Rating form completed by:

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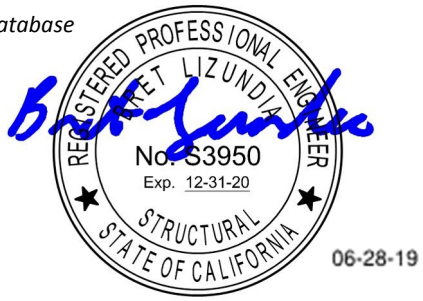
Evaluator: EB/WAL/BL
Date: 06/28/2019

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

DATE: 2019-06-28



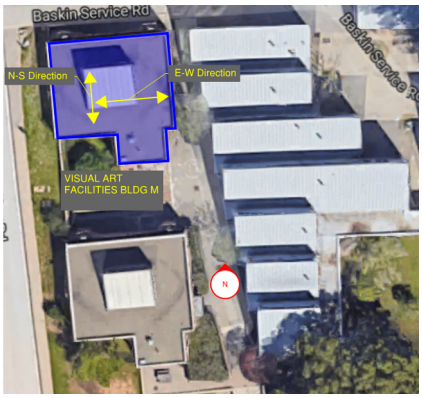
UC Santa Cruz building seismic ratings

Visual Arts Facilities-Building M

CAAN #7927
Elena Baskin Visual Arts, Santa Cruz, CA 95064
UCSC Campus: Main Campus

Northeast Elevation (Looking Southwest)

Plan



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	Focused on analysis of steel joist-column connections, roof-to-wall connections, cantilever column and diagonal tension rod bracing checks, and possible retrofit measures if needed.

[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.

Building information used in this evaluation

- Architectural drawings by Boora Architects, "Improvement to Arts, University of California, Sant Cruz," dated 1 November 1996, Sheets A121, A141, A221, A321, A322, A411, and A431-A433 pertinent to Buildings 'L','M,' and 'P'.
- 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 M 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 building is a single-story reinforced masonry structure that contains approximately 2,510 square feet. In plan, Building L is comprised of two rectangular sections: (1) the main room measuring 50 by 42 feet is used as a painting studio room, and (2) the secondary room measuring 22 by 13.25 ft is used as storage room. The west, south, and east walls of the painting room section are constructed with 8" thick (nominal) fully grouted reinforced masonry walls whereas the north wall is constructed with 5"ϕ steel pipe columns diagonally braced in tension. The bracing element are covered with wood panels (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). On top of them, glass windows are used. The storage room was built with reinforced masonry walls. The roof diaphragm of the painting room is a cellular metal roof deck supported by steel open web joists. The roof diaphragm over the storage room is metal deck supported by steel tubes and the CMU 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.

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

Identification of levels: The building has one story above a slab-on-grade. Grade around the southwest corner of the building gently slopes down to the south and southwest.

Foundation system: The CMU walls are supported on a 1'-6"x8" strip footing. The strip footing continues under openings. The steel pipe columns are welded to a 12"x12"x3/4" baseplate, anchored using four 3/4"ϕx12" anchor bolts, and supported on 3'x3'x12" isolated footing per Details 5, 7, and 15 on Sheet S201. A thickened slab edge per Detail 3/S201 runs along the north side of the building between spread footings. The wood stud wall at the north slab edge is supported on top of a 4" high concrete curb.

Structural system for vertical (gravity) load: The roof diaphragm of the painting room is comprised of 3" deep 20 gauge Type N cellular metal roof deck atop of four north-south steel open web joists (24 LH) spaced at 10' o.c. The north ends of the joists are supported on top of the steel pipe columns per Detail 11 on Sheet S301 whereas the south ends bear in pockets in the masonry walls per Detail 9 on Sheet S301. At the west and east CMU walls, the deck is supported on top of a L4x3x5/16 angle (long leg horizontal) anchored to a bond beam using 3/4"ϕ 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 steel joists. The monosloped skylight is comprised of translucent panels supported by TS3x6x5/16 structural tubing spaced 5' o.c. that slope 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.

On the storage room, the roof diaphragm is comprised of 3" deep 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 located at the center of the room.

Structural system for lateral forces: In the N-S direction, lateral forces are transferred from the metal deck-joist system to the perimeter masonry walls and from them to the strip foundations per Details 12 and 13 on Sheet S201. The joists are pinned-connected to the steel pipe columns through a welded connection (Detail 11 per Sheet S301) and on the opposite side to the masonry wall (Details 9 and 10 per Sheet S301).

