Rating form completed by:

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Evaluator: MTN/WAL/BL
Date: 06/28/2019

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

DATE: 2019-06-28

REGISTERED PROFESSIONAL ENGINEER
BRETT LIZUNDIA
No. S3950
Exp. 12-31-20
STRUCTURAL
STATE OF CALIFORNIA
06-28-19

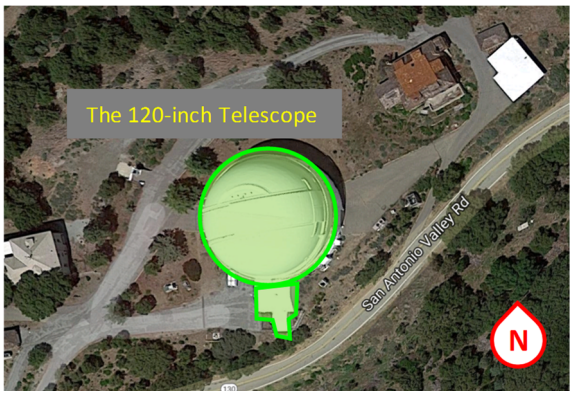
UC Santa Cruz Building Seismic Ratings

The 120-inch Telescope

CAAN #7276
7281 Mt Hamilton Rd, Mt Hamilton, CA 95140
UCSC Campus: Mt. Hamilton

East Elevation (Looking Southwest)

Plan



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	None	Priority A=Retrofit ASAP Priority B=Retrofit at next permit application
Ballpark total construction cost to retrofit to IV rating[2]	None	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 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 19 May 2017 *UC Seismic Safety Policy* and Method B of Section 321 of the 2016 *California 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 and structural drawings by Structural Engineer John Case, "The 120-inch Telescope, University of California, Lick Observatory," dated 21 October 1949, Sheets A-4 "First Floor Plan and Future Conditions Plan," A-5 "Second Floor Plan and Gallery Plan," A-9 "Longitudinal Sections," and A-11 "Miscellaneous Exterior…Details," S-2 "Second Floor Framing Plans and Slab Schedule," and S-9 "Light Tunnel and Misc. Concrete Details."
- Unattributed drawings "Mt Hamilton 120-in Telescope Building Rehabilitation," dated June 28, 1977, 2 sheets.

Additional building information known to exist

- 1978 drawings for "Coude Room Support," "Coude Spectrograph West Support," etc. were not reviewed.
- The 1949 architectural and structural drawings listed above were located in drawing storage drawers in the main administrative office of the observatory. It is anticipated they were once part of a fuller set of drawings which may be available from other sources.

Scope for completing this form

Reviewed architectural and structural drawings for original construction, made brief site visit on 11 June 2019, and carried out ASCE 41-17 Tier 1 evaluation.

Brief description of structure

The 120-inch telescope building was designed in 1949 by structural engineer John Case. The construction was completed in 1959.

The building is made of a concrete cylinder with an inner radius of 47'10" that rises up 34'5-5/8" above the first floor slab. The cylinder supports a hemispherical dome made of steel plates with stiffening ribs. It has a radius of 48'3" to the outside face of the dome. The dome bears on support bearings or trucks that roll on top of a track at the top of the concrete cylinder. The dome has a slot that can open up from the base to the top of the dome to permit telescope viewing and the telescope orientation to vary vertically. The dome can also rotate 360 degrees on the roller bearings or trucks, so the viewing slot can be located in any direction in plan. The dome weighs about 275 tons based on an information sign at the site. The building contains equipment and service areas at the first floor and offices at the perimeter of the second floor with an open working area in the middle.

The dome houses the 120-inch reflector telescope with a total weight of 145 tons (including moving parts) which floats on a thin film of oil in the support bearings. The support bearings are founded on two pile caps on the east side of at the first floor which aligns with grade on the south side. The telescope is largely independent of the building structure except at its base and will have limited interaction with the building.

Identification of levels: The building has a partial basement where a grinding pit is located at 11'6" below the first floor. The grinding pit is used for refinishing of the telescope reflector. There is a below grade "light tunnel" projecting northwest from the grinding pit that used originally for access. The first floor level is 3'6" below grade on the west entrance level with a loading dock area that drops 3'4" down to grade on the east side. Steps from the west entrance rise up 5'6" to a small lobby floor at the west entrance and then continue up 5'8" to the second floor level (14'8" above the first floor) which infills the entire portion of the cylinder. A gallery level is located 12'3" above the second floor. The gallery level is a cylindrical ring with an open area with a 26'0" radius in the center. A cylindrical ring catwalk with a width of about 8'3" is located 11'9" above the gallery floor. It is above the roller bearings and is connected to and moves with the base of the dome.

Foundation system: The perimeter concrete walls are supported on shallow strip footings. The telescope is supported on pile caps. The steel columns are founded on shallow spread footings.

Structural system for vertical (gravity) load: The circular perimeter bearing wall varies in thickness. At the base near grade, it is 20" thick and then steps inboard 6", leaving a 14" thickness. From that point, it narrows as it rises to 10" thick at the second floor level, and then stays at 10" to the top of the wall. The perimeter wall does not have pilasters, and it is assumed there is no embedded frame rebar detailing, so that it is a traditional bearing wall. The dome is made of steel plates supported with steel truss stiffening ribs on the inside. There is a second hemispherical nonstructural wall inboard of the steel dome that is insulated to provide thermal control. At the base of the dome

is the steel framed catwalk. The dome and catwalk ring bear on the roller trucks which in turn bear on the top of the concrete wall. The gallery floor is concrete over steel beams. The second floor is a reinforced concrete slab is supported by steel wide flange beams and the perimeter concrete wall. The floor steel girders span between the H columns and pockets in the perimeter concrete wall. The slab is dowelled into the wall. A note on the structural drawings indicates the second floor is to be either 6-3/4" of monolithic normal weight concrete or ¾" of normal weight concrete over 6" of lightweight concrete. The perimeter wall and steel columns are founded on shallow strip and single footings, respectively. The ground floor is a concrete slab with variable thickness (4"-6").

Structural system for lateral forces: The dome transfers the lateral loads at the roller trucks to the perimeter 10" concrete wall. When the telescope is not operating, power is shut off to the trucks, and they are fixed. Details are not known as to how lateral loads are transferred through the trucks to the top of the wall, either when they can roll or when they are fixed. The gallery floor serves as a diaphragm level. It is assumed it is doweled to the perimeter wall like the second floor, but details are not known. The second floor concrete diaphragm spans to the perimeter concrete wall. The perimeter cylinder wall has openings at the first story at the entrance and at the loading dock and a series of windows at the second story offices.

