Rating form completed by:

RUTHERFORD + CHEKENE
ruthchek.com
Evaluator: EB/WAL/BL
Date: 06/28/2019

Text in green is to be part of UCSC building database and may be part of UCOP database.

DATE: 2019-06-28

UC Santa Cruz building seismic ratings

Field House Addition

CAAN #7119.1
Elena Baskin Visual Arts, Santa Cruz, CA 95064
UCSC Campus: Main Campus

Southeast Corner (Looking Northwest)

Plan

Rating summary	Entry	Notes
UC Seismic Performance Level (rating)	V (Poor)	
Rating basis	Tier 1	ASCE 41-17[1]
Date of rating	2019	
Recommended list assignment (UC Santa Cruz category for retrofit)	Priority B	Priority A=Retrofit ASAP Priority B=Retrofit at next permit application
Ballpark total construction cost to retrofit to IV rating	Medium ($50-$200/sf)	See recommendations on further evaluation and retrofit.
Ballpark total construction cost to retrofit to IV rating[2]	Yes	Building was not previously rated.

[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 III.A.4.i of the 26 March 2019 *UC Seismic Program Guidebook, Version 1.3*, 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.

Rating summary	Entry	Notes
Further evaluation recommended?	Yes	Focused on adequacy of the glulam-steel column moment frames and their connections in the N-S directions, the roof-to-wall connection in the E-W direction, and possible retrofit measures if needed.

Building information used in this evaluation

- Architectural drawings:
  2nd Story addition: by J. Martin Rosse A.I.A. Architect, "Physical Activities Facilities East, University of California, Santa Cruz," dated 21 July 1975, Sheets A1 (existing conditions).
  Original 1st Story: by Callister, Payne & Rosse Architects, "Enclosed Courts, University of California, Santa Cruz," dated 6 May 1961, Sheets 1 to 3.
- Structural drawings:
  2nd Story addition: by Sexton, FitzGerald & Kaplan, Engineers, "Physical Activities Facilities East, University of California, Santa Cruz," dated 21 July 1975, Sheets S1 through S5 corresponding to the building added on top of the racquetball court existing building.
  Original 1st Story: by Stefan J. Medwadowski Consulting Structural Engineer, "Enclosed Courts, University of California, Santa Cruz," dated 6 May 1961, Sheets S.1 through S.3.
  Original 1st Story foundation retrofit: by Stefan J. Medwadowski Consulting Structural Engineer, "Enclosed Courts, University of California, Santa Cruz," dated 7 April 1970, Sheets S.4.

Additional building information known to exist

- None

Scope for completing this form

Reviewed structural drawings for original construction and carried out ASCE 41-17 Tier 1 evaluation including nonstructural life-safety hazards. The site visit was performed on May 16, 2019.

Brief description of structure

The Field House Addition (second story) was built on top of an existing structure (first story) made of reinforced concrete shear walls and a 12 inch thick concrete slab that house racquetball courts. The 1st story was designed by Callister, Payne & Rosse Architects and Stefan J. Medwadowsi Consulting Structural Engineer in 1961, and the addition was designed in 1975 by J. Martin Rosse A.I.A. Architect and the structural structural engineers Sexton, FitzGerald & Kaplan, Engineers.

The building is a two-story structure measuring 144' long (E-W direction) by 49' wide (N-S direction) with a total area of 6,650 sf at the second story and 6,405 sf at the first story. At the second story, thirteen frame lines (steel columns with glulam beams) are used in the N-S direction whereas plywood shear walls are used in the orthogonal direction. Beneath the second floor is a 126'10" long (E-W direction) by 50'6" wide (N-S direction) one-story first tory that houses racquetball courts. In the N-S direction, 12" reinforced concrete shear walls are used at the west and east perimeter. Additionally, five interior concrete shear walls (8" thick) supplement the lateral force-resisting system in this direction. In the E-W direction, there is a 12" thick full height wall on the north side adjacent to the original Field House building, and a 12" thick wall on the south side with a series of clerestory windows at the top. Five square columns (1'-2") are used atop the south wall, and they are aligned with the interior walls. The structure is located on a sloping site with highest elevation at the north face and lowest at the south and east face. The first story is 21'3" in height from the first floor to the second floor, but the first floor is depressed 10'6" below the lower south grade. The second story is 12'-9" in height from the main floor to the top of the perimeter walls at the eave of the roof and 22'-8" to the top of the skylight.

On the east side of the building, the second floor was expanded to the east with a reinforced concrete slab supported on beams and columns and the original east wall of the first story. The east edge of the original second floor was chipped so that rebar from the addition could be welded to the original second floor reinforcing. On the south side of the structure, a reinforced concrete cantilever hallway (4'-6" wide) was attached the edge of the second floor slab

similar to the approach at the east expansion. The roof diaphragm is framed using wood joists that span to arched glulams (5 1/8" thick) spaced at 10'-5" o.c. The roof diaphragm has an opening located at center that runs along the length of the longitudinal dimension of the building. A 12" thick reinforced concrete slab supported on the concrete walls serves as the diaphragm for the second floor.

Building condition: in general, the building is in good structural condition. No significant damage in the structural system was identified during the site visit. However, the bottom face of the exterior concrete slab use as hallway for the exterior stair was wet during the visit. Water marks, brown stains, and efflorescence were evident in the same area (see pictures in Appendix A). The columns along Gridlines 8 and 11 are rusted because they are exposed to the weather (see picture).

Identification of levels: The building has two stories. The first story is used as racquetball courts (existing building prior the construction of second story), and the second story is used as gymnasium. Grade on the west side of the building gently slopes down to the south. The north entrance of the second floor is on the higher grade level. The south and east grade is approximately 10'9" lower. The first floor for the racquetball courts is approximately 10'6" below the south and east grade.

Foundation system: The concrete walls of the perimeter of the building are supported on top of 10"x2'-4" reinforced concrete footings, except the south wall which is on top of a continuous 12"x6'0" footing. The interior walls are on top of 10"x3'0 footings. In 1970, the foundation was retrofitted in the southwest corner of the building. A total of eight 30" diameter x 20' minimum length drilled caissons were cast beneath the existing foundation. A concrete cap was used atop of them (per Sheet S.4). The west side of the building is located on a sloping ground and is supported on reinforced concrete walls that varied in height following the slope. The steel columns and the wood walls were anchored to the concrete slab. The second story steel columns are anchored to the existing concrete slab using two 3/4"diameter drilled anchors. The new columns of the first story are supported on shallow (12" thick) foundations.

