

Seismic Ratings

University of California

UCLA Southern Regional Library Facility CAAN No. 4562

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Job No. 15-G103A

Seismic Ratings

University of California

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Executive Summary

This report provides Seismic Ratings for all existing buildings listed in the Existing Building Matrix provided below. These buildings are located on various University of California campuses including Berkeley, Irvine, Los Angeles, Riverside, and San Diego.

The Seismic Ratings were based on University of California Seismic Safety Policy, Table A.1. 2016 *California Building Code (CBC)* – Part 10 and American Society of Civil Engineers Standard *Seismic Rehabilitation of Existing Buildings*, ASCE 41-13 were used for all building evaluations.

Record drawings were reviewed and Tier 1 and Tier 2 analysis was performed for each building for the BSE-1E level seismic demand for a Life Safety or Damage Control performance objective. Site visits and visual observation was performed for buildings for which record drawings were not available.

The seismic evaluation methodology was based on the ASCE 41-13 Tier 1 Screening and Tier 2 Deficiency Based Evaluation. The Tier 1 Screening consists of checklists, which allow for a rapid evaluation of the existing structure to a desired performance level.

The Basic Performance Objective for Existing Buildings (BPOE) for the buildings depends on their Risk Category as defined in Table 1604.5 of CBC 2016. Most of the buildings under this scope of work belonged to Risk Category III, while some belonged to Risk Categories I and II. For Tier 1 and Tier 2 analysis the BPOE was either Life Safety or Damage Control based on Table 2-1 of ASCE 41-13

Seismic spectral accelerations used in this evaluation for the various campuses were obtained from probabilistic seismic hazard mapping software developed by the United States Geological Survey (USGS). Some of the buildings being evaluated were located in the “Zones of Required Investigation”, published in the Regulatory Maps by the California Geological Survey. These maps locate the potential liquefaction and landslide zones in the State of California.

Most of the buildings that have been evaluated were found to qualify for a Seismic Rating of IV i.e. they either meet or exceed the requirements of Part 10 of the 2016 CBC, the *California Existing Building Code*, for Life Safety performance objective for a BSE-1E event that has a 20% probability of occurrence in 50 years. All these buildings belonged to Risk categories I, II or III.

Some of the buildings have been recently retrofitted that helped in increasing their rating from the original construction. These buildings have either been rated III i.e. they meet the structural requirements for a

new building per the 2016 CBC meeting the seismic demands of a BSE-1N event that has a 10% probability of occurrence in 475 years , or they have been rated IV.

Few buildings did not meet the criteria to qualify for a rating of III or IV, and they have been rated V i.e. they meet the Life Safety performance criteria if the seismic demands are reduced to 2/3 of a BSE-1E event.

Two buildings on the UC Berkeley campus, 1601 Allston Way and Cloyne Court are in the seismic “Zone of Required Investigation”. One of the buildings is located at the edge of a fault rupture zone and the other is located over a thin fragment of liquefaction zone. Structures located in such regulatory zones run the risk of increased seismic vulnerability due to a fault rupture or differential foundation settlement in case of liquefaction during a seismic event, respectively. It is recommended that the seismic rating of both these structures be confirmed via peer review.

Table shown below summarizes the seismic evaluation results derived from our analysis.

8	SRLF (UCLA Southern Regional Library)	Complete Set Available	PC2	1985	IV	1. Deflection Compatibility of secondary components: Insufficient ties in precast columns	1. Four story building 2. Extensive Self supporting book shelves present in the building. 3. Open front structure at north façade.
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1.0 Introduction

1.1 General

This report provides Seismic Ratings for all existing buildings listed in the Existing Building Matrix provided below. These buildings are located on various University of California campuses including Berkeley, Irvine, Los Angeles, Riverside, and San Diego.

Table 1.1 Existing Building Matrix

[illegible]

The Seismic Ratings were based on University of California Seismic Safety Policy, Table A.1 shown below. *2016 California Building Code (CBC)* – Part 10 and American Society of Civil Engineers Standard *Seismic Rehabilitation of Existing Buildings*, ASCE 41-13 were used for all building evaluations.

