Rating form completed by: **MAFFEI STRUCTURAL ENGINEERING**
maffei-structure.com
Tarek Elkhoraibi, Noelle Yuen, Joe Maffei

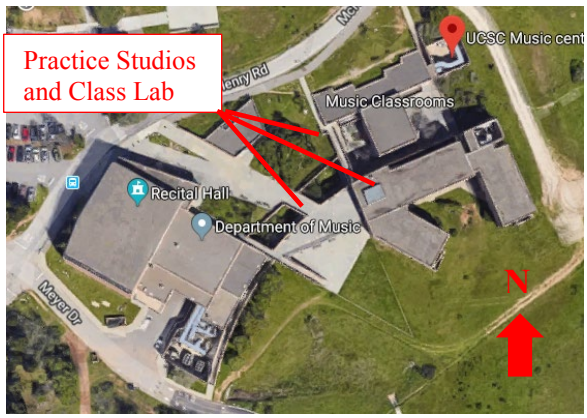
Text in green is to be part of UC Santa Cruz building database and may be part of UCOP database

UC Santa Cruz building seismic ratings

Music Center – Practice Studios and Class Lab

CAAN #7922
402 McHenry Road, Santa Cruz, CA 95064
UCSC Campus: Main Campus

DATE: 2019-06-30



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 B = Retrofit at next permit application
Ballpark total construction cost to retrofit to IV rating[2]	Medium ($50 to $200)	See recommendations on further evaluation and retrofit
Is 2018-2019 rating required by UCOP?	Yes	Building was not previously rated
Further evaluation recommended?	Yes	Tier 2 – Focused on connection of roof diaphragm to walls for in-plane and out-of-plane demands

[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 life-safety. See Section III B of the UC Seismic Policy and Method B of Section 321 of the 2016 California Existing Building Code.

[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 Antoine S. Predock: issued with Addendum 2 on 6 July 1994.
- Structural drawings by Robin E. Parke Associates, Inc.: issued with Addendum 2 on 6 July 1994.
- University of California building database information, "7922," provided by José Sanchez (UCSC) on 2019-05-30.

Additional building information known to exist

- None

Scope for completing this form

We reviewed the structural drawings for the original construction and carried out a site visit to verify that the existing drawings matched the existing structure to the best of our knowledge. An ASCE 41-17 Tier 1 evaluation was completed. We did not perform an ASCE 41 Tier 1 nonstructural evaluation, but we looked for potentially hazardous nonstructural components during our site visit.

Description of CAAN assignments

The Music Center is a cluster of structures that are separated from each other by expansion joints. As shown in the layout plan below, for the purpose of seismic evaluation, the buildings will be sub-divided into four CAANs. The Music Center, consisting of the Practice Studios/Class Lab, Recital Hall, and Ensemble Rehearsal Room (CAAN 7922, 7922.1, 7922.2) was designed in 1995 by the architectural office of Antoine S. Predock and the structural office of Robin E. Parke Associates. Soon after, the Music Building addition (CAAN 7922.3) was designed by the architectural office of Boora Architects and the structural office of KPFF Consulting Engineers.

This report is for the Music Center Practice Studios and Class Lab (CAAN 7922).

CAAN	Building Name
7922	Music Center (Practice Studios and Class Lab)
7922.1	Music Center Recital Hall
7922.2	Music Center Ensemble Rehearsal Wing
7922.3	Music Center Addition

East View of Practice Studios and Class Lab

South View of Practice Studios and Class Lab

Brief description of structure

As shown in the key plan below, the Practice Studios/Class Lab structure consists of a North and a South building, separated by an expansion joint at the south end of the North building at the end of the connecting bridge. The South building is one-story high at the west end of the building and two-stories high at the east end of the building, with the transition from one to two stories occurring at Gridline E (and where the west Addition occurs). The North building is largely one-story high with a high roof over the Class Lab room. The North building is partially below-grade, and the north, west, and east perimeter walls are retaining walls. An elevated walkway (bridge) connects the North and the South buildings at Level 2. The Practice Studios/Class Lab buildings amount to 18,800 sf in gross area.

