Source: University of California, Santa Cruz





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



Rating form completed by Heavenz Kaur, Jay Yin



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	Priority A	Priority A=Retrofit ASAP
Cruz priority category for retrofit		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

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

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

<u>Structural system for lateral forces:</u> 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.

3. 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)	Ν
Load path	Y	Liquefaction	Ν
Adjacent buildings	Y	Slope failure	Ν
Weak story	N	Surface fault rupture	Ν
Soft story	N	Masonry or concrete wall anchorage at flexible diaphragm	Y
Geometry (vertical irregularities)	N	URM wall height-to-thickness ratio	Ν
Torsion	N	URM parapets or cornices	Ν
Mass – vertical irregularity	N	URM chimney	Ν
Cripple walls	N	Heavy partitions braced by ceilings	Ν
Wood sills (bolting)	N	Appendages	Ν
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:

- 1. Brace connections are unable to develop the yield capacity of braces.
- 2. Beams in chevron braces are unable to resist the vertical load due to yielding and buckling of braces simultaneously
- 3. 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.
- 4. 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	П	
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 UE	3C	
Applicable code for partial retrofit	None		
Applicable code for full retrofit	None		
Model building data			
Model building type North-South	Flexible Diaph Steel, S2a - Bra	aced steel frame (with Flexible Diaphragm) asonry, RM1 - Reinforced Masonry Bearing Walls with	
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:

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



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

Appendix A ASCE 41-17 Checklists

UC Campus:			ampu	S: Santa Cruz	Date:		5/24/2019			
				N: 7146 Auxiliary CAAN:	By Firm:	Dege	enkolb Engin	ieers		
	Buil	ding	Nam		Initials:	нк	Checked:			
E	Buildin	ng Ao	ddres	S: 610 Red Hill Road, Santa Cruz, CA 95064	Page:	1	of	3		
	ASCE 41-17									
	Collapse Prevention Basic Configuration Checklist									
LO	LOW SEISMICITY									
BU	ILDI	NG	SYS	TEMS - GENERAL						
				Descripti	on					
С	NC	N/A		LOAD PATH: The structure contains a complete, well-defined load serves to transfer the inertial forces associated with the mass of al						
0	0	0	0	Sec. A.2.1.1. Tier 2: Sec. 5.4.1.1)		s saliality to t		,onninontary.		
				Comments:						
	NO.	N/A								
C				ADJACENT BUILDINGS: The clear distance between the building 0.25% of the height of the shorter building in low seismicity, 0.4						
		•		(Commentary: Sec. A.2.1.2. Tier 2: Sec. 5.4.1.2)						
				Comments:						
С	NC	N/A	U	MEZZANINES: Interior mezzanine levels are braced independent	ly from the mair	n structure or	are anchored to	the seismic-		
	\bigcirc	0	\odot	force-resisting elements of the main structure. (Commentary: Sec	. A.2.1.3. Tier 2	2: Sec. 5.4.1.	3)			
				Comments:						
BU	ILDI	NG	SYS	TEMS - BUILDING CONFIGURATION Descripti	<u></u>					
				Descripti						
C C		N/A		WEAK STORY: The sum of the shear strengths of the seismic-fo less than 80% of the strength in the adjacent story above. (Comn				ection is not		
				Comments:						
	NO						700/ 511			
C		N/A		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:						
С	NC	N/A	U	VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation.						
0	0	0	\odot	(Commentary: Sec. A.2.2.4. Tier 2: Sec. 5.4.2.3)		, - , - , - , - , - , - , - , - , - , -				
				Comments:						

UC Campus:		npus	Santa Cru	IZ	Date:		5/24/2019	
Buildi	Building CAAN: 7146 Auxiliary CAAN:		By Firm:	Degenkolb Engineers		ieers		
Build	ling N	lame	Central Heatin	g Plant	Initials:	нк	Checked:	
Building	g Add	lress	610 Red Hill Road, Santa	a Cruz, CA 95064	Page:	2	of	3
	ASCE 41-17 Collapse Prevention Basic Configuration Checklist							
	N/A		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:					
	N/A [] [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:					
	N/A U 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)

GE	OLC	OGIC	SI	re hazard
				Description
_				
С	NC	N/A	U	LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic
Ο		\odot	\odot	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:
				oomments.
С	NC	N/A	U	SLOPE FAILURE: The building site is located away from potential earthquake-induced slope failures or rockfalls so that it
Ο		0	\sim	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:
С	NC	N/A	U	SURFACE FAULT RUPTURE: Surface fault rupture and surface displacement at the building site are not anticipated.
Ο	\odot	\odot	\bigcirc	(Commentary: Sec. A.6.1.3. Tier 2: 5.4.3.1)
				Comments:

UC Campus	: Santa Cr	Santa Cruz			5/24/2019	
Building CAAN	N: 7146 Auxiliary CAAN: By Firm: Degenkolb E		enkolb Engin	gineers		
Building Name	: Central Heatin	ig Plant	Initials:	нк	Checked:	
Building Address	: 610 Red Hill Road, Sant	a Cruz, CA 95064	Page:	3	of	3
	Ą	SCE 41-17				
C	ollapse Prevention	Basic Configu	uration	Check	list	
HIGH SEISMI	CITY (COMPLETE TH		GITEMS	IN AD	DITION T	O THE
ITEMS FOR M	IODERATE SEISMIC	ITY)				
FOUNDATION C	CONFIGURATION					
		Descriptio	on			
	DVERTURNING: The ratio of the least			0,		ation level to
	he building height (base/height) is gre	ater than 0.65a. (Commenta	iry: Sec. A.o.z.	1. Tier 2: Sec	5. 5.4.3.3)	
	Comments: 74/36=2.06>0.6*1.5	543=0.958 (OK)				
	TIES BETWEEN FOUNDATION ELEMENTS: The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C. (Commentary: Sec. A.6.2.2. Tier 2: Sec. 5.4.3.4)					
	Comments: Site class C and slab on grade ties together spread footings.					

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Building CAAN:	7146 Auxiliary CAAN:			By Firm:	Degenkolb Engineers		
Building Name:	Central Heating Plant			Initials:	нк	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	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 O	NC	N/A	U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2. (Commentary: Sec. A.3.2.1.1. Tier 2: Sec. 5.5.1.1) Comments:
C O		N/A	U	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√ <i>f</i> ^c (Commentary: Sec. A.3.2.3.1. Tier 2: Sec. 5.5.3.1.1) Comments: D/C=0.20
_		N/A	U	REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area is not less than 0.0012 in the vertical direction and 0.0020 in the horizontal direction. (Commentary: Sec. A.3.2.3.2. Tier 2: Sec. 5.5.3.1.3) Comments: 8" thick walls w/#4@12 EF EW = 0.0031
-		N/A	-	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
DIA	PH	RAG	MS	Description

	UC Campus:		Camp	US: Santa C	Santa Cruz			5/24/2019		
	Building CAAN:) CAA	AN: 7146	Auxiliary CAAN:		By Firm:	Dege	enkolb Engin	eers
	Building Name: Central Heating Plant				Initials:	нк	Checked:			
	Building Address: 610 Red Hill Road, Santa Cruz, CA 95604				5604	Page:	2	of	4	
	ASCE 41-17 Collapse Prevention Structural Checklist For Building Type PC1-PC1A									
C	C N/A U 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) Comments:								ete topping	
со	NNE	ЕСТІ	ONS	8						
						Description	l			
		N/A	U	WOOD LEDGERS: The connection b tension in the wood ledgers. (Commer Comments: Section 29/S4 a	tary: Sec. A.5.1	.2. Tier 2: Sec	. 5.7.1.3)	does not ind	uce cross-grain	bending or
		N/A	U	TRANSFER TO SHEAR WALLS: Diap Sec. A.5.2.1. Tier 2: Sec. 5.7.2) Comments: Section 29/S4 a	0			forces to the	shear walls. (Co	mmentary:
C	 NC N/A U 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) Comments: 									
C		N/A	U	GIRDER–COLUMN CONNECTION: T the girder and the column support. (Co Comments:					ardware, or strap	s between

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

SEISMIC-FORCE-RESISTING SYSTEM

Description

		UC C	Camp	US: Santa Cru	JZ	Da	e:		5/24/2019	
	Bu	ilding	J CAA	AN: 7146	Auxiliary CAAN:	By Fir	m: E	Deg	enkolb Engin	eers
	Building Name: Central Heatin			ne: Central Heatin		Initia	s: HM	(Checked:	
	Build	ing A	ddre	SS: 610 Red Hill Road, Santa	a Cruz, CA 95604	Pag	e: 3		of	4
	ASCE 41-17									
C	Coll	aps	se	Prevention Structura	Checklist	For Bui	ding 7	Гу	be PC1-P	PC1A
С	NC	N/A	u	DEFLECTION COMPATIBILITY FOR RI	GID DIAPHRAGMS: S	Secondarv com	oonents hav	ve th	e shear capacity	to develop
0		0	0	the flexural strength of the components.					1 5	
				Comments: Steel columns ha	ve the shear capa	acity for defl	ection co	mpa	atibility	
6	NC	NI/A		WALL OPENINGS: The total width of op	enings along any perin	neter wall line o	onstitutos le	see th	an 75% of the lev	ogth of any
				perimeter wall when the wall piers have as						
				Comments:						
DIA	PHI	RAG	MS							
					Descrip	otion				
С			-	CROSS TIES IN FLEXIBLE DIAPHRAG Sec. A.4.1.2. Tier 2: Sec. 5.6.1.2)	GMS: There are contin	uous cross ties	between di	iaphr	agm chords. (Co	mmentary:
0	\odot	0	0	Comments:						
	NC	N/A		STRAIGHT SHEATHING: All straight-sl considered. (Commentary: Sec. A.4.2.1.		have aspect ra	ios less th	an 2	-to-1 in the dired	ction being
	0	0	0	Comments: Plywood sheathir	,	T&G straigh	sheathir	na.		
					ig arailable erei	i de chaigh	onoutin	.9.		
С	NC		U	SPANS: All wood diaphragms with spans (Commentary: Sec. A.4.2.2. Tier 2: Sec.		3 m) consist of v	ood structu	iral pa	anels or diagonal	sheathing.
0	0	0	0	Comments: Plywood sheathir	,	T&G straigh	sheathir	1α .		
					ig arailable erei	i de chaigh	onoutin	.9.		
С	NC			DIAGONALLY SHEATHED AND UNBLC diaphragms have horizontal spans less						
0		0	0	Sec. A.4.2.3. Tier 2: Sec. 5.6.2)						innentary.
				Comments:						
	NC	N/ A		OTHER DIAPHRAGMS: Diaphragms do	not consist of a eve	tem other than	wood met	tal d	eck concrete or	horizontal
		N/A		bracing. (Commentary: Sec. A.4.7.1. Tie			wood, mei		eck, concrete, or	nonzontai
	-	-	-	Comments:						
со	NNE	СТІ	ON	S						
	Description									

