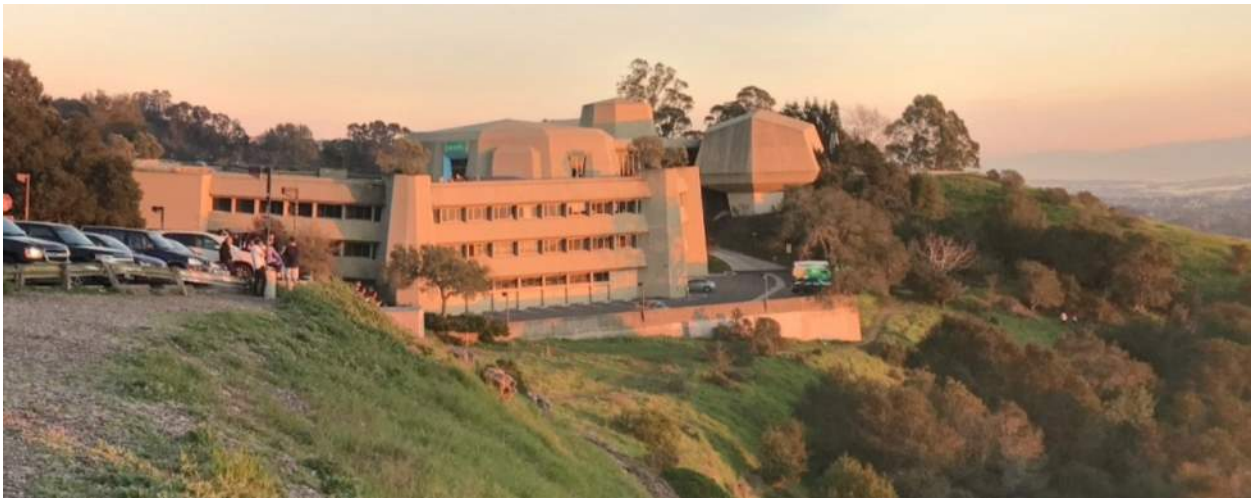
Evaluator: HK
Date: 03/29/19

ASCE 41-17 Tier 1 Seismic Evaluation

Building Name: Lawrence Hall of Science-Base
CAAN ID: 1800
Auxiliary Building ID: N/A
Address: 1 Centennial Drive, Berkeley, CA 94720
Site location coordinates: Latitude 37.8794 Longitudinal -122.2467

Plan Image or Aerial Photo

North Elevation Photo



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 – rigid diaphragm
b. Transverse Direction: **C2**, Concrete Shear Wall – rigid diaphragm

Square Footage: 119,188 sf out of 134,388 sf total.
Building Length: 270 ft
Building Width: 270 ft
Building Height: 34 ft (From Level D to Level A)
Story Height: 12 ft at base structure
Number of stories *above* grade: 4 Stories at base structure. Shell structures of the Entrance Foyer, Exhibition Halls and Memorial Room are either supported on the base structure completely or have their own foundation system.
Number of basement stories *below* grade: None
Year of Original Construction and Code Year: 1968, 1964 UBC
Year of Later Constuction and Code Year: 1983, 1979 UBC

COST RANGE TO RETROFIT (if applicable): Medium: Between $200-$400 per square foot

BUILDING DESCRIPTION

General

The Lawrence Hall is an unusual building with a combination of precast and cast in place elements that are either light weight or normal weight concrete depending upon the level they occur at. It is located on a sloping site and has some partial levels due to the sloped site and a two story space at Level C. The base structure has an octagonal shape, with another two story section called the Information Center located at the south end. There are various shell structures supported fully or partially on the base structure; the Exhibition Halls, the Entrance Foyer and the Memorial Room.

The building houses a museum above Level A, auditoriums at Level C and various offices and exhibits between Levels D through A.

Structural System

Base structure: The gravity system of the base structure is composed of a 24” deep waffle slab supported on precast or cast in place walls or columns. 24” deep solid concrete panels have been provided at columns supports to address punching shear demands. Precast walls range in thickness from 9” to 11” thick. Precast panels have been detailed with a key on both vertical edges to provide an interlock with adjacent cast in place or precast walls or columns. The foundations and beams have been dowelled into the precast vertical elements.

