



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

DATE: 2019-06-30

UC Santa Cruz building seismic ratings
Central Heating Plant

CAAN #7146

610 Red Hill Road, Santa Cruz, CA 95064, United States

UCSC Campus: Main Campus



6/28/19



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/sf-\$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?	Yes	It is recommended to expose all floor to wall connections to verify compliance with as- built

¹ We translate this Tier 1 evaluation to a Seismic Performance Level rating using professional judgment. Noncompliant 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.

drawings before proceeding with further analysis and retrofit.

Building information used in this evaluation

- 1966; Architectural drawings by Spencer, Lee & Busse Architects, Structural drawings by Pregnoff & Matheu Structural Engineers
- 1988; Structural drawings by Dewante and Stowell Consulting Engineers
- 1993; Architectural drawings by Bell+Associates, Structural drawings by Hoi Wong & Associates
- 2000; Architectural drawings by Bell+Associates, Structural drawings by Roy Hunt Engineering
- University of California building database information, "Central Heating Plant", provided by Jose Sanchez (UCSC)

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. We made a site visit on May 21st, 2019. We looked for potentially hazardous nonstructural components during the site visit. No nonstructural hazards were identified.

Brief description of structure

Precast concrete walls, reinforced concrete masonry walls and steel braced frames in a partially double story structure built in three phases from 1966-2000.

Identification of levels: Level 1, Level 2, Roof

Foundation system: Steel columns of braced frames are located on shallow spread footings and precast and masonry walls are supported on 15" deep continuous wall footings.

Structural system for vertical (gravity) load: Steel beams supported on precast concrete walls or steel columns in 1966 heat plant construction. Wood joists (2x or TJs) span between reinforced masonry walls in North addition built in 1988-2000. Plywood sheathing is provided as diaphragm on all parts of the building.

Structural system for lateral forces: Precast concrete shear walls and steel concentrically braced frames have been provided in the original 1966 heat plant construction. 8" thick reinforced masonry shear walls in north offices were provided in the later phases. Plywood diaphragm with straps or hold downs at perimeter walls have been provided for out-of-plane wall anchorage.

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

The building has three different lateral systems that were built in three phases. The building additions are tied into the original structure from 1966.

The building has the following structural deficiencies per Tier 1 quick checks for Collapse prevention performance objective at BSE 2E seismic event:

1. Out-of-plane wall anchorage at the masonry shear walls: this failure will cause separation of the building floors from the masonry walls and hence loss of gravity support at second floor and roof at building perimeter.
2. Connections of braced frames fail to develop brace buckling and yield capacity: this failure will cause rupture of bolts in shear and loss of lateral load carrying capacity of the braced frame that may cause the steel towers to lean away from the building.

- Steel beam at chevron braces fails under simultaneous buckling and yielding of steel braces. The brace connections will likely fail before the beam can yield under brace forces.

A more detailed Tier 2 analysis will provide a better understanding of the force demands on these wall connections.

Damage to masonry walls may occur at the 2" seismic joint due to pounding during an earthquake.

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	Y
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

No apparent non structural Life-Safety concerns were spotted during site visit.

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	N	Unrestrained hazardous materials storage	N
Heavy masonry or stone veneer above exit ways and public access areas	N	Masonry chimneys	N
Unbraced masonry parapets, cornices or other ornamentation above exit ways and public access areas	N	Unrestrained natural gas-fueled equipment such as water heaters, boilers, emergency generators, etc.	N

Discussion of rating

Following noncompliances in the Tier 1 checklist form the basis of rating:

- Brace connections are unable to develop the yield capacity of braces.
- Beams in chevron braces are unable to resist the vertical load due to yielding and buckling of braces simultaneously
- Out of plane anchorage check for masonry shear walls at plywood diaphragms has a D/C ratio of =1.5 (approximately) for BSE-2E event.
- Horizontal steel in some of the masonry walls is placed at 48" o.c.

One braced frame bay has been removed from Line A, this deviates from what is shown on as builts from 1966.

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.

Recommendations for further evaluation or retrofit

1. Tier 2 analysis recommended.
2. Installing additional hold downs at roof joists at 4'-0", epoxied into the masonry walls in the building additions to the north of original construction.
3. Welding braced frame gussets to braces, columns and beams where bolted connections occur.

Peer review of rating

This seismic evaluation was discussed in a peer review meeting on 28 May 2019. Reviewers present were Bret Lizundia of Rutherford and Chekene and Joe Maffei of Maffei Structural Engineering. Comments from the reviewers have been incorporated into this report. The reviewers agreed on the assigned rating.

Additional building data	Entry	Notes
Latitude	37.001025	
Longitude	-122.060803	
Are there other structures besides this one under the same CAAN#	No	
Number of stories above lowest perimeter grade	2	
Number of stories (basements) below lowest perimeter grade	0	
Building occupiable area (OGSF)	11323 sq ft	
Risk Category per 2016 CBC Table 1604.5	II	
Building structural height, h_n	24 ft.	Structural height defined per ASCE 7-16 Section 11.2
Coefficient for period, C_t	0.02	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	Geotech ⁴	
Site parameters F_a, F_v	1.2, 1.812	
Ground motion parameters S_{cs}, S_{c1}	1.544, 0.884	
S_a at building period	1.543	
Site V_{s30}	900 ft/s	
V_{s30} basis	Estimated	Estimated based on site classification of D

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>

Liquefaction potential	Low	
Liquefaction assessment basis	County Map	See footnote below
Landslide potential	Low	
Landslide assessment basis	County map	See footnote below
Active fault-rupture identified at site?	No	
Fault rupture assessment basis	County map	See footnote below
Site-specific ground motion study?	No	
Applicable code		
Applicable code or approx. date of original construction	Built: 1966 Code: 1964 UBC	
Applicable code for partial retrofit	None	
Applicable code for full retrofit	None	
Model building data		
Model building type North-South	Precast Concrete, PC1 - Precast or Tilt-Up Concrete Shear Walls (with Flexible Diaphragms) Steel, S2a - Braced steel frame (with Flexible Diaphragm) Reinforced Masonry, RM1 - Reinforced Masonry Bearing Walls with Flexible Diaphragms	
Model building type East-West	Precast Concrete, PC1 - Precast or Tilt-Up Concrete Shear Walls (with Flexible Diaphragms) Steel, S2a - Braced steel frame (with Flexible Diaphragm) Reinforced Masonry, RM1 - Reinforced Masonry Bearing Walls with Flexible Diaphragms	
FEMA P-154 score	N/A	Not included here because we performed ASCE 41 Tier 1 evaluation.
Previous ratings		
Most recent rating	Unknown	
Date of most recent rating	Unknown	
2 nd most recent rating	-	
Date of 2 nd most recent rating	-	
3 rd most recent rating	-	
Date of 3 rd most recent rating	-	
Appendices		
ASCE 41 Tier 1 checklist included here?	Yes	Refer to attached checklist file in Appendix A.

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:
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<https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/LandslideMap2009.pdf>
<https://gis.santacruzcounty.us/mapgallery/Emergency%20Management/Hazard%20Mitigation/FaultZoneMap2009.pdf>



University of California, Santa Cruz
ASCE 41-17 Tier 1 Seismic Evaluation
7146 - Central Heating Plant

Appendix A
ASCE 41-17 Checklists

UC Campus:	Santa Cruz		Date:	5/24/2019		
Building CAAN:	7146	Auxiliary CAAN:	By Firm:	Degenkolb Engineers		
Building Name:	Central Heating Plant		Initials:	HK	Checked:	
Building Address:	610 Red Hill Road, Santa Cruz, CA 95064		Page:	1	of	3

ASCE 41-17 Collapse Prevention Basic Configuration Checklist

LOW SEISMICITY

BUILDING SYSTEMS - GENERAL

	Description
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	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 <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	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:
C NC N/A U <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	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 <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	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. A.2.2.2. Tier 2: Sec. 5.4.2.1) Comments:
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	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 <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation. (Commentary: Sec. A.2.2.4. Tier 2: Sec. 5.4.2.3) Comments:

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

UC Campus:	Santa Cruz		Date:	5/24/2019		
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Building Address:	610 Red Hill Road, Santa Cruz, CA 95064		Page:	2	of	3

ASCE 41-17 Collapse Prevention Basic Configuration Checklist

C <input checked="" type="checkbox"/> NC <input checked="" type="checkbox"/> N/A <input type="checkbox"/> U <input type="checkbox"/>	GEOMETRY: There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines. (Commentary: Sec. A.2.2.5. Tier 2: Sec. 5.4.2.4)
	Comments:
C <input checked="" type="checkbox"/> NC <input checked="" type="checkbox"/> N/A <input type="checkbox"/> U <input type="checkbox"/>	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:
C <input checked="" type="checkbox"/> NC <input checked="" type="checkbox"/> N/A <input type="checkbox"/> U <input type="checkbox"/>	TORSION: The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension. (Commentary: Sec. A.2.2.7. Tier 2: Sec. 5.4.2.6)
	Comments:

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

GEOLOGIC SITE HAZARD

	Description
C <input checked="" type="checkbox"/> NC <input checked="" type="checkbox"/> N/A <input type="checkbox"/> U <input type="checkbox"/>	LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance do not exist in the foundation soils at depths within 50 ft (15.2m) under the building. (Commentary: Sec. A.6.1.1. Tier 2: 5.4.3.1)
	Comments:
C <input checked="" type="checkbox"/> NC <input checked="" type="checkbox"/> N/A <input type="checkbox"/> U <input type="checkbox"/>	SLOPE FAILURE: The building site is located away from potential earthquake-induced slope failures or rockfalls so that it is unaffected by such failures or is capable of accommodating any predicted movements without failure. (Commentary: Sec. A.6.1.2. Tier 2: 5.4.3.1)
	Comments:
C <input checked="" type="checkbox"/> NC <input checked="" type="checkbox"/> N/A <input type="checkbox"/> U <input type="checkbox"/>	SURFACE FAULT RUPTURE: Surface fault rupture and surface displacement at the building site are not anticipated. (Commentary: Sec. A.6.1.3. Tier 2: 5.4.3.1)
	Comments:

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ASCE 41-17 Collapse Prevention Basic Configuration Checklist

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

FOUNDATION CONFIGURATION

	Description
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<p>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)</p> <p>Comments: $74/36=2.06 > 0.6 * 1.543 = 0.958$ (OK)</p>
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<p>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)</p> <p>Comments: Site class C and slab on grade ties together spread footings.</p>

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Building Name:	Central Heating Plant			Initials:	HK	Checked:	
Building Address:	610 Red Hill Road, Santa Cruz, CA 95604			Page:	1	of	4

ASCE 41-17 Collapse Prevention Structural Checklist For Building Type PC1-PC1A

LOW SEISMICITY

CONNECTIONS

	Description
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7. (Commentary: Sec. A.5.1.1. Tier 2: Sec. 5.7.1.1) Comments:

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

SEISMIC-FORCE-RESISTING SYSTEM

	Description
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	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 <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	WALL SHEAR STRESS CHECK: The shear stress in the precast panels, 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.3.2.3.1. Tier 2: Sec. 5.5.3.1.1) Comments: D/C=0.20
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	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.3.2.3.2. Tier 2: Sec. 5.5.3.1.3) Comments: 8" thick walls w/#4@12 EF EW = 0.0031
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	WALL THICKNESS: Thicknesses of bearing walls are not less than 1/40 the unsupported height or length, whichever is shorter, nor less than 4 in. (101 mm) (Commentary: Sec. A.3.2.3.5. Tier 2: Sec. 5.5.3.1.2) Comments: 8" thick walls; Wall height =14ft/8"=21

DIAPHRAGMS

	Description

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

UC Campus:	Santa Cruz		Date:	5/24/2019		
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Building Address:	610 Red Hill Road, Santa Cruz, CA 95604		Page:	2	of	4

ASCE 41-17 Collapse Prevention Structural Checklist For Building Type PC1-PC1A

C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	<p>TOPPING SLAB: Precast concrete diaphragm elements are interconnected by a continuous reinforced concrete topping slab with a minimum thickness of 2 in. (51 mm) (Commentary: Sec. A.4.5.1. Tier 2: Sec. 5.6.4)</p> <p>Comments:</p>
CONNECTIONS				
Description				
C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	<p>WOOD LEDGERS: The connection between the wall panels and the diaphragm does not induce cross-grain bending or tension in the wood ledgers. (Commentary: Sec. A.5.1.2. Tier 2: Sec. 5.7.1.3)</p> <p>Comments: Section 29/S4 and 30/S4 on 1966 drawings.</p>
C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	<p>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)</p> <p>Comments: Section 29/S4 and 30/S4 on 1966 drawings.</p>
C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	<p>TOPPING SLAB TO WALLS OR FRAMES: Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements are doweled for transfer of forces into the shear wall or frame elements. (Commentary: Sec. A.5.2.3. Tier 2: Sec. 5.7.2)</p> <p>Comments:</p>
C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	<p>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)</p> <p>Comments:</p>

HIGH SEISMICITY (COMPLETE THE FOLLOWING ITEMS IN ADDITION TO THE ITEMS FOR LOW AND MODERATE SEISMICITY)	
SEISMIC-FORCE-RESISTING SYSTEM	
	Description

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UC Campus:	Santa Cruz		Date:	5/24/2019		
Building CAAN:	7146	Auxiliary CAAN:	By Firm:	Degenkolb Engineers		
Building Name:	Central Heating Plant		Initials:	HK	Checked:	
Building Address:	610 Red Hill Road, Santa Cruz, CA 95604		Page:	3	of	4

ASCE 41-17 Collapse Prevention Structural Checklist For Building Type PC1-PC1A

C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	DEFLECTION COMPATIBILITY FOR RIGID DIAPHRAGMS: 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: Steel columns have the shear capacity for deflection compatibility
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	WALL OPENINGS: The total width of openings along any perimeter wall line constitutes less than 75% of the length of any perimeter wall when the wall piers have aspect ratios of less than 2-to-1. (Commentary: Sec. A.3.2.3.3. Tier 2: Sec. 5.5.3.3.1) Comments:
DIAPHRAGMS	
	Description
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	CROSS TIES IN FLEXIBLE DIAPHRAGMS: There are continuous cross ties between diaphragm chords. (Commentary: Sec. A.4.1.2. Tier 2: Sec. 5.6.1.2) Comments:
C NC N/A U <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	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: Plywood sheathing available over T&G straight sheathing.
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	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: Plywood sheathing available over T&G straight sheathing.
C NC N/A U <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12.2 m) and aspect ratios less than or equal to 4-to-1. (Commentary: Sec. A.4.2.3. Tier 2: Sec. 5.6.2) Comments:
C NC N/A U <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	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

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

UC Campus:	Santa Cruz		Date:	5/24/2019		
Building CAAN:	7146	Auxiliary CAAN:	By Firm:	Degenkolb Engineers		
Building Name:	Central Heating Plant		Initials:	HK	Checked:	
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ASCE 41-17 Collapse Prevention Structural Checklist For Building Type PC1-PC1A

C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<p>MINIMUM NUMBER OF WALL ANCHORS PER PANEL: There are at least two anchors connecting each precast wall panel to the diaphragm elements. (Commentary: Sec. A.5.1.3. Tier 2: Sec. 5.7.1.4)</p> <p>Comments: Wall anchors present every 4' to 8' on center</p>
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<p>PRECAST WALL PANELS: Precast wall panels are connected to the foundation. (Commentary: Sec. A.5.3.6. Tier 2: Sec. 5.7.3.4)</p> <p>Comments: Section 1/S2, 1966 drawings</p>
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	<p>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)</p> <p>Comments:</p>
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<p>GIRDERS: Girders supported by walls or pilasters have at least two ties securing the anchor bolts unless provided with independent stiff wall anchors with strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7. (Commentary: Sec. A.5.4.2. Tier 2: Sec. 5.7.4.2)</p> <p>Comments: Connections have sufficient strength to resist force calculated by Quick Check procedure of Tier 1 analysis.</p>

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UC Campus:	Santa Cruz			Date:	5/24/2019		
Building CAAN:	7146	Auxiliary CAAN:		By Firm:	Degenkolb Engineers		
Building Name:	Central Heating Plant			Initials:	HK	Checked:	
Building Address:	610 Redhill Road, Santa Cruz, CA 95064			Page:	1	of	4

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

LOW AND MODERATE SEISMICITY

SEISMIC-FORCE-RESISTING SYSTEM

	Description
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	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 <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than 70 lb/in. ² (0.48 MPa). (Commentary: Sec. A.3.2.4.1. Tier 2: Sec. 5.5.3.1.1) Comments:
C NC N/A U <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls is greater than 0.002 of the wall with the minimum of 0.0007 in either of the two directions; the spacing of reinforcing steel is less than 48 in. (1220 mm), and all vertical bars extend to the top of the walls. (Commentary: Sec. A.3.2.4.2. Tier 2: Sec. 5.5.3.1.3) Comments: Two story reinforced masonry addition of 1993 has horizontal rebar #5@48" o.c.