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Building CA	AN: 7146	Auxiliary CAAN:		By Firm:	Dege	Degenkolb Engineers			
Building Nar	me: Central Heatin	ig Plant		Initials:	нк	Checked:			
Building Addre	ess: 610 Red Hill Road, Sant	a Cruz, CA 95	604	Page:	4	of	4		
Collapse I	ASCE 41-17 Collapse Prevention Structural Checklist For Building Type PC1-PC1A								
C NC N/A U	MINIMUM NUMBER OF WALL ANCHOP to the diaphragm elements. (Commentar				hors connec	ting each precast	t wall panel		
	Comments: Wall anchors pre	Comments: Wall anchors present every 4' to 8' on center							
C NC N/A U	PRECAST WALL PANELS: Precast wal 5.7.3.4)	l panels are co	onnected to the	e foundation. (Commentary	/: Sec. A.5.3.6. T	ier 2: Sec.		
	Comments: Section 1/S2, 196	6 drawings	i						
C NC N/A U	UPLIFT AT PILE CAPS: Pile caps have A.5.3.8. Tier 2: Sec. 5.7.3.5)	e top reinforce	ment, and pile	es are anchore	ed to the pile	e caps. (Comme	ntary: Sec.		
	Comments:								
		an nilaatana ka	ve et leest tw	e ties essuria	, the enclose	halta unlaga pro			
C NC N/A U	GIRDERS: Girders supported by walls of independent stiff wall anchors with streng 4.4.3.7. (Commentary: Sec. A.5.4.2. Tier	gth to resist the	connection for						
	Comments: Connections have sufficient strength to resist force calculated by Quick Check procedure of Tier 1 analysis.						k Check		

UC Campus: Santa Cruz				5/24/2019					
Building CAAN:	7146	7146 Auxiliary CAAN:			Degenkolb Engineers				
Building Name: Central Heating Plant				нк	Checked:				
Building Address:	610 Redhill Road, S	anta Cruz, CA 95064	Page:	1	of	4			
Collapse Pre	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	-	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	-	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	-	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
С	NC	N/A		TOPPING SLAB: Precast concrete diaphragm elements are interconnected by a continuous reinforced concrete topping
	\bigcirc	O	\odot	slab. (Commentary: Sec. A.4.5.1. Tier 2: Sec. 5.6.4)
				Comments:

CONNECTIONS

Description
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)

U	UC Campus:		Santa Cruz			Date:	5/24/2019		
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Colla	apse	Pre	A evention Structura	ASCE 4 ⁴		r Buildi	ing Ty	pe RM1-	RM2
	tension in the wood ledgers (Commentary: Sec. A 51.2. Tier 2: 9						does not ind	uce cross-grain	bending or
	00		nments:						
	V/A U		NSFER TO SHEAR WALLS: Diaphr A.5.2.1. Tier 2: Sec. 5.7.2)	agms are conr	nected for trans	sfer of seismic	forces to the	shear walls. (Co	mmentary:
	00		nments:						
	N/A U	diap	PING SLAB TO WALLS OR FRA hragm elements are doweled for tra 2: Sec. 5.7.2)						
		Cor	nments:						
	N/A U	573	NDATION DOWELS: Wall reinforc 3.4)	ement is dow	eled into the	foundation. (C	commentary:	Sec. A.5.3.5. T	ier 2: Sec.
	00		nments:						
	N/A U	airde	DER–COLUMN CONNECTION: The r and the column support. (Commen				nection hard	ware, or straps b	etween the
	00	-	nments:	•		,			

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

STIFF DIAPHRAGMS

				Description
C	NC	N/A	-	OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls are less than 25% of the wall length. (Commentary: Sec. A.4.1.4. Tier 2: Sec. 5.6.1.3) Comments:
C		N/A	-	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) Comments:

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

FLEXIBLE DIAPHRAGMS

	Description
	wall length (Commentary: Sec A 4 1 4 Tier 2: Sec 5 6 1 3)
	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)
C NC N/A	considered (Commentary: Sec. $A A 2 1$ Tier 2: Sec. 5.6.2)
C NC N/A	(Commontant): Soc. A 4.2.2. Tior 2: Soc. 5.6.2)
	diaphragms have horizontal spans less than 40 ft (12.2 m) and aspect ratios less than or equal to 4-to-1. (Commental
C NC N/A	bracing (Commentary Sec. A 4 7 1 Tier 2 Sec. 5 6 5)

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

CONNECTIONS Description C N/A U Image: Colspan="2">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) Comments:

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Collapse Prevention Structural Checklist For Building Type S2-S2A

LOW SEISMICITY

SEISMIC-FORCE-RESISTING SYSTEM

				Description
_		N/A	-	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:
-		N/A	-	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 O	_	N/A	-	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 0.50 <i>F_y</i> . (Commentary: Sec. A.3.3.1.2. Tier 2: Sec. 5.5.4.1) Comments:

CONNECTIONS

		Description
	/A U	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] []	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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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 REDUNDANCY: The number of braced bays in each line is greater than 2. (Commentary: Sec. A.3.3.1.1. Tier 2: Sec. C NC N/A U 5.5.1.1) Comments: Only one brace present along Line A, but precast walls along the same line ensure redundancy. CONNECTION STRENGTH: All the brace connections develop the buckling capacity of the diagonals. (Commentary: Sec. C NC N/A U A.3.3.1.5. Tier 2: Sec. 5.5.4.4) $\mathbf{0}$ $\mathbf{0}$ $\mathbf{0}$ $\mathbf{0}$ Comments: Detail J/S4 C NC N/A U 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: 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) C NC N/A U

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

SEISMIC-FORCE-RESISTING SYSTEM

Comments:

		Description
C	N/A	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 SLENDERNESS OF DIAGONALS: All diagonal elements required to carry compression have <i>Kllr</i> ratios less than 200. (Commentant: Sec A3314 Tigr 2: Sec 5543)										
Commentary: Sec. A.3.3.1.4. Tier 2: Sec. 5.5.4.3) Comments:										
C NC N/A U CONNECTION STRENGTH: All the brace connections develop the yield capacity of the diagonals. (C-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 COMPACT MEMBERS: All brace elements meet section requirements in accordance with AISC 341, moderately ductile members. (Commentary: Sec. A.3.3.1.7. Tier 2: Sec.5.5.4) Comments:										
C NC N/A U CHEVRON BRACING: Beams in chevron, or V-braced, bays are capable of resisting the vertical load r 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 CONCENTRICALLY BRACED FRAME JOINTS: All the diagonal braces frame into the beam-column joir (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 OPENINGS AT FRAMES: Diaphragm openings immediately adjacent to the braced frames extend less frame length. (Commentary: Sec. A.4.1.5. Tier 2: Sec. 5.6.1.3) Comments:										
FLEXIBLE DIAPHRAGMS										
Description										
C NC N/A U CROSS TIES: There are continuous cross ties between diaphragm chords. (Commentary: Sec. A.4.1.2. Tie Comments:	CROSS TIES: There are continuous cross ties between diaphragm chords. (Commentary: Sec. A.4.1.2. Tier 2: Sec. 5.6.1.2)									

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	ASCE 41-17 Collapse Prevention Structural Checklist For Building Type S2-S2A								
C NC N/A U	STRAIGHT SHEATHING: All straight-s considered. (Commentary: Sec. A.4.2.1.		is have a	spect ratios	less than 2-	to-1 in the direc	tion being		
	Comments: Plywood sheathing	ments: Plywood sheathing installed over T&G straight sheathing							
C NC N/A U	SPANS: All wood diaphragms with spans (Commentary: Sec. A.4.2.2. Tier 2: Sec.		(7.3 m) co	nsist of wood	structural pa	nels or diagonal	sheathing.		
	Comments:								
C NC N/A U	DIAGONALLY SHEATHED AND UNBLC diaphragms have horizontal spans less Sec. A.4.2.3. Tier 2: Sec. 5.6.2) Comments:								
C NC N/A U	OTHER DIAPHRAGMS: Diaphragms d bracing. (Commentary: Sec. A.4.7.1. Tie Comments:		system ot	ther than woo	od, metal de	ck, concrete, or	horizontal		

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UCOP SEISMIC SAFETY POLICY Falling Hazard Assessment Summary							

	Description
P N/A □ ⊠	Heavy ceilings, features or ornamentation above large lecture halls, auditoriums, lobbies, or other areas where large numbers of people congregate (50 ppl or more) Comments:
P N/A □ ⊠	Heavy masonry or stone veneer above exit ways or public access areas Comments:
P N/A □ ⊠	Unbraced masonry parapets, cornices, or other ornamentation above exit ways or public access areas Comments:
P N/A □ ⊠	Unrestrained hazardous material storage Comments:
P N/A □ ⊠	Masonry chimneys Comments:
P N/A □ ⊠	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	Other: Comments:
P N/A	Other: Comments:
P N/A	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



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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/ap	plication.php
Site Class:		D (default)	(Stiff Soil)	Site Class	[ASCE 41-17, §2.4.1.6]
Ss	=	1.286 g	(USGS) (5%/50 years)	USGS Mapped ($T = 0.2 \text{ sec}$)	[ASCE 41-17, §2.4.1.3]
S ₁	=	0.488 g	(USGS) (5%/50 years)	USGS Mapped ($T = 1.0 \text{ sec}$)	[ASCE 41-17, §2.4.1.3]
Fa	=	1.200	(Site Class D)	Site Coefficient ($T = 0.2 \text{ sec}$)	[ASCE 7-16, Table 11.4-
Fv	=	1.812	(Site Class D)	Site Coefficient ($T = 1.0 \text{ sec}$)	[ASCE 7-16, Table 11.4-
S _{XS}	=	1.543 g	$= F_a S_S$	Site-Adjusted Design ($T = 0.2 \text{ sec}$)	[ASCE 41-17, Eq. 2-1]
$\mathbf{S}_{\mathbf{X}1}$	=	0.884 g	$= F_v S_1$	Site-Adjusted Design ($T = 1.0 \text{ sec}$)	[ASCE 41-17, Eq. 2-2]
BUILDIN	G DATA:				
Building T	ype:	PC1	(Precast/Tilt-up Concrete Shea	ar Walls with Flexible Diaphragms)	[ASCE 41-17, Table 3-1
Year Built	:	1966			
Number of	f Stories:	1 story			
Parapet He	eight:	1.50 ft			
Roof Heig	ht:	14.00 ft			
Total Area	1:	2,663 sf			
	11-1-1-4	Elevetien Lanoth	Lonoth Auss Disulus	Dianhaam	