The lateral system of the Base Structure is mainly constituted of the seven, cast in place planter piers, distributed unifromly around the building perimeter. Some precast and cast in place concrete shear walls also occur at various locations in the Base Structure. The precast shear walls occur only at the bottom

most level at Level D and east side of Level C that is supported directly on foundations. The central part of the building that has the auditorium and lecture halls has 8" thick cast in place concrete shear walls that also support the Level A slab above.

The Base Structure is supported on 36" diamater concrete piers of varying lengths. The piers are lateraly tied with tie beams in both directions.

Information Center: The two-story structure located on Level A towards south of the Base Structure is called the Information Center. The gravity system is similar to the Base Structure with the exception that at the South Lobby, a one-story steel framed area supported on 24" diameter concrete piers that forms the entry pavilion to the south garden area. The Memorial Hall is a tall story space formed by a shell structure with 8" precast walls and 5" thick cast in place concrete roof slab spanning between concrete gravity frames, spanning across the diameter of the shell.

The lateral system of the Information Center is formed by precast concrete shear walls at Memorial Room and is attached to Level A of the Base Structure with rebar dowels. These shear walls are discontinuous and do not extend to the building foundation.

Entrance Foyer: This is a cast in place shell structure supported completely on the base structure at Level A. The gravity and lateral system both, are formed by concrete bends that span across the diameter of the building forming its volume, with an 8" thick concrete slab spanning in between these bends. These slabs form the diaphragm and shear walls of this structure.

A separate report has been prepared for the Exhibition Halls.

Building Condition
Good, no visible structural or non-structural damage.

Date of Site Visit: 3/26/2019, Ray Pugliesi and Heavenz Kaur, Degenkolb Engineers
Limitations of walk-through: None

SITE INFORMATION
Site Class (A-F): D Basis: Default
Site Specific Ground Motion Study? No
BSE-1N Spectral Accelerations: Basis: USGS Data
S_{DS}: 1.903 S_{D1}: 1.031
BSE-2E Spectral Accelerations: Basis: USGS Data
S_{XS}: 2.473 S_{X1}: 1.29
Level of Seismicity: High
Performance Level: Collapse Prevention Structural Performance (Risk category II, ASCE 41-17 Table 2-1)

Geologic Hazards:
Fault Rupture No Basis: Earthquake Zones of Required Investigation- Briones Valley
https://maps.conservation.ca.gov/cgs/informationwarehouse/regulatorymaps/

Liquefaction No Basis: Earthquake Zones of Required Investigation- Briones Valley https://maps.conservation.ca.gov/cgs/informationwarehouse/regulatorymaps/
Landslide No, but surrounded by region prone to landslide Basis: Earthquake Zones of Required Investigation- Briones Valley https://maps.conservation.ca.gov/cgs/informationwarehouse/regulatorymaps/

PREVIOUS RATINGS SUMMARY

1. Good – 1997 Preliminary Seismic Evaluation (SAFER), Forell/Elsesser Engineers Inc.

DOCUMENTATION

Architectural Drawings: Lawrence Memorial Hall of Science, by Anshen & Allen Architects, dated, December 15, 1964.

Lawrence Hall of Science Alterations, Step 1, by ED2 Architects, dated, March 4, 1982.

Structural Drawings: Lawrence Memorial Hall of Science, by Isadore Thompson SE Structural Engineer, dated, December 15, 1964.

Lawrence Hall of Science Alterations, Step 1, by Shapiro, Okino & Hom Structural Engineers, dated, March 4, 1982.

Seismic Evaluations: 1997 Preliminary Seismic Evaluation (SAFER), Forell/Elsesser Engineers Inc., July 8, 1997.

Geotechnical Reports: Not available

Other Documents:

CONSTRUCTION DATA

Gravity Load Structural System:	Base Structure and Information Center: 24” deep waffle slab supported on precast and cast in place columns. Entrance Foyer: 8” cast in place concrete slabs spanning between concrete frames spanning across the diameter of the structure.		
Exterior Transverse Walls:	9”-11” precast or 8” thick cast in place concrete walls at Base Structure. 8” thick precast shear walls at Memorial Room in Information Center and Entrance Foyer.	Opening(s)?	Yes
Exterior Longitudinal Walls:	Similar to Transverse Walls	Opening(s)?	Yes
Roof Materials/Framing:	Base structure: 24” deep waffle slab Information Center: 24” deep waffle slab Memorial Room: 5” thick concrete slab spanning between concrete frames. Entrance Foyer:8” thick concrete slab spanning between concrete frames.		
Intermediate Floors/Framing:	Similar to Roof framing at Base Structure only.		
Ground Floor:	4” slab on grade with #3@15” o.c. each way at Base Structure		

