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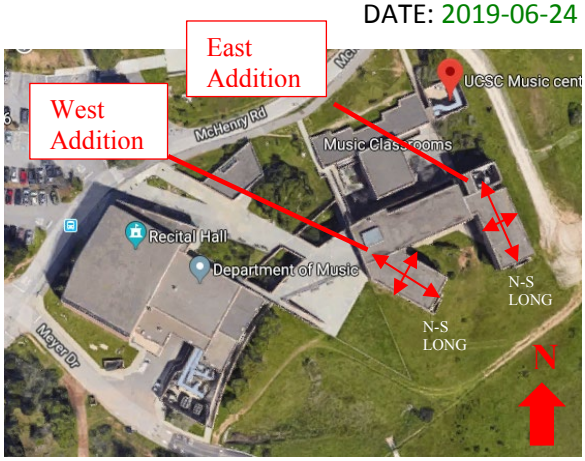
Text in green is to be part of UC Santa Cruz building database and may be part of UCOP database

UC Santa Cruz building seismic ratings

Music Center – Addition

CAAN #7922.3
402 McHenry Road, Santa Cruz, CA 95064
UCSC Campus: Main Campus

DATE: 2019-06-24



Rating summary	Entry	Notes
UC Seismic Performance Level (rating)	IV (Fair)	
Rating basis	Tier 1	ASCE 41-17[1]
Date of rating	2019	
Recommended UC Santa Cruz priority category for retrofit	-	
Ballpark total construction cost to retrofit to IV rating[2]	-	See recommendations on further evaluation and retrofit
Is 2018-2019 rating required by UCOP?	Yes	Building was not previously rated
Further evaluation recommended?	No	

[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 Boora Architects, Volume B: issued 1 November 1996 (stamped 13 November 1996).
- Structural drawings by KPFF Consulting Engineers, Volume B: issued 1 November 1996.
- 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 Addition (CAAN 7922.3).

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

Brief description of structure

The Music Building Addition is composed of two buildings (labeled 3W and 3E in picture above). The two structures are similar in structural system and height.

Building 3W is a 2-story structure that contains approximately 5,000 square feet in the shape of a 38' (east-west) by 66' (north-south) rectangle, with outside stairs on the south end. The structure measures 14'-8" in height from Level 1 to Level 2 and an additional 13'-4" to the roof, for a total height of 30' to the top of the 2' parapet on the roof. Reinforced and fully grouted concrete masonry unit (CMU) walls extend to the full height of the structure on all four sides of the building. All interior walls are also reinforced CMU walls. Floors at Level 2 are concrete fill over metal deck, and the roof is metal deck. The building is adjacent to the Practice Studios/ Class Lab building (CAAN 7922) to the north, and a 2" seismic isolation joint separates the two buildings.

Building 3E is also a 2-story structure that contains approximately 5,600 square feet in the shape of a 63-8" (east-west) by 79' (north-south) rectangle, with outside stairs on the south end. The structure measures 14'-8" feet in height from Level 1 to Level 2 and an additional 13'-4" to the roof, for a total height of 30' to the top of the 2' parapet on the roof. A 12" reinforced concrete wall acts as a retaining wall on the east side, and transitions into a reinforced and fully grouted concrete masonry unit (CMU) wall at the second floor. For the 3 remaining sides, reinforced and fully grouted CMU walls extend the full height of the structure. All interior walls are also reinforced CMU walls. Floors at Level 2 are concrete fill over metal deck, and the roof is metal deck. The building is adjacent to the Practice Studios/ Class Lab building (CAAN 7922) to the north, and a 2" seismic isolation joint separates the two buildings. The building is also adjacent to an enclosed mechanical area at the north end and is structurally connected to the south wall of the mechanical area.

Identification of levels: Level 1 is at elevation 643'-10'', Level 2 is at elevation 658'-6'', and the roof is at elevation 671'-10".

Foundation system: Building 3W bears on level ground. At Building 3E, the ground surface slopes down from east to west with an elevation differential of 10 feet. Level 1 is therefore partially embedded below grade, with a reinforced concrete retaining wall on the east side. The superstructure is founded on a reinforced concrete mat slab on grade.

