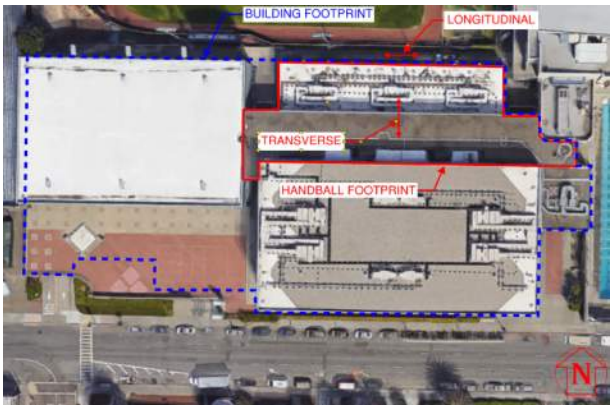
Degenkolb Berkeley UNIVERSITY OF CALIFORNIA

Evaluator: TAB
Date: 02/20/19

ASCE 41-17 Tier 1 Seismic Evaluation

Building Name: Recreational Sports Facility, Handball
CAAN ID: 1365
Auxiliary Building ID: 1365.1
Address: Core Campus, Berkeley, CA 94720
Site location coordinates: Latitude 37.8686 Longitudinal -122.2623



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: **S1A Steel MF** & C2A Conc. SW mixed system w/ flexible diaphragms
b. Transverse Direction: **S1A Steel MF** & C2A Conc. SW mixed system w/ flexible diaphragms

Concrete Shearwall Parking Garage Basement Calculations Included in Appendices

Square Footage: 18,000 ft^2 (+ 22,900ft^2 – Parking SF, ratio of superstructure SF/ total superstructure SF) out of 191,703 sf total
Building Length: 285'-4"
Building Width: 94'-0
Building Height: 38'-10"
Story Height: 26' (Ground to Lo-Roof), 38'-10" (Ground to Hi-Roof)
Number of stories *above* grade: 1
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): Medium: over $50 per sf and less than $200 per sf

BUILDING DESCRIPTION

General

This building finished construction in 1984 and is situated on a level site. The structure referenced as, "Handball", 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. The total superstructure footprint spans approximately 285' in the East-West direction and 94' in the North-South direction. The space is approximately 18,000 square feet and houses racquetball courts and an atrium to access the other spaces above the parking garage level. The handball courts and the atrium have separate roofs referred as "Lo-Roof" and "Hi-Roof" respectively. The Low-Roof is 23.5' above the racquetball courts, and the Hi-Roof at 39 ft tall. The atrium serves as an access corridor to the various superstructures above the parking level and houses a mezzanine that accesses the second level of the gymnasium.

Structural System

The gravity structural system consists of metal deck with intermediate steel open web joists framing to steel beams or reinforced shear walls. Laterally, the structural system consists of a flexible bare metal roof deck diaphragm that transfers lateral forces to concrete shear walls and steel moment frames (see Lateral Force Resisting System Layout in Appendix A). The transverse direction consists of 10 concrete shear walls that are discontinuous at the ground level which support the lo-roof. The hi-roof is supported by 15 lines of single bay moment frames. In the longitudinal direction there is a shear wall to the North and moment frame lines spaced approximately 41' to the South. The first line of moment frames support the transverse shear walls out-of-plane and the low-roof. At the ground level, the structure is supported by a mixture of precast/post tensioned tee beams with a 4" LWC topping slab, and a 5" slab with cast-in-place beams all supported by concrete walls down to the foundation. Two handball courts to the North East of the structure, are suspended above an existing set of racquetball courts. The shear walls are supported on pile foundations and tied together with a 6" slab on grade.

Building Condition

Good, no deteroiation observed.

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}: 3.15 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), Forell Elsesser Engineers, Inc.

