Rating form completed by:

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Evaluator: EB/WAL/BL

Date: 06/28/2019

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

DATE: 2019-06-28

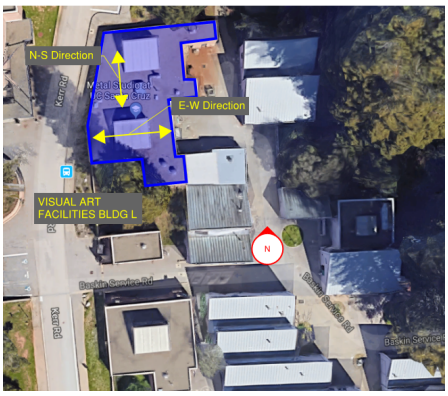
UC Santa Cruz building seismic ratings

Visual Arts Facilities-Building P

CAAN #7929

Elena Baskin Visual Arts, Santa Cruz, CA 95064

UCSC Campus: Main 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	Priority B	Priority A=Retrofit ASAP Priority B=Retrofit at next permit application
Ballpark total construction cost to retrofit to IV rating[2]	Medium ($50-200/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	Based on the inadequate load path to transfer the load from the diaphragm to the walls.

Building information used in this evaluation

- Architectural drawings by Boora Architects, "Improvement to Arts, University of California, Santa Cruz," dated 1 November 1996, Sheets A121, A141, A221, A321, A322, A411, and A431-A433 pertinent to Buildings 'L','M,' and 'P'.

[1] We translate this Tier 1 evaluation to a Seismic Performance Level rating using professional judgment. Non-compliant 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 safety. See Section III.B of the 19 May 2017 *UC Seismic Safety Policy* and Method B of Section 321 of the 2016 *California Building Code*.

[2] Per Section III.A.4.i of the 26 March 2019 *UC Seismic Program Guidebook, Version 1.3*, 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.

- Structural drawings KPFF Consulting Engineering, "Improvement to Arts, University of California, Santa Cruz," dated 1 November 1996, Sheets S121, S122, S201-S202, and S301-S306 pertinent to Buildings 'L','M,' and 'P'.

Additional building information known to exist

None

Scope for completing this form

Reviewed structural drawings for original construction, made brief site on 23 May 2019, and carried out ASCE 41-17 Tier 1 evaluation.

Brief description of structure

Baskin Building P is one of a cluster of three similar buildings added in 1998 to the visual art studios for the Department of Art. The Theater Arts complex is to the west; McHenry Library is to the northeast; and the Digital Arts Research Center is to the south. The three buildings added to the Baskin complex were designed in 1996 by Boora Architects. KPFF Consulting Engineering was the structural engineer. The construction completion date is unknown, but it is assumed to be 1998. The 1991 UBC was used, as indicated in the structural general notes.

The building is a single-story reinforced masonry structure that contains approximately 4,960 square feet. In plan, Building P is comprised of five rectangular sections: (1) two approximately 52 feet by 33 feet are used as ceramic and metal workshops; (2) one 26 feet by 16'-8" feet is used as storage room; (3) one 12 feet by 67 feet is used as storage of flammable material, tools room, and bathrooms; and (4) a 20 feet by 12 feet is used as mechanical and electrical rooms. The building was constructed using 8" thick (nominal) perimeter fully grouted reinforced masonry walls. The east side wall of each workshop was built using a three bay steel frame (MC6x5.1 column at each edge with two 2x5x5/16 vertical structural tubing at the middle, and a C15x33.9 beam) covered with a nonstructural wood panel and a metal roll up door. The wood panel is comprised of 2x6 stud with 1/2" plywood sheathing and 8d nails @ 6" o.c. at all panel edges and 8d @ 12" o.c. at intermediate supports.

The roof diaphragm of the workshop rooms is a metal roof deck supported by steel open web joists and by the masonry walls. The rest of the rooms use a metal roof deck supported by the walls. The floor of the building is a 4" slab-on-grade reinforced with #4 at 16" o.c., each way, over 2" of sand, a vapor retarder, and 6" of drain rock.

An approximately 15 feet by 18 feet steel canopy was built on the southeast side of the structure. A metal deck is supported by five W6x9 beams atop of TS3x3x1/4 structural tubing vertical post anchorage at the slab by two 3/4" diameter anchor bolts. Drawings indicated there should be a 3" seismic separation to an adjacent steel canopy on the north side of Building A. The Quick Check separation requirement is 2.3". The canopy column is 2 feet away from Building A at ground level and 1.75" away from gutter.

At the center of the workshop rooms, a 16x20 feet translucent panel skylight is supported on steel tube framing and slopes down toward south at a slope of 7V:12H. Translucent panel is used on the roof, the west and east side and glass on the north side.

Identification of levels: The building has one story above the grade. The grade slopes down to the east at the northeast corner.

Foundation system: The perimeter walls are supported on a 1'-6"x8" strip footing whereas the interior walls are on top of a thickened (12" total) portion of the slab-on-grade. . The east wall of the workshops is comprised by two vertical posts at the edge (TS8x2x5/16) welded to a 8"x12"x1/2" baseplate, anchored using four 3/4" diameter x 9" long bolts, and supported on 3'x3'x12" isolated footing per Details 5, 7, and 15 on Sheet S201. The top and bottom of the middle posts (MC6x5.1) are welded to a 6"x7-1/2"x1/4" galvanized plate anchored using two 3/8"diameter bolts to the CMU per Detail 6 on Sheet S202. The wood panel is supported on top of a 4" high concrete curb.

