Degenkolb

Rating form completed by
Jack Wegleitner, Jay Yin

*Text in green is to be part of UC Santa Cruz building database and may be part of UCOP database*

DATE: June 30,.2019

REGISTERED PROFESSIONAL ENGINEER
JAY C. YIN
No. 4521
STRUCTURAL
STATE OF CALIFORNIA

6/28/19

**UC Santa Cruz building seismic ratings**

# Long Marine Lab Younger Research Building, UCSC

CAAN #7437
103 McAllister Way Santa Cruz CA 95060
UCSC Campus: Coastal Science Campus


| Rating summary | Entry | Notes |
|---|---|---|
| UC Seismic Performance Level (rating) | V (Poor) | |
| Rating basis | Tier 1 | ASCE 41-17[1] |
| Date of rating | 2019 | |
| Recommended UC Santa Cruz priority category for retrofit | Category B | Priority A=Retrofit ASAP<br>Priority B=Retrofit at next permit application |
| Ballpark total construction cost to retrofit to IV rating[2] | Medium (~$50/sf-$200/sf) | See recommendations on further evaluation and retrofit. |
| Is 2018-2019 rating required by UCOP? | Yes | Building was not previously rated. |
| Further evaluation recommended? | Yes | Remove finishes to inspect roof diaphragm to CMU wall connection |

[1] We translate this Tier 1 evaluation to a Seismic Performance Level rating using professional judgment. Noncompliant items in the Tier 1 evaluation do not automatically put a building into a particular rating category, but we evaluate such items along with the combination of building features and potential deficiencies, focused on the potential for collapse or serious damage to the gravity supporting structure that may threaten occupant life-safety.

[2] Per Section 3.A.4.i of the Seismic Program Guidebook, the cost includes all construction cost necessitated by the seismic retrofit, including restoration of finishes and any triggered work on utilities or accessibility. It does not include soft costs such as design fees or campus costs. The cost is in 2019 dollars.

**Building information used in this evaluation**

Architectural drawings by Esherick Homsey Dodge and Davis Architects and Planners; and Rutherford and Chekene Consulting Engineers, "Coastal Marine Laboratory," as-built dated 19 Aug 1976 , Sheets A1-A5.

University of California building database information, Long Marine Lab Younger Research Building, provided by Jose Sanchez (UCSC) on 2018-11-20.

**Additional building information known to exist**

None

**Scope for completing this form**

Reviewed structural drawings and performed a site visit to confirm as-builts. Evaluated nonstructural life-safety hazards during site visit. Completed an ASCE41-17 Tier 1 evaluation.

**Brief description of structure**

The Younger Research Building is part of the Long Marine Laboratory on UCSC's Coastal Sciences Campus. The building was designed in 1976 by Esherick Homsey Dodge and Davis Architects and Planners; and Rutherford and Chekene Consulting Engineers. Construction was completed in 1978.

The building is a single story with a gable roof. Exterior CMU walls and interior wood partition walls support the roof. The CMU walls extend to the ridge of the gabled roof on either end of the building.

The building is divided into multiple lab and storage spaces. There is a trench that runs under the west side of the building to allow any spilled water from the wet labs to drain. In the wet lab, there are removable roof joists that allow for customization of equipment hanging and storage in the space. These joists rest on CMU corbels against the exterior wall and on a wood ledger where they meet an interior partition. On the south end of the building there is an attic storage space over an office that is accessible by interior stairs.

Identification of levels: Ground level with an attic storage space on the south end of the building (Ground Floor).

Foundation system: The site is level. The superstructure is supported by grade beams below the exterior CMU walls and a slab on grade. The slab is thickened underneath the interior gravity framing walls as well.

Structural system for vertical (gravity) load: The gravity system consists of exterior CMU walls and interior wood frame partition walls. The walls support a wood framed gabble roof and equipment hangers above the lab space.

Structural system for lateral forces: The TJI framed roof is sheathed with plywood. It is anchored to the exterior walls using a framing clip attached to a sloped wood plate that is nailed to a treated 2x6 which is anchor bolted to the 8" CMU wall. The CMU wall is fully grouted and reinforced each way with #4s at 24" on center. Dowels that match the wall reinforcement connect the exterior walls to the foundation.

**Brief description of seismic deficiencies and expected seismic performance including mechanism of nonlinear response and structural behavior modes**

The connections between the wood roof diaphragm and the CMU walls have a lower strength than required to resist the required in-plane and out-of-plane shear demands. The nails used to connect the diaphragm to the wood wall topper do not provide enough strength to transfer the forces to the perimeter walls.

The walls are expected to behave well based on the quick checks.

| Structural deficiency | Affects rating? | Structural deficiency | Affects rating? |
|---|---|---|---|
| Lateral system stress check (wall shear, column shear or flexure, or brace axial as applicable) | N | Openings at shear walls (concrete or masonry) | N |
| Load path | Y | Liquefaction | N |
| Adjacent buildings | N | Slope failure | N |
| Weak story | N | Surface fault rupture | N |
| Soft story | N | Masonry or concrete wall anchorage at flexible diaphragm | Y |
| Geometry (vertical irregularities) | N | URM wall height-to-thickness ratio | N |
| Torsion | N | URM parapets or cornices | N |
| Mass – vertical irregularity | N | URM chimney | N |
| Cripple walls | N | Heavy partitions braced by ceilings | N |
| Wood sills (bolting) | N | Appendages | N |
| Diaphragm continuity | N | | |

**Summary of review of non-structural life-safety concerns, including at exit routes.[3]**

Overhead lab storage and equipment hanging

Unrestrained items stored overhead in Lab space could become dislodged during an earthquake. Injury of lab occupants or blocking of exit routes is possible. Future investigation should look at how these items are anchored when stored.

| UCOP non-structural checklist item | Life safety hazard? | UCOP non-structural checklist item | Life safety hazard? |
|---|---|---|---|
| Heavy ceilings, feature or ornamentation above large lecture halls, auditoriums, lobbies or other areas where large numbers of people congregate | N | Unrestrained hazardous materials storage | N |
| Heavy masonry or stone veneer above exit ways and public access areas | N | Masonry chimneys | N |
| Unbraced masonry parapets, cornices or other ornamentation above exit ways and public access areas | N | Unrestrained natural gas-fueled equipment such as water heaters, boilers, emergency generators, etc. | N |

**Discussion of rating**

The following noncompliances in the Tier 1 checklist form the basis of rating:

1. Inadequate in-plane and out-of-plane anchorage of the perimeter CMU walls to the plywood roof diaphragm.

2. The stiffness of the wall anchors between the masonry walls and structural wood elements is unknown

This building was given a V rating with a priority B due to the deficiencies in the connection of the diaphragm to the lateral load system.