DOCUMENTATION

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

Structural Drawings: "University of California, Berkeley 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:	Superstructure: Metal deck on steel trusses framing into steel beams or concrete shear walls. Ground: 4" Topping Slab on PC/PT Tees and 5" Slab with Cast-In-Place Beams		
Exterior Transverse Walls:	Exposed concrete/glass façade	Opening(s)?	None @ concrete
Exterior Longitudinal Walls:	Exposed concrete/glass façade	Opening(s)?	None @ concrete
Roof Materials/Framing:	1 ½" 20 ga. Metal Deck		
Intermediate Floors/Framing:	N/A		
Ground Floor:	Varies: 4" Topping PC/PT Tees, 5" Slab on CIP Bms, 6" S.O.G		
Columns:	W14x120 – W14x159	Foundation:	Pile Foundations
General Condition of Structure:	Good		
Evidence of Settling?:	No		
Special Features & Comments:	Discontinuous shear walls in the transverse direction. Transverse shear walls are supported by WUF Moment Frame to South. Portion of the building is suspended over the previous handball courts		

LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
ASCE 41-17 Building Type:	C2: Concrete Shear Wall	C2: Concrete Shear Wall
Diaphragms:	1 ½" 20 ga. Metal Deck	1 ½" 20 ga. Metal Deck
Vertical Elements:	WF Columns/ Conc SW	WF Columns/ Conc SW
Connections:	WUF MC	WUF MC
Details:	1/S23,Q/S23,S20	1/S23,Q/S23,S20
Estimated Fundamental Period, T (sec):	0.312	0.312
BSE-2E Spectral Acceleration, S_a:	3.15g	3.15g
Modification Factor, C:	1.2 (C2 – Table 4-7)	1.2 (S4 – Table 4-7)
Building Weight, W (kips):	1902	1902
Seismic Base Shear, V (kips):	7189	7189
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

The below items have been identified as non-compliant:

1. *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.

2. *Redundancy* – The structure has only 1 shear wall in the East-West direction on the perimeter of the building, and relies on moment frames to resist the additional loads in this direction. The lack of redundancy in the shear wall system could potentially overstress the moment frame system.
3. *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 ~5.0% inter-story drift at the first floor per the quick check procedure, and significantly more drift at GL D if a flexible diaphragm is considered. This drift demand indicates the potential for significant structural and non-structural damage.
4. *Compact M*embers - Some moment frame beam types 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 and implications on global response.
5. *Vertical Irr*egularity – The transverse shear walls are discontinuous at the ground floor, and rely on the diaphragm to transfer shear forces to the walls that are doweled into the foundation. The shear wall ends land on perpendicular shear walls below grade, and this is expected to mitigate any potential damage caused by overturning in the walls. The North-East portion of the structure is suspended over existing racquetball courts, and transverse walls land on cast in place beams.
6. *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.

This structure has been assigned a SPL rating of V mainly due to the large drift demands at GL D and a system of Pre-Northridge moment connections and non-compact members at this frame. Preliminarily, this large deflection expectation can be attributed to the flexible diaphragm and the moment frame supporting the transverse shear walls out of plane. 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 nonstructural deficiencies are identified for this building.

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

The structure has a high level of complexity, and requires a more detailed analysis to better understand the force distribution and implications of the varying stiffness spread throughout the structure. It appears the flexible diaphragm is resulting in large demands at the moment frame line on GL D. To address this particular issues and the above deficiencies the follow retrofit scheme could be required.

Potential Retrofit Scheme: Diaphragm strengthening at the low roof with in plane structural steel bracing would help the system better distribute forces to the concrete shear walls and alleviate the demand in the moment frame at the shear wall. The moment frame could be strengthened with moment connection retrofits, intermediate beam bracing and column stiffening or BRB's could be installed in select bays to provide adequate stiffness in the moment frame directions.

