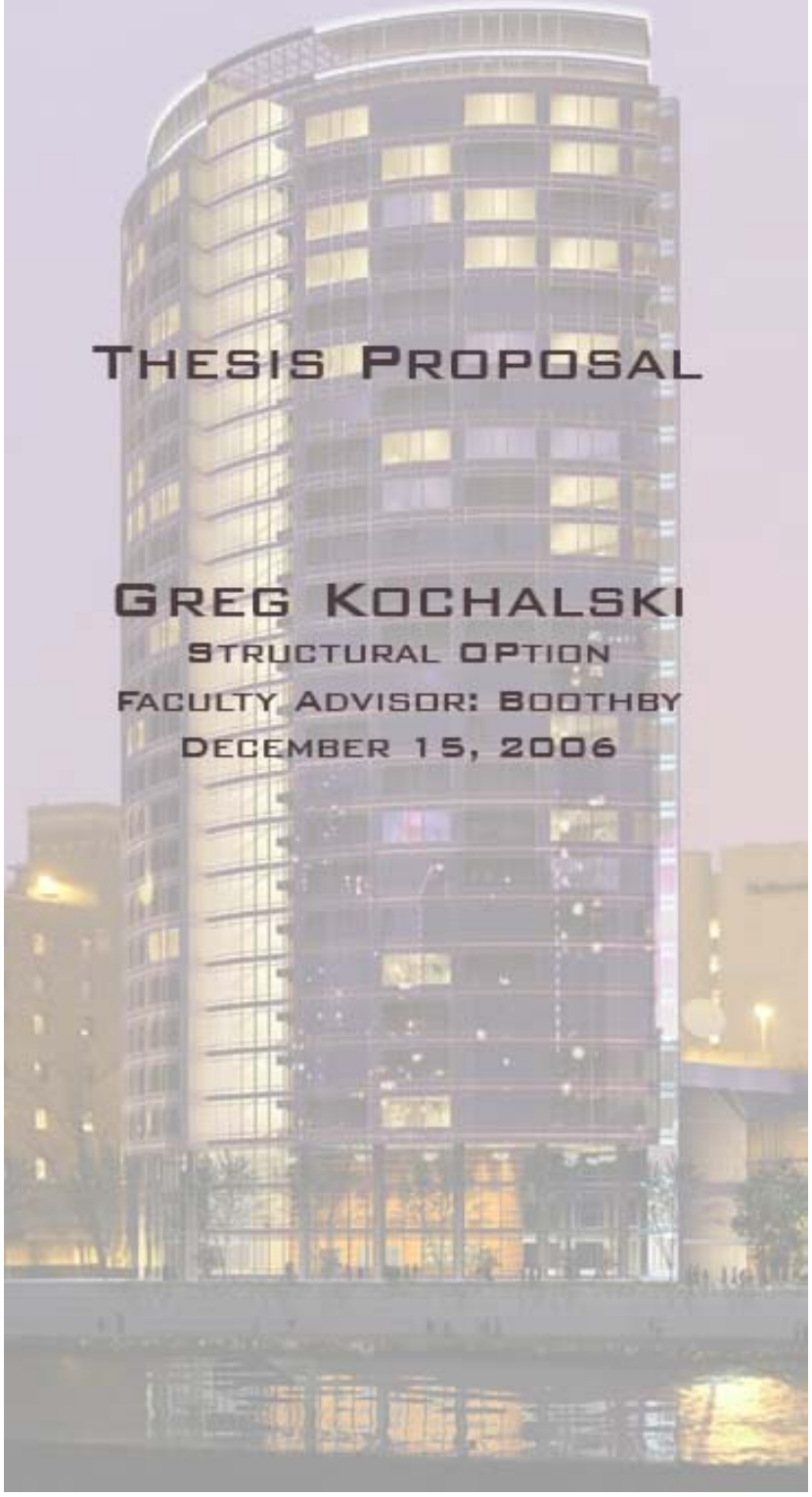
J W Marriott
Grand Rapids, MI



Thesis Proposal

Greg Kochalski

Structural Option

Faculty Advisor: Boothby

December 15, 2006

Executive Summary

Greg Kochalski
Structural
Advisor: Boothby

JW Marriott, Grand Rapids, MI
December 15, 2006

Building Description:

The JW Marriott is a 24 story hotel currently under construction in Grand Rapids. The 376,000 square foot hotel will offer over 300 guest rooms. With multiple accommodations including a business center, restaurant, 24 hour concierge the JW Marriott will match the service of any hotel in the area. A helipad, heated driveway and sidewalks, and an adjacent parking deck with a Sky Bridge give distinctive touches to the hotel. The unique elliptical shape will create a strong presence in the otherwise conservative Grand Rapids skyline. Reflective glass cladding helps to accentuate its place along the Grand River. The JW Marriott will welcome its first guests in the fall of 2007.

Proposal:

Given its location the JW Marriott is not likely to see high seismic loads throughout its lifetime. If the owner wished to use the same design in Monterey, California, a seismically active location, the design will need to change. I propose to redesign the structure to withstand the forces conforming of the new seismically active site.

Solution:

The primary focus will be to keep as many characteristics the same for the new JW Marriott. I will redesign the JW Marriott in accordance with California state codes and provisions. In doing so I will pay close attention to the floor, framing, and lateral force systems. These systems will need designed with higher capacities to withstand seismic forces.

Breadth Topics:

Along with the redesign of the building's structural system I plan to investigate the effects on the construction and mechanical system. The design must be done in a manner that concrete may be poured and assured of proper consolidation. If necessary I will investigate alternative concrete mix designs. Higher cooling loads and lower heating loads will warrant a new air to air handling unit for the building. I will determine the current and new heating loads then chose an AHU suitable for Monterey conditions.

Table of Contents

Introduction

The JW Marriott is a 24 story hotel currently under construction in Grand Rapids. The 376,000 square foot hotel will offer over 300 guest rooms. With multiple accommodations including a business center, restaurant, 24 hour concierge the JW Marriott will match the service of any hotel in the area. The unique elliptical shape will create a strong presence in the otherwise conservative Grand Rapids skyline. Reflective glass cladding helps to accentuate its place along the Grand River.

The hotel is being constructed under the 2003 Michigan Building Code. The 2003 MBC is an adoption of the 2003 IBC with state amendments. The building rises approximately 256 ft above grade. A helipad, heated driveway and sidewalks, and an adjacent parking deck with Sky Bridge give distinctive touches to the hotel. The architect and structural engineer determined that the absence of perimeter columns would have large aesthetic benefits with minimal structural efficiency penalties. Wall-columns were used instead of large circular perimeter columns. These members typically 10 in wide and 11 ft long are hidden within partitions between guest rooms.

Background

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.

Foundation:

The foundation of the JW Marriott consists of multiple parts. A slab on grade covers the entire basement with 6 inches of 4000 psi concrete reinforced with WWF and 10 inches

of 4000 psi concrete reinforced with 4#12 bars each way in the loading dock area. Grade beams travel between the building elevator core pile caps. The grade beams range in size from 16-28 inches wide by 42-48 inches in height. All grade beams are 6000 psi concrete reinforced top and bottom. Along the perimeter of the tower there are 21 piles that consist of (4-7) 200 ton micropiles. Each micropile drives 19' into the ground. In the elevator core there is a cache of micropiles, (94) 200 ton. Just outside the elevator core there are two groups of 8 micropiles, one of each side of the core in the North-South direction.

Framing System:

The repetitive tower framing plan offers a distinct advantage to the structural engineer and general contractor. The typical framing plans take affect from floor 5 through 23. On the first and second floor there are 21 reinforced concrete columns, 24 inches in diameter. The concrete in the columns change from 10 ksi to 8 ksi to 6 ksi at the sixth and fourteenth floors, respectively. Above the fifth floor the number of circular columns is reduced to four. In the guest rooms, columns are replaced by a series of 10 inch thick wall-columns to maximize views. The elevator core offers support for the interior of the structure.

Floor System:

The existing floor system of the JW is a one-way reinforced concrete flat plate from floors 5 through 22. The slab is 7.5 inches thick and uses 5000 psi strength concrete (unless otherwise noted). Fourteen openings in the slab, located in the main corridor, allow for mechanical duct access. The overall shallow depth of the system permits greater flexibility for the architect's interior design. Throughout the guest levels code specifies 40 psf live load. The size of the typical bay is a trapezoid with vertical lengths 10'-7" and increasing to 17'-9" and a horizontal length of 35'-3".

