

Rating form  
completed by:**MAFFEI STRUCTURAL ENGINEERING**  
maffei-structure.com

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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 – Ensemble Rehearsal Wing**

CAAN #7922.2

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 <sup>1</sup>
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 <sup>2</sup>	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

<sup>1</sup> 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.

<sup>2</sup> 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 Ensemble Rehearsal Wing (CAAN 7922.2).

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



South elevation



East elevation, looking north

### Brief description of structure

The Ensemble Rehearsal Wing consists of a 1 to 2-story structure, 12,500 sq. ft. gross area, with a tall 1-story Ensemble Rehearsal Hall at the center of the building. The Ensemble Rehearsal Hall is 32 feet in height from Level 1 slab on grade to the high point of the roof parapet. The foundation and walls of the Ensemble Rehearsal Hall are separated by an expansion joint from the surrounding structure.

The Ensemble Rehearsal Wing is adjacent to the Recital Hall (CAAN 7922.1) and a 1" expansion joint separates the two buildings. A 1" expansion joint also separates the building from the adjacent Practice Studios/Class Lab structure (CANN 7922) to the east.

Foundation system: The structure lies on moderately sloping ground. The building walls are founded on continuous strip footings.

Identification of levels: Level 1 is at elevation 643'-10" and Level 2 (which corresponds to the low roof elevation of the structure) is at elevation 656'-8". The roof is inclined between elevation 675'-4" at the west end to elevation 669'-8" at the east end, both measured at the top of the parapet.

Structural system for vertical (gravity) load: Reinforced and fully-grouted concrete masonry (CMU) walls support Level 2 and the roof. The Level 2 floor and roof framing consist of 2.5" thick concrete fill over 1.5" deep metal deck, spanning to steel W-beams which bear on the CMU walls.

Structural system for lateral forces: The concrete fill over metal deck diaphragm at the floor and 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.

At the Ensemble Rehearsal Hall roof, 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 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 seismic deficiency is identified:

- The connection of the concrete fill over metal deck roof diaphragm to the north and south walls of the Ensemble Rehearsal Hall relies on spot welds to a ledger angle running along the walls. The capacity of the welds is inadequate for lateral support of the top of the CMU wall.

Other seismic deficiencies include:

- The expansion joint between the Ensemble Rehearsal Wing and the adjacent Recital Hall (CAAN 7922.1) 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.
- In addition to the expansion joint between buildings, the foundation and walls of the Ensemble Rehearsal Hall are separated by a 1" expansion joint from the surrounding structure, except at the roof level where it is connected to the roof of the surrounding structure. Pounding may occur at the second floor/low roof, in which case the floor would pound on the CMU walls of the Ensemble Rehearsal Hall which has no floors at these elevations
- The roof-to-wall connection of the concrete fill over metal deck roof diaphragm to the walls, in the east-west direction for the Ensemble Rehearsal Hall, and north-south direction for the West wing consist of two 3/4" diameter anchor bolts at each W-beam and spot welds to the ledger angles along the walls. The margin of safety for transmitting the diaphragm seismic forces to the shear walls is small and should be re-examined. Current research suggests that welded connections of metal deck to supporting steel provide less ductility than other connection types such as fasteners.

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.<sup>3</sup>

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

<sup>3</sup> 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.

### Discussion of Rating

The connection of the concrete fill over metal deck roof diaphragm to the north and south walls of the Ensemble Rehearsal Hall is inadequate for lateral support of the CMU walls. A rating of V reflects this deficiency, in addition to other connection vulnerabilities as described above.

### Recommendations for further evaluation or retrofit

While the CMU 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 diaphragm to the north and south walls of the Ensemble Rehearsal Hall is inadequate for lateral support of the CMU walls. Further evaluation is also needed for the connection of roof to wall, which consists of two 3/4" diameter anchor bolts at each W-beam in addition to spot welds to a ledger angle along the perimeter of the walls. The capacity of these connections approaches the diaphragm seismic force transfer demands to the CMU 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.

