Designing for Construction Productivity and Safety

College of Continuing & Professional Studies

2024 Structural Engineering Series

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Vice President

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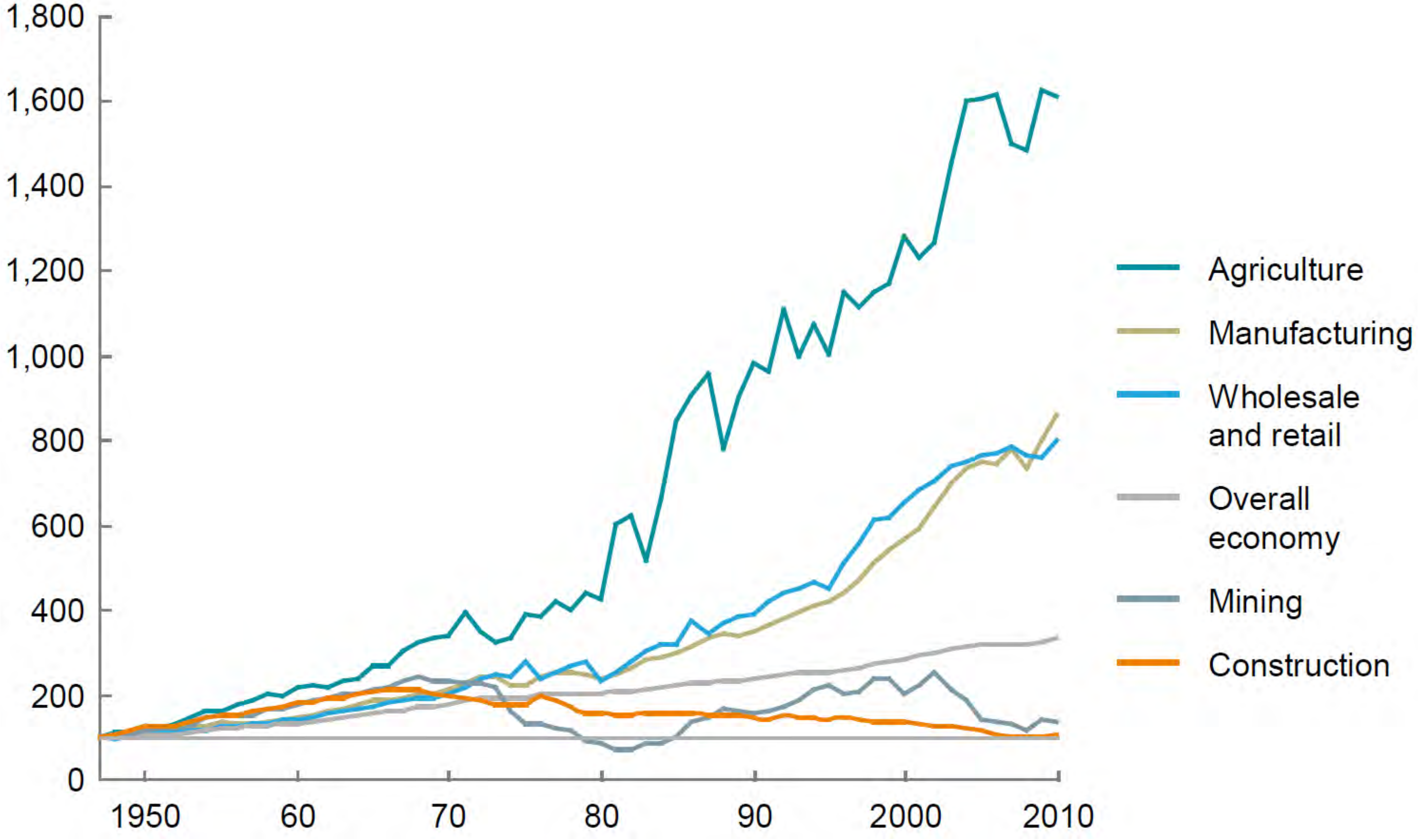
651-248-0593

In the United States, labor productivity in construction has declined since 1968, in contrast to rising productivity in other sectors

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(3) Messages

PRO

An ACI Center of Excellence for Advancing Productivity

PRO: An ACI Center of Excellence for Advancing Productivity is a catalyst for solving the barriers of constructability to advance concrete construction productivity.

Vision

According to McKinsey Global Institute, construction productivity lags behind other sectors. With a single focus to quickly stimulate industry change, PRO aims to increase the value of structural concrete to project owners.

The Center envisions a concrete industry where the productivity potential of contemporary materials and construction systems is fully realized and continually advanced.

INCREASE PRODUCTIVITY

REDUCE COSTS

ACCELERATE CONSTRUCTION

IMPROVE SAFETY

HIGHER QUALITY CONCRETE

PS=Ø® - MECHANICAL SPLICE

Eliminates pour strips, wall leave-outs, and expansion joints while maintaining structural integrity and allowing for volume change. Using proven coupler technologies recognized worldwide, featuring a thread on one end and a grout-filled sleeve on the other. The system is an ACI 318 code compliant full-tension mechanical Type 1 and Type 2 rebar splice, is ICC approved and made in the USA.

ICC
INTERNATIONAL CODE COUNCIL®

MADE IN USA

The Main Issue

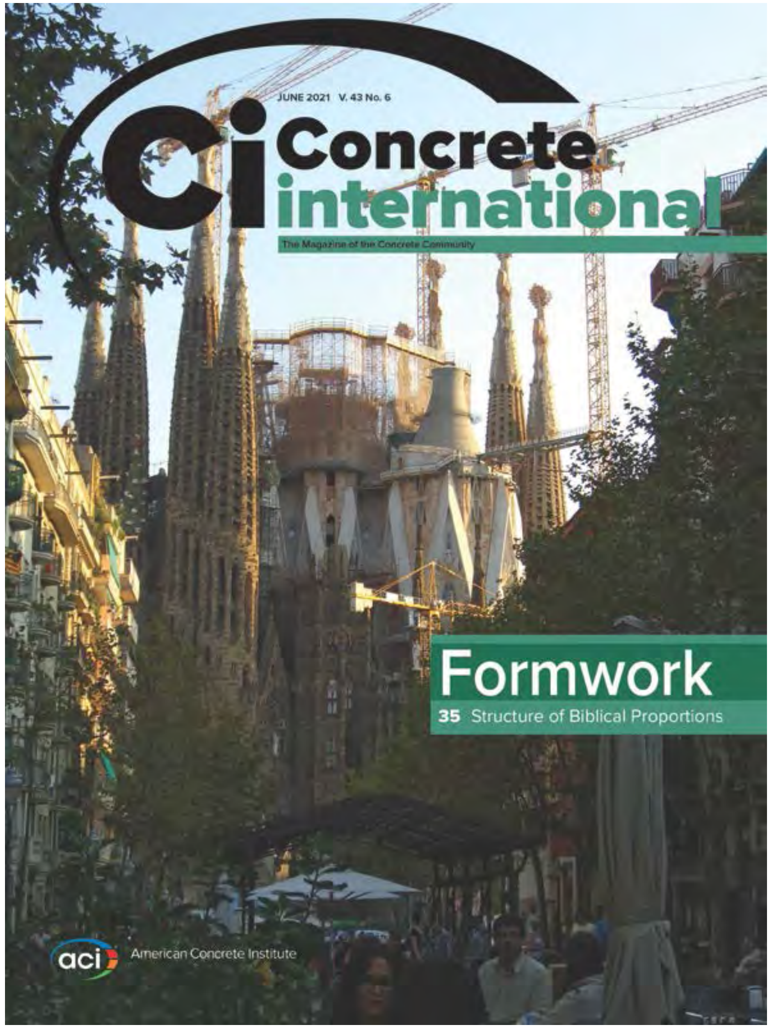
- Volume change

Location Matters

- Inflection point
- Mid-span

Slab-to-Slab Connectors

- Concrete anchors
- Mechanical couplers

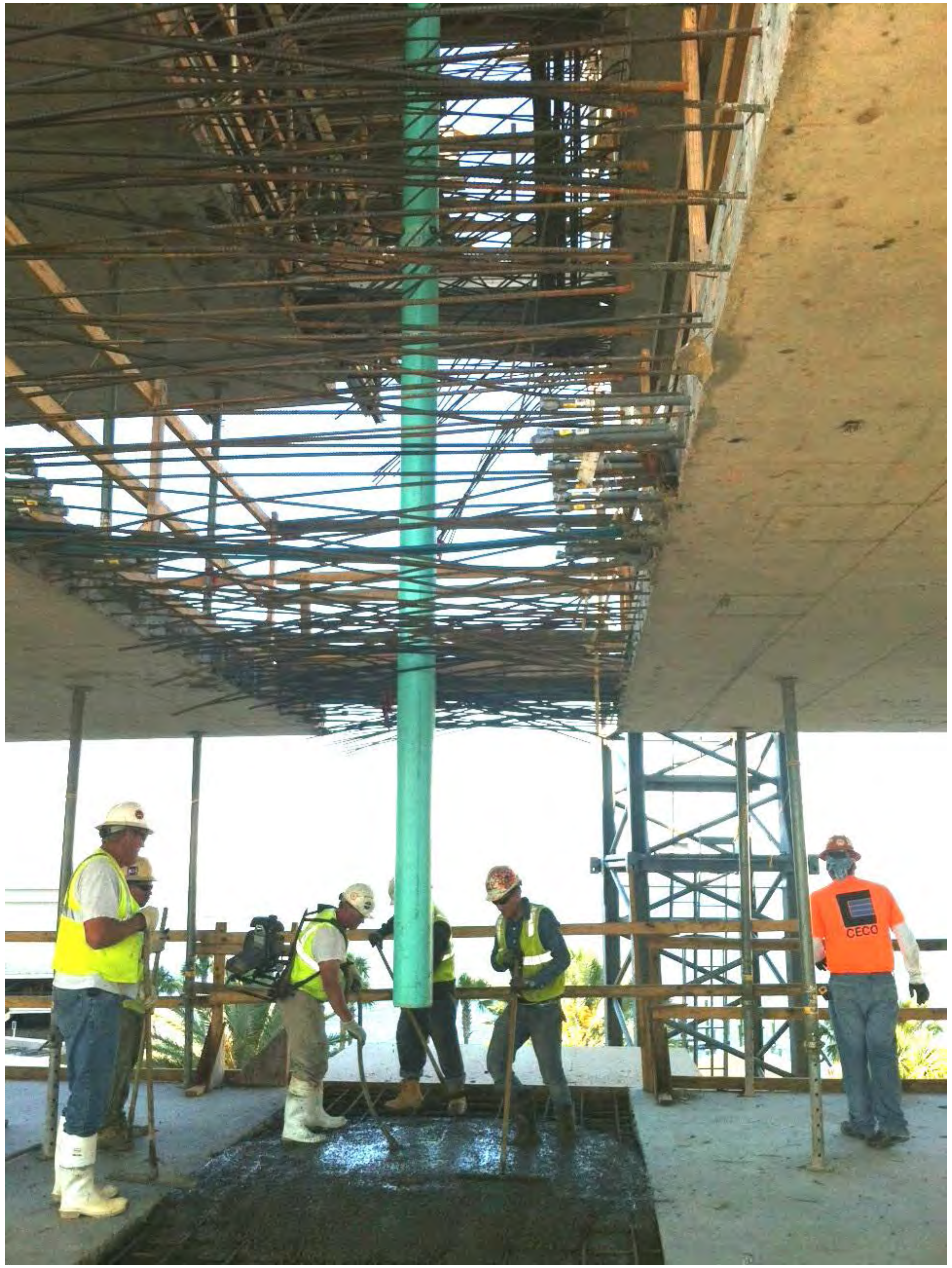


WHAT IS A POUR STRIP?

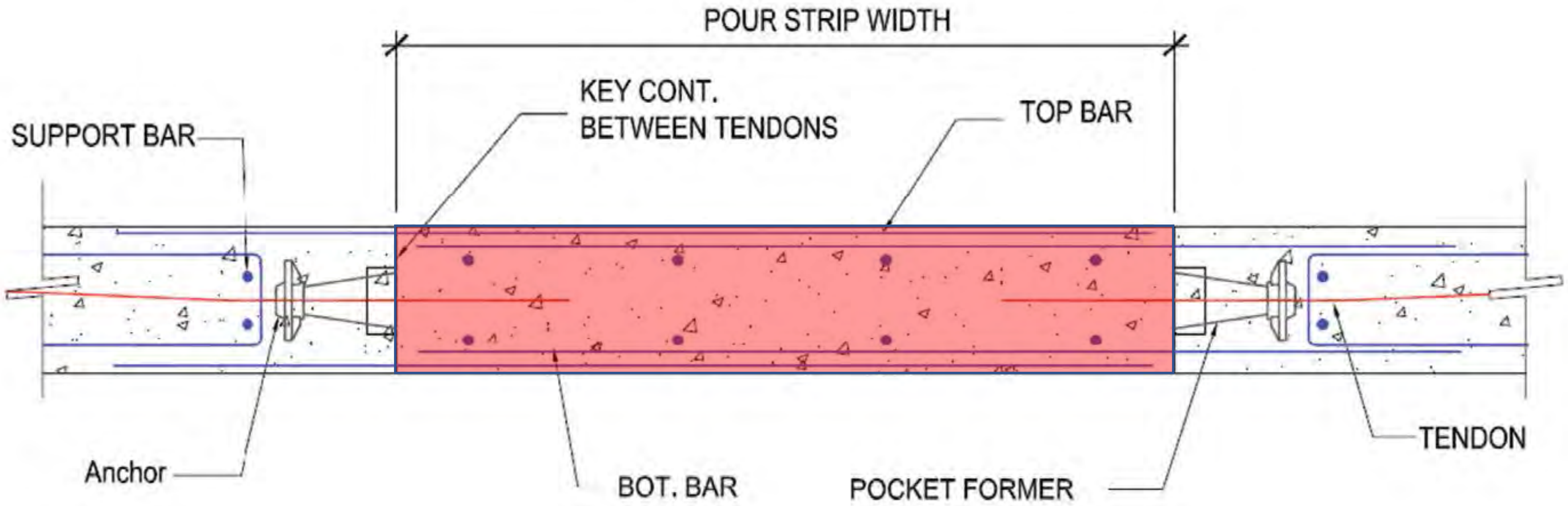
- A temporary leave-out
- Post-tensioned separately
- Allows for volume change
- A complete break in the structure
- 3-ft to 4-ft wide, or wider
- Poured back later
- 28-days to 120-days, or more
- Used in PT and RC

WHAT IS A POUR STRIP?

- Formwork left in place or reformed
- ACI lap splice
- Provides load transfer
- Provides diaphragm continuity
- Provides ACI integrity
- Safety hazard
- Critical path
- Delays other trades
- Most expensive concrete



WHAT IS A POUR STRIP?



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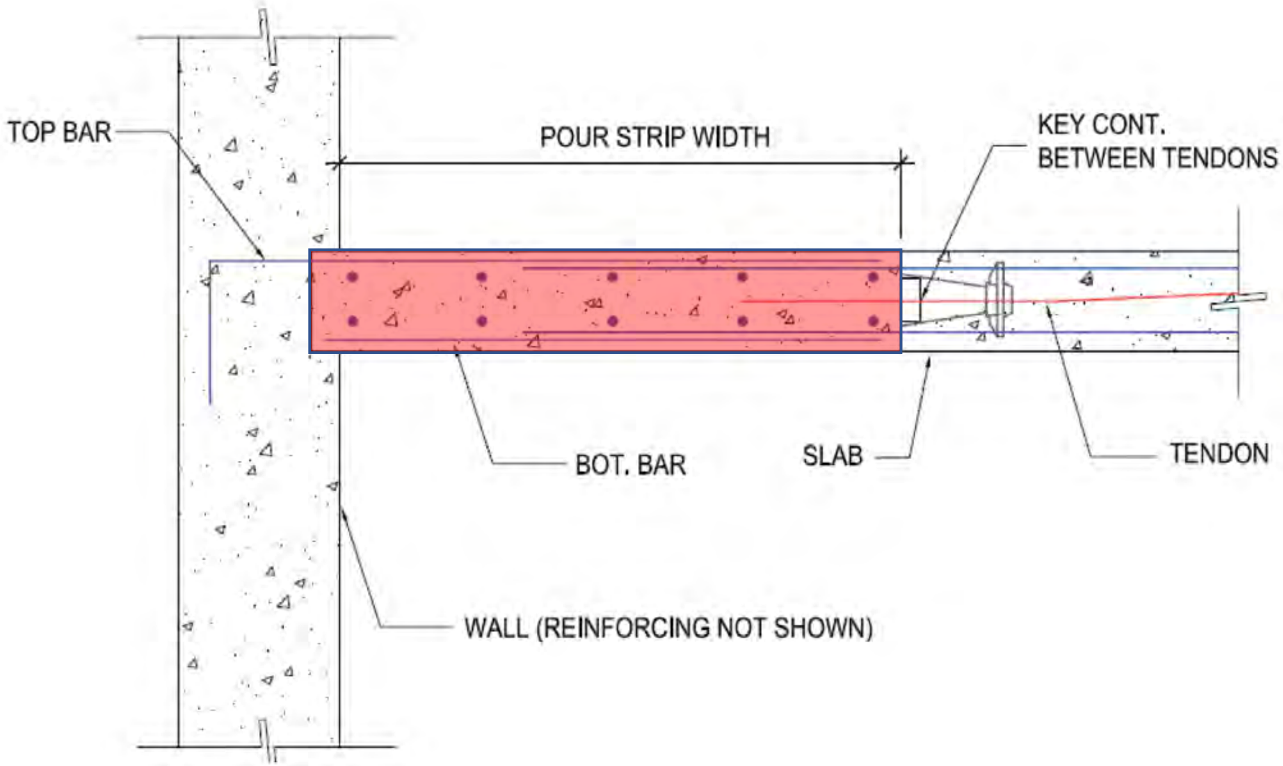


THE MAIN ISSUE

Volume change

- Shrinkage
- Temperature
- Elastic shortening – PT
- Creep – PT

Restraint to shortening (RTS)

ACI 209 – CREEP AND SHRINKAGE IN CONCRETE

- 8-in PT slab
- 100-ft long
- No restraint
- RH = 75%
- P/A = 200 psi
- f'c = 3,000 psi (release)
- f'c = 5,000 psi
- Temperature change = 70 F

Estimated Long-Term Shortening (25-yrs)

- ES (Elastic Shortening) = 0.07-in
- SH (Shrinkage shortening) = 0.5-in
- CR (Creep Shortening) = 0.11-in
- T (Temperature shortening) = 0.5-in
- Total without T = 0.68-in
- Total with T = 1.18-in

Estimated Short-Term Shortening (28-days)

- 40% of long-term
- Total without T = 0.26-in
- Total with T = 0.46-in

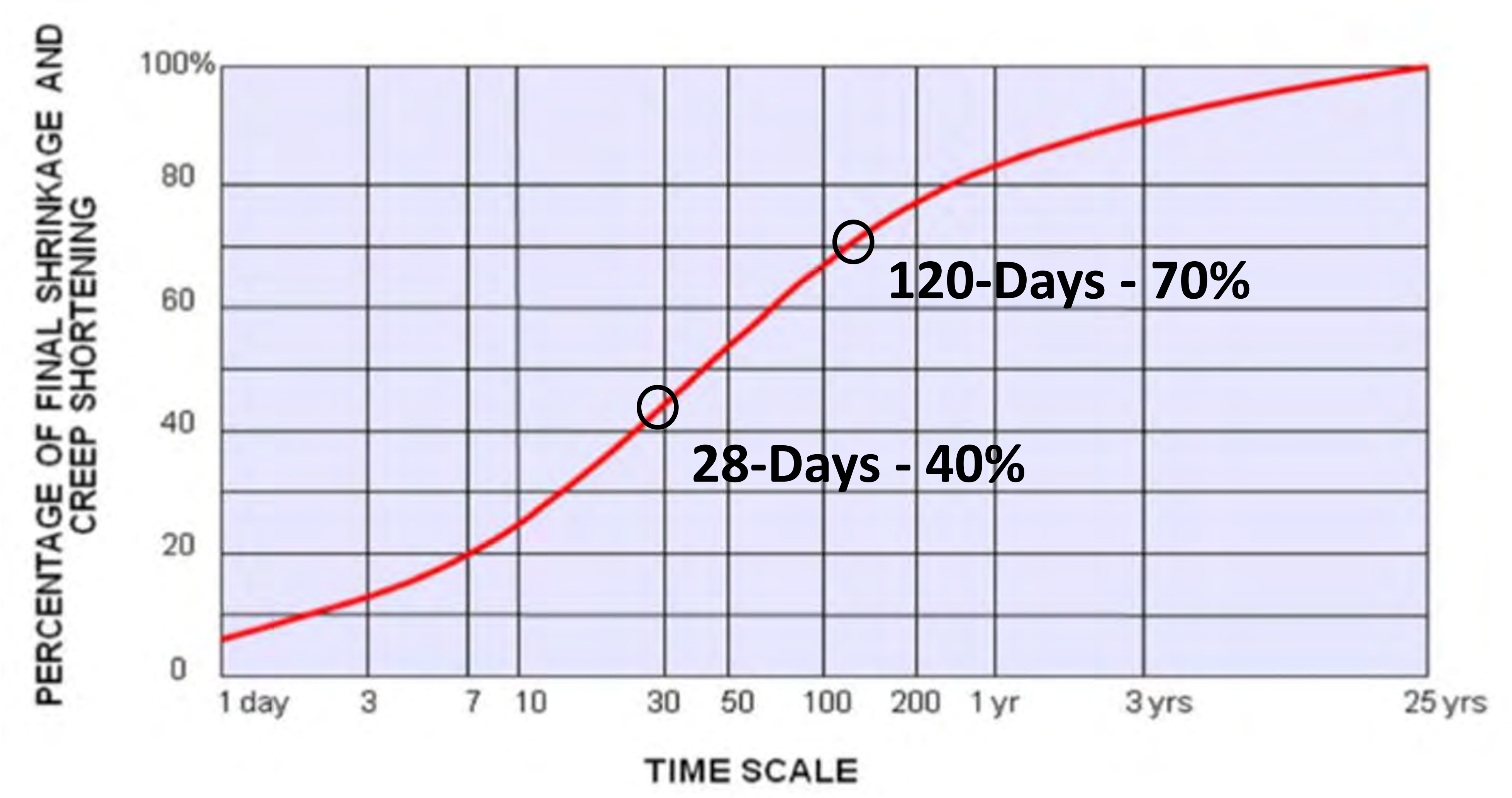
VOLUME CHANGE – PTI DC20.2-22

4.1.1 – Pour Strips

The separation allows each region to independently undergo its shortening. After a time period ranging anywhere from 14 to 60 days, the gap between the two post-tensioned slab regions (the pour strip) is closed by placing non-shrink concrete.

Time to casting of pour strip
The time necessary to keep a pour strip open is determined by the extent of shortening deemed necessary before the two slab regions are tied together. Many practicing engineers use 0.25 in. (6 mm) as the hypothetical displacement which can be accommodated in a post-tensioned structure without significant impairment to its serviceability. For example, the casting of the pour strip concrete should be placed at a time when the remaining calculated displacement of the slabs at each side of the pour strip is 0.25 in. (6 mm). Obviously, once the two slab regions are tied through the pour strip, the deferred displacement cannot take place. It is recognized that this is an empirical procedure backed by the satisfactory performance of pour strips in place. Section 3.2.1 discusses a simple method for estimating the closing time of a pour strip and Section 6 presents a detailed approach.

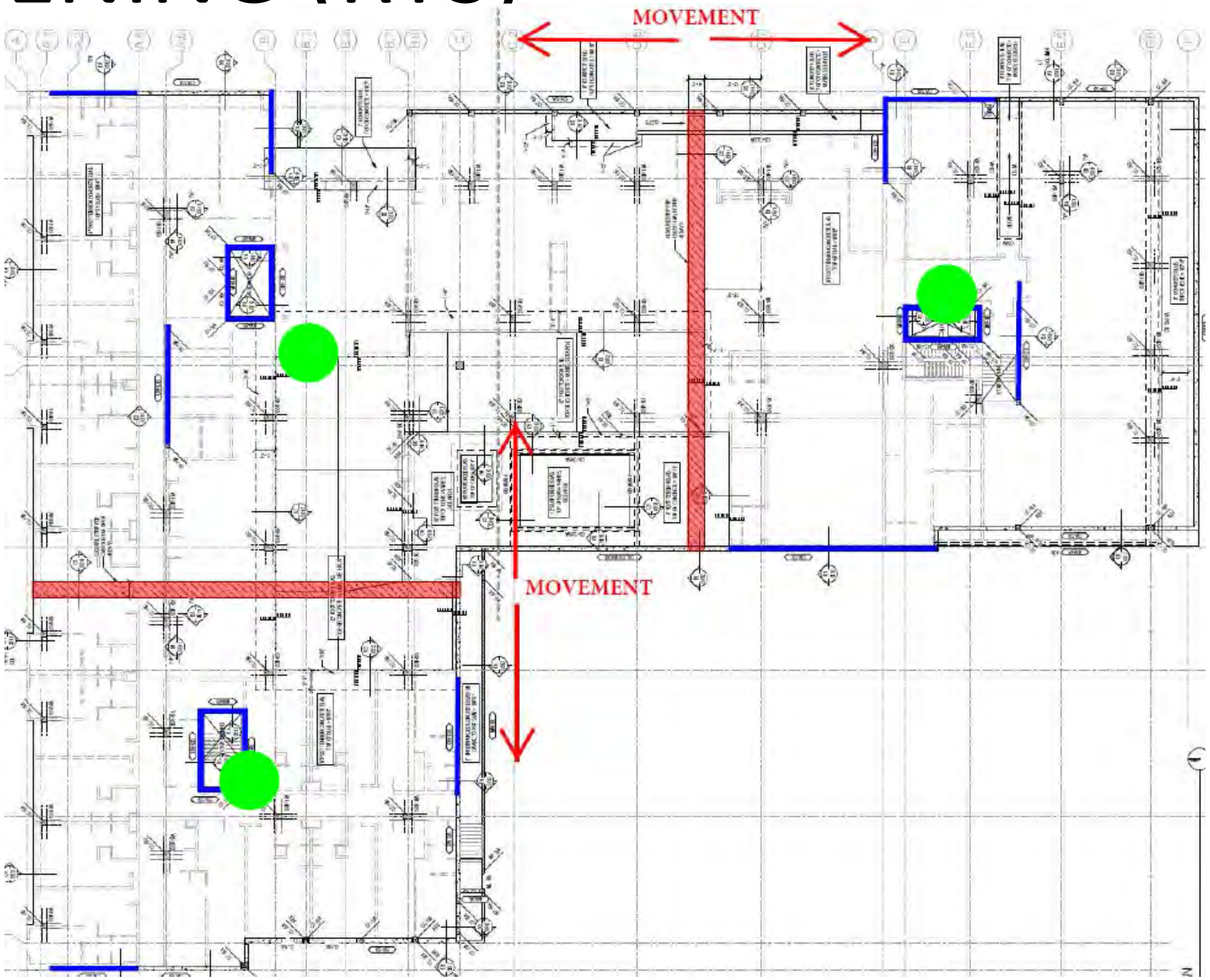
VOLUME CHANGE – PTI DC20.2-22



RESTRAINT TO SHORTENING (RTS)

- Stiff elements
- Building geometry

It gets complicated!



