Rating form completed by: **MAFFEI STRUCTURAL ENGINEERING**
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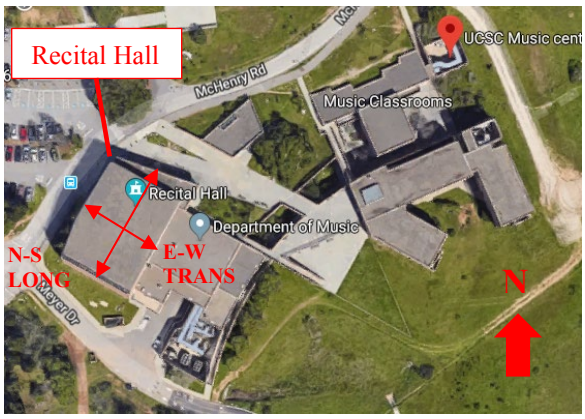
Text in green is to be part of UC Santa Cruz building database and may be part of UCOP database

UC Santa Cruz building seismic ratings

Music Center – Recital Hall

CAAN #7922.1
402 McHenry Road, Santa Cruz, CA 95064
UCSC Campus: Main Campus

DATE: 2019-06-24



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 bilding 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 Recital Hall (CAAN 7922.1).

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

[redacted]

Brief description of structure

The Recital Hall is a 2-story structure that contains approximately 10,000 square feet in the shape of an 82' (east-west) by 104' (north-south) rectangle, with a low-roofed outside reception and entrance space on the north side. An orchestra pit is located in the center of the hall. The structure measures 46' feet in height from the first floor to the roof, with a partial second floor at various elevations around the perimeter of the building. Reinforced concrete walls extend to the full height of the structure perimeter on 3 sides, the exception being on the west side where the wall includes a vertical gap for about half its length. Interior steel columns provide vertical support for the second floor. Floors at the second floor are mostly concrete fill over metal deck, with occasional reinforced concrete slabs. The roof consists of 3" concrete fill over 3" deep metal deck on steel joists that span east-west.

The building is adjacent to the Ensemble Rehearsal Wing located on the east and a 1" expansion joint separates the two buildings.

Foundation system: The structure lies on moderately sloping ground sloping down north to south and east to west, and therefore the first floor is partially embedded. The perimeter concrete walls are founded on continuous strip footings whereas the interior steel columns concrete mat slab on grade.

Identification of levels: To accommodate the sloped seating area, Level 1 varies in elevation between 643'-10'' at the stage to 656'-8" at the back of the audience seating and entry lobby. The partial Level 2 varies in elevation between 656'-8'' and 670'-8". The roof is inclined between elevation 690' at the north end to elevation 680' at the south end, both measured at the top of the parapet. The north entrance has a low roof at elevation 675'-4" measured at the top of the parapet.

Structural system for vertical (gravity) load: Reinforced concrete walls at the building perimeter, and steel columns on the building interior, support Level 2 and the roof. The roof framing consists of 3" thick concrete fill over 1.5" deep metal deck, supported by steel joists spaced 12 feet apart which span east to west and are supported on the perimeter concrete walls. Light gage steel members form a truss that hangs from the roof joists and supports the theater lighting equipment.

Level 2 consists of perimeter walkways and balconies, and is framed with 2.5" thick concrete fill over metal deck, spanning to steel W-beams supported at one end by the concrete perimeter wall and at the other end by steel columns. A portion of the perimeter walkway is framed with 8" concrete slab supported at one end by the concrete perimeter wall and at the other end by interior concrete walls.

Structural system for lateral forces: At Level 2, the portion of floor constructed with concrete fill over metal deck is anchored to the perimeter concrete walls by means of two 3/4" diameter anchor bolts at each beam, and where the second floor is built of concrete slab, the slab is keyed into the wall and the reinforcement is extended into the wall.

The concrete fill over metal deck diaphragm at the roof is anchored to the perimeter concrete 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 concrete walls all around the building perimeter. The steel beams that support the deck typically span east-west, so the walls on the east and west sides of the building are anchored to

the high roof diaphragm by both the beam connections and the puddle welds, but walls on the north and south sides of the building are anchored to the roof diaphragm with the puddle weld-to-ledger angle connection only.