[3] For these Tier 1 evaluations, we do not visit all spaces of the building; we rely on campus staff to report to us their understanding of if and where non-structural hazards may occur.

**Recommendations for further evaluation or retrofit**

Prior to proceeding with more advanced analysis for retrofit, it is recommended to expose the diaphragm to CMU wall connection to verify if it matches as builts.

Retrofitting the existing diaphragm connection by adding a direct connection between the roof and the wall.

**Peer review of rating**

This seismic evaluation was discussed in a peer review meeting on 17 June 2019. Reviewers present were Bret Lizundia of R+C and Joe Maffei of Maffei Structural Engineers. Comments from the reviewers have been incorporated into this report. The reviewers agreed with the assigned rating.

| Additional building data | Entry | Notes |
|---|---|---|
| Latitude | 36.94933 | |
| Longitude | -122.0656 | |
| Are there other structures besides this one under the same CAAN# | No | |
| Number of stories above lowest perimeter grade | 1 | |
| Number of stories (basements) below lowest perimeter grade | 0 | |
| Building occupiable area (OGSF) | 2979 sq ft | |
| Risk Category per 2016 CBC Table 1604.5 | II | |
| Building structural height, $h_n$ | 16.66 | Structural height defined per ASCE 7-16 Section 11.2 |
| Coefficient for period, $C_t$ | 0.02 | Estimated using ASCE 41-17 equation 4-4 and 7-18 |
| Coefficient for period, $\beta$ | 0.75 | Estimated using ASCE 41-17 equation 4-4 and 7-18 |
| Estimated fundamental period | 0.167 sec | Estimated using ASCE 41-17 equation 4-4 and 7-18 |
| **Site data** | | |
| 975 yr hazard parameters $S_s$, $S_1$ | 1.26, 0.47 | |
| Site class | D | |
| Site class basis | Geotech[4] | See footnote below |
| Site parameters $F_a$, $F_v$ | 1.2, 1.829 | |
| Ground motion parameters $S_{ds}$, $S_{d1}$ | 1.52, 0.86 | |
| $S_a$ at building period | 1.513 | |
| Site $V_{s30}$ | 900 ft/s | |
| $V_{s30}$ basis | Estimated | Estimated based on site classification of D. |

[4] Determination of site class and assessment of geotechnical hazards are based on correspondence with Pacific Crest Geotechnical Engineers and Nolan, Zinn, and Associates Geologists. [*Revised Geology and Geologic Hazards, Santa Cruz Campus, University of California*, Job # 04003-SC 13 May 2005]. Site class is taken as D throughout the main campus of UC Santa Cruz. The following links provide hazard maps for liquefaction, landslide, and fault rupture:
https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/LiquifactionMap2009.pdf
https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/LandslideMap2009.pdf
https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/FaultZoneMap2009.pdf

| | | |
|---|---|---|
| Liquefaction potential | Low | |
| Liquefaction assessment basis | County Map | See footnote 4 |
| Landslide potential | Low | |
| Landslide assessment basis | County Map | See footnote 4 |
| Active fault-rupture hazard identified at site? | No | |
| Fault rupture assessment basis | County Map | See footnote 4 |
| Site-specific ground motion study? | No | |
| **Applicable code** | | |
| Applicable code or approx. date of original construction | Built: 1978<br>Code: 1973 UBC | |
| Applicable code for partial retrofit | None | No partial retrofit |
| Applicable code for full retrofit | None | No full retrofit |
| **Model building data** | | |
| Model building type North-South | Reinforced Masonry,RM1 - Reinforced Masonry Bearing Walls with Flexible Diaphragms | |
| Model building type East-West | Reinforced Masonry,RM1 - Reinforced Masonry Bearing Walls with Flexible Diaphragms | |
| FEMA P-154 score | no | Not included here because we performed ASCE 41 Tier 1 evaluation. |
| **Previous ratings** | | |
| Most recent rating | | |
| Date of most recent rating | | |
| 2nd most recent rating | - | |
| Date of 2nd most recent rating | - | |
| 3rd most recent rating | - | |
| Date of 3rd most recent rating | - | |
| **Appendices** | | |
| ASCE 41 Tier 1 checklist included here? | Yes | Refer to attached checklist file in Appendix A. |

University of California, Santa Cruz
ASCE 41-17 Tier 1 Seismic Evaluation
7437 - Long Marine Lab Younger Research Building

# Appendix A
# ASCE 41-17 Checklists

| UC Campus: | Santa Cruz | | | Date: | 6/6/19 | | |
|---|---|---|---|---|---|---|---|
| Building CAAN: | 7437 | Auxiliary CAAN: | - | By Firm: | Degenkolb Engineers | | |
| Building Name: | Long Marine Lab Younger Research Building | | | Initials: | JSW | Checked: | |
| Building Address: | 103 McAllister Way Santa Cruz CA 95060 | | | 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)<br>**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)<br>**Comments:** |
| ☐ | ☐ | ☒ | ☐ | 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)<br>**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)<br>**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)<br>**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)<br>**Comments:** |

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

| UC Campus: | Santa Cruz | | | Date: | 6/6/19 | | |
|---|---|---|---|---|---|---|---|
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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)<br>**Comments:** |
| ◉ | ○ | ○ | ○ | 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)<br>**Comments:** |
| ◉ | ○ | ○ | ○ | 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)<br>**Comments:**<br>Symmetric building. |

## 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)<br>**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)<br>**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)<br>**Comments:** |

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|---|---|---|---|---|---|---|---|
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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)<br><br>**Comments:**<br>50/17=2.94<br>0.6*1.513=0.9078 |
| 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)<br><br>**Comments:**<br>Site class D and slab on grade with grade beams. |

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| UC Campus: | Santa Cruz | | | Date: | 6/7/19 | | |
|---|---|---|---|---|---|---|---|
| Building CAAN: | 7437 | Auxiliary CAAN: | - | By Firm: | Degenkolb Engineers | | |
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# ASCE 41-17
# Collapse Prevention Structural Checklist For Building Type RM1-RM2

## LOW AND MODERATE SEISMICITY

### SEISMIC-FORCE-RESISTING SYSTEM

| C | NC | N/A | U | Description |
|---|---|---|---|---|
| ● | ○ | ○ | ○ | 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)<br>**Comments:**<br>2 exterior shear walls in each direction |
| ● | ○ | ○ | ○ | SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than 70 lb/in.$^2$ (0.48 MPa). (Commentary: Sec. A.3.2.4.1. Tier 2: Sec. 5.5.3.1.1)<br>**Comments:** |
| ● | ○ | ○ | ○ | 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. (1220 mm), 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)<br>**Comments:** |