An unusual feature of the telescope building is the lack of a traditional lid or roof level diaphragm spanning between and bracing the top of the perimeter wall. The dome with its connections through the roller trucks can either be considered to be added inertial weight that adds out-of-plane loads or a curved diaphragm that resists out-of-plane loads, depending on the connections at the roller trucks and the relative stiffness of the dome and accounting for the large slot opening in the dome.

Building code: The building code used for design is not listed on the partial set of architectural or structural drawings that were available. The only date on the drawings is 21 October 1949. The 1946 or 1949 UBC are potential design code.

Response to the 1989 Loma Prieta Earthquake: Unknown.

Building condition: Structure is in relatively good condition. There is peeling paint and rust on the outside of the dome. Efflorescence and cracking were observed in the interior of the lowest story walls.

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

Identified seismic features and deficiencies of the building include the following:

- As a bearing wall system, the perimeter wall does not have either pilasters or an embedded reinforced frame. Although this is a checklist deficiency, it is considered not to be of significance.
- The concrete perimeter wall has sufficient capacity to meet the Tier 1 Quick Check requirements, both from an average stress view and looking at the worst net section where the second story office windows are located, with a demand-to-capacity ratio of 0.8. Reinforcing details for the perimeter wall are not available, but one detail at the base of the building implies that the perimeter wall has two curtains of reinforcing.
- The potential lack of a diaphragm at the top of the concrete wall could force the walls to cantilever up from the gallery level and resist loads in out-of-plane bending to some degree. However, because the dome is wider than the wall and has the stiffening catwalk ring at its base that projects inboard of the wall, it is difficult to visualize a situation where the dome could fall off the top of the wall and lose vertical load-carrying support.
- Facilities staff note that the building has resisted high winds over its 60-year life, reportedly without any damage, even to the dome.

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

We did not observe any falling hazards that pose a life-safety concern. Review of the telescope assembly is outside the scope of the Tier 1 assessment. Generally, chemical tanks in the first floor service area were restrained, but we did observe liquid nitrogen tanks that are unrestrained. Any hazardous materials should be properly restrained.

UCOP nonstructural checklist item	Life safety hazard?	UCOP nonstructural 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	Yes
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

Basis of rating

We assign a Seismic Performance Level rating of IV to this building because no major seismic deficiencies were identified in the ASCE 41-17 Tier 1 evaluation process, and we judge the structure to have adequate capacity to resist in-plane loads. If there is out-of-plane separation at the dome-to-wall interface, loss of vertical support appears unlikely due to the geometry of the base of the dome.

Recommendations for further evaluation or retrofit

None.

Peer review of rating

This seismic evaluation was discussed in a peer review meeting on 24 June 2019. Reviewers present were Joe Maffei of Maffei Structural Engineering and Jay Yin of Degenkolb Engineers. Comments from the reviewers have been incorporated into this report. The reviewers agreed with the assigned rating.

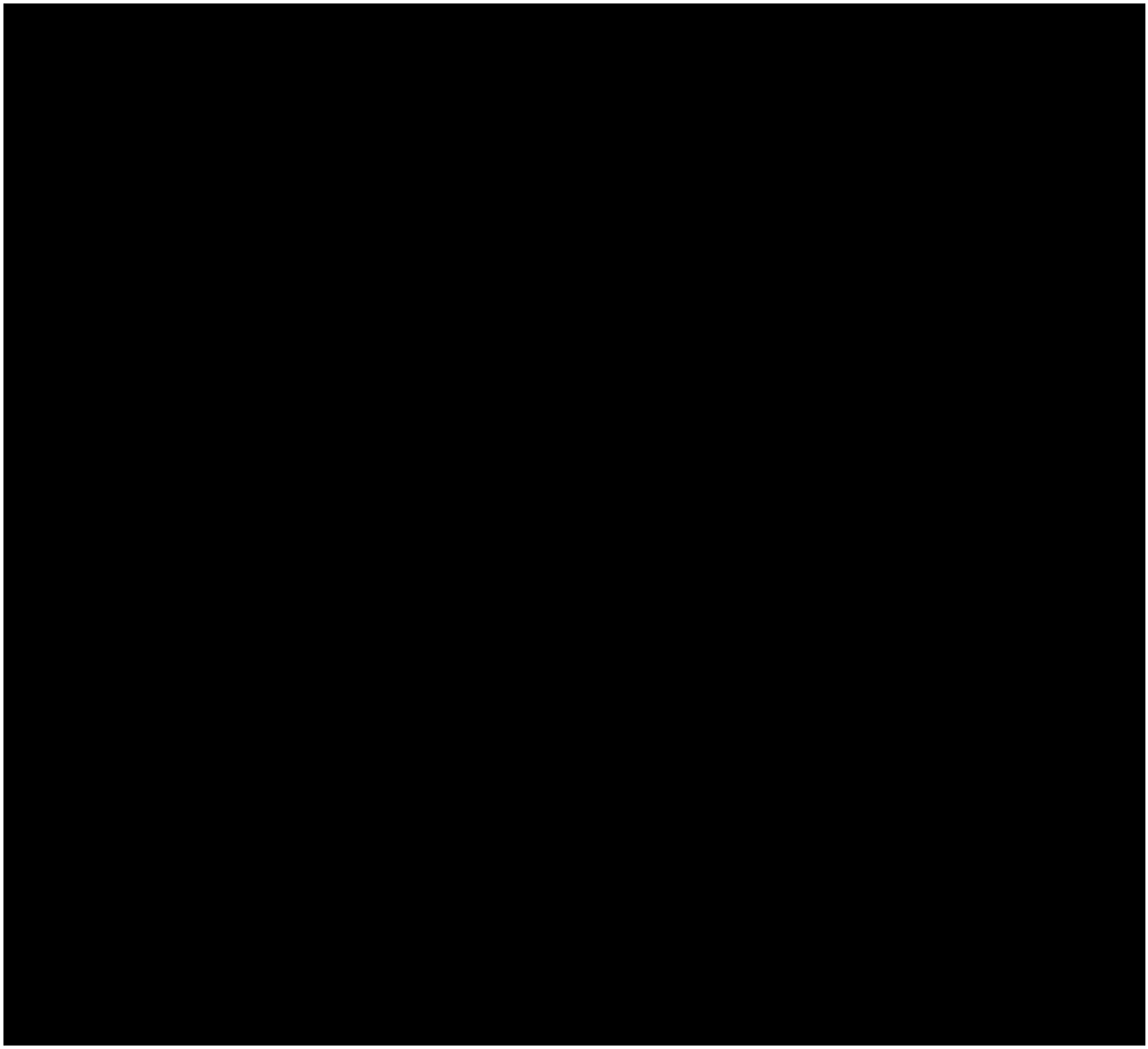
[3] For these Tier 1 evaluations, we do not visit all spaces of the building; we rely on campus staff to report to us their understanding of if and where non-structural hazards may occur.