Key plan

Foundation system: The structures are founded on reinforced concrete mat slabs. At the North building, the ground surface slopes down from north to south with an elevation differential of about 20 ft, and the north wall of the North building is a retaining wall.

Identification of levels: Level 1 is at elevation 643'-10'' and Level 2 is at elevation 658'-6''. The roof elevation varies, with the low roof of the South building equal to the Level 2 elevation, and the high roof of the South building at

elevation 673'-10" measured at the top of the parapet. The North building roof elevation slopes, with the lowest top of parapet elevation at 665.0' and the highest at 675.0' over the Class Lab.

Structural system for vertical (gravity) load: Reinforced and fully-grouted concrete masonry (CMU) walls support the 2nd floor and roof. The exception to this is the north wall of the North building, which is a reinforced concrete wall which acts as a retaining wall as well as a bearing wall. The high roof framing of the North building and the 2-story portion of the South building consists of 2-1/2" thick concrete fill over 1-1/2" deep metal deck, spanning to steel W-beams at approximately 7' o.c. which are supported by interior and exterior CMU or concrete walls. Level 2 of the 2-story portion of the South building (which is continuous with the low roof of the one-story portion of the South building) consists of 12" concrete slab spanning between interior and exterior CMU walls.

Structural system for lateral forces: At the South building, the second floor/low roof is reinforced concrete slab, which is supported by the CMU walls beneath. The vertical reinforcement in the CMU walls is carried into the slabs and provide the diaphragm force transfer mechanism.

The concrete fill over metal deck diaphragm at the high roof is anchored to the perimeter and interior CMU walls by means of two 3/4" diameter anchor bolts at each beam connection with the wall. In addition, the metal deck is attached with puddle welds to ledgers anchored into the CMU walls, all around the building perimeter. The steel beams that support the deck typically span north-south, so the walls on the north and south sides of the building are anchored to the high roof diaphragm by both the beam connections and the puddle welds, but walls on the east and west sides of the building are anchored to the roof diaphragm with the puddle weld-to-ledger angle connection only.

At the North building, the roof is also composite metal deck with the steel beams underneath spanning north-south and similar connections as the South building.

The bridge connecting the North and South buildings is supported by the North building with a reinforced concrete retaining wall at the north end in both the (in-plane) long direction and (out-of-plane) short direction. At the south end of the bridge, the bridge is connected to the South building with a connection that allows movement in the long direction.

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

The following major seismic deficiency is identified:

- In the south class lab of the North building, the connection of the concrete fill over metal deck roof diaphragm to the west and east CMU walls relies on spot welds to the ledger angles running along the walls. The connection is inadequate for lateral support of the walls.

Other seismic deficiencies include:

- For the South Building, the concrete fill over metal deck roof diaphragm is connected to the exterior walls with ledger angles anchored to the CMU walls and attached to the metal deck with puddle welds. Current research suggests that welded connections of metal deck to supporting steel provide less ductility than other connection types such as fasteners. In addition, the margin of safety for lateral support of the east and west walls is small and warrants further evaluation.
- The expansion gap between the south end of the bridge and the South building is 1" wide. It is likely that the gap is too small and that pounding might occur between the bridge and the building in the case of a significant seismic event. However, the floor levels are aligned for the two structures and the adverse effects of pounding are expected to be limited.
- Similarly, the seismic isolation joint between the South building and the Music Building Addition is 2" and pounding is likely to occur between these structures. However, the floor levels are aligned for the two structures (at the second floor and at the roof) and the adverse effects of pounding are expected to be limited.

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 non-structural life-safety concerns, including at exit routes.[3]

We walked through all floors of the building. We did not perform the Tier 1 nonstructural evaluation, but we looked for potentially hazardous nonstructural components during our site visit on 20 May 2019. As shown in the table below, no non-structural hazards were observed.