Loval	Height	Elevation	$Length_{N\text{-}S}$	$Length_{\text{E-W}}$	Area	Diaphragm	Diaphragm
Level	[ft]	[ft]	[ft]	[ft]	[sf]	Stiffness	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	-	-

Source: University of California, Santa Cruz

A Degenkolb

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WEIGHT TAKEOFF

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

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

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WEIGHT TAKEOFF

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

ALL TYPE:	WALL-P					
	Wall Covering		@	4.0 psf	0.0 psf	
3 in	Exterior Stucco		@	11.4 psf per inch.	34.2 psf	
1 in	Wood Sheathing		@	3.0 psf per inch	0.0 psf	
0.5 in	Gypsum Sheathing		@	4.0 psf per inch	0.0 psf	
0.5 in	Gypsum Wallboard		@	4.4 psf per inch	0.0 psf	
	Porcelain Enamel Panels		@	5.0 psf	0.0 psf	
	Metal Lath & Plaster	(Gypsum Plaster)	@	10.0 psf	0.0 psf	
	Wall Insulation		@	1.0 psf	0.0 psf	
1 in	Insulation	(Rigid)	@	1.5 psf per inch	0.0 psf	
1 in	Insulation Boards	(Fiber Board)	@	1.5 psf per inch	0.0 psf	
0.5 in	Fire Proofing		@	2 psf per inch	0.0 psf	
	Wall Framing		@	20.0 psf	0.0 psf	
8 in	Concrete Wall	(Normal Weight)	@	12.5 psf per inch	100.0 psf	
8 in	CMU Wall w/ Full Grouting	(Normal Weight)	@	83.0 psf	0.0 psf	
8 in	Solid CMU Wall	(Normal Weight)	@	87.0 psf	0.0 psf	Γ
4 in	HCB Wall w/ Full Grouting		@	38.0 psf	0.0 psf	
3.5 in	Solid Clay Brick Wall		@	11.1 psf per inch	0.0 psf	
0.5 in	Plywood		@	3.2 psf per inch	0.0 psf	
16 in O.C.	Wood Studs	(2x4)	@	1.1 plf	0.0 psf	
16 in O.C.	Metal Channel Studs		@	2.0 plf	0.0 psf	
8 ft O.C.	Steel Girts		@	6.0 plf	0.0 psf	
	Miscellaneous		@	1.8 psf	0.0 psf	
	Other		@	1.0 psf	0.0 psf	Γ
	Other		@	1.0 psf	0.0 psf	Γ
	Other		@	1.0 psf	0.0 psf	Γ
	Other		@	1.0 psf	0.0 psf	
	Other		@	1.0 psf	0.0 psf	
				Solid Wall Weight =	134.2 psf	
				Window & Door Weight =	8.0 psf	
				% Solid Wall =	100%	
				WALL-P WEIGHT =	134.2 nsf	

WALL-P WEIGHT = 134.2 psf

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WEIGHT TAKEOFF

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

ALL TYPE:	WALL-R					
	Wall Covering		@	4.0 psf	0.0 psf	
3 in	Exterior Stucco		@	11.4 psf per inch.	34.2 psf	
1 in	Wood Sheathing		@	3.0 psf per inch	0.0 psf	
0.5 in	Gypsum Sheathing		@	4.0 psf per inch	0.0 psf	
0.5 in	Gypsum Wallboard		a	4.4 psf per inch	0.0 psf	
	Porcelain Enamel Panels		@	5.0 psf	0.0 psf	
	Metal Lath & Plaster	(Gypsum Plaster)	@	10.0 psf	0.0 psf	
	Wall Insulation		@	1.0 psf	0.0 psf	
1 in	Insulation	(Rigid)	@	1.5 psf per inch	0.0 psf	
1 in	Insulation Boards	(Fiber Board)	@	1.5 psf per inch	0.0 psf	Γ
0.5 in	Fire Proofing		@	2 psf per inch	0.0 psf	Γ
	Wall Framing		@	20.0 psf	0.0 psf	
8 in	Concrete Wall	(Normal Weight)	@	12.5 psf per inch	100.0 psf	
8 in	CMU Wall w/ Full Grouting	(Normal Weight)	@	83.0 psf	0.0 psf	Γ
8 in	Solid CMU Wall	(Normal Weight)	@	87.0 psf	0.0 psf	
4 in	HCB Wall w/ Full Grouting		@	38.0 psf	0.0 psf	
3.5 in	Solid Clay Brick Wall		@	11.1 psf per inch	0.0 psf	Γ
0.5 in	Plywood		@	3.2 psf per inch	0.0 psf	
16 in O.C.	Wood Studs	(2x4)	@	1.1 plf	0.0 psf	Γ
16 in O.C.	Metal Channel Studs		@	2.0 plf	0.0 psf	
8 ft O.C.	Steel Girts		@	6.0 plf	0.0 psf	Γ
	Miscellaneous		@	1.8 psf	0.0 psf	
	Other		@	1.0 psf	0.0 psf	
	Other		@	1.0 psf	0.0 psf	Γ
	Other		@	1.0 psf	0.0 psf	
	Other		@	1.0 psf	0.0 psf	
	Other		@	1.0 psf	0.0 psf	
				Solid Wall Weight =	134.2 psf	
				Window & Door Weight =	8.0 psf	
				% Solid Wall =	100%	
				WALL-R WEIGHT =	134.2 nsf	

WALL-R WEIGHT = 134.2 psf



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SEISMIC MASS

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

ROOF/FLOOR WEIGHT SUMMARY:

Level	Weight	
Туре	[psf]	
ROOF	25	

WALL WEIGHT SUMMARY:

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

SEISMIC MASS SUMMARY:

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



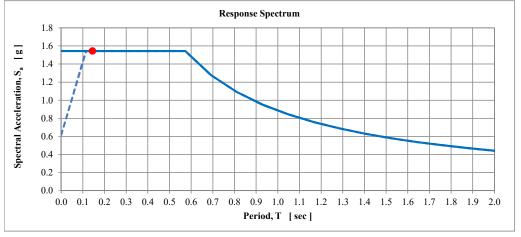
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SEISMIC FORCES

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

BUILDING TYPE:PC1SITE CLASS:D (default)		PC1	(Precast/Tilt-up Concrete Sl	near Walls with Flexible Diaphragms)	[ASCE 41-17, Table 3-1]
		D (default)	#N/A	[ASCE 41-17, §2.4.1.6]	
DESIGN	SPECTRA	L ACCELERATION	NS:		
$\mathbf{S}_{\mathbf{XS}}$	=	1.543 g	(BSE-2E)	Site-Adjusted Design ($T = 0.2 \text{ sec}$)	[ASCE 41-17, Eq. 2-1]
\mathbf{S}_{X1}	=	0.884 g	(BSE-2E)	Site-Adjusted Design ($T = 1.0 \text{ sec}$)	[ASCE 41-17, Eq. 2-2]
BUILDI	NG PERIOI):			
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]
Т	=	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)
С	=	1.0	(Building Type PC1)
S_a	=	1.543 g	= MIN { S_{X1} / T , S_{XS} }
V	=	1.543 W	$= C S_a W$

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	W _x	t. k	C _{vx}	F _x	Vj	$F_{x} = C_{vx} V = [w_{x} h_{x}^{k} / \Sigma (w_{x} h_{x}^{k})] V$	[ASCE 41-17, Eq. 4-2a]			
	Level	[ft]	[kips]	w _x h _x *	C _{vx}	[kips]	[kips]	$V_j = \Sigma F_x$	[ASCE 41-17, Eq. 4-2b]			
	Roof	14.0	236	3,299	1.00	364	364					
	TOTAL	-	236	3,299	1.00	364	-					

Total Number of Stories Modification Factor

Spectral Acceleration

Pseudo Lateral Force

[ASCE 41-17, Table 4-7]

[ASCE 41-17, Eq. 4-3]

[ASCE 41-17, Eq. 4-1]



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QUICK CHECKS

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

BUILDING TYPE: PC1 (Precast/Tilt-up Concrete Shear Walls with Flexible Diaphra	gms)
--------------------------------------------------------------------------------	------

(ASCE 41 Default)

= MAX { 100 psi , 2 $\sqrt{f'_c}$ }

COLLAPSE PREVENTION

STEEL REINFORCING RATIO CHECK:

[ASCE 41-17, Table 3-1]

[ASCE 41-17, §A.3.2.3.1]

[ASCE 41-17, Table 4-2]

[ASCE 41-17, §A.3.2.3.1]

[ASCE 41-17, Table 4-8]

[ASCE 41-17, Eq. 4-8]

[ASCE 41-17, §4.4.3.3]

Horizontal Reinforcing							Vertical Reinforcing					
Wall Type	t _w [in]	n _{curtains} [curtains]	Bar Size No.	Spacing [in]	$\rho_{\rm h}$	$\rho_h \!\geq \! 0.0020$	n _{curtains} [curtains]	Bar Size No.	Spacing [in]	$\rho_{\rm v}$	$\rho_v \!\geq \! 0.0012$	
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	

Concrete Compressive Strength

System Modification Factor

Average Shear Wall Stress

Shear Wall Capacity

Net Wall Area

AVERAGE SHEAR STRESS CHECK:

f'c	=	2,500 psi
v _n	=	100 psi
Ms	=	4.5
v _{j, avg}	=	$(1 / M_s) (V_j / A_w)$
A_w	=	t _w (L _{w, total} - L _{w, openings})

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			

[ASCE 41-17, §A.3.2.3.2]



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QUICK CHECKS

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

BUILDI	NG TYPE:	PC1	(Precast/Tilt-up Concrete Shea	r Walls with Flexible Diaphragms)	[ASCE 41-17, Table 3-1]
OUT-O	F-PLANE W	ALL ANCHORAG	E 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 ($T = 0.2 \text{ sec}$)	[ASCE 41-17, §2.4.1.1]
T _c	=	$\PsiS_{XS}w_pA_p$		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-S	outh Directi	on•			

