ASCE 41-17 Tier 1 Seismic Evaluation

Building Name: Recreational Sports Facility, Lobby
CAAN ID: 1365
Auxiliary Building ID: 1365.2
Address: Core Campus, Berkeley, CA 94720
Site location coordinates: Latitude 37.8686 Longitudinal -122.2623

Aerial Photo

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: **S1: Steel MF w/ Stiff Diaphragms**
b. Transverse Direction: **S1: Steel MF w/ Stiff Diaphragms**

Concrete SW Parking Garage Basement Calculations Included in Appendices

Square Footage: 4830 ft^2 (+ 2340 ft^2 – Parking SF, ratio of superstructure SF/ total superstructure SF) out of 191,703 ft^2 total
Building Length: 38'-4"
Building Width: 39'-8"
Building Height: 38'
Story Height: 13'-2" (1st), 12' (2nd), 13'-10" (3rd)
Number of stories *above* grade: 3
Number of basement stories *below* grade: 1

Year of Original Construction and Code Year: 1984, 1979 UBC
Year of Later Constuction and Code Year:
2007 (Wall Cladding Repair), 2001 CBC (Assumed)

COST RANGE TO RETROFIT (if applicable): **High: over $200 per sf and less than $400 per sf**

BUILDING DESCRIPTION

General

This building finished construction in 1984 and is situated on a level site. The structure referenced as, "Lobby", is part of the RSF complex. The RSF has two buildings that are separated with an expansion joint in the parking garage level creating an East and West building. These buildings have separate superstructures separated by seismic joints above grade. The Handball Superstructure is part of the East Building at the RSF complex. This superstructure has three stories for a total height of 38' above the parking garage. The building is rectangular in shape with a floor plan of about 38'-4" in the NS direction and 39'-8" in the EW direction. The building area is approximately 4,830 square feet and houses miscellaneous office space at the upper story and the main entrance to the recreational facility at the ground level.

Structural System

The gravity structural system consists of composite metal deck with LWC fill at the 2nd and 3rd story with intermediate steel open web joists framing to steel beams. The roof is comprised of sheet metal deck with the same framing type. The first floor is a reinforced concrete slab supported by concrete cast-in-place (CIP) beams framing to concrete walls that make up the parking garage level below. The steel beams frame into steel columns that are supported by concrete transfer beams at the first level. The lateral system consists of a steel moment frame system utilizing Pre-Northridge WUF moment connections. The steel moment frame is supported by concrete CIP transfer beams. The transfer beams span to shear walls in the basement level that are supported on pile foundations.

Building Condition

Good, no signs of deterioration found on limited site walk.

Date of Site Visit: 02/15/2019, 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}: 3.15S_{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), Forell Elsesser Engineers, Inc.

DOCUMENTATION

Architectural Drawings: "University of California, Berkley Intramural Sports Facility", ELS Design Group, 06/29/1982, A0.0-A9.7 (Sub Consultant DWG's Included)

Structural Drawings: "University of California, Berkley Intramural Sports Facility", T.Y. Lin International, 06/29/1982, S1-S25

Seismic Evaluations: "1997 Preliminary Seismic Evaluation (SAFER)", Forell Elsesser Engineers, Inc., 08/19/1997, FEMA-178 Structural Checklist

Geotechnical Reports: "Report of Soils and Foundation Investigation", Provenzano & Assoc., 05/15/1981

Other Documents: "Recreational Sports Facility – Wall Cladding Repair, Technical Roof Services, Inc., July, 2004, Drawings

CONSTRUCTION DATA

Gravity Load Structural System:	Metal deck on steel joists framing into steel WF beams on steel WF columns		
Exterior Transverse Walls:	Stud wall w/ plaster finish	Opening(s)?	Yes
Exterior Longitudinal Walls:	Stud wall w/ plaster finish	Opening(s)?	Yes
Roof Materials/Framing:	1 ½" Metal Deck		
Intermediate Floors/Framing:	1 ½" Composite Metal Deck w/ 3 ½" LWC Fill		
Ground Floor:	5" suspended slab		
Columns:	W14x90 Steel Columns	Foundation:	Pile Foundation
General Condition of Structure:	Good		
Evidence of Settling?:	No		
Special Features & Comments:	Pre-Northridge moment connections. Moment Frame systems is discontinuous on transfer concrete beams.		

LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
ASCE 41-17 Building Type:	S1: Steel MF w/ Stiff Diaphragms	S1: Steel MF w/ Stiff Diaphragms
Diaphragms:	Metal Deck with Conc. Top.	Metal Deck with Conc. Top.

	Metal Deck at Roof	Metal Deck at Roof
Vertical Elements:	W14x90	W14x90
Connections:	WUF MC	WUF MC
Details:	See S20 for conn. details	See S20 for conn. details
Estimated Fundamental Period, T (sec):	0.643	0.643
BSE-2E Spectral Acceleration, S_a:	1.63g	1.63g
Modification Factor, C:	1.1 (S4 – Table 4-7)	1.1 (S4 – Table 4-7)
Building Weight, W (kips):	327	327
Seismic Base Shear, V (kips):	588	588
System Modification Factor, M_s:	7.5 – Limited Safety	7.5 – Limited Safety

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 items have been identified as non-compliant:

1. *Drift Check:* The moment frame is flexible in the East-West direction due to all of the columns being framed in the weak axis. This increased flexibility is resulting in a 3.2% inter-story drift at the first floor per the quick check procedure. This drift demand indicates the potential for significant structural damage due to large rotation demands at joints and non-structural damage to components framed full story height.
2. *Moment Resisting Connections:* The moment connection utilized is a Pre-Northridge, Welded Unreinforced Flange (WUF) connection. This connection type is non-compliant and requires a more detailed analysis.
3. *Compact Members:* All the moment frame beam types except one have non-compact webs. This deficiency can lead to premature local buckling and generally poor inelastic behavior. A more detailed analysis is required to determine the members' adequacy.
4. *Vertical Irregularities:* The moment frame is not continuous to the foundation of the structure. The lobby columns land on concrete transfer beams that span between parking level walls. These transfer beams would likely see larger forces than the original design had intended. This could result in the formation of a shear or flexural mechanism in the transfer beam.
5. *Adjacent Buildings:* Seismic joints between the adjacent structures are inadequate for the expected displacements. The levels of the adjacent Gym Building are misaligned, which can result in increased structural and non-structural damage relative to an aligned level pounding scenario.

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.

No non-structural deficiencies are identified for this building.

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

Potential Retrofit Scheme: Strengthen the moment connection to provide improved performance. Potential retrofit connection configurations are described in FEMA 351, chapter 6. In addition to connection strengthening, beam bracing, and column stiffening may be necessary pending a more detailed analysis.

