ASCE 41-17 Tier 1 Seismic Evaluation

Building Name: Morrison Hall
CAAN ID: 1422
Auxiliary Building ID: - N/A
Address: Core Campus, Berkeley, CA 94720
Site location coordinates: Latitude 37.8709 Longitudinal -122.2565
Evaluator Name: Heavenz Kaur, Ray Pugliesi

Aerial Photo

East Exterior Elevation

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

BUILDING DATA

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

a. Longitudinal Direction: C2: Conc. SW with Stiff Diaphragms
b. Transverse Direction: C2: Conc. SW with Stiff Diaphragms

Square Footage: 42,926 ft^2
Building Length: 90'-0"
Building Width: 73'-0"
Building Height: 41'-0" Average Height
Story Height: 11'-0" at Ground Floor, 13'-0" at First Floor, 10'-6" at Second Floor
Number of stories *above* grade: 3. The Ground Floor daylights at the west elevation and has been considered a story instead of a basement.
Number of basement stories *below* grade: 0

Year of Original Construction and Code Year: 1958, 1955 UBC (Assumed)
Year of Later Constuction and Code Year: N/A

COST RANGE TO RETROFIT (if applicable): N/A

BUILDING DESCRIPTION

General

Morrison Hall is a three story, concrete building with a pitched roof located on a sloping site. The building has a rectangular footprint and measures approximately 90 ft in length in the east-west direction and 73 ft in width in the north-south direction and is about 50 ft above finished floor at the highest point. A covered concrete pathway is located between Morrison Hall and Hertz Hall on the east side of the building, that almost aligns with the Second Floor. Large, full story windows are located in parts of the exterior concrete walls along the north and south elevations.

The building area is approximately 43,000 square feet and is currently being used as a music building hosting a large inventory of musical instruments and books along with two large rooms known as the Reading Room and the Chorus Room located on the First and Second Floors, respectively.

Structural System

Gravity system of the building is composed of one way concrete joists spanning between exterior concrete walls and interior girders spanning to concrete columns founded on spread footings. In some parts the building also has 7" thick flat slabs with drop panels at column locations. The pitched roof is formed of concrete joists that span between interior girders and exterior walls. The roof steps at three locations by about two feet. The higher edge of the roof is supported by a concrete wall supported on a concrete girder.

Lateral system of the building is composed of 12" thick punched concrete shear walls located at the building exterior and around the stair and elevator cores. The shear walls are founded on continuous wall footings. The foundations are tied together by a concrete slab on grade at the Ground Level.

Building Condition

Good, no visible sign of structural or non structural damage were observed during the site visit. Some water damage in the Mechanical Room at the Ground Floor was noted.

Date of Site Visit: 05/31/2019, Ray Pugliesi & Heavenz Kaur, Degenkolb Engineers
Limitations of walk-through: None

SITE INFORMATION

Site Class (A-F): C Basis: Geologic Hazards and Site Classification Map of UC Berkeley by Geomatrix.

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}: 071

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), Degenkolb Engineers.

DOCUMENTATION

Architectural Drawings: Music Building, University of California, Berkeley,by Gardner A. Dailey and Associates Architects, dated, February 10, 1956

Structural Drawings: Music Building, University of California, Berkeley,by Walter T. Steilberg Consulting Architect, dated, February 10, 1956

Seismic Evaluations: 1997 Preliminary Seismic Evaluation (SAFER), dated September 3, 1997, by Degenkolb Engineers.

Geotechnical Reports: Not available

Other Documents: None

CONSTRUCTION DATA

Gravity Load Structural System:	Concrete joists and flat slabs supported on interior concrete columns and exterior concrete walls.		
Exterior Transverse Walls:	12" thick, punched, reinforced concrete shear walls	Opening(s)?	Yes
Exterior Longitudinal Walls:	Similar to Transverse Walls	Opening(s)?	Yes
Roof Materials/Framing:	Pitched concrete joists spanning between exterior walls and interior concrete girders.		
Intermediate Floors/Framing:	Concrete joists or flat slab at certain locations.		

