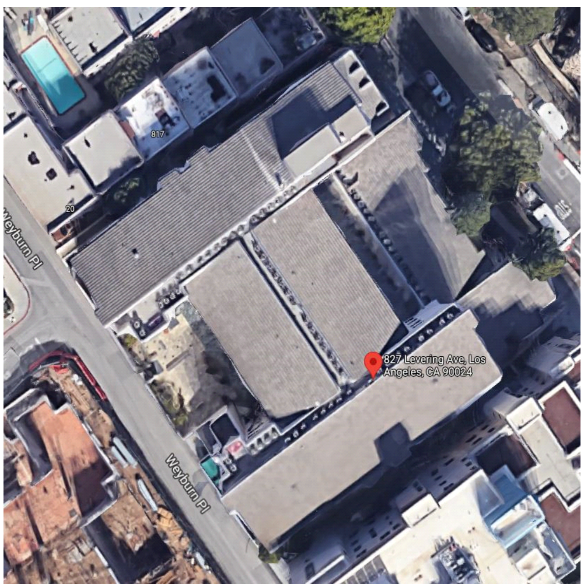
BUILDING REPORT REQUIREMENTS
ASCE 41-17 TIER 1 SEISMIC EVALUATIONS

BUILDING REPORT

1) UC Campus: Los Angeles
2) Building Name: Faculty Levering
3) Building CAAN ID: 4297
4) Auxiliary Building ID:
5) Date of Evaluation: 6/4/2021
6) Evaluation by: Englekirk, TAS
7) Seismic Performance Rating and Basis of Rating: V, ASCE 41-17 Tier 1
(Podium concrete wall shear stress is over the limit per the quick check procedure. Concrete columns are with large tie spacing, which may cause deflection non-compatibility. Shear capacity of steel moment frame panel zones does not meet the requirement per the checklist.)



8) Plan Image or Aerial Photo

9) Exterior Elevation Photo

10) Site Location
    (a) Latitude Decimal Coordinates: 34.0635085
    (b) Longitude Decimal Coordinates: -118.4496231
11) ASCE 41-17 Model Building Type and Description
    (a) Longitudinal Direction: W1a: Wood frame, wood shear panels;
    (b) C2: Concrete shear walls;
    (c) S1a: Steel Moment Frames
    (d) Transverse Direction: W1a: Wood frame, wood shear panels;
    (e) C2: Concrete shear walls;
12) Number of Stories
    (a) Above grade: 4
    (b) Below grade: 5
13) Original Building Design Code & Year: UBC-1979

14) Retrofit Building Design Code & Year (if applicable):
15) Cost Range to Retrofit (if applicable): (Low, Medium, High or Very High): Medium

Comments: The structure consists of 4 levels of wood superstructure supported by a 5-story concrete shear wall podium structure. There is another 4-story wood structure with wood panel shear walls and steel moment frames as the lateral system, which is also connected to the side of the concrete structure. Based on the drawing date, assuming the latest version of the building code was used at the time, the wood portion of the structure has a presumptive rating of IV. The concrete shear wall structure and steel moment frames were checked using ASCE-41 Tier 1 checklists, giving it a rating of V. The overall rating is V.

BACKGROUND INFORMATION

Site Information

16) Site Class (A – F) and Basis of Assessment
- (a) Site Class: D
- (b) Site Class Basis: Unknown (Default)
- (c) Site Class Company: None
- (d) Site Class Report Date: None
- (e) Site Class Ref Page No.: None

17) Geologic Hazards
- (a) Fault Rupture (Yes, No or Unknown) and Basis of Assessment: No, CGS Maps
- (b) Liquefaction (Yes, No or Unknown) and Basis of Assessment: No, CGS Maps
- (c) Landslide (Yes, No or Unknown) and Basis of Assessment: No, CGS Maps

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

Seismic design acceleration parameters of interest:	
For BSE-1N	1.628 and 0.825
For BSE-1E	0.895 and 0.515

19) Estimated Fundamental Period (seconds)
- (a) Longitudinal: 0.45
- (b) Transverse: 0.45

20) Falling Hazards Assessment Summary: None noted.

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

- (a) Lateral System Stress Check (wall shear, column shear or flexure, or brace axial as applicable): No deficiency noted
- (b) Load Path: No deficiency noted
- (c) Adjacent Buildings: No deficiency noted
- (d) Weak Story: No deficiency noted

(e) Soft Story: No deficiency noted
(f) Geometry (vertical irregularities): No deficiency noted
(g) Torsion: No deficiency noted
(h) Mass – Vertical Irregularity: No deficiency noted
(i) Cripple Walls: Not Applicable
(j) Wood Sills (bolting): No deficiency noted
(k) Diaphragm Continuity: No deficiency noted
(l) Openings at Shear Walls (concrete or masonry): No deficiency noted
(m) Liquefaction: No
(n) Slope Failure: No
(o) Surface Fault Rupture: No
(p) Masonry or Concrete Wall Anchorage at Flexible Diaphragm: Not Applicable
(q) URM wall height to thickness ratio: Not Applicable
(r) URM Parapets or Cornices: Not Applicable
(s) URM Chimney: Not Applicable
(t) Heavy Partitions Braced by Ceilings: Not Applicable
(u) Appendages: No deficiency noted

22) Brief Description of Anticipated Failure Mechanism
The concrete shear walls may fail in shear. The steel moment frame panel zone may fail in shear.

23) Seismic Retrofit Concept Sketches/Description (only required for buildings rated V or worse)
Add doubler plates at steel moment frame panel zones.

Building Report Appendices

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

B) Quick Check Calculations

Seismic Evaluation

University of California, Los Angeles,

Faculty Levering (CAAN 4297)

Los Angeles, California

Englekirk INSTITUTIONAL

September 24, 2021

Job No. 19-G118Q

Seismic Evaluation

University of California, Los Angeles,

Faculty Levering (CAAN 4297)

Los Angeles, California

Submitted to:
UCLA
Capital Programs
Los Angeles, CA 90024

September 24, 2021

Job No. 19-G1118Q

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TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 General

This report presents the findings of our seismic performance review of UCLA Faculty Levering apartment building located at 827 Levering Ave, Los Angeles, California. The evaluation was based on a review of the structure using the American Society of Civil Engineer's *Seismic Rehabilitation of Existing Buildings,* ASCE 41-17 Tier 1 and Tier 2 Procedures, the *2019 California Existing Building Code (CEBC*) Chapter 3, and the *2017 University of California Seismic Safety Policy*. A Target Earthquake Performance Level was assigned per the *University of California Seismic Safety Policy* Table A.1 to determine if the building satisfies the appropriate ASCE 41 standard.

