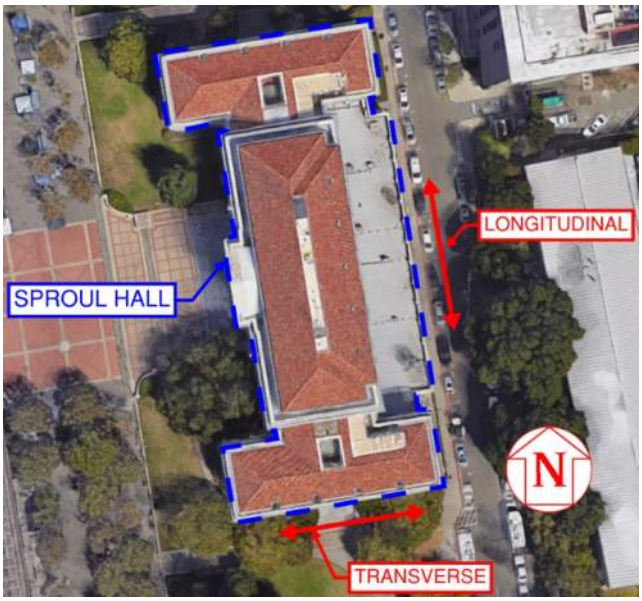
Degenkolb Berkeley UNIVERSITY OF CALIFORNIA

Evaluator: TAB
Date: 04/09/19

ASCE 41-17 Tier 1 Seismic Evaluation

Building Name: Sproul Hall
CAAN ID: 1210
Auxiliary Building ID: N/A
Address: Barrow Ln, Berkeley, CA 94704
Site location coordinates: Latitude 37.8696 Longitudinal -122.2590



Aerial Photo

West Elevation

UCOP *SEISMIC PERFORMANCE LEVEL* (OR "RATING") BASED ON TIER 1 EVALUATION FINDINGS: V

BUILDING DATA

ASCE 41-17 Model Building Type (Governing Building Type bolded for Seismic Risk Model when multiple types exist):

a. Longitudinal Direction: C2: Concrete Shear Wall
b. Transverse Direction: C2: Concrete Shear Wall

Square Footage: 111,476 ft^2
Building Length: 266'
Building Width: 118'
Building Height: 83'
Story Height: 11' (1^{st}), 15'-10" (2^{nd}), 15' (3^{rd}), 14'-6" (4^{th}), 13' (5^{th}), 13'-7" (Attic)
Number of stories *above* grade: 5
Number of basement stories *below* grade: 0

Year of Original Construction and Code Year: 1941, 1937 UBC (Assumed)
Year of Later Constuction and Code Year:

COST RANGE TO RETROFIT (if applicable): Medium: over $50 per sf and less than $200 per sf

BUILDING DESCRIPTION

General

This building was built in 1940 and is situated on a level site. The building has five stories plus a an attic. The building has a five story central rectangular portion of the building that covers a footprint of 162.5' in the North-South direction and 94.75' in the East-West direciton. To the North and South of the central portion are rectangular three story structures with usable attic space that measure 117.5' in the East-West direction and 58' in the North-South direction. Both the roofs on top of the wings and the central portion are clay tiled hip roofs with 5.5:12 and 7:12 roof slopes respectively. The building area is approximately 104,000 square feet and houses administration office space and the university police station in the bottom level.

Structural System

The gravity load structural system consists of 4 ½" – 5 ½" concrete slabs on wide flange steel framing that is encased in 2" of concrete. All concrete is assumed to be normal weight. The roof is a 4 ½" slab on inclined steel framing members to achieve the roof slopes. The basement floor is a reinforced 6"concrete slab-on-grade. The lateral load structural system consists of perimeter pier and spandrel concrete shear walls with interior unperforated concrete shear walls. The concrete slabs serve as horziontal diaphragms and the concrete shear walls as the vertical elements. The foundation consists of spread footings at the columns. The shear walls bear on the ground and span between footings at embedded columns.

Building Condition

Good, some façade deteoriation observed.

