Rating form completed by:
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Text in green is to be part of UCSF building database and may be part of UCOP database

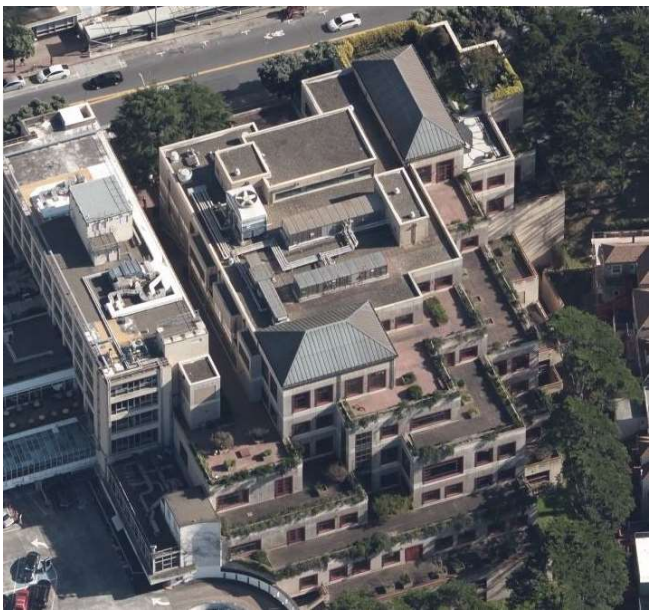
UCSF building seismic ratings

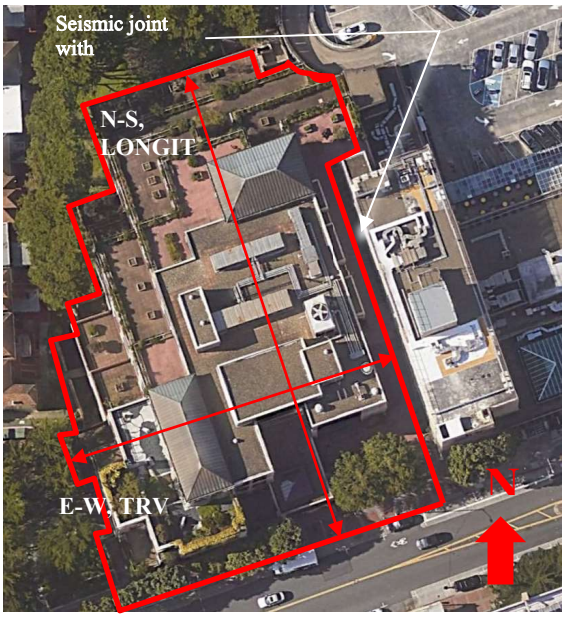
Kalmanovitz Library, University of California San Francisco

CAAN #2012
530 Parnassus Avenue, San Francisco, CA 94143
UCSF Campus: Parnassus

REGISTERED PROFESSIONAL ENGINEER
JOSEPH RICHARD MAFFEI
No. 3694
STRUCTURAL
STATE OF CALIFORNIA

DATE: 2020-06-26





Rating summary	Entry	Notes
UC Seismic Performance Level (rating)	V	Based on drawing review and Tier 1 evaluation[1]
Rating basis	Tier 1	ASCE 41-17
Date of rating	2019	
Recommended UCSF priority category for retrofit	Priority A	Priority A=Retrofit ASAP Priority B=Retrofit at next permit application for modification
Ballpark total construction cost to retrofit to IV rating[2]	Very High (> $400/sf)	See recommendations on further evaluation and retrofit.
Is 2018-2019 rating required by UCOP?	Yes	Building previously rated IV but does not have a fully documented previous review
Further evaluation recommended?	Tier 3 NLRHA	Further evaluation would initially be with pushover analysis and then eventually NLRHA needed to confirm rating

[1] The evaluations at UCSF translate the Tier 1 evaluation to a Seismic Performance Level rating using professional judgment discussed among the Seismic Review Committee. Non-compliant items in the Tier 1 evaluation do not automatically put a building into a particular rating category, but such items are evaluated 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.

[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.

Tier 3 nonlinear evaluation

Aspects of this report will be superseded by the Tier 3 Nonlinear evaluation in progress by MSE. The Seismic Performance Level Rating remains V. The nonlinear findings will provide revised information on the significance of the potential deficiencies.

Building information used in this evaluation

- Structural drawings by Rutherford & Chekene, "Campus Library, University of California San Francisco," dated 1987-09-18 (37 sheets)
- Architectural drawings by Esherick Homsey Dodge and Davis, "Campus Library, University of California San Francisco," dated 1987-09-18 (85 sheets)
- UCSF Group 2 Buildings –Tier 1 Geotechnical Assessment, San Francisco, California, report by John Egan, G.E., dated 2019-06-26

Additional building information known to exist

- Specifications by Esherick Homsey Dodge and Davis, "Campus Library, University of California San Francisco," dated October 1987
- Geotechnical report by Rutherford & Chekene, "Health Sciences Campus Library, University of California San Francisco," dated 1987-02-20

Scope for completing this form

We reviewed structural drawings for original construction and carried out an ASCE 41-17 Tier 1 evaluation. Rob Ward walked through the building on 31 August 2019 to confirm that the building generally matches the original drawings and to conduct a spot check for nonstructural items that could be falling hazards.

Brief description of structure

The building has an area of approximately 200,000 square feet, and an overall height of 95'. It was designed in the late 1980s by the structural and geotechnical engineering firm Rutherford & Chekene and architects Esherick Homsey Dodge and Davis. Construction was completed in 1990. It is 7 stories and is built into a hillside that slopes downward to the north. The upper 5 stories step back to create exterior terraces on all 4 sides of the building. The lower 5 stories are adjacent to the older Millberry building (1955, CAAN 2212) to the east, separated by a 6" seismic joint.

Identification of levels: The lower 2 stories are parking, designated Levels E (bottom-most) and F. The upper stories, designated Levels 1 through 5, contain the library. There is a four-story grade differential in the building: all 7 stories are above grade at the south side of the building and 3 stories are above grade at the north side. The library's main entrance occurs at grade on Level 3 at the south side of the building.

Structural system for vertical (gravity) load: The Level 2 through Level 5 floors and the roof consist of structural steel framing and composite metal deck with 3¼" of lightweight concrete fill supported on wide-flange columns. The typical column grid is 24' x 30'. The Level 1 floor is a concrete waffle slab and the Level F floor is a 12" thick 2-way flat slab. Both are supported on 24" x 24" concrete columns. The Level E floor is a 6" thick slab-on-grade.

Foundation system: Each concrete column is supported by a 42" diameter cast-in-drilled-hole concrete pier with a belled base. These piers vary in length from approximately 50' at the north side of Level E to 8' at the south side. Southmost portions of the building, including retaining walls at Levels 1 and 2, bear on similar 36" diameter piers. The tops of the 42" diameter piers are tied together by a grid of E-W and N-S grade beams. The tops of the 36" diameter piers are tied together by grade beams and slabs.

Structural system for lateral forces: Resistance to lateral forces for Level 5 through Level 2 is provided by steel frame moment connections, consisting of both beam flange connections at certain locations to the gravity load bearing columns, and single-story columns infilled into beam spans above and below. The infill columns have moment connections at each end to continuous beams that span between the gravity columns. Resistance to lateral forces for Level 1 through Level E is provided by 12" and 14" thick concrete shear walls. At Level 1, steel beams and columns are encased in concrete, transferring loads to the 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 include the following:

Structural feature or potential deficiency	Finding
Steel moment frame geometry	Moment frame geometry is irregular and is discontinuous in multiple places. This could lead to story concentrations of deformation and transfer forces in floor diaphragms and collectors that would have been underestimated in the original design, compared to post-1988 standards.
Welded moment connections	Full-penetration flange welds at steel frame moment connections likely to lack ductility because design and specification of the welds predates the October 1994 UBC Emergency Provisions for steel moment-resisting frames (i.e. pre-Northridge.) The welds have the potential to fracture when subjected to earthquake deformation demand. The issue has been studied for beams welded to columns. The severity of the issue for the infill columns welded to beams has to our knowledge not been studied.
Moment frame stability	There is limited lateral bracing at the connections of infill columns to beams. If the connections are not sufficiently braced, lateral buckling can limit the frame's ability to resist seismic forces and control story drift.
Lateral earth pressure	The lower 4 levels of the building are above grade at the north side of the building and resist lateral earth pressures from retaining walls at the south side. This asymmetry may result in a ratcheting seismic response that creates increasing story displacement toward the north (downhill) direction.
Plan torsion	Plan torsional response resulting from the more open northside walls at the lower levels may result high displacement demands on some columns and shear wall link beams.
6" min. gap between adjacent Millberry building at Level 3 and below	Gap distance may be insufficient to prevent pounding between the library and the Millberry building. Because the floor levels of the buildings do not completely align, pounding could damage vertical load-carrying elements (columns and walls), increasing the risk of collapse. Also, the effect of pounding on overall seismic response could be evaluated (for each building.) See section on p. 7.
CMU partitions	Some CMU infill walls are top braced for out-of-plane loads by moment frame members using fixed connections (i.e., without allowance for slip in the wall in-plane direction.) This could cause walls to take lateral force that they were not intended to take, which could lead to wall damage and/or alter the response of the moment frames, causing some higher than expected local forces or deformations.
Shear wall stresses	Concrete shear wall stresses are above Tier 1 compliance levels, indicating that shear wall strengthening may be required in order to meet the basic safety objective.

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

The building is clad with GFRC (glass fiber reinforced concrete) panels which are not considered a falling hazard. The attachment of the larger decorative pendant lights in the building should be reviewed and retrofitted if necessary.

[3] For these Tier 1 evaluations, we do not visit all spaces of the building; we rely on campus staff to report to us their understanding of the type and location of potential non-structural hazards.

UCOP non-structural checklist item	Life safety hazard?	UCOP non-structural checklist item	Life safety hazard?
Heavy ceilings, feature or ornamentation above large lecture halls, auditoriums, lobbies or other areas where large numbers of people congregate	None observed	Unrestrained hazardous materials storage	None observed
Heavy masonry or stone veneer above exit ways and public access areas [Or older or vulnerable precast concrete cladding]	None observed	Masonry chimneys	None observed
Unbraced masonry parapets, cornices or other ornamentation above exit ways and public access areas	Pendant lighting	Unrestrained natural gas-fueled equipment such as water heaters, boilers, emergency generators, etc.	None observed

Discussion of rating

We rate the building V primarily because of the irregular configuration of steel moment frames and the likelihood that their welded connections are vulnerable to fracture. The moment frame layout is discontinuous, and it uses an atypical infill column design. Also of concern is the adequacy of lower-level concrete walls, given the unequal distribution of wall openings and the lateral earth pressure that results from the building's embedment into the hillside. These aspects, along with welding specifications for the moment frames that pre-date the 1994 UBC Emergency Provisions, indicate that this building requires further study to confirm its rating and to identify retrofit steps if additional analysis shows that they are needed to improve the rating.

Recommendations for further evaluation or retrofit

We recommend that the University perform a more detailed seismic evaluation, preferably Tier 3 NLRHA preceded by a Tier 3 Nonlinear Static (pushover) evaluation, to confirm the rating and, if needed, define a more specific scope of retrofitting for this building. Further evaluation should identify vulnerabilities from discontinuities in the overall seismic force-resisting system necessitated by the building's irregular shape. Applicable retrofit measures may include repair and strengthening of welded connections, additional beam flange to column connections the addition of steel braces or dampers, and adding concrete walls or similar elements at the lower parking levels.

Peer review comments on rating

The structural members of the UCSF Seismic Review Committee (Lizundia, Moore, Phipps, Thiel) reviewed the presentation of this evaluation on 10 October 2019, and they reviewed this report. The SRC agrees that a Seismic Rating of V is appropriate based on this Tier 1 evaluation. They agree that additional investigation is necessary confirm this rating.

