

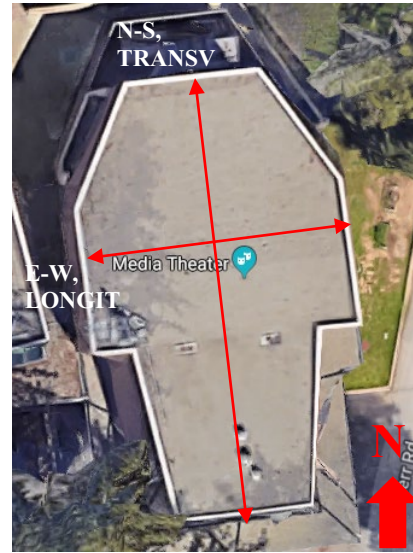
Text in green is to be part of UC Santa Cruz building database and may be part of UCOP database

UC Santa Cruz building seismic ratings
Theater Arts M Media Theater

CAAN #7924
 455 Kerr Road, Santa Cruz, CA 95064
 UCSC Campus: Main Campus



DATE: 2019-06-30



Rating summary	Entry	Notes
UC Seismic Performance Level (rating)	V	
Rating basis	Tier 1	ASCE 41-17 ¹
Date of rating	2019	
Recommended UC Santa Cruz priority category for retrofit	Priority B	Priority A=Retrofit ASAP Priority B=Retrofit at next permit application
Ballpark total project cost to retrofit to IV rating ²	Medium (\$50 to \$200 per sf)	
Is 2018-2019 rating required by UCOP?	Yes	Building was not previously rated
Further evaluation recommended?	Tier 2	Tier 2 – Focused on wall anchorage to diaphragm

¹ We translate this Tier 1 evaluation to a Seismic Performance Level rating using professional judgment. Non-compliant items in the Tier 1 evaluation do not automatically put a building into a particular rating category, but we evaluate such items along with the combination of building features and potential deficiencies, focused on the potential for collapse or serious damage to the gravity supporting structure that may threaten occupant safety. See Section III B of the 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 A: issued 1 November 1996 (stamped 13 November 1996), sheets A1-A3, A100-A102, A202, A301, A302, A401, A420-A427, A51-A534, A601 and A833 pertinent to Building 'M'.
- Structural drawings by KPFF Consulting Engineers, Volume A: issued 1 November 1996, sheets S1, S101-S104, S201-S203 and S301-S306 pertinent to Building 'M'.
- University of California building database information, "Cowell College," provided by Jose Sanchez (UCSC) on 2019-04-19.

Additional building information known to exist

- None

Scope for completing this form

Reviewed structural drawings for 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.

Brief description of structure

The Theater Arts M Media Theater is one of a cluster of several teaching facilities and theater arts at the campus. The complex was designed in 1996 by the architectural office of Boora Architects and the structural office of KPFF Consulting Engineers; construction was completed in late 1998.

The building is a 2-story structure that contains approximately 5,500 square feet in the shape of a 70' (east-west) by 67' (north-south) rectangle-shaped lecture hall with a platform on the north end, and stepped stands on the south end with an elevation difference of 14 feet, therefore transitioning into the second floor. Additional quarters on the south end of the building (approximately 40' by 40') form a south wing on the first and second floors, which include rooms for storage and for other uses, as well as for access to the south entrance to the lecture hall. A canopy also extends on the south end of the building. The structure measures 32'8" to the top of the 2' parapet on the roof.

Reinforced and fully grouted concrete masonry unit (CMU) walls (12" thick) extend to the full height of the structure on the exterior east and west sides, as well as on the north end of the structure. At the south end of the lecture hall an 8"-thick reinforced concrete shear wall extends from the 1st to the 2nd floor where it transitions into an 8"-thick RM shear wall. Floors at the second floor, which only occupies the south wing are mostly composite metal deck. The roof consists of steel trusses that span east-west supporting a flexible metal deck diaphragm. Two exit doors are at the south end of the building and an additional door is at the north end.

Identification of levels: Level 1 is at elevation 100', Level 2 is at elevation 114'8", and the roof is at elevation 130'8", slopping south to north in the northern half of the building to the elevation of 126'.

Foundation system: The site is almost flat. The superstructure is founded on shallow strip footings located under the RM exterior walls, as well as under the metal stud bearing walls that support the gravity load of the south wing second floor.

Structural system for vertical (gravity) load: The south wing second floor spans between the perimeter RM shear walls on the east and west sides, the RC shear wall on the north side of the south wing, and metal stud bearing walls on the south side of the structure. The roof trusses are spaced 10 feet apart, span east to west and are supported on the perimeter RM shear walls above the lecture hall.

