



# **Post-tensioning Design for the University of Arizona - Environmental and Natural Resources II Building**

by

**Asit Baxi, PhD, PE, FPTI  
Baxi Engineering Inc.**

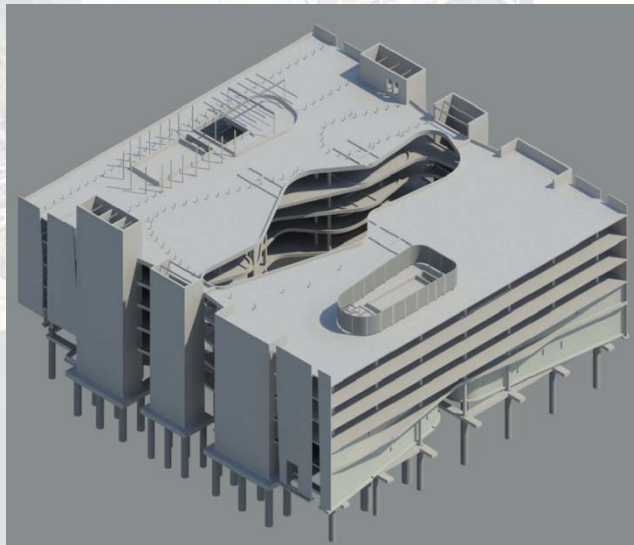


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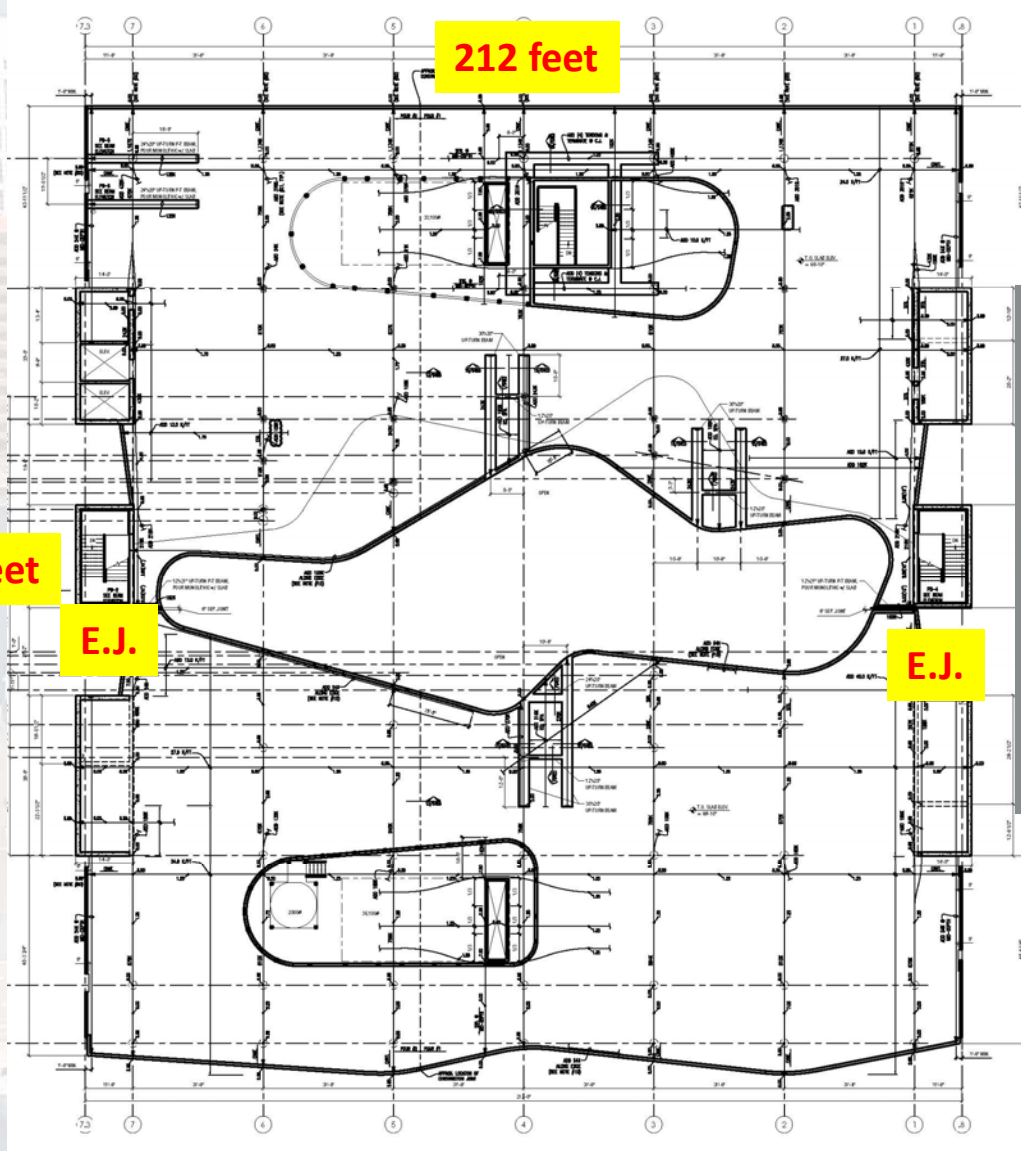
# University of Arizona - ENR II Building

## Project Description

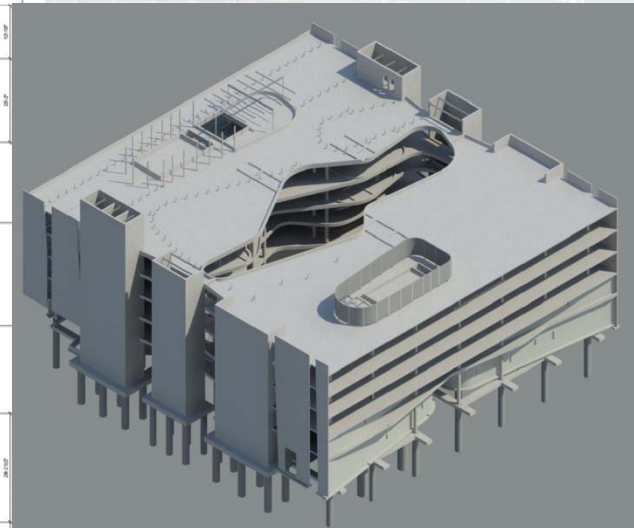
- Owner: **The University of Arizona**
- Architect of Record: **GLHN (Richard + Bauer)**
- Engineer of Record: **Turner Structural Engineering**
- Post-tensioning Specialty Eng. Firm: **Baxi Engineering Inc.**
- General Contractor: **Hensel Phelps**
- PT Supplier: **Suncoast Post-tension Ltd**



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10 inch Flat Plate with Upturn Beams  
Total Load = SW + 105 to 145 psf