Structural system for vertical (gravity) load: A flexible roof diaphragm is framed with 2x6 at 16" o.c. wood joists and ½" thick plywood sheathing. The joists transfer the load to a pair of 5-1/8" thick arched glulam girders connected to steel columns (2C12x20.7) using four 3/4"diameter machine bolts with 4" diameter shear plates at each side dapped into the face of the glulam. The columns are welded to a 3/8" baseplate anchored to the second floor concrete slab using two 3/4"diameter drilled anchors. The second floor slab is a 12" thick one-way slab spanning east-west between north-south concrete bearing walls and concrete girders. Two curtains of continuous #5 @ 12" o.c. are used as top and bottom reinforcement. Additionally, a #6x13' @ 6" o.c. and #5x12' @ 6" are used on the top curtain to resist the negative moment and #5x15' @ 6" and #4x12' @ 6" are used on the bottom curtain to resist the positive moment per Detail A/S.3. On the east side, the new concrete slab is supported on a concrete beam floor system framed into six reinforced concrete columns which transfer the load using shallow foundations. The slab-on-grade is 5" thick, reinforced with #4 bars at 12" o.c., e.w., over a vapor retarder over 4" of drain rock.

Structural system for lateral forces: At the second story, the lateral force in the N-S direction is resisted by thirteen lines of moment frames. The load from the plywood roof diaphragm is transferred to 5/8" thick glulam beams framed into composite steel-wood columns. The columns were built using two back-to-back C12x20.7 channels with two 1 ½"x5 1/8" wood infill members bolted with 1/2" diameter bolts at 2" o.c. A 3/8" thick steel plate was used at the base to anchor the columns to the existing slab using two 3/4"diameter drilled anchors. The beam-column connection was made using four 3/4"diameter bolts with 4" diameter shear plates on each side. In the E-W direction, the lateral force is resisted by two lines of wood walls located at the north and east perimeter of the structure framed using 2x4@16" o.c. vertical stud and 1/2" plywood sheathing. However, based on the structural drawings, the load transfer relies on a complicated load path from the roof around and through the roof eave and into the top plate of the stud wall. A clear connection at the top plate is not shown. The walls were anchored at the existing slab using 5/8" diameter x 14" long threaded rods at 4'-6" o.c. grouted with non-expansive mortar. Plywood sheathed roof diaphragms transfer lateral inertial forces to the vertical elements of the lateral force-resisting system. The structural system used in the transverse direction of the second story of the building cannot be classified using the building types listed in Table 3-1 of ASCE 41-17.

At the first story, in the N-S direction, the lateral loads are resisted by seven concrete walls. The west and east ends have full length 50'6" long by 12" thick walls; then there are two 41'6" long by 8" thick walls one bay inboard of the perimeter; and finally there are three 6'0" long by 14" thick walls at the interior bays adjacent to the north wall. In

the E-W direction, there is a full length 12" thick shear wall at the north side. At the south façade, rather than a solid shear wall, there are a fire 14" x14" columns that span7'6" between a below grade retaining wall and a 2'4" deep by 1'2" thick spandrel beam with a 14" thick concrete wall beneath the windows. The columns are reinforced with four #8 longitudinal bars and #4 closed ties at 12" o.c. (with 135 degree hooks). The space between columns appears to be infilled with nonstructural gypboard infill panels. The walls transfer the load to the shallow foundations and to the drilled caissons in the southwest corner.

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:

- Moment frames: The moment connections between the glulam and the steel columns at the second story are unusual and may not have sufficient capacity and ductility to resist the applied demands. Similarly, the glulam beam and steel column capacity may be insufficient. There is no Quick Check equation for this type of frame in the Tier 1 of ASCE 41-17.

- The concrete columns at the first story on the south façade have poor detailing which does not provide ductility to resist the lateral forces. The columns are not able to develop the moment capacity at the ends of the member. They reach their shear capacity at a relatively low drift level of only 0.13". They also may be taking moment from earth pressure as they are connected to the top of the retaining walls.

- If nailing at the top plate of the second story wood walls is inadequate, then there may be a weak link in the east west load path from the roof to the walls.

- The separation between the Field House Addition and North Building of the East Field House is shown as 1" on the addition drawings which is less than the 2.2" required by the ASCE 41-17 Tier 1 Quick Check, but the structures align at the concrete terrace levels, and they are relatively stiff shear wall structures. Damage from pounding is considered a comparatively low concern.

- Although the center of rigidity at the second floor is located at the north wall, there are substantial walls in the north-south direction that can help resist torsion from east-west loading at the second floor.

- The reinforcement of the new concrete slabs was welded to the existing walls reinforcement per Detail 11 and Section D on Sheet S3. Because the first ASTM A706 steel reinforcement was first published in 1974, it is unclear if this practice damaged the reinforcement at the corner of the existing walls or if a test was performed to qualify this type of connection.

Nonlinear behavior is expected to be limited to roof diaphragms, second story moment frames and second story shear walls. The first story concrete shear walls have substantial overstrength and are expected to remain essentially elastic, but there is the possibility that interstory drift could compromise the columns on the first story.

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

No nonstructural life safety concerns were identified, but it is not known if gas-fueled equipment such as heaters and boilers are used.

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	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.	Unknown

Basis of rating

A Seismic Performance Level rating of V is assigned based on the absence of an ASCE 41-17 Tier 1 quick check procedure for hybrid wood-steel frames, the limited ductility in the frame connections, the potentially inadequate transfer mechanism of the load in the E-W direction at the top plate of the second story walls, and the limited drift capacity of the first story concrete columns.

Recommendations for further evaluation or retrofit

We recommend that a Tier 2 linear evaluation be performed of the glulam-steel moment frames and their connections to determine whether there is adequate capacity and ductility. Field review is recommended to determine the details of the roof-to-top plate connections at the second story shear walls. In the orthogonal direction, a review of the connection is needed to make sure how the lateral load is transmitted to the shear walls. A refined estimate of the interstory drift at the first story is needed to assess the adequacy of the columns.

Peer review of rating

This seismic evaluation was discussed in a peer review meeting on 28 May 2019. Reviewers present were Joe Maffei of Maffei Structural Engineering and Robert Graff 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.