Structural system for vertical (gravity) load: Reinforced and fully grouted concrete masonry (CMU) walls support Level 2 and the roof. The Level 2 floor framing consists of concrete fill over metal deck supported by steel W-beams

spanning to CMU walls; the roof framing consists of bare 3" deep metal deck supported by steel W-beams also spanning to CMU walls.

Structural system for lateral forces: In Building 3W, the concrete fill over metal deck at Level 2 is supported on steel W-beams spanning east to west, which are tied to the CMU walls with two 1/2" diameter studs at the exterior walls and two 3/4" diameter studs at the interior walls. The roof is metal deck on steel W-beams spanning east to west, which are tied to the CMU walls below with two 1/2" diameter studs at the exterior walls and two 3/4" diameter studs at the interior walls. Spot welds are applied along the perimeter supports of the Level 2 and roof floor diaphragms.

Building 3E is similar to Building 3W, except that the south of the Level 2 portion (thicker composite metal deck approximately 24 foot long) is supported by steel W-beams spanning north-south.

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

No major seismic deficiencies are identified in the building. It is important to note that:

- The seismic isolation gap between buildings 3E and 3W on one side and the adjacent Lab Studios (CAAN 7922) building is 2" wide. It is likely that the seismic gap is too small and that pounding might occur between the buildings in the case of a significant seismic event. Since the floor levels align on each side of the joint, this is not anticipated to affect the rating.
- The concrete fill over metal deck roof diaphragm is connected to the perimeter supporting walls by puddle welds to steel ledgers anchored to the walls. 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	N	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 rating of IV reflects the adequacy of seismic design capable of resisting the BSE-C level motion; the shear stress in the walls is estimated to meet the required limit of 70 lb/in^2, and the connections between roof and walls are considered adequate, but not strong enough to merit a rating of III.

Recommendations for further evaluation or retrofit

None

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)	10,600	
Risk Category per 2016 CBC Table 1604.5	II	
Building structural height, h_n	28 ft	Structural height defined per ASCE 7-16 Section 11.2
Coefficient for period, C_t	0.020	Estimated using ASCE 41-17 equation 4-4 and 7-18
Coefficient for period, β	0.75	Estimated using ASCE 41-17 equation 4-4 and 7-18
Estimated fundamental period	0.24 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	