The building, as shown in Figure 1.1, is located to the southwest of the University of California, Los Angeles campus, having latitude and longitude coordinates of 34.0635085 and -118.4496231, respectively. The east elevation of the structure is shown in Figure 1.2.

Figure 1.1: Building East Elevation (Source: Google Earth)

Figure 1.2: Building East Elevation (Source: Google Maps)

1.2 Information Reviewed

Record structural drawings for the building, prepared by Samuel Wacht Associates, dated August 18, 1983, were reviewed. The drawing set is incomplete with at least S1 and S2 sheets missing. A geotechnical soils report was not available. A site visit was performed to review the structure and assess the condition of the existing elements.

The scope of this study is limited to the seismic evaluation of the structure and does not include issues related to nonstructural components. Our review and the findings presented herein are limited to the observable conditions and available information found within the original structural drawings.

1.3 Tasks Performed

The following tasks were performed as a part of our review of the building:

- Review existing drawings, determine the building's structural system, and assess critical seismic detailing and other relevant seismic characteristics of the building.
- Perform a site visit to survey the existing condition of the building.
- Obtain response spectra parameters consistent with the *University of California Seismic Safety Policy*.
- Review Fault Locations and Liquefaction Zones based on information available from the California Geological Survey.
- Perform an ASCE 41 Tier 1 seismic evaluation to identify key potential deficiencies in the building.
- Perform an ASCE 41 Tier 2 analysis to assess the significance of potential deficiencies identified in the Tier 1 review.
- Based on the results of the analysis, prepare an evaluation of the anticipated seismic performance of the existing structure, and provide a seismic rating based on the *University of California Seismic Safety Policy.*

2.0 BUILDING DESCRIPTION

2.1 General Building Description

UCLA Faculty Levering is located on a sloped site. The building consists of east and west wings connected to each other without a seismic gap, as shown in the overall building section presented in Figure 2.1. The west wing is a 5-story reinforced concrete structure with a 4-story wood-framed structure above it. The concrete structure changes from 5-stories on the east side (downslope) to 3-stories on the west side (upslope) following the site slope.

The typical concrete floor has plan dimensions of 140 ft. by 120 ft., with an area of approximately 17,000 SF, other than at the two lower levels at the east side. The lowest level of the concrete structure is aligned with Levering Ave. on the east side. The uppermost floor of the concrete structure is aligned with Weyburn Place on the west side.

The footprint of the wood superstructure at the west wing is an I-shape, as shown in Figure 2.3. The typical floor area is approximately 14,000 SF. The east wing consists of a 4-story wood-framed structure with two steel moment frames on the east face. The floors of the east wing are aligned with the concrete floors of the west wing, each with an area of approximately 5,100 SF.

The applicable building code is not specified on the record drawings. Based on the date of the record drawings, it is our opinion that the building was originally built under the 1979 Uniform Building Code. The wood-framed portion of the structure can be considered as a Benchmark building per Table 1 of the UC Seismic Program Guidebook. The overall building height from the lowest level of the concrete structure to the roof of the wood superstructure at the west wing is approximately 82 ft. The typical concrete floor plan is presented in Figure 2.2. In the same plan, the wood-framed floor of the east wing is also shown. The typical floor plan of the 4-story wood superstructure over the concrete structure is presented in Figure 2.3.

The main floor framing system of the concrete structure consists of 12” thick, reinforced concrete two-way flat slabs supported on columns or perimeter walls. The typical bay is approximately 27 ft. by 30 ft. The reinforced concrete columns are reinforced with vertical bars and confined typically using (6) #4 ties spaced at 4” o.c. at top and bottom of the columns, and #3 or #4 ties spaced at 6” to 12” o.c. for the remainder of the column height, as shown in Figure 2.4. The perimeter walls on the north, west, and east sides are supported by concrete shoring piles. Per the record structural drawings, the detailed shoring pile information is shown on the shoring drawings, which is not available for review. The rest of the walls and columns are mostly supported on spread/combined/continuous footings.

As noted, the drawing set is incomplete, and the material properties are not available. Default values per ASCE 41 are used in the analysis.

2.2 Lateral System

For the concrete structure, the lateral system consists of reinforced concrete shear walls along the perimeter over approximately full length. The diaphragm consists of flat concrete two-way slabs at all floors. Figure 2.5 shows a section at the west concrete wall.

For the wood superstructure above the concrete podium structure, the lateral system consists of a plywood panel diaphragm and plywood panel shear walls with holdowns at the ends of the shear walls.

For the wood-framed structure at the east wing, in addition to the lateral system described above, there are two 4-story steel moment frames at the east face of the building to accommodate the large openings on this elevation, one with three bays and the other with only one bay, as shown in Figure 2.6.