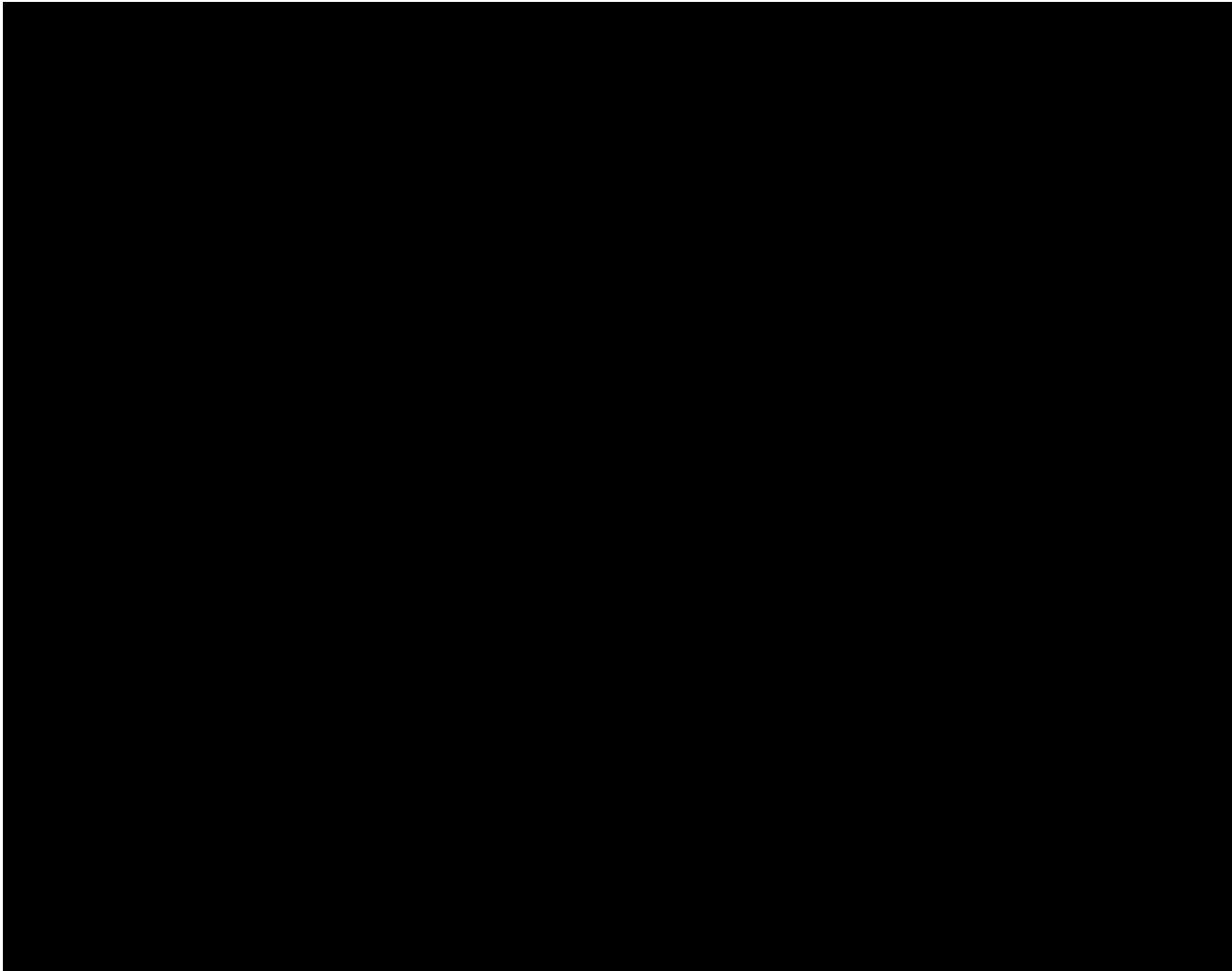
Additional building data	Entry	Notes
Latitude	36.993094	
Longitude	-122.061334	
Are there other structures besides this one under the same CAAN#	No	
Number of stories above lowest perimeter grade	2	
Number of stories (basements) below lowest perimeter grade	0	
Building occupiable area (OGSF)	12,500	
Risk Category per 2016 CBC Table 1604.5	II	Assembly occupancy
Building structural height, $h_n$	26.5 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, $\beta$	0.75	Estimated using ASCE 41-17 equation 4-4 and 7-18
Estimated fundamental period	0.23 sec	Estimated using ASCE 41-17 equation 4-4 and 7-18
<b>Site data</b>		
975 yr hazard parameters $S_s, S_1$	1.28, 0.485	
Site class	D	
Site class basis <sup>4</sup>	Geotech	See footnote below

