Rating form completed by:

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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

Theater Arts B Drama Building

CAAN #7312

465 Kerr Road, Santa Cruz, CA 95064

UCSC Campus: Main Campus

DATE: 2019-06-30

Rating summary	Entry	Notes
UC Seismic Performance Level (rating)	V (Poor)	
Rating basis	Tier 1	ASCE 41-17[1]
Date of rating	2019	
Recommended UC Santa Cruz priority category for retrofit	Priority A	Priority A=Retrofit ASAP Priority B=Retrofit at next permit application
Ballpark total construction cost to retrofit to IV rating[2]	Medium ($50-$200/sf)	See recommendations on further evaluation and retrofit.
Is 2018-2019 rating required by UCOP?	Yes	Building was not previously rated
Further evaluation recommended?	Tier 2	Focused on walkway, exterior elevator structure, and lack of hold-downs at east-west walls

[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 Ralph Rapson and Associates Inc., "Performing Arts Building, University of California Santa Cruz," as-built dated 30 June 1969
- Structural drawings by Pregnoff and Matheu, "Performing Arts Building, University of California Santa Cruz," as-built dated 30 June 1969
- University of California Facilities Link building database information, "7312" 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.

Brief description of structure

Theater Arts B Drama is one of a cluster of eleven buildings that forms the Theater Arts complex. The complex was designed in 1969 by the architectural office of Ralph Rapson and Associates and the structural office of Pregnoff and Matheu.

The building is two-story structure that contains approximately 4900 square feet. The building is rectangular in plan, with a building footprint of approximately 40' x 60' at Level 1. The north exterior wall is sloped and has a large window opening. The structure measures 32 feet in height from the grade at Level 1 to the highest point of the sloping roof. A large floor opening occurs at the southwest corner of Level 2.

An exterior walkway at Level 2 connects this building to Theater Arts A (CAAN 7311), Theater Arts C (CAAN 7313), Theater Arts D (CAAN 7314), and Theater Arts E (CAAN 7315). The walkway consists of a concrete topping slab over wood framing, and is attached to each building with no seismic separation joints between buildings.

An elevator structure provides access to the walkway and is located east of Theater Arts B. No drawings were available for this structure.

Identification of levels: Level 1 (elevation 690.0'), Level 2 (elevation 704.0'), Roof (722.0' at highest point)

Foundation system: The superstructure is founded on shallow strip footings located around the building perimeter and under the interior wood bearing wall. The site is moderately sloping downhill to the northeast and the footings step downward such that the footings bear 9' lower at the northwest corner than at the south east corner. Perimeter foundation walls are provided around the building perimeter as retaining walls. The Level 1 floor is slab-on-grade, except for at the north side of the building where the slab cantilevers past the foundation wall. Presumably the foundation wall was set back from the building perimeter to avoid the roots of a group of trees at the north side of the building.

Structural system for vertical (gravity) load: The Level 2 floor and roof are framed with wood joists bearing on steel W-girders and wood bearing walls. The steel girders are supported on wood posts that are located within the width of the wood walls.

Structural system for lateral forces: Plywood sheathed floor and roof diaphragms transfer lateral inertial forces from floors (and roof) to plywood sheathed wood walls.

Structural system for walkway: The walkway is approximately 7' wide, constructed with wood joists spanning across the width of the walkway, topped with plywood sheathing, a waterproofing membrane, and a sloped concrete topping slab 2.75" thick on average. Gravity support for the joists is provided on one side by the building adjacent to the walkway, and on the other side by steel W-beams supported by wood posts. Where the walkway is perpendicular to the building, steel beams support the joists for the walkway, and the steel beams are supported by

wood posts that are located within the exterior walls of the building. The walkway does not have its own lateral system and is supported for lateral demands by the adjacent buildings.

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

Identified seismic deficiencies of the building include the following:

- The Level 2 exterior walkway connects five buildings – CAAN 7311, 7312, 7313, 7314, and 7315. There are no seismic separations in the walkway between buildings, and differential movement between the buildings could cause damage in the walkway. At this building, the walkway joists are connected to a ledger that is face-nailed to the face of the east exterior wall. The connection of the walkway joists to the ledger are not shown on the drawings. If the walkway joists are not adequately tied into the building, the walkway joists could lose their support if the building moves west, away from the walkway.
- There appears to be no vertical connection of the walls through the floors, and no hold-downs at the base of the walls. This is especially a concern at the short walls in the east-west direction.
- Walls in east-west direction may be overstressed, especially the wall at gridline 34. The Tier 1 check indicates that torsional plan irregularity exists at the roof because of the imbalance of the long wall at the south end of the building and the short walls at the north end of the building. Although torsional irregularity itself did not impact this rating since the building has flexible diaphragms, the location of the long wall at one end of the building (and adjacent to a large slab opening at Level 2) may result in errors in the Tier 1 quick check for shear demand, since the assumption that all walls share the lateral demand equally may not be valid. We did a spot-check using flexible diaphragm assumptions and found that the wall on gridline 34 has a DCR of 1.2. This calculation assumes that the wall has plywood sheathing on both sides, which seems to be indicated on the drawings but should be verified in the field as the drawings are not very clear.
- There is a large floor opening at Level 2, and there appears to be no continuous chord at the inside corner in the east-west direction. This deficiency is mitigated by the straps provided at the walls to the north of the opening; these provide continuity near the location where the chord should be located.
- An elevator structure is located on the east side of this building and appears to be connected to this building by the Level 2 walkway. No drawings were available for the elevator structure. This structure should be evaluated.