Appendices

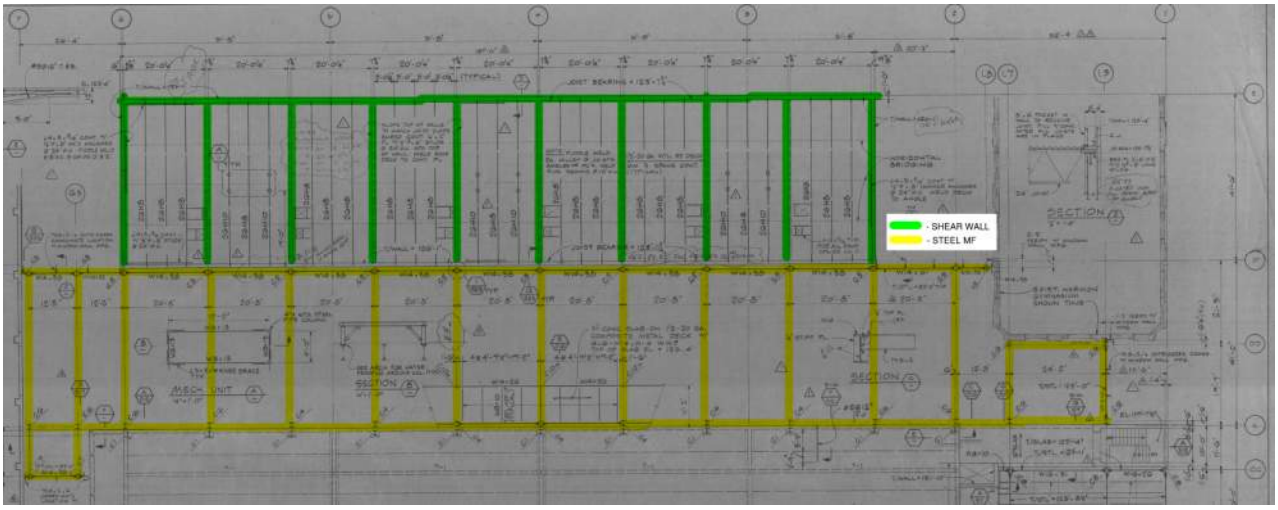
A. Additional Photos

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



Lateral Force Resisting System Layout

Moment Frame on Gridline D

Mezzanine Elevation on Gridline C

Discontinuous Transverse Shear Wall Shown Between Precast Tee Flanged Sections

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

UC Campus:	Berkeley			Date:	2/20/2019		
Building CAAN:	1365	Auxiliary CAAN:	1365.1	By Firm:	Degenkolb Engineers		
Building Name:	Recreational Sports Facility, Handball			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:** Transverse shear walls are discontinuous at ground level, and moment frame columns do not extend to the foundation

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

UC Campus:	Berkeley			Date:	2/20/2019		
Building CAAN:	1365	Auxiliary CAAN:	1365.1	By Firm:	Degenkolb Engineers		
Building Name:	Recreational Sports Facility, Handball			Initials:	TAB	Checked:	
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ASCE 41-17
Collapse Prevention Basic Configuration Checklist

C	NC	N/A	U	
☐	☑	☐	☐	GEOMETRY: There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines. (Commentary: Sec. A.2.2.5. Tier 2: Sec. 5.4.2.4) **Comments:** The change in the lateral force system from the high-roof to the low-roof changes by ~50% in the East-West direction
☑	☐	☐	☐	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:** Roofs are light and not flagged for this reason.
☑	☐	☐	☐	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:** Diaphragms are flexible which resolves torsion.

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:	2/20/2019		
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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:**
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:**

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

UC Campus:	Berkeley			Date:	2/20/19		
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ASCE 41-17
Collapse Prevention Structural Checklist For Building Type S4

LOW SEISMICITY

SEISMIC-FORCE-RESISTING SYSTEM

	Description
C ☐ NC ☒ N/A ☐ U ☐	REDUNDANCY: The number of lines of braced frames or shear walls in each principal direction is greater than or equal to 2. (Commentary: Sec. A.3.2.1.1 and Sec. A.3.3.1.1. Tier 2: Sec. 5.5.1.1) **Comments:** Only 1 shear wall line in the East-West direction.
C ☐ NC ☒ N/A ☐ U ☐	DRIFT CHECK: The drift ratio of the steel moment frames acting alone, calculated using the Quick Check procedure of Section 4.4.3.1 using 25% of V_c, is less than 0.025. (Commentary: Sec. A.3.1.3.1. Tier 2: Sec. 5.5.2.1.2) **Comments:** Excessive drifts in the moment frames at the shear wall forces levels (Dual System Demands). Based on both the tributary force demand for flexible diaphragms and the demand from prescriptive procedures of Quick Check procedure.
C ☒ NC ☐ N/A ☐ U ☐	COLUMN AXIAL STRESS CHECK: The axial stress caused by gravity loads in frame 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:** Columns only support a light roof for gravity
C ☐ NC ☐ N/A ☒ U ☐	BRACE AXIAL STRESS CHECK: The axial stress in the diagonal braces, calculated using the Quick Check procedure of Section 4.4.3.4 and neglecting the steel moment frame, is less than $0.50F_y$. (Commentary: Sec. A.3.3.1.2. Tier 2: Sec. 5.5.4.1) **Comments:**
C ☒ NC ☐ N/A ☐ U ☐	COMPLETE FRAMES: Steel 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 ☐	SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 4.4.3.3 and neglecting the steel moment frame, 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:**