Date of Site Visit: Date of Site Visit: 03/28/2019, Ray Pugliesi & Torrey Bolden, Degenkolb Engineers
Limitations of walk-through: None

SITE INFORMATION

Site Class (A-F): C Basis: Geologic Hazards and Site Classification, Geomatrix Plate 2
Site Specific Ground Motion Study? Yes, 2015 Update to the Site-Specific Seismic Hazard Analyses and Development of Seismic Design Ground Motions
BSE-1N Spectral Accelerations: Basis: 2015 Site Specific Report Table 5 for 36-75 ft Soil
S_{DS}: 2.40 S_{D1}: 0.71
BSE-2E Spectral Accelerations: Basis: 2015 Site Specific Report Table 6 for 36-75 ft Soil
S_{XS}: 3.15 S_{X1}: 1.05
Level of Seismicity: High
Performance Level: Collapse Prevention Structural Performance

Geologic Hazards:
Fault Rupture No Basis: Earthquake Zones of Required Investigation- Oakland West Quadrangle https://maps.conservation.ca.gov/cgs/informationwarehouse/regulatorymaps/
Liquefaction No Basis: Earthquake Zones of Required Investigation- Oakland West Quadrangle https://maps.conservation.ca.gov/cgs/informationwarehouse/regulatorymaps/
Landslide No Basis: Earthquake Zones of Required Investigation- Oakland West Quadrangle https://maps.conservation.ca.gov/cgs/informationwarehouse/regulatorymaps/

PREVIOUS RATINGS SUMMARY

1. Good – 1997 Preliminary Seismic Evaluation (SAFER), Rutherfod & Chekene

DOCUMENTATION

Architectural Drawings: "Administration Building, University of California", Arthur Brown Jr., 07/31/1940, A1-A21

Structural Drawings: "Administration Building, University of California", Hall & Pregnoff, 06/03/1940, S1-S6, C1-C10

Seismic Evaluations: "1997 Preliminary Seismic Evaluation (SAFER)", Rutherfod & Chekene, 07/02/1997, FEMA-178 Structural Checklist

Geotechnical Reports: N/A

Other Documents: N/A

CONSTRUCTION DATA

Gravity Load Structural System:	Concrete slabs over steel wide flange framing encased in concrete		
Exterior Transverse Walls:	Terra Cotta Facade	Opening(s)?	Yes
Exterior Longitudinal Walls:	Terra Cotta Facade	Opening(s)?	Yes
Roof Materials/Framing:	4 ½" Concrete Slab on Steel Wide Flanges with Clay tile roof		
Intermediate Floors/Framing:	5 ½" Concrete Slab on Steel Wide Flanges		
Ground Floor:	6" concrete slab on grade		
Columns:	Wide Flange Steel Members	Foundation:	Spread footings
General Condition of Structure:	Good, some terra cotta façade deterioration		
Evidence of Settling?:	No		
Special Features & Comments:	This structure has discontinuous shear walls at the 2nd and 4th story.		
	Terra cotta facades with hip roofs covered with clay tiles.		

LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
ASCE 41-17 Building Type:	C2: Conc. Shear wall	C2: Conc. Shear wall
Diaphragms:	Concrete Slab	Concrete Slab
Vertical Elements:	Concrete Wall Piers	Concrete Wall Piers
Connections:	2'-2.5' lap, #4 @ 8" ties wrapping WF steel columns	2'-2.5' lap, #4 @ 8" ties wrapping WF steel columns
Details:	Sheets C3-C6	Sheets C3-C6
Estimated Fundamental Period, T (sec):	0.481	0.481
BSE-2E Spectral Acceleration, S_a:	2.18g	2.18g
Modification Factor, C:	1.0 (C2 – Table 4-7)	1.0 (C2 – Table 4-7)
Building Weight, W (kips):	20509	20509
Seismic Base Shear, V (kips):	44732	44732
System Modification Factor, M_s:	3.0 LS @ BSE-2E (Risk IV)	3.0 LS @ BSE-2E (Risk IV)

Significant Structural Deficiencies, Potentially Affecting *Seismic Performance Level* Designation:

- ☑ Lateral System Stress Check (wall shear, column shear or flexure, or brace axial as applicable)
- ☑ Load Path
- ☐ Adjacent Buildings
- ☐ Weak Story
- ☐ Soft Story
- ☑ Geometry (vertical irregularities)
- ☐ Torsion
- ☐ Mass – Vertical Irregularity
- ☐ Cripple Walls
- ☐ Wood Sills (bolting)
- ☐ Diaphragm Continuity
- ☑ Openings at Shear Walls (concrete or masonry)
- ☐ Liquefaction
- ☐ Slope Failure
- ☐ Surface Fault Rupture
- ☐ Masonry or Concrete Wall Anchorage at Flexible Diaphragm
- ☐ URM wall height to thickness ratio
- ☐ URM Parapets or Cornices
- ☐ URM Chimney
- ☐ Heavy Partitions Braced by Ceilings
- ☐ Appendages

OVERALL SEISMIC DEFICIENCIES & EXPECTED SEISMIC PERFORMANCE

The below deficiencies have been identified for this structure:

1. *Wall Shear Stress:* Based on the quick check procedure, the stresses in the concrete walls are high in the longitudinal and transverse directions up the height of the structure. The shear stresses are particularly high in the transverse direction at the high roof where there is less wall supporting a heavy roof. The concrete walls are not bearing, and they may be able to

accommodate increased deformations, but stress levels indicate the structure may lack the global strength for the required seismic demands.

2. *Discontinuous Shear Walls:* Discontinuous shear walls exist on the 2nd story and the 4th story. The 4th floor is discontinuous on transfer girders around the perimeter North, South and West elevations. The overturning forces may overload the beam or its connections. The 2nd story discontinuous wall is the East wall of the center portion of the structure. This 162' long, 10" wall is discontinuous over steel columns with 15', 8" wall segment at each end of the wall. This discontinuity may overload these short wall segments, as the discontinuous wall above is half of the lateral system of the central portion of the building in the longitudinal direction.
3. *Wall Foundation Dowels:* The walls do not have a foundation to dowel into. The wall bears on the soil and spans from spread footings located at the columns partial embedded in the wall. Lack of a foundation for the walls may overload the isolated spread footing foundations and the connections to the columns and slab.
4. *Openings at Shear Walls:* The shear walls located by the stair wells have openings immediately adjacent to the wall for the full length of the wall. This is not expected to have a significant impact on the structural performance as there is a shear wall on each side of the stair openings.

As a result of these deficiencies, the structure has been assigned a SPL V rating. A more detailed Tier 2 or Tier 3 analysis will provide a better understanding of the force distribution and ductility demands to better evaluate the importance of the current identified deficiencies.

The exposed structure appeared to be in good condition, although the façade shows signs of deterioration in isolated locations

The below non-structural deficiencies have been identified.

1. Terra cotta clay tile is used on the façade. During this time period, post 1933 Long Beach earthquake, it was common to provide anchorage of terra cotta tiles. The cornices show anchorage but the document available do not show anchorage of the typical façade tiles. This is a hazard because these tiles are located up the height of the structure and could be a life safety hazard during a seismic event is there is not proper anchorage detailing. (See Figures 2 & 3)
2. Hollow clay tile is used as a partition walls in the basement level. This material is brittle and is susceptible to damage under story drifts caused by earthquake loads. (See Figure 4)
3. There are glass skylights at both the north and south wings that appear to be part of the original construction. The glass does not have embedded wire mesh or appear to be tempered. This may pose a falling hazard in a seismic event. (See Figure 5)

Seismic Retrofit Concept Sketches/Description (only if above-listed rating is V or greater):

Based on the quick check procedure, this structure lacks shearwall capacity in the transverse and longitudinal direction. It is recommended to thicken the existing concrete shear walls in select locations and potentially add a new shear wall underneath discontinuous shear walls. The goal of this scheme would be to mitigate the local effects of the discontinuous shear wall while increasing the global strength of the structure with new shear walls. Below are potential locations shown on the first story plan. These walls could taper up the height structure to meet the required demands. *Note: Due to the presence of the campus police headquaters in the building, this building would likely have to be retrofitted to SPL III.*