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:

- The connection of the concrete fill over metal deck roof diaphragm to the north and south walls is inadequate for lateral support of the top of the concrete wall.
- The connection of the concrete fill over metal deck roof diaphragm is significantly inadequate to transfer the diaphragm seismic forces to the perimeter concrete walls.

Other seismic deficiencies include:

- The expansion gap between the Recital Hall and the adjacent Ensemble Rehearsal building (CAAN #7922.2) at east side, is 1" wide. It is likely that the gap is too small and that pounding might occur between the buildings in the case of a significant seismic event. Because the floors of the adjacent buildings do not align, the second floor and roof of the Ensemble Rehearsal Building would pound on the east concrete wall of the Recital Hall which has no floors at these elevations, and at roof level is at a higher elevation than that of the Ensemble Rehearsal building.
- The concrete fill over metal deck roof diaphragm is connected to the exterior walls with ledger angles anchored to the concrete 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.
- The roof diaphragm is discontinuous at the south end of the building, with a step at the connection of the diaphragm to the wall. Further evaluation is required to determine whether the step details are adequate for in-plane and out-of-plane diaphragm demands.
- The west wall of the building is discontinuous for over 80% of its length. Because wall shear stresses are low and the wall bears on solid wall at each end, it is not anticipated that this affects the building rating.

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 is inadequate for lateral support of the concrete wall, and significantly inadequate (DCR = 0.6) to transfer the diaphragm seismic forces to the perimeter concrete walls. A rating of V reflects this major deficiency.

Recommendations for further evaluation or retrofit

While the 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 concrete walls, which relies on the joists underlying the roof and running east to west consists of two 3/4" diameter anchor bolts at each joist in addition to spot welds to a ledger angle along the perimeter of the walls. The capacity of this connection is significantly inadequate to transmit the diaphragm seismic force to the concrete walls and should be evaluated further for the purpose of retrofit.

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.

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)	10,000	
Risk Category per 2016 CBC Table 1604.5	III	Assembly occupancy
Building structural height, h_n	33 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

[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.

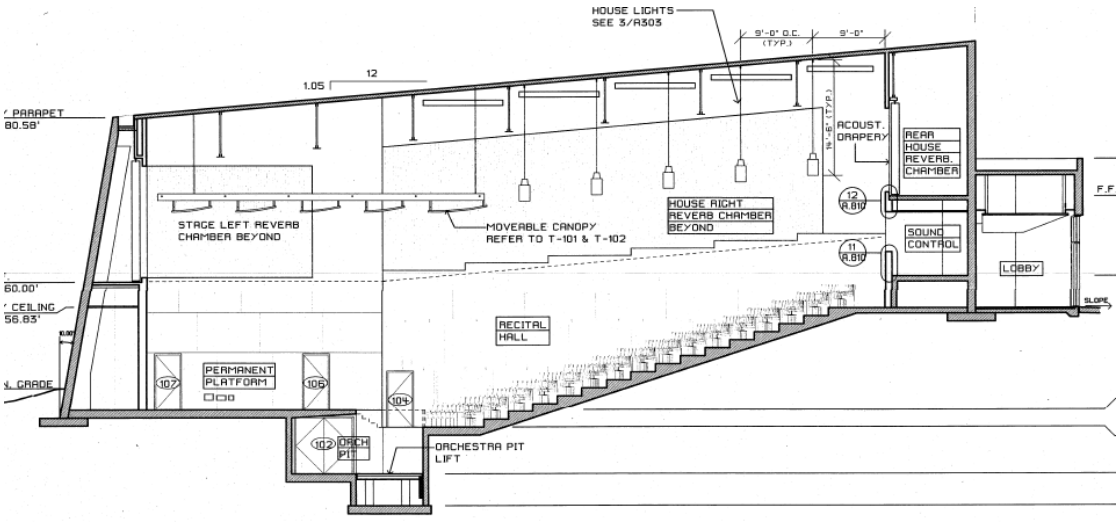
Estimated fundamental period	0.28 sec	Estimated using ASCE 41-17 equation 4-4 and 7-18
Site data		
975 yr hazard parameters S_s, S_1	1.28, 0.485	
Site class	D	
Site class basis[4]	Geotech	See footnote below
Site parameters F_a, F_v[5]	1, 1.815	
Ground motion parameters S_{cs}, S_{c1}	1.278, 0.878	
S_a 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	Santa Cruz County map	See footnote below
Landslide potential	Low	
Landslide assessment basis	Santa Cruz 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: 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	C2 – Concrete shear walls	Stiff diaphragm at roof
Model building type East-West	C2 – Concrete shear walls	Stiff diaphragm at roof
FEMA P-154 score	N/A	Not included here because we performed ASCE 41 Tier 1 evaluation.