Appendices

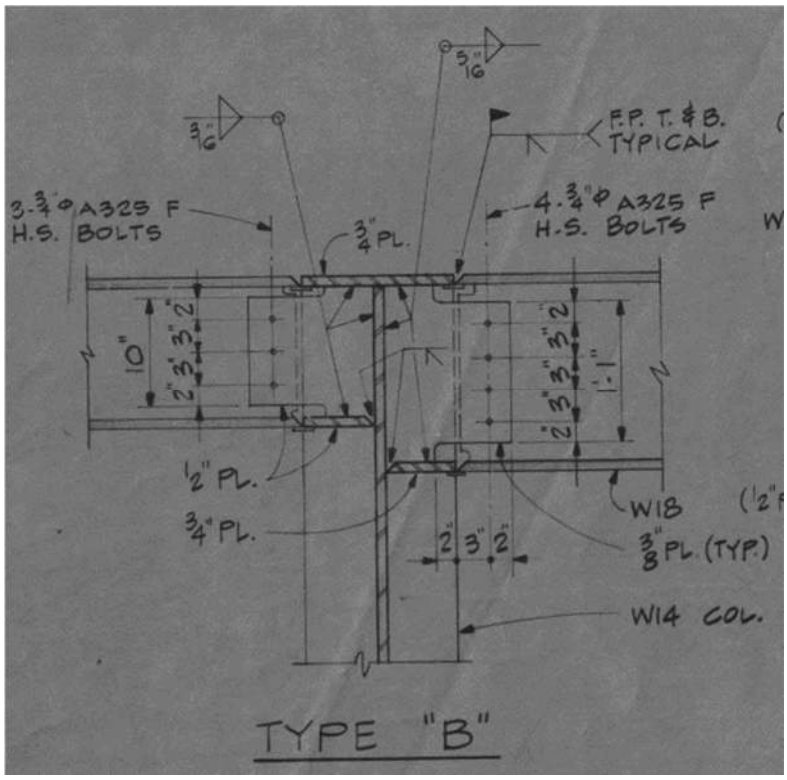
A. Additional Photos

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



Typical Moment Frame Connection

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

UC Campus:	Berkeley			Date:	2/20/2019		
Building CAAN:	1365	Auxiliary CAAN:	1365.2	By Firm:	Degenkolb Engineers		
Building Name:	Recreational Sports Facility, Lobby			Initials:	TAB	Checked:	
Building Address:	2301 Bancroft Way, Berkeley, CA			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:**
☐	☒	☐	☐	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:** Expansion joint of 1 ½" inadequate. See detail 3/A3.11.
☐	☐	☒	☐	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:** Moment frame columns are discontinuous at the ground level. Terminate at concrete transfer beams.

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

UC Campus:	Berkeley			Date:	2/20/2019		
Building CAAN:	1365	Auxiliary CAAN:	1365.2	By Firm:	Degenkolb Engineers		
Building Name:	Recreational Sports Facility, Lobby			Initials:	TAB	Checked:	
Building Address:	2301 Bancroft Way, Berkeley, CA			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:** The change in the lateral force system from the superstructure to the basement level changes by >50% in the both directions
☐	☑	☐	☐	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:** Superstructure first story relative to parking garage ground level is greater than 50% difference.
☑	☐	☐	☐	TORSION: The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension. (Commentary: Sec. A.2.2.7. Tier 2: Sec. 5.4.2.6) **Comments:**

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

GEOLOGIC SITE HAZARD

				Description
C	NC	N/A	U	
☑	☐	☐	☐	LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance do not exist in the foundation soils at depths within 50 ft (15.2m) under the building. (Commentary: Sec. A.6.1.1. Tier 2: 5.4.3.1) **Comments:**
☑	☐	☐	☐	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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UC Campus:	Berkeley			Date:	2/20/2019		
Building CAAN:	1365	Auxiliary CAAN:	1365.2	By Firm:	Degenkolb Engineers		
Building Name:	Recreational Sports Facility, Lobby			Initials:	*TAB*	Checked:	
Building Address:	2301 Bancroft Way, Berkeley, CA			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:**
C ☒ NC ☐ N/A ☐ U ☐	TIES BETWEEN FOUNDATION ELEMENTS: The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C. (Commentary: Sec. A.6.2.2. Tier 2: Sec. 5.4.3.4) **Comments:**

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UC Campus:	Berkeley			Date:	2/12/2019		
Building CAAN:	1365	Auxiliary CAAN:	1365.2	By Firm:	Degenkolb Engineers		
Building Name:	Recreational Sports Facility, Lobby			Initials:	TAB	Checked:	
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ASCE 41-17
Collapse Prevention Structural Checklist For Building Type S1-S1A