Table 1.2 Seismic Ratings and Expected Seismic performance Level

Table A.1. Determination of Expected Seismic Performance Level¹ Based on the Edition, California Code of Regulations, Part 10, California Building Code (CBC) (current edition)

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

Notes:

1. Expected seismic performance levels are indicated by Roman numerals I through VII. Assignments are to be made following a professional assessment of the building's expected seismic performance as measured by a CSE's experience or referenced technical standard and earthquake ground motions. Equivalent Arabic numerals, fractional values, or plus or minus values are not to be used. These assignments were prepared by a task force of state agency technical personnel, including the California State University, the University of California, the California Department of General Services, the Division of the State Architect, and the Administrative Office of the Courts. The levels apply to structural and non-structural elements of the building as contained in Chapter 3, CBC Part 10 requirements. These definitions replace those previously used by these agencies.
2. Chapter 3 of the California Building Code Part 10, current edition, regulates existing buildings. It uses and references the American Society of Civil Engineers Standard *Seismic Rehabilitation of Existing Buildings*, ASCE-41-13. All earthquake ground motion criteria are specific to the site of the evaluated building. The CBC definitions for earthquake ground motions to be assessed are paraphrased below for convenience:
3. BSE-2N, the 2,475-year return period earthquake ground motion, or 150% of the Maximum Considered Earthquake ground motion for the site.
 BSE-C, the 975-year return period earthquake ground motion.
 BSE-1N, two-thirds of the BSE-2N, nominally, the 475-year return period earthquake ground motion. BSE-R, the 225-year return period earthquake ground motion.
Risk Category is defined in the CBC Table 1604A.5. The risk category sets the level of required seismic building performance under the CBC. Risk Category IV includes acute care hospitals, fire, rescue and police stations and emergency vehicle garages, designated emergency shelters, emergency operations centers, and structures containing highly toxic materials where the quantities exceed the maximum allowed quantities, among others. Risk categories I-III includes all other building uses that include most state-owned buildings.

1.2 Tasks Performed

The following Tasks were performed for providing Seismic ratings for all buildings:

1. Review of existing drawings and other available documentation as provided by the various University campuses.
2. Site visits were performed for the following buildings because no record drawings could be obtained from the University archives:
3. Consistent with the requirements of ASCE 41-13 and the Seismic Performance Level, seismic ground motion parameters were obtained from the probabilistic seismic hazard mapping software developed by the United States geological Survey (USGS).

4. Review of fault locations in the vicinity of the buildings based on the maps published by the California Geological Survey.
5. Identification of the seismic force resisting system for the building based on record drawings or visual observation followed by the qualitative review of the lateral elements based on Tier 1 checklists for various Building Types included in ASCE 41-13. All Tier 1 checklists have been provided in Appendix A.
6. Tier 2 evaluations, per ASCE 41-13, for the deficiencies observed in the Tier 1 checklists. All Tier 2 calculations have been provided in Appendix B.
7. Seismic Ratings were assigned for all buildings included in the Existing Building Matrix based on the results of the Tier 1 and Tier 2 evaluations.

UC Seismic Safety Policy Section III, Sub-section C, Footnote 2, states “ For purposes of seismic performance levels, falling hazards are interior and exterior building elements that may fall or slide during an earthquake, including parapets, ornamentation, chimneys, walls and partitions, but excluding equipment, fixtures, ceilings, furniture, furnishings, and other contents. The excluded elements should not be considered in the determination of the seismic performance rating of a facility.” The relevant nonstructural elements that affect the seismic rating were detailed on the record drawings; as a result Tier 1 non-structural checklists had no bearing on the Seismic Rating of the buildings.

2.0 Seismic Evaluation Methodology

The seismic evaluation methodology is based on the ASCE 41-13 Tier 1 Screening and Tier 2 Deficiency Based Evaluation. The Tier 1 Screening consists of checklists, which allow for a rapid evaluation of the existing structure to desired performance level.