### STIFF DIAPHRAGMS

| C | NC | N/A | U | Description |
|---|---|---|---|---|
| ○ | ○ | ● | ○ | 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)<br>**Comments:**<br>Wood roof acts as diaphragm |

### CONNECTIONS

| C | NC | N/A | U | Description |
|---|---|---|---|---|
| ○ | ● | ○ | ○ | 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 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)<br>**Comments:**<br>16d wire nails at 12” o.c. are the critical element of the diaphragm to wall connection. They do not have the strength to resist the force calculated in the Quick Check procedure. |

| UC Campus: | Santa Cruz | | | Date: | 6/7/19 | | |
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# ASCE 41-17
# Collapse Prevention Structural Checklist For Building Type RM1-RM2

| 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)<br>**Comments:**<br>Diaphragm connected to top of walls |
| ◉ | ○ | ○ | ○ | 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)<br>**Comments:**<br>Diaphragms are connected to exterior shear walls. Connection is weak. See “Wall Anchorage” |
| ○ | ○ | ◉ | ○ | 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)<br>**Comments:**<br>No topping slab |
| ◉ | ○ | ○ | ○ | FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation. (Commentary: Sec. A.5.3.5. Tier 2: Sec. 5.7.3.4)<br>**Comments:**<br>Dowels match wall verticals per drawings |
| ○ | ○ | ◉ | ○ | 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)<br>**Comments:**<br>No girder column connections |

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

### STIFF DIAPHRAGMS

| | Description |
|---|---|
| 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)<br>**Comments:**<br>No openings on in roof diaphragm |
| 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 (2.4 m) long. (Commentary: Sec. A.4.1.6. Tier 2: Sec. 5.6.1.3)<br>**Comments:**<br>No openings on in roof diaphragm |

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

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# ASCE 41-17
# Collapse Prevention Structural Checklist For Building Type RM1-RM2

## 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)<br>**Comments:** |
| ◉ | ○ | ○ | ○ | 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)<br>**Comments:** |
| ◉ | ○ | ○ | ○ | OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls are not greater than 8 ft (2.4 m) long. (Commentary: Sec. A.4.1.6. Tier 2: Sec. 5.6.1.3)<br>**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)<br>**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)<br>**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)<br>**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)<br>**Comments:** |

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# ASCE 41-17
# Collapse Prevention Structural Checklist For Building Type RM1-RM2

## CONNECTIONS

| C | NC | N/A | U | Description |
|---|---|---|---|---|
| ○ | ○ | ○ | ◉ | 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. (3 mm) before engagement of the anchors. (Commentary: Sec. A.5.1.4. Tier 2: Sec. 5.7.1.2)<br><br>**Comments:** |

University of California, Santa Cruz
ASCE 41-17 Tier 1 Seismic Evaluation
7437 - Long Marine Lab Younger Research Building

# Appendix B
# Quick Check Calculations

Degenkolb

| | | | | | |
|---|---|---|---|---|---|
| **Subject:** | Global Data | **Job Number:** | B9956006.00 | **Date:** | 06/27/19 |
| **Job:** | UCSC Tier 1 Seismic Evaluations CAAN 7437 | **By:** | JSW | **Section:** | |
| | | **Checked By:** | | **Page** | |

**GLOBAL DATA**

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CHAPTER 4 - TIER 1 EVALUATION
LINEAR STATIC PROCEDURE
COLLAPSE PREVENTION
BSE-2E HAZARD LEVEL

**SITE DATA:**

| | | | | | | |
|---|---|---|---|---|---|---|
| Latitude: | | 36.949 | °N | 8635 Kennel Way | *USGS Seismic Design Map Application:* | |
| Longitude: | | 122.066 | °W | La Jolla, CA 94166 | *http://geohazards.usgs.gov/hazardtool/application.php* | |
| Site Class: | | D (default) | | ( Stiff Soil ) | Site Class | [ ASCE 41-17, §2.4.1.6 ] |
| $S_S$ | = | 1.261 | g | ( USGS ) ( 5% / 50 years ) | USGS Mapped ( T = 0.2 sec ) | [ ASCE 41-17, §2.4.1.3 ] |
| $S_1$ | = | 0.471 | g | ( USGS ) ( 5% / 50 years ) | USGS Mapped ( T = 1.0 sec ) | [ ASCE 41-17, §2.4.1.3 ] |
| $F_a$ | = | 1.200 | | ( Site Class D ) | Site Coefficient ( T = 0.2 sec ) | [ ASCE 7-16, Table 11.4-1] |
| $F_v$ | = | 1.829 | | ( Site Class D ) | Site Coefficient ( T = 1.0 sec ) | [ ASCE 7-16, Table 11.4-2] |
| $S_{XS}$ | = | 1.513 | g | = $F_a$ $S_S$ | Site-Adjusted Design ( T = 0.2 sec ) | [ ASCE 41-17, Eq. 2-1 ] |
| $S_{X1}$ | = | 0.861 | g | = $F_v$ $S_1$ | Site-Adjusted Design ( T = 1.0 sec ) | [ ASCE 41-17, Eq. 2-2 ] |

**BUILDING DATA:**

| | | | | |
|---|---|---|---|---|
| Building Type: | RM1 | | ( Reinforced Masonry Bearing Walls with Flexible Diaphragms ) | [ ASCE 41-17, Table 3-1 ] |
| Year Built: | 1973 | | | |
| Number of Stories: | 1 | story | | |
| Parapet Height: | 0.00 | ft | | |
| Roof Height: | 17.00 | ft | | |
| Total Area: | 2,979 | sf | | |

| Level | Height [ ft ] | Elevation [ ft ] | $Length_{N-S}$ [ ft ] | $Length_{E-W}$ [ ft ] | Area [ sf ] | Diaphragm Stiffness | Diaphragm Description |
|---|---|---|---|---|---|---|---|
| Roof | 17.0 | 17.0 | 75 | 51 | 3,825 | Flexible | Concrete Toping w/ hollow clay planks |
| 1st | 0.0 | 0.0 | 75 | 51 | 3,825 | - | - |

Degenkolb

| | | | | | |
|---|---|---|---|---|---|
| **Subject:** | Weight Take Off | **Job Number:** | B9956006.00 | **Date:** | 06/27/19 |
| **Job:** | UCSC Tier 1 Seismic Evaluations CAAN 7437 | **By:** | JSW | **Section:** | |
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**WEIGHT TAKEOFF**