<sup>4</sup> 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:

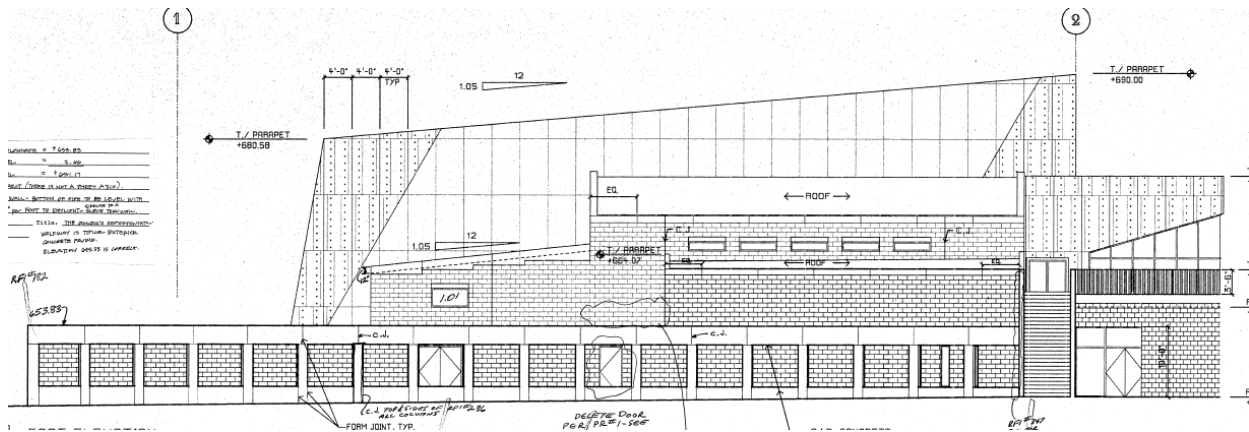
<https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/LiquifactionMap2009.pdf>  
<https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/LandslideMap2009.pdf>  
<https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/FaultZoneMap2009.pdf>

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	
<b>Applicable code</b>		
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	
<b>Model building data</b>		
Model building type North-South	RM2 – Reinforced Masonry	
Model building type East-West	RM2 – Reinforced Masonry	
FEMA P-154 score	N/A	Not included here because we performed ASCE 41 Tier 1 evaluation.
<b>Previous ratings</b>		
Most recent rating	none	
Date of most recent rating	-	
2 <sup>nd</sup> most recent rating	-	
Date of 2 <sup>nd</sup> most recent rating	-	
<b>Appendices</b>		
ASCE 41 Tier 1 checklist included here?	Yes	Refer to attached checklist file