Additional building data	Entry	Notes
Latitude	37.342982	
Longitude	-121.637224	
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	1	Small grinding pit and Coude Room below grade
Building occupiable area (OGSF)	24,630	From UCSC facilities database.
Risk Category per 2016 CBC Table 1604.5	II	
Building structural height, h_n	35.4 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	0.29 sec	Estimated using ASCE 41-17 equation 4-4 and 7-18
Site data		
975-year hazard parameters S_s, S_1	2.241, 0.788	From SEAOC/OSHPD website
Site class	B	
Site class basis	Inferred	The Lick Observatory complex is built on a rocky outcropping at the top of Mt. Hamilton. Fractured rock is visible adjacent to the building.
Ground motion parameters S_{cs}, S_{c1}	1.705, 0.557	From SEAOC/OSHPD website
S_a at building period	1.705	
Site V_{s30}	3750 ft/s	
V_{s30} basis	Estimated	Estimated based on site classification of B, using middle of 2,500-5,000 ft/s range.
Liquefaction potential	Low	
Liquefaction assessment basis	Inferred	Engineering judgment given the lack of surficial soils and mountaintop location.
Landslide potential	Low	
Landslide assessment basis	Inferred	Engineering judgment given the building site is relatively level.
Active fault rupture identified at site?	No	
Fault rupture assessment basis	CGS Website	The Earthquake Zones of Required Investigation Lick Observatory Quadrangle has no Earthquake Fault Zones near Mt. Hamilton. The Mt. Hamilton area was "not evaluated for liquefaction or landslides." See http://gmw.conservation.ca.gov/SHP/EZRIM/Maps/LICK_OBSERVATORY_EZRIM.pdf
Site-specific ground motion study?	No	

Applicable code		
Applicable code or approx. date of original construction	Built: 1959 Code: Unknown	
Applicable code for partial retrofit	None	No partial retrofit.
Applicable code for full retrofit	None	No full retrofit
FEMA P-154 data		
Model building type - north-south	C2-Concrete Shear Walls with Stiff Diaphragms	
Model building type - east-west	C2-Concrete Shear Walls with Stiff Diaphragms	
FEMA P-154 score	N/A	Not included here because we performed ASCE 41 Tier 1 evaluation.
Previous ratings		
Most recent rating	-	Not evaluated before.
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.