Structural system for vertical (gravity) load: The roof diaphragm of the workshop rooms is comprised of 3" deep unfilled 20 gauge Type N cellular metal roof deck atop of four north-south steel open web joist (24 LH) spaced 10' o.c. The joists are supported on top of the interior masonry walls per Detail 8/S301. At the perimeter, the joists bear in pockets in the masonry walls per Detail 9/S301. On the west and east masonry walls, the deck is supported on top of an L4x3x5/16 angle (long leg horizontal) anchored to a bond beam using 3/4"diameter anchor bolts spaced 32"

o.c. In the E-W direction, at the corner of the skylight opening, steel cross-bracing runs across the length of the building tying together the top and bottom chords of all the joists. In the same direction, TS3x2x1/4 structural tubing chords provide support to the deck. They are welded to an L4x3x5/16 angle bolted to a bond beam using four 3/4"ϕ bolts spaced 8" o.c. (Detail 9 on Sheet S303). The mono-sloped skylight is comprised of translucent panel supported by TS3x6x5/16 structural tubing spaced 5' o.c. that sloped with the roof (7V:12H). The diagonal tubes are welded to TS3x3x3/16 vertical structural tubing. A C15x33.9 channel section welded at the bottom to an L6x3x1/2x5/16 angle were used as a perimeter ring around the skylight opening to support the cellular metal roof deck and the skylight structure. This ring was welded on top of the open web joists.

At the rest of the rooms, the roof diaphragm is comprised of 3" deep, unfilled 20 gauge Type N metal roof deck supported atop the masonry walls. Two intermediate TS6x6x1/4 structural tubes are used to support a mechanical unit installed on top of the roof.

Structural system for lateral forces: In the N-S direction, lateral forces are transferred from the metal deck-joist floor system to the perimeter masonry walls and from them to the strip foundations per Details 12 and 16 on Sheet S201. The joists are connected to the masonry wall per Details 9 and 10 per Sheet S301. The same mechanism is used in the E-W direction, the lateral forces are delivered to the masonry wall and from them to the ground through a strip footing. Chords and cross bracing run along the E-W and N-S directions to tie together the roof structure.

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

Identified seismic deficiencies of the building include the following:

- Roof-to-wall tie: The typical roof-to-wall tie per Detail 7/S3.01 at the west and east walls relies on puddle welds from the deck to the top of an L4x3x3/8" ledger which are connected with ¾" diameter bolt at 32" o.c. to a bond beam in the CMU wall. In addition, between CMU walls, there are two concentrated tube-to-wall connections along the wall length per Detail 9/S3.03 that use a similar approach as Detail 7/S3.01, but with four anchor bolts centered about the tube. At the north and south CMU perimeter walls, the deck flutes are parallel to the wall, so the only out-of-plane tie is from the open web joists to a pocket in the wall per Detail 9/S3.01. At the pocket, the top chord of the joist bears on a base plate which has two ¾" anchor bolts into the CMU wall which resist loads in shear. Information showing how the top chord of the joists is connected to the base plate is missing. A
- The west CMU wall is continuous and relatively straight. The east side of the building, on the other hand, has a series of plan shifts, reentrant corners, and much shorter north-south CMU walls. There are some locations where there are designed collectors into north-south CMU wall at Line 1.6, but other locations at and near Line 2 have less developed collectors into the diaphragms and rely on loads moving farther eastward through narrower diaphragms to north-south walls east of Line 2.
- The canopy separation is slightly less than the Quick Check requirement (1.75" vs. 3"), but the and the canopy is relatively light and independently supported. This is not considered to be a significant issue.

The amount of vertical and horizontal reinforcement provided complies with ASCE 41-17 Tier 1 Quick Check. The calculated shear stress in the walls is well below the ASCE41-17 limit because the building has enough number of walls in both directions to withstand the relatively low seismic load. Inelastic action is likely to be concentrated in the diaphragm and at the reentrant corners.

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	N
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 nonstructural life safety concerns, including at exit routes.[3]

The room containing flammable materials was inaccessible during the site visit.

UCOP nonstructural checklist item	Life safety hazard?	UCOP nonstructural 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	None observed	Unrestrained hazardous materials storage	Unknown
Heavy masonry or stone veneer above exit ways and public access areas	None observed	Masonry chimneys	None observed
Unbraced masonry parapets, cornices or other ornamentation above exit ways and public access areas	None observed	Unrestrained natural gas-fueled equipment such as water heaters, boilers, emergency generators, etc.	None observed

Basis of rating

A Seismic Performance Level Rating of Level V is assigned to the building. Although there are fewer CMU walls on the east side and a more complete set of collectors at the reentrant corners would be desirable, the In-plane wall loads in the CMU are relatively low. The anchor bolts does not have enough capacity to transfer the load to the walls in either of the orthogonal directions. Therefore, there is not a complete load path for tension and shear forces from the roof diaphragm to the walls.

Recommendations for further evaluation or retrofit

We recommend the Campus to perform a more detailed review of the anchorage used to transfer the load from the diaphragm to the walls in both orthogonal directions.

Peer review of rating

This seismic evaluation was discussed in a peer review meeting on 24 June 2019. Reviewers present were Joe Maffei of Maffei Structural Engineering and Jay Yin of Degenkolb. Comments from the reviewers have been incorporated into this report. The reviewers agreed with the assigned rating.