[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

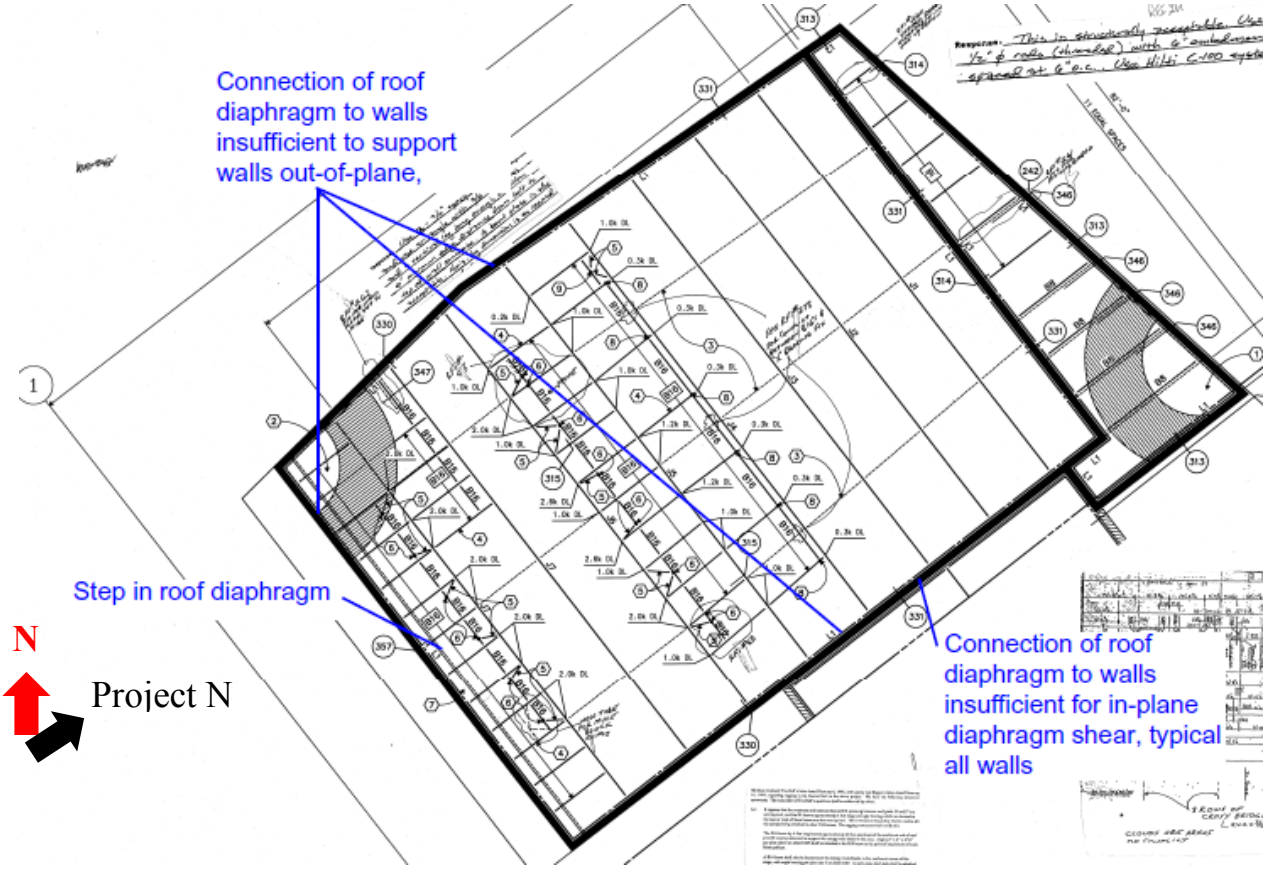
[5] F_V factor used does not include the requirements of Section 11.4.8-3 of ASCE 7-16 that are applicable to Site Class D, and which per Exception 2 would result in an effective F_V factor of 2.72 (1.5 times larger). At the Santa Cruz main campus this only affects structures with T>0.69 seconds. We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