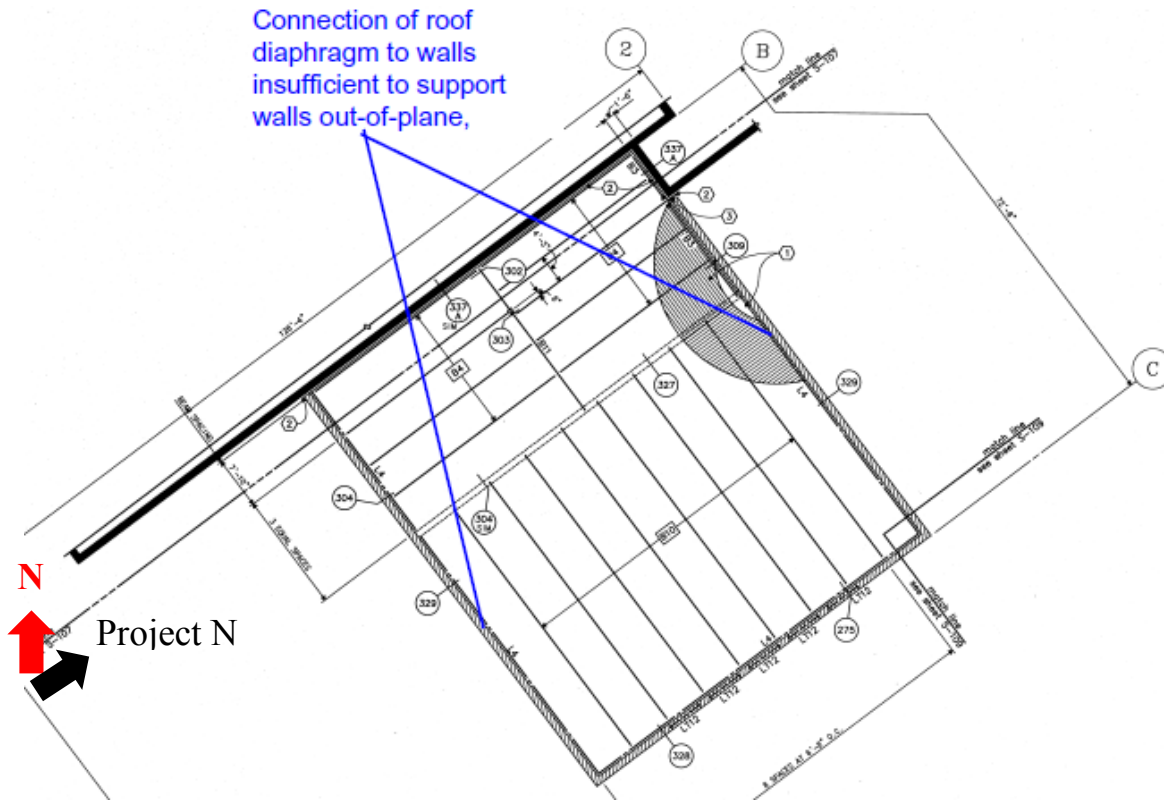
<sup>5</sup>  $F_v$  factor used does not include the requirements of Section 11.4.8-3 of ASCE 7-16 that are applicable to Site Class D, and which per Exception 2 would result in an effective  $F_v$  factor of 2.72 (1.5 times larger). At the Santa Cruz main campus this only affects structures with  $T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



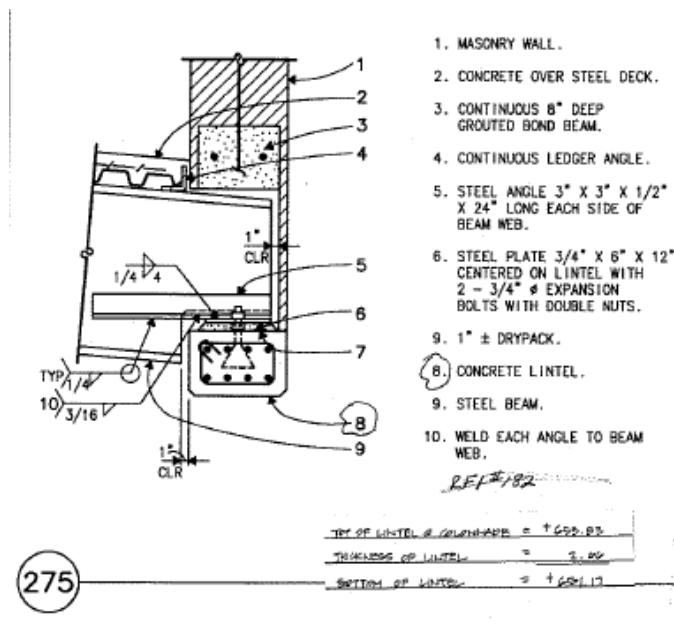
Annotated 2<sup>nd</sup> Floor Plan of Rehearsal Wing