Appendices

A. Additional Photos

B. ASCE 41-17 Tier 1 Checklists (Structural)

C. UCOP Seismic Safety Policy Falling Hazards Assessment Summary

D. Quick Check Calculations

APPENDIX A

Additional Photos

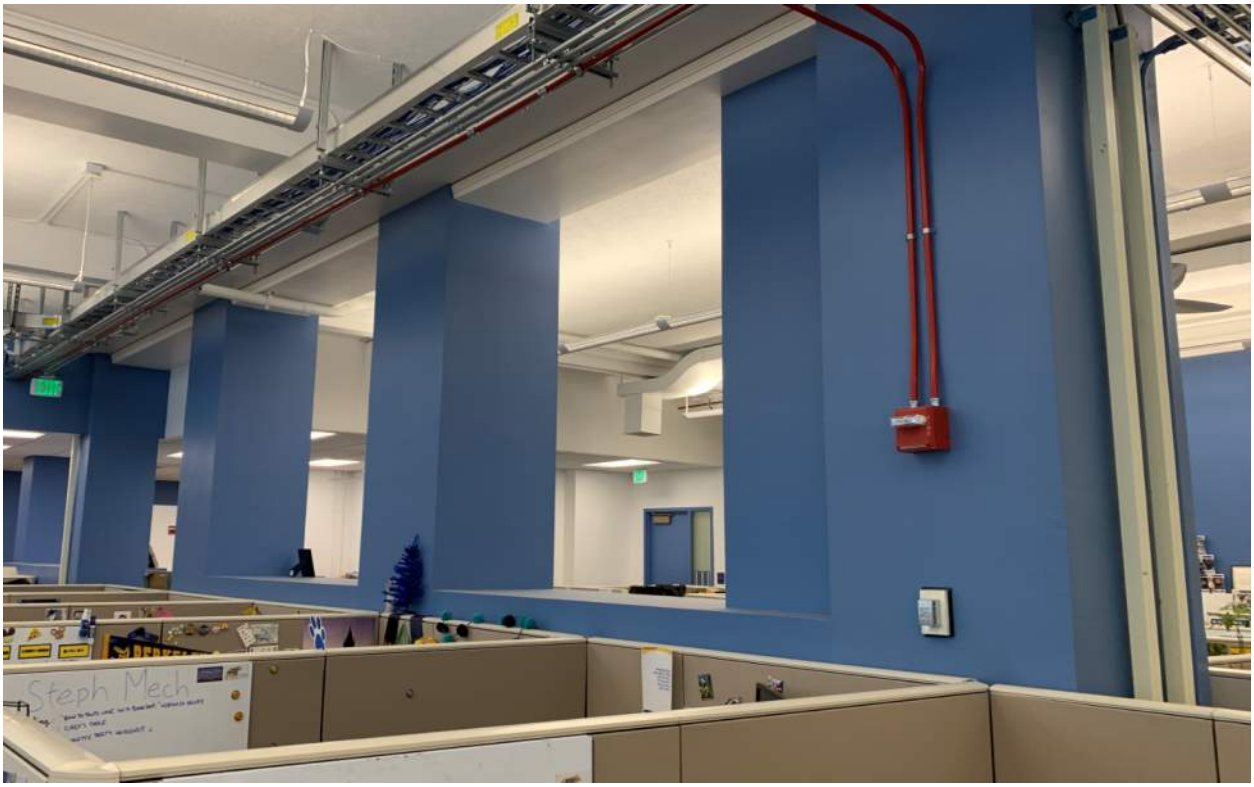


Figure 1 Columns at 1st story supporting discontinuous shear walls above

Figure 2 Deterioration in the Terra Cotta facade

Figure 3 Terra Cotta deterioration

Figure 4 Hollow Clay Tile Used as Partitions in Basement

Figure 5 Glass skylight in the North and South Wings

APPENDIX B
ASCE 41-17 Tier 1 Checklist (Structural)

UC Campus:	Berkeley			Date:	4/10/19		
Building CAAN:	1210	Auxiliary CAAN:	-	By Firm:	Degenkolb Engineers		
Building Name:	Sproul Hall			Initials:	*TAB*	Checked:	
Building Address:	Barrow Ln, Berkeley, CA 94704			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:** Discontinuous shear walls are present
☐	☐	☒	☐	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:**
☐	☐	☒	☐	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*

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:**
☒	☐	☐	☐	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:**
☐	☒	☐	☐	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:** Discontinuous shear walls at the 2nd story and 4th story. The 4th story shear walls bear on transfer girders.