STIFF DIAPHRAGMS

	Description
C NC N/A U <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	TOPPING SLAB: Precast concrete diaphragm elements are interconnected by a continuous reinforced concrete topping slab. (Commentary: Sec. A.4.5.1. Tier 2: Sec. 5.6.4) Comments:

CONNECTIONS

	Description
C NC N/A U <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7. (Commentary: Sec. A.5.1.1. Tier 2: Sec. 5.7.1.1) Comments: D/C of quick check =1.55 (approximately)

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

C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<p>WOOD LEDGERS: The connection between the wall panels and the diaphragm does not induce cross-grain bending or tension in the wood ledgers. (Commentary: Sec. A.5.1.2. Tier 2: Sec. 5.7.1.3)</p> <p>Comments:</p>
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<p>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)</p> <p>Comments:</p>
C NC N/A U <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	<p>TOPPING SLAB TO WALLS OR FRAMES: Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements are doweled for transfer of forces into the shear wall or frame elements. (Commentary: Sec. A.5.2.3. Tier 2: Sec. 5.7.2)</p> <p>Comments:</p>
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<p>FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation. (Commentary: Sec. A.5.3.5. Tier 2: Sec. 5.7.3.4)</p> <p>Comments:</p>
C NC N/A U <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	<p>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)</p> <p>Comments:</p>

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

STIFF DIAPHRAGMS

	Description
C NC N/A U <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	<p>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)</p> <p>Comments:</p>
C NC N/A U <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	<p>OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls are not greater than 8 ft (2.4 m) long. (Commentary: Sec. A.4.1.6. Tier 2: Sec. 5.6.1.3)</p> <p>Comments:</p>

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

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)			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Comments:			
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)			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Comments:			
C	NC	N/A	U	OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls are not greater than 8 ft (2.4 m) long. (Commentary: Sec. A.4.1.6. Tier 2: Sec. 5.6.1.3)			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Comments:			
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)			
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Comments:			
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)			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Comments:			
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 aspect ratios less than or equal to 4-to-1. (Commentary: Sec. A.4.2.3. Tier 2: Sec. 5.6.2)			
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Comments:			
C	NC	N/A	U	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)			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Comments:			

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

CONNECTIONS							
				Description			
C	NC	N/A	U	STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements are installed taut and are stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 in. (3 mm) before engagement of the anchors. (Commentary: Sec. A.5.1.4. Tier 2: Sec. 5.7.1.2)			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				

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ASCE 41-17 Collapse Prevention Structural Checklist For Building Type S2-S2A

LOW SEISMICITY

SEISMIC-FORCE-RESISTING SYSTEM

	Description
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	REDUNDANCY: The number of lines of braced frames in each principal direction is greater than or equal to 2. (Commentary: Sec. A.3.3.1.1. Tier 2: Sec. 5.5.1.1) Comments:
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	COLUMN AXIAL STRESS CHECK: The axial stress caused by gravity loads in columns subjected to overturning forces is less than $0.10F_y$. Alternatively, the axial stress caused by overturning forces alone, calculated using the Quick Check procedure of Section 4.4.3.6, is less than $0.30F_y$. (Commentary: Sec. A.3.1.3.2. Tier 2: Sec. 5.5.2.1.3) Comments:
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	BRACE AXIAL STRESS CHECK: The axial stress in the diagonals, calculated using the Quick Check procedure of Section 4.4.3.4, is less than $0.50F_y$. (Commentary: Sec. A.3.3.1.2. Tier 2: Sec. 5.5.4.1) Comments:

CONNECTIONS

	Description
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	TRANSFER TO STEEL FRAMES: Diaphragms are connected for transfer of seismic forces to the steel frames. (Commentary: Sec. A.5.2.2. Tier 2: Sec. 5.7.2) Comments: Section 26/S4 and 27/S4
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	STEEL COLUMNS: The columns in seismic-force-resisting frames are anchored to the building foundation. (Commentary: Sec. A.5.3.1. Tier 2: Sec. 5.7.3.1) Comments: Section 2/S2

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Building CAAN:	7146	Auxiliary CAAN:	By Firm:	Degenkolb Engineers		
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ASCE 41-17 Collapse Prevention Structural Checklist For Building Type S2-S2A

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

SEISMIC-FORCE-RESISTING SYSTEM

	Description
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	REDUNDANCY: The number of braced bays in each line is greater than 2. (Commentary: Sec. A.3.3.1.1. Tier 2: Sec. 5.5.1.1) Comments: Only one brace present along Line A, but precast walls along the same line ensure redundancy.
C NC N/A U <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	CONNECTION STRENGTH: All the brace connections develop the buckling capacity of the diagonals. (Commentary: Sec. A.3.3.1.5. Tier 2: Sec. 5.5.4.4) Comments: Detail J/S4
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	COMPACT MEMBERS: All brace elements meet compact section requirements in accordance with AISC 360, Table B4.1. (Commentary: Sec. A.3.3.1.7. Tier 2: Sec. 5.5.4) Comments:
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	K-BRACING: The bracing system does not include K-braced bays. (Commentary: Sec. A.3.3.2.1. Tier 2: Sec. 5.5.4.6) Comments:

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 <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	COLUMN SPLICES: All column splice details located in braced frames develop 50% of the tensile strength of the column. (Commentary: Sec. A.3.3.1.3. Tier 2: Sec. 5.5.4.2) Comments:

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ASCE 41-17 Collapse Prevention Structural Checklist For Building Type S2-S2A

C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	SLENDERNESS OF DIAGONALS: All diagonal elements required to carry compression have Kl/r ratios less than 200. (Commentary: Sec. A.3.3.1.4. Tier 2: Sec. 5.5.4.3) Comments:
C NC N/A U <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	CONNECTION STRENGTH: All the brace connections develop the yield capacity of the diagonals. (Commentary: Sec. A.3.3.1.5. Tier 2: Sec. 5.5.4.4) Comments: See quick checks for Tier 1 calculation
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	COMPACT MEMBERS: All brace elements meet section requirements in accordance with AISC 341, Table D1.1, for moderately ductile members. (Commentary: Sec. A.3.3.1.7. Tier 2: Sec.5.5.4) Comments:
C NC N/A U <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	CHEVRON BRACING: Beams in chevron, or V-braced, bays are capable of resisting the vertical load resulting from the simultaneous yielding and buckling of the brace pairs. (Commentary: Sec. A.3.3.2.3. Tier 2: Sec. 5.5.4.6) Comments: See quick checks for Tier 1 calculation
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	CONCENTRICALLY BRACED FRAME JOINTS: All the diagonal braces frame into the beam-column joints concentrically. (Commentary: Sec. A.3.3.2.4. Tier 2: Sec. 5.5.4.8) Comments:
DIAPHRAGMS (STIFF OR FLEXIBLE)	
	Description
C NC N/A U <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	OPENINGS AT FRAMES: Diaphragm openings immediately adjacent to the braced frames extend less than 25% of the frame length. (Commentary: Sec. A.4.1.5. Tier 2: Sec. 5.6.1.3) Comments:
FLEXIBLE DIAPHRAGMS	
	Description
C NC N/A U <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	CROSS TIES: There are continuous cross ties between diaphragm chords. (Commentary: Sec. A.4.1.2. Tier 2: Sec. 5.6.1.2) Comments:

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

UC Campus:	Santa Cruz		Date:	5/24/2019		
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ASCE 41-17 Collapse Prevention Structural Checklist For Building Type S2-S2A

C <input checked="" type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	<p>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)</p> <p>Comments: Plywood sheathing installed over T&G straight sheathing</p>
C <input checked="" type="checkbox"/> NC <input type="checkbox"/> N/A <input type="checkbox"/> U <input type="checkbox"/>	<p>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)</p> <p>Comments:</p>
C <input type="checkbox"/> NC <input type="checkbox"/> N/A <input checked="" type="checkbox"/> U <input type="checkbox"/>	<p>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)</p> <p>Comments:</p>
C <input checked="" type="checkbox"/> NC <input type="checkbox"/> N/A <input type="checkbox"/> U <input type="checkbox"/>	<p>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)</p> <p>Comments:</p>

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

UC Campus:	Santa Cruz		Date:	5/24/2019		
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UCOP SEISMIC SAFETY POLICY Falling Hazard Assessment Summary

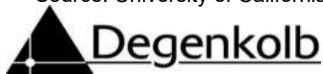
	Description
P N/A <input type="checkbox"/> <input checked="" type="checkbox"/>	Heavy ceilings, features or ornamentation above large lecture halls, auditoriums, lobbies, or other areas where large numbers of people congregate (50 ppl or more) Comments:
P N/A <input type="checkbox"/> <input checked="" type="checkbox"/>	Heavy masonry or stone veneer above exit ways or public access areas Comments:
P N/A <input type="checkbox"/> <input checked="" type="checkbox"/>	Unbraced masonry parapets, cornices, or other ornamentation above exit ways or public access areas Comments:
P N/A <input type="checkbox"/> <input checked="" type="checkbox"/>	Unrestrained hazardous material storage Comments:
P N/A <input type="checkbox"/> <input checked="" type="checkbox"/>	Masonry chimneys Comments:
P N/A <input type="checkbox"/> <input checked="" type="checkbox"/>	Unrestrained natural gas-fueled equipment such as water heaters, boilers, emergency generators, etc. Comments: Generator in the plant was well anchored to the mechanical pad on the slab on grade.
P N/A <input type="checkbox"/> <input type="checkbox"/>	Other: Comments:
P N/A <input type="checkbox"/> <input type="checkbox"/>	Other: Comments:
P N/A <input type="checkbox"/> <input type="checkbox"/>	Other: Comments:

Falling Hazards Risk: Low



University of California, Santa Cruz
ASCE 41-17 Tier 1 Seismic Evaluation
7146 - Central Heating Plant

Appendix B
Quick Check Calculations



Subject: Global Data	Job Number: B9959006.00	Date: 06/20/19
Job: UCSC Tier 1 Seismic Evaluations	By: HK	Section:
	Checked By:	Page

GLOBAL DATA

ASCE 41-17 SEISMIC EVALUATION & RETROFIT OF EXISTING BUILDINGS
 CHAPTER 4 - TIER 1 EVALUATION
 LINEAR STATIC PROCEDURE
 COLLAPSE PREVENTION
 BSE-2E HAZARD LEVEL

SITE DATA:

Latitude:	37.00103 °N	610 Red Hill Road	USGS Seismic Design Map Application:
Longitude:	122.06080 °W	Santa Cruz, CA 95064	http://geohazards.usgs.gov/hazardtool/application.php
Site Class:	D (default)	(Stiff Soil)	Site Class [ASCE 41-17, §2.4.1.6]
S _s	= 1.286 g	(USGS) (5% / 50 years)	USGS Mapped (T = 0.2 sec) [ASCE 41-17, §2.4.1.3]
S ₁	= 0.488 g	(USGS) (5% / 50 years)	USGS Mapped (T = 1.0 sec) [ASCE 41-17, §2.4.1.3]
F _a	= 1.200	(Site Class D)	Site Coefficient (T = 0.2 sec) [ASCE 7-16, Table 11.4-1]
F _v	= 1.812	(Site Class D)	Site Coefficient (T = 1.0 sec) [ASCE 7-16, Table 11.4-2]
S _{XS}	= 1.543 g	= F _a S _s	Site-Adjusted Design (T = 0.2 sec) [ASCE 41-17, Eq. 2-1]
S _{X1}	= 0.884 g	= F _v S ₁	Site-Adjusted Design (T = 1.0 sec) [ASCE 41-17, Eq. 2-2]

BUILDING DATA:

Building Type:	PC1	(Precast/Tilt-up Concrete Shear Walls with Flexible Diaphragms)	[ASCE 41-17, Table 3-1]
Year Built:	1966		
Number of Stories:	1 story		
Parapet Height:	1.50 ft		
Roof Height:	14.00 ft		
Total Area:	2,663 sf		

Level	Height [ft]	Elevation [ft]	Length _{N-S} [ft]	Length _{E-W} [ft]	Area [sf]	Diaphragm Stiffness	Diaphragm Description
Roof	14.0	14.0	75	36	2,663	Flexible	3/8" Plywood sheathing over 2x T&G
1st	0.0	0.0	75	36	2,663	-	-



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WEIGHT TAKEOFF

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 BSE-2E HAZARD LEVEL

ROOF TYPE: ROOF

	Roofing / Re-roofing	@	5.0 psf	5.0 psf	y
0.5 in	Rock Ballast (Gravel)	@	8.0 psf per inch	0.0 psf	n
3 ply	Ready Roofing	@	0.3 psf per ply	0.0 psf	n
5 ply	Felt Roofing	@	0.5 psf per ply	0.0 psf	n
0.25 in	Slate	@	40.0 psf per inch	0.0 psf	n
	Shingles (Asphalt)	@	2.0 psf	0.0 psf	n
	Copper or Tin	@	1.0 psf	0.0 psf	n
	Corrugated Asbestos-Cement	@	4.0 psf	0.0 psf	n
	Waterproofing Membranes (Smooth Bituminous)	@	1.5 psf	1.5 psf	y
	Cement Tiles	@	16.0 psf	0.0 psf	n
	Clay Tiles (Spanish)	@	19.0 psf	0.0 psf	n
	Mortar Bed for Clay Tiles	@	10.0 psf	0.0 psf	n
	Roof Insulation	@	1.0 psf	1.0 psf	y
1 in	Insulation (Rigid)	@	1.5 psf per inch	0.0 psf	n
1 in	Insulation Boards (Fibrous Glass)	@	1.1 psf per inch	0.0 psf	n
3 in	Vermiculite Concrete	@	2.5 psf per inch	0.0 psf	n
0.5 in	Fire Proofing	@	2.0 psf per inch	0.0 psf	n
	Diaphragm - core planks	@	35.0 psf	0.0 psf	n
2.5 in	Concrete Slab (Normal Weight)	@	12.5 psf per inch	0.0 psf	n
4.75 in	Concrete Fill (Light Weight)	@	9.2 psf per inch	0.0 psf	n
0.5 in	Concrete Overpour (Light Weight)	@	9.2 psf per inch	0.0 psf	n
18 ga	Bare Metal Deck	@	3.0 psf	0.0 psf	n
2 in	Wood Decking	@	2.5 psf per inch	0.0 psf	n
2 in	Wood Sheathing	@	3.0 psf per inch	6.0 psf	y
0.5 in	Plywood	@	3.2 psf per inch	1.6 psf	y
	Framing	@	20.0 psf	0.0 psf	n
8 ft O.C.	Steel Beams	@	22.0 plf	2.8 psf	y
36 ft O.C.	Steel Girders	@	76.0 plf	0.0 psf	n
2 ft O.C.	Wood Sub-Purlins	@	1.8 plf	0.0 psf	n
8 ft O.C.	Wood Purlins	@	3.0 plf	0.0 psf	n
20 ft O.C.	Wood Girders	@	5.0 plf	0.0 psf	n
12.75 ft O.C.	Concrete Beams	@	800.0 plf	0.0 psf	n
20 ft O.C.	Concrete Girders	@	300.0 plf	0.0 psf	n
7.00 ft trib. ht.	Typical Columns (A _{trib} = 459 sf)	@	600.0 plf	0.0 psf	n
	Ceiling	@	5.0 psf	0.0 psf	n
0.5 in	Gypsum Board Ceiling	@	4.4 psf per inch	0.0 psf	n
	Acoustical Fiber Board	@	1.0 psf	0.0 psf	n
	Plaster Ceiling (On Tile)	@	5.0 psf	0.0 psf	n
	Suspended Metal Lath & Plaster (Gypsum Plaster)	@	10.0 psf	0.0 psf	n
	Suspended Steel Channel System	@	2.0 psf	0.0 psf	n
	Suspended Wood Furring System	@	2.5 psf	0.0 psf	n
	T-bar Ceiling System	@	3.0 psf	0.0 psf	n
10% floor area	Interior Partitions (Below)	@	5.0 psf	0.5 psf	y
	M.E.P.	@	5.0 psf	5.0 psf	y
	Miscellaneous	@	1.7 psf	1.7 psf	y
	Percast Fascia (4sqft)	@	47.1 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n

