Degenkolb

Rating form completed by
Jay Yin

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

DATE: 2019-06-30

6/28/19

UC Santa Cruz building seismic ratings

Social Sciences 2 South

CAAN #7921.1
712 College Ten Road, Santa Cruz CA 95064
UCSC Campus: Main Campus

Rating summary	Entry	Notes
UC Seismic Performance Level (rating)	V (Poor)	
Rating basis	ASCE 41-17 Tier 1	ASCE 41-17[1]
Date of rating	2019	
Recommended UC Santa Cruz priority category for retrofit	Priority B	Priority A=Retrofit ASAP Priority B=Retrofit at next permit application
Ballpark total construction cost to retrofit to IV rating[2]	Medium (~$50/sf-$200/sf)	See recommendations on further evaluation and retrofit.
Is 2018-2019 rating required by UCOP?	Yes	
Further evaluation recommended?	Yes	

[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.

Building information used in this evaluation

- Architectural Drawings by Esherick Homsey Dodge and Davis, "College 10 Academic, University of California Santa Cruz", original issue date 29 July, 1993.
- Structural Drawings by SOH & Associates, original issue date 29 July, 1993.

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. Made site visit to verify actual construction generally conforms to drawings and identify nonstructural life-safety hazards.

Brief description of structure

This is the south tower of the two tower structure for Social Science 2 building. The two towers are supported by a common base structure at 1st Floor. The base structure has a sloped foundation system that is consisted of spread footings and grade beams. The south side of the base structure is a full story with "Ground Floor" as the lower level and 1st Floor as the upper level. The north side of the base structure has short shear walls on graded beams, the top of the grade beams is at approximately 5' below "1st Floor". The base structure has perimeter and interior shear walls with some perimeter braced frames. The two towers are seismically separated with a separation joint. The south tower has perimeter braced frames from the 1st Floor to the 3rd Floor. The south tower then transitions to moment frames from the 3rd Floor to the roof on the east, west, and south elevations. The braced frames continue up to the roof on the north side from the 3rd Floor.

Identification of levels: 4 Stories: Ground Floor, First Floor, Second Floor, Third Floor, Roof.

Foundation system: Shallow foundations with grade beams and spread footings.

Structural system for vertical (gravity) load: Concrete over metal deck supported on steel beams, with beams supported on steel columns. Metal deck over steel beams at roofs.

Structural system for lateral forces: Steel concentric braced frames with shear walls.

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

Identified seismic deficiencies of the building including the following:

- The beams intersected by the chevron braces do not have adequate capacity to resist the net vertical load due to unbalanced tension and compression brace forces from below.
- The brace to the gusset connection does not have the capacity to withstand the expected tensile yield force of the brace as required in AISC 341-10. The main deficiencies are the net section and at the welds connecting the gusset to the brace.
- The seismic joint between Social Sciences North and South does not satisfy ASCE 41-17 Tier 1 Checklist requirements.

Structural deficiency	Affects rating?	Structural deficiency	Affects rating?
Lateral system stress check (wall shear, column shear or flexure, or brace axial as applicable)	Y	Openings at shear walls (concrete or masonry)	N
Load path	N	Liquefaction	N
Adjacent buildings	Y	Slope failure	N

Weak story	N	Surface fault rupture	N
Soft story	N	Masonry or concrete wall anchorage at flexible diaphragm	N
Geometry (vertical irregularities)	N	URM wall height-to-thickness ratio	N
Torsion	N	URM parapets or cornices	N
Mass – vertical irregularity	N	URM chimney	N
Cripple walls	N	Heavy partitions braced by ceilings	N
Wood sills (bolting)	N	Appendages	N
Diaphragm continuity	N		

Summary of review of non-structural life-safety concerns, including at exit routes.[3]

No nonstructural life-safety concerns seen in or around the structure.

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

The following noncompliance items from the Tier 1 checklist form the basis of rating:

- The connection strength is not adequate to develop the full yield capacity of the brace where the brace net section is coped at the gusset.
- The beams intersected by the chevron braces do not have adequate capacity to resist the net vertical load due to unbalanced tension and compression brace forces from below.

Recommendations for further evaluation or retrofit

A Tier 3 evaluation and a retrofit of the building are recommended based on the deficiencies found.

A retrofit of this building would consist of strengthening the beams intersected by the chevron braces. The net section of the brace and the brace to gusset weld also need to be strengthened. Pounding between the two structures should also be investigate further.

Peer review of rating

The key issues and expected seismic performance of this building are essentially the same as that for building 7921 (Social Sciences 2 North). The peer review of that building, carried out 24 June 2019, applies to this building; reviewers present were Bret Lizundia of R+C and Joe Maffei of Maffei Structural Engineering.

Additional building data	Entry	Notes
Latitude	37.003	
Longitude	-122.059	

[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 nonstructural hazards may occur.

Are there other structures besides this one under the same CAAN#	Yes	
Number of stories above lowest perimeter grade	5	
Number of stories (basements) below lowest perimeter grade	0	
Building occupiable area (OGSF)	32,194 sq ft	
Risk Category per 2016 CBC Table 1604.5	II	
Building structural height, h_n	56 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	0.42 sec	Estimated using ASCE 41-17 equation 4-4 and 7-18

Site data		
975 yr hazard parameters S_s, S_1	1.291,.49	
Site class	D	
Site class basis	Geotech[4]	See footnote below. [4]
Site parameters F_a, F_v	1.2, 1.811	
Ground motion parameters S_{cs}, S_{c1}	1.549, .887	
S_a at building period	1.549	
Site V_{s30}	900 ft/s	
V_{s30} basis	Estimated	
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: 1993 Code: 1991 UBC	

[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

Is this a benchmark building	No	
Is this a retrofit building?	No	
Applicable code for retrofit		
Model building data		
Model building type North-South	Steel,S2 - Steel Braced Frames (with Stiff Diaphragm) Concrete,C2 - Concrete Shear Walls (with Stiff Diaphragms)	
Model building type East-West	Steel,S2 - Steel Braced Frames (with Stiff Diaphragm) Concrete,C2 - Concrete Shear Walls (with Stiff Diaphragms)	
FEMA P-154 score	N/A	Not included here because we performed ASCE 41 Tier 1 evaluation.
Previous ratings		
Most recent rating	Unknown	
Date of most recent rating	Unkonwn	
2nd most recent rating	-	
Date of 2nd most recent rating	-	
3rd most recent rating	-	
Date of 3rd most recent rating	-	
Appendices		
ASCE 41 Tier 1 checklist included here?	Yes	Refer to attached checklist file in Appendix A.

University of California, Santa Cruz
ASCE 41-17 Tier 1 Seismic Evaluation
7921.1 - Social Sciences 2 South

Appendix A
ASCE 41-17 Checklists

UC Campus:	UCSC			Date:	6/27/19		
Building CAAN:	7121.1	Auxiliary CAAN:	-	By Firm:	Degenkolb Engineers		
Building Name:	Social Science 2			Initials:	TAB	Checked:	
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ASCE 41-17
Collapse Prevention Basic Configuration Checklist

LOW SEISMICITY

BUILDING SYSTEMS - *GENERAL*

C	NC	N/A	U	Description
●	○	○	○	LOAD PATH: The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation. (Commentary: Sec. A.2.1.1. Tier 2: Sec. 5.4.1.1) **Comments:**
○	●	○	○	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building is greater than 0.25% of the height of the shorter building in low seismicity, 0.5% in moderate seismicity, and 1.5% in high seismicity. (Commentary: Sec. A.2.1.2. Tier 2: Sec. 5.4.1.2) **Comments:**
○	○	●	○	MEZZANINES: Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure. (Commentary: Sec. A.2.1.3. Tier 2: Sec. 5.4.1.3) **Comments:**

BUILDING SYSTEMS - *BUILDING CONFIGURATION*

C	NC	N/A	U	Description
●	○	○	○	WEAK STORY: The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in the adjacent story above. (Commentary: Sec. A2.2.2. Tier 2: Sec. 5.4.2.1) **Comments:**
●	○	○	○	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:**
●	○	○	○	VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation. (Commentary: Sec. A.2.2.4. Tier 2: Sec. 5.4.2.3) **Comments:**