In the E-W direction, the lateral forces are transmitted to a masonry wall on the south side and to the tension rod-braced steel pipe columns on the north side. The tension rod diagonal bracing comprised of three bays of 3/4"ϕ ASTM A36 rod "X"-braces with turnbuckles at each end. The turnbuckle clevises are connected to ½" plates welded to the steel column at the base per Detail 10/S202 and at 9' above the ground per Detail 19/S301. An "L"-shape section joins together the top of the steel columns, but there is no horizontal steel member between columns at the top of the tension rods. The installed joist-to-column connection differs from what is shown in Detail 11/S301. Lateral loads are transfer from the walls and columns to the strip and isolated foundations respectively.

Building condition: Some cracking was observed in the CMU walls at the intersection of the south wall of the painting room with the orthogonal wall of the storage room. Staining was observed on face of the CMU and wood wall on the north side. The observed conditions do not appear to significantly impact lateral force resistance.

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:

- Tension rod diagonal "X" bracing (3/4"ϕ ASTM A36 rods connected to a 1/2" steel plate) are used in three of the five bays along Gridline C to brace the bottom portion of the steel pipe columns below the clerestory window. The top of the connection is located at 9' above the grade and 4'-3" below the top of the columns, so the columns must cantilever up the remaining distance from the top of the braces to the top of the columns at the roof level In addition to cantilever bending, because the rods have no tension stiffness or strength, they will introduce a seismic shear at the middle of the columns, similar to the effect created by a K-braced system, potentially compromising the vertical load-carrying capacity of the columns. The calculated average axial stress in the diagonal rods is 70% greater than the allowable stress per Tier 1 evaluation.
- The joist-to-column connection detail is different from the detail shown in the structural drawings. The main differences are: (1) an angle was welded at the end of the joist, one leg is welded above the top chord of the joist and the other to the top of the bearing plate (see the last two pictures on Appendix A); this angle connects all the steel columns; (2) A vertical steel plate was welded to the end of the joist to stiffen the top chord and to transfer vertical load; (3) Two thick bearing plates were welded to the column horizontal plate. During the site visit, it was not possible to inspect the welds used in this connection. Without closer inspection, it is not clear if there is a compliant positive tie from the joist to the bearing plate and then from the bearing plates to the column cap plate.
- Roof-to-wall tie: The typical roof-to-wall tie per Detail 7/S301 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, 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 south wall, 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.

Structural deficiency	Affects rating?	Structural deficiency	Affects rating?
Lateral system stress check (wall shear, column shear or flexure, or brace axial as applicable)	Y	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]

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	None observed
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

The building is assigned a Seismic Performance Level Rating of Level V based on poor "K"-braced and cantilevered configuration and limited ductility of the north framing with cantilevered columns rising up above diagonal tension rod "X" bracing, the overstress of the diagonal tension rods, and the limited capacity of the roof-to-wall connections.

Recommendations for further evaluation or retrofit

We recommend that the campus perform a Tier 2 evaluation to review the lateral force-resisting capacity of the diagonal bracing members, their connections, the cantilever columns, the roof-to-wall connections, and the joist-to-column connections. If the braced elements were found to be inadequate, replacement of the elements could be made with tubes including horizontal struts at the top of the diagonals, and the connections could be strengthened if the welds are found inappropriate. We assign the building to Priority Category B, as the retrofit of the building should be done when there are any plans for modifying or change of occupancy. Falling hazards reduction, such as the unbraced lockers, should be addressed.

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 Engineers. Comments from the reviewers have been incorporated into this report. The reviewers agreed with the assigned rating.

[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.