Additional building data	Entry	Notes
Latitude	37.76352	
Longitude	-122.45914	
Are there other structures besides this one under the same CAAN#	No	
Number of stories above lowest perimeter grade	7	
Number of stories (basements) below lowest perimeter grade	0	Hillside building; 4 stories below highest perimeter grade
Building occupiable area (OGSF)	195,062	From UCOP spreadsheet
Risk Category per 2016 CBC 1604.5	III	Occupant load > 500 (campus to confirm) and contains educational occupancy above 12th grade
Building structural height, h_n	95 ft	Structural height defined per ASCE 7-16 Section 11.2
Estimated fundamental period	0.7 sec	Estimated using ASCE 41-17 equation 4-5
Site data		
975 yr hazard parameters S_s, S_1	1.537, 1.030	

Site class	C	
Site class basis	Geotech Parameters	UCSF Group 2 Buildings –Tier 1 Geotechnical Assessment, Egan (2019)
Site parameters F_a, F_v	1.2, 1.5	Per ASCE 7-16 Tables 11.4-1 and 11.4-2
Ground motion parameters S_{cs}, S_{c1}	1.855, 0.854	UCSF Group 2 Buildings –Tier 1 Geotechnical Assessment, Egan (2019)
S_a at building period	1.25	
Site V_{s30}	475 m/s	
V_{s30} basis	Estimated	UCSF Group 2 Buildings –Tier 1 Geotechnical Assessment, Egan (2019)
Liquefaction potential	No	
Liquefaction assessment basis	Study	UCSF Group 2 Buildings –Tier 1 Geotechnical Assessment, Egan (2019)
Landslide potential	No	
Landslide assessment basis	Study	UCSF Group 2 Buildings –Tier 1 Geotechnical Assessment, Egan (2019)
Active fault-rupture identified at site?	No	
Fault rupture assessment basis	Study	UCSF Group 2 Buildings –Tier 1 Geotechnical Assessment, Egan (2019)
Site-specific ground motion study?	No	
Applicable code		
Applicable code or approx. date of original construction	Built: 1988 -1990 Code: 1979 UBC	Code identified on Sheet S0.1
Applicable code for partial retrofit	None	No partial retrofit known
Applicable code for full retrofit	None	No full retrofit known
Model building data		
Model building type Levels F, 1, 2	C2 Concrete wall	
Model building type Levels 3, 4, 5, R	S1 Steel moment frame	
FEMA P-154 score	N/A	Not included here because we performed ASCE 41 Tier 1 evaluation
Previous ratings		
Most recent rating	IV	2013 report
Date of most recent rating	2013-10-07	Basis: qualitative assessment based on document review
2nd most recent rating	Fair	In spreadsheet. Basis for rating is unknown
Date of 2nd most recent rating	-	Rating date is unknown
3rd most recent rating	-	
Date of 3rd most recent rating	-	
Appendices		
ASCE 41 Tier 1 checklist included here?	Yes	Refer to attached checklist file

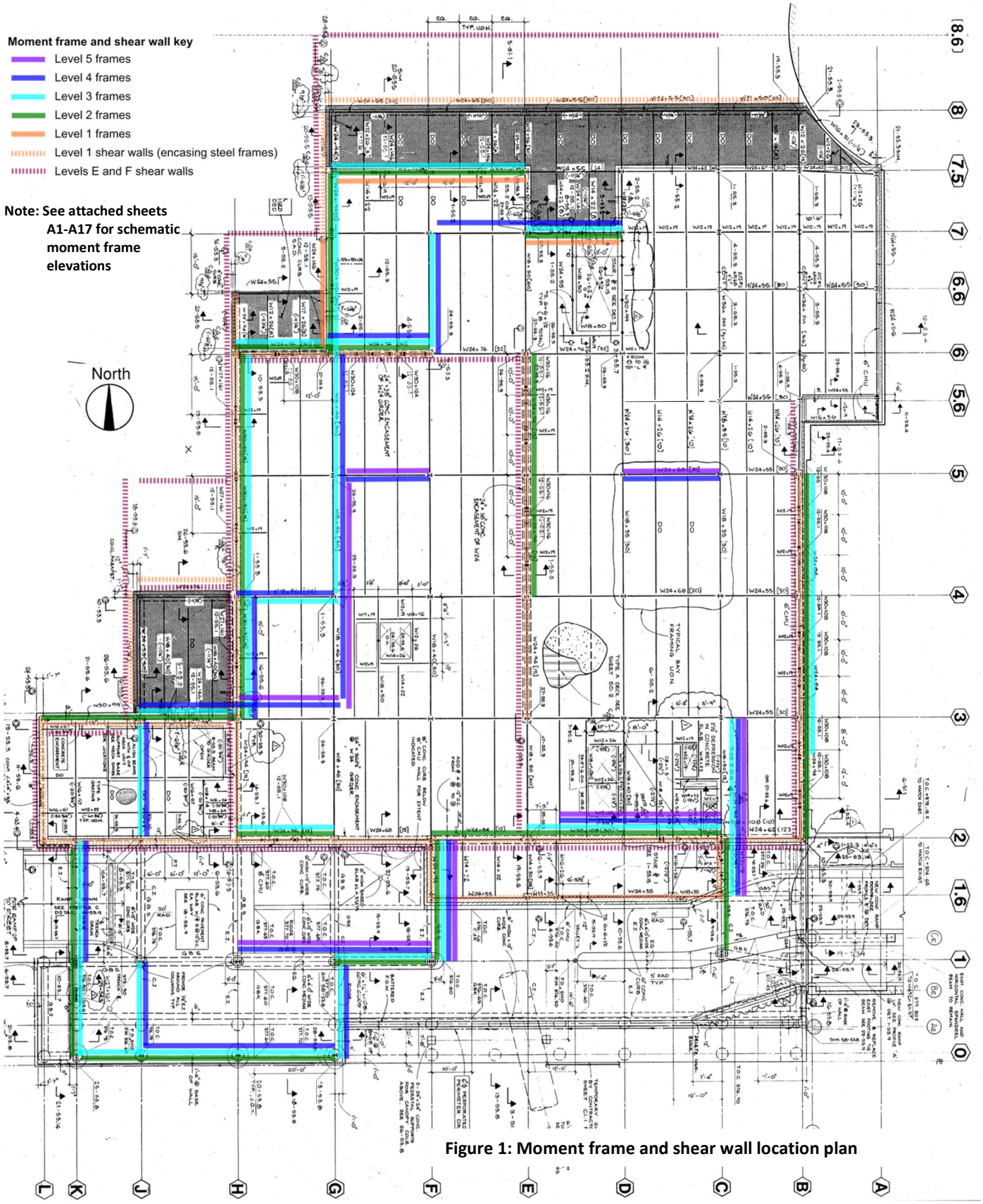


Figure 1: Moment frame and shear wall location plan

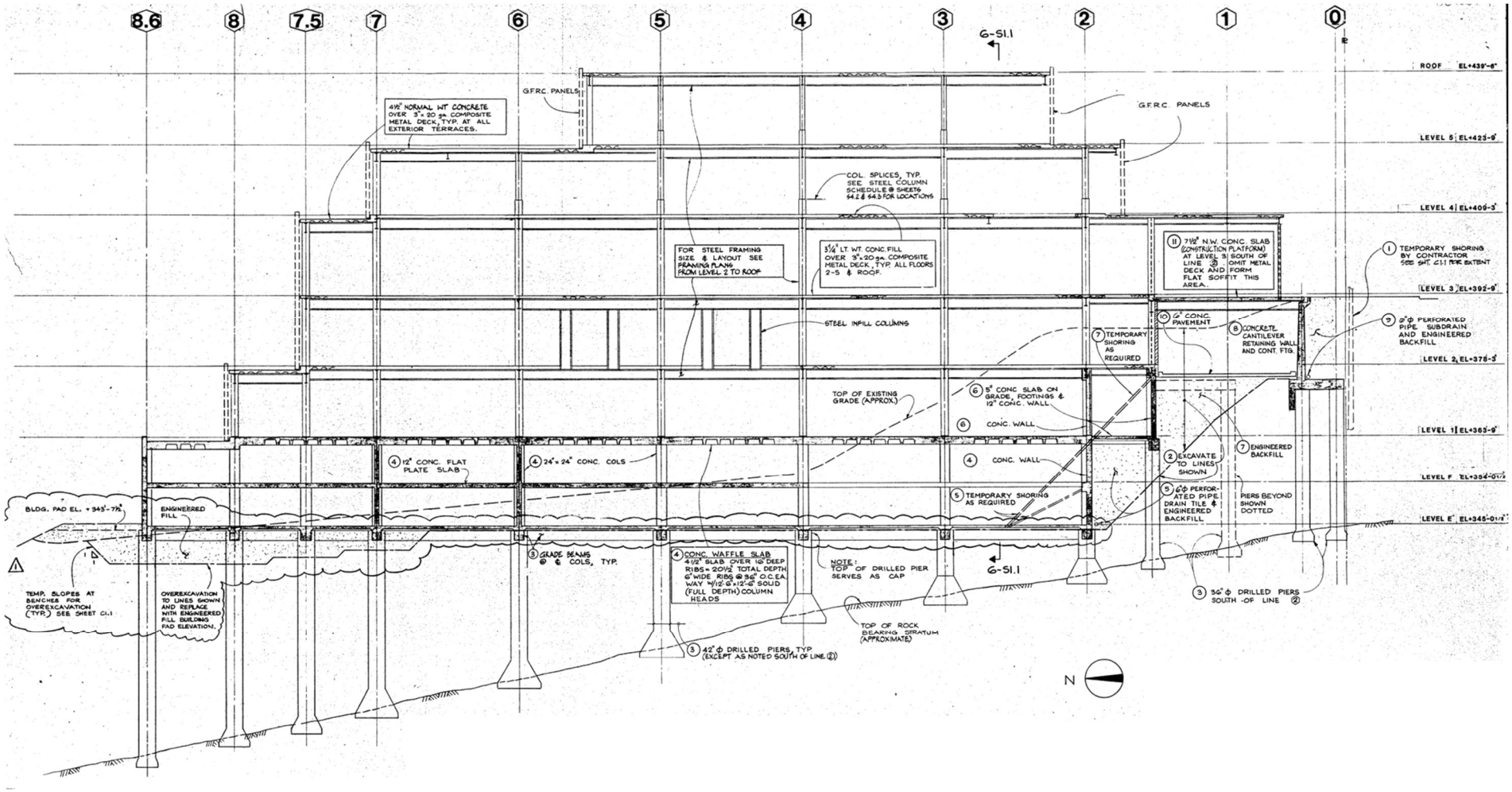


Figure 2: Building section looking east (Ref. sheet S1.1)

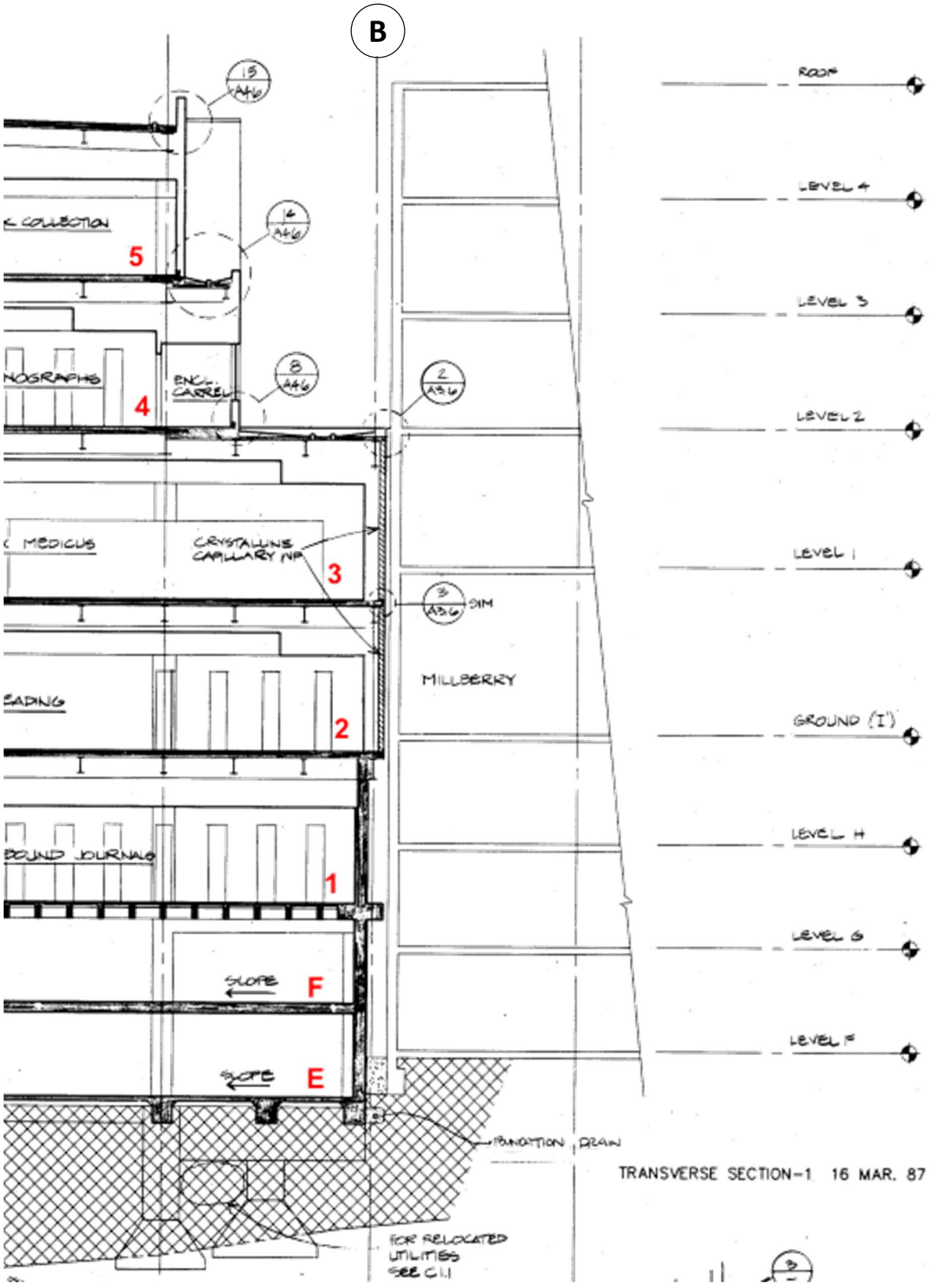


Figure 3: Partial section looking north (Ref. sheet A3.6)

South elevation

Partial west elevation

Partial east elev. & 4th floor terrace (Millberry building at right)