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

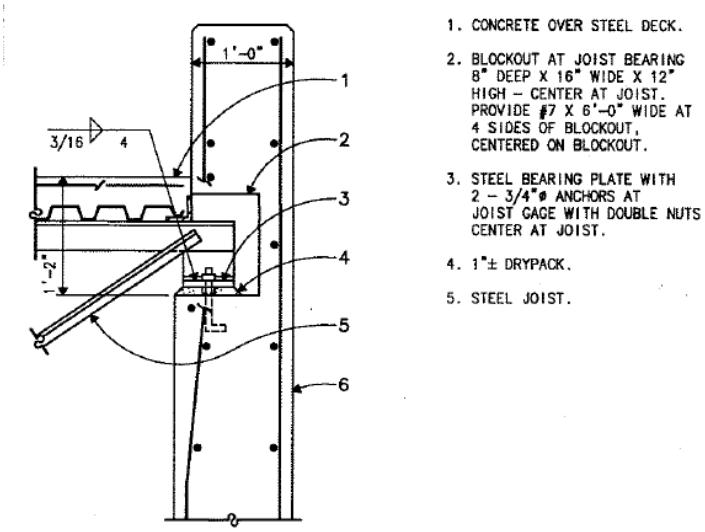
Annotated 1st Floor Plan of Recital Hall