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

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Collapse Prevention Basic Configuration Checklist

C	NC	N/A	U	
○	●	○	○	GEOMETRY: There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines. (Commentary: Sec. A.2.2.5. Tier 2: Sec. 5.4.2.4) **Comments:** Shear wall length increases at the lower stories.
●	○	○	○	MASS: There is no change in effective mass of more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered. (Commentary: Sec. A.2.2.6. Tier 2: Sec. 5.4.2.5) **Comments:**
●	○	○	○	TORSION: The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension. (Commentary: Sec. A.2.2.7. Tier 2: Sec. 5.4.2.6) **Comments:**

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

GEOLOGIC SITE HAZARD

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

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Collapse Prevention Basic Configuration Checklist

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

FOUNDATION CONFIGURATION

	Description
C ☉ NC ☐ N/A ☐ U ☐	OVERTURNING: The ratio of the least horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than $0.6S_a$. (Commentary: Sec. A.6.2.1. Tier 2: Sec. 5.4.3.3) **Comments:** T=Ct*h^b = 0.02*56^0.75=.42 Sa=Sx1/T=.885/.42=2.11 0.6*2.11=1.26, 84/60=1.4
C ☉ NC ☐ N/A ☐ U ☐	TIES BETWEEN FOUNDATION ELEMENTS: The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C. (Commentary: Sec. A.6.2.2. Tier 2: Sec. 5.4.3.4) **Comments:** Slab on grade.

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

LOW SEISMICITY

SEISMIC-FORCE-RESISTING SYSTEM

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

CONNECTIONS

	Description
C ◉ NC ○ N/A ○ U ○	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:**
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:**

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

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

SEISMIC-FORCE-RESISTING SYSTEM

	Description
C ● NC ○ N/A ○ U ○	REDUNDANCY: The number of braced bays in each line is greater than 2. (Commentary: Sec. A.3.3.1.1. Tier 2: Sec. 5.5.1.1) **Comments:**
C ● NC ○ N/A ○ U ○	CONNECTION STRENGTH: All the brace connections develop the buckling capacity of the diagonals. (Commentary: Sec. A.3.3.1.5. Tier 2: Sec. 5.5.4.4) **Comments:**
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:**
C ● NC ○ N/A ○ U ○	K-BRACING: The bracing system does not include K-braced bays. (Commentary: Sec. A.3.3.2.1. Tier 2: Sec. 5.5.4.6) **Comments:**

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

SEISMIC-FORCE-RESISTING SYSTEM

	Description
C ● NC ○ N/A ○ U ○	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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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 *Kl/r* ratios less than 200. (Commentary: Sec. A.3.3.1.4. Tier 2: Sec. 5.5.4.3) **Comments:**
○	◉	○	○	CONNECTION STRENGTH: All the brace connections develop the yield capacity of the diagonals. (Commentary: Sec. A.3.3.1.5. Tier 2: Sec. 5.5.4.4) **Comments:**
◉	○	○	○	COMPACT MEMBERS: All brace elements meet section requirements in accordance with AISC 341, Table D1.1, for moderately ductile members. (Commentary: Sec. A.3.3.1.7. Tier 2: Sec.5.5.4) **Comments:**
○	◉	○	○	CHEVRON BRACING: Beams in chevron, or V-braced, bays are capable of resisting the vertical load resulting from the simultaneous yielding and buckling of the brace pairs. (Commentary: Sec. A.3.3.2.3. Tier 2: Sec. 5.5.4.6) **Comments:**
◉	○	○	○	CONCENTRICALLY BRACED FRAME JOINTS: All the diagonal braces frame into the beam–column joints concentrically. (Commentary: Sec. A.3.3.2.4. Tier 2: Sec. 5.5.4.8) **Comments:**

DIAPHRAGMS (STIFF OR FLEXIBLE)

				Description
C	NC	N/A	U	
◉	○	○	○	OPENINGS AT FRAMES: Diaphragm openings immediately adjacent to the braced frames extend less than 25% of the frame length. (Commentary: Sec. A.4.1.5. Tier 2: Sec. 5.6.1.3) **Comments:**

FLEXIBLE DIAPHRAGMS

				Description
C	NC	N/A	U	
○	○	◉	○	CROSS TIES: There are continuous cross ties between diaphragm chords. (Commentary: Sec. A.4.1.2. Tier 2: Sec. 5.6.1.2) **Comments:**

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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-sheathed diaphragms have aspect ratios less than 2-to-1 in the direction being considered. (Commentary: Sec. A.4.2.1. Tier 2: Sec. 5.6.2) **Comments:**
☐	☐	☐	☐	SPANS: All wood diaphragms with spans greater than 24 ft (7.3 m) consist of wood structural panels or diagonal sheathing. (Commentary: Sec. A.4.2.2. Tier 2: Sec. 5.6.2) **Comments:**
☐	☐	☐	☐	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12.2 m) and aspect ratios less than or equal to 4-to-1. (Commentary: Sec. A.4.2.3. Tier 2: Sec. 5.6.2) **Comments:**
☐	☐	☐	☐	OTHER DIAPHRAGMS: Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Commentary: Sec. A.4.7.1. Tier 2: Sec. 5.6.5) **Comments:**

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ASCE 41-17
Collapse Prevention Structural Checklist For Building Type C2-C2A

Low And Moderate Seismicity

Seismic-Force-Resisting System

C	NC	N/A	U	Description
●	○	○	○	COMPLETE FRAMES: Steel or concrete frames classified as secondary components form a complete vertical-load-carrying system. (Commentary: Sec. A.3.1.6.1. Tier 2: Sec. 5.5.2.5.1) **Comments:**
●	○	○	○	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:** Equivalent length of wall is one shear wall in each direction. Equivalent length of braced frame in each direction is also one line.
●	○	○	○	SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the greater of 100 lb/in.^{2} (0.69 MPa) or $2\sqrt{f'_c}$. (Commentary: Sec. A.3.2.2.1. Tier 2: Sec. 5.5.3.1.1) **Comments:** See quick checks
●	○	○	○	REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area is not less than 0.0012 in the vertical direction and 0.0020 in the horizontal direction. (Commentary: Sec. A.3.2.2.2. Tier 2: Sec. 5.5.3.1.3) **Comments:** See quick checks

Connections

C	NC	N/A	U	Description
○	○	●	○	WALL ANCHORAGE AT FLEXIBLE DIAPHRAGMS: Exterior concrete or masonry walls that are dependent on flexible diaphragms for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7. (Commentary: Sec. A.5.1.1. Tier 2: Sec. 5.7.1.1) **Comments:**
●	○	○	○	TRANSFER TO SHEAR WALLS: Diaphragms are connected for transfer of seismic forces to the shear walls. (Commentary: Sec. A.5.2.1. Tier 2: Sec. 5.7.2) **Comments:** Beam parallel to shear wall has shear studs

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ASCE 41-17
Collapse Prevention Structural Checklist For Building Type C2-C2A

C	NC	N/A	U	
◉	○	○	○	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation with vertical bars equal in size and spacing to the vertical wall reinforcing directly above the foundation. (Commentary: Sec. A.5.3.5. Tier 2: Sec. 5.7.3.4) **Comments:** Indicated in drawings

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

Seismic-Force-Resisting System

				Description
C	NC	N/A	U	DEFLECTION COMPATIBILITY: Secondary components have the shear capacity to develop the flexural strength of the components. (Commentary: Sec. A.3.1.6.2. Tier 2: Sec. 5.5.2.5.2) **Comments:**
○	○	◉	○	FLAT SLABS: Flat slabs or plates not part of the seismic-force-resisting system have continuous bottom steel through the column joints. (Commentary: Sec. A.3.1.6.3. Tier 2: Sec. 5.5.2.5.3) **Comments:**
○	○	◉	○	COUPLING BEAMS: The ends of both walls to which the coupling beam is attached are supported at each end to resist vertical loads caused by overturning. (Commentary: Sec. A.3.2.2.3. Tier 2: Sec. 5.5.3.2.1) **Comments:** No coupling beams are present