Ground Floor:	4"thick concrete slab on grade		
Columns:	Range in size from 12"x12" to 14"x20"	Foundation:	Spread footings at columns and continuous footings at walls.
General Condition of Structure:	Good		
Evidence of Settling?:	No		
Special Features & Comments:	East walkway canopy may pound against the building in case of lateral movement.		
	Very large windows located on the north and south exterior walls of the building.		
	A sub-basement level is located at the north-west part of ground floor that houses the mechanical room and entrance to the loading dock.		

LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
ASCE 41-17 Building Type:	C2: Concrete SW	C2: Concrete SW
Diaphragms:	One way slab spanning between concrete joists and 7" thick flat slab at certain locations	One way slab spanning between concrete joists and 7" thick flat slab at certain locations
Vertical Elements:	Concrete columns and concrete shear walls	Concrete columns and concrete shear walls
Connections:	Dowelled cast in place concrete connections	Dowelled cast in place concrete connections
Details:	S2-S11	S2-S11
Estimated Fundamental Period, T (sec):	0.306	0.306
BSE-2E Spectral Acceleration, S_a:	3.15g	3.15g
Modification Factor, C:	1.0 (C2 – Table 4-7)	1.0 (C2 – Table 4-7)
Building Weight, W (kips):	7474	7474
Seismic Base Shear, V (kips):	23,542	23,542
System Modification Factor, M_s:	4.5 - Collapse Prevention	4.5 - Collapse Prevention

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

Morrison Hall does not have any structural deficiency per Tier 1 analysis. The quick check for shear wall stresses fails in Tier 1 analysis, but a Tier 2 shear check was performed to ensure the walls had sufficient capacity. The only other potential significant issue would be the pounding between the east perimeter wall and the concrete canopy. The canopy roof roughly aligns with the Second Level so pounding should not cause significant damage to either structures, but the east wall may sustain some damages on the surface finish.

Recommended Next Steps

None, since the building has been rated IV.

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

None

Appendices

A. Additional Photos

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

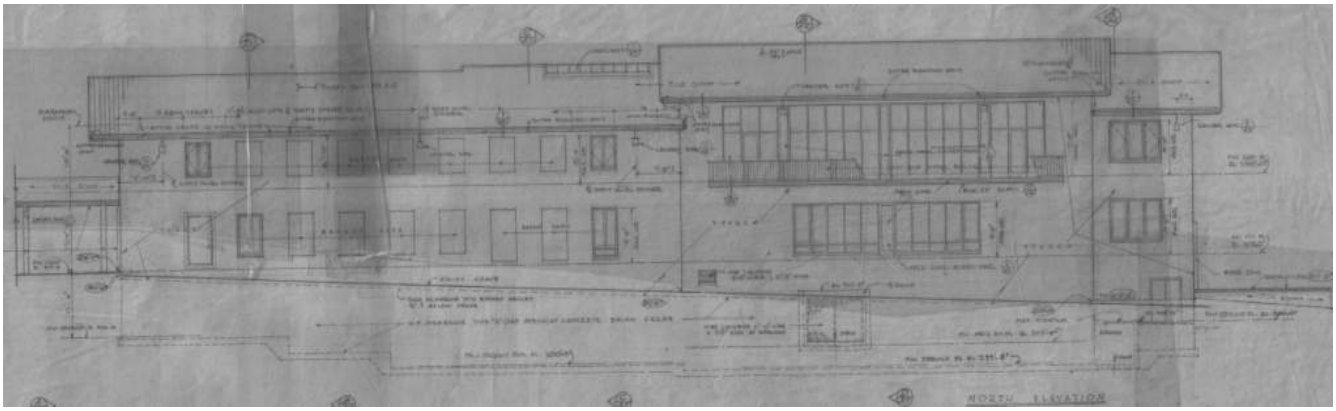
C. UCOP Seismic Safety Policy Falling Hazards Assessment Summary