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	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

Discussion of Rating

The connection of the concrete fill over metal deck roof diaphragm to the wall in the east-west direction for the North building is inadequate for lateral support of the CMU wall. A rating of V reflects this deficiency, in addition to other deficiencies as outlined in the report.

Recommendations for further evaluation or retrofit

While the CMU and concrete walls are adequately sized to resist a BSE-C level seismic event and possibly larger, the connection of the concrete fill over metal deck roof to the CMU and concrete walls do not provide adequate lateral support for the underlying walls, particularly at the Class Lab room of the North Building.

Peer review of rating

This seismic evaluation was discussed in a peer review meeting on 24 July 2019. Reviewers present were Bret Lizundia of R+C and Jay Yin of Degenkolb. Comments from the reviewers have been incorporated into this report. The reviewers agreed with the assigned rating.

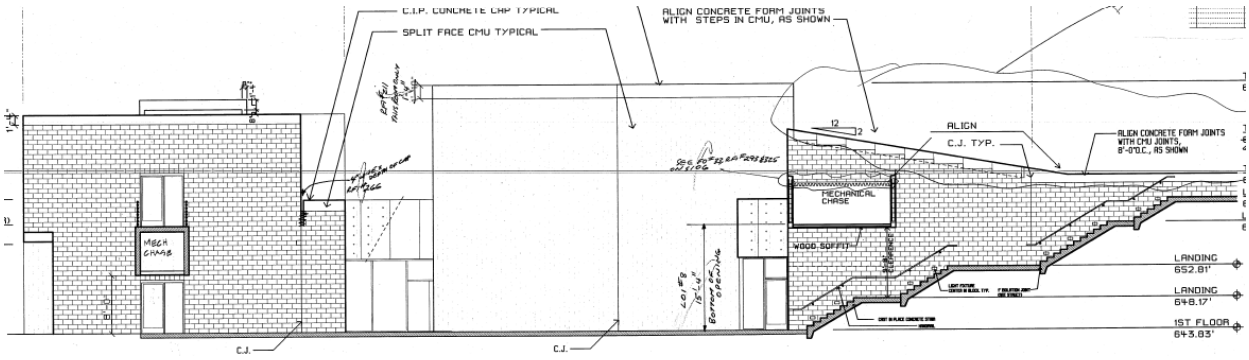
[3] For these Tier 1 evaluations, we do not visit all spaces of the building; we rely on campus staff to report to us their understanding of if and where non-structural hazards may occur.

Additional building data	Entry	Notes
Latitude	36.993094	
Longitude	-122.061334	
Are there other structures besides this one under the same CAAN#	No	
Number of stories above lowest perimeter grade	2	
Number of stories (basements) below lowest perimeter grade	0	
Building occupiable area (OGSF)	18,800	
Risk Category per 2016 CBC Table 1604.5	II	
Building structural height, h_n	30 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	0.75	Estimated using ASCE 41-17 equation 4-4 and 7-18
Estimated fundamental period	0.26 sec	Estimated using ASCE 41-17 equation 4-4 and 7-18
Site data		
975 yr hazard parameters S_s, S_1	1.28, 0.485	
Site class	D	
Site class basis[4]	Geotech	See footnote below
Site parameters F_a, F_v[5]	1, 1.815	
Ground motion parameters S_{cs}, S_{c1}	1.278, 0.878	
S_a at building period	1.283	
Site V_{s30}	1500 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