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	N	Liquefaction	N
Adjacent buildings	Y	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 and we looked for potentially hazardous nonstructural components during our site visit on 13 June 2019. As shown in the table below, no non-structural hazards were observed inside the building. The exterior walkway is a potential life safety concern, because it is connected to multiple buildings at Level 2, with no seismic separation joints between buildings. Review of details of construction of the connection of the walkway to the building and locating seismic separation joints should be the focus of further review and retrofit for nonstructural hazards.

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	Walkway	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 V (Poor) is because of the potential life safety hazard of the exterior walkway and the high shear demand in the short east-west wall at the building interior, which has no tie-downs. A Tier 2 evaluation may find that the building itself could be rated IV (Fair) if the walkway is fixed.

Recommendations for further evaluation or retrofit

We recommend that the Campus perform a more detailed review of the adequacy of the plywood sheathed walls for both shear capacity and for floor-to-wall hold-down connections. The campus should also check the condition of the exterior walkway and consider providing separation joints in the walkway between buildings. An evaluation of the adjacent elevator structure should be done. We put the building on Priority Category A, because the walkway modifications should be done as soon as possible.

Peer review of rating

This seismic evaluation was discussed in a peer review meeting on 24 June 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	36.9951722	
Longitude	-122.06144	
Are there other structures besides this one under the same CAAN#	Yes	Exterior walkway structure
Number of stories above lowest perimeter grade	2	
Number of stories (basements) below lowest perimeter grade	0	
Building occupiable area (OGSF)	4858 sq. ft.	
Risk Category per 2016 CBC Table 1604.5	II	Educational occupancy (classroom)

[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.

Building structural height, h_n	25 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	0.22 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_{c1}	1.286, 0.885	
S_a at building period	1.28	
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	Designed: 1969 Code: 1967 UBC	Code inferred based on design year
Applicable code for partial retrofit	None	None
Applicable code for full retrofit	None	None
Model building data		
Model building type North-South	W2 – Wood frame	
Model building type East-West	W2 – Wood frame	
FEMA P-154 score	N/A	Not included here. 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

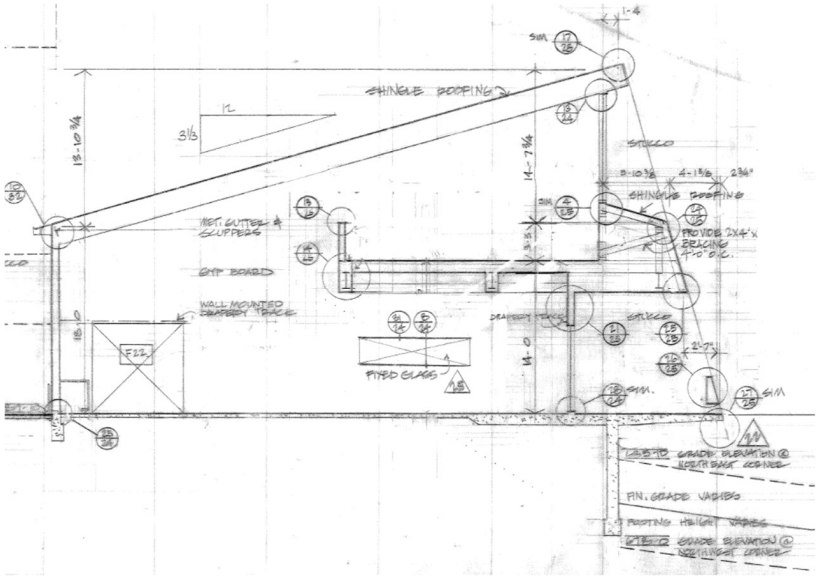
[5] F_V factor used does not include the requirements of Section 11.4.8-3 of ASCE 7-16 that are applicable to Site Class D, and which per Exception 2 would result in an effective F_V factor of 2.72 (1.5 times larger). At the Santa Cruz main campus this only affects structures with T>0.69 seconds. We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