Diaphragms (Stiff Or Flexible)

				Description
C	NC	N/A	U	DIAPHRAGM CONTINUITY: The diaphragms are not composed of split-level floors and do not have expansion joints. (Commentary: Sec. A.4.1.1. Tier 2: Sec. 5.6.1.1) **Comments:** No split level diaphragms
○	○	◉	○	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:**

Flexible Diaphragms

				Description

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

UC Campus:	Santa Cruz			Date:	6/27/2019		
Building CAAN:	7921	Auxiliary CAAN:	7921.1	By Firm:	Degenkolb Engineers		
Building Name:	Social Sciences 2			Initials:	JSW	Checked:	
Building Address:	712 College Ten Road Santa Cruz, CA 95064			Page:	3	of	3

ASCE 41-17
Collapse Prevention Structural Checklist For Building Type C2-C2A

C	NC	N/A	U	
○	○	◉	○	CROSS TIES: There are continuous cross ties between diaphragm chords. (Commentary: Sec. A.4.1.2. Tier 2: Sec. 5.6.1.2) **Comments:**
○	○	◉	○	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 2-to-1 in the direction being considered. (Commentary: Sec. A.4.2.1. Tier 2: Sec. 5.6.2) **Comments:**
○	○	◉	○	SPANS: All wood diaphragms with spans greater than 24 ft (7.3 m) consist of wood structural panels or diagonal sheathing. (Commentary: Sec. A.4.2.2. Tier 2: Sec. 5.6.2) **Comments:**
○	○	◉	○	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12.2 m) and aspect ratios less than or equal to 4-to-1. (Commentary: Sec. A.4.2.3. Tier 2: Sec. 5.6.2) **Comments:**
○	○	◉	○	OTHER DIAPHRAGMS: Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Commentary: Sec. A.4.7.1. Tier 2: Sec. 5.6.5) **Comments:**

Connections

		Description
C	NC N/A U	
○	○ ◉ ○	UPLIFT AT PILE CAPS: Pile caps have top reinforcement, and piles are anchored to the pile caps. (Commentary: Sec. A.5.3.8. Tier 2: Sec. 5.7.3.5) **Comments:** Spread and strip footings utilized

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

University of California, Santa Cruz
ASCE 41-17 Tier 1 Seismic Evaluation
7921.1 - Social Sciences 2 South

Appendix B
Quick Check Calculations

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Subject:	Global Data	**Job Number:**	B9956006.00	**Date:**	06/28/19
Job:	UCSC Tier 1 Seismic Evaluations CAAN #7921.1	**By:**	JCY	**Section:**	
		Checked By:		**Page**	

GLOBAL DATA

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

SITE DATA:

Latitude:		37.804813	°N	712 College Ten Road	*USGS Seismic Design Map Application:*	
Longitude:		-122.273562	°W	Santa Cruz, CA 95064	*http://geohazards.usgs.gov/hazardtool/application.php*	
Site Class:		D (default)		(Stiff Soil)	Site Class	[ASCE 41-17, §2.4.1.6]
S_S	=	1.291	g	(USGS) (5% / 50 years)	USGS Mapped (T = 0.2 sec)	[ASCE 41-17, §2.4.1.3]
S_1	=	0.490	g	(USGS) (5% / 50 years)	USGS Mapped (T = 1.0 sec)	[ASCE 41-17, §2.4.1.3]
F_a	=	1.200		(Site Class D)	Site Coefficient (T = 0.2 sec)	[ASCE 7-16, Table 11.4-1]
F_v	=	1.810		(Site Class D)	Site Coefficient (T = 1.0 sec)	[ASCE 7-16, Table 11.4-2]
S_{XS}	=	1.549	g	= F_a S_S	Site-Adjusted Design (T = 0.2 sec)	[ASCE 41-17, Eq. 2-1]
S_{X1}	=	0.887	g	= F_v S_1	Site-Adjusted Design (T = 1.0 sec)	[ASCE 41-17, Eq. 2-2]

BUILDING DATA:

Building Type:	S2	(Steel Braced Frames with Stiff Diaphragms)	[ASCE 41-17, Table 3-1]
Year Built:	1993		
Number of Stories:	4	stories	
Parapet Height:	4.00	ft	
Roof Height:	58.00	ft	
Total Area:	29,826	sf	

Level	Height [ft]	Elevation [ft]	$Length_{N-S}$ [ft]	$Length_{E-W}$ [ft]	Area [sf]	Diaphragm Stiffness	Diaphragm Description
Roof	17.0	58.0	31	21	661	Rigid	Concrete Fill over Metal Deck
3rd	13.0	41.0	84	93	6,488	Rigid	Concrete Fill over Metal Deck
2nd	13.0	28.0	84	93	7,433	Rigid	Concrete Fill over Metal Deck
1st	15.0	15.0	84	93	7,433	Rigid	Concrete Fill over Metal Deck
Ground	0.0	0.0	84	93	7,811	Rigid	Concrete Fill over Metal Deck

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Subject:	Seismic Mass	**Job Number:**	B9956006.00	**Date:**	06/28/19
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SEISMIC MASS

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BSE-2E HAZARD LEVEL

ROOF/FLOOR WEIGHT SUMMARY:

Level Type	Weight [psf]
ROOF	242.6
FLR-4	66.8
FLR-3	64.9
FLR-2	65.4

SEISMIC MASS SUMMARY:

Level	FLOOR			WALL ABOVE				WALL BELOW				TOTAL
	Level Type	Weight [psf]	Area [sf]	Wall Type	Weight [psf]	Length [ft]	Height [ft]	Wall Type	Weight [psf]	Length [ft]	Height [ft]	WEIGHT [kips]
Roof	ROOF	199	661	WALL-P	13.0	0	4.00	WALL-R	13.0	261	8.50	160
3rd	FLR-4	59	6,488	WALL-R	13.0	261	8.50	WALL-4	13.0	261	6.50	434
2nd	FLR-3	59	7,433	WALL-4	13.0	261	6.50	WALL-3	13.0	261	6.50	483
1st	FLR-2	59	7,433	WALL-3	13.0	261	6.50	WALL-2	13.0	261	7.50	486
											TOTAL	1,563

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Subject:	Seismic Forces	**Job Number:**	B9956006.00	**Date:**	06/28/19
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SEISMIC FORCES

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

BUILDING TYPE: S2 (Steel Braced Frames with Stiff Diaphragms) [ASCE 41-17, Table 3-1]
SITE CLASS: D (default) #N/A [ASCE 41-17, §2.4.1.6]

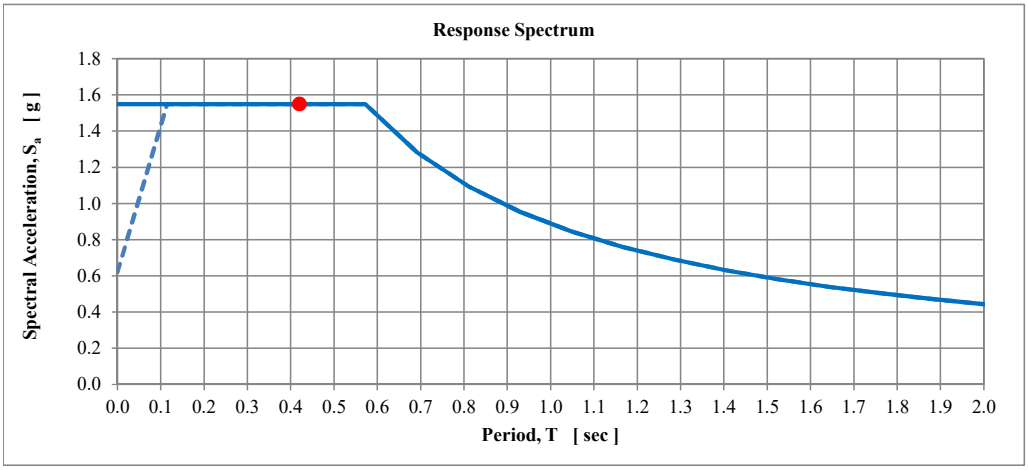
DESIGN SPECTRAL ACCELERATIONS:

S_{XS}	=	1.549 g	(BSE-2E)	Site-Adjusted Design (T = 0.2 sec)	[ASCE 41-17, Eq. 2-1]
S_{X1}	=	0.887 g	(BSE-2E)	Site-Adjusted Design (T = 1.0 sec)	[ASCE 41-17, Eq. 2-2]

BUILDING PERIOD:

h_n	=	58.0 ft	(Base to Roof)	Building Height	[ASCE 41-17, §4.4.2.4]
C_t	=	0.020	(Building Type S2)	Period Coefficient	[ASCE 41-17, §4.4.2.4]
β	=	0.750	(Building Type S2)	Period Exponent	[ASCE 41-17, §4.4.2.4]
T	=	0.420 sec	$= C_t h_n^{\beta}$	Fundamental Period	[ASCE 41-17, Eq. 4-4]

RESPONSE SPECTRUM:



PSEUDO LATERAL FORCE:

n	=	4	($n \geq 4$)	Total Number of Stories	
C	=	1.0	(Building Type S2)	Modification Factor	[ASCE 41-17, Table 4-7]
S_a	=	1.549 g	$= MIN \{ S_{X1} / T , S_{XS} \}$	Spectral Acceleration	[ASCE 41-17, Eq. 4-3]
V	**=**	**1.549 W**	$= C S_a W$	Pseudo Lateral Force	[ASCE 41-17, Eq. 4-1]

VERTICAL DISTRIBUTION OF SEISMIC FORCES:

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

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

$V_j = \Sigma F_x$ [ASCE 41-17, Eq. 4-2b]

Level	h_x [ft]	w_x [kips]	$w_x h_x^{k}$	C_{vx}	F_x [kips]	V_j [kips]
Roof	58.0	160	9,302	0.19	470	470
3rd	41.0	434	17,781	0.37	899	1,369
2nd	28.0	483	13,514	0.28	683	2,052
1st	15.0	486	7,291	0.15	369	2,421
TOTAL	-	1,563	47,888	1.00	2,421	-

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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:	S2	(Steel Braced Frames with Stiff Diaphragms)	[ASCE 41-17, Table 3-1]
FRAME TYPE:	CBF	(Concentrically Braced Frame)	
CONFIGURATION:	Inverted V	(Inverted V-Bracing)	
BRACE TYPE:	W	(Wide Flange Braces)	
AXIAL LOAD:	T+C	(Tension and Compression)	
LOAD DIRECTION:	Transverse		

FRAME PROPERTIES:

Level	n_f [frames]	n_c [columns]	n_{bays} [bays]	n_{br} [braces]	L_f [ft]	$L_{typical\ bay}$ [ft]	DL [psf]	LL [psf]	A_{trib} [ft^2]	P_D [kips]	P_L [kips]
Roof	2	10	4	4	40.0	21	243	20	310	75	6
3rd	2	10	4	4	40.0	21	67	50	310	96	27
2nd	2	10	4	4	40.0	21	65	50	310	116	47
1st	2	10	4	4	40.0	21	65	50	310	136	67

FRAME MEMBER PROPERTIES: [ASCE 41-17 §4.2.3]

Material Properties:

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

Column Properties:

Level	Section	Bending Axis	L_c [ft]	A_c [in^2]
Roof	W12x79	x	17.0	23.2
3rd	W12x96	x	13.0	28.2
2nd	W12x96	x	13.0	28.2
1st	W12x336	x	15.0	98.9

Brace Properties:

Level	Section	$L_{br,x}$ [ft]	$L_{br,y}$ [ft]	L_{br} [ft]	A_{br} [in^2]	d_{br} / t_{br}	b/t	λ_r	λ_{hd}	Kl/r
Roof	W12x87	10.7	17.0	20.1	25.60	n/a	7.48	14.89	10.14	78.44
3rd	W12x87	10.7	13.0	16.8	25.60	n/a	7.48	14.89	10.14	65.73
2nd	W12x120	10.7	13.0	16.8	35.20	n/a	5.57	14.89	10.14	64.47
1st	W12x170	10.7	15.0	18.4	50.00	n/a	4.03	14.89	10.14	68.59

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QUICK CHECKS

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CHAPTER 4 - TIER 1 EVALUATION
LINEAR STATIC PROCEDURE
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BSE-2E HAZARD LEVEL

BUILDING TYPE: S2 (Steel Braced Frames with Stiff Diaphragms) [ASCE 41-17, Table 3-1]
LOAD DIRECTION: Transverse

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

M_s	=	2.5	COLLAPSE PREVENTION	System Modification Factor	[ASCE 41-17, §4.4.3.6]
F_{yc}	=	41 ksi	(ASTM A572 / Structural)	Column Yield Stress	[ASCE 41-17, §4.2.3]
$P_{n,E} / A_c$	=	12.3 ksi	= 0.30 F_{yc}	Seismic Axial Stress Capacity	[ASCE 41-17, §A.3.1.3.2]
$P_{n,G} / A_c$	=	4.1 ksi	= 0.10 F_{yc}	Gravity Axial Stress Capacity	[ASCE 41-17, §A.3.1.3.2]
$M_{x,ot}$	=	$\Sigma (F_x h_x)$		Global Overturning Moment	[ASCE 41-17, §4.4.3.6]
P_E	=	$(1 / M_s) (M_{x,ot} / n_f) / L_f$		Seismic Axial Load due to Overturning	[ASCE 41-17, §4.4.3.6]
P_G	=	$P_D + P_L$		Unfactored Gravity Load	[ASCE 41-17, §A.3.1.3.2]
P_D	=	$\Sigma (DL A_{trib})$		Gravity Dead Load	[ASCE 41-17, §4.4.3.6]
P_L	=	$\Sigma (LL A_{trib})$		Gravity Live Load	[ASCE 41-17, §4.4.3.6]

Level	Section	A_c [in^2]	h_x [ft]	F_x [kips]	$M_{x,ot}$ [k-ft]	P_E [kips]	$P_E / F_{yc} A_c$	P_G [kips]	$P_G / F_{yc} A_c$	DCR		Quick Check
										Seismic	Gravity	
Roof	W12x79	23.2	58.0	470	7,995	40	0.04	81	0.09	0.14	0.86	OK
4th	W12x79	23.2	41.0	0	7,995	40	0.04	81	0.09	0.14	0.86	OK
3rd	W12x96	28.2	41.0	899	25,795	129	0.11	123	0.11	0.37	1.06	OK
2nd	W12x96	28.2	28.0	683	52,476	262	0.23	163	0.14	0.76	1.41	OK
1st	W12x336	98.9	15.0	369	88,792	444	0.11	204	0.05	0.36	0.50	OK

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

M_s	=	7.0	(Tube, $d_{br} / t_{br} < 90 / \sqrt{F_{yebr}}$)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
		3.5	(Tube, $d_{br} / t_{br} > 190 / \sqrt{F_{yebr}}$)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
		7.0	(Pipe, $d_{br} / t_{br} < 1500 / F_{yebr}$)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
		3.5	(Pipe, $d_{br} / t_{br} > 6000 / F_{yebr}$)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
		3.5	(Tension-Only Braces)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
		3.5	(Cold-formed steel strap-braced wa	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
		7.0	(All Other Brace Types)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
F_{ybr}	=	41 ksi	(ASTM A572 / Structural)	Brace Yield Stress	[ASCE 41-13, Table 4-5]
F_{yebr}	=	51 ksi	= 1.25 F_{ybr}	Brace Expected Yield Stress	[ASCE 41-17, §4.4.3.4]
f_{nbr}	=	21 ksi	= 0.50 F_{ybr}	Brace Axial Stress Capacity	[ASCE 41-17, §A.3.3.1.2]
$f_{j,avg}$	=	$(1 / M_s) (V_j / (L_{br,x} n_{br})) (L_{br} / A_{br})$		Average Brace Axial Stress	[ASCE 41-17, Eq. 4-9]