Section Elevation of Recital Hall looking West



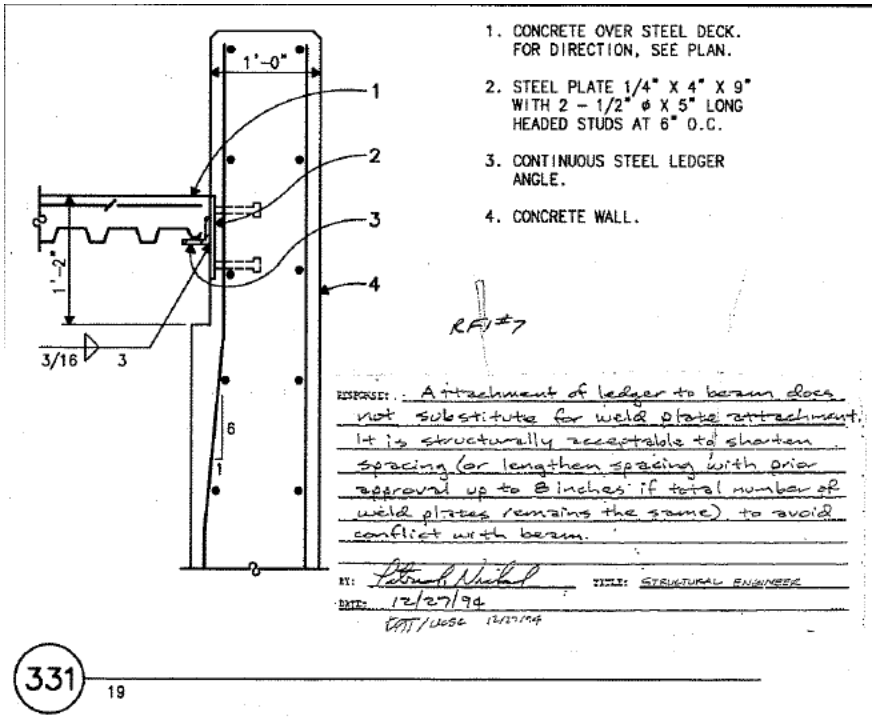
Roof Plan of Recital Hall



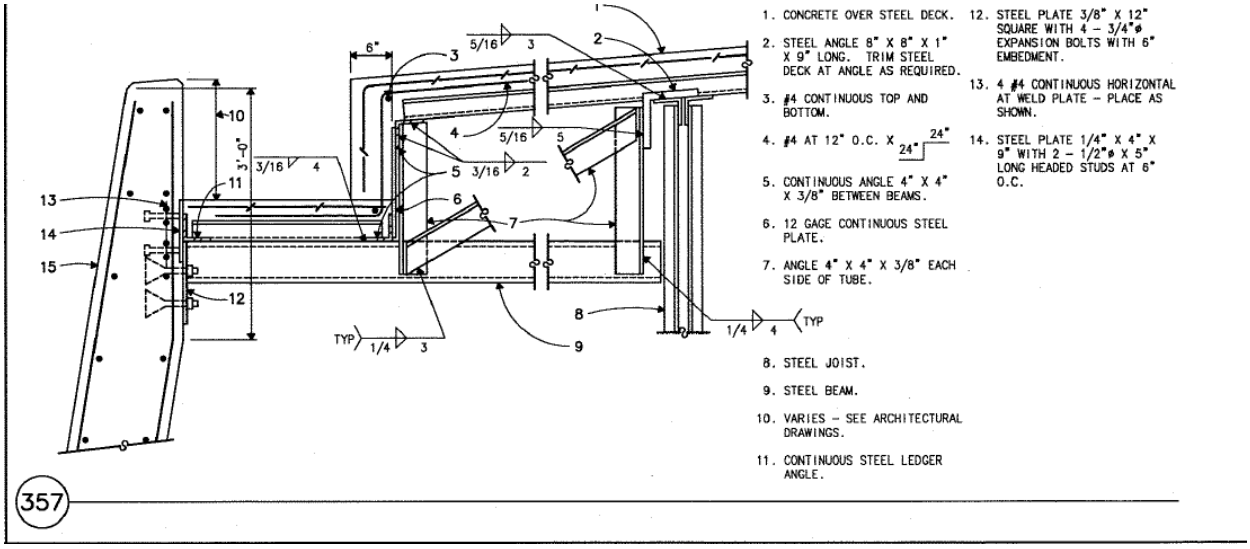
1. CONCRETE OVER STEEL DECK.
2. BLOCKOUT AT JOIST BEARING 8" DEEP X 16" WIDE X 12" HIGH – CENTER AT JOIST. PROVIDE #7 X 6'-0" WIDE AT 4 SIDES OF BLOCKOUT, CENTERED ON BLOCKOUT.
3. STEEL BEARING PLATE WITH 2 – 3/4"ø ANCHORS AT JOIST GAGE WITH DOUBLE NUTS CENTER AT JOIST.
4. 1"± DRYPACK.
5. STEEL JOIST.