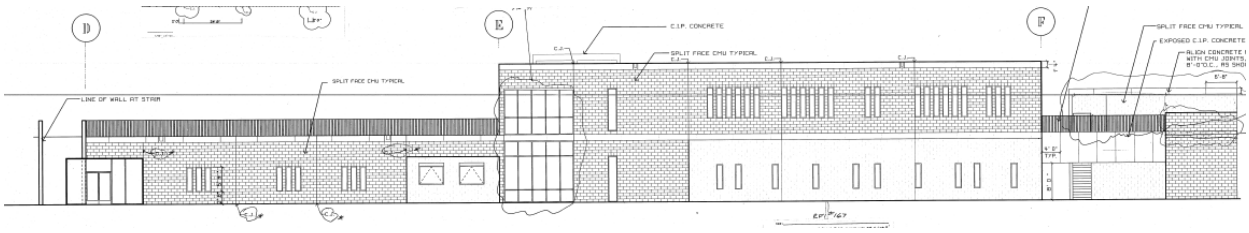
[4] Determination of site class and assessment of geotechnical hazards are based on correspondence with Pacific Crest Geotechnical Engineers and Nolan, Zinn, and Associates Geologists. [*Revised Geology and Geologic Hazards, Santa Cruz Campus, University of California*, Job # 04003-SC 13 May 2005]. Site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

[5] F_V factor used does not include the requirements of Section 11.4.8-3 of ASCE 7-16 that are applicable to Site Class D, and which per Exception 2 would result in an effective F_V factor of 2.72 (1.5 times larger). At the Santa Cruz main campus this only affects structures with T>0.69 seconds. We understand that the appropriateness of this requirement of Section 11.4.8 might be reviewed by UCOP.

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: 1996 Code: 1991 UBC	Code specified on structural drawings
Applicable code for partial retrofit	N/A	
Applicable code for full retrofit	N/A	
Model building data		
Model building type North-South	RM1 / RM2 – Reinforced Masonry	
Model building type East-West	RM1 / RM2 – Reinforced Masonry	
FEMA P-154 score	N/A	Not included here because we performed ASCE 41 Tier 1 evaluation.
Previous ratings		
Most recent rating	none	
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



East Elevation of Music Center Practice Studios and Class Lab



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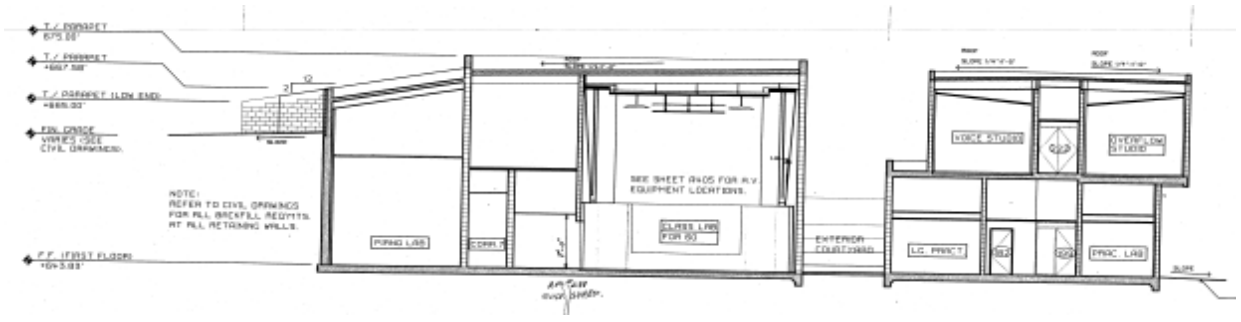
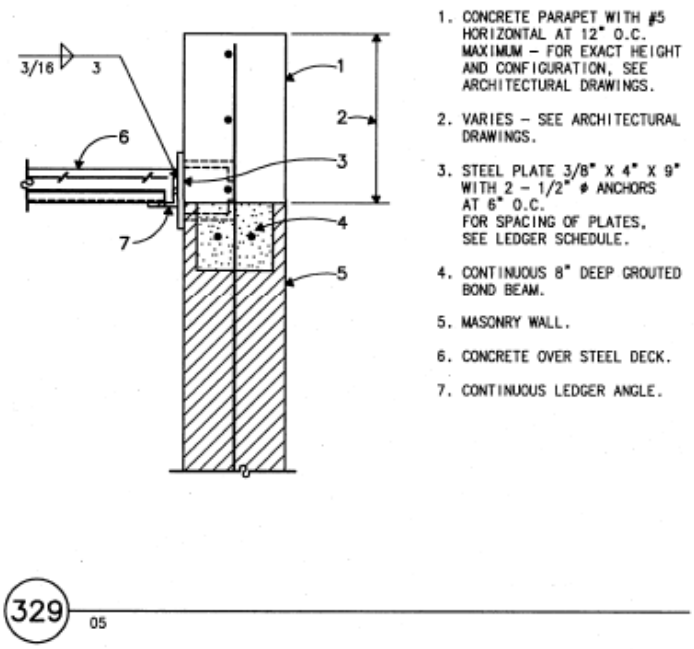


