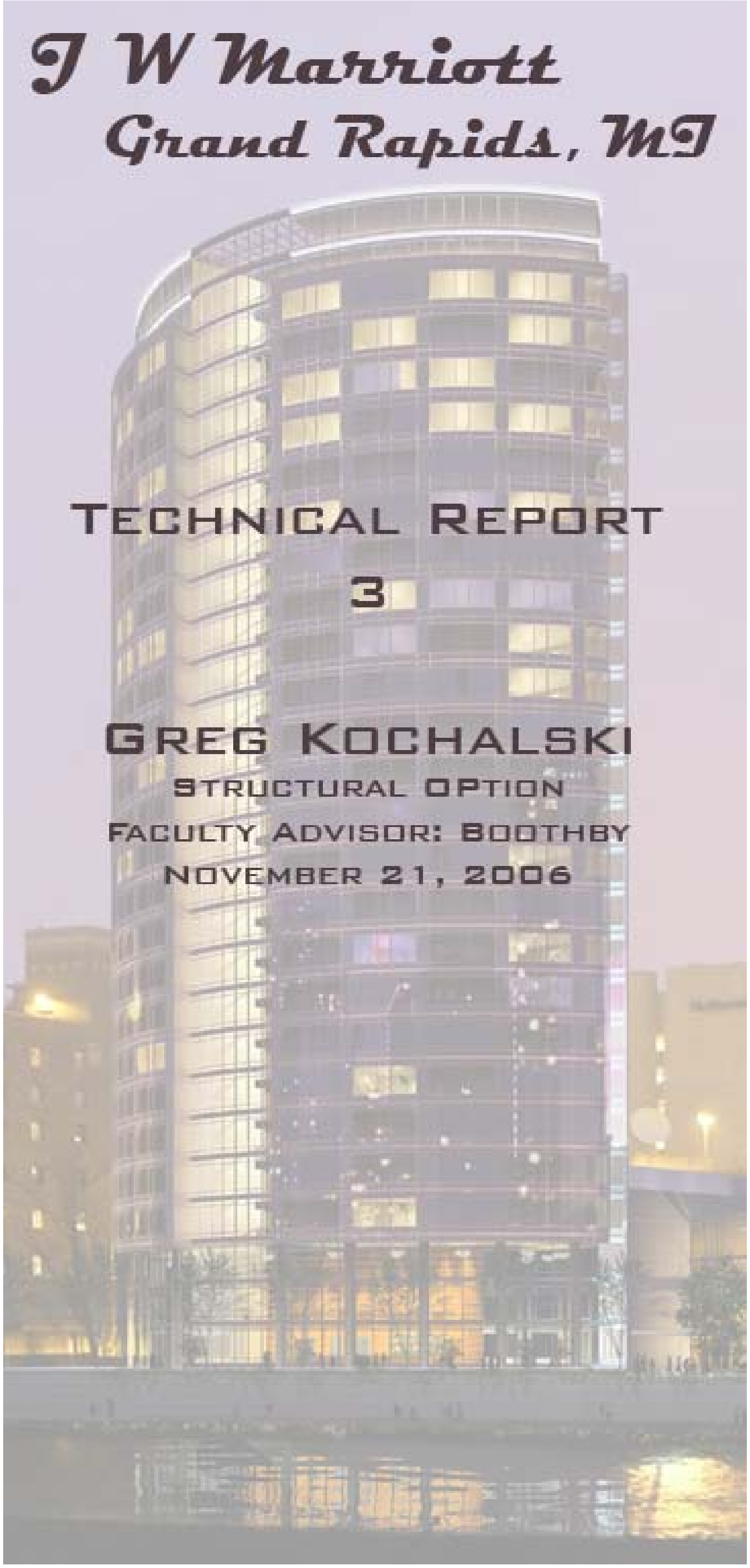

J W Marriott
Grand Rapids, MI

TECHNICAL REPORT
3

GREG KOCHALSKI

STRUCTURAL OPTION

FACULTY ADVISOR: BOOTHBY

NOVEMBER 21, 2006

EXECUTIVE SUMMARY

GREG KOCHALSKI

JW MARRIOTT, GRAND RAPIDS, MI
STRUCTURAL
NOVEMBER 21, 2006
ADVISOR: BOOTHBY

The JW Marriott is a 24 story hotel currently under construction in Grand Rapids, Michigan and is being constructed under the 2003 Michigan Building Code. The JW will offer over 300 guest rooms and multiple accommodations including a business center, restaurant, and 24 hour concierge. The unique elliptical shape will create a strong presence in the otherwise conservative Grand Rapids skyline.

Purpose:

The goal of this report is to investigate the existing lateral force resisting system used in the JW Marriott. The unique elliptical shape creates a complex array of lateral resisting elements. With four major shear walls located in the elevator core, the system would appear to be straight forward. However, due to the architect’s choice to use wall-columns along the radial perimeter, the wall-columns create obstacles in the form of effective rigidities in both North-South and East-West planes.

This report will be a complete analysis of the existing system. The loads and load cases have been identified, distribution of forces to individual elements has been preformed, and member checks have been calculated and compared to gathered data. A combination of hand analysis and ETABS computer analysis were utilized to achieve a proper data collection.

Conclusion:

ETABS computer modeling data was not deemed to be accurate when compared to hand-analysis. This may be due to the many unspecified assumptions, not apparent to the user, made by the computer program. In light of this, deflection calculations were done by hand instead of as originally intended. The 1.87 inch displacement was found to be well within the 7.68 inch limit.

When individual members were checked against the distributed forces, direct and torsional shear, the members were found to be significantly over-designed. I believe this is a cause of the flat plate floor system utilized by the JW. In order to achieve the necessary spans for the flat plate system used on typical floors, the shear walls and wall-columns become longer to allow for minimum plate thickness. Such limits as punching shear and deflection can be significantly reduced by implementing longer wall columns. This action will create members unnecessarily large if one analyzes only the member’s lateral resisting capacity.

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INTRODUCTION

Description:

The JW Marriott is a 24 story hotel currently under construction in Grand Rapids, Michigan and is being constructed under the 2003 Michigan Building Code. The JW will offer over 300 guest rooms and multiple accommodations including a business center, restaurant, and 24 hour concierge. The unique elliptical shape will create a strong presence in the otherwise conservative Grand Rapids skyline.

The building rises approximately 256 ft above grade and utilizes a reinforced flat plate gravity framing system. Wall-columns situated between guest rooms, typically 10 inches wide and 11 ft long, add a unique touch to the gravity framing system that minimizes view disruption. Concrete shear walls located within the elevator core provide the primary lateral force resistance for the structure. These walls span from the basement to the helipad atop the structure.

In this report I will study the lateral force resisting system present in the JW. The investigation will be carried out using a number of methods including but not limited to hand calculations and ETABS computer modeling. Within the report I will summarize loads and load cases applied to the building. I will also provide detailed results on how the loads distribute themselves into individual walls, overturning of the structure will also be considered. The report will also include a number of member checks to verify the computer findings. Based on those checks, I will accept or reject my findings. All calculations within this technical report will be done in accordance with the codes listed herein.

Structural Codes:

- *Building Code*
  Michigan Building Code 2003. The 2003 Michigan Building Code is an adoption of the IBC 2003 with state amendments.
- *Structural Concrete*
  ACI 318-2002. Building Code Requirements for Structural Concrete.
- *Concrete Masonry*
  ACI 530-1999. Building Code Requirements for Masonry Structures.
- *Structural Steel*
  LRFD Specification for Structural Steel Buildings, 2nd Edition. AISC.

EXISTING LATERAL SYSTEM

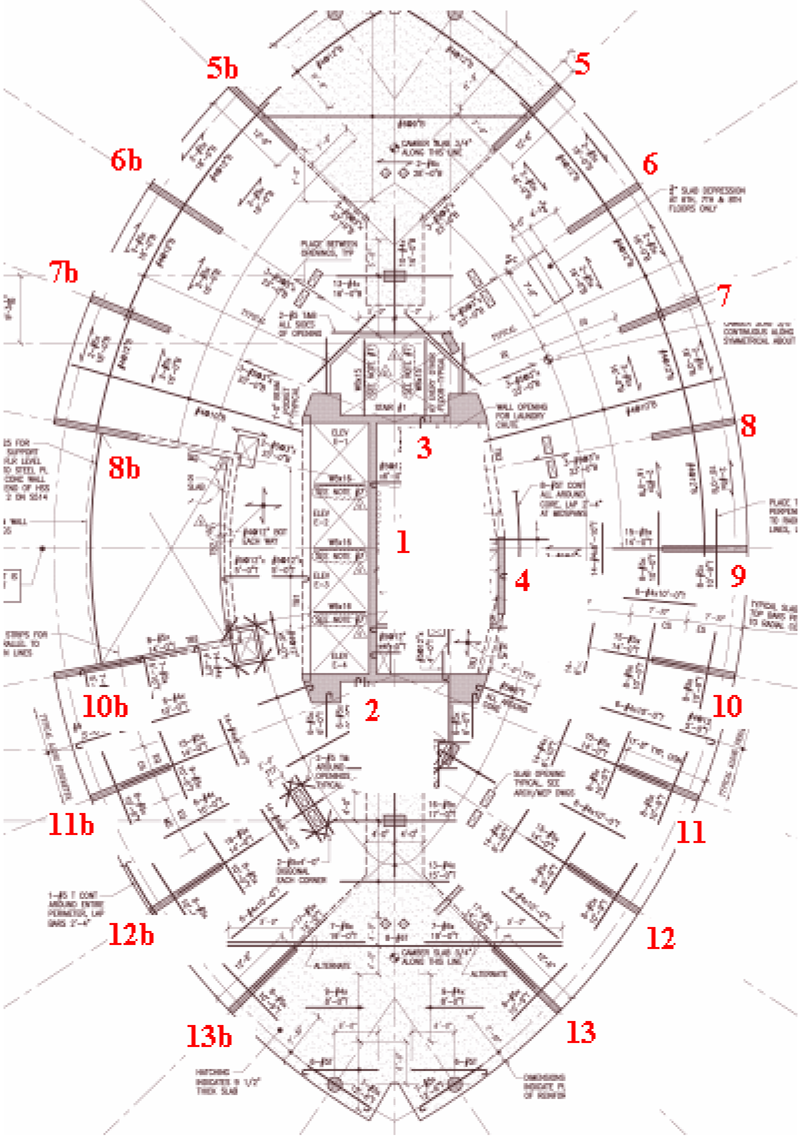
Description:

Concrete shear walls are currently under construction in the JW Marriott and will serve as the primary lateral force resistance. Located within the elevator core, the walls will span from the basement to the roof. Two major pairs span in each direction (two 25’-6” walls in the East-West direction and in the North-South direction a 35’ and a 10’-7” wall). All shear walls are 12 inches thick.

Additional lateral support must be considered from the wall-columns placed along the exterior of the JW. These walls are typically 11’-8” wide and 10” wide. Even though the walls are placed in a radial pattern they offer some effective rigidity. The wall-columns are staggered at angles ranging from approximately 45-78 degrees from vertical.

The concrete used in both shear walls and wall-columns vary with height above grade from 6 to 10 ksi. The shear wall naming convention used throughout this report is illustrated in Figure A.

Figure A. Naming Convention



LOADS AND LOAD CASES

The loads for the JW Marriott are presented in an abridged form below. The Michigan Building Code 2003 adopts the live and dead loads from the IBC 2003. Story shears that act on the lateral system of the JW were found for wind and seismic. Of the two load cases studied without computer assistance, seismic loading was found to govern. The loads presented in this section were used to determine forces present on the lateral resisting system by hand analysis and when using ETABS, unless otherwise noted.

Loads:

For the purpose of this report the code specifies 40 psf live load. This live load matches the designer's choice. The designer also specified 20 psf dead load for the partitions, flooring, MEP, etc. This is a generous allowance in part because the interior spaces had yet to be designed once erection began. The code calls for 12 psf for the partitions used. This allows the designer 8 psf remaining for the flooring and MEP, which usually is 3 psf and 5 psf. The loads and load cases used throughout this report have been summarized below.

Live Load

- 40 psf typical

Dead Load

- 20 psf typical

Load Combinations

- 1.2 Dead + 1.6 Live
- 1.2 Dead + 1.6 Live + 0.8 Wind
- 1.2 Dead + 0.5 Live + 1.6 Wind
- 1.2 Dead + 1.0 Live + 1.0 Quake

Major Assumptions:

- JW Marriott soil conditions are that of Site Class D.
- Normalization of the JW's elliptical shape into a rectangle of similar dimensions for wind analysis done by hand.
- Openings in the slab will be accounted for in ETABS only for the atrium and elevator shaft openings.
- Deflection analysis may be completed in ETABS.
- Shears are not to be reduced by the presence of negative torsional shears.
- Foundation deformation is neglected.

Wind:

Wind loads determined for the JW Marriot were carried out under Section 6 of ASCE7-02. Factors were based on building characteristics, location, and height of the building. Assumptions include the normalization of the JW Marriott's elliptical shape into a rectangle of the same design width and length. The high-rise was found to be flexible and was analyzed as such. A summary of the complete analytical procedure is presented within this section. General information and story shears may be found in tables 1 and 2, respectively. An illustrative representation of Table 2 has been presented in Figure 1. The complete analysis may be found in Appendix B. In later pages the story shears shall be distributed to individual elements and presented in an abridged form.

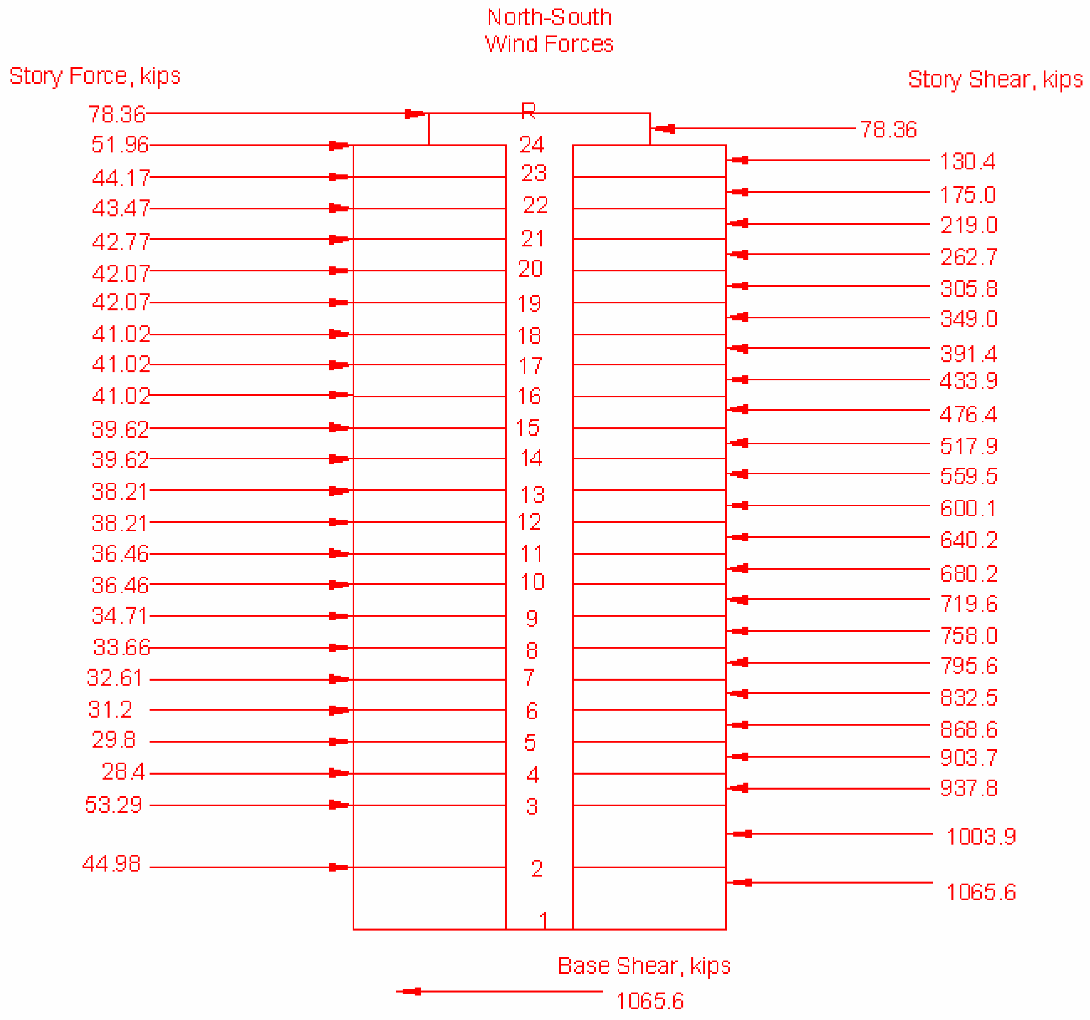
Table 1. General Information

Building Category	III	
Importance Factor, I	1.2	
Exposure Category	B	
k_d	0.9	
$k_{zt}=(1=k1k2k3)^2$	1.0	
V (mph)	90.0	
Period, T		
Tower	T_a	2.9
Multi use	T	0.4
C_T	0.0	
h_n	256.1	
x	0.9	
Frequency, n_1	0.3	
North South Length	160.6	
East West Length	95.3	
Building Height, h_n		
Tower	256.1	
Multi use	48.2	

Table 2. Story Shears (k)

Floor	N/S	E/W
1	1066	516
2	1004	488
3	938	457
4	904	441
5	869	425
6	833	408
7	796	390
8	758	372
9	720	354
10	680	334
11	641	315
12	600	296
13	559	276
14	518	256
15	476	235
16	434	214
17	391	194
18	349	173
19	306	151
20	263	130
21	219	109
22	175	87
23	130	65
MP	78	39
Roof	0	0

Figure 1. North South Wind Story Shears



Seismic:

Seismic calculations were carried out in accordance with the equivalent lateral force procedure outlined in Section 9 of ASCE7-02. A summary of the calculations are presented herein. All relevant accelerations and factors have been determined in accordance with Section 9. The complete data, assumptions, and calculations may be found in Appendix A. The primary assumption made in these analyses conservatively classified the building as Site Class D. The geotechnical report was not made available for this report, thus making such an assumption necessary.

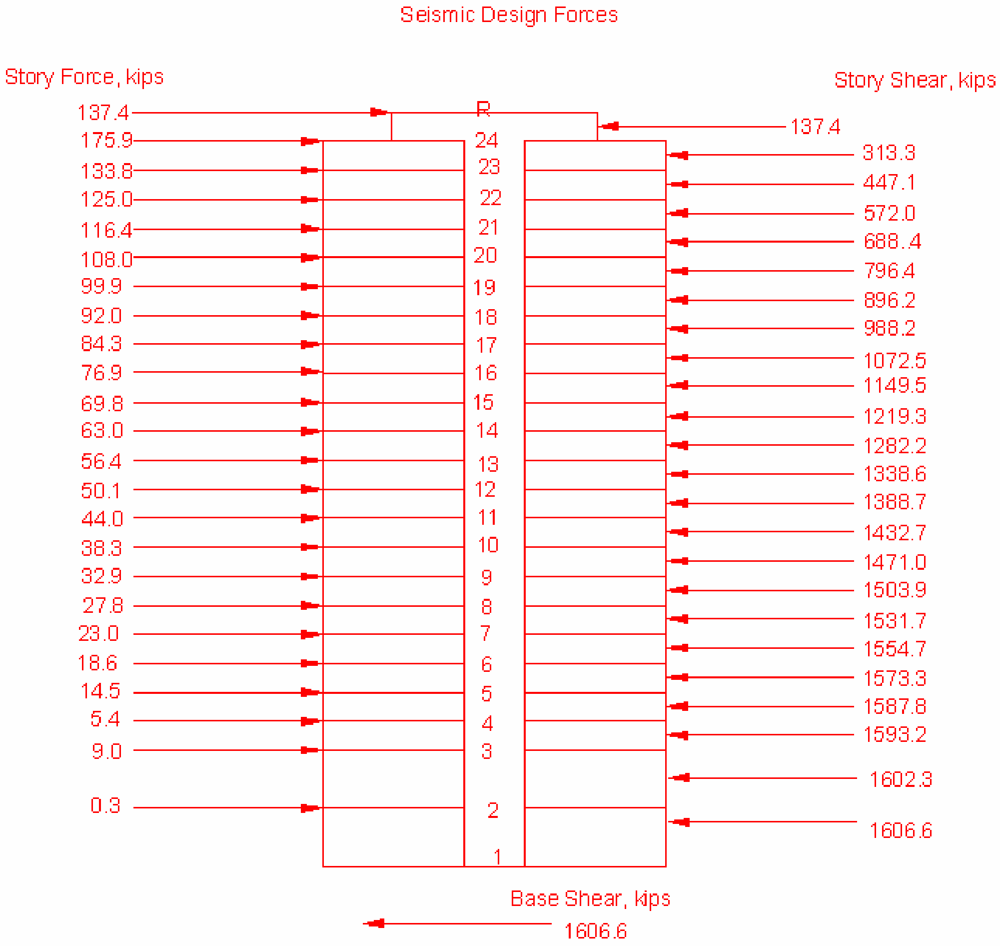
The information within this report section is concerning the tower high-rise only. The multi use facility and high-rise portions of the complex were analyzed as two separate structures. Story shears and general information are given in tables 3 and 4, respectively. An illustrative representation of Table 3 can be seen in Figure 2.

The tower weight used for the equivalent lateral force procedure is based on the column, slab, and dead loads of the building. The base shear was found to be approximately 1607 kips with an overturning moment of 296,400 ft-kips.