North-South Direction:

	WALL ABOVE			WALL BELOW OUT-OF-PLANE ANCHORAGE						AGE		
Level	Wall	Weight	Height	Wall	Weight	Height	Sanchor	w _p A _p	T _c	T _{cn}	DCR	Quick
	Туре	[psf]	[ft]	Туре	[psf]	[ft]	[ft]	[lb]	[lb]	[lb]	DCK	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:

Lust mest	Direction											
	WALL ABOVE			WALL BELOW			OUT-OF-PLANE ANCHORAGE					
Level	Wall	Weight	Height	Wall	Weight	Height	Sanchor	w _p A _p	T _c	T _{cn}	DCR	Quick
	Туре	[psf]	[ft]	Туре	[psf]	[ft]	[ft]	[lb]	[lb]	[lb]	DCK	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

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:

Year Built:

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/ap	plication.php
Site Class:		D (default)	(Stiff Soil)	Site Class	[ASCE 41-17, §2.4.1.6]
Ss	=	1.286 g	(USGS) (5%/50 years)	USGS Mapped ($T = 0.2 \text{ sec}$)	[ASCE 41-17, §2.4.1.3]
S_1	=	0.488 g	(USGS) (5%/50 years)	USGS Mapped ($T = 1.0 \text{ sec}$)	[ASCE 41-17, §2.4.1.3]
Fa	=	1.200	(Site Class D)	Site Coefficient ($T = 0.2 \text{ sec}$)	[ASCE 7-16, Table 11.4-1]
F_v	=	1.812	(Site Class D)	Site Coefficient ($T = 1.0 \text{ sec}$)	[ASCE 7-16, Table 11.4-2]
S _{XS}	=	1.543 g	$= F_a S_S$	Site-Adjusted Design ($T = 0.2 \text{ sec}$)	[ASCE 41-17, Eq. 2-1]
$\mathbf{S}_{\mathbf{X}1}$	=	0.884 g	$= F_v S_1$	Site-Adjusted Design ($T = 1.0 \text{ sec}$)	[ASCE 41-17, Eq. 2-2]
BUILDING	G DATA:				
Building Ty	ype:	RM1	(Reinforced Masonry Bearing	Walls with Flexible Diaphragms)	[ASCE 41-17, Table 3-1]

Number of Stories:	1	story
Parapet Height:	2.50	ft
Roof Height:	11.50	ft
Total Area:	1.539	sf

1988

Total Area:		1,539	sf				
Level	Height	Elevation	$Length_{N\text{-}S}$	$Length_{\text{E-W}}$	Area	Diaphragm	Diaphragm
Level	[ft]	[ft]	[ft]	[ft]	[sf]	Stiffness	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

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

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

ROOF WEIGHT = 14.0 psf

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

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

Window & Door Weight = % Solid Wall = 100%

WALL-P WEIGHT = 83.0 psf

0.0 psf

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

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

Window & Door Weight = % Solid Wall = 100%

WALL-R WEIGHT = 83.0 psf

0.0 psf



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SEISMIC MASS

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

ROOF/FLOOR WEIGHT SUMMARY:

Level	Weight	
Туре	[psf]	
ROOF	14	

WALL WEIGHT SUMMARY:

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

SEISMIC MASS SUMMARY:

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



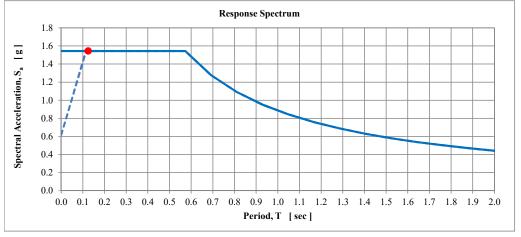
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SEISMIC FORCES

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

		RM1	(Reinforced Masonry Bearing	ng Walls with Flexible Diaphragms)	[ASCE 41-17, Table 3-1]
		D (default)	#N/A	#N/A	
DESIGN SI	PECTRA	L ACCELERATION	IS:		
S _{XS}	=	1.543 g	(BSE-2E)	Site-Adjusted Design ($T = 0.2 \text{ sec}$)	[ASCE 41-17, Eq. 2-1]
S_{X1}	=	0.884 g	(BSE-2E)	Site-Adjusted Design ($T = 1.0 \text{ sec}$)	[ASCE 41-17, Eq. 2-2]
BUILDING	PERIOI):			
h _n	=	11.5 ft	(Base to Roof)	Building Height	[ASCE 41-17, §4.4.2.4]
Ct	=	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]
Т	=	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)
С	=	1.0	(Building Type RM1)
$\mathbf{S}_{\mathbf{a}}$	=	1.543 g	= MIN { S_{X1} / T , S_{XS} }
V	=	1.543 W	$= C S_a W$

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	W _x		C _{vx}	F _x	Vj	$F_{x} = C_{vx} V = [w_{x} h_{x}^{k} / \Sigma (w_{x} h_{x}^{k})] V$	[ASCE 41-17, Eq. 4-2a]
Level	[ft]	[kips]	w _x h _x ^k	C _{vx}	[kips]	[kips]	$V_j = \Sigma F_x$	[ASCE 41-17, Eq. 4-2b]
Roof	11.5	107	1,236	1.00	166	166		
TOTAL	-	107	1,236	1.00	166	-		

Total Number of Stories Modification Factor

Spectral Acceleration

Pseudo Lateral Force

[ASCE 41-17, Table 4-7]

[ASCE 41-17, Eq. 4-3]

[ASCE 41-17, Eq. 4-1]



[ASCE 41-17, §A.3.2.4.2]

[ASCE 41-17, §A.3.2.4.1]

[ASCE 41-17, §A.3.2.4.1]

[ASCE 41-17, Table 4-8]

OK

[ASCE 41-17, Eq. 4-8]

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QUICK CHECKS

ASCE 41-17 SEISMIC EVALUATION & RETROFIT OF EXISTING BUILDINGS CHAPTER 4 - TIER 1 EVALUATION LINEAR STATIC PROCEDURE COLLAPSE PREVENTION 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:

	Horizontal Reinforcing			Vertical Reinforcing				Total Reinforcing				
Wall	s _{grout}	t _w	Bar Size	Spacing	ρ _h	$\rho_{\rm h} \ge 0.0007$	Bar Size	Spacing	ρ _v	$\rho_{\rm v} \ge 0.0007$	Ptot	$\rho_{tot} \ge 0.002$
Туре	[in]	[in]	No.	[in]	Fn	Fn — ••••••	No.	[in]	FV	FV = ••••••	FIOL	
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

Shear Wall Capacity

System Modification Factor

Average Shear Wall Stress

54

Net Wall Area (Reduced for Partial Grouting) [ASCE 41-17, §4.4.3.3]

7

0.11

4,941

AVERAGE SHEAR STRESS CHECK:

v _n	=	70 psi	(RM Shear Wall)

4.5	COLLAPSE PREVENTION

1.00

7.625

 $\nu_{j,\,avg} \qquad \qquad = \qquad (\,\,1\,/\,M_s\,)\,(\,V_j\,/\,A_w\,)$

=

166

 $A_w \qquad \qquad = \qquad t_w \left(\ L_{w, \ total} \ \text{-} \ L_{w, \ openings} \ \right) \left(\ A_{partial \ grout} \ / \ A_{full \ grout} \ \right)$

WALL-P

8

North-South Direction:

 $M_{\rm s}$

Roof

Level	V _j [kips]	Wall Type	s _{grout} [in]	$\frac{A_{partial\ grout}}{A_{full\ grout}}$	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]	$\frac{A_{partial\ grout}}{A_{full\ grout}}$	t _w [in]	L _{w, total} [ft]	L _{w, openings} [ft]	L _w [ft]	A _w [in ²]	ν _{j, avg} [psi]	DCR	Quick Check

54

0



[ASCE 41-17, §A.3.2.4.4]

[ASCE 41-17, §A.5.1.1]

[ASCE 41-17, §4.4.3.7]

[ASCE 41-17, Eq. 4-12]

[ASCE 41-17, §4.4.3.7]

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QUICK CHECKS

ASCE 41-17 SEISMIC EVALUATION & RETROFIT OF EXISTING BUILDINGS CHAPTER 4 - TIER 1 EVALUATION LINEAR STATIC PROCEDURE COLLAPSE PREVENTION 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)	

Out-of-Plane Wall Anchorage Coefficient

Out-of-Plane Wall Anchorage Force

Tributary Mass to Anchorage

Design Spectral Acceleration (T = 0.2 sec) [ASCE 41-17, §2.4.1.1]

WALL HEIGHT-TO-THICKNESS RATIO CHECK:									
Wall	h _w	t _w	h _w / t _w	MAX	Quick				

Туре	[ft]	[in]	n _w / t _w	$h_{\rm w}/t_{\rm w}$	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:

Ψ	=	1.0	COLLAPSE PREVENTION
S _{XS}	=	1.543 g	(BSE-2E)
T _c	=	$\Psi S_{XS} W_p A_p$	

 $w_p \; A_p \qquad \qquad = \qquad (\; w_{w,\; above} \; h_{w,\; above} + w_{w,\; below} \; h_{w,\; below} \;) \; s_{anchor}$

North-South Direction:

	WALL ABOVE			WALL BELOW			OUT-OF-PLANE ANCHORAGE					
Level	Wall	Weight	Height	Wall	Weight	Height	Sanchor	w _p A _p	T _c	T _{cn}	DCR	Quick
	Туре	[psf]	[ft]	Туре	[psf]	[ft]	[ft]	[lb]	[lb]	[lb]	DCK	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:

	WALL ABOVE			WALL BELOW			OUT-OF-PLANE ANCHORAGE					
Level	Wall	Weight	Height	Wall	Weight	Height	Sanchor	w _p A _p	T _c	T _{cn}	DCR	Quick
	Туре	[psf]	[ft]	Туре	[psf]	[ft]	[ft]	[lb]	[lb]	[lb]	DCK	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