North elevation

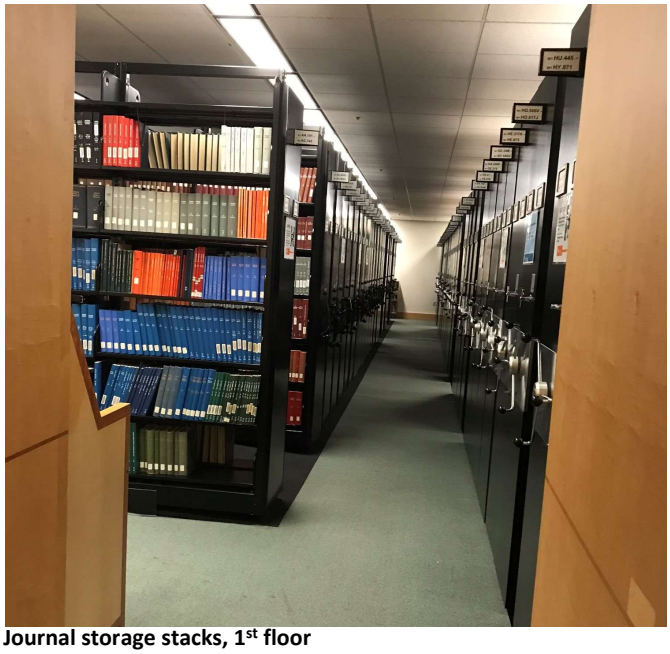
Roof membrane ballast, AHUs, and piping

5th floor & 4th floor south terraces

Lighting, 5th floor lounge area

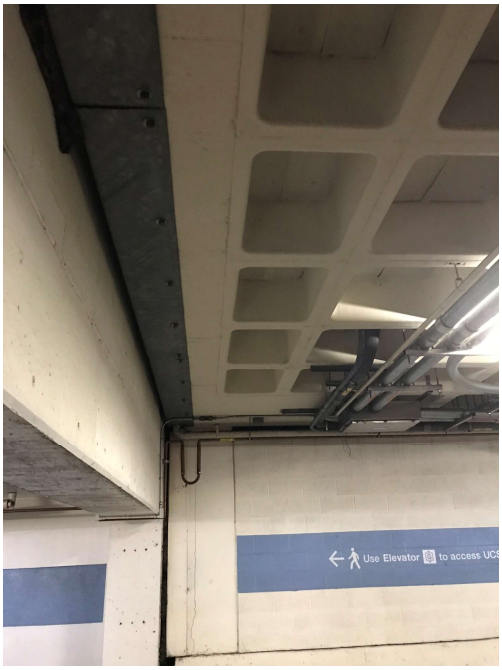
Special collections reading room, 5th floor

Typical stacks, 3rd, 4th, & 5th floors

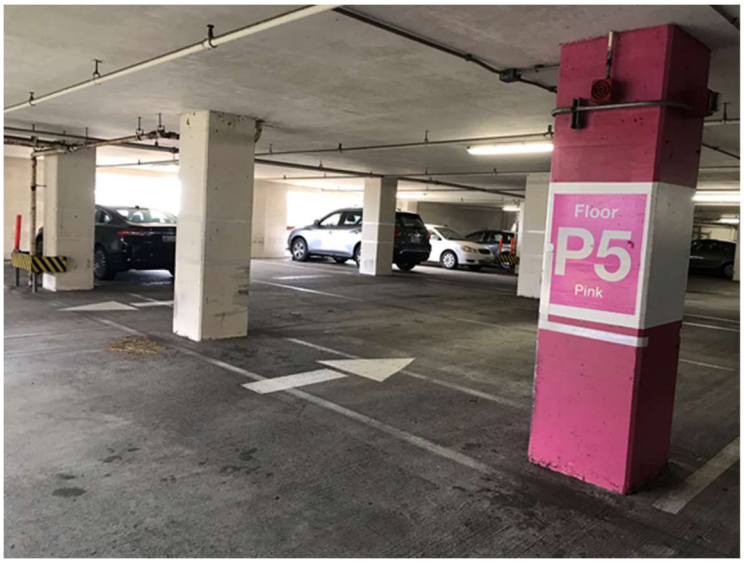


Journal storage stacks, 1st floor

Absorption chiller piping at level E (1st floor slab above)



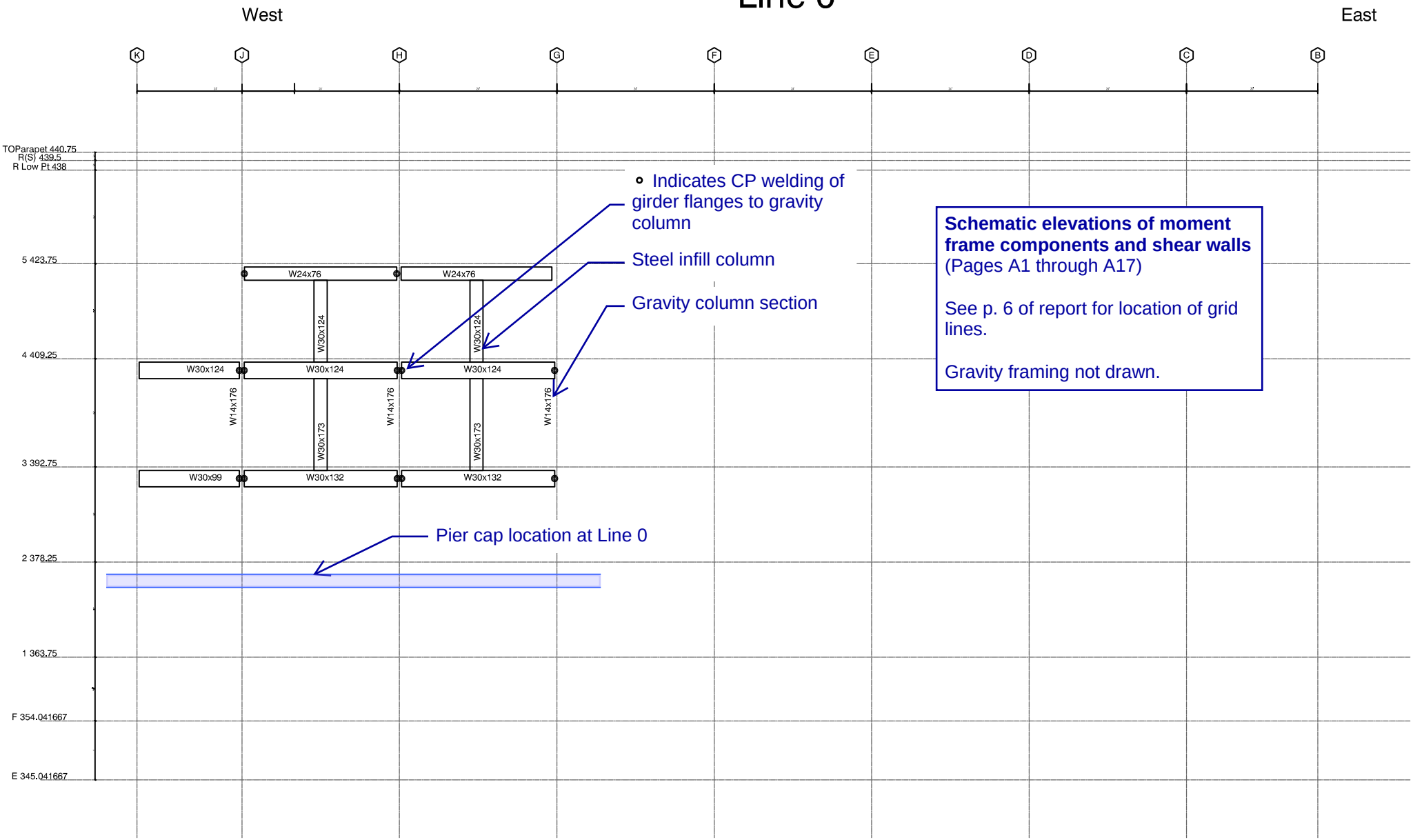
Level F ceiling at Millberry building (on the left)



Level E

West side areaway at parking levels E & F

Line 0

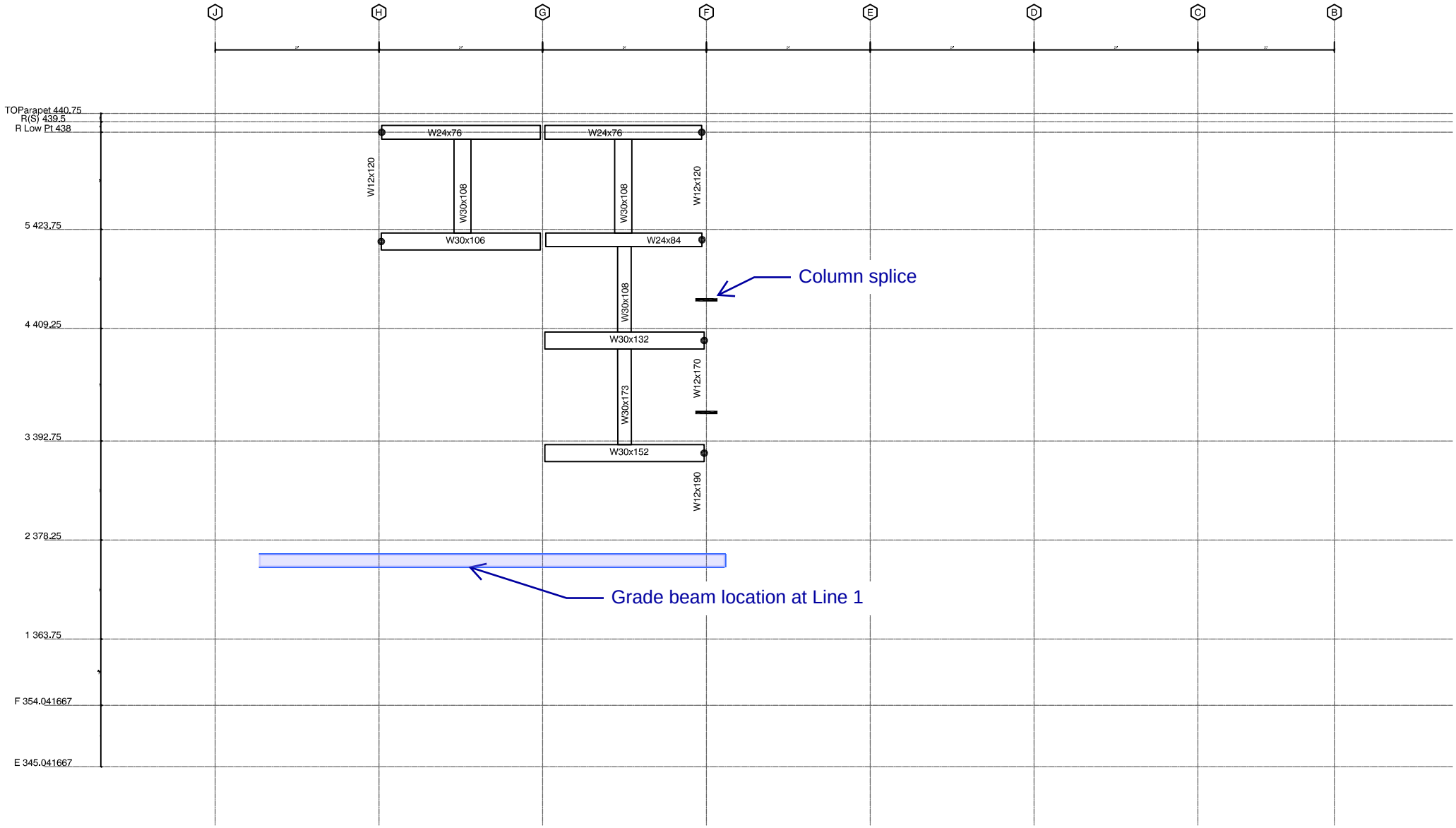


Schematic elevations of moment frame components and shear walls (Pages A1 through A17)

See p. 6 of report for location of grid lines.

Gravity framing not drawn.

Line 1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TOParapet 440.75
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F 354.041667
E 345.041667
W24x76
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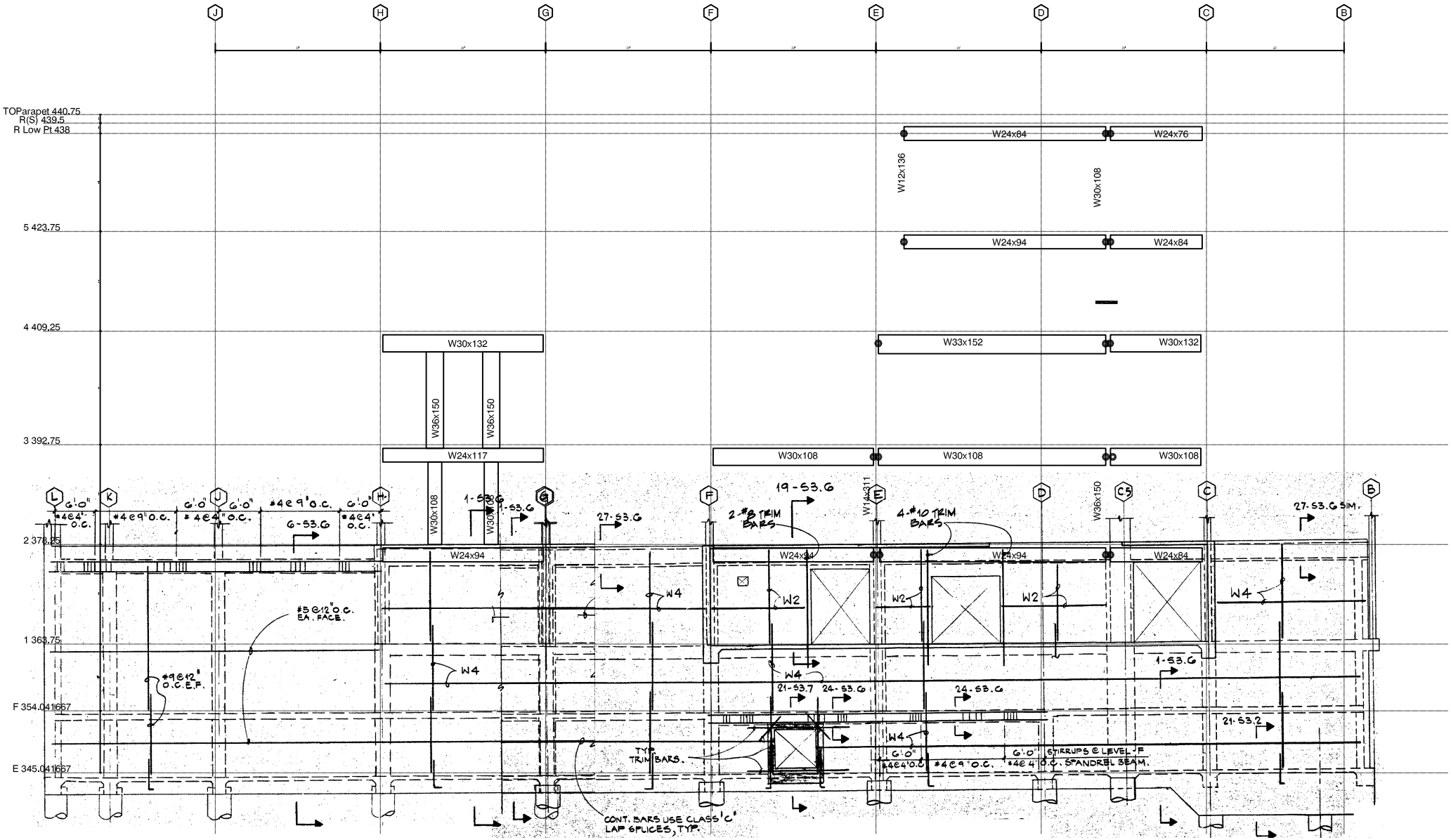
W12x120
W30x108
W30x108
W12x120
W30x106
W24x84
W30x108
Column splice
W30x132
W12x170
W30x173
W30x152
W12x190
Grade beam location at Line 1