Level	V_j [kips]	n_{br} [braces]	$L_{br,x}$ [ft]	L_{br} [ft]	A_{br} [in^2]	d_{br} / t_{br}	M_s	$f_{j,avg}$ [ksi]	DCR	Quick Check
Roof	470	4	10.7	20.1	25.60	n/a	7.00	1.2	0.06	OK
4th	470	4	10.7	10.7	19.10	n/a	7.00	0.9	0.04	OK
3rd	1,369	4	10.7	16.8	25.60	n/a	7.00	3.0	0.15	OK
2nd	2,052	4	10.7	16.8	35.20	n/a	7.00	3.3	0.16	OK
1st	2,421	4	10.7	18.4	50.00	n/a	7.00	3.0	0.15	OK

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QUICK CHECKS

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BSE-2E HAZARD LEVEL

BUILDING TYPE: S2 (Steel Braced Frames with Stiff Diaphragms) [ASCE 41-17, Table 3-1]

LOAD DIRECTION Longitudinal

FRAME PROPERTIES:

Level	n_f [frames]	n_c [columns]	n_{bays} [bays]	n_{br} [braces]	L_f [ft]	$L_{typical\ bay}$ [ft]	DL [psf]	LL [psf]	A_{trib} [ft^2]	P_D [kips]	P_L [kips]
Roof	2	8	4	8	62.0	31.0	243	20	310	75	6
3rd	2	8	4	8	62.0	31.0	67	50	310	96	27
2nd	2	8	4	8	62.0	31.0	65	50	310	116	47
1st	2	8	4	8	62.0	31.0	65	50	310	136	67

FRAME MEMBER PROPERTIES: [ASCE 41-17, §4.2.3]

Material Properties: (ASCE 41 Default)

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

Column Properties:

Level	Section	Bending Axis	L_c [ft]	A_c [in^2]
Roof	W12x96	x	17.0	28.2
3rd	W12x96	x	13.0	28.2
2nd	W12x96	x	13.0	28.2
1st	W12x96	x	15.0	28.2

Brace Properties:

Level	Section	$L_{br,x}$ [ft]	$L_{br,y}$ [ft]	L_{br} [ft]	A_{br} [in^2]	d_{br} / t_{br}	b/t	λ_r	λ_{hd}	Kl/r
Roof	W12x53	15.5	17.0	23.0	15.60	n/a	8.69	14.89	10.14	111.32
3rd	W12x58	15.5	13.0	20.2	17.00	n/a	7.82	14.89	10.14	96.72
2nd	W12x65	15.5	13.0	20.2	19.10	n/a	9.92	14.89	10.14	80.38
1st	W12x65	15.5	15.0	21.6	19.10	n/a	9.92	14.89	10.14	85.71

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BSE-2E HAZARD LEVEL

BUILDING TYPE: S2 (Steel Braced Frames with Stiff Diaphragms) [ASCE 41-17, Table 3-1]
LOAD DIRECTION Longitudinal

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

M_s	=	2.5	COLLAPSE PREVENTION	System Modification Factor	[ASCE 41-17, §4.4.3.6]
F_{yc}	=	41 ksi	(ASTM A572 / Structural)	Column Yield Stress	[ASCE 41-17, §4.2.3]
$P_{n,E} / A_c$	=	12.3 ksi	= 0.30 F_{yc}	Seismic Axial Stress Capacity	[ASCE 41-17, §A.3.1.3.2]
$P_{n,G} / A_c$	=	4.1 ksi	= 0.10 F_{yc}	Gravity Axial Stress Capacity	[ASCE 41-17, §A.3.1.3.2]
$M_{x,ot}$	=	$\Sigma (F_x h_x)$		Global Overturning Moment	[ASCE 41-17, §4.4.3.6]
P_E	=	$(1 / M_s) (M_{x,ot} / n_f) / L_f$		Seismic Axial Load due to Overturning	[ASCE 41-17, §4.4.3.6]
P_G	=	$P_D + P_L$		Unfactored Gravity Load	[ASCE 41-17, §A.3.1.3.2]
P_D	=	$\Sigma (DL A_{trib})$		Gravity Dead Load	[ASCE 41-17, §4.4.3.6]
P_L	=	$\Sigma (LL A_{trib})$		Gravity Live Load	[ASCE 41-17, §4.4.3.6]

Level	Section	A_c [in^2]	h_x [ft]	F_x [kips]	$M_{x,ot}$ [k-ft]	P_E [kips]	$P_E / F_{yc} A_c$	P_G [kips]	$P_G / F_{yc} A_c$	DCR		Quick Check
										Seismic	Gravity	
Roof	W12x96	28.2	58.0	470	7,995	26	0.02	81	0.07	0.07	0.70	OK
4th	W12x79	23.2	41.0	0	7,995	26	0.03	81	0.09	0.09	0.86	OK
3rd	W12x96	28.2	41.0	899	25,795	83	0.07	123	0.11	0.24	1.06	OK
2nd	W12x96	28.2	28.0	683	52,476	169	0.15	163	0.14	0.49	1.41	OK
1st	W12x96	28.2	15.0	369	88,792	286	0.25	204	0.18	0.83	1.76	OK

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

M_s	=	7.0	(Tube, $d_{br} / t_{br} < 90 / \sqrt{F_{yebr}}$)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
		3.5	(Tube, $d_{br} / t_{br} > 190 / \sqrt{F_{yebr}}$)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
		7.0	(Pipe, $d_{br} / t_{br} < 1500 / F_{yebr}$)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
		3.5	(Pipe, $d_{br} / t_{br} > 6000 / F_{yebr}$)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
		3.5	(Tension-Only Braces)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
		3.5	(Cold-formed steel strap-braced wa	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
		7.0	(All Other Brace Types)	System Modification Factor (CP)	[ASCE 41-17, Table 4-9]
F_{ybr}	=	41 ksi	(ASTM A572 / Structural)	Brace Yield Stress	[ASCE 41-13, Table 4-5]
F_{yebr}	=	51 ksi	= 1.25 F_{ybr}	Brace Expected Yield Stress	[ASCE 41-17, §4.4.3.4]
f_{nbr}	=	21 ksi	= 0.50 F_{ybr}	Brace Axial Stress Capacity	[ASCE 41-17, §A.3.3.1.2]
$f_{j,avg}$	=	$(1 / M_s) (V_j / (L_{br,x} n_{br})) (L_{br} / A_{br})$		Average Brace Axial Stress	[ASCE 41-17, Eq. 4-9]

Level	V_j [kips]	n_{br} [braces]	$L_{br,x}$ [ft]	L_{br} [ft]	A_{br} [in^2]	d_{br} / t_{br}	M_s	$f_{j,avg}$ [ksi]	DCR	Quick Check
Roof	470	8	15.5	23.0	15.60	n/a	7.00	0.8	0.04	OK
4th	470	8	15.5	15.5	17.00	n/a	7.00	0.5	0.02	OK
3rd	1,369	8	15.5	20.2	17.00	n/a	7.00	1.9	0.09	OK
2nd	2,052	8	15.5	20.2	19.10	n/a	7.00	2.5	0.12	OK
1st	2,421	8	15.5	15.0	19.10	n/a	7.00	2.2	0.11	OK

Degenkolb

Subject: Brace Connection Check
Job: UCSC Tier 1 - CAAN#7921.1
Job Number: B959006.00
By: JSW/JCY
Checked By:
Date: 06/28/2019
Section:
Page: 1 of 1

Purpose: To check if the W12x53 brace connection can develop the full tensile capacity of the diagonal