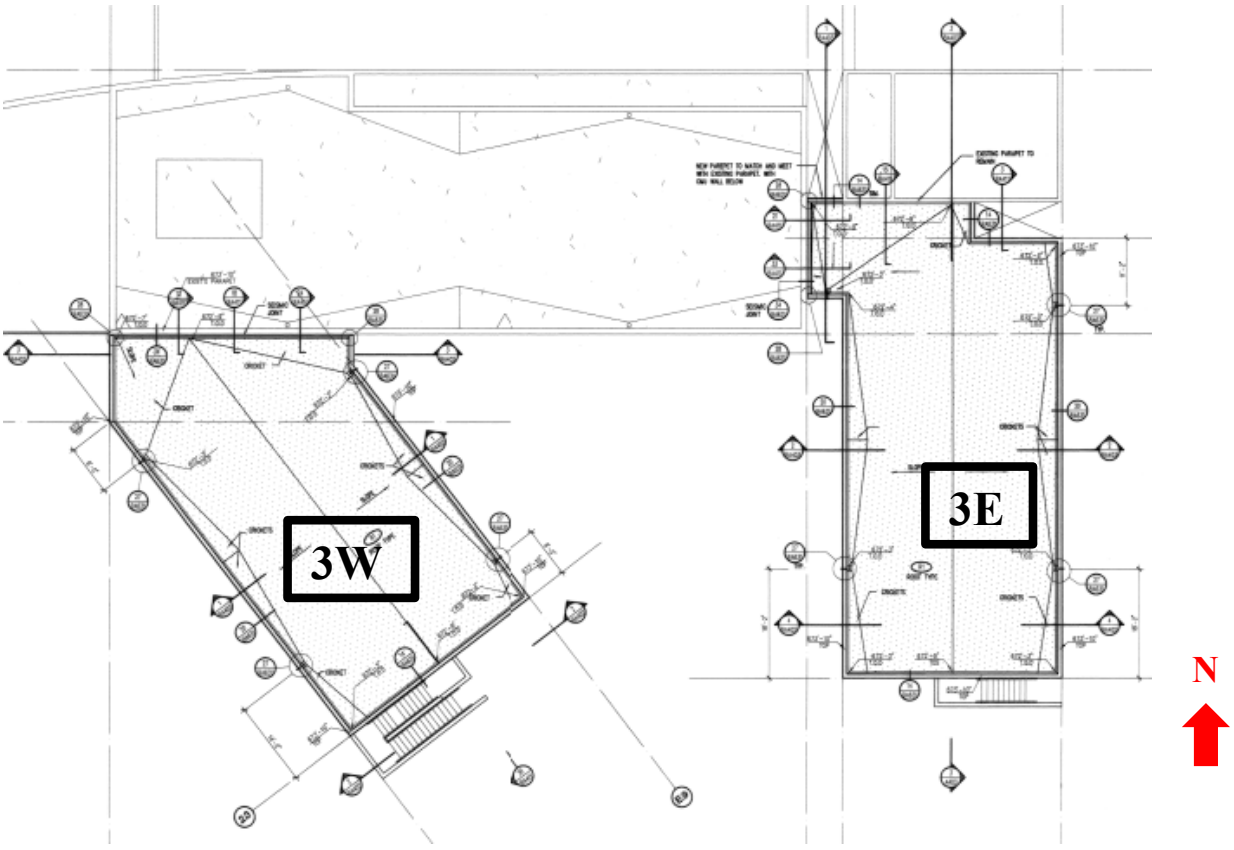
[3] For these Tier 1 evaluations, we do not visit all spaces of the building; we rely on campus staff to report to us their understanding of if and where non-structural hazards may occur.

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: 1998 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	2nd floor diaphragm is stiff, roof diaphragm is flexible
Model building type East-West	RM1 / RM2 – Reinforced Masonry	2nd floor diaphragm is stiff, roof diaphragm is flexible
FEMA P-154 score	N/A	Not included here because we performed ASCE 41 Tier 1 evaluation.

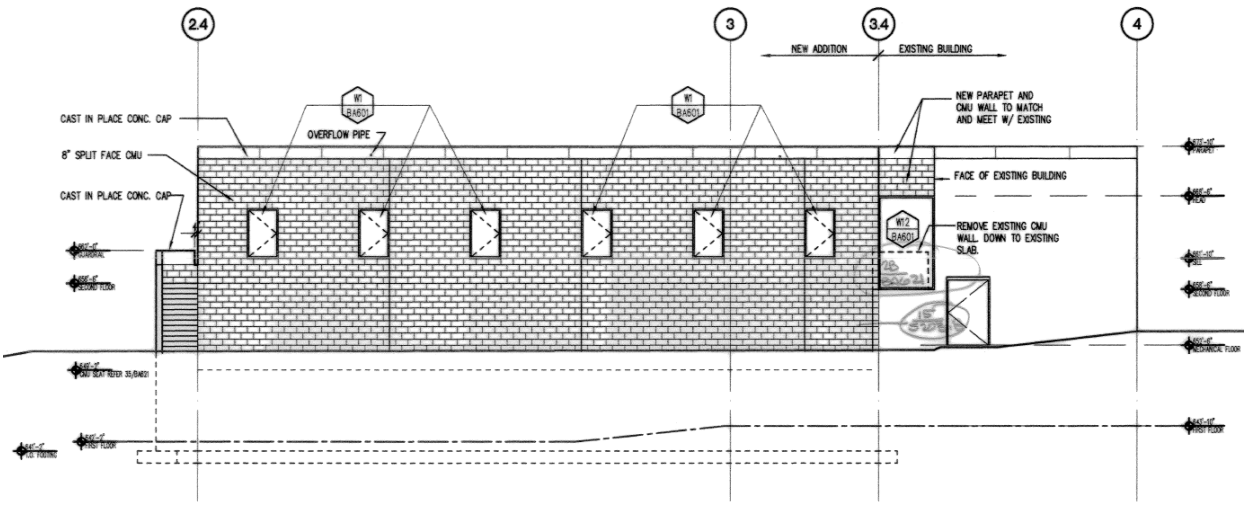
[4] Determination of site class and assessment of geotechnical hazards are based on correspondence with Pacific Crest Geotechnical Engineers and Nolan, Zinn, and Associates Geologists. [*Revised Geology and Geologic Hazards, Santa Cruz Campus, University of California*, Job # 04003-SC 13 May 2005]. Site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