Structural system for lateral forces: The steel trusses at the roof level, support a flexible metal deck diaphragm and transfer the lateral load from the roof to the east and west perimeter RM shear walls. The 12-inch thick RM shear walls consist of fully grouted concrete masonry units. The lateral loads are transferred by 4- $\frac{3}{4}$ " bolts anchored in the RM shear walls. The south wing at the second floor consists of a composite metal deck braced to the perimeter east and west RM shear walls.

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

The following main seismic deficiency is identified:

- The connection of the roof metal deck diaphragm to the wall in the east-west direction (4-3/4" anchor bolts per truss) does not provide enough lateral support for the walls and is inadequate to transfer the diaphragm seismic forces to the perimeter concrete shear walls.

Other seismic deficiencies include:

- In the east west direction, the 2nd floor area lies mostly outside (south of) the shear walls and is likely to cause torsion. The vertical support for this part of the 2nd floor is the RC shear wall on the north side, the bearing stud wall on the south side, and the RM shear walls on the east and west sides.
- The metal deck roof diaphragm is connected to perimeter supporting steel by puddle welds. 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)	Y	Openings at shear walls (concrete or masonry)	N
Load path	Y	Liquefaction	N
Adjacent buildings	N	Slope failure	N
Weak story	N	Surface fault rupture	N
Soft story	N	Masonry or concrete wall anchorage at flexible diaphragm	Y
Geometry (vertical irregularities)	N	URM wall height-to-thickness ratio	N
Torsion	Y	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. 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

While the shear stress is estimated to meet the required limit of 70 lb/in² at the BSE-C level of motion, the rating of V reflects the inadequacy of the roof to wall connection, as described above.

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 the type and location of potential non-structural hazards.

Recommendations for further evaluation or retrofit

The connection of the roof metal deck diaphragm to the wall in the east-west direction (4-3/4" anchor bolts per truss) does not provide enough lateral support for the walls and is inadequate to transfer the diaphragm seismic forces to the perimeter concrete shear walls. Further evaluation is required to investigate this connection problem, as well as the adequacy of spot welds used to connect the second-floor catwalk to perimeter supporting walls, and the metal deck roof diaphragm to perimeter supporting steel.

Peer review of rating

This seismic evaluation was discussed in a peer review meeting on 17 June 2019. The reviewer present was Bret Lizundia of R+C. Comments from the reviewer have been incorporated into this report. The reviewer agreed with the assigned rating.

Additional building data	Entry	Notes
Latitude	36.99518	
Longitude	-122.06143	
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)	8,264	
Risk Category per 2016 CBC Table 1604.5	III	Assumed based on understanding from UCSC staff that occupancy is 400 and that primary occupancy is public assembly. UCSC please confirm.
Building structural height, h_n	30 ft	Structural height defined per ASCE 7-16 Section 11.2
Coefficient for period, C_t	0.020	Estimated using ASCE 41-17 equation 4-4 and 7-18
Coefficient for period, β	0.75	Estimated using ASCE 41-17 equation 4-4 and 7-18
Estimated fundamental period	0.26 sec	Estimated using ASCE 41-17 equation 4-4 and 7-18
Site data		
975 yr hazard parameters S_s, S_1	1.286, 0.488	
Site class	D	
Site class basis ⁴	Geotech	See footnote below
Site parameters F_a, F_v ⁵	1, 1.81	
Ground motion parameters S_{cs}, S_{xl}	1.286, 0.885	
S_o at building period	1.283	

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:

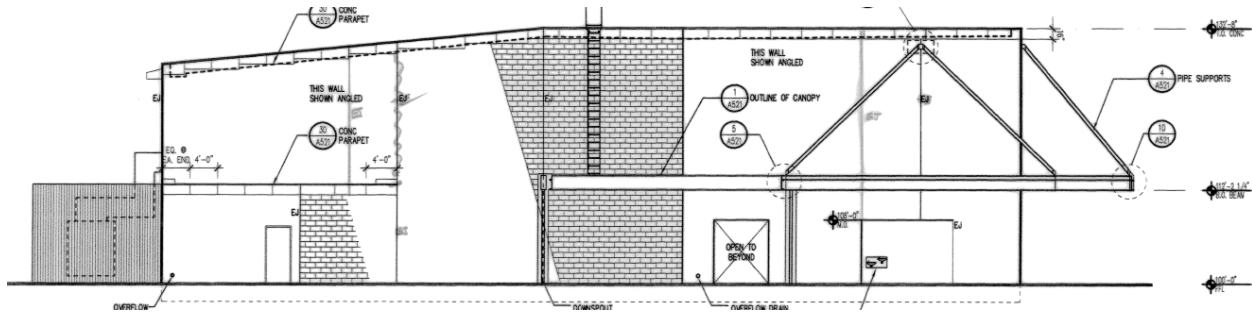
<https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/LiquifactionMap2009.pdf>

<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.