FORMING, SHORING, RESHORING, AND BACKSHORING

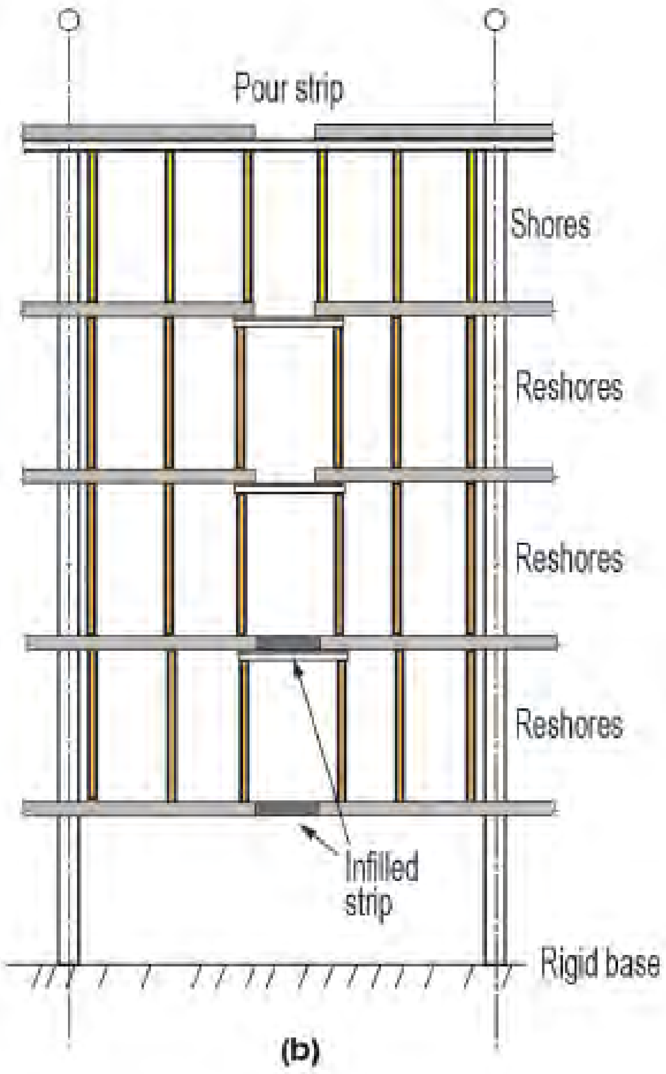
RESHORES – ACI 347

- Shores placed snugly under a stripped concrete slab or other structural member after the original forms and shores have been removed from a full bay, requiring the new slab or structural member to deflect and support its own weight and existing construction loads to be applied before installation of reshores.

BACKSHORES – ACI 347

- Shores left in place or shores placed snugly under a concrete slab or structural member after the original formwork and shores have been removed from a small area, without allowing the entire slab or member to deflect or support its self-weight and construction loads.

RESHORING VS. BACKSHORING



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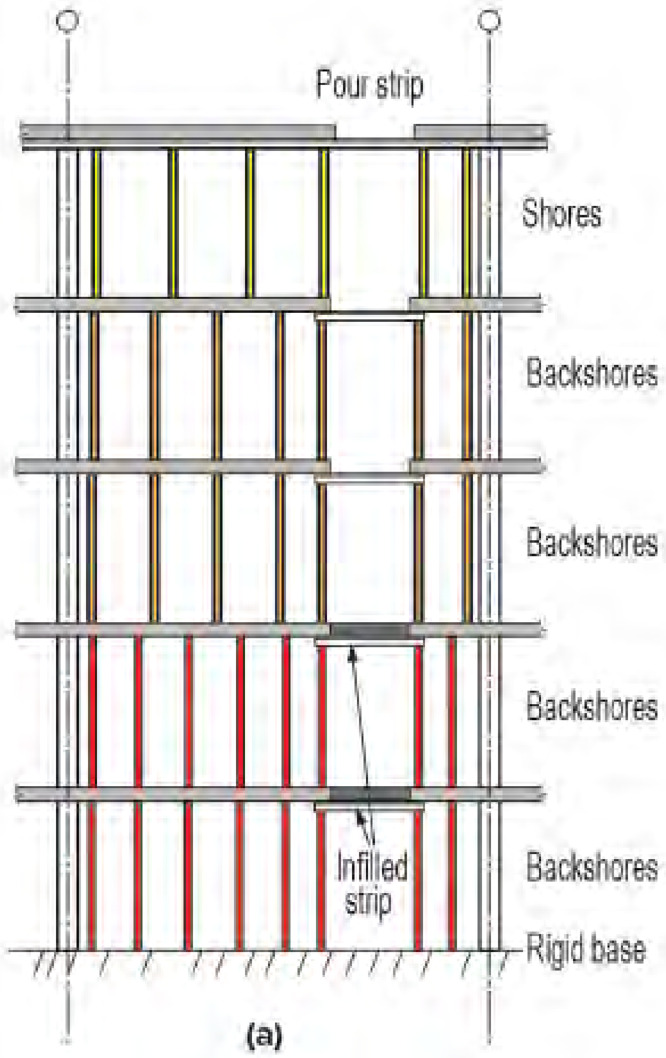
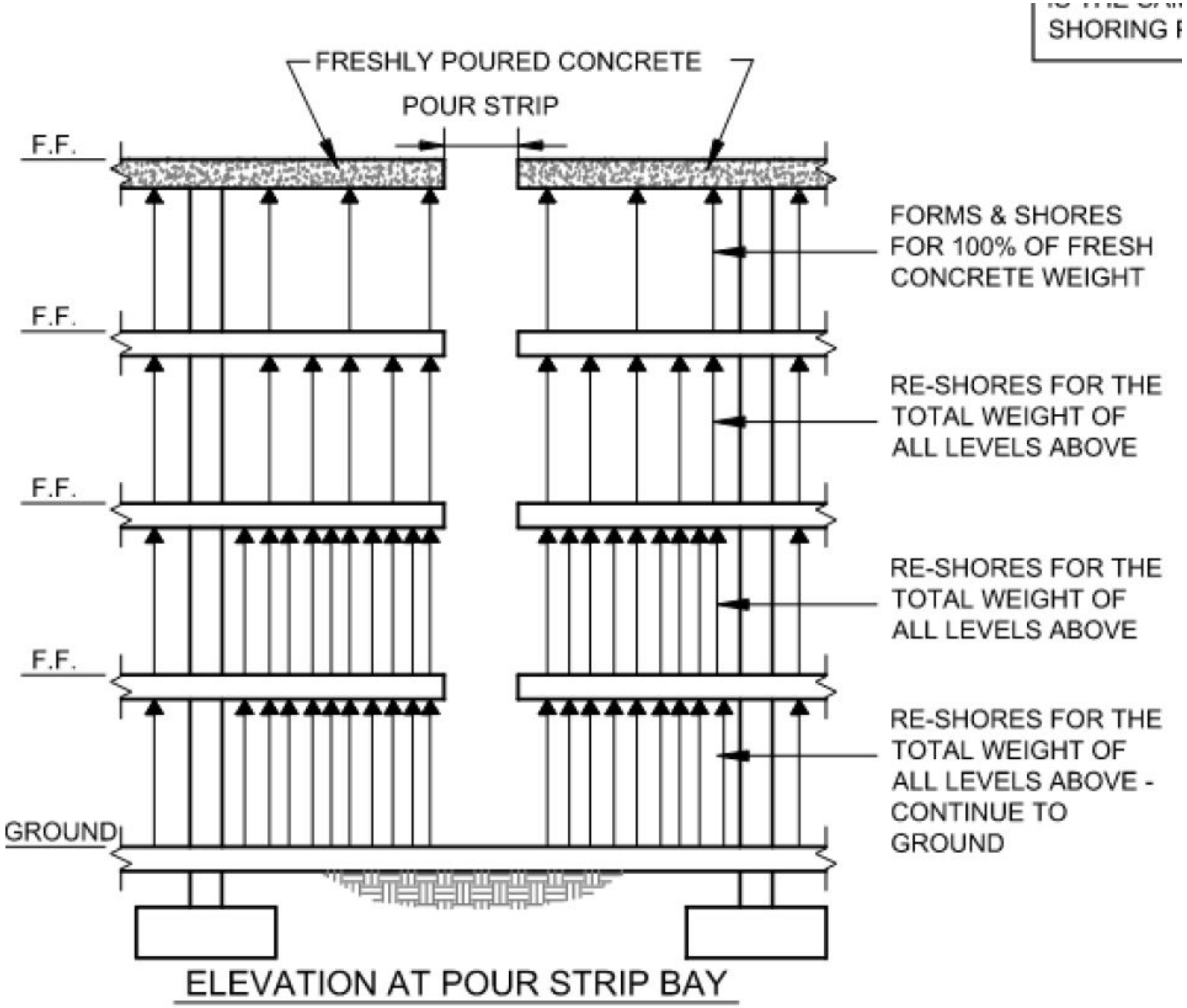


RESHORING VS. BACKSHORING

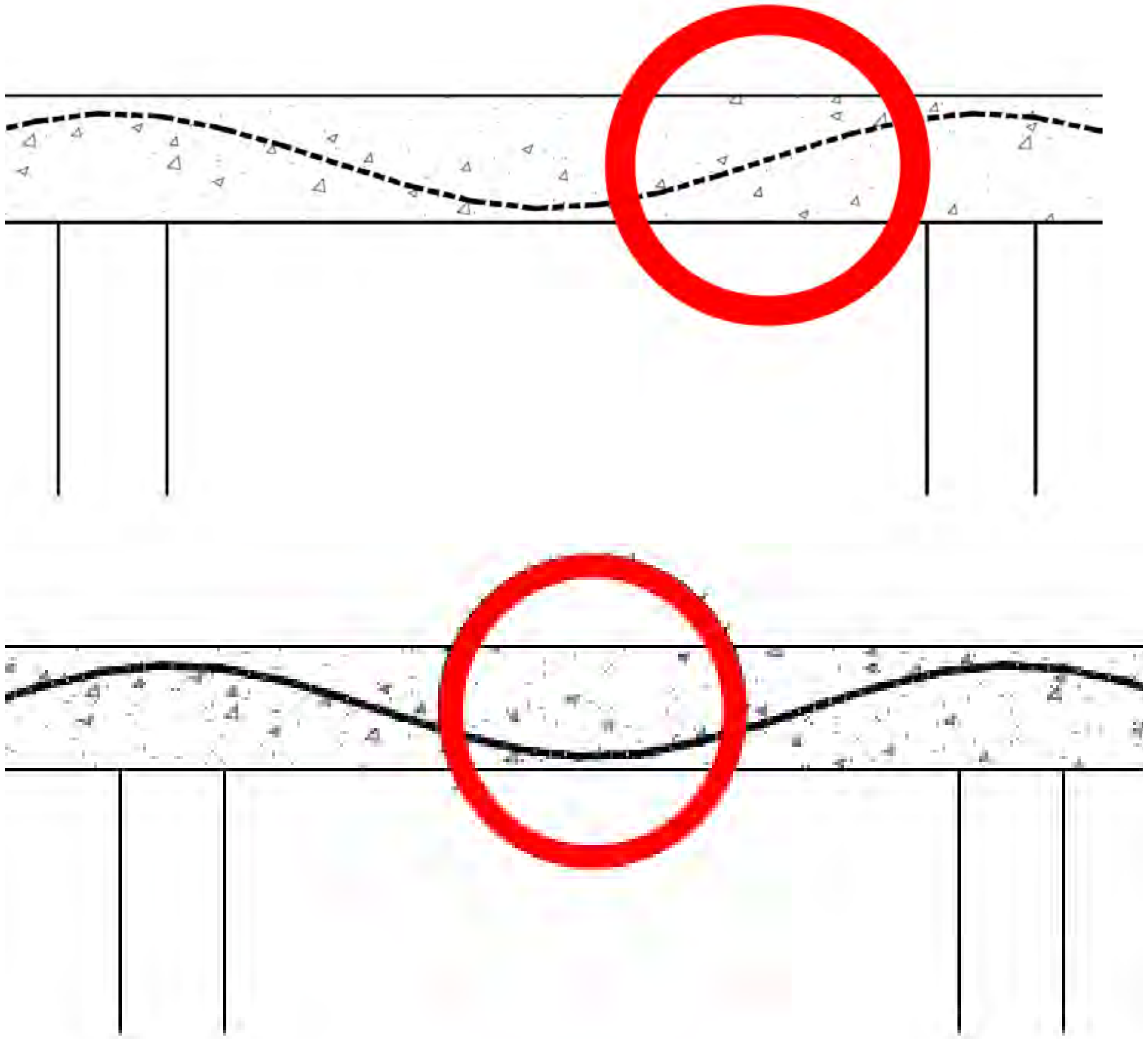


LOCATION MATTERS

Inflection Point

OR

Mid-Span



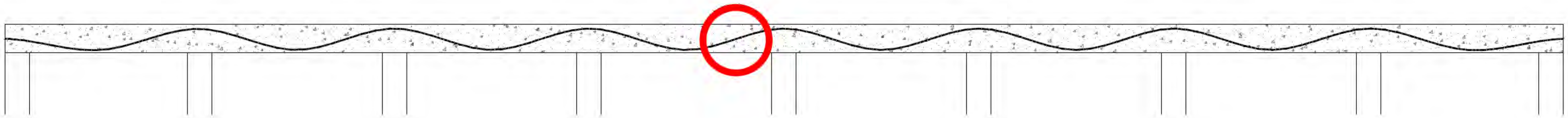
LOCATION MATTERS – PTI DC20.2-22

4.1.1 – Pour Strips: Location

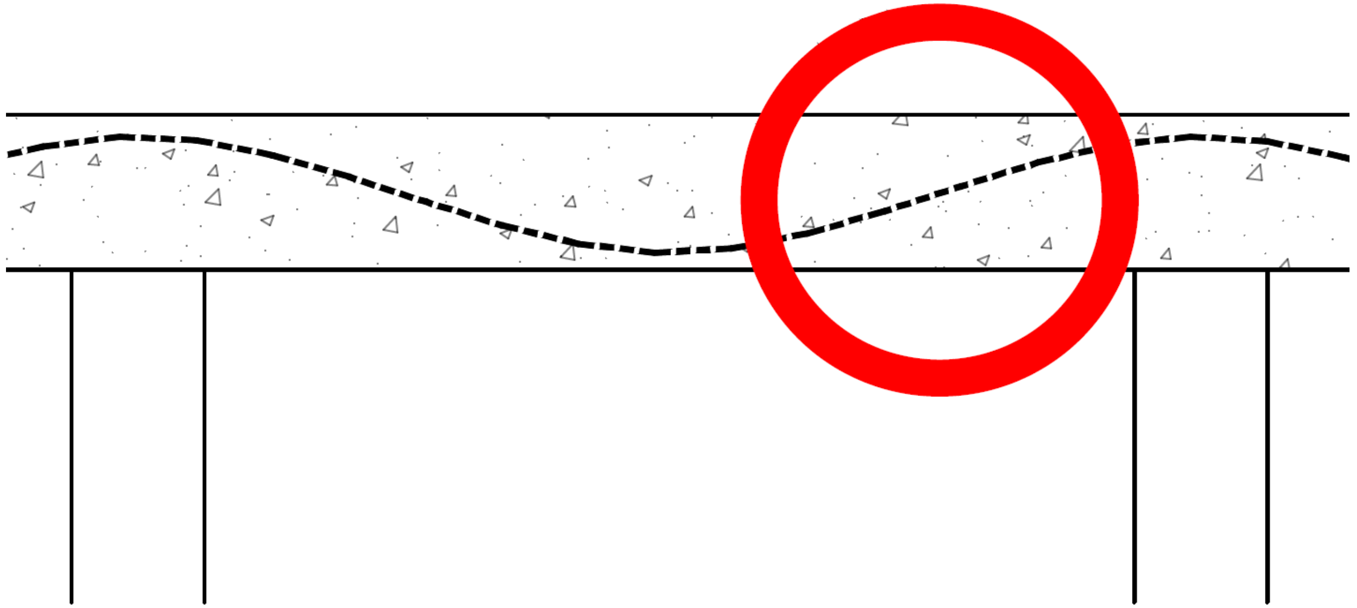
Location within a span and shoring

Between two adjacent supports, for regular conditions, the preferred location of a pour strip within a span is at midspan. For long spans, an alternate approach is to place the pour strip at the quarter span where the moments are typically small. It is important to carefully review predicted deflection at the end of the two cantilevers at the time the closure will be poured to ensure the closure is level and flat. The cumulative shoring requirements at all pour strip bays should be carefully reviewed. Other considerations, however, may dictate the location of the pour strip.

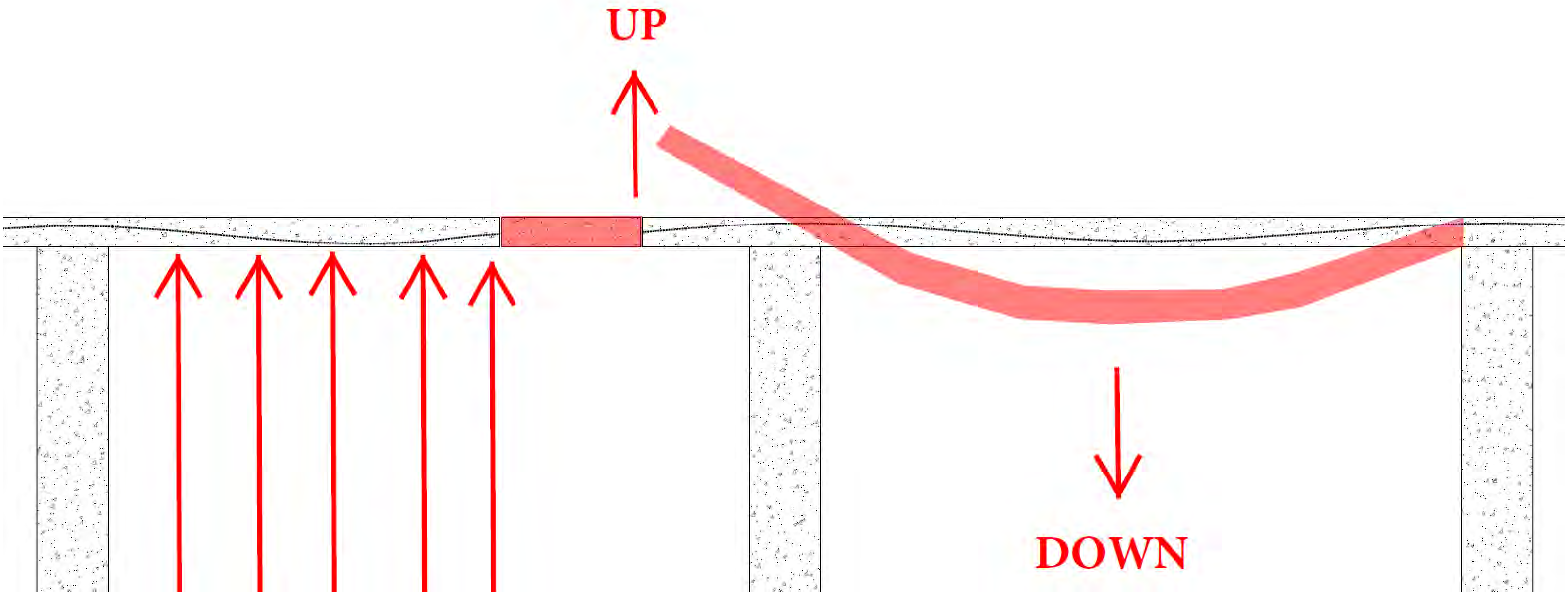
INFLECTION POINT



- Low bending moment
- High shear
- Tendons at mid depth
- PT/rebar most economical
- Not self-supporting
- Cannot be fully released
- Requires backshores
- Short cantilever lifts up



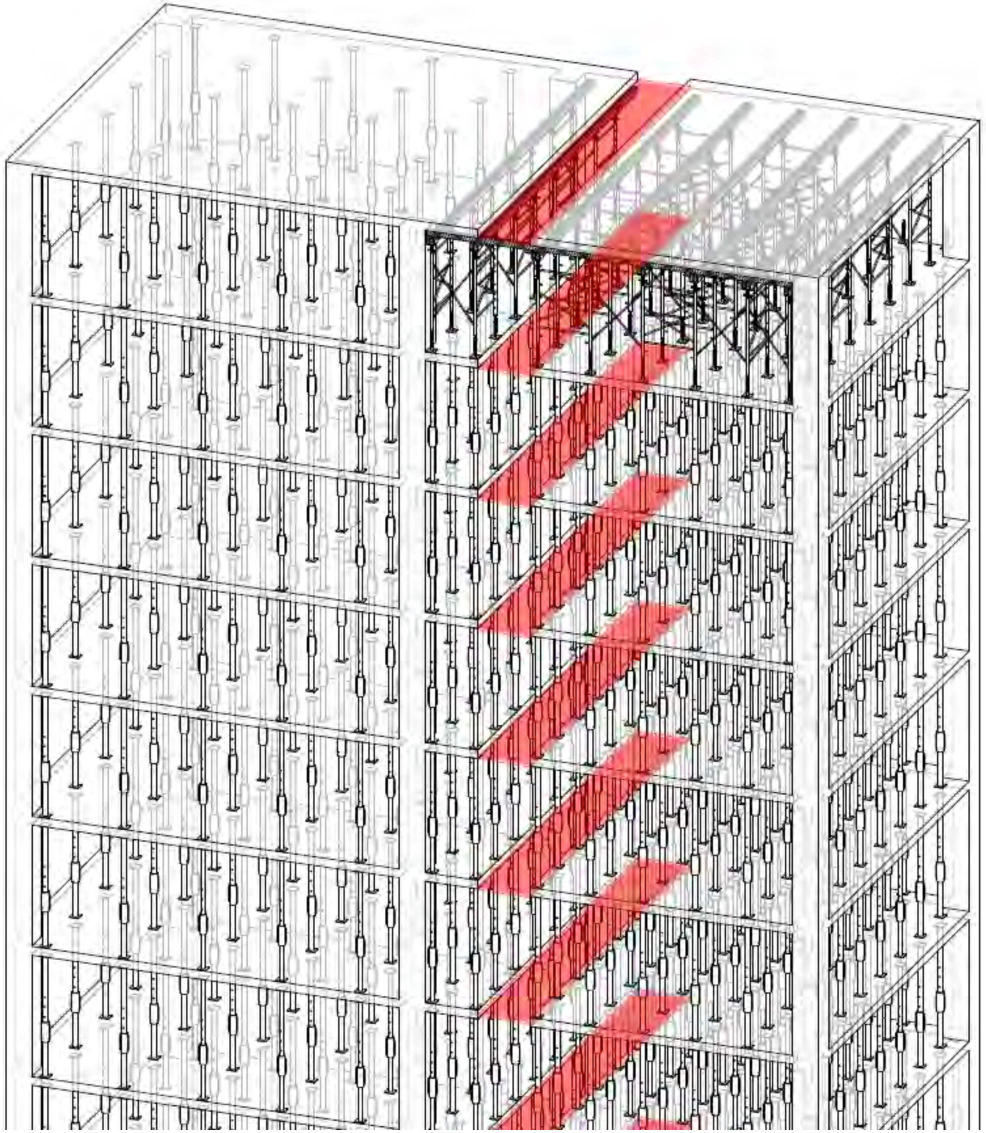
INFLECTION POINT



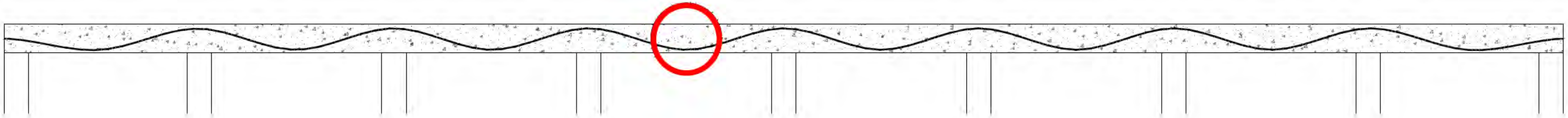
INFLECTION POINT

BACKSHORES – ACI 347

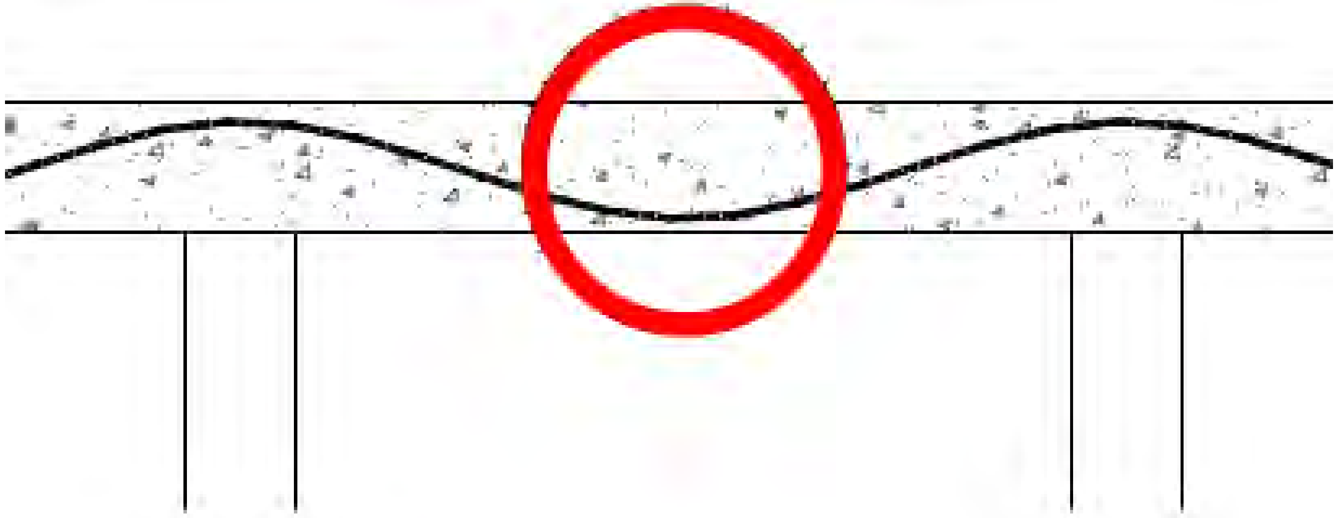
- Shores left in place or shores placed snugly under a concrete slab or structural member after the original formwork and shores have been removed from a small area, without allowing the entire slab or member to deflect or support its self-weight and construction loads.