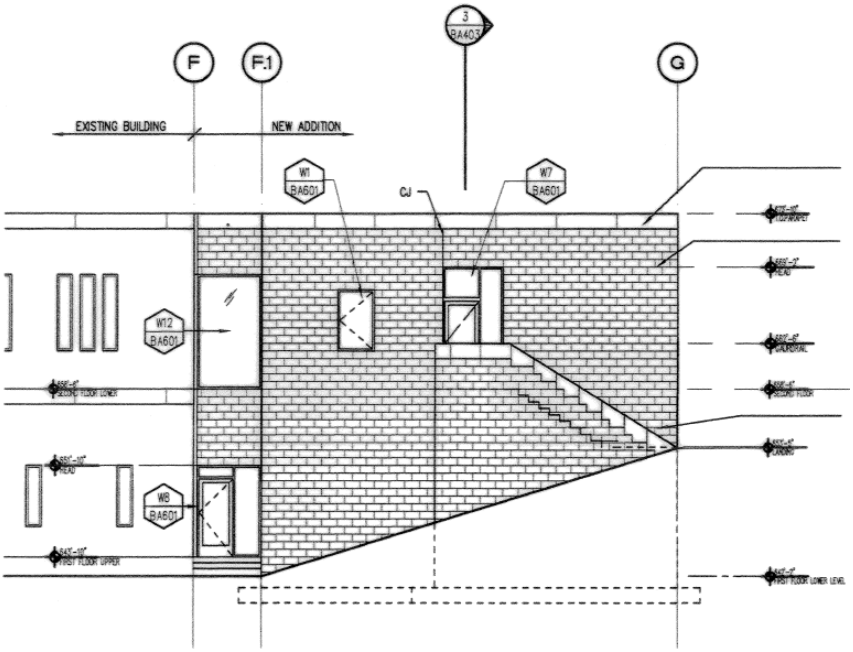
Previous ratings		
Most recent rating	none	
Date of most recent rating	-	
2nd most recent rating	-	
Date of 2nd most recent rating	-	
3rd most recent rating	-	
Date of 3rd most recent rating	-	
Appendices		
ASCE 41 Tier 1 checklist included here?	Yes	Refer to attached checklist file