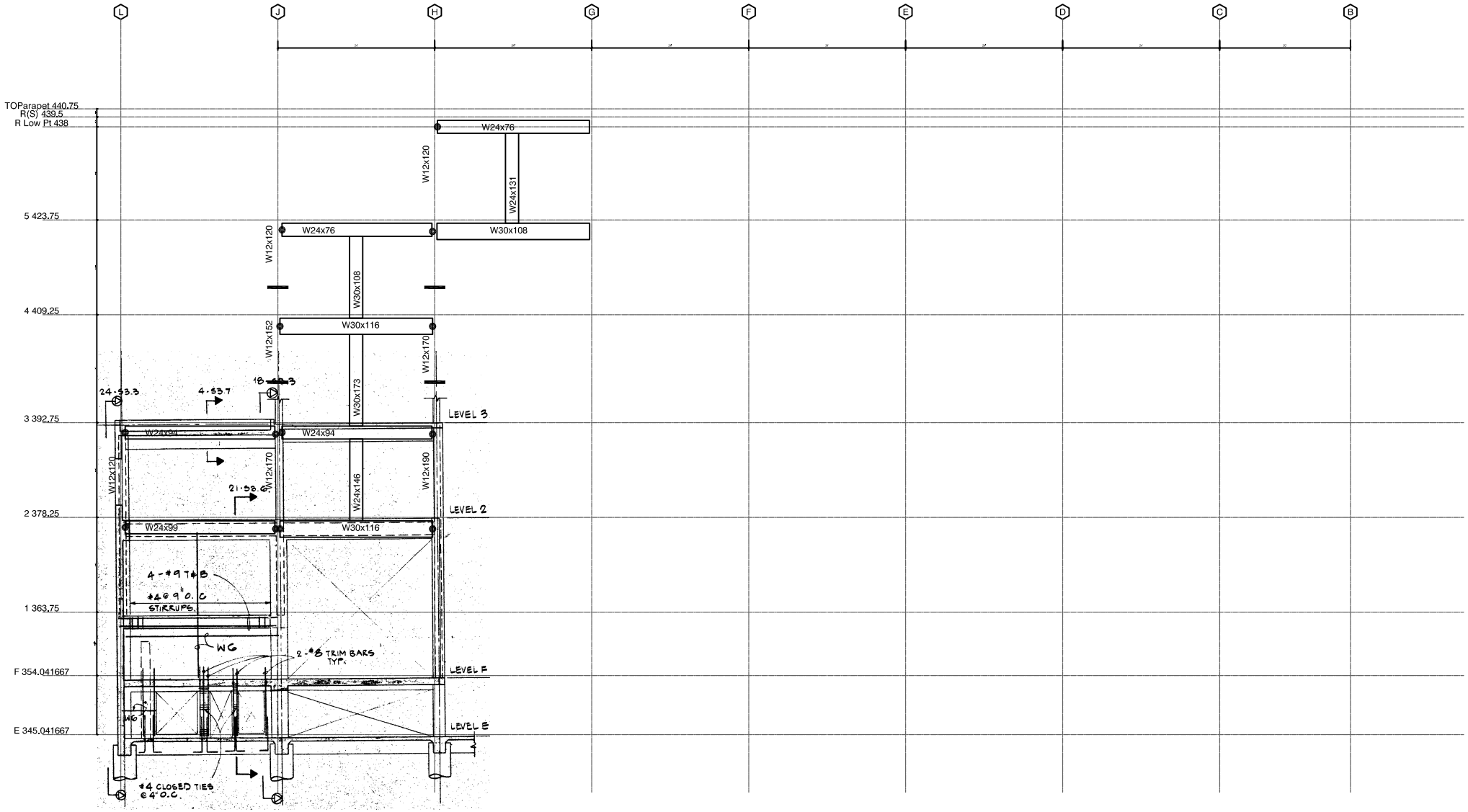
Line 2

West East



Line 3

West East



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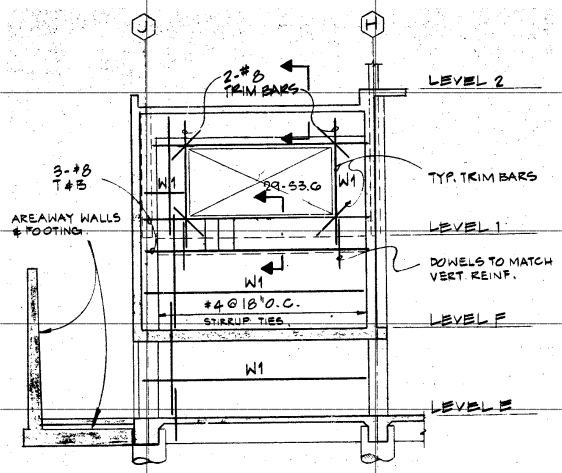

Line 5

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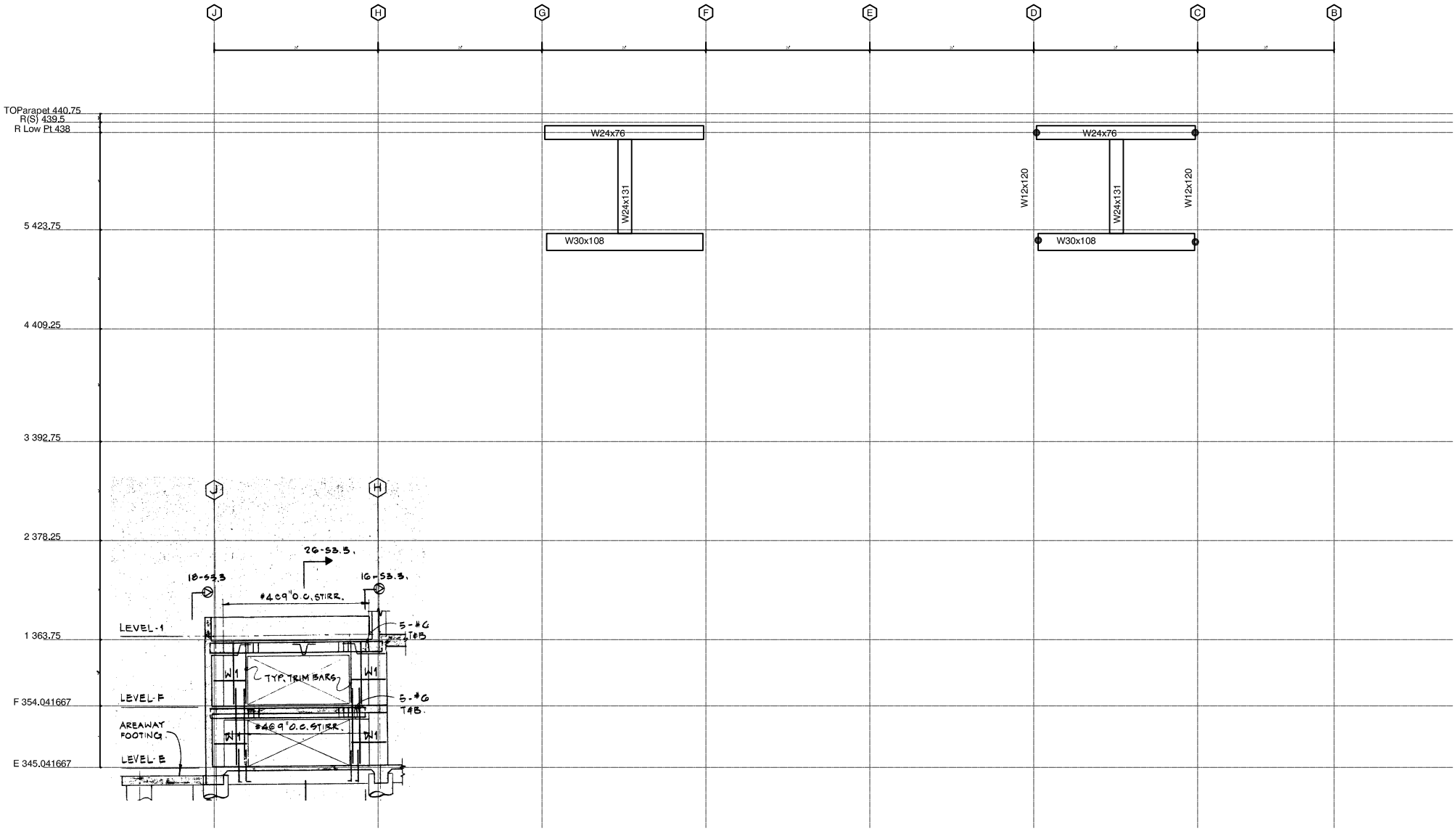