MID-SPAN – NOT SELF-SUPPORTING



- High bending moment
- Low shear
- Tendons at bottom
- PT/rebar less economical
- Slabs cannot self-support
- Cannot be fully released
- Requires backshores



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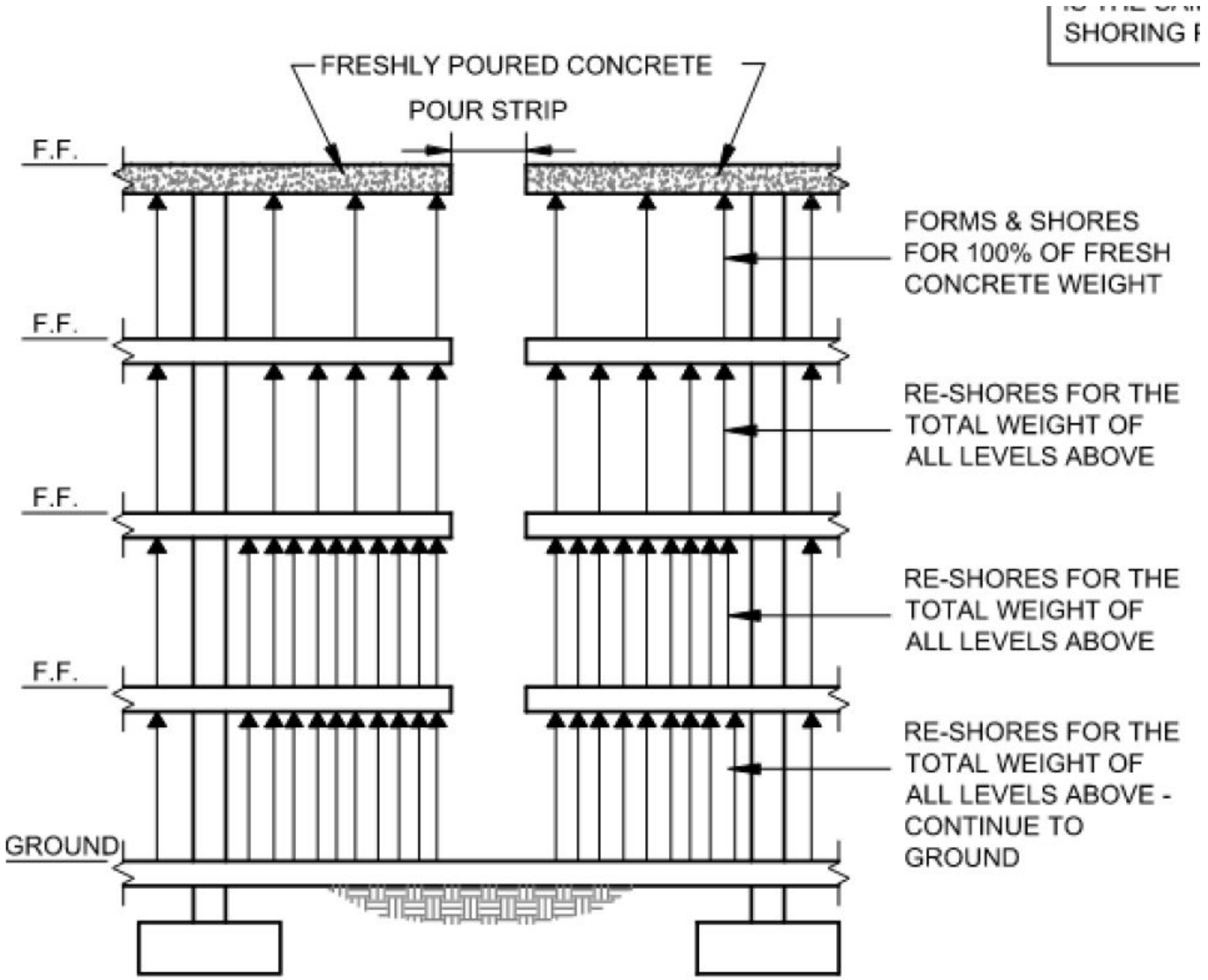
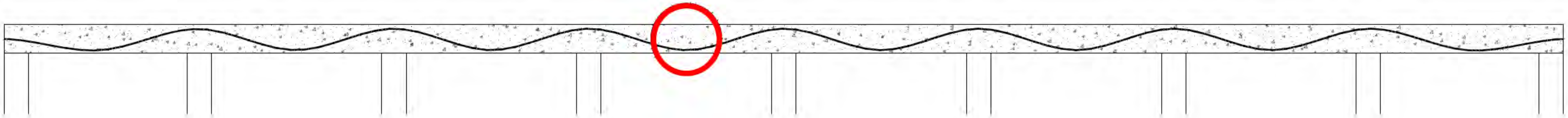
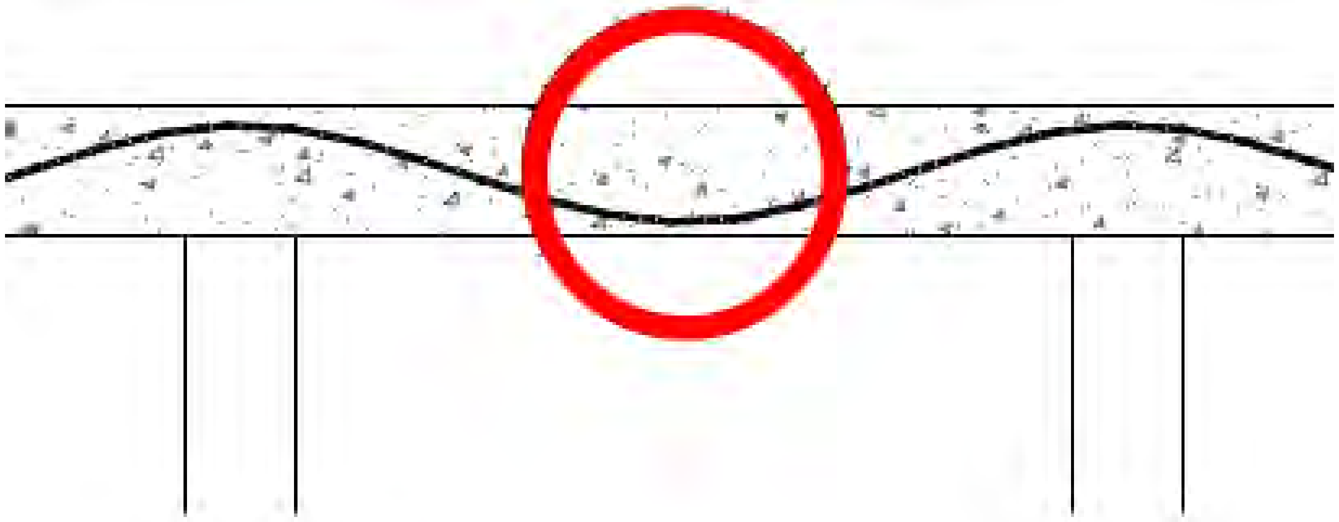


ELEVATION AT POUR STRIP BAY

MID-SPAN – SELF-SUPPORTING



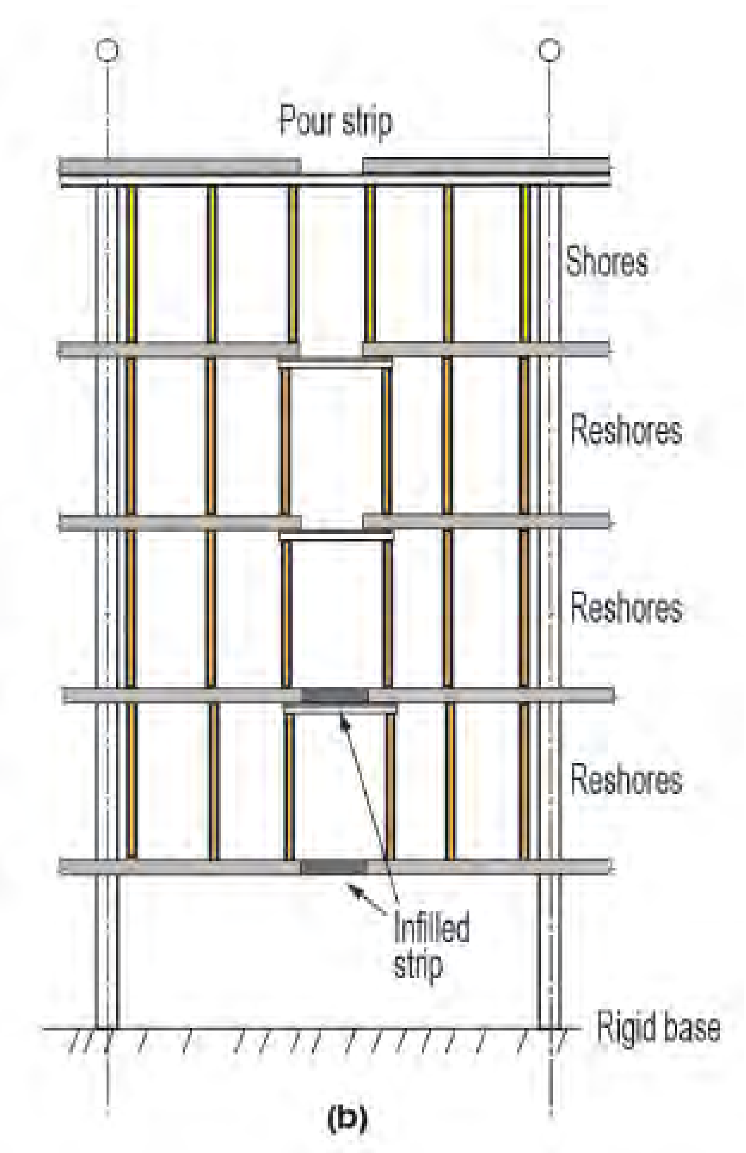
- High bending moment
- Low shear
- Tendons at bottom
- Added PT – higher stress
- PT/rebar least economical
- Slabs can self-support
- Slabs can be fully released
- No backshores

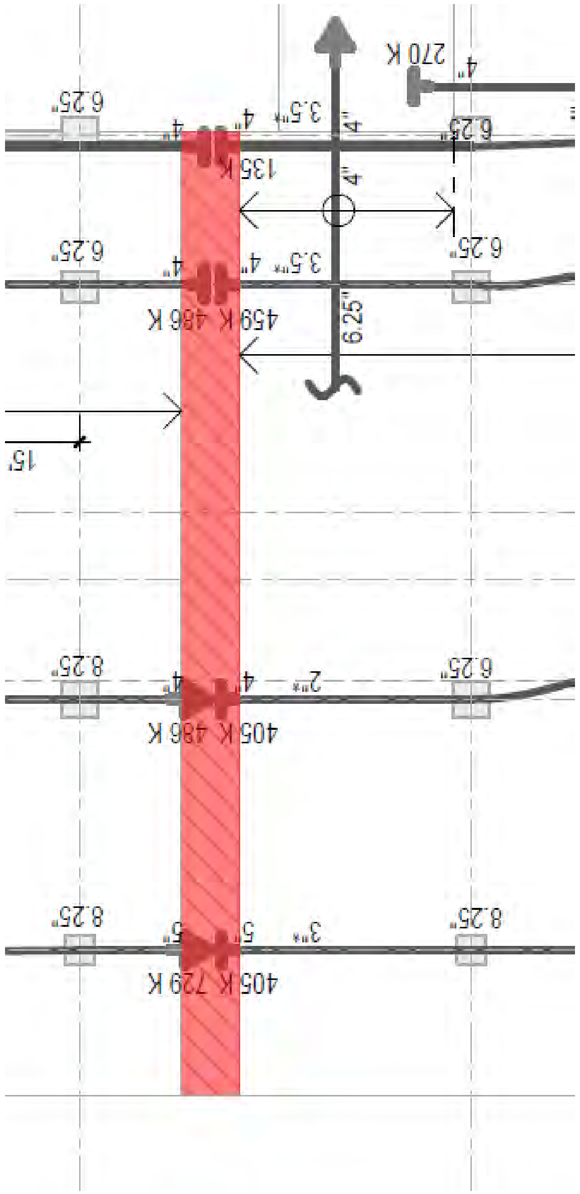


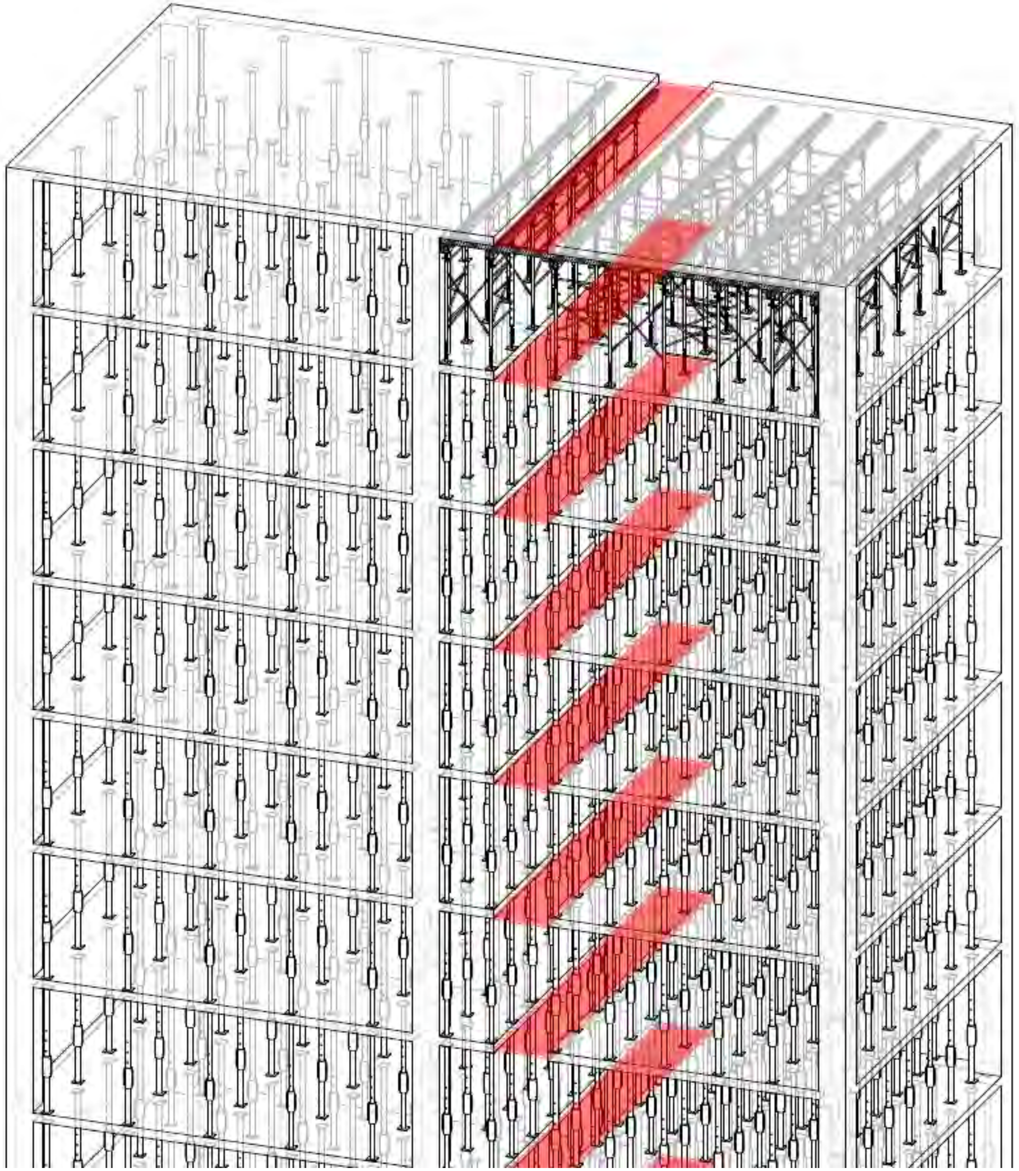
MID-SPAN – SELF-SUPPORTING

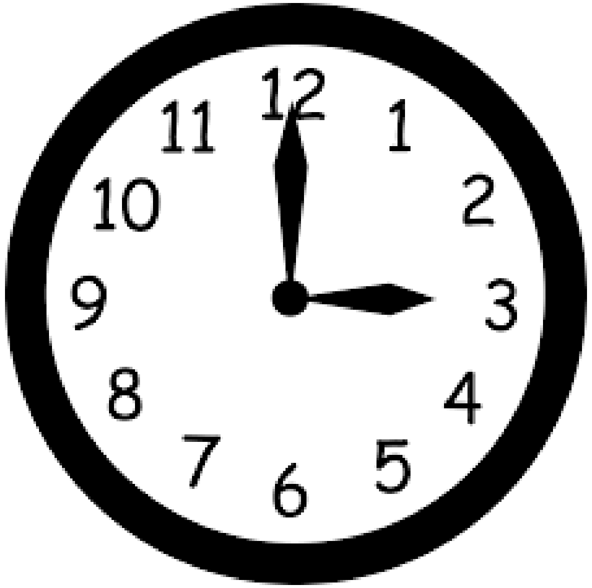
RESHORES – ACI 347

- Shores placed snugly under a stripped concrete slab or other structural member after the original forms and shores have been removed from a full bay, requiring the new slab or structural member to deflect and support its own weight and existing construction loads to be applied before installation of reshores.




270 K
135 K
459 K
486 K
405 K
729 K
6.25"
8.25"
3.5"
4"
15"

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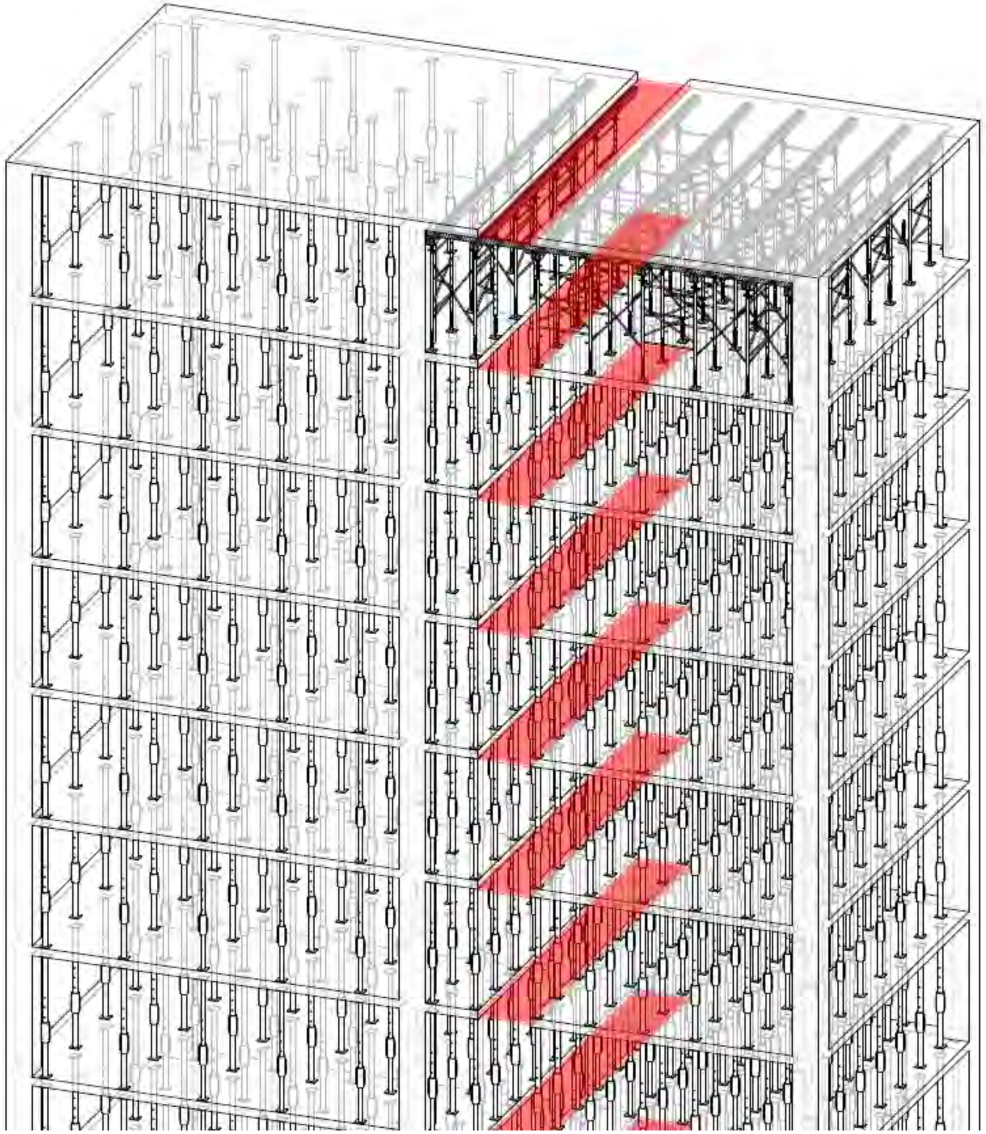
Safety

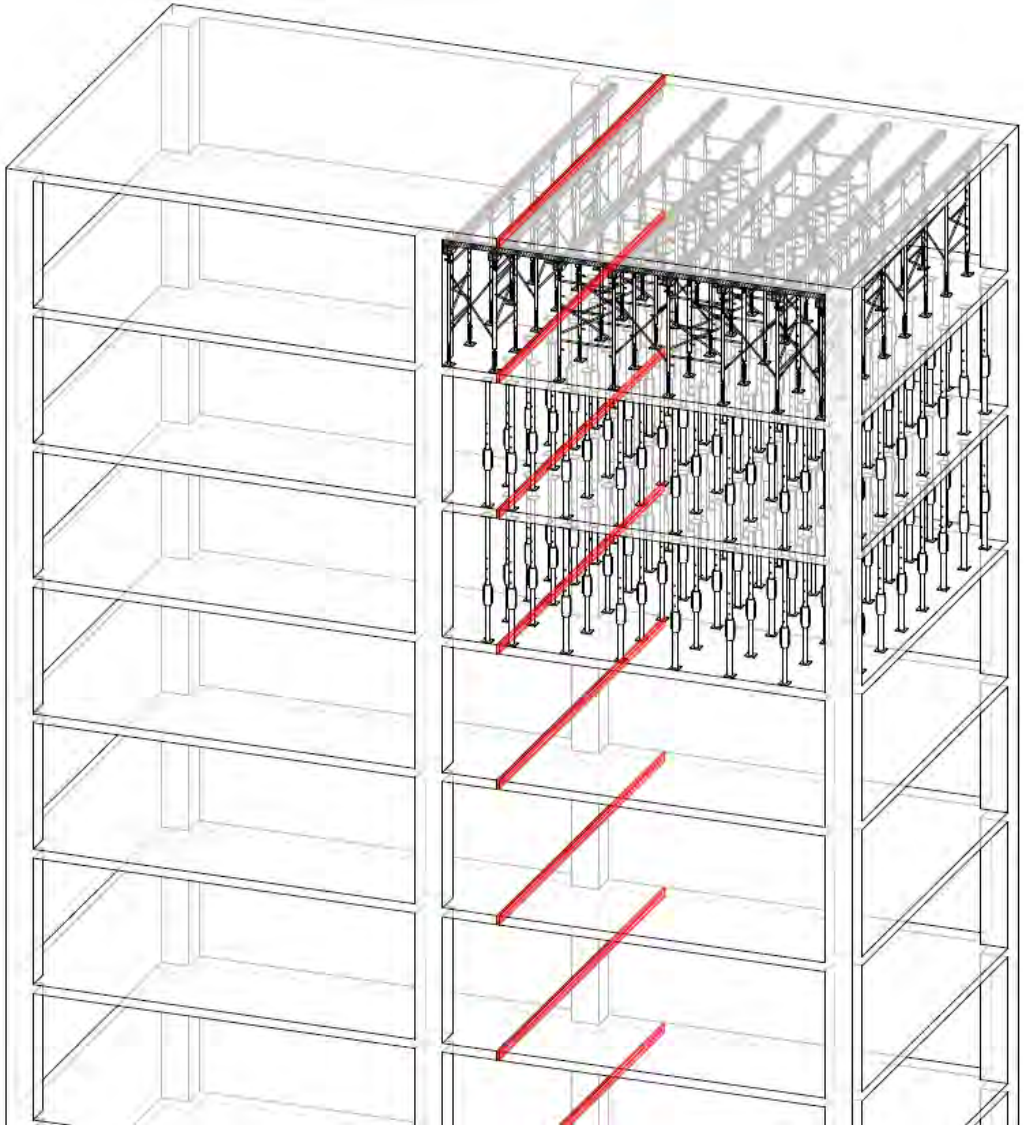
SLAB-TO-SLAB CONNECTORS

Embedded Release Devices (PTI DC20.2-22)

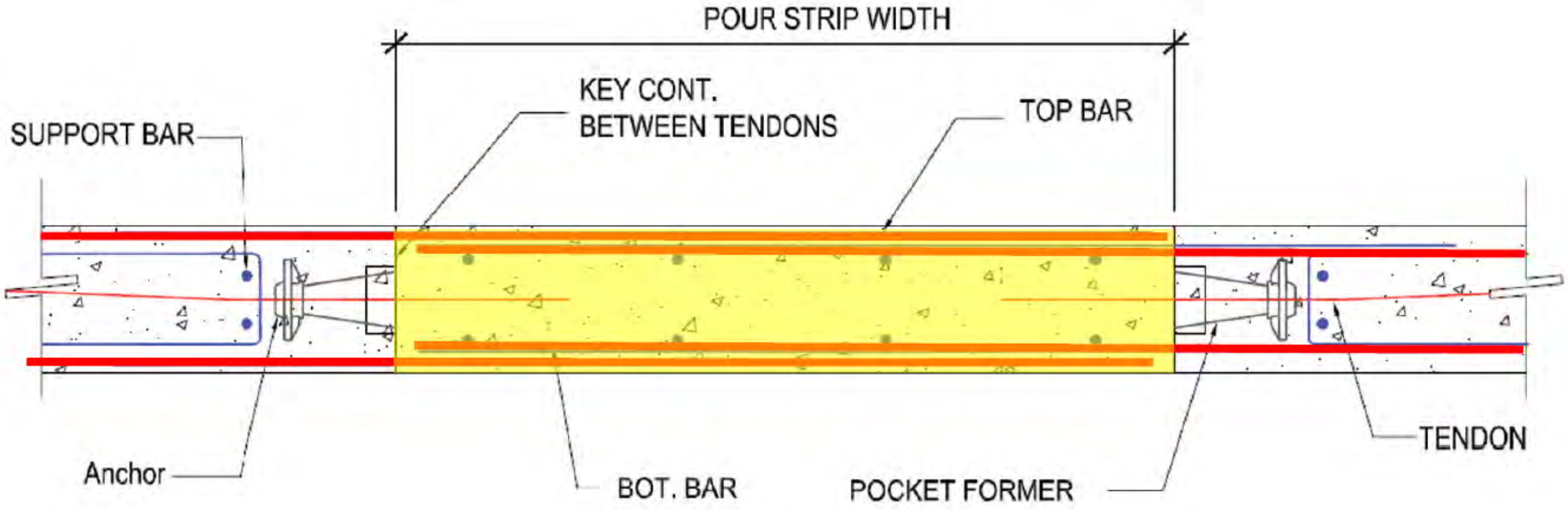
- Concrete anchors
- Mechanical splices - PS=Ø®



VS.

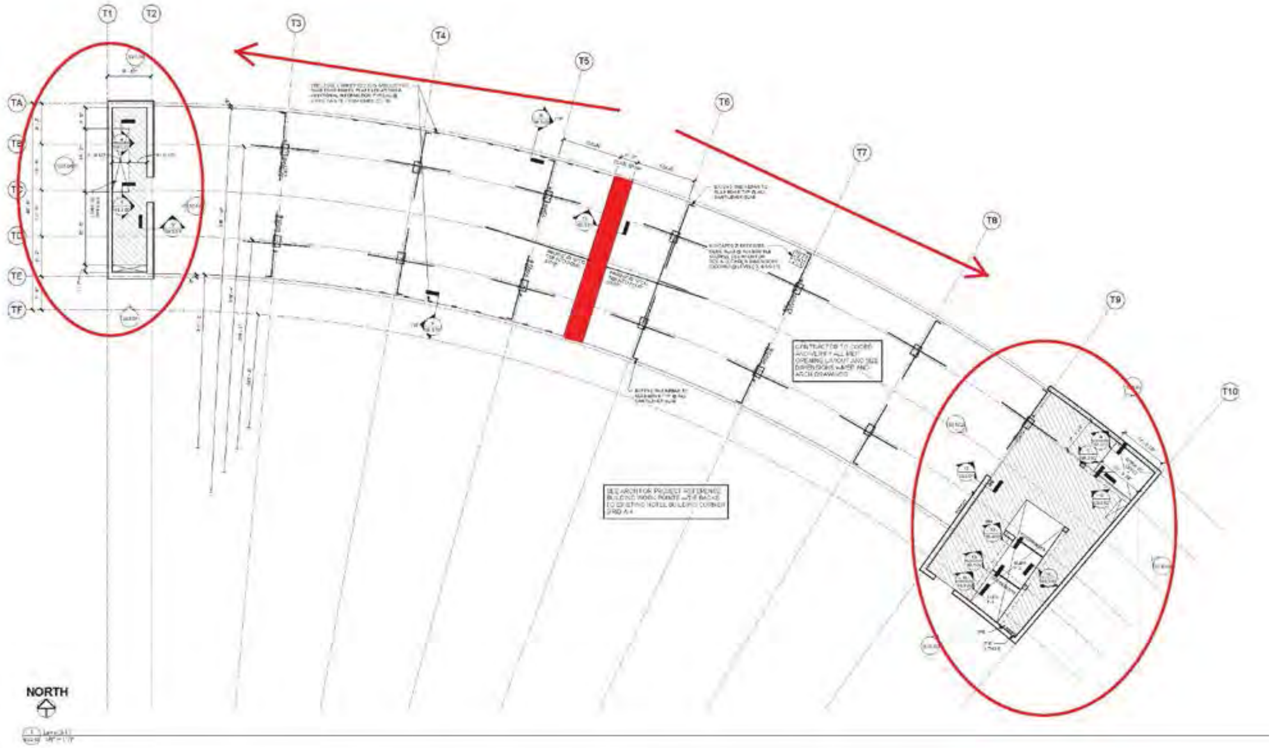


POUR STRIP LAP SPLICE



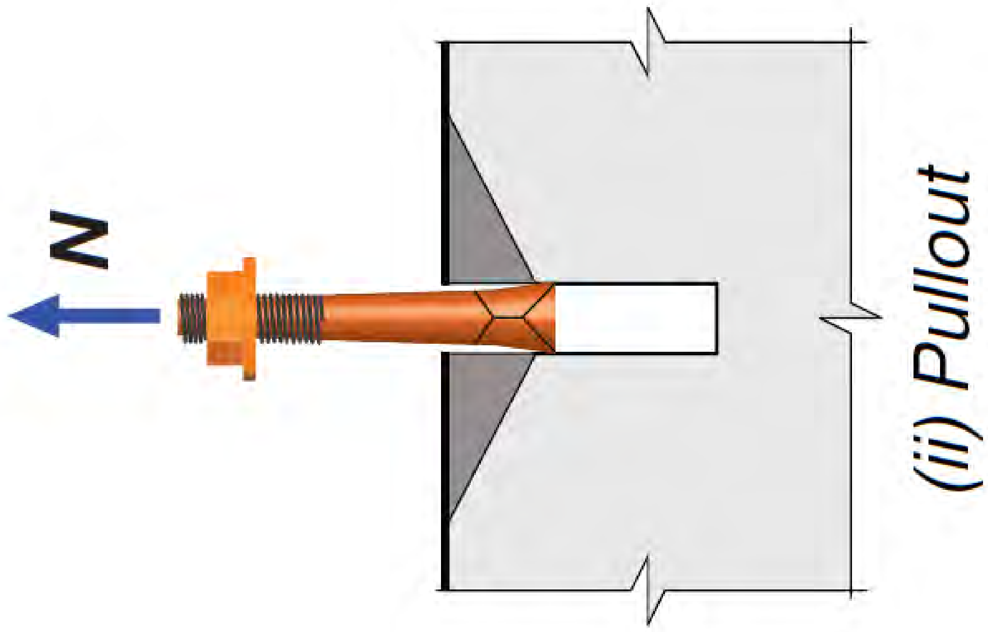
- ACI-permitted splice
- Meets ACI integrity
- Shear friction
- Continuous rebar
- Yielding
- Ductility
- Fixed
- Fire rated

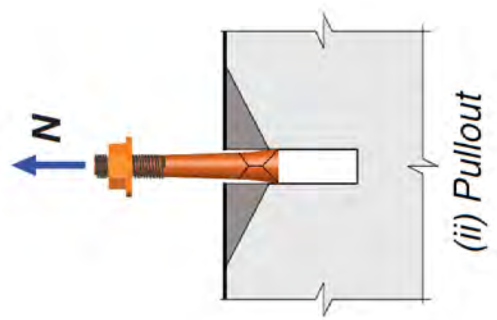
CONCRETE ANCHORS

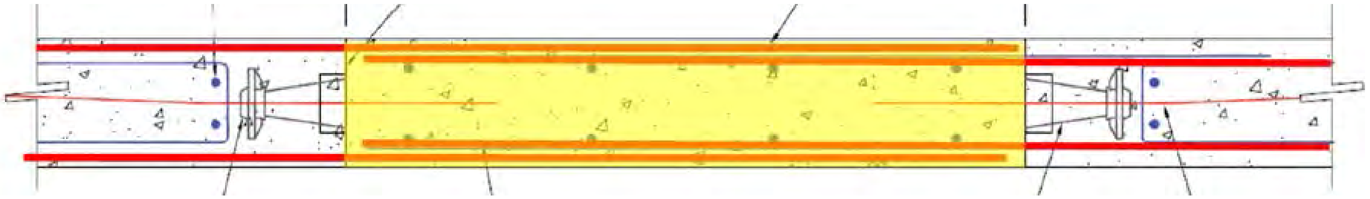


CONCRETE ANCHORS

- Met local shear
- Did not meet local moment
- Did not transfer forces like a lap splice
- Did not meet ACI integrity
- Rebar not continuous
- Permanent hinge – expansion joint
- Required redesign of the slab and lateral sys
- Uses epoxy grout – No fire rating
- Not ICC-approved
- Not an ACI-permitted splice
- Needed additional confinement steel







• Not ACI-permitted splice • Does not meet ACI integrity • No shear friction • No continuous rebar • No yielding • No ductility • Hinge • Not fire rated	VS.	• ACI-permitted splice • Meets ACI integrity • Shear friction • Continuous rebar • Yielding • Ductility • Fixed • Fire rated

CONCRETE ANCHORS – COULD THEY WORK?