Annotated Roof Plan



East Elevation of Building 3E



South Elevation of Building 3E

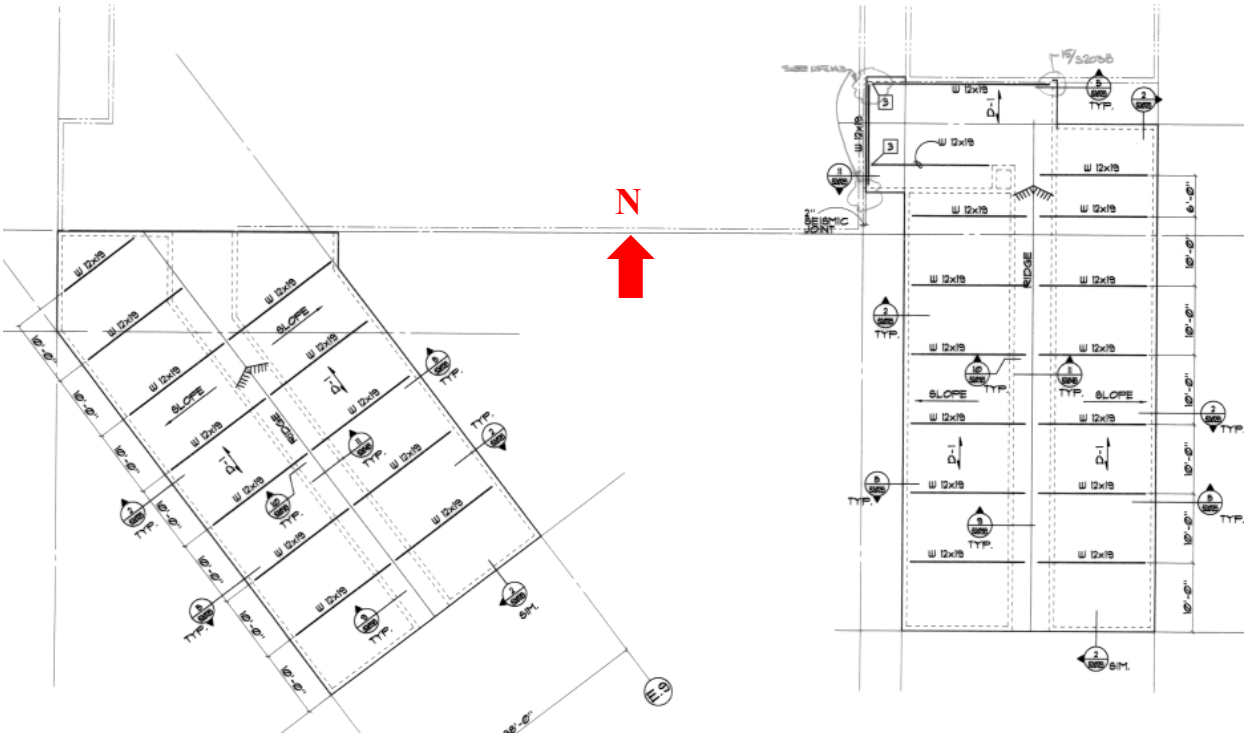
East elevation of Building 3W and south elevation of CAAN 7922, looking north

East elevation of Building 3E and south elevation of CAAN 7922, looking north

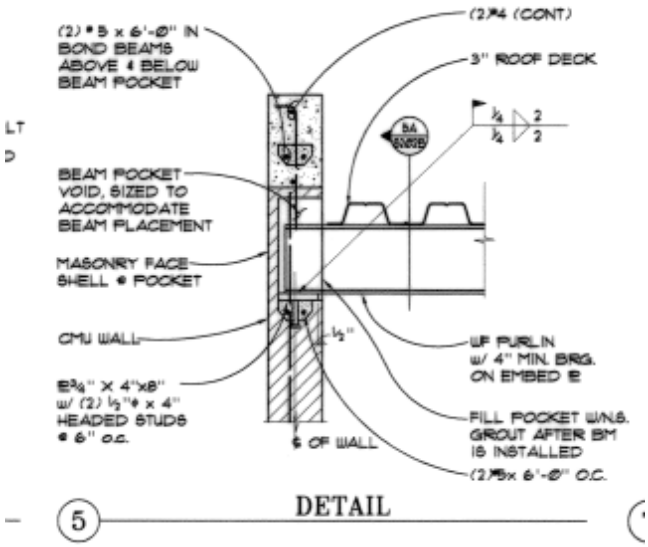
South elevation of Building 3E looking north