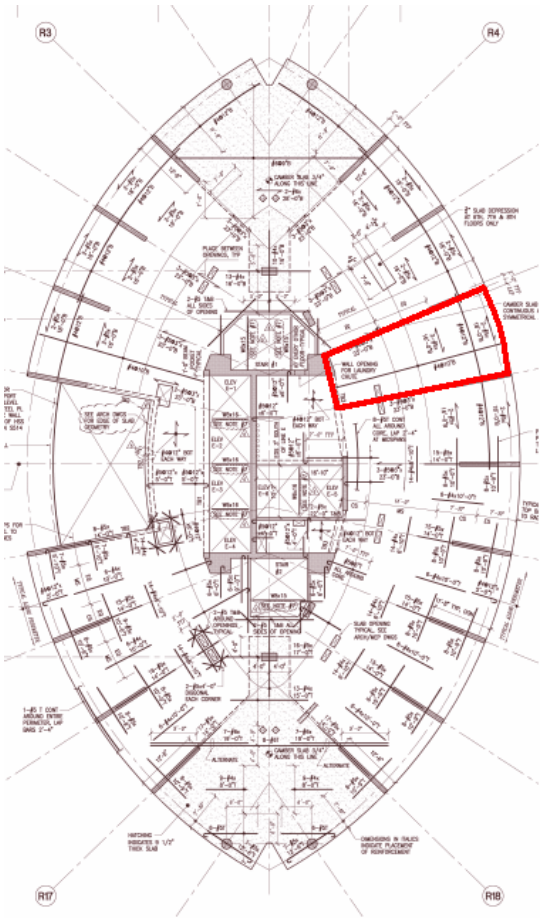


Figure 1. Typical Bay

Lateral System:

Concrete shear walls and will serve as the primary lateral force resistance. Located within the elevator core, the walls will span from the basement to the helipad. 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 is gained from the wall-columns placed along the exterior of the JW. These walls are typically 11'-8" wide and 10" wide. 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.

Problem Statement

The JW Marriott has been designed with great care to optimize all building systems in conjunction with the architect's difficult plan. The structural system used has proven to be the best choice based on research done in technical reports 2 and 3. In technical report 2, the flat plate framing system bested all alternatives keeping with industry standards for mid rise residential structures. The lateral system proved to be sufficient when analyzed and compared to ASCE7-02 for wind and seismic loading in technical report 3. The JW Marriott performs sufficiently for low seismic activity. However, if the owner wished to use the same unique building design in Monterey, California, an area of high seismic activity, the structural system would certainly need to be changed.

Problem Solution

Industry standards have proven that the most efficient material for mid rise residential structures is concrete.

Therefore, the floor system should remain a flat plate system to optimize material and labor costs. Attention must be paid to joints and interfaces connecting columns, beams, and slabs together to assure proper rotational capability. The current 7.5 in flat plate system will be redesigned if the current thickness and concrete slab strength (5000 psi) are found to be insufficient for the new loading conditions and code requirements.

Shear wall lateral systems have proven to be reliable under high seismic activity. With this in mind the lateral system will be redesigned to withstand much larger seismic forces in accordance with the appropriate codes.

Solution Method

Floor System:

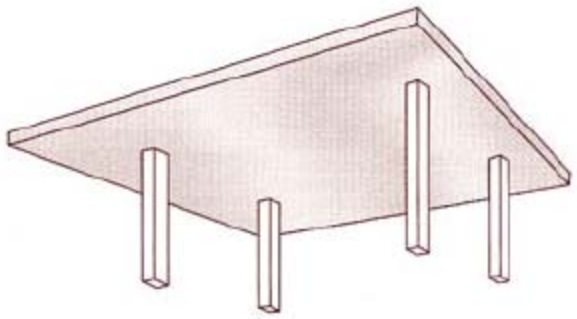


Figure 2. Flat Plate System

The flat plate floor system will be designed in accordance with ACI 318 Chapter 21 Section 21.11 with special checks for deformation capability. Computer modeling with ETABS will be done to simulate the floor system and then compared to manual findings. The live loads shall be in accordance with ASCE7-05. Pattern loadings will be checked for full live load on all spans, full and half live load on adjacent spans, and ¾ full loads and no load on adjacent spans will be investigated.

Lateral System:

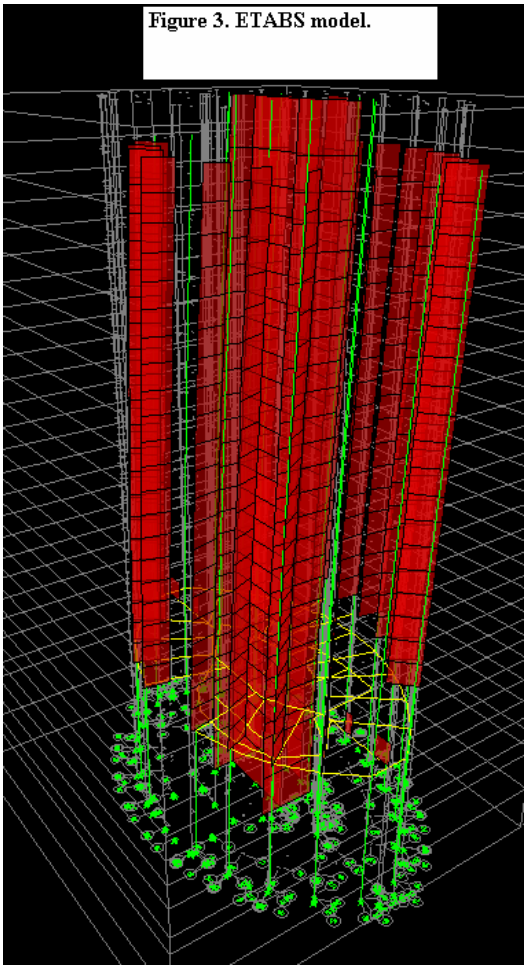


Figure 3. ETABS model.

The lateral system will be analyzed for the wind and seismic loading conditions set forth in ACI 318-05 Chapter 21 Section 21.7 with special checks for deformation capability. All applicable loading combinations will be investigated per ASCE7-05. The loading data will then be placed into ETABS and analyzed to determine the forces within each wall. The computer model forces will be compared to those found by hand analysis. The wall will then be designed based on the worst case loading combination of forces.

Note: For both systems, in addition to what has been mentioned above the following topics will need to be considered.

- *Accidental torsion and amplification*
- *Redundancy Factor*
- *Overstrength Factor*
- *Deflection and amplification Factor*
- *Vertical Earthquake Effects*

Breath Options

Redesigning the JW Marriott for a high seismic zone, Monterey, California, will offer many opportunities for breadth study. I will focus on two major areas of study, construction management and mechanical systems.

First, construction must be considered because joints connecting building elements are likely to endure rebar congestion. The design must be done in a manner that concrete may be fittingly poured and reach proper consolidation. If necessary I will investigate alternative concrete mix designs to solve any dilemmas. 3-D AutoCad drawings will be made to show examples of critical joints and the rebar inside them.

Second, if the building is to be built in Monterey the mechanical system will be subject to change as well. Higher cooling loads and lower heating loads will warrant a new air to air heat exchanger. For instance, average January temperatures differ by 31 degrees between Grand Rapids and Monterey. With this in mind I will determine the current heating loads, new heating loads, and then chose a handler suitable for Monterey.

Tasks and Tools

Phase 1. Flat Plate Floor System.

Task 1. Determine superimposed loads
- Determine dead loads from architectural and structural drawings
- Determine live loads in accordance with ASCE7-05

Task 2. Establish trial member sizes
- Determine minimum slab thickness from ACI 318 Ch. 9 Sect 9.5.3 to control deflections
- Consult PCA Simplified Design publications

Task 3. Refine Floor System
- Use SEAOC Seismic Design Manual
- Verify findings with ACI 318-05 Chapter 21 Sect. 21.11 with special checks for deformation capability

Sub-Task 7. Determine Constructability of Members
- Investigate beam/column/slab/shear wall joints for rebar congestion
- Determine if alternate concrete mix designs necessary for proper consolidation, if so, design new mix

Phase 2. Main Lateral Force Resisting System.