ROOF WEIGHT = 25.0 psf



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WEIGHT TAKEOFF

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WALL TYPE: **WALL-P**

	Wall Covering	@	4.0 psf	0.0 psf	n
3 in	Exterior Stucco	@	11.4 psf per inch.	34.2 psf	y
1 in	Wood Sheathing	@	3.0 psf per inch	0.0 psf	n
0.5 in	Gypsum Sheathing	@	4.0 psf per inch	0.0 psf	n
0.5 in	Gypsum Wallboard	@	4.4 psf per inch	0.0 psf	n
	Porcelain Enamel Panels	@	5.0 psf	0.0 psf	n
	Metal Lath & Plaster (Gypsum Plaster)	@	10.0 psf	0.0 psf	n
	Wall Insulation	@	1.0 psf	0.0 psf	n
1 in	Insulation (Rigid)	@	1.5 psf per inch	0.0 psf	n
1 in	Insulation Boards (Fiber Board)	@	1.5 psf per inch	0.0 psf	n
0.5 in	Fire Proofing	@	2 psf per inch	0.0 psf	n
	Wall Framing	@	20.0 psf	0.0 psf	n
8 in	Concrete Wall (Normal Weight)	@	12.5 psf per inch	100.0 psf	y
8 in	CMU Wall w/ Full Grouting (Normal Weight)	@	83.0 psf	0.0 psf	n
8 in	Solid CMU Wall (Normal Weight)	@	87.0 psf	0.0 psf	n
4 in	HCB Wall w/ Full Grouting	@	38.0 psf	0.0 psf	n
3.5 in	Solid Clay Brick Wall	@	11.1 psf per inch	0.0 psf	n
0.5 in	Plywood	@	3.2 psf per inch	0.0 psf	n
16 in O.C.	Wood Studs (2 x 4)	@	1.1 plf	0.0 psf	n
16 in O.C.	Metal Channel Studs	@	2.0 plf	0.0 psf	n
8 ft O.C.	Steel Girts	@	6.0 plf	0.0 psf	n
	Miscellaneous	@	1.8 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n

Solid Wall Weight = 134.2 psf
 Window & Door Weight = 8.0 psf
 % Solid Wall = 100%
WALL-P WEIGHT = 134.2 psf



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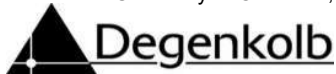
WEIGHT TAKEOFF

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 BSE-2E HAZARD LEVEL

WALL TYPE: **WALL-R**

	Wall Covering	@	4.0 psf	0.0 psf	n
3 in	Exterior Stucco	@	11.4 psf per inch.	34.2 psf	y
1 in	Wood Sheathing	@	3.0 psf per inch	0.0 psf	n
0.5 in	Gypsum Sheathing	@	4.0 psf per inch	0.0 psf	n
0.5 in	Gypsum Wallboard	@	4.4 psf per inch	0.0 psf	n
	Porcelain Enamel Panels	@	5.0 psf	0.0 psf	n
	Metal Lath & Plaster (Gypsum Plaster)	@	10.0 psf	0.0 psf	n
	Wall Insulation	@	1.0 psf	0.0 psf	n
1 in	Insulation (Rigid)	@	1.5 psf per inch	0.0 psf	n
1 in	Insulation Boards (Fiber Board)	@	1.5 psf per inch	0.0 psf	n
0.5 in	Fire Proofing	@	2 psf per inch	0.0 psf	n
	Wall Framing	@	20.0 psf	0.0 psf	n
8 in	Concrete Wall (Normal Weight)	@	12.5 psf per inch	100.0 psf	y
8 in	CMU Wall w/ Full Grouting (Normal Weight)	@	83.0 psf	0.0 psf	n
8 in	Solid CMU Wall (Normal Weight)	@	87.0 psf	0.0 psf	n
4 in	HCB Wall w/ Full Grouting	@	38.0 psf	0.0 psf	n
3.5 in	Solid Clay Brick Wall	@	11.1 psf per inch	0.0 psf	n
0.5 in	Plywood	@	3.2 psf per inch	0.0 psf	n
16 in O.C.	Wood Studs (2 x 4)	@	1.1 plf	0.0 psf	n
16 in O.C.	Metal Channel Studs	@	2.0 plf	0.0 psf	n
8 ft O.C.	Steel Girts	@	6.0 plf	0.0 psf	n
	Miscellaneous	@	1.8 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n

Solid Wall Weight = 134.2 psf
 Window & Door Weight = 8.0 psf
 % Solid Wall = 100%
WALL-R WEIGHT = 134.2 psf



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SEISMIC MASS

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ROOF/FLOOR WEIGHT SUMMARY:

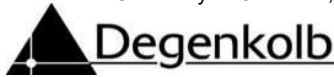
Level Type	Weight [psf]
ROOF	25

WALL WEIGHT SUMMARY:

Wall Type	Weight [psf]		
	Net	Solid	Openings
WALL-P	134.2	134.2	8
WALL-R	134.2	134.2	8

SEISMIC MASS SUMMARY:

Level	FLOOR			WALL ABOVE				WALL BELOW				TOTAL WEIGHT [kips]
	Level Type	Weight [psf]	Area [sf]	Wall Type	Weight [psf]	Length [ft]	Height [ft]	Wall Type	Weight [psf]	Length [ft]	Height [ft]	
Roof	ROOF	25	2,663	WALL-P	134.2	0	1.50	WALL-P	134.2	180	7.00	236
											TOTAL	236



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SEISMIC FORCES

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BUILDING TYPE: PC1 (Precast/Tilt-up Concrete Shear Walls with Flexible Diaphragms) [ASCE 41-17, Table 3-1]
SITE CLASS: D (default) #N/A [ASCE 41-17, §2.4.1.6]

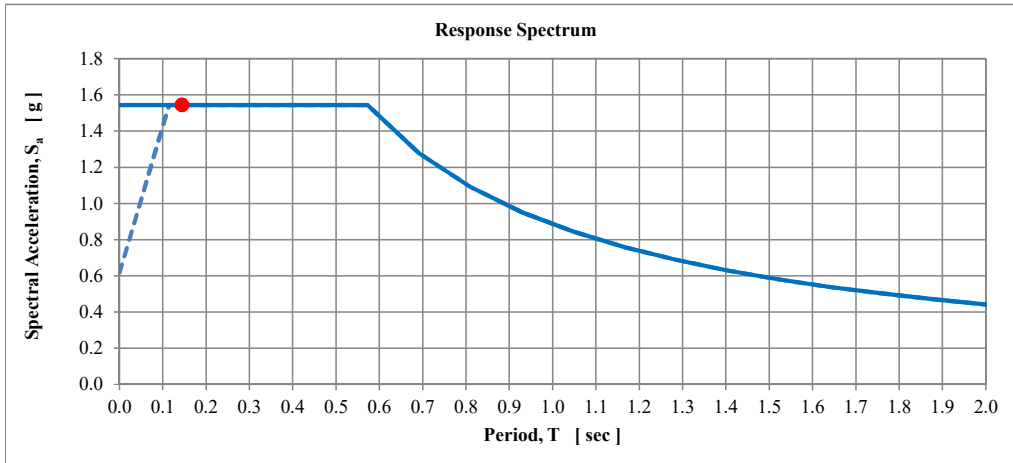
DESIGN SPECTRAL ACCELERATIONS:

S_{XS} = 1.543 g (BSE-2E) Site-Adjusted Design (T = 0.2 sec) [ASCE 41-17, Eq. 2-1]
 S_{X1} = 0.884 g (BSE-2E) Site-Adjusted Design (T = 1.0 sec) [ASCE 41-17, Eq. 2-2]

BUILDING PERIOD:

h_n = 14.0 ft (Base to Roof) Building Height [ASCE 41-17, §4.4.2.4]
 C_t = 0.020 (Building Type PC1) Period Coefficient [ASCE 41-17, §4.4.2.4]
 β = 0.750 (Building Type PC1) Period Exponent [ASCE 41-17, §4.4.2.4]
 T = 0.145 sec = $C_t h_n^\beta$ Fundamental Period [ASCE 41-17, Eq. 4-4]

RESPONSE SPECTRUM:



PSEUDO LATERAL FORCE:

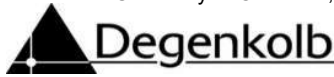
n = 1 (n = 1) Total Number of Stories
 C = 1.0 (Building Type PC1) Modification Factor [ASCE 41-17, Table 4-7]
 S_a = 1.543 g = MIN { S_{X1} / T , S_{XS} } Spectral Acceleration [ASCE 41-17, Eq. 4-3]
 V = 1.543 W = $C S_a W$ Pseudo Lateral Force [ASCE 41-17, Eq. 4-1]

VERTICAL DISTRIBUTION OF SEISMIC FORCES:

k = 1.00 ($T \leq 0.5$ sec) Seismic Distribution Exponent [ASCE 41-17, §4.4.2.2]

Level	h_x [ft]	w_x [kips]	$w_x h_x^k$	C_{vx}	F_x [kips]	V_j [kips]
Roof	14.0	236	3,299	1.00	364	364
TOTAL	-	236	3,299	1.00	364	-

$F_x = C_{vx} V = [w_x h_x^k / \sum (w_x h_x^k)] V$ [ASCE 41-17, Eq. 4-2a]
 $V_j = \sum F_x$ [ASCE 41-17, Eq. 4-2b]



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QUICK CHECKS

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 BSE-2E HAZARD LEVEL

BUILDING TYPE: PC1 (Precast/Tilt-up Concrete Shear Walls with Flexible Diaphragms) [ASCE 41-17, Table 3-1]

STEEL REINFORCING RATIO CHECK: [ASCE 41-17, §A.3.2.3.2]

Wall Type	t _w [in]	Horizontal Reinforcing					Vertical Reinforcing				
		n _{curtains} [curtains]	Bar Size No.	Spacing [in]	ρ _h	ρ _h ≥ 0.0020	n _{curtains} [curtains]	Bar Size No.	Spacing [in]	ρ _v	ρ _v ≥ 0.0012
WALL-P	8	2	4	16	0.0031	OK	2	4	16	0.0031	OK
WALL-R	8	2	4	16	0.0031	OK	2	4	16	0.0031	OK

AVERAGE SHEAR STRESS CHECK:

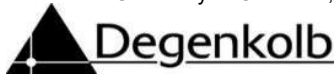
f' _c	=	2,500 psi	(ASCE 41 Default)	Concrete Compressive Strength	[ASCE 41-17, Table 4-2]
v _n	=	100 psi	= MAX { 100 psi , 2 √ f' _c }	Shear Wall Capacity	[ASCE 41-17, §A.3.2.3.1]
M _s	=	4.5	COLLAPSE PREVENTION	System Modification Factor	[ASCE 41-17, Table 4-8]
v _{j, avg}	=	(1 / M _s) (V _j / A _w)		Average Shear Wall Stress	[ASCE 41-17, Eq. 4-8]
A _w	=	t _w (L _{w, total} - L _{w, openings})		Net Wall Area	[ASCE 41-17, §4.4.3.3]

North-South Direction:

Level	V _j [kips]	Wall Type	t _w [in]	L _{w, total} [ft]	L _{w, openings} [ft]	L _w [ft]	A _w [in ²]	v _{j, avg} [psi]	DCR	Quick Check
Roof	364	WALL-P	8	75	25	50	4,800	17	0.17	OK

East-West Direction:

Level	V _j [kips]	Wall Type	t _w [in]	L _{w, total} [ft]	L _{w, openings} [ft]	L _w [ft]	A _w [in ²]	v _{j, avg} [psi]	DCR	Quick Check
Roof	364	WALL-P	8	71	20	51	4,896	17	0.17	OK



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QUICK CHECKS

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BUILDING TYPE: PC1 (Precast/Tilt-up Concrete Shear Walls with Flexible Diaphragms) [ASCE 41-17, Table 3-1]

OUT-OF-PLANE WALL ANCHORAGE CHECK: [ASCE 41-17, §A.5.1.1]

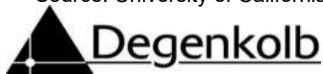
Ψ = 1.0 COLLAPSE PREVENTION Out-of-Plane Wall Anchorage Coefficient [ASCE 41-17, §4.4.3.7]
 S_{XS} = 1.543 g (BSE-2E) Design Spectral Acceleration (T = 0.2 sec) [ASCE 41-17, §2.4.1.1]
 T_c = $\Psi S_{XS} w_p A_p$ Out-of-Plane Wall Anchorage Force [ASCE 41-17, Eq. 4-12]
 $w_p A_p$ = ($w_{w, above} h_{w, above} + w_{w, below} h_{w, below}$) S_{anchor} Tributary Mass to Anchorage [ASCE 41-17, §4.4.3.7]

North-South Direction:

Level	WALL ABOVE			WALL BELOW			OUT-OF-PLANE ANCHORAGE					
	Wall Type	Weight [psf]	Height [ft]	Wall Type	Weight [psf]	Height [ft]	S_{anchor} [ft]	$w_p A_p$ [lb]	T_c [lb]	T_{cn} [lb]	DCR	Quick Check
Roof	WALL-P	134.2	1.50	WALL-P	134.2	7.00	8.00	9,126	14,083	21,000	0.67	OK

East-West Direction:

Level	WALL ABOVE			WALL BELOW			OUT-OF-PLANE ANCHORAGE					
	Wall Type	Weight [psf]	Height [ft]	Wall Type	Weight [psf]	Height [ft]	S_{anchor} [ft]	$w_p A_p$ [lb]	T_c [lb]	T_{cn} [lb]	DCR	Quick Check
Roof	WALL-P	134.2	1.50	WALL-P	134.2	7.00	4.00	4,563	7,041	11,000	0.64	OK



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GLOBAL DATA

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SITE DATA:

Latitude:	37.00103 °N	610 Red Hill Road	USGS Seismic Design Map Application:
Longitude:	122.06080 °W	Santa Cruz, CA 95064	http://geohazards.usgs.gov/hazardtool/application.php
Site Class:	D (default)	(Stiff Soil)	Site Class [ASCE 41-17, §2.4.1.6]
S _s	= 1.286 g	(USGS) (5% / 50 years)	USGS Mapped (T = 0.2 sec) [ASCE 41-17, §2.4.1.3]
S ₁	= 0.488 g	(USGS) (5% / 50 years)	USGS Mapped (T = 1.0 sec) [ASCE 41-17, §2.4.1.3]
F _a	= 1.200	(Site Class D)	Site Coefficient (T = 0.2 sec) [ASCE 7-16, Table 11.4-1]
F _v	= 1.812	(Site Class D)	Site Coefficient (T = 1.0 sec) [ASCE 7-16, Table 11.4-2]
S _{XS}	= 1.543 g	= F _a S _s	Site-Adjusted Design (T = 0.2 sec) [ASCE 41-17, Eq. 2-1]
S _{X1}	= 0.884 g	= F _v S ₁	Site-Adjusted Design (T = 1.0 sec) [ASCE 41-17, Eq. 2-2]

BUILDING DATA:

Building Type:	RM1	(Reinforced Masonry Bearing Walls with Flexible Diaphragms)	[ASCE 41-17, Table 3-1]
Year Built:	1988		
Number of Stories:	1 story		
Parapet Height:	2.50 ft		
Roof Height:	11.50 ft		
Total Area:	1,539 sf		

Level	Height [ft]	Elevation [ft]	Length _{N-S} [ft]	Length _{E-W} [ft]	Area [sf]	Diaphragm Stiffness	Diaphragm Description
Roof	11.5	11.5	57	27	1,539	Flexible	1/2" Plywood sheathing
1st	0.0	0.0	57	27	1,539	-	-



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WEIGHT TAKEOFF

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ROOF TYPE:		ROOF				
		Roofing / Re-roofing	@	5.0 psf	5.0 psf	y
0.5 in		Rock Ballast (Gravel)	@	8.0 psf per inch	0.0 psf	n
3 ply		Ready Roofing	@	0.3 psf per ply	0.0 psf	n
5 ply		Felt Roofing	@	0.5 psf per ply	0.0 psf	n
0.25 in		Slate	@	40.0 psf per inch	0.0 psf	n
		Shingles (Asphalt)	@	2.0 psf	0.0 psf	n
		Copper or Tin	@	1.0 psf	0.0 psf	n
		Corrugated Asbestos-Cement	@	4.0 psf	0.0 psf	n
		Waterproofing Membranes (Smooth Bituminous)	@	1.5 psf	1.5 psf	y
		Cement Tiles	@	16.0 psf	0.0 psf	n
		Clay Tiles (Spanish)	@	19.0 psf	0.0 psf	n
		Mortar Bed for Clay Tiles	@	10.0 psf	0.0 psf	n
		Roof Insulation	@	1.0 psf	1.0 psf	y
1 in		Insulation (Rigid)	@	1.5 psf per inch	0.0 psf	n
1 in		Insulation Boards (Fibrous Glass)	@	1.1 psf per inch	0.0 psf	n
3 in		Vermiculite Concrete	@	2.5 psf per inch	0.0 psf	n
0.5 in		Fire Proofing	@	2.0 psf per inch	0.0 psf	n
		Diaphragm - core planks	@	35.0 psf	0.0 psf	n
2.5 in		Concrete Slab (Normal Weight)	@	12.5 psf per inch	0.0 psf	n
4.75 in		Concrete Fill (Light Weight)	@	9.2 psf per inch	0.0 psf	n
0.5 in		Concrete Overpour (Light Weight)	@	9.2 psf per inch	0.0 psf	n
18 ga		Bare Metal Deck	@	3.0 psf	0.0 psf	n
2 in		Wood Decking	@	2.5 psf per inch	0.0 psf	n
2 in		Wood Sheathing	@	3.0 psf per inch	0.0 psf	n
0.5 in		Plywood	@	3.2 psf per inch	1.6 psf	y
		Framing	@	20.0 psf	0.0 psf	n
8 ft O.C.		Steel Beams	@	22.0 plf	0.0 psf	n
36 ft O.C.		Steel Girders	@	76.0 plf	0.0 psf	n
2 ft O.C.		Wood Sub-Purlins	@	1.8 plf	0.0 psf	n
2 ft O.C.		Wood Purlins	@	3.0 plf	1.5 psf	y
20 ft O.C.		Wood Girders	@	5.0 plf	0.0 psf	n
12.75 ft O.C.		Concrete Beams	@	800.0 plf	0.0 psf	n
20 ft O.C.		Concrete Girders	@	300.0 plf	0.0 psf	n
5.75 ft trib. ht.		Typical Columns (A _{trib} = 459 sf)	@	600.0 plf	0.0 psf	n
		Ceiling	@	5.0 psf	0.0 psf	n
0.5 in		Gypsum Board Ceiling	@	4.4 psf per inch	2.2 psf	y
		Acoustical Fiber Board	@	1.0 psf	0.0 psf	n
		Plaster Ceiling (On Tile)	@	5.0 psf	0.0 psf	n
		Suspended Metal Lath & Plaster (Gypsum Plaster)	@	10.0 psf	0.0 psf	n
		Suspended Steel Channel System	@	2.0 psf	0.0 psf	n
		Suspended Wood Furring System	@	2.5 psf	0.0 psf	n
		T-bar Ceiling System	@	3.0 psf	0.0 psf	n
10% floor area		Interior Partitions (Below)	@	5.0 psf	0.0 psf	n
		M.E.P.	@	5.0 psf	0.0 psf	n
		Miscellaneous	@	1.2 psf	1.2 psf	y
		Percast Fascia (4sqft)	@	47.1 psf	0.0 psf	n
		Other	@	1.0 psf	0.0 psf	n
		Other	@	1.0 psf	0.0 psf	n
		Other	@	1.0 psf	0.0 psf	n
		Other	@	1.0 psf	0.0 psf	n

ROOF WEIGHT = 14.0 psf



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WEIGHT TAKEOFF

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 BSE-2E HAZARD LEVEL

WALL TYPE: WALL-P

	Wall Covering	@	4.0 psf	0.0 psf	n
3 in	Exterior Stucco	@	11.4 psf per inch.	0.0 psf	n
1 in	Wood Sheathing	@	3.0 psf per inch	0.0 psf	n
0.5 in	Gypsum Sheathing	@	4.0 psf per inch	0.0 psf	n
0.5 in	Gypsum Wallboard	@	4.4 psf per inch	0.0 psf	n
	Porcelain Enamel Panels	@	5.0 psf	0.0 psf	n
	Metal Lath & Plaster (Gypsum Plaster)	@	10.0 psf	0.0 psf	n
	Wall Insulation	@	1.0 psf	0.0 psf	n
1 in	Insulation (Rigid)	@	1.5 psf per inch	0.0 psf	n
1 in	Insulation Boards (Fiber Board)	@	1.5 psf per inch	0.0 psf	n
0.5 in	Fire Proofing	@	2 psf per inch	0.0 psf	n
	Wall Framing	@	20.0 psf	0.0 psf	n
8 in	Concrete Wall (Normal Weight)	@	12.5 psf per inch	0.0 psf	n
8 in	CMU Wall w/ Full Grouting (Normal Weight)	@	83.0 psf	83.0 psf	y
8 in	Solid CMU Wall (Normal Weight)	@	87.0 psf	0.0 psf	n
4 in	HCB Wall w/ Full Grouting	@	38.0 psf	0.0 psf	n
3.5 in	Solid Clay Brick Wall	@	11.1 psf per inch	0.0 psf	n
0.5 in	Plywood	@	3.2 psf per inch	0.0 psf	n
16 in O.C.	Wood Studs (2 x 4)	@	1.1 plf	0.0 psf	n
16 in O.C.	Metal Channel Studs	@	2.0 plf	0.0 psf	n
8 ft O.C.	Steel Girts	@	6.0 plf	0.0 psf	n
	Miscellaneous	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n

Solid Wall Weight = 83.0 psf
 Window & Door Weight = 0.0 psf
 % Solid Wall = 100%
WALL-P WEIGHT = 83.0 psf



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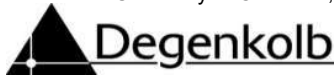
WEIGHT TAKEOFF

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 BSE-2E HAZARD LEVEL

WALL TYPE: **WALL-R**

	Wall Covering	@	4.0 psf	0.0 psf	n
3 in	Exterior Stucco	@	11.4 psf per inch.	0.0 psf	n
1 in	Wood Sheathing	@	3.0 psf per inch	0.0 psf	n
0.5 in	Gypsum Sheathing	@	4.0 psf per inch	0.0 psf	n
0.5 in	Gypsum Wallboard	@	4.4 psf per inch	0.0 psf	n
	Porcelain Enamel Panels	@	5.0 psf	0.0 psf	n
	Metal Lath & Plaster (Gypsum Plaster)	@	10.0 psf	0.0 psf	n
	Wall Insulation	@	1.0 psf	0.0 psf	n
1 in	Insulation (Rigid)	@	1.5 psf per inch	0.0 psf	n
1 in	Insulation Boards (Fiber Board)	@	1.5 psf per inch	0.0 psf	n
0.5 in	Fire Proofing	@	2 psf per inch	0.0 psf	n
	Wall Framing	@	20.0 psf	0.0 psf	n
8 in	Concrete Wall (Normal Weight)	@	12.5 psf per inch	0.0 psf	n
8 in	CMU Wall w/ Full Grouting (Normal Weight)	@	83.0 psf	83.0 psf	y
8 in	Solid CMU Wall (Normal Weight)	@	87.0 psf	0.0 psf	n
4 in	HCB Wall w/ Full Grouting	@	38.0 psf	0.0 psf	n
3.5 in	Solid Clay Brick Wall	@	11.1 psf per inch	0.0 psf	n
0.5 in	Plywood	@	3.2 psf per inch	0.0 psf	n
16 in O.C.	Wood Studs (2 x 4)	@	1.1 plf	0.0 psf	n
16 in O.C.	Metal Channel Studs	@	2.0 plf	0.0 psf	n
8 ft O.C.	Steel Girts	@	6.0 plf	0.0 psf	n
	Miscellaneous	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n

Solid Wall Weight = 83.0 psf
 Window & Door Weight = 0.0 psf
 % Solid Wall = 100%
WALL-R WEIGHT = 83.0 psf



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SEISMIC MASS

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ROOF/FLOOR WEIGHT SUMMARY:

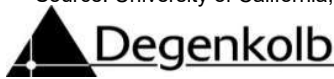
Level Type	Weight [psf]
ROOF	14

WALL WEIGHT SUMMARY:

Wall Type	Weight [psf]		
	Net	Solid	Openings
WALL-P	83.0	83	0

SEISMIC MASS SUMMARY:

Level	FLOOR			WALL ABOVE				WALL BELOW				TOTAL WEIGHT [kips]	
	Level Type	Weight [psf]	Area [sf]	Wall Type	Weight [psf]	Length [ft]	Height [ft]	Wall Type	Weight [psf]	Length [ft]	Height [ft]		
Roof	ROOF	14	1,539	WALL-P	83.0	0	2.50	WALL-P	83.0	180	5.75	107	
												TOTAL	107



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SEISMIC FORCES

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BUILDING TYPE: RM1 (Reinforced Masonry Bearing Walls with Flexible Diaphragms) [ASCE 41-17, Table 3-1]
SITE CLASS: D (default) #N/A [ASCE 41-17, §2.4.1.6]

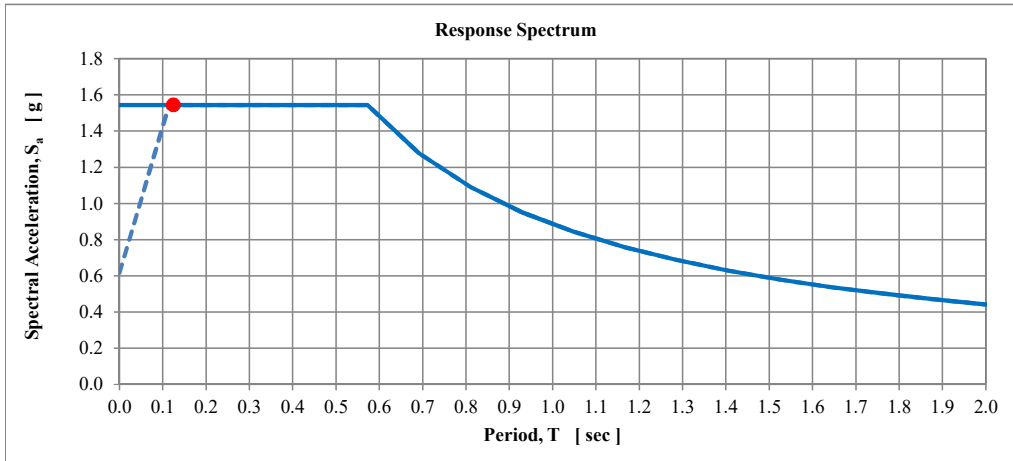
DESIGN SPECTRAL ACCELERATIONS:

S_{XS} = 1.543 g (BSE-2E) Site-Adjusted Design (T = 0.2 sec) [ASCE 41-17, Eq. 2-1]
 S_{X1} = 0.884 g (BSE-2E) Site-Adjusted Design (T = 1.0 sec) [ASCE 41-17, Eq. 2-2]

BUILDING PERIOD:

h_n = 11.5 ft (Base to Roof) Building Height [ASCE 41-17, §4.4.2.4]
 C_t = 0.020 (Building Type RM1) Period Coefficient [ASCE 41-17, §4.4.2.4]
 β = 0.750 (Building Type RM1) Period Exponent [ASCE 41-17, §4.4.2.4]
 T = 0.125 sec = $C_t h_n^\beta$ Fundamental Period [ASCE 41-17, Eq. 4-4]

RESPONSE SPECTRUM:



PSEUDO LATERAL FORCE:

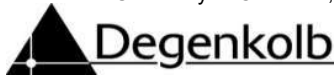
n = 1 (n = 1) Total Number of Stories
 C = 1.0 (Building Type RM1) Modification Factor [ASCE 41-17, Table 4-7]
 S_a = 1.543 g = MIN { S_{X1} / T , S_{XS} } Spectral Acceleration [ASCE 41-17, Eq. 4-3]
 V = **1.543 W** = $C S_a W$ Pseudo Lateral Force [ASCE 41-17, Eq. 4-1]

VERTICAL DISTRIBUTION OF SEISMIC FORCES:

k = 1.00 ($T \leq 0.5$ sec) Seismic Distribution Exponent [ASCE 41-17, §4.4.2.2]

Level	h_x [ft]	w_x [kips]	$w_x h_x^k$	C_{vx}	F_x [kips]	V_j [kips]
Roof	11.5	107	1,236	1.00	166	166
TOTAL	-	107	1,236	1.00	166	-

$F_x = C_{vx} V = [w_x h_x^k / \sum (w_x h_x^k)] V$ [ASCE 41-17, Eq. 4-2a]
 $V_j = \sum F_x$ [ASCE 41-17, Eq. 4-2b]



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QUICK CHECKS

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 BSE-2E HAZARD LEVEL

BUILDING TYPE: RM1 (Reinforced Masonry Bearing Walls with Flexible Diaphragms) [ASCE 41-17, Table 3-1]
MASONRY TYPE: CMU (Concrete Masonry Units)

STEEL REINFORCING RATIO CHECK: [ASCE 41-17, §A.3.2.4.2]

Wall Type	s _{grout} [in]	t _w [in]	Horizontal Reinforcing				Vertical Reinforcing				Total Reinforcing	
			Bar Size No.	Spacing [in]	ρ _h	ρ _h ≥ 0.0007	Bar Size No.	Spacing [in]	ρ _v	ρ _v ≥ 0.0007	ρ _{tot}	ρ _{tot} ≥ 0.002
WALL-P	8	7.625	5	24	0.0017	OK	4	24	0.0011	OK	0.0028	OK
WALL-R	8	7.625	5	24	0.0017	OK	4	24	0.0011	OK	0.0028	OK