Table 3. Story Shears (k)	
Floor	
1	1602.6
2	1602.3
3	1593.2
4	1587.8
5	1573.3
6	1554.7
7	1531.7
8	1503.9
9	1471.0
10	1432.7
11	1388.7
12	1338.6
13	1282.2
14	1219.3
15	1149.5
16	1072.5
17	988.2
18	896.2
19	796.4
20	688.4
21	572.0
22	447.1
23	313.2
MP	137.4
Roof	0.0

Table 4. Seismic General Information		
Occupancy Type	III	
Seismic Use Group	II	
Site Class	D	
Seismic Design Category	A	
Short period spectral response	S_s	0.10
Spectral response at 1 Sec	S_1	0.04
Maximum short period spectral response	S_{ms}	0.16
Maximum spectral response at 1 sec	S_{m1}	0.10
Design short period spectral response	S_{DS}	0.11
Design spectral response at 1 Sec	S_{D1}	0.06
Response Modification Coefficient	R	5.00
Seismic Response Coefficient	Cs	0.0208
Effective Period	T	1.28
Height Above Grade	h_{nTower}	$h_{nMulti\ Use}$
	256.13	48.16
Base Shear	V_{Tower}	$V_{Multi\ Use}$
	1602.58	221.86
Overturning Moment	M_{Tower}	$M_{Multi\ Use}$
	296396.7	7746.0

Figure 2. Seismic Story Shears.



DISTRIBUTION OF LATERAL FORCES

Introduction:

The JW Marriott will receive its primary lateral support from two major pairs of shear walls located within the elevator core. Both pairs are 12 inches thick

Due to the unique design of the JW, additional lateral support must be considered from the wall-columns placed on a radial pattern along the perimeter of the building. These walls are typically 11'-8" wide and 10" wide and are staggered at angles ranging from 45-78 degrees from vertical. The rigidity of the wall-columns will vary proportional to the Cosine^2 of its respective angle. This will, in effect, give each wall-column a North-South and East-West rigidity. In some cases, the individual rigidities were determined to be negligible when compared to their entire floor level rigidity. Those instances are marked with the letter 'N' in the rigidity spreadsheets found in Appendix C. The tower geometry may be found within structural document S266 in Appendix E.

The concrete used in both shear walls and wall-columns vary with height above grade from 6 to 10 ksi. The twenty five levels of the JW have been separated into four groups. The color coding is as follows; floors 1 through 6 (blue), 7 through 13 (orange), 14 through 19 (yellow), and 20 through Roof (green). These levels were chosen to keep elements of similar strength grouped together.

Data:

Selected data elements and spreadsheets are presented herein. The complex geometry of the JW resulted in many data sets. In addition the concrete strength changes at levels 6 and 13 making analysis even more complex. It should be noted that some data and spreadsheets within this section are only intended to illustrate the procedure and may be intentionally incomplete. A more complete analysis may be found in Appendix C.

Rigidity:

$$R = E * t * \left[(h/L)^3 + (h/L) \right]^{(-1)}$$

Table 5. Rigidities

							Story	Elevation
		E	Shear	Shear	Thickness 1-4	Thickness 5-5b	H	H
	f'c (psi)	(psi)	N-S	E-W	(in)	(in)	(in)	(in)
Roof	6000	4695982			12	10	198	3072
MP	6000	4695982	78	39	12	10	132	2876
23	6000	4695982	130	65	12	10	114	2744
22	6000	4695982	175	87	12	10	114	2630
21	6000	4695982	219	109	12	10	114	2516
20	6000	4695982	263	130	12	10	114	2402

Table 6. North South Rigidity (Roof - 20)

Wall	1	2	3	4	5	6	7
Angle	0	90	90	0	45.7	56.8	67.8
(Cosine)^2	1	0	0	1	0.48	0.3	N
Roof	139382	0	0	3974.78			
MP	139382	0	0	3974.78			
23	139382	0	0	3974.78	2617.8	1330.7	0
22	139382	0	0	3974.78	2617.8	1330.7	0
21	139382	0	0	3974.78	2617.8	1330.7	0
20	139382	0	0	3974.78	2617.8	1330.7	0

Table 7. East West Rigidity (Roof - 20)

Wall	1	2	3	4	5	6	7
Angle	90	0	0	90	44.3	33.2	22.2
(Cosine)^2	0	1	1	0	N	0.7	0.85
Roof	0	51985.9	51985.9	0			
MP	0	51985.9	51985.9	0			
23	0	51985.9	51985.9	0	0	3725.8	4524.24
22	0	51985.9	51985.9	0	0	3725.8	4524.24
21	0	51985.9	51985.9	0	0	3725.8	4524.24
20	0	51985.9	51985.9	0	0	3725.8	4524.24

Distribution to Each Resisting Element:

Proportion, P = R_i / $\sum R_n$

Table 8. North South Wall Proportion (19 - 14)

Wall	1	2	3	4	5	6	7
Floor							
19	0.873201	0	0	0.025483	0.016792	0.008537	0
18	0.873201	0	0	0.025483	0.016792	0.008537	0
17	0.873201	0	0	0.025483	0.016792	0.008537	0
16	0.873201	0	0	0.025483	0.016792	0.008537	0
15	0.873201	0	0	0.025483	0.016792	0.008537	0
14	0.873201	0	0	0.025483	0.016792	0.008537	0

Table 9. East West Wall Proportion (19 - 14)

Wall	1	2	3	4	5	6	7
Floor							
19	0	0.339268	0.339268	0	0	0.020383	0.02475
18	0	0.339268	0.339268	0	0	0.020383	0.02475
17	0	0.339268	0.339268	0	0	0.020383	0.02475
16	0	0.339268	0.339268	0	0	0.020383	0.02475
15	0	0.339268	0.339268	0	0	0.020383	0.02475
14	0	0.339268	0.339268	0	0	0.020383	0.02475

Wall Shear Loads: Shown in kips.

$V_{wall} = P_{wall} * V_{story}$

Table 10. North South Wall Shears

Wall	1	2	3	4	5	6	7
Roof	0.0			0.0			
MP	76.2			2.2			
23	115.2			3.3	2.2	1.1	
22	153.3			4.4	2.9	1.5	
21	191.9			5.5	3.6	1.8	
20	230.1			6.6	4.4	2.2	

Torsion:

Given the symmetrical shape of the JW Marriott it was necessary to use the 5% incidental eccentricity to perform the torsional analysis of earthquake loads. The longer building dimension was conservatively used to determine the incidental eccentricity, or 8.0 ft.

Torsion, $T_i = \left[e * R_i x_i / \sum Rx^2 \right] * V_{Story}$

	Torsional Shear @ 8				
	R	x	Rx^2	$Rx/\sum Rc^2$	Torsion (k)
Wall					
1					
2	411334.7	17.91	131943039	0.009209	110.7921
3	411334.7	17.91	131943039	0.009209	110.7921
4					
5		59.93			
6	25047.76	47.24	55897024.4	0.001479	17.79495
7	30415.14	32.5	32125990	0.001236	14.8659
8	34351.22	16.56	9420257.4	0.000711	8.555008
9	35782.52	0			
10	34351.22	16.56	9420257.4	0.000711	8.555008
11	30415.14	32.5	32125990	0.001236	14.8659
12	30415.14	47.24	67874958.2	0.001796	21.60815
13	25047.76	59.93	89961661.4	0.001876	22.57518
13b		59.93			
12b	25047.76	47.24	55897024.4	0.001479	17.79495
11b	30415.14	32.5	32125990	0.001236	14.8659
10b	34351.22	16.56	9420257.4	0.000711	8.555008
8b	34351.22	16.56	9420257.4	0.000711	8.555008
7b	30415.14	32.5	32125990	0.001236	14.8659
6b	25047.76	27.24	18585879.6	0.000853	10.2611
5b		59.93			

	Torsional Shear @ 8			
	R	y	Ry^2	$Ry/\sum Rc^2$
Wall				
1	1078344	3.03	9900173	0.0040843
2				
3				
4	32096.75	14.8	7030471.8	0.0005938
5	21101.64	18.37	7120894.3	0.0004846
6	10734.75	29.07	9071564.4	0.0003901
7		36.79		
8		41.54		
9		43.15		
10		41.54		
11		36.79		
12	10734.75	29.07	9071564.4	0.0003901
13	21101.64	18.37	7120894.3	0.0004846
13b	21101.64	18.37	7120894.3	0.0004846
12b	10734.75	29.07	9071564.4	0.0003901
11b		36.79		
10b		41.54		
8b		41.54		
7b		36.79		
6b	10734.75	29.07	9071564.4	0.0003901
5b	21101.64	18.37	7120894.3	0.0004846

$\sum Rx^2$	718287615		$\sum Rc^2$	799988095			$\sum Ry^2$	81700480

ANALYSIS

Drift:

The drift analysis was carried out using ETABS computer modeling. After the analysis had run it was determined that inherent discrepancies arose in the modeling. There are numerous assumptions and necessary details that lend themselves easily to mistakes for a building geometry such as the JW Marriott. Those discrepancies resulted in a deflection that was unrealistic with respect to the H/400 limit for drift. Therefore, the ETABS computer analysis was rejected. With this in mind, a simple set of hand calculations were preformed in order to obtain a more realistic result. The resulting drift of 1.87" is well within the H/400 limit, or 7.68". The complete set of drift calculations may be found in Appendix D.

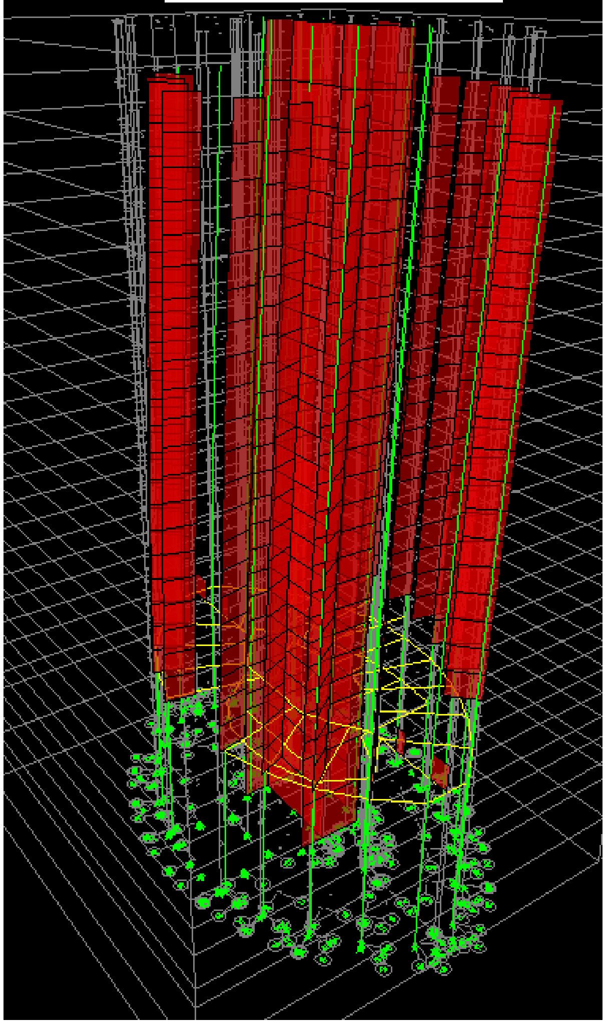


Figure 3. ETABS model.

Member Checks:

Shear Wall:

Shear wall 2 at the ground level was checked in order to verify the distribution of loads into the walls. In addition a wall-column 6 was checked at a typical floor level, level 3. The calculation considered all components, x and y, of direct and torsional shear forces present in the wall-column. Both members were found to be of sufficient capacity.

The analysis of the shear walls was carried out using the method of The Seismic Design Handbook, Naeim 2001. Torsion was considered in this report, which had not been done in previous reports.

Overturning:

The effects of overturning were considered at the basement level of the structure. After investigating the necessary tributary area needed to offset over turning it was concluded that overturning will not be an issue. In this report the contribution of the mini-piles used in the foundation system was not considered. The contribution would be very significant on its own. Therefore, overturning will not occur.

All complete member check calculations may be found in Appendix D.

Conclusion:

The JW Marriott has a complex array of shear walls in part because of the varying concrete strength and radial pattern. Unfortunately, the ETABS computer modeling data was not deemed to be accurate when compared to hand-analysis. This may be due to the many unspecified assumptions, not apparent to the user, made by the computer program. In light of this, deflection calculations were done by hand instead of as originally intended. The 1.87 inch displacement was found to be well within the 7.68 inch limit.

When individual members were checked against the distributed forces, direct and torsional shear, the members were found to be significantly over-designed. I believe this is a cause of the flat plate floor system utilized by the JW. In order to achieve the necessary spans for the flat plate system used on typical floors, the shear walls and wall-columns become longer to allow for minimum plate thickness. Such limits as punching shear and deflection can be significantly reduced by implementing longer wall columns along the perimeter and shear walls in the elevator core. This action will create section unnecessarily large if one analyzes only the shear capacity of the member.

APPENDICES

APPENDIX A

GENERAL INFORMATION		
Occupancy Type	III	
Seismic Use Group	II	
Site Class	D	
Seismic Design Category	A	
Short period spectral response	S_s	0.10
Spectral response at 1 Sec	S_1	0.04
Maximum short period spectral response	S_{ms}	0.16
Maximum spectral response at 1 sec	S_{m1}	0.10
Design short period spectral response	S_{DS}	0.11
Design spectral response at 1 Sec	S_{D1}	0.06
Response Modification Coefficient	R	5.00
Seismic Response Coefficient	Cs	0.0208
Effective Period	T	1.28
Height Above Grade	h_{nTower}	$h_{nMulti\ Use}$
	256.13	48.16
Base Shear	V_{Tower}	$V_{Multi\ Use}$
	1602.58	221.86
Overturning Moment	M_{Tower}	$M_{Multi\ Use}$
	296396.7	7746.0

TOWER MASS					
Floor	Area (sf)	Slab Thk (ft)	Slab Weight (kips)	Dead Load (psf)	Dead Wt. (kips)
1					
2	1716.47	0.50	123.59	10.00	17.16
3	5149.40	0.67	494.34	20.00	102.99
4	2574.70	0.67	247.17	20.00	51.49
5	5149.40	0.67	494.34	20.00	102.99
6	5149.40	0.67	494.34	20.00	102.99
7	5149.40	0.67	494.34	20.00	102.99
8	5149.40	0.67	494.34	20.00	102.99
9	5149.40	0.67	494.34	20.00	102.99
10	5149.40	0.67	494.34	20.00	102.99
11	5149.40	0.67	494.34	20.00	102.99
12	5149.40	0.67	494.34	20.00	102.99
13	5149.40	0.67	494.34	20.00	102.99
14	5149.40	0.67	494.34	20.00	102.99

15	5149.40	0.67	494.34	20.00	102.99
16	5149.40	0.67	494.34	20.00	102.99
17	5149.40	0.67	494.34	20.00	102.99
18	5149.40	0.67	494.34	20.00	102.99
19	5149.40	0.67	494.34	20.00	102.99
20	5149.40	0.67	494.34	20.00	102.99
21	5149.40	0.67	494.34	20.00	102.99
22	5149.40	0.67	494.34	20.00	102.99
23	5149.40	0.67	494.34	20.00	102.99
24	5149.40	1.00	741.51	30.00	154.48
Roof	2574.70	1.00	370.76	40.00	102.99
			Total kips		Total kips
			11369.88		2385.89

TOWER MASS (2)

Floor	Column Area (sf)	Col Ht. (ft)	Column Wt (kip)	Floor Wt (kip)
1				
2	93.02	19.66	263.35	404.10
3	1234.50	19.00	3377.60	3974.93
4	1001.18	9.50	1369.62	1668.28
5	2022.86	9.50	2767.28	3364.61
6	2022.86	9.50	2767.28	3364.61
7	2022.86	9.50	2767.28	3364.61
8	2022.86	9.50	2767.28	3364.61
9	2022.86	9.50	2767.28	3364.61
10	2022.86	9.50	2767.28	3364.61
11	2022.86	9.50	2767.28	3364.61
12	2022.86	9.50	2767.28	3364.61
13	2022.86	9.50	2767.28	3364.61
14	2022.86	9.50	2767.28	3364.61
15	2022.86	9.50	2767.28	3364.61
16	2022.86	9.50	2767.28	3364.61
17	2022.86	9.50	2767.28	3364.61
18	2022.86	9.50	2767.28	3364.61
19	2022.86	9.50	2767.28	3364.61
20	2022.86	9.50	2767.28	3364.61
21	2022.86	9.50	2767.28	3364.61
22	2022.86	9.50	2767.28	3364.61
23	2022.86	9.50	2767.28	3364.61
24	2022.86	11.00	3204.22	4100.21
Roof	1011.43	16.50	2403.16	2876.91
			Total kips	Total Mass (kips)
			63196.21	76951.98

TOWER LOADS

Floor	$W_x h_x^k$	h	C_{vx}	k	F_x	M (ft-kip)	Story Shear
1				1.61			kip
2	48849	19.66	0.0002	1.61	0.3	6.1	1602.6
3	1427083	38.66	0.0056	1.61	9.0	349.7	1602.3
4	851392	48.10	0.0034	1.61	5.4	259.6	1593.2
5	2295102	57.60	0.0091	1.61	14.5	837.9	1587.8
6	2934469	67.10	0.0116	1.61	18.6	1248.1	1573.3
7	3631626	76.60	0.0144	1.61	23.0	1763.3	1554.7
8	4383651	86.10	0.0173	1.61	27.8	2392.4	1531.7
9	5188090	95.60	0.0205	1.61	32.9	3143.8	1503.9
10	6042839	105.10	0.0239	1.61	38.3	4025.6	1471.0
11	6946068	114.60	0.0275	1.61	44.0	5045.6	1432.7
12	7896166	124.10	0.0312	1.61	50.1	6211.2	1388.7
13	8891696	133.60	0.0352	1.61	56.4	7529.8	1338.6
14	9931367	143.10	0.0393	1.61	63.0	9008.2	1282.2
15	11014010	152.60	0.0436	1.61	69.8	10653.5	1219.3
16	12138560	162.10	0.0480	1.61	76.9	12472.1	1149.5
17	13304040	171.60	0.0526	1.61	84.3	14470.8	1072.5
18	14509550	181.10	0.0574	1.61	92.0	16655.7	988.2
19	15754256	190.60	0.0623	1.61	99.9	19033.2	896.2
20	17037383	200.10	0.0674	1.61	108.0	21609.3	796.4
21	18358209	209.60	0.0726	1.61	116.4	24390.0	688.4
22	19716057	219.10	0.0780	1.61	125.0	27381.2	572.0
23	21110292	228.60	0.0835	1.61	133.8	30588.7	447.1
24	27747402	239.60	0.1097	1.61	175.9	42140.5	313.2
Roof	21672086	256.10	0.0857	1.61	137.4	35180.4	137.4
	Total			Base Shear		Overturning Moment	
	252830244			V=	1602.6	M=	296396.7

MULTI USE MASS

Floor	Floor Area (sf)	Slab Thk (ft)	Floor wt (kips)	Column Ht.	Column Wt (plf)
1					
2	34365.7	0.7	3299.1	19.7	90.0
3	34365.7	0.7	3299.1	19.0	90.0
Roof	16111.9	45 psf	725.0	9.5	120.0
			Total (kips)		
			7323.3		

MULTI USE MASS (2)

Floor	Dead Load (psf)	No. Columns	Col. Wt. (kips)	Dead wt (kips)	Floor Wt (kips)
1					
2	10.0	38.0	67.3	343.7	3710.0
3	10.0	38.0	65.0	343.7	3707.7
Roof	10.0	14.0	16.0	161.1	902.1
			Total (kips)	Total (kips)	Total (kips)
			148.2	848.4	8319.9

MULTI USE LOADS						
Floor	$W_x h_x^k$	h	C_{vx}	k	F_x	Moment (ft-kip)
1						
2	72939.0	19.66	0.28	1.00	62.3	1224.9
3	143341.4	38.66	0.55	1.00	122.4	4733.7
Roof	43446.0	48.16	0.17	1.00	37.1	1787.3
	Total				Base Shear	Overturning Moment
	259726.4				221.9	7746.0

APPENDIX B

GENERAL INFO		
Building Category	III	
Importance Factor, I	1.15	
Exposure Category	B	
k_d	0.85	
k_{zt}=(1=k1k2k3)^2	1.00	
V (mph)	90.00	
Period, T		
Tower	T_a	2.94
Multi use	T	0.40
C_T	0.02	
h_n	256.13	
x	0.90	
Frequency, n_1	0.34	
North South Length	160.61	
East West Length	95.34	
Building Height, h_n		
Tower	256.13	
Multi use	48.16	

TOWER GUST FACTOR		
	N-S	E-W
L	160.61	95.34
B	95.34	160.61
n_1	0.34	0.34
TYPE	FLEXIBLE	FLEXIBLE
z_{min}	30.00	30.00
c	0.30	0.30
I_z	0.23	0.23
h	129.67	129.67
L_z	534.38	534.38
ℓ	320.00	320.00
z	153.68	153.68
epsilon hat	0.33	0.33
Q	1.00	0.98
g_Q	3.40	3.40
g_v	3.40	3.40
G		
g_r	3.92	3.92
R_h	2.44	2.44
R_B	2.96	2.16
R_L	4.48	6.86
MU_{Rh}	0.00	0.00
MU_{RB}	0.00	0.00
MU_{RL}	0.00	0.00
Beta	0.50	0.50
Vz	2821054.12	2821054.12
b	0.45	0.45
alpha	7.00	7.00
N_1	0.00	0.00
R_n	0.00	0.00
R	0.14	0.14
G_F	0.93	0.92

TOWER					
No. of Stories		24			
Typ. Story Height (ft)		9.5			
Builidng Height (ft)		256.125			
L/B in N-S Direction		1.68			
L/B in E-W Direction		0.59			
h/L in N-S Direction		1.59			
h/L in E-W Direction		2.69			
		$C_{p,windward}$	$C_{p,leeward}$	$C_{p,side\ wall}$	Gust Factor
N-S Direciton:		0.80	-0.42	-0.70	0.93
E-W Direciton:		0.80	-0.23	-0.70	0.92
Gcpi	Enlosed +/-	0.18			
Internal Pressure +/-		4.71			