Task 4. Verify wind and seismic loads
- Use ASCE7-05 to determine wind and seismic loading

Task 5. Determine Loads on individual structural members
- Use ETABS computer modeling with previously determined lateral loads
- Use manual and spreadsheet analysis (in part from technical report 3) to find loads to individual members
- Compare computer to manual findings

Task 6. Design Lateral System Members

- Use SEAOC Seismic Design Manual and PCA notes on ACI 318 to establish trial sizes
- Design concrete sections in accordance with ACI 318-05 Ch. 21 Sect. 21.7 with special checks for deformation capability
- Design reinforcement and layout in accordance with ACI 318

Sub-Task 7. Determine constructability of members

- Investigate beam/column/slab/shear wall joints for rebar congestion
- Determine if alternate concrete mix designs necessary for proper consolidation, if so design new mix

Phase 3. Breath Studies.

Task 7. Determine constructability of members

- Construct 3-D AutoCad representations of typical joints

Task 8. Design mechanical air handling unit

- Determine Grand Rapids and Monterey cooling and heating loads
- Select new air to air heat exchanger

Time Table

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Task 1								
Task 2								
Task 3								
Task 4								
Task 5								
Task 6								
Task 7								
Task 8								
Compile Final Report								
Create Final Presentation								
Present to Faculty								

	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15	Week 16	Week 17
Task 1								
Task 2								
Task 3								
Task 4								
Task 5								
Task 6								
Task 7								
Task 8								
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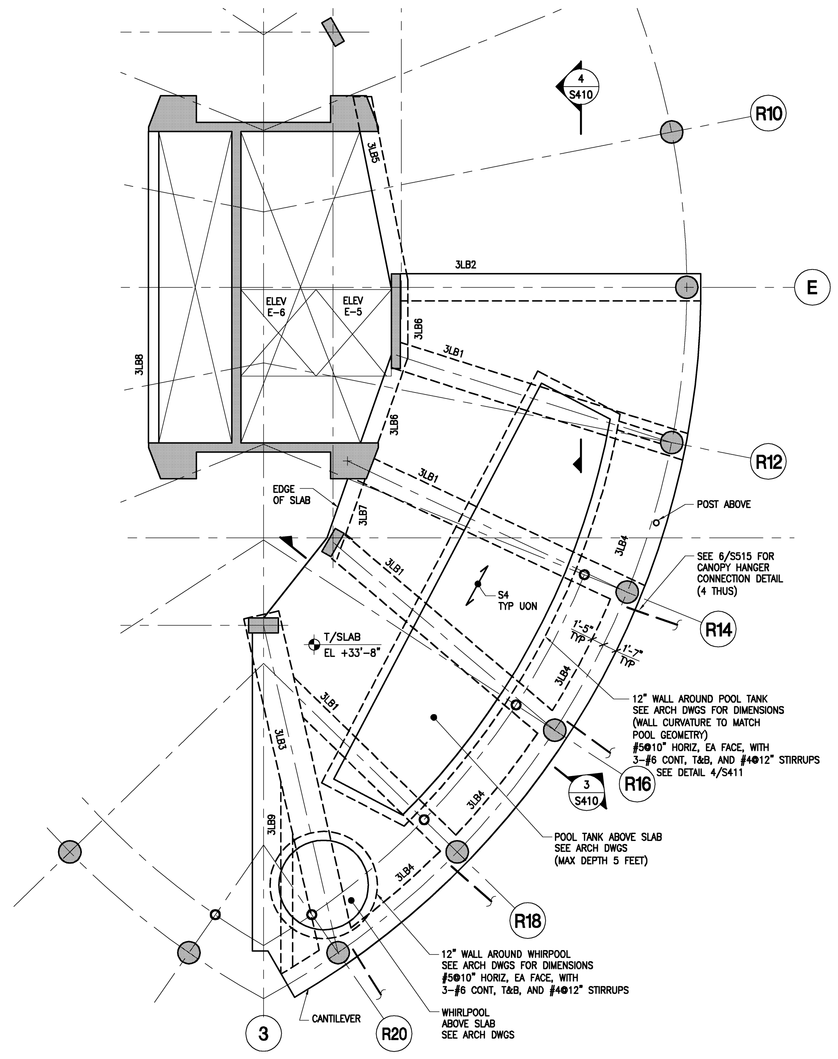
Appendix: Floor Plans



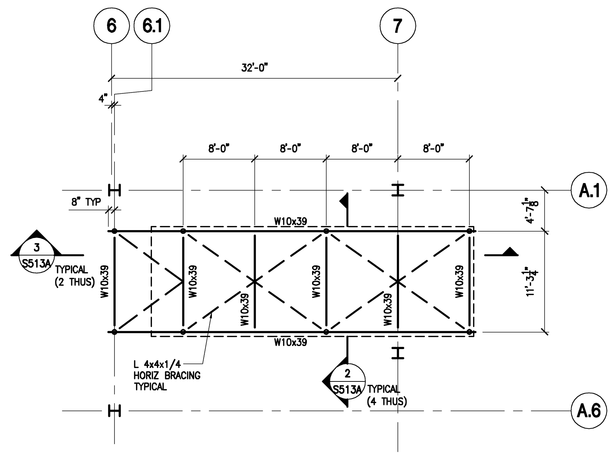
N 3 **PARTIAL FRAMING PLAN**

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



N 4 **PLATFORM FRAMING PLAN**

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

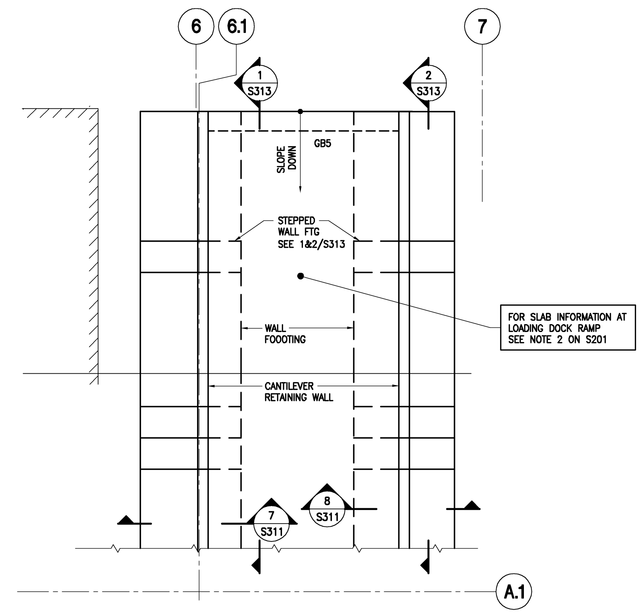
COOLING TOWER SUPPORT PLATFORM

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.

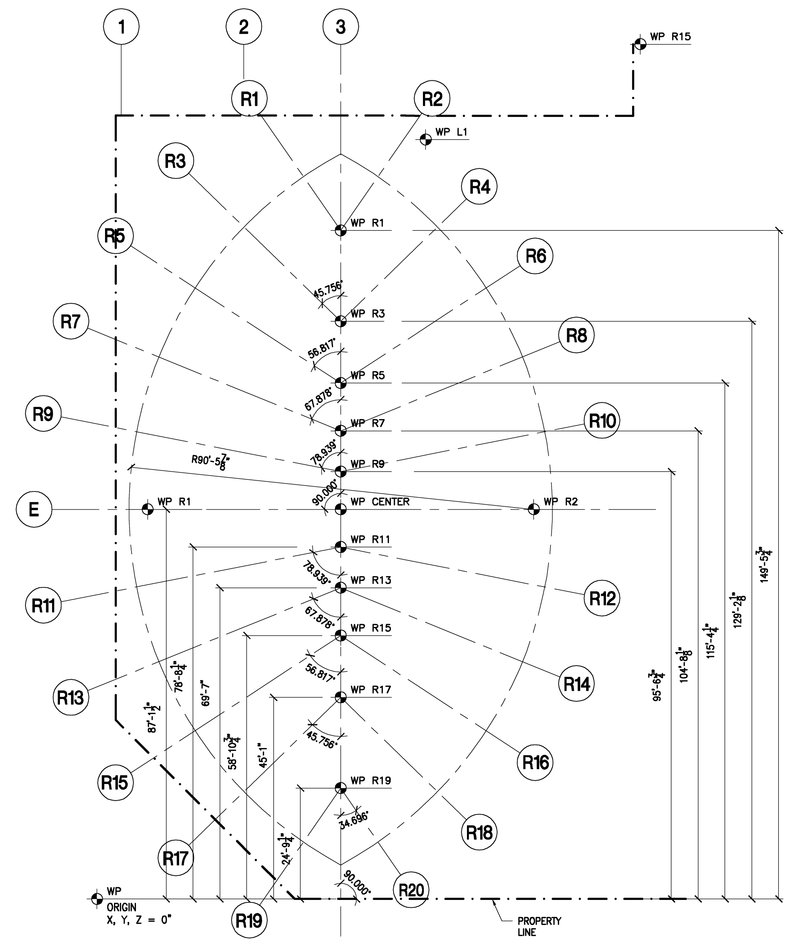


N 1 **PARTIAL PLAN**

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

NOTES:

1. SEE S201 FOR ADDITIONAL INFORMATION



NOTE:
1. SEE ARCH DRAWINGS FOR ADDITIONAL INFORMATION

N 2 **TOWER GEOMETRY**

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

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NO.	DATE	DESCRIPTION
17	02 DEC 05	ISSUED FOR CONSTRUCTION AND PERMIT
16	28 OCT 05	OWNER AND MARRIOTT CO 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"

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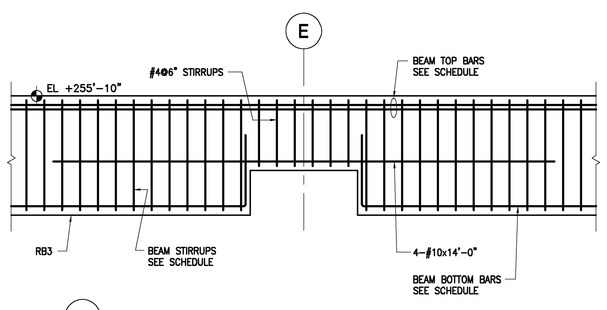
DRAWN BY:
CHECKED BY:
PROJECT NO.: CC4467.00

DRAWING NUMBER:

S266



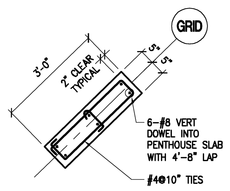
5 RB3 ELEVATION

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

2 ROOF FRAMING PLAN

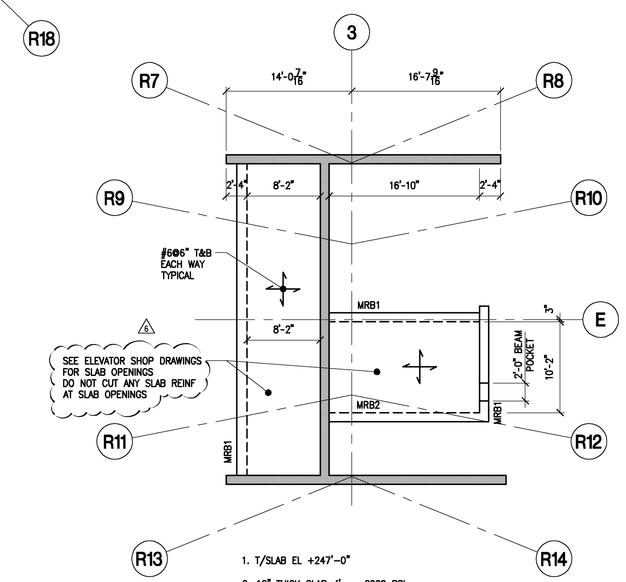
SCALE: 1/8"=1'-0"

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

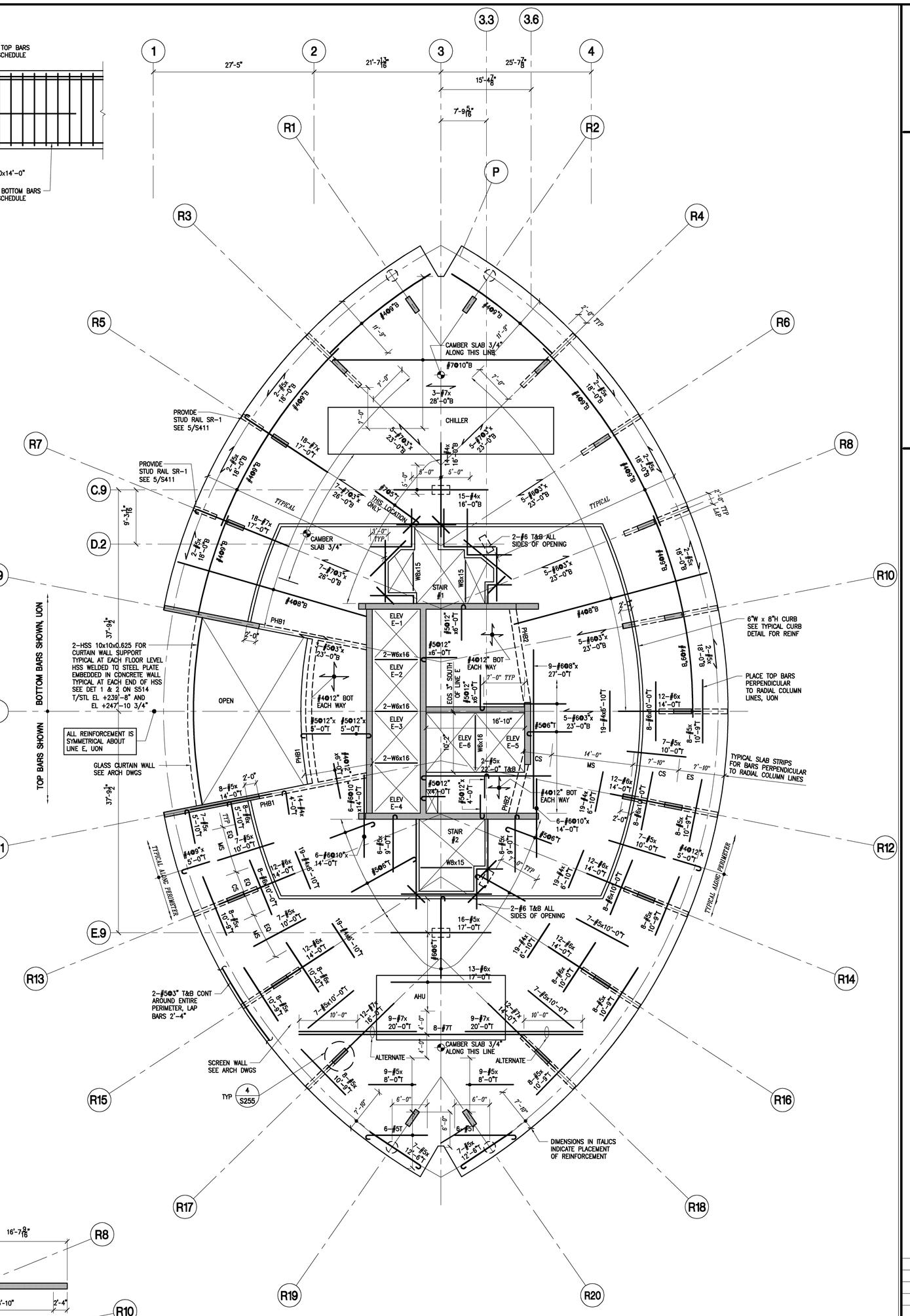
f'c=5000 PSI



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
1	10 DEC 04	SCHEMATIC DESIGN
2	15 APR 05	IN-PROGRESS DESIGN DEVELOPMENT
3	29 APR 05	DESIGN DEVELOPMENT
5	20 MAY 05	REVISED DESIGN DEVELOPMENT
9	03 AUG 05	STRUCTURAL STEEL BID PACKAGE
15	24 OCT 05	TOWER CONCRETE BID PACKAGE
16	28 OCT 05	OWNER AND MARRIOTT CD REVIEW
17	02 DEC 05	ISSUED FOR CONSTRUCTION AND PERMIT
6	09 JAN 06	ADDENDUM #6

SHEET TITLE:

MECHANICAL PENTHOUSE AND ROOF FRAMING PLAN

PROJECT ELEVATION + 0.0" = GRAND RAPIDS + 615.0'