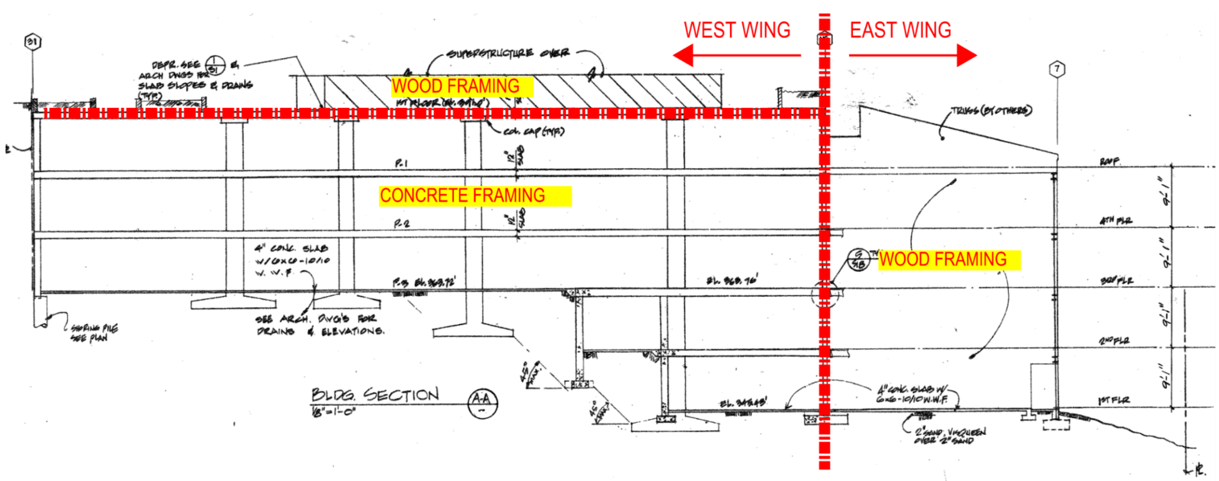

Figure 2.1: Building East-West

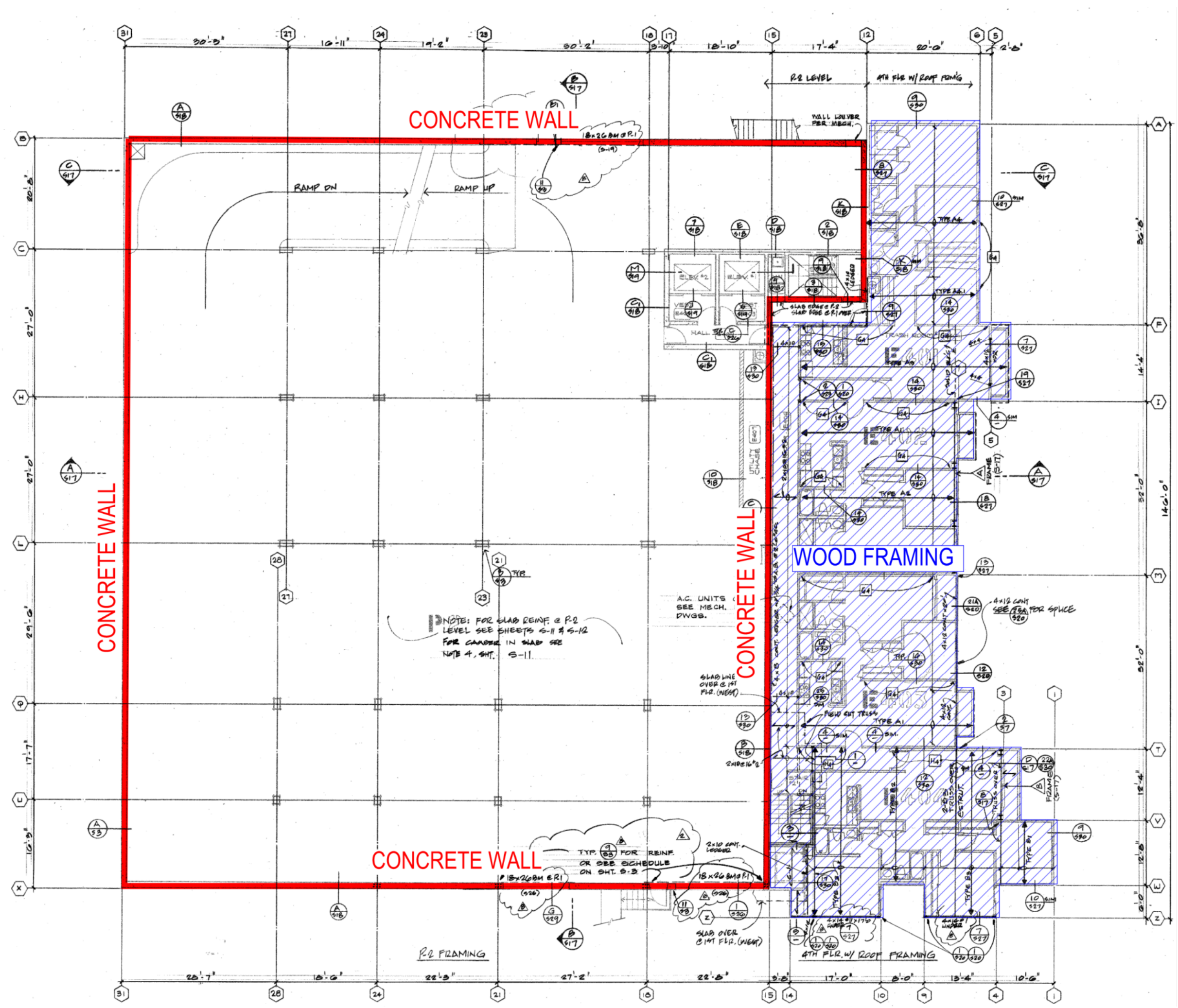

Figure 2.2: Typical Concrete Floor Plan

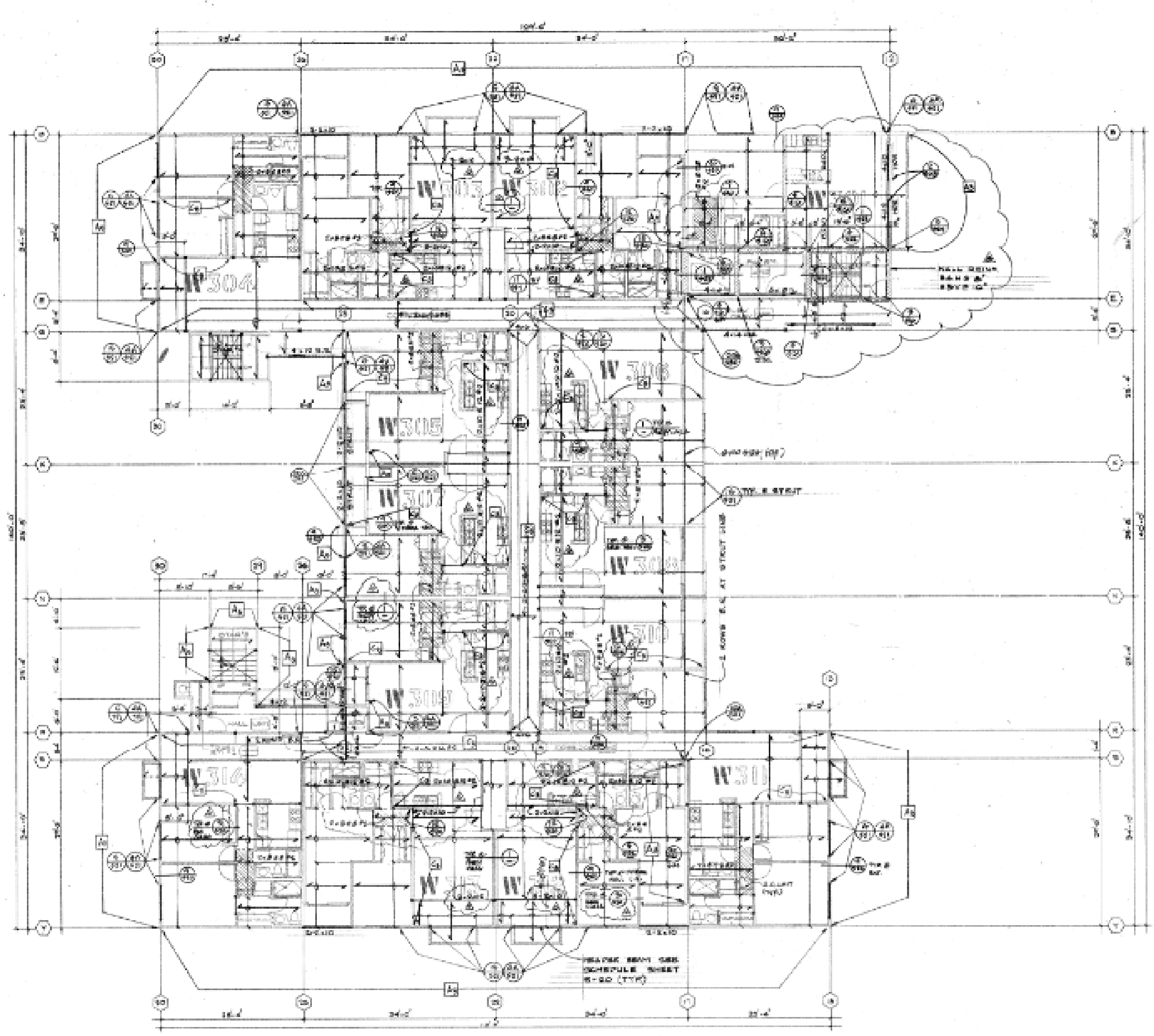

Figure 2.3: Typical Wood Superstructure Floor Plan

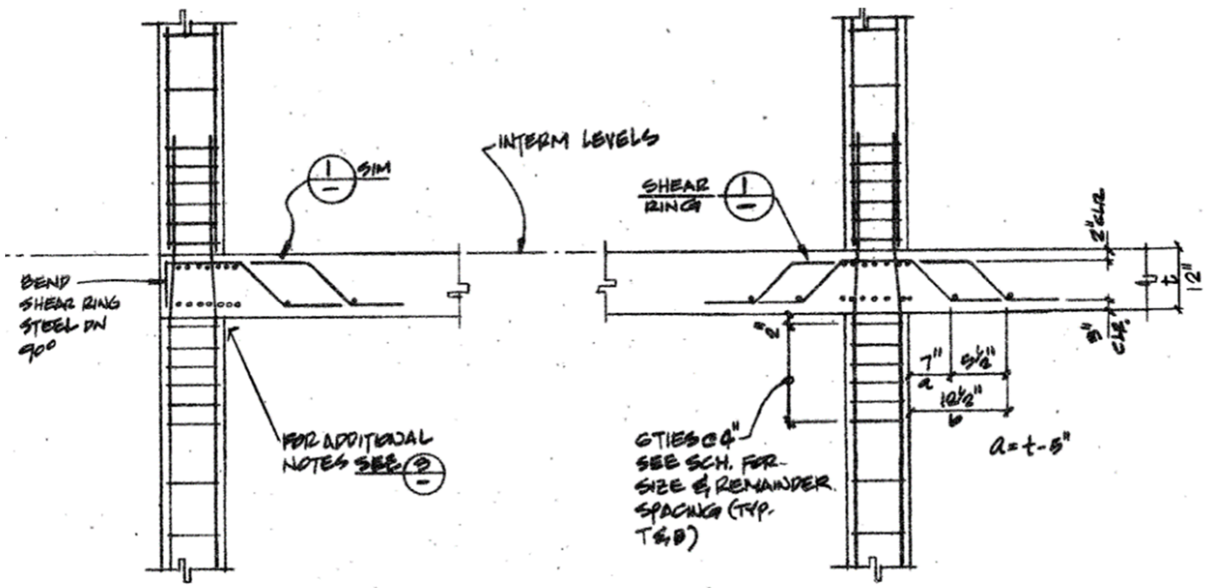

Figure 2.4: Typical Concrete Column Details

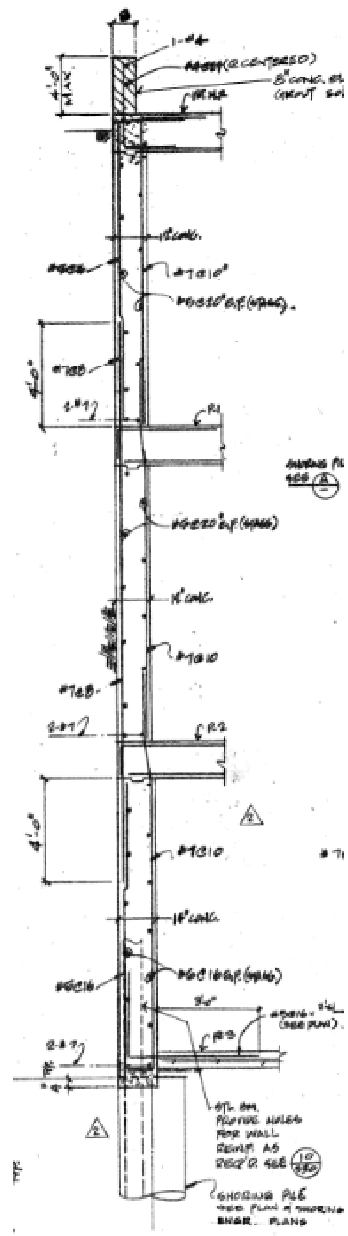

Figure 2.5: Typical Perimeter Concrete Wall Section

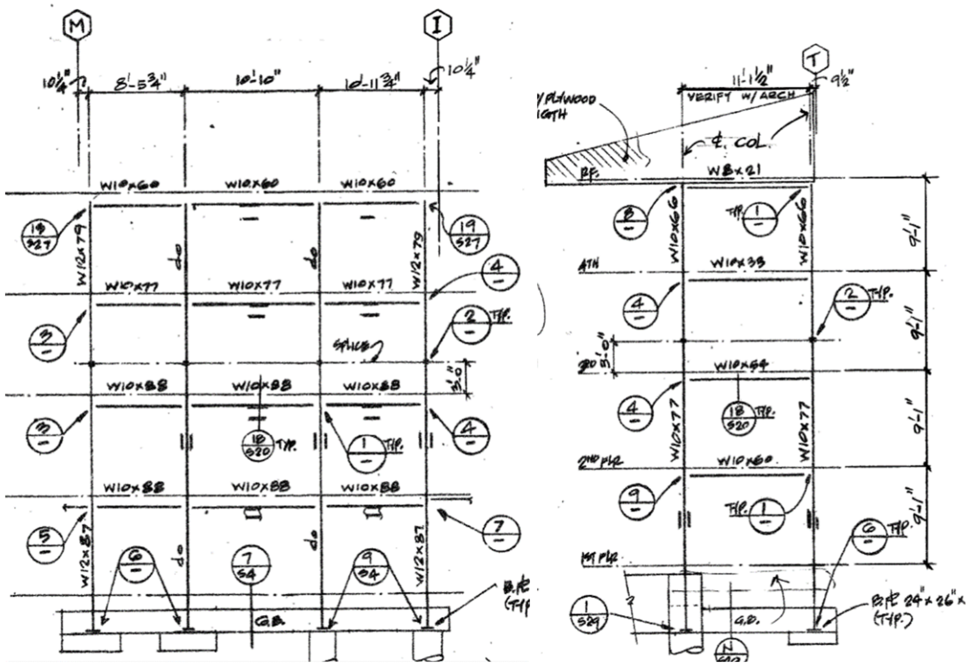

Figure 2.6: Steel Moment Frame Elevations

3.0 SEISMIC EVALUATION METHODOLOGY

We applied the ASCE 41-17 Tier 1 and Tier 2 methodology to evaluate the seismic performance of the structure. An ASCE 41-17 *Tier 1 Screening* forms the basis of the first step of the seismic evaluation and consists of checklists that allow identification of potential deficiencies of the building based on the lateral force resisting system type. It provides a qualitative review of the structure's performance under an established performance level. ASCE 41 defines *Basic Performance Objectives for Existing Buildings (BPOE)* depending on the building *Risk Category* based on Table 1604.5 of CBC 2019. This structure is in Risk Category II.

The evaluation utilized *California Existing Building Code* (CEBC) Table 317.5 to establish the appropriate BPOE. For this risk category, the BPOE for Collapse Prevention is S-5, using a seismic demand defined by BSE-C hazard level (similar to BSE-2E in ASCE 41), and for Life Safety is S-3 under BSE-R (similar to BSE-1E in ASCE 41). An explanation of the different hazard levels can be found in Section 4.

Tier 1 checklists applicable to this structure were completed for the appropriate performance level to assist in developing an opinion about the seismic performance of the building. Checklist items were marked as compliant, non-compliant, unknown or not applicable. Potential deficiencies discovered in a Tier 1 evaluation require further study through a Tier 2 deficiency-based evaluation. Additional analysis and evaluation of each potential deficiency were completed in accordance with Tier 2 procedures to either confirm the deficiency or demonstrate the adequacy of the structure as it relates to the potential deficiency. For instance, structural analysis was performed to evaluate stresses imposed on the reinforced concrete shear walls.