Additional building data	Entry	Notes
Latitude	36.995043	
Longitude	-122.061300	

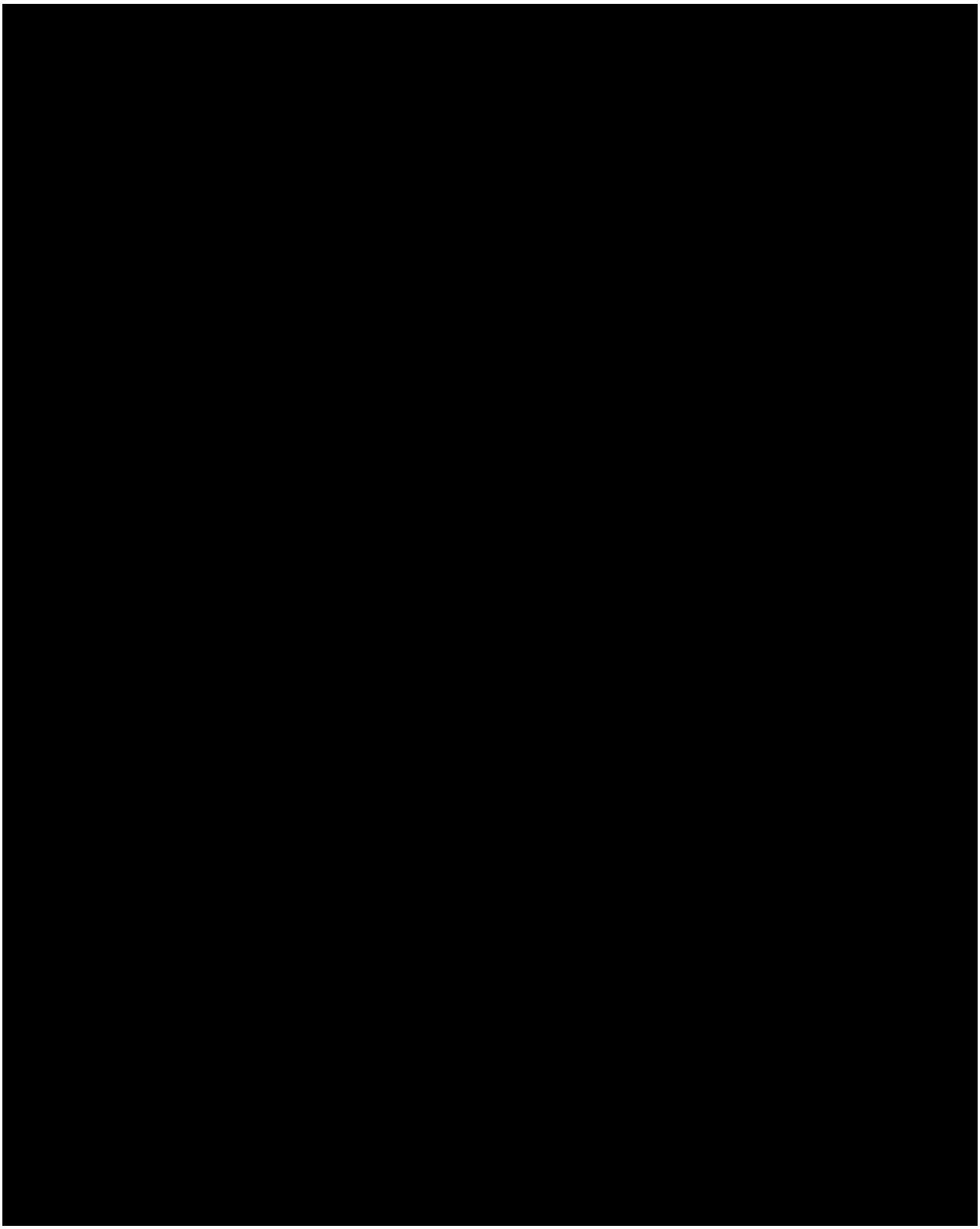
[3] For these Tier 1 evaluations, we do not visit all spaces of the building; we rely on campus staff to report to us their understanding of if and where nonstructural hazards may occur.

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)	4,960	The facilities database has 5,545 sf.
Risk Category per 2016 CBC Table 1604.5	II	
Building structural height, h_n	12.75 ft	Structural height defined per ASCE 7-16 Section 11.2
Coefficient for period, C_t	0.020	Estimated using ASCE 41-17 equation 4-4 and 7-18
Coefficient for period, β	0.75	Estimated using ASCE 41-17 equation 4-4 and 7-18
Estimated fundamental period	0.13 sec	Estimated using ASCE 41-17 equation 4-4 and 7-18
Site data		
975-year hazard parameters S_s, S_1	1.281, 0.485	From OSHPD/SEAOC website
Site class	D	
Site class basis	Geotech[4]	See footnote below
Site parameters F_a, F_v	1.0, 1.815	From OSHPD/SEAOC website
Ground motion parameters S_{cs}, S_{c1}	1.281, 0.880	From OSHPD/SEAOC website
S_a at building period	1.28	
Site V_{s30}	900 ft/s	
V_{s30} basis	Estimated	Estimated based on site classification of D.
Liquefaction potential	Low	
Liquefaction assessment basis	County map	See footnote below
Landslide potential	Low	
Landslide assessment basis	County map	See footnote below
Active fault rupture identified at site	No	
Fault rupture assessment basis	County map	See footnote below
Site-specific ground motion study?	No	
Applicable code		
Applicable code or approx. date of original construction	Built: 1998 Code: 1991 UBC	From General Structural Notes on Sheet S1.