D. Quick Check Calculations

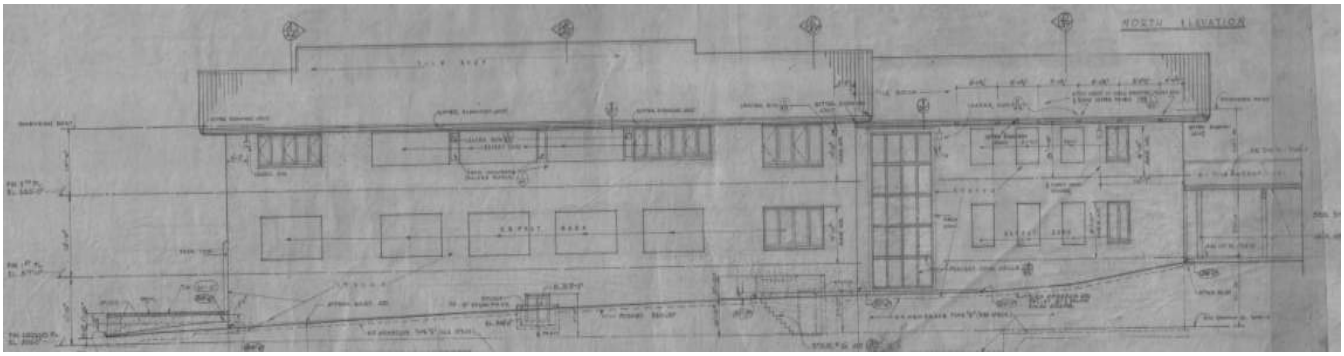
APPENDIX A
Additional Photos

Concrete canopy at walkway between Morrison Hall and Hertz Hall (East elevation)