Procedure: The calcuation steps are as follows

Step 1: Check the brace net section rupture capacity

Step 2: Check brace to gusset weld

Step 1: Check the brace net section rupture capacity

Per AISC 341-10 the connection must develop the expected tensile yield strength of the brace Per the general notes, structural steel members are ASTM A36. Per S37 the gussets are ASTM A572 Gr. 50. The expected material strength of the braces is calculated by multiplying fy by Ry per table A3.1

$f_y := 36\ ksi$ $f_u := 58\ ksi$ $A_{brace} := 15.6\ in^2$

$R_y := 1.5$ $t_f := 0.575 \cdot in$

$t_w := 0.345 \cdot in$

$f_{ye} := f_y \cdot R_y = 54\ ksi$ $b_f := 10\ in$

$d := 12.1\ in$

$T_u := f_{ye} \cdot A_{brace} = 842.4\ kip$ $l_{weld} := 22\ in$

Original drawings say gusset is 1" thick. Drawings indicated that beam flange is coped to beam web on one side for brace to gusset attachment. Take this as the net section area for tensile rupture

$A_n := A_{brace} - 2 \cdot t_f \cdot \frac{(b_f - t_w)}{2} = 10.05\ in^2$

$l_{weld} > 2 \cdot d = 0$

$2\ d > l_{weld} > 1.5 \cdot d = 1$

$U := .87$ Table D3.1 AISC 360-10

$A_e := A_n \cdot U = 8.74\ in^2$

$T_n := f_u \cdot A_e = 507.04\ kip$

Existing building so use a phi of 1

$\phi := 1$

$DCR := \frac{T_u}{\phi \cdot T_n} = 1.66$

Step 2: Check brace to gusset weld

$l_{weld} = 22\ in$ $T_u = 842.4\ kip$

$t_{weld} := 0.69\ in$ $\phi = 1$

$F_{EXX} := 70\ ksi$

Eq 8-1

$R_n := 2 \cdot 0.6 \cdot F_{EXX} \cdot \frac{\sqrt{2}}{2}\ t_{weld} \cdot l_{weld} = 901.65\ kip$ $DCR_{weld} := \frac{T_u}{\phi \cdot R_n} = 0.93$

Degenkolb

Subject: Brace Connection Check
Job: UCSC Tier 1 - CAAN#7921.1
Job Number: B959006.00
By: JSW/JCY
Checked By:
Date: 06/28/2019
Section:

Purpose: To check if the W24x76 bream can resist the effect of the combine tensile and compressive brace capacities applied at midspan

Procedure: The calcuation steps are as follows
Step 1: Determine brace capacities
Step 2: Check beam in chevron configuration

Step 1: Determine brace capacities

Per AISC 341-10 the connection must develop the expected tensile yield strength of the brace Per the general notes, wide flange sections are either ASTM A36 and/or ASTM A572 Gr. 50. The expected material strength of each is close after multiplying by Ry per table A3.1

$f_y := 36\ ksi$ $A_{brace} := 15.6\ in^2$
$R_y := 1.5$
$f_u := 58\ ksi$
$E := 29000\ ksi$

Tension
$f_{ye} := f_y \cdot R_y = 54\ ksi$
$T_u := f_{ye} \cdot A_{brace} = 842.4\ kip$

Compression
No slender elements from quick check worksheet. Kl/r calculated in quick check worksheet

$Klr := 132.8$

$F_e := \frac{\pi^2 \cdot E}{Klr^2} = 16.23\ ksi$

$\frac{f_y}{F_e} = 2.22$ $\frac{f_y}{F_e} \le 2.25 = 1$

$F_{cr} := \left(0.658^{\frac{f_y}{F_e}}\right) \cdot f_y = 14.23\ ksi$

$P_n := A_{brace} \cdot F_{cr} = 221.93\ kip$
$C_u := 0.3 \cdot P_n = 66.58\ kip$ AISC 341-10 F1.4a

Degenkolb

Subject: Brace Connection Check
Job: UCSC Tier 1 - CAAN#7921.1
Job Number: B959006.00
By: JSW/JCY
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Step 2: Check W24x76 beam in chevron configuration

$l_{beam} := 31\ ft$

$\theta := \text{acos}\left(\frac{15.5\ ft}{21.6\ ft}\right) = 44.14\ deg$

$P := \sin(\theta) \cdot (T_u - C_u) = 540.33\ kip$

$M_u := \frac{P \cdot l_{beam}}{4} = 50250.76\ kip \cdot in$ Pin Pin per connection assumed based on details

$Z_{beam} := 200\ in^3$

$M_n := f_{ye} \cdot Z_{beam} = 10800\ kip \cdot in$

$\phi := 1$

$DCR := \frac{M_u}{\phi \cdot M_n} = 4.65$

Degenkolb

Subject:	Quick Checks	**Job Number:**	B9956006.00	**Date:**	06/28/19
Job:	UCSC Tier 1 Seismic Evaluations CAAN #7921.1	**By:**	JCY	**Section:**	
		Checked By:		**Page**	

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: C2 (Concrete Shear Walls with Stiff Diaphragms) [ASCE 41-17, Table 3-1]

STEEL REINFORCING RATIO CHECK: [ASCE 41-17, §A.3.2.2.2]

		Horizontal Reinforcing					Vertical Reinforcing				
Wall Type	t_w [in]	$n_{curtains}$ [curtains]	Bar Size No.	Spacing [in]	ρ_h	$\rho_h \geq 0.0020$	$n_{curtains}$ [curtains]	Bar Size No.	Spacing [in]	ρ_v	$\rho_v \geq 0.0012$
WALL-2	12	2	5	10	0.0052	OK	2	5	8	0.0065	OK

AVERAGE SHEAR STRESS CHECK: [ASCE 41-17, §A.3.2.2.1]

f'_c	=	4,000 psi	(ASCE 41 Default)	Concrete Compressive Strength	[ASCE 41-17, Table 4-2]
v_n	=	126 psi	= MAX { 100 psi , 2 $\sqrt{f'_c}$ }	Shear Wall Capacity	[ASCE 41-17, §A.3.2.2.1]
M_s	=	4.5	COLLAPSE PREVENTION	System Modification Factor	[ASCE 41-17, Table 4-8]
$v_{j,\,avg}$	=	(1 / M_s) (V_j / A_w)		Average Shear Wall Stress	[ASCE 41-17, Eq. 4-8]
A_w	=	t_w ($L_{w,\,total}$ - $L_{w,\,openings}$)		Net Wall Area	[ASCE 41-17, §4.4.3.3]

North-South Direction:

Level	V_j/2 [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
1st	1,211	WALL-2	12	64	0	64	9,215	29	0.23	OK

East-West Direction:

Level	V_j/2 [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
1st	1,211	WALL-2	16	62	0	62	11,904	23	0.18	OK

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7921.1 Social Sciences 2 South

Appendix C
Photos and Details

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7921.1 Social Sciences 2 South

Figure 1 - South Elevation View of the South Tower

Figure 2 - Seismic Joint between the North and South Towers (North is to the right)

Figure 3 - View of hall way looking toward north. Seismic Joint is seen above the doors.