AVERAGE SHEAR STRESS CHECK:

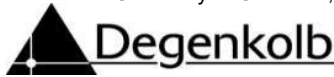
v_n = 70 psi (RM Shear Wall) Shear Wall Capacity [ASCE 41-17, §A.3.2.4.1]
 M_s = 4.5 COLLAPSE PREVENTION System Modification Factor [ASCE 41-17, Table 4-8]
 v_{j, avg} = (1 / M_s) (V_j / A_w) Average Shear Wall Stress [ASCE 41-17, Eq. 4-8]
 A_w = t_w (L_{w, total} - L_{w, openings}) (A_{partial grout} / A_{full grout}) Net Wall Area (Reduced for Partial Grouting) [ASCE 41-17, §4.4.3.3]

North-South Direction:

Level	V _j [kips]	Wall Type	s _{grout} [in]	A _{partial grout} / A _{full grout}	t _w [in]	L _{w, total} [ft]	L _{w, openings} [ft]	L _w [ft]	A _w [in ²]	v _{j, avg} [psi]	DCR	Quick Check
Roof	166	WALL-R	8	1.00	7.625	114	0	114	10,431	4	0.05	OK

East-West Direction:

Level	V _j [kips]	Wall Type	s _{grout} [in]	A _{partial grout} / A _{full grout}	t _w [in]	L _{w, total} [ft]	L _{w, openings} [ft]	L _w [ft]	A _w [in ²]	v _{j, avg} [psi]	DCR	Quick Check
Roof	166	WALL-P	8	1.00	7.625	54	0	54	4,941	7	0.11	OK



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QUICK CHECKS

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BUILDING TYPE: RM1 (Reinforced Masonry Bearing Walls with Flexible Diaphragms) [ASCE 41-17, Table 3-1]
MASONRY TYPE: CMU (Concrete Masonry Units)

WALL HEIGHT-TO-THICKNESS RATIO CHECK: [ASCE 41-17, §A.3.2.4.4]

Wall Type	h_w [ft]	t_w [in]	h_w / t_w	MAX h_w / t_w	Quick Check
WALL-P	2.50	7.625	3.9	30	OK
WALL-R	11.50	7.625	18.1	30	OK

OUT-OF-PLANE WALL ANCHORAGE CHECK: [ASCE 41-17, §A.5.1.1]

Ψ = 1.0 COLLAPSE PREVENTION Out-of-Plane Wall Anchorage Coefficient [ASCE 41-17, §4.4.3.7]
 S_{XS} = 1.543 g (BSE-2E) Design Spectral Acceleration (T = 0.2 sec) [ASCE 41-17, §2.4.1.1]
 T_c = $\Psi S_{XS} w_p A_p$ Out-of-Plane Wall Anchorage Force [ASCE 41-17, Eq. 4-12]
 $w_p A_p$ = ($w_{w, above} h_{w, above} + w_{w, below} h_{w, below}$) s_{anchor} Tributary Mass to Anchorage [ASCE 41-17, §4.4.3.7]

North-South Direction:

Level	WALL ABOVE			WALL BELOW			OUT-OF-PLANE ANCHORAGE					
	Wall Type	Weight [psf]	Height [ft]	Wall Type	Weight [psf]	Height [ft]	s_{anchor} [ft]	$w_p A_p$ [lb]	T_c [lb]	T_{cn} [lb]	DCR	Quick Check
Roof	WALL-R	83	2.50	WALL-R	83	5.75	4.00	2,739	4,227	2,653	1.59	NO GOOD

East-West Direction:

Level	WALL ABOVE			WALL BELOW			OUT-OF-PLANE ANCHORAGE					
	Wall Type	Weight [psf]	Height [ft]	Wall Type	Weight [psf]	Height [ft]	s_{anchor} [ft]	$w_p A_p$ [lb]	T_c [lb]	T_{cn} [lb]	DCR	Quick Check
Roof	WALL-P	83	2.50	WALL-P	83	5.75	4.00	2,739	4,227	3,941	1.07	NO GOOD



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GLOBAL DATA

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SITE DATA:

Latitude:	37.00103 °N	610 Red Hill Road	USGS Seismic Design Map Application:
Longitude:	122.06080 °W	Santa Cruz, CA 95064	http://geohazards.usgs.gov/hazardtool/application.php
Site Class:	D (default)	(Stiff Soil)	Site Class [ASCE 41-17, §2.4.1.6]
S _s	= 1.286 g	(USGS) (5% / 50 years)	USGS Mapped (T = 0.2 sec) [ASCE 41-17, §2.4.1.3]
S ₁	= 0.488 g	(USGS) (5% / 50 years)	USGS Mapped (T = 1.0 sec) [ASCE 41-17, §2.4.1.3]
F _a	= 1.200	(Site Class D)	Site Coefficient (T = 0.2 sec) [ASCE 7-16, Table 11.4-1]
F _v	= 1.812	(Site Class D)	Site Coefficient (T = 1.0 sec) [ASCE 7-16, Table 11.4-2]
S _{XS}	= 1.543 g	= F _a S _s	Site-Adjusted Design (T = 0.2 sec) [ASCE 41-17, Eq. 2-1]
S _{X1}	= 0.884 g	= F _v S ₁	Site-Adjusted Design (T = 1.0 sec) [ASCE 41-17, Eq. 2-2]

BUILDING DATA:

Building Type:	RM1	(Reinforced Masonry Bearing Walls with Flexible Diaphragms)	[ASCE 41-17, Table 3-1]
Year Built:	1993/2000		
Number of Stories:	2 stories		
Parapet Height:	0.67 ft		
Roof Height:	24.00 ft		
Total Area:	4,050 sf		

Level	Height [ft]	Elevation [ft]	Length _{N-S} [ft]	Length _{E-W} [ft]	Area [sf]	Diaphragm Stiffness	Diaphragm Description
Roof	11.0	24.0	27	75	2,025	Flexible	5/8" Plywood sheathing
2nd	13.0	13.0	27	75	2,025	Flexible	3/4" CDX plywood T&G Sheathing
1st	0.0	0.0	27	75	2,025	-	-



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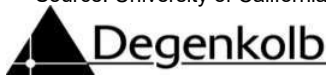
WEIGHT TAKEOFF

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ROOF TYPE: ROOF

	Roofing / Re-roofing	@	5.0 psf	5.0 psf	y
0.5 in	Rock Ballast (Gravel)	@	8.0 psf per inch	0.0 psf	n
3 ply	Ready Roofing	@	0.3 psf per ply	0.0 psf	n
5 ply	Felt Roofing	@	0.5 psf per ply	0.0 psf	n
0.25 in	Slate	@	40.0 psf per inch	0.0 psf	n
	Shingles (Asphalt)	@	2.0 psf	0.0 psf	n
	Copper or Tin	@	1.0 psf	0.0 psf	n
	Corrugated Asbestos-Cement	@	4.0 psf	0.0 psf	n
	Waterproofing Membranes (Smooth Bituminous)	@	1.5 psf	1.5 psf	y
	Cement Tiles	@	16.0 psf	0.0 psf	n
	Clay Tiles (Spanish)	@	19.0 psf	0.0 psf	n
	Mortar Bed for Clay Tiles	@	10.0 psf	0.0 psf	n
	Roof Insulation	@	1.0 psf	1.0 psf	y
1 in	Insulation (Rigid)	@	1.5 psf per inch	0.0 psf	n
1 in	Insulation Boards (Fibrous Glass)	@	1.1 psf per inch	0.0 psf	n
3 in	Vermiculite Concrete	@	2.5 psf per inch	0.0 psf	n
0.5 in	Fire Proofing	@	2.0 psf per inch	0.0 psf	n
	Diaphragm - core planks	@	35.0 psf	0.0 psf	n
2.5 in	Concrete Slab (Normal Weight)	@	12.5 psf per inch	0.0 psf	n
4.75 in	Concrete Fill (Light Weight)	@	9.2 psf per inch	0.0 psf	n
0.5 in	Concrete Overpour (Light Weight)	@	9.2 psf per inch	0.0 psf	n
18 ga	Bare Metal Deck	@	3.0 psf	0.0 psf	n
2 in	Wood Decking	@	2.5 psf per inch	0.0 psf	n
2 in	Wood Sheathing	@	3.0 psf per inch	0.0 psf	n
0.5 in	Plywood	@	3.2 psf per inch	1.6 psf	y
	Framing	@	20.0 psf	0.0 psf	n
8 ft O.C.	Steel Beams	@	22.0 plf	0.0 psf	n
36 ft O.C.	Steel Girders	@	76.0 plf	0.0 psf	n
2 ft O.C.	Wood Sub-Purlins	@	1.8 plf	0.0 psf	n
2 ft O.C.	Wood Purlins	@	3.0 plf	1.5 psf	y
20 ft O.C.	Wood Girders	@	5.0 plf	0.0 psf	n
12.75 ft O.C.	Concrete Beams	@	800.0 plf	0.0 psf	n
20 ft O.C.	Concrete Girders	@	300.0 plf	0.0 psf	n
5.50 ft trib. ht.	Typical Columns (A _{trib} = 459 sf)	@	600.0 plf	0.0 psf	n
	Ceiling	@	5.0 psf	0.0 psf	n
0.5 in	Gypsum Board Ceiling	@	4.4 psf per inch	2.2 psf	y
	Acoustical Fiber Board	@	1.0 psf	0.0 psf	n
	Plaster Ceiling (On Tile)	@	5.0 psf	0.0 psf	n
	Suspended Metal Lath & Plaster (Gypsum Plaster)	@	10.0 psf	0.0 psf	n
	Suspended Steel Channel System	@	2.0 psf	0.0 psf	n
	Suspended Wood Furring System	@	2.5 psf	0.0 psf	n
	T-bar Ceiling System	@	3.0 psf	0.0 psf	n
10% floor area	Interior Partitions (Below)	@	5.0 psf	0.0 psf	n
	M.E.P.	@	5.0 psf	0.0 psf	n
	Miscellaneous	@	1.2 psf	1.2 psf	y
	Percast Fascia (4sqft)	@	47.1 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n

ROOF WEIGHT = 14.0 psf



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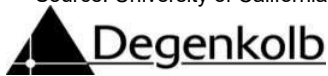
WEIGHT TAKEOFF

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 BSE-2E HAZARD LEVEL

FLOOR TYPE: FLR-2

	Flooring		@	2.0 psf	2.0 psf	y
1 in	Floor Tiles	(Terrazzo)	@	13.0 psf per inch	0.0 psf	n
0.75 in	Wood Flooring	(Hardwood)	@	4.6 psf per inch	0.0 psf	n
2 in	Wood Blocks		@	3.3 psf per inch	0.0 psf	n
2 in	Asphalt Blocks		@	12.0 psf per inch	0.0 psf	n
0.75 in	Mastic		@	12.0 psf per inch	0.0 psf	n
1 in	Cement Finish		@	12.0 psf per inch	0.0 psf	n
2 in	Mortar Bed		@	12.0 psf per inch	0.0 psf	n
2 in	Floor Fill	(Stone Concrete)	@	12.0 psf per inch	0.0 psf	n
0.75 in	Subflooring		@	4.0 psf per inch	0.0 psf	n
	Marble & Mortar, Stone Concrete		@	33.0 psf	0.0 psf	n
	Solid Flat Tile, 1-in Mortar Base		@	23.0 psf	0.0 psf	n
	Floor Insulation		@	1.0 psf	1.0 psf	y
1 in	Insulation	(Rigid)	@	1.5 psf per inch	0.0 psf	n
1 in	Insulation Boards	(Fibrous Glass)	@	1.1 psf per inch	0.0 psf	n
3 in	Vermiculite Concrete		@	2.5 psf per inch	0.0 psf	n
0.5 in	Fire Proofing		@	2 psf per inch	0.0 psf	n
	Diaphragm		@	20.0 psf	0.0 psf	n
3 in	Concrete Slab	(Normal Weight)	@	12.5 psf per inch	0.0 psf	n
4.75 in	Concrete Fill	(Light Weight)	@	9.2 psf per inch	0.0 psf	n
0.5 in	Concrete Overpour	(Light Weight)	@	9.2 psf per inch	0.0 psf	n
18 ga	Bare Metal Deck		@	3.0 psf	0.0 psf	n
2 in	Wood Decking		@	2.5 psf per inch	0.0 psf	n
0.75 in	Wood Sheathing		@	3.0 psf per inch	2.3 psf	y
0.5 in	Plywood		@	3.2 psf per inch	0.0 psf	n
	Framing		@	20.0 psf	0.0 psf	n
6 ft O.C.	Steel Beams		@	22.0 plf	0.0 psf	n
36 ft O.C.	Steel Girders		@	76.0 plf	0.0 psf	n
2 ft O.C.	Wood Sub-Purlins		@	1.8 plf	0.0 psf	n
2 ft O.C.	Wood Purlins		@	3.0 plf	1.5 psf	y
20 ft O.C.	Wood Girders		@	5.0 plf	0.0 psf	n
8 ft O.C.	Concrete Beams		@	200.0 plf	0.0 psf	n
20 ft O.C.	Concrete Girders		@	300.0 plf	0.0 psf	n
12.5 ft trib. ht.	Typical Columns	(A _{trib} = 400 sf)	@	233.0 plf	0.0 psf	n
	Ceiling		@	5.0 psf	5.0 psf	y
0.5 in	Gypsum Board Ceiling		@	4.4 psf per inch	0.0 psf	n
	Acoustical Fiber Board		@	1.0 psf	0.0 psf	n
	Plaster Ceiling	(On Tile)	@	5.0 psf	0.0 psf	n
	Suspended Metal Lath & Plaster	(Gypsum Plaster)	@	10.0 psf	0.0 psf	n
	Suspended Steel Channel System		@	2.0 psf	0.0 psf	n
	Suspended Wood Furring System		@	2.5 psf	0.0 psf	n
	T-bar Ceiling System		@	3.0 psf	0.0 psf	n
100% floor area	Interior Partitions	(Above & Below)	@	10.0 psf	10.0 psf	y
	M.E.P.		@	5.0 psf	0.0 psf	n
	Miscellaneous		@	1.2 psf	1.2 psf	y
	Other		@	1.0 psf	0.0 psf	n
	Other		@	1.0 psf	0.0 psf	n
	Other		@	1.0 psf	0.0 psf	n
	Other		@	1.0 psf	0.0 psf	n
	Other		@	1.0 psf	0.0 psf	n

FLR-2 WEIGHT = 23.0 psf



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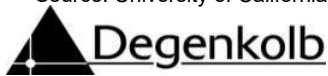
WEIGHT TAKEOFF

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WALL TYPE: **WALL-P**

	Wall Covering	@	4.0 psf	0.0 psf	n
3 in	Exterior Stucco	@	11.4 psf per inch.	0.0 psf	n
1 in	Wood Sheathing	@	3.0 psf per inch	0.0 psf	n
0.5 in	Gypsum Sheathing	@	4.0 psf per inch	0.0 psf	n
0.5 in	Gypsum Wallboard	@	4.4 psf per inch	0.0 psf	n
	Porcelain Enamel Panels	@	5.0 psf	0.0 psf	n
	Metal Lath & Plaster (Gypsum Plaster)	@	10.0 psf	0.0 psf	n
	Wall Insulation	@	1.0 psf	0.0 psf	n
1 in	Insulation (Rigid)	@	1.5 psf per inch	0.0 psf	n
1 in	Insulation Boards (Fiber Board)	@	1.5 psf per inch	0.0 psf	n
0.5 in	Fire Proofing	@	2 psf per inch	0.0 psf	n
	Wall Framing	@	20.0 psf	0.0 psf	n
8 in	Concrete Wall (Normal Weight)	@	12.5 psf per inch	0.0 psf	n
8 in	CMU Wall w/ Full Grouting (Normal Weight)	@	83.0 psf	83.0 psf	y
8 in	Solid CMU Wall (Normal Weight)	@	87.0 psf	0.0 psf	n
4 in	HCB Wall w/ Full Grouting	@	38.0 psf	0.0 psf	n
3.5 in	Solid Clay Brick Wall	@	11.1 psf per inch	0.0 psf	n
0.5 in	Plywood	@	3.2 psf per inch	0.0 psf	n
16 in O.C.	Wood Studs (2 x 4)	@	1.1 plf	0.0 psf	n
16 in O.C.	Metal Channel Studs	@	2.0 plf	0.0 psf	n
8 ft O.C.	Steel Girts	@	6.0 plf	0.0 psf	n
	Miscellaneous	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n