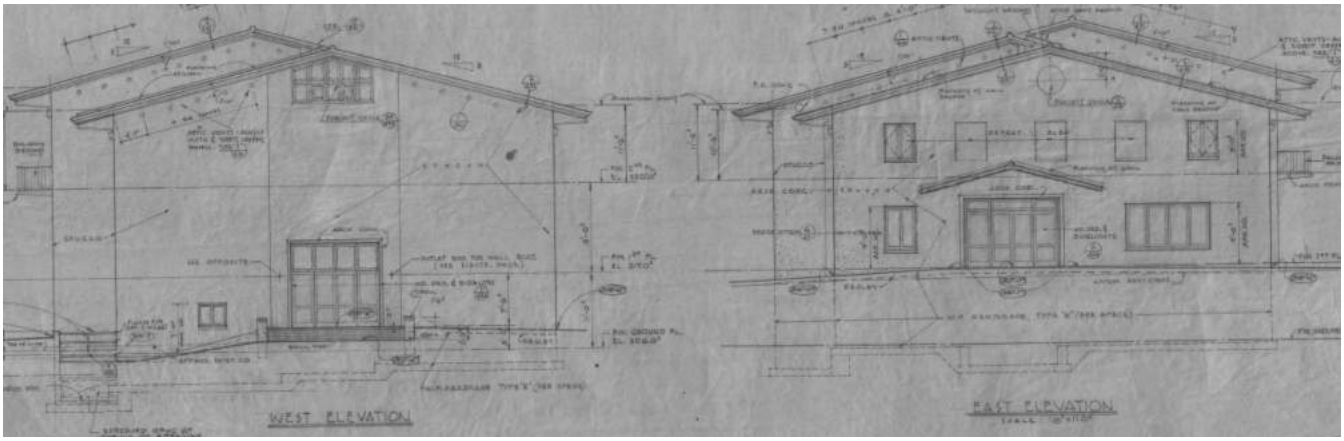
Large windows along north exterior wall



North elevation showing large windows and step in the roof level



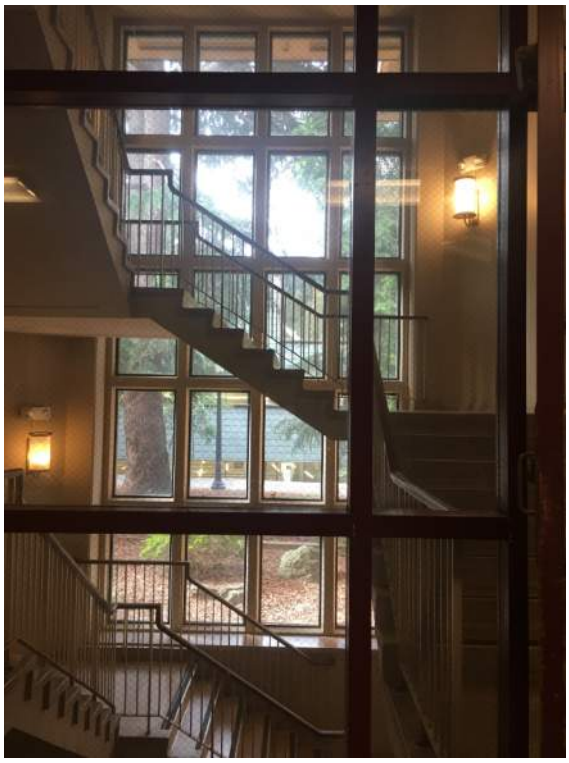
South elevation showing large windows and step in the roof level



West and east elevations

Typical concrete joist framing

Reading Room with tall windows at Second Level



Stairwell along north exterior wall

Chorus Room at First Level

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

UC Campus:	BERKELEY			Date:	6/13/2019		
Building CAAN:	1422	Auxiliary CAAN:	-	By Firm:	DEGENKOLB ENGINEERS		
Building Name:	MORRIOSN HALL			Initials:	*HK*	Checked:	
Building Address:	CORE CAMPUS, BERKELEY, CA 94720			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:** A covered walkway canopy connecting Morrison Hall and Hertz Hall abuts the building that may pound against it in case of a seismic event.
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:** 1 story structure.
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:**

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

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:**

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:**

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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:** 63/282.25>0.6*3.15=1.89
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:** Concrete SOG acts as a tie between all footings.

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

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

Low And Moderate Seismicity

Seismic-Force-Resisting System

	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:** Shear wall stresses exceed capacity for Tier 1 check, however, a Tier 2 check for shear wall stresses was performed and wall demands were less than capacity provided by Tier 2 analysis.
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

	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:**
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:**
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:**

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

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

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

Seismic-Force-Resisting System

C	NC	N/A	U	Description
●	○	○	○	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:**
●	○	○	○	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:** Bottom reinforcing in drop panels is developed with hooks.
○	○	●	○	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)

C	NC	N/A	U	Description
●	○	○	○	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 roof diaphragm steps at three locations, but in all three cases the diaphragm engages shear walls, and there is a load path for loads to travel from the higher roof plane into the shear walls.
●	○	○	○	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:**

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:**

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Collapse Prevention Structural Checklist For Building Type C2-C2A

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:**
○	○	●	○	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:**

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

APPENDIX C
UCOP Seismic Safety Policy Falling Hazards Assessment Summary

UC Campus:	BERKELEY			Date:	6/13/2019		
Building CAAN:	1422	Auxiliary CAAN:	-	By Firm:	DEGENKOLB ENGINEERS		
Building Name:	MORRIOSN HALL			Initials:	*HK*	Checked:	
Building Address:	CORE CAMPUS, BERKELEY, CA 94720			Page:	1	of	1

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:**
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 Hazards Risk: Low

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

APPENDIX D
ASCE 41-17 Quick Check Calculations

Degenkolb Engineers
1300 Clay St, 9th Floor
Oakland, CA 94612-2047
Phone: 510.272.9040
Fax: 510.272.9526