Based upon the results of the Tier 1 review and Tier 2 analyses, a seismic performance level can be determined for the building per the *University of California Seismic Safety Policy*, Table A.1 (Figure 3.1), as discussed in Section 6.0. Note that the reference to CBC Part 10 Chapter 3 in Table A.1 should be replaced by CEBC Chapter 3 because the two building codes were separated in the 2019 edition of both standards.

Definitions based upon California Building Code (CBC) requirements for seismic evaluation of buildings using Risk Categories of CBC Table 1604A.5, depending on which applies, and performance criteria in CBC Table 317.5[2]	Expected Seismic Performance Level [1]
A building evaluated as meeting or exceeding the requirements of CBC Part 10 Chapter 3 for Risk Category IV performance criteria with BSE-1N and BSE-2N hazard levels replacing BSE-R and BSE-C as given in Chapter 3.	I
A building evaluated as meeting or exceeding the requirements of CBC Part 10 Chapter 3 for Risk Category IV performance criteria.	II
A building evaluated as meeting or exceeding the requirements of CBC Part 10 Chapter 3 for Risk Category I-III performance criteria with BSE- 1N and BSE-2N hazard levels replacing BSE-R and BSE-C respectively as given in Chapter 3; alternatively, a building meeting CBC requirements for a new building.	III
A building evaluated as meeting or exceeding the requirements of CBC Part 10 Chapter 3 for Risk Category I-III performance criteria.	IV
A building evaluated as meeting or exceeding the requirements of CBC Part 10 Chapter 3 for Risk Category I-III performance criteria only if the BSE-R and BSE-C values are reduced to 2/3 of those specified for the site.	V
A building evaluated as not meeting the minimum requirements for Level V designation and not requiring a Level VII designation.	VI