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/d	pplication.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 ($T = 0.2 \text{ sec}$)	[ASCE 41-17, §2.4.1.3]
S ₁ =	0.488 g	(USGS) (5%/50 years)	USGS Mapped ($T = 1.0 \text{ sec}$)	[ASCE 41-17, §2.4.1.3]
F _a =	1.200	(Site Class D)	Site Coefficient ($T = 0.2 \text{ sec}$)	[ASCE 7-16, Table 11.4-1]
$F_v =$	1.812	(Site Class D)	Site Coefficient ($T = 1.0 \text{ sec}$)	[ASCE 7-16, Table 11.4-2]
S _{XS} =	1.543 g	$= F_a S_S$	Site-Adjusted Design ($T = 0.2 \text{ sec}$)	[ASCE 41-17, Eq. 2-1]
$S_{X1} =$	0.884 g	$= F_v S_1$	Site-Adjusted Design ($T = 1.0 \text{ sec}$)	[ASCE 41-17, Eq. 2-2]

BUILDING DATA:

Building Ty	ype:	RM1		(Reinforce	ed Masonry	Bearing Wa	Ils with Flexible Diaphragms) [ASCE 41-17, Table 3-1]
Year Built:		1993/2000					
Number of	Stories:	2	stories				
Parapet Hei	ight:	0.67	ft				
Roof Heigh	it:	24.00	ft				
Total Area:		4,050	sf				
Level	Height	Elevation	$Length_{N\text{-}S}$	$Length_{\text{E-W}}$	Area	Diaphragm	Diaphragm
Level	[ft]	[ft]	[ft]	[ft]	[sf]	Stiffness	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 Sheahting
1st	0.0	0.0	27	75	2,025	-	-



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

ROOF TYPE:	ROOF					
	Roofing / Re-roofing		@	5.0 psf	5.0 psf	у
0.5 in	Rock Ballast (Gravel)		(<i>a</i>)	8.0 psf per inch	0.0 psf	n
3 ply	Ready Roofing		(a)	0.3 psf per ply	0.0 psf	n
5 ply	Felt Roofing		a)	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	у
	Cement Tiles	(Shiooth Dituinitous)	@ @	16.0 psf	0.0 psf	n
	Clay Tiles	(Spanish)	@ @	19.0 psf	0.0 psf	n
	Mortar Bed for Clay Tiles	(Opamon)		10.0 psf	0.0 psf	
	Roof Insulation		@	1.0 psf		n
1.1.		(Diaid)	@		1.0 psf	У
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		a	2.0 psf per inch	0.0 psf	n
	Diaphragm - core planks		a	35.0 psf	0.0 psf	n
2.5 in	Concrete Slab	(Normal Weight)	a	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)	a	9.2 psf per inch	0.0 psf	n
18 ga	Bare Metal Deck		a	3.0 psf	0.0 psf	n
2 in	Wood Decking		a	2.5 psf per inch	0.0 psf	n
2 in	Wood Sheathing		a	3.0 psf per inch	0.0 psf	n
0.5 in	Plywood		@	3.2 psf per inch	1.6 psf	у
	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		a	76.0 plf	0.0 psf	n
2 ft O.C.	Wood Sub-Purlins		a	1.8 plf	0.0 psf	n
2 ft O.C.	Wood Purlins		a	3.0 plf	1.5 psf	у
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	$(A_{trib} = 459 \text{ sf})$	a	600.0 plf	0.0 psf	n
	Ceiling		(a)	5.0 psf	0.0 psf	n
0.5 in	Gypsum Board Ceiling		(<i>a</i>)	4.4 psf per inch	2.2 psf	у
	Acoustical Fiber Board		(a)	1.0 psf	0.0 psf	n
	Plaster Ceiling	(On Tile)	a a	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
noor alou	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
L			8	ROOF WEIGHT =	14.0 psf	

ROOF WEIGHT = 14.0 psf

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FLOOR TYPE:	FLR-2					
	Flooring		a	2.0 psf	2.0 psf	у
1 in	Floor Tiles	(Terrazzo)	a	13.0 psf per inch	0.0 psf	n
0.75 in	Wood Flooring	(Hardwood)	a	4.6 psf per inch	0.0 psf	n
2 in	Wood Blocks		a	3.3 psf per inch	0.0 psf	n
2 in	Asphalt Blocks		(a)	12.0 psf per inch	0.0 psf	n
0.75 in	Mastic		a	12.0 psf per inch	0.0 psf	n
1 in	Cement Finish		a)	12.0 psf per inch	0.0 psf	n
2 in	Mortar Bed		a)	12.0 psf per inch	0.0 psf	n
2 in	Floor Fill	(Stone Concrete)	(a)	12.0 psf per inch	0.0 psf	n
0.75 in	Subflooring	× ,	<u>(a)</u>	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	
3 in	Vermiculite Concrete	(Thorous Glass)	-		-	n
0.5 in	Fire Proofing		@ @	2.5 psf per inch 2 psf per inch	0.0 psf 0.0 psf	n n
0.5 III	Diaphragm		-		-	
3 in	Concrete Slab	(Normal Weight)	@	20.0 psf	0.0 psf	n
4.75 in		(Normal Weight)	@	12.5 psf per inch	0.0 psf	n
	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	У
0.5 in	Plywood		a	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		a	76.0 plf	0.0 psf	n
2 ft O.C.	Wood Sub-Purlins		a	1.8 plf	0.0 psf	n
2 ft O.C.	Wood Purlins		(a)	3.0 plf	1.5 psf	У
20 ft O.C.	Wood Girders		a	5.0 plf	0.0 psf	n
8 ft O.C.	Concrete Beams		a	200.0 plf	0.0 psf	n
20 ft O.C.	Concrete Girders		a	300.0 plf	0.0 psf	n
12.5 ft trib. ht.	Typical Columns	$(A_{trib} = 400 \text{ sf})$	a	233.0 plf	0.0 psf	n
	Ceiling		a	5.0 psf	5.0 psf	у
0.5 in	Gypsum Board Ceiling		a	4.4 psf per inch	0.0 psf	n
	Acoustical Fiber Board		a	1.0 psf	0.0 psf	n
	Plaster Ceiling	(On Tile)	a	5.0 psf	0.0 psf	n
	Suspended Metal Lath & Plaster	(Gypsum Plaster)	a	10.0 psf	0.0 psf	n
	Suspended Steel Channel System		a	2.0 psf	0.0 psf	n
	Suspended Wood Furring System		a a	2.5 psf	0.0 psf	n
	T-bar Ceiling System		œ	3.0 psf	0.0 psf	n
100% floor area	Interior Partitions	(Above & Below)	@	10.0 psf	10.0 psf	у
	M.E.P.		(a)	5.0 psf	0.0 psf	n
	Miscellaneous		@	1.2 psf	1.2 psf	у
	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
			(H)	FLR-2 WEIGHT =	23.0 psf	**

FLR-2 WEIGHT = 23.0 psf



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

Solid Wall Weight = Window & Door Weight =

w & Door Weight = 0.0 psf % Solid Wall = 100%

WALL-P WEIGHT = 83.0 psf



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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)	a	83.0 psf	83.0 psf	у
8 in	Solid CMU Wall	(Normal Weight)	a	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		a	11.1 psf per inch	0.0 psf	n
0.5 in	Plywood		a	3.2 psf per inch	0.0 psf	n
16 in O.C.	Wood Studs	(2 x 4)	a	1.1 plf	0.0 psf	n
16 in O.C.	Metal Channel Studs		a	2.0 plf	0.0 psf	n
8 ft O.C.	Steel Girts		a	6.0 plf	0.0 psf	n
	Miscellaneous		@	1.0 psf	0.0 psf	n
	Other		a	1.0 psf	0.0 psf	n
	Other		a	1.0 psf	0.0 psf	n
	Other		a	1.0 psf	0.0 psf	n
	Other		a	1.0 psf	0.0 psf	n
	Other		a	1.0 psf	0.0 psf	n
				Solid Wall Weight	= 83.0 psf	

Solid Wall Weight = Window & Door Weight =

ow & Door Weight = 0.0 psf % Solid Wall = 100%

WALL-R WEIGHT = 83.0 psf



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SEISMIC MASS

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

ROOF/FLOOR WEIGHT SUMMARY:

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

WALL WEIGHT SUMMARY:

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

SEISMIC MASS SUMMARY:

	FLOOR			WALL ABOVE			WALL BELOW				TOTAL	
Level	Level	Weight	Area	Wall	Weight	Length	Height	Wall	Weight	Length	Height	WEIGHT
	Туре	[psf]	[sf]	Туре	[psf]	[ft]	[ft]	Туре	[psf]	[ft]	[ft]	[kips]
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



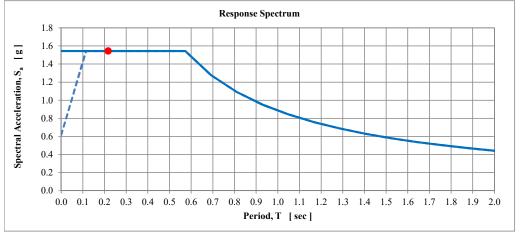
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SEISMIC FORCES

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

BUILDING TYPE: SITE CLASS:		RM1	(Reinforced Masonry Bearin	g Walls with Flexible Diaphragms)	[ASCE 41-17, Table 3-1]	
		D (default)	#N/A	#N/A		
DESIGN SPE	CTRAI	L ACCELERATION	S:			
S _{XS}	=	1.543 g	(BSE-2E)	Site-Adjusted Design ($T = 0.2 \text{ sec}$)	[ASCE 41-17, Eq. 2-1]	
$\mathbf{S}_{\mathbf{X}1}$	=	0.884 g	(BSE-2E)	Site-Adjusted Design ($T = 1.0 \text{ sec}$)	[ASCE 41-17, Eq. 2-2]	
BUILDING P	ERIOD):				
h _n	=	24.0 ft	(Base to Roof)	Building Height	[ASCE 41-17, §4.4.2.4]	
Ct	=	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]	
Т	=	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)
С	=	1.0	(Building Type RM1)
$\mathbf{S}_{\mathbf{a}}$	=	1.543 g	= MIN { S_{X1} / T , S_{XS} }
V	=	1.543 W	$= C S_a W$

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	W _x	w _x h _x ^k	C _{vx}	F _x	Vj	$F_{x} = C_{vx} V = [w_{x} h_{x}^{k} / \Sigma (w_{x} h_{x}^{k})] V$	[ASCE 41-17, Eq. 4-2a]
Level	[ft]	[kips]	W _x n _x	C _{vx}	[kips]	[kips]	$V_j = \Sigma F_x$	[ASCE 41-17, Eq. 4-2b]
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	-		

Total Number of Stories Modification Factor

Spectral Acceleration

Pseudo Lateral Force

[ASCE 41-17, Table 4-7]