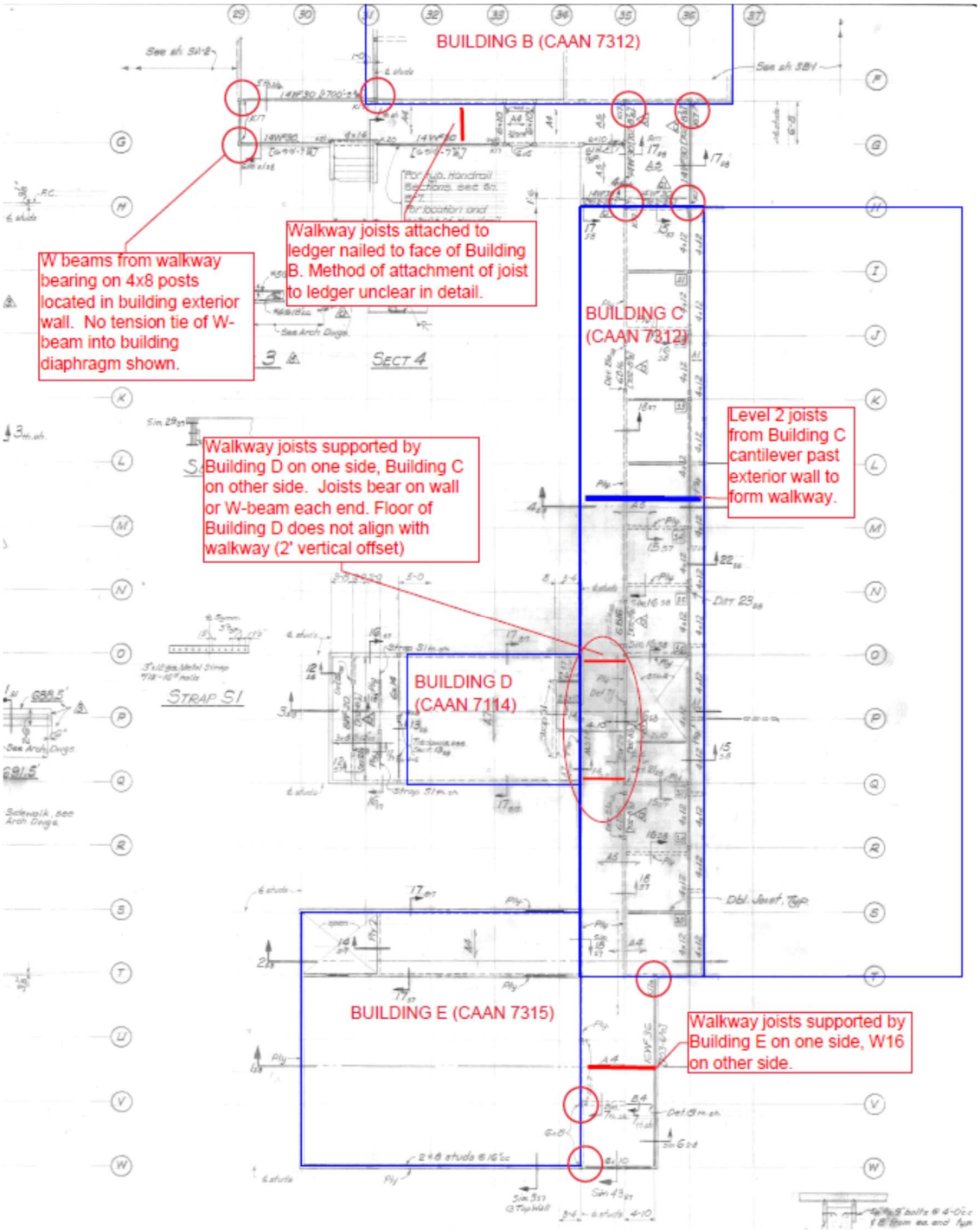
[redacted]

Building section (looking west)