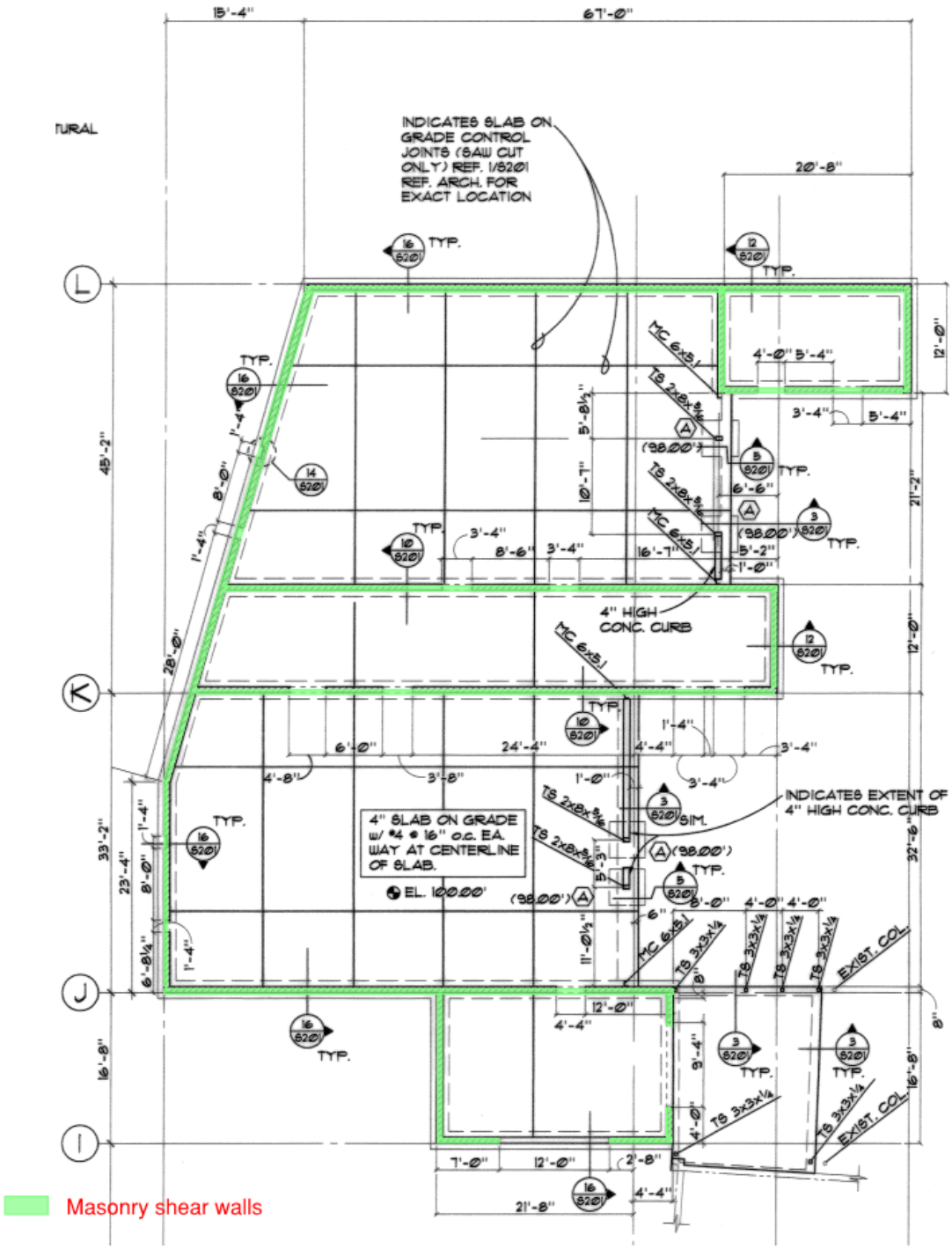
[4] Determination of site class and assessment of geotechnical hazards are based on correspondence with Pacific Crest Geotechnical Engineers and Nolan, Zinn, and Associates Geologists. [*Revised Geology and Geologic Hazards, Santa Cruz Campus, University of California*, Job # 04003-SC 13 May 2005]. Site 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

Applicable code for partial retrofit	None	No partial retrofit.
Applicable code for full retrofit	None	No full retrofit
FEMA P-154 data		
Model building type North-South	RM1 – Masonry shear wall	
Model building type East-West	RM1 – Masonry shear wall	
FEMA P-154 score	N/A	Not included here because we performed ASCE 41 Tier 1 evaluation.
Previous ratings		
Most recent rating	-	Not evaluated before.
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.

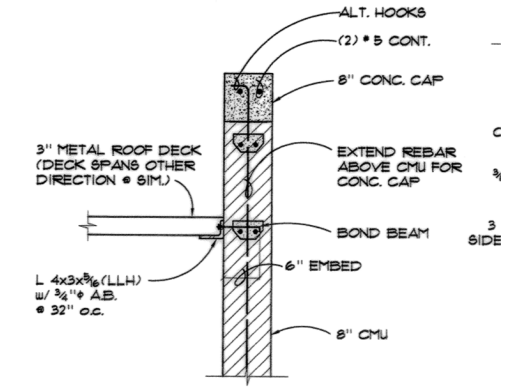
Color Coded Floor Plan:



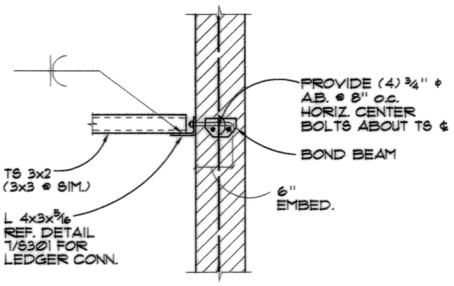
Structural System:



Roof-to-wall connection (Details 7/S301 and 9/S303)