Columns:	Various types: 18” diameter, 18”x18” cast in place columns to 8”x20” precast columns. 12” diameter precast columns at South Lobby in Information Center.	Foundation:	24” and 36” diameter concrete piers with 12”x12” tie beams
General Condition of Structure:	Good		
Evidence of Settling?:	No		
Special Features & Comments:	The building is located on a sloping site and is highly irregular in plan. Along with the base structure there are four shell structures located on or adjacent to the building.		

LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
ASCE 41-17 Building Type:	C2: Concrete SW	C2: Concrete SW
Diaphragms:	Base Structure and Information Center:24” thick waffle slab at base structure Entrance Foyer: 8” thick cast in place concrete slab.	Base Structure and Information Center:24” thick waffle slab at base structure Entrance Foyer: 8” thick cast in place concrete slab.
Vertical Elements:	Base structure: 8”-11” precast walls, 8” cast in place walls, cast in place and precast columns	Base structure: 8”-11” precast walls, 8” cast in place walls, cast in place and precast columns
Connections:	Dowelled in cast in place concrete	Dowelled in cast in place concrete
Details:	On structural set	On structural set
Estimated Fundamental Period, T (sec):	0.294	0.294
BSE-2E Spectral Acceleration, S_a:	2.47g	2.47g
Modification Factor, C:	1.1 (C2 – Table 4-7)	1.1 (C2 – Table 4-7)
Building Weight, W (kips):	Base Structure: 26,572 Information Center: 1,466 Entrance Foyer: 4,350	Base Structure: 26,572 Information Center: 1,466 Entrance Foyer: 4,350
Seismic Base Shear, V (kips):	Base Structure: 72,283 Information Center: 4,717 Entrance Foyer: 13,985	Base Structure: 72,283 Information Center: 4,717 Entrance Foyer: 13,985
System Modification Factor, M_s:	4.5 for reinforced concrete shear wall at CP, per Table 4-8 of ASCE 41-17	4.5 for reinforced concrete shear wall at CP, per Table 4-8 of ASCE 41-17