LOW SEISMICITY

SEISMIC-FORCE-RESISTING SYSTEM

	Description
C ☒ NC ☐ N/A ☐ U ☐	REDUNDANCY: The number of lines of moment frames in each principal direction is greater than or equal to 2. (Commentary: Sec. A.3.1.1.1. Tier 2: Sec. 5.5.1.1) **Comments:**
C ☐ NC ☒ N/A ☐ U ☐	DRIFT CHECK: The drift ratio of the steel moment frames, calculated using the Quick Check procedure of Section 4.4.3.1, is less than 0.030. (Commentary: Sec. A.3.1.3.1. Tier 2: Sec. 5.5.2.1.2) **Comments:** The drift in the East-West Direction is 0.032 for the typical framing configuration at the second floor
C ☒ NC ☐ N/A ☐ U ☐	COLUMN AXIAL STRESS CHECK: The axial stress caused by gravity loads in columns subjected to overturning forces is less than $0.10F_y$. Alternatively, the axial stress caused by overturning forces alone, calculated using the Quick Check procedure of Section 4.4.3.6, is less than $0.30F_y$. (Commentary: Sec. A.3.1.3.2. Tier 2: Sec. 5.5.2.1.3) **Comments:** Gravity demands are less than 0.1Fy.
C ☒ NC ☐ N/A ☐ U ☐	FLEXURAL STRESS CHECK: The average flexural stress in the moment frame columns and beams, calculated using the Quick Check procedure of Section 4.4.3.9, is less than F_y. Columns need not be checked if the strong column–weak beam checklist item is compliant. (Commentary: Sec. A.3.1.3.3. Tier 2: Sec. 5.5.2.1.2) **Comments:** Average flexural stress is 35.9 ksi < 36 ksi.

CONNECTIONS

	Description
C ☐ NC ☒ N/A ☐ U ☐	TRANSFER TO STEEL FRAMES: Diaphragms are connected for transfer of seismic forces to the steel frames. (Commentary: Sec. A.5.2.2. Tier 2: Sec. 5.7.2) **Comments:** Composite decks are specified, but drawings give no guidance on deck to frame connections
C ☒ NC ☐ N/A ☐ U ☐	STEEL COLUMNS: The columns in seismic-force-resisting frames are anchored to the building foundation. (Commentary: Sec. A.5.3.1. Tier 2: Sec. 5.7.3.1) **Comments:**

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ASCE 41-17
Collapse Prevention Structural Checklist For Building Type S1-S1A

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

SEISMIC-FORCE-RESISTING SYSTEM

C	NC	N/A	U	Description
●	○	○	○	REDUNDANCY: The number of bays of moment frames in each line is greater than or equal to 2. (Commentary: Sec. A.3.1.1.1. Tier 2: Sec. 5.5.1.1) **Comments:**
●	○	○	○	INTERFERING WALLS: All concrete and masonry infill walls placed in moment frames are isolated from structural elements. (Commentary: Sec. A.3.1.2.1. Tier 2: Sec. 5.5.2.1.1) **Comments:**
○	●	○	○	MOMENT-RESISTING CONNECTIONS: All moment connections can develop the strength of the adjoining members based on the specified minimum yield stress of steel. (Commentary: Sec. A.3.1.3.4. Tier 2: Sec. 5.5.2.2.1). **Comments:** Pre-northridge WUF moment connection with in place back-up bars

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
○	●	○	○	MOMENT-RESISTING CONNECTIONS: All moment connections are able to develop the strength of the adjoining members or panel zones based on 110% of the expected yield stress of the steel in accordance with AISC 341, Section A3.2. (Commentary: Sec. A.3.1.3.4. Tier 2: Sec. 5.5.2.2.1) **Comments:**
●	○	○	○	PANEL ZONES: All panel zones have the shear capacity to resist the shear demand required to develop 0.8 times the sum of the flexural strengths of the girders framing in at the face of the column. (Commentary: Sec. A.3.1.3.5. Tier 2: Sec. 5.5.2.2.2) **Comments:** Doubler plates provided to strengthen panel zones

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ASCE 41-17
Collapse Prevention Structural Checklist For Building Type S1-S1A

C	NC	N/A	U	
☐	☐	☒	☐	COLUMN SPLICES: All column splice details located in moment-resisting frames include connection of both flanges and the web. (Commentary: Sec. A.3.1.3.6. Tier 2: Sec. 5.5.2.2.3) **Comments:** No column splices
☒	☐	☐	☐	STRONG COLUMN—WEAK BEAM: The percentage of strong column–weak beam joints in each story of each line of moment frames is greater than 50%. (Commentary: Sec. A.3.1.3.7. Tier 2: Sec. 5.5.2.1.5) **Comments:**
☐	☒	☐	☐	COMPACT MEMBERS: All frame elements meet section requirements in accordance with AISC 341, Table D1.1, for moderately ductile members. (Commentary: Sec. A.3.1.3.8. Tier 2: Sec. 5.5.2.2.4) **Comments:** All except 1 beam type does not meet to moderate ductility requirements for web compactness.