A building evaluated as posing an immediate life-safety hazard to its occupants under gravity loads. The building should be evacuated and posted as dangerous until remedial actions are taken to assure the building can support CBC prescribed dead and live loads.	VII

Figure 3.1: Expected Seismic Performance Levels for Existing Buildings per *University of California Seismic Safety Policy* (2017), Appendix A

4.0 SITE SEISMICITY

4.1 Ground Motion Estimates

The *California Existing Building Code* (CEBC) regulates existing buildings. CEBC Chapter 3 references American Society of Civil Engineers *Seismic Evaluation and Retrofit of Existing Buildings*, ASCE-41, as the standard for evaluating existing buildings. CEBC Table 317.5 identifies the earthquake hazard to be used when seismically evaluating a building. The CEBC definitions for earthquake ground motions to be assessed are summarized below for convenience.

- **CEBC BSE-C**: 5 percent 50-year maximum direction spectral response acceleration curves or by a Site-Specific Response Spectrum developed in accordance with ASCE 41, Section 2.4.2.1.
- **ASCE 41 BSE-2E**: Basic Safety Earthquake-2 for use with the Basic Performance Objective for Existing Buildings, taken as a seismic hazard with a 5% probability of exceedance in 50 years, but not greater than the BSE-2N, at a site.
- **CEBC BSE-R**: 20 percent 50-year maximum direction spectral response acceleration curves or by a Site Specific Response Spectrum developed in accordance with ASCE 41, Section 2.4.2.1.
- **ASCE 41 BSE-1E**: Basic Safety Earthquake-1 for use with the Basic Performance Objective for Existing Buildings, taken as a seismic hazard with a 20% probability of exceedance in 50 years, but not greater than the BSE-1N, at a site.

The United States Geological Survey (USGS) has modeled seismic hazards, but results are presented consistently with only ASCE 41. A user interface is required to extract these results from the USGS database. Response spectral acceleration information was obtained from the *SEAOC/OSHPD Seismic Design Maps* user inface for this site. Since a geotechnical report was not available for review, site geotechnical conditions were assumed to be consistent with default Site Class D – Default (ASCE 41, Section 2.4.1.6.2).

