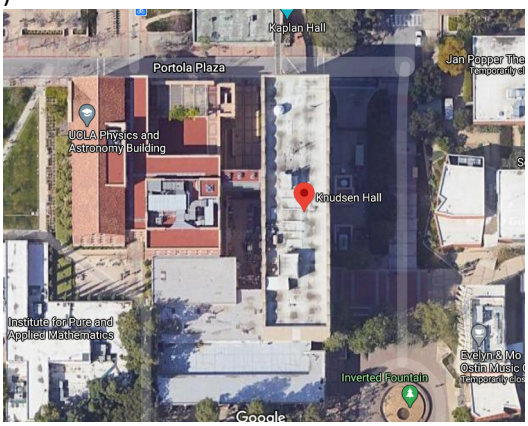
UNIVERSITY OF CALIFORNIA

BUILDING REPORT

1) UC Campus: UCLA
2) Building Name: Knudsen Hall
3) Building CAAN ID: 4363
4) Auxiliary Building ID[1]: N/A
5) Date of Evaluation: October 30, 2020
   Evaluation by (Firm, Evaluator Name, Signature, Stamp): John A. Martin & Associates, Inc., RO, JL
6) Seismic Performance Rating[2] and Basis of Rating: IV, University of California Seismic Safety Policy and ASCE 41-17 Tier 1 evaluation. Discontinuous shear walls occur along gridlines A and G in the transverse direction, and the west wall of the elevator shaft between gridlines M and N. Most of the transverse shear walls exceed the stress limits per the Tier 1 requirements. However, a Tier 2 evaluation will likely eliminate many of the shear stress deficiencies. The nonlinear viscous dampers that were added in the 1998 retrofit likely eliminated the deficiencies in the longitudinal shear walls. A Tier 3 analysis is recommended to confirm this rating.

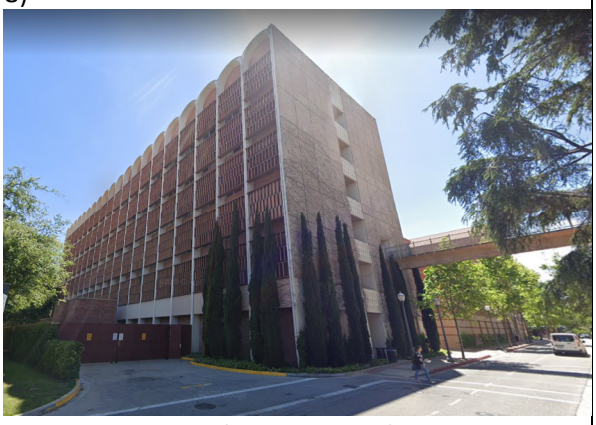
REGISTERED PROFESSIONAL ENGINEER
KALMAN VAN BENUSKA
No. 3504
STRUCTURAL
STATE OF CALIFORNIA
10/30/2020

7)



Aerial View (Google Maps)

8)



Exterior Elevation (Google Maps)

9) Site Location
   (a) Latitude Decimal Coordinates: 34.07
   (b) Longitude Decimal Coordinates: -118.44

10) ASCE 41-17 Model Building Type and Description[3]
   (a) Longitudinal Direction: Building Type C2 (Concrete Shear Walls with Stiff Diaphragms)
   (b) Transverse Direction: Building Type C2 (Concrete Shear Walls with Stiff Diaphragms)

[1] Applicable only for individual buildings that are structurally separate units within a building complex. Each auxiliary building shall be designated with the main building CAAN ID with a decimal number suffix (i.e. main building CAAN ID 5534; auxiliary building CAAN ID 5534.1). Auxiliary building ID is null for a single building or the main building in a building complex.
[2] The designated Seismic Performance Rating shall be a Roman numeral associated with the most applicable performance description from Table 1 of the UC Facilities Manual, UC Seismic Program Guidelines.
[3] If a building has multiple building types in one story, the model building type should be designated based on engineering judgement as the lateral system that would have the most predominantly negative effect on the seismic behavior of the building in that respective direction.

Knudsen Hall is an eight-story building with two floors below grade and six stories above grade. The building is 240 feet long in the longitudinal direction and 65'-8" in the transverse direction. Knudsen Hall is separated from Kinsey Pavilion to the south with a 1 ½-inch gap. A bridge connecting the first four stories above grade of Knudsen Hall to the Physics and Astronomy Building to the west is separated by an 18-inch seismic gap. The gravity system consists of 6-inch one-way slabs at the elevated floors and a 4 ½-inch one-way slab at the roof supported by reinforced concrete beams and girders. Concrete beams span between interior concrete girders and the exterior 1'-0" x 3'-4" columns. The girders span 24 feet in the longitudinal direction between 2'-0" square reinforced concrete columns. The lateral system consists of reinforced concrete shear walls. There are two 10-inch reinforced concrete shear walls that make up the exterior walls in the transverse direction as well as 8-inch interior reinforced concrete shear walls around the stairwells and elevator shafts. The foundation consists of continuous wall footings for the shear walls and spread footings for the columns.

The lateral force resisting system in the longitudinal direction was seismically retrofitted in 1998. Viscous dampers were installed in two bays of steel tubular chevron braces along two interior lines for a total of four retrofitted bays. The columns resisting the brace forces were jacketed with steel plates and angles to provide additional axial strength. As part of the retrofit, the 30-inch thick shear walls at the first floor around the Shield Room were sawcut and disconnected from the second floor diaphragm. The objective of the retrofit was to improve the building performance to satisfy a "Fair" to "Good" seismic rating as defined by UC's Historic Seismic Performance Rating. These ratings correspond with current UC Seismic Ratings IV and III, respectively. Viscous dampers are outside the scope of an ASCE 41 Tier 1 analysis and were not evaluated in this report. The existing shear walls in the longitudinal direction were evaluated.