330 19

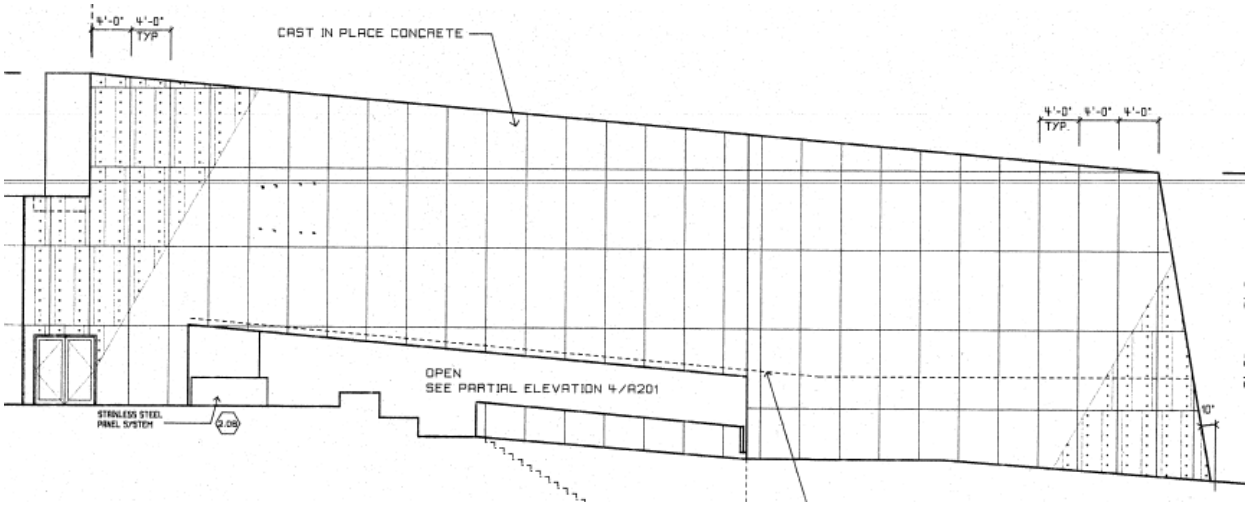
Joist connection at roof diaphragm to concrete wall, used at east and west walls only



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



Connection at roof diaphragm to concrete wall, at diaphragm step at the south wall



West Elevation of Recital Hall showing discontinuous wall at west wall

Discontinuous wall at west elevation of Recital Hall (looking north)

UC Campus:	UC Santa Cruz			Date:	6/24/19		
Building CAAN:	7922	Auxiliary CAAN:	7922.1	By Firm:	Maffei Structural Engineering		
Building Name:	Music Center – Recital Hall			Initials:	*TE/NY*	Checked:	*JM*
Building Address:	402 McHenry Road, 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
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 1" expansion joint between adjacent buildings. The shorter height is 28 ft which in high seismicity requires 5" 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:**
NC	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:** The west concrete shear wall offsets at Level 2.

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

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Building Name:	Music Center – Recital Hall			Initials:	*TE/NY*	Checked:	*JM*
Building Address:	402 McHenry Road, Santa Cruz, CA 95064			Page:	2	of	3

ASCE 41-17
Collapse Prevention Basic Configuration Checklist

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:**

UC Campus:	UC Santa Cruz			Date:	6/24/19		
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Building Name:	Music Center – Recital Hall			Initials:	*TE/NY*	Checked:	*JM*
Building Address:	402 McHenry Road, 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

	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 = 76/33=2.3 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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Building Address:	402 McHenry Road, Santa Cruz, CA 95064				1	of	3

ASCE 41-17
Collapse Prevention Structural Checklist For Building Type C2-C2A

Low And Moderate Seismicity

Seismic-Force-Resisting System

	Description
C NC N/A U ○ ○ ○ ○ NC	COMPLETE FRAMES: Steel or concrete frames classified as secondary components form a complete vertical-load-carrying system. (Commentary: Sec. A.3.1.6.1. Tier 2: Sec. 5.5.2.5.1) **Comments:** Concrete perimeter walls are bearing walls.
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 concrete shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the greater of 100 lb/in.^{2} (0.69 MPa) or 2 f'_c. (Commentary: Sec. A.3.2.2.1. Tier 2: Sec. 5.5.3.1.1) **Comments:** Shear stress is 59 psi max < 100 psi.
C NC N/A U ○ ○ ○ ○ C	REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area is not less than 0.0012 in the vertical direction and 0.0020 in the horizontal direction. (Commentary: Sec. A.3.2.2.2. Tier 2: Sec. 5.5.3.1.3) **Comments:** 14” perimeter wall typical with #4@10” e.f. horizontal reinforcement

Connections

	Description
C NC N/A U ○ ○ ◉ ○ NC	WALL ANCHORAGE AT FLEXIBLE DIAPHRAGMS: Exterior concrete or masonry walls that are dependent on flexible diaphragms 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:** Roof diaphragm is concrete fill over metal deck, so not flexible diaphragm. However, connections at the roof do not offer enough capacity to fully support the top of the concrete wall at 3 sides of the building. .
C NC N/A U ○ ○ ○ ○ NC	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:** Connections at the roof do not offer enough capacity to transfer diaphragm seismic demands to the concrete wall.