ASCE 41-17
Collapse Prevention Structural Checklist For Building Type S4

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	
☐	☒	☐	☐	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:** Moment frame columns land on haunches at the concrete shear walls. Concrete column detailing not continuous to the foundation.
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	
☒	☐	☐	☐	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:**
C	NC	N/A	U	
☒	☐	☐	☐	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation. (Commentary: Sec. A.5.3.5. Tier 2: Sec. 5.7.3.4) **Comments:** Foundation walls are doweled into the pile caps

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

SEISMIC-FORCE-RESISTING SYSTEM

				Description
C	NC	N/A	U	
☐	☐	☒	☐	REDUNDANCY: For braced frames, the number of braced bays in each line is greater than 2. (Commentary: Sec. A.3.2.1.1 and Sec. A.3.3.1.1. Tier 2: Sec. 5.5.1.1) **Comments:**

ASCE 41-17
Collapse Prevention Structural Checklist For Building Type S4

C	NC	N/A	U	
☐	☒	☐	☐	MOMENT-RESISTING CONNECTIONS: All moment connections are able to develop the strength of the adjoining members based on the specified minimum yield stress of the steel. (Commentary: Sec. A.3.1.3.4. Tier 2: Sec. 5.5.2.2.1). **Comments:** Pre-Northridge WUF is non-compliant.
☒	☐	☐	☐	COMPACT MEMBERS: All moment frame and brace elements meet section requirements in accordance with AISC 360, Table B4.1. (Commentary: Sec. A.3.1.3.7 and Sec. A.3.1.3.8. Tier 2: Sec. 5.5.2.2.5) **Comments:**
☐	☐	☒	☐	CONNECTION STRENGTH: All the brace connections develop the buckling capacity of the diagonals. (Commentary: Sec. A.3.3.1.5. Tier 2: Sec. 5.5.4.4) **Comments:**
☐	☐	☒	☐	K-BRACING: The bracing system does not include K-braced bays. (Commentary: Sec. A.3.3.2.1. Tier 2: Sec. 5.5.4.6) **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	
☐	☒	☐	☐	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 per AISC 341, Section A3.2. (Commentary: Sec. A.3.1.3.4. Tier 2: Sec. 5.5.2.2.1) **Comments:** Pre-Northridge WUF is non-compliant.
☐	☐	☒	☐	COLUMN SPLICES: All column splice details located in moment 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 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:**

ASCE 41-17
Collapse Prevention Structural Checklist For Building Type S4

C	NC	N/A	U	
☐	☒	☐	☐	COMPACT MEMBERS: All moment frame and brace elements meet section requirements in accordance with AISC 341, Table D1.1 for moderately ductile members. (Commentary: Secs. A.3.1.3.7 and A.3.1.3.8. Tier 2: Secs. 5.5.2.2.4 and 5.5.4) **Comments:** W18x40 Beams are non-compact
☐	☐	☒	☐	COLUMN SPLICES: All column splice details located in braced frames develop 50% of the tensile strength of the column. (Commentary: Sec. A.3.3.1.3. Tier 2: Sec. 5.5.4.2) **Comments:** No splices
☐	☐	☒	☐	SLENDERNESS OF DIAGONALS: All diagonal elements required to carry compression have *Kl*/*r* ratios less than 200. (Commentary: Sec. A.3.3.1.4. Tier 2: Sec. 5.5.4.3) **Comments:**
☐	☐	☒	☐	CONNECTION STRENGTH: All the brace connections develop the yield capacity of the diagonals. (Commentary: Sec. A.3.3.1.5. Tier 2: Sec. 5.5.4.4) **Comments:**
☐	☐	☒	☐	CHEVRON BRACING: Beams in chevron, or V-braced, bays are capable of resisting the vertical load resulting from the simultaneous yielding and buckling of the brace pairs. (Commentary: Sec. A.3.3.2.3. Tier 2: Sec. 5.5.4.6) **Comments:**
☐	☐	☒	☐	CONCENTRICALLY BRACED FRAME JOINTS: All the diagonal braces frame into the beam–column joints concentrically. (Commentary: Sec. A.3.3.2.4. Tier 2: Sec. 5.5.4.8) **Comments:**
☐	☐	☒	☐	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:**

FLEXIBLE DIAPHRAGMS

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:** Lateral elements provided on all sides of the split diaphragm.