The Basic Performance Objective for Existing Buildings (BPOE) for the buildings depends on their Risk Category as defined in Table 1604.5 of CBC 2016. Most of the buildings under this scope of work belonged to Risk Category III, while some belonged to Risk Categories I and II. For Tier 1 and Tier 2 analysis the BPOE was either life Safety or Damage Control based on Table 2-1 of ASCE 41-13 as shown below:

Table 2.1 Basic Performance Objective for Existing Buildings (BPOE)
(Ref. ASCE 41-13 Table 2-1)

Risk Category	Tier 1	Tier 2
	BSE-1E	BSE-1E
I & II	Life Safety Structural Performance Life Safety Nonstructural Performance (3-C)	Life Safety Structural Performance Life Safety Nonstructural Performance (3-C)
III	See Note 1 for Structural Performance Position Retention Nonstructural Performance (2B)	Damage Control Structural Performance Position Retention Nonstructural Performance (2-B)
IV	Immediate Occupancy Structural Performance Position Retention Nonstructural Performance (1-B)	Immediate Occupancy Structural Performance Position Retention Nonstructural Performance (1-B)

Note 1: For Risk category III, Tier I Screening Checklists shall be based on Life Safety Performance Level (S-3), except that checklist statements using Quick Check procedures of Section 4.5.3 shall be based on Ms-factors and other limits that are an average of the values for Life Safety and Immediate Occupancy.

The Tier 1 checklists were completed with each checklist item marked as any of the following: Compliant, Non-Compliant, Unknown or Not Applicable. Following the completion of the Tier 1 phase, Deficiency

based Tier 2 checks were performed. The scope of the tier 2 checks was limited to items marked as Non-Compliant per the Tier 1 Checklists.

Following the completion of Tier 2 Evaluation, we assigned a Seismic Rating to each building.