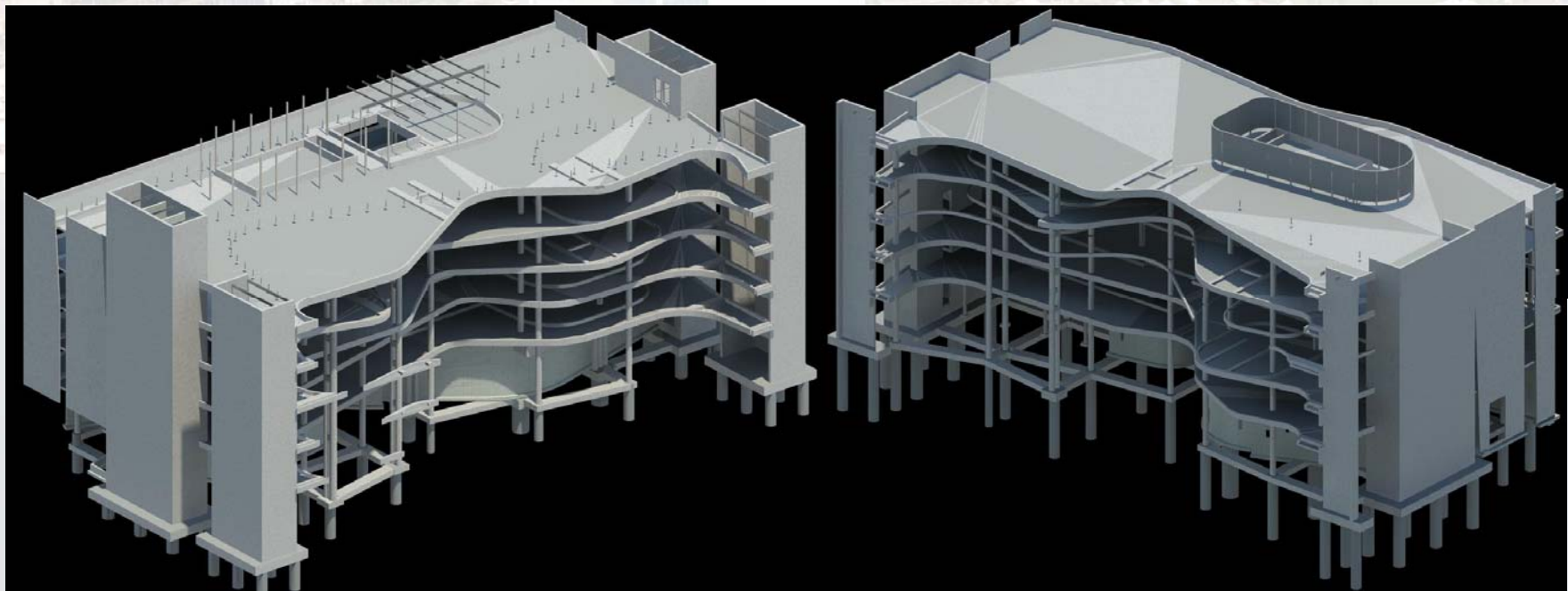




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North

South

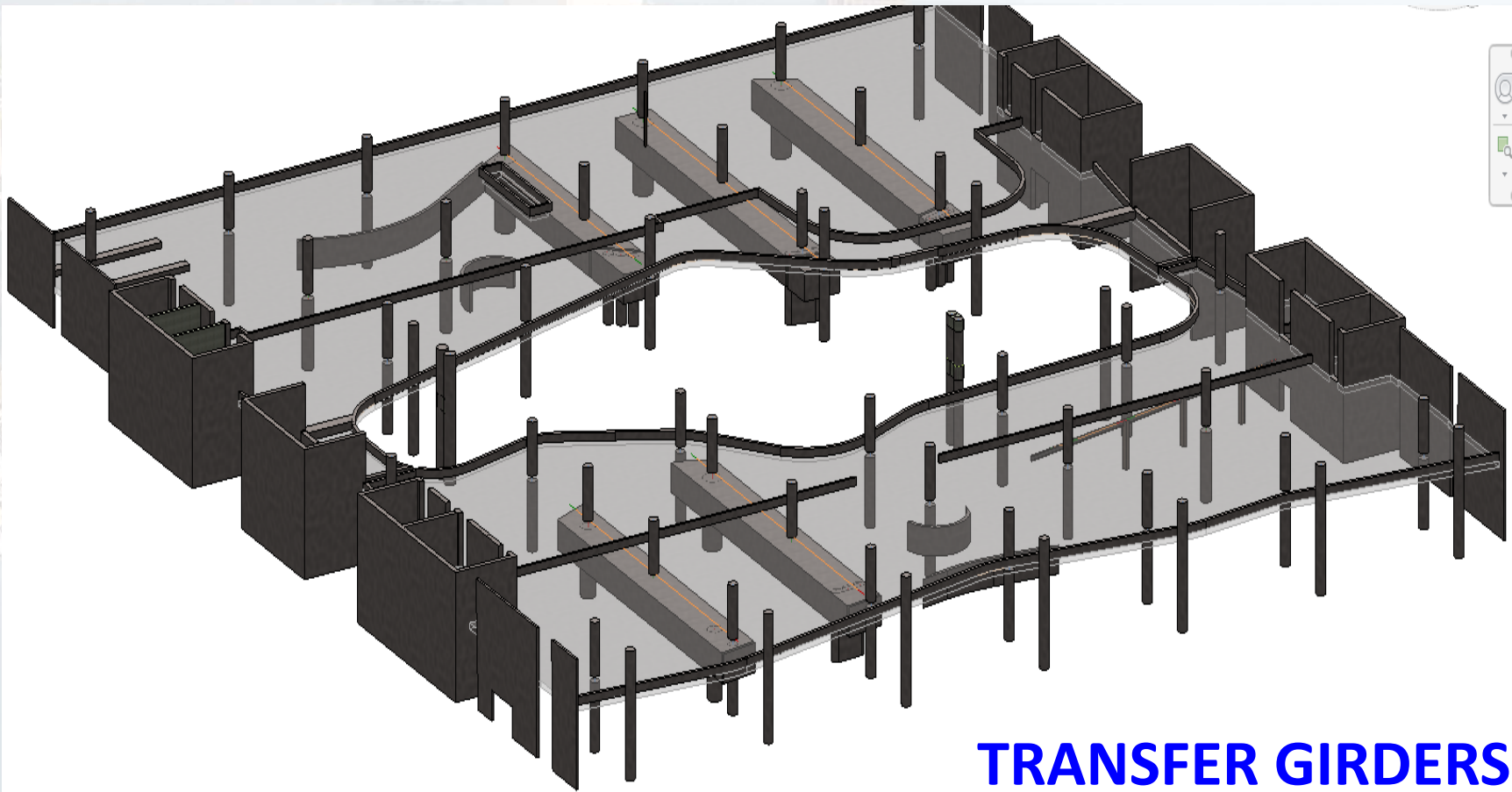


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## Presentation Highlights

- **Post-tensioning Design Challenges**
  - ☐ **Transfer Girders**
  - ☐ **Long Cantilevers**
  - ☐ **Wavy Edges**
  - ☐ **Column Isolation Detail**
- **Use of BIM Modeling**
- **Laser Scans**
- **Specifications – Tendon Finishing (Capping Report)**