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

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ASCE 41-17
Collapse Prevention Basic Configuration Checklist

C	NC	N/A	U	
☒	☐	☐	☐	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:** Symmetric building.

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

GEOLOGIC SITE HAZARD

C	NC	N/A	U	Description
☒	☐	☐	☐	LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance do not exist in the foundation soils at depths within 50 ft (15.2m) under the building. (Commentary: Sec. A.6.1.1. Tier 2: 5.4.3.1) **Comments:**
☒	☐	☐	☐	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:**
☒	☐	☐	☐	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:**

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

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ASCE 41-17
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:** 117.5/69.5=1.69 0.6*2.18=1.308
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:** Site class C and slab on grade tie together spread footings.

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

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Building CAAN:	1210	Auxiliary CAAN:	-	By Firm:	Degenkolb Engineers		
Building Name:	Sproul Hall			Initials:	TAB	Checked:	
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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
☒	☐	☐	☐	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:** Steel frames embedded in concrete walls
☒	☐	☐	☐	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:**
☐	☒	☐	☐	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:** The shear walls are generally more overstressed at the higher stories due to the heavy roofs and the reduction in wall thickness. The maximum wall stress of 611 psi is below the fifth story in the transverse direction. See quick check procedure
☒	☐	☐	☐	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
☐	☐	☒	☐	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:**
☒	☐	☐	☐	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:** End hooks into the wall at edge of slabs.

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

C	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:** Walls are embedded into the ground and spans to spread footings at embedded columns.

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

Seismic-Force-Resisting System

				Description
C	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:** Steel columns adequate
☐	☐	☑	☐	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:** One-way slabs
☑	☐	☐	☐	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	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:**
☐	☑	☐	☐	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:** Stair openings immediately adjacent to shear walls full length of the shear wall.

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

Flexible Diaphragms

C	NC	N/A	U	Description
☐	☐	☒	☐	CROSS TIES: There are continuous cross ties between diaphragm chords. (Commentary: Sec. A.4.1.2. Tier 2: Sec. 5.6.1.2) **Comments:**
☐	☐	☒	☐	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:**
☐	☐	☒	☐	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:**
☐	☐	☒	☐	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:**
☒	☐	☐	☐	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
☐	☐	☒	☐	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:**

APPENDIX C
UCOP Seismic Safety Policy Falling Hazards Assessment Summary

UC Campus:	Berkeley			Date:	4/10/2019		
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Building Name:	Sproul Hall			Initials:	TAB	Checked:	
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UCOP SEISMIC SAFETY POLICY
Falling Hazard Assessment Summary

	Description
P ☐ N/A ☒	**Heavy ceilings, features or ornamentation above large lecture halls, auditoriums, lobbies, or other areas where large numbers of people congregate (50 ppl or more)** **Comments:**
P ☒ N/A ☐	**Heavy masonry or stone veneer above exit ways or public access areas** **Comments:** Façade is constructed of terra cotta tiles. No anchorage detail is explicitly shown on the drawings. The façade is up the full height of the building and could be a significant collapse hazard if not anchored.
P ☐ N/A ☒	**Unbraced masonry parapets, cornices, or other ornamentation above exit ways or public access areas** **Comments:**
P ☐ N/A ☒	**Unrestrained hazardous material storage** **Comments:**
P ☐ N/A ☒	**Masonry chimneys** **Comments:**
P ☐ N/A ☒	**Unrestrained natural gas-fueled equipment such as water heaters, boilers, emergency generators, etc.** **Comments:**
P ☐ N/A ☐	**Other:** **Comments:**
P ☐ N/A ☐	**Other:** **Comments:**
P ☐ N/A ☐	**Other:** **Comments:**