- Non seismic
- Non high wind
- Don’t need ACI integrity
- Don’t need ICC
- Don’t need continuous rebar
- Don’t need yielding
- Don’t need ductility
- Hinge – OK
- Don’t need tension like rebar splice
- Two separate lateral systems
- Cantilever column
- Shear only
- Don’t need a fire rating
  - See PTI DC20.2-22, 4.4 – Embedded Release Devices

ACI 318 REVIEW – NOT A PERMITTED SPLICE

318 Sub D – Members
ACI 318 Spring Convention
Quebec City Convention Center
Quebec City

Tuesday, March 26, 2019 **2104 B** **1:30 PM – 6:00 PM**

Minutes

4. Lockable Dowels

Dan Mullins provided a short presentation on the practical code implications of using "lockable dowels" for pour strips. Dan made the argument that although lockable dowels may meet localized shear and moment force transfer requirements, they do not meet continuity requirements. The committee agreed with Dan's assessment, and the committee indicated that this topic should be considered for new business in the next code cycle.

ACI 318-19: STRUCTURAL INTEGRITY

structural integrity—ability of a structure through strength, redundancy, ductility, and detailing of reinforcement to redistribute stresses and maintain overall stability if localized damage or significant overstress occurs.

Table 4.10.2.1—Minimum requirements for structural integrity

Member type	Section
Nonprestressed one-way cast-in-place slabs	7.7.7
Nonprestressed two-way slabs	8.7.4.2
Prestressed two-way slabs	8.7.5.6
Nonprestressed two-way joist systems	8.8.1.6
Cast-in-place beam	9.7.7
Nonprestressed one-way joist system	9.8.1.6
Precast joints and connections	16.2.1.8

ACI 318-19: DIAPHRAGMS – SPLICES

12.7.3.1 Except for slabs-on-ground, diaphragms that are part of floor or roof construction shall satisfy reinforcement detailing of one-way slabs in accordance with 7.7 or two-way slabs in accordance with 8.7, as applicable.

12.7.1.3 Splices of deformed reinforcement shall be in accordance with 25.5.

SPLICES – WHAT DOES ACI PERMIT?

American Concrete Institute
Always advancing

25.5—Splices

25.5.1 *General*

- Lap splice
- End-bearing splice
- Mechanical splice
- Welded splice

ACI 318-19: MECHANICAL SPLICES

18.2.7.1 Mechanical splices shall be classified as (a) or (b):

(a) Type 1 – Mechanical splice conforming to 25.5.7

(b) Type 2 – Mechanical splice conforming to 25.5.7 and capable of developing the specified tensile strength of the spliced bars

25.5.7.1 A mechanical or welded splice shall develop in tension or compression, as required, at least **1.25**f_y of the bar.

R25.5.7.1 To ensure sufficient strength in splices so that yielding can be achieved in a member and thus brittle failure avoided, the 25 percent increase above the specified yield strength was selected as both an adequate minimum for safety and a practicable maximum for economy.

MECHANICAL SPLICES

- Coupler for Thread-Deformed Bar
- Upset Straight Thread Coupler
- Non-Upset Straight Thread Coupler
- Cold-Swaged Threaded Coupler
- Taper-Threaded Coupler
- Straight Threaded Coupler with Upset Rebar Ends
- Grout-Filled Coupling Sleeve
- Combo Grout-Filled/Threaded Sleeve
- Steel-Filled Coupling Sleeve
- Cold-Swaged Coupling Sleeve
- Shear Screw Coupling Sleeve
- Extruded Coupling Sleeve
- Coupling Sleeve with Double Wedge
- Coupling Sleeve with Shear Bolt/Wedge
- Dowel Bar Mechanical Splice
- Compression-Only Mechanical Splices

CRSI Concrete Reinforcing Steel Institute

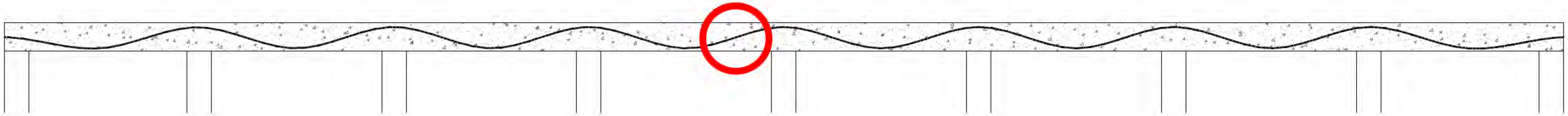
PS=Ø® - MECHANICAL SPLICE

Eliminates pour strips, wall leave-outs, and expansion joints while maintaining structural integrity and allowing for volume change. Using proven coupler technologies recognized worldwide, featuring a thread on one end and a grout-filled sleeve on the other. The system is an ACI 318 code compliant full-tension mechanical Type 1 and Type 2 rebar splice, is ICC approved and made in the USA.

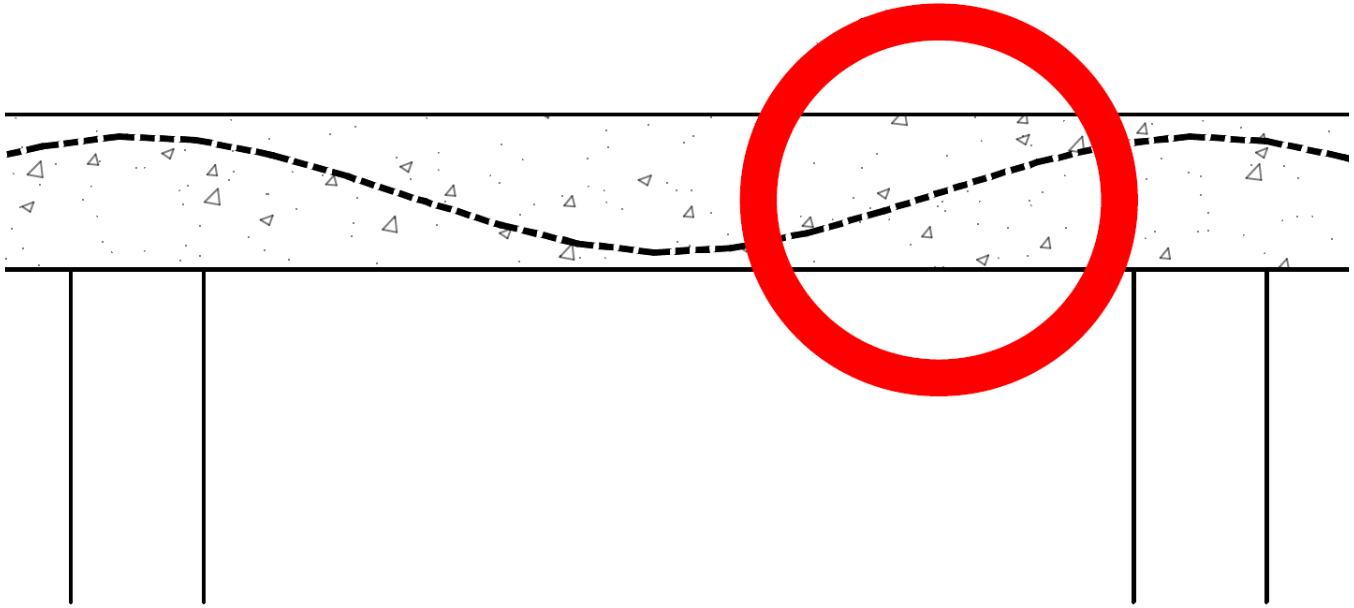
INTERNATIONAL CODE COUNCIL®

MADE IN USA

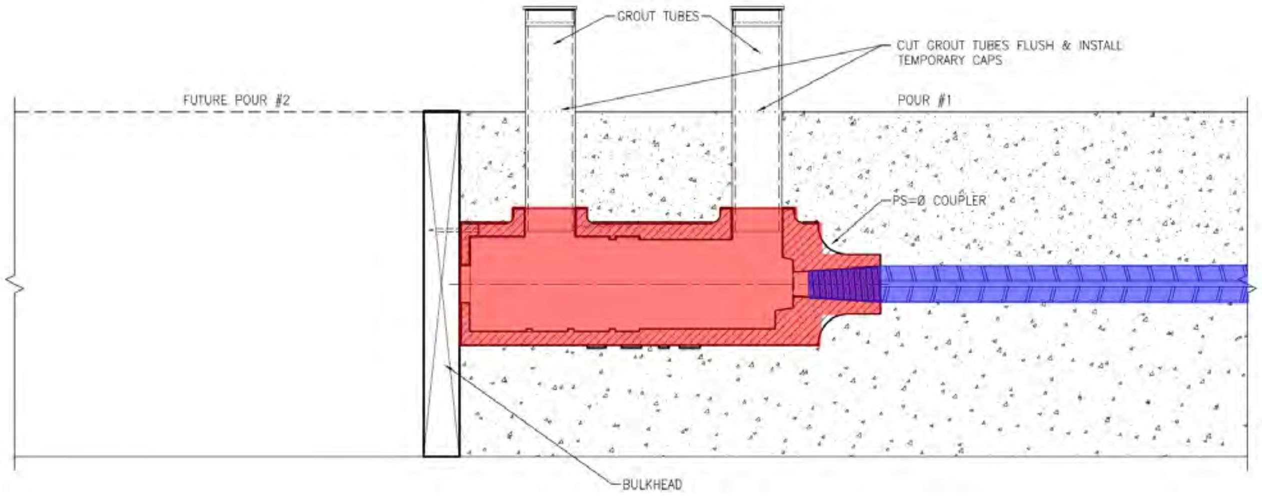
HOW IT WORKS - INFLECTION POINT



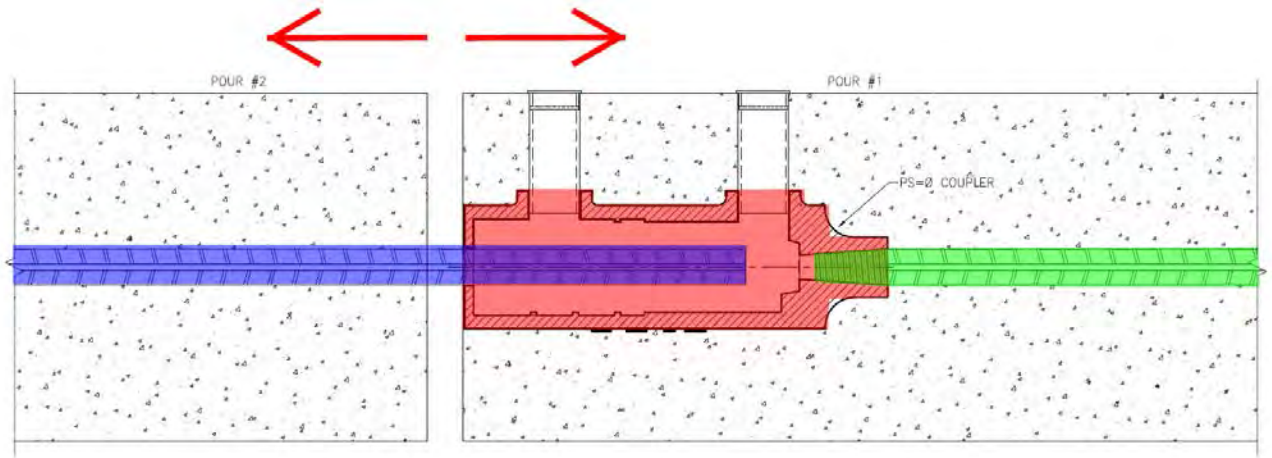
- Low bending moment
- High shear
- Tendons at mid-depth
- PT, rebar most economical
- Self-supporting
- No Backshoring
- PS=Ø® at mid-depth



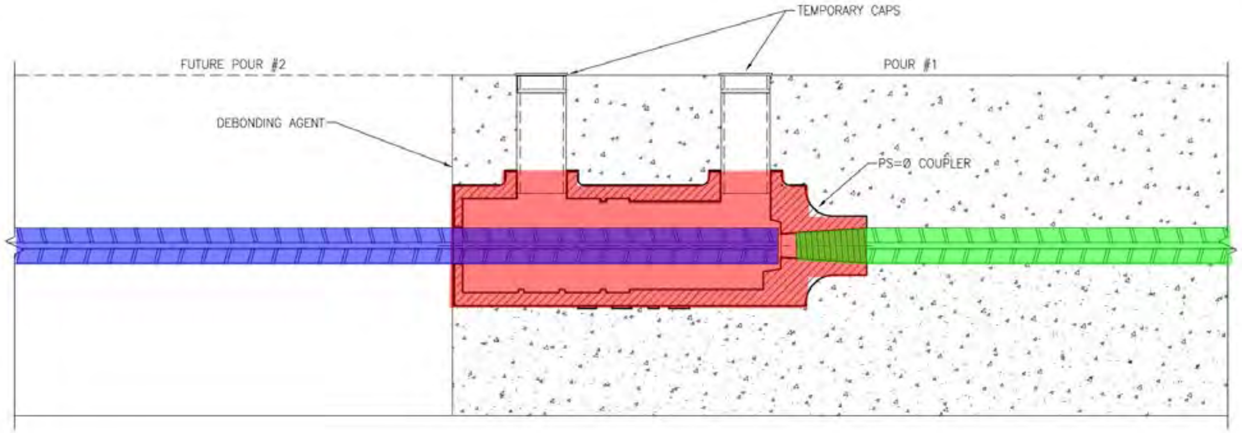
STEP 1



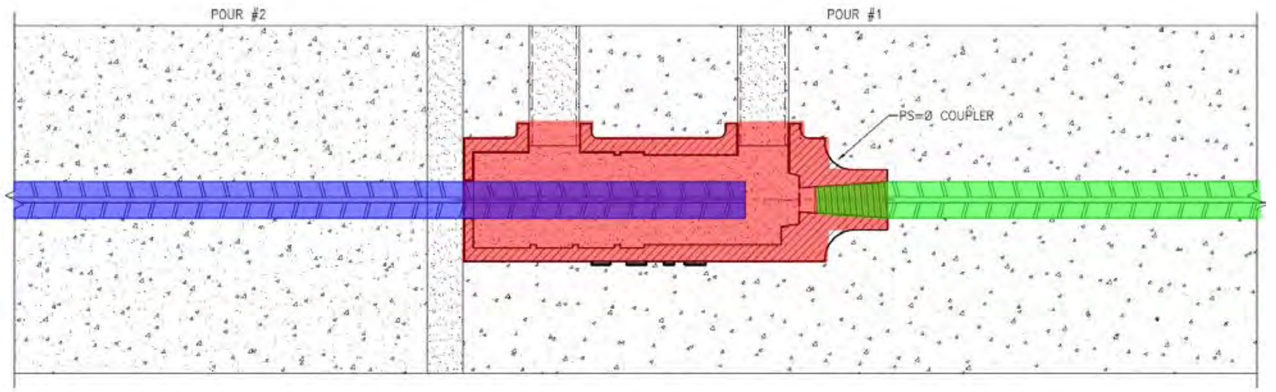
STEP 3



STEP 2



STEP 4

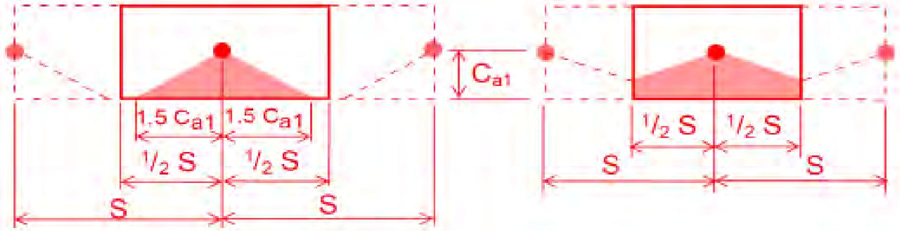


PS=Ø
Tech Sales, LLC
192 W 9th St
St Paul, MN 55102

SHEAR CAPACITY BASED ON CONCRETE BREAK OUT

ACI 318-19 Chapter 17

CASE 1 **CASE 2**



Anchor is at Mid. Depth

Slab thickness, t =	10.38 in	Supplement rebars =	No
Concrete strength, f'c =	3,000 psi	ϕ =	0.7 ACI T 17.5.3(b)
rebar size, #	7	Rebar spacing, S =	18 in
Rebar diameter, d_a =	0.875 in		CASE 1

$$V_{b1} = \left(7\left(\frac{l_e}{d_a}\right)^{0.2}\sqrt{d_a}\right)\lambda_a\sqrt{f_c'}\,(c_{a1})^{1.5}$$ ACI 17.7.2.2.1a

$$V_{b2} = 9\,\lambda_a\sqrt{f'c}\,(c_{a1})^{1.5}$$ ACI 17.7.2.2.1b

λ_a = 1.0 λ for cast-in anchors = 1 n/w conc. ACI - T 17.2.4.1

le = hef = min. (1.5 Ca1, 8da) = 7 in

Rebar location, C_{a1} = 5.19 in

V_{b1} = 6,423 lbs V_{b2} = 5,824 lbs

A_{VC} = 4.5 $(c_{a1})^2$ - Case 1 or 1.5 S (c_{a1}) = 121.0957 in^2 A_{VCO} = 4.5 (c_{a1}^2) = 121.10 in^2

Reduction factor

Edge factorfor the slab $\psi_{ed,V} = 0.7 + 0.3\frac{c_{a2}}{1.5c_{a1}}$ ACI 17.7.2.4.1
if 1/2 S < 1.5 ca1 $\psi_{ed,V}$ = 1

Breakout cracking factor $\psi_{c,V}$ = 1 ACI 17.7.2.5.1

Breakout thickness factor $\psi_{h,V} = \sqrt{\frac{1.5\,c_{a1}}{h_a}} =$ $\psi_{h,V}$ = 1 ACI 17.7.2.6.1

$$\emptyset Vn = \emptyset\,\frac{A_{VC}}{A_{VCO}}\,\psi_{ed,V}\,\psi_{c,V}\,\psi_{h,V}\,V_b$$ ACI Eq. 17.7.2.1a

ϕVn = 4,077 lbs

PS=Ø
Tech Sales, LLC
192 W 9th St
St Paul, MN 55102

SHEAR CAPACITY BASED ON CONCRETE BREAK OUT

ACI 318-19 Chapter 17

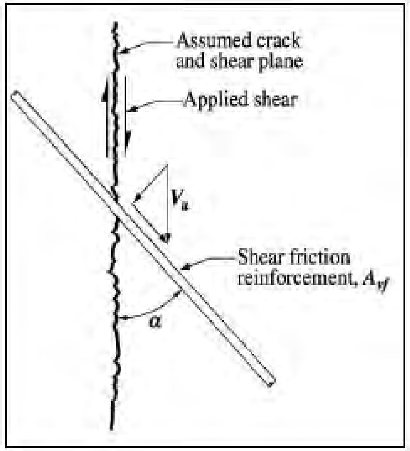
t slab	(in)	14	8	9	10.375	11	13
f'c	psi	3,000	3,000	3,000	3,000	3,000	3,000
ϕ		0.7	0.7	0.7	0.7	0.7	0.7
α_a = 1.0 α		1	1	1	1	1	1
spacing	(in)	18	18	18	18	18	18
C_{a1}	(in)	7	4	4.5	5.1875	5.5	6.5
A_{vco}	in^2	220.5	72	91.125	121.095703	136.125	190.125
A_{vc}	in^2	189	72	91.125	121.095703	136.125	175.5
bar size	#	7	7	7	7	7	7
da	in	0.875	0.875	0.875	0.875	0.875	0.875
le	in	7	6	6.75	7	7	7
V_{b1}	lbs	10068	4217	5152	6423	7012	9008
V_{b2}	lbs	9130	3944	4706	5824	6358	8169
$\Psi_{ed,V}$		0.96	1.00	1.00	1.00	1.00	0.98
$\Psi_{c,V}$		1.00	1.00	1.00	1.00	1.00	1.00
$\Psi_{h,V} = (1.5\,c_{a1}/h_a)$^0.5		1.00	1.00	1.00	1.00	1.00	1.00
ϕV_n	**lbs**	5,243	2,761	3,294	4,077	4,451	5,157

PS=0®
Tech Sales, LLC
192 W 9th St
St Paul, MN 55102

Project : 121 E Wilson
Date : 11/9/2023
Engineer : JP

Shear Friction Design Method

ACI 318-19, Sec 22.9



$\phi V_n = \phi A_{vf} f_y (\mu \sin \alpha_f + \cos \alpha_f)$ [22.9.4.3]

$\phi V_n = \phi \mu A_{vf} f_y$ where $\alpha_f = 90°$ [22.9.4]

$\phi =$ 0.75 [T 21.2.1]

Coeff. of friction, μ = Against NOT intentionally roughened surface

$\mu =$ 0.6 λ [T22.9.4.2]

Concrete Type, λ = Normalweight

$\lambda =$ 1 [T19.2.4.1]

fy = 60 ksi
α_f = 90 °
bar # 7
A_{vf} = 0.60 in^2
n, number of bars = 1
ΣA_{vf} = 0.6 in^2

ϕV_n = 16.20 kips / bars
Total ϕV_n = 16.20 kips

Shear Plan, Limit Based on Concrete :

f'c = 6,000 psi
t = 11 in
Spacing, L = 18 in
Ac = t L = 198 in^2 Ac = Area of concrete section resisting shear transfer

If μ = 1.4 or 1 $\phi Vn_2 = \phi\mu$ min (0.2 f'c Ac, (480+0.08 f'c) Ac, 1600 Ac) 85.5 kips
If μ = 0.6 or 0.7 $\phi Vn_2 = \phi\mu$ min (0.2 f'c Ac, 800 Ac) 71.3 kips

