Seismic Ratings

University of California

Brain Mapping Building

CAAN: 4251

(Excerpt from 2017 UC Seismic Ratings Study)

Englekirk INSTITUTIONAL

June 30, 2017

Job No. 15-G103A

Seismic Ratings

University of California

Submitted to:
University of California
Office of the President

June 30, 2017

Job No. 15-G103A

Englekirk
INSTITUTIONAL

888 S. Figueroa Street
18th Floor
Los Angeles, CA 90017

323.733.6673 T
323.733.8682 F

TABLE OF CONTENTS

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 Unites 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.

13	**BRAIN MAPPING** (UCLA 604 Circle Drive, CA 90095)	Complete Set Available	RM2	1995	IV	--	1. Two story Builing with in plan torsion.

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

Ref #	Campus	Zip	CAAN	Name
13	UCLA	90095	4251	BRAIN MAPPING

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 Level[1] 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)

	Tier 1	Tier 2
Risk Category	**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 Sturtcural 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 checklists 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	Fa = 1.183	$S_{XS,\ 20\%/50}$ = 0.938g
1.0	$S_{1,\ 20\%/50}$ = 0.284g	Fv = 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”.

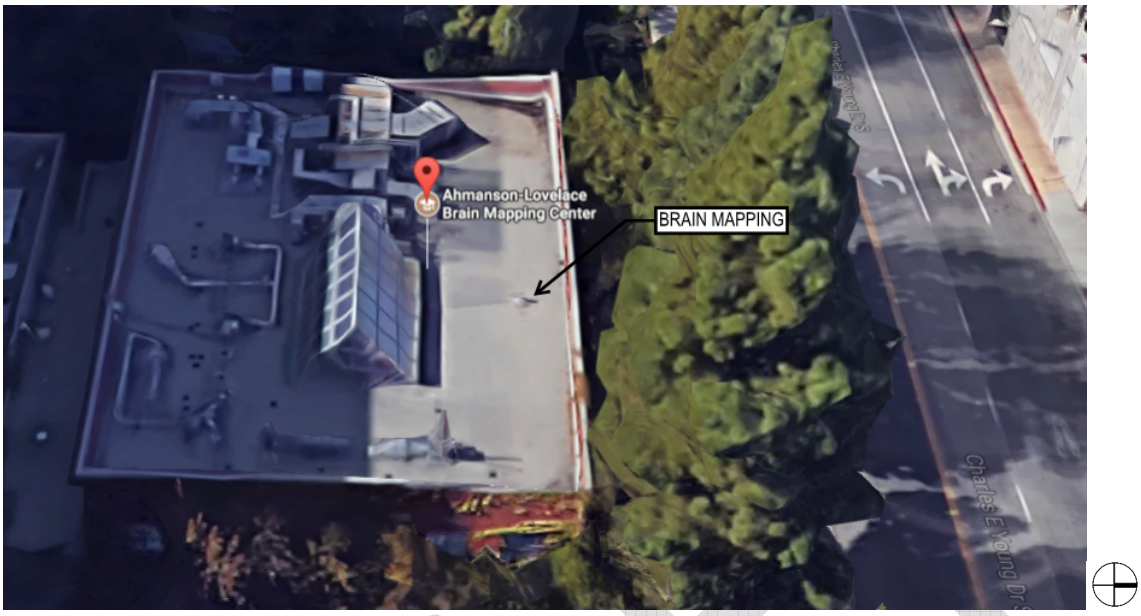

Figure 4.11.1 Brain Mapping, UCLA (Source: Google Maps)

4.11.1 Building Description and Building Type: This building is a two-story structure with approximately fifteen foot story height. The floor and roof are framed with 3" metal deck with 3 ¼" light weight concrete topping spanning between W18x beams, supported by W18x girders and steel columns, or perimeter walls. A large skylight is located at the roof level at the center of the building. The columns and walls are supported by spread footings. A 4" thick concrete slab on grade forms the floor at Level 1.