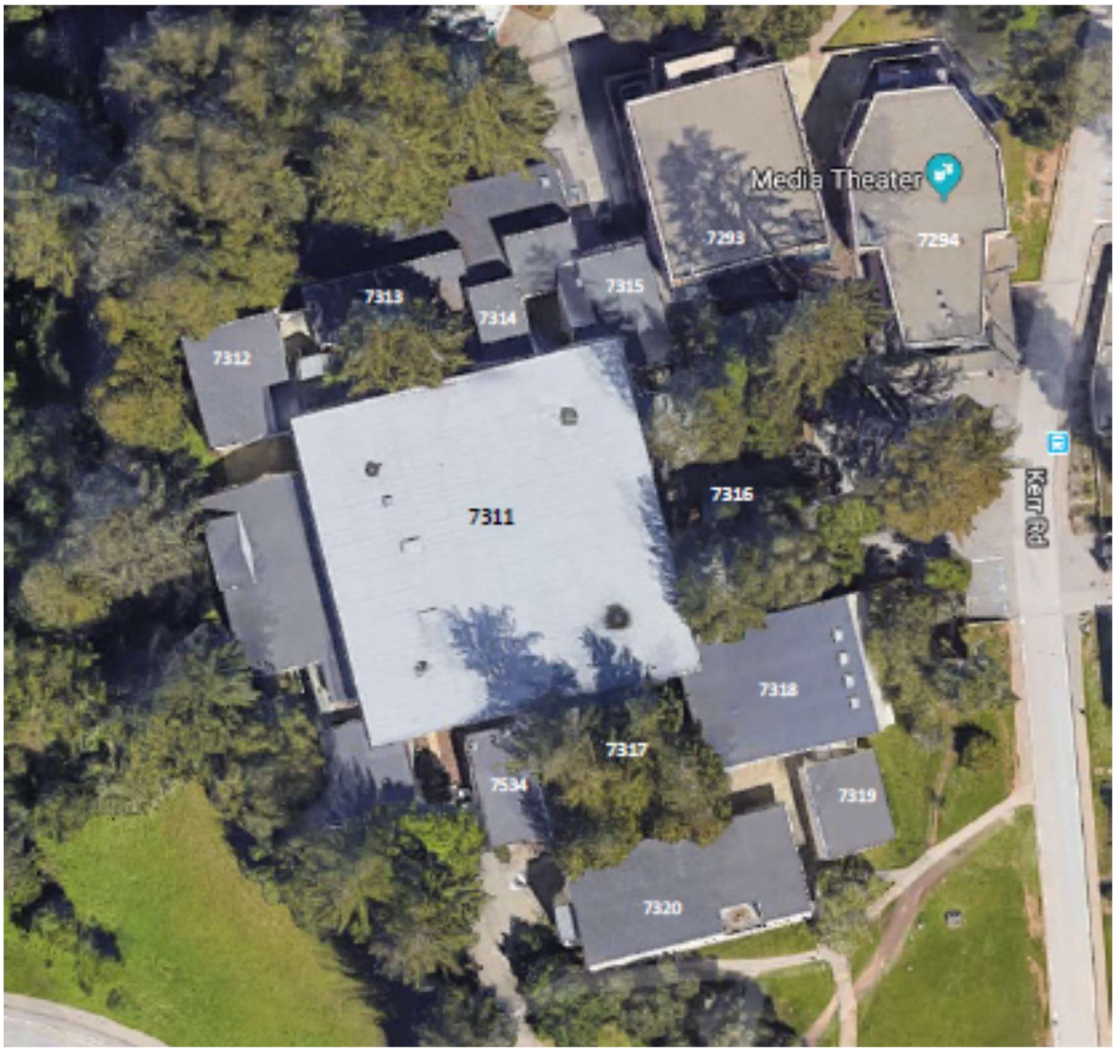


Plan at walkway:

- Locations where walkway W-beams are supported on posts located within building exterior walls shown:
- Locations where walkway joists are attached to ledger nailed to face of building exterior wall shown:



Site map at Theater Arts complex



- Theatre Arts A Main Stage (CAAN 7311)
- Theater Arts B Drama (CAAN 7312)
- Theater Arts C Studio (CAAN 7313)
- Theater Arts D Student Production (CAAN 7314)
- Theater Arts E Classroom (CAAN 7315)
- Theater Arts F Ticket Office (CAAN 7316)
- Theater Arts G Toilet Room (CAAN 7317)
- Theater Arts H Second Stage (CAAN 7318)
- Theater Arts I Second Stage Annex (CAAN 7319)
- Theater Arts J Office (CAAN 7320)
- Theater Arts L Experimental Theater (CAAN 7293)
- Theater Arts M Media Theater (CAAN 7294)

Walkway at east side of building (building to the left, elevator structure to the right)

North side of building, looking east. Foundation wall below Level 1 and cantilever slab at Level 1

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ASCE 41-17
Collapse Prevention Basic Configuration Checklist

LOW SEISMICITY

BUILDING SYSTEMS - *GENERAL*

	Description
C NC N/A U	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:**
C NC N/A U	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:** The exterior walkway has no seismic separation between buildings.
C NC N/A U	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*

	Description
C NC N/A U	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 NC N/A U	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 NC N/A U	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:** Wall at north side of building bears on cantilevered concrete slab at Level 1 instead of bearing on grade beams.

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

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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:**
○	○	○	○	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:**
○	○	○	○	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:** Noncompliant at roof because there is a very long wall at the south end of the building.

