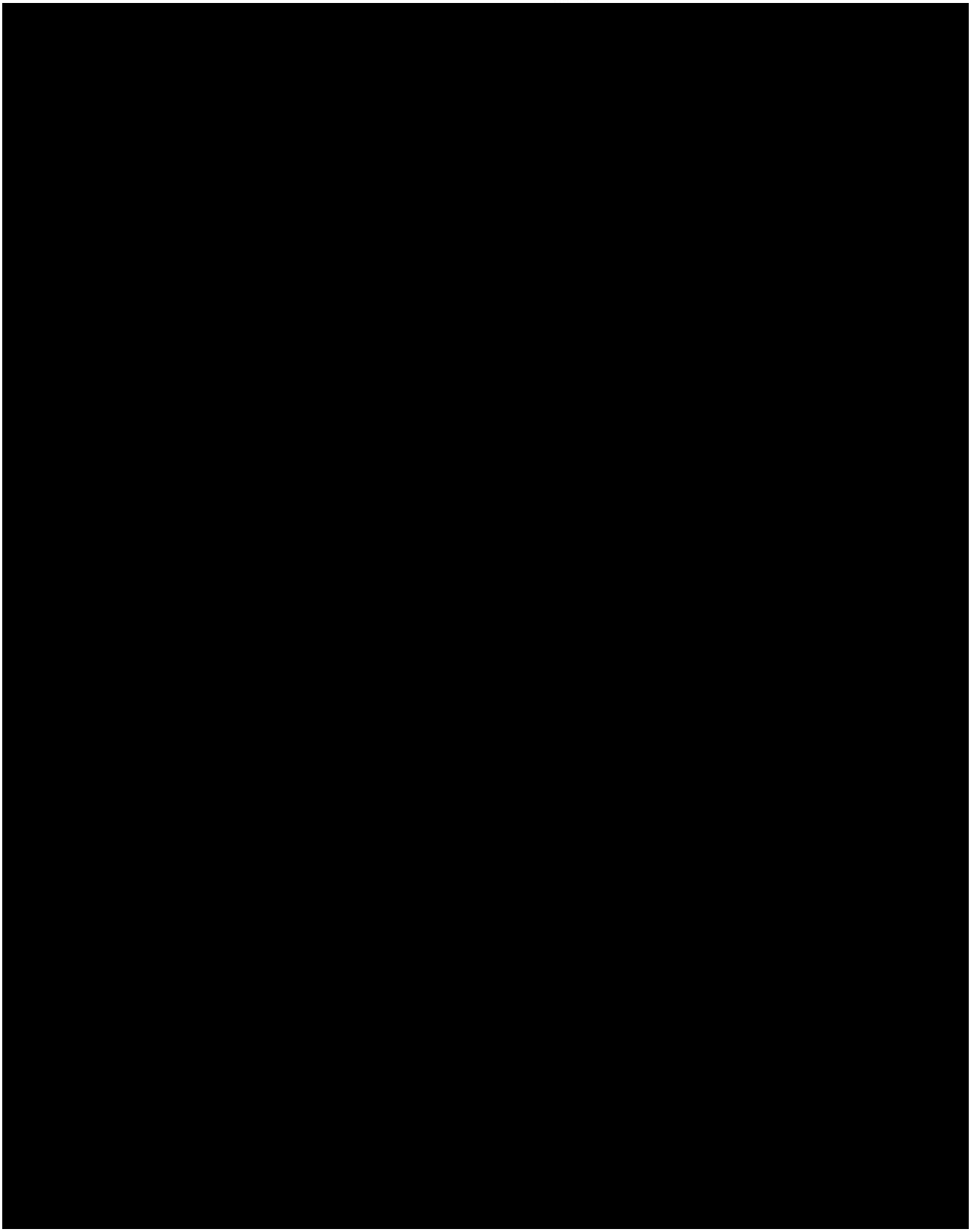
Additional building data	Entry	Notes
Latitude	36.989832	
Longitude	-122.064263	
Are there other structures besides this one under the same CAAN#	No	
Number of stories above lowest perimeter grade	3	
Number of stories (basements) below lowest perimeter grade	0	
Building occupiable area (OGSF)	11,567	
Risk Category per 2016 CBC Table 1604.5	II	Residential occupancy (dormitory).
Building structural height, h_n	27 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	0.24 sec	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	1.28	