DIAPHRAGMS (STIFF OR FLEXIBLE)

				Description
C	NC	N/A	U	
☒	☐	☐	☐	OPENINGS AT FRAMES: Diaphragm openings immediately adjacent to the moment frames extend less than 25% of the total frame length. (Commentary: Sec. A.4.1.5. Tier 2: Sec. 5.6.1.3) **Comments:**

FLEXIBLE DIAPHRAGMS

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

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Building Address:	2301 Bancroft Way, Berkeley, CA			Page:	4	of	4

ASCE 41-17
Collapse Prevention Structural Checklist For Building Type S1-S1A

C	NC	N/A	U	
☐	☐	☒	☐	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12.2 m) and aspect ratios less than or equal to 4-to-1. (Commentary: Sec. A.4.2.3. Tier 2: Sec. 5.6.2) **Comments:**
☐	☐	☒	☐	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:**

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

UC Campus:	Berkeley			Date:	2/12/19		
Building CAAN:	1356	Auxiliary CAAN:	-	By Firm:	Degenkolb Engineers		
Building Name:	Recreational Sports Facility, Basement Parking			Initials:	TAB	Checked:	
Building Address:	2301 Bancroft Way, Berkeley, CA			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:** Concrete walls support lateral systems above and ground floor slab. No continuous concrete column detailing to the foundation.
C ☒ NC ☐ N/A ☐ U ☐	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2. (Commentary: Sec. A.3.2.1.1. Tier 2: Sec. 5.5.1.1) **Comments:**
C ☒ NC ☐ N/A ☐ U ☐	SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the greater of 100 lb/in.^{2} (0.69 MPa) or $2\sqrt{f'_c}$. (Commentary: Sec. A.3.2.2.1. Tier 2: Sec. 5.5.3.1.1) **Comments:**
C ☒ NC ☐ N/A ☐ U ☐	REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area is not less than 0.0012 in the vertical direction and 0.0020 in the horizontal direction. (Commentary: Sec. A.3.2.2.2. Tier 2: Sec. 5.5.3.1.3) **Comments:**

Connections

	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:** Bearing wall system in basement utilized in the basement.
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:**

APPENDIX C
UCOP Seismic Safety Policy Falling Hazards Assessment Summary

UC Campus:	Berkeley			Date:	2/14/2019		
Building CAAN:	1365	Auxiliary CAAN:	1365.2	By Firm:	DEGENKOLB ENGINEERS		
Building Name:	Recreational Sports Facility, Lobby			Initials:	*TAB*	Checked:	
Building Address:	2301 Bancroft Way, Berkeley, CA			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 Hazard Risk: Low

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:**	7/11/2019
Job:	RSF Lobby	**By:**	TAB	**Section:**	
		Checked By:		**Page/of:**	

Roofing	
Material	Area Weight
1.5" 16 GA Metal Deck	4
2 1/2" LWC Fill	19
4 ply felt and gravel	5.5
H-Joists	3
Σ	**32**

75 pcf assumed

Interior Level Office	
Material	Area Weight
1.5" 20 GA Metal Deck	2
2 1/4" Cellular Conc. Fill	39
Flooring	2
Misc Mep	2
H-Joists	3
Σ	**49**

110 pcf assumed

Exterior Partition	
Material	Area Weight
6" Struct Studs	1.5
1" Rigid Insulation	1.5
Batt Insulation	1
7/8" Cem Plaster	11
1/2" Gyp	2
Σ	**17**

Floor Geometry

L =	39.66	ft
D =	38.33	ft
Area =	1601	ft^2

Roof

Item	Total #	Area ft2	Length ft	Height ft	Area Weight psf	Weight lbf	
Roofing		1601			32	51245	
Interior Partition		1601			5	8007	
Exterior Wall			117	6.63	17	13177	
					Σ W_{floor}	**72**	**kip**