Color Coded Floor Plan

Layout of Concrete Shear Walls on the Second Floor Plan

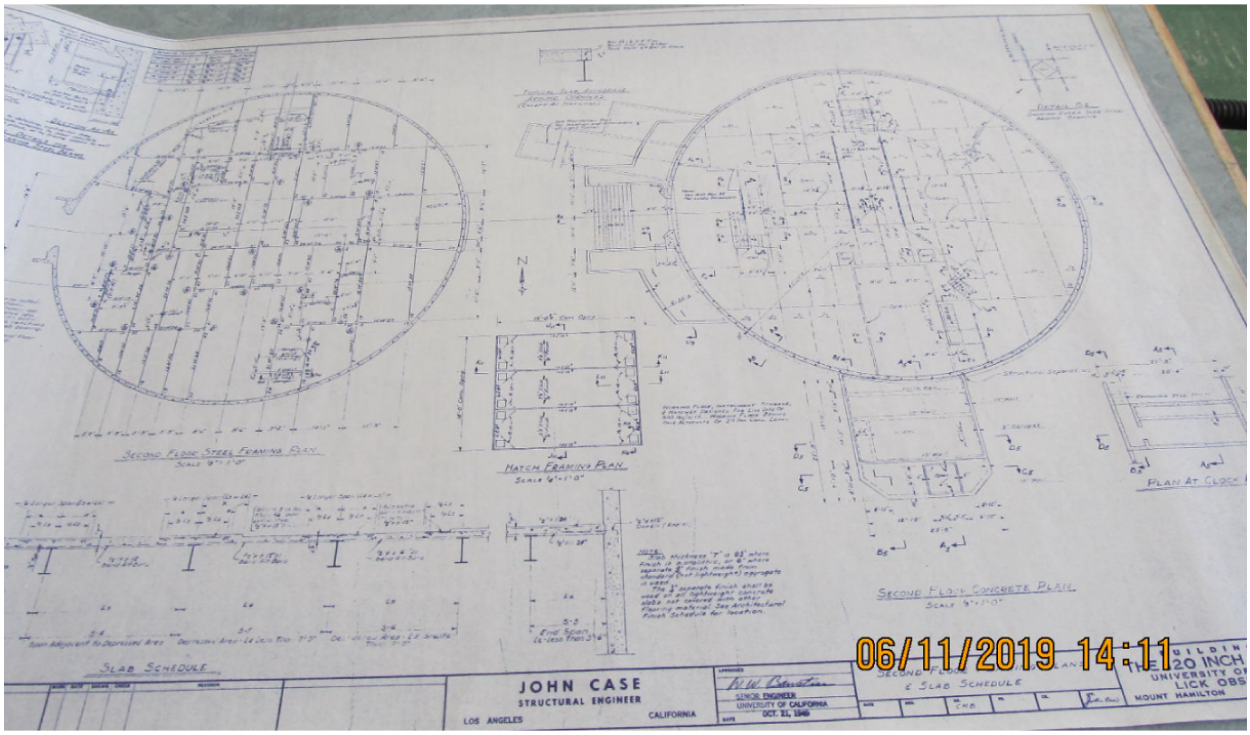


Section Through Observatory Dome (Looking East) from Sheet A-9

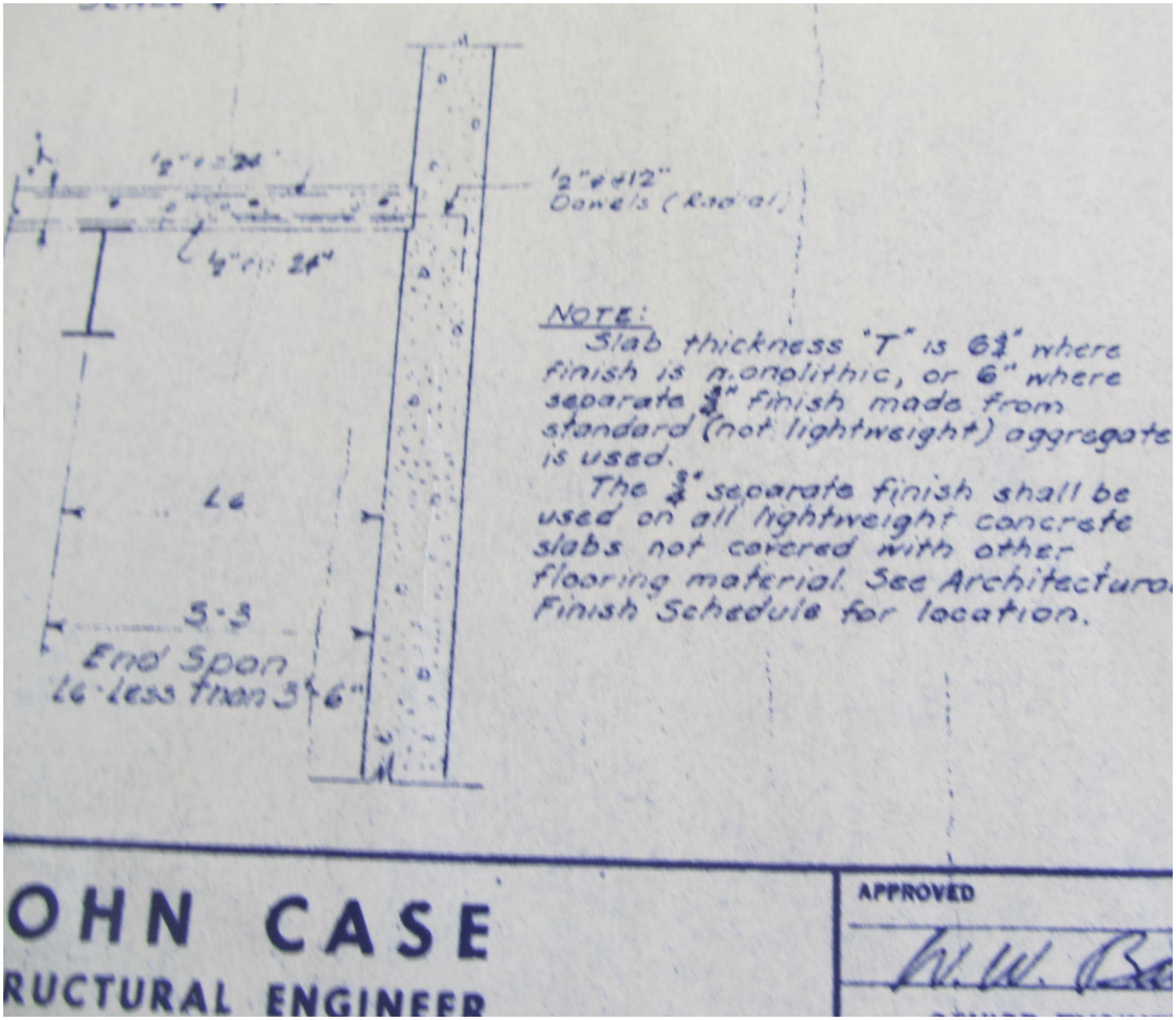
First Floor Plan (Sheet A-4)

Second Floor Plan (Sheet A-5)

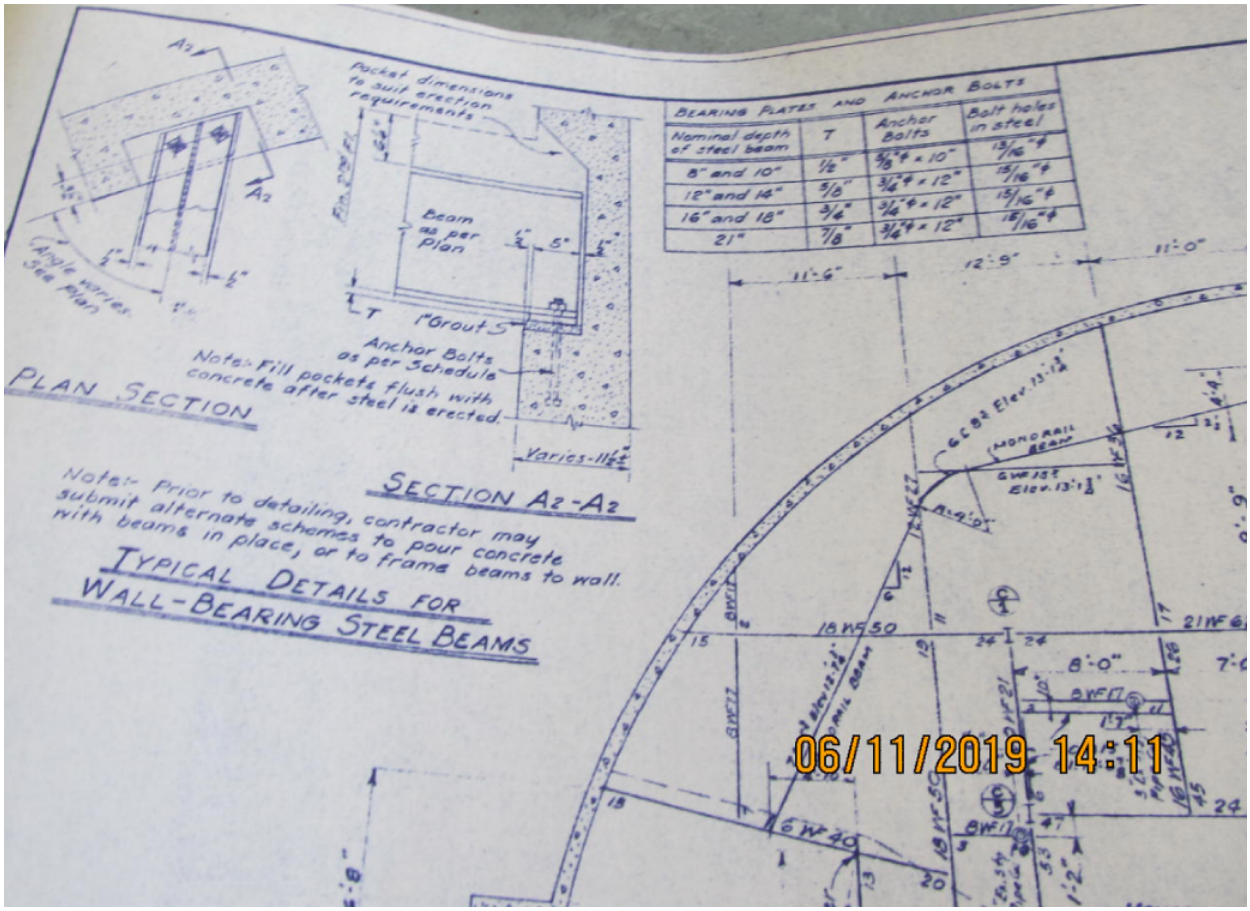
Gallery Floor Plan (Sheet A-5)