GENERAL INFO		
Building Cate	III	
Importance F	1.15	
Exposure Cat	B	
k_d	0.85	
k_{zt}=(1=k1k2k	1.00	
V (mph)	90.00	
Period, T		
Tower	T_a	2.94
Multi use	T	0.40
C_T	0.02	
h_n	256.13	
x	0.90	
Frequency, n	0.34	
North South L	160.61	
East West Le	95.34	
Building Height, h_n		
Tower	256.13	
Multi use	48.16	

MULTI USE GUST FACTOR			
	N-S	E-W	
L	199.33	170.67	
B	170.67	199.33	
n_1	2.50	2.50	
TYPE	RIGID	RIGID	G_F=0.85
z_{min}	30.00	30.00	
c	0.30	0.30	
I_z	0.31	0.31	
h	129.67	129.67	
L_z	306.14	306.14	
ℓ	320.00	320.00	
z	28.90	28.90	
epsilon hat	0.33	0.33	
Q	1.00	0.97	
g_Q	3.40	3.40	
g_v	3.40	3.40	
G	0.92	0.91	
g_r	4.40	4.40	
R_h	#VALUE!	#VALUE!	
R_B	#VALUE!	#VALUE!	
R_L	#VALUE!	#VALUE!	
MU_{Rh}	#VALUE!	#VALUE!	
MU_{RB}	#VALUE!	#VALUE!	
MU_{RL}	#VALUE!	#VALUE!	
Beta	0.50	0.50	
Vz			
b	0.45	0.45	
alpha	7.00	7.00	
N_1	#VALUE!	#VALUE!	
R_n	#VALUE!	#VALUE!	
R	#VALUE!	#VALUE!	
G_F	FALSE	FALSE	

MULTI USE	
No. of Stories	4
Typ. Story Height (ft)	19
Builidng Height (ft)	48.16
L/B in N-S Direction	1.17
L/B in E-W Direction	0.86
h/L in N-S Direction	0.24
h/L in E-W Direction	0.28

		$C_{p,windward}$	$C_{p,leeward}$	$C_{p,side wall}$	Gust Factor
N-S Direciton:		0.80	-0.50	-0.70	0.85
E-W Direciton:		0.80	-0.50	-0.70	0.85
Gcpi	Enlosed +/-	0.18			
Internal Pressure +/-		2.96			

TOWER				
Floor	h(above grade)	Floor height	k_z	q_z
1	0.00			
2	19.66	19.66	0.62	12.57
3	38.66	19.00	0.76	15.40
4	48.10	9.50	0.81	16.42
5	57.60	9.50	0.85	17.23
6	67.10	9.50	0.89	18.04
7	76.60	9.50	0.93	18.85
8	86.10	9.50	0.96	19.46
9	95.60	9.50	0.99	20.07
10	105.10	9.50	1.04	21.08
11	114.60	9.50	1.04	21.08
12	124.10	9.50	1.09	22.09
13	133.60	9.50	1.09	22.09
14	143.10	9.50	1.13	22.90
15	152.60	9.50	1.13	22.90
16	162.10	9.50	1.17	23.72
17	171.60	9.50	1.17	23.72
18	181.10	9.50	1.17	23.72
19	190.60	9.50	1.20	24.32
20	200.10	9.50	1.20	24.32
21	209.60	9.50	1.22	24.73
22	219.10	9.50	1.24	25.13
23	228.60	9.50	1.26	25.54
24	239.60	11.00	1.28	25.94
Roof	256.10	16.46	1.29	26.15

Tower Pressures (psf)					
NS windward	NS leeward	NS side wall	EW windward	EW leeward	EW side wall
9.35	-10.19	-8.18	9.25	-5.57	-8.09
11.46	-10.19	-10.03	11.34	-5.57	-9.92
12.22	-10.19	-10.69	12.08	-5.57	-10.57
12.82	-10.19	-11.22	12.68	-5.57	-11.10
13.42	-10.19	-11.74	13.28	-5.57	-11.62
14.02	-10.19	-12.27	13.87	-5.57	-12.14
14.48	-10.19	-12.67	14.32	-5.57	-12.53
14.93	-10.19	-13.06	14.77	-5.57	-12.92
15.68	-10.19	-13.72	15.52	-5.57	-13.58
15.68	-10.19	-13.72	15.52	-5.57	-13.58
16.44	-10.19	-14.38	16.26	-5.57	-14.23
16.44	-10.19	-14.38	16.26	-5.57	-14.23
17.04	-10.19	-14.91	16.86	-5.57	-14.75
17.04	-10.19	-14.91	16.86	-5.57	-14.75
17.64	-10.19	-15.44	17.45	-5.57	-15.27

17.64	-10.19	-15.44	17.45	-5.57	-15.27
17.64	-10.19	-15.44	17.45	-5.57	-15.27
18.10	-10.19	-15.83	17.90	-5.57	-15.66
18.10	-10.19	-15.83	17.90	-5.57	-15.66
18.40	-10.19	-16.10	18.20	-5.57	-15.93
18.70	-10.19	-16.36	18.50	-5.57	-16.19
19.00	-10.19	-16.63	18.80	-5.57	-16.45
19.30	-10.19	-16.89	19.10	-5.57	-16.71
19.45	-10.19	-17.02	19.24	-5.57	-16.84

Forces (k)		**Shears (k)**		**Moments (ft-k)**	
N/S	E/W	N/S	E/W	Moment	Moment
				NS	EW
61.69	27.77	1065.64	515.59	1212.85	545.93
66.06	30.62	1003.95	487.82	1255.19	581.78
34.18	15.99	937.89	457.20	324.73	151.86
35.10	16.53	903.71	441.22	333.47	157.00
36.02	17.07	868.61	424.69	342.21	162.13
36.94	17.61	832.58	407.62	350.96	167.27
37.63	18.01	795.64	390.02	357.52	171.12
38.32	18.42	758.01	372.00	364.07	174.97
39.47	19.09	719.68	353.59	375.00	181.39
39.47	19.09	680.21	334.49	375.00	181.39
40.62	19.77	640.74	315.40	385.93	187.80
40.62	19.77	600.11	295.63	385.93	187.80
41.54	20.31	559.49	275.86	394.68	192.94
41.54	20.31	517.94	255.55	394.68	192.94
42.47	20.85	476.40	235.24	403.42	198.07
42.47	20.85	433.93	214.39	403.42	198.07
42.47	20.85	391.47	193.54	403.42	198.07
43.16	21.26	349.00	172.69	409.98	201.92
43.16	21.26	305.85	151.44	409.98	201.92
43.62	21.53	262.69	130.18	414.35	204.49
44.08	21.80	219.07	108.66	418.72	207.06
44.54	22.07	175.00	86.86	423.09	209.63
52.10	25.86	130.46	64.80	573.11	284.49
78.36	38.93	78.36	38.93	1289.82	640.86
Total					
1065.64	515.59			12001.55	5780.90

MULTI USE				
Floor	h(above grade)	Floor height	k_Z	q_Z
1	0			
2	19.66	19.66	0.62	12.57
3	38.66	19.00	0.76	15.40
4	48.16	9.50	0.81	16.42

M-U Pressures (psf)						
Floor	NS windward	NS leeward	NS side wall	EW windward	EW leeward	EW side wall
1						
2	8.55	-5.34	-7.48	8.55	-5.34	-7.48
3	10.48	-6.55	-9.17	10.48	-6.55	-9.17
4	11.16	-6.98	-9.77	11.16	-6.98	-9.77

M-U Forces (k)			Shears (k)	
Floor	N/S	E/W	N/S	E/W
1				
2	54.42	46.59	54.42	46.59
3	64.47	55.20	118.89	101.79
4	34.36	29.41	153.24	131.21
Total	153.24	131.21	326.55	279.59

APPENDIX C

The information presented in this appendix is only a representation of the work completed. The work in its entirety is too long to present in this report but is available for review.

Rigidities

	f'c (psi)	E (psi)	Shear N-S	Shear E-W	Thickness 1-4 (in)	Thickness 5-5b (in)	Story H (in)	Elevation H (in)
Roof	6000	4695982			12	10	198	3072
MP	6000	4695982	78	39	12	10	132	2876
23	6000	4695982	130	65	12	10	114	2744
22	6000	4695982	175	87	12	10	114	2630
21	6000	4695982	219	109	12	10	114	2516
20	6000	4695982	263	130	12	10	114	2402
19	6000	4695982	306	151	12	10	114	2288
18	6000	4695982	349	173	12	10	114	2174
17	6000	4695982	391	194	12	10	114	2060
16	6000	4695982	434	214	12	10	114	1946
15	6000	4695982	476	235	12	10	114	1832
14	6000	4695982	518	256	12	10	114	1718
13	8000	5422453	559	276	12	10	114	1604
12	8000	5422453	600	296	12	10	114	1490
11	8000	5422453	641	315	12	10	114	1376
10	8000	5422453	680	334	12	10	114	1262
9	8000	5422453	720	354	12	10	114	1148
8	8000	5422453	758	372	12	10	114	1034
7	8000	5422453	796	390	12	10	114	920
6	10000	6062487	833	408	12	10	114	806
5	10000	6062487	869	425	12	10	114	692
4	10000	6062487	904	441	12	10	114	578
3	10000	6062487	938	457	12	10	228	464
2	10000	6062487	1004	488	12	10	236	236
1	10000	6062487	1066	516	12	10	0	0

Length (ft)																				
1	2	3	4	5	6	7	8	9	10	11	12	13	13b	12b	11b	10b	8b	7b	6b	5b
34.8	25.0	25.0	10.6	NA																
34.8	25.0	25.0	10.6	NA																
34.8	25.0	25.0	10.6	12.5	11.7	11.7	16.5	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	16.5	16.5	0.0	0.0	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	12.5	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	11.7	11.7	11.7	11.7	11.7	11.7	12.5
34.8	25.0	25.0	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34.8	25.0	25.0	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6. North South Rigidity (Roof - 20)

Wall	1	2	3	4	5	6	7	8	9	10	11	12	13	13b	12b	11b	10b	8b	7b	6b	5b
Angle	0	90	90	0	45.7	56.8	67.8	78.9	90	78.9	67.8	56.8	45.7	45.7	56.8	67.8	78.9	78.9	67.8	56.8	45.7
(Cosine)^2	1	0	0	1	0.48	0.3	N	N	N	N	N	0.3	0.48	0.48	0.3	N	N	N	N	0.3	0.48
Roof	139382	0	0	3974.78																	
MP	139382	0	0	3974.78																	
23	139382	0	0	3974.78	2617.8	1330.7	0	0	0	0	0	1330.7	2617.8	2617.8	1330.7	0	0	0	0	0	2617.8
22	139382	0	0	3974.78	2617.8	1330.7	0	0	0	0	0	1330.7	2617.8	2617.8	1330.7	0	0	0	0	1330.66	2617.8
21	139382	0	0	3974.78	2617.8	1330.7	0	0	0	0	0	1330.7	2617.8	2617.8	1330.7	0	0	0	0	1330.66	2617.8
20	139382	0	0	3974.78	2617.8	1330.7	0	0	0	0	0	1330.7	2617.8	2617.8	1330.7	0	0	0	0	1330.66	2617.8

Table 7. East West Rigidity (Roof - 20)

Wall	1	2	3	4	5	6	7	8	9	10	11	12	13	13b	12b	11b	10b	8b	7b	6b	5b
Angle	90	0	0	90	44.3	33.2	22.2	11.1	0	11.1	22.2	33.2	44.3	44.3	33.2	22.2	11.1	11.1	22.2	33.2	44.3
(Cosine)^2	0	1	1	0	N	0.7	0.85	0.96	1	0.96	0.85	0.7	N	N	0.7	0.85	0.96	0.96	0.85	0.7	N
Roof	0	51985.9	51985.9	0																	
MP	0	51985.9	51985.9	0																	
23	0	51985.9	51985.9	0	0	3725.8	4524.24	14370.4	5322.64	5109.7	4524.2	3725.8	0	0	3725.8	4524.2	14370	14370.4	0	0	0
22	0	51985.9	51985.9	0	0	3725.8	4524.24	5109.73	5322.64	5109.7	4524.2	3725.8	0	0	3725.8	4524.2	5109.7	5109.73	4524.2	3725.848	0
21	0	51985.9	51985.9	0	0	3725.8	4524.24	5109.73	5322.64	5109.7	4524.2	3725.8	0	0	3725.8	4524.2	5109.7	5109.73	4524.2	3725.848	0
20	0	51985.9	51985.9	0	0	3725.8	4524.24	5109.73	5322.64	5109.7	4524.2	3725.8	0	0	3725.8	4524.2	5109.7	5109.73	4524.2	3725.848	0

North South Wall Proportion

	1	2	3	4	5	6	7
Roof	0.972273	0	0	0.027727			
MP	0.972273	0	0	0.027727			
23	0.88317	0	0	0.025186	0.016588	0.008432	0
22	0.875786	0	0	0.024975	0.016588	0.008432	0
21	0.875786	0	0	0.024975	0.016588	0.008432	0
20	0.875786	0	0	0.024975	0.016588	0.008432	0
19	0.873201	0	0	0.025483	0.016792	0.008537	0
18	0.873201	0	0	0.025483	0.016792	0.008537	0
17	0.873201	0	0	0.025483	0.016792	0.008537	0
16	0.873201	0	0	0.025483	0.016792	0.008537	0
15	0.873201	0	0	0.025483	0.016792	0.008537	0
14	0.873201	0	0	0.025483	0.016792	0.008537	0
13	0.871188	0	0	0.025931	0.017048	0.008673	0
12	0.871188	0	0	0.025931	0.017048	0.008673	0
11	0.871188	0	0	0.025931	0.017048	0.008673	0
10	0.871188	0	0	0.025931	0.017048	0.008673	0
9	0.871188	0	0	0.025931	0.017048	0.008673	0
8	0.871188	0	0	0.025931	0.017048	0.008673	0
7	0.871188	0	0	0.025931	0.017048	0.008673	0
6	0.853468	0	0	0.029639	0.019349	0.009875	0
5	0.853468	0	0	0.029639	0.019349	0.009875	0
4	0.906446	0	0	0.031479	0	0	0
3	0.906446	0	0	0.031479	0	0	0
2	0.966438	0	0	0.033562	0	0	0
1	0.966438	0	0	0.033562	0	0	0

Table 10. North South Wind Wall Shears

Wall	1	2	3	4	5	6	7
Roof	0.0			0.0			
MP	76.2			2.2			
23	115.2			3.3	2.2	1.1	
22	153.3			4.4	2.9	1.5	
21	191.9			5.5	3.6	1.8	
20	230.1			6.6	4.4	2.2	
19	267.1			7.8	5.1	2.6	
18	304.7			8.9	5.9	3.0	
17	341.8			10.0	6.6	3.3	
16	378.9			11.1	7.3	3.7	
15	416.0			12.1	8.0	4.1	
14	452.3			13.2	8.7	4.4	
13	487.4			14.5	9.5	4.9	
12	522.8			15.6	10.2	5.2	
11	558.2			16.6	10.9	5.6	
10	592.6			17.6	11.6	5.9	
9	627.0			18.7	12.3	6.2	
8	660.4			19.7	12.9	6.6	
7	693.2			20.6	13.6	6.9	
6	710.6			24.7	16.1	8.2	
5	741.3			25.7	16.8	8.6	
4	819.2			28.4	0.0	0.0	
3	850.1			29.5	0.0	0.0	
2	970.3			33.7	0.0	0.0	
1	1029.9			35.8	0.0	0.0	

North South Quake Wall Shears

Wall	1	2	3	4	5	6	7
Roof	0.0			0.0			
MP	133.6			3.8			
23	276.7			7.9	0.0	2.6	
22	391.5			11.2	7.4	3.8	
21	501.0			14.3	9.5	4.8	
20	602.9			17.2	11.4	5.8	
19	695.4			20.3	13.4	6.8	
18	782.6			22.8	15.0	7.7	
17	862.9			25.2	16.6	8.4	
16	936.5			27.3	18.0	9.2	
15	1003.7			29.3	19.3	9.8	
14	1064.7			31.1	20.5	10.4	
13	1117.1			33.2	21.9	11.1	
12	1166.2			34.7	22.8	11.6	
11	1209.8			36.0	23.7	12.0	
10	1248.1			37.2	24.4	12.4	
9	1281.5			38.1	25.1	12.8	
8	1310.2			39.0	25.6	13.0	
7	1334.4			39.7	26.1	13.3	
6	1326.9			46.1	30.1	15.4	
5	1342.7			46.6	30.4	15.5	
4	1439.3			50.0	0.0	0.0	
3	1444.2			50.2	0.0	0.0	
2	1548.5			53.8	0.0	0.0	
1	1548.8			53.8	0.0	0.0	

	Torsional Shear @ 1				
	R	x	Rx^2	$Rx/\sum Rc^2$	orsion(ft-1)*e
Wall					
1					
2	3294904	17.91	1056900072	0.02625	336.5447
3	3294904	17.91	1056900072	0.02625	336.4797
4					
5		59.93			
6		47.24			
7		32.5			
8		16.56			
9		0			
10		16.56			
11		32.5			
12		47.24			
13		59.93			
13b		59.93			
12b		47.24			
11b		32.5			
10b		16.56			
8b		16.56			
7b		32.5			
6b		27.24			
5b		59.93			

	Torsional Shear @ 1				
	R	y	Ry^2	$Ry/\sum Rc^2$	Torsion (k)
Wall					
1	7996666	3.03	73416593	0.0107782	138.1834
2				0	0
3				0	0
4	277707.3	14.8	60828999	0.0018283	23.224
5		18.37			
6		29.07			
7		36.79			
8		41.54			
9		43.15			
10		41.54			
11		36.79			
12		29.07			
13		18.37			
13b		18.37			
12b		29.07			
11b		36.79			
10b		41.54			
8b		41.54			
7b		36.79			
6b		29.07			
5b		18.37			

$\sum Rx^2$ 2113800143

$\sum Rc^2$ 2248045734

$\sum Ry^2$ 134245591

	Torsional Shear @ 2				
	R	x	Rx^2	$Rx/\sum Rc^2$	Torsion (k)
Wall					
1					
2	3294904	17.91	1056900072	0.02625	336.4797
3	3294904	17.91	1056900072	0.02625	336.4797
4					
5		59.93			
6		47.24			
7		32.5			
8		16.56			
9		0			
10		16.56			
11		32.5			
12		47.24			
13		59.93			
13b		59.93			
12b		47.24			
11b		32.5			
10b		16.56			
8b		16.56			
7b		32.5			
6b		27.24			
5b		59.93			

	Torsional Shear @ 2				
	R	y	Ry^2	$Ry/\sum Rc^2$	Torsion (k)
Wall					
1	7996666	3.03	73416593	0.0107782	138.1567
2				0	0
3				0	0
4	277707.3	14.8	60828999	0.0018283	23.43524
5		18.37			
6		29.07			
7		36.79			
8		41.54			
9		43.15			
10		41.54			
11		36.79			
12		29.07			
13		18.37			
13b		18.37			
12b		29.07			
11b		36.79			
10b		41.54			
8b		41.54			
7b		36.79			
6b		29.07			
5b		18.37			

$\sum Rx^2$ 2113800143

$\sum Rc^2$ 2248045734

$\sum Ry^2$ 134245591

APPENDIX D

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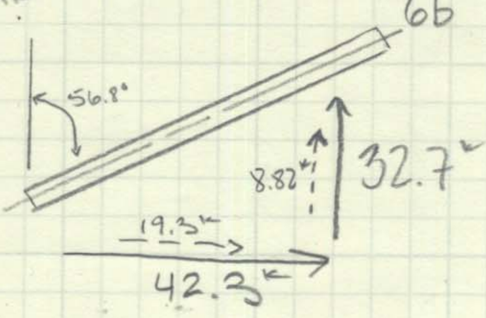
MEMBER CHECK | W-C 6b@ LEVEL 3