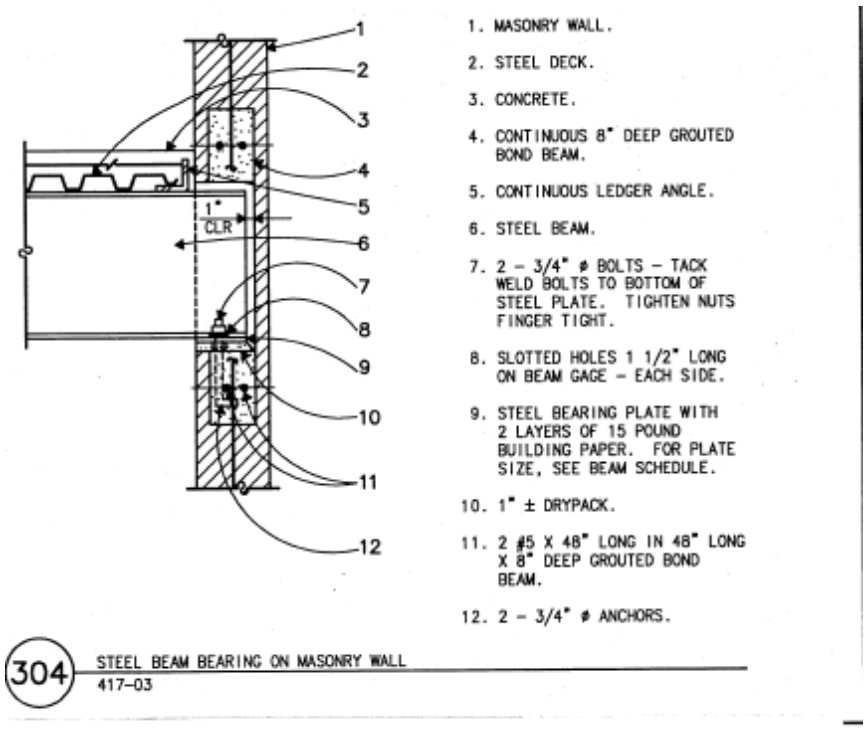
Section View Looking East

2nd Floor Plan of Practice Studios / Class Lab

High roof Plan of Practice Studios / Class Lab



Ledger angle connection at roof diaphragm to CMU wall, used around entire building perimeter



Joist connection at roof diaphragm to CMU wall, used at north and south walls only

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ASCE 41-17
Collapse Prevention Basic Configuration Checklist

LOW SEISMICITY

BUILDING SYSTEMS - *GENERAL*

C NC N/A U	Description
C	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:**
NC	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 a 2” seismic isolation joint between adjacent buildings. The shorter height is 28 ft which in high seismicity requires 5” separation. There is a 1” expansion joint between a walkway bridge and one of the structures. The shorter height is 15 ft which in high seismicity requires 2.7” separation.
N/A	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:**

BUILDING SYSTEMS - *BUILDING CONFIGURATION*

C NC N/A U	Description
C	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:**
C	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:**
C	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:**

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

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C	NC	N/A	U	
C				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:**
C				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:**
C				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:**