Line 6

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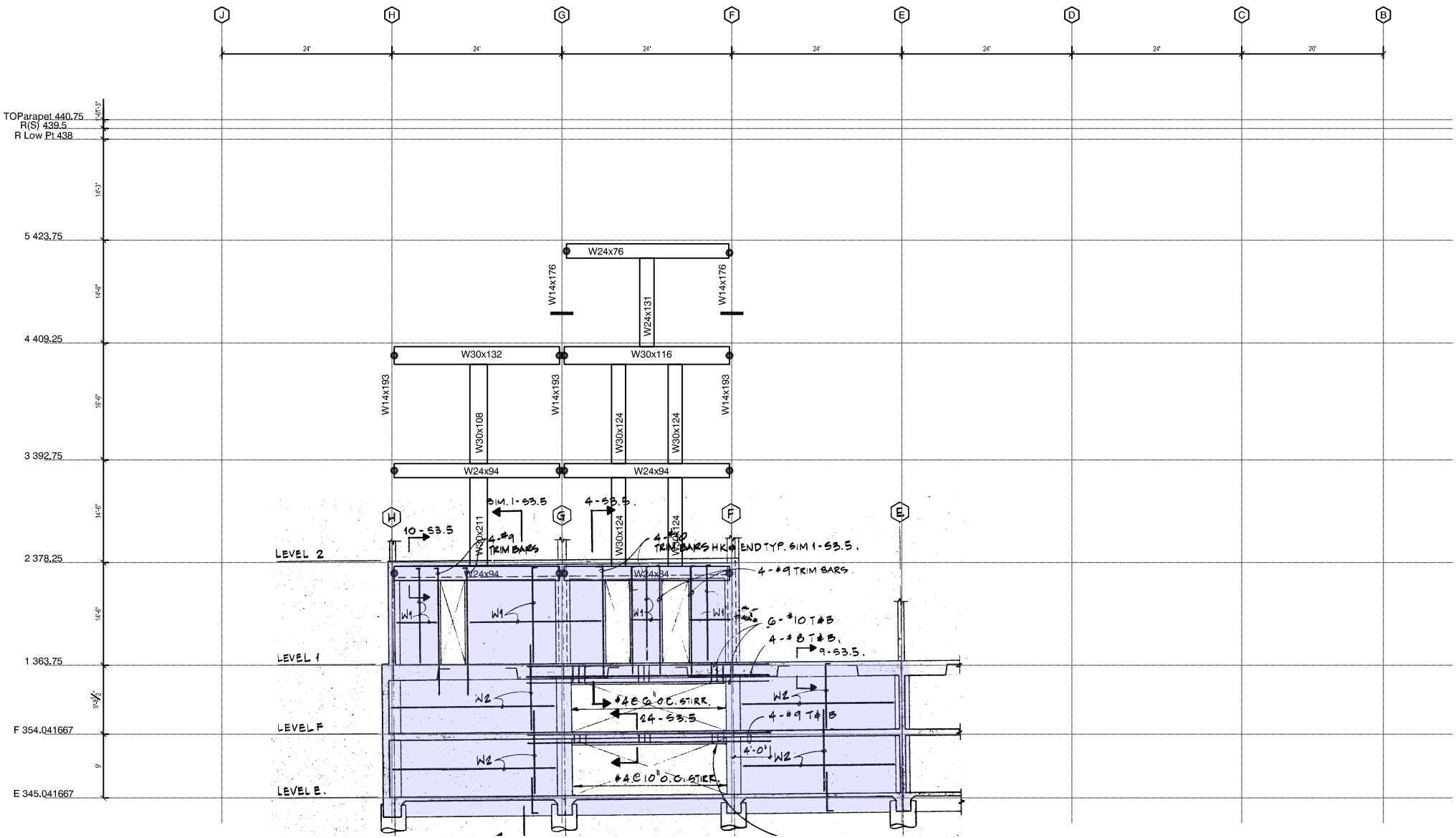
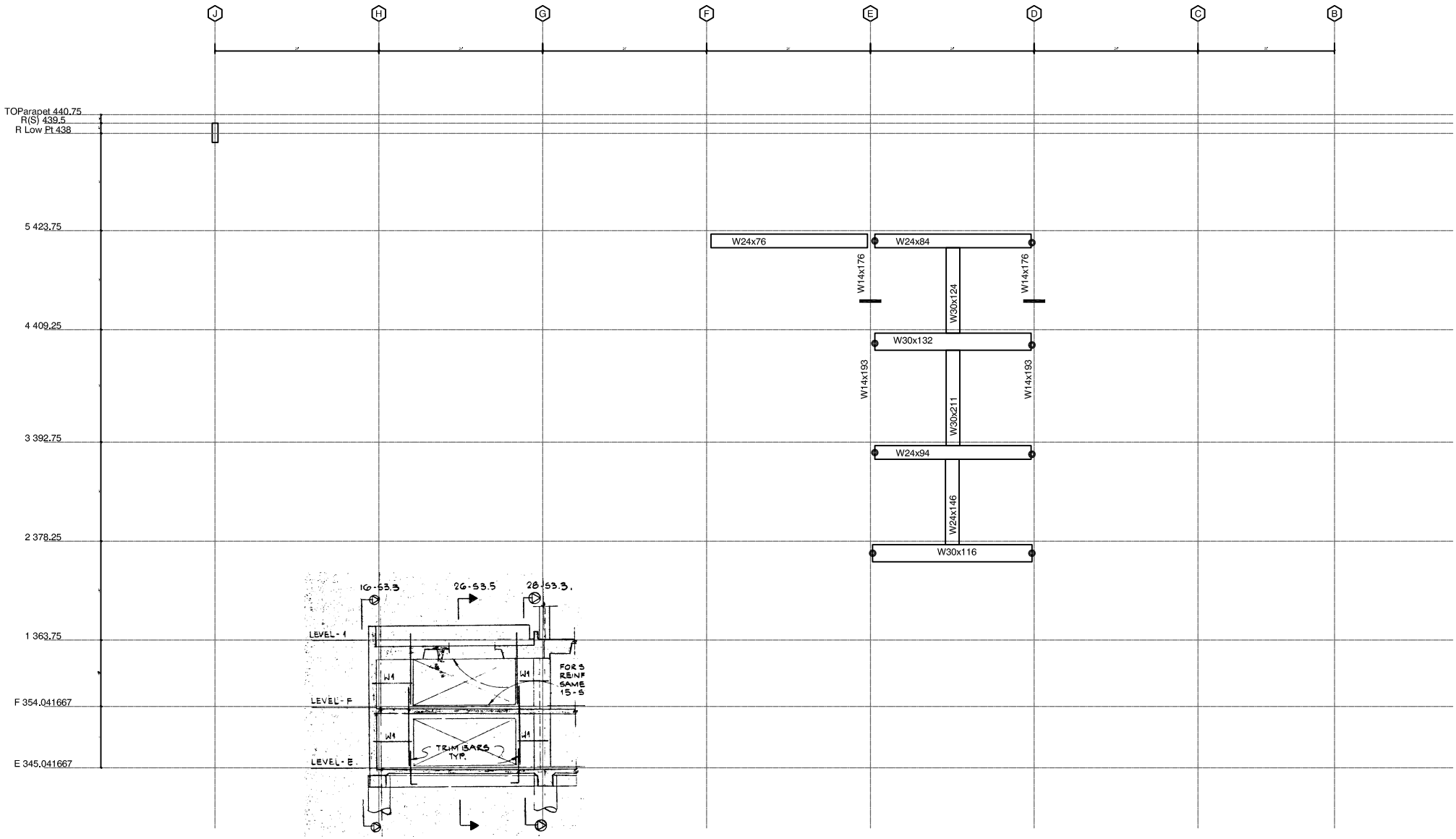


Line 7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W14x176
W30x132
W14x193
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W14x193
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W30x116
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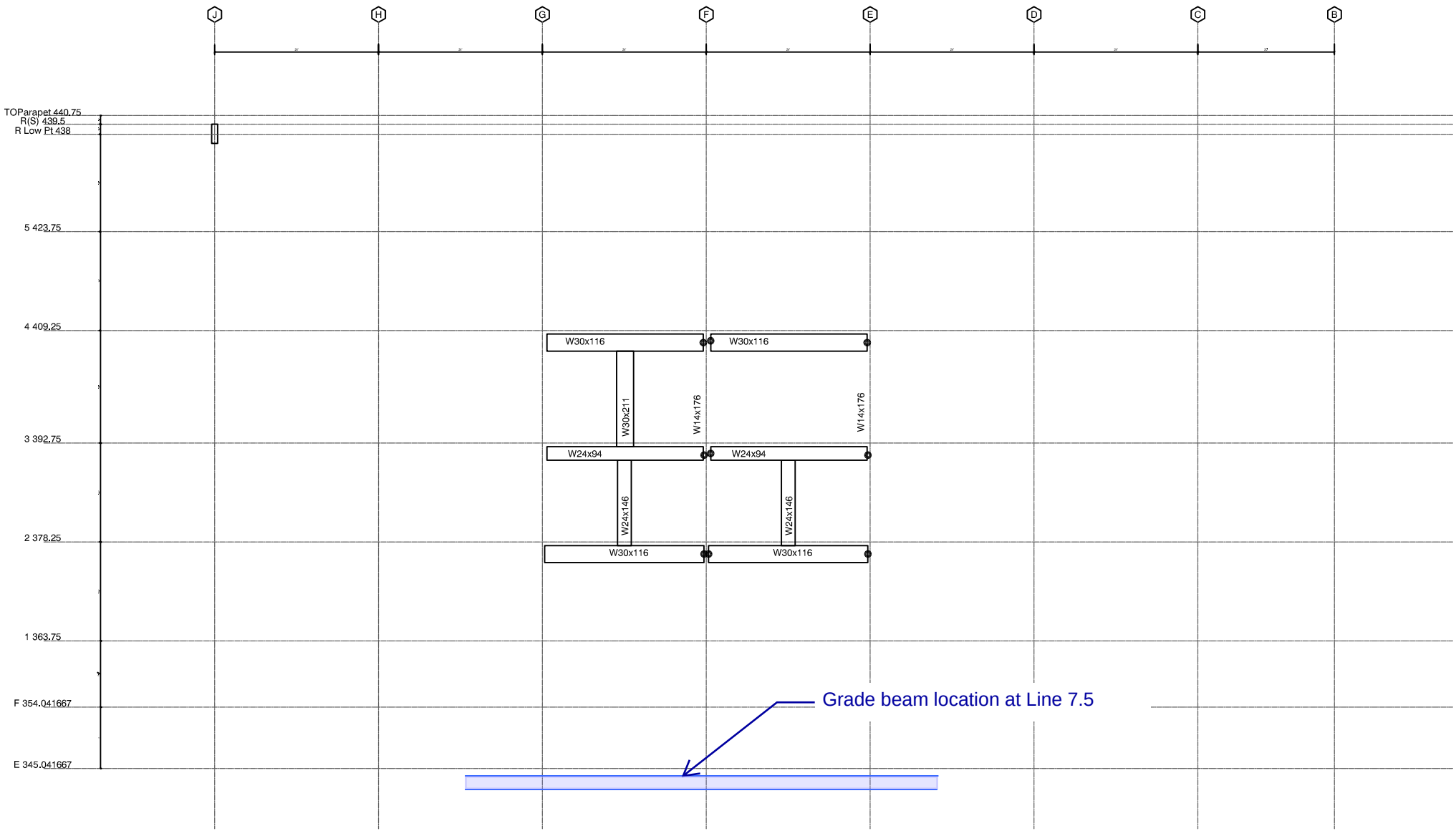
Line 7.5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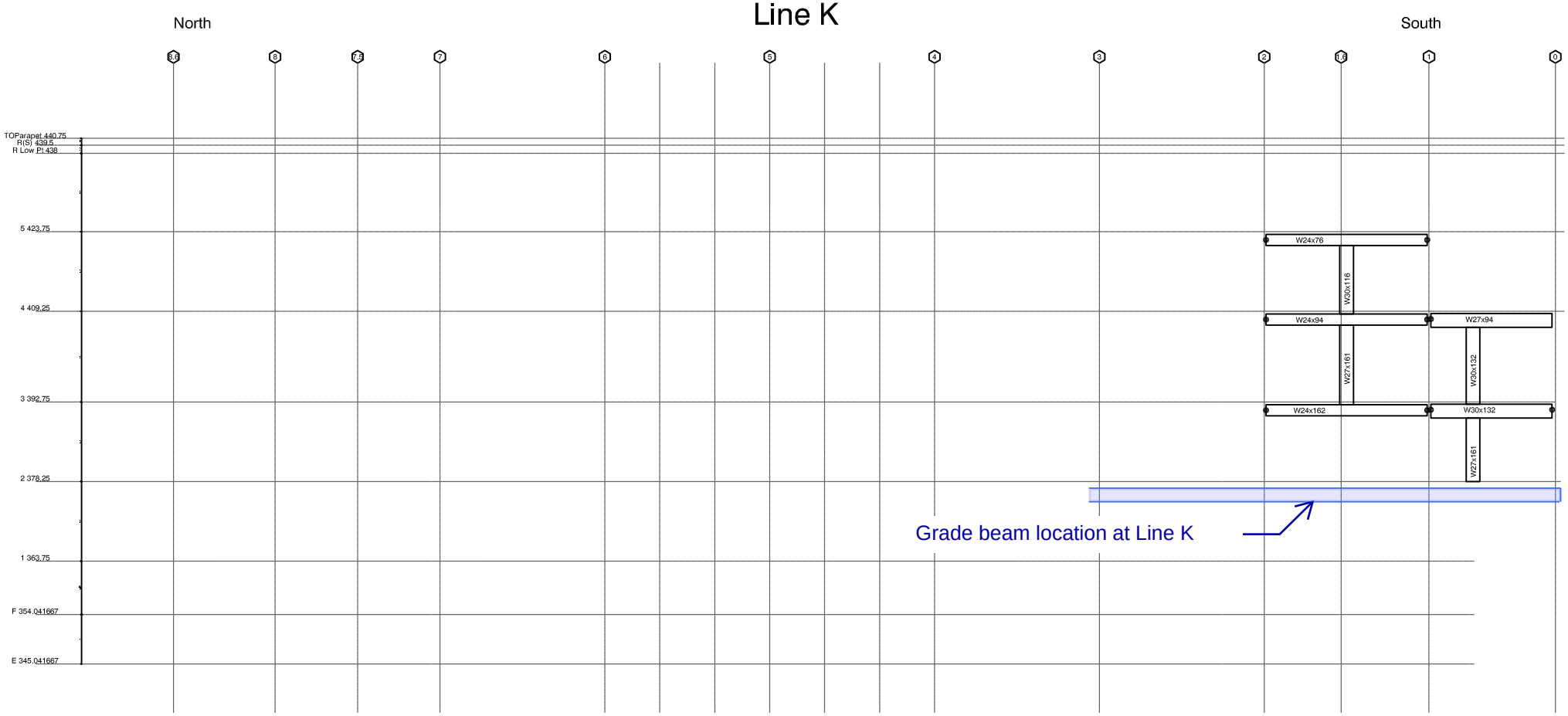
W30x116
Grade beam location at Line 7.5

Line K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W30x116
W24x94
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W24x162
W30x132
W27x161
Grade beam location at Line K

Line J

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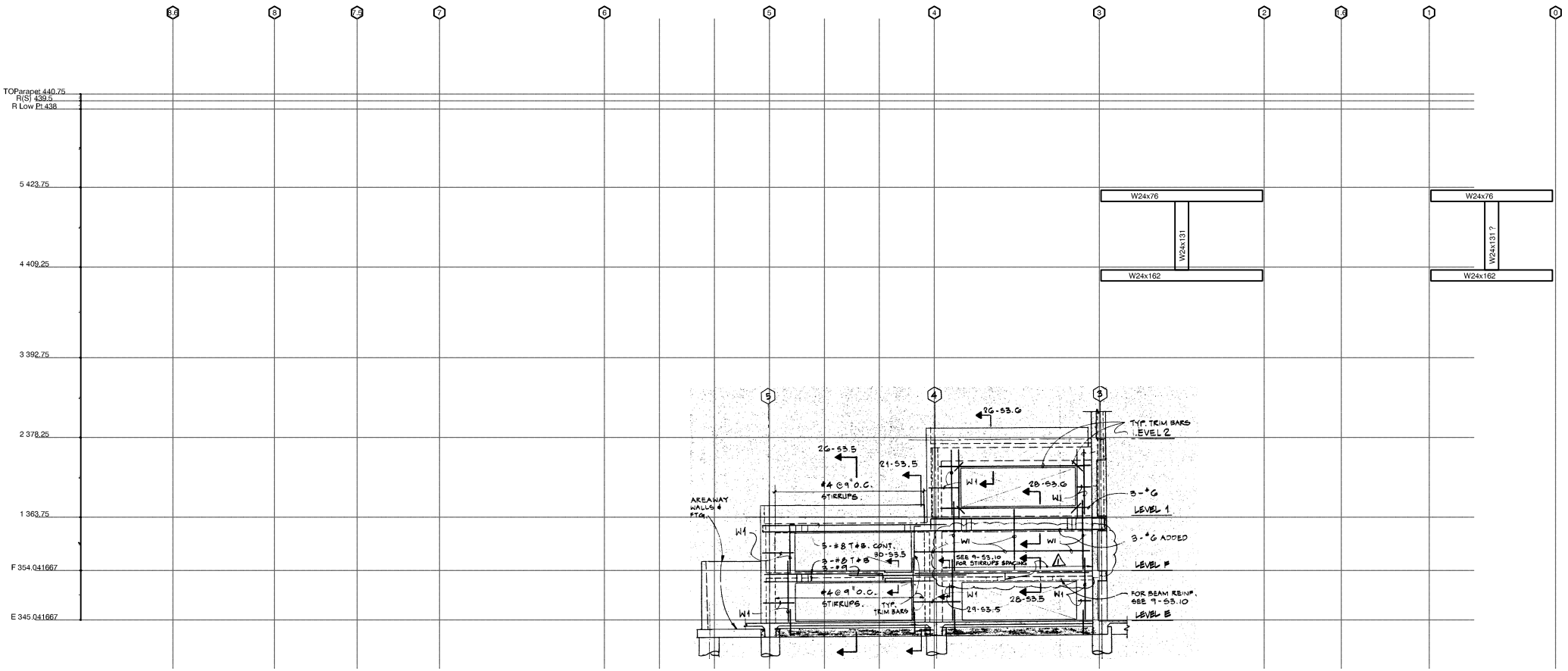
South