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### TRANSFER GIRDERS

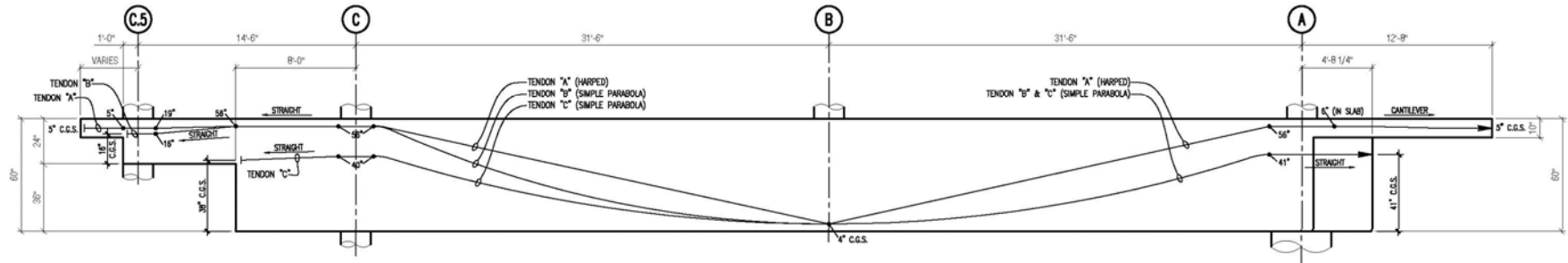
**5 Transfer Girders on Level 2**

**Size: 96"x 60",  $f'_c$  (28 days) = 6000 psi,  $f'_{ci}$  = 4000 psi**

**Forces from 3510 kips (130 tendons) to 2079 kips (77 tendons)**



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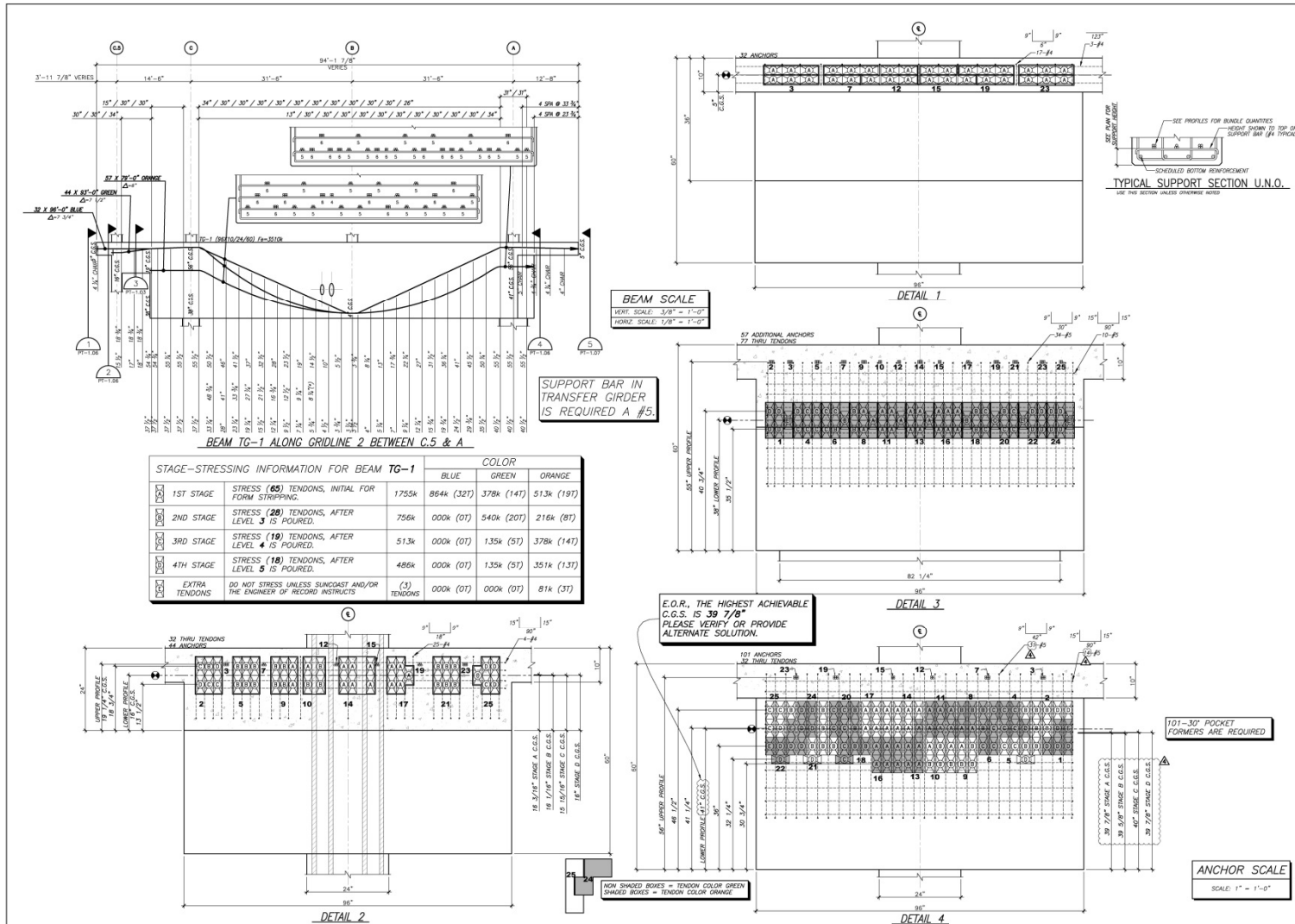


TG-1 STAGE-TENSIONING SCHEDULE

TENDON TYPE	STAGE 1	STAGE 2	STAGE 3	STAGE 4	TOTAL
TENDON "A"	864K	—	—	—	864K
TENDON "B"	378K	540K	135K	135K	1,188K
TENDON "C"	513K	216K	378K	351K	1,458K
TOTAL	1,755K	756K	513K	486K	3,510K
STAGE 1	INITIAL STRESSING				
STAGE 2	AFTER LEVEL 3 HAS BEEN POURED & STRESSED				
STAGE 3	AFTER LEVEL 4 HAS BEEN POURED & STRESSED				
STAGE 4	AFTER LEVEL 5 HAS BEEN POURED & STRESSED				

BEAM TO REMAIN FORMED & SHORED UNTIL STAGE 3 TENDONS HAVE BEEN STRESSED & ELONGATIONS APPROVED. P-T SUPPLIER TO ADD 3 EXTRA TENDONS IN BEAM WITH TENDON "C" TO ACCOUNT FOR LOW ELONGATIONS &/OR BROKEN TENDONS. THE EXTRA TENDONS TO BE STRESSED @ THE DISCRETION OF THE STRUCTURAL ENGINEER.

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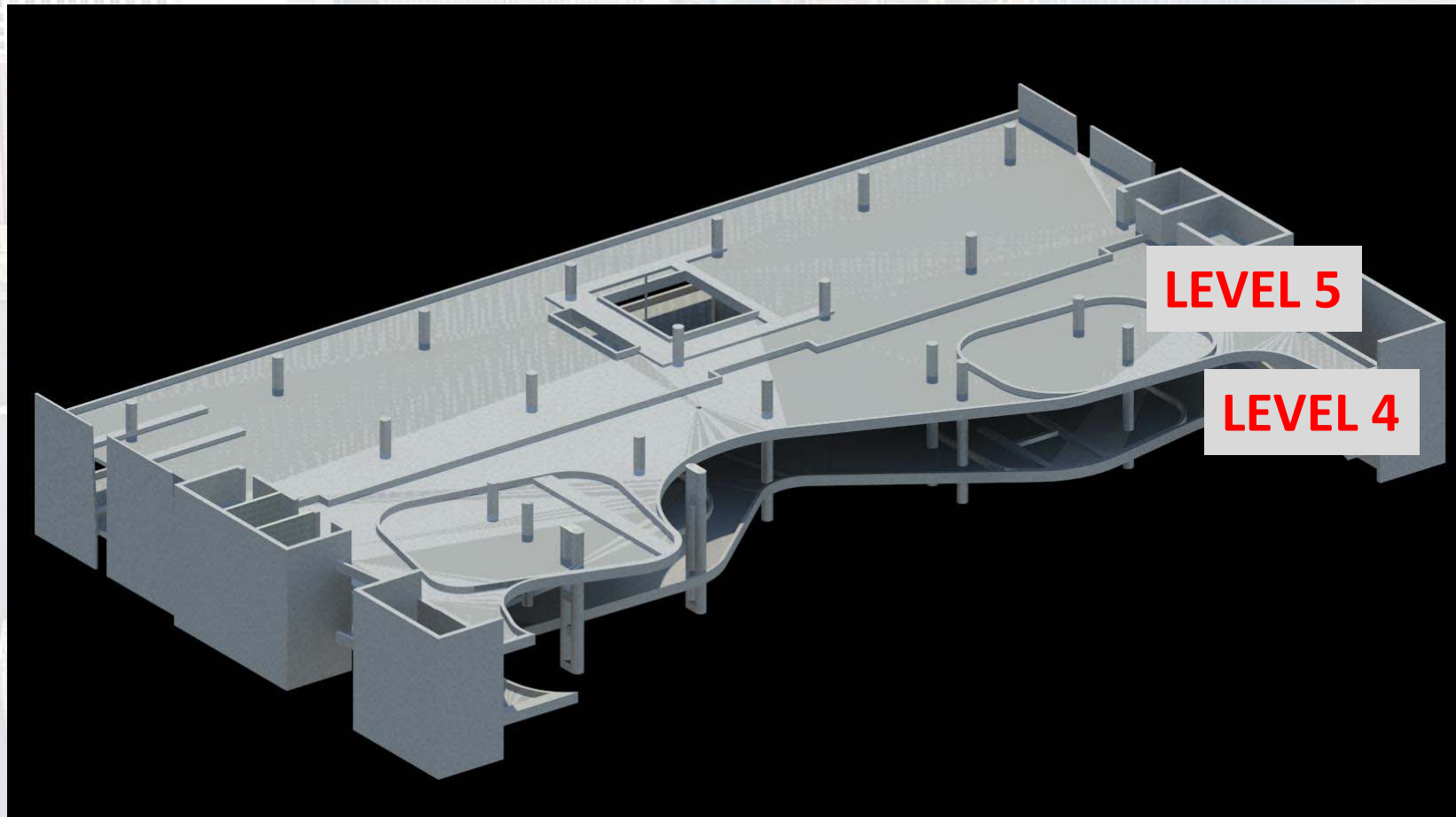