Second Floor

Item	Total #	Area ft2	Length ft	Height ft	Area Weight psf	Weight lbf	
Interior Office Floor		1601			49	78469	
Interior Partition		1601			15	24021	
Exterior Wall			117	12.63	17	25111	
					Σ W_{floor}	**128**	**kip**

First Floor

Item	Total #	Area ft2	Length ft	Height ft	Area Weight psf	Weight lbf	
Interior Office Floor		1601			49	78469	
Interior Partition		1601			15	24021	
Exterior Wall			117	12.46	17	24780	
					Σ W_{floor}	**127**	**kip**

W_{total} Σ	**327**	**kip**

Degenkolb

Subject:	Base forces	**Job Number:**	B8114004	**Date:** 7/11/2019
Job:	RSF Lobby	**By:**	TAB	
		Checked By:		

ASCE 41-17 Linear Static Base Shear
Tier 1

INPUT DATA

C:	Modification factor (Table 4-7) =	1.1		3 MF Stories
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 =	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	2.0	1.8	1.6	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 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. =	1.05		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 =	0.8		(4.4.2.4)
C_t:	Building System Coefficient =	0.035		(4.4.2.4)
W:	Total Building Weight =	327	kips	
hn:	Total Building Height =	38.0	feet	*conservative
n:	Number of Stories =	2		
S_{M1}:	Spectral Response Acceleration @ 1 sec. =	1.07		(2-2)
S_{Ms}:	Short Period Acceleration = F_a*S_s =	3.60		(2-1)
S_{d1}:	Design spectral acceleration, 1 s =	0.71		
S_{ds}:	Design spectral acceleration, short =	2.40		

CALCULATE BASE SHEAR FOR BSE-2 (MCE)

T:	Fundamental Period of Vibration = C_t * h^{β} =	0.643	sec.	(4-4)
S_a:	Spectral Acceleration at Building Period =	1.63		(4-3)
V:	Pseudo Seismic Force =	588	kips	(4-1)

Degenkolb

Subject:	MF Drift Check *4.4.3.1*	**Job Number:**	B8114004	**Date:**	7/11/2019
Job:	RSF Lobby	**By:**	TAB		
		Checked By:			

North-South

Ib =	609	in4
L =	230	in
Ic =	999	in4
h =	151.5	in
E =	29000	ksi
V =	588	kips
Ncol =	9	columns
Vcol =	65	kips
kb =	2.65	
kc =	6.59	

story drift ratio

Dr = 0.015 < 0.03 Drift req

East-West

Ib =	338	in4
L =	239.5	in
Ic =	362	in4
h =	151.5	in
E =	29000	ksi
V =	588	kips
Ncol =	9	columns
Vcol =	65	kips
kb =	1.41	
kc =	2.39	

story drift ratio

Dr = 0.032 < 0.03 Drift req

Subject:	Column Axial Demands	**Job Number:**	B8114004	**Date:**	7/11/2019
Job:	RSF Lobby	**By:**	TAB		
		Checked By:			

Material Properties

f_y = 36 ksi

f_{ye} = - ksi

East-West Direction

Tributary Area

Column B/1.3

wtrib = 19.8 ft

htrib = 19.2 ft

Atrib = 380 ft2

	DL	LL	
Roof	32.0	20	psf
2nd	49.0	50	psf
first	49.0	50	psf

W_{grav} = 49.4 45.6 kip

$W_{factored}$ = 66.9 kip 1.1 (DL + 0.25 x LL)

Column Axial Stress Due to Gravity

Property	W14x90		
Ag in^2	26.5		
Fy x Ag	954		
Pg / Py	**0.05**	**< 0.1**	Gravity Req

Degenkolb

Subject:	Flexural Stress - *4.4.3.9*	**Job Number:**	B8114004	**Date:**	7/11/2019
Job:	RSF Lobby	**By:**	TAB		
		Checked By:			

Ms =	9	Collapse Prevention system modification factor	
nc =	9	frame columns	
nf =	6	frames	
h =	180	in	
Z1col =	75.6		
Zcol =	680.4	in3	*Weak Axis
Zbm=	589.2	in3	