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

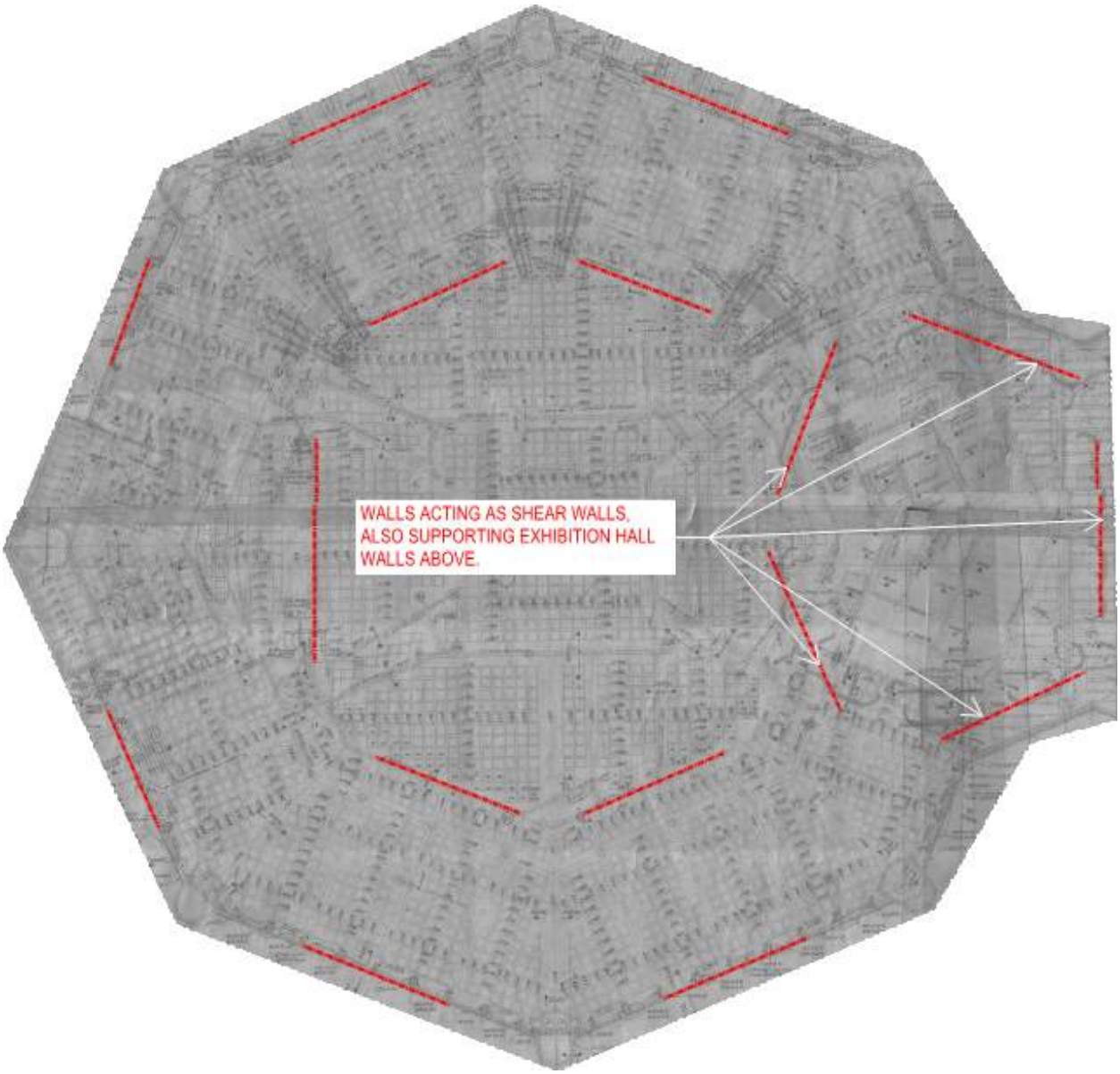
The major deficiencies and non-compliances of this building are related to its overall geometry and layout.

1. Shear Stress check: The cast in place planter shear wall piers exceed the 2√f'c shear stress.
2. Discontinuous load path: The Shell structures supported on the Base Structure do not have shear walls extending to the foundations. This may cause damage to the supporting structure due to overturning forces generated in the building.
3. Geometry: Vertical irregularities include discontinuous hear walls as described above.
4. Torsion: The irregular plan of the Information Center causes torsion in the building as well. This may cause unequal shear stresses on different parts of the shear walls, potentially overwhelming some parts of the walls.

Tier 1 is likely too simplistic an anlysis for such an unusual building. A more detailed Tier 2/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 in the building.

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

Additional shear walls are required to mitigate the excessive shear stress on the existing shear walls and support discontinuous walls above slab.



Level A Plan with proposed shear walls below extending to foundations

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 A.1 Entrance Foyer at Level A at building exterior