Line H

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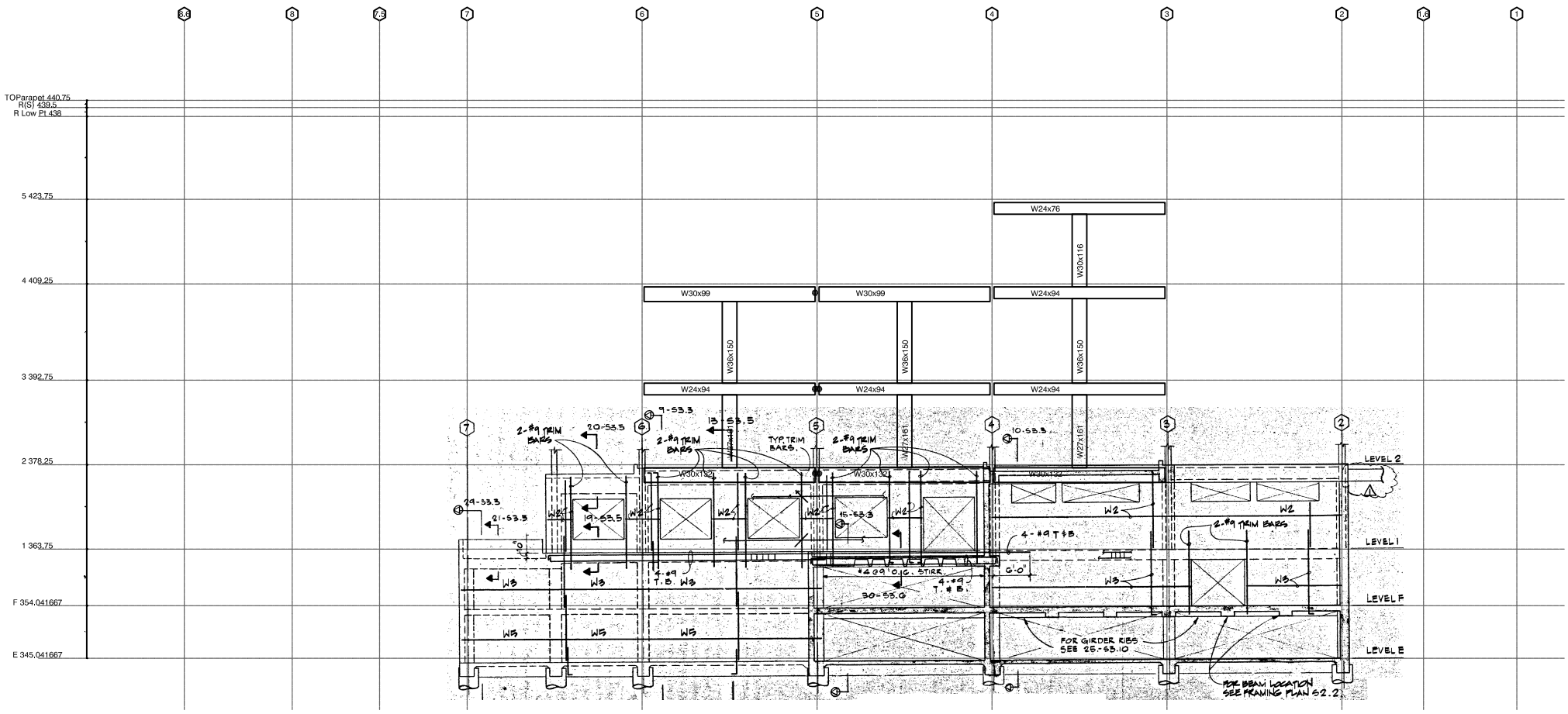

Line G

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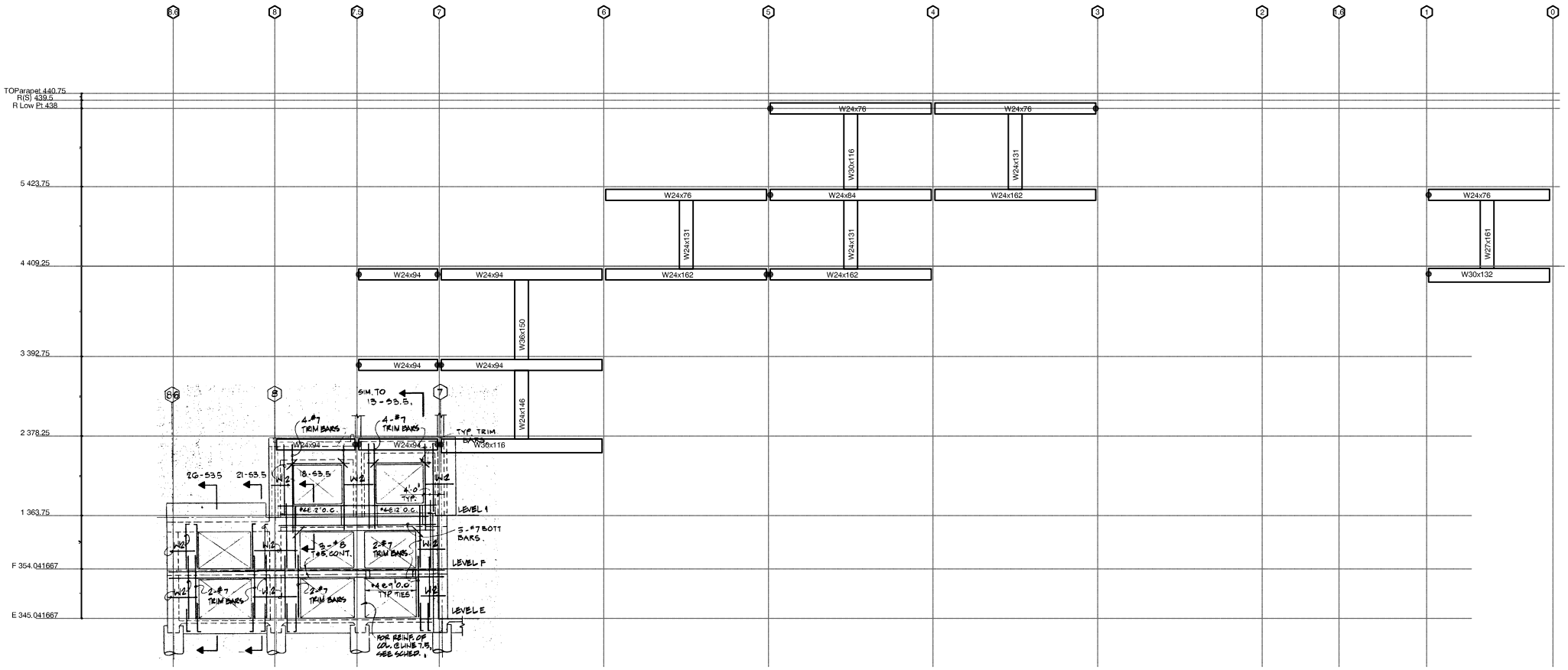

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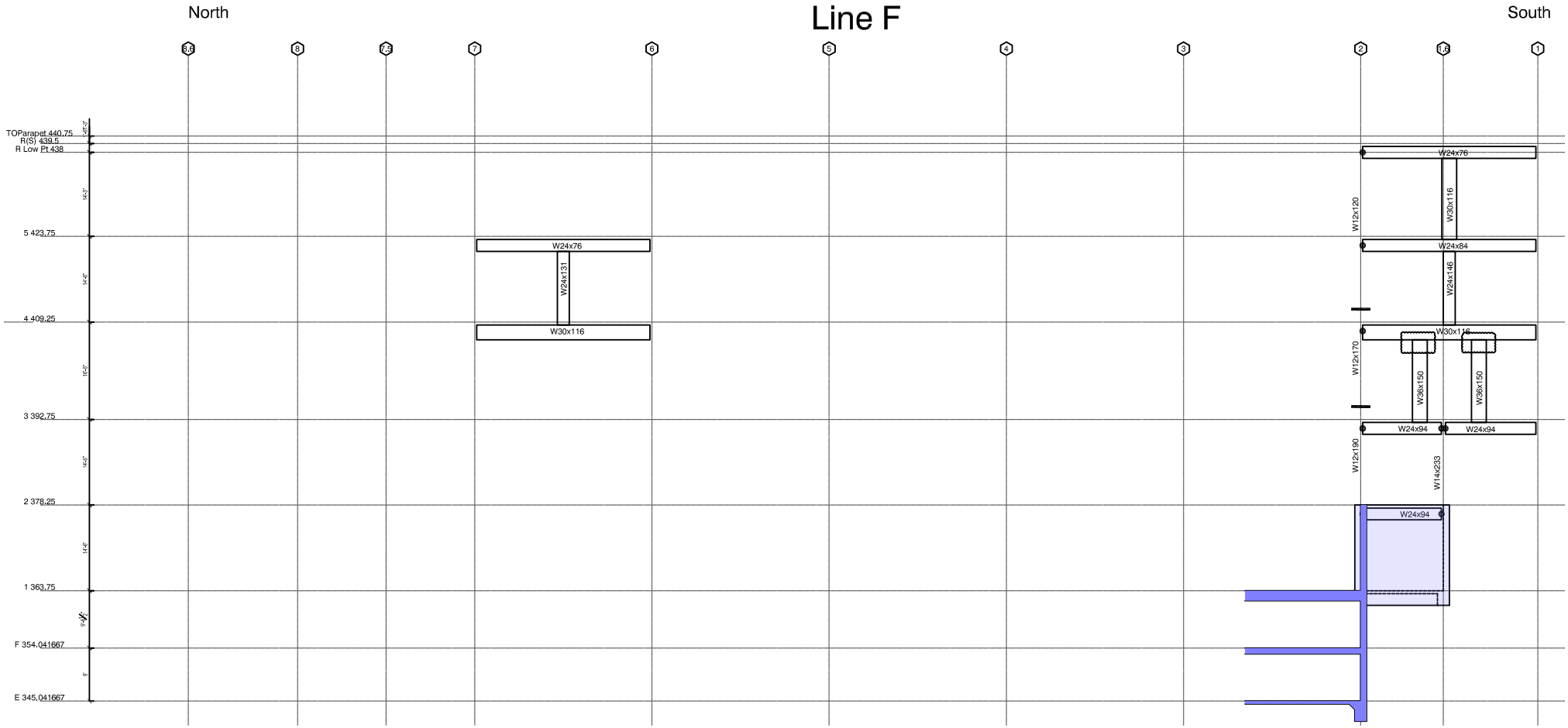
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W30x116
W12x120
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W24x146
W30x116
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Line E

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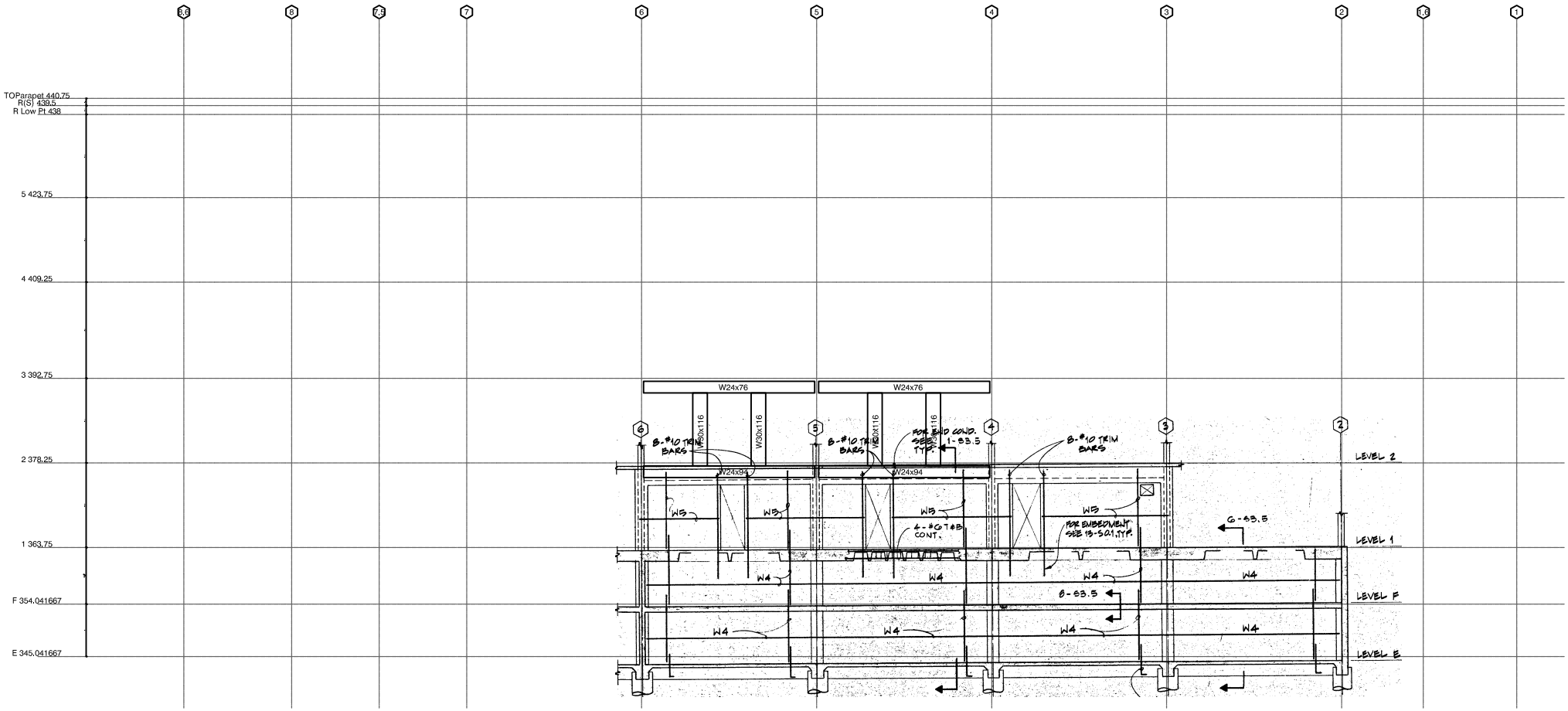