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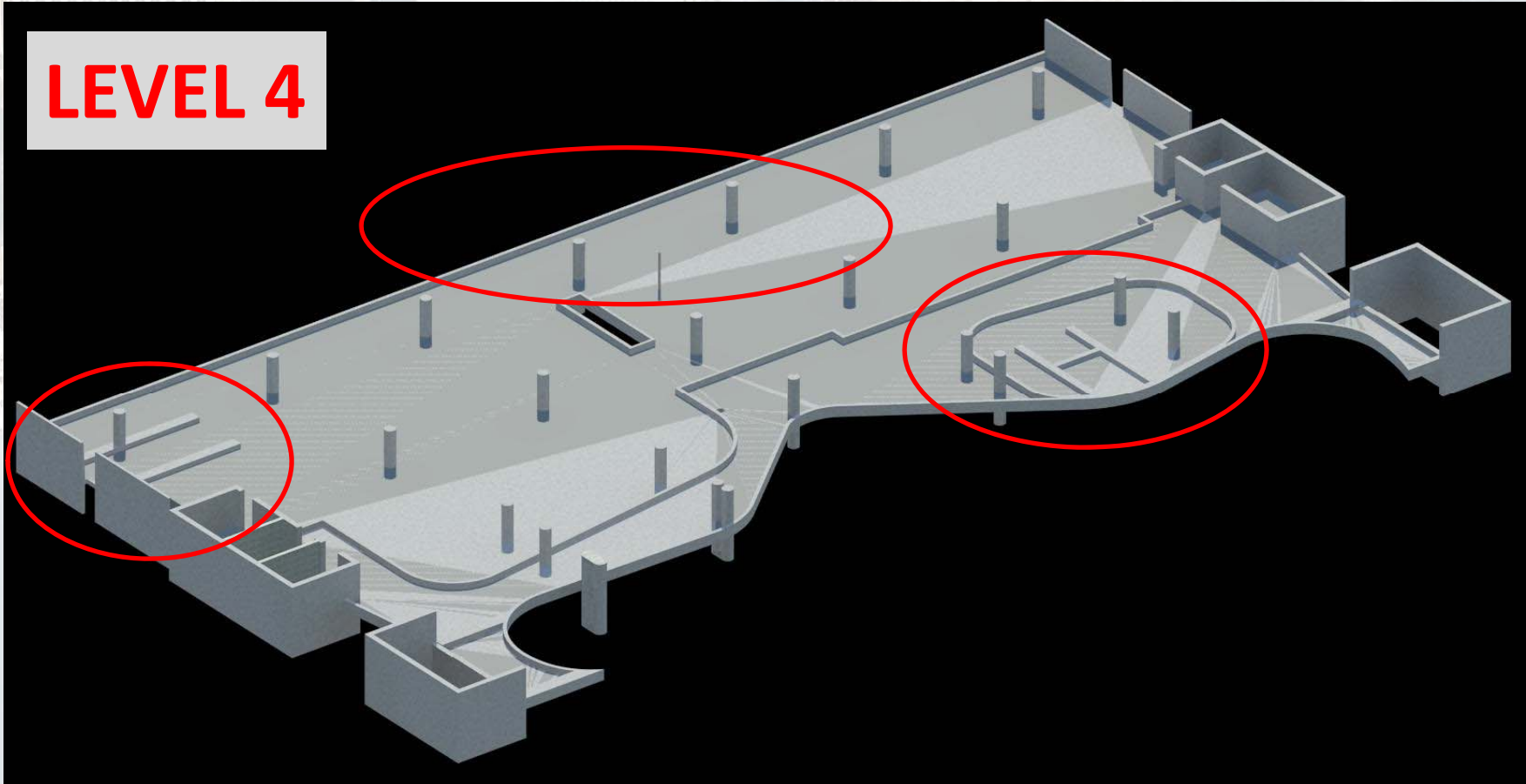
## LONG CANTILEVERS





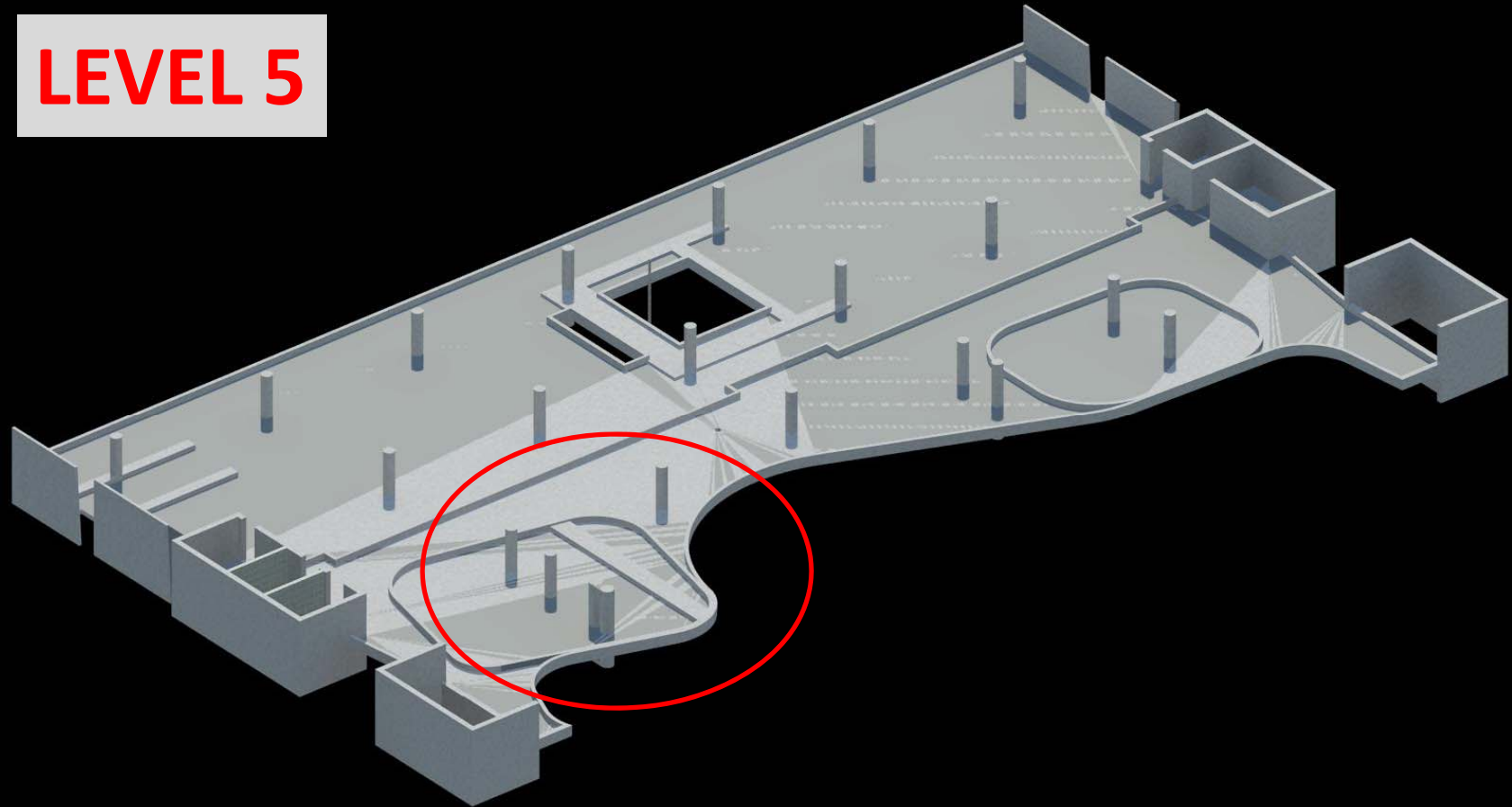
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**LEVEL 4**

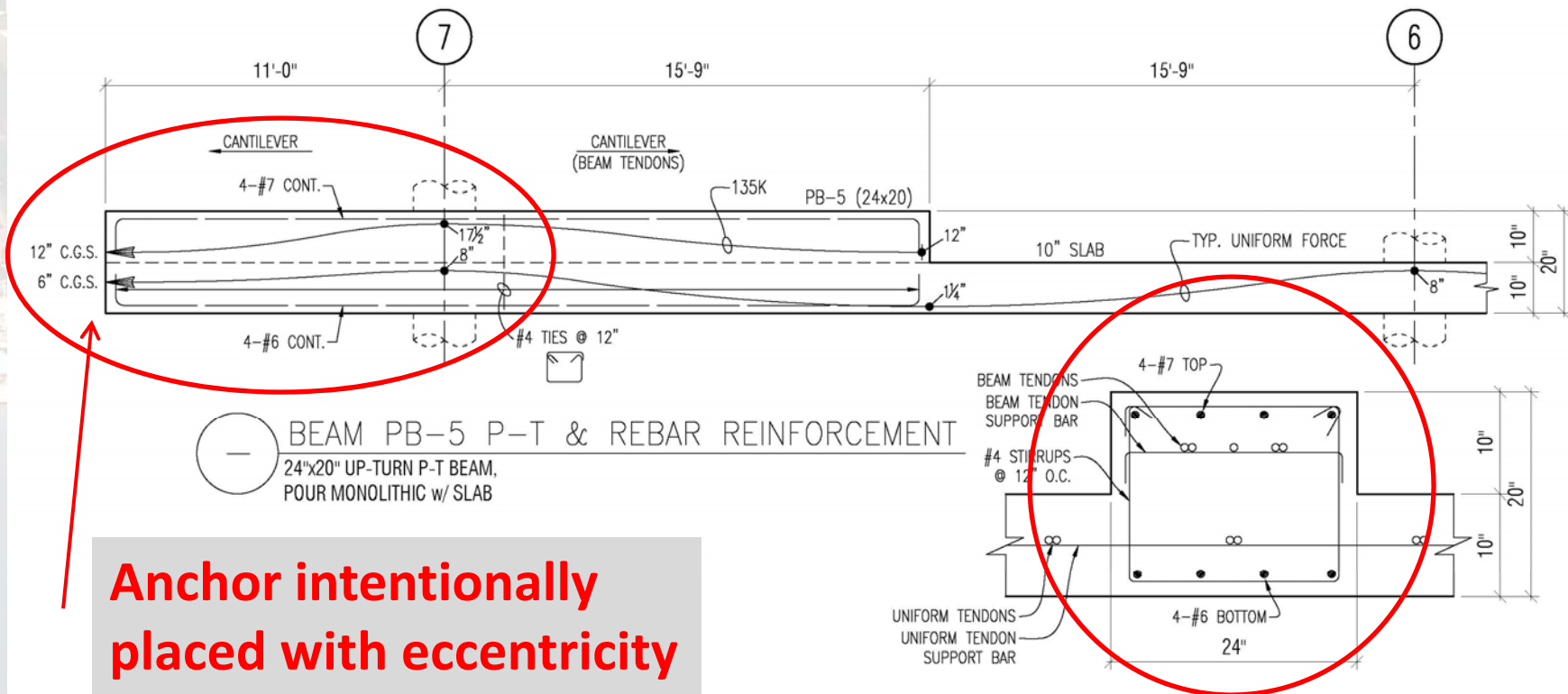


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**LEVEL 5**



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## Long Term Deflection LC: Max Deflection Plan