For this site, the spectral acceleration parameters for the BSE-C/BSE-2E and BSE-R/BSE-1E hazards are:

BSE-C / BSE-2E: SXS = 1.847g and SX1 = 0.943g

BSE-R / BSE-1E: SXS = 0.895g and SX1 = 0.515g

4.2 Seismic or Geotechnical Hazards

The State of California has issued a set of regulatory maps detailing regions of potential liquefaction, landslide, and ground fault rupture. The *California Geological Survey* (CGS) maps were consulted to determine whether the structure was constructed within an earthquake fault zone or in an area that would require evaluation of liquefaction or landslide potential. The *California Geologic Survey* identifies the closest active fault to the Los Angeles (UCLA) campus as the Santa Monica fault mapped at a distance of about 2 km from the site. According to the CGS maps, the Faculty Levering Building does not appear to be within a liquefaction nor a landslide hazard zone per the partial map shown in Figure 4.1.

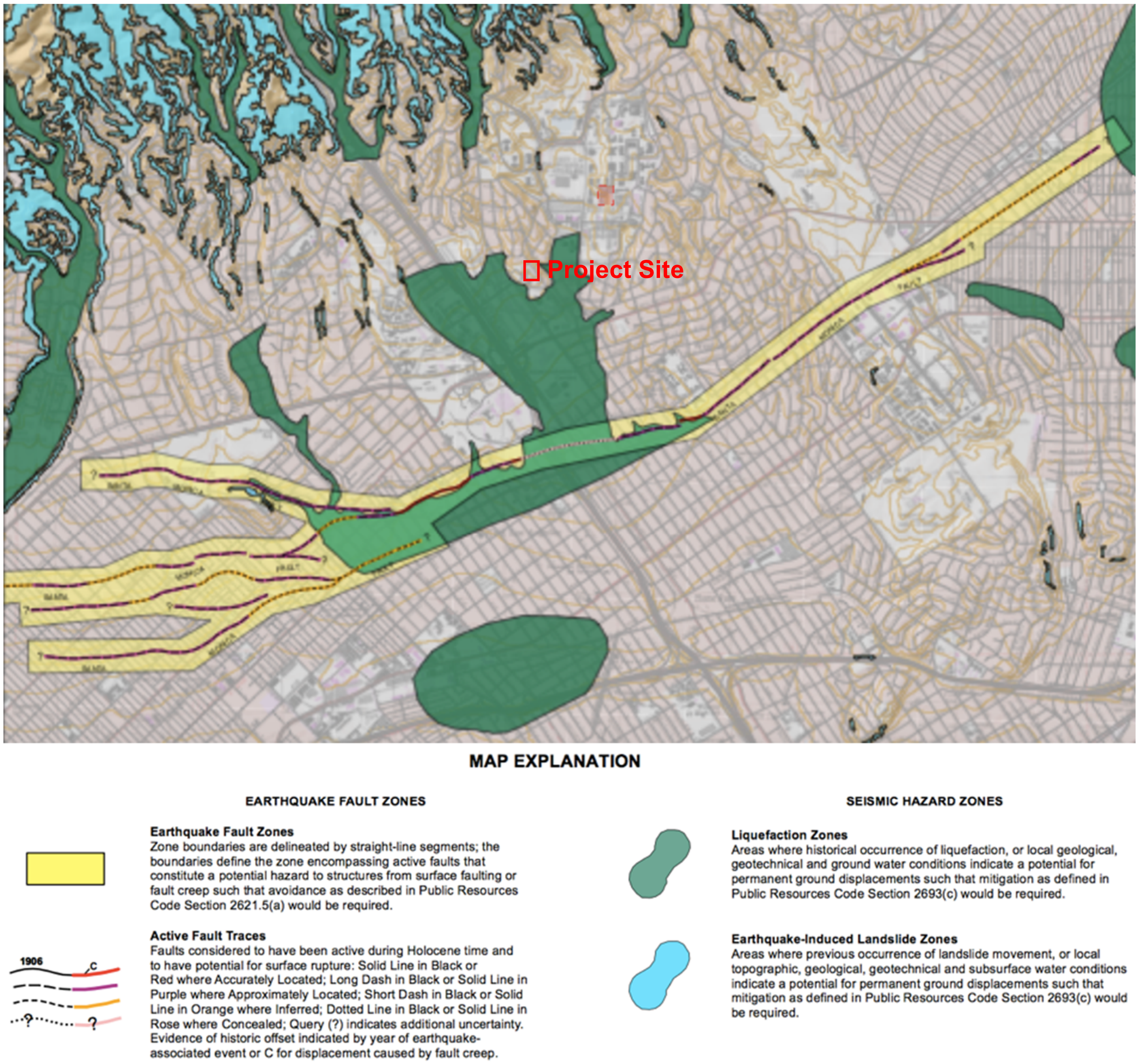

Figure 4.1: California Geological Survey Map (Partial Map of Beverly Hills Quadrangle)

5.0 SEISMIC EVALUATION

5.1 ASCE 41 Tier 1

Given the building type and date of construction, the concrete portion of the building and the steel moment frames do not satisfy the requirements of a benchmark building (i.e., it is not a reinforced concrete shear wall building constructed in accordance with the 1994 *Uniform Building Code* or later versions and the steel moment frames were not constructed in accordance with *1997 Uniform Building Code* or the later versions). The wood-framed portion of the building, consisting of the east wing and the wood superstructure of the west wing, satisfies the requirements of a benchmark building (i.e., it is a wood-framed structure with wood shear panels constructed in accordance with 1976 *Uniform Building Code or later versions*). In general, a benchmark building is deemed to satisfy the specified seismic performance levels and no additional review is required. In the case of this building, a Tier 1 analysis is required for the concrete portion of the building as well as the steel moment frames. The wood-framed portion of the building does not require a Tier 1 evaluation.

Tier 1 checklists were completed for the seismic force resisting system (SFRS) for the applicable building type in ASCE 41 Table 3-1. The SFRS for the main building consists of *C2: Concrete Shear Walls with Stiff Diaphragms* and *S1A: Steel Moment Frames with Flexible Diaphragms*. The following Tier 1 checklists were completed for the main building:

- Table 17-2: Collapse Prevention Basic Configuration Checklist.
- Table 17-24: Collapse Prevention Structural Checklist for Building Types C2 and C2a
- Table 17-8: Collapse Prevention Structural Checklist for Building Type S1 and S1a

All the checklist items were found to comply or not be applicable to this building, with the exceptions identified below. A non-compliant item does not mean that a structural deficiency necessarily exists, but it flags the items for additional review using a Tier 2 evaluation.