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ASCE 41-17
Collapse Prevention Structural Checklist For Building Type C2-C2A

C NC N/A U	
C	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation with vertical bars equal in size and spacing to the vertical wall reinforcing directly above the foundation. (Commentary: Sec. A.5.3.5. Tier 2: Sec. 5.7.3.4) **Comments:**

High Seismicity (Complete The Following Items In Addition To The Items For Low And Moderate Seismicity)

Seismic-Force-Resisting System

	Description
C NC N/A U C	DEFLECTION COMPATIBILITY: Secondary components have the shear capacity to develop the flexural strength of the components. (Commentary: Sec. A.3.1.6.2. Tier 2: Sec. 5.5.2.5.2) **Comments:** Steel interior columns
C NC N/A U N/A	FLAT SLABS: Flat slabs or plates not part of the seismic-force-resisting system have continuous bottom steel through the column joints. (Commentary: Sec. A.3.1.6.3. Tier 2: Sec. 5.5.2.5.3) **Comments:**
C NC N/A U N/A	COUPLING BEAMS: The ends of both walls to which the coupling beam is attached are supported at each end to resist vertical loads caused by overturning. (Commentary: Sec. A.3.2.2.3. Tier 2: Sec. 5.5.3.2.1) **Comments:**

Diaphragms (Stiff Or Flexible)

	Description
C NC N/A U NC	DIAPHRAGM CONTINUITY: The diaphragms are not composed of split-level floors and do not have expansion joints. (Commentary: Sec. A.4.1.1. Tier 2: Sec. 5.6.1.1) **Comments:** Step in roof diaphragm occurs at south wall
C NC N/A U 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:** No diaphragm openings adjacent to walls

UC Campus:	UC Santa Cruz			Date:	6/24/19		
Building CAAN:	7922	Auxiliary CAAN:	7922.1	By Firm:	Maffei Structural Engineering		
Building Name:	Music Center – Recital Hall			By:	*TK/NY*	Checked:	*JM*
Building Address:	402 McHenry Road, Santa Cruz, CA 95064				3	of	3

ASCE 41-17
Collapse Prevention Structural Checklist For Building Type C2-C2A

Flexible Diaphragms

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

	Description
C NC N/A U ○ ○ ○ ○ N/A	UPLIFT AT PILE CAPS: Pile caps have top reinforcement, and piles are anchored to the pile caps. (Commentary: Sec. A.5.3.8. Tier 2: Sec. 5.7.3.5) **Comments:**

SEISMIC EVALUATION OF EXISTING BUILDINGS - TIER 1 SCREENING

ASCE 41-17 Chapter 4

General				Reference
Building	Music Center - Recital Hall			
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	III	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	C2: Concrete shear wall with stiff diaphragms		(ASCE 41-17 Table 3-1)

Material properties				Notes	
CMU	f'_c	4000	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					
Steel	F_y	36	ksi	ASTM A36	(ASCE 41-17 Table 9-1)

Checklists

Benchmark building	No	(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 C2	(ASCE 41-17 Table 4-6)
	~~17.19 Nonstructural Checklist~~ (not performed)	(ASCE 41-17 Table 4-6)

Seismic forces

V	5894	kip	$V = Cs_a W$	= 1.54W	(ASCE 41-17 Eq 4-1)
W	3837	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	0.28	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	33	ft	building height		(ASCE 41-17 Eq 4-4)

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

Note:

Story	w kip	story ht ft	h ft	wh^k	F_{story}	F_{story} kip	V_{story} kip
Roof	2134		33	70422	0.73	4325	
2	1703	18.0	15	25545	0.27	1569	4325
1		15.0	0	0	0.00	0	5894
Total	3837			95967	1.0	5894	

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	23136	18528	42	52	0.3	0.4
1	23136	22272	57	59	0.4	0.5
Total						

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

v_{limit} 126 psi $v_{limit} = 2\sqrt{f_c'} \geq 100$ psi

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