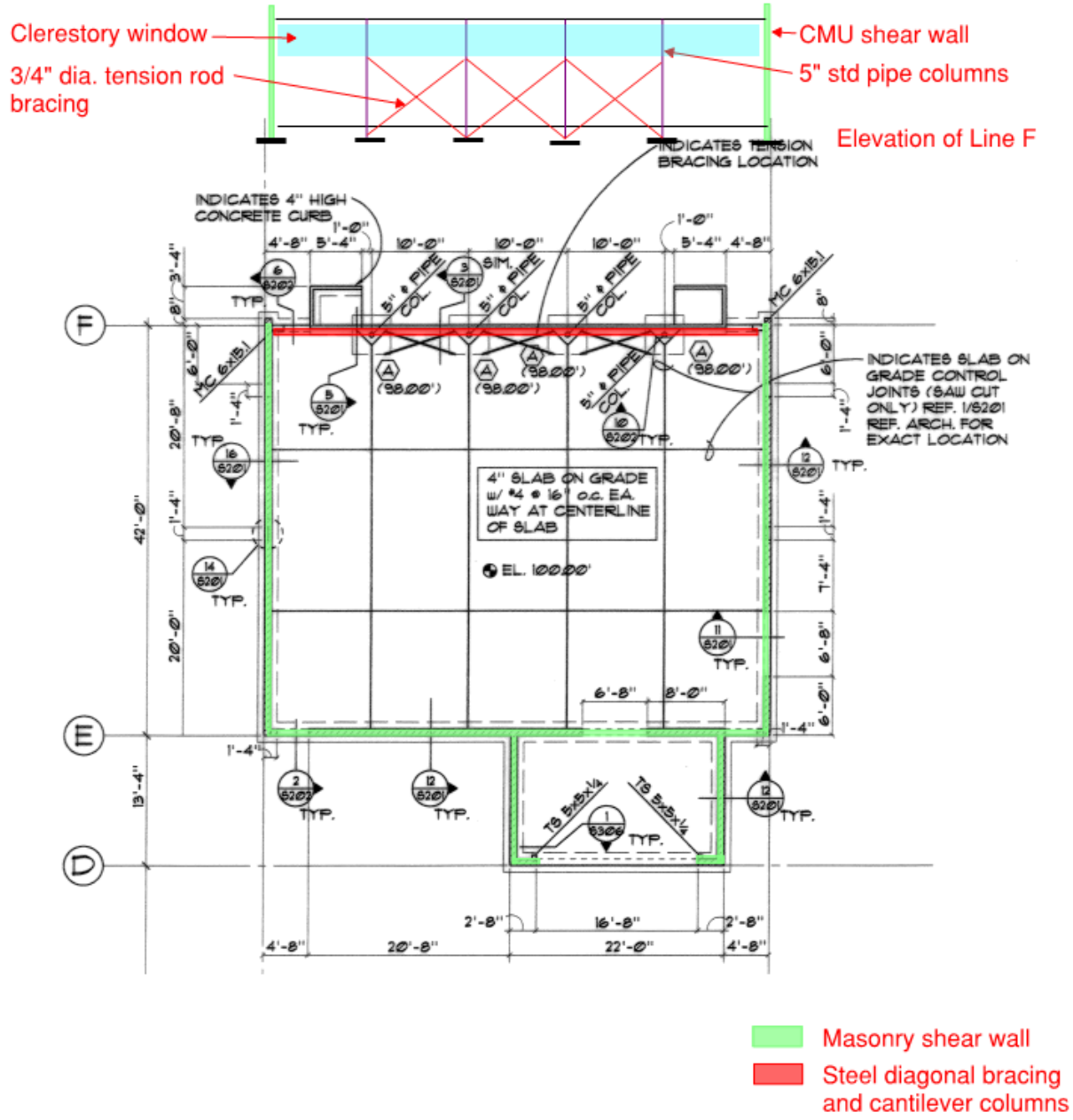
Additional building data	Entry	Notes
Latitude	36.994650	
Longitude	-122.061265	
Are there other structures besides this one under the same CAAN#	No	
Number of stories above lowest perimeter grade	1	
Number of stories (basements) below lowest perimeter grade	0	
Building occupiable area (OGSF)	2,510	The UCSC facilities database has 2,477 sf.
Risk Category per 2016 CBC Table 1604.5	II	
Building structural height, h_n	13.25 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	0.14 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}	1.631,0.625	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	

[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

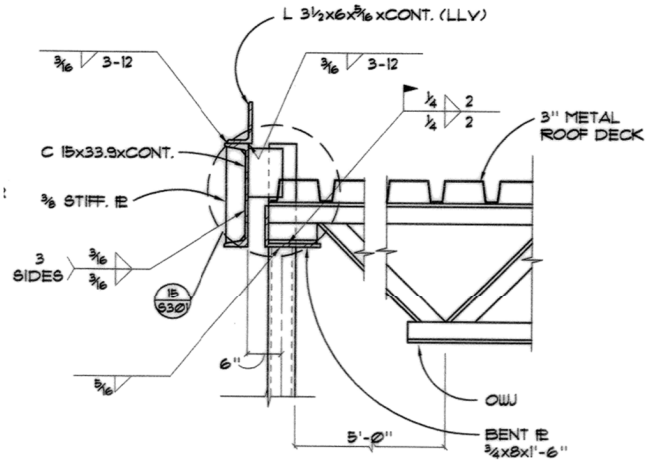
Applicable code		
Applicable code or approx. date of original construction	Built: 1998 Code: 1991 UBC	From General Structural Notes on Sheet S1.
Applicable code for partial retrofit	None	No partial retrofit.
Applicable code for full retrofit	None	No full retrofit
FEMA P-154 data		
Model building type North-South	RM1-Masonry	
Model building type East-West	RM1/S2a	
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