Falling Hazard Risk: Moderate, due to unverified Terra Cotta Tile anchorage

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

APPENDIX D
ASCE 41-17 Quick Check Calculations

Degenkolb Engineers
375 Beale St. Ste. 500
San Francisco, CA 94105

Subject:	Weight Take Off	**Job Number:**	B8114004.00	**Date:**	7/15/2019
Job:	Sproul Hall	**By:**	TAB	**Section:**	
		Checked By:		**Page/of:**	

Typical Slab DL	
Material	Area Weight
Flooring	5
Partition	10
Steel Framing	11
Concrete Encasement of Steel Framing	36
Misc, MEP	3
Σ	**65**

Terra Cotta Voids Filled	120 pcf
Terra Cotta Voids Unfilled	72 pcf

4th Floor Roof

Slope **5.5** : **12**

Area Factor 1.10

Material	Area Weight
Clay Tile Roofing, with Mortar	20
4 1/2" NWC Slab	56.25
Partition	5
Steel Framing	11
Concrete Encasement of Steel Framing	31
Misc, MEP	3
Effective Weight Σ	**139**

4th Floor Roof

Slope **7** : **12**

Area Factor 1.16

Material	Area Weight
Clay Tile Roofing, with Mortar	20
4 1/2" NWC Slab	56.25
Partition	5
Steel Framing	11
Concrete Encasement of Steel Framing	31
Misc, MEP	3
Effective Weight Σ	**147**

First Floor

Area = 26500 ft^2 Perimeter = 899 ft

Item	Area	Length	Height	Area Weight	Weight	
	ft^2	ft	ft	psf	lbf	
5 1/2" NWC Slab	26500			68.75	1821875	
Typ Floor DL	26500			65	1722500	
4 1/2" Terra Cotta Fill Façade 70% Cover		899	13.42	31.5	379940	
12" Wall, Above, 70% Open (Perimeter)		161	7.92	105.0	133831	
10" Wall, Above, 70% Open (Perimeter)		738	7.92	87.5	511219	
10" Wall, Above		49	7.92	125	48490	
8" Wall, Above		126	7.92	100.0	99750	
12" Wall, Below		237	5.50	150	195525	
10" Wall, Below		711	5.50	125	488813	
8" Wall, Below		217	5.50	100.0	119350	
				Σ W_{floor}	**5402**	**kip**

Second Floor

Area = 26500 ft^2 Perimeter = 899 ft

Item	Area	Length	Height	Area Weight	Weight	
	ft^2	ft	ft	psf	lbf	
5 1/2" NWC Slab	26500			68.75	1821875	
Typ Floor DL	26500			65	1722500	
4 1/2" T.C. Filled Façade 70% Cover Below		899	7.92	31.5	224188	
4 1/2" T.C. Filled Façade 70% Cover Above		904	7.50	31.5	213570	
12" Wall, Below, 70% Open (Perimeter)		161	7.92	105.0	133831	
10" Wall, Below, 70% Open (Perimeter)		738	7.92	87.5	511219	
10" Wall, Below		49	7.92	125	48490	
8" Wall, Below		126	7.92	100.0	99750	
10" Wall, Above 70% Open		778	7.50	87.5	510563	
10" Wall, Above Interior		48	7.50	125	45000	
8" Wall, Above Interior		48	7.50	100.0	36000	
				ΣW_{floor}	**5331**	**kip**

Third Floor

Area = 20500 ft^2 Perimeter = 904 ft
Roof Area = 10000 ft^2

Item	Area	Length	Height	Area Weight	Weight	
	ft^2	ft	ft	psf	lbf	
5 1/2" NWC Slab	10500			68.75	721875	
Typ Floor DL	10500			65	682500	
4th Floor Hip Roof	10000			139	1390000	
4 1/2" T.C. Filled Façade 70% Cover Below		904	7.50	31.5	213570	
4 1/2" T.C. Filled Façade 70% Cover Above		904	7.25	31.5	206451	
10" Wall, Below 70% Open		778	7.50	87.5	510563	
10" Wall, Below Interior		48	7.50	125	45000	
8" Wall, Below Interior		48	7.50	100.0	36000	
10" Wall, Above 70% Open		778	7.25	87.5	493544	
10" Wall, Above Interior		48	7.25	125	43500	
6" Wall, Above Interior		48	7.25	75.0	26100	
				ΣW_{floor}	**4369**	**kip**