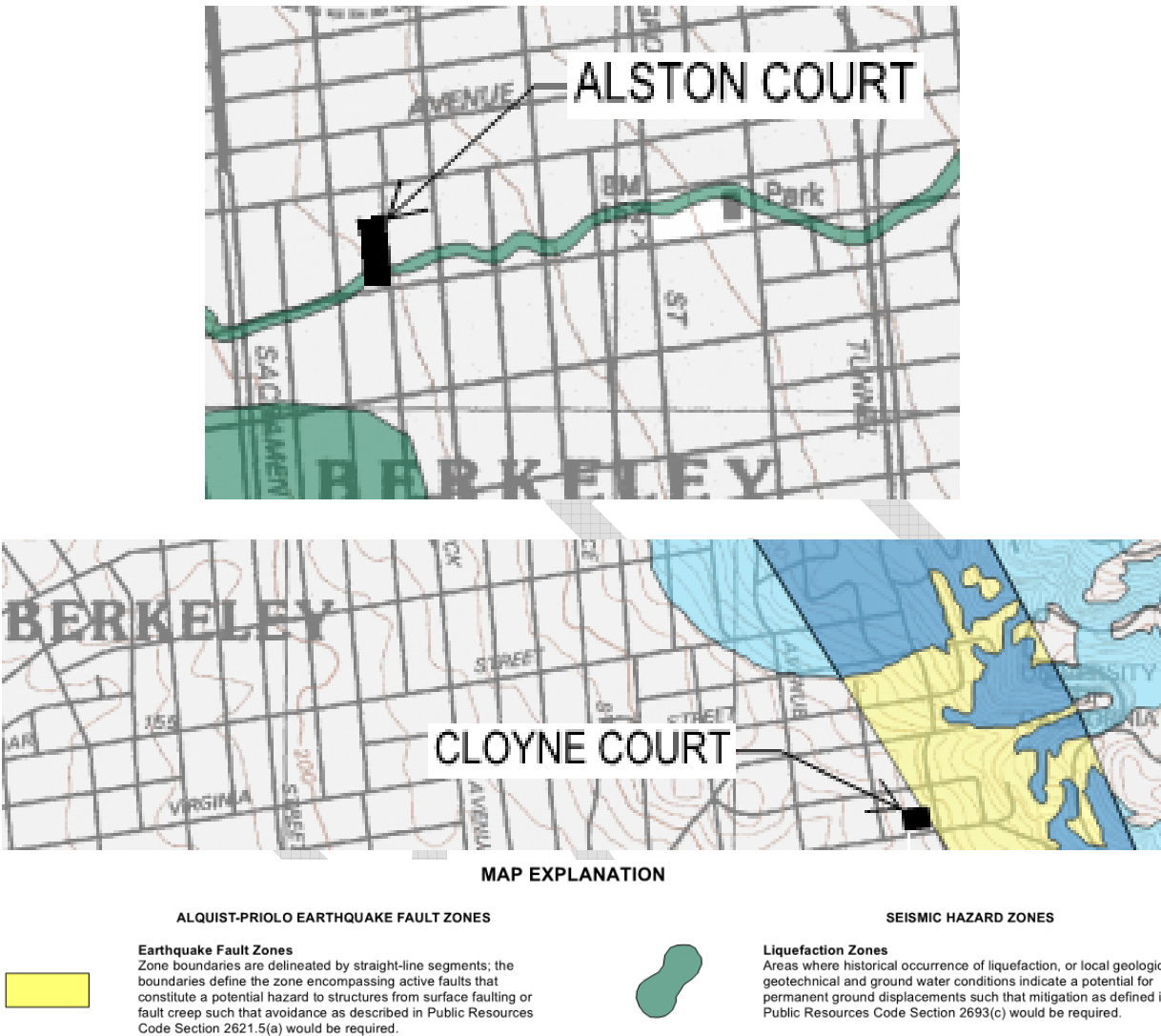


Figure 3.1.1 Zone of Require Investigation

3.3 University of California, Los Angeles

Site Latitude: 34.07407°N

Site Longitude: 118.44323°W

Site Class: D

Period (sec)	Spectral Accelerations for BSE-1E	Site Coefficients from ASCE 41-13 Tables 2-3,2-4	Design values per ASCE 41-13 Eqs. 2-4, 2-5
0.2	$S_S, 20\%/50 = 0.793g$	$F_a = 1.183$	$S_{XS}, 20\%/50 = 0.938g$
1.0	$S_1, 20\%/50 = 0.284g$	$F_v = 1.831$	$S_{X1}, 20\%/50 = 0.521g$

Based on the 0.2 second and 1.0 second spectral accelerations, in accordance with ASCE 41-13 Table 2-4, the level of seismicity at this site is defined as High.

The buildings being investigated are not located in a "Zone of Required Investigation".



Figure 4.8.1 Southern Regional Library, UCLA (Source: Google Maps)