[ASCE 41-17, Eq. 4-3]

[ASCE 41-17, Eq. 4-1]



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QUICK CHECKS

ASCE 41-17 SEISMIC EVALUATION & RETROFIT OF EXISTING BUILDINGS CHAPTER 4 - TIER 1 EVALUATION LINEAR STATIC PROCEDURE COLLAPSE PREVENTION 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:

Horizontal Reinforcing							Vertical Reinforcing				Total Reinforcing	
Wall Type	s _{grout} [in]	t _w [in]	Bar Size No.	Spacing [in]	$\rho_{\rm h}$	$\rho_h \!\geq \! 0.0007$	Bar Size No.	Spacing [in]	$\rho_{\rm v}$	$\rho_{\rm v}\!\geq\!0.0007$	ρ_{tot}	$\rho_{tot} \! \geq \! 0.002$
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

Shear Wall Capacity

System Modification Factor

Average Shear Wall Stress

Net Wall Area (Reduced for Partial Grouting) [ASCE 41-17, §4.4.3.3]

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

COLLAPSE PREVENTION

(RM Shear Wall)

AVERAGE SHEAR STRESS CHECK:

		ornabo onnorn
ν_n	=	70 psi
Ms	=	4.5
$\nu_{j, \; avg}$	=	$(1/M_{s})(V_{j}/A_{w})$

 $A_w = t_w (L_{w, total} - L_{w, openings}) (A_{partial grout} / A_{full grout})$ North-South Direction:

North-Sou	North-South Direction:											
Level	Vj	Wall	s _{grout}	A _{partial grout}	t _w	L _{w, total}	L _{w, openings}	L _w	A_w	$\nu_{j, \; avg}$	DCR	Quick
	[kips]	Туре	[in]	A _{full grout}	[in]	[ft]	[ft]	[ft]	[in ²]	[psi]	DOR	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]	$\frac{A_{partial\ grout}}{A_{full\ grout}}$	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	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

[ASCE 41-17, §A.3.2.4.2]

[ASCE 41-17, §A.3.2.4.1]

[ASCE 41-17, §A.3.2.4.1]

[ASCE 41-17, Table 4-8]

[ASCE 41-17, Eq. 4-8]



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QUICK CHECKS

ASCE 41-17 SEISMIC EVALUATION & RETROFIT OF EXISTING BUILDINGS CHAPTER 4 - TIER 1 EVALUATION LINEAR STATIC PROCEDURE COLLAPSE PREVENTION 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)	

WALL HEIGHT-TO-THICKNESS RATIO CHECK:

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

S _{XS}	=	1.543 g	(BSE-2E)
-----------------	---	---------	----------

 $\Psi S_{XS} w_p A_p$ T_c =

 $W_p A_p$ = ($w_{w, above} h_{w, above} + w_{w, below} h_{w, below}$) s_{anchor}

North-South Direction:

	WALL ABOVE			WALL BELOW			OUT-OF-PLANE ANCHORAGE					
Level	Wall	Weight	Height	Wall	Weight	Height	Sanchor	$w_p A_p$	T _c	T _{cn}	DCR	Quick
	Туре	[psf]	[ft]	Туре	[psf]	[ft]	[ft]	[lb]	[lb]	[lb]	DCK	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:

WALL ABOVE			W	WALL BELOW		OUT-OF-PLANE ANCHORAGE						
Level	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

Out-of-Plane Wall Anchorage Coefficient Design Spectral Acceleration (T = 0.2 sec) [ASCE 41-17, §2.4.1.1] Out-of-Plane Wall Anchorage Force Tributary Mass to Anchorage

[ASCE 41-17, §A.5.1.1] [ASCE 41-17, §4.4.3.7] [ASCE 41-17, Eq. 4-12] [ASCE 41-17, §4.4.3.7]

[ASCE 41-17, §A.3.2.4.4]



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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/ap	plication.php
Site Class:		D (default)	(Stiff Soil)	Site Class	[ASCE 41-17, §2.4.1.6]
Ss	=	1.286 g	(USGS) (5%/50 years)	USGS Mapped ($T = 0.2 \text{ sec}$)	[ASCE 41-17, §2.4.1.3]
S_1	=	0.488 g	(USGS) (5%/50 years)	USGS Mapped ($T = 1.0 \text{ sec}$)	[ASCE 41-17, §2.4.1.3]
Fa	=	1.200	(Site Class D)	Site Coefficient ($T = 0.2 \text{ sec}$)	[ASCE 7-16, Table 11.4-1]
F _v	=	1.812	(Site Class D)	Site Coefficient ($T = 1.0 \text{ sec}$)	[ASCE 7-16, Table 11.4-2]
S _{XS}	=	1.543 g	$= F_a S_S$	Site-Adjusted Design ($T = 0.2 \text{ sec}$)	[ASCE 41-17, Eq. 2-1]
\mathbf{S}_{X1}	=	0.884 g	$= F_v S_1$	Site-Adjusted Design ($T = 1.0 \text{ sec}$)	[ASCE 41-17, Eq. 2-2]
BUILDING	G DATA:				
Building Ty	pe:	S2A	(Steel Braced Frames with Fle	xible Diaphragms)	[ASCE 41-17, Table 3-1]

Year Built:		1966					
Number of	Stories:	1	story				
Parapet Hei	ight:	1.50	ft				
Roof Heigh	it:	14.00	ft				
Total Area:		2,250	sf				
Level	Height	Elevation	$Length_{N\text{-}S}$	$Length_{\text{E-W}}$	Area	Diaphragm	Diaphragm
Level	[ft]	[ft]	[ft]	[ft]	[sf]	Stiffness	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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	o week		w	ROOF WEIGHT =	25.0 psf	п
	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
	Percast Fascia (4sqft)		a a	47.1 psf	0.0 psf	n
	Miscellaneous		<u>a</u>	1.7 psf	1.7 psf	y
1070 11001 alca	M.E.P.	(2000)	<u>a</u>	5.0 psf	5.0 psf	y y
10% floor area	T-bar Ceiling System Interior Partitions	(Below)	@ @	3.0 psf 5.0 psf	0.0 psf 0.5 psf	n y
	Suspended Wood Furring System		@ @	2.5 psf	0.0 psf	n
	Suspended Steel Channel System		@ @	1	1	n
	Suspended Metal Lath & Plaster	(Gypsum r laster)	@ @	10.0 psf 2.0 psf	0.0 psf 0.0 psf	n
	Plaster Ceiling	(On Tile) (Gypsum Plaster)	@ @	5.0 psf	0.0 psf	n
	Acoustical Fiber Board	(On Tile)	@	1.0 psf	0.0 psf	n
0.5 in	Gypsum Board Ceiling		@	4.4 psf per inch	0.0 psf	n
0.5	Ceiling		@	5.0 psf	0.0 psf	n
7.00 ft trib. ht.	Typical Columns	$(A_{trib} = 459 \text{ sf})$	@	600.0 plf	0.0 psf	n
20 ft O.C.	Concrete Girders	$(\Lambda - 450 - 5)$	@ @	300.0 plf	0.0 psf	n
12.75 ft O.C.	Concrete Beams		@	800.0 plf	0.0 psf	n
20 ft O.C.	Wood Girders		@	5.0 plf	0.0 psf	n
8 ft O.C.	Wood Purlins		@	3.0 plf	0.0 psf	n
2 ft O.C.	Wood Sub-Purlins		@	1.8 plf	0.0 psf	n
36 ft O.C.	Steel Girders		@	76.0 plf	0.0 psf	n
8 ft O.C.	Steel Beams		@	22.0 plf	2.8 psf	У
	Framing		@	20.0 psf	0.0 psf	n
0.5 in	Plywood		@	3.2 psf per inch	1.6 psf	У
2 in	Wood Sheathing		a)	3.0 psf per inch	6.0 psf	У
2 in	Wood Decking		@	2.5 psf per inch	0.0 psf	n
18 ga	Bare Metal Deck		@	3.0 psf	0.0 psf	n
0.5 in	Concrete Overpour	(Light Weight)	@	9.2 psf per inch	0.0 psf	n
4.75 in	Concrete Fill	(Light Weight)	@	9.2 psf per inch	0.0 psf	n
2.5 in	Concrete Slab	(Normal Weight)	@	12.5 psf per inch	0.0 psf	n
	Diaphragm - core planks		@	35.0 psf	0.0 psf	n
0.5 in	Fire Proofing		a	2.0 psf per inch	0.0 psf	n
3 in	Vermiculite Concrete		a	2.5 psf per inch	0.0 psf	n
1 in	Insulation Boards	(Fibrous Glass)	æ	1.1 psf per inch	0.0 psf	n
1 in	Insulation	(Rigid)	æ	1.5 psf per inch	0.0 psf	n
	Roof Insulation		æ	1.0 psf	1.0 psf	у
	Mortar Bed for Clay Tiles		a	10.0 psf	0.0 psf	n
	Clay Tiles	(Spanish)	@	19.0 psf	0.0 psf	n
	Cement Tiles		@	16.0 psf	0.0 psf	n
	Waterproofing Membranes	(Smooth Bituminous)	a	1.5 psf	1.5 psf	у
	Corrugated Asbestos-Cement		a	4.0 psf	0.0 psf	n
	Copper or Tin		@	1.0 psf	0.0 psf	n
	Shingles	(Asphalt)	(a)	2.0 psf	0.0 psf	n
0.25 in	Slate		@	40.0 psf per inch	0.0 psf	n
5 ply	Felt Roofing		@	0.5 psf per ply	0.0 psf	n
3 ply	Ready Roofing		(a)	0.3 psf per ply	0.0 psf	n
0.5 in	Rock Ballast (Gravel)		a	8.0 psf per inch	0.0 psf	n
	Roofing / Re-roofing		(a)	5.0 psf	5.0 psf	У