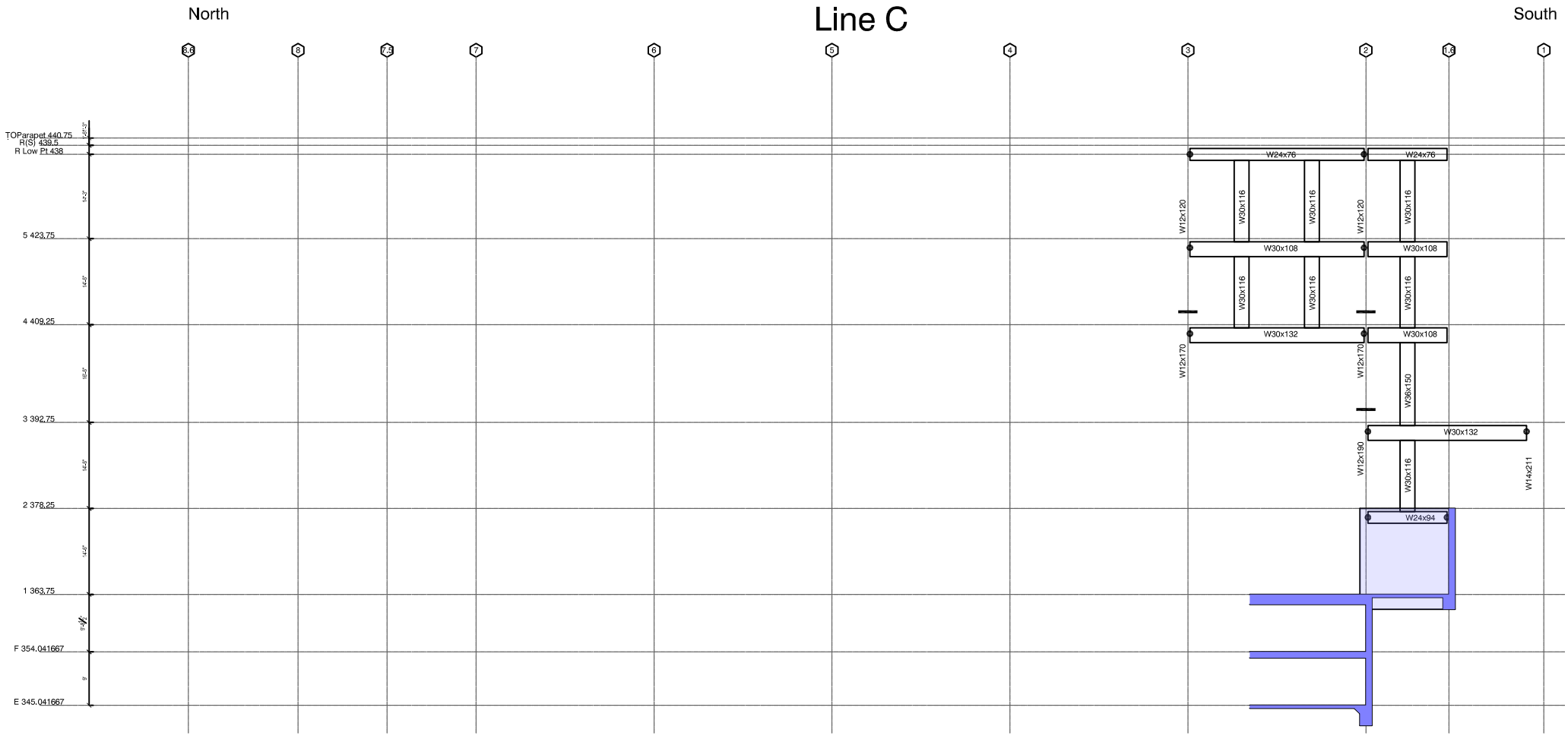
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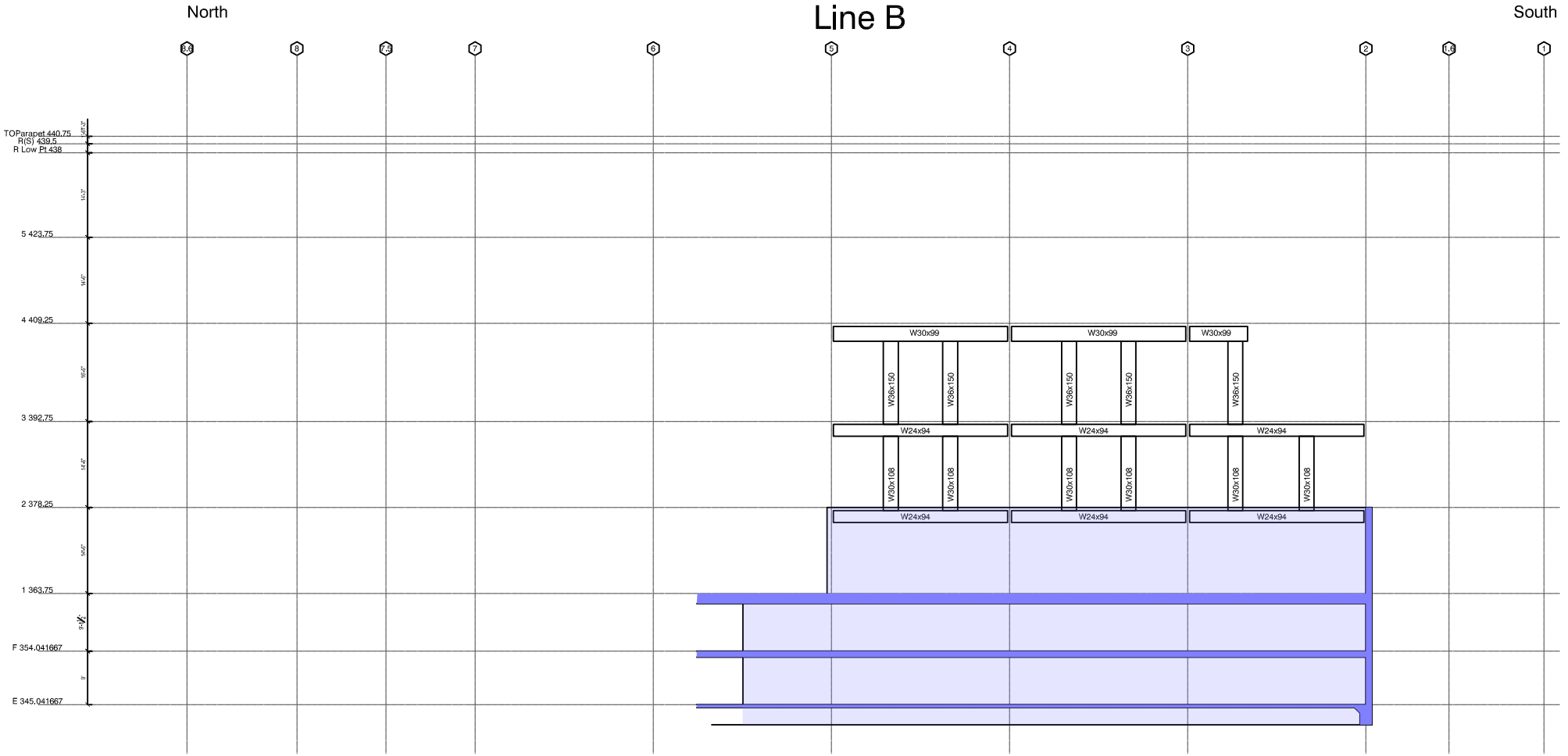
W24x76
W24x76
W12x120
W30x116
W30x116
W12x120
W30x116
W30x108
W30x108
W30x116
W30x116
W30x116
W30x132
W30x108
W12x170
W12x170
W36x150
W30x132
W12x190
W30x116
W14x211
W24x94


North
Line B
South
8.8
8
7.5
7
6
5
4
3
2
1.8
1
TOParapet 440.75
R(S) 439.5
R Low Pt 438
5 423.75
4 409.25
3 392.75
2 378.25
1 363.75
F 354.041667
E 345.041667
W30x99
W36x150
W24x94
W30x108

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ASCE 41-17
Collapse Prevention Basic Configuration Checklist

LOW SEISMICITY

BUILDING SYSTEMS - *GENERAL*

	Description
C NC N/A U ● ○ ○ ○	LOAD PATH: The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation. (Commentary: Sec. A.2.1.1. Tier 2: Sec. 5.4.1.1) **Comments:**
C NC N/A U ○ ● ○ ○	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building is greater than 0.25% of the height of the shorter building in low seismicity, 0.5% in moderate seismicity, and 1.5% in high seismicity. (Commentary: Sec. A.2.1.2. Tier 2: Sec. 5.4.1.2) **Comments:** Lower 4 stories are adjacent to the Millberry building and parking structure to the east. 0.015 x 95' = 17" > 6" (Detail 29/S5.2)
C NC N/A U ○ ○ ● ○	MEZZANINES: Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure. (Commentary: Sec. A.2.1.3. Tier 2: Sec. 5.4.1.3) **Comments:**

BUILDING SYSTEMS - *BUILDING CONFIGURATION*

	Description
C NC N/A U ● ○ ○ ○	WEAK STORY: The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in the adjacent story above. (Commentary: Sec. A2.2.2. Tier 2: Sec. 5.4.2.1) **Comments:**
C NC N/A U ● ○ ○ ○	SOFT STORY: The stiffness of the seismic-force-resisting system in any story is not less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffness of the three stories above. (Commentary: Sec. A.2.2.3. Tier 2: Sec. 5.4.2.2) **Comments:**

ASCE 41-17
Collapse Prevention Basic Configuration Checklist

C	NC	N/A	U	
○	◉	○	○	VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation. (Commentary: Sec. A.2.2.4. Tier 2: Sec. 5.4.2.3) **Comments:** In-fill moment columns are not continuous.
○	◉	○	○	GEOMETRY: There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines. (Commentary: Sec. A.2.2.5. Tier 2: Sec. 5.4.2.4) **Comments:**
○	◉		○	MASS: There is no change in effective mass of more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered. (Commentary: Sec. A.2.2.6. Tier 2: Sec. 5.4.2.5) **Comments:** Estimated effective mass at Level 1 (storage floor) is approximately twice that of Level 2.
◉	○	○	○	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:** Checked at Levels 3 through 5

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

GEOLOGIC SITE HAZARD

C	NC	N/A	U	Description
◉	○	○	○	LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance do not exist in the foundation soils at depths within 50 ft (15.2m) under the building. (Commentary: Sec. A.6.1.1. Tier 2: 5.4.3.1) **Comments:** per UCSF Group 2 Buildings –Tier 1 Geotechnical Assessment, Egan (2019)
◉	○	○	○	SLOPE FAILURE: The building site is located away from potential earthquake-induced slope failures or rockfalls so that it is unaffected by such failures or is capable of accommodating any predicted movements without failure. (Commentary: Sec. A.6.1.2. Tier 2: 5.4.3.1) **Comments:** per UCSF Group 2 Buildings –Tier 1 Geotechnical Assessment, Egan (2019)

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

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Collapse Prevention Basic Configuration Checklist

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

GEOLOGIC SITE HAZARD

C	NC	N/A	U	
◉	○	○	○	SURFACE FAULT RUPTURE: Surface fault rupture and surface displacement at the building site are not anticipated. (Commentary: Sec. A.6.1.3. Tier 2: 5.4.3.1) **Comments:** per UCSF Group 2 Buildings –Tier 1 Geotechnical Assessment, Egan (2019)

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

FOUNDATION CONFIGURATION

C	NC	N/A	U	Description
◉	○	○	○	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:** 200'/94.5' = 2.1 > 0.6Sa = .73
◉	○	○	○	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:** Piers supporting the base level are tied together with grade beams (sheet S2.1) Uphill piers are restrained by slabs.