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:**
○	○	○	○	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:**
○	○	○	○	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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HIGH SEISMICITY (COMPLETE THE FOLLOWING ITEMS IN addition TO THE ITEMS FOR MODERATE SEISMICITY)

FOUNDATION CONFIGURATION

	Description
C **NC** N/A U	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:** Worst case wall at north face of building L/h = 10'/17.92' = 0.56 is not greater than 0.6Sa =0.6(1.28) = 0.768
C NC N/A U	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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Collapse Prevention Structural Checklist For Building Type W2

LOW AND MODERATE SEISMICITY

SEISMIC-FORCE-RESISTING SYSTEM

	Description
(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:**
C **(NC)** N/A U	SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the following values: (Commentary: Sec. A.3.2.7.1. Tier 2: Sec. 5.5.3.1.1) Structural panel sheathing: 1,000 lb/ft Diagonal sheathing: 700 lb/ft Straight sheathing: 100 lb/ft All other conditions: 100 lb/ft **Comments:** Flexible diaphragm analysis shows that center wall at gridline 34 has shear stress of 2344 #/lf. Capacity assumed as 2000 lb/ft because plans indicate that wall has sheathing on both sides. DCR = 1.15.
C NC **(N/A)** U	STUCCO (EXTERIOR PLASTER) SHEAR WALLS: Multi-story buildings do not rely on exterior stucco walls as the primary seismic-force-resisting system. (Commentary: Sec. A.3.2.7.2. Tier 2: Sec. 5.5.3.6.1) **Comments:**
C NC **(N/A)** U	GYPSUM WALLBOARD OR PLASTER SHEAR WALLS: Interior plaster or gypsum wallboard is not used for shear walls on buildings more than one story high with the exception of the uppermost level of a multi-story building. (Commentary: Sec. A.3.2.7.3. Tier 2: Sec. 5.5.3.6.1) **Comments:**
(C) NC N/A U	NARROW WOOD SHEAR WALLS: Narrow wood shear walls with an aspect ratio greater than 2-to-1 are not used to resist seismic forces. (Commentary: Sec. A.3.2.7.4. Tier 2: Sec. 5.5.3.6.1) **Comments:**
C **(NC)** N/A U	WALLS CONNECTED THROUGH FLOORS: Shear walls have an interconnection between stories to transfer overturning and shear forces through the floor. (Commentary: Sec. A.3.2.7.5. Tier 2: Sec. 5.5.3.6.2) **Comments:** No tie downs at any wall, any floor

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

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C	NC	N/A	U	
○	○	○	○	HILLSIDE SITE: For structures that are taller on at least one side by more than one-half story because of a sloping site, all shear walls on the downhill slope have an aspect ratio less than 1-to-1. (Commentary: Sec. A.3.2.7.6. Tier 2: Sec. 5.5.3.6.3) **Comments:**
○	○	●	○	CRIPPLE WALLS: Cripple walls below first-floor-level shear walls are braced to the foundation with wood structural panels. (Commentary: Sec. A.3.2.7.7. Tier 2: Sec. 5.5.3.6.4) **Comments:**
○	○	○	○	OPENINGS: Walls with openings greater than 80% of the length are braced with wood structural panel shear walls with aspect ratios of not more than 1.5-to-1 or are supported by adjacent construction through positive ties capable of transferring the seismic forces. (Commentary: Sec. A.3.2.7.8. Tier 2: Sec. 5.5.3.6.5) **Comments:**

CONNECTIONS

				Description
○	○	○	○	WOOD POSTS: There is a positive connection of wood posts to the foundation. (Commentary: Sec. A.5.3.3. Tier 2: Sec. 5.7.3.3) **Comments:**
○	○	○	○	WOOD SILLS: All wood sills are bolted to the foundation. (Commentary: Sec. A.5.3.4. Tier 2: Sec. 5.7.3.3) **Comments:**
○	○	○	○	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:**

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

CONNECTIONS

	Description
C NC N/A U	WOOD SILL BOLTS: Sill bolts are spaced at 6 ft (1.8 m) or less with acceptable edge and end distance provided for wood and concrete. (Commentary: A.5.3.7. Tier 2: Sec. 5.7.3.3) **Comments:**

DIAPHRAGMS

	Description
C NC N/A U	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:**
C NC N/A U	ROOF CHORD CONTINUITY: All chord elements are continuous, regardless of changes in roof elevation. (Commentary: Sec. A.4.1.3. Tier 2: Sec. 5.6.1.1) **Comments:**
C NC N/A U	DIAPHRAGM REINFORCEMENT AT OPENINGS: There is reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. (Commentary: Sec. A.4.1.8. Tier 2: Sec. 5.6.1.5) **Comments:** No continuous chord at 2nd floor opening at Line E.2, but straps are provided at walls north of where chord should occur.
C NC N/A U	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:** Wood structural panel diaphragms
C NC N/A U	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:** Wood structural panel diaphragms

UC Campus:	UC Santa Cruz			Date:	6/30/2019		
Building CAAN:	7312	Auxiliary CAAN:		By Firm:	Maffei Structural Engineering		
Building Name:	TA Drama			Initials:	*NY*	Checked:	*JM*
Building Address:	465 Kerr Road, Santa Cruz, CA 95064			Page:	4	of	4