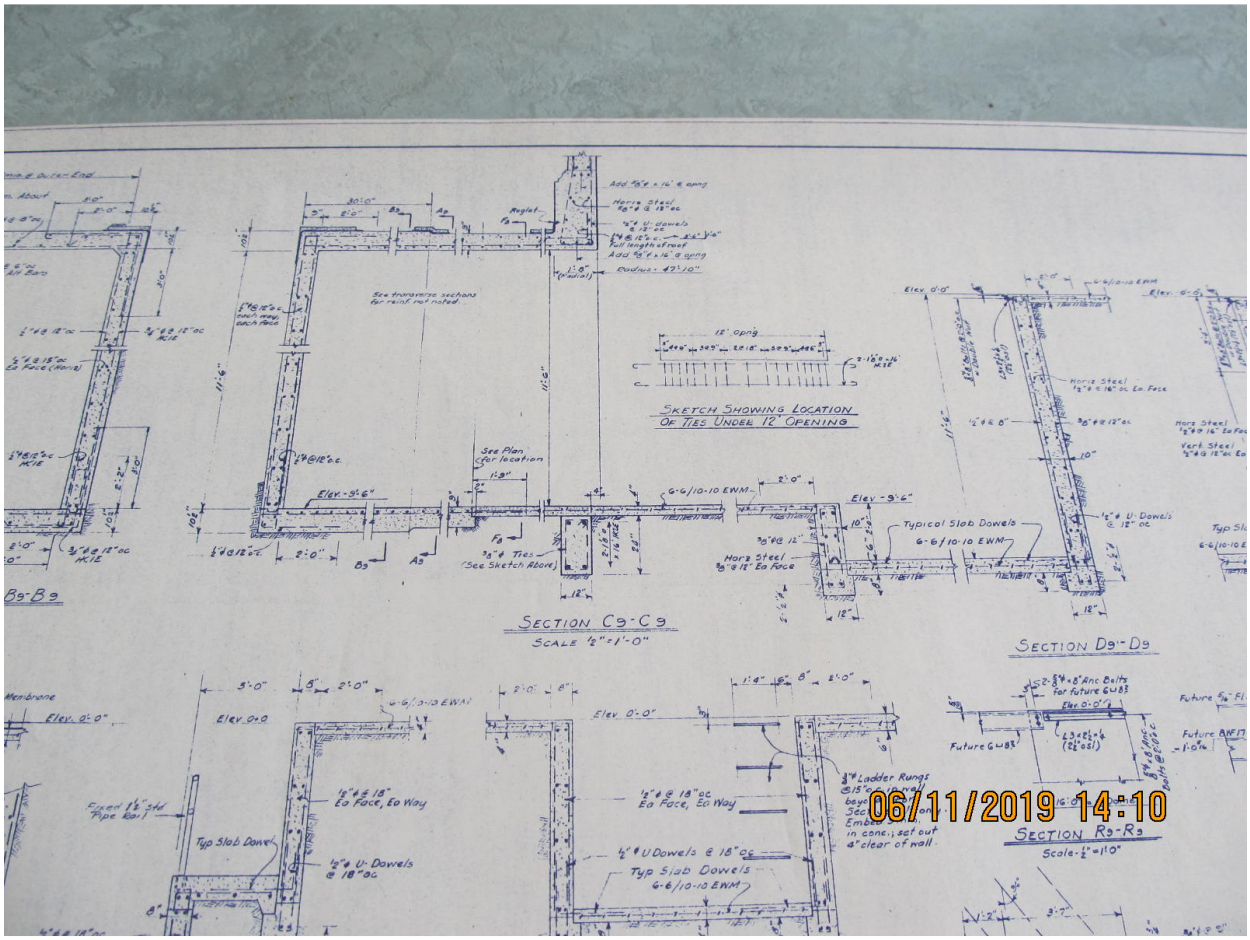
Second Floor Steel Framing (Left) and Concrete Plan (Right)