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CHECKED BY:
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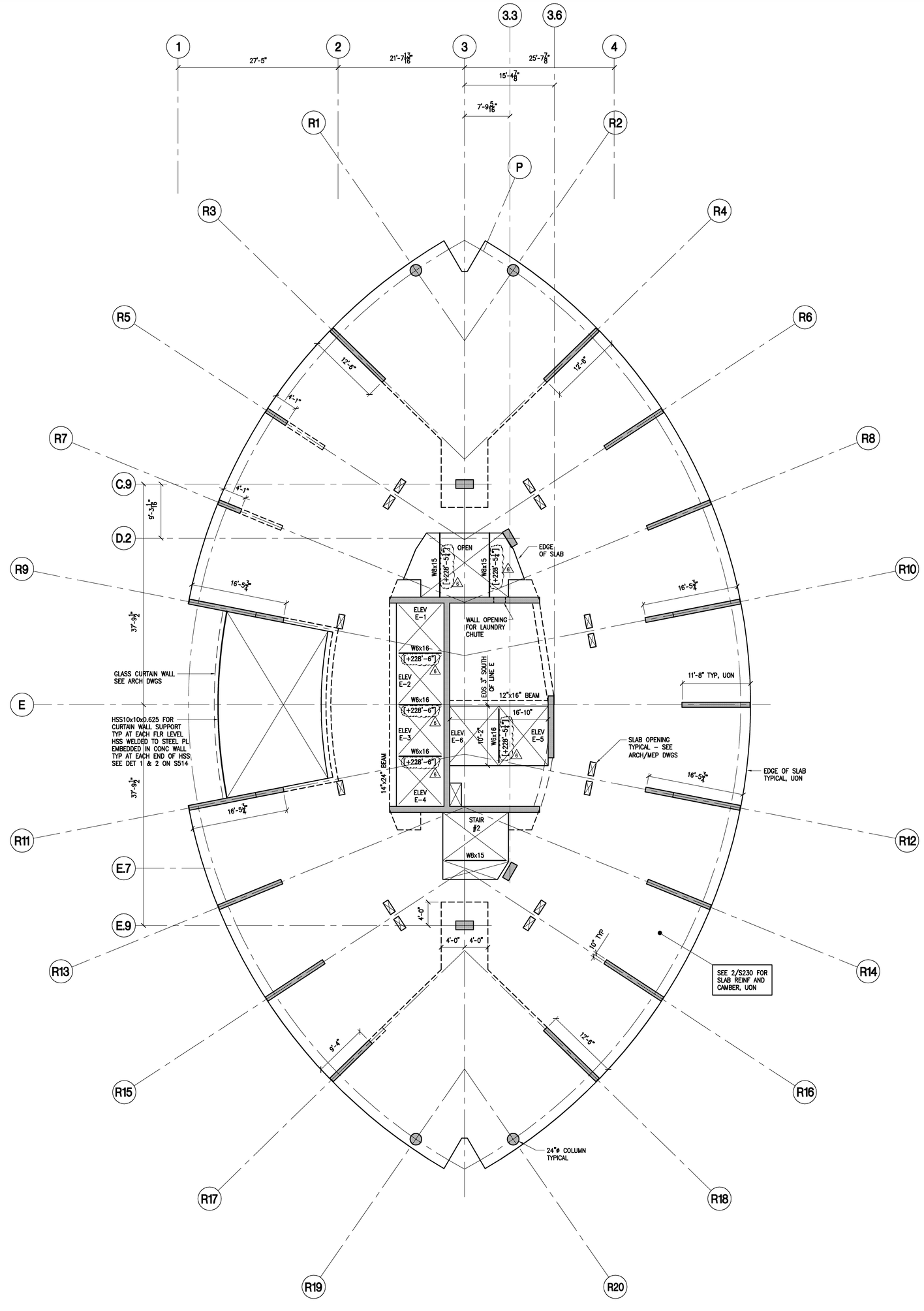

N

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
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2	15 APR 05	IN-PROGRESS DESIGN DEVELOPMENT

SHEET TITLE:

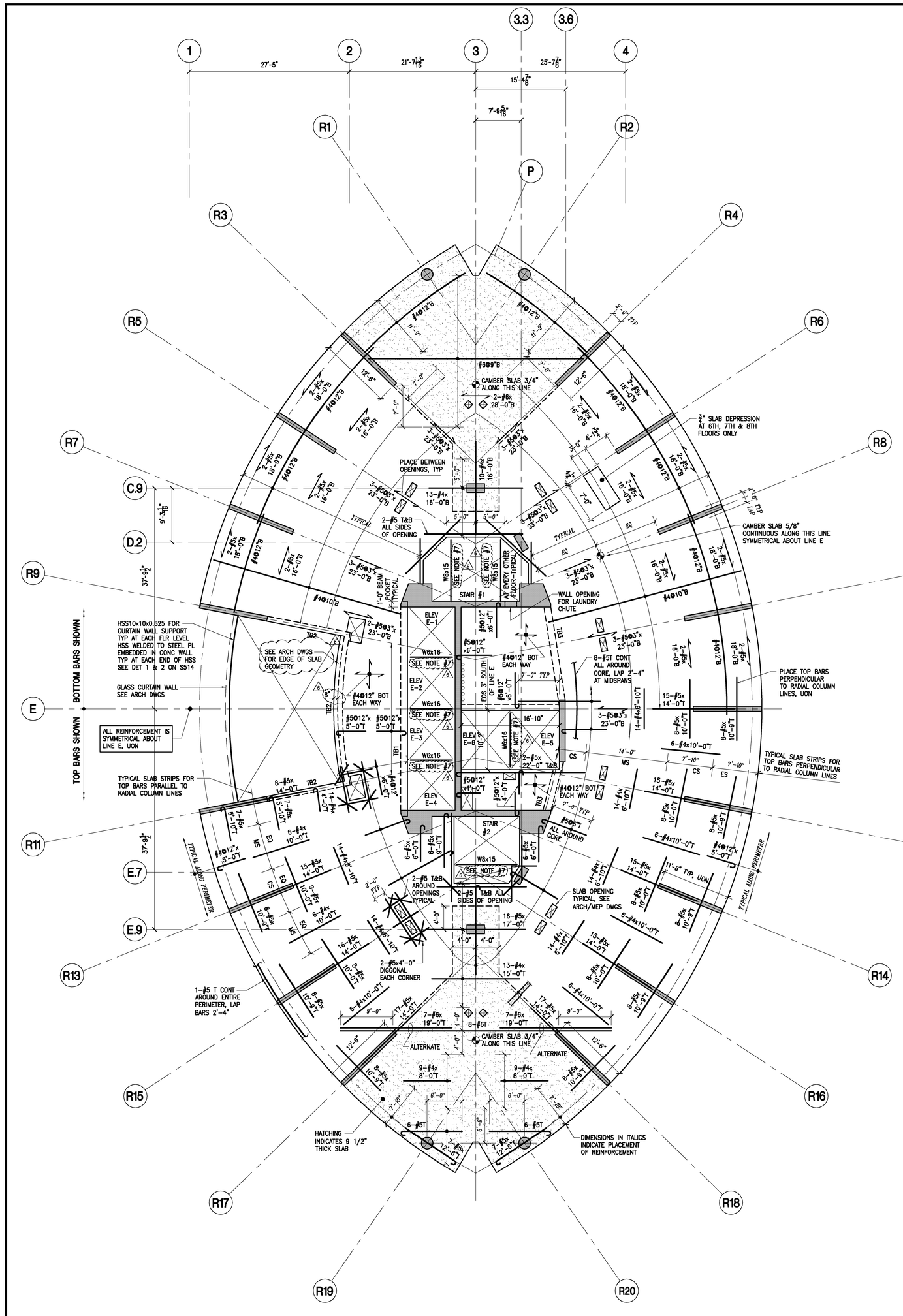
23RD FLOOR FRAMING PLAN

PROJECT ELEVATION + 0.0" = GRAND RAPIDS + 615.0"

SEAL:

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

S240



6TH-22ND FLOOR FRAMING PLAN

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

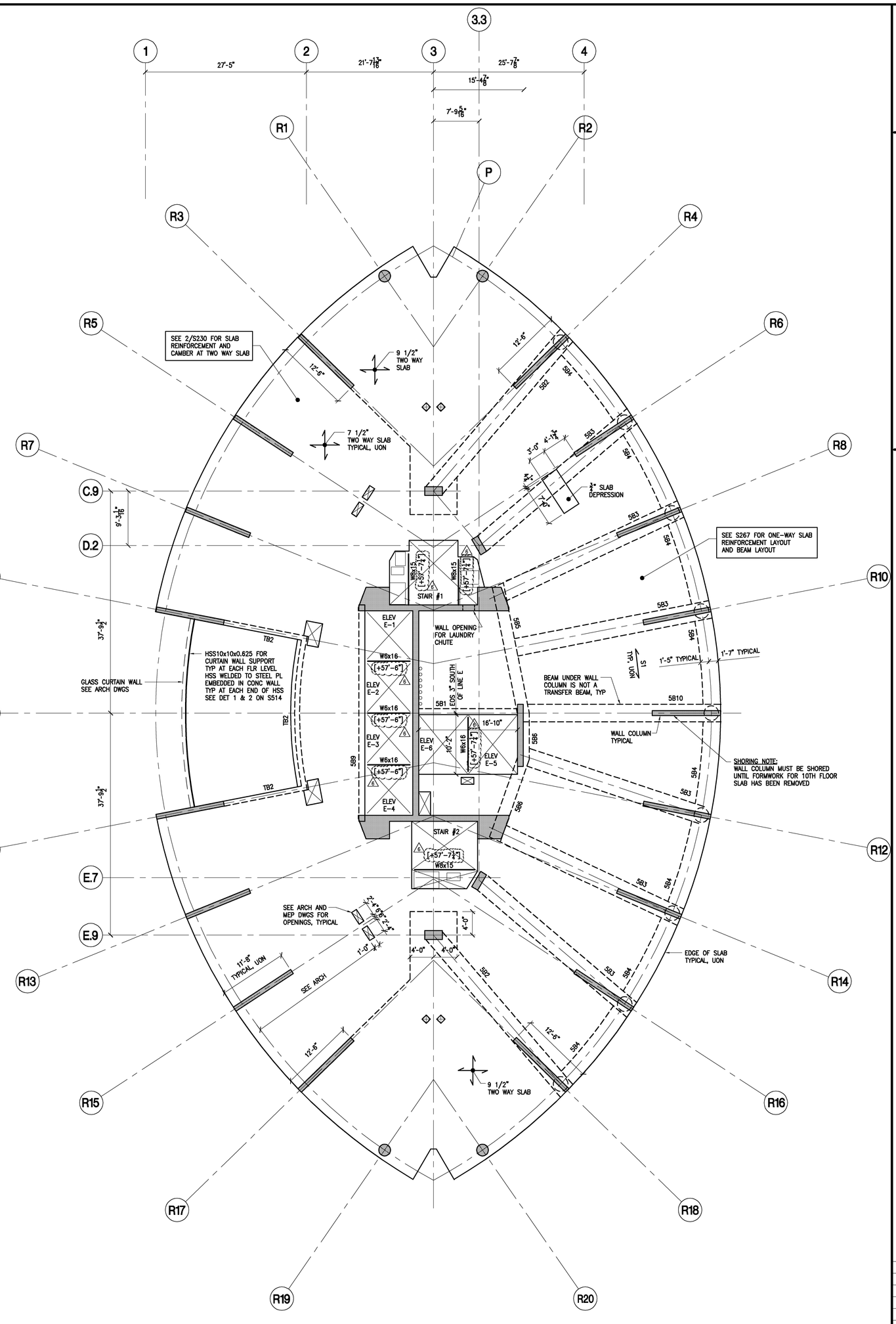
1. T/SLAB EL: SEE LIST ON THIS DRAWING
2. 7 1/2"THICK SLAB, UON, NORMAL WEIGHT CONCRETE
3. CONCRETE STRENGTH f'c = 5700 PSI AT 6TH - 8TH FLOORS
   f'c = 5000 PSI, TYPICAL
4. BOTTOM BARS SHOWN THUS ⟷ ARE IN ADDITION TO TYPICAL CONTINUOUS BOTTOM BARS
5. BAR PLACEMENT SEQUENCE:
   1. BOTTOM BARS PARALLEL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

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.



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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GRAND RAPIDS

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

SHEET TITLE:

5TH AND 6TH-22ND FLOOR FRAMING PLANS

PROJECT ELEVATION + 0.0" = GRAND RAPIDS + 615.0"

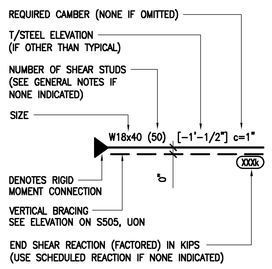
SEAL:

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

DRAWING NUMBER:

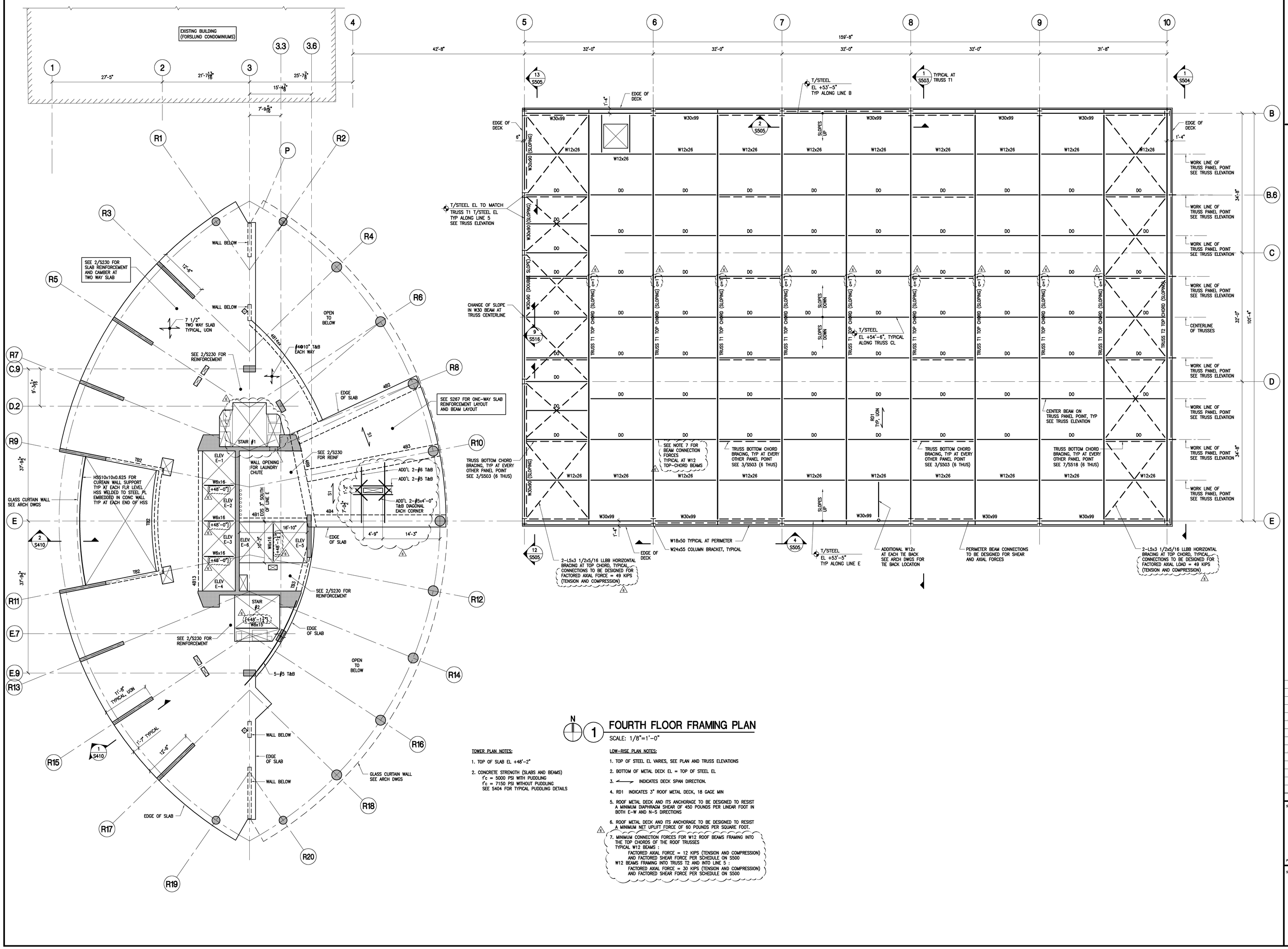
S230

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.