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

GEOLOGIC SITE HAZARD

	Description
C NC N/A U: C	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:**
C NC N/A U: C	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:**
C NC N/A U: C	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:**

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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 ○ ○ ○ ○ C	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:** W/H = 44/30=1.47 0.6 Sa = 0.6 x 1.28 = 0.77 g
C NC N/A U ○ ○ ○ ○ C	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:**

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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 C	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:**
C NC N/A U C	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:**
C NC N/A U C	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:**

STIFF DIAPHRAGMS

	Description
C NC N/A U N/A	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:**

CONNECTIONS

	Description
C NC N/A U NC	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:** The east and west walls of the south Class Lab in Building N rely on spot welds between the composite metal deck roof and the ledger angle along the walls for lateral support. In addition to the welded connections providing less ductility than other types of connection, the capacity of the welds is not adequate for lateral support of the wall.
C NC N/A U N/A	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:**

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

C NC N/A U	
C	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:**
N/A	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:**
C	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation. (Commentary: Sec. A.5.3.5. Tier 2: Sec. 5.7.3.4) **Comments:**
N/A	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:**

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

STIFF DIAPHRAGMS

C NC N/A U	Description
C	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:**
C	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:**

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

FLEXIBLE DIAPHRAGMS

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

CONNECTIONS

C NC N/A U	Description
N/A	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:**

SEISMIC EVALUATION OF EXISTING BUILDINGS - TIER 1 SCREENING

ASCE 41-17 Chapter 4

General					**Reference**
Building	Music Center North building - Class Labs				
Architect	Antoine S. Predock				
Structural Engineer	Robin E. Parke Associates, Inc.				
Location	402 McHenry Road, Santa Cruz, CA 95064				
Design date	1994				
Latitude	36.99309				
Longitude	-122.06133				
Stories above grade	2				

Seismic parameters					
Risk Category	II	2016 CBC Table 1604.5			III if occupancy greater t (ASCE 41-17 2.4.1.6, ASCE 7-16 Chapter 20)
Site Class	D	https://earthquake.usgs.gov/hazards/urban/sfbay/soiltype/			
Liquefaction hazard	Low	http://data-sccgis.opendata.arcgis.com/datasets/77d380d355934b38a44894154377e28d_62			(ASCE 41-17 3.3.4)
Landslide hazard	Low	http://data-sccgis.opendata.arcgis.com/datasets/7984aabd55ec4a4794ae33d7919bd9c7_133			
S_{DS}	1.087	https://hazards.atcouncil.org/	Based on ASCE 7-16 DE, used to determine "Level of Seismicity"		(ASCE 41-17 Eq 2-4)
S_{D1}	Null	https://hazards.atcouncil.org/	Based on ASCE 7-16 DE, used to determine "Level of Seismicity"		(ASCE 41-17 Eq 2-5)
S_{XS}	1.28	For BSE-2E hazard level		https://hazards.atcouncil.org/	(ASCE 41-17 Table 2-2)
S_{X1}	0.880	For BSE-2E hazard level		https://hazards.atcouncil.org/	(ASCE 41-17 Table 2-2)

Scope			
Performance level	Collapse Prevention		(ASCE 41-17 Table 2-2)
Seismic hazard level	BSE-2E		(ASCE 41-17 Table 2-2)
Level of seismicity	High		(ASCE 41-17 Table 2-4)
Building type	RM2: Reinforced Masonry Bearing Walls with Stiff Diaphragms + Partial C2		(ASCE 41-17 Table 3-1)

Material properties				Notes	
CMU	f'_m	1500	psi	Specified on drawings, NWC	(ASCE 41-17 Table 10-4)
Reinf.	f_y	60	ksi	Specified on Drawings	(ASCE 41-17 Table 10-4)
Grout		2000			
Steel	F_y	36	ksi	ASTM A36	(ASCE 41-17 Table 9-1)