The perimeter walls serve as shear walls. The bottom floor is braced with 7 ½" thick concrete walls with 8" thick solid grouted, reinforced, concrete masonry block walls built on top, starting at Level 2 and terminating at roof parapets. A typical framing plan is shown in Figure 4.13.2.

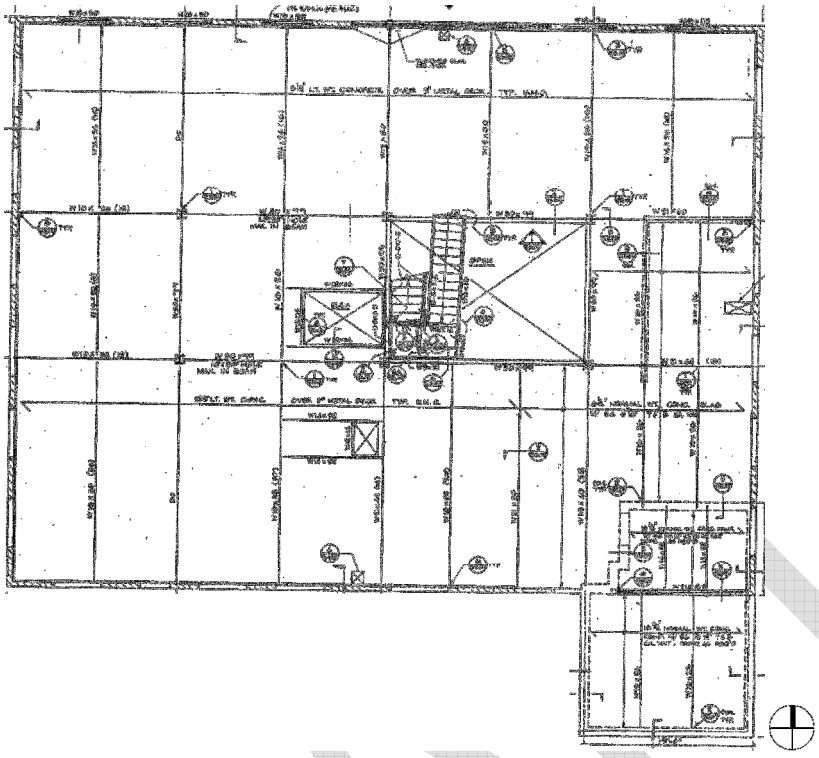

Figure 4.11.2 Typical framing plan

Per ASCE 41-13, the building is classified as Building Type RM2 and C2 due to different lateral systems up the height of the building.

4.11.2 Seismic Rating: No Tier 1 deficiencies were observed in this building. The building qualifies for a Seismic Rating of III, as defined in Table 1.2.

4.12 MOLECULR SCIENCE: Molecular Science building located at the UC Los Angeles campus was built in 1989. Record drawings titled, “UCLA Chemistry & Biological Sciences Building”, dated, May 1, 1989, and prepared by Ove Arup & Partners California structural engineers and Anshen + Allen Architects, were reviewed for this evaluation. An aerial view of the building is shown in Figure 4.12.1.

APPENDIX A

Tier 1 Checklists

16.1.2LS Life Safety Basic Configuration Checklist

Low Seismicity

Building System

GENERAL	
C NC U NA	LOAD PATH. The structure shall contain 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)
C NC U NA	ADJACENT BUILDING. The clear distance between the building being evaluated and any adjacent building is greater than 4% of the height of the shorter building. This statement shall not apply for the following building types: W1, W1a, and W2. (Commentary: Sec. A.2.1.2. Tier 2: Sec. 5.4.1.2)
C NC U NA	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)
BUILDING CONFIGURATION	
C NC U NA	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. A.2.2.2. Tier 2: Sec. 5.4.2.1)
C NC U NA	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)
C NC U NA	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)
C NC U NA	GEOMETRY. There are no changes in the 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)
C NC U NA	MASS. There is no change in effective mass 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)
C NC U NA	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)

Moderate Seismicity (Complete the following items in addition to the items for Low Seismicity)