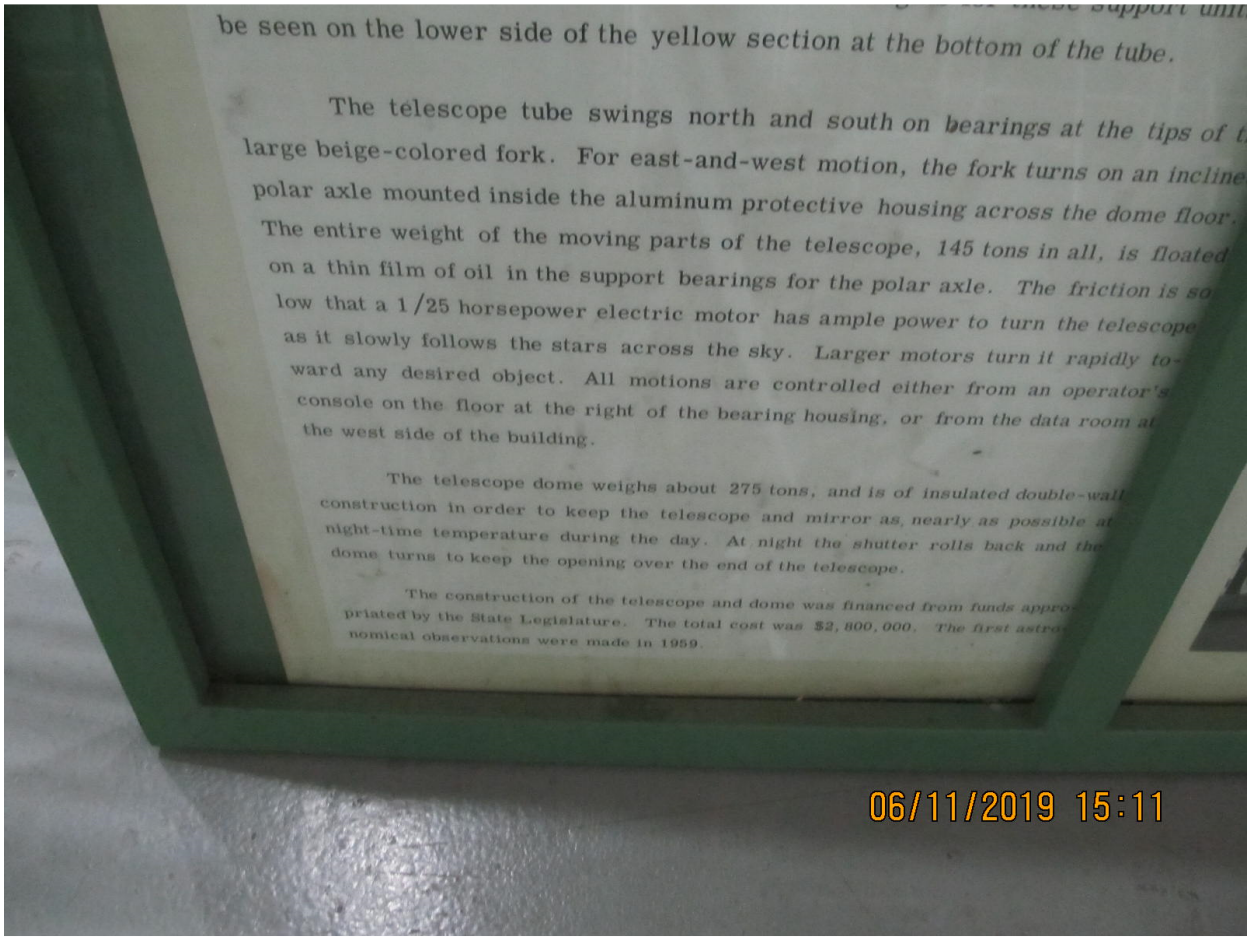
Detail at Connection of Second Floor to Perimeter Wall (Sheet S-2)



Partial Second Floor Framing Plan with "Wall-Bearing" Steel Beam Details (Sheet S-2)



Section Cut at Base Showing Two Curtains of Steel in Base of Perimeter Wall Above (Sheet S-9)



Information Sign on the Gallery Floor of the Telescope Noting that the Dome Weighs 275 Tons

APPENDIX A

Additional Photos

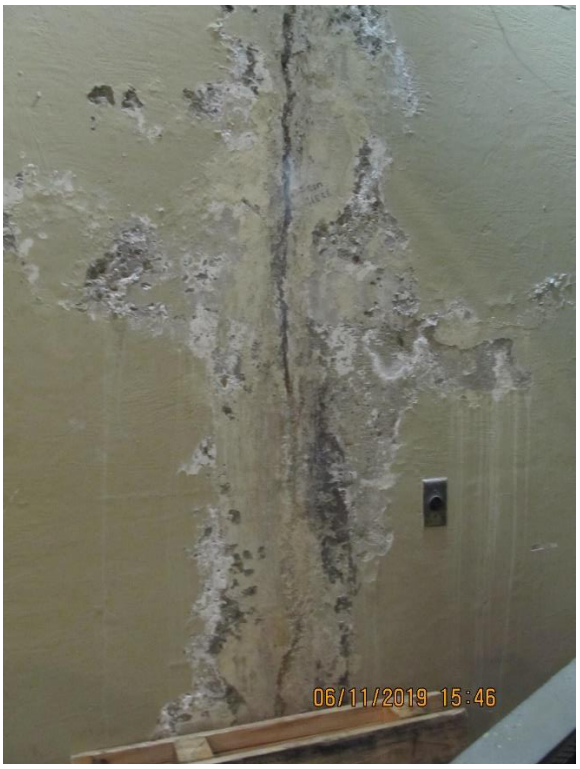
East elevation

West elevation (main entrance)

120-inch reflector

Gallery floor and catwalk

Unbraced liquid Nitrogen tanks in service area at first floor



Crack and efflorescence located in light tunnel

Roller trucks supporting the dome

The underside of the catwalk ring with power rails that move with the catwalk/dome and are connected to fixed power supply points beyond

Inside view of the dome with stiffening ribs and periodic trussed ribs

Nonstructural inner wall of the dome

APPENDIX B

ASCE 41-17 Tier 1 Checklists (Structural)

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7276	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
Building Name:	The 120 inch Telescope			Initials:	MN	Checked:	WAL/BL
Building Address:	7281 Mt Hamilton Rd, Mt Hamilton, CA 95140			Page:	1	of	3

ASCE 41-17
Collapse Prevention Basic Configuration Checklist

LOW SEISMICITY

BUILDING SYSTEMS - *GENERAL*

C	NC	N/A	U	Description
●	○	○	○	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:** The second floor and gallery floor diaphragms (concrete slab supported by typical wide flange beams) deliver the loads to the concrete shear wall all around the perimeter of the building (with circular plan) and steel H columns. The telescope dome bears on top of the concrete shear wall in a circular track. The concrete shear wall is founded on a shallow strip footing at the ground level. The telescope is supported by the bearings which are founded on two pile caps on the east side of at the first floor which aligns with grade on the south side. The steel columns are founded on shallow single footings.
○	○	●	○	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:** No adjacent building.
●	○	○	○	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:** The gallery ring is assumed to be anchored to the perimeter wall like the second floor diaphragm.

BUILDING SYSTEMS - *BUILDING CONFIGURATION*

C	NC	N/A	U	Description
●	○	○	○	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:** No weak story.
●	○	○	○	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:** - The thickness of the concrete shear wall slightly increases from top to the bottom over the height. - Story heights are approximately the same from floor to floor.
●	○	○	○	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 perimeter concrete shear wall is continuous to the foundation.

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

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ASCE 41-17
Collapse Prevention Basic Configuration Checklist

C	NC	N/A	U	
◉	○	○	○	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:** The net horizontal dimension of the seismic force-resisting system is approximately the same in both stories.
◉	○	○	○	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:** There is no significant change in the effective mass over the height of the building.
◉	○	○	○	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:** The center of mass and center of rigidity are approximately at the same point (center of the plan circle).