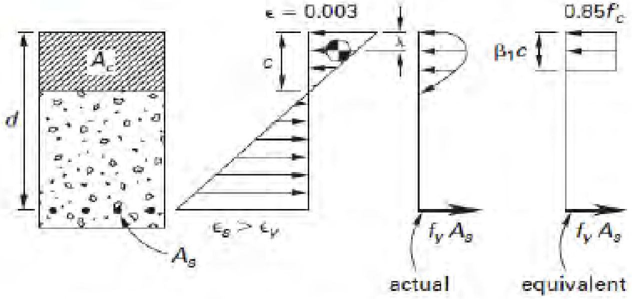
ϕV_{n2} = 71.28 kips

Use ϕ Vn = **16.20 kips**

PS=0®
Tech Sales, LLC
192 W 9th St
St Paul, MN 55102

Project: 121 E Wilson
Engineer: JP
Date: 1/5/2024

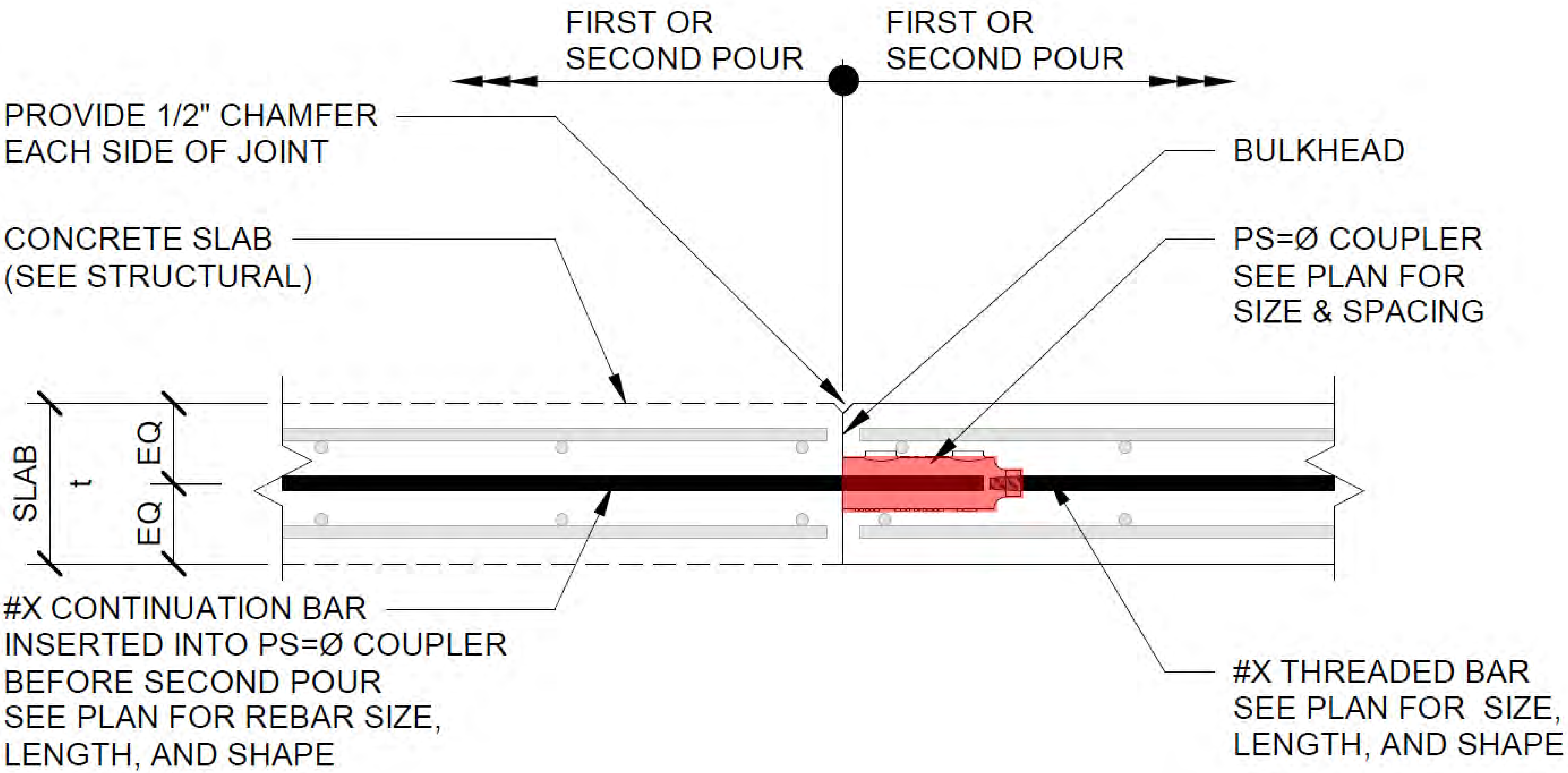
Note: P2,P1

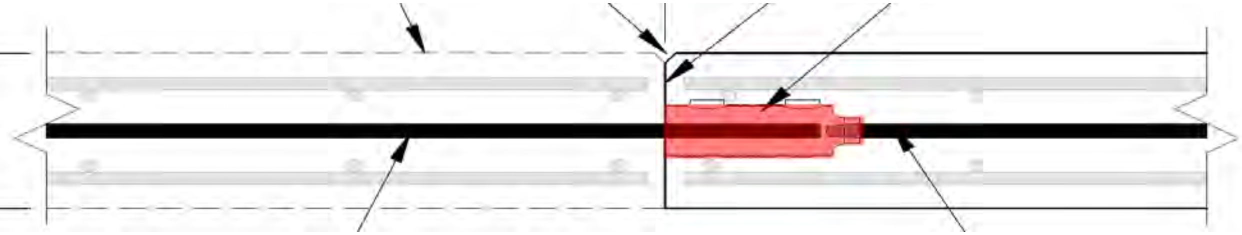


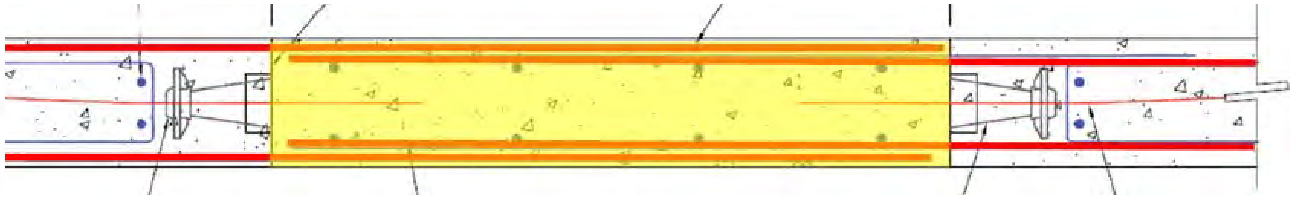
(a) strain distribution (b) compressive stress distribution (c) equivalent rectangular compressive stress block

s =	18	in	Coupler spacing
d =	5.1875	in	depth of rienforcement
f_y =	60,000	psi	Tension steel yield strength
A_s =	0.6	in^2	Area of rebar being coupled
F_c' =	6,000	psi	Concrete compressive strength
T_u =	21	k/ft	Tension Demand per foot
M_u =	2	k-ft/ft	Moment demand Per foot
A_c=	7.06	in^2	Area of concrete in compression
λ=	0.20	in	Distance from centroid of compression to extreme compression fiber
ϕT_n =	21.60	k/ft	Tension Capacity per foot
ϕM_n =	8.98	k-ft/ft	Flexural capacity of slab per linear ft across joint
Combined interaction	0.99	=<1	$(T_u/\phi T_n)^2 + (M_u/\phi M_n)^2$ - Combined capacity of slab per linear ft across joint

s in	d in	fy psi	Bar Size	As in^2	f'c psi	Ac in^2	λ in	Tu k/ft	Mu k-ft/ft	ϕT_n k/ft	ϕM_n k-ft/ft	Combined Interaction
18	6.5	60,000	# 7	0.60	6,000	7.06	0.20	21.00	2.50	21.60	11.35	0.994
18	5.1875	60,000	# 7	0.60	6,000	7.06	0.20	21.00	2.00	21.60	8.98	0.995
18	8	60,000	# 7	0.60	6,000	7.06	0.20	15.00	9.80	21.60	14.05	0.969
16	5.1875	60,000	# 7	0.60	6,000	7.06	0.22	0.00	9.80	24.30	10.06	0.949
0	0	60,000	# 7	0.60	6,000	7.06	#DIV/0!	12.50	6.00	#DIV/0!	#DIV/0!	#DIV/0!


FIRST OR
SECOND POUR
FIRST OR
SECOND POUR
PROVIDE 1/2" CHAMFER
EACH SIDE OF JOINT
BULKHEAD
CONCRETE SLAB
(SEE STRUCTURAL)
PS=Ø COUPLER
SEE PLAN FOR
SIZE & SPACING
SLAB
t
EQ
EQ
#X CONTINUATION BAR
INSERTED INTO PS=Ø COUPLER
BEFORE SECOND POUR
SEE PLAN FOR REBAR SIZE,
LENGTH, AND SHAPE
#X THREADED BAR
SEE PLAN FOR SIZE,
LENGTH, AND SHAPE





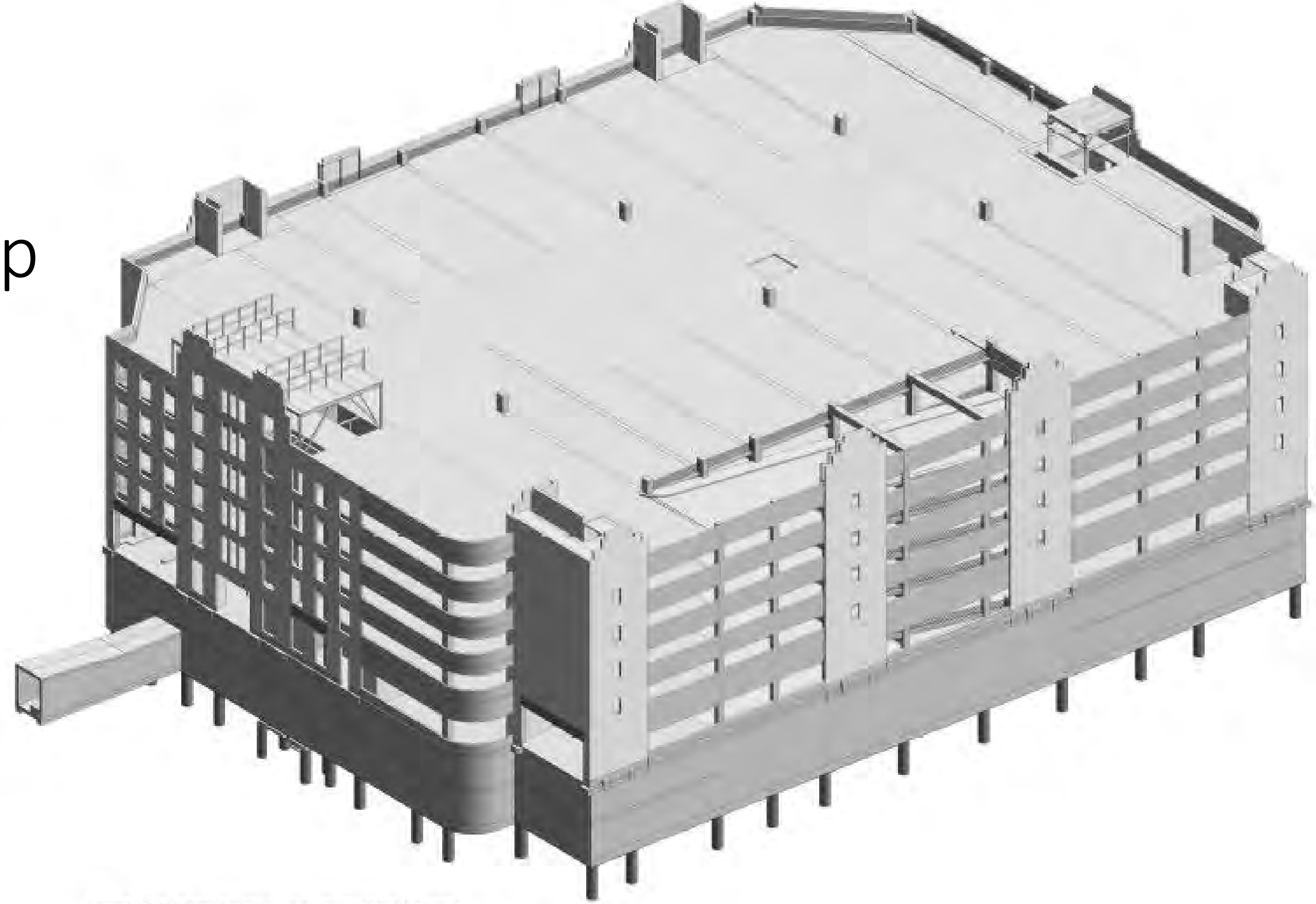
- ACI-permitted splice
- Meets ACI integrity
- Shear friction
- Continuous rebar
- Yielding
- Ductility
- Fixed
- Fire rated

VS.

- ACI-permitted splice
- Meets ACI integrity
- Shear friction
- Continuous rebar
- Yielding
- Ductility
- Fixed
- Fire rated

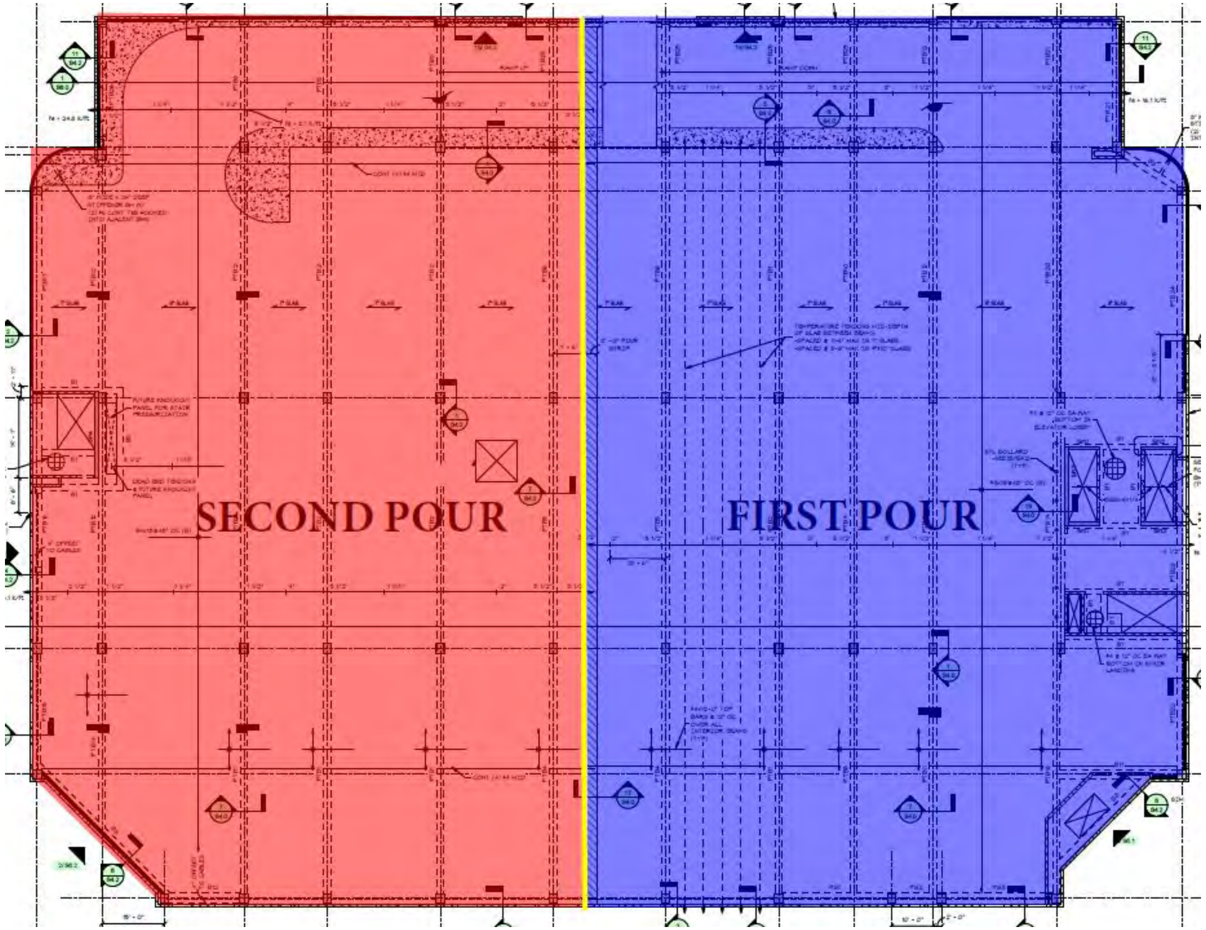
HOW IT WORKS

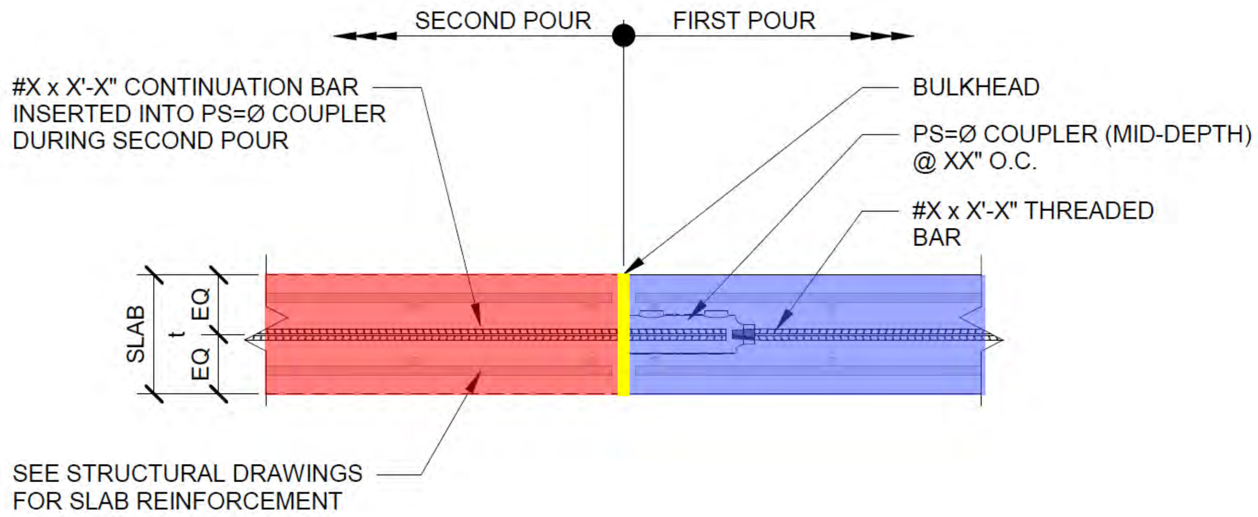
1. Slab to Slab
2. Temporary Stressing Strip
3. Slab to Wall
4. Sequencing
5. Expansion Joints