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BSE-2E HAZARD LEVEL

**ROOF TYPE:** ROOF

| | | | | | | |
|---|---|---|---|---|---|---|
| | Roofing / Re-roofing | | @ | 5.0 psf | 0.0 psf |
| 0.5 in | Rock Ballast (Gravel) | | @ | 8.0 psf per inch | 0.0 psf |
| 3 ply | Ready Roofing | | @ | 0.3 psf per ply | 0.0 psf |
| 5 ply | Felt Roofing | | @ | 0.5 psf per ply | 2.5 psf |
| 0.25 in | Slate | | @ | 40.0 psf per inch | 0.0 psf |
| | Shingles | ( Asphalt ) | @ | 2.0 psf | 2.0 psf |
| | Copper or Tin | | @ | 1.0 psf | 0.0 psf |
| | Corrugated Asbestos-Cement | | @ | 4.0 psf | 0.0 psf |
| | Waterproofing Membranes | ( Smooth Bituminous ) | @ | 1.5 psf | 0.0 psf |
| | Cement Tiles | | @ | 16.0 psf | 0.0 psf |
| | Clay Tiles | ( Spanish ) | @ | 19.0 psf | 0.0 psf |
| | Mortar Bed for Clay Tiles | | @ | 10.0 psf | 0.0 psf |
| | Roof Insulation | | @ | 1.0 psf | 1.0 psf |
| 1 in | Insulation | ( Loose ) | @ | 0.5 psf per inch | 0.5 psf |
| 1 in | Insulation Boards | ( Fibrous Glass ) | @ | 1.1 psf per inch | 0.0 psf |
| 3 in | Vermiculite Concrete | | @ | 2.5 psf per inch | 0.0 psf |
| 0.5 in | Fire Proofing | | @ | 2.0 psf per inch | 0.0 psf |
| | Diaphragm - core planks | | @ | 35.0 psf | 0.0 psf |
| 2.5 in | Concrete Slab | ( Normal Weight ) | @ | 12.5 psf per inch | 0.0 psf |
| 4.75 in | Concrete Fill | ( Light Weight ) | @ | 9.2 psf per inch | 0.0 psf |
| 0.5 in | Concrete Overpour | ( Light Weight ) | @ | 9.2 psf per inch | 0.0 psf |
| 18 ga | Bare Metal Deck | | @ | 3.0 psf | 0.0 psf |
| 2 in | Wood Decking | | @ | 2.5 psf per inch | 0.0 psf |
| 2 in | Wood Sheathing | | @ | 3.0 psf per inch | 0.0 psf |
| 0.5 in | Plywood | | @ | 3.2 psf per inch | 1.6 psf |
| | Framing | | @ | 20.0 psf | 0.0 psf |
| 6 ft O.C. | Steel Beams | | @ | 22.0 plf | 0.0 psf |
| 36 ft O.C. | Steel Girders | | @ | 76.0 plf | 0.0 psf |
| 2 ft O.C. | Wood Sub-Purlins | | @ | 1.8 plf | 0.0 psf |
| 8 ft O.C. | Wood Purlins | | @ | 3.0 plf | 0.4 psf |
| 20 ft O.C. | Wood Girders | | @ | 5.0 plf | 0.0 psf |
| 12.75 ft O.C. | Concrete Beams | | @ | 800.0 plf | 0.0 psf |
| 20 ft O.C. | Concrete Girders | | @ | 300.0 plf | 0.0 psf |
| 8.50 ft trib. ht. | Typical Columns | ( $A_{trib}$ = 459 sf ) | @ | 600.0 plf | 0.0 psf |
| | Ceiling | | @ | 5.0 psf | 5.0 psf |
| 0.5 in | Gypsum Board Ceiling | | @ | 4.4 psf per inch | 0.0 psf |
| | Acoustical Fiber Board | | @ | 1.0 psf | 0.0 psf |
| | Plaster Ceiling | ( On Tile ) | @ | 5.0 psf | 0.0 psf |
| | Suspended Metal Lath & Plaster | ( Gypsum Plaster ) | @ | 10.0 psf | 0.0 psf |
| | Suspended Steel Channel System | | @ | 2.0 psf | 0.0 psf |
| | Suspended Wood Furring System | | @ | 2.5 psf | 0.0 psf |
| | T-bar Ceiling System | | @ | 3.0 psf | 0.0 psf |
| 100% floor area | Interior Partitions | ( Below ) | @ | 5.0 psf | 5.0 psf |
| | M.E.P. | | @ | 5.0 psf | 5.0 psf |
| | Miscellaneous | | @ | 1.0 psf | 1.0 psf |
| | Percast Fascia (4sqft) | | @ | 47.1 psf | 0.0 psf |
| | Suspended Equipment | | @ | 5.0 psf | 5.0 psf |
| | Other | | @ | 1.0 psf | 0.0 psf |
| | Other | | @ | 1.0 psf | 0.0 psf |
| | Other | | @ | 1.0 psf | 0.0 psf |
| | | | | **ROOF WEIGHT =** | **29.0 psf** |

Degenkolb

| | | | | | |
|---|---|---|---|---|---|
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**WEIGHT TAKEOFF**

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CHAPTER 4 - TIER 1 EVALUATION
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BSE-2E HAZARD LEVEL

**WALL TYPE:** WALL-R

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Wall Covering | | @ | 4.0 | psf | 4.0 psf |
| 1 | in | Exterior Stucco | | @ | 11.4 | psf per inch. | 0.0 psf |
| 1 | in | Wood Sheathing | | @ | 3.0 | psf per inch | 0.0 psf |
| 0.5 | in | Gypsum Sheathing | | @ | 4.0 | psf per inch | 0.0 psf |
| 0.5 | in | Gypsum Wallboard | | @ | 4.4 | psf per inch | 0.0 psf |
| | | Porcelain Enamel Panels | | @ | 5.0 | psf | 0.0 psf |
| | | Metal Lath & Plaster | ( Gypsum Plaster ) | @ | 10.0 | psf | 0.0 psf |
| | | Wall Insulation | | @ | 1.0 | psf | 1.0 psf |
| 1 | in | Insulation | ( Rigid ) | @ | 1.5 | psf per inch | 0.0 psf |
| 1 | in | Insulation Boards | ( Fiber Board ) | @ | 1.5 | psf per inch | 0.0 psf |
| 0.5 | in | Fire Proofing | | @ | 2 | psf per inch | 0.0 psf |
| | | Wall Framing | | @ | 20.0 | psf | 0.0 psf |
| 8 | in | Concrete Wall | ( Normal Weight ) | @ | 12.5 | psf per inch | 0.0 psf |
| 8 | in | CMU Wall w/ Full Grouting | ( Normal Weight ) | @ | 83.0 | psf | 83.0 psf |
| 8 | in | Solid CMU Wall | ( Normal Weight ) | @ | 87.0 | psf | 0.0 psf |
| 4 | in | HCB Wall w/ Full Grouting | | @ | 38.0 | psf | 0.0 psf |
| 3.5 | in | Solid Clay Brick Wall | | @ | 11.1 | psf per inch | 0.0 psf |
| 0.5 | in | Plywood | | @ | 3.2 | psf per inch | 0.0 psf |
| 16 | in O.C. | Wood Studs | ( 2 x 4 ) | @ | 1.1 | plf | 0.0 psf |
| 16 | in O.C. | Metal Channel Studs | | @ | 2.0 | plf | 0.0 psf |
| 8 | ft O.C. | Steel Girts | | @ | 6.0 | plf | 0.0 psf |
| | | Miscellaneous | | @ | 1.0 | psf | 1.0 psf |
| | | Other | | @ | 1.0 | psf | 0.0 psf |
| | | Other | | @ | 1.0 | psf | 0.0 psf |
| | | Other | | @ | 1.0 | psf | 0.0 psf |
| | | Other | | @ | 1.0 | psf | 0.0 psf |
| | | Other | | @ | 1.0 | psf | 0.0 psf |