ASCE 41-17
Collapse Prevention Structural Checklist For Building Type W2

C	NC	N/A	U	
○	○	○	○	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 have aspect ratios less than or equal to 4-to-1. (Commentary: Sec. A.4.2.3. Tier 2: Sec. 5.6.2) **Comments:** No diagonally sheathed or unblocked diaphragms
○	○	○	○	OTHER DIAPHRAGMS: The 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:** Wood diaphragms

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

MAFFEI STRUCTURAL ENGINEERING

Project:_____
Subject:_____
By:_____
Date:_____

SEISMIC EVALUATION OF EXISTING BUILDINGS - TIER 1 SCREENING

ASCE 41-17 Chapter 4

General			**Reference**
Architect	Ralph Rapson and Associates Inc		
Structural Engineer	Pregnoff & Matheu		
Location	465 Kerr Road		
Design date	1971		
Latitude	36.9951722		(Google Earth)
Longitude	-122.06144		"
Stories above grade	2	*MSE rule for establishing occupant load for risk category is needed. Here, I assume 20 net sf/person per 2016 CBC table 1004.1.2 for "Educational, classroom" function or 100 gross sf/person (need a good reference for this assumption, I saw it mentioned online in a discussion). Assume 0.6Gross square feet = Net square feet. Therefore, 20640 sf/100 = 206 and 20640 sf(0.6)/20 = 620. Assume 620 occupants. Propose to use a similar approach for other buildings.	
Seismic parameters			
Risk Category	II	2016 CBC Table 1604.5	
Site Class	D	https://earthquake.usgs.gov/hazards/urban/sfbay/soilt	(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.atcour Based on ASCE 7-16 DE, used to determine "Level of Seismicity"	(ASCE 41-17 Eq 2-4)
S_{D1}	N/A	https://hazards.atcouncil.org/ Based on ASCE 7-16 DE, used to determine "Level of Seismicity"	(ASCE 41-17 Eq 2-5)
S_{XS}	1.281	For BSE-2E hazard level	(ASCE 41-17 Table 2-2)
S_{X1}	0.88	For BSE-2E hazard level	(ASCE 41-17 Table 2-2)
Scope			
Performance level	Collapse Preventon		(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	W2: Wood Frames, Commerical and Industrial		(ASCE 41-17 Table 3-1)

Material properties				Notes	
Concrete	f'_c	4000	psi	Specified on drawings, NWC	(ASCE 41-17 Table 10-4)
Reinf.	f_y	60	ksi	#6 and larger A432	(ASCE 41-17 Table 10-4)
	f_y	40	ksi	All other bars A-15 Intermediate	(ASCE 41-17 Table 10-4)
Steel	F_y	N/A	ksi	N/A	(ASCE 41-17 Table 9-1)

Checklists

Benchmark building	No	(ASCE 41-17 Table 3-2)
Checklist(s) req'd	17.1.2 Basic Configuration	(ASCE 41-17 Table 4-6)
	17.12 Structural Checklist for Building Types W2	(ASCE 41-17 Table 4-6)
	~~17.19 Nonstructural Checklist~~ (not performed)	(ASCE 41-17 Table 4-6)

Seismic forces

V	275	kip	$V = Cs_a W$	= 1.41W	(ASCE 41-17 Eq 4-1)
W	195	kip	building weight		(ASCE 41-17 4.4.2.1)
C	1.1		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	0.22	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	25	ft	building height		(ASCE 41-17 Eq 4-4)

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

Story	w	story ht	h	wh^k	F_{story}	F_{story}	V_{story}
	kip	ft	ft			kip	kip
Roof	53	10.57	25	1302	0.40	109	109
2	142.1	14.0	14	1989	0.60	166	275
Total	195			3292	1.0	275	
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	$L_{w\ N\text{-}S}$	$L_{w\ E\text{-}W}$	v_{NS}^{avg}	v_{EW}^{avg}	D/C_{NS}	D/C_{EW}
	ft	ft	p/ft	p/ft		
Roof	120	48	201	504	0.2	0.5
2	120	58	509	1053	0.5	1.1
Total						

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

v_{limit} 1000 p/ft

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

BUILDING B CAAN 7312 - Calculations

SEISMIC WEIGHT TABLE

ROOF
- → 9 shingle roofing
- → 1/2" ply
- → 2x6 @ 16" c 2x8 @ 16"
- → 5/8" Gyp.
- → insul., MEP, misc.