Vj =	588	kips at ground floor
fj-avg =	30.0	ksi

Zbm

W16x31	W16x26
54	44.2
6	6
324	265.2
Σ	589.2

Degenkolb

Subject:	Panel Zone Check	**Job Number:**	B8114004	**Date:**	7/11/2019
Job:	RSF Lobby	**By:**	TAB		
		Checked By:			

Using middle column, O9 at second floor
Beams - W21x44 and W16x31
Column - W14x90

Zbeam =	149.4	in3	
tweb,col =	1.69	in	5/8" Doubler Plate EA Face
dcol =	14	in	
fy-spec =	36	ksi	
dbeam =	20.7	in	
Mpu-total =	5378.4	kip-in	
0.8*Mpu =	4302.72	kip-in	
Vweb =	208	kip	
vweb =	9	ksi	
0.6Fy =	21.6	ksi	

Degenkolb

Subject:	SCWB Check	**Job Number:**	B8114004	**Date:**	7/11/2019
Job:	RSF Lobby	**By:**	TAB		
		Checked By:			

Using middle column, B/1.3 at second floor
W16x31 and W16x26
W14x90 column, weak axis

East-West

fy-spec =	36	ksi
Zbeam_L =	54	in3
Zbeam_R =	44.2	in3
Σ Mpb =	3535.2	kip-in
Zcol_T =	75.6	in3
Zcol_B =	75.6	
Σ Mpc =	5443.2	kip-in

$$\frac{\Sigma\ Mpc}{\Sigma\ Mpb} = 1.54$$

North-South

fy-spec =	36	ksi
Zbeam_L =	95.4	in3
Zbeam_R =	54	in3
Σ Mpb =	5378.4	kip-in
Zcol_T =	157	in3
Zcol_B =	157	
Σ Mpc =	11304	kip-in

$$\frac{\Sigma\ Mpc}{\Sigma\ Mpb} = 2.10$$

E = 29000 ksi
fy = 36 ksi

AISC 341, TBL D1.1 Criteria

Frame Members	b/t	h/t_w	Flange λ_{md}	Web λ_{md}	Flange	Web
W14x90	10.2	25.9	10.79	42.29	C	C
W16x31	6.28	51.6	10.79	42.29	C	NC
W16x26	7.97	56.8	10.79	42.29	C	NC
W21x44	7.22	53.6	10.79	42.29	C	NC
W14x22	7.46	53.3	10.79	42.29	C	NC
W14x38	6.57	39.6	10.79	42.29	C	C

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

Subject:	Weight Take Off	**Job Number:**	B8114004.00	**Date:**	7/11/2019
Job:	RSF - Parking	**By:**	TAB	**Section:**	
		Checked By:		**Page/of:**	

Roofing	
Material	Area Weight
1.5" 16 GA Metal Deck	4
4 ply felt and gravel	5.5
R-11 Insulation	2.25
Σ	**12**

Tee "T1" Slab Weight 110 **pcf**

Section	**Area [ft^2]**		
Flange	4.17	46	
Flange Taper	1.36	15	
Web	2	22	
	Σ	83	psf

Exterior Partition	
Material	Area Weight
6" Struct Studs	1.5
1" Rigid Insulation	1.5
Batt Insulation	1
7/8" Cem Plaster	11
1/2" Gyp	2
Σ	**17**

Gym Floor	
Material	Area Weight
T1 PC/PT	83
Batt Insulation	0.5
Wood Plat.	1.5
Σ	**85**

Roof

L = 228.66 ft
D = 147.5 ft
Area = 33727 ft^2

Item	**Total #**	**Area ft2**	**Length ft**	**Height ft**	**Area Weight psf**	**Weight lbf**	
Roofing		33727			12	404728	
50% PV Allowance		33727			7.5	252955	
Exterior Partition Wall			753	10.3	17	131210	
					Σ W_{floor}	**789**	**kip**