East Elevation of Ensemble Rehearsal Wing with Recital Hall (CAAN 7922.1) behind



Roof Plan of Ensemble Rehearsal Hall

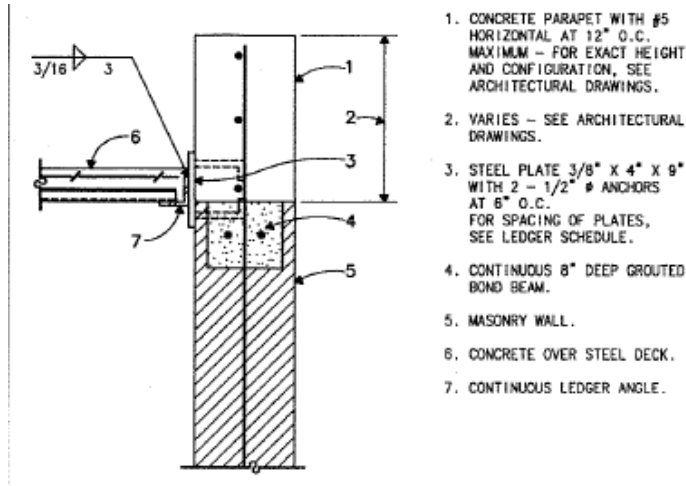


1. MASONRY WALL.
  2. CONCRETE OVER STEEL DECK.
  3. CONTINUOUS 8" DEEP GROUTED BOND BEAM.
  4. CONTINUOUS LEDGER ANGLE.
  5. STEEL ANGLE 3" X 3" X 1/2" X 24" LONG EACH SIDE OF BEAM WEB.
  6. STEEL PLATE 3/4" X 6" X 12" CENTERED ON LINTEL WITH 2 - 3/4"  $\phi$  EXPANSION BOLTS WITH DOUBLE NUTS.
  9. 1"  $\pm$  DRYPACK.
  8. CONCRETE LINTEL.
  9. STEEL BEAM.
  10. WELD EACH ANGLE TO BEAM WEB.
- REF # 192

TOP OF LINTEL @ CORNER/END	= + 652.83
THICKNESS OF LINTEL	= 2.00
SETTING OF LINTEL	= + 650.17

275





1. CONCRETE PARAPET WITH #5 HORIZONTAL AT 12" O.C. MAXIMUM - FOR EXACT HEIGHT AND CONFIGURATION, SEE ARCHITECTURAL DRAWINGS.
2. VARIES - SEE ARCHITECTURAL DRAWINGS.
3. STEEL PLATE 3/8" X 4" X 9" WITH 2 - 1/2" Ø ANCHORS AT 8" O.C. FOR SPACING OF PLATES, SEE LEDGER SCHEDULE.
4. CONTINUOUS 8" DEEP GROUTED BOND BEAM.
5. MASONRY WALL.
6. CONCRETE OVER STEEL DECK.
7. CONTINUOUS LEDGER ANGLE.

329 05

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

UC Campus:	UC Santa Cruz			Date:	6/24/19		
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Building Name:	Music Center – Ensemble Rehearsal Wing			Initials:	TE/INY	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

	Description
<b>C NC N/A U</b> <input checked="" type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <b>C</b>	<b>LOAD PATH:</b> 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)  <b>Comments:</b>
<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <b>NC</b>	<b>ADJACENT BUILDINGS:</b> 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)  <b>Comments:</b> There is a 1" expansion joint between adjacent buildings. The shorter height is 28 ft which in high seismicity requires 5" separation.
<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <b>N/A</b>	<b>MEZZANINES:</b> 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)  <b>Comments:</b>

#### BUILDING SYSTEMS - BUILDING CONFIGURATION

	Description
<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <b>C</b>	<b>WEAK STORY:</b> 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. A.2.2.2. Tier 2: Sec. 5.4.2.1)  <b>Comments:</b>
<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <b>C</b>	<b>SOFT STORY:</b> 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)  <b>Comments:</b>
<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <b>C</b>	<b>VERTICAL IRREGULARITIES:</b> 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)  <b>Comments:</b>

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

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## ASCE 41-17 Collapse Prevention Basic Configuration Checklist

<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>  NC	<p><b>GEOMETRY:</b> 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)</p> <p><b>Comments:</b> The roof, as well as the corresponding lateral load resisting system, has a much reduced surface area than the low roof/second floor. This is not considered a deficiency.</p>
<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>  NC	<p><b>MASS:</b> 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)</p> <p><b>Comments:</b> The roof has a much reduced surface area than the low-roof/second floor. This is not considered a deficiency.</p>
<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>  C	<p><b>TORSION:</b> 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)</p> <p><b>Comments:</b></p>