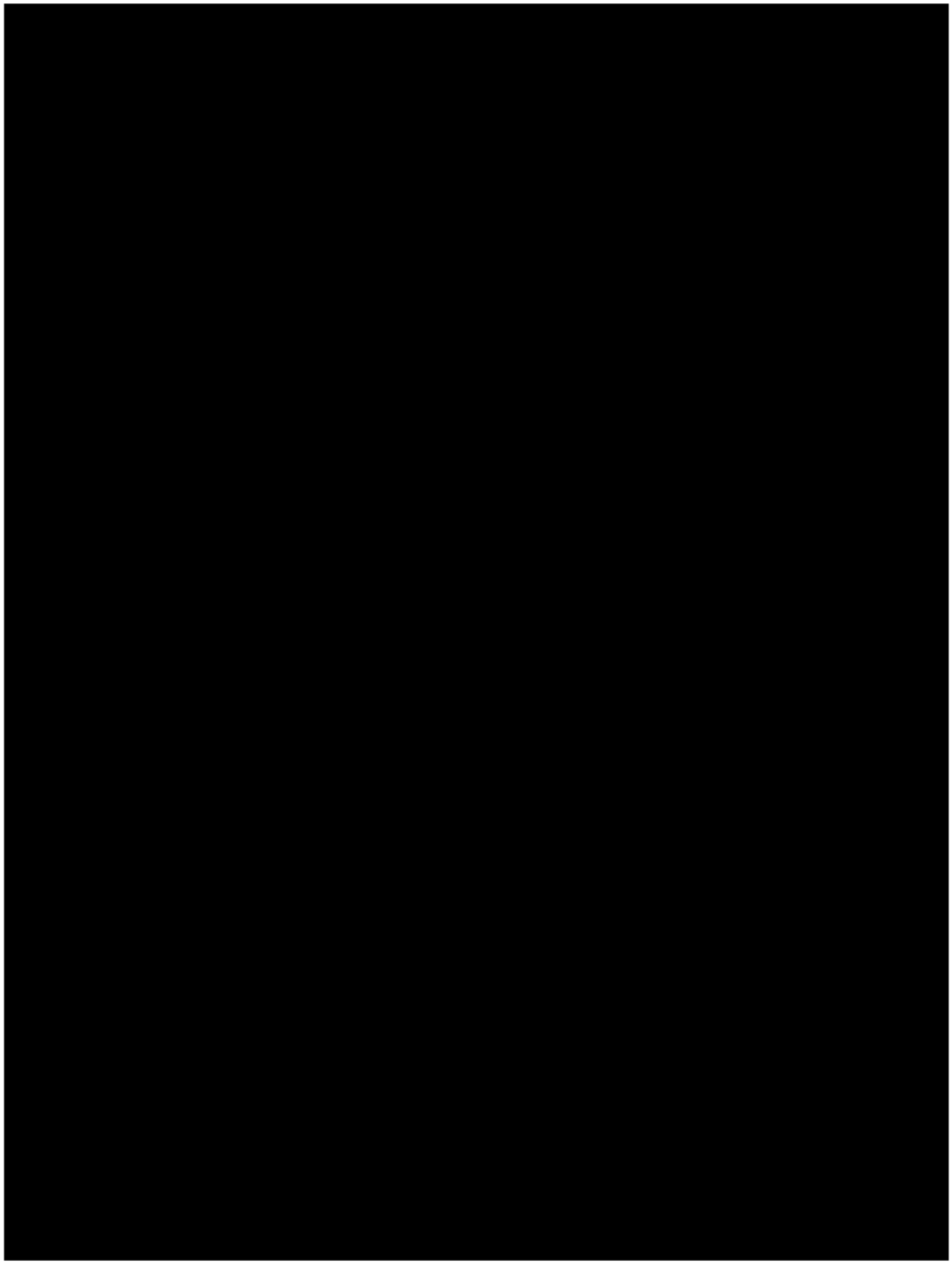
Additional building data	Entry	Notes
Latitude	36.994242	
Longitude	-122.055037	
Are there other structures besides this one under the same CAAN#	Yes	
Number of stories above lowest perimeter grade	2	
Number of stories (basements) below lowest perimeter grade	0	
Building occupiable area (OGSF)	13,300	
Risk Category per 2016 CBC Table 1604.5	II	
Building structural height, h_n	28.3 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	0.25 sec	Estimated using ASCE 41-17 equation 4-4 and 7-18
Site data		
975-year hazard parameters S_s, S_1	1.284, 0.486	From OSHPD/SEAOC website
Site class	D	
Site class basis	Geotech[4]	See footnote below
Site parameters F_a, F_v	1.0, 1.814	From OSHPD/SEAOC website
Ground motion parameters S_{cs}, S_{c1}	1.284, 0.882	From OSHPD/SEAOC website
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	

[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

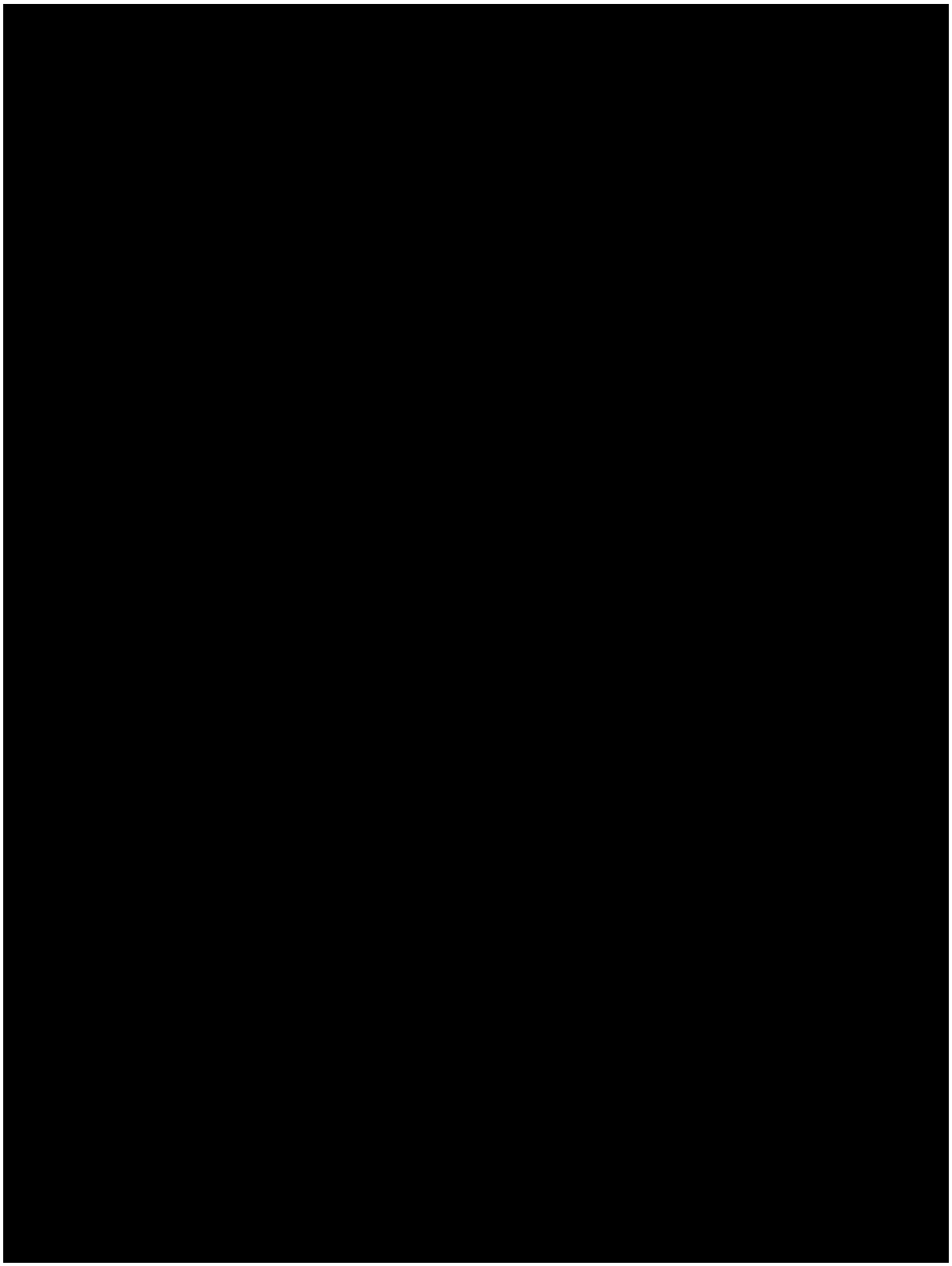
Applicable code		
Applicable code or approx. date of original construction	Built: 2nd story: 1975 1st story: 1969 Code: UBC 2nd story: 1973 1st story: 1967	Code inferred based on design year
Applicable code for partial retrofit	UBC 1970	Foundation retrofits of the southwest corner
Applicable code for full retrofit	None	No full retrofit
FEMA P-154 data		
Model building type North-South	2nd story: Steel-wood frame 1st story: C2 – concrete shear walls	The structural system used on the second story is not defined in Tier 1 of ASCE 41-17
Model building type East-West	2nd story: W2 - Wood frame 1st story: C2 – concrete shear walls	
FEMA P-154 score	N/A	Not included here because we performed ASCE 41-17 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:

2nd Story:

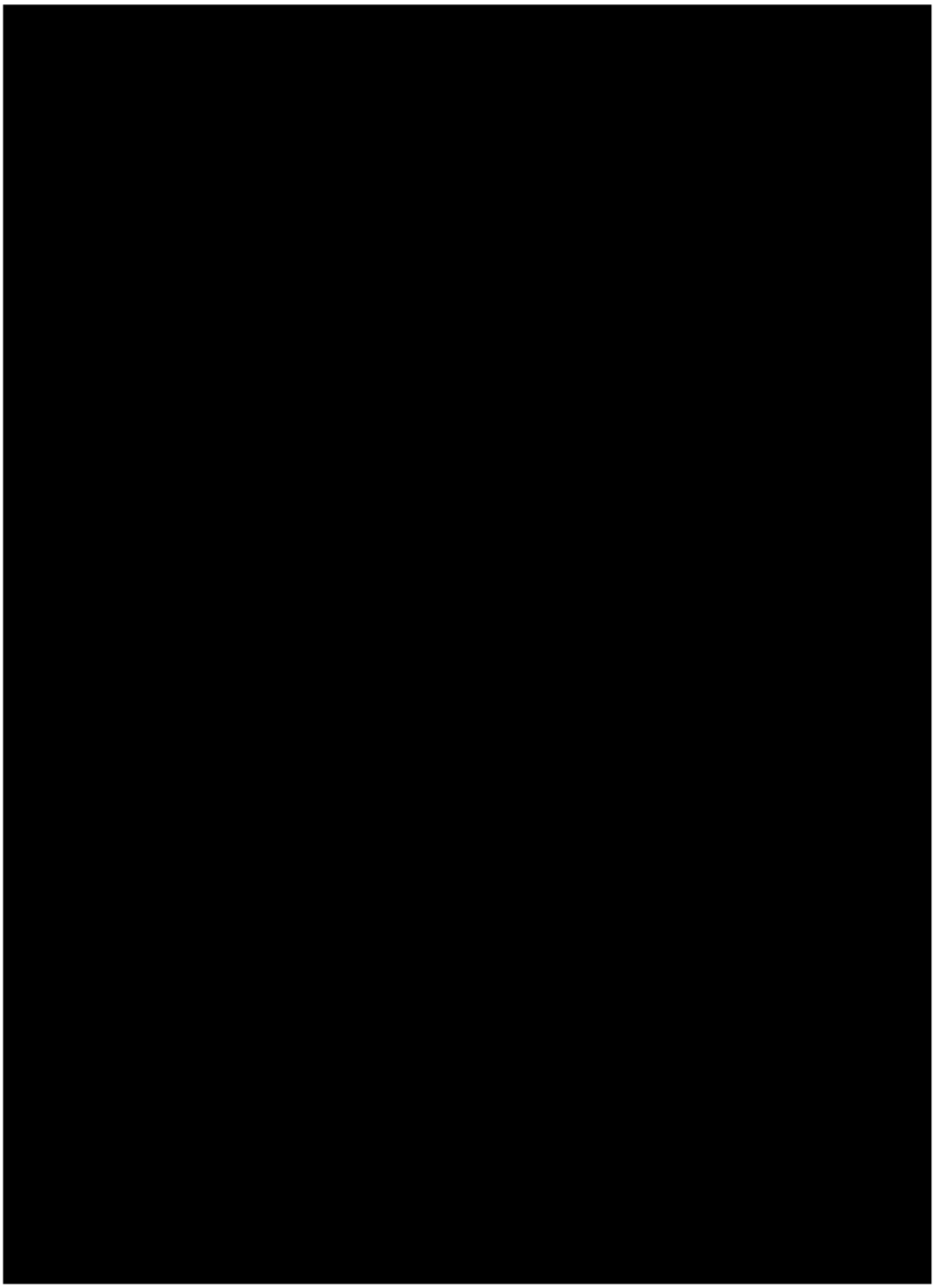


1st Story:

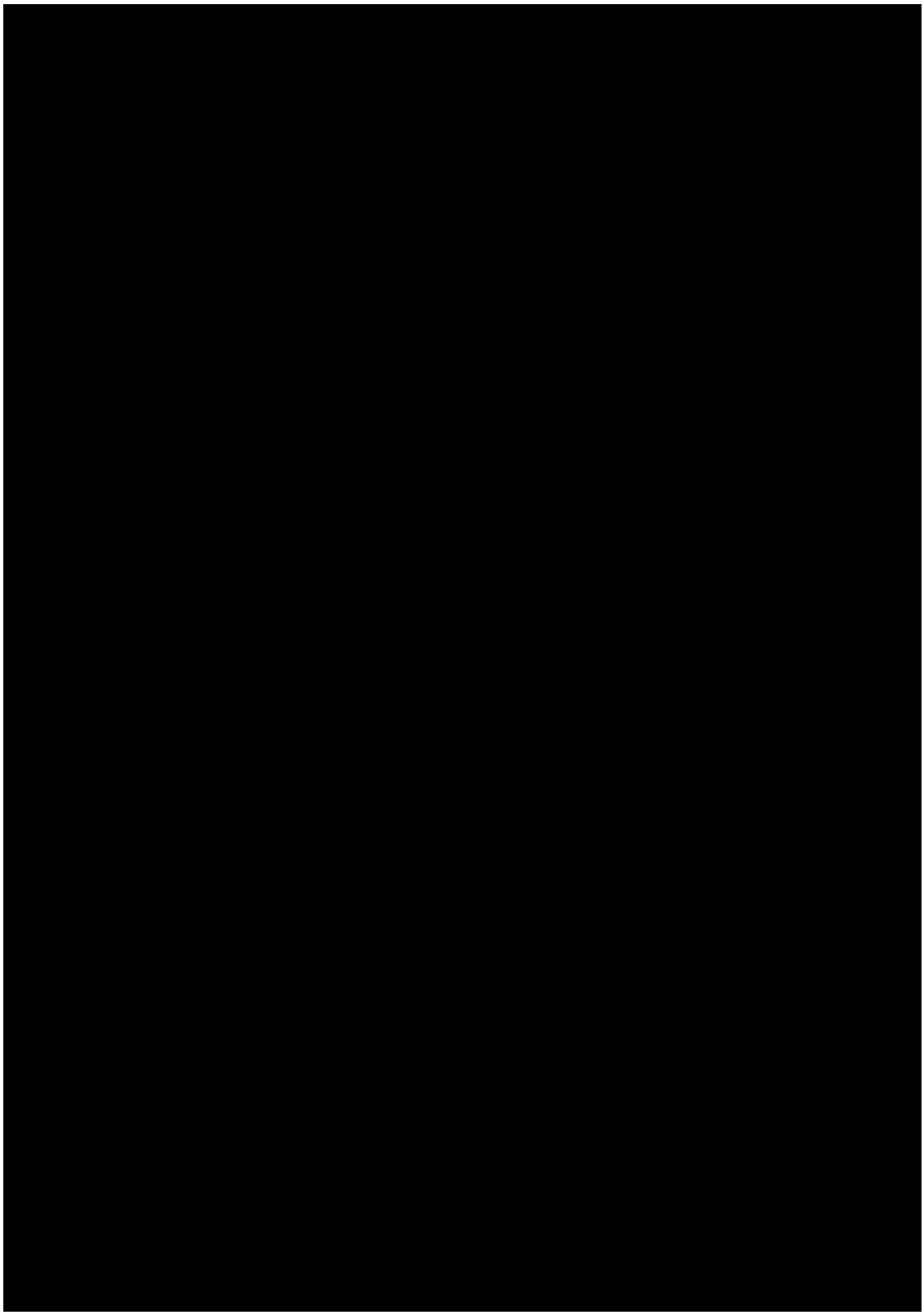


Structural system:

2nd Story:

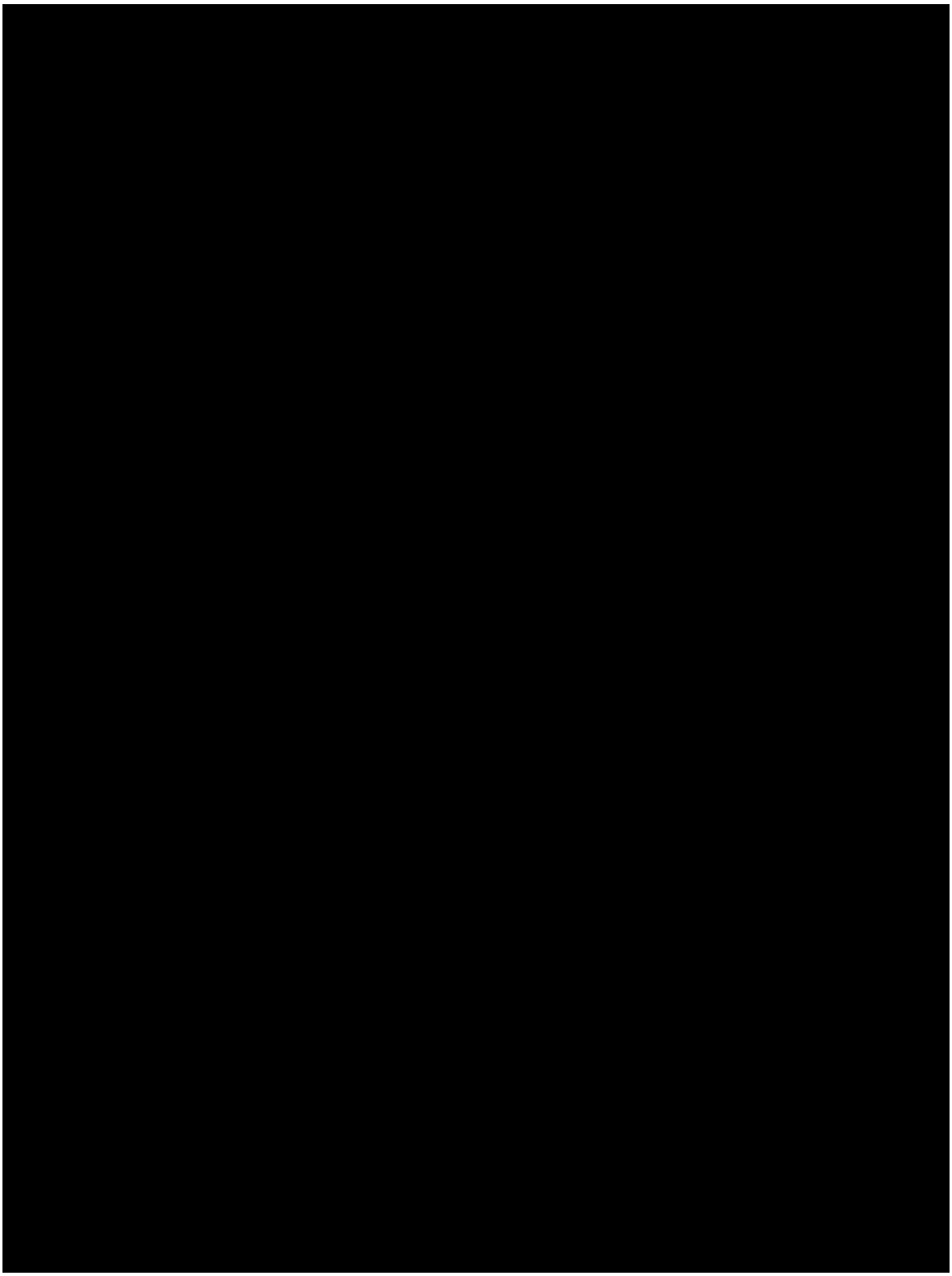


1st Story:

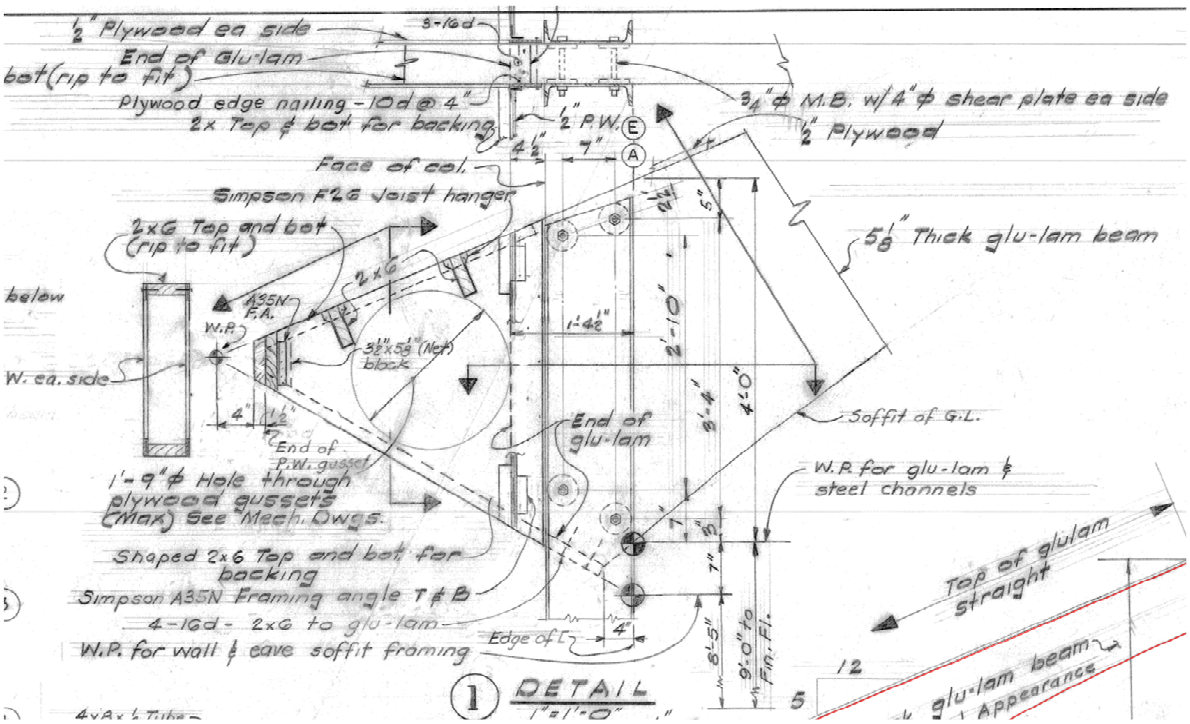


Glulam/Steel connection:

Frame elevation (per Sheet S.2):



Connection detail (per Sheet S.2):



APPENDIX A

Additional Photos

Partial North Elevation (Looking Southeast)

Partial South Elevation (Looking North)

West Elevation (Looking East)

Building Name: Field House Addition
CAAN ID: 7119.1

Evaluator: R+C
Date: 06/28/19

Partial East Elevation (Looking Southwest)

Roof Glulam Beams

Water Marks on the Exterior Stairs Hallway (South)

Rusted columns on Gridlines 8 and 11.

APPENDIX B

ASCE 41-17 Tier 1 Checklists (Structural)

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7119.1	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
Building Name:	2nd story: Field House Addition			Initials:	EB	Checked:	WAL/BL
Building Address:	Santa Cruz, CA 95064			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:** 1/2" plywood roof diaphragms deliver the loads to the moment frames and plywood shear walls at the second story, which are connected to the existing concrete slab through anchors bolts. The second floor concrete slab transfers loads to first story concrete shear walls.
○	●	○	○	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 field house addition abuts the PE facility to the north. Structural drawings for the addition indicate there is a 1" seismic expansion joint which has less than 12'0" x 0.015 =2.2" as required for high seismicity. However, the buildings align vertically at the terrace level concrete slabs.
●	○	○	○	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:** Four small triangular-shape mezzanines used as fan rooms are isolated from the main lateral force-resisting system. Isolated shear walls framed using double 2x4@16" o.c. vertical studs and 1/2" plywood sheathing are used as vertical system. Plywood sheathing with a 1 1/2" lightweight concrete floor diaphragms transfer the load to the walls.

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:** The first story is stronger than the second 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 concrete first story is stiffer than the second story.
●	○	○	○	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:** All lateral force-resisting system elements are continuous to the foundation.

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

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7119.1	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
Building Name:	2nd story: Field House Addition			Initials:	EB	Checked:	WAL/BL
Building Address:	Santa Cruz, CA 95064			Page:	2	of	3

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:** No change in the horizontal dimensions.
◉	○	○	○	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:** At the first story, there is only one east-west wall line located at the north perimeter. The center of rigidity is thus at the same location and exceeds the 20% threshold.

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:** Per 2009 County map at https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/LiquifactionMap2009.pdf
◉	○	○	○	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:** Per 2009 County map at https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/LandslideMap2009.pdf
◉	○	○	○	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:** Per 2009 County map at https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/FaultZoneMap2009.pdf

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

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7119.1	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
Building Name:	2nd story: Field House Addition			Initials:	EB	Checked:	WAL/BL
Building Address:	Santa Cruz, CA 95064			Page:	3	of	3

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 ( )	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 = 49', Building Height is H = 17.7', B/H = 2.77 Sa = 1.28g per ATC at BSE-2E 0.6 x Sa = 0.768 B/H > 0.6 Sa OK
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:** Soil Class D assumed. The foundations of the first-story concrete shear walls are strip footings, and the reinforced slab-on-grade is positively connected to the footings.

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

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7119.1	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
Building Name:	1st story: Field House Addition			Initials:	EB	Checked:	WAL/BL
Building Address:	Santa Cruz, CA 95064			Page:	1	of	3

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:** There are no secondary elements.
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 the first story, two lines of shear walls in the E-W direction are used, whereas eight lines of shear wall are used in the N-S direction. This checklist does not apply for the second floor (see accompanying Type W2 Checklist).
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 b/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:** Concrete shear walls shear stress demands of 33 psi in transverse direction and 43 psi in longitudinal direction are smaller than 110 psi.
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:** Per Sheet S.2: 1. VERTICAL REINFORCEMENT: 2#5@12" o.c., $\rho_V = 0.00431$ greater than 0.0012 → OK 2. HORIZONTAL REINFORCEMENT: 2#4@12" o.c., $\rho_H = 0.00278$ greater than 0.0020 → OK

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:** No flexible diaphragms.

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

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7119.1	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
Building Name:	1st story: Field House Addition			Initials:	EB	Checked:	WAL/BL
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Collapse Prevention Structural Checklist For Building Type C2-C2A

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:** Diaphragms connected to the shear walls per Details N, P, Q, and R on Sheet S.2.
●	○	○	○	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:** Dowels per Details N, P, Q, and R on Sheet S.2.

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

Seismic-Force-Resisting System

				Description
C	NC	N/A	U	
○	●	○	○	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:** The columns on the south façade are shear critical and they only have the capacity to deform 0.13" before reaching their shear capacity.
○	○	●	○	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:** The slabs that are not part of the seismic force-resisting system have continuous bottom steel. However, they were not built next to columns.
○	○	●	○	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:** No coupling beams.

Diaphragms (Stiff Or Flexible)

				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:** A continuous reinforced concrete slab was used.

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

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7119.1	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
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Collapse Prevention Structural Checklist For Building Type C2-C2A

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:** No opening in the diaphragm.

Flexible Diaphragms

				Description
C	NC	N/A	U	
○	○	◉	○	CROSS TIES: There are continuous cross ties between diaphragm chords. (Commentary: Sec. A.4.1.2. Tier 2: Sec. 5.6.1.2) **Comments:** No flexible diaphragm.
○	○	◉	○	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:** No wood diaphragm.
○	○	◉	○	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:** No wood diaphragm.
○	○	◉	○	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:** No wood diaphragm.
○	○	◉	○	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:**

Connections

				Description
C	NC	N/A	U	
◉	○	○	○	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:** Properly detailed pile caps and piles.