ROOF WEIGHT = 25.0 psf



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

Window & Door Weight =

& Door Weight = 0.0 psf % Solid Wall = 100%

WALL-P WEIGHT = 134.2 psf



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LL TYPE:	WALL-R					
	Wall Covering		a	4.0 psf	0.0 psf	
3 in	Exterior Stucco		(a)	11.4 psf per inch.	34.2 psf	
1 in	Wood Sheathing		a	3.0 psf per inch	0.0 psf	
0.5 in	Gypsum Sheathing		a	4.0 psf per inch	0.0 psf	
0.5 in	Gypsum Wallboard		a	4.4 psf per inch	0.0 psf	
	Porcelain Enamel Panels		a	5.0 psf	0.0 psf	
	Metal Lath & Plaster	(Gypsum Plaster)	a	10.0 psf	0.0 psf	
	Wall Insulation		@	1.0 psf	0.0 psf	
1 in	Insulation	(Rigid)	a	1.5 psf per inch	0.0 psf	
1 in	Insulation Boards	(Fiber Board)	a	1.5 psf per inch	0.0 psf	
0.5 in	Fire Proofing		a	2 psf per inch	0.0 psf	
	Wall Framing		a	20.0 psf	0.0 psf	
8 in	Concrete Wall	(Normal Weight)	a	12.5 psf per inch	100.0 psf	
8 in	CMU Wall w/ Full Grouting	(Normal Weight)	a	83.0 psf	0.0 psf	
8 in	Solid CMU Wall	(Normal Weight)	a	87.0 psf	0.0 psf	
4 in	HCB Wall w/ Full Grouting		a	38.0 psf	0.0 psf	
3.5 in	Solid Clay Brick Wall		a	11.1 psf per inch	0.0 psf	
0.5 in	Plywood		a	3.2 psf per inch	0.0 psf	
16 in O.C.	Wood Studs	(2x4)	a	1.1 plf	0.0 psf	
16 in O.C.	Metal Channel Studs		a	2.0 plf	0.0 psf	
8 ft O.C.	Steel Girts		a	6.0 plf	0.0 psf	
	Miscellaneous		a	1.8 psf	0.0 psf	
	Other		a	1.0 psf	0.0 psf	
	Other		a	1.0 psf	0.0 psf	
	Other		a	1.0 psf	0.0 psf	
	Other		a	1.0 psf	0.0 psf	
	Other		(a)	1.0 psf	0.0 psf	

Solid Wall Weight = Window & Door Weight =

w & Door Weight = 0.0 psf % Solid Wall = 100%

WALL-R WEIGHT = 134.2 psf



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SEISMIC MASS

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

ROOF/FLOOR WEIGHT SUMMARY:

Level	Weight	
Туре	[psf]	
ROOF	25	

WALL WEIGHT SUMMARY:

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

SEISMIC MASS SUMMARY:

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



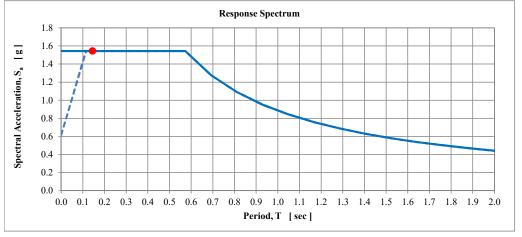
Subject:	Seismic Forces	Job Number:	B9959006.00	Date:	06/20/19
Job:	UCSC Tier 1 Seismic Evaluations	By:	HK	Section:	
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SEISMIC FORCES

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

BUILDING T	YPE:	S2A	(Steel Braced Frames with F	Texible Diaphragms)	[ASCE 41-17, Table 3-1]
SITE CLASS:		D (default)	#N/A		[ASCE 41-17, §2.4.1.6]
DESIGN SPEC	CTRAL	ACCELERATION	(S:		
S _{XS}	=	1.543 g	(BSE-2E)	Site-Adjusted Design ($T = 0.2 \text{ sec}$)	[ASCE 41-17, Eq. 2-1]
S _{X1}	=	0.884 g	(BSE-2E)	Site-Adjusted Design ($T = 1.0 \text{ sec}$)	[ASCE 41-17, Eq. 2-2]
BUILDING PI	ERIOD:				
h _n	=	14.0 ft	(Base to Roof)	Building Height	[ASCE 41-17, §4.4.2.4]
Ct	=	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]
Т	=	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)
С	=	1.0	(Building Type S2A)
\mathbf{S}_{a}	=	1.543 g	= MIN { S_{X1} / T , S_{XS} }
V	=	1.543 W	$= C S_a W$

Total Number of Stories Modification Factor Spectral Acceleration Pseudo Lateral Force

[ASCE 41-17, Table 4-7] [ASCE 41-17, Eq. 4-3] [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	W _x	w h ^k	C	F _x	Vj	$F_x = C_{vx} V = [w_x h_x^k / \Sigma (w_x h_x^k)] V$	[ASCE 41-17, Eq. 4-2a]
Level	[ft]	[kips]	w _x h _x "	C_{vx}	[kips]	[kips]	$V_j = \Sigma F_x$	[ASCE 41-17, Eq. 4-2b]
Roof	14.0	225	3,155	1.00	348	348		
TOTAL	-	225	3,155	1.00	348	-		



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QUICK CHECKS

ASCE 41-17 SEISMIC EVALUATION & RETROFIT OF EXISTING BUILDINGS CHAPTER 4 - TIER 1 EVALUATION LINEAR STATIC PROCEDURE COLLAPSE PREVENTION 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:

Laval	n _f	n _c	n _{bays}	n _{br}	L _f	L _{typical bay}	DL	LL	A _{trib}	P _D	PL
Level	[frames]	[columns]	[bays]	[braces]	[ft]	[ft]	[psf]	[psf]	[ft²]	[kips]	[kips]
Roof	2	6	4	8	50.0	25.0	25	20	563	14	11

FRAME MEMBER PROPERTIES:

Material Properties:

	ropertiest									
Fyc	=	50	ksi	(ASTM A	572 / Struct	ural)	Column Yi	eld Stress	(ASCE 41 Default)	[ASCE 41-17, §4.2.3]
Fybr	=	50 ksi 29,000 ksi Bending L _e		(ASTM A	572 / Struct	ural)	Brace Yield Stress (ASCE 41 Default			[ASCE 41-13, Table 4-5]
Е	=	29,000	ksi		Modulus of Elasticity					[ASCE 41-17, §4.2.3]
Column Pr	roperties:				_					
Level	Section	Bending	L _c	A _c						
Level	Section	Axis	[ft]	[in ²]						
Roof	W8x31	х	14.0	9.1						
Brace Prop	perties:								_	
Level		Section		L _{br,x}	L _{br,y}	L _{br}	A _{br}	d _{br} / t _{br}		
Level	rel Section			[ft]	[ft]	[ft]	[in ²]	u _{br} / u _{br}		
Roof		W8x18		12.5	14.0	18.8	5.26	n/a		

[ASCE 41-17 §4.2.3]



Subject:	Quick Che	cks					Job Numb	er:	B9959006.	00	Date: 06/20/19			
Job:	UCSC Tie	r 1 Seismic E	valuations				By:		HK		Section:			
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QUICK C	HECKS													
		EVALUAT	ION & RE	TROFIT OF	EXISTING	BUILDING	3S							
CHAPTEF	R 4 - TIER 1	EVALUATI	ON											
LINEAR S	STATIC PRO	OCEDURE												
COLLAPS	E PREVEN	TION												
BSE-2E H	AZARD LE	VEL												
	G TYPE:	S2A		(Steel Bra	ced Frames	with Flexit	ole Diaphragr	ns)			[ASCE 4]	1-17, Table 3-1]		
LOAD DI	RECTION	N-S												
COLUMN	NAXIAL ST	FRESS CHE	CK:								[ASCE 4]	1-17, §A.3.1.3.2		
M _s	=	2.5		COLLAPSI	E PREVEN	TION	System Mo	dification F	actor		[ASCE 4]	1-17, §4.4.3.6]		
F _{yc}	=	50	ksi	(ASTM A572 / Structural)			Column Yield Stress				[ASCE 4]	1-17, §4.2.3]		
$P_{n,E} / A_c$	=	15.0	ksi	$= 0.30 F_{yc}$			Seismic Axial Stress Capacity				[ASCE 4]	1-17, §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}	=	$\Sigma\left(F_xh_x\right)$					Global Overturning Moment				[ASCE 41-17, §4.4.3.6]			
P _E	=	(1/M _s)(1	$M_{x, ot} / n_f$	L _f			Seismic Ax	ial Load du	e to Overturi	ning	[ASCE 4]	1-17, §4.4.3.6]		
P _G	=	$P_D + P_L$					Unfactored	Gravity Lo	ad		[ASCE 4]	1-17, §A.3.1.3.2		
P _D	=	Σ (DL A _{trib})				Gravity De	ad Load			[ASCE 4]	1-17, §4.4.3.6]		
P _L	=	Σ (LL A _{trib})			-	Gravity Liv	e Load		-	[ASCE 4]	1-17, §4.4.3.6]		
Level	Section	A _c	h _x	F _x	M _{x, ot}	$P_{\rm E}$	P _E / F _{yc} A _c	P_G	P _G / F _{yc} A _c		CR	Quick		
20.01	Stellon	[in ²]	[ft]	[kips]	[k-ft]	[kips]	- E · - yc - c	[kips]	- u · - yc - c	Seismic	Gravity	Check		
Roof	W8x31	9.1	14.0	348	4,868	19	0.04	25	0.06	0.14	0.55	OK		
	VIAL OTD	ESS CHEC	17.								LARCEA	1 17 84 2 2 1 2		
DKAUĽ A	ATAL SIR	ESS CHECI 7.0		(Tube, d _h	/t. < 90 /	√F.)	System Mo	dification F	actor (CD)			1-17, §A.3.3.1.2		
		7.0		(Tube, d _{bi}) (Tube, d _{bi}			System Mo System Mo		. ,		[ASCE 41-17, Table 4-9]			
		5.5		(Tube, d _{bi}	$v_{\rm br} > 190$	/ v r _{yebr})	System Mo	unication F	actor (CP)		[ASCE 41-17, Table 4-9]			