Figure A.2 Roof at Entrance Foyer

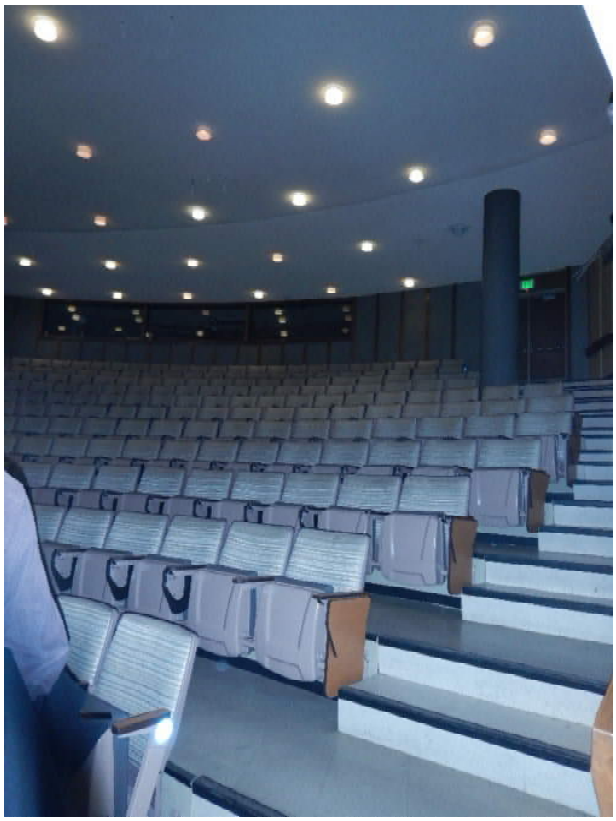


Figure A.3 Auditorium at Level C

Figure A.3 Typical waffle slab

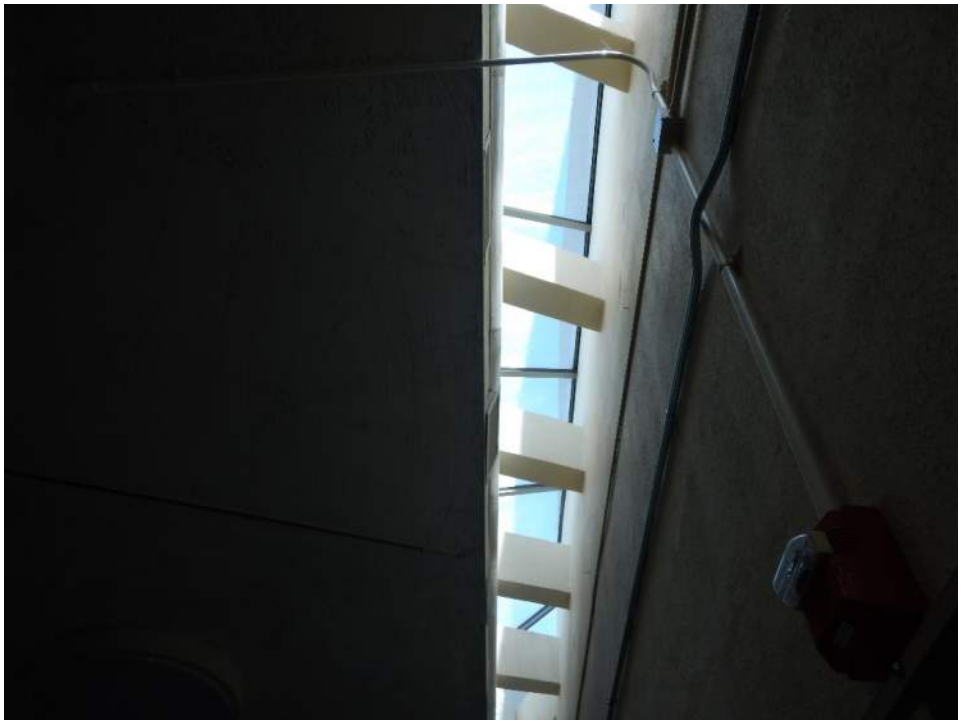


Figure A.4 Roof of Information Center to the Memorial Room shell with concrete beams