$\longrightarrow$ DIRECT SHEAR
$- - \rightarrow$ TORSIONAL SHEAR



$t = 10''$
$l = 140''$
$f'_c = 10\,ksi$

RESULTANT SHEAR

$$V = \sqrt{42.3^2 + 32.7^2 + 19.3^2 + 8.82^2}\,]$$

$$V = 57.5^k @ 56.8° \text{ FROM VERTICAL}$$

$$\phi V_n = \phi\left[\alpha_c\sqrt{f'_c} + \rho_t f_y\right]$$

$$\frac{h_w}{l_w} = \frac{256}{11.7} > 2 \longrightarrow \alpha = 2.0$$

$$A_{cv} = (10'')(140'') = 1400\,in^2$$

A_{sl} = #7 @ 6" ON 320 FLOOR

$$= 0.60\,in^2\left(\frac{12}{6.0}\right) = 1.20\,in^2$$

$$\rho = \frac{A_{sl}}{12(t)} = \frac{1.20}{12(10)} = 0.010$$

$$\phi V_n = 0.6\left[1400\left(2\sqrt{10000} + 0.010(60000)\right)\right]$$

$$\phi V_n = 557^k > V_u = 57.5^k$$

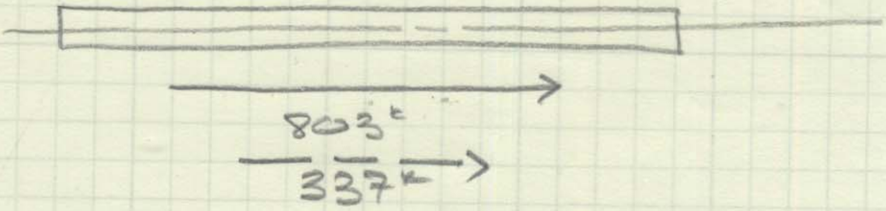
MEMBER CHECK | SW 2C LEVEL 1

$f'_c = 10^{ksi}$ $f_y = 60^{ksi}$

$l = 25.6$ ft $h = 256$ ft

——→ DIRECT V

– – –→ TORSIONAL V



RESULTANT = 1140 k

SW2C LEVEL 1

$$V_u \leq A_{cv}(\alpha_c\sqrt{f'_c} + \rho_t f_y)$$

$$\frac{h_w}{l_w} = \frac{256}{25.66} = 9.98 > 2 \therefore \alpha_c = 2.0$$

$$A_{cv} = 12(25.66)(12) = 3695.0 \text{ in}^2$$

$$A_{sl} = (4)(1.0) = 4.0 \text{ in}^2/$$

$$\rho = \frac{A_{sl}}{12t} = \frac{4.0}{12(12)} = 0.0278$$

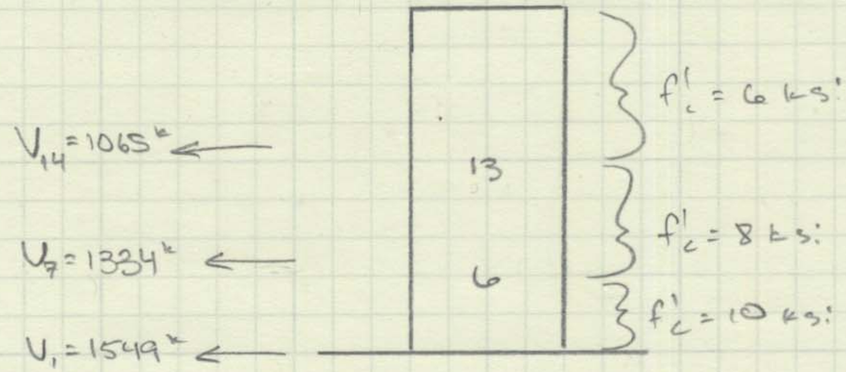
$$V_n = 3695\left[2.0\sqrt{10000} + 0.0278(60000)\right]$$

$$= 6900 \text{ kip}$$

$$\phi V_n = 0.6(6900)$$

$$= 4141 \text{ kip} > 1140\text{k} \quad \underline{\text{ok}}$$

DEFLECTION | N-S | WALL 1 (QUAKE)



$$\Delta = \frac{1.5V}{tE}\left[\left(\frac{H}{L}\right)^3 + \frac{H}{L}\right]$$

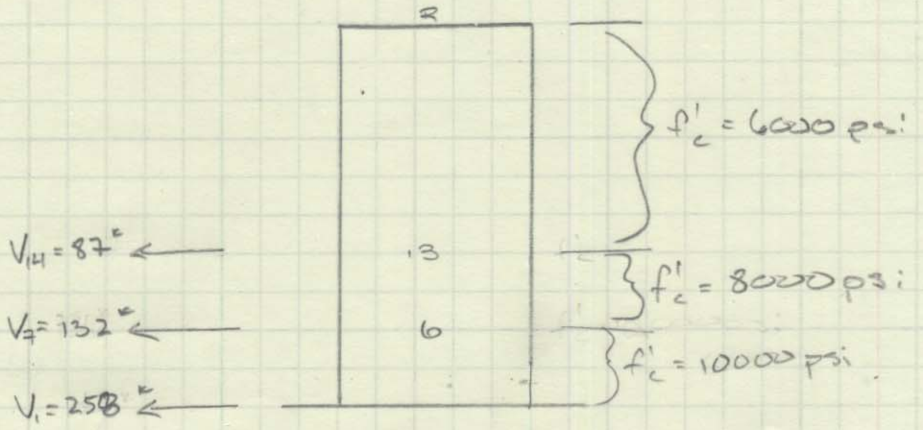
$$A_1 = \frac{1.5(1549)1000}{12(6062487)}\left[\left(\frac{806}{420}\right)^3 + \frac{806}{420}\right] = 0.29''$$

$$A_2 = \frac{1.5(1334)1000}{12(5422453)}\left[\left(\frac{1604-806}{420}\right)^3 + \left(\frac{798}{420}\right)\right] = 0.27''$$

$$A_3 = \frac{1.5(1065)1000}{12(4695982)}\left[\left(\frac{3072-1604}{420}\right)^3 + \frac{1468}{420}\right] = 1.31''$$

$A_T = 1.87''$

DEFLECTION E-W WALL 2 (WIND)



$$\Delta = \frac{1.5V}{tE}\left[\left(\frac{H}{L}\right)^3 + \left(\frac{H}{L}\right)\right]$$

$$\Delta_1 = \frac{1.5(258)1000}{(12)(6062487)}\left[\left(\frac{806}{25(12)}\right)^3 + \left(\frac{806}{25(12)}\right)\right] = 0.12''$$

$$\Delta_2 = \frac{1.5(132)(1000)}{(12)(5422453)}\left[\left(\frac{1604-806}{300}\right)^3 + \left(\frac{1604-806}{300}\right)\right] = 0.065''$$

$$\Delta_3 = \frac{1.5(87)1000}{(12)(4695982)}\left[\left(\frac{3072-1604}{300}\right)^3 + \frac{3072-1604}{300}\right] = 0.283''$$

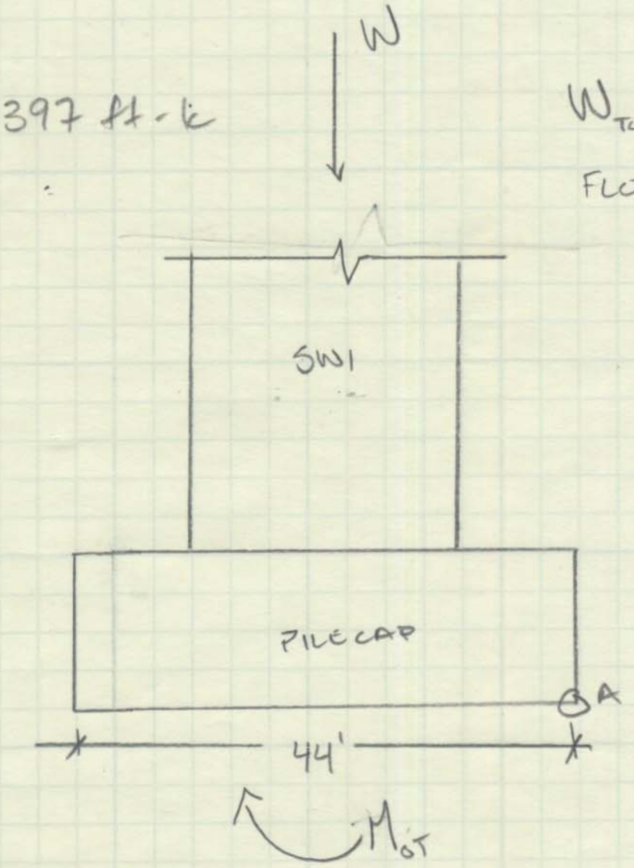
$$\Delta_T = 0.468''$$

OVERTURNING

$M_{OT} = 296397$ ft-k

$W_{TOWER} = 76952^{k}$

FLOOR AREA: 5150 #



ΣM_A:

$$\Sigma M_A = W(22) - M$$

IF $W < \frac{M}{22}$ THEN O.T. MAY BE PROBLEM

$$W_{MIN} = \frac{296397}{22} = 13472 \text{ KIPS}$$

$$A_{TRIBUTARY\ SW1} \geq \frac{13472}{76952}(100\%) = 17.5\% \text{ FLOOR AREA}$$

= 901 s.f. WITH OUT CONSIDERING SUPPORT OF MINI PILES

∴ CONSIDERING SW1 HAS 35' LENGTH THE NECESSARY TRIBUTARY WIDTH WOULD ONLY HAVE TO BE 25.75' FOR OVERTURNING NOT TO OCCUR. THIS IS OF COURSE W/O CONSIDERING THE CONTRIBUTION OF MINI PILES

⟹ O.T. OKAY

APPENDIX E

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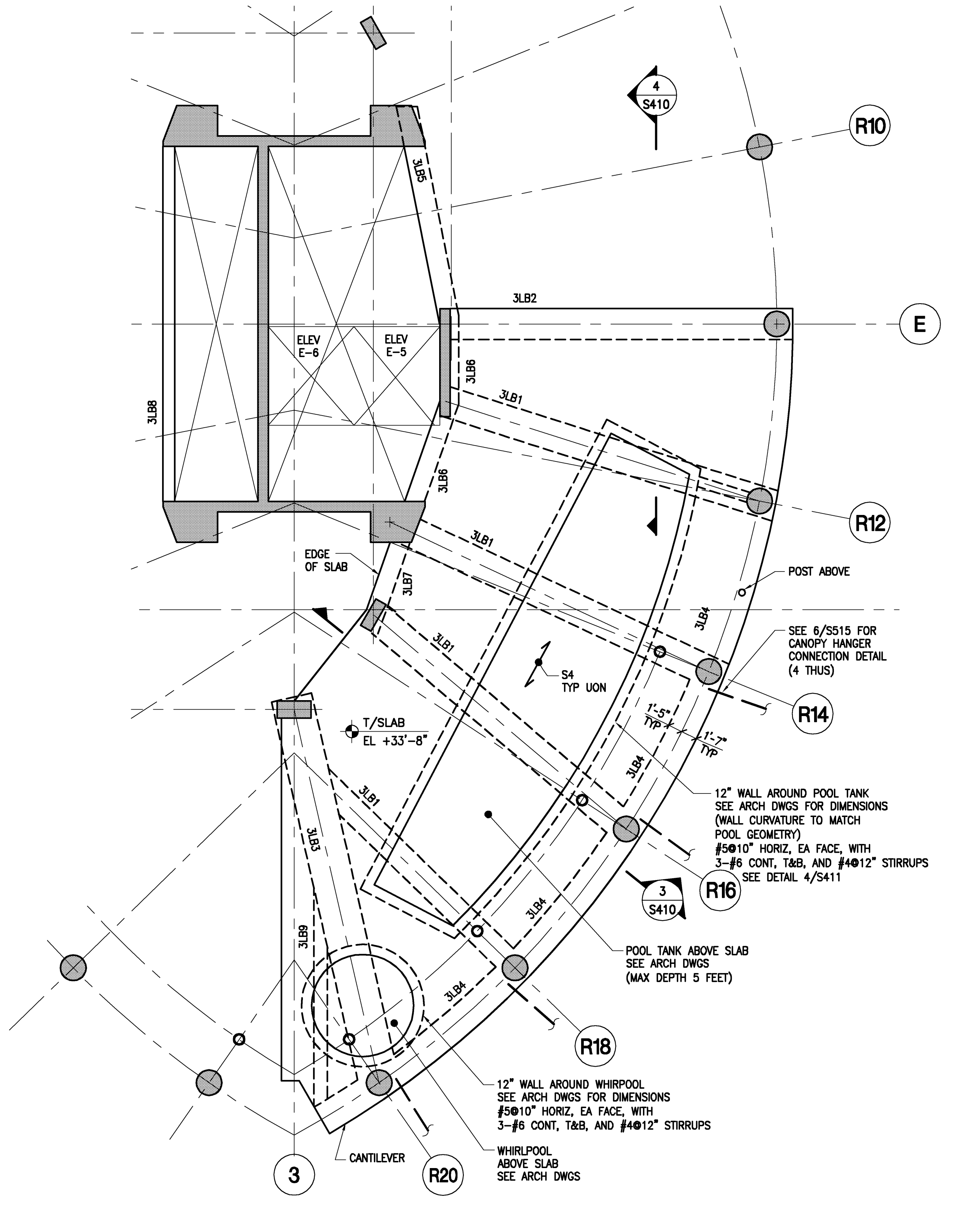
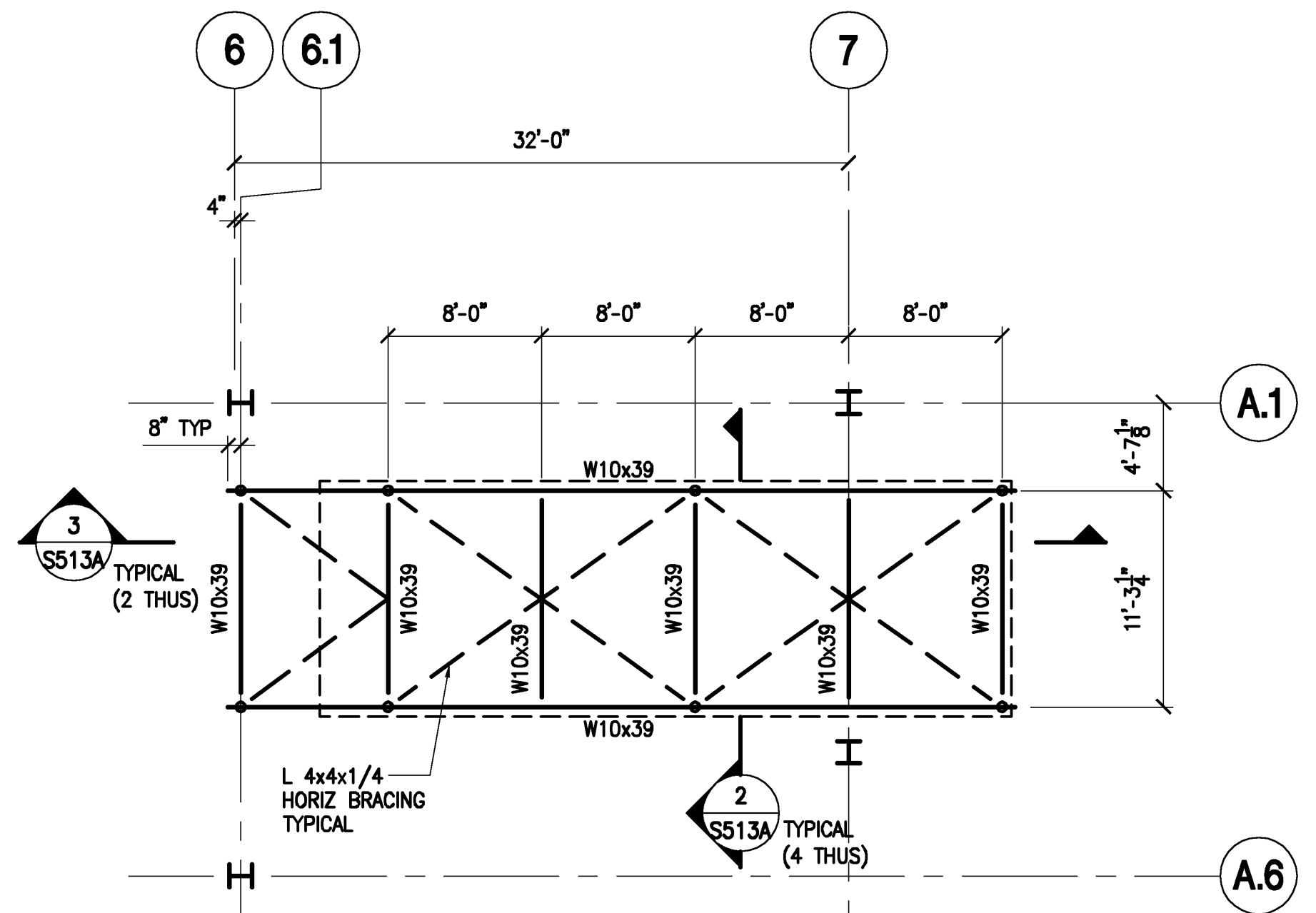


3 PARTIAL FRAMING PLAN

SCALE: 1/8"=1'-0"

TOWER PLAN NOTES:

1. TOP OF SLAB EL SEE PLAN
2. CONCRETE STRENGTH (SLABS AND BEAMS)
   f'c = 5000 PSI WITH PUDDLING
   f'c = 7150 PSI WITHOUT PUDDLING
   SEE S404 FOR TYPICAL PUDDLING DETAILS



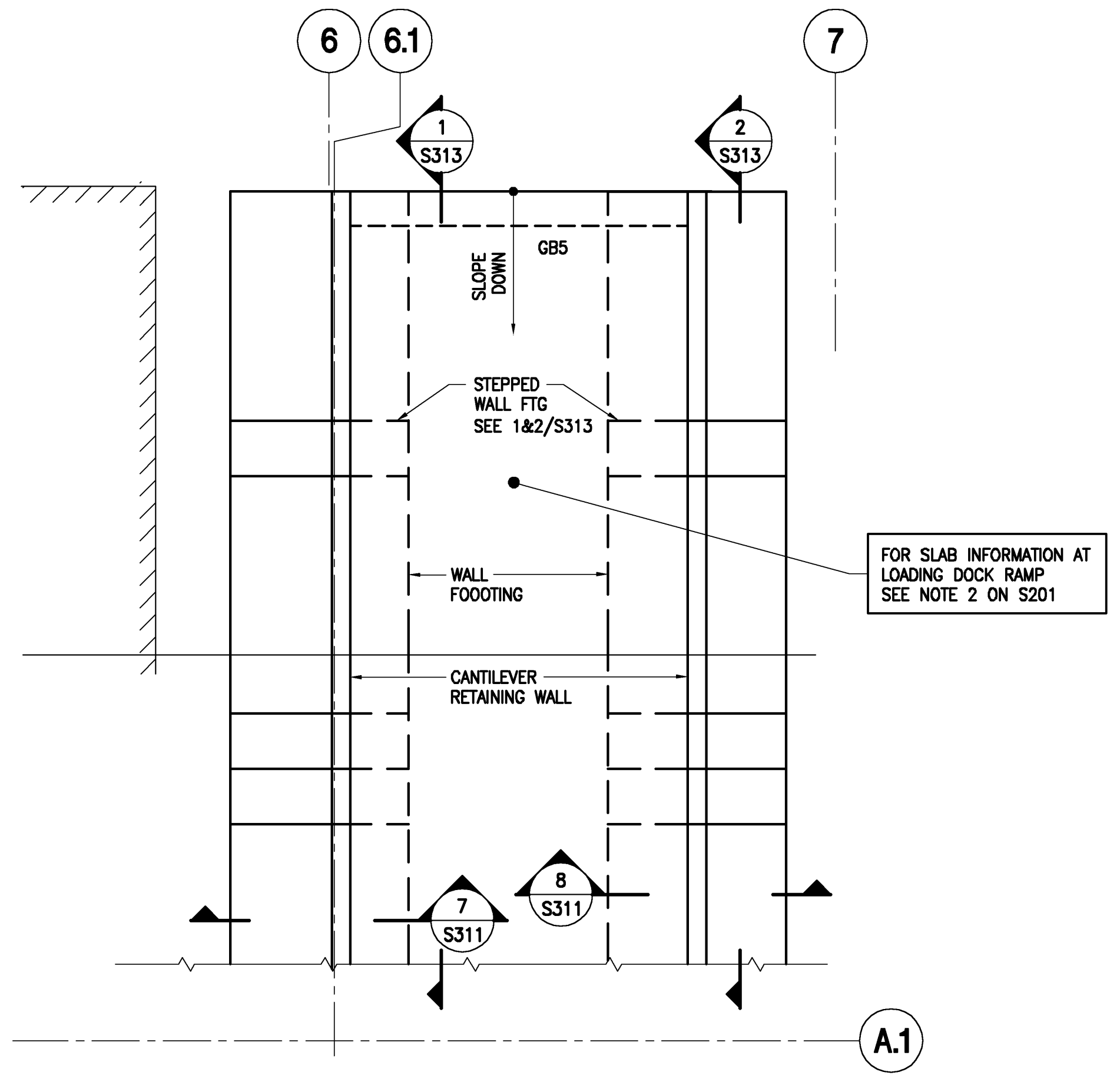
4 PLATFORM FRAMING PLAN

SCALE: 1/8"=1'-0"

COOLING TOWER SUPPORT PLATFORM

NOTES:

1. TOP OF STEEL EL +36'-2"
2. ALL DIMENSIONS AND ELEVATIONS MUST BE VERIFIED BY ELEVATOR MANUFACTURER. CONTRACTOR TO COORDINATE.
3. REFER TO EQUIPMENT DRAWINGS FOR MOUNTING HOLE LOCATIONS.