2 ISOMETRIC VIEW - SOUTHEAST CORNER
SCALE

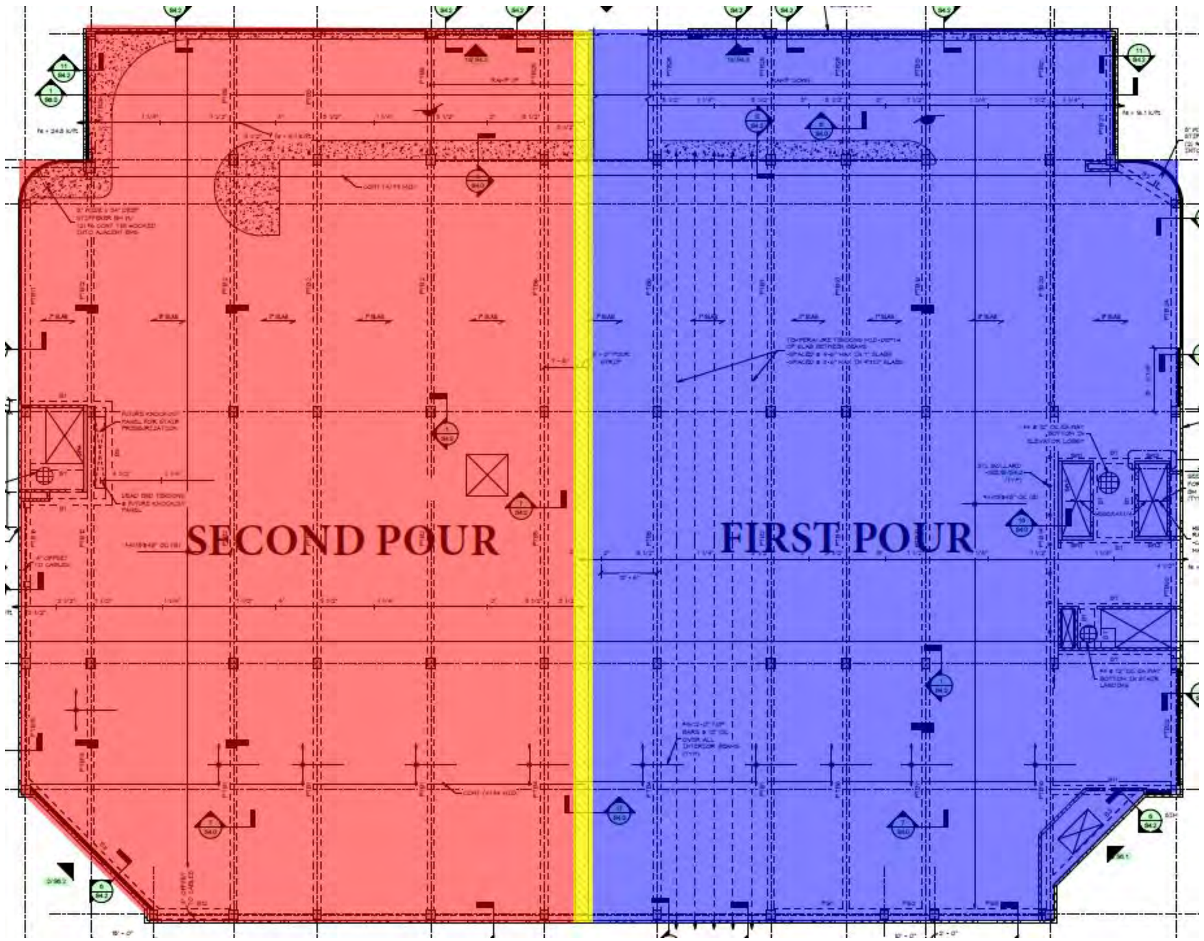
SLAB TO SLAB

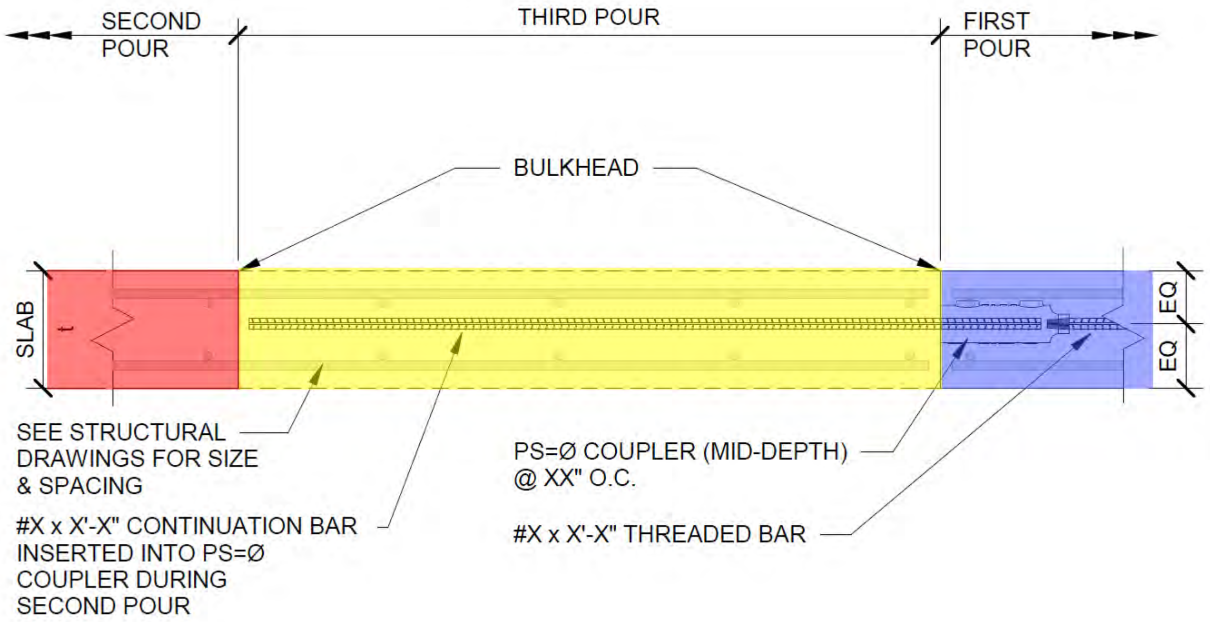




INFLECTION POINT

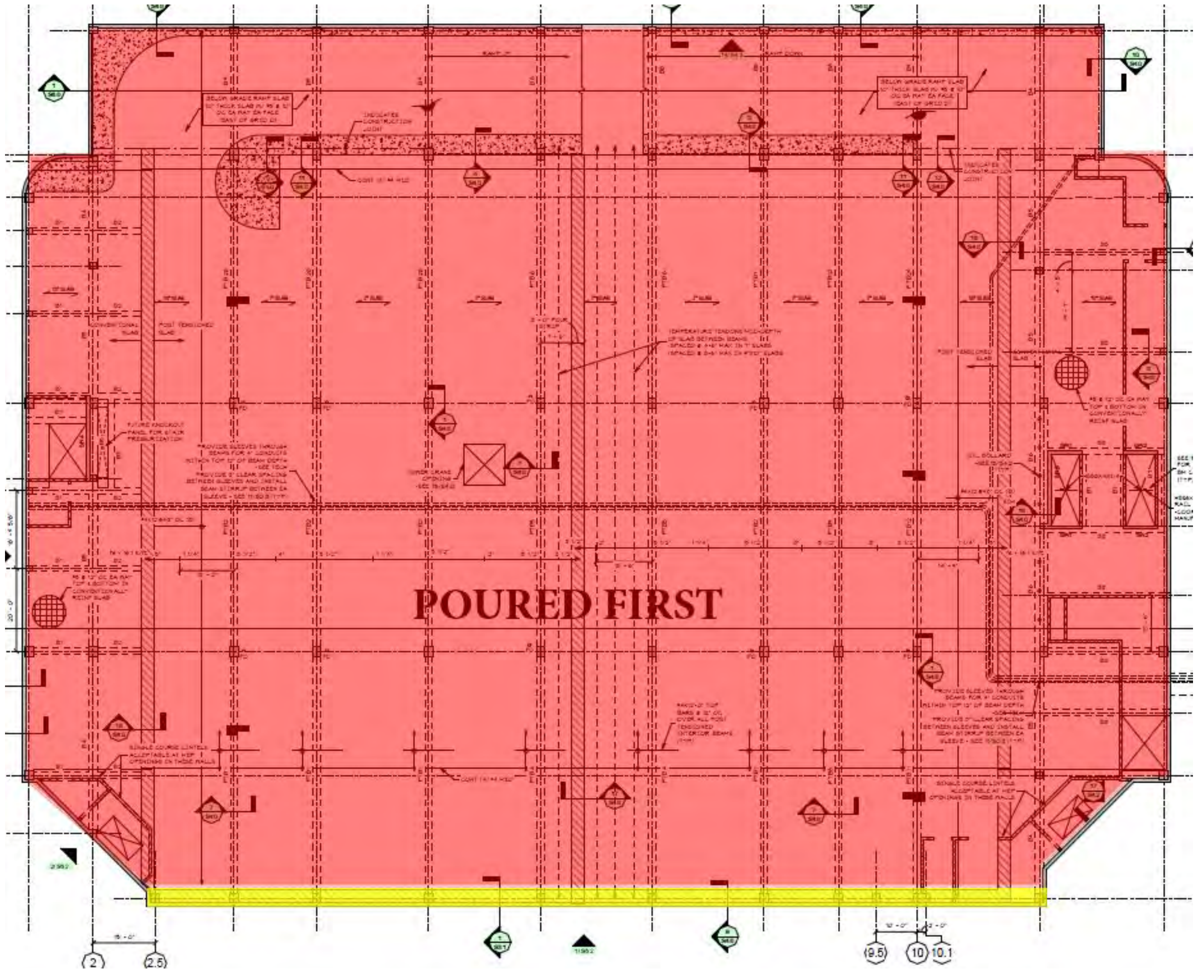
TEMPORARY STRESSING STRIP

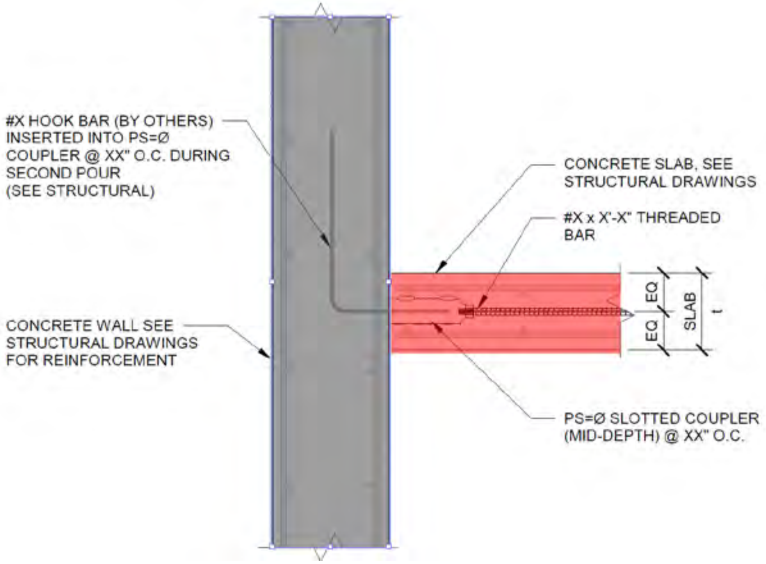


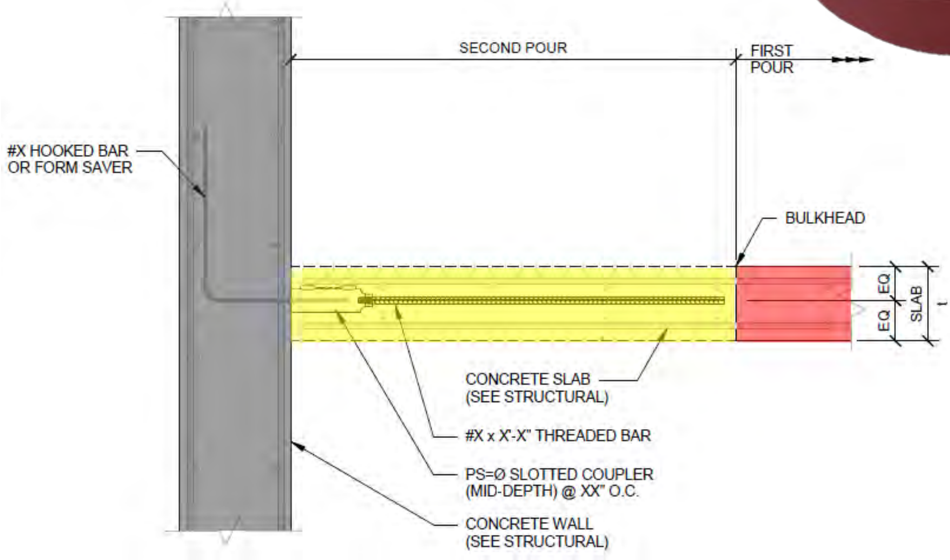


INFLECTION POINT

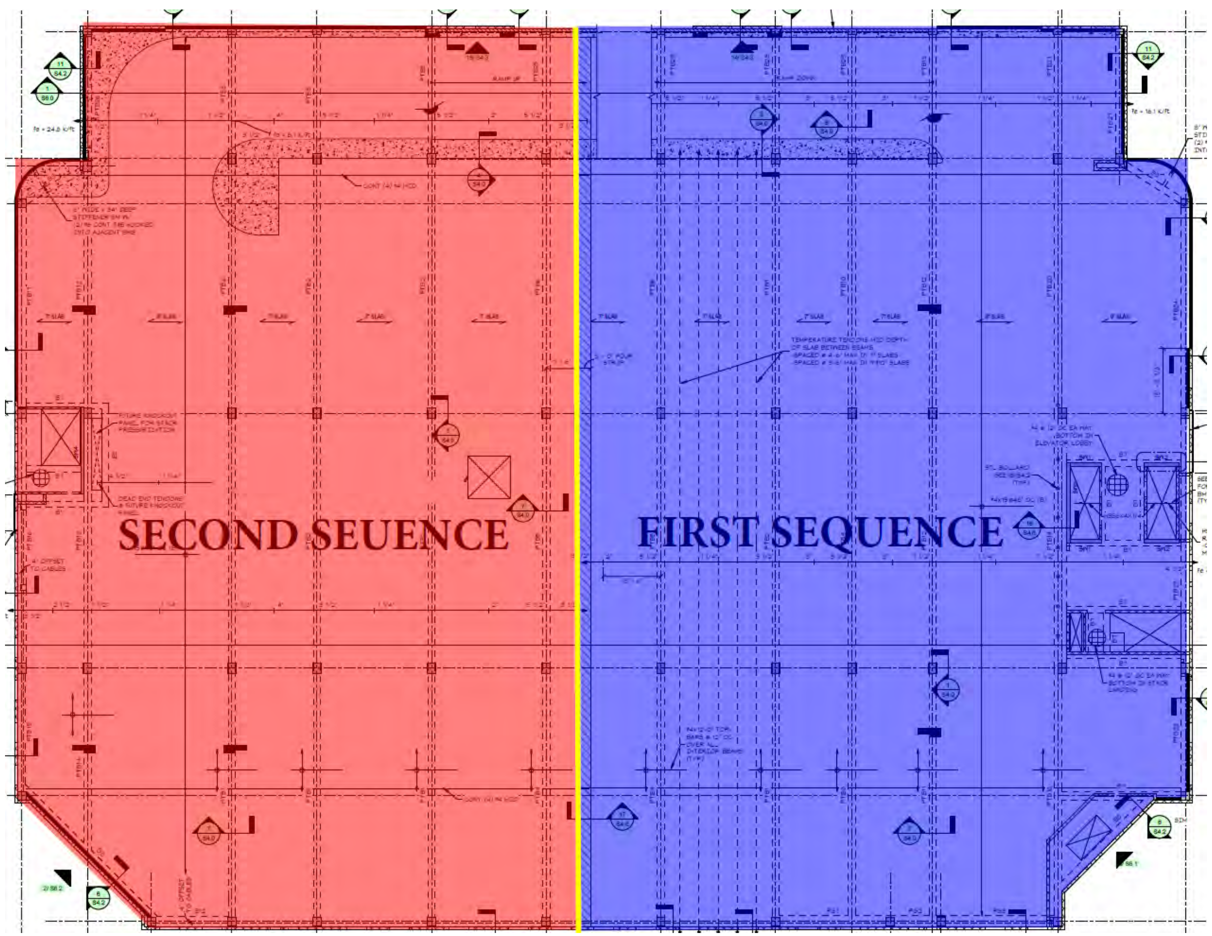
SLAB TO WALL

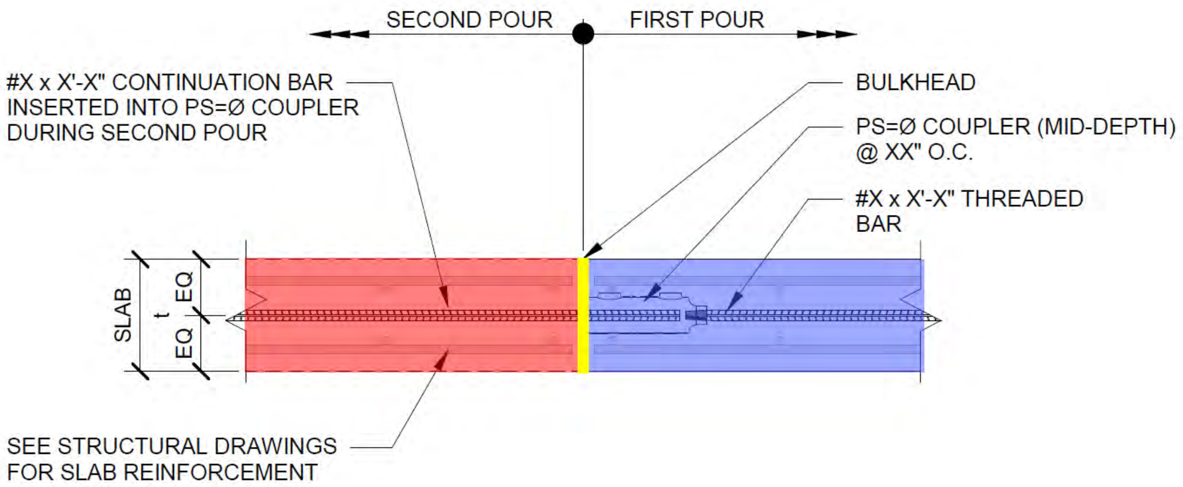

POURED FIRST


#X HOOK BAR (BY OTHERS) INSERTED INTO PS=Ø COUPLER @ XX" O.C. DURING SECOND POUR (SEE STRUCTURAL)
CONCRETE WALL SEE STRUCTURAL DRAWINGS FOR REINFORCEMENT
CONCRETE SLAB, SEE STRUCTURAL DRAWINGS
#X x X'-X" THREADED BAR
PS=Ø SLOTTED COUPLER (MID-DEPTH) @ XX" O.C.
EQ
EQ
SLAB
t

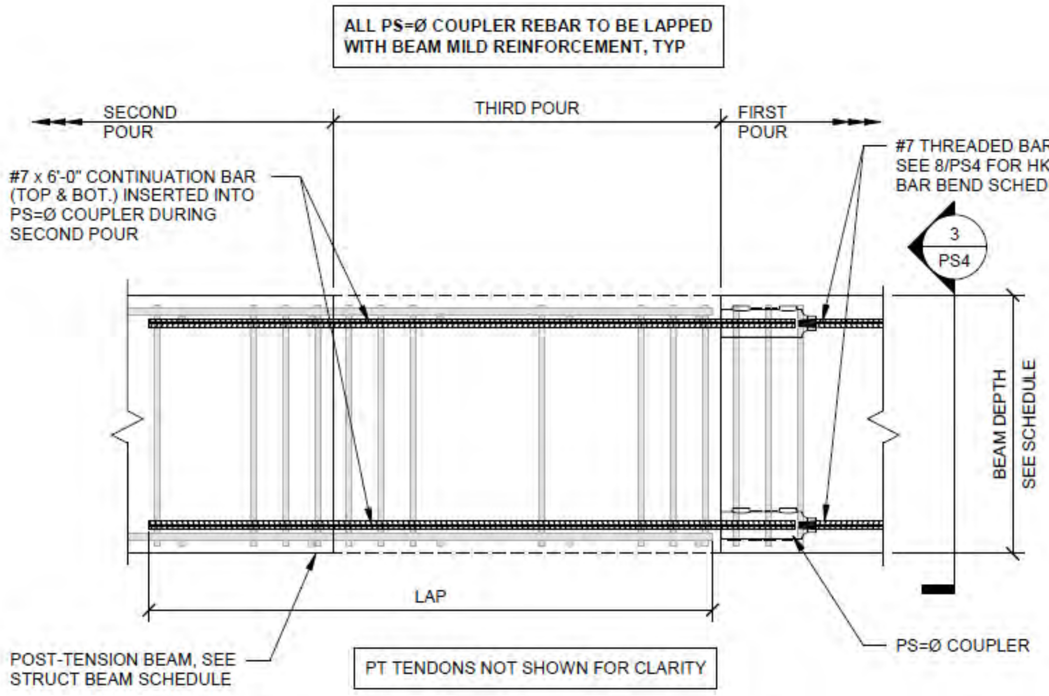

SECOND POUR
FIRST POUR
#X HOOKED BAR OR FORM SAVER
BULKHEAD
EQ
EQ
SLAB
t
CONCRETE SLAB (SEE STRUCTURAL)
#X x X'-X" THREADED BAR
PS=Ø SLOTTED COUPLER (MID-DEPTH) @ XX" O.C.
CONCRETE WALL (SEE STRUCTURAL)

SEQUENCING


SECOND SEUENCE
FIRST SEQUENCE

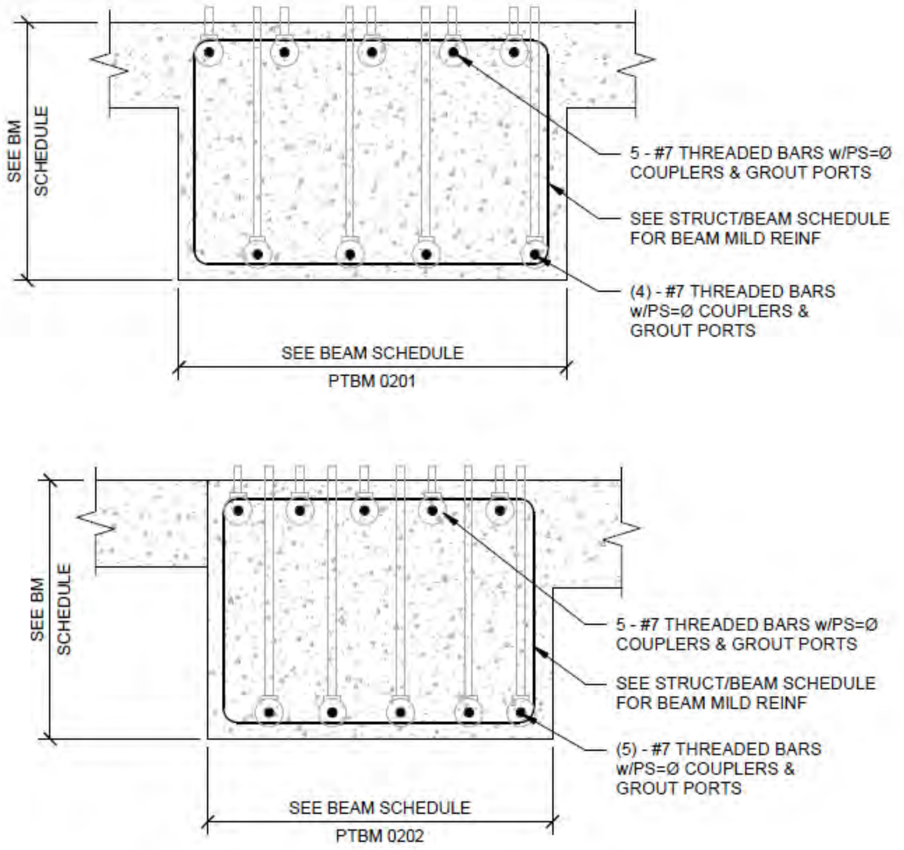

SECOND POUR
FIRST POUR
#X x X'-X" CONTINUATION BAR INSERTED INTO PS=Ø COUPLER DURING SECOND POUR
BULKHEAD
PS=Ø COUPLER (MID-DEPTH) @ XX" O.C.
#X x X'-X" THREADED BAR
SLAB
t
EQ
EQ
SEE STRUCTURAL DRAWINGS FOR SLAB REINFORCEMENT

BEAMS: PT and RC



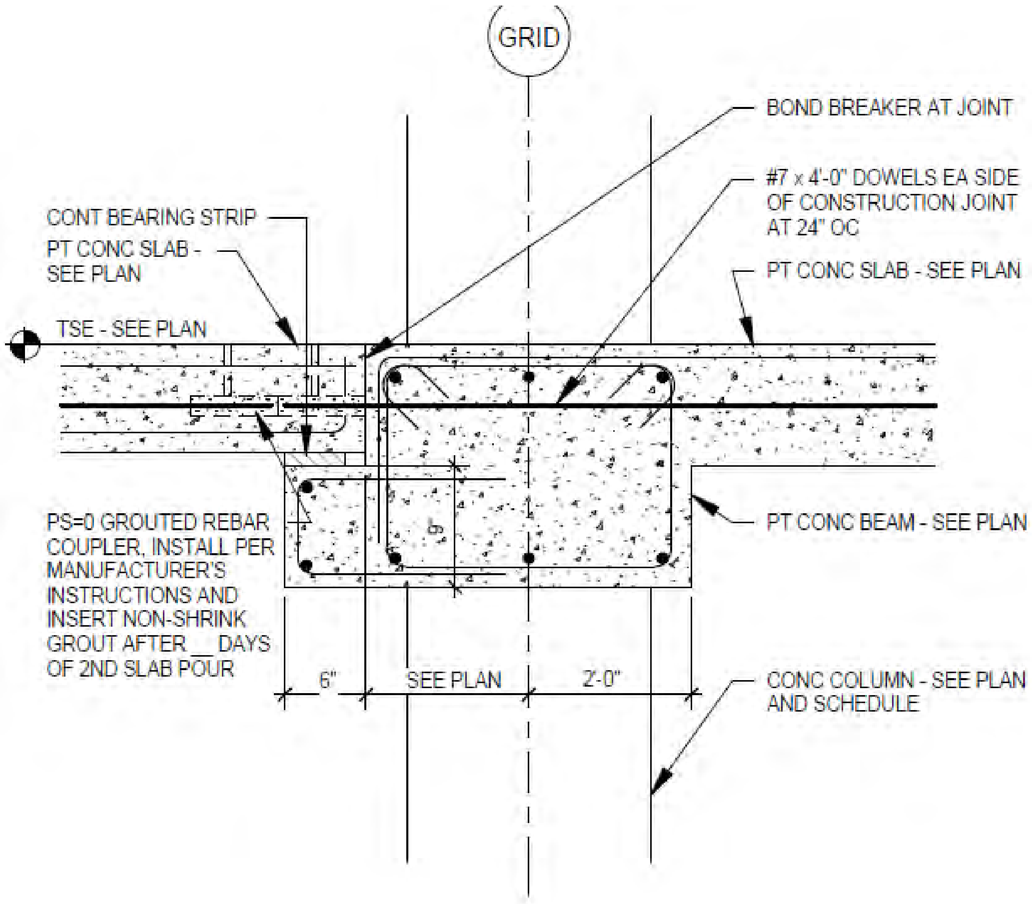
NOTES:
1. APPLY NOX-CRETE SILCOSEAL CLASSIC BOND-BREAKER BETWEEN FIRST AND THIRD POUR.
2. THE PS=Ø RELIEF JOINT TO REMAIN OPEN FOR XX DAYS (E.O.R. TO SPECIFY).
3. AFTER THE TIME PERIOD SPECIFIED ABOVE, THE PS=Ø COUPLERS AND JOINT TO BE GROUTED WITH BASF MASTERFLOW 885 HIGH-PRECISION, NONSHRINK METALLIC-AGGERATE GROUT.
4. SEE PS=Ø MANUFACTURE DATA FOR MORE INFORMATION.

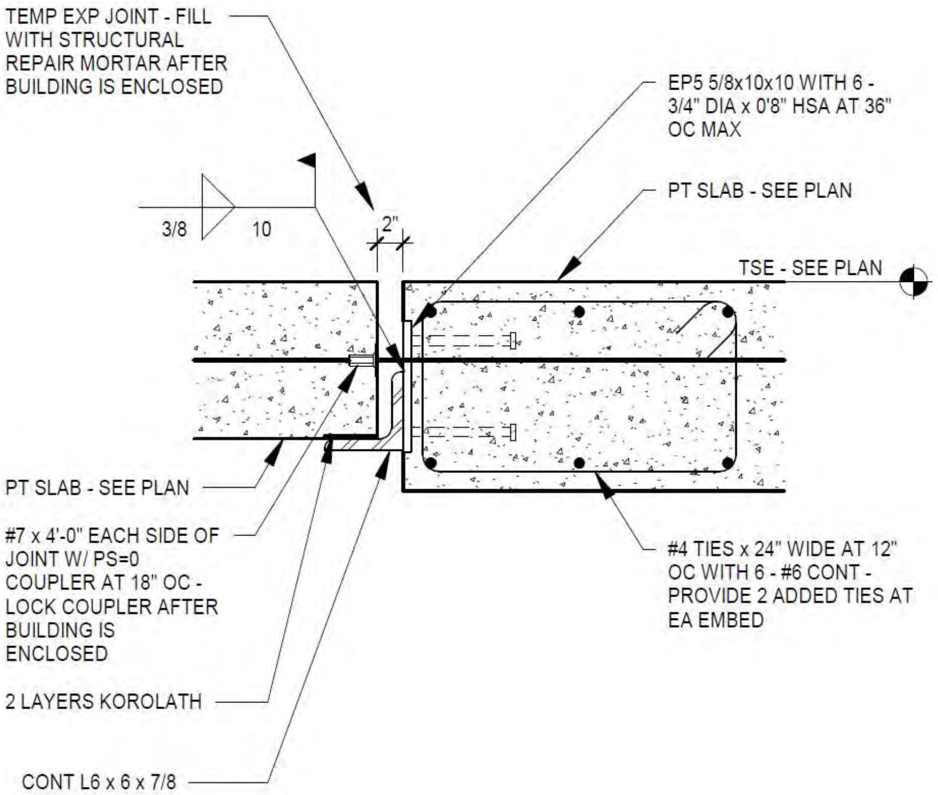
2 / PS4 DETAIL - PS=Ø STRESSING STRIP @ POST-TENSION BEAM
1" = 1'-0"



3 / PS4 DETAIL - POST TENSION BEAM PROFILES w/PS=Ø COUPLERS
1" = 1'-0"

EXPANSION JOINTS





WHAT'S OFFERED

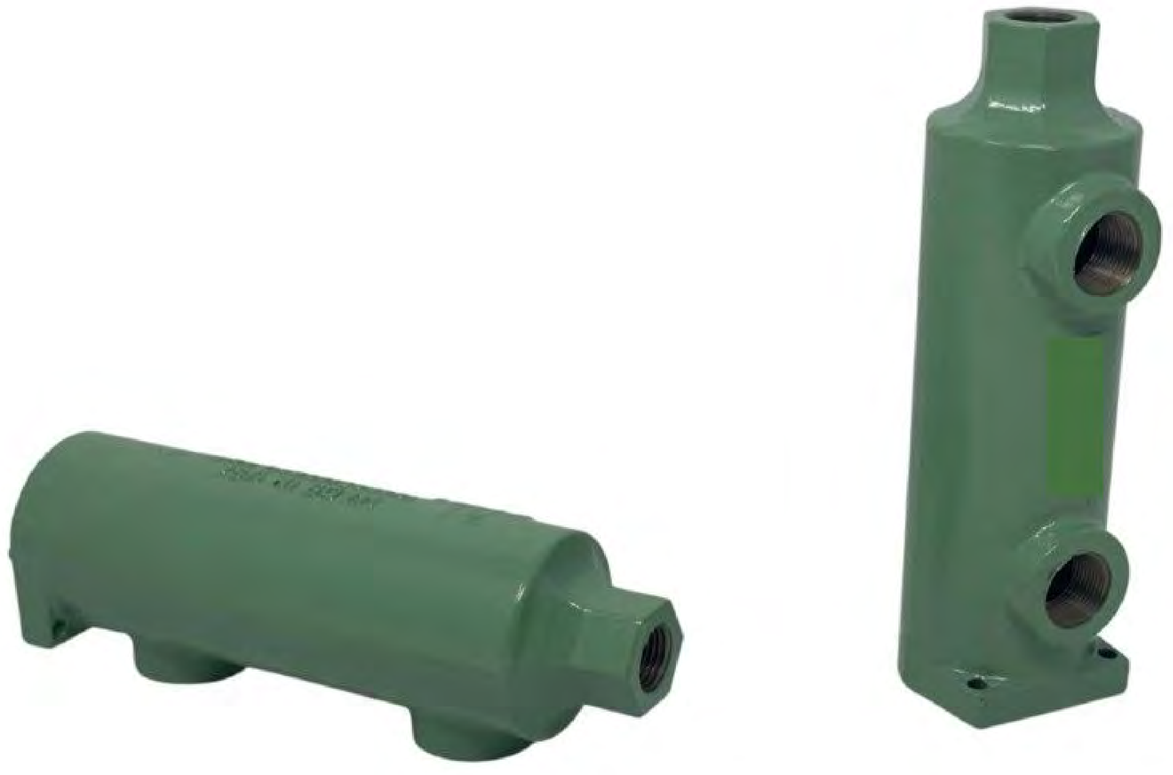
- Full tension mechanical splice
    - Type 1 & Type 2
    - #6 (Gr.60)
    - #7(Gr.60)
    - #8(Gr.60, Gr.80)
    - Epoxy coated

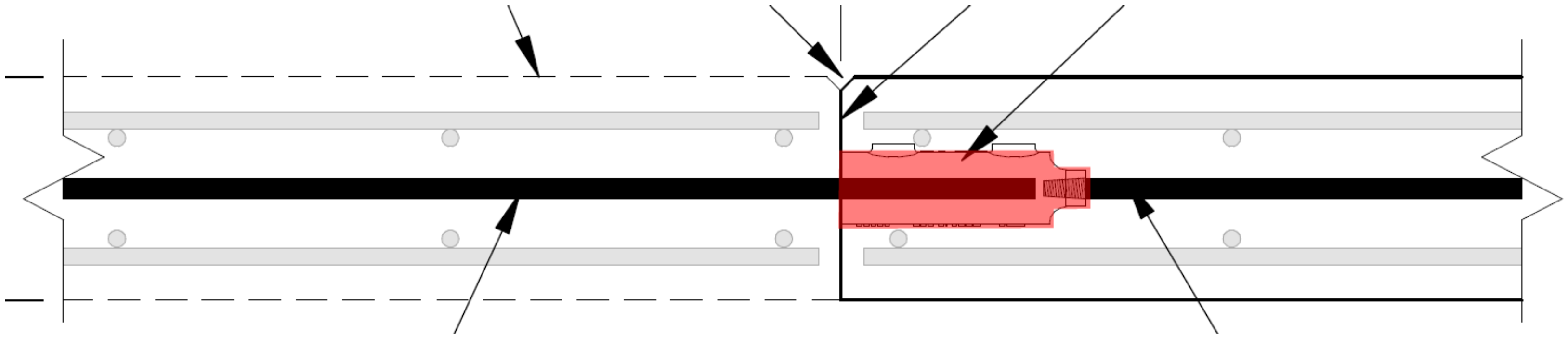
- Movement
    - Longitudinal
    - Transverse

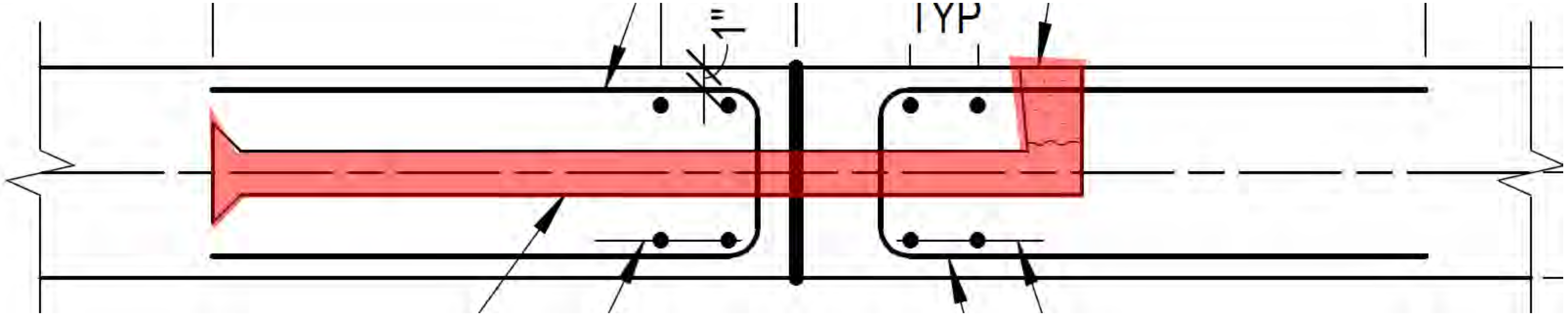
WHAT'S INCLUDED

- Full package
  - Mechanical coupler
  - Torque wrench
  - Grout tubes with caps
  - Bond breaker
  - Sprayer for bond breaker
  - Non-shrink grout

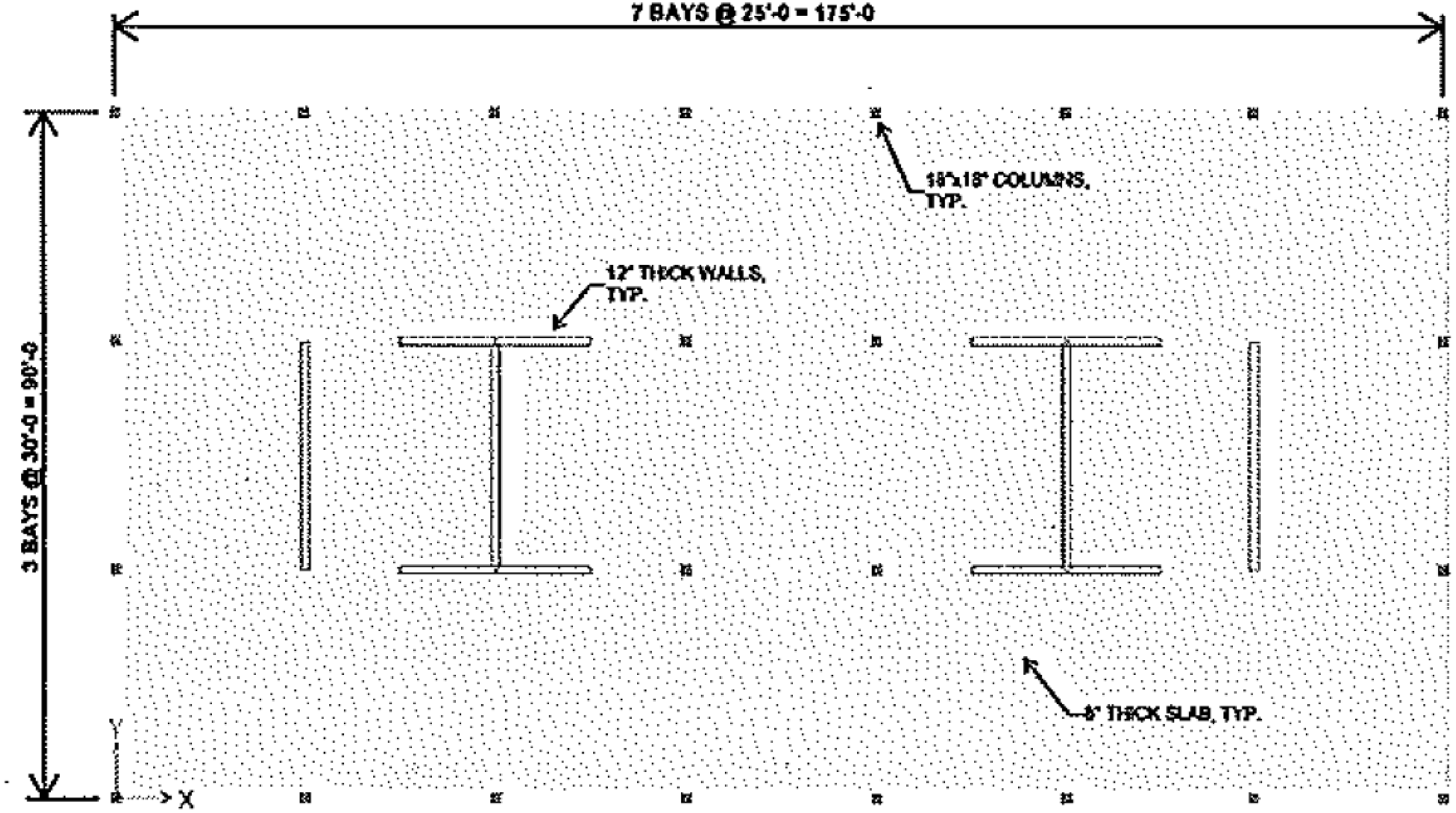
- Full support
  - Technical
  - Shop drawings
  - On-site assistance