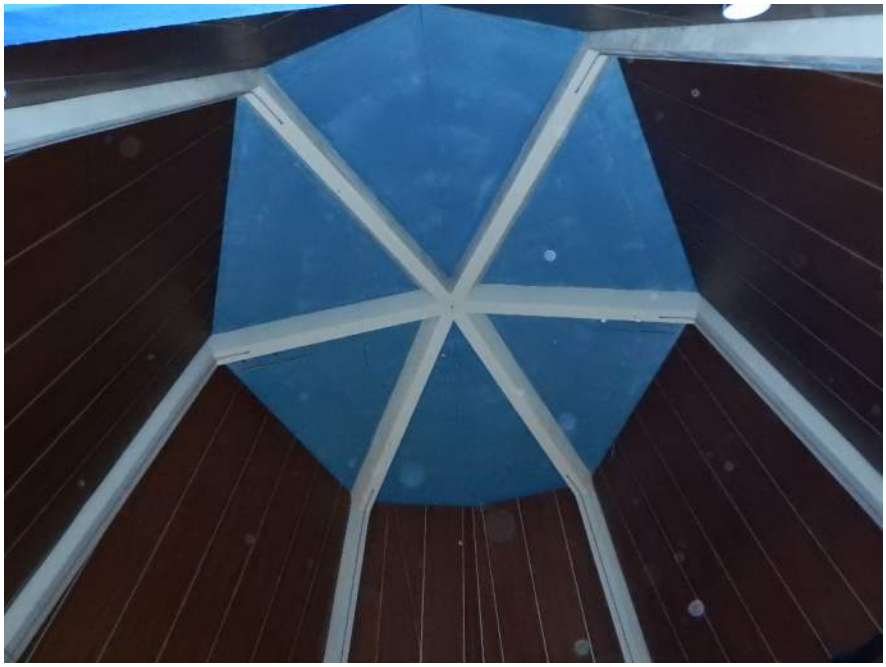


Figure A.2 Roof of Memorial Room in Information Center

APPENDIX B

ASCE 41-17 Tier 1 Checklists (Structural)

UC Campus:	BERKELEY			Date:	03/29/2019		
Building CAAN:	1800	Auxiliary CAAN:	N/A	By Firm:	DEGENKOLB ENGINEERS		
Building Name:	LAWRENCE HALL OF SCIENCE-BASE			Initials:	*HK*	Checked:	
Building Address:	BERKELEY, CA 94720			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 at the Entry Foyer and Memorial hall shell structures.
●	○	○	○	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:** 2" seismic joint at Level A near Exhibition Halls
●	○	○	○	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:** Level B mezzanine is attached to the shear walls of the main structure.

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 Entry Foyer and Memorial Hall shell structures.

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

UC Campus:	BERKELEY			Date:	03/29/2019		
Building CAAN:	1800	Auxiliary CAAN:	N/A	By Firm:	DEGENKOLB ENGINEERS		
Building Name:	LAWRENCE HALL OF SCIENCE-BASE			Initials:	*HK*	Checked:	
Building Address:	BERKELEY, CA 94720			Page:	2	of	3

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:** At Level A, Memorial Hall shell structure forms the lateral system of the Information Center.
○	●	○	○	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:** At Level A, Library roof is less than 50% mass of Level A.
○	●	○	○	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:**

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

UC Campus:	BERKELEY			Date:	03/29/2019		
Building CAAN:	1800	Auxiliary CAAN:	N/A	By Firm:	DEGENKOLB ENGINEERS		
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Building Address:	BERKELEY, CA 94720			Page:	3	of	3

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:** Base/Height = 264'/48'=5.5>0.6*2.47 (Sa)=1.48
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:** Tie beams are present between foundation piers.

UC Campus:	BERKELEY			Date:	03/29/2019		
Building CAAN:	1800	Auxiliary CAAN:	N/A	By Firm:	DEGENKOLB ENGINEERS		
Building Name:	LAWRENCE HALL OF SCIENCE-BASE			Initials:	*HK*	Checked:	
Building Address:	BERKELEY, CA 94720			Page:	1	of	3

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:** Average shear stress d/c in the walls is about 4 in N/S direction and about 1.7 in E/W direction.
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:** Typically 8” thick walls w/#3@11 (H) EF

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:**

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:**

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:**
◉	○	○	○	
C	NC	N/A	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	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	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	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:**
◉	○	○	○	

Flexible Diaphragms

	Description

UC Campus:	BERKELEY			Date:	03/29/2019		
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Building Address:	BERKELEY, CA 94720			Page:	3	of	3

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

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:**
○	○	◉	○	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

				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:** Wall rebar has been directly developed into the piles. No pile caps are present in the building.

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:	3/29/2019		
Building CAAN:	1800	Auxiliary CAAN:	N/A	By Firm:	DEGENKOLB ENGINEERS		
Building Name:	LAWRENCE HALL OF SCEINCE-BASE			Initials:	*HK*	Checked:	
Building Address:	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:** Ceilings in large auditoriums are acoustic tiles.
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

Quick Check Calculations

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

Degenkolb

Subject:	Weight Take Off	**Job Number:**	B8114004.00	**Date:**	3/29/2019
Job:	UCB, LAWRENCE HALL	**By:**	HK	**Section:**	
		Checked By:		**Page/of:**	

Level C

Effective Flat Dead Load+Misc	188	psf
Floor weight	1663	kips

Level B Mezz

Effective Flat Dead Load	127	psf
Floor Weight	2212	kips

Level A

Effective Flat Dead Load+ Floor Paving (50 psf overall)	393	psf
Floor Weight+Entry Foyer+Library Roof+Memorial Hall	30665	kips