Solid Wall Weight = 83.0 psf
 Window & Door Weight = 0.0 psf
 % Solid Wall = 100%
WALL-P WEIGHT = 83.0 psf



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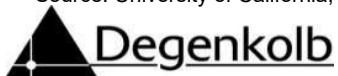
WEIGHT TAKEOFF

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WALL TYPE: WALL-R

	Wall Covering	@	4.0 psf	0.0 psf	n
3 in	Exterior Stucco	@	11.4 psf per inch.	0.0 psf	n
1 in	Wood Sheathing	@	3.0 psf per inch	0.0 psf	n
0.5 in	Gypsum Sheathing	@	4.0 psf per inch	0.0 psf	n
0.5 in	Gypsum Wallboard	@	4.4 psf per inch	0.0 psf	n
	Porcelain Enamel Panels	@	5.0 psf	0.0 psf	n
	Metal Lath & Plaster (Gypsum Plaster)	@	10.0 psf	0.0 psf	n
	Wall Insulation	@	1.0 psf	0.0 psf	n
1 in	Insulation (Rigid)	@	1.5 psf per inch	0.0 psf	n
1 in	Insulation Boards (Fiber Board)	@	1.5 psf per inch	0.0 psf	n
0.5 in	Fire Proofing	@	2 psf per inch	0.0 psf	n
	Wall Framing	@	20.0 psf	0.0 psf	n
8 in	Concrete Wall (Normal Weight)	@	12.5 psf per inch	0.0 psf	n
8 in	CMU Wall w/ Full Grouting (Normal Weight)	@	83.0 psf	83.0 psf	y
8 in	Solid CMU Wall (Normal Weight)	@	87.0 psf	0.0 psf	n
4 in	HCB Wall w/ Full Grouting	@	38.0 psf	0.0 psf	n
3.5 in	Solid Clay Brick Wall	@	11.1 psf per inch	0.0 psf	n
0.5 in	Plywood	@	3.2 psf per inch	0.0 psf	n
16 in O.C.	Wood Studs (2 x 4)	@	1.1 plf	0.0 psf	n
16 in O.C.	Metal Channel Studs	@	2.0 plf	0.0 psf	n
8 ft O.C.	Steel Girts	@	6.0 plf	0.0 psf	n
	Miscellaneous	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n

Solid Wall Weight = 83.0 psf
 Window & Door Weight = 0.0 psf
 % Solid Wall = 100%
WALL-R WEIGHT = 83.0 psf



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SEISMIC MASS

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ROOF/FLOOR WEIGHT SUMMARY:

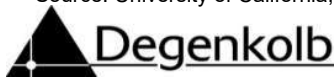
Level Type	Weight [psf]
ROOF	14
FLR-2	23

WALL WEIGHT SUMMARY:

Wall Type	Weight [psf]		
	Net	Solid	Openings
WALL-P	83.0	83	0
WALL-R	83	83	0
WALL-2	83	83	0

SEISMIC MASS SUMMARY:

Level	FLOOR			WALL ABOVE				WALL BELOW				TOTAL WEIGHT [kips]	
	Level Type	Weight [psf]	Area [sf]	Wall Type	Weight [psf]	Length [ft]	Height [ft]	Wall Type	Weight [psf]	Length [ft]	Height [ft]		
Roof	ROOF	14	2,025	WALL-P	83.0	204	0.67	WALL-P	83.0	204	5.50	133	
2nd	FLR-2	23	2,025	WALL-P	83.0	204	5.50	WALL-P	83.0	204	6.50	250	
												TOTAL	383



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SEISMIC FORCES

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BUILDING TYPE: RM1 (Reinforced Masonry Bearing Walls with Flexible Diaphragms) [ASCE 41-17, Table 3-1]
SITE CLASS: D (default) #N/A [ASCE 41-17, §2.4.1.6]

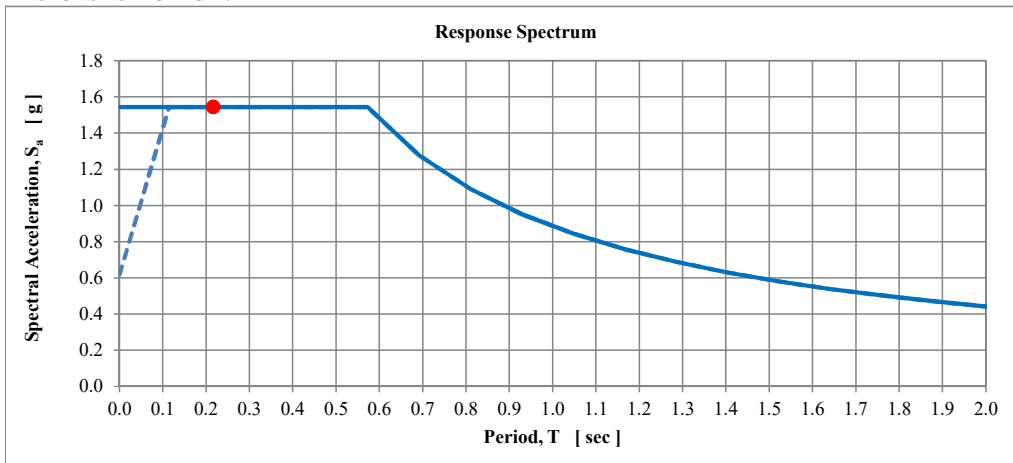
DESIGN SPECTRAL ACCELERATIONS:

S_{XS} = 1.543 g (BSE-2E) Site-Adjusted Design (T = 0.2 sec) [ASCE 41-17, Eq. 2-1]
 S_{X1} = 0.884 g (BSE-2E) Site-Adjusted Design (T = 1.0 sec) [ASCE 41-17, Eq. 2-2]

BUILDING PERIOD:

h_n = 24.0 ft (Base to Roof) Building Height [ASCE 41-17, §4.4.2.4]
 C_t = 0.020 (Building Type RM1) Period Coefficient [ASCE 41-17, §4.4.2.4]
 β = 0.750 (Building Type RM1) Period Exponent [ASCE 41-17, §4.4.2.4]
 T = 0.217 sec = $C_t h_n^\beta$ Fundamental Period [ASCE 41-17, Eq. 4-4]

RESPONSE SPECTRUM:



PSEUDO LATERAL FORCE:

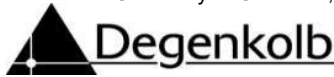
n = 2 (n = 2) Total Number of Stories
 C = 1.0 (Building Type RM1) Modification Factor [ASCE 41-17, Table 4-7]
 S_a = 1.543 g = MIN { S_{X1} / T , S_{XS} } Spectral Acceleration [ASCE 41-17, Eq. 4-3]
 V = **1.543 W** = $C S_a W$ Pseudo Lateral Force [ASCE 41-17, Eq. 4-1]

VERTICAL DISTRIBUTION OF SEISMIC FORCES:

k = 1.00 (T ≤ 0.5 sec) Seismic Distribution Exponent [ASCE 41-17, §4.4.2.2]

Level	h_x [ft]	w_x [kips]	$w_x h_x^k$	C_{vx}	F_x [kips]	V_j [kips]
Roof	24.0	133	3,188	0.50	292	292
2nd	13.0	250	3,247	0.50	298	590
TOTAL	-	383	6,435	1.00	590	-

$F_x = C_{vx} V = [w_x h_x^k / \sum (w_x h_x^k)] V$ [ASCE 41-17, Eq. 4-2a]
 $V_j = \sum F_x$ [ASCE 41-17, Eq. 4-2b]



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QUICK CHECKS

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 BSE-2E HAZARD LEVEL

BUILDING TYPE: RM1 (Reinforced Masonry Bearing Walls with Flexible Diaphragms) [ASCE 41-17, Table 3-1]
MASONRY TYPE: CMU (Concrete Masonry Units)

STEEL REINFORCING RATIO CHECK: [ASCE 41-17, §A.3.2.4.2]

Wall Type	s _{grout} [in]	t _w [in]	Horizontal Reinforcing				Vertical Reinforcing				Total Reinforcing	
			Bar Size No.	Spacing [in]	ρ _h	ρ _h ≥ 0.0007	Bar Size No.	Spacing [in]	ρ _v	ρ _v ≥ 0.0007	ρ _{tot}	ρ _{tot} ≥ 0.002
WALL-P	8	7.625	5	48	0.0008	OK	6	16	0.0036	OK	0.0045	OK
WALL-R	8	7.625	5	48	0.0008	OK	6	16	0.0036	OK	0.0045	OK
WALL-2	8	7.625	5	48	0.0008	OK	6	16	0.0036	OK	0.0045	OK

*Reinforcing bar spacings in red text are not less than 48-in and thus noncompliant per ASCE 41-13 Section A.3.2.4.2.

AVERAGE SHEAR STRESS CHECK:

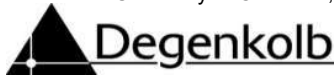
v_n = 70 psi (RM Shear Wall) Shear Wall Capacity [ASCE 41-17, §A.3.2.4.1]
 M_s = 4.5 COLLAPSE PREVENTION System Modification Factor [ASCE 41-17, Table 4-8]
 v_{j, avg} = (1 / M_s) (V_j / A_w) Average Shear Wall Stress [ASCE 41-17, Eq. 4-8]
 A_w = t_w (L_{w, total} - L_{w, openings}) (A_{partial grout} / A_{full grout}) Net Wall Area (Reduced for Partial Grouting) [ASCE 41-17, §4.4.3.3]

North-South Direction:

Level	V _j [kips]	Wall Type	s _{grout} [in]	$\frac{A_{\text{partial grout}}}{A_{\text{full grout}}}$	t _w [in]	L _{w, total} [ft]	L _{w, openings} [ft]	L _w [ft]	A _w [in ²]	v _{j, avg} [psi]	DCR	Quick Check
Roof	292	WALL-R	8	1.00	7.625	54	0	54	4,941	13	0.19	OK
2nd	590	WALL-2	8	1.00	7.625	54	0	54	4,941	27	0.38	OK

East-West Direction:

Level	V _j [kips]	Wall Type	s _{grout} [in]	$\frac{A_{\text{partial grout}}}{A_{\text{full grout}}}$	t _w [in]	L _{w, total} [ft]	L _{w, openings} [ft]	L _w [ft]	A _w [in ²]	v _{j, avg} [psi]	DCR	Quick Check
Roof	292	WALL-P	8	1.00	7.625	150	0	150	13,725	5	0.07	OK
2nd	590	WALL-2	8	1.00	7.625	150	0	150	13,725	10	0.14	OK



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QUICK CHECKS

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BUILDING TYPE: RM1 (Reinforced Masonry Bearing Walls with Flexible Diaphragms) [ASCE 41-17, Table 3-1]
MASONRY TYPE: CMU (Concrete Masonry Units)

WALL HEIGHT-TO-THICKNESS RATIO CHECK: [ASCE 41-17, §A.3.2.4.4]

Wall Type	h_w [ft]	t_w [in]	h_w / t_w	MAX h_w / t_w	Quick Check
WALL-P	0.67	7.625	1.1	30	OK
WALL-R	11.00	7.625	17.3	30	OK
WALL-2	13.00	7.625	20.5	30	OK

OUT-OF-PLANE WALL ANCHORAGE CHECK:

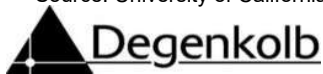
Ψ = 1.0 COLLAPSE PREVENTION Out-of-Plane Wall Anchorage Coefficient [ASCE 41-17, §A.5.1.1]
 S_{XS} = 1.543 g (BSE-2E) Design Spectral Acceleration (T = 0.2 sec) [ASCE 41-17, §4.4.3.7]
 T_c = $\Psi S_{XS} w_p A_p$ Out-of-Plane Wall Anchorage Force [ASCE 41-17, Eq. 4-12]
 $w_p A_p$ = ($w_{w, above} h_{w, above} + w_{w, below} h_{w, below}$) S_{anchor} Tributary Mass to Anchorage [ASCE 41-17, §4.4.3.7]

North-South Direction:

Level	WALL ABOVE			WALL BELOW			OUT-OF-PLANE ANCHORAGE					
	Wall Type	Weight [psf]	Height [ft]	Wall Type	Weight [psf]	Height [ft]	S_{anchor} [ft]	$w_p A_p$ [lb]	T_c [lb]	T_{cn} [lb]	DCR	Quick Check
Roof	WALL-P	83	0.67	WALL-P	83	5.50	4.00	2,048	3,161	3,941	0.80	OK
2nd	WALL-P	83	5.50	WALL-P	83	6.50	4.00	3,984	6,148	3,941	1.56	NO GOOD

East-West Direction:

Level	WALL ABOVE			WALL BELOW			OUT-OF-PLANE ANCHORAGE					
	Wall Type	Weight [psf]	Height [ft]	Wall Type	Weight [psf]	Height [ft]	S_{anchor} [ft]	$w_p A_p$ [lb]	T_c [lb]	T_{cn} [lb]	DCR	Quick Check
Roof	WALL-R	83	0.67	WALL-R	83	5.50	4.00	2,048	3,161	3,941	0.80	OK
2nd	WALL-R	83	5.50	WALL-R	83	6.50	4.00	3,984	6,148	3,941	1.56	NO GOOD



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GLOBAL DATA

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SITE DATA:

Latitude:	37.00103 °N	610 Red Hill Road	USGS Seismic Design Map Application:
Longitude:	122.06080 °W	Santa Cruz, CA 95064	http://geohazards.usgs.gov/hazardtool/application.php
Site Class:	D (default)	(Stiff Soil)	Site Class [ASCE 41-17, §2.4.1.6]
S _s	= 1.286 g	(USGS) (5% / 50 years)	USGS Mapped (T = 0.2 sec) [ASCE 41-17, §2.4.1.3]
S ₁	= 0.488 g	(USGS) (5% / 50 years)	USGS Mapped (T = 1.0 sec) [ASCE 41-17, §2.4.1.3]
F _a	= 1.200	(Site Class D)	Site Coefficient (T = 0.2 sec) [ASCE 7-16, Table 11.4-1]
F _v	= 1.812	(Site Class D)	Site Coefficient (T = 1.0 sec) [ASCE 7-16, Table 11.4-2]
S _{XS}	= 1.543 g	= F _a S _s	Site-Adjusted Design (T = 0.2 sec) [ASCE 41-17, Eq. 2-1]
S _{X1}	= 0.884 g	= F _v S ₁	Site-Adjusted Design (T = 1.0 sec) [ASCE 41-17, Eq. 2-2]

BUILDING DATA:

Building Type:	S2A	(Steel Braced Frames with Flexible Diaphragms)	[ASCE 41-17, Table 3-1]
Year Built:	1966		
Number of Stories:	1 story		
Parapet Height:	1.50 ft		
Roof Height:	14.00 ft		
Total Area:	2,250 sf		