7 TYP. LEDGER CONN. TO CMU WALL
1"=1'-0" S122



9 TS STRUT CONN. TO CMU WALL
1"=1'-0" S122

APPENDIX A

Additional Photos

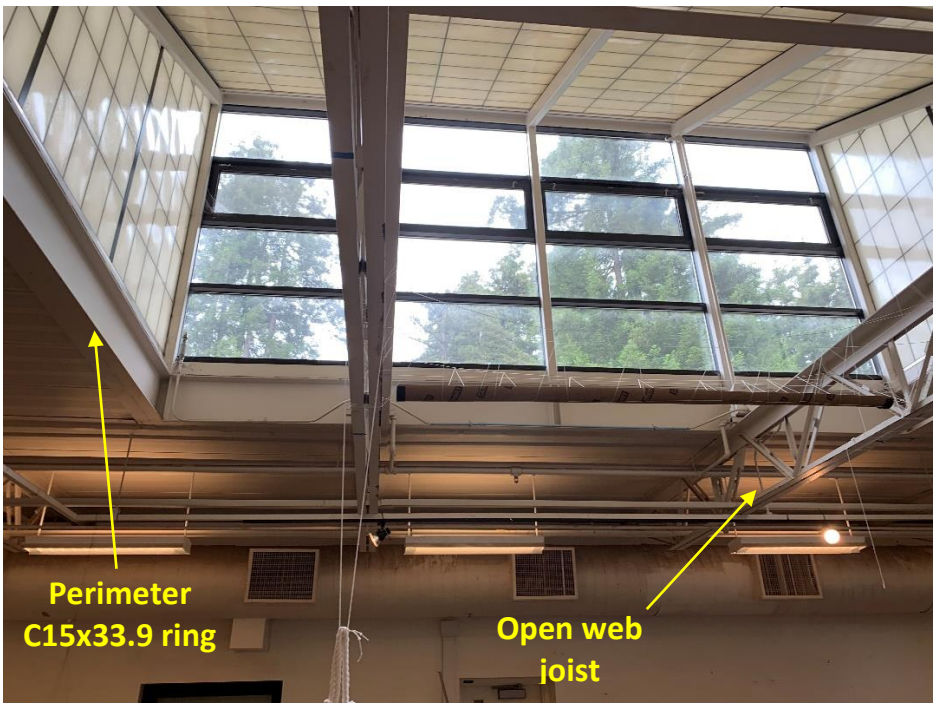
Partial east elevation (looking west at the ceramic workshop)

Northwest corner (Looking southeast)

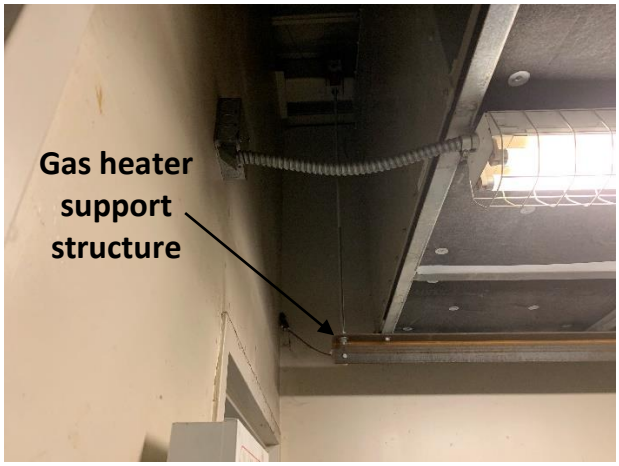
Partial west elevation (looking east)

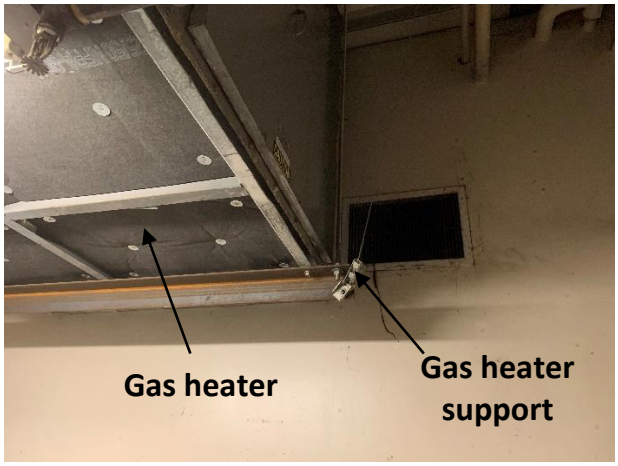
Slope on west elevation (Looking east from the street)

Metal workshop (looking west)



Skylight (looking north)





Gas heater support

Gas heater support to metal deck

APPENDIX B

ASCE 41-17 Tier 1 Checklists (Structural)

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7929	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
Building Name:	Elena Baskin Visual Arts Building P			Initials:	EB	Checked:	WAL/BL
Building Address:	Santa Cruz, CA 95064			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) **Comments:** In both directions, cellular metal deck roof diaphragms deliver loads to the reinforced masonry shear walls and from them to the soil through strip footings.
○	●	○	○	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) **Comments:** The drawings show a 3" seismic separation. The column is 2 feet away from Building A. The gutter is 1.75". The Quick Check separation is larger at 12.67' x 12"/ft x 0.015 = 2.3".
●	○	○	○	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) **Comments:** There are no mezzanines.

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) **Comments:** Single story structure.
●	○	○	○	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) **Comments:** Single story structure.
●	○	○	○	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) **Comments:** All lateral force-resisting system elements are continuous to the foundation.

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

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7929	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
Building Name:	Elena Baskin Visual Arts Building P			Initials:	EB	Checked:	WAL/BL
Building Address:	Santa Cruz, CA 95064			Page:	2	of	3

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) **Comments:** Single story structure.
◉	○	○	○	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) **Comments:** Single story structure.
◉	○	○	○	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) **Comments:** Flexible diaphragm.

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) **Comments:** There is no mapped liquefaction on https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/LiquifactionMap2009.pdf.
○	○	○	◉	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) **Comments:** There are no mapped landslides on https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/LandslideMap2009.pdf.
○	○	○	◉	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) **Comments:** There are no faults at the project site per https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/FaultZoneMap2009.pdf.

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

UC Campus:	Santa Cruz			Date:	06/28/2019		
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Building Address:	Santa Cruz, CA 95064			Page:	3	of	3

ASCE 41-17
Collapse Prevention Basic Configuration Checklist

HIGH SEISMICITY (COMPLETE THE FOLLOWING ITEMS IN addition TO THE ITEMS FOR MODERATE SEISMICITY)

FOUNDATION CONFIGURATION

C	NC	N/A	U	Description
◉	○	○	○	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) **Comments:** Building width B = 67'-8", Building Height is H = 12'-8", B/H = 5.34 Sa = 1.281g per ATC at BSE-2E 0.6 x Sa = 0.77 B/H > 0.8 Sa
○	○	○	◉	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) **Comments:** Site Class D. Reinforced slab ties the footings together per Details 12,16/S201.