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

GEOLOGIC SITE HAZARD

C	NC	N/A	U	Description
◉	○	○	○	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:** Engineering judgement given the lack of surficial soils and mountaintop location.
◉	○	○	○	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:** Engineering judgement given the building site is relatively level.
◉	○	○	○	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:** No. The Earthquake Zones of Required Investigation Lick Observatory Quadrangle has no Earthquake Fault Zones near Mt. Hamilton. See http://gmw.conservation.ca.gov/SHP/EZRIM/Maps/LICK_OBSERVATORY_EZRIM.pdf

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

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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

C	NC	N/A	U	Description
●	○	○	○	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:** Building width B = 95'-8" Building Height is H = 35', B/H = 2.75 Sa = 1.705g per OSHPD/SEAOC at BSE-2E 0.6 x Sa = 1.02 B/H > 0.6 Sa
●	○	○	○	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:** Site Class B is assumed, and reinforced slab ties the footings together.

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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 ○	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:** Loads from the steel frame at the second floor are supported by concrete shear wall all around the perimeter. There are no embedded columns in the walls at the locations where the floor steel beams meet the wall. A typical detail for wall-bearing steel beams is shown in Section A2-A2, Sheet S-2.
C ◉ NC ○ N/A ○ U ○	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:** In plan, the building is circular and the concrete shear walls are continuous over the perimeter.
C ◉ NC ○ N/A ○ U ○	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 $2\sqrt{f'_c}$. (Commentary: Sec. A.3.2.2.1. Tier 2: Sec. 5.5.3.1.1) **Comments:** As shown below, the average shear stress calculated using Quick Check procedure is below the 100 psi threshold. • **First Story:** - Average shear stress: 65 psi < 100 psi → OK • **Second Story:** - Average shear stress at a section above the second floor: 40 psi < 100 psi → OK - Average shear stress in the net section excluding openings below gallery floor: 82 psi < 100 psi → OK
C ○ NC ○ N/A ○ U ◉	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:** Limited availability of existing drawings. Wall sections showing amount of reinforcing steel were not found. Unable to check.

Connections

	Description
C ○ NC ○ N/A ◉ U ○	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:** Building has rigid diaphragms.

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C	NC	N/A	U	
◉	○	○	○	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:** • Per Sheet S-2, Section A2-A2, floor steel beams are typically anchored to the shear wall with 5/8" or ¾" Φ anchor bolts, depending on the depth of the steel beam. • Per Sheet S-2, Slab Schedule details, the slab bottom reinforcing (1/2" Φ at 12") is doweled into the wall with hooks oriented in the vertical direction.
○	○	○	◉	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:** Limited availability of existing drawings. Wall sections showing reinforcing steel connection to foundation was not found. Unable to check.

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

Seismic-Force-Resisting System

C	NC	N/A	U	Description
○	○	◉	○	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:** There are no concrete secondary components to which this check is applicable.
○	○	◉	○	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:** There are no concrete flat slabs or plates in this building.
○	○	◉	○	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:** There are no coupling beams in this building.

Diaphragms (Stiff Or Flexible)

C	NC	N/A	U	Description
◉	○	○	○	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:** There are no split levels.

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C	NC	N/A	U	
◉	○	○	○	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:** The telescope well opening on the south side of the second floor is adjacent to the shear wall. The Length of the opening is less than 25% of the effective wall length.

Flexible Diaphragms

C	NC	N/A	U	Description
○	○	◉	○	CROSS TIES: There are continuous cross ties between diaphragm chords. (Commentary: Sec. A.4.1.2. Tier 2: Sec. 5.6.1.2) **Comments:** The diaphragm is stiff.
○	○	◉	○	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:** The diaphragm is stiff.
○	○	◉	○	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:** The diaphragm is stiff.
○	○	◉	○	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:** The diaphragm is stiff.
○	○	◉	○	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:** The diaphragms in the building are concrete.

Connections

C	NC	N/A	U	Description
○	○	○	◉	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:** Limited availability of existing drawings. Sections showing reinforcing steel connection to pile caps was not found. Unable to check.

APPENDIX C

UCOP Seismic Safety Policy Falling Hazards Assessment Summary

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7276	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
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UCOP SEISMIC SAFETY POLICY
Falling Hazard Assessment Summary

	Description
P ☐ N/A ☒	**Heavy ceilings, features or ornamentation above large lecture halls, auditoriums, lobbies, or other areas where large numbers of people congregate (50 ppl or more)** **Comments:** There are no heavy ceilings, features, or ornamentation in this building.
P ☐ N/A ☒	**Heavy masonry or stone veneer above exit ways or public access areas** **Comments:** There are no heavy masonry or stone veneer above exit ways.
P ☐ N/A ☒	**Unbraced masonry parapets, cornices, or other ornamentation above exit ways or public access areas** **Comments:** There are no unbraced masonry parapets cornices, or other ornamentation above exit ways.
P ☒ N/A ☐	**Unrestrained hazardous material storage** **Comments:** Liquid nitrogen tanks at in the first story service area were not restrained.
P ☐ N/A ☒	**Masonry chimneys** **Comments:** There are no masonry chimneys.
P ☐ N/A ☒	**Unrestrained natural gas-fueled equipment such as water heaters, boilers, emergency generators, etc.** **Comments:** Unknown.
P ☐ N/A ☒	**Other:** **Comments:**
P ☐ N/A ☒	**Other:** **Comments:**
P ☐ N/A ☐	**Other:** **Comments:**

Falling Hazards Risk: Low
Unrestrained Hazardous Materials Risk: Moderate

Note: P= Present, N/A = Not Applicable

APPENDIX D

Quick Check Calculations

Unit Weights:

	Seismic Weight	Dead Load	
Second Floor	**psf**	**psf**	**Remarks**
Concrete slab	65	65	typ. 6 3/4" slab; Lightweight concrete at 115 pcf
Steel framing (Girders/joists and columns)	10	10	Assumed: rule of thumb
Ceiling	2	2	typ. Gyp. Board assumed: No information found in drawings provided.
MEP	20	20	Assumed
Lighting and misc.	5	5	Assumed
Partition	10	10	
Total	112	112	

	Seismic Weight	Dead Load	
Gallery	**psf**	**psf**	**Remarks**
Concrete slab	65	65	typ. 6 3/4" slab; Lightweight concrete at 115 pcf
Ceiling	9	9	Plaster on metal furring (1" plaster assumed)
Steel framing (Girders/joists and columns)	10	10	Assumed: rule of thumb
MEP	5	5	
Lighting and misc.	5	5	
Partition	10	10	
Total	104	104	