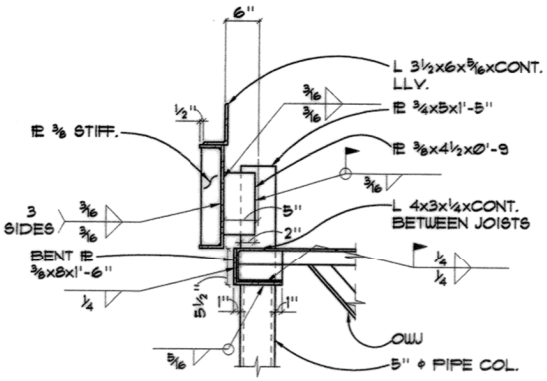
Structural System:



Joist-to-column connection (Details 11 and 15 per Sheet S301)

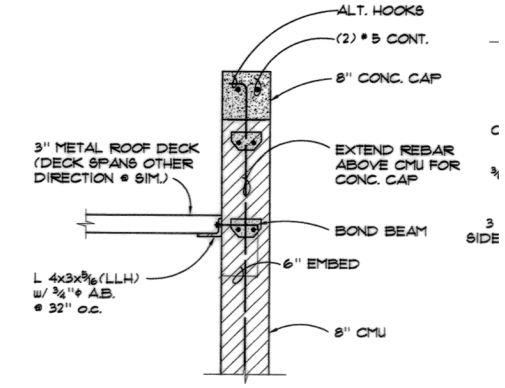


11 TYP. OWJ TO T.S. COLUMN
1"=1'-0" S122

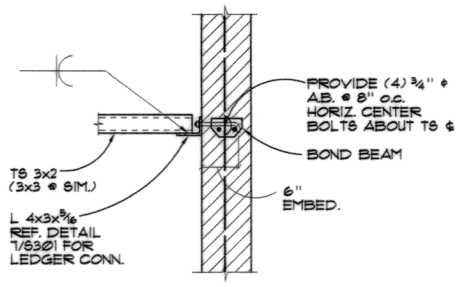


15 OWJ/CHANNEL TO COLUMN
1"=1'-0" S301

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

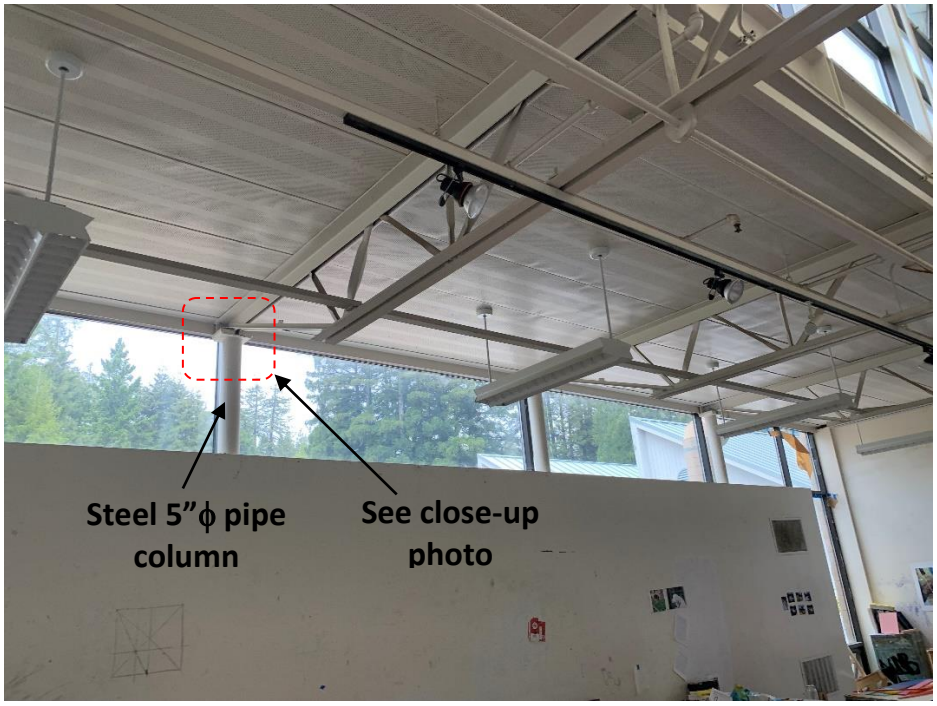
Southeast corner (looking northwest)

Northwest corner (looking southeast)