| | | |
|---|---|---|
| Solid Wall Weight = | 89.0 | psf |
| Window & Door Weight = | 8.0 | psf |
| % Solid Wall = | 80% | |
| **WALL-R WEIGHT =** | **72.8** | **psf** |

Degenkolb

| | | | | | |
|---|---|---|---|---|---|
| **Subject:** | Seismic Mass | **Job Number:** | B9956006.00 | **Date:** | 06/27/19 |
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**SEISMIC MASS**

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**ROOF/FLOOR WEIGHT SUMMARY:**

| Level Type | Weight [ psf ] |
|---|---|
| ROOF | 29 |

**WALL WEIGHT SUMMARY:**

| Wall Type | Weight [ psf ] | | |
|---|---|---|---|
| | Net | Solid | Openings |
| WALL-P | 89.0 | 89 | 8 |
| WALL-R | 72.8 | 89 | 8 |

**SEISMIC MASS SUMMARY:**

| Level | FLOOR | | | WALL ABOVE | | | | WALL BELOW | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Level Type | Weight [ psf ] | Area [ sf ] | Wall Type | Weight [ psf ] | Length [ ft ] | Height [ ft ] | Wall Type | Weight [ psf ] | Length [ ft ] | Height [ ft ] | WEIGHT [ kips ] |
| Roof | ROOF | 29 | 3,825 | WALL-P | 89.0 | 0 | 0.00 | WALL-R | 72.8 | 0 | 8.50 | 111 |
| | | | | | | | | | | | TOTAL | 111 |

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| | | | | | |
|---|---|---|---|---|---|
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**SEISMIC FORCES**

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**BUILDING TYPE:** RM1 ( Reinforced Masonry Bearing Walls with Flexible Diaphragms ) [ ASCE 41-17, Table 3-1 ]
**SITE CLASS:** D (default) #N/A [ ASCE 41-17, §2.4.1.6 ]

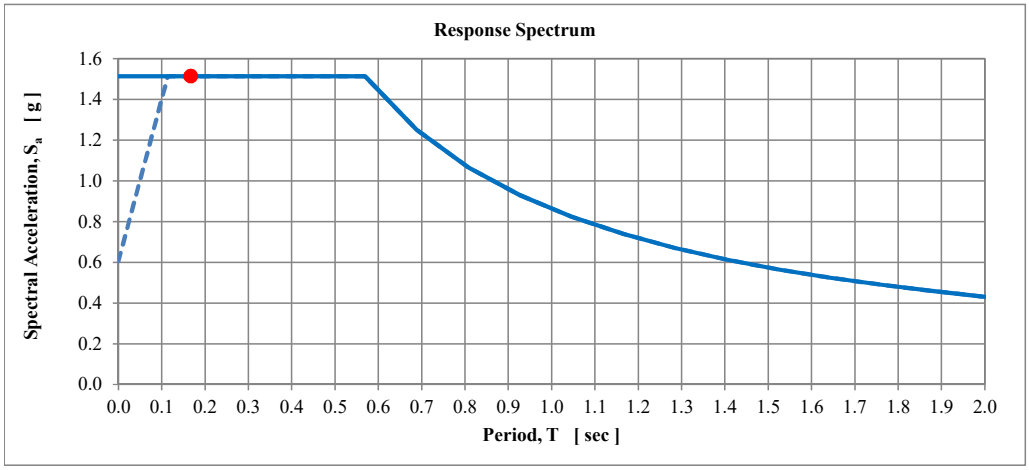
**DESIGN SPECTRAL ACCELERATIONS:**

| | | | | | |
|---|---|---|---|---|---|
| $S_{XS}$ | = | 1.513 g | ( BSE-2E ) | Site-Adjusted Design ( T = 0.2 sec ) | [ ASCE 41-17, Eq. 2-1 ] |
| $S_{X1}$ | = | 0.861 g | ( BSE-2E ) | Site-Adjusted Design ( T = 1.0 sec ) | [ ASCE 41-17, Eq. 2-2 ] |

**BUILDING PERIOD:**

| | | | | | |
|---|---|---|---|---|---|
| $h_n$ | = | 17.0 ft | ( Base to Roof ) | Building Height | [ ASCE 41-17, §4.4.2.4 ] |
| $C_t$ | = | 0.020 | ( Building Type RM1 ) | Period Coefficient | [ ASCE 41-17, §4.4.2.4 ] |
| $\beta$ | = | 0.750 | ( Building Type RM1 ) | Period Exponent | [ ASCE 41-17, §4.4.2.4 ] |
| T | = | 0.167 sec | $= C_t h_n^{\beta}$ | Fundamental Period | [ ASCE 41-17, Eq. 4-4 ] |

**RESPONSE SPECTRUM:**




**PSEUDO LATERAL FORCE:**

| | | | | | |
|---|---|---|---|---|---|
| n | = | 1 | ( n = 1 ) | Total Number of Stories | |
| C | = | 1.0 | ( Building Type RM1 ) | Modification Factor | [ ASCE 41-17, Table 4-7 ] |
| $S_a$ | = | 1.513 g | $= MIN \{ S_{X1} / T , S_{XS} \}$ | Spectral Acceleration | [ ASCE 41-17, Eq. 4-3 ] |
| **V** | **=** | **1.513 W** | $= C S_a W$ | Pseudo Lateral Force | [ ASCE 41-17, Eq. 4-1 ] |

**VERTICAL DISTRIBUTION OF SEISMIC FORCES:**

k = 1.00 ( T ≤ 0.5 sec ) Seismic Distribution Exponent [ ASCE 41-17, §4.4.2.2 ]