Fourth Floor

Interior Area = 9750 ft^2 Perimeter = 402 ft
Roof Area = 10000 ft^2

Item	Area	Length	Height	Area Weight	Weight	
	ft^2	ft	ft	psf	lbf	
5 1/2" NWC Slab	9750			68.75	670313	
Typ Floor DL	9750			65	633750	
4 1/2" T.C. Filled Façade 70% Cover Below		904	7.25	31.5	206451	
4 1/2" T.C. Filled Façade 70% Cover Above		402	6.50	31.5	82310	
10" Wall, Below 70% Open		778	7.25	87.5	493544	
10" Wall, Below Interior		48	7.25	125	43500	
8" Wall, Below Interior		48	7.25	100.0	34800	
8" Wall, Above 70% Open		402	7.25	70	204015	
6" Wall, Above		13.5	7.25	75	7341	
				ΣW_{floor}	**2376**	**kip**

Fifth Floor

Interior Area = 9750 ft^2 Perimeter = 402 ft
Roof Area = 10000 ft^2

Item	Area	Length	Height	Area Weight	Weight	
	ft^2	ft	ft	psf	lbf	
5 1/2" NWC Slab	9750			68.75	670313	
Typ Floor DL	9750			65	633750	
5th Floor Hip Roof	9750			147	1433250	
4 1/2" T.C. Filled Façade 70% Cover Above		402	6.50	31.5	82310	
8" Wall, Above 70% Open		402	7.25	70	204015	
6" Wall, Above		13.5	7.25	75	7341	
				ΣW_{floor}	**3031**	**kip**

Story	Weight
	kip
Fifth	3031
Fourth	2376
Third	4369
Second	5331
First	5402
Σ Building	20509

Degenkolb

Subject:	Base forces	**Job Number:**	B8114004	**Date:** 7/15/2019
Job:	Sproul Hall	**By:**	TAB	
		Checked By:		

ASCE 41-17 Linear Static Base Shear & Vertical Force Distribution
Tier 1

INPUT DATA

C:	Modification factor (Table 4-7) =	1		4 Conc. SW
S_1:	Spectral Response Acceleration @ 1 sec. =	1.05		(from Site Specific)
S_s:	Short Period Response Acceleration =	3.15		(from Site Specific)
SC:	Soil Class =	C		(A through F), 1.6.1.4.1

Table 1-5:	S_1 <= 0.1	S_1 = 0.2	S_1 = 0.3	S_1 = 0.4	S_1 >= 0.5
Soil Class C	1.7	1.6	1.5	1.4	1.3
F_v	-	-	-	-	1.30

F_v:	Site Coefficient for S_1 =	1.30		(Table 11.4-1)

Table 1-4:	S_s <= 0.25	S_s = 0.50	S_s = 0.75	S_s = 1.00	S_s >= 1.25
Soil Class C	1.2	1.2	1.1	1.0	1.0
F_a	-	-	-	-	1.00

F_a:	Site Coefficient for S_s =	1.00		(Table 11.4-2)
S_{X1}:	Spectral Response Acceleration @ 1 sec. =	1.05		Table 6, UCB Site Specific
S_{xs}:	Short Period Acceleration = F_a*S_s =	3.15		Table 6, UCB Site Specific
β:	Building System Exponent =	0.75		(4.4.2.4)
C_t:	Building System Coefficient =	0.02		(4.4.2.4)
W:	Total Building Weight =	20509	kips	
hn:	Total Building Height =	69.5	feet	
n:	Number of Stories =	5		
S_{M1}:	Spectral Response Acceleration @ 1 sec. =	1.07		(2-2)
S_{Ms}:	Short Period Acceleration = F_a*S_s =	3.15		(2-1)
S_{d1}:	Design spectral acceleration, 1 s =	0.71		
S_{ds}:	Design spectral acceleration, short =	2.10		

CALCULATE BASE SHEAR FOR BSE-2 (MCE)

T:	Fundamental Period of Vibration = C_t * h^{β} =	0.481	sec.	(4-4)
S_a:	Spectral Acceleration at Building Period =	2.18		(4-3)
V:	Pseudo Seismic Force =	44732	kips	(4-1)