Information Center Roof

Effective Flat Dead Load	104	psf
Floor Weight+Memorial Hall	1266	kips

	Area (ft2)	Thickness (in)	Weight (pcf)	Flat Load (psf)	Weight (kips)
Entry Foyer, Memorial Room Exhibition Halls					
8" Shells					
Entry Foyer	29000	8	150	150	4350
Memorial Hall	1950	8	110	103	200.2
2x Exhibition Halls	13740	8	150	150	3320.5

Total Building Weight	35806	kips

Degenkolb

Subject:	Base forces	**Job Number:** B8114004.00	**Date:** 29-Mar-2019
Job:	UCB, LAWRENCE 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) =	1.1		
S_1:	Spectral Response Acceleration @ 1 sec. =	0.76		USGS Data
S_s:	Short Period Response Acceleration =	2.06		USGA Data
SC:	Soil Class =	D		(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 D	2.4	2.2	2.0	1.9	1.8
F_v	-	-	-	-	1.80

F_v:	Site Coefficient for S_1 =	1.80	(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 D	1.6	1.4	1.2	1.1	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. =	1.290		USGS Data
S_{xs}:	Short Period Acceleration =	2.473		USGS Data
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 =	35806	kips	
hn:	Total Building Height =	36	feet	Level A- Level D
n:	Number of Stories =	3		

CALCULATE BASE SHEAR FOR BSE-2E (MCE)

T:	Fundamental Period of Vibration = $C_t * h^{\beta}$ =	0.294	sec.	(4-4)
S_a:	Spectral Acceleration at Building Period =	2.47		(4-3)
V:	Pseudo Seismic Force =	97402	kips	(4-1)

Degenkolb

Subject:	ASCE 41 Shear Stress check, Section 4.4.3.3	**Job Number:**	B8114004.00
Job:	UCB, LAWRENCE HALL	**By:**	HK
Model:	ASCE 41, TIER 1	**Checked By:**	

Story Shears

BASE STRUCTURE

Base Shear V **97402** 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		
Level A	30665	48	1471914	92056	92056		
Level B Mezz	2212	30	66348	4150	29518	Area B/Area A	0.276
Level C	1663	11.5	19126	1196	16155	C(Sus.)/Ar	0.507
			1557388				

Level	Wall Length N/S	Wall Length E/W	Wall Thickness N/S	Wall Thickness E/W	f'c	2sqrt(f'cE) (psi)	Demand (psi) N/S	Demand (psi) E/W	D/C- Tier 1 N/S	D/C- Tier 1 E/W
Level A	424.00	660.00	8.00	8.00	4000.00	141.42	502.58	322.87	3.55	1.72
Level B Mezz	122.00	211.00	8.00	8.00	4000.00	141.42	560.07	323.83	3.96	1.73
Level C	257.00	128.00	9.00	8.00	4000.00	141.42	129.34	292.15	0.91	1.75

Entry Foyer

C	1.3	
Sa	2.47	
W	4350	
Base Shear V	**13985** kips	
k	1	
Ms	4.5 for RC wall, Collapse Prevention	

x	w_x	h_x	$w_x h_x^k$	F_x	V_i
Roof					13985

Level	Wall Length		Wall Thickness		f'c	2sqrt(f'cE) (psi	Demand (psi)		D/C- Tier 1	
	N/S	E/W	N/S	E/W			N/S	E/W	N/S	E/W
Roof	358.00	288.00	8.00	8.00	4000.00	141.42	90.43	112.40	0.64	0.80

Memorial Hall

C	1.3	
Sa	2.47	
W	1466	Memorial Hall Shell+12202 sq ft of Library Roof
Base Shear V	**4714** kips	
k	1	
Ms	4.5 for RC wall, Collapse Prevention	

x	w_x	h_x	$w_x h_x^k$	F_x	V_i
Roof					4714

Level	Wall Length		Wall Thickness		f'c	2sqrt(f'cE) (psi	Demand (psi)		D/C- Tier 1	
	N/S	E/W	N/S	E/W			N/S	E/W	N/S	E/W
x	104.00	48.00	8.00	8.00	4500.00	150.00	104.92	227.32	0.70	1.10