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ASCE 41-17
Collapse Prevention Structural Checklist For Building Type S1-S1A

LOW SEISMICITY

SEISMIC-FORCE-RESISTING SYSTEM

	Description
C NC N/A U ● ○ ○ ○	REDUNDANCY: The number of lines of moment frames in each principal direction is greater than or equal to 2. (Commentary: Sec. A.3.1.1.1. Tier 2: Sec. 5.5.1.1) **Comments:**
C NC N/A U ○ ○ ○ ●	DRIFT CHECK: The drift ratio of the steel moment frames, calculated using the Quick Check procedure of Section 4.4.3.1, is less than 0.030. (Commentary: Sec. A.3.1.3.1. Tier 2: Sec. 5.5.2.1.2) **Comments:** Moment frames are not regular, so Quick Check procedure is not applicable. Tier 2 analysis has not yet been performed.
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 ○ ○ ○ ●	FLEXURAL STRESS CHECK: The average flexural stress in the moment frame columns and beams, calculated using the Quick Check procedure of Section 4.4.3.9, is less than F_y. Columns need not be checked if the strong column–weak beam checklist item is compliant. (Commentary: Sec. A.3.1.3.3. Tier 2: Sec. 5.5.2.1.2) **Comments:** Strong column – weak beam checklist item is compliant. Moment frames are not regular, so Quick Check procedure is not applicable. Tier 2 analysis has not yet been performed.

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:** Deck puddle welds 2/S0.2, shear studs 8/S0.2
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:** Steel columns are encased in concrete at Level 1, with shear studs per 8/S4.2

ASCE 41-17
Collapse Prevention Structural Checklist For Building Type S1-S1A

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 bays of moment frames in each line is greater than or equal to 2. (Commentary: Sec. A.3.1.1.1. Tier 2: Sec. 5.5.1.1) **Comments:**
C ○ NC ◉ N/A ○ U ○	INTERFERING WALLS: All concrete and masonry infill walls placed in moment frames are isolated from structural elements. (Commentary: Sec. A.3.1.2.1. Tier 2: Sec. 5.5.2.1.1) **Comments:** Detail 11/S3.4: Moment frame is supporting top of CMU infill wall.
C ○ NC ◉ N/A ○ U ○	MOMENT-RESISTING CONNECTIONS: All moment connections can develop the strength of the adjoining members based on the specified minimum yield stress of steel. (Commentary: Sec. A.3.1.3.4. Tier 2: Sec. 5.5.2.2.1). **Comments:** Full-penetration flange welds considered non-compliant at Tier 1 per A3.1.3.4

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 ○	MOMENT-RESISTING CONNECTIONS: All moment connections are able to develop the strength of the adjoining members or panel zones based on 110% of the expected yield stress of the steel in accordance with AISC 341, Section A3.2. (Commentary: Sec. A.3.1.3.4. Tier 2: Sec. 5.5.2.2.1) **Comments:** Full-penetration flange welds considered non-compliant at Tier 1 per A3.1.3.4
C ○ NC ◉ N/A ○ U ○	PANEL ZONES: All panel zones have the shear capacity to resist the shear demand required to develop 0.8 times the sum of the flexural strengths of the girders framing in at the face of the column. (Commentary: Sec. A.3.1.3.5. Tier 2: Sec. 5.5.2.2.2) **Comments: 3** panel zones were checked; 1 was found to be noncompliant.

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Collapse Prevention Structural Checklist For Building Type S1-S1A

C	NC	N/A	U	
◉	○	○	○	COLUMN SPLICES: All column splice details located in moment-resisting frames include connection of both flanges and the web. (Commentary: Sec. A.3.1.3.6. Tier 2: Sec. 5.5.2.2.3) **Comments:** Detail 17/S5.1: welded web for columns weighing > 100 plf which covers moment frame columns
◉	○	○	○	STRONG COLUMN—WEAK BEAM: The percentage of strong column–weak beam joints in each story of each line of moment frames is greater than 50%. (Commentary: Sec. A.3.1.3.7. Tier 2: Sec. 5.5.2.1.5) **Comments:** Majority of moment of connections are to in-fill columns, which are not part of the gravity system.
◉	○	○	○	COMPACT MEMBERS: All frame elements meet section requirements in accordance with AISC 341, Table D1.1, for moderately ductile members. (Commentary: Sec. A.3.1.3.8. Tier 2: Sec. 5.5.2.2.4) **Comments:**

DIAPHRAGMS (STIFF OR FLEXIBLE)

C	NC	N/A	U	Description
○	◉	○	○	OPENINGS AT FRAMES: Diaphragm openings immediately adjacent to the moment frames extend less than 25% of the total frame length. (Commentary: Sec. A.4.1.5. Tier 2: Sec. 5.6.1.3) **Comments:** Non-compliant at Stair 2, Line 7. However non-moment frame girders at Line 7 will act as drag struts.

FLEXIBLE DIAPHRAGMS

C	NC	N/A	U	Description
○	○	◉	○	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:**

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ASCE 41-17
Collapse Prevention Structural Checklist For Building Type S1-S1A

C	NC	N/A	U	
○	○	◉	○	SPANS: All wood diaphragms with spans greater than 24 ft (7.3 m) consist of wood structural panels or diagonal sheathing. (Commentary: Sec. A.4.2.2. Tier 2: Sec. 5.6.2) **Comments:**
○	○	◉	○	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:**

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

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

Low And Moderate Seismicity

Seismic-Force-Resisting System

	Description
C NC N/A U ◉ ○ ○ ○	COMPLETE FRAMES: Steel or concrete frames classified as secondary components form a complete vertical-load-carrying system. (Commentary: Sec. A.3.1.6.1. Tier 2: Sec. 5.5.2.5.1) **Comments:**
C NC N/A U ◉ ○ ○ ○	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2. (Commentary: Sec. A.3.2.1.1. Tier 2: Sec. 5.5.1.1) **Comments:**
C NC N/A U ○ ◉ ○ ○	SHEAR STRESS CHECK: The shear stress in the 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:** Quick check DCRs are between 1.0 and 2.0
C NC N/A U ◉ ○ ○ ○	REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area is not less than 0.0012 in the vertical direction and 0.0020 in the horizontal direction. (Commentary: Sec. A.3.2.2.2. Tier 2: Sec. 5.5.3.1.3) **Comments:** Per 4/S3.3

Connections

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

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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:** 17/S3.3

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:** Column tie spacing meets A3.1.4.11 See 3/S4.1
C	NC	N/A	U	
◉	○	○	○	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:** At Level F slab: 3 - #5 bottom bars with 20” min. lap splice. See 1/S3.10 & 6/S0.1
C	NC	N/A	U	
◉	○	○	○	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:**

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

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

Flexible Diaphragms

C	NC	N/A	U	Description
○	○	◉	○	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

C	NC	N/A	U	Description
◉	○	○	○	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:** sheet S3.1

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

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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:** none
P ☐ **N/A** ☒	**Heavy masonry or stone veneer above exit ways or public access areas** **Comments:** none
P ☒ **N/A** ☐	**Unbraced masonry parapets, cornices, or other ornamentation above exit ways or public access areas** **Comments:** The attachment of the decorative pendant light fixtures in the building, including those in the main south stairway, should be checked. The fixtures should be restrained from swinging.
P ☐ **N/A** ☒	**Unrestrained hazardous material storage** **Comments:** none
P ☐ **N/A** ☒	**Masonry chimneys** **Comments:** none
P ☐ **N/A** ☒	**Unrestrained natural gas-fueled equipment such as water heaters, boilers, emergency generators, etc.** **Comments:** none
P ☐ **N/A** ☐	**Other:** **Comments:**

Falling Hazards Risk: Low

Note: P= Present, N/A = Not Applicable; Falling Hazards Risk: Low, Moderate, or High

SEISMIC EVALUATION OF EXISTING BUILDINGS - TIER 1 SCREENING

ASCE 41-17 Chapter 4

General

Building	Kalmanovitz Library, University of California San Francisco	
Architect	Esherick Homsey Dodge and Davis	
Structural Engineer	Rutherford & Chekene	
Location	530 Parnassus Avenue, San Francisco, CA 94143	
Design date	1987	
Latitude	37.764083	(Google Earth)
Longitude	-122.45916	"
Stories above grade	7	

Seismic parameters

Risk Category	III	(CBC 2016 Table 1604.5)
Site Class	C	Egan, 06/2019
Liquefaction hazard	Very Low	Egan, 06/2019
S_{CS}	1.855	Egan, 06/2019
S_{C1}	0.854	Egan, 06/2019
S_{rS}	0.904	Egan, 06/2019
S_{r1}	0.408	Egan, 06/2019

Scope

Performance level	S-5 CP	RC III per 2016 CEBC Table 317.5	(4.1.1, Table 2-1)
Seismic hazard level	BSE-2E		(4.1.2, Table 2-1)
Level of seismicity	High		(4.1.3, Table 2-4)
Building type	C2: Concrete shear walls with stiff diaphragms		(4.2.2, Table 3-1)
	S1: Steel moment frames with stiff diaphragms		

Material properties

				Notes
Concrete	f'_c	4000	psi	Properties per sht. S.01
Reinf.	f_y	60	ksi	
Steel bms	f_y	37	ksi	and infill cols.
Steel cols	f_y	50	ksi	W12s & W14s only

Checklists

Benchmark building	No	(Table 3-2)
Checklist(s) req'd	ASCE 41-17 Collapse Prevention Structural Checklist Basic Configuration	
	ASCE 41-17 Collapse Prevention Structural Checklist for Building Type C2-C2A	
	ASCE 41-17 Collapse Prevention Basic Configuration for Buolding Type S1-S1A	
	UCOP SEISMIC SAFETY POLICY Falling Hazard Assessment Summary	

Seismic forces

V	33806	kip	$V = CS_a W$	= 1.22W	(4-1)
W	27710	kip	building weight		(4.4.2.1)
C	1.0				(Table 4-7)
S_a	1.22	g	$S_a = S_{x1}/T \le S_{XS}$		(4-4)
T	0.70	sec	$T = 0.1n$		(4-5)
n	7		number of stories		
h_n	94.5	ft	building height		

Story Forces (4-3a) (4-3b)

Story	w kip	story ht ft	h ft	wh^k	F_{story}	F_{story} kip	V_{story} kip
Roof	1246		95	185564	0.13	4413	
5	2215	15.75	79	269929	0.19	6419	4413
4	2806	14.50	64	273368	0.19	6501	10832
3	3476	16.50	48	244315	0.17	5810	17334
2	3784	14.50	33	178617	0.13	4248	23144
1	7951	14.50	19	199859	0.14	4753	27392
F	6232	9.75	9	69871	0.05	1662	32145
E		9.00	0				33806
Total	27710			1421522	1.0	33806	

k 1.10 k = 1.0 for T < 0.5, 2.0 for T > 2.5, linear interpolation between

$F_{story} = V(wh^k)/(\Sigma wh^k)$ (4-3a)

$V_{story} = \Sigma_{above} F_{story}$ (4-3b)

Shear stress in shear walls (4-9) (4-9)

Story	$A_{w\,N\text{-}S}$ in^2	$A_{w\,E\text{-}W}$ in^2	v_{NS}^{avg} psi	v_{EW}^{avg} psi	D/C_{NS}	D/C_{EW}
1	38376	46502	159	131	1.3	1.0
F	30888	37200	231	192	1.8	1.5
E	30888	37200	243	202	1.9	1.6
Total						

M_s 4.5 ASCE 41-17 Table 4-8 (CP per CEBC Table 317.5)

v_{limit} 126 psi $v_{limit} = 2\sqrt{f_c'} \ge 100$ psi, f'c is spec'd strength

$v^{avg} = (1/M_S)(V_{story}/A_w)$ (4-9)

Panel Zones

Level	Grid	Column Section above	Beam Section	Column Section below	Column F_y (ksi)	Beam F_y (ksi)	No. of DP	t_{DP} (in)	Z_{ca} (in^3)	Z_b (in^3)	Z_{cb} (in^3)	R_n (kip)	ΣR (kip)	0.8·ΣR (kip)	Check
3	H-5-6	W27x161	W24x94	W36x150	37	37	2	0.625	515	254	581	952	1333	1067	NC
4	H-3-4	W30X116	W24x94	W36x150	37	37	2	0.625	378	254	581	952	1095	876	C
5	G-4-5	W30X116	W24x84	W24X131	37	37	2	0.625	378	224	370	920	1061	849	C

Column Stress

trib area	720	ft^2	24' x 30' bay
dist wts			
roof	92		
Level 5	88		
Level 4	87		
Level 3	97		
Level 2	139		
DL	**362.16**	**kip**	est. DL on column

Location	Section	f_y (ksi)	f_a (ksi)	$0.1 \cdot f_y$	Check
E4	W30x116	37	7.66	3.7	NC
E4	W12x120	37	7.45	3.7	NC
H6	W27X161	37	7.61	3.7	NC

Compact Members

E	29000	ksi	elastic modulus	
f_{y36}	37	ksi	specified min yield stress	
f_{y50}	50	ksi	specified min yield stress	
R_{y36}	1.5		expected/min yield stress ratio	AISC 341 Table A3.1
R_{y50}	1.1		expected/min yield stress ratio	AISC 341 Table A3.1
ϕ_c	0.9		resistance factor for compression	AISC 360 H1.1
C_a	0.1		(assumed value)	AISC 341 Table D1.1

Check moment frame members using Table D1.1

Section	b/t	λ_{md}	Check	h/t_w	λ_{md}	Check
W24x131	6.70	9.1	C	35.6	63	C
W24x146	5.92	9.1	C	33.2	63	C
W24x162	5.31	9.1	C	30.6	63	C
W24x76	6.61	9.1	C	49	63	C
W24x84	5.86	9.1	C	45.9	63	C
W24x94	5.18	9.1	C	41.9	63	C
W27x161	6.49	9.1	C	36.1	63	C
W27x94	6.70	9.1	C	49.5	63	C
W30x116	6.17	9.1	C	47.8	63	C
W30x132	5.27	9.1	C	43.9	63	C
W30x99	7.80	9.1	C	51.9	63	C
W36x150	6.37	9.1	C	51.9	63	C
W12x120	5.57	9.2	C	13.7	63	C
W12x136	4.96	9.2	C	12.3	63	C