Story	w	h	w x h	Cx	Fx	Vx
Fifth	3031	69.5	210653	0.29	12877	12877
Fourth	2376	56.5	134245	0.18	8206	21083
Third	4369	42	183502	0.25	11217	32301
Second	5331	27	143937	0.20	8799	41099
First	5402	11	59421	0.08	3632	44732
Σ	20509	Σ	731758	Σ	44732	

Degenkolb

Subject:	Shear Stress Check *4.4.3.3*	**Job Number:** B8114004	**Date:** 7/15/2019
Job:	Sproul Hall	**By:** TAB	
		Checked By:	

f'c =	3000	psi
f'ce =	4500	psi
2 √ f'c =	110	psi
2 √ f'ce =	134	psi

Ms = **4.5** *TBL 4-8*, Collapse Prevention

North South

Story	Length of Wall						Aw	Vx	σ_v	DCR
	Thickness	Thickness	Thickness	Thickness	Thickness	Thickness				
	7	9	8	10	11.5	12.5	in^2	kip	psi	2 √ f'c
Fifth	192.5	0	0	0	0	0	16170	12877	177	1.62
Fourth	0	168.5	0	0	0	0	18198	21083	257	2.35
Third	0	314	0	0	0	0	33912	32301	212	1.93
Second	0	282.5	39.5	0	96.5	0	47619	41099	192	1.75
First	0	0	87.625	212.5	0	230.125	68430.75	44732	145	1.33

East West

Story	Length of Wall					Aw	Vx	σ_v	DCR
	Thickness	Thickness	Thickness	Thickness	Thickness				
	6	7	8	9	10	in^2	kip	psi	2 √ f'c
Fifth	13.5	72	0	0	0	7020	12877	408	3.72
Fourth	48	0	0	96	0	13824	21083	339	3.09
Third	0	0	48	207	48	32724	32301	219	2.00
Second	0	0	96	171.5	57.5	34638	41099	264	2.41
First	0	0	168	0	284	50208	44732	198	1.81

Degenkolb

Subject:	Wall Steel Reinforcement Ratio	**Job Number:**	B8114004	**Date:**	7/15/2019
Job:	Sproul Hall	**By:**	TAB		
		Checked By:			

Concrete Walls

12" Wall

Vertical: #4 at 12" o.c., each way, both faces

twall =	12	in	
Abar =	0.4	in2	
spacing =	12	in	
rho =	0.0028	OK	> 0.0012 vertical minimum ratio

Horziontal #4 at 12" o.c., each way, both faces

twall =	12	in	
Abar =	0.4	in2	
spacing =	12	in	
rho =	0.0028	OK	> 0.002 horizontal minimum ratio

10" Wall

4/S5.03

Vertical: #4 at 12" o.c., each way, both faces

twall =	10	in	
Abar =	0.4	in2	
spacing =	12	in	
rho =	0.0033	OK	> 0.0012 vertical minimum ratio

Horziontal #4 at 12" o.c., each way, both faces

twall =	10	in	
Abar =	0.4	in2	
spacing =	12	in	
rho =	0.0033	OK	> 0.002 horizontal minimum ratio

8" Wall

7/S5.03

Vertical: #4 at 12" o.c., each way

twall =	8	in	
Abar =	0.2	in2	
spacing =	12	in	
rho =	0.0021	OK	> 0.0012 vertical minimum ratio

Horziontal #4 at 12" o.c., each way

twall =	8	in	
Abar =	0.2	in2	
spacing =	12	in	
rho =	0.0021	OK	> 0.002 horizontal minimum ratio

6" Wall

8/S5.03

Vertical:	#4 at 12" o.c., each way, both faces		
twall =	6	in	
Abar =	0.2	in2	
spacing =	12	in	
rho =	0.0028	OK	> 0.0012 vertical minimum ratio

Horziontal	#4 at 12" o.c., each way, both faces		
twall =	6	in	
Abar =	0.2	in2	
spacing =	12	in	
rho =	0.0028	OK	> 0.002 horizontal minimum ratio