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

#### GEOLOGIC SITE HAZARD

	Description
<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>  C	<p><b>LIQUEFACTION:</b> 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)</p> <p><b>Comments:</b></p>
<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>  C	<p><b>SLOPE FAILURE:</b> 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)</p> <p><b>Comments:</b></p>
<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>  C	<p><b>SURFACE FAULT RUPTURE:</b> 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)</p> <p><b>Comments:</b></p>

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## ASCE 41-17 Collapse Prevention Basic Configuration Checklist

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

#### FOUNDATION CONFIGURATION

	Description												
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"><b>C</b></td> <td style="text-align: center;"><b>NC</b></td> <td style="text-align: center;"><b>N/A</b></td> <td style="text-align: center;"><b>U</b></td> </tr> <tr> <td style="text-align: center;"><input type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> </tr> <tr> <td colspan="4" style="text-align: center; padding-top: 10px;"><b>C</b></td> </tr> </table>	<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>C</b>				<p><b>OVERTURNING:</b> 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 <math>0.6S_a</math>. (Commentary: Sec. A.6.2.1. Tier 2: Sec. 5.4.3.3)</p> <p><b>Comments:</b> <math>W/H = 70/23=3.0</math>  <math>0.6 S_a = 0.6 \times 1.28 = 0.77 \text{ g}</math></p>
<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>										
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>										
<b>C</b>													
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"><b>C</b></td> <td style="text-align: center;"><b>NC</b></td> <td style="text-align: center;"><b>N/A</b></td> <td style="text-align: center;"><b>U</b></td> </tr> <tr> <td style="text-align: center;"><input type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> </tr> <tr> <td colspan="4" style="text-align: center; padding-top: 10px;"><b>C</b></td> </tr> </table>	<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>C</b>				<p><b>TIES BETWEEN FOUNDATION ELEMENTS:</b> 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)</p> <p><b>Comments:</b></p>
<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>										
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>										
<b>C</b>													

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

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

LOW AND MODERATE SEISMICITY							
SEISMIC-FORCE-RESISTING SYSTEM							
				Description			
<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>	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)			
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Comments:</b>			
C							
<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>	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. <sup>2</sup> (0.48 MPa). (Commentary: Sec. A.3.2.4.1. Tier 2: Sec. 5.5.3.1.1)			
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Comments:</b>			
C							
<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>	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)			
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Comments:</b>			
C							
STIFF DIAPHRAGMS							
				Description			
<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>	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)			
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Comments:</b>			
N/A							
CONNECTIONS							
				Description			
<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>	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)			
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Comments:</b> The North and South walls of the Ensemble Rehearsal hall 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.			
NC							

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Building CAAN:	7922	Auxiliary CAAN:	7922.2	By Firm:	Maffei Structural Engineering		
Building Name:	Music Center – Ensemble Rehearsal Wing			Initials:	TEINY	Checked:	JM
Building Address:	402 McHenry Road, Santa Cruz, CA 95064			Page:	2	of	4

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

<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>  N/A	<b>WOOD LEDGERS:</b> 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)  <b>Comments:</b>
<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>  C	<b>TRANSFER TO SHEAR WALLS:</b> Diaphragms are connected for transfer of seismic forces to the shear walls. (Commentary: Sec. A.5.2.1. Tier 2: Sec. 5.7.2)  <b>Comments:</b> Even when accounting for spot weld connection capacity, the margin of capacity to demand is small.
<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>  N/A	<b>TOPPING SLAB TO WALLS OR FRAMES:</b> 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)  <b>Comments:</b>
<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>  C	<b>FOUNDATION DOWELS:</b> Wall reinforcement is doweled into the foundation. (Commentary: Sec. A.5.3.5. Tier 2: Sec. 5.7.3.4)  <b>Comments:</b>
<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>  N/A	<b>GIRDER–COLUMN CONNECTION:</b> 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)  <b>Comments:</b>

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

#### STIFF DIAPHRAGMS

	Description
<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>  C	<b>OPENINGS AT SHEAR WALLS:</b> 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)  <b>Comments:</b>
<b>C NC N/A U</b> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>  C	<b>OPENINGS AT EXTERIOR MASONRY SHEAR WALLS:</b> 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)  <b>Comments:</b>