- **Non-Compliant Items for Collapse Prevention Structural Checklist for Building Types C2 and C2a:**
  - SHEAR STRESS CHECK: The Quick Check procedure indicates that the shear stress of the concrete shear walls is greater than $2\sqrt{f'c}$.
  - DEFLECTION COMPATIBILITY: A significant percentage of the columns have large tie spacing, e.g., 12" on center. The shear capacities may be insufficient to develop the flexural strength of the columns.
  - FLAT SLAB: The record structural drawings are incomplete, and the typical slab detail sheet is missing. It is unknown if the slabs have continuous bottom steel through the column joints.

- **Non-Compliant Items for Collapse Prevention Structural Checklist for Building Types S1 and S1a:**
  - PANEL ZONE: The panel zones don't 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.

5.2 ASCE 41 Tier 2 Seismic Evaluation

Based on the potential deficiencies outlined in Section 5.1, a linear dynamic analysis was performed to assess their significance on the seismic performance of the concrete portion of the structure since none of the irregularities described in ASCE 41-17 Sections 7.3.1.1.1 through 7.3.1.1.4 is anticipated to exist in this building. A linear static analysis was performed to assess the significance of the panel zone deficiency on the seismic performance of the steel moment frames. The evaluation was performed using the ASCE 41 Tier 2 Deficiency-Based Evaluation.

A 3-D model of the concrete structure was developed in the analysis software ETABS by CSI, Inc. Major seismic related structural elements, including the reinforced concrete slab, walls, and columns, were modeled. Figure 5.1 shows the 3D representation of the concrete structure. No specified material properties are available on the incomplete record drawings. Default concrete specified strength of 3,000 psi is assumed based on the estimated year of construction per ASCE 41-17 Table 4-2. Both grade 40 and 60 reinforcing steel were available in the year of construction. No supporting information is available indicating grade 60 reinforcing was used. Default reinforcing steel yield strength of 40 ksi is conservatively assumed per ASCE 41-17 Table 4-3. Expected strength values for reinforced concrete shear walls (i.e., f'_{cE} = 1.5 f'_c = 4,500 psi) were used during the Tier 2 evaluation in accordance with Section 10.7 of ASCE 41. Effective stiffness values for reinforced concrete shear walls were also used in accordance with Table 10-5 of ASCE 41, including a wall flexural effective stiffness of 0.35 $E_{CE}A_g$ and wall shear stiffness of $0.4E_{cE}A_w$. A semi-rigid diaphragm was assumed for all floor slabs, and the seismic base was at the first floor of east wing.

A 3D model of the steel moment frames was developed in the analysis software RAM Structural by Bentley. Beams and columns of the moment frames are modeled. Tributary gravity and seismic loads were assigned as line loads on the beams and point loads at floor levels. Figure 5.2 shows the representation of steel moment frame model elevation. Similar to the concrete material properties used, ASTM A36 structural steel is assumed to be used in the moment frames construction per ASCE 41-17 Table 4-5. Expected yield strength was calculated with the translating factors of 1.1 per ASCE 41-17 Table 9-3.