GEOLOGIC SITE HAZARDS	
C NC U NA	LIQUEFACTION. Liquefaction-susceptible, saturated, loose granular soils granular soils that could jeopardize the building's seismic performance shall not exist in the foundation soils at depths within 50 ft. under the building. (Commentary: Sec. A.6.1.1. Tier 2: Sec. 5.4.3.1)

C NC U NA	SLOPE FAILURE. The building site sufficiently remote from potential earthquake-induced slope failures or rockfalls to be unaffected by such failures or is capable of accommodating any predicted movements without failure. (Commentary: Sec. A.6.1.2. Tier 2: Sec. 5.4.3.1)
C NC U NA	SURFACE FAULT RUPTURE. Surface fault rupture and surface displacement at the building site are not anticipated. (Commentary: Sec. A.6.1.3. Tier 2: Sec. 5.4.3.1)

High Seismicity (Complete the following items in addition to the items for Low and Moderate Seismicity)

FOUNDATION CONFIGURATION	
C NC U NA	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)
C NC U NA	THIS 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)

Project: _____ Location: _____

Completed by: _____ Date: _____

16.15LS LIFE SAFETY STRUCTURAL CHECKLIST FOR BUILDING TYPES RM1: REINFORCED MASONRY BEARING WALLS WITH FLEXIBLE DIAPHRAGMS AND RM2: REINFORCED MASONRY BEARING WALLS WITH STIFF DIAPHRAGMS

Low and Moderate Seismicity

Seismic-Force-Resisting System

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)

C NC N/A U SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 4.5.3.3, is less than 70 lb/in.^{2}. (Commentary: Sec. A.3.2.4.1. Tier 2: Sec. 5.5.3.1.1)

C NC N/A U REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls is greater than 0.002 of the wall with the minimum of 0.0007 in either of the two directions; the spacing of reinforcing steel is less than 48 in., and all vertical bars extend to the top of the walls. (Commentary: Sec. A.3.2.4.2. Tier 2: Sec. 5.5.3.1.3)

Stiff Diaphragms

C NC N/A U TOPPING SLAB: Precast concrete diaphragm elements are interconnected by a continuous reinforced concrete topping slab. (Commentary: Sec. A.4.5.1. Tier 2: Sec. 5.6.4)

Connections

C NC N/A U WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm 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 shall have adequate strength to resist the connection force calculated in the Quick Check procedure of Section 4.5.3.7. (Commentary: Sec. A.5.1.1. Tier 2: Sec. 5.7.1.1)

C NC N/A U WOOD LEDGERS: The connection between the wall panels and the diaphragm does not induce cross-grain bending or tension in the wood ledgers. (Commentary: Sec. A.5.1.2. Tier 2: Sec. 5.7.1.3)

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)

C NC N/A U TOPPING SLAB TO WALLS OR FRAMES: Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements are doweled for transfer of forces into the shear wall or frame elements. (Commentary: Sec. A.5.2.3. Tier 2: Sec. 5.7.2)

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)

C NC N/A U GIRDER–COLUMN CONNECTION: There is a positive connection using plates, connection hardware, or straps between the girder and the column support. (Commentary: Sec. A.5.4.1. Tier 2: Sec. 5.7.4.1)

High Seismicity: Complete the Following Items in Addition to the Items for Low and Moderate Seismicity.

Stiff Diaphragms

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)

C NC N/A U OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls are not greater than 8 ft long. (Commentary: Sec. A.4.1.6. Tier 2: Sec. 5.6.1.3)

Flexible Diaphragms

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

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)

C NC N/A U OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls are not greater than 8 ft long. (Commentary: Sec. A.4.1.6. Tier 2: Sec. 5.6.1.3)

C NC N/A U 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)

C NC N/A U SPANS: All wood diaphragms with spans greater than 24 ft consist of wood structural panels or diagonal sheathing. (Commentary: Sec. A.4.2.2. Tier 2: Sec. 5.6.2)

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

C NC N/A U OTHER DIAPHRAGMS: The diaphragm shall 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)

Connections

C NC N/A U STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements are installed taut and are stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 in. before engagement of the anchors. (Commentary: Sec. A.5.1.4. Tier 2: Sec. 5.7.1.2)