First Brace Level

Item	**Total #**	**Area ft2**	**Length ft**	**Height ft**	**Area Weight psf**	**Weight lbf**	
Exterior Partition Wall			524	18.6	17	165355	
					Σ W_{floor}	**165**	**kip**
					Σ W_{total}	**954**	**kip**

2nd Floor

Item	Total	Area	Length	Height	Area Weight	Weight
	#	ft2	ft	ft	psf	lbf
Slab Area		33727			85	2866825
4" LWC Topping		33727			37	1236670
Exterior Partition Wall			524	8.3	17	74048
Exterior Partition Wall			228.66	8.3	10	19007
12" Conc Wall, 75% Open			939.57	12.5	112.5	1321270
					ΣW_{floor}	**5518**

SuperStructure Weight	**6472**	**kip**

1st Floor

Item	Total	Area	Length	Height	Area Weight	Weight
	#	ft2	ft	ft	psf	lbf
12" Conc Wall, 75% Open			939.57	12.5	112.5	1321270
Slab Area		50125			119	5988545
						7310

BSMT

Item	Total	Area	Length	Height	Area Weight	Weight
	#	ft2	ft	ft	psf	lbf
12" Conc Wall, 80% Open			1520	6.5	127.5	1259700
						1260

Total Weight	15042	kip
Lobby Weight	327	kip
Handball Weight	1902	kip
Seismic Weight Garage	**17271**	**kip**

Degenkolb

Subject:	Base forces	**Job Number:**	B8114004	**Date:** 7/11/2019
Job:	RSF - Parking	**By:**	TAB	
		Checked By:		

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

INPUT DATA

C: Modification factor (Table 4-7) = 1.1 — 2 Conc. SW w/ BF above

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 = 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	2.0	1.8	1.6	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 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. = 1.05 — 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 = 17271 kips

hn: Total Building Height = 52.3 feet — *shortest structure

n: Number of Stories = 3

S_{M1}: Spectral Response Acceleration @ 1 sec. = 1.07 — (2-2)

S_{Ms}: Short Period Acceleration = F_a*S_s = 3.60 — (2-1)

S_{d1}: Design spectral acceleration, 1 s = 0.71

S_{ds}: Design spectral acceleration, short = 2.40

CALCULATE BASE SHEAR FOR BSE-2 (MCE)

T: Fundamental Period of Vibration = $C_t * h^{\beta}$ = 0.389 sec. — (4-4)

S_a: Spectral Acceleration at Building Period = 2.70 — (4-3)

V: Pseudo Seismic Force = 51321 kips — (4-1)

Degenkolb

Subject:	Shear Stress Check *4.4.3.3*	**Job Number:**	B8114004	**Date:**	7/11/2019
Job:	RSF - Parking	**By:**	TAB		
		Checked By:			

Considering All Possible Wall

East West

L_{12w} =	812	ft
L_{24w} =	66	ft
twall =	12	in
Ms =	4.5	for Conc. SW, Limited Safety
Aw =	135936	in^2
V_{base}=	51321	kip
vj-avg =	84	psi

North-South Loading

L_{6w} =	70.66	ft
L_{12w} =	782.75	ft
twall =	12	in
twall =	6	in
Ms =	4.5	for Conc. SW, Limited Safety
Aw =	117804	in^2
V_{base}=	51321	kip
vj-avg =	97	psi

Subject:	Wall Steel Reinforcement Ratio	**Job Number:**	B8114004	**Date:**	7/11/2019
Job:	RSF - Parking	**By:**	TAB		
		Checked By:			

Concrete Walls

Typical 12" Wall

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

twall =	12	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 =	12	in	
Abar =	0.2	in2	
spacing =	12	in	
rho =	0.0028	OK	> 0.002 horizontal minimum ratio

Typical 6" Wall

Vertical: #3 at 12" o.c., each way, both faces

twall =	6	in	
Abar =	0.11	in2	
spacing =	12	in	
rho =	0.0015	OK	> 0.0012 vertical minimum ratio

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

twall =	6	in	
Abar =	0.2	in2	
spacing =	12	in	
rho =	0.0028	OK	> 0.002 horizontal minimum ratio