Figure 4 - View of stepped perimeter shear wall (East Elevation)

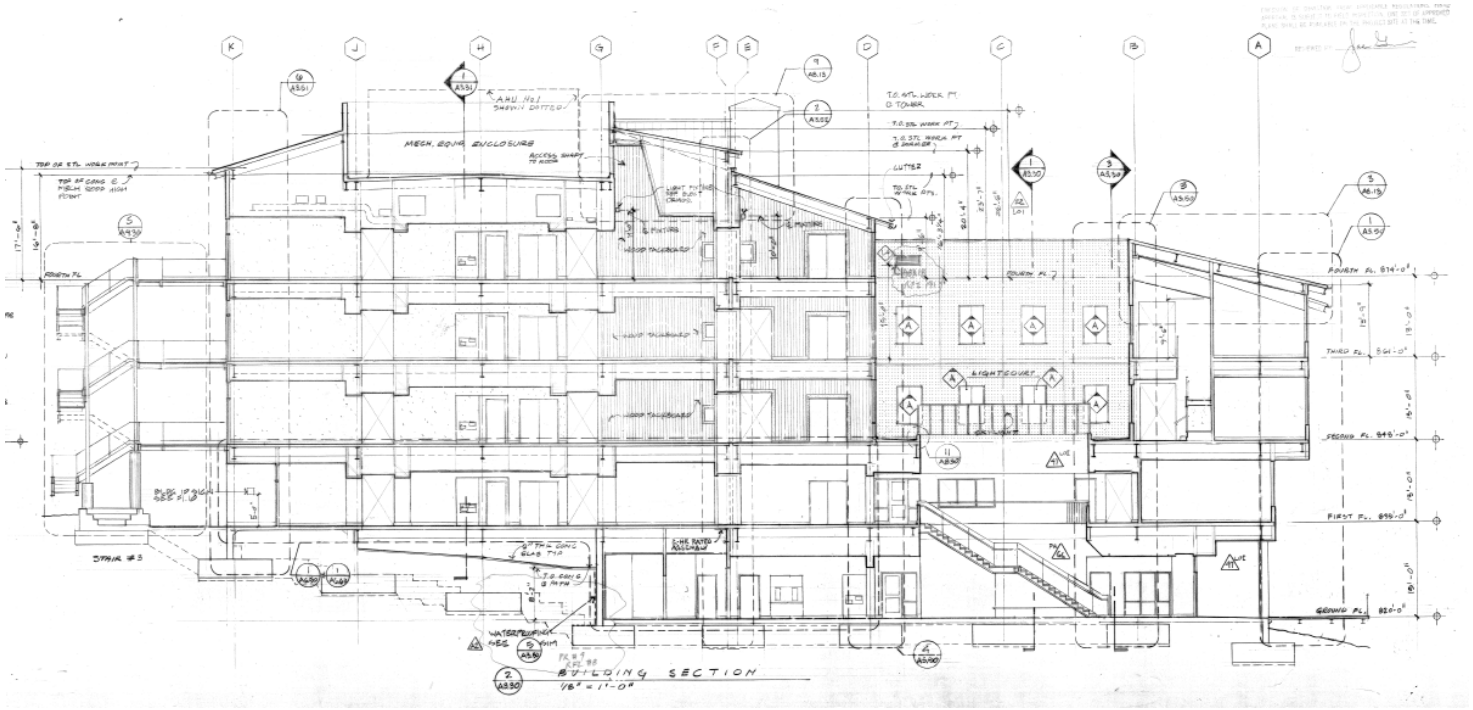

Figure 5 - Architectural Section of Both Towers Looking Toward East

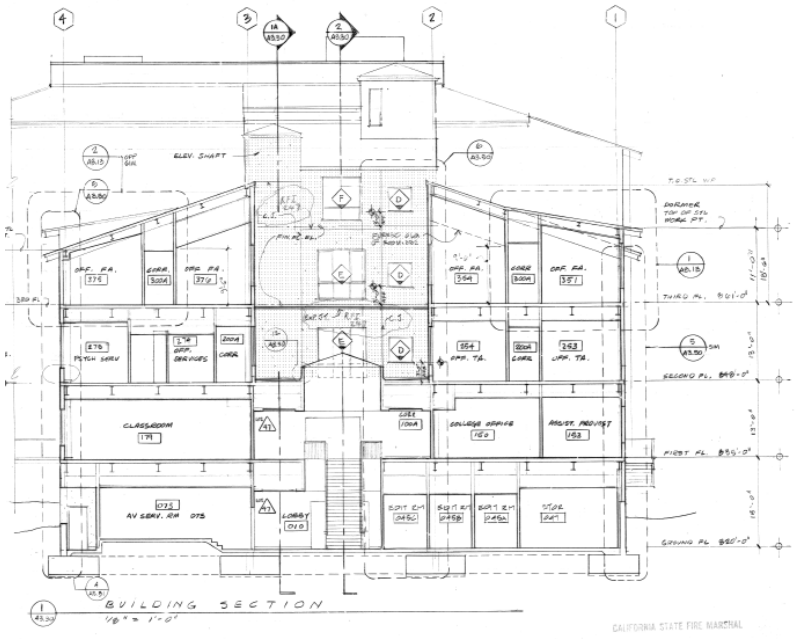

Figure 6 - Architectural Section of South Tower Looking Toward North

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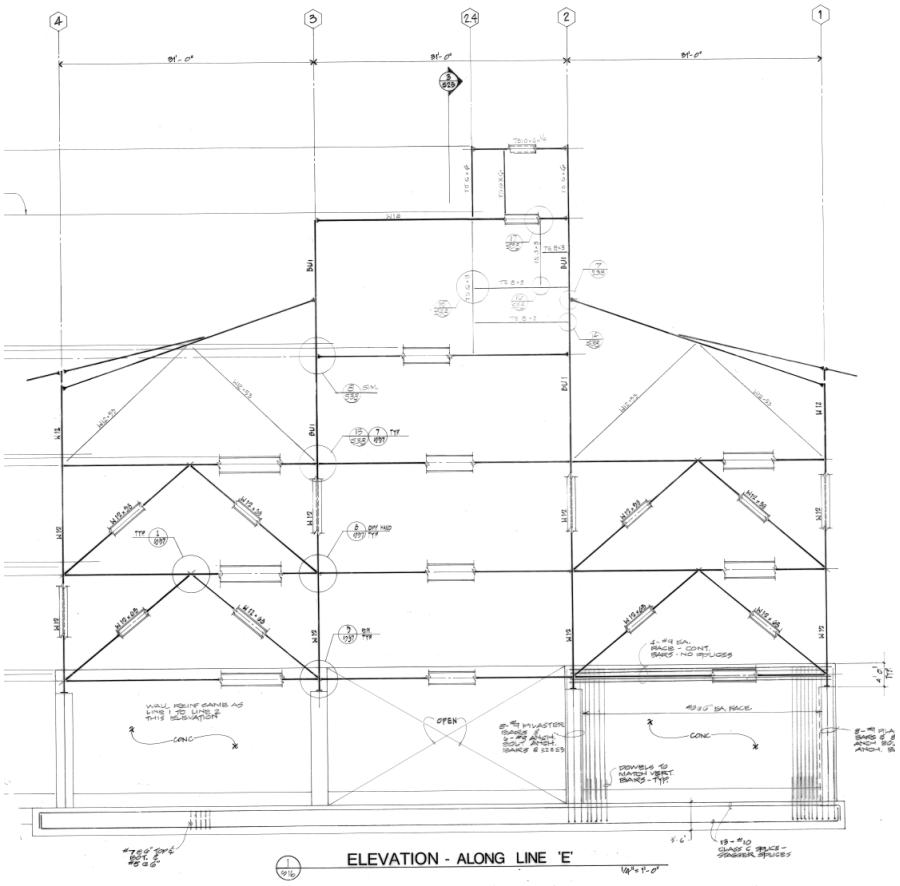

Figure 7 - Longitudinal Frame Elevation (North Elevation)