Transition from CAAN 7922 to Building 3W at Level 2 entrance, looking east

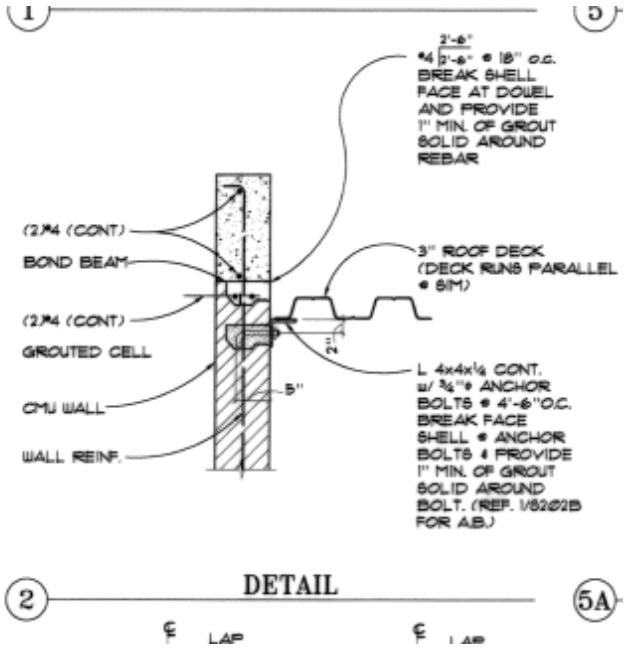
Expansion joint at Building 3W, looking south



Roof Plan of Addition



W-beam connection at roof diaphragm to CMU wall, used at east and west walls only



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

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Building CAAN:	7922	Auxiliary CAAN:	7922.3	By Firm:	Maffei Structural Engineering		
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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 in high seismicity requires 5".
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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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:** Light roof
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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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 = 36.67/29.67=1.24 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:** Spacing of reinforcement is 48 in O.C.

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 ○ ○ ○ ○ C	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:**
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
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:**

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

FLEXIBLE DIAPHRAGMS

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

UC Campus:	UC Santa Cruz			Date:	6/24/19		
Building CAAN:	7922	Auxiliary CAAN:	7922.3	By Firm:	Maffei Structural Engineering		
Building Name:	Music Center – Music Building Addition			Initials:	*TE/NY*	Checked:	*JM*
Building Address:	402 McHenry Road, Santa Cruz, CA 95064			Page:	4	of	4

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

CONNECTIONS

	Description
C NC N/A U ○ ○ ○ ○ 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 - Music Biulding Addition			
Architect	BOORA ARCHITECTS			
Structural Engineer	KPFF Consulting Engineers			
Location	402 McHenry Road, Santa Cruz, CA 95064			
Design date	1996			
Latitude	36.99309			
Longitude	-122.06133			
Stories above grade	2			

Seismic parameters					
Risk Category	II	2016 CBC Table 1604.5			
Site Class	D	https://earthquake.usgs.gov/hazards/urban/sfbay/soiltype/			(ASCE 41-17 2.4.1.6, ASCE 7-16 Chapter 20)
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 2nd floor Diaphragms nd fl		(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	1981	kip	$V = Cs_a W$	= 1.54W	(ASCE 41-17 Eq 4-1)
W	1290	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	0.24	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	28	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	519		28	14532	0.56	1114	
2nd	771	13.3	15	11311	0.44	867	1114
1		14.7	0	0	0.00	0	1981
Total	1290			25843	1.0	1981	
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						
2nd	14304	6144	17	40	0.2	0.6
1	14304	9216	31	48	0.4	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)

SEISMIC EVALUATION OF EXISTING BUILDINGS - TIER 1 SCREENING

ASCE 41-17 Chapter 4

General				Reference
Building	Music Center - Music Biulding Addition			
Architect	BOORA ARCHITECTS			
Structural Engineer	KPFF Consulting Engineers			
Location	402 McHenry Road, Santa Cruz, CA 95064			
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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
Site Class	D	https://earthquake.usgs.gov/hazards/urban/sfbay/soiltype/			(ASCE 41-17 2.4.1.6, ASCE 7-16 Chapter 20)
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 2nd floor Diaphragms nd fl		(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	2120	kip	$V = Cs_a W$	= 1.54W	(ASCE 41-17 Eq 4-1)
W	1380	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	0.24	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	28	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	448		30	13274	0.47	988	
2nd	932	13.3	16	15192	0.53	1131	988
1		16.3	0	0	0.00	0	2120
Total	1380			28466	1.0	2120	
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						
2nd	11328	6816	19	32	0.3	0.5
1	17184	13728	27	34	0.4	0.5
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)