N

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

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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 CO REVIEW
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:

FOURTH FLOOR FRAMING PLAN

PROJECT ELEVATION = 0.0" = GRAND RAPIDS + 615.0'

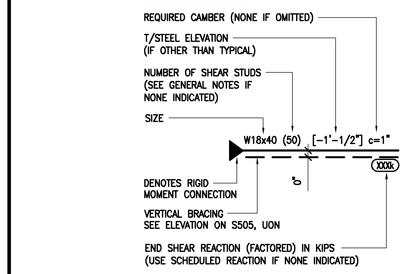
SEAL:

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

DRAWING NUMBER:

S226

STEEL BEAM KEY PLAN:



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

N

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
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
18	09 JAN 06	ADDENDUM #6
17	02 DEC 05	ISSUED FOR CONSTRUCTION AND PERMIT
16	28 OCT 05	OWNER AND MARRIOTT CO REVIEW
15	24 OCT 05	TOWER CONCRETE BID PACKAGE
13	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 + 815.0'

SEAL:

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

DRAWING NUMBER:

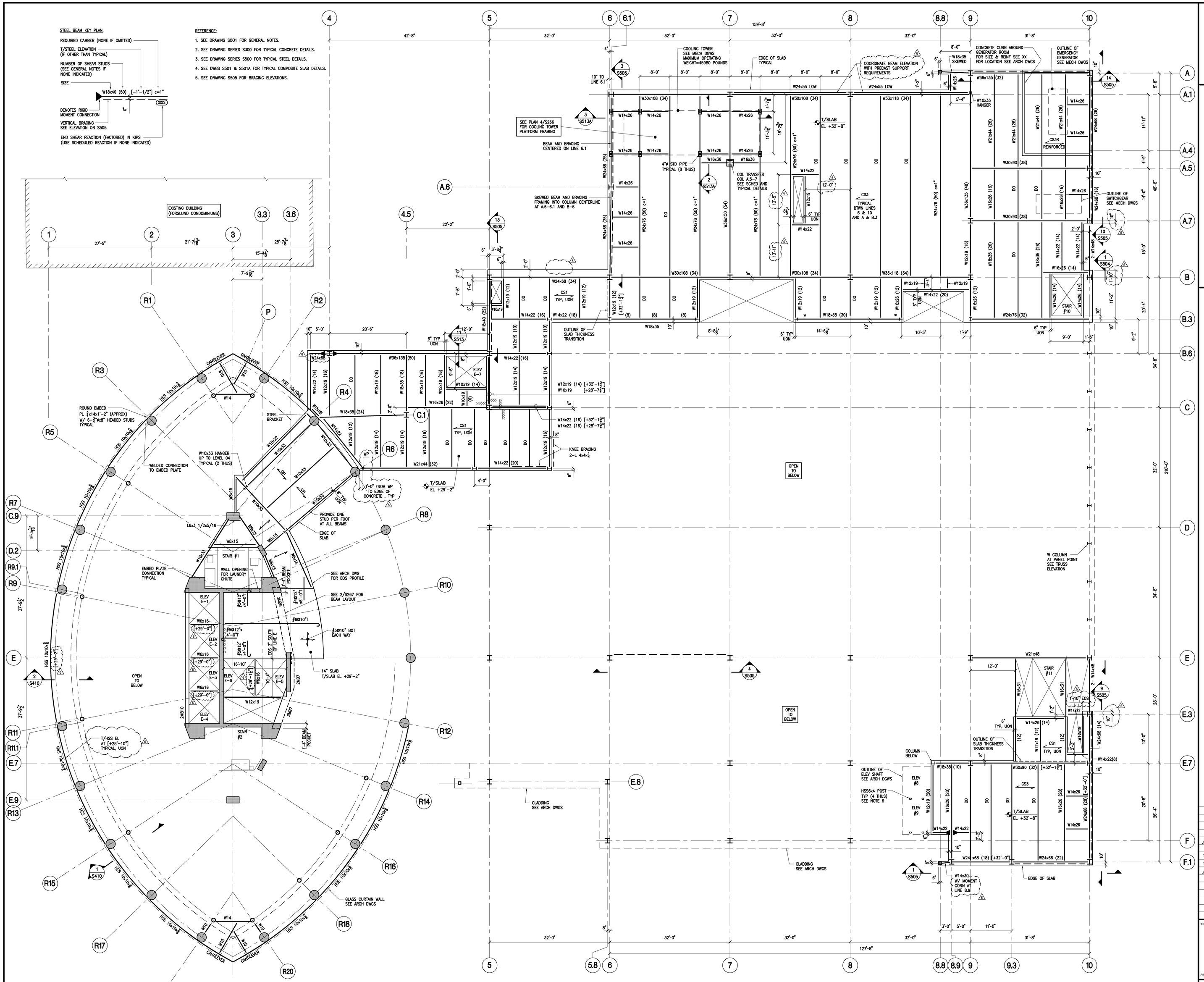
S221

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"
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.



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

1 SECOND MEZZANINE 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. 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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NO.	DATE	DESCRIPTION
19	09 JAN 06	ADDENDUM #6
17	02 DEC 05	ISSUED FOR CONSTRUCTION AND PERMIT
16	28 OCT 05	OWNER AND MARRIOTT CO REVIEW
15	24 OCT 05	TOWER CONCRETE BID PACKAGE
14	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:

SECOND MEZZANINE 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:

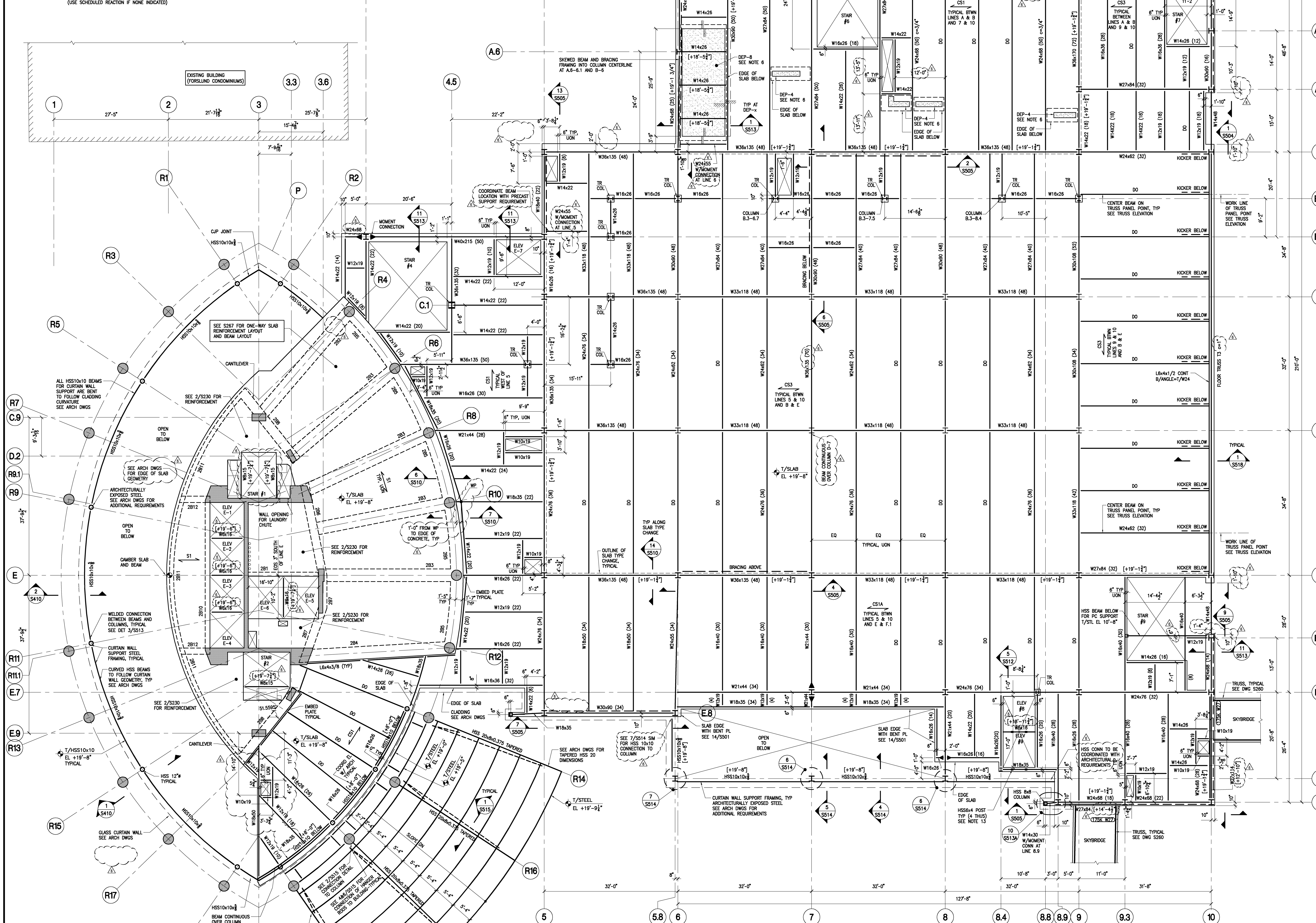
S216

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.