11) Number of Stories
    (a) Above grade: 6
    (b) Below grade: 2

10) Original Building Design Code & Year: 1958 Uniform Building Code

12) Retrofit Building Design Code & Year (if applicable): Retrofitted in 1998 per the 1994 Uniform Building Code

13) Cost Range to Retrofit (if applicable)[4] (Low, Medium, High or Very High): Low

Please assume a "Low" cost-range corresponds to a complete retrofit cost less than $50 per square foot (sf), a "Medium" cost-range corresponds to a complete retrofit cost greater than $50 per sf and less than $200 per sf, a "High" cost-range corresponds to a complete retrofit cost greater than $200 per sf and less than $400 per sf, and a "Very High" cost-range corresponds to a complete retrofit cost greater than $400 per sf.

[4] Assume a complete retrofit conforming to the current UC Seismic Safety Policy. Note this range includes all construction costs, including code upgrades (e.g., accessibility, fire and life safety, mechanical, electrical, plumbing) triggered by the seismic retrofit. No specific estimate is required to be supplied at this time (i.e., provide an approximate cost to retrofit using Low, Medium, High or Very High cost-range categories). It is acknowledged that such a cost range is assumed to be based only on the engineer's rough estimate and is not intended to require input from a professional cost estimator. For estimation purposes, CSEs may judgmentally determine an approximate cost range for seismic retrofits based on recent relevant experience, and then apply a multiplier to approximate total construction costs.

BACKGROUND INFORMATION

Site Information

14) Site Class (A – F) and Basis of Assessment: Site Class D (default site class per code; no geotechnical reports available)

15) Geologic Hazards
   (a) Fault Rupture (Yes, No or Unknown) and Basis of Assessment: No, based on "Fault Activity Map of California" from California Geological Survey.
   (b) Liquefaction (Yes, No or Unknown) and Basis of Assessment: No, based on "Earthquake Zones of Required Investigation Beverly Hills Quadrangle" map published by the California Geological Survey, dated January 11, 2018.
   (c) Landslide (Yes, No or Unknown) and Basis of Assessment: No, based on "Earthquake Zones of Required Investigation Beverly Hills Quadrangle" map published by the California Geological Survey, dated January 11, 2018.

16) Site-specific Ground Motion Study? (Yes or No): No

Seismic design acceleration parameters of interest:	
For BSE-2E	S_{XS}: 1.863g S_{X1}: 0.949g
For BSE-1E	S_{XS}: 0.898g S_{X1}: 0.517g

17) Estimated Fundamental Period (seconds)
   (a) Longitudinal: 0.54s
   (b) Transverse: 0.54s

18) Falling Hazards Assessment Summary: A structural observation could not be conducted as the campus is currently closed due to the Covid-19 pandemic. Based on our review of the record structural drawings, the building does not appear to have significant falling hazards around the perimeter of the building. Online photos indicate an exterior façade comprised of vertical slats. It is unknown what the façade material is and method of attachment to the primary structure. Further investigation is required to verify the connection of the façade to the primary structure is sufficient.

19) Structural Non-Compliances/Findings Significantly Affecting Rating Determination Summary
Significant Structural Deficiencies, Potentially Affecting *Seismic Performance Rating* Designation:

   a) Adjacent Buildings
   The clear distance between Knudsen Hall and the adjacent buildings is 1 ½ inches per the structural drawings (reference sheet S-4), which is less than the required clear distance per the Tier 1 checklist. A 3D analysis model and Tier 2 evaluation may show that the existing seismic joint is sufficient to accommodate the relative displacement between the adjacent buildings.

   b) Vertical Irregularities

A segment of the south elevation shear wall along gridline A discontinues at the first floor level. The shear wall lining the elevator shaft between gridlines M and N discontinues at the second floor. The shear wall along gridline G, between gridlines 1 and 2, occurs only at the first floor.

c) Overturning

The ratio between the least horizontal dimensions of Knudsen Hall (taken to be the same as the width of the building) to the building height is less than permissible per the Tier 1 checklist.

d) Shear Wall Stress Checks

The average shear stress in the concrete shear walls in both orthogonal directions of the building exceed the shear stress limit per the Tier 1 calculations. Please note that the 1998 retrofit in the longitudinal north-south direction significantly reduces the demand on the existing shear walls oriented in this direction. A Tier 2 evaluation may eliminate some of the shear stress deficiencies and show that the existing walls meet the required acceptance criteria. A Tier 3 nonlinear analysis is required to analyze the effects of the nonlinear viscous dampers and is outside the scope of this report.

e) Foundation Dowels

Vertical reinforcing in the walls along gridlines 1 and 4 is greater than the dowel reinforcing into the foundations.

f) Openings at Shear Walls

The diaphragm opening in Stair #2 is more than 25% of the length of the shear wall adjacent to the opening along Gridline W between Gridlines 1 and 2 and is identified as a deficiency per the Tier 1 checklist.

20) Brief Description of Anticipated Failure Mechanism

Select concrete walls may experience in-plane shear failure during a seismic event.

21) Seismic Retrofit Concept Sketches/Description (only required for buildings rated V or worse)

Building Report Appendices

A) ASCE 41-17 Tier 1 Checklists (Structural only)

B) Quick Check Calculations