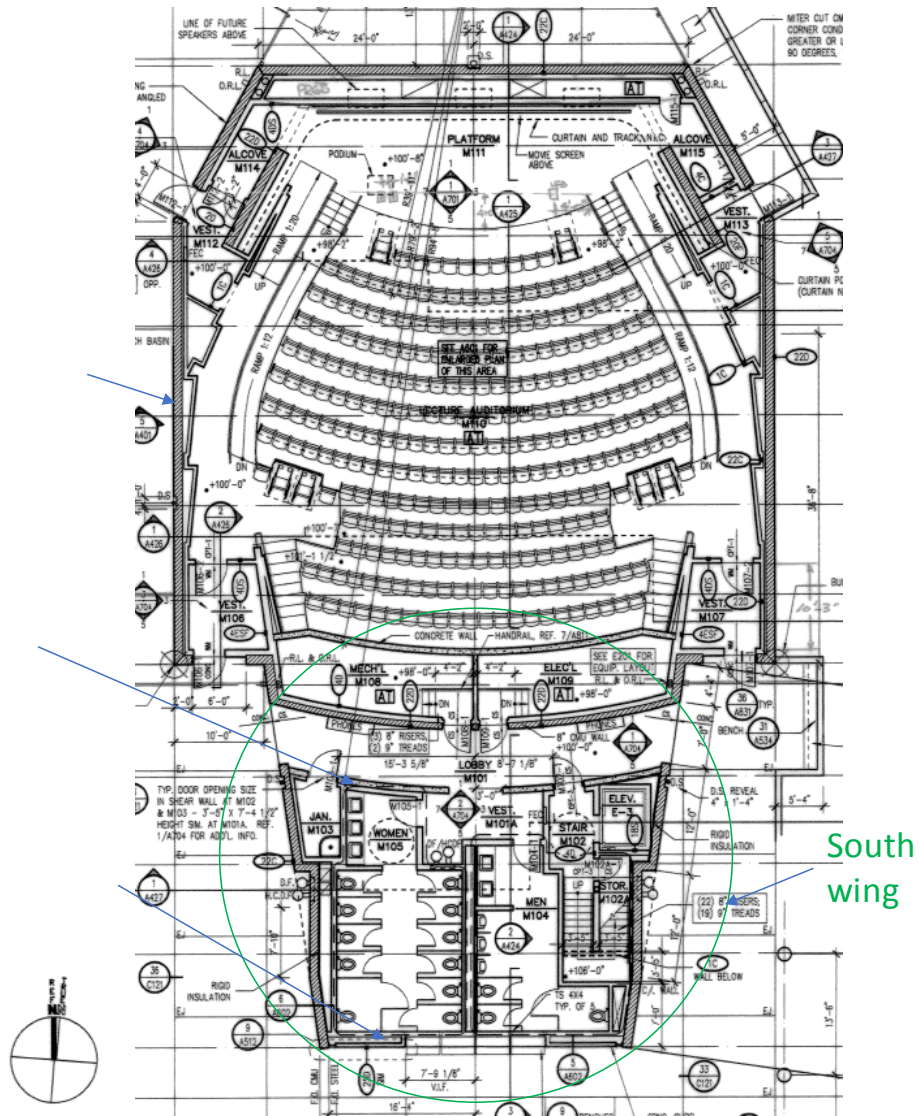
Site V_{s30}	900 ft/s	
V_{s30} basis	Estimated	Estimated based on site classification of D
Liquefaction potential	Low	
Liquefaction assessment basis	County map	See footnote below
Landslide potential	Low	
Landslide assessment basis	County map	See footnote below
Active fault-rupture identified at site?	No	
Fault rupture assessment basis	County map	See footnote below
Site-specific ground motion study?	No	
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 – Reinforced Masonry (Flexible Diaphragm)	
Model building type East-West	RM1 – Reinforced Masonry (Flexible Diaphragm)	
FEMA P-154 score	N/A	Not included here because we performed ASCE 41 Tier 1 evaluation.
Previous ratings		
Most recent rating	N/A	
Date of most recent rating		
2 nd most recent rating	-	
Date of 2 nd most recent rating	-	
3 rd most recent rating	-	
Date of 3 rd most recent rating	-	
Appendices		
ASCE 41 Tier 1 checklist included here?	Yes	Refer to attached checklist file



West Elevation



South Elevation



Annotated floor plan (2nd floor shown)