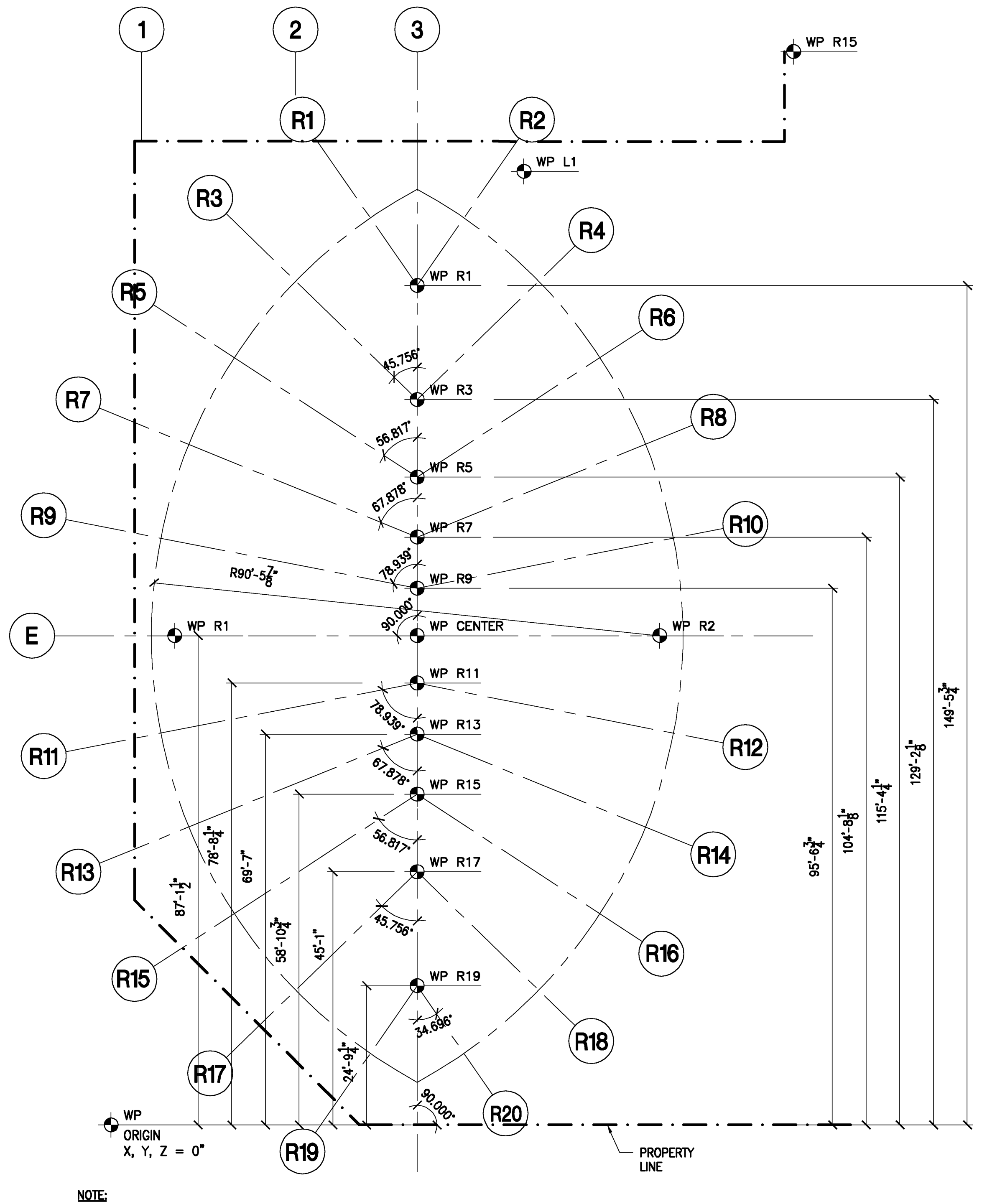
FOR SLAB INFORMATION AT LOADING DOCK RAMP SEE NOTE 2 ON S201

1 PARTIAL PLAN

SCALE: 1/8"=1'-0"

NOTES:

1. SEE S201 FOR ADDITIONAL INFORMATION



NOTE:
1. SEE ARCH DRAWINGS FOR ADDITIONAL INFORMATION

2 TOWER GEOMETRY

SCALE: 1/16"=1'-0"

JW MARRIOTT
GRAND RAPIDS

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NO.	DATE	DESCRIPTION
17	02 DEC 05	ISSUED FOR CONSTRUCTION AND PERMIT
16	28 OCT 05	OWNER AND MARRIOTT CD REVIEW
15	24 OCT 05	TOWER CONCRETE BID PACKAGE
9	29 JULY 05	STRUCTURAL STEEL BID PACKAGE

SHEET TITLE:

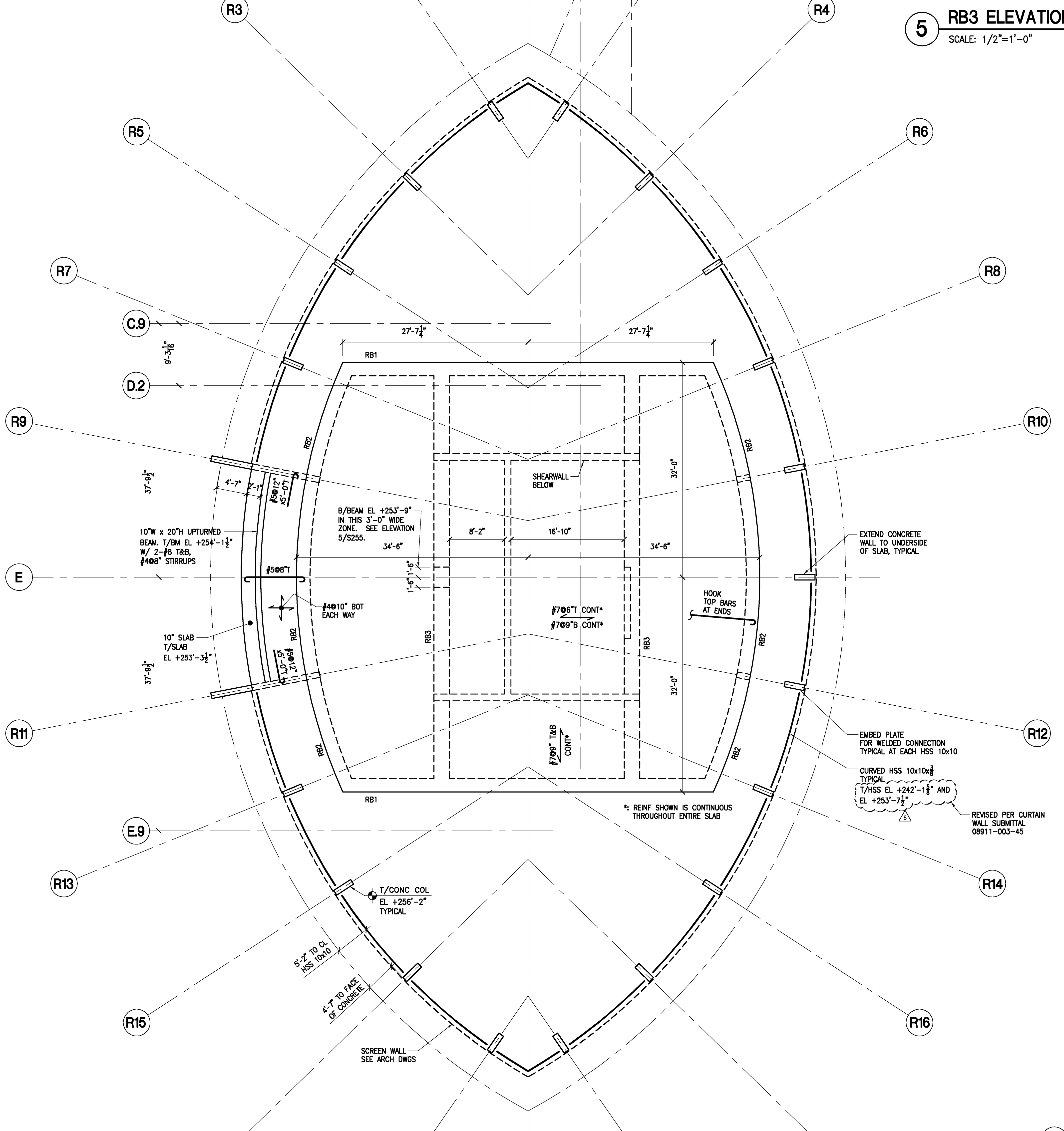
PARTIAL
FRAMING PLANS

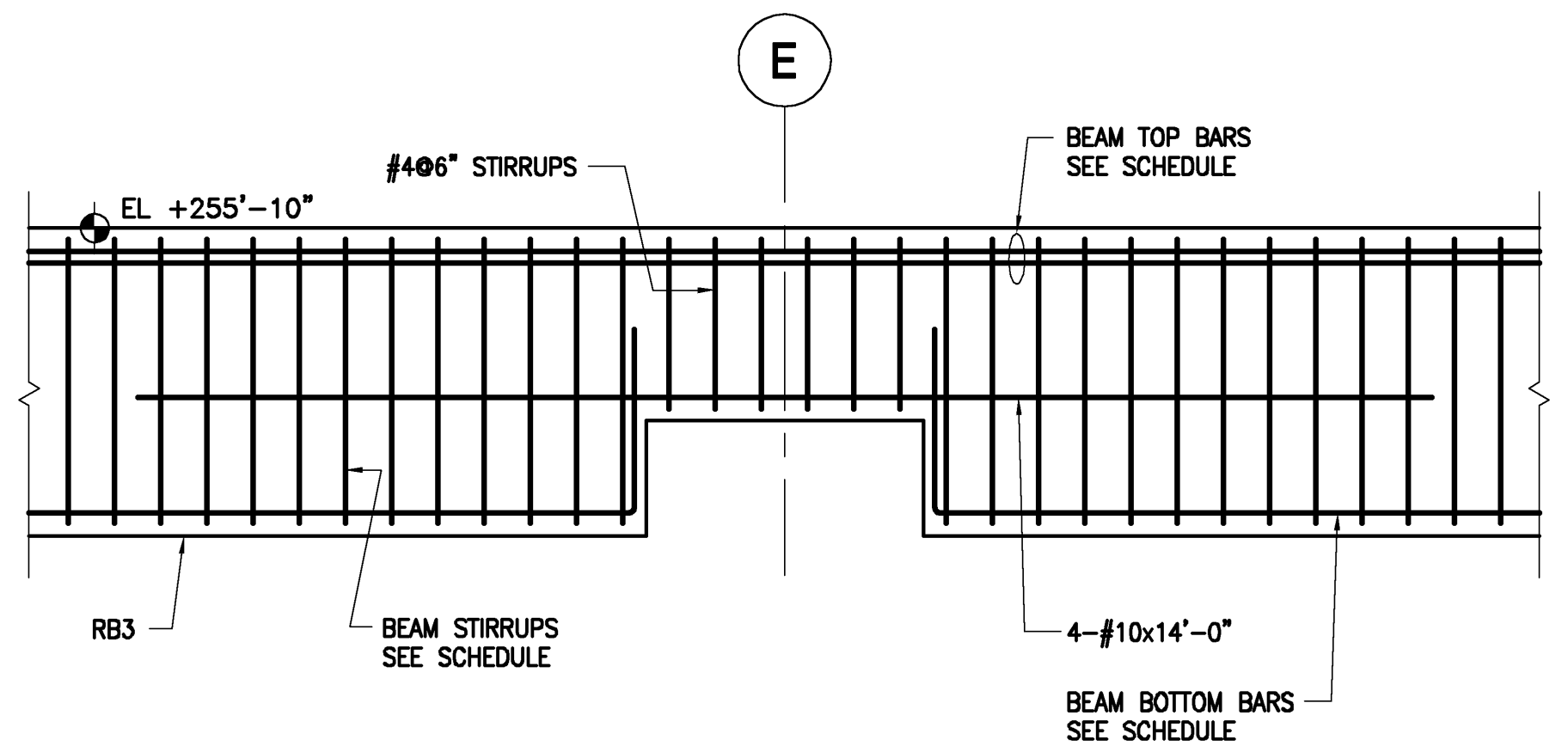
PROJECT ELEVATION + 0.0' = GRAND RAPIDS + 615.0'

SEAL:

SCALE: AS SHOWN
DRAWN BY:
CHECKED BY:
PROJECT NO.: CC4467.00
DRAWING NUMBER:

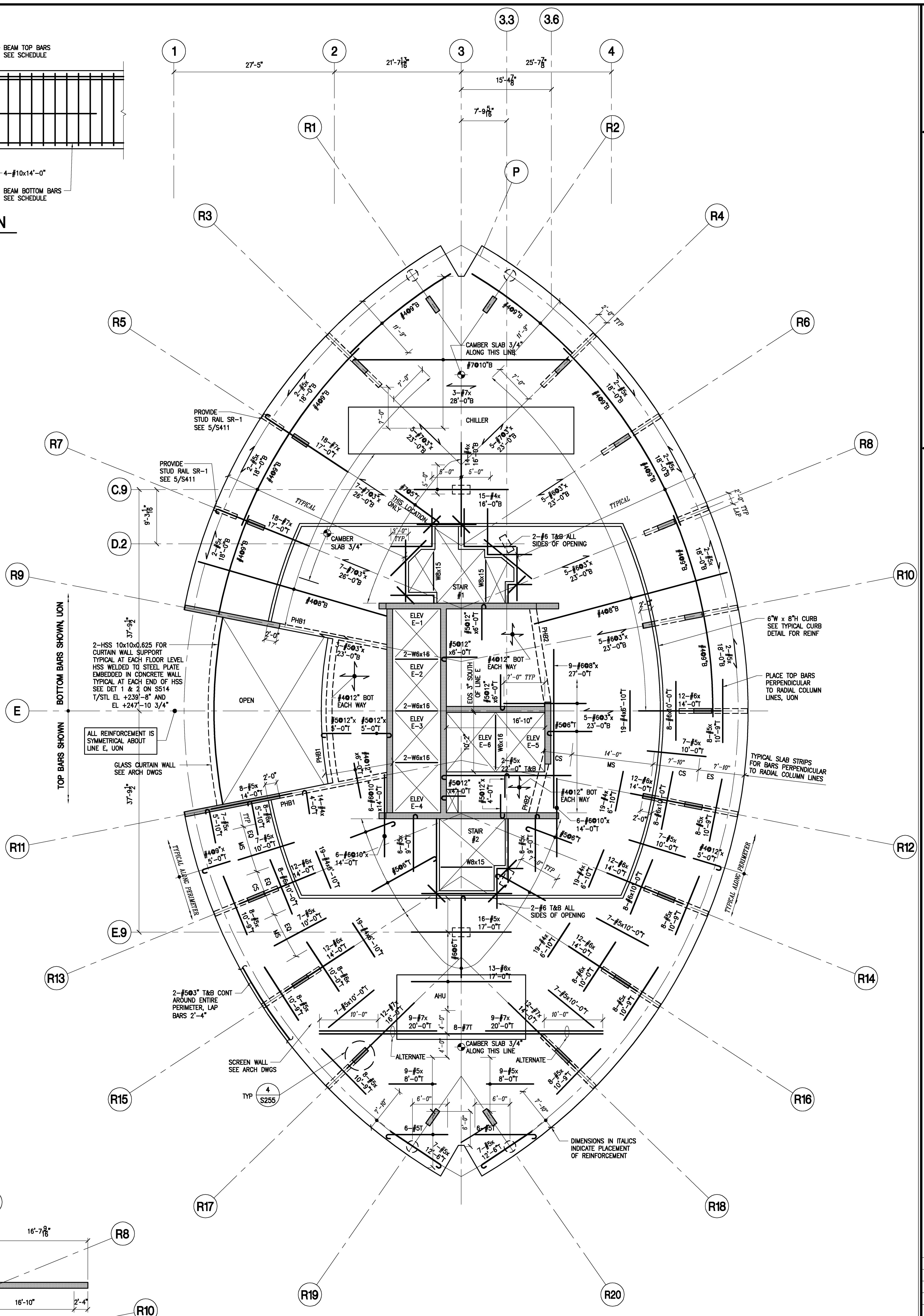
S266

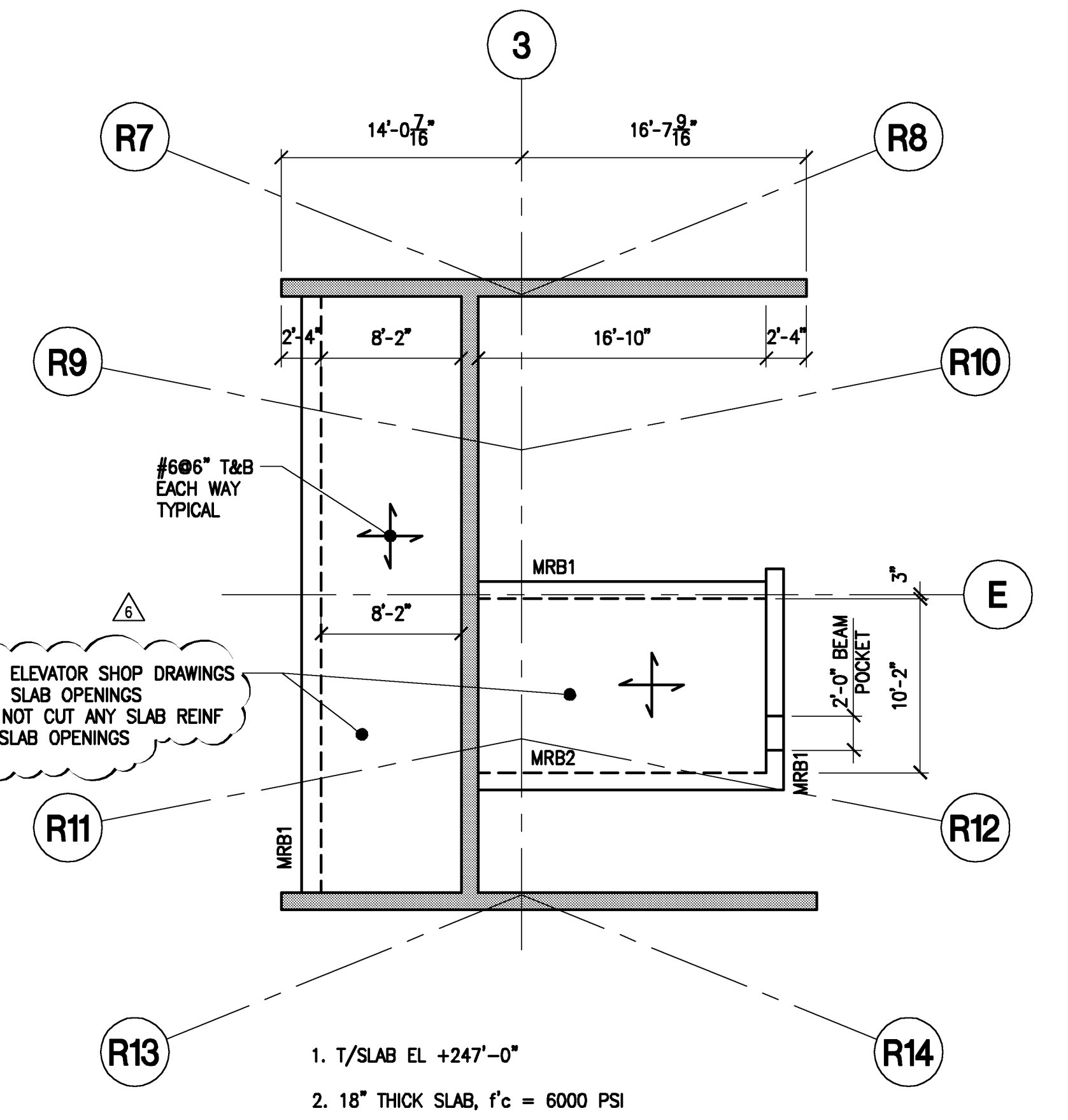




5 RB3 ELEVATION

SCALE: 1/2"=1'-0"

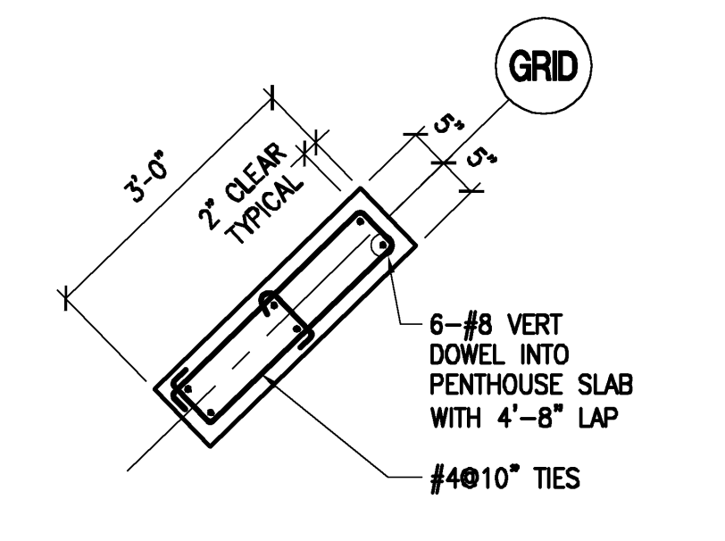




2 ROOF FRAMING PLAN

SCALE: 1/8"=1'-0"

1. T/STRUCTURAL SLAB EL +255'-10"
2. T/TOPPING SLAB EL +256'-8" LP, +256'-6 1/2" HP-SEE ARCH FOR SLOPES
3. STRUCTURAL SLAB 10" THICK, NORMAL WEIGHT CONCRETE
4. TOPPING SLAB = 4" THICK WITH #4@12" EACH WAY EPOXY COATED AT MID DEPTH OF SLAB. PROVIDE CONTRACTION JOINTS AT 12'-0" OC MAXIMUM SPACING
5. CONCRETE STRENGTH f'c = 6000 PSI
6. BAR PLACEMENT SEQUENCE:
   1. E-W BOTTOM
   2. N-S BOTTOM
   3. N-S TOP
   4. E-W TOP
7. CLEAR COVER TO TOP AND BOTTOM BARS = 3/4"



4 SCREEN WALL COLUMN DETAIL

f'c=5000 PSI

1. T/SLAB EL +247'-0"
2. 18" THICK SLAB, f'c = 6000 PSI

3 ELEVATOR MACHINE ROOM FRAMING PLAN

SCALE: 1/8"=1'-0"

1 MECHANICAL PENTHOUSE FLOOR FRAMING PLAN

SCALE: 1/8"=1'-0"

1. T/SLAB EL +239'-8" LP AND INSIDE MECHANICAL PENTHOUSE
   EL +240'-2" HP - SEE ARCH DWGS FOR ROOF SLOPES
2. B/SLAB EL +238'-8" CONSTANT
3. 12" THICK SLAB, NORMAL WEIGHT CONCRETE
4. CONCRETE STRENGTH f'c = 6000 PSI
5. BOTTOM BARS SHOWN THUS ⟷ ARE IN ADDITION TO TYPICAL CONTINUOUS BOTTOM BARS
6. BAR PLACEMENT SEQUENCE:
   1. BOTTOM BARS PARALLEL TO RADIAL COLUMN LINES
   2. BOTTOM BARS PERPENDICULAR TO RADIAL COLUMN LINES
   3. TOP BARS PERPENDICULAR TO RADIAL COLUMN LINES
   4. TOP BARS PARALLEL TO RADIAL COLUMN LINES
7. CLEAR COVER TO TOP AND BOTTOM BARS = 3/4"

REFERENCE:

1. SEE DRAWING S001 FOR GENERAL NOTES.
2. SEE DRAWING S400 FOR CONCRETE COLUMN DETAILS.
3. SEE DRAWINGS S401 & S402 FOR CONCRETE WALL DETAILS.
4. SEE DRAWINGS S403 & S404 FOR CONCRETE SLAB DETAILS.
5. SEE DRAWINGS S405 & S405A FOR CONCRETE BEAM DETAILS.