Long Term Deflection LC: Max Deflection Plan  
Drawing Report User No. 1: User Name: User Organization:  
Drawing: Max Deflection Above, Max Deflection Below, Max Deflection Outside, Max Deflection Inside, Max Deflection Outside, Max Deflection Inside, Max Deflection Outside, Max Deflection Inside  
Scale: 1/8" = 1'-0"

Long Term Deflection LC: Max Deflection Plan  
Min Value: -4.200 inches @ (10.0, 10.0) Max Value: 0.750 inches @ (10.0, 10.0)

0.75±

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Long Term Deflection (LT Defl) (ft) = User Units / User Dimensions;  
 Drawing Point (ft) (ft) = User Units / User Dimensions;  
 Element: max Elements Above, min Elements Below, min Element Outline On; Column Elements Above, Column Elements Below; Span Elements, Span Element Outline On;  
 Units = 1200  
 Long Term Deflection (LT Defl) (Deflection Ratio) (Minimum Value)

Min Value = -0.2003 (ft/in)    Max Value = 0.2047 (ft/in)

0.75±



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## Long Term Deflection LC: Max Deflection Plan


Long Term Deflection LC: Max Deflection Plan  
Drawing Report: User Name: User Name; User Organization:  
User Email: User Email; User Phone: User Phone; User Address: User Address;  
User City: User City; User State: User State; User Zip: User Zip;  
Scale = 1/8"=1'-0"

**0.75±**

**0.4±**

**0.92±**

The contour plot displays the distribution of maximum long-term deflection across the building's footprint. The color gradient ranges from blue (representing lower deflection values around 0.25 inches) through green and yellow to red (representing higher deflection values up to 0.92 inches). A central rectangular area is shown in white, indicating no deflection data or a specific structural zone. Three specific locations are annotated with grey boxes containing red text: 0.75± at the top center, 0.4± on the left edge, and 0.92± at the bottom center.

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(Long Title Definition C); User Link; User Name; User Organization;  
 Printing report User Link; User Role; User Organization;  
 Element: map Elements Data; Map Elements Axis X; Map Elements City; Column Elements Data; Column Elements Axis; Sub Elements; Sub Elements Outlines City;  
 Date = 1209  
 (Long Title Definition L-Vertical Definition M)(Maximum Value)

Min Value = -2.218 Index = 16.712(8.4) Max Value = 1.66 Index = 62.18(9.77)

0.4±

0.92±



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One or two cantilever  
upturn beams





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One or two cantilever  
upturn beams





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Cantilever with add tendons  
and intentional eccentricity at  
live end

01/16/2014 16:23



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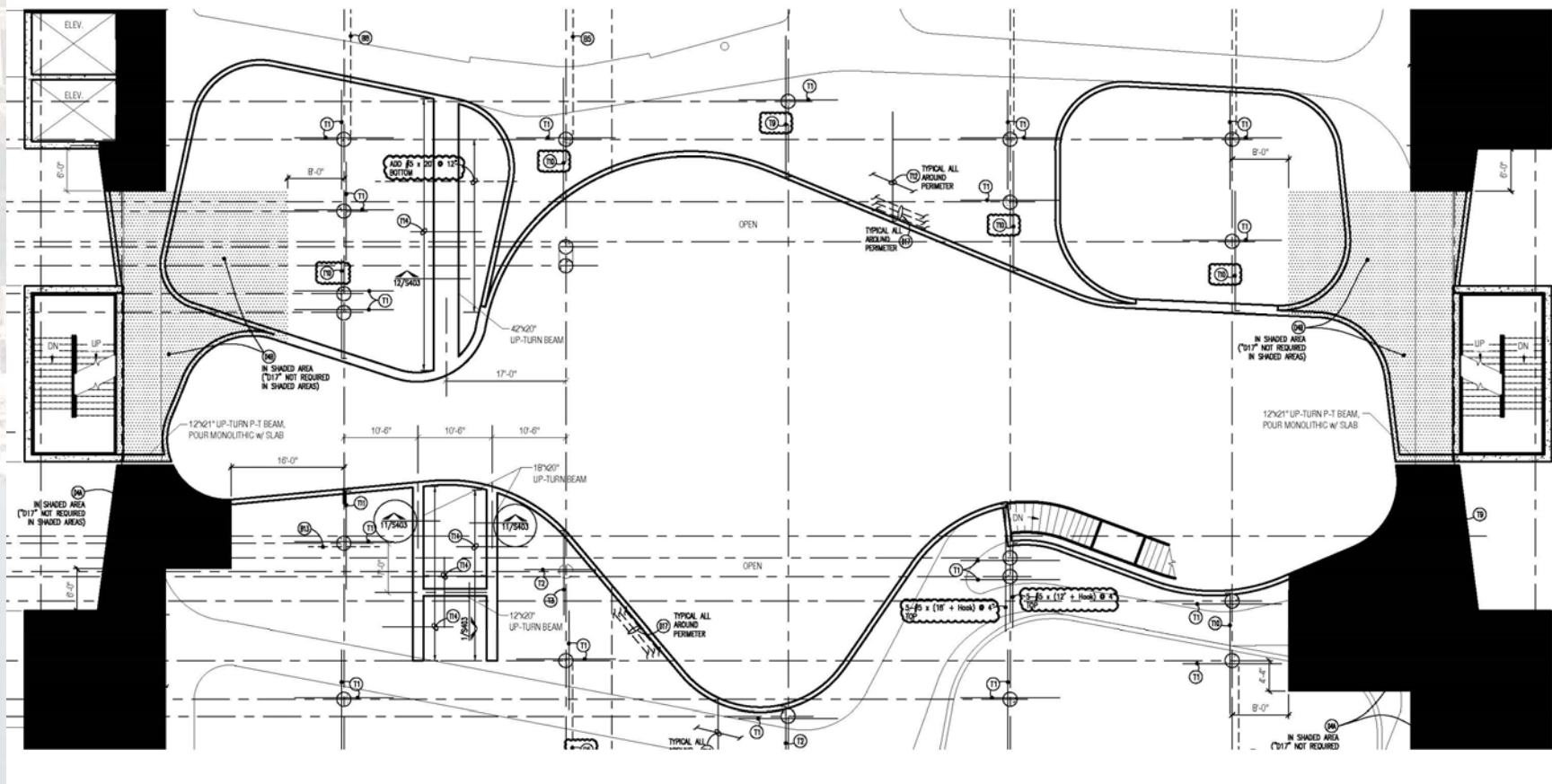
One or two cantilever upturn beams





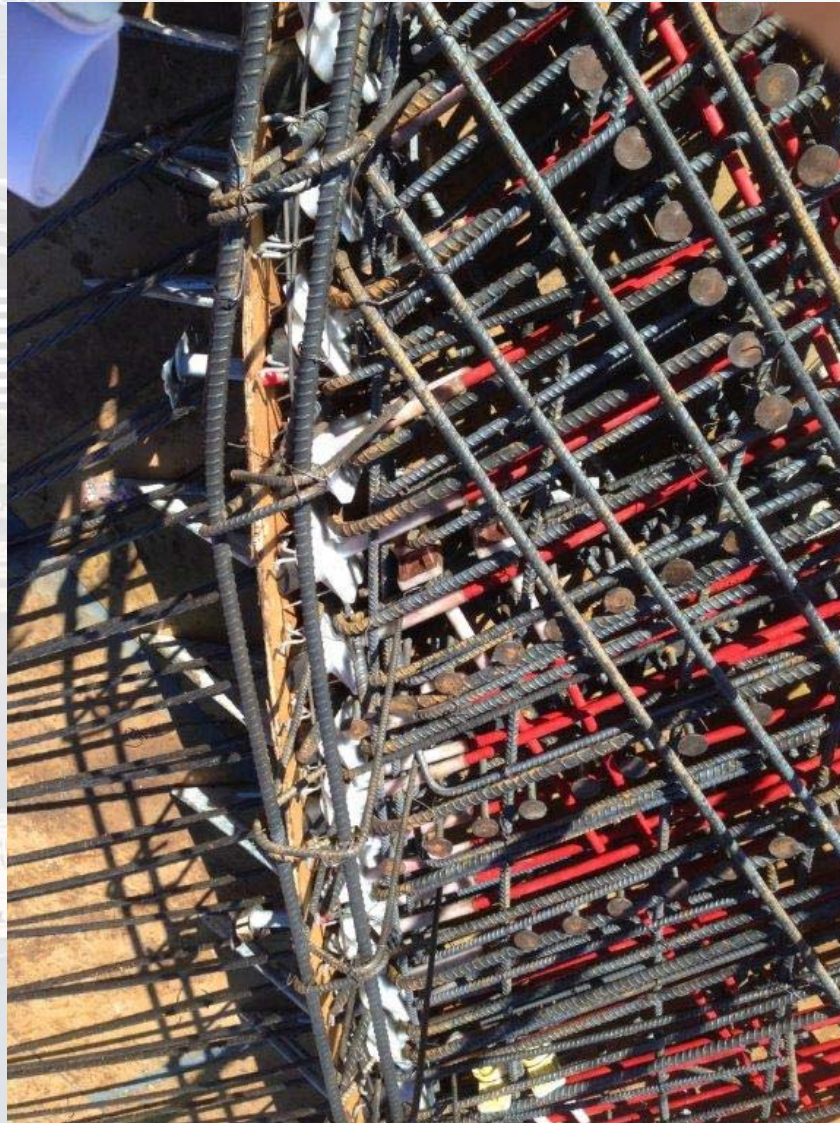
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## WAVY EDGES – VARIES AT EACH LEVEL