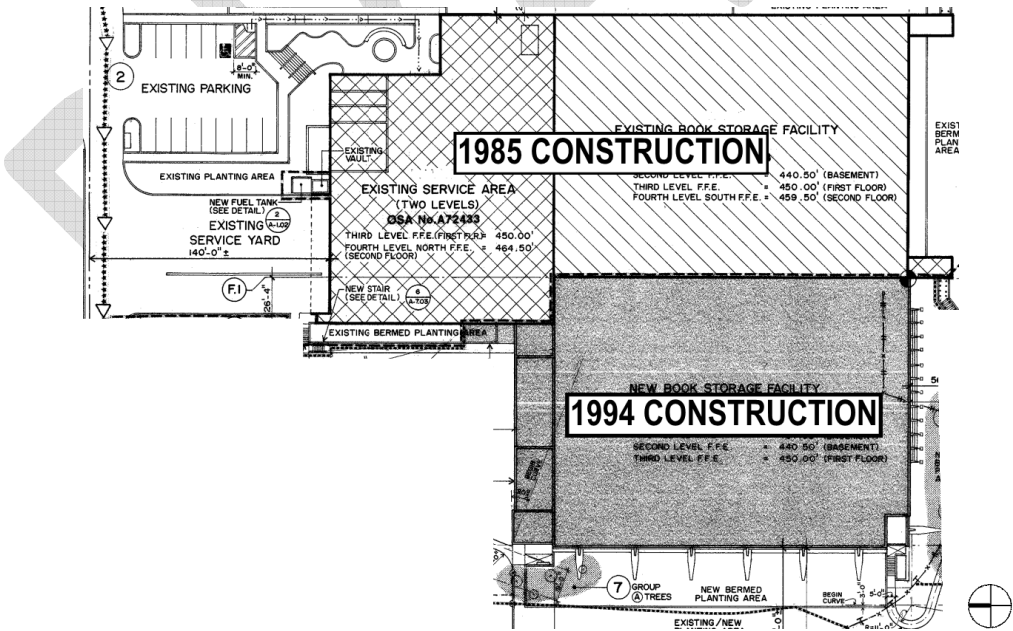


Figure 4.8.2 Construction Phases

4.8 SOUTHERN REGIONAL LIBRARY: Located at the UC Los Angeles campus. Record drawings titled, “Southern Regional Library – Compact Shelving Facility”, dated, July 2, 1985, prepared by Wilhelm & Barelli, Inc. Consulting Structural Engineers and Leidenfrost/Horowitz & Associates Architects were reviewed for this evaluation. Phase II drawings, dated March 30, 1994, prepared by same team were also reviewed. An aerial view of the building is shown in Figure 4.8.1. A key plan of the various phases of construction is shown in Figure 4.8.2.

4.8.1 Building Description and Building Type: The UCLA SRL houses extensive self-supporting book shelves interconnected with steel walkways. The book shelves have not been evaluated for the purpose of this study.

The southern half of the original structure built in 1985, is a single-story concrete shear wall building with two subterranean levels and perimeter basement shear walls. This part of the building has single tall story to house the book shelves. The roof is framed with precast concrete double tees spanning to precast concrete girders and precast columns. This part is approximately 33,000 sq. ft. in plan area.

The northern half of the 1985 building is a two-story structure with perimeter shear walls, and a single subterranean level. Due to the sloping nature of the site, the northern part of the building has two levels above grade whereas the southern part has only one level above grade when they have almost similar roof elevation. The floor and roof are framed with metal deck with concrete topping spanning between steel beams, supported by steel columns at the interior and perimeter walls at the exterior. The north face of the structure is braced with steel concentric braced frames. The north and south parts of the building share a common concrete shear wall. The north part of the building is approximately 18,500 sq. ft. in plan area. Roof framing plans for 1985 construction are shown in Figure 4.8.3.