Subject:	Weight Take Off	**Job Number:**	B8114004.00	**Date:**	6/14/2019
Job:	UCB, MORRISON HALL	**By:**	HK	**Section:**	
		Checked By:		**Page/of:**	

First Level

	Area (ft2)	Thickness (in)	Weight (pcf)		Flat Load (psf)	
Waffle Slab (6"x14" joist w/2 1/2" slab)	6400		150		75	
7" Slab	3800		150		88	
11" Slab	2800		150		138	
	PLF			Total Length (ft)	Convert to Flat Load (psf)	
					0	
	Number of columns	Height (ft)	Weight (plf)	Weight (lbs)	Convert to Flat Load (psf)	
Columns 12x12	21	11	150.0	17325	1	
		Length (ft)	Height (ft)	Weight (psf)	Weight (lbs)	Convert to Flat Load (psf)
12" Perimeter Wall		658	11	150	1085700	84
Total Flat Load: (Slab)*(Area - Open)+Beams+Girder+Col+Ext.Panel+5 psf				2366	kips	
Effective Flat Dead Load (includes 10psf Partition)				192	psf	

Second Level

	Area (ft2)	Thickness (in)	Weight (pcf)		Flat Load (psf)	
Waffle Slab (6"x14" joist w/2 1/2" slab)	13000		150		75	
Library Stacks					50	overall
	PLF			Total Length (ft)	Convert to Flat Load (psf)	
					0	
	Number of columns	Height (ft)	Weight (plf)	Weight (lbs)	Convert to Flat Load (psf)	
Columns 12x12	21	13	150.0	20475	2	
		Length (ft)	Height (ft)	Weight (psf)	Weight (lbs)	Convert to Flat Load (psf)
12" Perimeter Wall		658	13	150	1283100	99
Total Flat Load: (Slab)*(Area - Open)+Beams+Girder+Col+Ext.Panel+5 psf				2994	kips	
Effective Flat Dead Load (includes 10psf Partition)				240	psf	

Roof

	Area (ft2)	Thickness (in)	Weight (pcf)		Flat Load (psf)	
Roof Tile					17.4	16% increas due to gable roof
Waffle Slab (4"x12" joist w/2" slab)	13000		150		58	16% increas due to gable roof
	PLF			Length (ft)	Convert to Flat Load (psf)	
					0	
	Number of columns	Height (ft)	Weight (plf)	Weight (lbs)	Convert to Flat Load (psf)	
Columns 12x12	21	10.5	150.0	33075	3	
		Length (ft)	Height (ft)	Weight (psf)	Weight (lbs)	Convert to Flat Load (psf)
12" Perimeter Wall		658	10.5	150	1036350	80
Total Flat Load: (Slab)*(Area - Open)+Beams+Girder+Col+Ext.Panel+5psf				2115	kips	
Effective Flat Dead Load				163	psf	

Total Building Weight 7474 kips

Degenkolb

Subject:	Base forces	**Job Number:**	B8114004.00	**Date:**	14-Jun-2019
Job:	UCB, MORRISON HALL	**By:**	HK		
	Tier 1 evaluation, RC shear walls	**Checked By:**			

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

INPUT DATA

C:	Modification factor (Table 4-7) =	1.0	
S_1:	Spectral Response Acceleration @ 1 sec. =	1.03	(from MCE maps or Site Specific)
S_s:	Short Period Response Acceleration =	2.47	(from MCE maps or 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	1.5	1.5	1.5	1.5	1.5
F_v	-	-	-	-	1.50

F_v:	Site Coefficient for S_1 =	1.50	(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	1.3	1.3	1.2	1.2	1.2
F_a	-	-	-	-	1.20