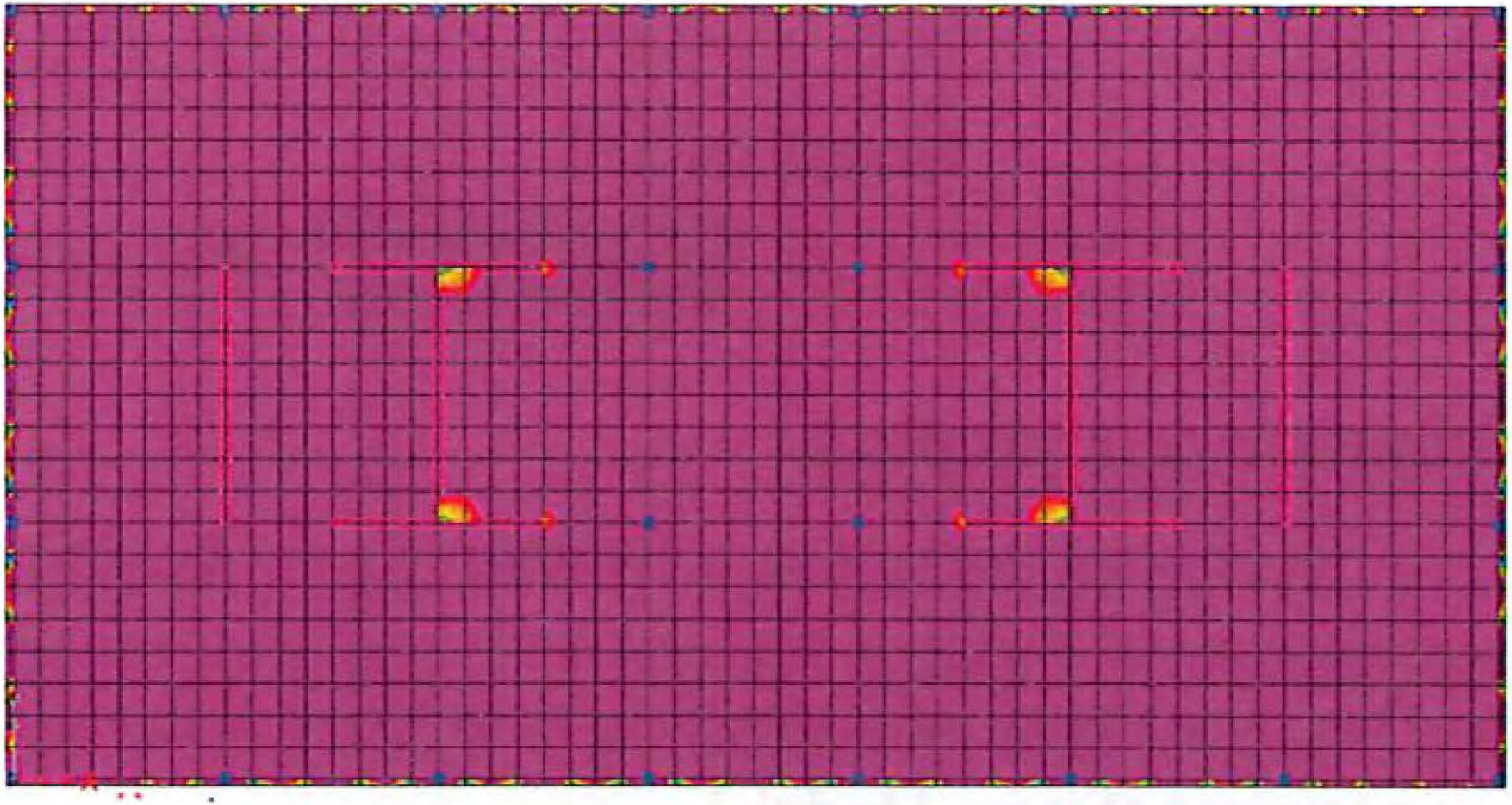

TYP

PTI DC20.2-22: 7.2 – Model Examples – Model 1



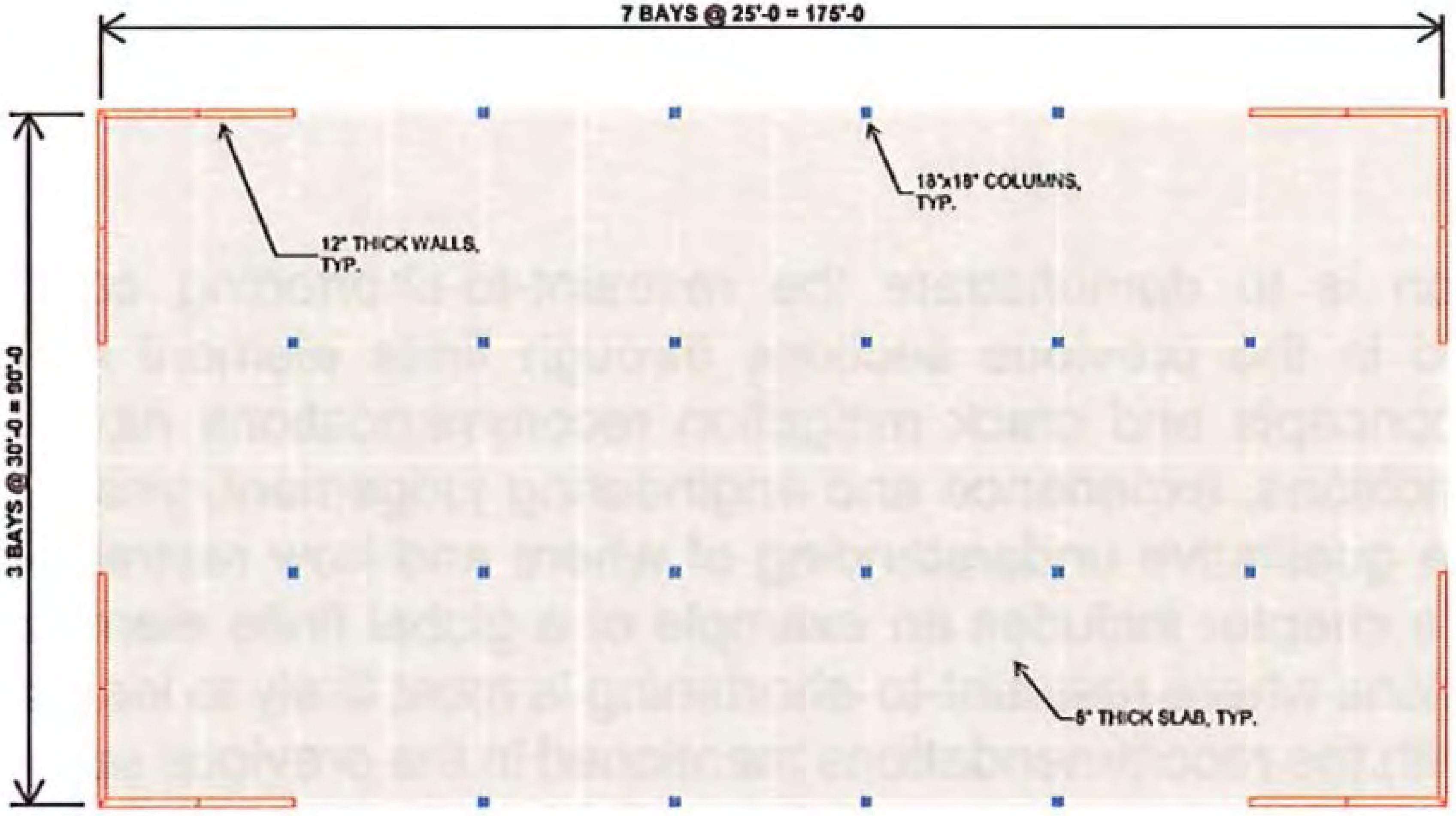
25 ft x 30 ft bays, 8 in. slab, 12 in. walls

PTI DC20.2-22: 7.2 – Model Examples – Model 1



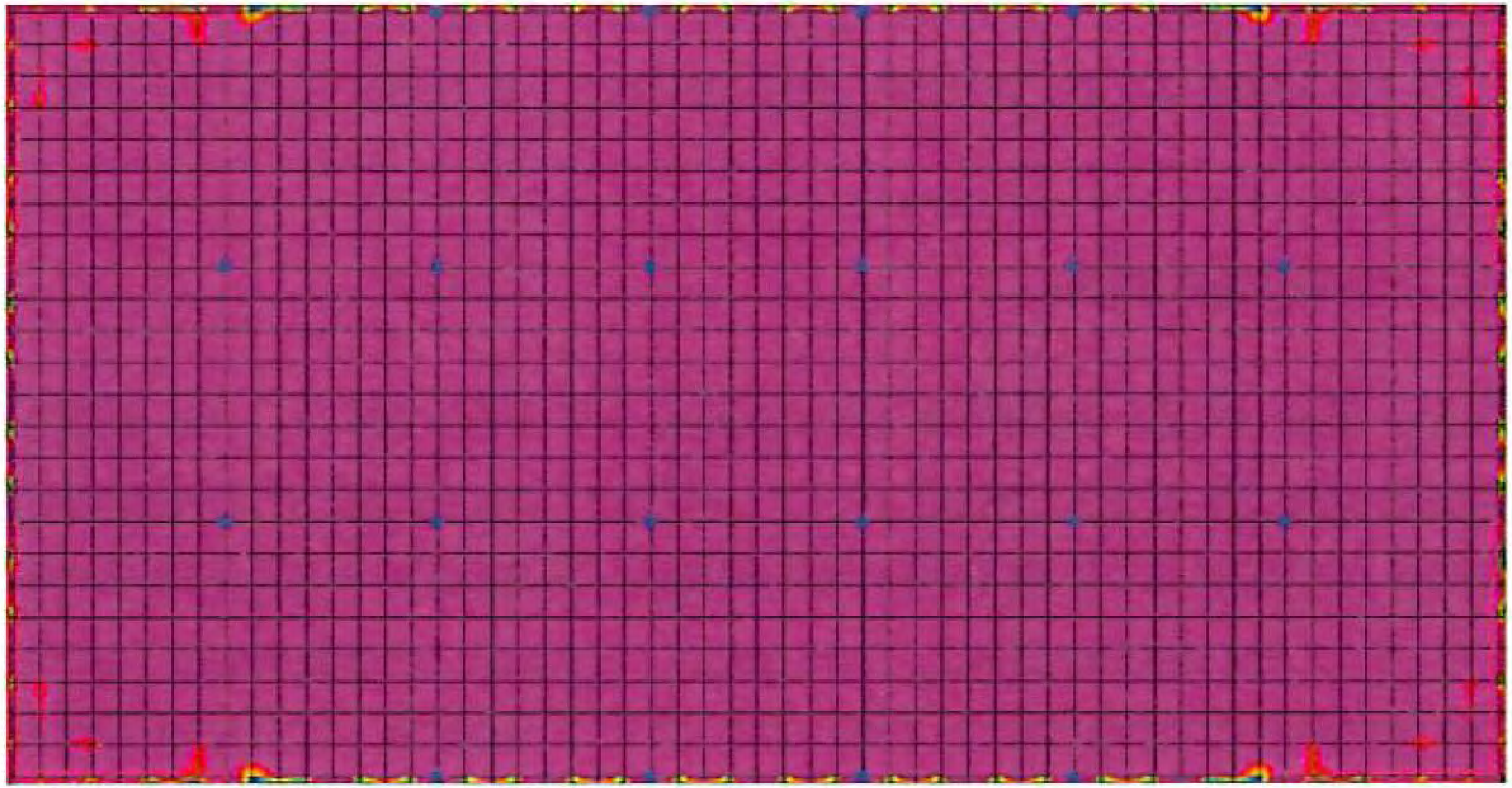
Fully Connected at Final

PTI DC20.2-22: 7.2 – Model Examples – Model 2



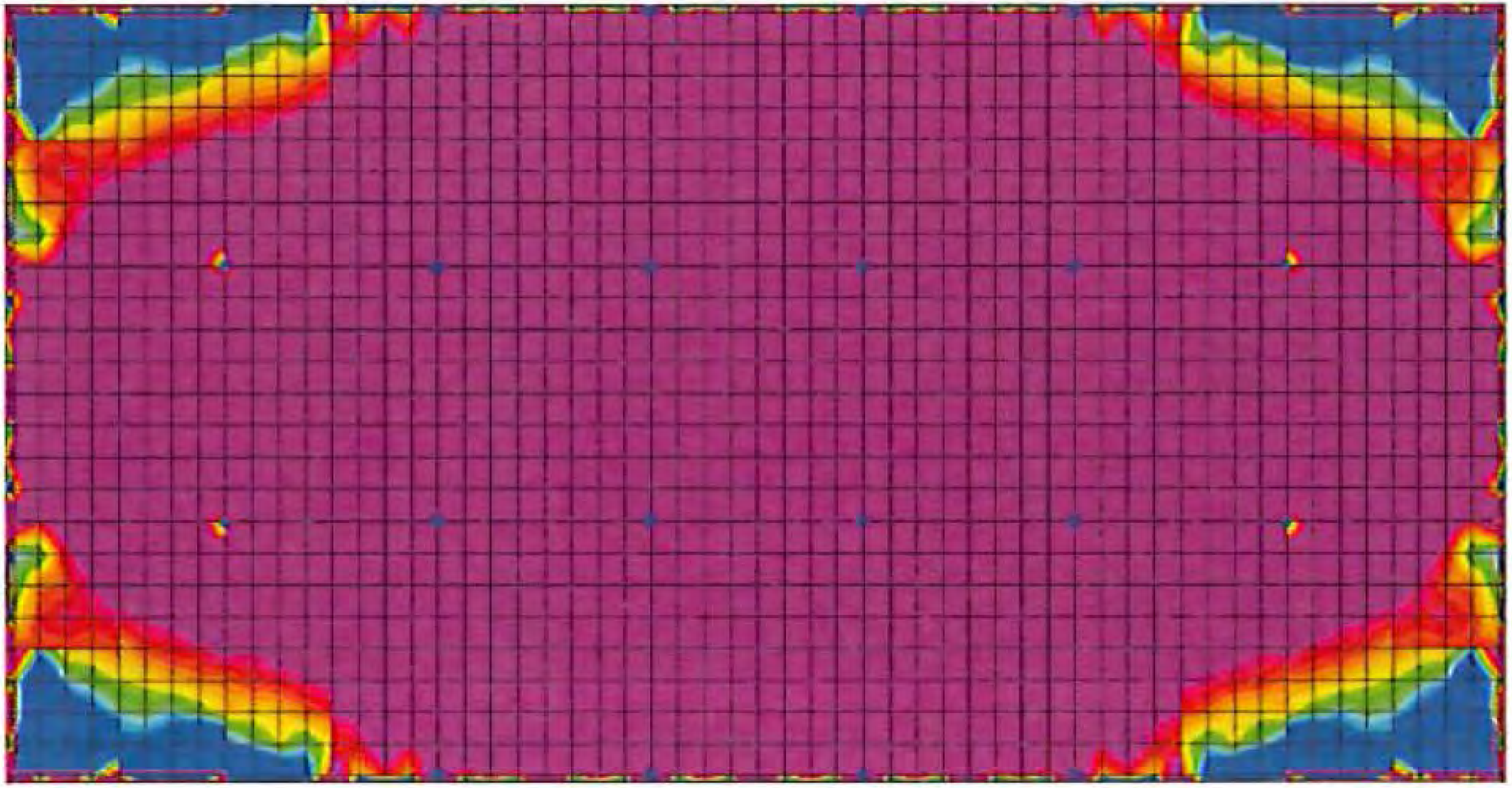
25 ft x 30 ft bays, 8 in. slab, 12 in. walls

PTI DC20.2-22: 7.2 – Model Examples – Model 2



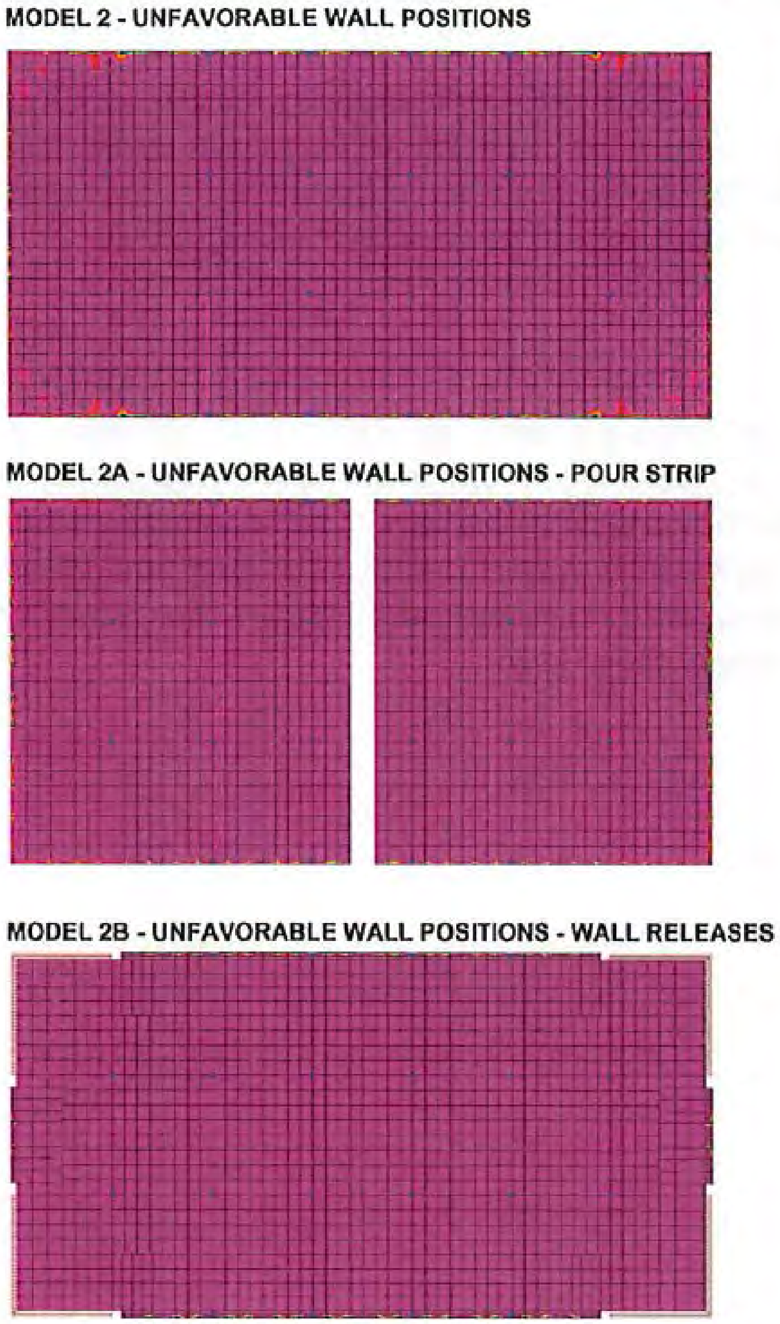
Fully Connected at 30 days

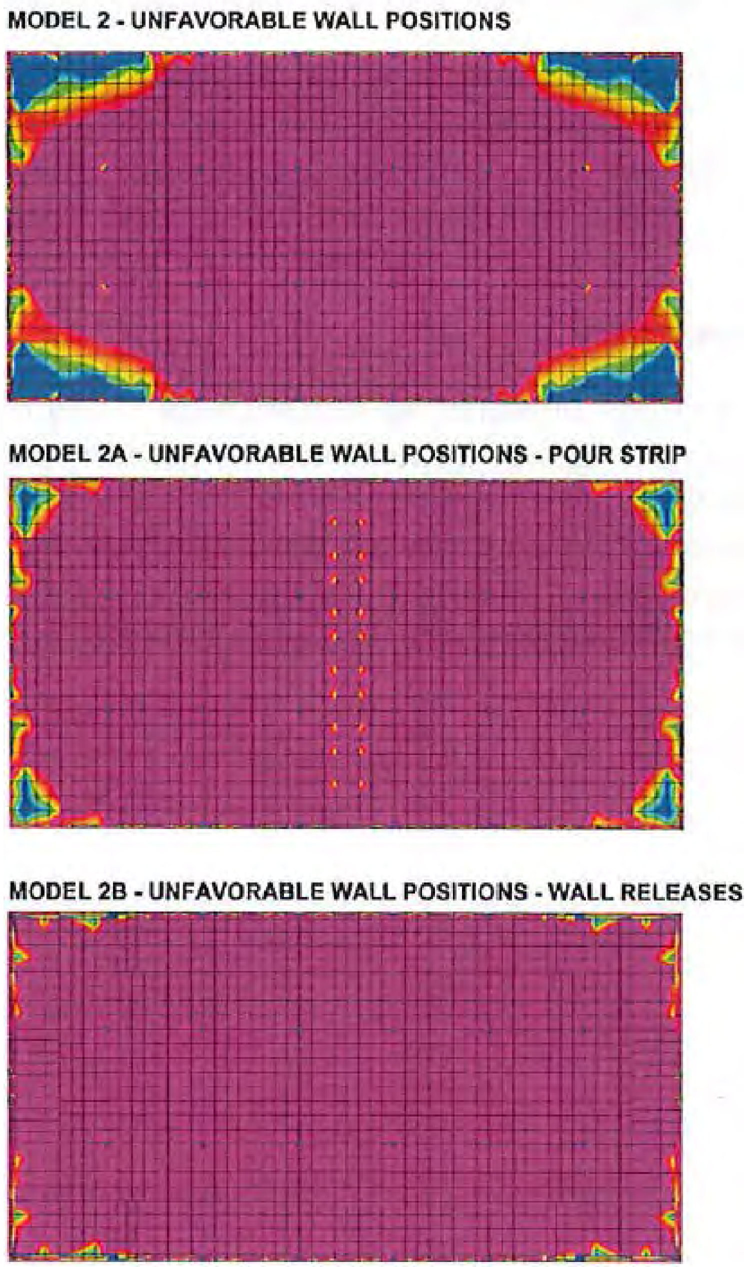
PTI DC20.2-22: 7.2 – Model Examples – Model 2