		/.0		$(100e, u_{b})$	$r / t_{br} < 90 /$	ν Γ _{yebr})	System Mo	diffication Fa	actor (CP)		[ASCE 41-17, Table 4-9]		
		3.5		(Tube, d _b	$_{\rm r}$ / $t_{\rm br}$ > 190 /	′√F _{yebr})	System Mor	dification Fa	actor (CP)		[ASCE 41-17, Table 4-9]		
		7.0		(Pipe, d _{br}	/ $t_{br} < 1500$	/ F _{yebr})	System Mo	dification Fa		[ASCE 41-17, Table 4-9]			
M_s	= -	3.5		(Pipe, d _{br}	/ $t_{br} > 6000$	/ F _{yebr})	System Mo	dification Fa	actor (CP)		[ASCE 41-17, Table 4-9]		
		3.5		(Tension-	Only Braces)	System Mo	dification Fa	actor (CP)		[ASCE 41-17, Table 4-9]		
		3.5		(Cold-form	ned steel stra	p-braced wa	a System Mo	dification Fa	actor (CP)		[ASCE 41-17, Table 4-9]		
	L	7.0		(All Other	Brace Type	s)	System Modification Factor (CP)				[ASCE 41-17, Table 4-9]		
Fybr	=	50	ksi	(ASTM A	572 / Struct	ural)	Brace Yield	l Stress		[ASCE 41-13, Table 4-5]			
Fyebr	=	63	ksi	$= 1.25 F_{ybr}$			Brace Expe	cted Yield S	Stress		[ASCE 41-17, §4.4.3.4]		
f _{nbr}	=	25	ksi	$= 0.50 \text{ F}_{ybr}$			Brace Axial Stress Capacity				[ASCE 41-17, §A.3.3.1.2]		
f _{j, avg}	=	$(1 / M_s) (V_s)$	$V_j / (L_{br,x} n_b)$	or)) (L _{br} / A	_{br})		Average Br	ace Axial St	ress		[ASCE 41-17, Eq. 4-9]		
Level	Vj	n _{br}	L _{br,x}	L _{br}	A _{br}	d _{br} / t _{br}	Ms	f _{j, avg}	DCR	Quick	ſ		
Level	[kips]	[braces]	[ft]	[ft]	[in ²]	u _{br} / u _{br}	IVI _S	[ksi]	DCK	Check			
Roof	348	8	12.5	18.8	5.26	n/a	7.00	1.8	0.07	OK	ſ		



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QUICK CHECKS

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

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

Column Yield Stress

Modulus of Elasticity

Brace Yield Stress

FRAME PROPERTIES:

Loval	n _f	n _c	n _{bays}	n _{br}	L _f	L _{typical bay}	DL	LL	A _{trib}	P _D	PL
Level	[frames]	[columns]	[bays]	[braces]	[ft]	[ft]	[psf]	[psf]	[ft²]	[kips]	[kips]
Roof	2	3	4	8	45.0	22.5	25	20	563	14	11

FRAME MEMBER PROPERTIES:

Material	Properties:		(ASCE 41 Default)
Fyc	=	50 ksi	(ASTM A572 / Structural)
Fybr	=	50 ksi	(ASTM A572 / Structural)
Е	=	29,000 ksi	
Column H	Properties:		

Column 110perties.											
Level	Section	Bending	L _c	A _c							
Level	Section	Axis	[ft]	[in ²]							
Roof	koof 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

[ASCE 41-17, §4.2.3]

[ASCE 41-17, §4.2.3] [ASCE 41-13, Table 4-5] [ASCE 41-17, §4.2.3]



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lob:	UCSC Tier	1 Seismic E	Evaluations				By:		HK		Section:				
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DICK C	HECKS														
ASCE 41-1	7 SEISMIC	EVALUAT	ION & RE	TROFIT OF	EXISTING	BUILDING	3S								
CHAPTER	4 - TIER 1	EVALUATI	ON												
LINEAR S	TATIC PRO	CEDURE													
COLLAPS	E PREVEN	ΓΙΟΝ													
BSE-2E H	AZARD LE'	VEL													
BUILDIN	G TYPE:	S2A		(Steel Bra	ced Frames	with Flexib	ole Diaphragn	ns)			[ASCE 41-	-17, Table 3-			
LOAD DI	RECTION:	E-W													
COLUMN	AXIAL ST	RESS CHE	CK:								[ASCE 41-	-17, §A.3.1.3			
M _s	=	2.5		COLLAPS	E PREVEN	ΓΙΟΝ	System Mo	dification F		[ASCE 41-17, §4.4.3.6]					
Fyc	=	50	ksi	(ASTM A	572 / Struct	ural)	Column Yie	eld Stress		[ASCE 41-17, §4.2.3]					
$P_{n,E} / A_c$	=	15.0	ksi	$= 0.30 \ F_{yc}$			Seismic Ax	ial Stress C		[ASCE 41-17, §A.3.1.3.2]					
$P_{n,G} / A_c$	=	5.0	ksi	$= 0.10 \text{ F}_{yc}$			Gravity Axi	ial Stress Ca		[ASCE 41-17, §A.3.1.3.2]					
M _{x, ot}		$\Sigma\left(F_xh_x\right)$					Global Ove	rturning Mo		[ASCE 41-17, §4.4.3.6]					
P _E	=	$(1 / M_s)(1)$	$M_{x, ot} / n_f$)	/ L _f			Seismic Ax	ial Load du	ning	[ASCE 41-17, §4.4.3.6]					
G	=	$P_{\rm D} + P_{\rm L}$					Unfactored	Gravity Loa		[ASCE 41-17, §A.3.1.3.2					
PD	=	Σ (DL A_{trib})				Gravity Dea	ad Load		[ASCE 41-17, §4.4.3.6]					
PL	=	Σ (LL A _{trib}		1			Gravity Live Load				[ASCE 41-17, §4.4.3.6]				
Level	Section	A _c	h _x	F _x	M _{x, ot}	P _E	$P_E / F_{vc} A_c$	P _G	$P_G / F_{vc} A_c$		CR	Quick			
		[in ²]	[ft]	[kips]	[k-ft]	[kips]		[kips]		Seismic	Gravity	Check			
Roof	W8x31	9.1	14.0	348	4,868	22	0.05	25	0.06	0.16	0.55	OK			
BRACE A	XIAL STR	ESS CHEC	K:								[ASCE 41-	-17, §A.3.3.1			
	Г	7.0		(Tube, d _h	$t_{\rm br} < 90 / t_{\rm br}$	√ F _{vebr})	F _{vebr}) System Modification Factor (CP)					[ASCE 41-17, Table 4-9			
		3.5			$t_{\rm br} > 190$		System Mo		. ,		5	-17, Table 4-			
		7.0			$/ t_{\rm br} < 1500$,	System Mo		. ,			-17, Table 4-			

		3.5		(Tube, d _b	$_{\rm r}$ / ${\rm t}_{\rm br}$ > 190 /	√√F _{yebr})	System Mo	dification Fa	[ASCE 41-17, Table 4-9]		
		7.0		(Pipe, d_{br}	/ $t_{br} < 1500$	/ F _{yebr})	System Mo	dification Fa		[ASCE 41-17, Table 4-9]	
Ms	= -	3.5		(Pipe, d _{br}	/ $t_{br} > 6000$	/ F _{yebr})	System Mo	dification Fa	actor (CP)		[ASCE 41-17, Table 4-9]
		3.5		(Tension-	Only Braces)	System Mo	dification Fa	actor (CP)		[ASCE 41-17, Table 4-9]
		3.5		(Cold-form	ned steel stra	p-braced w	System Modification Factor (CP)				[ASCE 41-17, Table 4-9]
	Ĺ	7.0		(All Other	Brace Type	es)	System Mo	dification Fa		[ASCE 41-17, Table 4-9]	
Fybr	=	50	ksi	(ASTM A	572 / Struct	ural)	Brace Yield Stress				[ASCE 41-13, Table 4-5]
Fyebr	=	63	ksi	$= 1.25 F_{ybr}$			Brace Expected Yield Stress				[ASCE 41-17, §4.4.3.4]
\mathbf{f}_{nbr}	=	25	ksi	$= 0.50 F_{ybr}$			Brace Axial Stress Capacity				[ASCE 41-17, §A.3.3.1.2]
f _{j, avg}	=	$(1 / M_s)(7)$	$V_j / (L_{br,x} n_b)$	_{or})) (L _{br} / A	(h _{br})		Average Br	ace Axial St	ress		[ASCE 41-17, Eq. 4-9]
Level	Vj	n _{br}	L _{br,x}	L _{br}	A _{br}	d _{br} / t _{br}	Ms	f _{j, avg}	DCR	Quick	I
Level	[kips]	[braces]	[ft]	[ft]	[in ²]	u _{br} / t _{br}	IVIS	[ksi]	DCK	Check	
Roof	348	8	11.3	18.0	5.26	n/a	7.00	1.9	0.08	OK	I

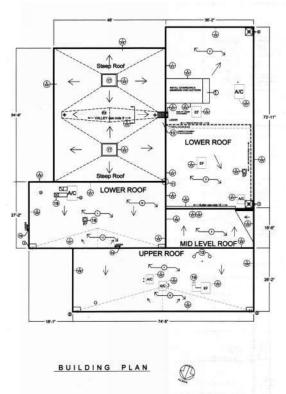


University of California, Santa Cruz ASCE 41-17 Tier 1 Seismic Evaluation 7146 - Central Heating Plant

> Appendix C Photos and Details



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



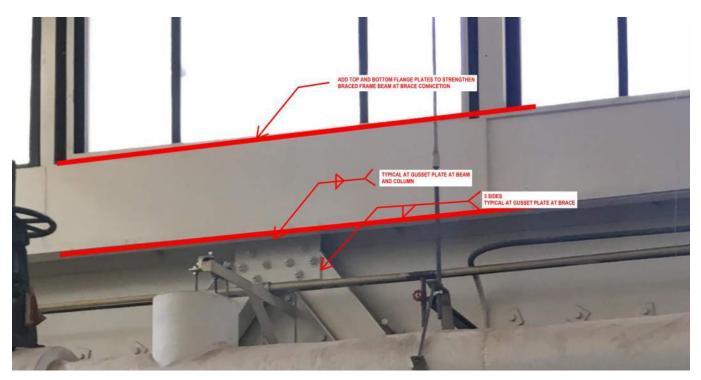
Roof Plan



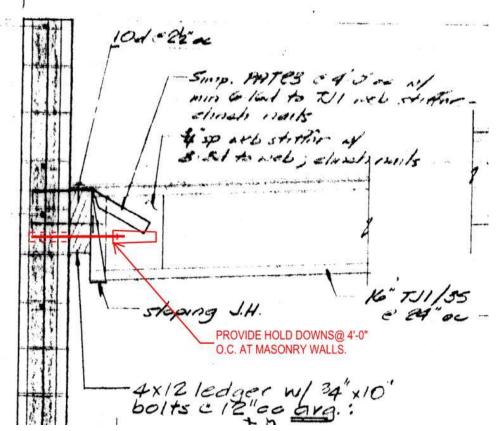
Steel towers with clear story windows below



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



Proposed retrofit for braced frame beam



Proposed retrofit for wood floor to wall connection