2 + 1.5 + 4 + 2.75 + 3 } → 13.25 → 13 psf

2ND LEVEL
- → 3/4" tile on deck
- → 3/4" plywood
- → 5/8" Gyp + 2(2x4 @ 16")
- → JOIST AVG
- → insul, MEP, misc

30 + 3 + 4.9 + 3.7 + 5 } → 46.6 → 47 psf → use 49 psf @ walkway incl. stucco on underside

→ use 47 psf @ floor

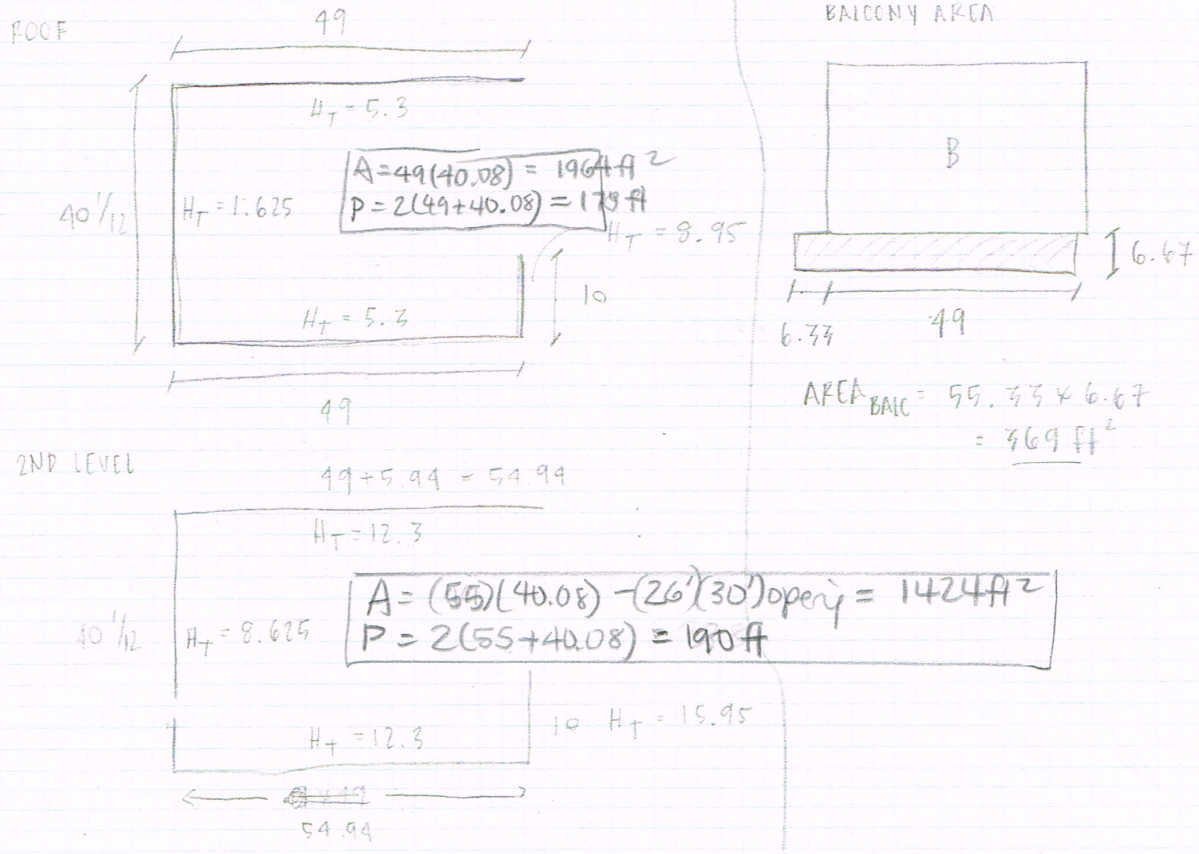
WALL WEIGHT

EXT
- → 1" stucco
- → 3/8" ply
- → 2x6 @ 16" studs
- → 5/8" Gyp + insul.

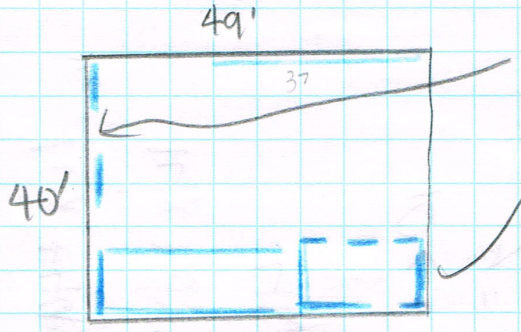
11 + 2 + 2.75 + 1.75 } 17.7 psf → 18 psf @ ext. wall

INT
- → 10 psf

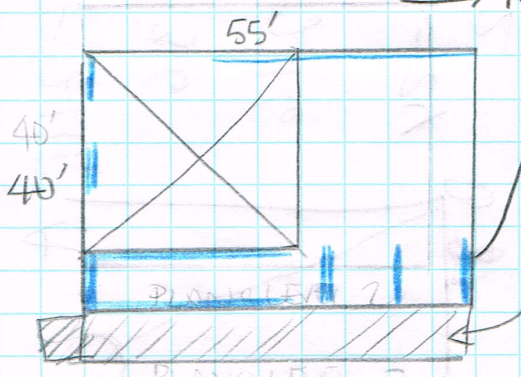
→ 10 psf (per floor area) @ int partition