$F_x = C_{vx} V = [ w_x h_x^k / \Sigma ( w_x h_x^k ) ] V$ [ ASCE 41-17, Eq. 4-2a ]
$V_j = \Sigma F_x$ [ ASCE 41-17, Eq. 4-2b ]

| Level | $h_x$ [ ft ] | $w_x$ [ kips ] | $w_x h_x^k$ | $C_{vx}$ | $F_x$ [ kips ] | $V_j$ [ kips ] |
|---|---|---|---|---|---|---|
| Roof | 17.0 | 111 | 1,886 | 1.00 | 168 | 168 |
| TOTAL | - | 111 | 1,886 | 1.00 | 168 | - |

Degenkolb

| | | | | | |
|---|---|---|---|---|---|
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**QUICK CHECKS**

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BSE-2E HAZARD LEVEL

**BUILDING TYPE:** RM1 ( Reinforced Masonry Bearing Walls with Flexible Diaphragms ) [ ASCE 41-17, Table 3-1 ]
**MASONRY TYPE:** CMU ( Concrete Masonry Units )

**STEEL REINFORCING RATIO CHECK:** [ ASCE 41-17, §A.3.2.4.2 ]

| | | | Horizontal Reinforcing | | | | Vertical Reinforcing | | | | Total Reinforcing | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wall Type | $s_{grout}$ [ in ] | $t_w$ [ in ] | Bar Size No. | Spacing [ in ] | $\rho_h$ | $\rho_h \geq 0.0007$ | Bar Size No. | Spacing [ in ] | $\rho_v$ | $\rho_v \geq 0.0007$ | $\rho_{tot}$ | $\rho_{tot} \geq 0.002$ |
| WALL-R | 8 | 7.625 | 4 | 24 | 0.0011 | OK | 4 | 24 | 0.0011 | OK | 0.0022 | OK |

**AVERAGE SHEAR STRESS CHECK:** [ ASCE 41-17, §A.3.2.4.1 ]

| | | | | | |
|---|---|---|---|---|---|
| $\nu_n$ | = | 70 psi | ( RM Shear Wall ) | Shear Wall Capacity | [ ASCE 41-17, §A.3.2.4.1 ] |
| $M_s$ | = | 4.5 | COLLAPSE PREVENTION | System Modification Factor | [ ASCE 41-17, Table 4-8 ] |
| $\nu_{j,\,avg}$ | = | $( 1 / M_s ) ( V_j / A_w )$ | | Average Shear Wall Stress | [ ASCE 41-17, Eq. 4-8 ] |
| $A_w$ | = | $t_w ( L_{w,\,total} - L_{w,\,openings} ) ( A_{partial\ grout} / A_{full\ grout} )$ | | Net Wall Area (Reduced for Partial Grouting) | [ ASCE 41-17, §4.4.3.3 ] |

**North-South Direction:**

| Level | $V_j$ [ kips ] | Wall Type | $s_{grout}$ [ in ] | $\frac{A_{partial\ grout}}{A_{full\ grout}}$ | $t_w$ [ in ] | $L_{w,\,total}$ [ ft ] | $L_{w,\,openings}$ [ ft ] | $L_w$ [ ft ] | $A_w$ [ $in^2$ ] | $\nu_{j,\,avg}$ [ psi ] | DCR | Quick Check |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roof | 168 | WALL-R | 8 | 1.00 | 7.625 | 150 | 38 | 112 | 10,248 | 4 | 0.05 | OK |

**East-West Direction:**

| Level | $V_j$ [ kips ] | Wall Type | $s_{grout}$ [ in ] | $\frac{A_{partial\ grout}}{A_{full\ grout}}$ | $t_w$ [ in ] | $L_{w,\,total}$ [ ft ] | $L_{w,\,openings}$ [ ft ] | $L_w$ [ ft ] | $A_w$ [ $in^2$ ] | $\nu_{j,\,avg}$ [ psi ] | DCR | Quick Check |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roof | 168 | WALL-R | 8 | 1.00 | 7.625 | 102 | 42 | 60 | 5,490 | 7 | 0.10 | OK |

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| | | | | | |
|---|---|---|---|---|---|
| **Subject:** | Quick Checks | **Job Number:** | B9956006.00 | **Date:** | 06/28/19 |
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**QUICK CHECKS**

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BSE-2E HAZARD LEVEL

**BUILDING TYPE:** RM1 ( Reinforced Masonry Bearing Walls with Flexible Diaphragms ) [ ASCE 41-17, Table 3-1 ]
**MASONRY TYPE:** CMU ( Concrete Masonry Units )

**WALL HEIGHT-TO-THICKNESS RATIO CHECK:** [ ASCE 41-17, §A.3.2.4.4 ]

| Wall Type | $h_w$ [ ft ] | $t_w$ [ in ] | $h_w / t_w$ | MAX $h_w / t_w$ | Quick Check |
|---|---|---|---|---|---|
| WALL-R | 17.00 | 7.625 | 26.8 | 30 | OK |

**OUT-OF-PLANE WALL ANCHORAGE CHECK:** [ ASCE 41-17, §A.5.1.1 ]

| | | | | | |
|---|---|---|---|---|---|
| $\Psi$ | = | 1.0 | COLLAPSE PREVENTION | Out-of-Plane Wall Anchorage Coefficient | [ ASCE 41-17, §4.4.3.7 ] |
| $S_{XS}$ | = | 1.513 g | ( BSE-2E ) | Design Spectral Acceleration ( T = 0.2 sec ) | [ ASCE 41-17, §2.4.1.1 ] |
| $T_c$ | = | $\Psi\ S_{XS}\ w_p\ A_p$ | | Out-of-Plane Wall Anchorage Force | [ ASCE 41-17, Eq. 4-12 ] |
| $w_p\ A_p$ | = | $( w_{w,\ above}\ h_{w,\ above} + w_{w,\ below}\ h_{w,\ below} )\ s_{anchor}$ | | Tributary Mass to Anchorage | [ ASCE 41-17, §4.4.3.7 ] |

**North-South Direction:**

| Level | WALL ABOVE | | | WALL BELOW | | | OUT-OF-PLANE ANCHORAGE | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wall Type | Weight [ psf ] | Height [ ft ] | Wall Type | Weight [ psf ] | Height [ ft ] | $s_{anchor}$ [ ft ] | $w_p\ A_p$ [ lb ] | $T_c$ [ lb ] | $T_{cn}$ [ lb ] | DCR | Quick Check |
| Roof | WALL-P | 89 | 0.00 | WALL-R | 89 | 8.50 | 1.00 | 757 | 1,145 | 97 | 11.80 | NO GOOD |