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NO.	DATE	DESCRIPTION
6	09 JAN 06	ADDENDUM #6
17	02 DEC 05	ISSUED FOR CONSTRUCTION AND PERMIT
16	28 OCT 05	OWNER AND MARRIOTT CD REVIEW
15	24 OCT 05	TOWER CONCRETE BID PACKAGE
9	03 AUG 05	STRUCTURAL STEEL BID PACKAGE
5	20 MAY 05	REVISED DESIGN DEVELOPMENT
3	29 APR 05	DESIGN DEVELOPMENT
2	15 APR 05	IN-PROGRESS DESIGN DEVELOPMENT
1	10 DEC 04	SCHEMATIC DESIGN

SHEET TITLE:

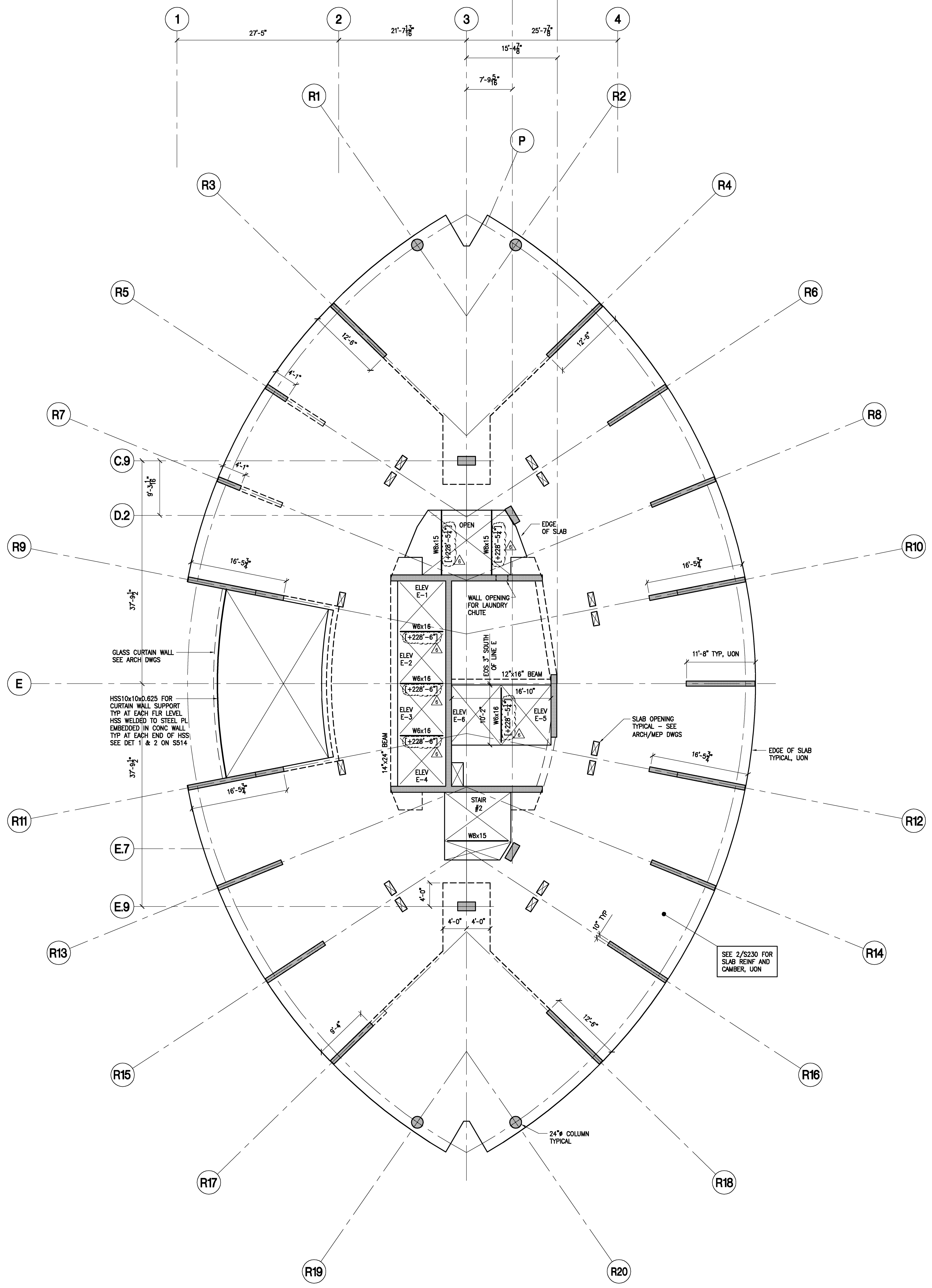
MECHANICAL PENTHOUSE AND ROOF FRAMING PLAN

PROJECT ELEVATION + 0.0' = GRAND RAPIDS + 615.0'

SEAL:

SCALE: AS SHOWN
DRAWN BY:
CHECKED BY:
PROJECT NO.: CC4467.00

DRAWING NUMBER:
S255



2 23RD FLOOR FRAMING PLAN

SCALE: 1/8"=1'-0"

1. T/SLAB EL +228'-8"
2. 7 1/2"THICK SLAB, UON, NORMAL WEIGHT CONCRETE
3. CONCRETE STRENGTH f'c = 5700 PSI AT 6TH – 8TH FLOORS
   f'c = 5000 PSI, TYPICAL
4. BOTTOM BARS SHOWN THUS ⟷ ARE IN ADDITION TO TYPICAL CONTINUOUS BOTTOM BARS
5. BAR PLACEMENT SEQUENCE:
   1. BOTTOM BARS PARALLEL TO RADIAL COLUMN LINES
   2. BOTTOM BARS PERPENDICULAR TO RADIAL COLUMN LINES
   3. TOP BARS PERPENDICULAR TO RADIAL COLUMN LINES
   4. TOP BARS PARALLEL TO RADIAL COLUMN LINES
6. CLEAR COVER TO TOP AND BOTTOM BARS = 3/4"

REFERENCE:

1. SEE DRAWING S001 FOR GENERAL NOTES.
2. SEE DRAWING S400 FOR CONCRETE COLUMN DETAILS.
3. SEE DRAWINGS S401 & S402 FOR CONCRETE WALL DETAILS.
4. SEE DRAWINGS S403 & S404 FOR CONCRETE SLAB DETAILS.
5. SEE DRAWINGS S405 & S405A FOR CONCRETE BEAM DETAILS.

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2	15 APR 05	IN-PROGRESS DESIGN DEVELOPMENT

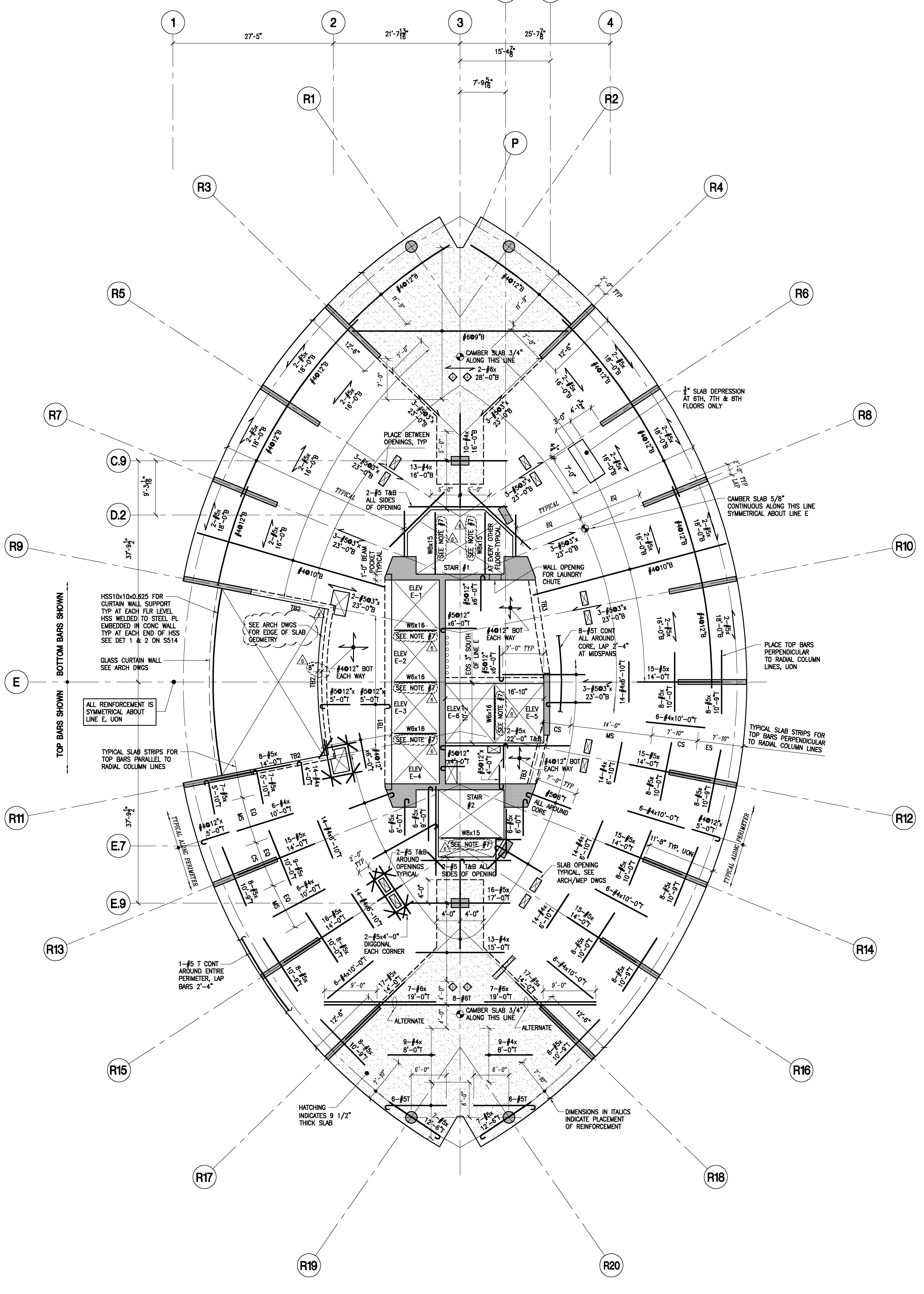
SHEET TITLE:

23RD FLOOR
FRAMING PLAN

PROJECT ELEVATION + 0.0' = GRAND RAPIDS + 615.0'

SEAL:

SCALE: AS SHOWN
DRAWN BY:
CHECKED BY:
PROJECT NO.: CC4467.00
DRAWING NUMBER: S240



2 6TH-22ND FLOOR FRAMING PLAN

SCALE: 1/8"=1'-0"

1. T/SLAB EL: SEE LIST ON THIS DRAWING
2. 7 1/2"THICK SLAB, UON, NORMAL WEIGHT CONCRETE
3. CONCRETE STRENGTH f'c = 5700 PSI AT 6TH - 8TH FLOORS
   f'c = 5000 PSI, TYPICAL
4. BOTTOM BARS SHOWN THUS ⟷ ARE IN ADDITION TO TYPICAL CONTINUOUS BOTTOM BARS
5. BAR PLACEMENT SEQUENCE:
   1. BOTTOM BARS PARALLEL TO RADIAL COLUMN LINES
   2. BOTTOM BARS PERPENDICULAR TO RADIAL COLUMN LINES
   3. TOP BARS PERPENDICULAR TO RADIAL COLUMN LINES
   4. TOP BARS PARALLEL TO RADIAL COLUMN LINES
6. CLEAR COVER TO TOP AND BOTTOM BARS = 3/4"
7. T/W6 EL AT ELEVATORS E1–E4 = 2" BELOW T/SLAB EL
   T/W6 EL AT ELEVATORS E5–E6 = 3/4" BELOW T/SLAB EL
   T/W8 EL AT STAIRS #1 AND #2 = 3/4" BELOW T/SLAB EL

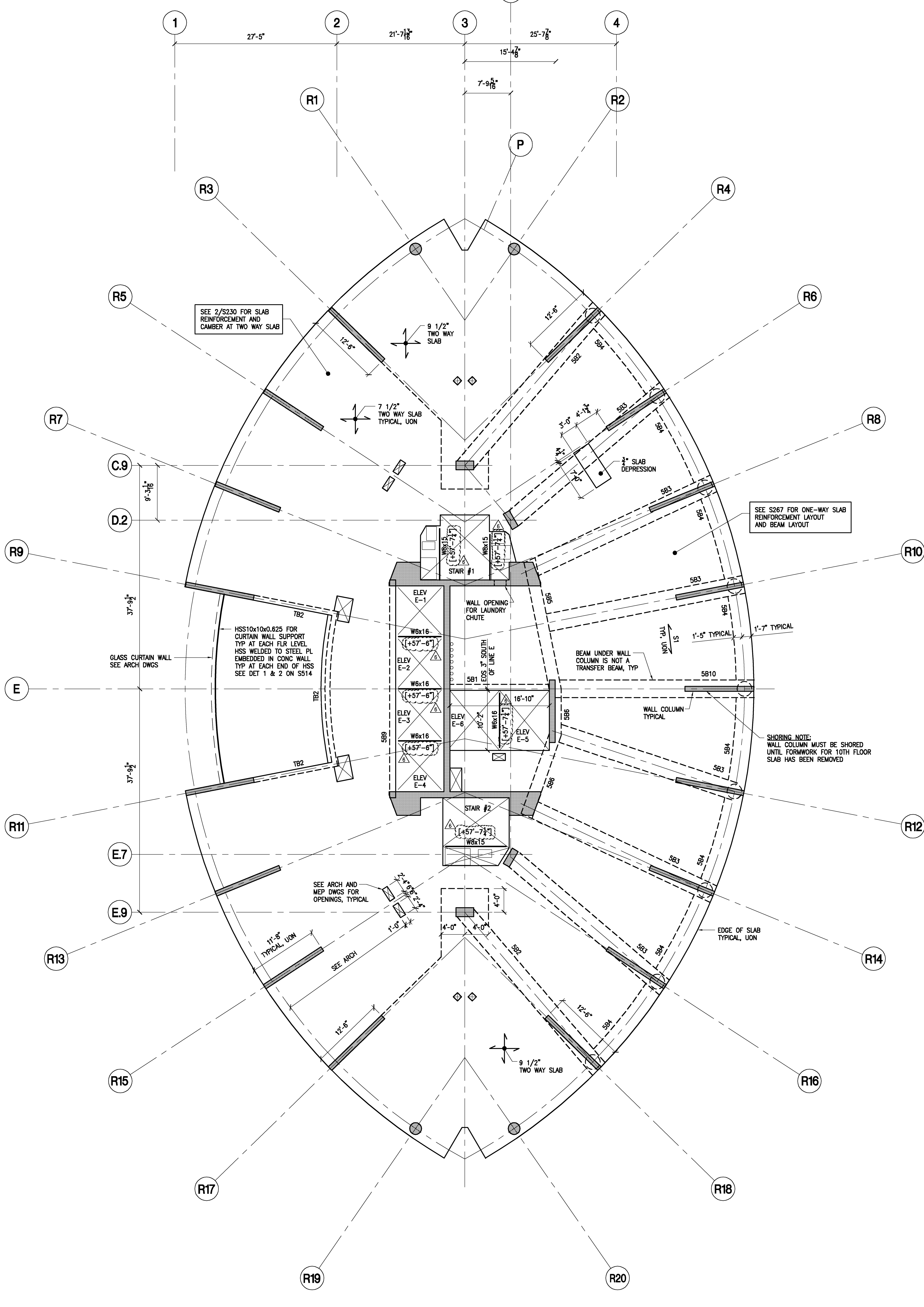
△6

T/SLAB ELEVATIONS:

6TH FLOOR	+67'–2"
7TH FLOOR	+76'–8"
8TH FLOOR	+86'–2"
9TH FLOOR	+95'–8"
10TH FLOOR	+105'–2"
11TH FLOOR	+114'–8"
12TH FLOOR	+124'–2"
13TH FLOOR	+133'–8"
14TH FLOOR	+143'–2"
15TH FLOOR	+152'–8"
16TH FLOOR	+162'–2"
17TH FLOOR	+171'–8"
18TH FLOOR	+181'–2"
19TH FLOOR	+190'–8"
20TH FLOOR	+200'–2"
21ST FLOOR	+209'–8"
22ND FLOOR	+219'–2"

REFERENCE:

1. SEE DRAWING S001 FOR GENERAL NOTES.
2. SEE DRAWING S400 FOR CONCRETE COLUMN DETAILS.
3. SEE DRAWINGS S401 & S402 FOR CONCRETE WALL DETAILS.
4. SEE DRAWINGS S403 & S404 FOR CONCRETE SLAB DETAILS.
5. SEE DRAWINGS S405 & S405A FOR CONCRETE BEAM DETAILS.



1 5TH FLOOR FRAMING PLAN

SCALE: 1/8"=1'-0"

1. T/SLAB EL +57'–8", UON
2. CONCRETE STRENGTH, f'c = 5700 PSI

REFERENCE:

1. SEE DRAWING S001 FOR GENERAL NOTES.
2. SEE DRAWING S400 FOR CONCRETE COLUMN DETAILS.
3. SEE DRAWINGS S401 & S402 FOR CONCRETE WALL DETAILS.
4. SEE DRAWINGS S403 & S404 FOR CONCRETE SLAB DETAILS.
5. SEE DRAWINGS S405 & S405A FOR CONCRETE BEAM DETAILS.

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3	29 APR 05	DESIGN DEVELOPMENT
2	15 APR 05	IN-PROGRESS DESIGN DEVELOPMENT
1	10 DEC 04	SCHEMATIC DESIGN

SHEET TITLE:

5TH AND 6TH-22ND FLOOR
FRAMING PLANS

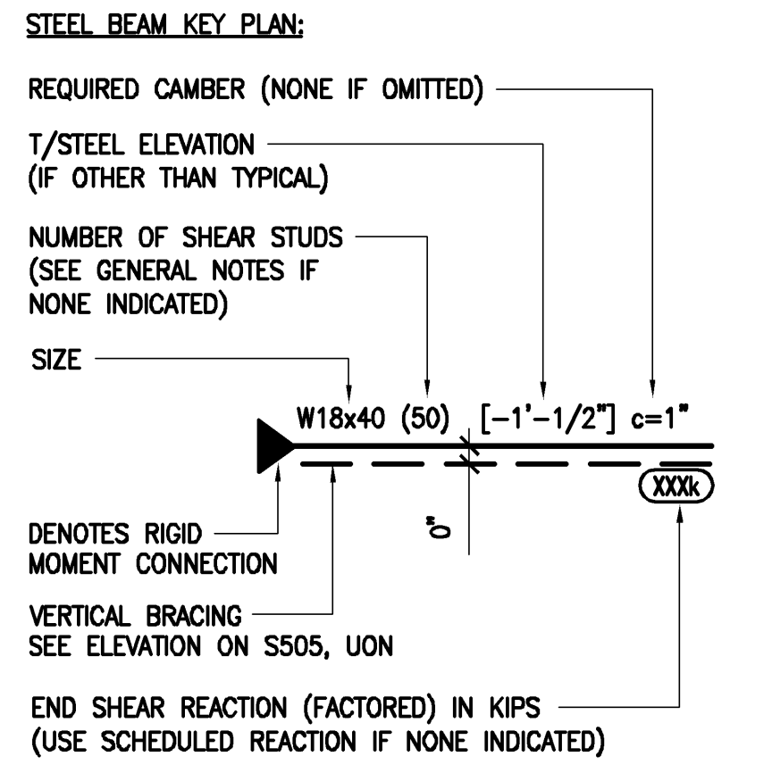
PROJECT ELEVATION + 0.0' = GRAND RAPIDS + 615.0'

SEAL:

SCALE: AS SHOWN
DRAWN BY:
CHECKED BY:
PROJECT NO.: CC4467.00

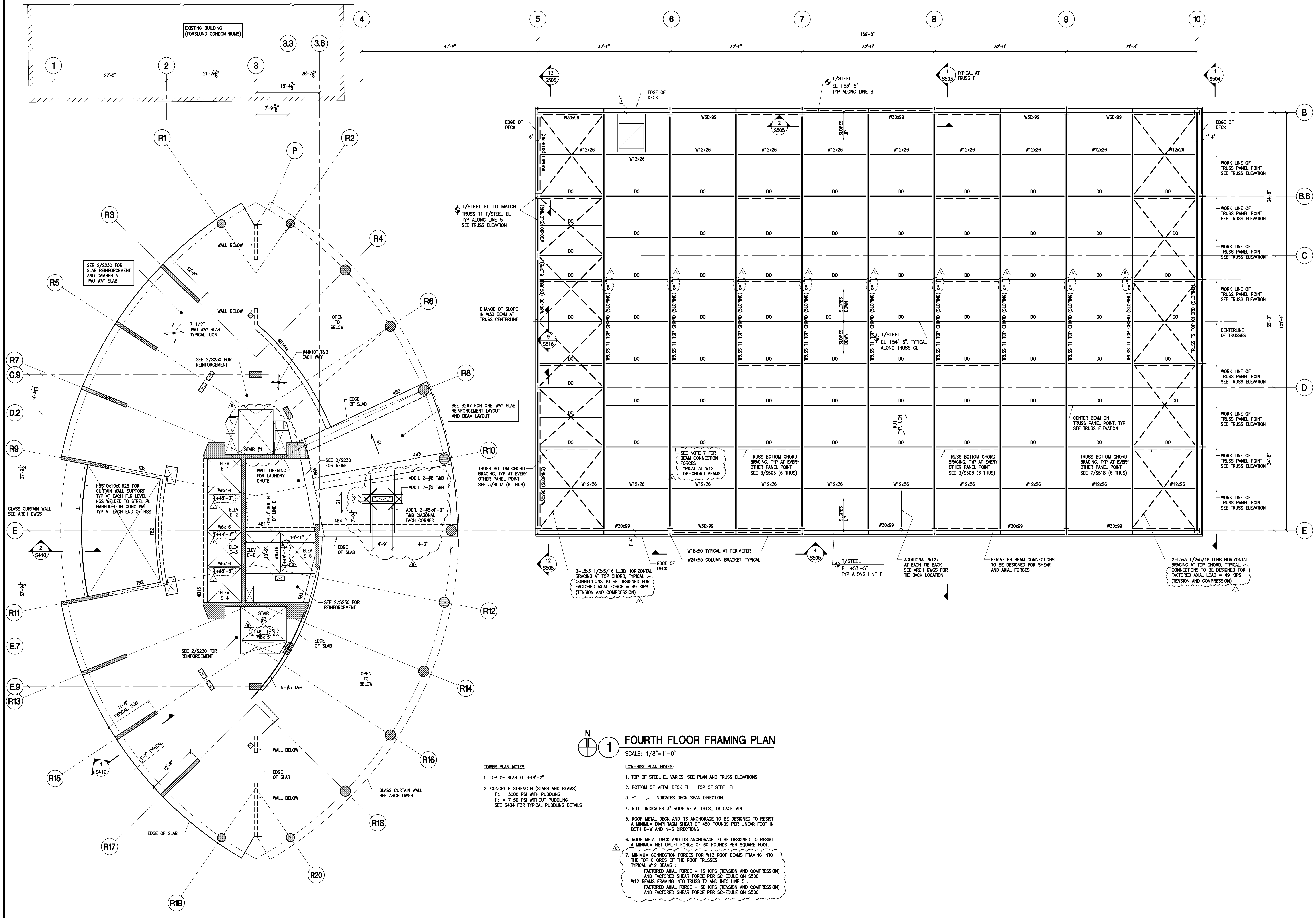
DRAWING NUMBER:
S230

STEEL BEAM KEY PLAN:



REFERENCE:

1. SEE DRAWING S001 FOR GENERAL NOTES.
2. SEE DRAWING SERIES S300 FOR TYPICAL CONCRETE DETAILS.
3. SEE DRAWING SERIES S500 FOR TYPICAL STEEL DETAILS.
4. SEE DWGS S501 & S501A FOR TYPICAL COMPOSITE SLAB DETAILS.
5. SEE DRAWING S505 FOR BRACING ELEVATIONS.
6. SEE DRAWING S503 AND S504 FOR TRUSS ELEVATIONS.