[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

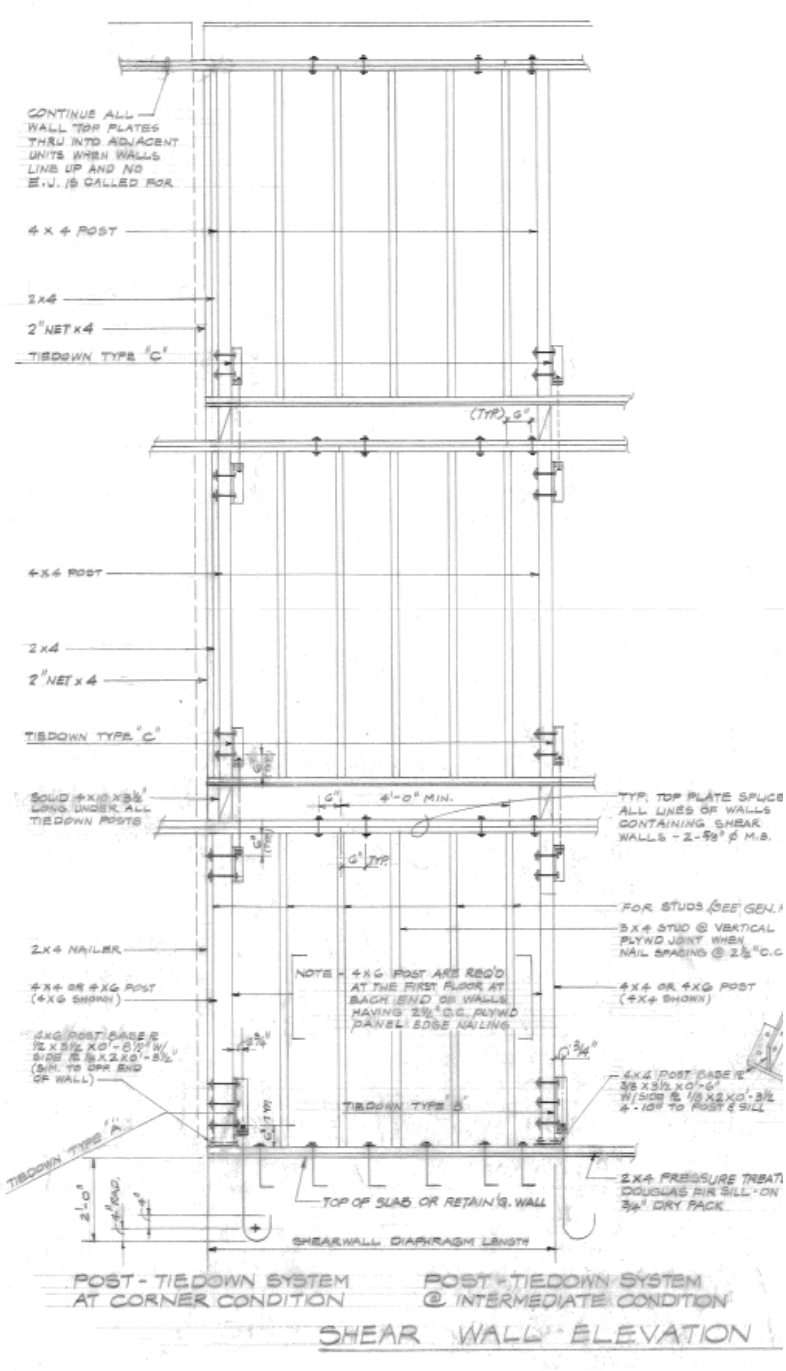
[5] F_V factor used does not include the requirements of Section 11.4.8-3 of ASCE 7-16 that are applicable to Site Class D, and which per Exception 2 would result in an effective F_V factor of 2.72 (1.5 times larger). At the Santa Cruz main campus this only affects structures with T>0.69 seconds. We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