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

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7929	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
Building Name:	EBASK BLDG P			Initials:	EB	Checked:	WAL/BL
Building Address:	Santa Cruz, CA 95064			Page:	1	of	5

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

LOW AND MODERATE SEISMICITY

SEISMIC-FORCE-RESISTING SYSTEM

	Description
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) **Comments:** **Four and two lines of masonry shear walls are used in the E-W and N-S directions, respectively.**
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 4.4.3.3, 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) **Comments:** **The calculated average shear stress in the masonry shear walls is 5.6 and 3.2 psi in the longitudinal and transverse direction, respectively.**
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. (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) **Comments:** **Per General Notes of Sheet S1:** **1. VERTICAL REINFORCEMENT: 1#6@48" o.c., $\rho_V = 0.00115$ greater than 0.0007 → OK** **2. HORIZONTAL REINFORCEMENT: 2#4@48" o.c., $\rho_H = 0.00104$ greater than 0.0007 → OK** **3. TOTAL REINFORCEMENT: $\rho_{TOTAL} = 0.00219$ greater than 0.002 → OK** **4. SPACING: Horizontal and vertical spacing equal to 48 in. → OK** **5. BAR EXTENSION: bars are extended to the top of the wall → OK**

STIFF DIAPHRAGMS

	Description
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) **Comments:** **Flexible diaphragm.**

CONNECTIONS

	Description

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

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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 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)

Comments:

MASONRY AND ANCHOR BOLTS:

In the E-W direction, metal roof deck is welded atop the steel joists (spaced 10 feet) which are supported on a 1/2" plate anchored to the wall with 2 – 3/4"ϕ anchor bolts spaced 8" o.c. per Detail 9 on Sheet S301.

$$T_c = \psi S_{xs} w_p A_p = 1.0 \times 1.087 \times 83psf \times \left(\frac{15.3333}{2} \times 10\right) = 6.9 \text{ kips}$$

Using TEK 12-3C:

1. **Masonry breakout:** $B_{vb} = 4A_{pv}\sqrt{f'_m} = 4 \times \left(\frac{\pi x 6^2}{2}\right)\sqrt{1500} = 8.8$ **kips**
2. **Crushing of masonry:** $B_{vc} = 1050\sqrt[4]{f'_m A_b} = 1050\sqrt[4]{1500 \times 0.44} = 5.3$ **kips → CONTROLS!**
3. **Masonry pryout:** $B_{vpry} = 8A_{pt}\sqrt{f'_m} = 8 \times (\pi \times 6^2)\sqrt{1500} = 35$ **kips**
4. **Anchor yielding:** $B_{vs} = 0.6A_b f_y = 0.6 \times 2 \times 0.44 \times 36 = 19$ **kips**

$$T_C = 6.9 > \phi B_{vc} = 0.5 \times 5.3 = 2.65 \rightarrow \text{NG}$$

In the N-S direction, metal roof deck is welded atop a L4x3x5/16 ledger which is anchored to the wall with 1 – 3/4"ϕ anchor bolts spaced 32" o.c. per Detail 7 on Sheet S301.

$$T_c = \psi S_{xs} w_p A_p = 1.0 \times 1.087 \times 83psf \times \left(\frac{15.3333}{2} \times \frac{32}{12}\right) = 1.8 \text{ kips}$$

Using TEK 12-3C:

1. **Masonry breakout:** $B_{vb} = 4A_{pv}\sqrt{f'_m} = 4 \times \left(\frac{\pi x 6^2}{2}\right)\sqrt{1500} = 8.8$ **kips**
2. **Crushing of masonry:** $B_{vc} = 1050\sqrt[4]{f'_m A_b} = 1050\sqrt[4]{1500 \times 0.44} = 5.3$ **kips → CONTROLS!**
3. **Masonry pryout:** $B_{vpry} = 8A_{pt}\sqrt{f'_m} = 8 \times (\pi \times 6^2)\sqrt{1500} = 35$ **kips**
4. **Anchor yielding:** $B_{vs} = 0.6A_b f_y = 0.6 \times 0.44 \times 36 = 9.5$ **kips**

$$T_C = 1.8 < \phi B_{vc} = 0.5 \times 5.3 = 2.65 \rightarrow \text{OK}$$

ARC SPOT WELDS:

1. **Weld shear:**

$$\phi P_n = \phi\left(\frac{\pi d_e^2}{4}\right)\left(\frac{3F_{XX}}{4}\right)$$

$$d_e = 0.7d - 1.5t = 0.7 \times 0.5 - 1.5 \times \frac{3}{80} = 0.29 \text{ in.}$$

$$\phi P_n = 0.6\left(\frac{\pi(0.29)^2}{4}\right)\left(\frac{3 \times 70}{4}\right) = 2.1 \text{ kips} \rightarrow \text{CONTROLS!}$$

2. **Sheet tear:**

$$\frac{d_a}{t} < 0.815\sqrt{\frac{E}{F_u}} \quad ; \quad d_a = d - t = 0.5 - \frac{3}{80} = 0.4625 \text{ in.}$$

$$\frac{0.4625}{3/80} = 12.33 < 0.815\sqrt{\frac{29000}{90}} = 14.63 \rightarrow \phi P_n = \phi 2.20 t d_a F_u$$

$$\phi P_n = 0.7 \times 2.2 \times \frac{3}{80} \times 0.4625 \times 90 = 2.4 \text{ kips}$$

Arc spot weld @ 12" o.c.: in $L_{wall} = 42'$ there are $n = 42$ spot welds

$$\phi P_n = 2.1 \text{ kips} > T_c = 1.0 \times 1.087 \times 83psf \times \left(\frac{15.3333}{2} \times \frac{12}{12}\right) = 0.7 \text{ kips} \rightarrow \text{OK}$$

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)

Comments:

There are no wood ledgers.