Checklists

Benchmark building	No	Retrofit also pre-benchmark	(ASCE 41-17 Table 3-2)
Checklist(s) req'd	17.1.2 Basic Configuration		(ASCE 41-17 Table 4-6)
	17.12 Structural Checklist for Building Types RM		(ASCE 41-17 Table 4-6)
	~~17.19 Nonstructural Checklist~~	(not performed)	(ASCE 41-17 Table 4-6)

Seismic forces

V	4184	kip	$V = Cs_a W$	= 1.54W	(ASCE 41-17 Eq 4-1)
W	2724	kip	building weight		(ASCE 41-17 4.4.2.1)
C	1.2		Convert linear elastic to inelastic disp.		(ASCE 41-17 Table 4-7)
S_a	1.28	g	$S_a = S_{x1}/T \le S_{XS}$		(ASCE 41-17 Eq 4-3)
T	0.23	sec	$T = C_t h_n^{\beta}$		(ASCE 41-17 Eq 4-4)
C_t	0.020				(ASCE 41-17 Eq 4-4)
β	0.75				(ASCE 41-17 Eq 4-4)
h_n	26	ft	building height		(ASCE 41-17 Eq 4-4)

Story Forces (ASCE 41-17 4-2a) (ASCE 41-17 4-2b)

Note: The followings computation is for each of two wings separately

Story	w	story ht	h	wh^k	F_{story}	F_{story}	V_{story}
	kip	ft	ft			kip	kip
Roof	2469		26	64194	0.95	3964	
Loft	255	12.0	14	3570	0.05	220	3964
1		14.0	0	0	0.00	0	4184
Total	2724			67764	1.0	4184	

k 1.00 k = 1.0 for T < 0.5, 2.0 for T > 2.5, linear interpolation between

$F_{story} = V(wh^k)/(\Sigma wh^k)$ (ASCE 41-17 4-2a)

$V_{story} = \Sigma_{above} F_{story}$ (ASCE 41-17 4-2b)

Shear stress in shear walls (ASCE 41-17 4-8) (ASCE 41-17 4-8)

Story	$A_{w\,N\text{-}S}$ in^2	$A_{w\,E\text{-}W}$ in^2	v_{NS}^{avg} psi	v_{EW}^{avg} psi	D/C_{NS}	D/C_{EW}
Roof						
Loft	35184	38304	25	23	0.4	0.3
1	35184	38304	26	24	0.4	0.3
Total						

M_s 4.50 (ASCE 41-17 Table 4-8)

v_{limit} 70 psi v_{limit} = 70 psi RM

$v^{avg} = (1/M_S)(V_{story}/A_w)$ (ASCE 41-17 Eq 4-8)

SEISMIC EVALUATION OF EXISTING BUILDINGS - TIER 1 SCREENING

ASCE 41-17 Chapter 4

General			Reference
Building	Music Center South Building - Practice Studios / Low String & Grand Piano Studios		
Architect	Antoine S. Predock		
Structural Engineer	Robin E. Parke Associates, Inc.		
Location	402 McHenry Road, Santa Cruz, CA 95064		
Design date	1994		
Latitude	36.99309		
Longitude	-122.06133		
Stories above grade	2		

Seismic parameters

Risk Category	II	2016 CBC Table 1604.5		III if occupancy greater t (ASCE 41-17 2.4.1.6, ASCE 7-16 Chapter 20)
Site Class	D	https://earthquake.usgs.gov/hazards/urban/sfbay/soiltype/		
Liquefaction hazard	Low	http://data-sccgis.opendata.arcgis.com/datasets/77d380d355934b38a44894154377e28d_62		(ASCE 41-17 3.3.4)
Landslide hazard	Low	http://data-sccgis.opendata.arcgis.com/datasets/7984aabd55ec4a4794ae33d7919bd9c7_133		
S_{DS}	1.087	https://hazards.atcouncil.org/	Based on ASCE 7-16 DE, used to determine "Level of Seismicity"	(ASCE 41-17 Eq 2-4)
S_{D1}	Null	https://hazards.atcouncil.org/	Based on ASCE 7-16 DE, used to determine "Level of Seismicity"	(ASCE 41-17 Eq 2-5)
S_{XS}	1.28	For BSE-2E hazard level	https://hazards.atcouncil.org/	(ASCE 41-17 Table 2-2)
S_{X1}	0.880	For BSE-2E hazard level	https://hazards.atcouncil.org/	(ASCE 41-17 Table 2-2)