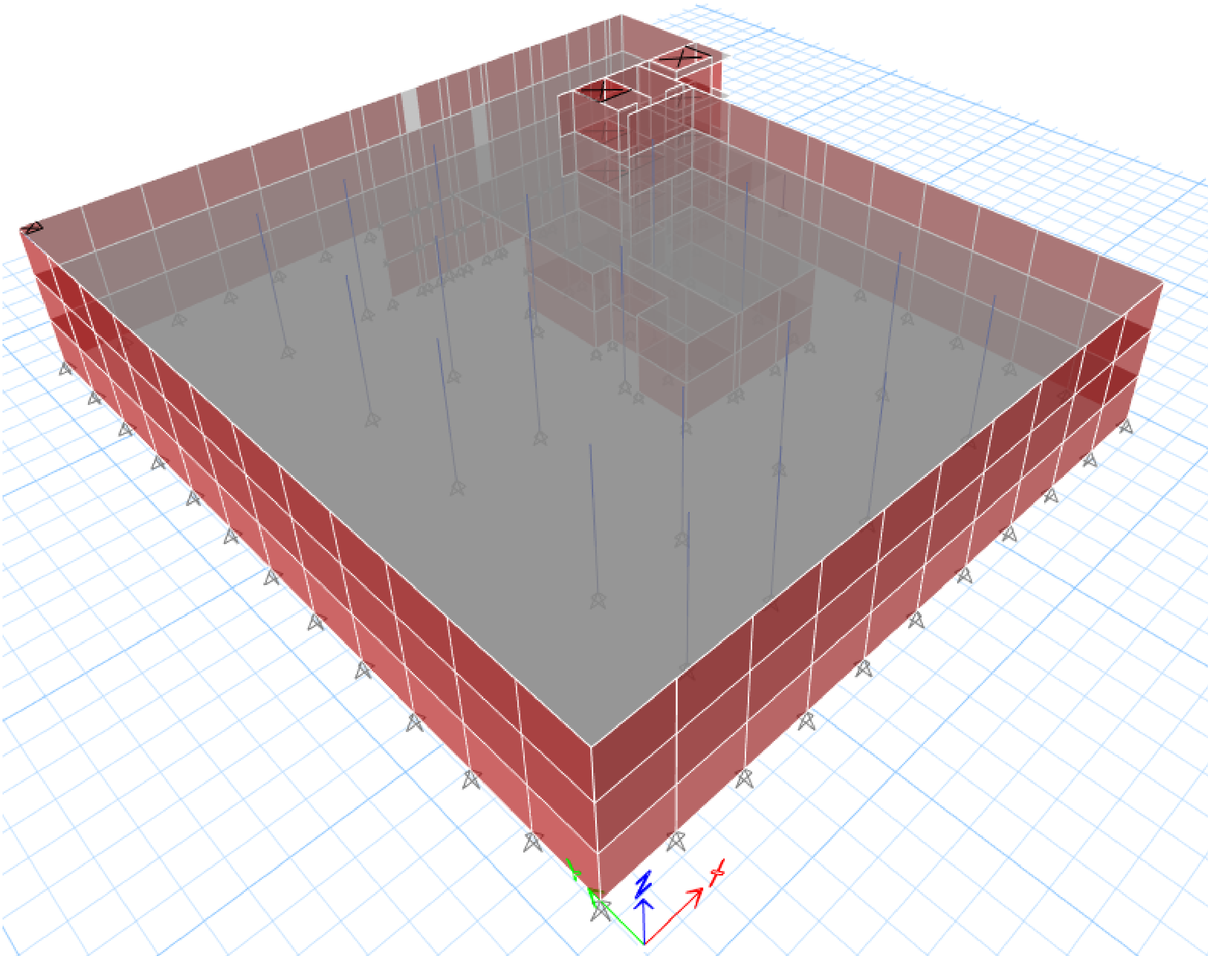

Figure 5.1: ETABS Model 3D View

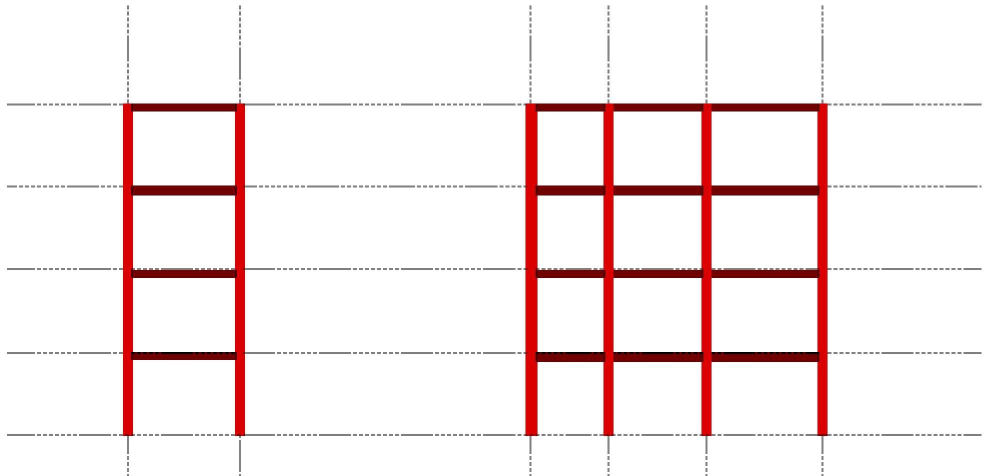

Figure 5.2: RAM Structural Model Moment Frame Elevation

5.2.1 Component Strength versus Acceptance Criteria

ASCE 41 classifies actions as deformation-controlled or force-controlled. A deformation-controlled action is defined as an action that has an allowable deformation greater than the deformation associated with the yield strength of a member, and a force-controlled action is defined as an action that has a deformation that is not allowed to exceed the deformation associated with the yield strength of the member. Members with limited ductility are considered force-controlled. Where actions are considered deformation-controlled, ASCE 41 allows the use of a component capacity modification factor, "*m,*" to account for the expected ductility associated with these actions at the selected Performance Level. The demand is then compared with the component's expected strength, calculated using conventional structural engineering methods and standards, multiplied by a strength reduction factor, ϕ, equal to unity.

For deformation-controlled actions, the acceptance criteria and the equivalent lateral load, Q_{UD} , are defined as:

$$mkQ_{CE} \geq Q_{UD}$$

$$Q_{UD} = Q_G \pm Q_E$$

where:

Q_{CE} = Expected strength of the component

m = Component modification factor

k = Knowledge factor

As discussed in the previous sections, there is no information of the material properties used. Based on this and the site, a knowledge factor equal to 0.75 is considered appropriate for this review per Chapter 6 of ASCE 41.

For force-controlled actions, the demands are compared with the lower bound strength, calculated using conventional structural engineering methods and standards, and multiplied by a strength reduction factor, ϕ, equal to unity. The acceptance criteria and the equivalent lateral load, Q_{UF}, are defined as:

$$kQ_{CL} > Q_{UF}$$

$$Q_{UF} = Q_G \pm Q_E/C_1C_2J$$

where:

Q_{CL} = Lower bound strength of the component

Q_G = Gravity load effect

Q_E = Seismic load effect

C_1 *and* C_2 = Modification factors specified for the structural component being evaluated

J = Force delivery reduction factor

5.2.2 Analytical Results

Based on analysis results conducted using Tier 2 procedures, the non-compliant conditions identified in the Tier 1 Screening were confirmed as compliant or not critical under the Tier 2 requirements of ASCE 41. See detailed descriptions below.

5.2.2.1 C2 & C2a: Shear Stress Check

Shear forces of the concrete shear walls were obtained from the linear dynamic analysis and checked against the capacities as deformation-controlled actions. The shear demand-capacity ratios of the concrete walls are well below 1.0, and the checklist item is considered compliant. This is consistent with the expectation considering the walls occur all along the perimeter of the concrete structure on all sides.

5.2.2.2 C2 & C2a: Deflection Compatibility

Concrete columns were modeled in the 3D linear model with full fixity at both ends. The shear and moment demands of the columns were obtained from the linear dynamic analysis. Shear capacities were calculated and compared against the demand. PMM interaction checks were conducted using SpColumn software to verify the moment demands against the capacities. The results show the demand-capacity ratios of both shear and flexural are less than 1.0. Hence the checklist item is considered compliant based on the Tier 2 results.

5.2.2.3 C2 & C2a: Flat Slab

The intent of running at least two continuous bottom bars through the columns at the flat slab is to provide limited resistance against two-way shear demand at the slab-column joint due to high seismic drift. Per ACI 318-14 Chapter 18.14.5, seismic shear reinforcement requirement is not required if the story drift is less than 0.5%. The story drifts of this building were obtained from the 3D linear dynamic analysis. The maximum story drift under BSE-2E earthquake occurs at the top floor of the concrete structure, which is approximately 0.25%. The drifts are significantly less than 0.5%. In addition, the record drawings show that a considerable amount of shear reinforcement is provided at the slab-column joints. It is our opinion that the intent of the checklist item is satisfied, and the item can be considered compliant.

5.2.2.4 S1 & S1a: Panel Zone

A linear static analysis was conducted to evaluate the steel moment frames. The demands on the panel zones were calculated based on the tributary seismic and gravity loads applied on the moment frames. The capacities were calculated as deformation-controlled action. The demand-capacity ratios of the panel zone are all less than 1.0. This checklist item is considered compliant.

6.0 CONCLUSIONS

As described above, the four non-compliant Tier 1 items were analyzed in greater detail, and we concluded that these items satisfied the more detailed acceptance criteria associated with a Tier 2 evaluation. Based on an evaluation of the building using ASCE 41-17 Tier 1 Checklists, the results from the Tier 2 analysis, site observations, evaluation of the record drawings, and the requirements of the 2019 CEBC, we recommend a Seismic Performance Rating of Level IV, as defined by the University of California Seismic Safety Policy, Appendix A.

TAS:jq:klc