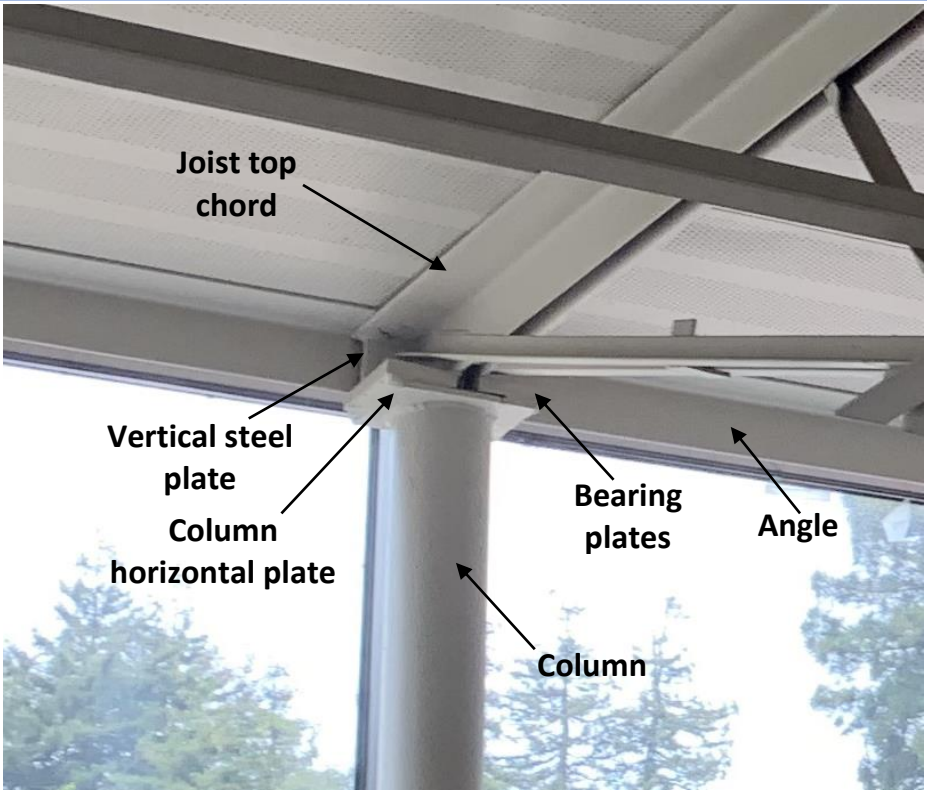
West elevation (looking east)

Partial north elevation (looking south)

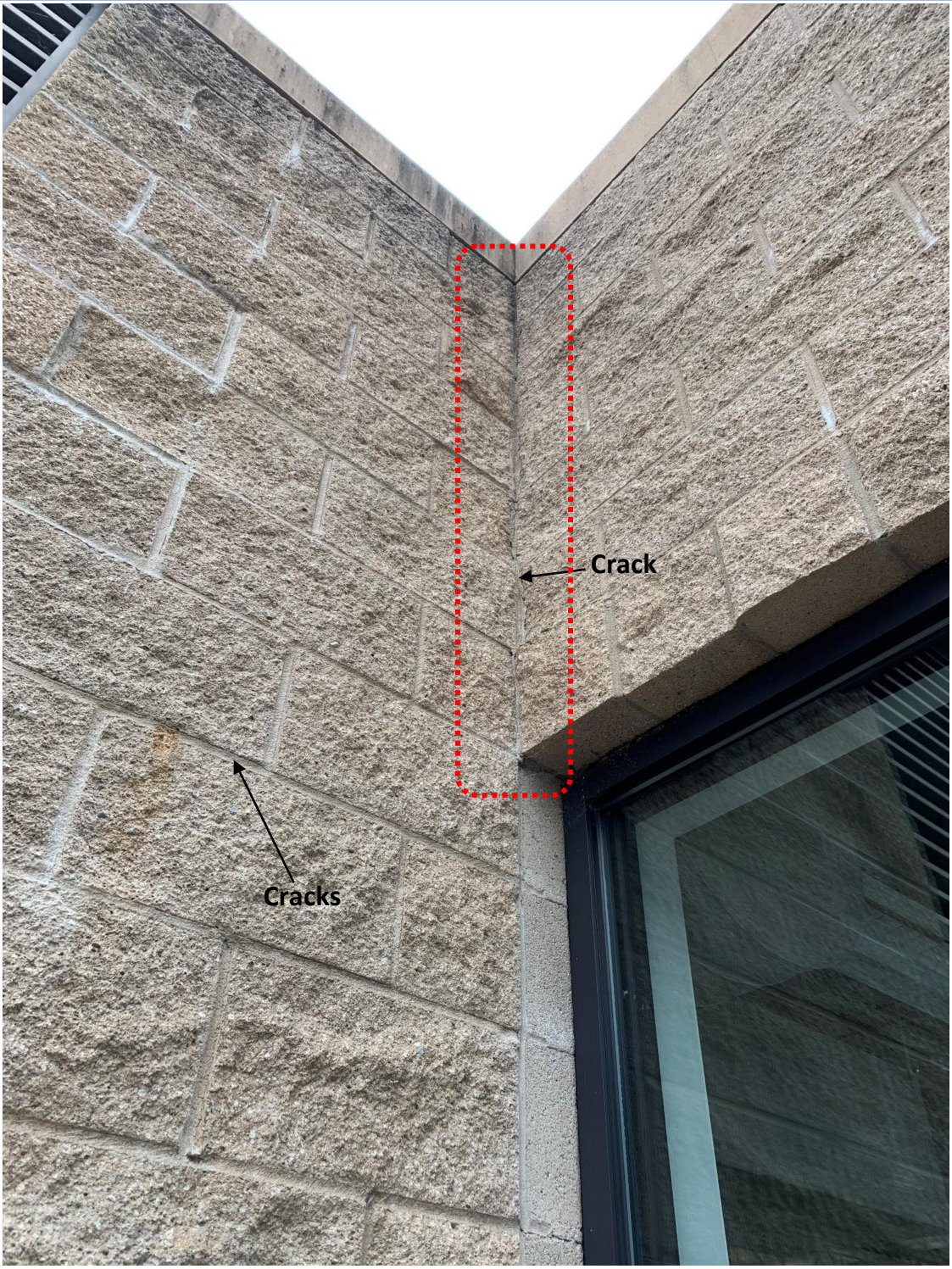
Main room view (looking southwest)