UC Campus:	Berkeley			Date:	2/20/19		
Building CAAN:	1365	Auxiliary CAAN:	1365.1	By Firm:	Degenkolb Engineers		
Building Name:	Recreational Sports Facility, Handball			Initials:	*TAB*	Checked:	
Building Address:	2301 Bancroft Way, Berkeley, CA			Page:	5	of	5

ASCE 41-17
Collapse Prevention Structural Checklist For Building Type S4

C	NC	N/A	U	
☐	☐	☒	☐	OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls are less than 15% of the wall length. (Commentary: Sec. A.4.1.4. Tier 2: Sec. 5.6.1.3) **Comments:**
☐	☐	☒	☐	OPENINGS AT FRAMES: Diaphragm openings immediately adjacent to the braced frames or moment frames extend less than 25% of the frame length. (Commentary: Sec. A.4.1.5. Tier 2: Sec. 5.6.1.3) **Comments:**

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:**

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:	3	of	3

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

Flexible Diaphragms

C	NC	N/A	U	Description
☒	☐	☐	☐	CROSS TIES: There are continuous cross ties between diaphragm chords. (Commentary: Sec. A.4.1.2. Tier 2: Sec. 5.6.1.2) **Comments:**
☐	☐	☒	☐	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 2-to-1 in the direction being considered. (Commentary: Sec. A.4.2.1. Tier 2: Sec. 5.6.2) **Comments:**
☐	☐	☒	☐	SPANS: All wood diaphragms with spans greater than 24 ft (7.3 m) consist of wood structural panels or diagonal sheathing. (Commentary: Sec. A.4.2.2. Tier 2: Sec. 5.6.2) **Comments:**
☐	☐	☒	☐	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12.2 m) and aspect ratios less than or equal to 4-to-1. (Commentary: Sec. A.4.2.3. Tier 2: Sec. 5.6.2) **Comments:**
☐	☐	☒	☐	OTHER DIAPHRAGMS: Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Commentary: Sec. A.4.7.1. Tier 2: Sec. 5.6.5) **Comments:**

Connections

C	NC	N/A	U	Description
☐	☒	☐	☐	UPLIFT AT PILE CAPS: Pile caps have top reinforcement, and piles are anchored to the pile caps. (Commentary: Sec. A.5.3.8. Tier 2: Sec. 5.7.3.5) **Comments:** Positive connections to existing piles not shown in drawings referenced for this evaluation. Believed to be part of previous sub-package.

APPENDIX C
UCOP Seismic Safety Policy Falling Hazards Assessment Summary

UC Campus:	Berkeley			Date:	2/14/2019		
Building CAAN:	1365	Auxiliary CAAN:	1365.1	By Firm:	DEGENKOLB ENGINEERS		
Building Name:	Recreational Sports Facility, Handball			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 Handball	**By:**	TAB	**Section:**	
		Checked By:		**Page/of:**	

Roofing	
Material	Area Weight
1.5" 16 GA Metal Deck	4
2 1/2" AAC Fill	19
4 ply felt and gravel	5.5
H-Joists	3
R-11 Batt	1
Σ	**33**

75 pcf assumed

Racquet Wall	
Material	Area Weight
12" Conc Wall	150
4" CMU Interior	50
1" Rigid Insulation	1.5
Σ	**202**

Interior Roofing	
Material	Area Weight
1.5" 16 GA Metal Deck	4
2 1/2" AAC Fill	19
4 ply felt and gravel	5.5
H-Joists	3
R-11 Batt	1
5/8" Gyp w/ 2" Stud w/ Fur	3
Σ	**36**

75 pcf assumed

Racquet Ball Roof Geometry

L =	186.66	ft	L =	269.5	ft
D =	41.5	ft	D =	41	ft
Area =	7828	ft^2	Area =	11131	ft^2