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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) **Comments:** **Metal roof deck is welded atop the steel joists which are supported on a 1/2" plate anchored to the wall with 2 – 3/4"ϕ anchor bolts spaced 8" o.c. per Detail 9 on Sheet S301.**
○	○	◉	○	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) **Comments:** **No precast concrete diaphragm.**
◉	○	○	○	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation. (Commentary: Sec. A.5.3.5. Tier 2: Sec. 5.7.3.4) **Comments:** **Dowels are provided per Detail 12 and 16 on Sheet S201.**
○	○	◉	○	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) **Comments:** **There are 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) **Comments:** **Flexible 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) **Comments:** **Flexible diaphragm.**

FLEXIBLE DIAPHRAGMS

	Description

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

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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) **Comments:** **Cellular metal deck without concrete toping is used. In the N-S direction, the joists are anchored to the walls. In the E-W direction, 3x3x5/16 structural tubing connects the walls with the joists and the interior skylight ring.**
○	○	●	○	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) **Comments:** **There are no diaphragm openings immediately adjacent to the shear walls.**
○	○	●	○	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) **Comments:** **There are no diaphragm openings adjacent to exterior masonry shear walls.**
○	○	●	○	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) **Comments:** **There are no straight-sheathed diaphragms.**
○	○	●	○	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) **Comments:** **There are no wood diaphragms.**
○	○	●	○	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) **Comments:** **There are no wood diaphragms.**
●	○	○	○	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) **Comments:** **Metal deck diaphragms are used.**

CONNECTIONS

	Description

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

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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. (3 mm) before engagement of the anchors. (Commentary: Sec. A.5.1.4. Tier 2: Sec. 5.7.1.2) **Comments:** **There are no wood structural elements.**

APPENDIX C

UCOP Seismic Safety Policy Falling Hazards Assessment Summary

UC Campus:	Santa Cruz			Date:	06/28/2019		
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UCOP SEISMIC SAFETY POLICY
Falling Hazard Assessment Summary

	Description
P ☒ N/A ☐	**Heavy ceilings, features or ornamentation above large lecture halls, auditoriums, lobbies, or other areas where large numbers of people congregate (50 ppl or more)** **Comments:** The small crane at the metal workshop is properly attached at six points along its length. A S7x15.3 beam (hoist support) is welded to a 3/8" plate, which is attached to the joist using two 7/8"ϕ A325 bolts (see Detail 13 on sheet S301).
P ☐ N/A ☒	**Heavy masonry or stone veneer above exit ways or public access areas** **Comments:** There is no veneer used at Building P.
P ☐ N/A ☒	**Unbraced masonry parapets, cornices, or other ornamentation above exit ways or public access areas** **Comments:** There is no unreinforced masonry used at Building P.
P ☒ N/A ☐	**Unrestrained hazardous material storage** **Comments:** The room where flammable material is storage was inaccessible during the site visit.
P ☐ N/A ☒	**Masonry chimneys** **Comments:** There are no masonry chimneys.
P ☐ N/A ☒	**Unrestrained natural gas-fueled equipment such as water heaters, boilers, emergency generators, etc.** **Comments:**
P ☐ N/A ☒	**Other:** Lockers in tool room **Comments:** The lockers and cabinets are anchored.
P ☐ N/A ☒	**Other:** Heater and ducts in main room and storage room **Comments:** The existing heater and ducts are anchored to the metal deck.
P ☐ N/A ☒	**Other:** Machines in metal workshop. **Comments:** All the machines are properly anchored to the slab.

Falling Hazards Risk: Low

Note: P= Present, N/A = Not Applicable

APPENDIX D

Quick Check Calculations

Rating form completed by:

RUTHERFORD + CHEKENE
ruthchek.com
Evaluator: EB/WAL/BL

Date: 06/28/2019

Unit Weights:

For Tier 1 check, the entire building weight is considered without acknowledging the actual out-of-plane and in-plane CMU loads in each direction.

Masonry Walls:

Story 1							
Type	t (in)	Length (ft)	Height (ft)		Area (ft^2)	Unit weight (pcf)	Weight (kips)
CMU - 8"	8	410.0	15.67			84.0	359.71

Σ =	359.7	kips
A_trib (ft^2)=	4,960	
Trib. Weight=	72.522	psf

Roof structure:

2nd Level (Roof)							
Girder ID	Length (ft)	B (in)	D (in)	Number	Area (ft^2)	Unit weight (plf)	Weight (kips)
OWJ: 24 LH	33.166667			8		12.6	3.35
OWJ: 16 K5	26			1		12.6	0.33
TS 6x6x1/4	12			4		19.0	0.91
TS 6x6x5/16	12			1		23.3	0.28
TS 3x3x5/16	15.00			4		10.6	0.63
S7x15.3	50			1		15.3	0.77
C15x33.9	54.333333			1		33.9	1.84
C8x11.50	27			1		11.5	0.31

Σ =	8.4	kips
A_trib (ft^2)=	4,960	
Trib. Weight=	1.698	psf

Columns:

1st Level to 2nd Level (roof)						
Col type	ϕ (in)	Height (ft)	Area (ft^2)	Number	Unit weight (plf)	Weight (kips)
MC6x5.1		12.7		4	5.1	0.26
TS 2x8x5/16		12.7		4	19.08	0.97

Σ =	1.2	kips
A_{trib} (ft^2)=	4,960	
Trib. Weight=	0.247	psf

	Seismic Weight	Dead Load	
Roof	**psf**	**psf**	**Remarks**
Roofing: 3"-20 G.A. cellular metal deck Type N	4.5	4.5	Metal roof per arch dwg; Product specification not available
C15x33.9 ring	1.1	1.1	Based on C15x33.9 with L3x3x1/4
Gravel	4.0	4.0	Gravel on top of roofing per visit
Skylight structure	4.2	4.2	Per Sheet S303
Columns	0.124	0.25	Structure at the entrance of each workshop
Beams/joists/Structural tubing	1.7	1.7	Horizontal structure at the roof
Walls	36.3	72.5	Based on 8" CMU solid grouted: 84 pcf. Half
Ceiling	0.0	0.0	No ceiling
Lighting and misc.	5	5	
Total	57	93	

Story Weights

Level	Area (ft^2)	Unit Weight (psf)	Seismic Weight (kips)
Roof	4960	57	282
TOTAL			282

Period

C_t [1]	0.02
h_n (ft) [2]	12.67
β	0.75

T (sec) [3]	0.13	sec

Notes:

[1] C_t and β are for "all other framing system" per ASCE 41-17 Section 4.4.2.4.