Load transfer along curved edges with use of tendons and rebar

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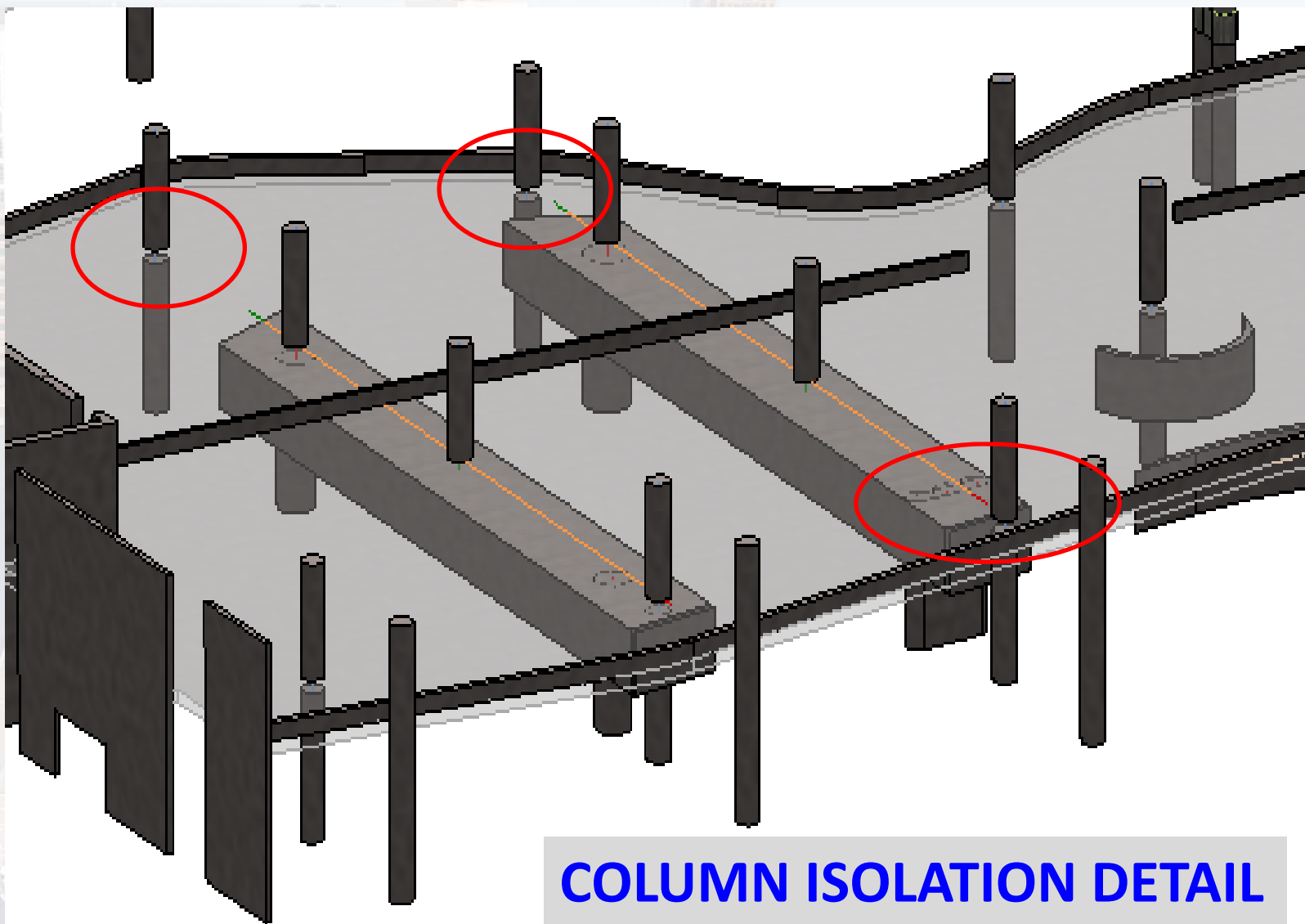




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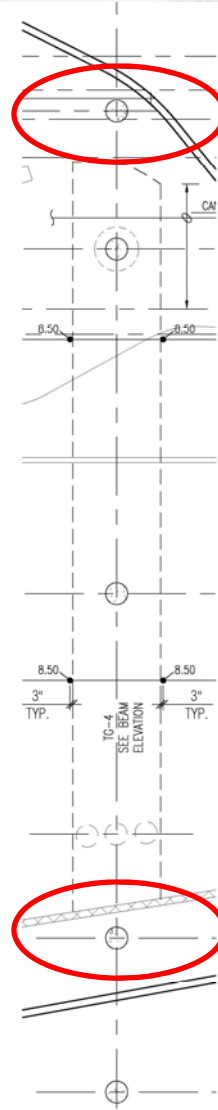
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**COLUMN ISOLATION DETAIL**