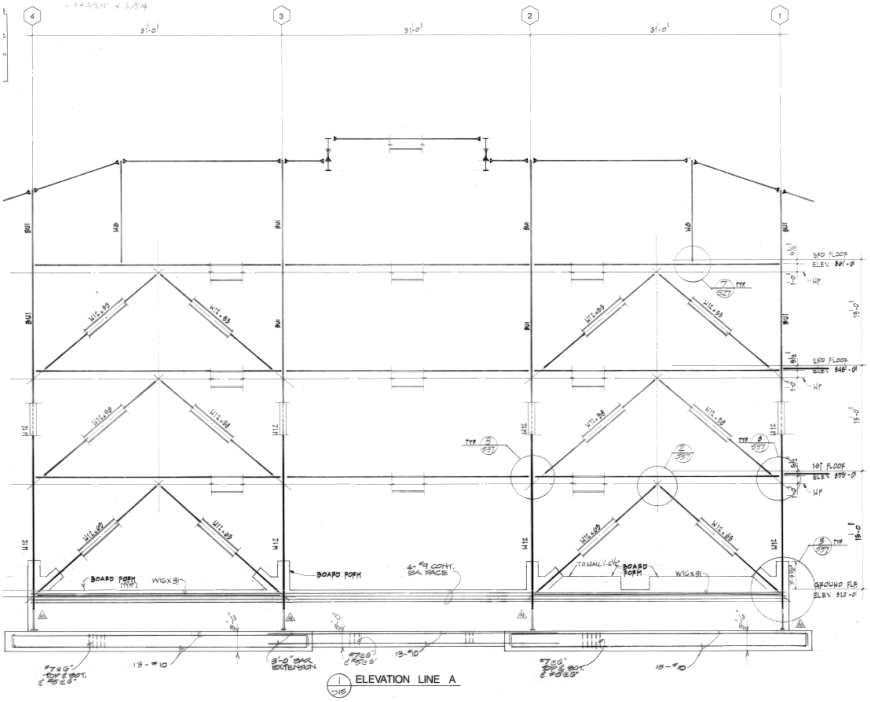

Figure 8 - Longitudinal Frame Elevation (South Elevation)

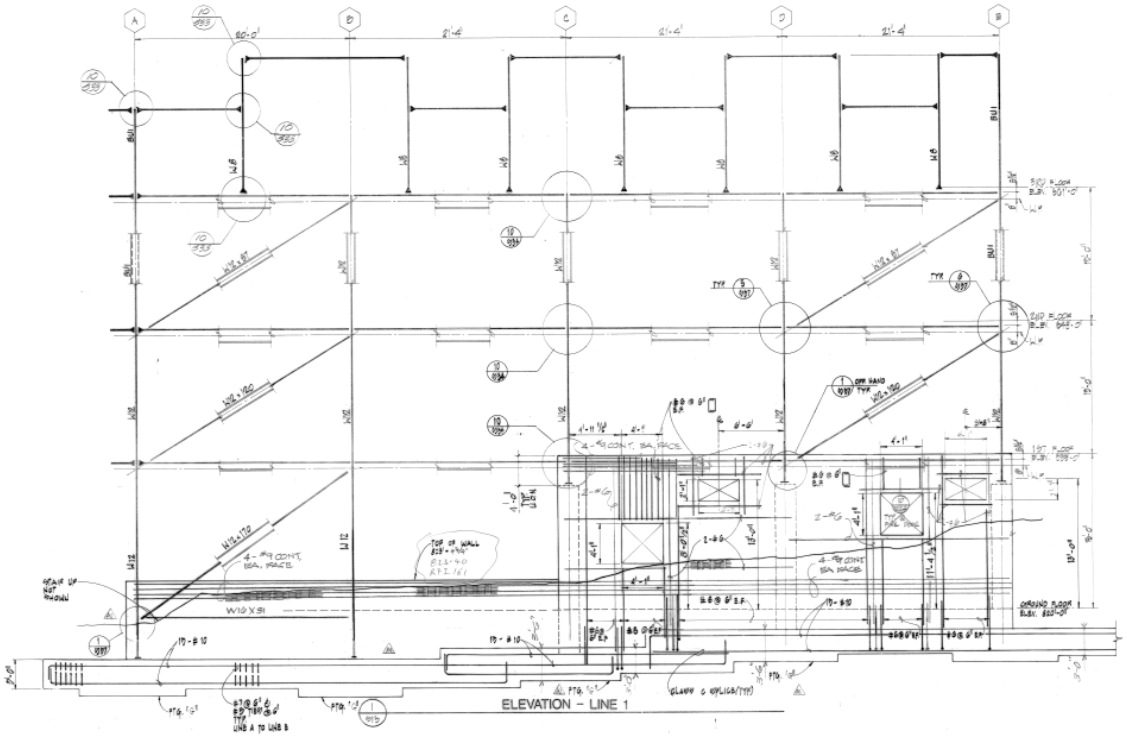

Figure 9 - Transverse Frame Elevation (East)

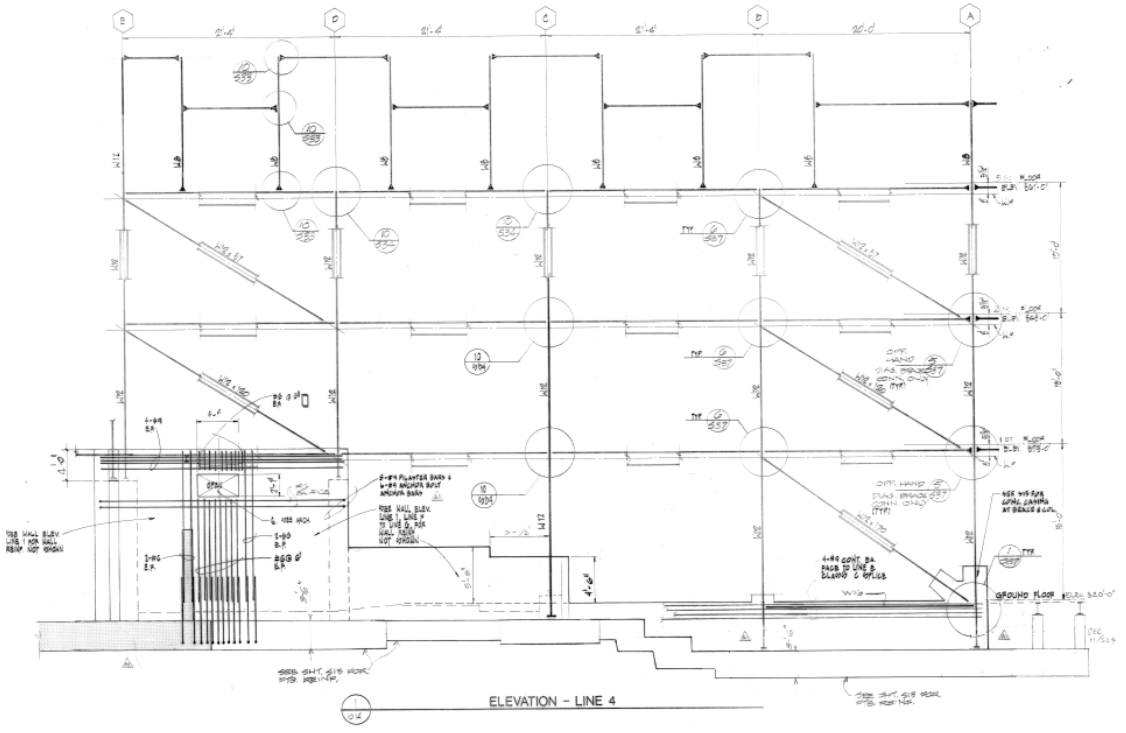

Figure 10 - Transverse Frame Elevation (West)

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Figure 11 - Typical Floor Plan (Second Floor Shown, North is to the Left)

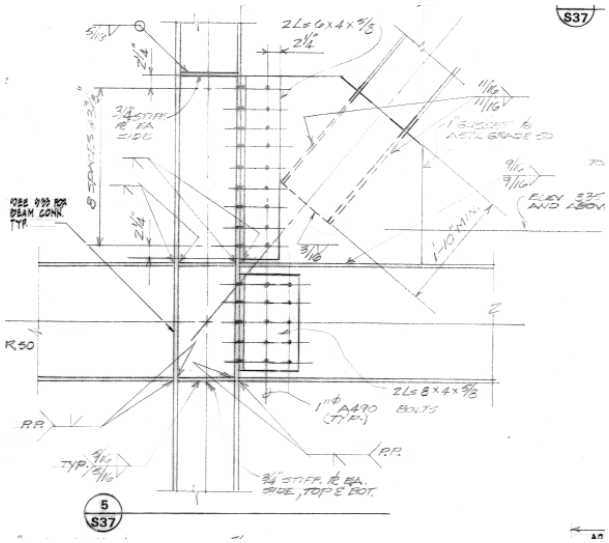

Figure 12- Typical Gusset Connection