F_a:	Site Coefficient for S_s =	1.20		(Table 11.4-2)
S_{X1}:	Spectral Response Acceleration @ 1 sec. =	1.050		Table 6, Site Specific
S_{xs}:	Short Period Acceleration =	3.150		Table 6, 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 =	7474	kips	
hn:	Total Building Height =	38	feet	
n:	Number of Stories =	3		

CALCULATE BASE SHEAR FOR BSE-2E (MCE)

T:	Fundamental Period of Vibration = $C_t * h^{\beta}$ =	0.306	sec.	(4-4)
S_a:	Spectral Acceleration at Building Period =	3.15		(4-3)
V:	Pseudo Seismic Force =	23542	kips	(4-1)

Degenkolb

Subject:	ASCE 41 Shear Stress check, Section 4.4.3.3		**Job Number:**
Job:	UCB, MORRISON HALL		**By:**
Model:	ASCE 41, TIER 1		**Checked By:**

Story Shears

Base Shear V **23542** kips
k 1
Ms 4.5 for RC wall, Collapse Prevention

x	w_x	h_x	$w_x h_x^k$	F_x	V_j
Roof	2115	34.5	72955	10054	10054
Level 2	2994	24	71846	9902	19956
Level 1	2366	11	26021	3586	23542
	7474		170821	23542	

Level	Wall Length N/S	Wall Length E/W	Average Wall thickness	f'c	2sqrt(f'c) (psi)	Demand (psi) N/S	Demand (psi) E/W	D/C- Tier 1 N/S	D/C- Tier 1 E/W
Roof	168.00	163.00	12.00	2500.00	100.00	92.36	95.19	0.92	0.95
Level 2	168.00	173.00	12.00	2500.00	100.00	183.3	178.01	1.83	1.78
Level 1	213.00	384.00	12.00	2500.00	100.00	170.6	94.61	1.71	0.95

Tier 2

Base Shear V **20717** kips
k 1
m 3 (Table 10-22)

x	w_x	h_x	$w_x h_x^k$	F_x	V_j
Roof	2115	35	72955	8848	8848
Level 2	2994	24	71846	8713	17561
Level 1	2366	11	26021	3156	20717
	7474		170821	20717	

Level	Wall Length N/S	Wall Length E/W	Average Wall thickness	Ast	2sqrt(f'cE) + Ast*fyE(psi)	Demand (psi) N/S	Demand (psi) E/W	D/C- Tier 2 N/S	D/C- Tier 2 E/W
Roof	168.00	163.00	12.00	#4@12 EF EW	237.06	121.91	125.65	0.51	0.53
Level 2	168.00	173.00	12.00	#4@12 EF EW	237.06	241.97	234.98	1.02	0.99
Level 1	213.00	384.00	12.00	#4@12 EF EW	237.06	225.15	124.89	0.95	0.53

f'c=2500psi
fy=33 ksi

Degenkolb

Subject:	Column Deflection Compatability	**Job Number:**	B8114004	**Date:**	3/7/2019
Job:	UCB, MORRISON HALL	**By:**	HK		
		Checked By:			

Material Properties

f_y =	60	ksi	f'_c =	5000	psi
f_{ye} =	75	ksi	f'_{ce} =	7500	psi

Section Moment Capacity

Using Expected Material Properties

M_{max} =	252	k-ft	@ 137 k Axially
l =	11	ft	
Vlsa =	45.8	kip	
	14"x14"		

Shear Capacity

Shear Design @ Hinge

#3 @ 8" oc

Av =	0.22	in^2	
s =	8	in	
d =	12.125	in	
fyE =	32	ksi	
λ =	1		
knl =	1	displacement ductility factor	
Mud/Vud*d =	4		
αcol =	1		
Ag =	196	in^2	
V steel=	11	kips	
V conc=	47	kips	
Vcol =	57.4	kip	ASCE 41-17, EQ (10-3)

Axial Load

			psf
	Weight	1402	psf
L1	11	ft	
L2	11	ft	
A_{trib}	310	ft^2	
Total Load	435	kips	