CAAN 7312 - BUILDING B TA DRAMA



PLAN @ ROOF



PLAN @ LEVEL 2

- Length of wall N-S = (49' - 12' opening) + (49' - 3(3' opening) + (49' - 2(3' opening) = 120'
  Length of wall E-W = (40' - 3(4' opening) + 10' + 10' = 48'

- Length of wall N-S = 120'
  Length of wall E-W = 48' + 10 = 58'

- Calc bldg weight

Roof: (1964 ft²)(18+5 psf) + (178 ft)(18 psf)(11'/2) =
= 35.4 + 17.6 = 53.0k

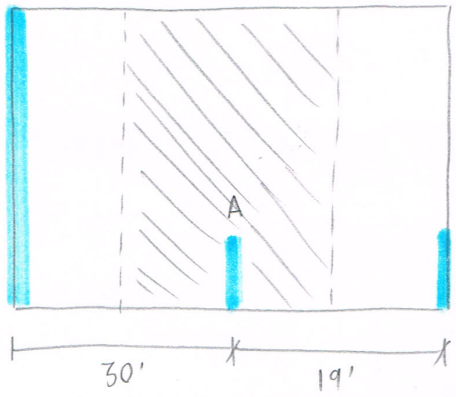
2nd: (1424 ft)(47+10) + (190)(18)(11/2 + 14/2) + (369 ft²)(49 psf walkway)
= 81.2 + 42.8 + 18.1 = 142.1k

- Calc C.O.R vs com in EW direction

- ROOF: $COR = \frac{40'(0) + 10'(30') + 10'(49')}{40+10+10} = 13.1 > .2(49) = 9.1'$ NG

- 2nd - ok by inspection since walls are centered over floor area when opening is considered.

ROOF ⇓ 109k



USING FLEX DIAPHRAGM ASSUMPTION, CALCULATE LOAD TO WALL A:

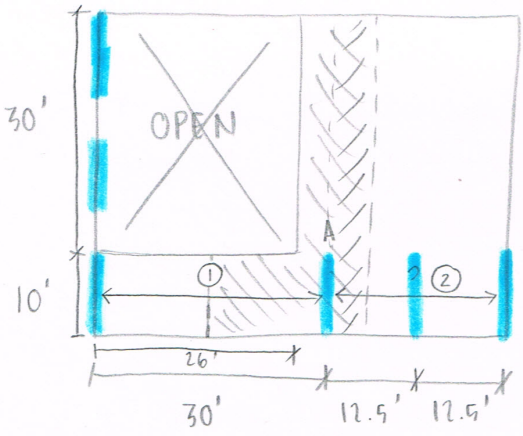
DISTRIBUTED LOAD $\omega = \frac{109k}{49'} = 2.2$ klf

TRIBUTARY LENGTH OF WALL A $L_T = \frac{30'}{2} + \frac{19'}{2} = 24.5'$

$F_{WALL A,R} = \omega \times L_T$

$= (2.2\text{klf})(24.5') = \underline{54.5\ k}$

2ND LEVEL ⇓ 166k



USING FLEX DIAPHRAGM ASSUMPTION, CALCULATE LOAD TO WALL A:

DISTRIBUTED LOAD OVER REGION 1 ω_1

$= \frac{166k}{(2^{ND}\text{ FLOOR AREA})} \times 10'$

$= \frac{166k}{(55' \times 40' - 26' \times 30')} \times 10'$

$= \frac{166k}{1424\,ft^2} \times 10' = 1.2$ klf

DISTRIBUTED LOAD OVER REGION 2 ω_2

$= \frac{166^k}{1424\,ft^2} \times 40' = 4.6$ klf

TRIBUTARY LENGTH OF WALL A ON SIDE 1 $L_{T,1}$

$= (30'/2) = 15'$

TRIBUTARY LENGTH OF WALL A ON SIDE 2 $L_{T,2}$

$= (12.5'/2) = 6.25'$

$F_{WALL A,L} = \omega_1 (L_{T,1}) + \omega_2 (L_{T,2})$

$= (1.2\text{ klf})(15') + (4.6\text{ klf})(6.25')$

$= \underline{46.0k}$

TOTAL $F_{WALL A} = F_{WALL A,R} + F_{WALL A,2} = 54.5\ k + 46.0\ k = \boxed{100.5k}$

* USING TIER 1 QUICK CHECK METHOD, CHECK SHEAR DEMAND:

$F_{WALL,A}$ IN LBS: $100.5k \times \frac{1000\text{ LBS}}{k}$

$= 100{,}500$ LBS

$\text{DEMAND} = \frac{F_{WALL,A}}{(10') \times (4.5)}$

$= \frac{100500\text{ LBS}}{(10') \times (4.5)}$

2223 plf

NG 2223 plf > 2000 plf (DOUBLE SHEATHED)