Level	Height [ft]	Elevation [ft]	Length _{N-S} [ft]	Length _{E-W} [ft]	Area [sf]	Diaphragm Stiffness	Diaphragm Description
Roof	14.0	14.0	50	45	2,250	Flexible	3/8" Plywood sheathing over 2x T&G
1st	0.0	0.0	50	45	2,250	-	-



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WEIGHT TAKEOFF

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 BSE-2E HAZARD LEVEL

ROOF TYPE: ROOF

	Roofing / Re-roofing	@	5.0 psf	5.0 psf	y
0.5 in	Rock Ballast (Gravel)	@	8.0 psf per inch	0.0 psf	n
3 ply	Ready Roofing	@	0.3 psf per ply	0.0 psf	n
5 ply	Felt Roofing	@	0.5 psf per ply	0.0 psf	n
0.25 in	Slate	@	40.0 psf per inch	0.0 psf	n
	Shingles (Asphalt)	@	2.0 psf	0.0 psf	n
	Copper or Tin	@	1.0 psf	0.0 psf	n
	Corrugated Asbestos-Cement	@	4.0 psf	0.0 psf	n
	Waterproofing Membranes (Smooth Bituminous)	@	1.5 psf	1.5 psf	y
	Cement Tiles	@	16.0 psf	0.0 psf	n
	Clay Tiles (Spanish)	@	19.0 psf	0.0 psf	n
	Mortar Bed for Clay Tiles	@	10.0 psf	0.0 psf	n
	Roof Insulation	@	1.0 psf	1.0 psf	y
1 in	Insulation (Rigid)	@	1.5 psf per inch	0.0 psf	n
1 in	Insulation Boards (Fibrous Glass)	@	1.1 psf per inch	0.0 psf	n
3 in	Vermiculite Concrete	@	2.5 psf per inch	0.0 psf	n
0.5 in	Fire Proofing	@	2.0 psf per inch	0.0 psf	n
	Diaphragm - core planks	@	35.0 psf	0.0 psf	n
2.5 in	Concrete Slab (Normal Weight)	@	12.5 psf per inch	0.0 psf	n
4.75 in	Concrete Fill (Light Weight)	@	9.2 psf per inch	0.0 psf	n
0.5 in	Concrete Overpour (Light Weight)	@	9.2 psf per inch	0.0 psf	n
18 ga	Bare Metal Deck	@	3.0 psf	0.0 psf	n
2 in	Wood Decking	@	2.5 psf per inch	0.0 psf	n
2 in	Wood Sheathing	@	3.0 psf per inch	6.0 psf	y
0.5 in	Plywood	@	3.2 psf per inch	1.6 psf	y
	Framing	@	20.0 psf	0.0 psf	n
8 ft O.C.	Steel Beams	@	22.0 plf	2.8 psf	y
36 ft O.C.	Steel Girders	@	76.0 plf	0.0 psf	n
2 ft O.C.	Wood Sub-Purlins	@	1.8 plf	0.0 psf	n
8 ft O.C.	Wood Purlins	@	3.0 plf	0.0 psf	n
20 ft O.C.	Wood Girders	@	5.0 plf	0.0 psf	n
12.75 ft O.C.	Concrete Beams	@	800.0 plf	0.0 psf	n
20 ft O.C.	Concrete Girders	@	300.0 plf	0.0 psf	n
7.00 ft trib. ht.	Typical Columns (A _{trib} = 459 sf)	@	600.0 plf	0.0 psf	n
	Ceiling	@	5.0 psf	0.0 psf	n
0.5 in	Gypsum Board Ceiling	@	4.4 psf per inch	0.0 psf	n
	Acoustical Fiber Board	@	1.0 psf	0.0 psf	n
	Plaster Ceiling (On Tile)	@	5.0 psf	0.0 psf	n
	Suspended Metal Lath & Plaster (Gypsum Plaster)	@	10.0 psf	0.0 psf	n
	Suspended Steel Channel System	@	2.0 psf	0.0 psf	n
	Suspended Wood Furring System	@	2.5 psf	0.0 psf	n
	T-bar Ceiling System	@	3.0 psf	0.0 psf	n
10% floor area	Interior Partitions (Below)	@	5.0 psf	0.5 psf	y
	M.E.P.	@	5.0 psf	5.0 psf	y
	Miscellaneous	@	1.7 psf	1.7 psf	y
	Percast Fascia (4sqft)	@	47.1 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n

ROOF WEIGHT = 25.0 psf



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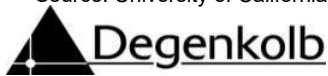
WEIGHT TAKEOFF

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WALL TYPE: **WALL-P**

	Wall Covering	@	4.0 psf	0.0 psf	n
3 in	Exterior Stucco	@	11.4 psf per inch.	34.2 psf	y
1 in	Wood Sheathing	@	3.0 psf per inch	0.0 psf	n
0.5 in	Gypsum Sheathing	@	4.0 psf per inch	0.0 psf	n
0.5 in	Gypsum Wallboard	@	4.4 psf per inch	0.0 psf	n
	Porcelain Enamel Panels	@	5.0 psf	0.0 psf	n
	Metal Lath & Plaster (Gypsum Plaster)	@	10.0 psf	0.0 psf	n
	Wall Insulation	@	1.0 psf	0.0 psf	n
1 in	Insulation (Rigid)	@	1.5 psf per inch	0.0 psf	n
1 in	Insulation Boards (Fiber Board)	@	1.5 psf per inch	0.0 psf	n
0.5 in	Fire Proofing	@	2 psf per inch	0.0 psf	n
	Wall Framing	@	20.0 psf	0.0 psf	n
8 in	Concrete Wall (Normal Weight)	@	12.5 psf per inch	100.0 psf	y
8 in	CMU Wall w/ Full Grouting (Normal Weight)	@	83.0 psf	0.0 psf	n
8 in	Solid CMU Wall (Normal Weight)	@	87.0 psf	0.0 psf	n
4 in	HCB Wall w/ Full Grouting	@	38.0 psf	0.0 psf	n
3.5 in	Solid Clay Brick Wall	@	11.1 psf per inch	0.0 psf	n
0.5 in	Plywood	@	3.2 psf per inch	0.0 psf	n
16 in O.C.	Wood Studs (2 x 4)	@	1.1 plf	0.0 psf	n
16 in O.C.	Metal Channel Studs	@	2.0 plf	0.0 psf	n
8 ft O.C.	Steel Girts	@	6.0 plf	0.0 psf	n
	Miscellaneous	@	1.8 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n

Solid Wall Weight = 134.2 psf
 Window & Door Weight = 0.0 psf
 % Solid Wall = 100%
WALL-P WEIGHT = 134.2 psf



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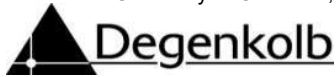
WEIGHT TAKEOFF

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 BSE-2E HAZARD LEVEL

WALL TYPE: WALL-R

	Wall Covering	@	4.0 psf	0.0 psf	n
3 in	Exterior Stucco	@	11.4 psf per inch.	34.2 psf	y
1 in	Wood Sheathing	@	3.0 psf per inch	0.0 psf	n
0.5 in	Gypsum Sheathing	@	4.0 psf per inch	0.0 psf	n
0.5 in	Gypsum Wallboard	@	4.4 psf per inch	0.0 psf	n
	Porcelain Enamel Panels	@	5.0 psf	0.0 psf	n
	Metal Lath & Plaster (Gypsum Plaster)	@	10.0 psf	0.0 psf	n
	Wall Insulation	@	1.0 psf	0.0 psf	n
1 in	Insulation (Rigid)	@	1.5 psf per inch	0.0 psf	n
1 in	Insulation Boards (Fiber Board)	@	1.5 psf per inch	0.0 psf	n
0.5 in	Fire Proofing	@	2 psf per inch	0.0 psf	n
	Wall Framing	@	20.0 psf	0.0 psf	n
8 in	Concrete Wall (Normal Weight)	@	12.5 psf per inch	100.0 psf	y
8 in	CMU Wall w/ Full Grouting (Normal Weight)	@	83.0 psf	0.0 psf	n
8 in	Solid CMU Wall (Normal Weight)	@	87.0 psf	0.0 psf	n
4 in	HCB Wall w/ Full Grouting	@	38.0 psf	0.0 psf	n
3.5 in	Solid Clay Brick Wall	@	11.1 psf per inch	0.0 psf	n
0.5 in	Plywood	@	3.2 psf per inch	0.0 psf	n
16 in O.C.	Wood Studs (2 x 4)	@	1.1 plf	0.0 psf	n
16 in O.C.	Metal Channel Studs	@	2.0 plf	0.0 psf	n
8 ft O.C.	Steel Girts	@	6.0 plf	0.0 psf	n
	Miscellaneous	@	1.8 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n
	Other	@	1.0 psf	0.0 psf	n

Solid Wall Weight = 134.2 psf
 Window & Door Weight = 0.0 psf
 % Solid Wall = 100%
WALL-R WEIGHT = 134.2 psf



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SEISMIC MASS

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ROOF/FLOOR WEIGHT SUMMARY:

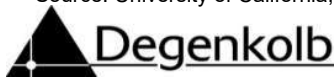
Level Type	Weight [psf]
ROOF	25

WALL WEIGHT SUMMARY:

Wall Type	Weight [psf]		
	Net	Solid	Openings
WALL-P	134.2	134.2	0
WALL-R	134.2	134.2	0

SEISMIC MASS SUMMARY:

Level	FLOOR			WALL ABOVE				WALL BELOW				TOTAL WEIGHT [kips]
	Level Type	Weight [psf]	Area [sf]	Wall Type	Weight [psf]	Length [ft]	Height [ft]	Wall Type	Weight [psf]	Length [ft]	Height [ft]	
Roof	ROOF	25	2,250	WALL-P	134.2	0	1.50	WALL-P	134.2	180	7.00	225
											TOTAL	225



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SEISMIC FORCES

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BUILDING TYPE: S2A (Steel Braced Frames with Flexible Diaphragms) [ASCE 41-17, Table 3-1]
SITE CLASS: D (default) #N/A [ASCE 41-17, §2.4.1.6]

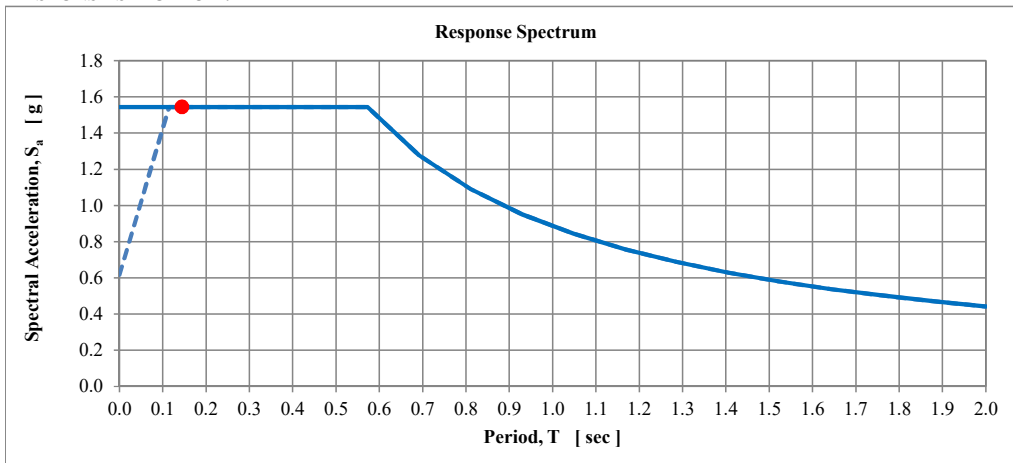
DESIGN SPECTRAL ACCELERATIONS:

S_{XS} = 1.543 g (BSE-2E) Site-Adjusted Design (T = 0.2 sec) [ASCE 41-17, Eq. 2-1]
 S_{X1} = 0.884 g (BSE-2E) Site-Adjusted Design (T = 1.0 sec) [ASCE 41-17, Eq. 2-2]

BUILDING PERIOD:

h_n = 14.0 ft (Base to Roof) Building Height [ASCE 41-17, §4.4.2.4]
 C_t = 0.020 (Building Type S2A) Period Coefficient [ASCE 41-17, §4.4.2.4]
 β = 0.750 (Building Type S2A) Period Exponent [ASCE 41-17, §4.4.2.4]
 T = 0.145 sec = $C_t h_n^\beta$ Fundamental Period [ASCE 41-17, Eq. 4-4]

RESPONSE SPECTRUM:



PSEUDO LATERAL FORCE:

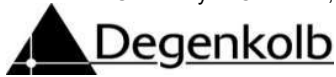
n = 1 (n = 1) Total Number of Stories
 C = 1.0 (Building Type S2A) Modification Factor [ASCE 41-17, Table 4-7]
 S_a = 1.543 g = MIN { S_{X1} / T , S_{XS} } Spectral Acceleration [ASCE 41-17, Eq. 4-3]
 V = 1.543 W = $C S_a W$ Pseudo Lateral Force [ASCE 41-17, Eq. 4-1]

VERTICAL DISTRIBUTION OF SEISMIC FORCES:

k = 1.00 ($T \leq 0.5$ sec) Seismic Distribution Exponent [ASCE 41-17, §4.4.2.2]

Level	h_x [ft]	w_x [kips]	$w_x h_x^k$	C_{vx}	F_x [kips]	V_j [kips]
Roof	14.0	225	3,155	1.00	348	348
TOTAL	-	225	3,155	1.00	348	-

$F_x = C_{vx} V = [w_x h_x^k / \sum (w_x h_x^k)] V$ [ASCE 41-17, Eq. 4-2a]
 $V_j = \sum F_x$ [ASCE 41-17, Eq. 4-2b]



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 BSE-2E HAZARD LEVEL

BUILDING TYPE:	S2A	(Steel Braced Frames with Flexible Diaphragms)	[ASCE 41-17, Table 3-1]
FRAME TYPE:	CBF	(Concentrically Braced Frame)	
CONFIGURATION:	V	(V-Bracing)	
BRACE TYPE:	W	(Wide Flange Braces)	
AXIAL LOAD:	T+C	(Tension and Compression)	
LOAD DIRECTION:	N-S		

FRAME PROPERTIES:

Level	n _f [frames]	n _c [columns]	n _{bays} [bays]	n _{br} [braces]	L _f [ft]	L _{typical bay} [ft]	DL [psf]	LL [psf]	A _{trib} [ft ²]	P _D [kips]	P _L [kips]
Roof	2	6	4	8	50.0	25.0	25	20	563	14	11

FRAME MEMBER PROPERTIES:

[ASCE 41-17 §4.2.3]

Material Properties:

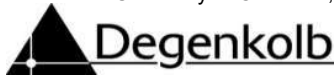
F _{yc}	=	50 ksi	(ASTM A572 / Structural)	Column Yield Stress	(ASCE 41 Default)	[ASCE 41-17, §4.2.3]
F _{ybr}	=	50 ksi	(ASTM A572 / Structural)	Brace Yield Stress	(ASCE 41 Default)	[ASCE 41-13, Table 4-5]
E	=	29,000 ksi		Modulus of Elasticity		[ASCE 41-17, §4.2.3]

Column Properties:

Level	Section	Bending Axis	L _c [ft]	A _c [in ²]
Roof	W8x31	x	14.0	9.1

Brace Properties:

Level	Section	L _{br,x} [ft]	L _{br,y} [ft]	L _{br} [ft]	A _{br} [in ²]	d _{br} / t _{br}
Roof	W8x18	12.5	14.0	18.8	5.26	n/a



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BUILDING TYPE: S2A (Steel Braced Frames with Flexible Diaphragms) [ASCE 41-17, Table 3-1]
LOAD DIRECTION: N-S

COLUMN AXIAL STRESS CHECK: [ASCE 41-17, §A.3.1.3.2]