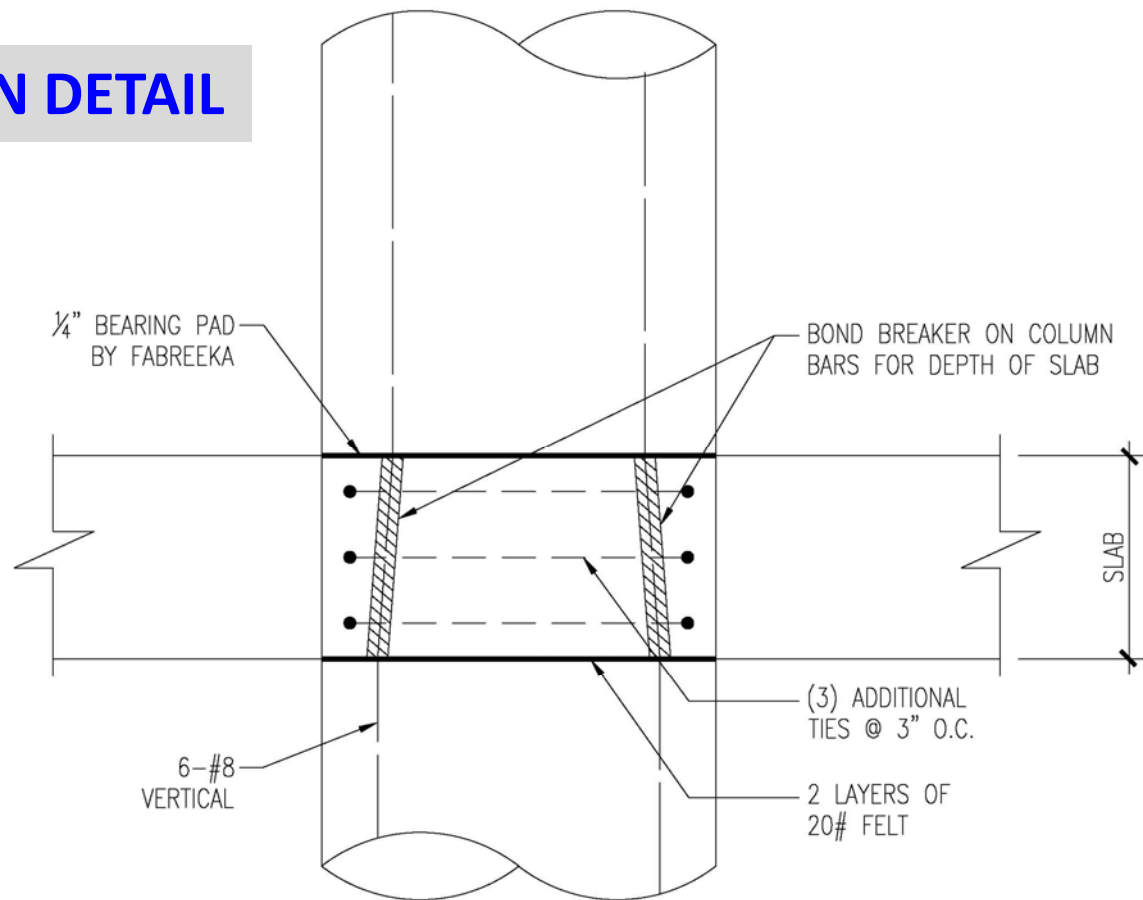


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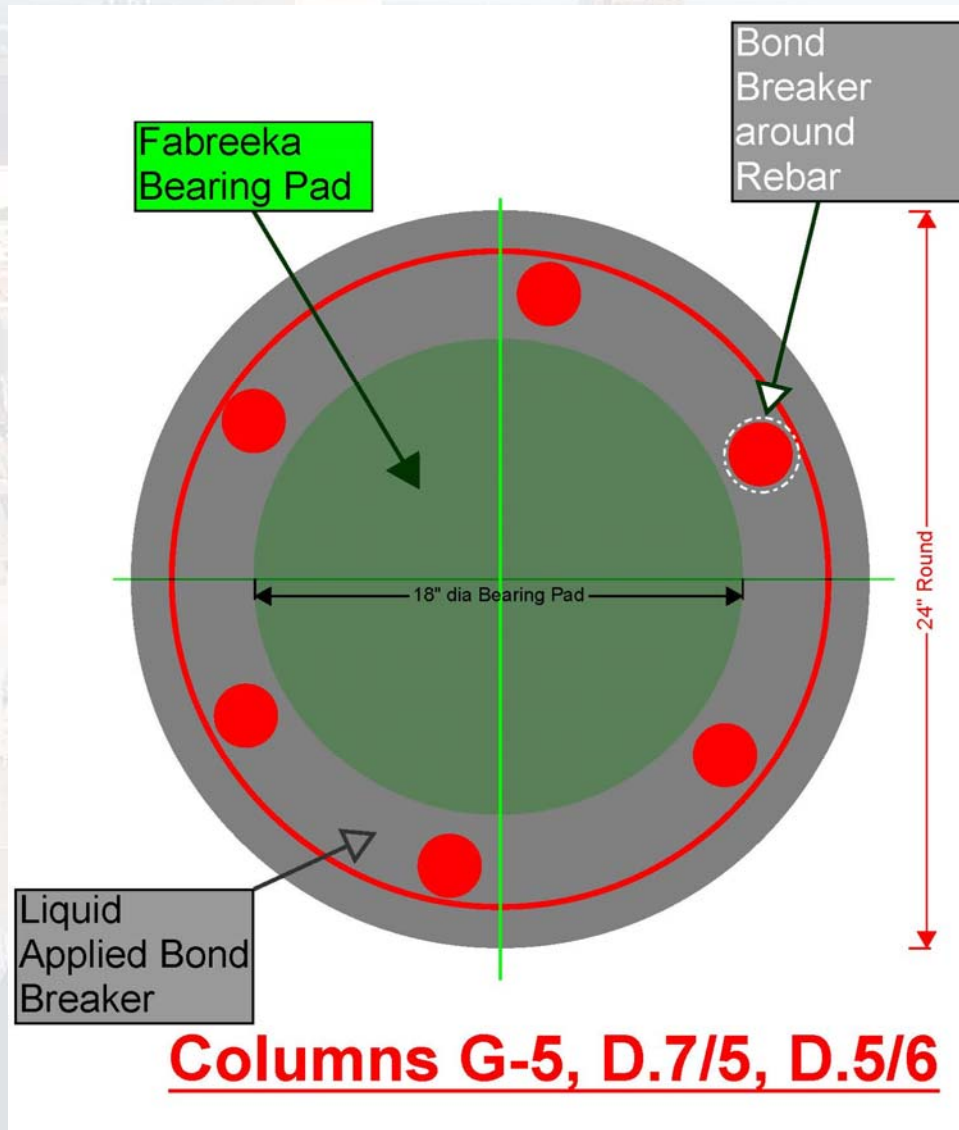
## COLUMN ISOLATION DETAIL