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

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7119.1	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
Building Name:	Field House Addition, 2nd Story			Initials:	EB	Checked:	WAL/BL
Building Address:	Santa Cruz, CA 95064			Page:	1	of	4

ASCE 41-17
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:** There are two lines of shear walls in the east west direction.
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 b/ft Straight sheathing 100 b/ft All other conditions 100 b/ft **Comments:** The average shear stress of the second-floor wood shear walls in the E-W direction is 929 plf. Concrete walls are used in the first story (see accompanying Type C2 Checklist). In the N-S direction this form is not applicable as the lateral force-resisting system in the second story is a hybrid wood and steel moment frame. On the first-floor, concrete shear walls were used (see accompanying Type C2 Checklist).
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:** The second story relies on plywood shear walls and moment frames.
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:** The second story relies on plywood shear walls and moment frames.
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:** The walls used for the seismic force-resisting elements do not have aspect ratios greater than 2V:1H.

UC Campus:	Santa Cruz			Date:	06/28/2019		
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Collapse Prevention Structural Checklist For Building Type W2

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:** Wood shear walls and steel columns are connected to the concrete slabs through threaded bars.
○	○	◉	○	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:** Does not apply as the wood frame is only at the upper story.
○	○	◉	○	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**: No cripple walls.
◉	○	○	○	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:** No large openings observed in wood shear walls.

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:** There are no freestanding wood posts.
◉	○	○	○	WOOD SILLS: All wood sills are bolted to the foundation. (Commentary: Sec. A.5.3.4. Tier 2: Sec. 5.7.3.3) **Comments:** Wood sills are bolted using 5/8"ϕx10" anchor bolts spaced 4'-6" o.c. between columns per Detail 13 and 15 on Sheet S-3.
◉	○	○	○	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:** 4-3/4"ϕ bolts with 4"ϕ shear plates each side per Detail 1 on Sheet S2.

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

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7119.1	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
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ASCE 41-17
Collapse Prevention Structural Checklist For Building Type W2

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

CONNECTIONS

C	NC	N/A	U	Description
●	○	○	○	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:** Wood sills are bolted using 5/8"ϕx10" anchor bolts spaced 4'-6" o.c. between columns per Detail 13 and 15 on Sheet S-3.

DIAPHRAGMS

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 level floors.
●	○	○	○	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:** Chord are continuous.
●	○	○	○	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:** The skylight opening at the roof diaphragm runs the full east-west length of the roof and is reinforced with 2 – 2x6 chords spliced 1'-6" with 10-16d per Section D on Sheet S2. Because there are frames every 10"5" which cross the skylight opening, the diaphragm aspect ratio is 19'3" deep by 10'5".
●	○	○	○	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 roof is sheathed with plywood.
○	○	●	○	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:** Spans smaller than 24 ft per Roof Framing Plan on Sheet S2.

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

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7119.1	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
Building Name:	Field House Addition, 2nd Story			Initials:	EB	Checked:	WAL/BL
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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 structural panel were used.
○	○	◉	○	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:** 5/8" plywood diaphragms

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

APPENDIX C

UCOP Seismic Safety Policy Falling Hazards Assessment Summary

UC Campus:	Santa Cruz			Date:	06/28/2019		
Building CAAN:	7119.1	Auxiliary CAAN:		By Firm:	Rutherford + Chekene		
Building Name:	Field House Addition			Initials:	EB	Checked:	WAL/BL
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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, feature or ornamentation above the dance studio space.
P ☐ N/A ☒	Heavy masonry or stone veneer above exit ways or public access areas **Comments:** There is no masonry or stone veneer.
P ☐ N/A ☒	Unbraced masonry parapets, cornices, or other ornamentation above exit ways or public access areas **Comments:** There are no masonry parapets, cornices or other ornamentation.
P ☐ N/A ☒	Unrestrained hazardous material storage **Comments:** No hazardous material storage was observed.
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

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

APPENDIX D

Quick Check Calculations

Unit Weights:

	Seismic Weight	Dead Load	
2nd story	Weight [psf]		Observations
Roofs heathing	1.7	1.7	1/2" plywood
Joist	2.03	2.03	considering 2x6@16" and 36 pcf
Glulam	3.7	4	13 beams + 2 to consider the W and E roof structure.
MEP	3	6	
ceiling	2	2	typ. gypboard ceiling panels
mis c+lighting	5	5	
partition including shear walls	7.5	15	half of 15 psf. The fan room are is olated so no weight is going to be considered for seismic
Steel columns	2.1	4.2	half
Total	27	40	

	Seismic Weight	Dead Load	
1st story	Weight [psf]		Observations
Slab	150	150	Based on t_{slab} = 1 ft (per Section C on sheet S4)
Walls	116.4	232.7	Base of t_{walls} = 12" and 8" (per Floor plan on Sheet S1)
New slab	21.9	22	t_{slab} = 11". The portion of the slab on grade on N side not considered.
New columns	1.0	2.0	Assuming h_{col} = 10'-7"
New beams	10.4	10.4	
partition including shear walls	7.5	15	half of 15 psf. The fan room are is olated so no weight is going to be considered for seismic
Steel columns	2.1	4.2	half
ceiling	2	2	typ. gypboard ceiling panels
mis c+lighting	5	5	
Total	316	443	

Story	W (psf)
Roof	27
1st floor	316
TOTAL	343

Story Weights

Level	Area (ft^2)	Unit Weight (psf)	Seismic Weight (kips)
2nd floor	6650	27	179
1st floor	6650	316	2103
TOTAL			2282

Rating form completed by:

RUTHERFORD + CHEKENE
ruthchek.com
Evaluator: EB/WAL/BL
Date: 06/28/2019

Period

C_t	0.02
h_n [ft]	28.28
β	0.75

T [sec]	0.25

BSE-2E Response Spectrum

OSHPD

7199.1

Latitude, Longitude: 36.994242, -122.055037

Date	5/30/2019, 3:54:40 PM
Design Code Reference Document	ASCE41-17
Custom Probability	
Site Class	D - Stiff Soil

Type	Description	Value
Hazard Level		BSE-2E
S_S	spectral response (0.2 s)	1.284
S_1	spectral response (1.0 s)	0.486
S_{XS}	site-modified spectral response (0.2 s)	1.284
S_{X1}	site-modified spectral response (1.0 s)	0.882
f_a	site amplification factor (0.2 s)	1
f_v	site amplification factor (1.0 s)	1.814

Story Shears

Sa [g]	1.28
W [kips]	2282
C [1]	1.2

V [kips]	3516

k= 1.00

Floor Levels	h_i [ft]	h_x [ft]	W_i [kips]	$w_i*h_x^k$	coeff	F_x [kips]	V_j [kips]
2nd floor (roof)	17.70	28.28	179	5077	0.19	653	653
1st floor	10.58	10.58	2103	22254	0.81	2863	3516
Σ			2282	27331		3516	

Notes:

[1] Modification Factor, C, per ASCE 41-17, Table 4-7.

Table 4-7. Modification Factor, *C*

	Number of Stories			
Building Type[a]	**1**	**2**	**3**	**≥4**
Wood and cold-formed steel shear wall (W1, W1a, W2, CFS1) Moment frame (S1, S3, C1, PC2a)	1.3	1.1	1.0	1.0
Shear wall (S4, S5, C2, C3, PC1a, PC2, RM2, URMa) Braced frame (S2) Cold-formed steel strap-brace wall (CFS2)	1.4	1.2	1.1	1.0
Unreinforced masonry (URM) Flexible diaphragms (S1a, S2a, S5a, C2a, C3a, PC1, RM1)	1.0	1.0	1.0	1.0

[a] Defined in Table 3-1.