Scope

Performance level	Collapse Prevention	(ASCE 41-17 Table 2-2)
Seismic hazard level	BSE-2E	(ASCE 41-17 Table 2-2)
Level of seismicity	High	(ASCE 41-17 Table 2-4)
Building type	RM2: Reinforced Masonry Bearing Walls with Stiff Diaphragms	(ASCE 41-17 Table 3-1)

Material properties

				Notes	
CMU	f'_m	1500	psi	Specified on drawings, NWC	(ASCE 41-17 Table 10-4)
Reinf.	f_y	60	ksi	Specified on Drawings	(ASCE 41-17 Table 10-4)
Grout		2000			
Steel	F_y	36	ksi	ASTM A36	(ASCE 41-17 Table 9-1)

Checklists

Benchmark building	No	Retrofit also pre-benchmark	(ASCE 41-17 Table 3-2)
Checklist(s) req'd	17.1.2 Basic Configuration		(ASCE 41-17 Table 4-6)
	17.12 Structural Checklist for Building Types RM		(ASCE 41-17 Table 4-6)
	~~17.19 Nonstructural Checklist~~	(not performed)	(ASCE 41-17 Table 4-6)

Seismic forces

V	6771	kip	$V = Cs_a W$	= 1.54W	(ASCE 41-17 Eq 4-1)
W	4408	kip	building weight		(ASCE 41-17 4.4.2.1)
C	1.2		Convert linear elastic to inelastic disp.		(ASCE 41-17 Table 4-7)
S_a	1.28	g	$S_a = S_{x1}/T \le S_{XS}$		(ASCE 41-17 Eq 4-3)
T	0.26	sec	$T = C_t h_n^{\beta}$		(ASCE 41-17 Eq 4-4)
C_t	0.020				(ASCE 41-17 Eq 4-4)
β	0.75				(ASCE 41-17 Eq 4-4)
h_n	30	ft	building height		(ASCE 41-17 Eq 4-4)

Story Forces (ASCE 41-17 4-2a) (ASCE 41-17 4-2b)

Note: The followings computation is for each of two wings separately

Story	w	story ht	h	wh^k	F_{story}	F_{story}	V_{story}
	kip	ft	ft			kip	kip
Roof	1630		30	48900	0.54	3656	
2	2778	15.0	15	41670	0.46	3115	3656
1		15.0	0	0	0.00	0	6771
Total	4408			90570	1.0	6771	
k	1.00	k = 1.0 for T < 0.5, 2.0 for T > 2.5, linear interpolation between					

$F_{story} = V(wh^k)/(\Sigma wh^k)$ (ASCE 41-17 4-2a)

$V_{story} = \Sigma_{above} F_{story}$ (ASCE 41-17 4-2b)

Shear stress in shear walls (ASCE 41-17 4-8) (ASCE 41-17 4-8)

Story	$A_{w\,N\text{-}S}$ in^2	$A_{w\,E\text{-}W}$ in^2	v_{NS}^{avg} psi	v_{EW}^{avg} psi	D/C_{NS}	D/C_{EW}
Roof						
2	26112	26880	31	30	0.4	0.4
1	35616	36672	42	41	0.6	0.6
Total						

M_s 4.50 (ASCE 41-17 Table 4-8)

v_{limit} 70 psi v_{limit} = 70 psi RM

$v^{avg} = (1/M_S)(V_{story}/A_w)$ (ASCE 41-17 Eq 4-8)