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

FLEXIBLE DIAPHRAGMS							
				Description			
<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>	CROSS TIES: There are continuous cross ties between diaphragm chords. (Commentary: Sec. A.4.1.2. Tier 2: Sec. 5.6.1.2)			
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Comments:</b>			
N/A							
<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>	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)			
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Comments:</b>			
N/A							
<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>	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)			
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Comments:</b>			
N/A							
<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>	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)			
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Comments:</b>			
N/A							
<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>	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)			
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Comments:</b>			
N/A							
<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>	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)			
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Comments:</b>			
N/A							
<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>	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)			
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Comments:</b>			
C							

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

CONNECTIONS							
				Description			
<b>C</b>	<b>NC</b>	<b>N/A</b>	<b>U</b>	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)			
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<b>Comments:</b>			
N/A							

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## SEISMIC EVALUATION OF EXISTING BUILDINGS - TIER 1 SCREENING

### ASCE 41-17 Chapter 4

#### General

Building	Music Center - Ensemble Rehearsal Wing
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

#### Reference

#### 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	<a href="https://earthquake.usgs.gov/hazards/urban/sfbay/soiltype/">https://earthquake.usgs.gov/hazards/urban/sfbay/soiltype/</a>	Chapter 20)
Liquefaction hazard	Low	<a href="http://data-sccgis.opendata.arcgis.com/datasets/77d380d355934b38a44894154377e28d_62">http://data-sccgis.opendata.arcgis.com/datasets/77d380d355934b38a44894154377e28d_62</a>	(ASCE 41-17 3.3.4)
Landslide hazard	Low	<a href="http://data-sccgis.opendata.arcgis.com/datasets/7984aabd55ec4a4794ae33d7919bd9c7_133">http://data-sccgis.opendata.arcgis.com/datasets/7984aabd55ec4a4794ae33d7919bd9c7_133</a>	
$S_{DS}$	1.087	Based on ASCE 7-16 DE, used to determine "Level of Seismicity" <a href="https://hazards.atcouncil.org/">https://hazards.atcouncil.org/</a>	(ASCE 41-17 Eq 2-4)
$S_{D1}$	Null	Based on ASCE 7-16 DE, used to determine "Level of Seismicity" <a href="https://hazards.atcouncil.org/">https://hazards.atcouncil.org/</a>	(ASCE 41-17 Eq 2-5)
$S_{XS}$	1.28	For BSE-2E hazard level <a href="https://hazards.atcouncil.org/">https://hazards.atcouncil.org/</a>	(ASCE 41-17 Table 2-2)
$S_{X1}$	0.880	For BSE-2E hazard level <a href="https://hazards.atcouncil.org/">https://hazards.atcouncil.org/</a>	(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)



Project: \_\_\_\_\_  
 Subject: \_\_\_\_\_  
 By: \_\_\_\_\_  
 Date: \_\_\_\_\_

**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**

$V$	3566	kip	$V = C_s a W = 1.54W$	(ASCE 41-17 Eq 4-1)
$W$	2322	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	$S_a = S_{x1} / T \leq S_{XS}$	(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)
$\beta$	0.75			(ASCE 41-17 Eq 4-4)
$h_n$	25.5	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 kip	story ht ft	h ft	$wh^k$	$F_{story}$	$F_{story}$ kip	$V_{story}$ kip
Roof	810		26	20655	0.53	1899	
2	1511.8	13.5	12	18142	0.47	1668	1899
1		12.0	0	0	0.00	0	3566
<b>Total</b>	<b>2322</b>			<b>38797</b>	<b>1.0</b>	<b>3566</b>	

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

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

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



Project: \_\_\_\_\_  
 Subject: \_\_\_\_\_  
 By: \_\_\_\_\_  
 Date: \_\_\_\_\_

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

Story	$A_{wN-S}$ in <sup>2</sup>	$A_{wE-W}$ in <sup>2</sup>	$v_{NS}^{avg}$ psi	$v_{EW}^{avg}$ psi	$D/C_{NS}$	$D/C_{EW}$
Roof						
2	14976	17093	28	25	0.4	0.4
1	24576	16603	32	48	0.5	0.7
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)