Site 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: 1974 Code: 1970 UBC	Code on drawings
Applicable code for partial retrofit	None	No partial retrofit
Applicable code for full retrofit	None	No full retrofit
Model building data		
Model building type North-South	W1a	Residential Wood Light Frames
Model building type East-West	W1a	Residential Wood Light Frames
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

Annotated Floor plan (2nd floor shown)



Shear wall typical detail



Photos

Photos of walkway and stairs

Table 17-2. Collapse Prevention Basic Configuration Checklist

Status	Evaluation Statement	
Low Seismicity		
Building System—General		
(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.	
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.	Seismic Gap too small
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.	No Mezzanine
Building System—Building Configuration		
(C) NC N/A U	WEAK STORY: The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in the adjacent story above.	
(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.	
(C) NC N/A U	VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation.	
(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.	
(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.	
(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.	
Moderate Seismicity (Complete the Following Items in Addition to the Items for Low Seismicity)		
Geologic Site Hazards		
(C) NC N/A U	LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance do not exist in the foundation soils at depths within 50 ft (15.2 m) under the building.	
(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.	
(C) NC N/A U	SURFACE FAULT RUPTURE: Surface fault rupture and surface displacement at the building site are not anticipated.	
High Seismicity (Complete the Following Items in Addition to the Items for Moderate Seismicity)		
Foundation Configuration		
C (NC) N/A U	OVERTURNING: The ratio of the least horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than $0.6S_a$.	6ft/27ft = .22 < 0.6*1.15g
(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.	

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

ASCE 41-17 - Tier 1 Calculations

Oakes Residential Buildings

Building Properties:

Seismic Parameters:

Risk Category: II 2016 CBC table 1604.5

Site Class: D Assummed

Probability: 5% in 50 years

$S_{XS} = 1.276$ for BSE-2E hazard level

$S_{X1} = 0.877$ for BSE-2E hazard level

Seismic Forces:

$T = C_t \cdot h_n^{\beta} \rightarrow 0.24$ sec (ASCE 41-17 Eqn. 4-4)

$C_t = 0.02$

$\beta = 0.75$

$h_n = 27$ ft

$S_a = min\left(\frac{S_{X1}}{T}, S_{XS}\right) \rightarrow 1.28$ g (ASCE 41-17 Eqn. 4-3)

$V = C \cdot S_a \cdot W_{total} \rightarrow 128\,kips$ (ASCE 41-17 Eqn. 4-1)

$C = 1$ (ASCE41-17 Table 4-7)

Building Weight:

$A_{floor} = 34\,ft \cdot 34\,ft \rightarrow 1{,}156\,ft^2$

$floor_{unit,weight} = \Sigma\left(tbl_{floor\,Unit_{weight}}\right) \rightarrow 29\,psf$

$floor_{weight} = \Sigma\left(tbl_{floor\,Weight_{floor}}\right) \rightarrow 33.5\,kips$

$W_{total} = 3 \cdot floor_{weight} \rightarrow 101\,kips$

Shear Stress Check: ASCE 41-17 Sec. 4.4.3.3

$L_w = 6\,ft + 6\,ft + 8\,ft + 12\,ft \rightarrow 32\,ft$ minimum wall for any pod in any direction w/ 3 stories

$M_s = 4.5$ (ASCE 41-17 Table 4-8)

$v_j = \frac{1}{M_s} \cdot \left(\frac{V}{L_w}\right) \rightarrow 891\,plf$

Shear stress OK, Limit 1000plf