Average Stress:

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

N-S direction (Transverse)	Steel moment frame
$M_{s,Frames}$ [1]	9
h (in.)	17.7
Z (in^3)	1331.2
n_c	26
n_f	13

N-S direction (Transverse)	Concrete Shear Walls
$M_{s,Shear\ walls}$ [2]	4.5

Level	Force (kips)	h (for MF in ft) Area (for SW in^2)	f_j^{avg}	Tier 1 Shear Stress Limit	Units	Result
2nd floor (moment frame) [3]	653	17.7	11.6	37 [4]	ksi	OK
1st floor (Concrete SW)	3516	23520	33	110 [5]	psi	OK

E-W direction (Longitudinal)	Shear Walls
M_s	4.5 CP of wood shear wall

Level	Force (kips)	L (for wood SW in ft) Area (for conc SW in^2)	f_j^{avg}	Tier 1 Shear Stress Limit	Units	Result
2nd floor (Wood SW)	653	156.3	929	1000	plf	OK
1st floor (Concrete SW)	3516	18060	43	110 [5]	psi	OK

Notes:

[1] M_s Factor per section 4.4.3.9 of ASCE 41-17.

[2] M_s Factor per ASCE 41-17, Table 4-8.

Table 4-8. M_s Factors for Shear Walls

	Level of Performance		
Wall Type	**CP[a]**	**LS[a]**	**IO[a]**
Reinforced concrete, precast concrete, wood, reinforced masonry, and cold-formed steel	4.5	3.0	1.5
Unreinforced masonry	1.75	1.25	1.0

[a] CP = Collapse Prevention, LS = Life Safety, IO = Immediate Occupancy.

[3] Equation 4-14 of Section 4.4.3.9 of ASCE 47-17 was used to checked the moment frame of the second story in the N-S direction.

[4] Assuming F_y = 37 ksi per Table 4-5 of ASCE 47-17.

[5] Greater of 100 psi or $2\sqrt{f'_c}$, assuming f'_c=3000 psi per Table 4-2 of ASCE 41-17.

COLUMN DEFORMATION COMPATIBILTY (1.1DL+0.275LL)

Material properties

- Concrete	f'_c	4	ksi	Based upon general notes, on Sheet S.1 of 1961 structural drawings
- Steel rebar, longitudinal rebar	f_y	40	ksi	Based upon general notes, on Sheet S.1 of 1961 structural drawings

Other parameters

- Flexural ductility	k_{nl}	0.7
- Normal weight concrete	λ	1.0

spColumn Model	Col Location (Column Type)[6]	Level	Type	SIZE			LONGITUDINAL			TRANVERSE						DIMENSION				CONFINEMENT		FLEX. YIELD			AXIAL				
				b (in)	h (in)	A_G (in^2)	n-#	D (in)	A_S (in^2)	n-#-s (in)		D (in)	A_V (in^2)	f_{yt} (ksi)		d (in) [1]	h_b (in)	L (ft)	L_n (in)	s/d	a_{col}	$L_n/2d_c$	$M_{ub}/V_{ub}d$	$6f'^{0.5}/(M/Vd)$	N_{UG} (k) [2]	x (ft)	y (ft)	A_{trib} (ft^2)	$(1+N/6Af'^{0.5})^{0.5}$
#Columns (X-Dir)-1F-4#8	Columns (X-Dir)	1	Tied	14	14	196.0	4 #8	1	3.1	2.0	#4	12	0.5	0.39	0	11.90	1.5	7.75	91.5	1.01	0.0	3.8	3.8	0.10	13	4.0	10.0	40.0	1.1

Notes:

1 - Effective depth, d, is computed as 0.85h, where h is the dimension of the column in the direction of shear.

2 - Based on 1.1DL+0.275LL.

3 - Per 10.3.4/ASCE 41-17, lap-spliced reinforcement in tied columns is assumed to be ineffective in regions of high ductility demand.

4 - Shear capacity of column is based on ASCE 41-17 Eq 10-3 using nominal material strengths with ϕ=1.0.

$$V_{.col} = k_{nl}\left[\alpha_{.col}\left(\frac{A_{.v}\cdot f_{ytLE}\cdot d}{s}\right) + \lambda\cdot\left[\sqrt{1+\frac{N_{UG}}{6\cdot A_g\cdot\sqrt{f_{cLE}}}}\cdot\frac{6\cdot(f_{cLE})}{\left(\frac{M_{UD}}{V_{UD}\cdot d}\right)}\right]\cdot 0.8\cdot A_g\right]$$

α_{col} = 1.0 for s/d <= 0.75, 0.0 for s/d >=1.0

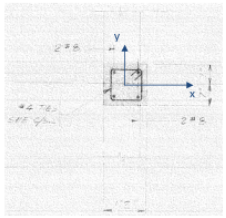
5 - Plastic moment capacity of the column is based upon expected flexural strength using 1.5 f'c and 1.25 fy.

6 - Shear induced due to drift of a fixed-fixed column.

$$V_{prob} = \frac{12E\cdot 0.5\cdot I_g\cdot\Delta}{L^3}$$

7- Vprob is compared to Vcol. If Vprob <Vcol, Shear failure is not likely to occur.

8 - Column gross area, A_G, is based on Details E / S.2 . X- and Y-directions for analysis are shown below.



9 - Maximum drift calculates lateral displacement to reach expected shear capacity, Vcol, under assumed high ductility condition.

10 - For comparison, maximum drift for tied columns assuming lap-spliced transverse reinforcement is 50% effective (valid for regions of moderate ductility demand).

Rating form completed by:

RUTHERFORD + CHEKENE
ruthchek.com

Evaluator: EB/WAL/BL

Date: 06/28/2019

Trib Area (ft2)	Unit weight (psf)	DL (kips)	0.9DL	1.1DL	W_LL (psf)	LL (kips)	1.1DL + 0.275LL
	40	197	12	10	13	40	2	13

SHEAR			FLEXURE			SHEAR/FLEX. CONTROL	ADDITIONAL CHECK (LIMITED BY DRIFT)						MAXIMUM DRIFT [4]			MAX DRIFT ASSUMING MODERATE DUCTILITY [4]	
V_s (k) [1]	V_c (k)	V_{max} (k) [4]	M_{max} (k-ft) [2]	M (k-ft) [3]	2M/L (k)		Vp/Vreal	E (ksi)	I_g (in^4)	Δ (in)	I_i (in)	Vprob (k) [4]	Acceptance criteria [4]	Δ (in)	$V_{max\,at\,\Delta max}$ (k)	Δ (in)	$V_{max\,at\,moderate\,ductility}$ (k)
0.0	16.8	11.8	35.0	58.0	15.2	Shear	1.29	3605.0	3,201.3	0.5	93.0	43.0	NG	0.14	11.8		