**East-West Direction:**

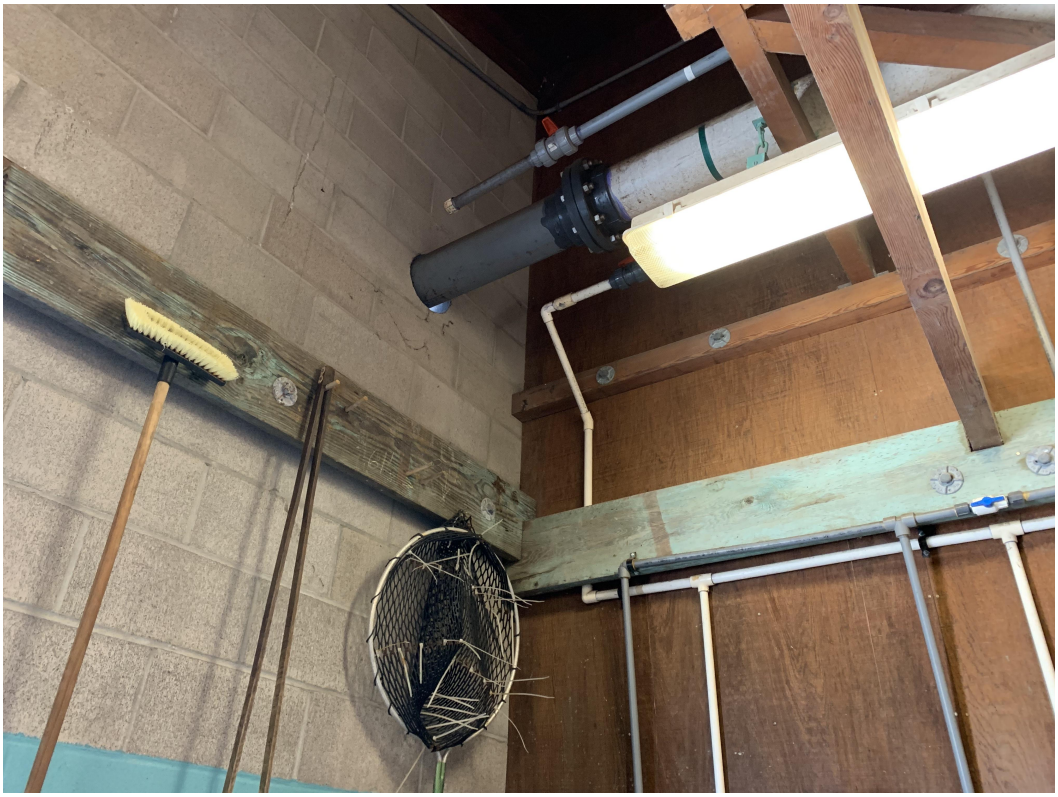
| Level | WALL ABOVE | | | WALL BELOW | | | OUT-OF-PLANE ANCHORAGE | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wall Type | Weight [ psf ] | Height [ ft ] | Wall Type | Weight [ psf ] | Height [ ft ] | $s_{anchor}$ [ ft ] | $w_p\ A_p$ [ lb ] | $T_c$ [ lb ] | $T_{cn}$ [ lb ] | DCR | Quick Check |
| Roof | WALL-P | 89 | 0.00 | WALL-R | 89 | 8.50 | 1.00 | 757 | 1,145 | 97 | 11.80 | NO GOOD |

University of California, Santa Cruz
ASCE 41-17 Tier 1 Seismic Evaluation
7437 - Long Marine Lab Younger Research Building

# Appendix C
# Pictures and Details

University of California, Santa Cruz
ASCE 41-17 Tier 1 Seismic Evaluation
7437 - Long Marine Lab Younger Research Building

Western Interior View



Northern Interior View

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Interior Wall and Removable Joist

Exterior View and Removable Joist

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Southern Attic View

Equipment Storage Falling Hazards

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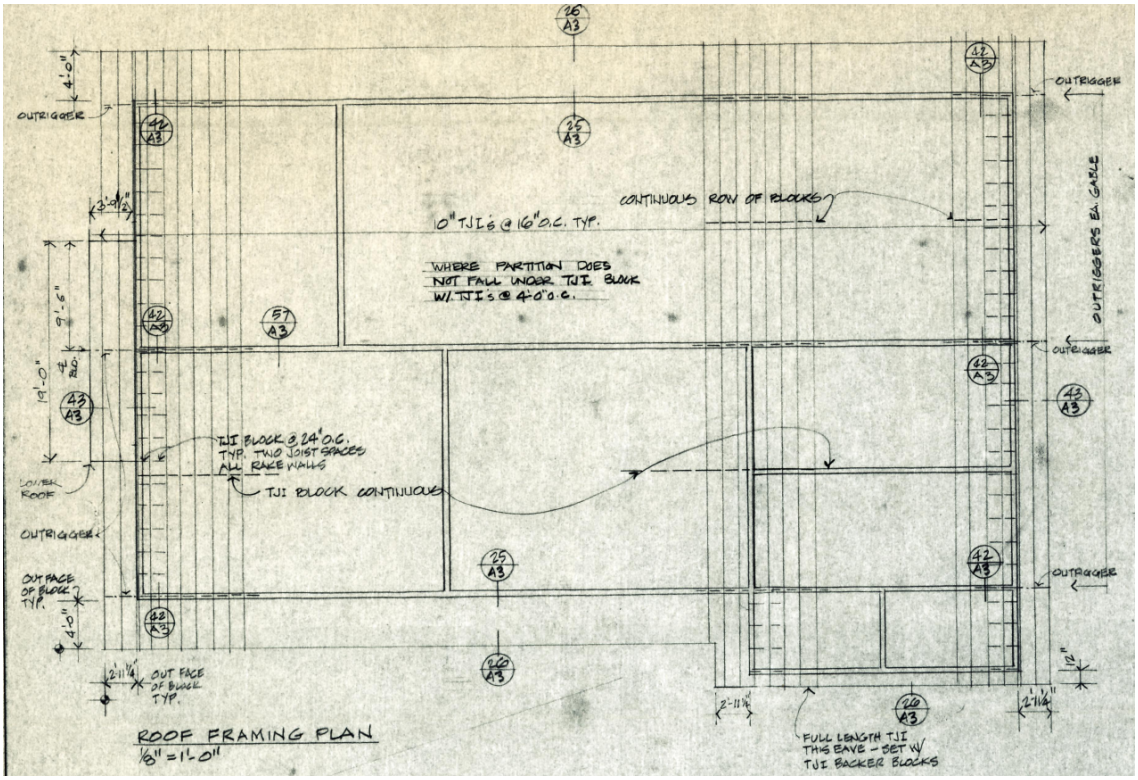
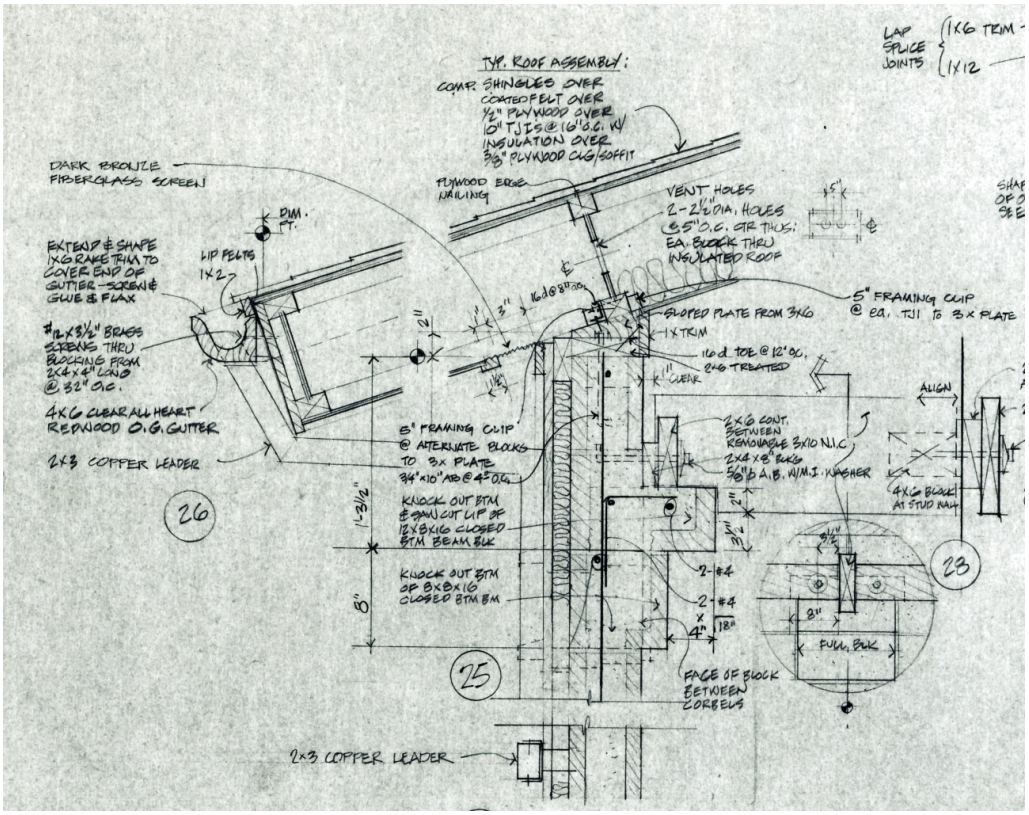
7437 - Long Marine Lab Younger Research Building