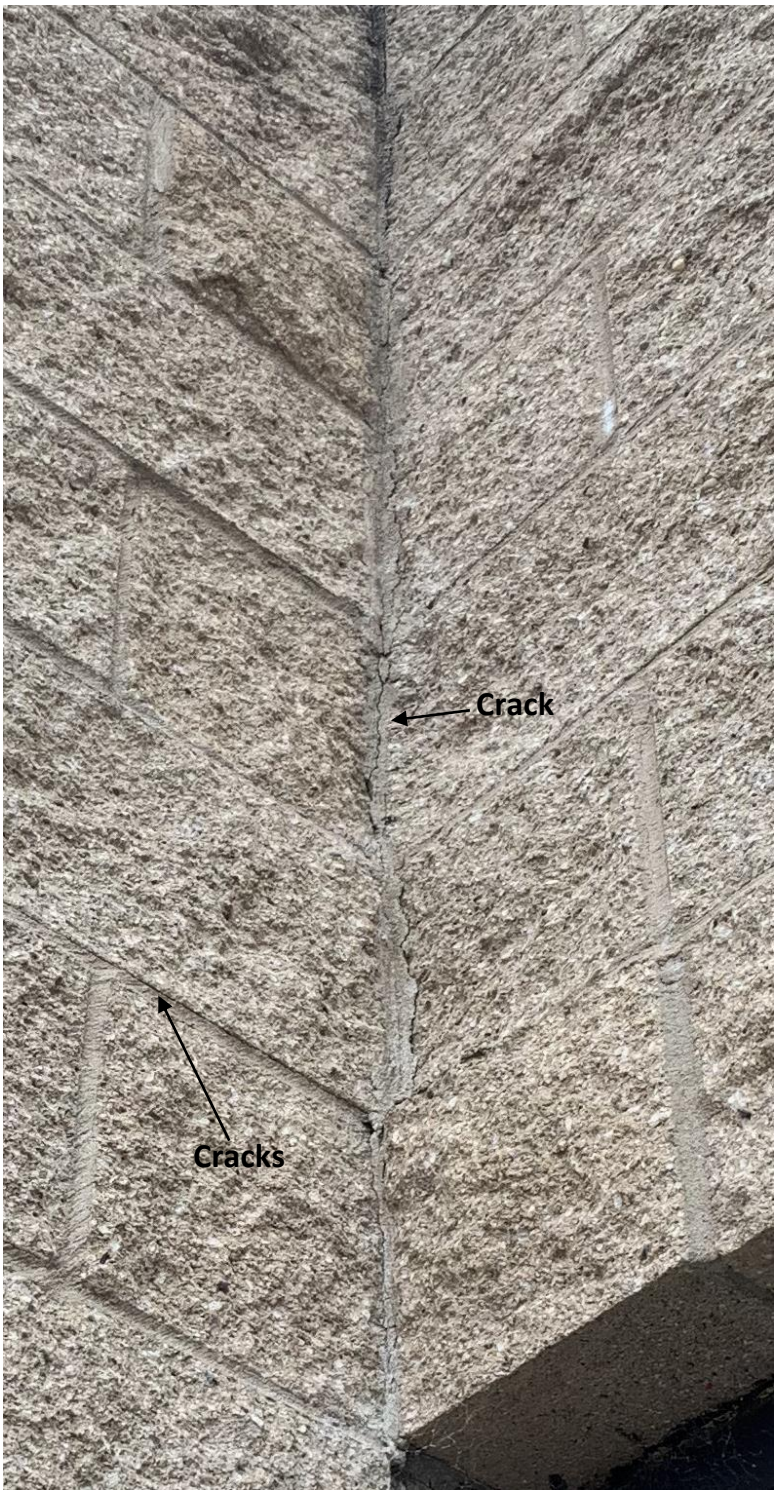
Steel pipe columns of north side of the building