1 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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NO.	DATE	DESCRIPTION
6 (triangle)	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
4 (triangle)	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:

SECOND FLOOR FRAMING PLAN

PROJECT ELEVATION + 0.0' = GRAND RAPIDS + 615.0'

SEAL:

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

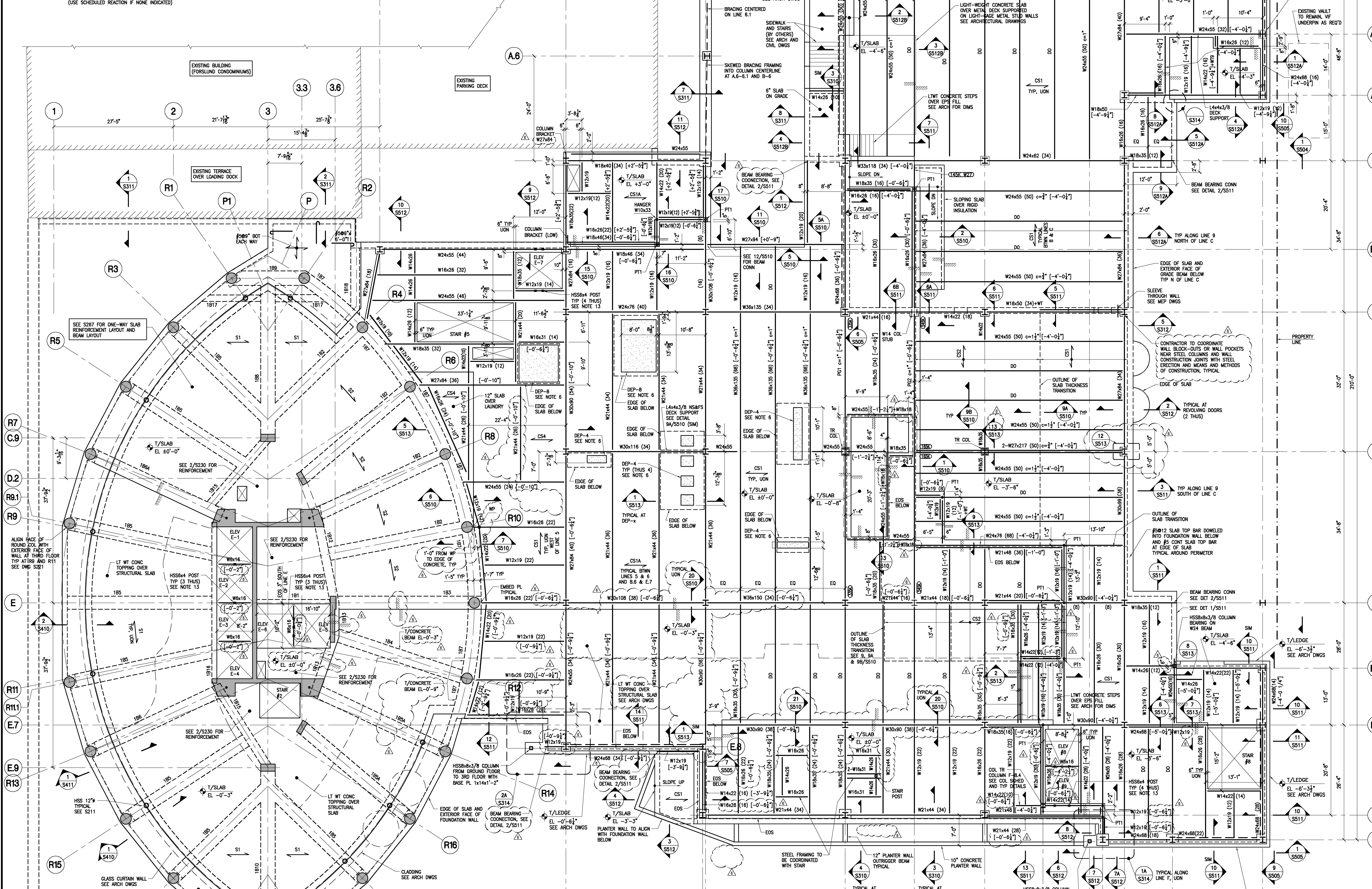
DRAWING NUMBER: S211

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"
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.



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

1 GROUND FLOOR FRAMING PLAN

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

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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GROUND FLOOR FRAMING PLAN

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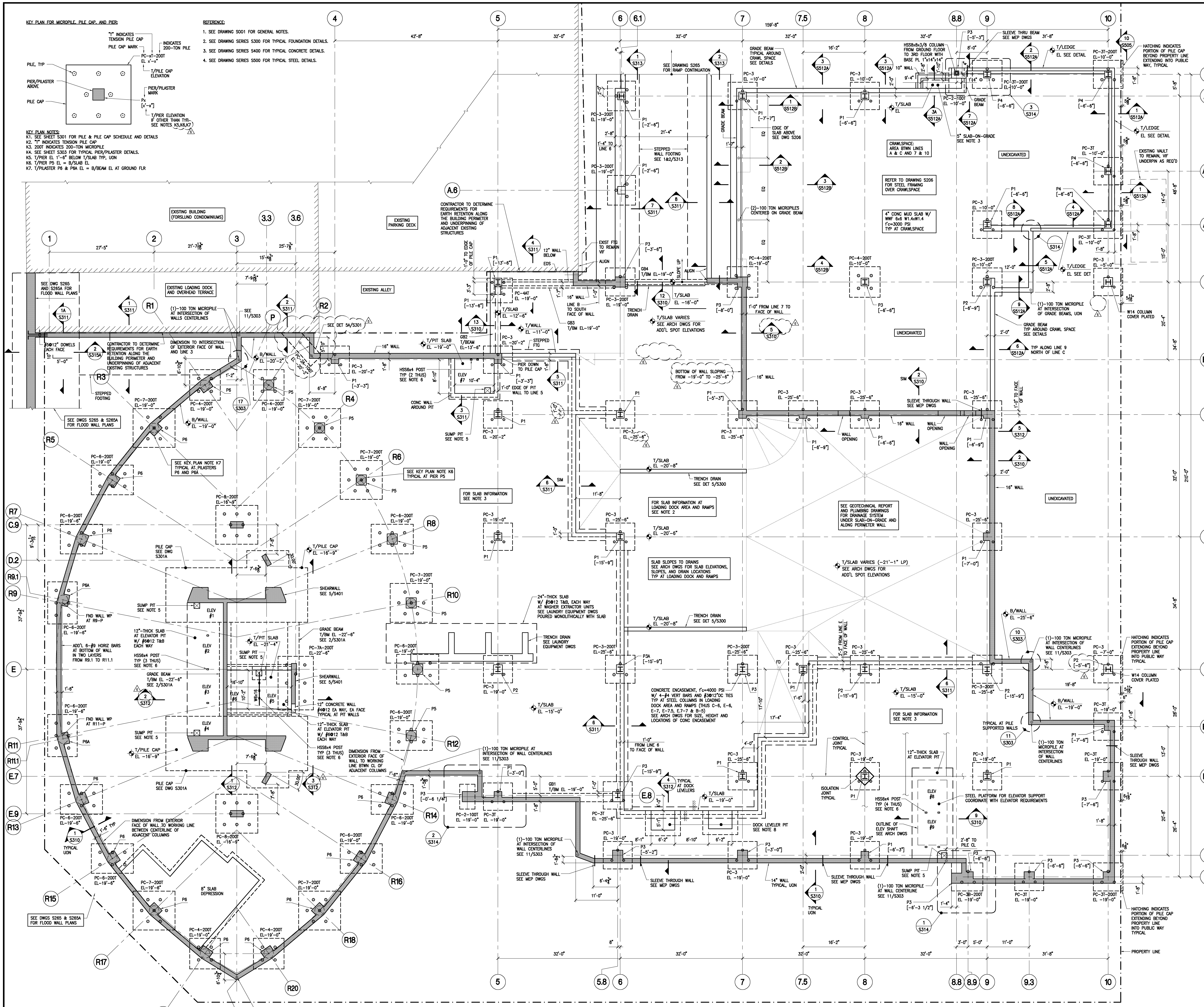
S206

KEY PLAN FOR MICROPILE, PILE CAP, AND PIER:

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

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.



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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S201