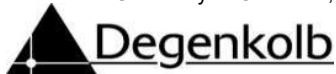
M_s	=	2.5	COLLAPSE PREVENTION	System Modification Factor	[ASCE 41-17, §4.4.3.6]
F_{yc}	=	50 ksi	(ASTM A572 / Structural)	Column Yield Stress	[ASCE 41-17, §4.2.3]
$P_{n,E} / A_c$	=	15.0 ksi	= 0.30 F_{yc}	Seismic Axial Stress Capacity	[ASCE 41-17, §A.3.1.3.2]
$P_{n,G} / A_c$	=	5.0 ksi	= 0.10 F_{yc}	Gravity Axial Stress Capacity	[ASCE 41-17, §A.3.1.3.2]
$M_{x,ot}$	=	$\Sigma (F_x h_x)$		Global Overturning Moment	[ASCE 41-17, §4.4.3.6]
P_E	=	$(1 / M_s) (M_{x,ot} / n_f) / L_f$		Seismic Axial Load due to Overturning	[ASCE 41-17, §4.4.3.6]
P_G	=	$P_D + P_L$		Unfactored Gravity Load	[ASCE 41-17, §A.3.1.3.2]
P_D	=	$\Sigma (DL A_{trib})$		Gravity Dead Load	[ASCE 41-17, §4.4.3.6]
P_L	=	$\Sigma (LL A_{trib})$		Gravity Live Load	[ASCE 41-17, §4.4.3.6]

Level	Section	A_c [in ²]	h_x [ft]	F_x [kips]	$M_{x,ot}$ [k-ft]	P_E [kips]	$P_E / F_{yc} A_c$	P_G [kips]	$P_G / F_{yc} A_c$	DCR		Quick Check
										Seismic	Gravity	
Roof	W8x31	9.1	14.0	348	4,868	19	0.04	25	0.06	0.14	0.55	OK

BRACE AXIAL STRESS CHECK: [ASCE 41-17, §A.3.3.1.2]

M_s	=	7.0	(Tube, $d_{br} / t_{br} < 90 / \sqrt{F_{yibr}}$)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
			(Tube, $d_{br} / t_{br} > 190 / \sqrt{F_{yibr}}$)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
			(Pipe, $d_{br} / t_{br} < 1500 / F_{yibr}$)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
			(Pipe, $d_{br} / t_{br} > 6000 / F_{yibr}$)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
			(Tension-Only Braces)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
			(Cold-formed steel strap-braced w/)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
			(All Other Brace Types)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
F_{yibr}	=	50 ksi	(ASTM A572 / Structural)	Brace Yield Stress	[ASCE 41-13, Table 4-5]
F_{yibr}	=	63 ksi	= 1.25 F_{yibr}	Brace Expected Yield Stress	[ASCE 41-17, §4.4.3.4]
f_{nibr}	=	25 ksi	= 0.50 F_{yibr}	Brace Axial Stress Capacity	[ASCE 41-17, §A.3.3.1.2]
$f_{i,avg}$	=	$(1 / M_s) (V_j / (L_{br,x} n_{br})) (L_{br} / A_{br})$		Average Brace Axial Stress	[ASCE 41-17, Eq. 4-9]

Level	V_j [kips]	n_{br} [braces]	$L_{br,x}$ [ft]	L_{br} [ft]	A_{br} [in ²]	d_{br} / t_{br}	M_s	$f_{i,avg}$ [ksi]	DCR	Quick Check
Roof	348	8	12.5	18.8	5.26	n/a	7.00	1.8	0.07	OK



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BUILDING TYPE: S2A (Steel Braced Frames with Flexible Diaphragms) [ASCE 41-17, Table 3-1]

LOAD DIRECTION: E-W

FRAME PROPERTIES:

Level	n _f [frames]	n _c [columns]	n _{bays} [bays]	n _{br} [braces]	L _f [ft]	L _{typical bay} [ft]	DL [psf]	LL [psf]	A _{trib} [ft ²]	P _D [kips]	P _L [kips]
Roof	2	3	4	8	45.0	22.5	25	20	563	14	11

FRAME MEMBER PROPERTIES:

[ASCE 41-17, §4.2.3]

Material Properties:

(ASCE 41 Default)

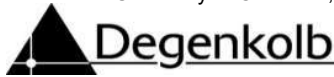
F _{yc}	=	50 ksi	(ASTM A572 / Structural)	Column Yield Stress	[ASCE 41-17, §4.2.3]
F _{ybr}	=	50 ksi	(ASTM A572 / Structural)	Brace Yield Stress	[ASCE 41-13, Table 4-5]
E	=	29,000 ksi		Modulus of Elasticity	[ASCE 41-17, §4.2.3]

Column Properties:

Level	Section	Bending Axis	L _c [ft]	A _c [in ²]
Roof	W8x31	x	14.0	9.1

Brace Properties:

Level	Section	L _{br,x} [ft]	L _{br,y} [ft]	L _{br} [ft]	A _{br} [in ²]	d _{br} / t _{br}
Roof	W8x18	11.3	14.0	18.0	5.26	n/a



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BUILDING TYPE: S2A (Steel Braced Frames with Flexible Diaphragms) [ASCE 41-17, Table 3-1]
LOAD DIRECTION: E-W

COLUMN AXIAL STRESS CHECK: [ASCE 41-17, §A.3.1.3.2]

M_s	=	2.5	COLLAPSE PREVENTION	System Modification Factor	[ASCE 41-17, §4.4.3.6]
F_{yc}	=	50 ksi	(ASTM A572 / Structural)	Column Yield Stress	[ASCE 41-17, §4.2.3]
$P_{n,E} / A_c$	=	15.0 ksi	= 0.30 F_{yc}	Seismic Axial Stress Capacity	[ASCE 41-17, §A.3.1.3.2]
$P_{n,G} / A_c$	=	5.0 ksi	= 0.10 F_{yc}	Gravity Axial Stress Capacity	[ASCE 41-17, §A.3.1.3.2]
$M_{x,ot}$	=	$\Sigma (F_x h_x)$		Global Overturning Moment	[ASCE 41-17, §4.4.3.6]
P_E	=	$(1 / M_s) (M_{x,ot} / n_f) / L_f$		Seismic Axial Load due to Overturning	[ASCE 41-17, §4.4.3.6]
P_G	=	$P_D + P_L$		Unfactored Gravity Load	[ASCE 41-17, §A.3.1.3.2]
P_D	=	$\Sigma (DL A_{trib})$		Gravity Dead Load	[ASCE 41-17, §4.4.3.6]
P_L	=	$\Sigma (LL A_{trib})$		Gravity Live Load	[ASCE 41-17, §4.4.3.6]

Level	Section	A_c [in ²]	h_x [ft]	F_x [kips]	$M_{x,ot}$ [k-ft]	P_E [kips]	$P_E / F_{yc} A_c$	P_G [kips]	$P_G / F_{yc} A_c$	DCR		Quick Check
										Seismic	Gravity	
Roof	W8x31	9.1	14.0	348	4,868	22	0.05	25	0.06	0.16	0.55	OK

BRACE AXIAL STRESS CHECK: [ASCE 41-17, §A.3.3.1.2]

M_s	=	7.0	(Tube, $d_{br} / t_{br} < 90 / \sqrt{F_{yibr}}$)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
			(Tube, $d_{br} / t_{br} > 190 / \sqrt{F_{yibr}}$)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
			(Pipe, $d_{br} / t_{br} < 1500 / F_{yibr}$)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
			(Pipe, $d_{br} / t_{br} > 6000 / F_{yibr}$)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
			(Tension-Only Braces)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
			(Cold-formed steel strap-braced w/)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
			(All Other Brace Types)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
F_{yibr}	=	50 ksi	(ASTM A572 / Structural)	Brace Yield Stress	[ASCE 41-13, Table 4-5]
F_{yibr}	=	63 ksi	= 1.25 F_{yibr}	Brace Expected Yield Stress	[ASCE 41-17, §4.4.3.4]
f_{nibr}	=	25 ksi	= 0.50 F_{yibr}	Brace Axial Stress Capacity	[ASCE 41-17, §A.3.3.1.2]
$f_{i,avg}$	=	$(1 / M_s) (V_j / (L_{br,x} n_{br})) (L_{br} / A_{br})$		Average Brace Axial Stress	[ASCE 41-17, Eq. 4-9]

Level	V_j [kips]	n_{br} [braces]	$L_{br,x}$ [ft]	L_{br} [ft]	A_{br} [in ²]	d_{br} / t_{br}	M_s	$f_{i,avg}$ [ksi]	DCR	Quick Check
Roof	348	8	11.3	18.0	5.26	n/a	7.00	1.9	0.08	OK

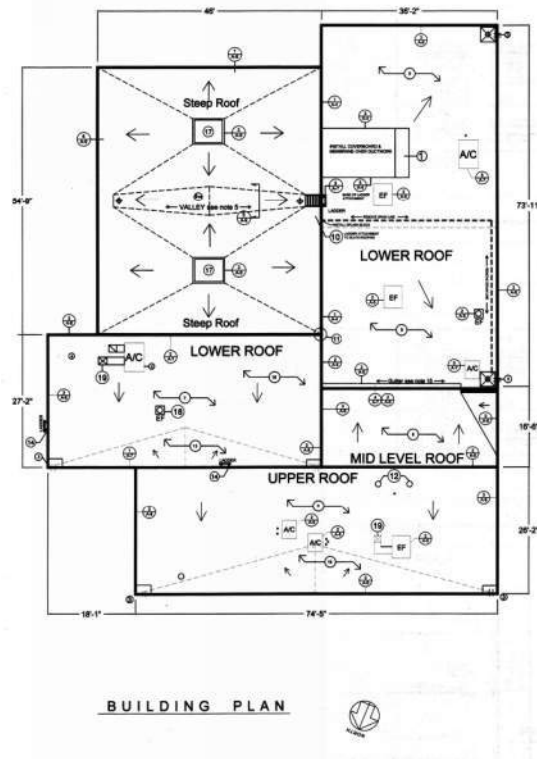


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Appendix C
Photos and Details



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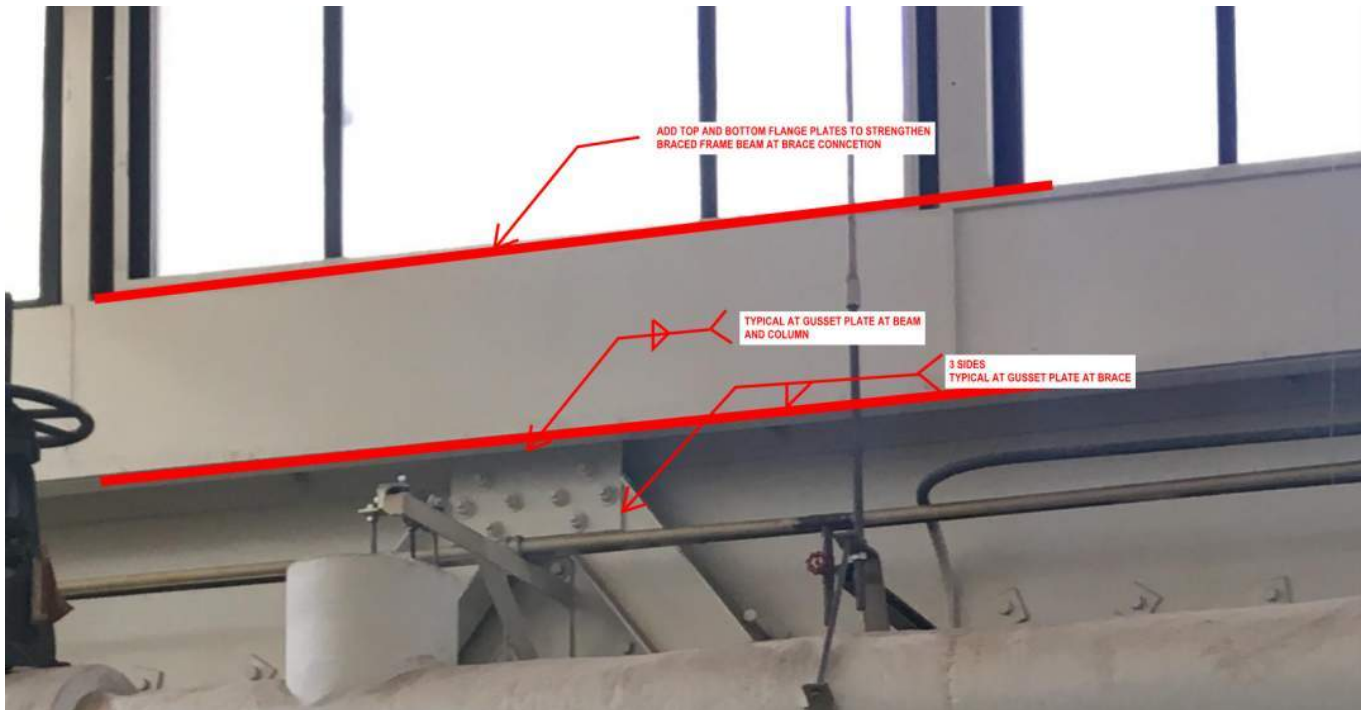
Roof Plan



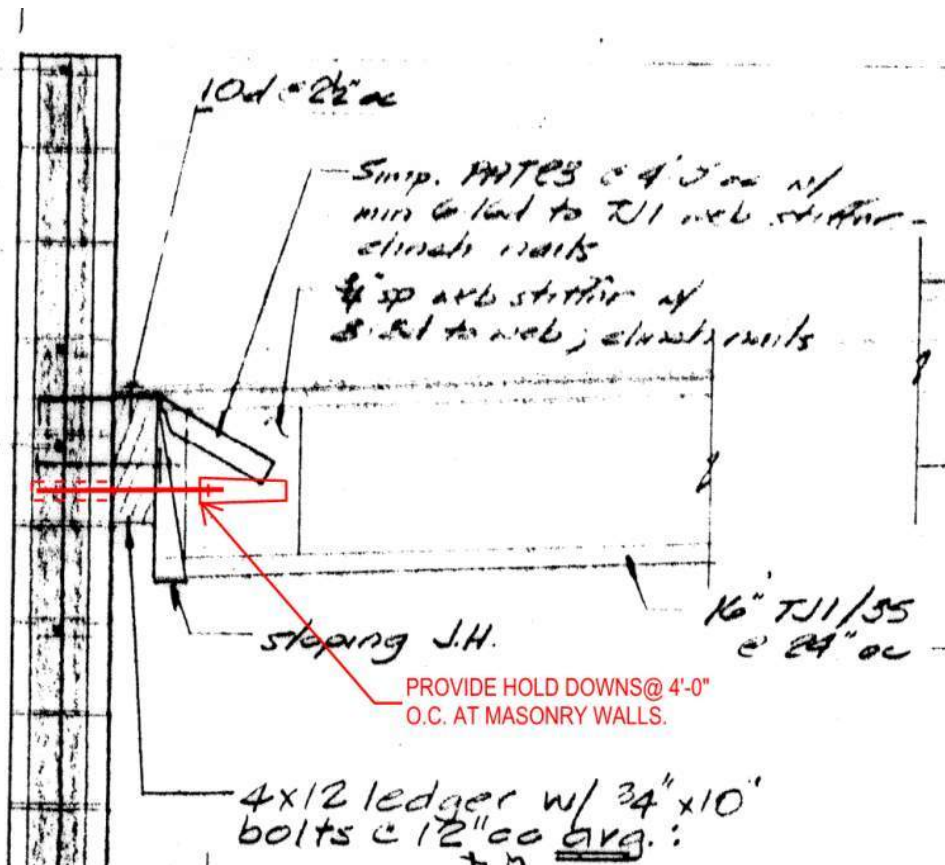
Steel towers with clear story windows below



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Proposed retrofit for braced frame beam



Proposed retrofit for wood floor to wall connection