High Roof

Item	Total #	Area ft2	Length ft	Height ft	Area Weight psf	Weight lbf	
Interior Office Floor		10500			36	378006	
Exterior Wall			260	14.00	17	61880	
					Σ W_{floor}	**440**	**kip**

Raquetball Roof

Item	Total #	Area ft2	Length ft	Height ft	Area Weight psf	Weight lbf	
Roofing		7828			33	258312	
7 3/4" Transverse Wall			332	11.75	97	377909	
9 7/8" Transverse Wall			83	11.75	123	120382	
Racquet Wall			186.66	14.25	202	537301	
7 3/4" Transverse Wall			186.66	6.00	150	167994	
					Σ W_{floor}	**1462**	**kip**

Σ W_{total} = 1902 kip

Degenkolb

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

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

INPUT DATA

C:	Modification factor (Table 4-7) =	1.2		2 Stories S4
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 =	1902	kips	
hn:	Total Building Height =	39.0	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-2E

T:	Fundamental Period of Vibration = C_t * h^{β} =	0.312	sec.	(4-4)
S_a:	Spectral Acceleration at Building Period =	3.15		(4-3)
V:	Pseudo Seismic Force =	7189	kips	(4-1)

Level	h (ft)	w (kip)	w x h	C_{vx}	F_x
Hi Roof	39	440	17156	0.33	2394
Racquet Roof	23.5	1462	34355	0.67	4795
		Σ	51510	Σ	7189

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

Considering All Possible Wall

East-West Loading

Lwall =	186.66	ft
twall =	12	in
Ms =	4.5	RC Shear Wall, CP
Aw =	26879	in^2
V_{base}=	7189	kip
vj-avg =	59	psi

North-South Loading

Lwall =	415	ft
twall =	7.75	in *Min SW thickness
Ms =	4.5	RC Shear Wall, CP
Aw =	38595	
V_{base}=	7189	kip
vj-avg =	41	psi

Degenkolb

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

Concrete Walls

8" Wall

Vertical: #3 at 18" o.c., each way, both faces

twall =	8	in	
Abar =	0.11	in2	
spacing =	18	in	
rho =	0.0015	OK	> 0.0012 vertical minimum ratio, **req**

Vertical: #4 at 18" o.c., each way, both faces

twall =	8	in	
Abar =	0.2	in2	
spacing =	18	in	
rho =	0.0028	OK	> 0.002 horizontal minimum ratio, **req**

10" Wall

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

twall =	10	in	
Abar =	0.2	in2	
spacing =	12	in	
rho =	0.0033	OK	> 0.0012 vertical minimum ratio, **req**

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

twall =	10	in	
Abar =	0.2	in2	
spacing =	12	in	
rho =	0.0033	OK	> 0.002 horizontal minimum ratio, **req**

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, **req**

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

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

Degenkolb

Subject:	Column Deflection Compatability	**Job Number:**	B8114004	**Date:**	7/11/2019
Job:	RSF Handball	**By:**	TAB		
		Checked By:			

Material Properties

f_y =	60	ksi	f'_c =	4000	psi
f_{ye} =	75	ksi	f'_{ce} =	6000	psi

Section Moment Capacity

Using Expected Material Properties

M_{max} =	322	k-ft	@ 242 k Axially
l =	12.25	ft	
Vlsa =	52.6	kip	

Shear Capacity

Shear Design @ Hinge

3 #3 @ 6" oc

Av =	0.33	in^2		
s =	6	in		
d =	14.4	in	0.8 x Ø	
fy =	60	ksi		
Vs =	47.52	kip		

Degenkolb

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

Flexible Diaphragm Assumption

East West Direction

Half Raquet Roof and High Roof Trib

Ib =	385	in4	
L =	248	in	
Ic =	495	in4	
h =	282	in	
E =	29000	ksi	
V =	3,594	kips	GL D, Flexible Diaphragm Assumption
$V_{25\%}$ =	1,797		All Columns Considered
Ncol =	14	columns	
$Ncol_{25\%}$ =	33		
Vcol =	257	kips	
$V_{25\%Col}$ =	54.46019		
kb =	1.55		
kc =	1.76		

story drift ratio

Dr =	**0.253**	< 0.025 Drift req
$D_{r25\%}$ =	**0.054**	< 0.025 Drift req

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

Degenkolb

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