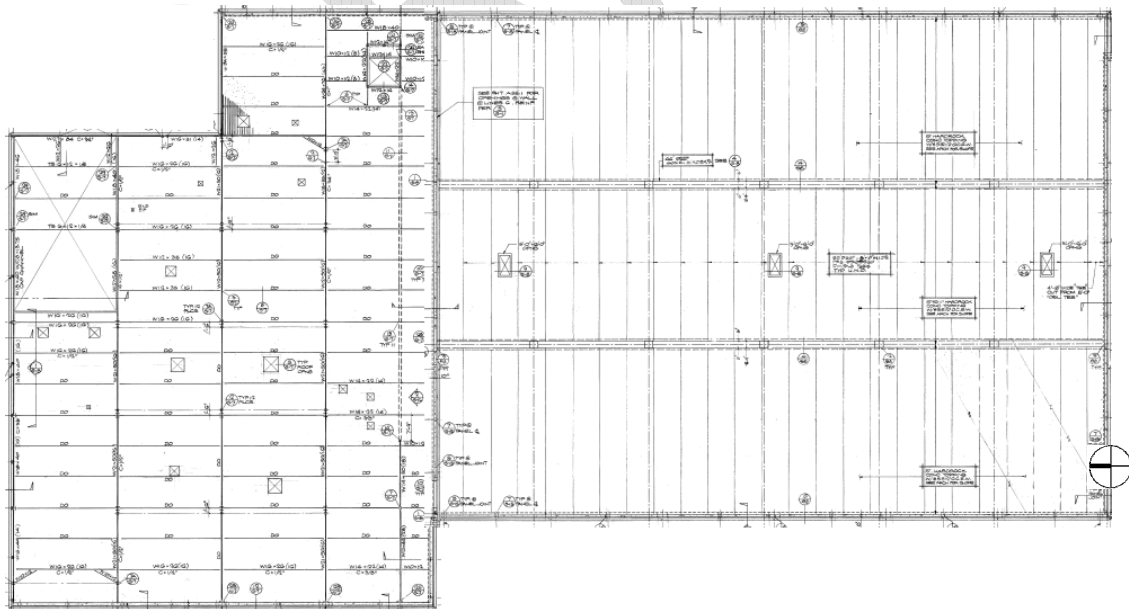


Figure 4.8.3 Roof Framing Plan, 1985 Construction

Phase II built in 1994, shares the western perimeter concrete wall with the southern half of the original construction. Phase II, is also a single-story building with two subterranean levels. The roof structure is framed with precast planks spanning to precast concrete beams, supported by precast columns and perimeter walls. Phase II is approximately 33,000 sq. ft. in plan area. Roof framing plans for 1994 construction are shown in Figure 4.8.4.

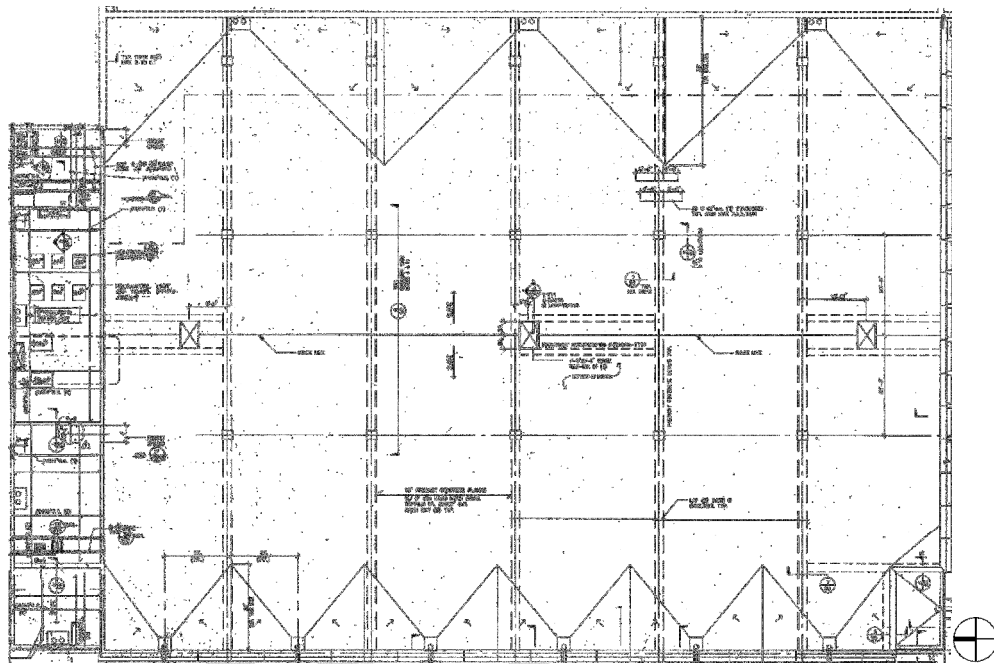


Figure 4.8.4 Roof Framing Plan, 1994 Construction

Per ASCE 41-13, this building is classified as PC2.

4.8.2 Seismic Rating: Tier 1 deficiency observed in the building was: Deflection Compatibility of secondary components due to insufficient ties in precast columns.

This building qualifies for a Seismic Rating of IV, as defined in Table 1.2, because, the Tier 1 stress checks demonstrate that the shear walls have sufficient capacity to resist the seismic demands imposed on the building due to a BSE-1E seismic event. Most of the building is subterranean, the drifts are expected to be less than that of a typical three-story shear wall building, therefore, the shear demand on the columns will not be significantly large and the Tier 1 deficiency does not cause structural concern.