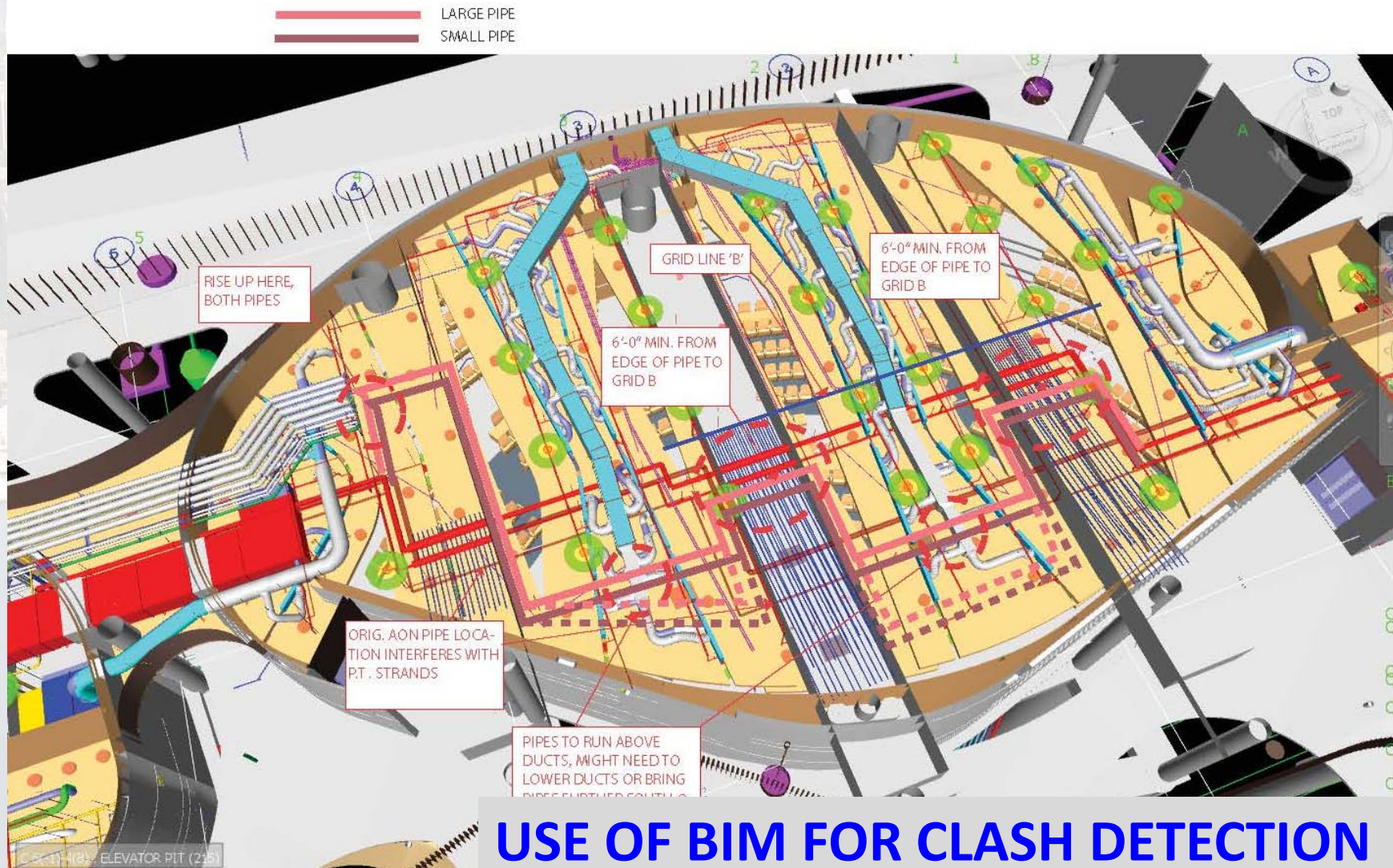
2 DETAIL @ G/5, D.7/5, & D.5/6



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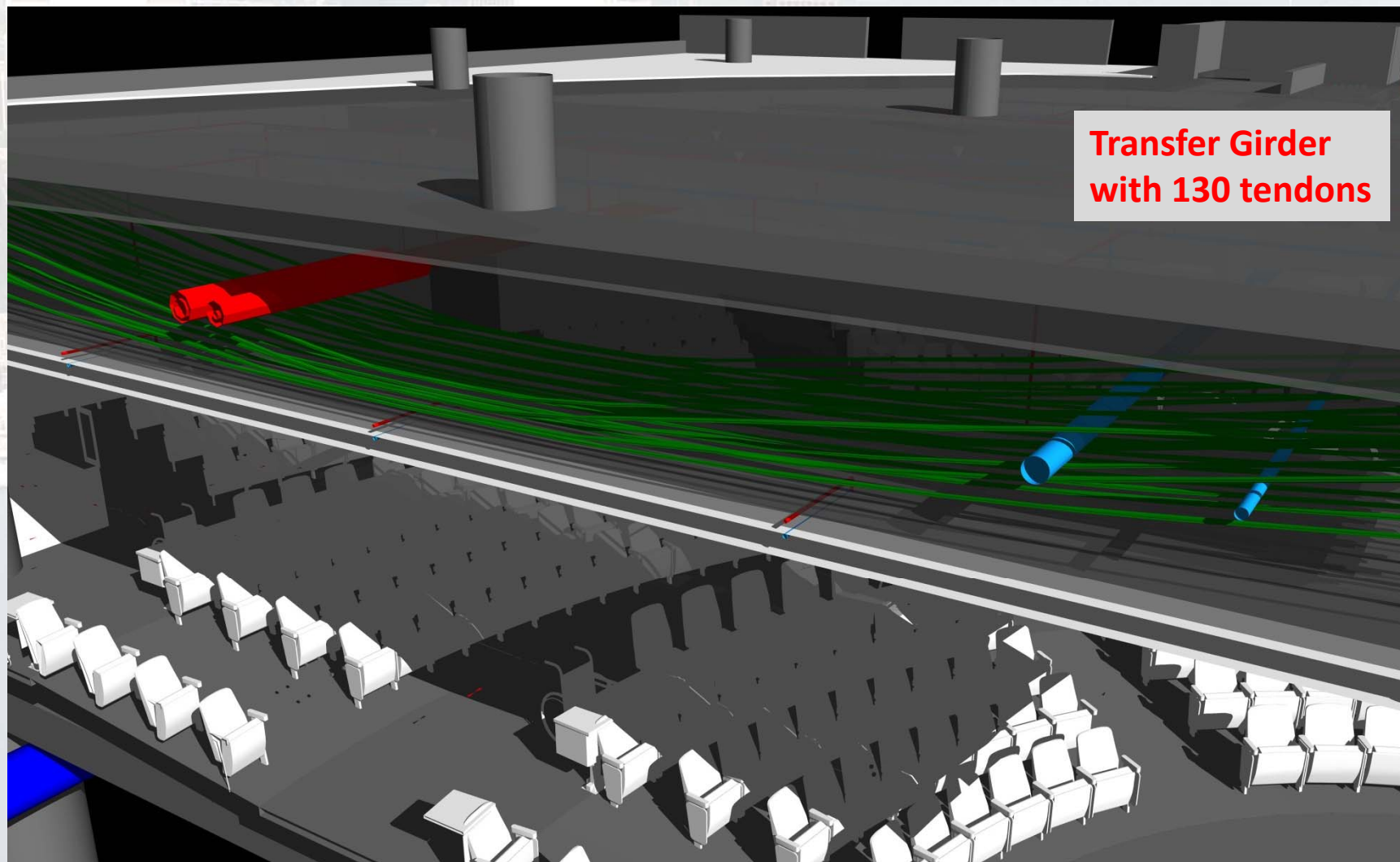


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# Capping and Grouting Report Q3 Level2



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## SPECIAL INSPECTION REPORT - MONOSTRAND STRESSING

Project No. 13-147	Project Name UA ENR2	Date 1-28-14	Page 1-1			
Address University of Arizona		Arrival Time 1000	Weather clear			
Work Inspected level 2 NW Quad	Dwg/Doc Ref. PT 1.00	Inspector D. Nelson				
Req'd concrete strength reached? <input type="checkbox"/>	Tendons perpendicular to anchors? <input type="checkbox"/>	Tendon reference marks painted? <input type="checkbox"/>				
Stressing sequence EOR approved? <input type="checkbox"/>	Pocket formers removed? <input type="checkbox"/>	Wedges placed evenly & seated without? <input type="checkbox"/>				
Stressing equipment checked? <input type="checkbox"/>	Any voids near anchorage repaired? <input type="checkbox"/>	Measured elongations within tolerance? <input type="checkbox"/>				
Jacking Information: Jack Serial No. _____ Calibration Date: _____		Remarks: Tendon Finishing Report				
Gauge Serial No. _____						
Stressed By: _____						
Tendon No.	Location	Jacking Force	Gauge Reading	Calc. Elong.	Measured Elongation End 1   End 2   Total	% Deviation
✓	Engineering Approval					
✓	Tendons cut to length					
✓	Pockets clean					
✓	PT encapsulation cap Fixed					
✓	Good to govt. 5000 psi NS ASTM-1106					

### Jacking Information:

Jack Serial No. \_\_\_\_\_ Calibration Date: \_\_\_\_\_

Gauge Serial No. \_\_\_\_\_

Stressed By: \_\_\_\_\_

### Remarks:

Tendon Finishing Report

Tendon No.	Location	Jacking Force	Gauge Reading	Calc. Elong.	Measured Elongation		
					End 1	End 2	Total
✓	Engineering Approval						
✓	Tendons cut to length						
✓	Pockets clean						
✓	PT encapsulation cap Fixed						
✓	Good to govt. 5000 psi NS ASTM-1106						

15201 721-2324 F  
8230 E. BROADWAY

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University of Arizona Project #03-8526  
Environmental & Natural Resources Phase 2 (ENR2) Special Inspections  
Structural Concepts Special Inspections Report Listing

Report #	Date	Time	Description	Compliant	Non-Compliant
136	3/20/14	1:00pm	Reinforcing steel	X	
137	3/21/14	2:00am	Concrete placement	X	
138	3/21/14	7:30am	Concrete placement	X	
139	3/21/14	9:00am	Reinforcing steel	X	
140	3/19/14	9:30am	Reinforcing steel	X	
141	3/24/14	7:30am	Reinforcing steel	X	
142	3/24/14	7:30am	Capped tendons	X	
143	3/24/14	8:30am	Monostrand stressing		
143.1	3/24/14	8:30am	Monostrand stressing		
144	3/25/14	7:30am	Reinforcing steel		
145	3/25/14	12:00pm	Concrete placement		
146	3/26/14	3:00am	Concrete Placement		
147	3/26/14	8:30am	Reinforcing steel		
148	3/26/14	9:00am	Capped tendons		
149	3/26/14	2:00pm	Monostrand stressing		
150	3/27/14	6:00am	Concrete placement		
151	3/27/14	9:00am	Capped tendons		
152	3/27/14	10:00am	Reinforcing steel		
153	3/28/14	3:00am	Concrete placement		
154	3/28/14	12:30pm	Capped tendons (R156)		
155	3/31/14	8:00am	Monostrand stressing		
156	3/31/14	1:00pm	Capped tendons		
157	3/31/14	7:00am	Reinforcing steel		
158	4/1/14	2:00am	Concrete placement		
159	4/1/14	6:00am	Concrete placement		
160	4/2/14	7:00am			
161	4/2/14	8:00am			
162	4/2/14	8:00am			
163	4/3/14	3:00am			
164	4/3/14	8:00am			
165	4/3/14	8:00am			
166					
167					
168					
169					
170					
171					
172					
173					
174					
175					

139	3/21/14	9:00am	Reinforcing steel	X	
140	3/19/14	9:30am	Reinforcing steel	X	
141	3/24/14	7:30am	Reinforcing steel	X	
142	3/24/14	7:30am	Capped tendons	X	
143	3/24/14	8:30am	Monostrand stressing	submit for review	
143.1	3/24/14	8:30am	Monostrand stressing	submit for review	
144	3/25/14	7:30am	Reinforcing steel	X	
145	3/25/14	12:00pm	Concrete placement	X	
146	3/26/14	3:00am	Concrete Placement	X	
147	3/26/14	8:30am	Reinforcing steel	X	
148	3/26/14	9:00am	Capped tendons	pending	
149	3/26/14	2:00pm	Monostrand stressing	submit for review	
150	3/27/14	6:00am	Concrete placement	X	
151	3/27/14	9:00am	Capped tendons	pending	
152	3/27/14	10:00am	Reinforcing steel	X	
153	3/28/14	3:00am	Concrete placement	X	
154	3/28/14	12:30pm	Capped tendons (R156)	X	
155	3/31/14	8:00am	Monostrand stressing	submit for review	
156	3/31/14	1:00pm	Capped tendons	X	
157	3/31/14	7:00am	Reinforcing steel	X	
158	4/1/14	2:00am	Concrete placement	X	
159	4/1/14	6:00am	Concrete placement	X	



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## LASER SCAN VIDEO OF DECK BEFORE INSTALLATION



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**THANK YOU FOR YOUR ATTENTION**