[2] The building height is taken from the 1st floor to the roof.

[3] The period calculated per ASCE 41-17 Equation 4-4.

$$T = C_t h_n^{\beta}$$

BSE-2E Response Spectrum

7929

Latitude, Longitude: 36.995043, -122.061300

Date	5/31/2019, 8:56:10 AM
Design Code Reference Document	ASCE41-17
Custom Probability	
Site Class	D - Stiff Soil

Type	Description	Value
Hazard Level		BSE-2N
S_S	spectral response (0.2 s)	1.631
S_1	spectral response (1.0 s)	0.625
S_{XS}	site-modified spectral response (0.2 s)	1.631
S_{X1}	site-modified spectral response (1.0 s)	1.063
F_a	site amplification factor (0.2 s)	1
F_v	site amplification factor (1.0 s)	1.7
ssuh	max direction uniform hazard (0.2 s)	1.754
crs	coefficient of risk (0.2 s)	0.93
ssrt	risk-targeted hazard (0.2 s)	1.631
ssd	deterministic hazard (0.2 s)	3.018
s1uh	max direction uniform hazard (1.0 s)	0.686
cr1	coefficient of risk (1.0 s)	0.911
s1rt	risk-targeted hazard (1.0 s)	0.625
s1d	deterministic hazard (1.0 s)	1.027

Type	Description	Value
Hazard Level		BSE-1N
S_{XS}	site-modified spectral response (0.2 s)	1.087
S_{X1}	site-modified spectral response (1.0 s)	0.709

Type	Description	Value
Hazard Level		BSE-2E
S_S	spectral response (0.2 s)	1.281
S_1	spectral response (1.0 s)	0.485
S_{XS}	site-modified spectral response (0.2 s)	1.281
S_{X1}	site-modified spectral response (1.0 s)	0.88
f_a	site amplification factor (0.2 s)	1
f_v	site amplification factor (1.0 s)	1.815

Type	Description	Value
Hazard Level		BSE-1E
S_S	spectral response (0.2 s)	0.689
S_1	spectral response (1.0 s)	0.243
S_{XS}	site-modified spectral response (0.2 s)	0.861
S_{X1}	site-modified spectral response (1.0 s)	0.513
F_a	site amplification factor (0.2 s)	1.249
F_v	site amplification factor (1.0 s)	2.115

Type	Description	Value
Hazard Level		T-Sub-L Data
T-Sub-L	Long-period transition period in seconds	12

Shear walls

Direction	Wall ID	Thickness (in.)	Length (ft)	Is Structural?	Area (ft^2)
Longitudinal	1, 1.1, 2.1, 3, 4	8	150.8	Y	100.56
Transverse	I, J, K, K.1, L	8	259.2	Y	172.78

Σ = 273.33

Story Shears

Sa [g]	1.28
W [kips]	282
C [1]	1

V [kips]	362

k= 1.00

Floor Levels	h_i [ft]	h_x [ft]	W_i [kips]	$w_i*h_x^k$	coeff	F_x [kips]	V_j [kips]
Roof	12.67	12.67	282	3578	1.00	362	362
Σ			282	3578		362	

Notes:

[1] Modification Factor, C, per ASCE 41-17, Table 4-7.

Table 4-7. Modification Factor, *C*

	Number of Stories			
Building Type[a]	**1**	**2**	**3**	**≥4**
Wood and cold-formed steel shear wall (W1, W1a, W2, CFS1) Moment frame (S1, S3, C1, PC2a)	1.3	1.1	1.0	1.0
Shear wall (S4, S5, C2, C3, PC1a, PC2, RM2, URMa) Braced frame (S2) Cold-formed steel strap-brace wall (CFS2)	1.4	1.2	1.1	1.0
Unreinforced masonry (URM) Flexible diaphragms (S1a, S2a, S5a, C2a, C3a, PC1, RM1)	1.0	1.0	1.0	1.0

[a] Defined in Table 3-1.

Average Stress:

E-W direction (Longitudinal)	Masonry Shear Walls
$M_{s,Shear\ walls}$ [1]	4.5

Level	V_j (kips)	A_w (ft^2)	f_j^{avg}	Tier 1 Shear Stress Limit	Units	Result
1st story (mansory wall) [2]	362	100.6	5.6	70	psi	OK

N-S direction (Transverse)	Masonry Shear Walls
$M_{s,Shear\ walls}$ [1]	4.5

Level	Force (kips)	A_w (ft^2)	f_j^{avg}	Tier 1 Shear Stress Limit	Units	Result
1st story (mansory wall) [2]	362	172.8	3.2	70	psi	OK

Notes:

[1] M_s Factor per ASCE 41-17, Table 4-8.

Table 4-8. M_s Factors for Shear Walls

	Level of Performance		
Wall Type	**CP[a]**	**LS[a]**	**IO[a]**
Reinforced concrete, precast concrete, wood, reinforced masonry, and cold-formed steel	4.5	3.0	1.5
Unreinforced masonry	1.75	1.25	1.0

[a] CP = Collapse Prevention, LS = Life Safety, IO = Immediate Occupancy.

[2] Equation 4-8 of Section 4.4.3.3 per ASCE 41-17 was used to checked the shear walls.