Roof Plan (A1)




Roof Diaphragm to Wall Detail (A3)

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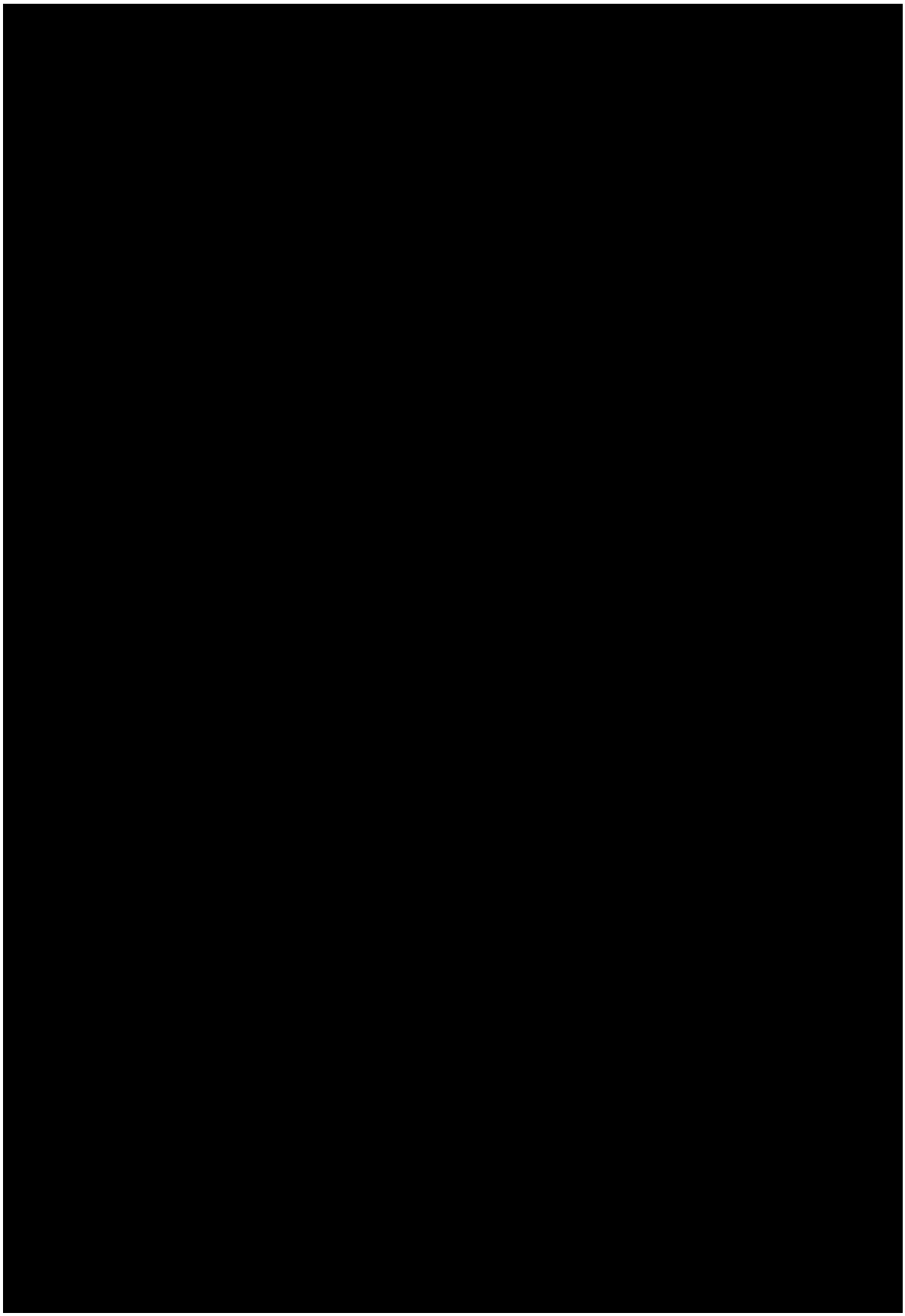
ASCE 41-17 Tier 1 Seismic Evaluation
7437 - Long Marine Lab Younger Research Building



Floor Plan (A1)