1 FOURTH FLOOR FRAMING PLAN

SCALE: 1/8"=1'-0"

TOWER PLAN NOTES:

1. TOP OF SLAB EL +48'-2"
2. CONCRETE STRENGTH (SLABS AND BEAMS)
   f'c = 5000 PSI WITH PUDDLING
   f'c = 7150 PSI WITHOUT PUDDLING
   SEE S404 FOR TYPICAL PUDDLING DETAILS

LOW-RISE PLAN NOTES:

1. TOP OF STEEL EL VARIES, SEE PLAN AND TRUSS ELEVATIONS
2. BOTTOM OF METAL DECK EL = TOP OF STEEL EL
3. ⟷ INDICATES DECK SPAN DIRECTION.
4. RD1 INDICATES 3" ROOF METAL DECK, 18 GAGE MIN
5. ROOF METAL DECK AND ITS ANCHORAGE TO BE DESIGNED TO RESIST A MINIMUM DIAPHRAGM SHEAR OF 450 POUNDS PER LINEAR FOOT IN BOTH E-W AND N-S DIRECTIONS
6. ROOF METAL DECK AND ITS ANCHORAGE TO BE DESIGNED TO RESIST A MINIMUM NET UPLIFT FORCE OF 60 POUNDS PER SQUARE FOOT.
7. MINIMUM CONNECTION FORCES FOR W12 ROOF BEAMS FRAMING INTO THE TOP CHORDS OF THE ROOF TRUSSES
   TYPICAL W12 BEAMS :
      FACTORED AXIAL FORCE = 12 KIPS (TENSION AND COMPRESSION) AND FACTORED SHEAR FORCE PER SCHEDULE ON S500
   W12 BEAMS FRAMING INTO TRUSS T2 AND INTO LINE 5 :
      FACTORED AXIAL FORCE = 30 KIPS (TENSION AND COMPRESSION) AND FACTORED SHEAR FORCE PER SCHEDULE ON S500

△6

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△4	23 SEPT 05	BID ADDENDUM #4 -STRUCTURAL STEEL & FOUNDATIONS
9	03 AUG 05	STRUCTURAL STEEL BID PACKAGE
5	20 MAY 05	REVISED DESIGN DEVELOPMENT
3	29 APR 05	DESIGN DEVELOPMENT
2	15 APR 05	IN-PROGRESS DESIGN DEVELOPMENT
1	10 DEC 04	SCHEMATIC DESIGN
NO.	DATE	DESCRIPTION

SHEET TITLE:

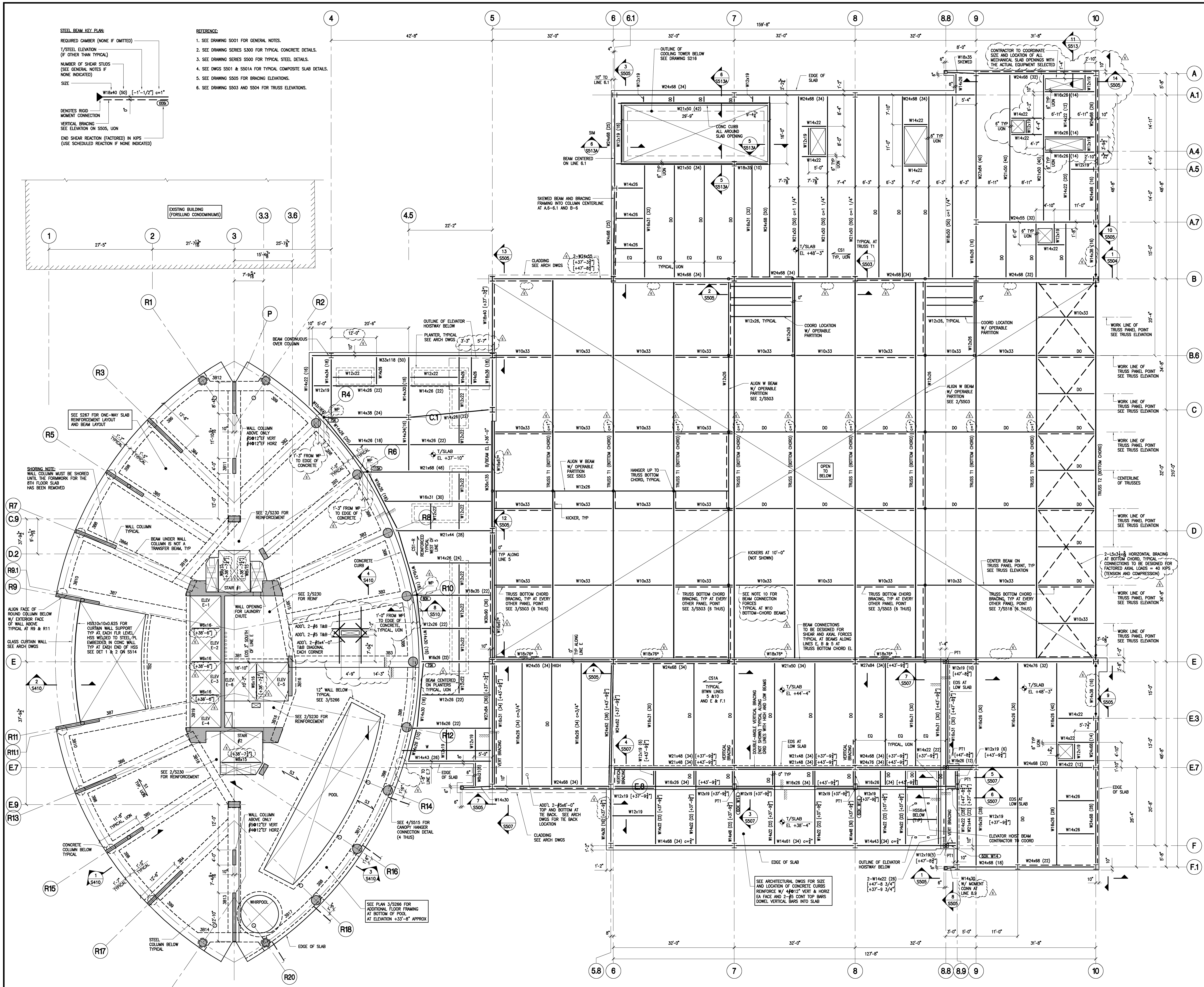
FOURTH FLOOR
FRAMING PLAN

PROJECT ELEVATION + 0.0' = GRAND RAPIDS + 615.0'

SEAL:

SCALE: AS SHOWN
DRAWN BY:
CHECKED BY:
PROJECT NO.: CC4467.00
DRAWING NUMBER:

S226



STEEL BEAM KEY PLAN:

REQUIRED CAMBER (NONE IF OMITTED)

T/STEEL ELEVATION (IF OTHER THAN TYPICAL)

NUMBER OF SHEAR STUDS (SEE GENERAL NOTES IF NONE INDICATED)

SIZE

W18x40 (50) [−1'−1/2"] c=1"

0"

XXXk

DENOTES RIGID MOMENT CONNECTION

VERTICAL BRACING SEE ELEVATION ON S505, UON

END SHEAR REACTION (FACTORED) IN KIPS (USE SCHEDULED REACTION IF NONE INDICATED)

REFERENCE:

1. SEE DRAWING S001 FOR GENERAL NOTES.
2. SEE DRAWING SERIES S300 FOR TYPICAL CONCRETE DETAILS.
3. SEE DRAWING SERIES S500 FOR TYPICAL STEEL DETAILS.
4. SEE DWGS S501 & S501A FOR TYPICAL COMPOSITE SLAB DETAILS.
5. SEE DRAWING S505 FOR BRACING ELEVATIONS.
6. SEE DRAWING S503 AND S504 FOR TRUSS ELEVATIONS.

TOWER PLAN NOTES:

1. TOP OF SLAB EL +38'-8", UON
2. CONCRETE STRENGTH (SLABS AND BEAMS)
   f'c = 5000 PSI WITH PUDDLING
   f'c = 7150 PSI WITHOUT PUDDLING
   SEE S404 FOR TYPICAL PUDDLING DETAILS

1 THIRD FLOOR FRAMING PLAN

SCALE: 1/8"=1'-0"

LOW-RISE PLAN NOTES:

1. TOP OF SLAB EL VARIES, SEE PLAN
2. TOP OF STEEL EL = T/SLAB EL MINUS SLAB THICKNESS, UON
3. ⟵⟶ INDICATES DECK SPAN DIRECTION.
4. CS1 INDICATES 3" COMPOSITE METAL DECK, 20 GAGE MIN WITH 3 1/4" LIGHTWEIGHT CONCRETE TOPPING SLAB f'c=4000 PSI, REINFORCED WITH WWF 6x6−W2.1xW2.1 TOTAL SLAB THICKNESS: 6 1/4"
5. CS1A INDICATES COMPOSITE SLAB SAME AS CS1 WITH 18 GAGE MIN
6. CS1−R INDICATES COMPOSITE SLAB SAME AS CS1 WITH ADDITIONAL BARS #5@12" TOP AND BOTTOM
7. CS3 INDICATES 3" COMPOSITE METAL DECK, 16 GAGE MIN WITH 5" NORMALWEIGHT CONCRETE TOPPING SLAB f'c=4000 PSI, REINFORCED WITH WWF 6x6−W2.1xW2.1 TOTAL SLAB THICKNESS: 8"
8. PT1 INDICATES W10x33 POST WITH BASE PL 3/4x10x1'−0" WITH 4−3/4"ø A325 BOLTS
9. "W16x67*" AND "W18x76*" INDICATE BEAM CENTERLINE TO MATCH CENTERLINE OF TRUSS BOTTOM CHORD 6
10. MINIMUM CONNECTION FORCES FOR W10 BEAMS FRAMING INTO THE BOTTOM CHORDS OF THE ROOF TRUSSES
    TYPICAL W10 BEAMS :
        FACTORED AXIAL FORCE = 10 KIPS (TENSION AND COMPRESSION)
        FACTORED SHEAR FORCE = 12 KIPS (PER NOTE SC−7 ON S001)
    W10 BEAMS FRAMING INTO TRUSS T2 :
        FACTORED AXIAL FORCE = 25 KIPS (TENSION AND COMPRESSION)
        FACTORED SHEAR FORCE = 12 KIPS (PER NOTE SC−7 ON S001)

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NO.	DATE	DESCRIPTION
6	09 JAN 06	ADDENDUM #6
17	02 DEC 05	ISSUED FOR CONSTRUCTION AND PERMIT
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15	24 OCT 05	TOWER CONCRETE BID PACKAGE
4	23 SEPT 05	BID ADDENDUM #4 −STRUCTURAL STEEL & FOUNDATIONS
9	03 AUG 05	STRUCTURAL STEEL BID PACKAGE
5	20 MAY 05	REVISED DESIGN DEVELOPMENT
3	29 APR 05	DESIGN DEVELOPMENT
2	15 APR 05	IN−PROGRESS DESIGN DEVELOPMENT
1	10 DEC 04	SCHEMATIC DESIGN

SHEET TITLE:

THIRD FLOOR FRAMING PLAN

PROJECT ELEVATION + 0.0' = GRAND RAPIDS + 615.0'

SEAL:

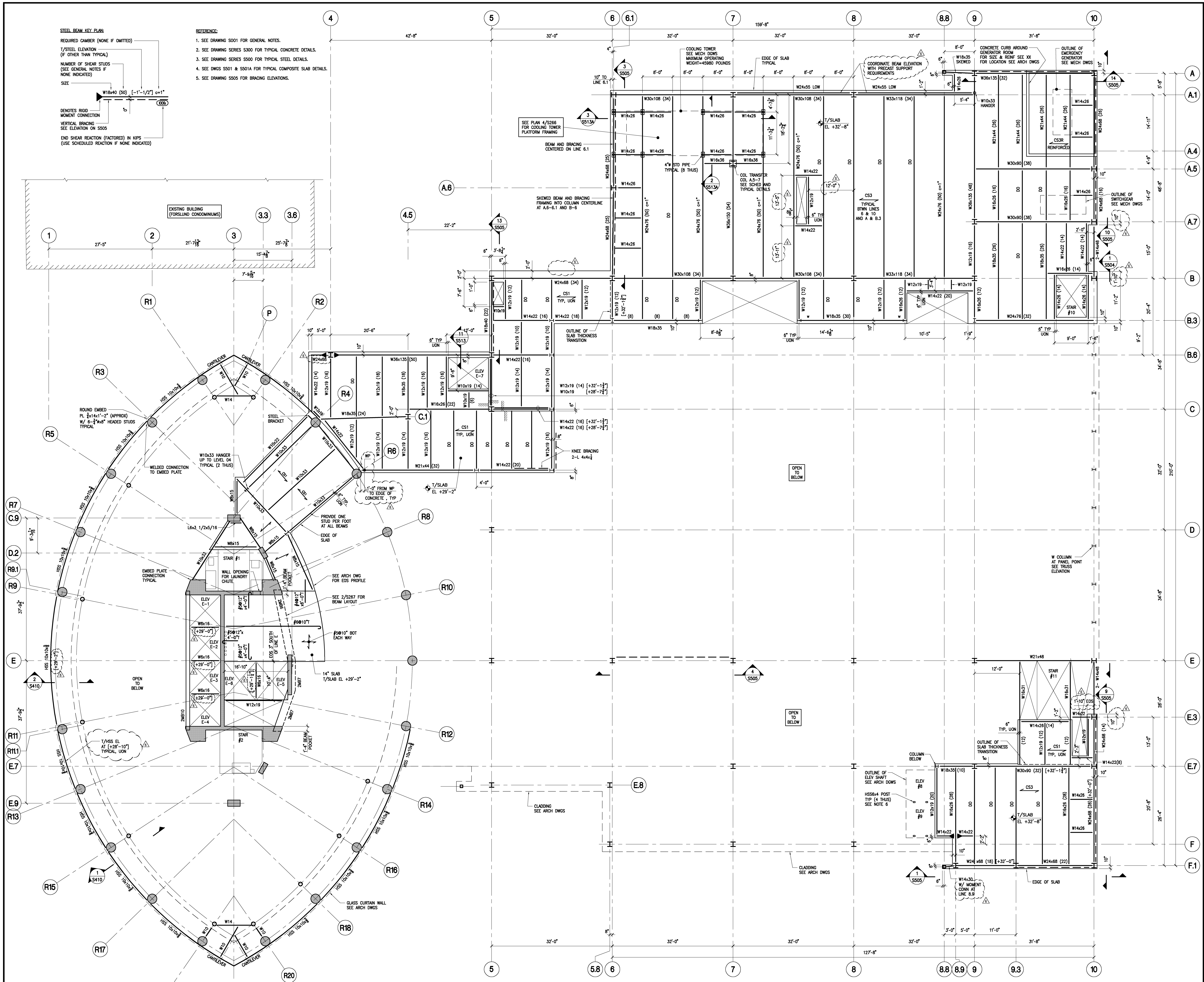
SCALE: AS SHOWN
DRAWN BY:
CHECKED BY:
PROJECT NO.: CC4467.00
DRAWING NUMBER: S221

STEEL BEAM KEY PLAN:

REQUIRED CAMBER (NONE IF OMITTED)
T/STEEL ELEVATION (IF OTHER THAN TYPICAL)
NUMBER OF SHEAR STUDS (SEE GENERAL NOTES IF NONE INDICATED)
SIZE
W18x40 (50) [-1'-1/2"] c=1"
0"
XXXk
DENOTES RIGID MOMENT CONNECTION
VERTICAL BRACING SEE ELEVATION ON S505
END SHEAR REACTION (FACTORED) IN KIPS (USE SCHEDULED REACTION IF NONE INDICATED)

REFERENCE:

1. SEE DRAWING S001 FOR GENERAL NOTES.
2. SEE DRAWING SERIES S300 FOR TYPICAL CONCRETE DETAILS.
3. SEE DRAWING SERIES S500 FOR TYPICAL STEEL DETAILS.
4. SEE DWGS S501 & S501A FOR TYPICAL COMPOSITE SLAB DETAILS.
5. SEE DRAWING S505 FOR BRACING ELEVATIONS.



1 SECOND MEZZANINE FLOOR FRAMING PLAN

SCALE: 1/8"=1'-0"

TOWER PLAN NOTES:

1. TOP OF SLAB EL SEE PLAN
2. CONCRETE STRENGTH, f'c = 5000 PSI WITH PUDDLING
f'c = 7150 PSI WITHOUT PUDDLING
SEE S404 FOR TYPICAL PUDDLING DETAILS

LOW RISE PLAN NOTES:

1. TOP OF SLAB EL VARIES, SEE PLAN
2. TOP OF STEEL EL = T/SLAB EL MINUS SLAB THICKNESS, UON
3. ⟷ INDICATES DECK SPAN DIRECTION.
4. CS1 INDICATES 3" COMPOSITE METAL DECK, 20 GAGE MIN WITH 3 1/4" LIGHTWEIGHT CONCRETE TOPPING SLAB f'c=4000 PSI, REINFORCED WITH WWF 6x6-W2.1xW2.1 TOTAL SLAB THICKNESS: 6 1/4"
5. CS3 INDICATES 3" COMPOSITE METAL DECK, 16 GAGE MIN WITH 5" NORMALWEIGHT CONCRETE TOPPING SLAB f'c=4000 PSI, REINFORCED WITH WWF 6x6-W2.1xW2.1 AND #5@12 TOP & BOTTOM TOTAL SLAB THICKNESS: 8"
5A. CS3-R INDICATES COMPOSITE SLAB SAME AS CS3 WITH ADDITIONAL BARS #5@12" TOP AND BOTTOM
6. HSS6x4 POST IS PROVIDED FOR SUPPORT OF ELEVATOR GUIDE RAILS. EXACT NUMBER AND LOCATION OF POSTS TO BE DETERMINED BASED ON ELEVATOR REQUIREMENTS. CONTRACTOR TO COORDINATE WITH ELEVATOR MANUFACTURER. SEE DETAIL

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SHEET TITLE:

SECOND MEZANINE FLOOR FRAMING PLAN

PROJECT ELEVATION + 0.0' = GRAND RAPIDS + 615.0'

SEAL:

SCALE: AS SHOWN
DRAWN BY:
CHECKED BY:
PROJECT NO.: CC4467.00

DRAWING NUMBER:

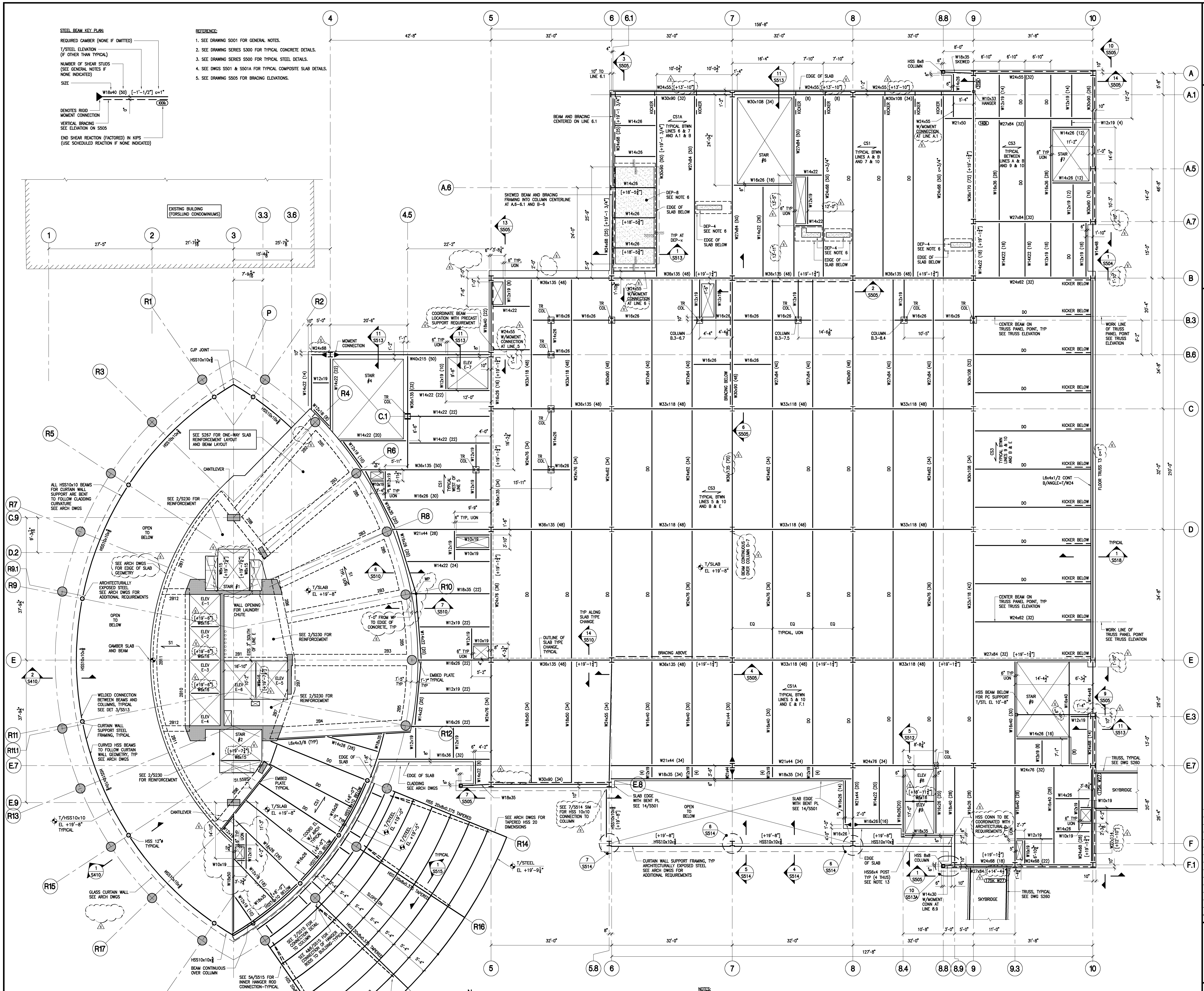
S216

STEEL BEAM KEY PLAN:

- REQUIRED CAMBER (NONE IF OMITTED)
- T/STEEL ELEVATION (IF OTHER THAN TYPICAL)
- NUMBER OF SHEAR STUDS (SEE GENERAL NOTES IF NONE INDICATED)
- SIZE
- W18x40 (50) [–1'–1/2"] c=1"
- XXXk
- DENOTES RIGID MOMENT CONNECTION
- VERTICAL BRACING SEE ELEVATION ON S505
- END SHEAR REACTION (FACTORED) IN KIPS (USE SCHEDULED REACTION IF NONE INDICATED)

REFERENCE:

1. SEE DRAWING S001 FOR GENERAL NOTES.
2. SEE DRAWING SERIES S300 FOR TYPICAL CONCRETE DETAILS.
3. SEE DRAWING SERIES S500 FOR TYPICAL STEEL DETAILS.
4. SEE DWGS S501 & S501A FOR TYPICAL COMPOSITE SLAB DETAILS.
5. SEE DRAWING S505 FOR BRACING ELEVATIONS.



SECOND FLOOR FRAMING PLAN

SCALE: 1/8"=1'-0"

TOWER PLAN NOTES:

1. TOP OF SLAB EL VARIES, SEE PLAN
2. CONCRETE STRENGTH (SLABS AND BEAMS):
   f'c = 5000 PSI WITH PUDDLING
   f'c = 7150 PSI WITHOUT PUDDLING
   SEE S404 FOR TYPICAL PUDDLING DETAILS

NOTES:

1. TOP OF SLAB EL VARIES, SEE PLAN
2. TOP OF STEEL EL = T/SLAB EL MINUS SLAB THICKNESS, UON
3. ⟷ INDICATES DECK SPAN DIRECTION.
4. CS1 INDICATES 3" COMPOSITE METAL DECK, 20 GAGE MIN WITH 3 1/4" LIGHTWEIGHT CONCRETE TOPPING SLAB f'c=4000 PSI, REINFORCED WITH WWF 6x6–W2.1xW2.1 TOTAL SLAB THICKNESS: 6 1/4"
5. CS3 INDICATES 3" COMPOSITE METAL DECK, 16 GAGE MIN WITH 5" NORMALWEIGHT CONCRETE TOPPING SLAB f'c=4000 PSI, REINFORCED WITH WWF 6x6–W2.1xW2.1 TOTAL SLAB THICKNESS: 8"
6. DEP–x INDICATES SLAB DEPRESSION, VALUE "x" INDICATES DEPTH OF DEPRESSION IN INCHES (8" OR 4") COMPOSITE SLAB AT DEPRESSION IS SIMILAR TO TYPE CS1 WITH 3" COMPOSITE DECK, 18 GAGE MIN, SEE DET 1/S513 CONTRACTOR TO COORDINATE SIZE AND LOCATION WITH ARCH DWGS AND WITH EQUIPMENT REQUIREMENTS.
7. CS1A INDICATES COMPOSITE SLAB SAME AS CS1 WITH MIN 18 GAGE
8. TR COL INDICATES COLUMN TRANSFER, SEE TYPICAL DETAILS
9. HSS6x4 POST IS PROVIDED FOR SUPPORT OF ELEVATOR GUIDE RAILS. EXACT NUMBER AND LOCATION OF POSTS TO BE DETERMINED BASED ON ELEVATOR REQUIREMENTS. CONTRACTOR TO COORDINATE WITH ELEVATOR MANUFACTURER. SEE DETAILS 9 & 10 ON S507

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1	10 DEC 04	SCHEMATIC DESIGN

SHEET TITLE:

SECOND FLOOR
FRAMING PLAN

PROJECT ELEVATION + 0.0' = GRAND RAPIDS + 615.0'

SEAL:

SCALE: AS SHOWN

DRAWN BY:

CHECKED BY:

PROJECT NO.: CC4467.00

DRAWING NUMBER:

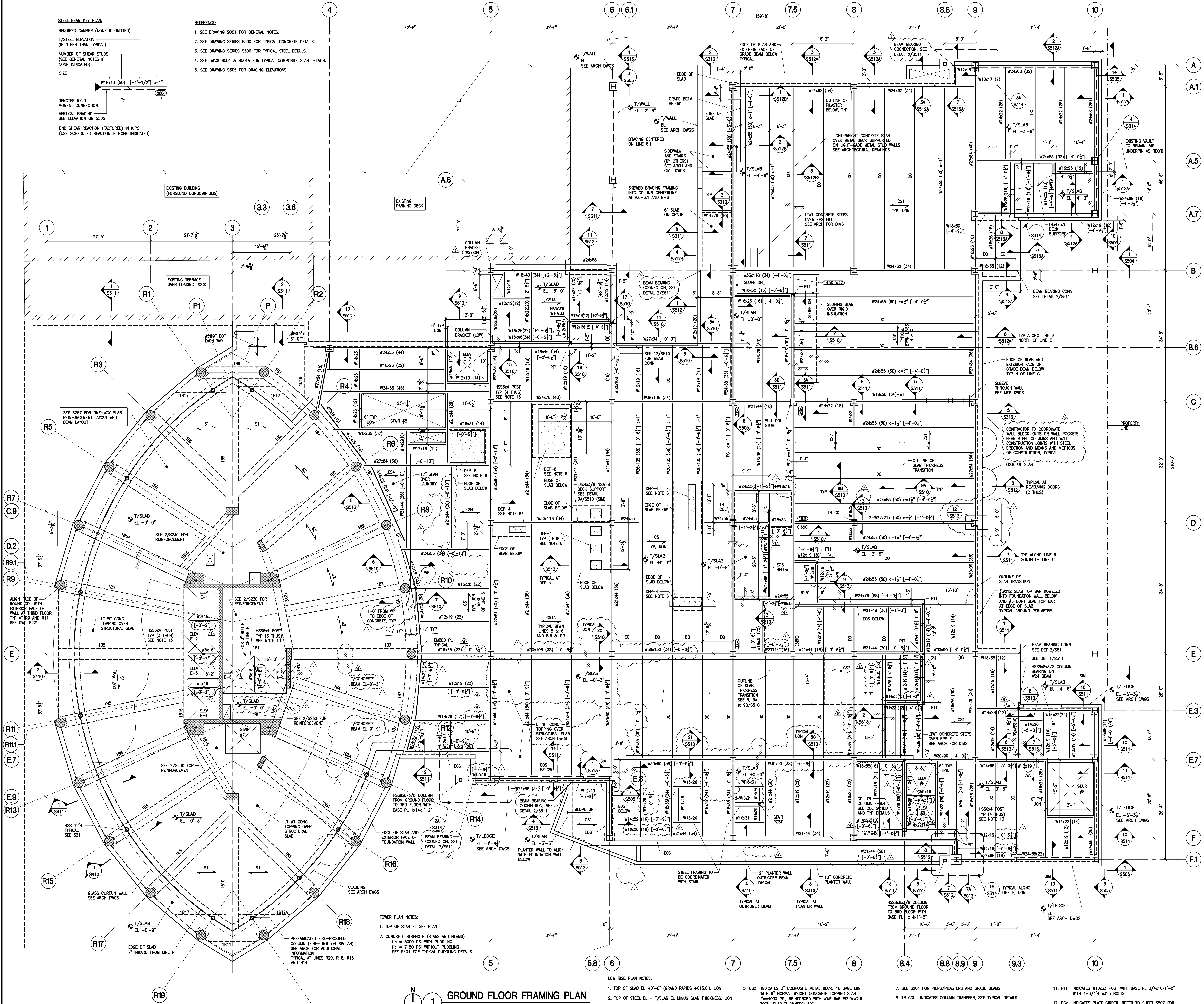
S211

STEEL BEAM KEY PLAN:

REQUIRED CAMBER (NONE IF OMITTED)
T/STEEL ELEVATION (IF OTHER THAN TYPICAL)
NUMBER OF SHEAR STUDS (SEE GENERAL NOTES IF NONE INDICATED)
SIZE
W18x40 (50) [-1'-1/2"] c=1"
XXXk
0"
DENOTES RIGID MOMENT CONNECTION
VERTICAL BRACING SEE ELEVATION ON S505
END SHEAR REACTION (FACTORED) IN KIPS (USE SCHEDULED REACTION IF NONE INDICATED)

REFERENCE:

1. SEE DRAWING S001 FOR GENERAL NOTES.
2. SEE DRAWING SERIES S300 FOR TYPICAL CONCRETE DETAILS.
3. SEE DRAWING SERIES S500 FOR TYPICAL STEEL DETAILS.
4. SEE DWGS S501 & S501A FOR TYPICAL COMPOSITE SLAB DETAILS.
5. SEE DRAWING S505 FOR BRACING ELEVATIONS.



GROUND FLOOR FRAMING PLAN

SCALE: 1/8"=1'-0"

TOWER PLAN NOTES:

1. TOP OF SLAB EL SEE PLAN
2. CONCRETE STRENGTH (SLABS AND BEAMS)
   f'c = 5000 PSI WITH PUDDLING
   f'c = 7150 PSI WITHOUT PUDDLING
   SEE S404 FOR TYPICAL PUDDLING DETAILS

LOW RISE PLAN NOTES:

1. TOP OF SLAB EL +0'-0" (GRAND RAPIDS +615.0'), UON
2. TOP OF STEEL EL = T/SLAB EL MINUS SLAB THICKNESS, UON
3. ⟷ INDICATES DECK SPAN DIRECTION.
4. CS1 INDICATES 3" COMPOSITE METAL DECK, 20 GAGE MIN WITH 3 1/4" LIGHTWEIGHT CONCRETE TOPPING SLAB f'c=4000 PSI, REINFORCED WITH WWF 6x6-W2.1xW2.1 TOTAL SLAB THICKNESS: 6 1/4"
5. CS2 INDICATES 3" COMPOSITE METAL DECK, 16 GAGE MIN WITH 9" NORMAL WEIGHT CONCRETE TOPPING SLAB f'c=4000 PSI, REINFORCED WITH WWF 6x6-W2.9xW2.9 TOTAL SLAB THICKNESS: 12" METAL DECK TO BE SHORED
6. DEP-x INDICATES SLAB DEPRESSION, VALUE "x" INDICATES DEPTH OF DEPRESSION IN INCHES (8" OR 4") COMPOSITE SLAB AT DEPRESSION IS SIMILAR TO TYPE CS1 WITH 3" COMPOSITE DECK, 18 GAGE MIN, SEE DET 1/S513 CONTRACTOR TO COORDINATE SIZE AND LOCATION WITH ARCH DWGS AND WITH EQUIPMENT REQUIREMENTS.
7. SEE S201 FOR PIERS/PILASTERS AND GRADE BEAMS
8. TR COL INDICATES COLUMN TRANSFER, SEE TYPICAL DETAILS
9. CS1A INDICATES COMPOSITE SLAB SAME AS CS1 WITH 18 GAGE MIN
10. CS4 INDICATES 3" COMPOSITE METAL DECK, 16 GAGE MIN WITH 7" NORMAL WEIGHT CONCRETE TOPPING SLAB f'c=4000 PSI, REINFORCED WITH #7@12"B AND #5@6"T, SEE DET 11/S501 TOTAL SLAB THICKNESS: 10" METAL DECK TO BE SHORED
11. PT1 INDICATES W10x33 POST WITH BASE PL 3/4x10x1'-0" WITH 4-3/4"ø A325 BOLTS
12. PGx INDICATES PLATE GIRDER. REFER TO SHEET S507 FOR PLATE GIRDER SCHEDULE AND DETAILS
13. HSS6x4 POST IS PROVIDED FOR SUPPORT OF ELEVATOR GUIDE RAILS. EXACT NUMBER AND LOCATION OF POSTS TO BE DETERMINED BASED ON ELEVATOR REQUIREMENTS. CONTRACTOR TO COORDINATE WITH ELEVATOR MANUFACTURER. SEE DETAIL

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SHEET TITLE:

GROUND FLOOR FRAMING PLAN

PROJECT ELEVATION + 0.0' = GRAND RAPIDS + 615.0'

SEAL:

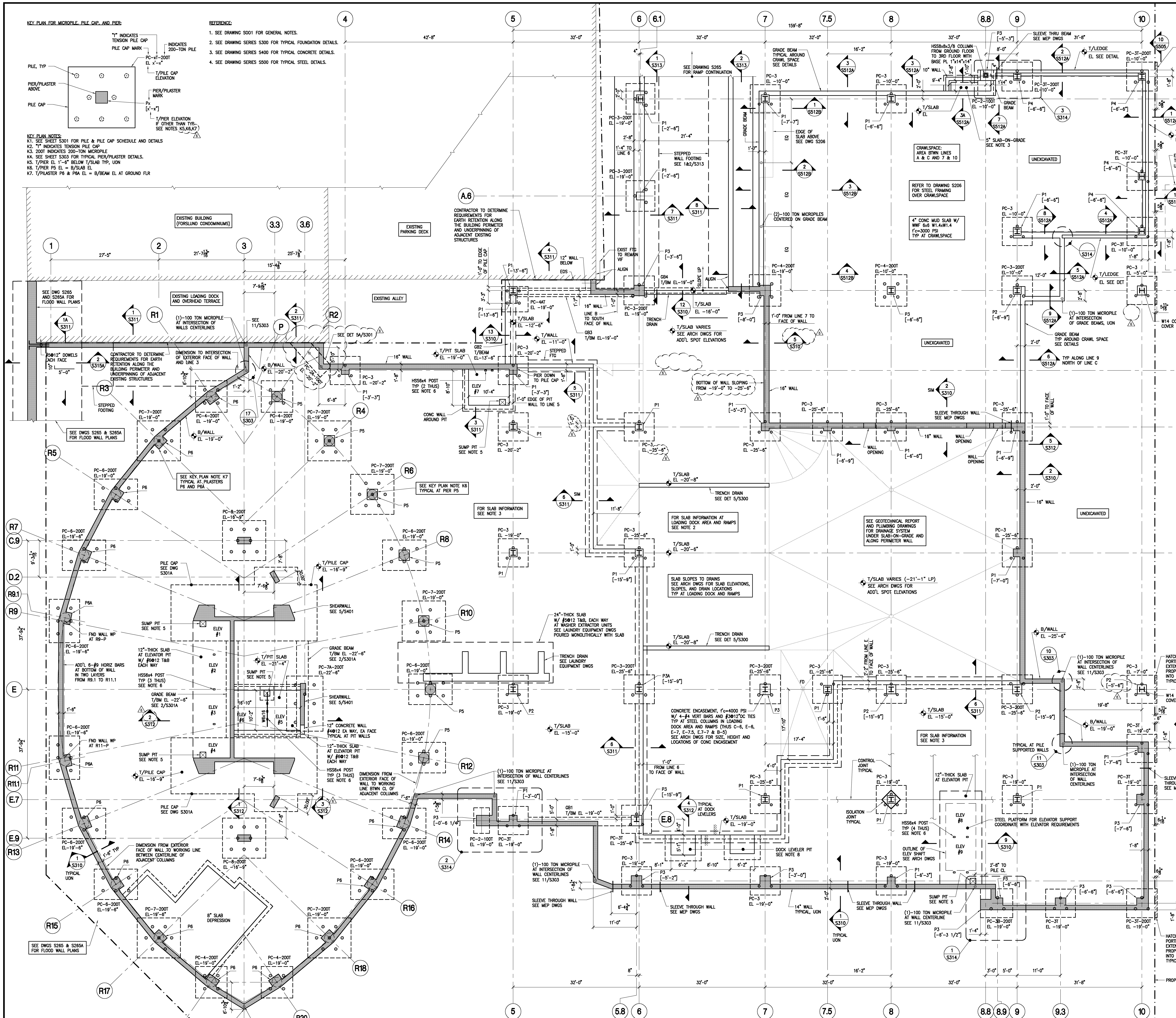
SCALE: AS SHOWN
DRAWN BY:
CHECKED BY:
PROJECT NO.: CC4467.00

DRAWING NUMBER:
S206

KEY PLAN FOR MICROPILE, PILE CAP, AND PIER:

REFERENCE:

1. SEE DRAWING S001 FOR GENERAL NOTES.
2. SEE DRAWING SERIES S300 FOR TYPICAL FOUNDATION DETAILS.
3. SEE DRAWING SERIES S400 FOR TYPICAL CONCRETE DETAILS.
4. SEE DRAWING SERIES S500 FOR TYPICAL STEEL DETAILS.



KEY PLAN NOTES:

K1. SEE SHEET S301 FOR PILE & PILE CAP SCHEDULE AND DETAILS
K2. "T" INDICATES TENSION PILE CAP
K3. 200T INDICATES 200-TON MICROPILE
K4. SEE SHEET S303 FOR TYPICAL PIER/PILASTER DETAILS.
K5. T/PIER EL 1'-6" BELOW T/SLAB TYP, UON
K6. T/PIER P5 EL = B/SLAB EL
K7. T/PILASTER P6 & P6A EL = B/BEAM EL AT GROUND FLR

1 FOUNDATION AND BASEMENT PLAN

SCALE: 1/8"=1'-0"

PLAN NOTES:

1. TOP OF SLAB EL VARIES, SEE PLAN
2. BASEMENT SLAB AT LOADING DOCK AREA AND RAMPS:
   10" CONCRETE SLAB ON GRADE, f'c=4000 PSI, REINFORCED WITH #4@12" TOP & BOTTOM EACH WAY
   SLAB TOP BARS TO BE EPOXY COATED
   SUBGRADE PREPARATION REQUIRED PER GEOTECHNICAL RECOMMENDATIONS
   REMOVE AND REPLACE UNSUITABLE EXISTING SOIL BELOW BASEMENT SLAB PER GEOTECHNICAL RECOMMENDATIONS
3. BASEMENT SLAB AT EL -15'-0":
   6" CONCRETE SLAB ON GRADE, f'c=4000 PSI, REINFORCED WITH WWF 6x6-W2.9xW2.9
   SUBGRADE PREPARATION REQUIRED PER GEOTECHNICAL RECOMMENDATIONS
   REMOVE AND REPLACE UNSUITABLE EXISTING SOIL BELOW BASEMENT SLAB PER GEOTECHNICAL RECOMMENDATIONS
4. Px INDICATES CONCRETE PIER OR PILASTER
   SEE LEGEND ON THIS SHEET
5. ELEVATOR SUMP PIT: 1'-6"x1'-6"x1'-6"
   VERIFY SIZE AND LOCATION WITH ELEVATOR REQUIREMENTS
6. HSS6x4 POST IS PROVIDED FOR SUPPORT OF ELEVATOR GUIDE RAILS. EXACT NUMBER AND LOCATION OF POSTS TO BE DETERMINED BASED ON ELEVATOR REQUIREMENTS. CONTRACTOR TO COORDINATE WITH ELEVATOR MANUFACTURER. SEE DETAIL
7. GBx INDICATES CONCRETE GRADE BEAM
   SEE DWG S302 FOR TYPICAL DETAILS AND SCHEDULE
8. ALL DIMENSIONS AND ELEVATIONS AT DOCK LEVELER PITS MUST BE VERIFIED WITH MANUFACTURER AND WITH THE ARCH DWGS. CONTRACTOR TO COORDINATE. SEE ARCH DWGS FOR ADD'L INFORMATION.

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SHEET TITLE:

FOUNDATION AND BASEMENT PLAN

PROJECT ELEVATION + 0.0' = GRAND RAPIDS + 615.0'

SEAL:

SCALE: AS SHOWN
DRAWN BY:
CHECKED BY:
PROJECT NO.: CC4467.00
DRAWING NUMBER: S201