Close-up of the joist-to-column connection



Intersection of main storage room wall (left)
with painting studio south wall (right)



Close-up of the cracks

APPENDIX B

ASCE 41-17 Tier 1 Checklists (Structural)

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7927	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
Building Name:	Elena Baskin Visual Arts Building M			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 the E-W direction (transverse), metal deck roof diaphragms deliver loads to the reinforced masonry shear walls and cantilever steel columns partially braced with tension rod "X" bracing over strip and isolated footings, respectively. In the N-S direction (longitudinal), reinforced masonry shear walls over strip footings are used.
●	○	○	○	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:** There is more than 1.5% of the height of the building to the closest structure.
●	○	○	○	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:	7927	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
Building Name:	Elena Baskin Visual Arts Building M			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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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 = 42', Building Height is H = 13'-3", B/H = 3.17 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

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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:** **In the N-S direction (transverse) masonry shear walls are used (this Checklist). In the E-W direction (longitudinal) masonry shear walls are used in the south side of the building whereas tension rod-braced steel pipe columns are used in the north side (see accompanying S2a Checklist).**
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 shear stresses in the masonry shear walls are 3.4 and 3.5 psi in the longitudinal and transverse directions, 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#6@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.**

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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)

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:**

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

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

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

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**

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

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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:** **No wood ledgers.**
◉	○	○	○	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 per Details 12, 13, 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:** **The installed open web joist to steel column connection is different than Details 11,15/S301. Positive connections between all elements could not be viewed in the field due to access.**

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.**

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

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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) **Comments:** **Cellular metal deck without concrete topping 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.**

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

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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) **Comments:** **There are no wood structural elements.**

APPENDIX C

UCOP Seismic Safety Policy Falling Hazards Assessment Summary

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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:**
P ☐ N/A ☒	**Heavy masonry or stone veneer above exit ways or public access areas** **Comments:**
P ☐ N/A ☒	**Unbraced masonry parapets, cornices, or other ornamentation above exit ways or public access areas** **Comments:**
P ☐ N/A ☒	**Unrestrained hazardous material storage** **Comments:**
P ☐ N/A ☒	**Masonry chimneys** **Comments:**
P ☐ N/A ☒	**Unrestrained natural gas-fueled equipment such as water heaters, boilers, emergency generators, etc.** **Comments:** Gas heater in storage room is anchored to the metal deck.
P ☐ N/A ☒	**Other:** Lockers in storage room **Comments:** Existing lockers are anchored.
P ☒ N/A ☐	**Other:** **Comments:**
P ☒ N/A ☐	**Other:** **Comments:**

Falling Hazards Risk: Low

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

APPENDIX D

Quick Check Calculations

Unit Weights:

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

Masonry Walls:

Roof							
Type	t (in)	Length (ft)	Height (ft)		Area (ft^2)	Unit weight (pcf)	Weight (kips)
CMU - 8"	8	183.3	15.67			84.0	160.84

Σ =	160.8	kips
A_trib (ft2)=	2,510	
Trib. Weight=	64.081	psf

Roof structure:

Roof							
Girder ID	Length (ft)	B (in)	D (in)	Number	Area (ft^2)	Unit weight (plf)	Weight (kips)
OWJ: 24 LH	42			8		12.6	4.24
TS 6x6x1/4	13.333333			2		19.0	0.51
TS 3x2x1/4	21.00			4		7.1	0.60
C8x11.50	27			1		11.5	0.31

Σ =	5.7	kips
A_{trib} (ft^2)=	4,960	
Trib. Weight=	1.140	psf

Columns:

1st Level to 2nd Level (roof)						
Col type	ϕ (in)	Height (ft)	Area (ft^2)	Number	Unit weight (plf)	Weight (kips)
5" STD Pipe	5	13.9		5	38.6	2.69

0.0	Σ =	2.7	kips
	A_trib (ft2)=	2,510	
	Trib. Weight=	1.070	psf

	Seismic Weight	Dead Load	
Roof	**psf**	**psf**	**Remarks**
Roof deck: 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	Per site visit
Skylight structure	2.1	2.1	Per Sheet S303
Columns	0.5	1.1	5"ϕ Pipe
Girders/joists	2.3	2.3	
Walls	32.0	64.1	Based on 8" CMU solid grouted: 84 pcf (half). See previous calculation
Ceiling	0.0	0.0	No ceiling
Lighting and misc.	5	5	
Total	52	84	

Story Weights

Level	Area (ft^2)	Unit Weight (psf)	Seismic Weight (kips)
Roof	2510	52	129
TOTAL			129

Period

C_t [1]	0.02
h_n (ft) [2]	13.25
β	0.75

T (sec) [3]	0.14	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

7927

Latitude, Longitude: 36.994650, -122.061265

Date	5/31/2019, 8:55:05 AM
Design Code Reference Document	ASCE41-17
Custom Probability	
Site Class	D - Stiff Soil

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

Shear walls

Direction	Wall ID	Thickness (in.)	Length (ft)	Is Structural?	Area (ft^2)
Longitudinal	A, B	8	57	Y	38.00
Transverse	1, 1.1, 1.2, 2	8	110.7	Y	73.78

Σ = 111.78

Story Shears

Sa [g]	1.28
W [kips]	129
C [1]	1

V [kips]	166

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	13.25	13.25	129	1716	1.00	166	166
Σ			129	1716		166	

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)	Braces
$M_{k,Braces}$ [1]	3.5
L_{br} (ft)	13.68
A_{br} (in^2)	0.44
s (ft)	10
N_w	3

E-W direction (Longitudinal)	Columns
$M_{k,Columns}$ [2]	2.5
h_c (ft) (Base-Roof)	13.25
L (ft)	30.00
A_{col} (in^2)	11.30
N_c	1

E-W direction (Longitudinal)	Masonry Shear Walls
$M_{k,Shear\ walls}$ [3]	4.5

Level	V_j (kips)	A_w (ft^2), A_{br} (in^2) or A_{col} (in^2)	f_j^{avg} or p_{ot}	Tier 1 Stress Limit	Units	Result
1st story (masonry wall) [4]	83	38.0	3.4	70	psi	OK
1st story (axial, braces) [5]	83	0.44	24.6	18 [6]	ksi	NG
1st story (axial, columns) [7]	83	11.3	0.9	10.8 [8]	ksi	OK

N-S direction (Transverse)	Masonry Shear Walls
$M_{k,Shear\ walls}$ [3]	4.5

Level	Force (kips)	A_w (ft^2)	f_j^{avg}	Tier 1 Shear Stress Limit	Units	Result
1st story (masonry wall)	166	73.8	3.5	70	psi	OK

Notes:

[1] M_s Factor per ASCE 41-17, Table 4-9.

Table 4-9. M_s Factors for Diagonal Braces

		Level of Performance		
Brace Type	***d/t*[b]**	**CP[a]**	**LS[a]**	**IO[a]**
Tube[b]	$<90/(F_{ye})^{1/2}$	7.0	4.5	2.0
	$>190/(F_{ye})^{1/2}$	3.5	2.5	1.25
Pipe[c]	$<1{,}500/F_{ye}$	7.0	4.5	2.0
	$>6{,}000/F_{ye}$	3.5	2.5	1.25
Tension-only		3.5	2.5	1.25
Cold-formed steel strap-braced wall		3.5	2.5	1.25
All others		7.0	4.5	2.0

Note: $F_{ye} = 1.25F_y$; expected yield stress.
[a] CP = Collapse Prevention, LS = Life Safety, IO = Immediate Occupancy.
[b] Depth-to-thickness ratio.
[c] Interpolation to be used for tubes and pipes.

[2] M_s Factor per section 4.4.3.6 of ASCE 41-17.

[3] 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.

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

[5] Equation 4-9 of Section 4.4.3.4 of ASCE 41-17 was used to checked the braces of the steel pipes in the E-W direction. Tension braces used: 3/4"ϕ A36 rods.

[6] Assuming F_y = 36 ksi per General Structural Notes on Sheet S1.

[7] Equation 4-11 of Section 4.4.3.6 per ASCE 41-17 was used to checked the columns axial stess.