	Seismic Weight	Dead Load	
Catwalk	**psf**	**psf**	**Remarks**
Concrete slab	65	65	typ. 6 3/4" slab; Lightweight concrete at 115 pcf
Ceiling	9	9	Plaster on metal furring (1" plaster assumed)
Steel framing (Girders/joists and columns)	5	5	Assumed: rule of thumb
MEP	5	5	
Lighting and misc.	5	5	
Partition	5	5	Half of 10 psf
Total	94	94	

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Date: 06/28/2019

Story Weights

w_conc [4] = 150 pcf

Floor Levels	Net Floor Area (ft2)	Floor Weight (psf)	Wall Weight [1,2]: Wall height below floor level (ft)	Wall height tributary to each floor level (ft)	Wall Area below (ft^2)	Wall Weight below (kips)	Wall Seismic Weight (kips)	Additional Weight (kips)	Total Seismic Weight (kips)
Roof (Dome)[3]			20.75	10.38	248	773	386	550	936
2nd Floor	6,222	112	14.67	17.71	248	546	659		1,354
Gallary	4,403	104							457
Catwalk	2,266	94							212
								Total Weight =	2,960

Notes:
1 - Seismic base is set at the 1st floor. Soil-structure interaction is ignored for ASCE 41-17 Tier 1.
2 - Wall weight includes area of perimeter concrete walls.
3 - Total telescope dome weight is 275 tons, per information provided on site.
4 - Normal weight concrete assumed for the concrete wall around the perimeter.

Period

C_t=	0.02
h_n (ft)=	35.42
B=	0.75

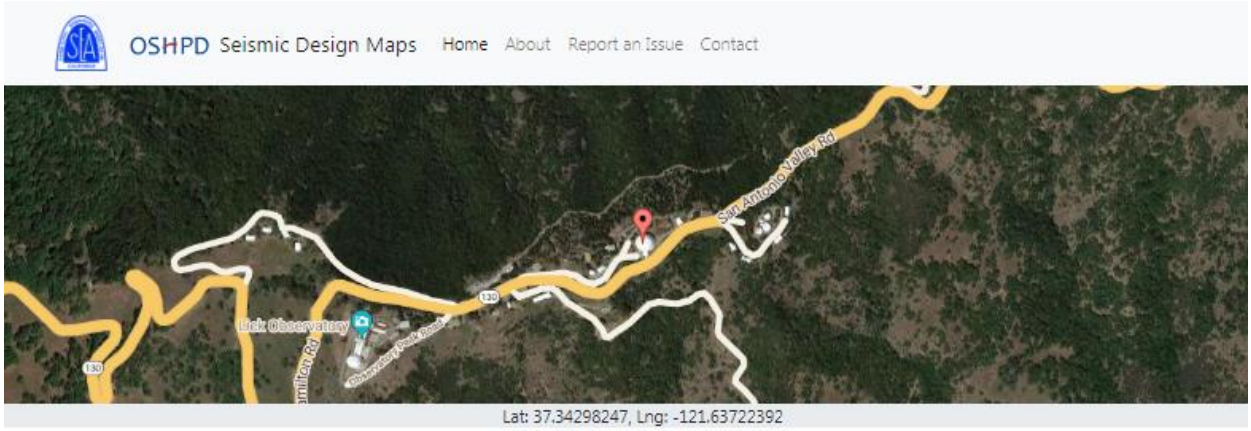
T=	0.29	sec

Notes:
1- The period calculated per ASCE 41-17 Equation 4-4.

$$T = C_t \cdot h_n^{\ B}$$

2- Ct and B are for "all other framing system" per ASCE 41-17 Section 4.4.2.4.
3- The building height is taken from the 1st floor to the roof (top of concrete shear wall on the perimeter)

BSE-2E Response Spectrum



Search for Address or Coordinates

Reference: ASCE 41-17 | Custom Probability: for eg. 0.10 | Site Class: B - Rock

Project Title (optional) | Address | Coords: 37.34298247, -121.63722392 | Go

7281 Mt Hamilton Rd, Mt Hamilton, CA 95140, USA
Latitude, Longitude: 37.341413, -121.64291020000002

Print

Date	6/27/2019, 2:04:53 PM
Design Code Reference Document	ASCE41-17
Custom Probability	
Site Class	B - Rock

Type	Description	Value
Hazard Level		BSE-2E
S_S	spectral response (0.2 s)	2.241
S_1	spectral response (1.0 s)	0.788
S_{XS}	site-modified spectral response (0.2 s)	1.705
S_{X1}	site-modified spectral response (1.0 s)	0.557
f_a	site amplification factor (0.2 s)	0.9
f_v	site amplification factor (1.0 s)	0.8

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Date: 06/28/2019

Story Shears

Sa=	1.705	
W=	2,960	kips
C=	1.2	Per ASCE 41-17 Table 4-7

V=	6,055	kips

k=	1.00	

Floor Levels	Story Height (ft)	Total Height, H (ft)	Weight, W (kips)	W x H^k	coeff	Fx (kips)	Story Shear, V (kips)
Roof[1]	20.75	35.42	1,377	48,766	0.68	4,103	4,103
Second floor[2]	14.67	14.67	1,583	23,213	0.32	1,953	6,055
			Σ=	71,979	1	6,055	

1 - Includes the seismic weight of roof (dome), catwalk, and half of the seismic weight of gallery.
2 - Includes the seismic weight of the second floor and half of the seismic weight of gallery.

General Notes:
1- The base of building is assumed to be at the 1st floor.
2- Modification Factor, C, per ASCE 41-17, Table 4-7.

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Date: 06/28/2019

Average Wall Stress Check Under ASCE 41-13 BSE-2E Site Specific Spectra

Average Stresses

Ms =	4.5

Story	Story Shear	Wall Area[1]	Average Shear Stress	Tier 1 Shear Stress Limit	Wall OK?
	(kips)	(in^2)	(psi)	(psi)	
Second Story	4,103	22,960	40	100	OK
Second Story: net section excluding openings below gallery floor[2]	4,103	11,140	82	100	OK
First Story	6,055	20,660	65	100	OK

1 - Projected wall area, A_pr, is used, defined as:
A_pr = 2 x (2xRxT)
where R is the wall outer radius and T is the wall thickness.

2 - The projected net section area is defined by subtracting the projected area of openings from the projected section area.