Fully Connected at Final

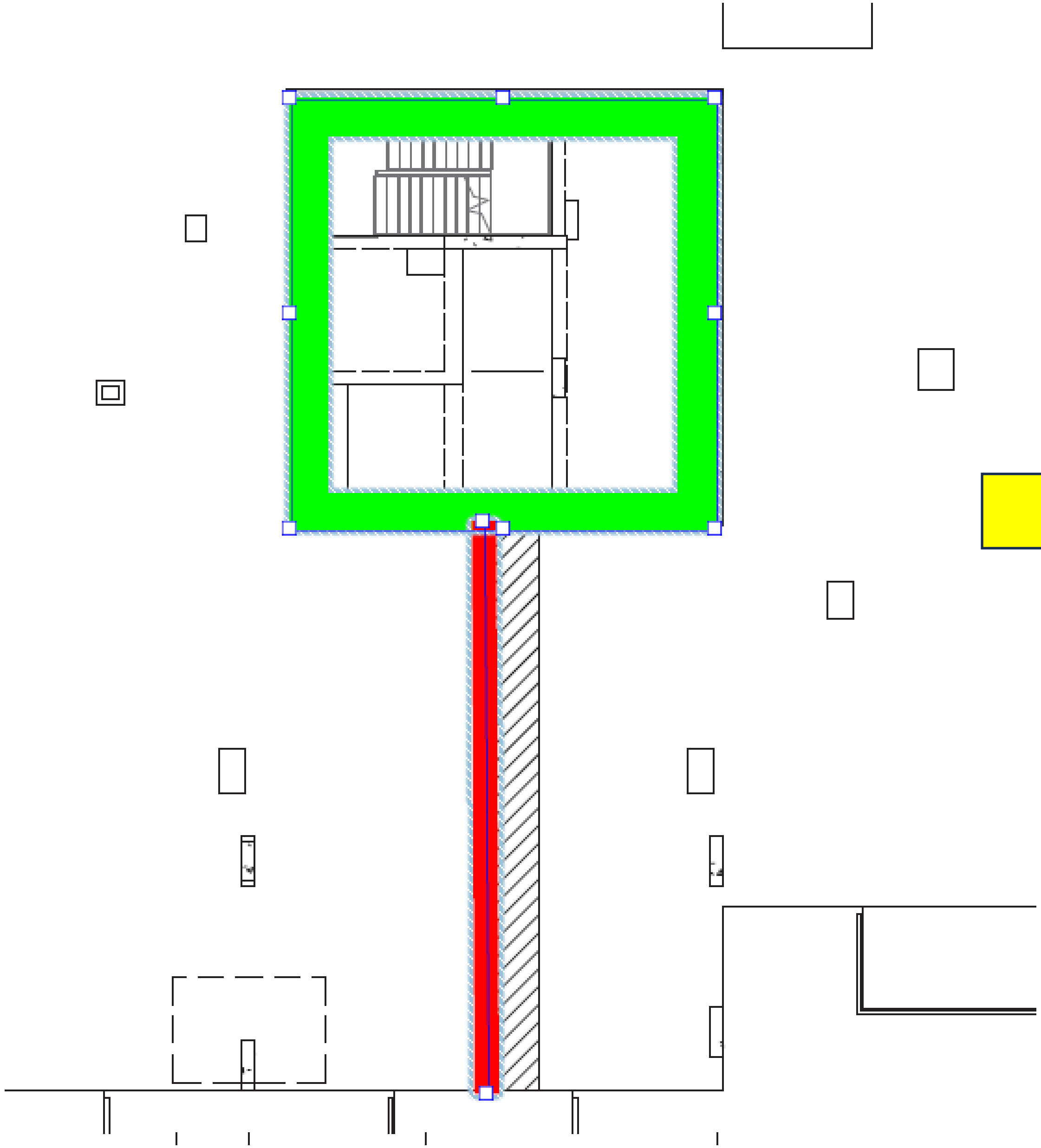
30 Days

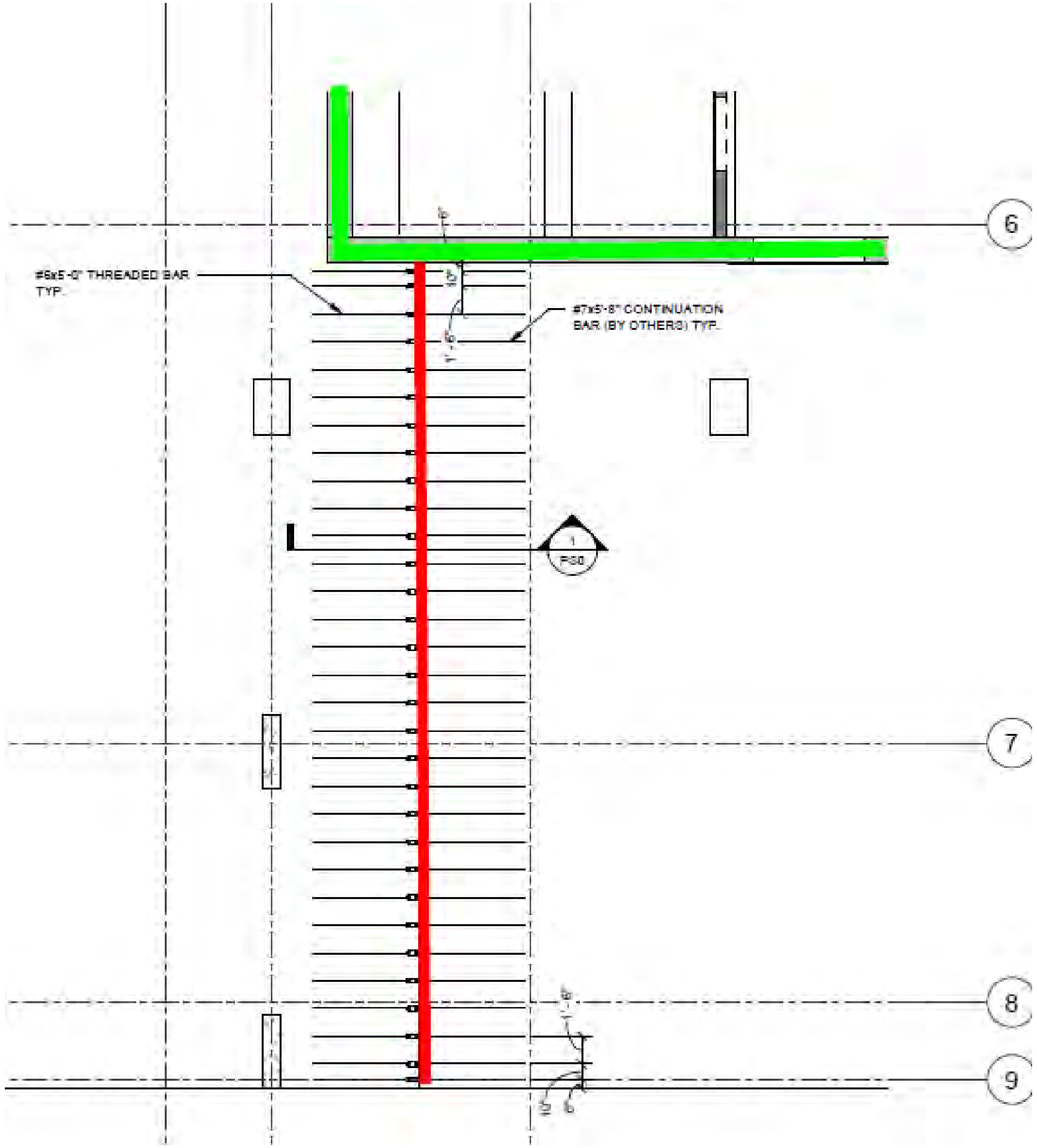


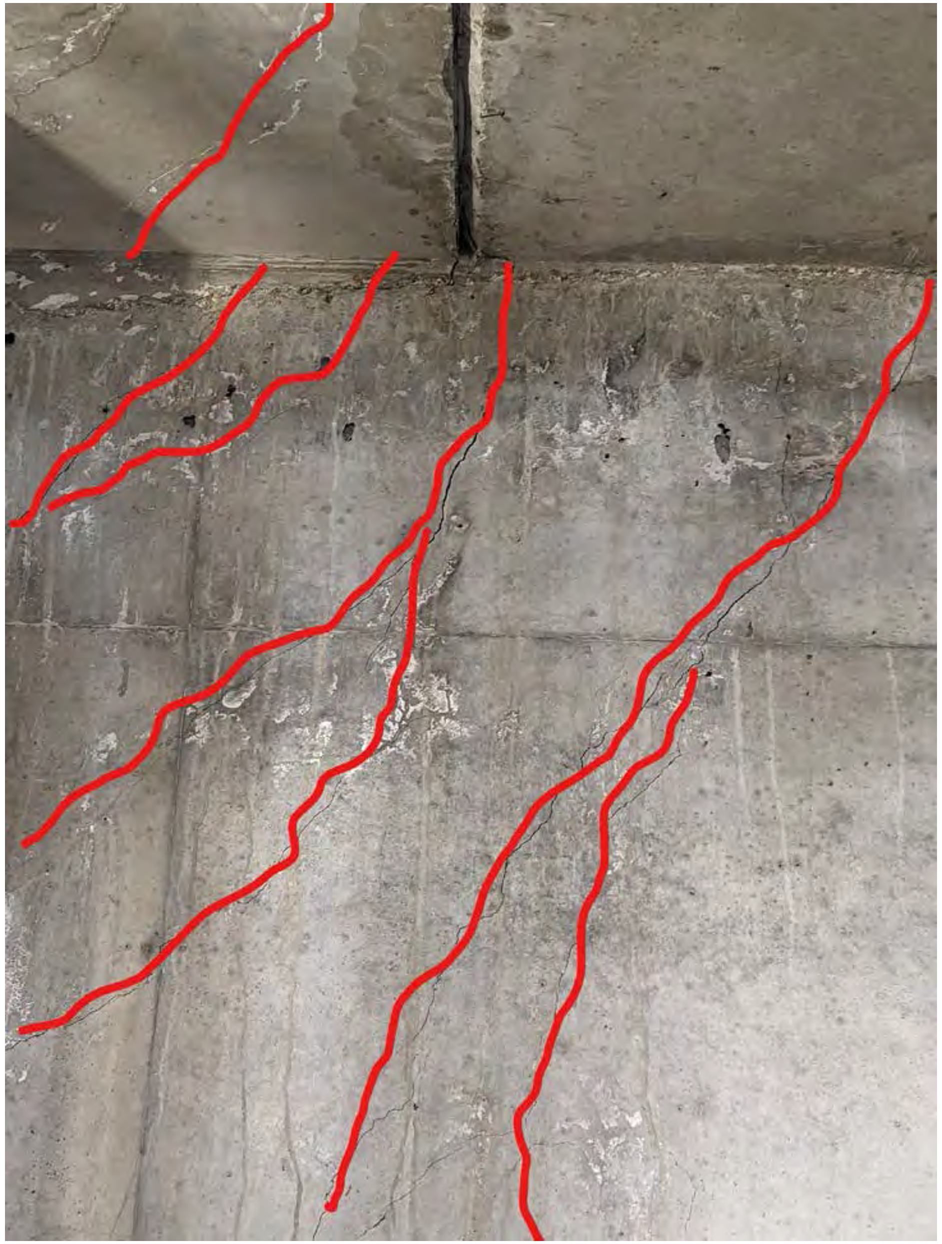


Final

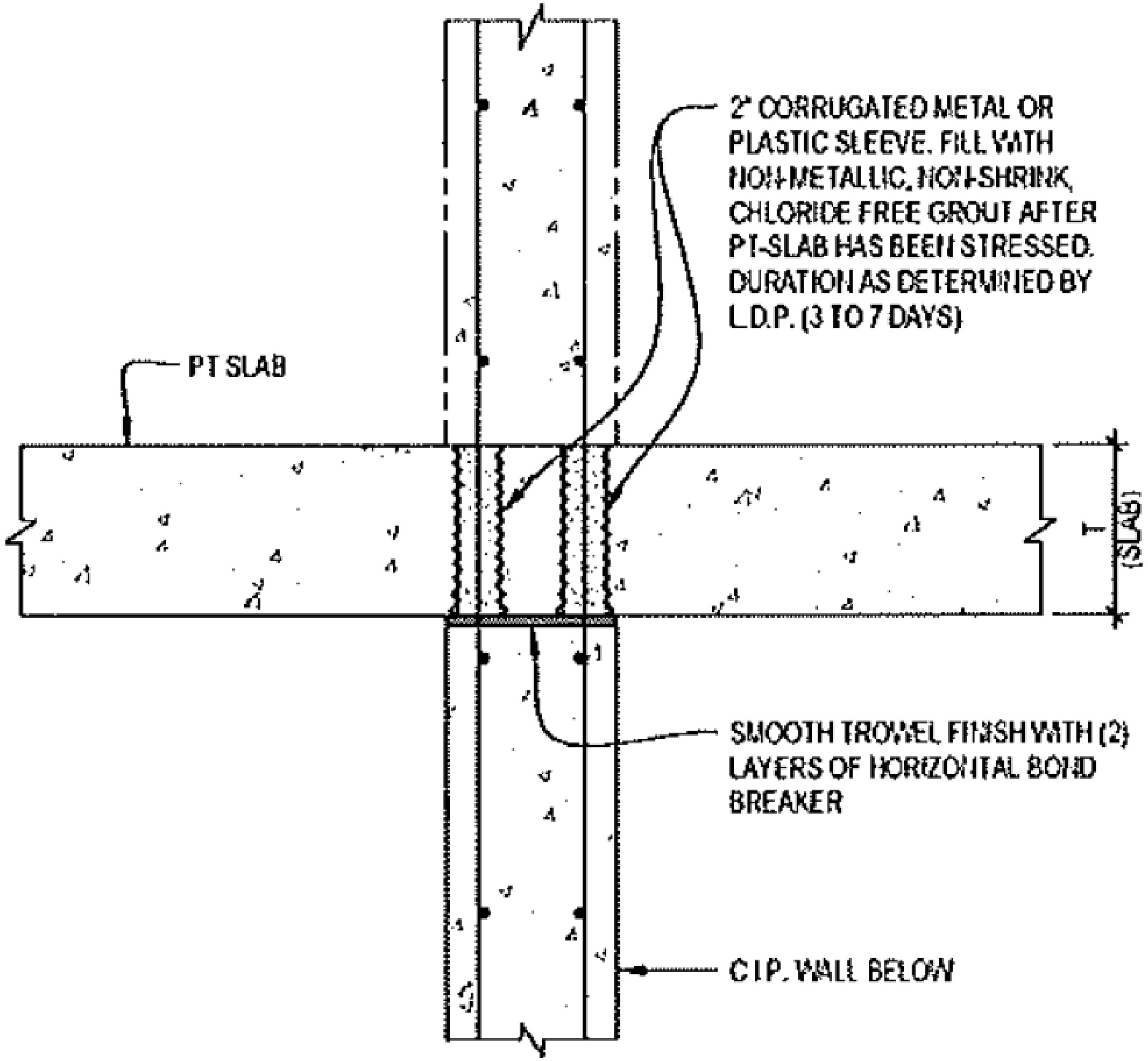
SALT LAKE CITY HOTEL

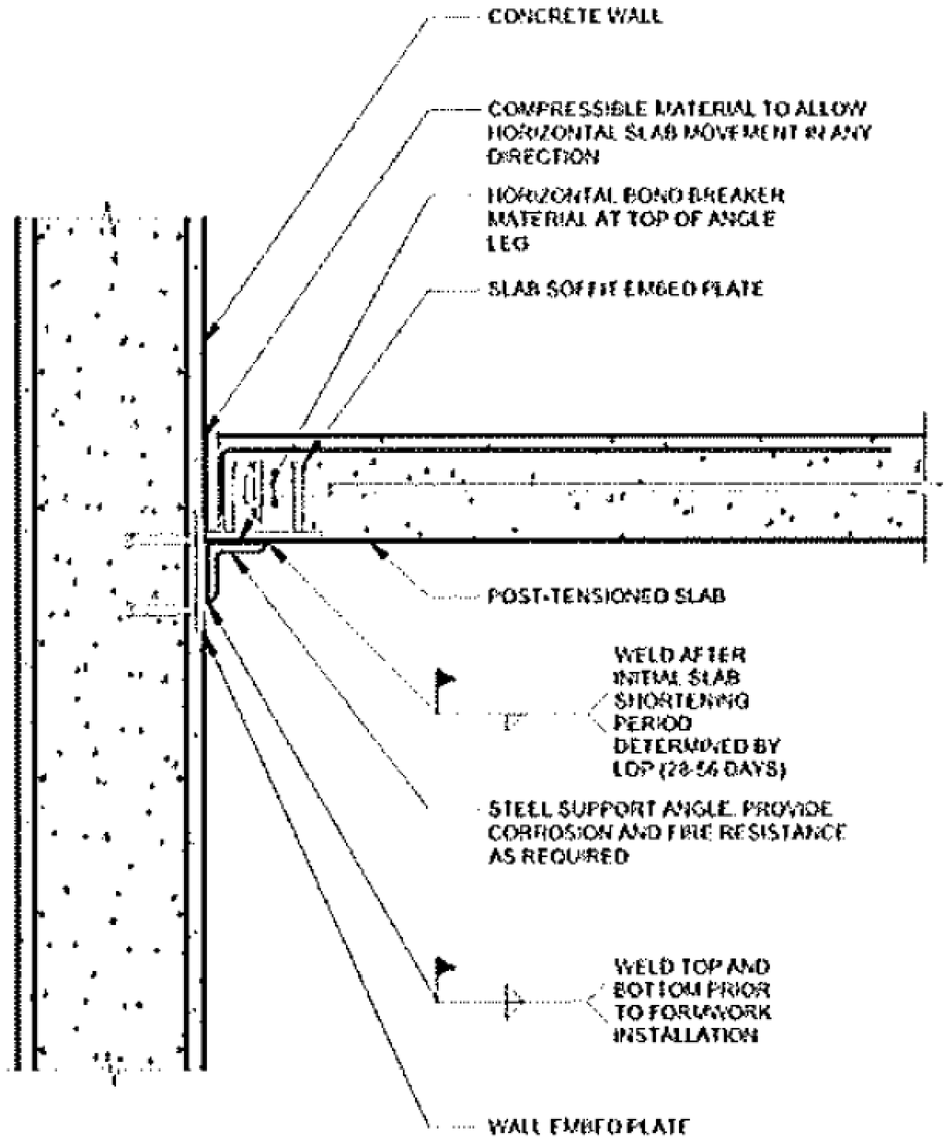



#6x5'-0" THREADED BAR TYP.
#7x5'-8" CONTINUATION BAR (BY OTHERS) TYP.
6
7
8
9

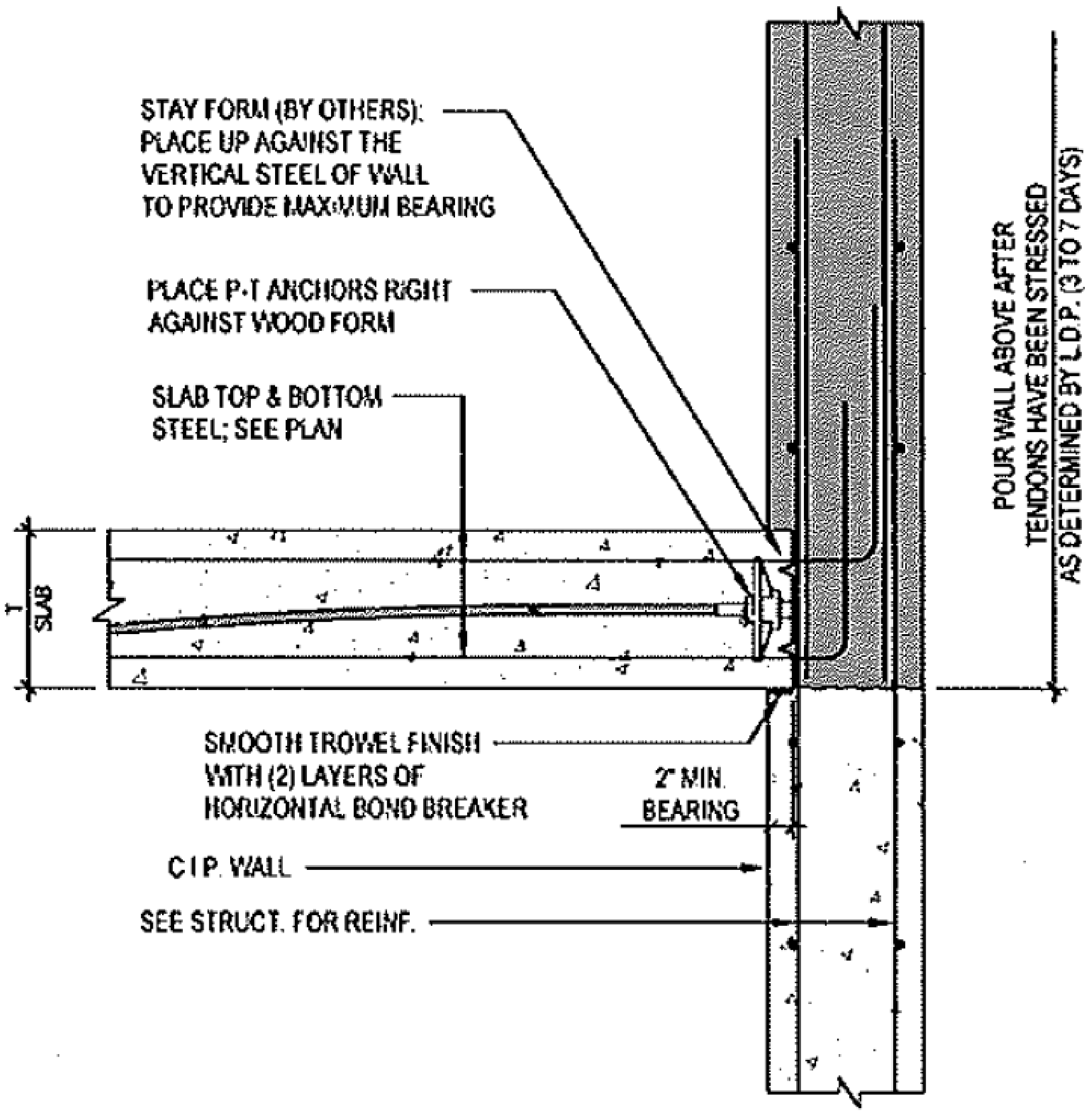


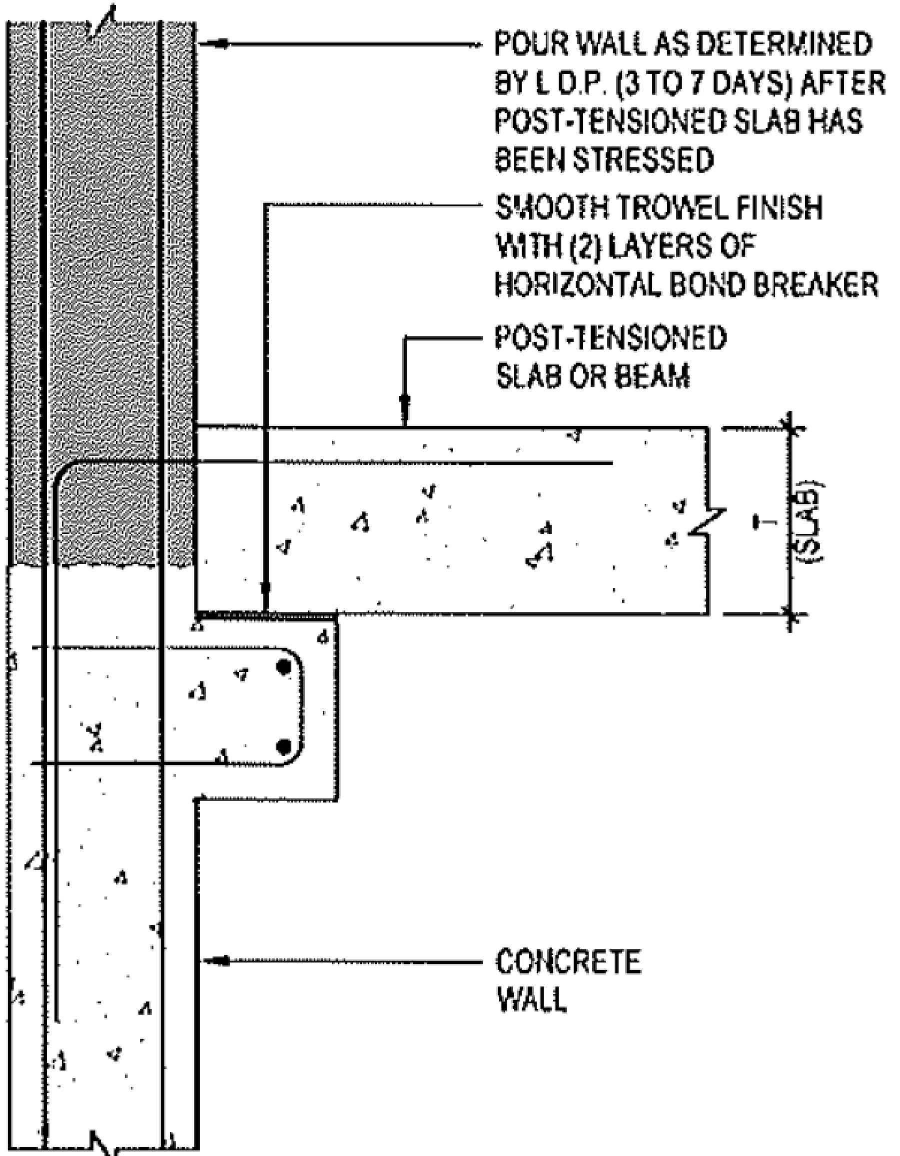
PTI DC20.2-22: 4 – CRACK MITIGATION DETAILS



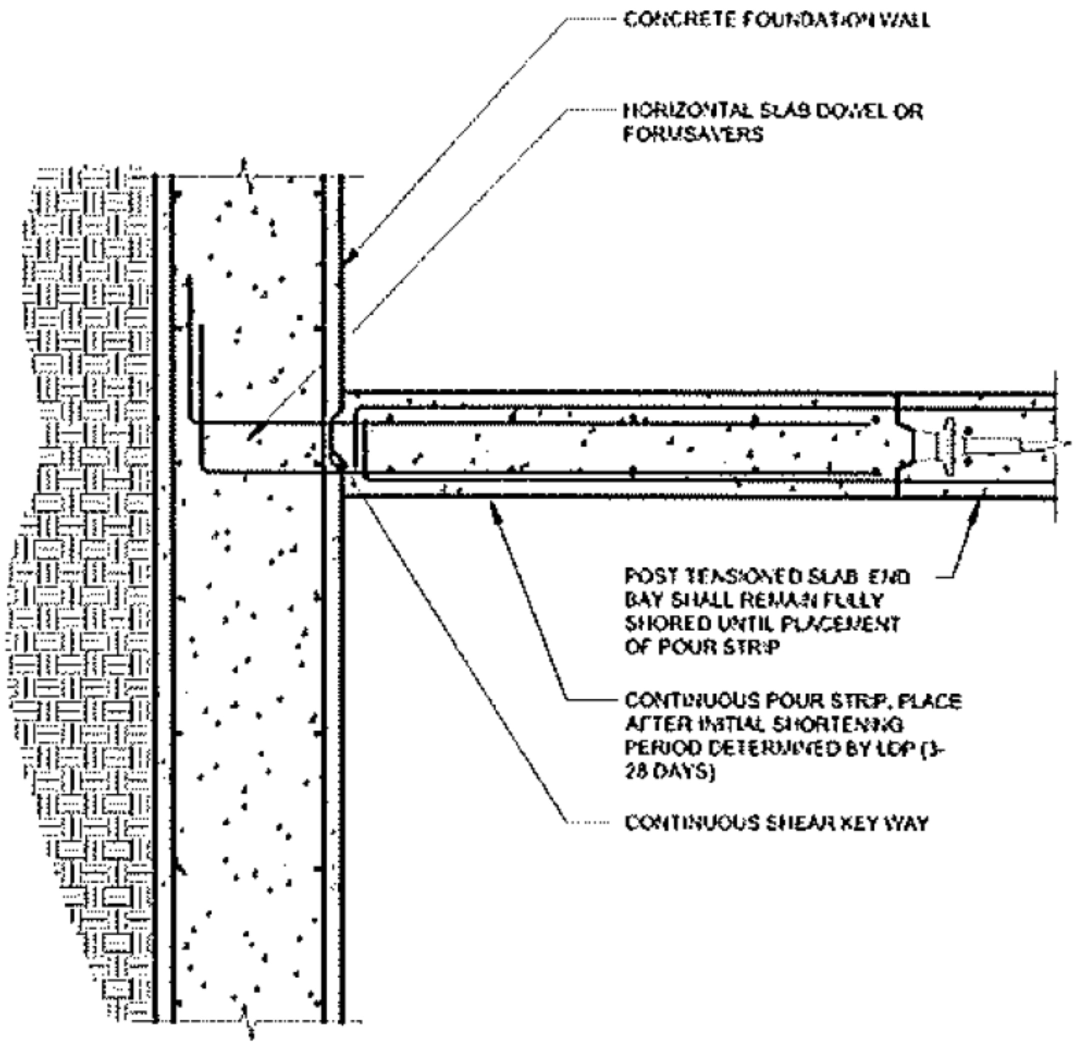


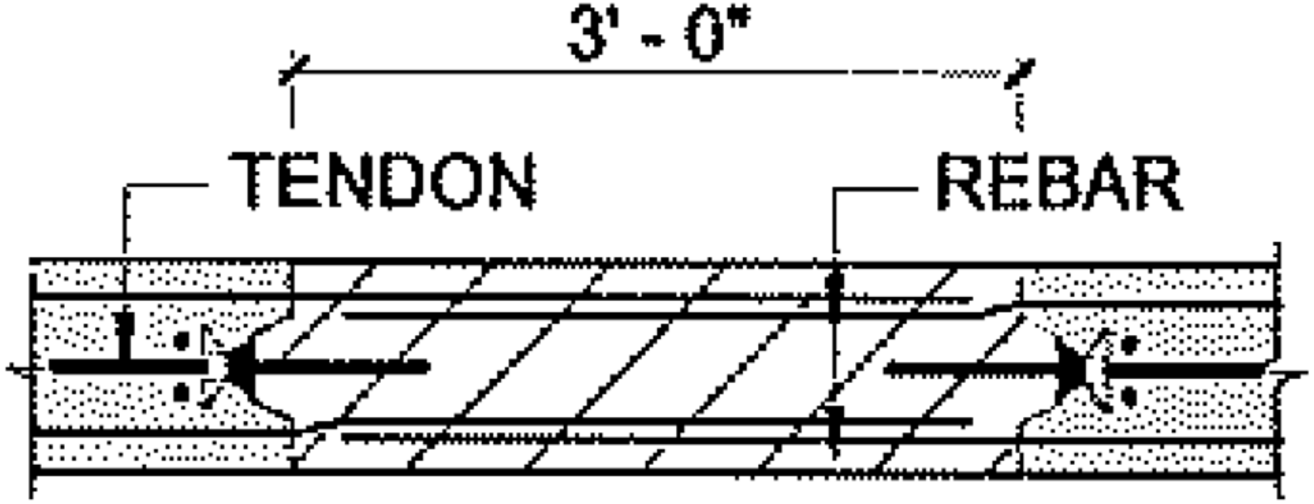
PTI DC20.2-22: 4 – CRACK MITIGATION DETAILS





PTI DC20.2-22: 4 – CRACK MITIGATION DETAILS

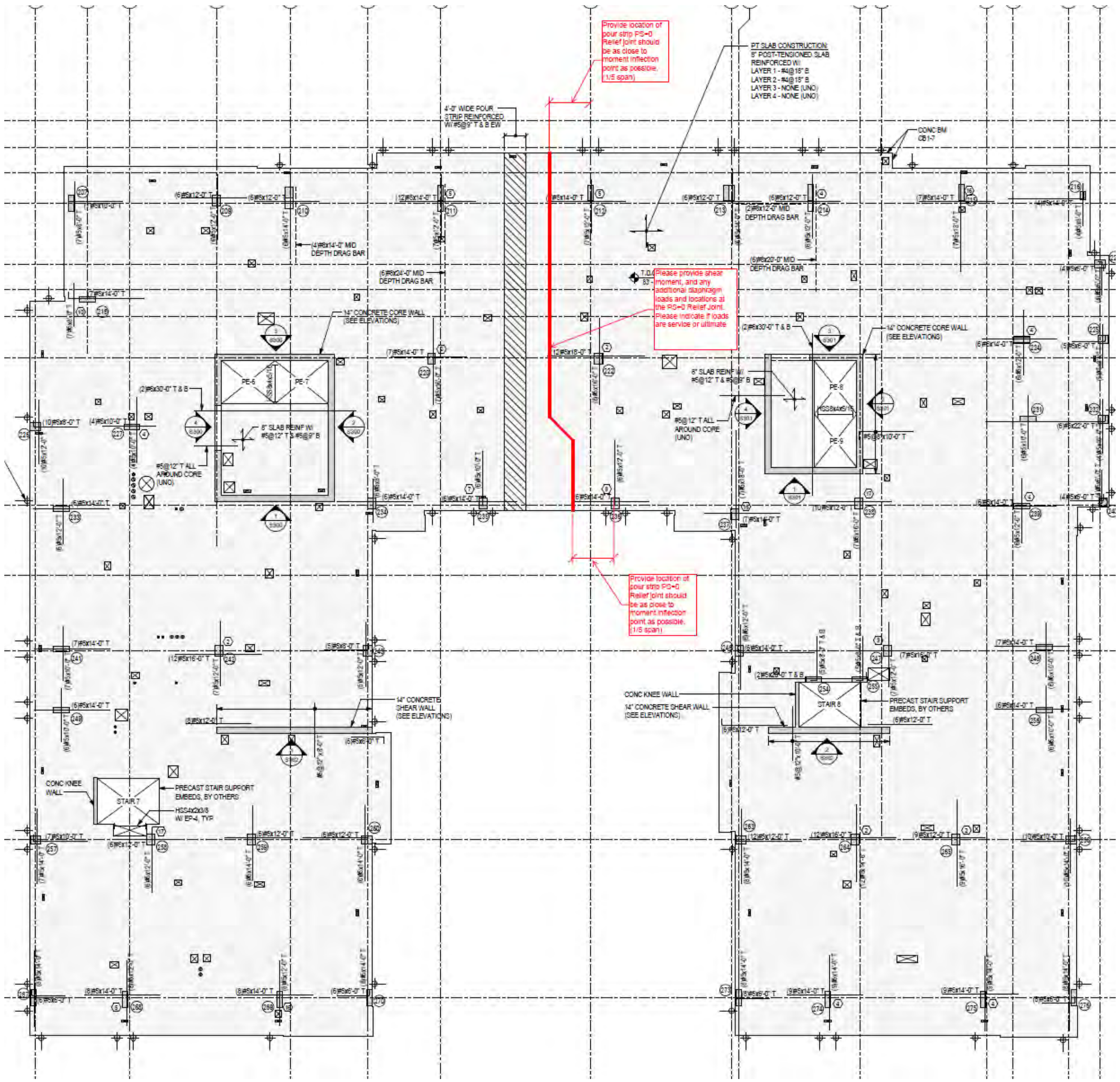


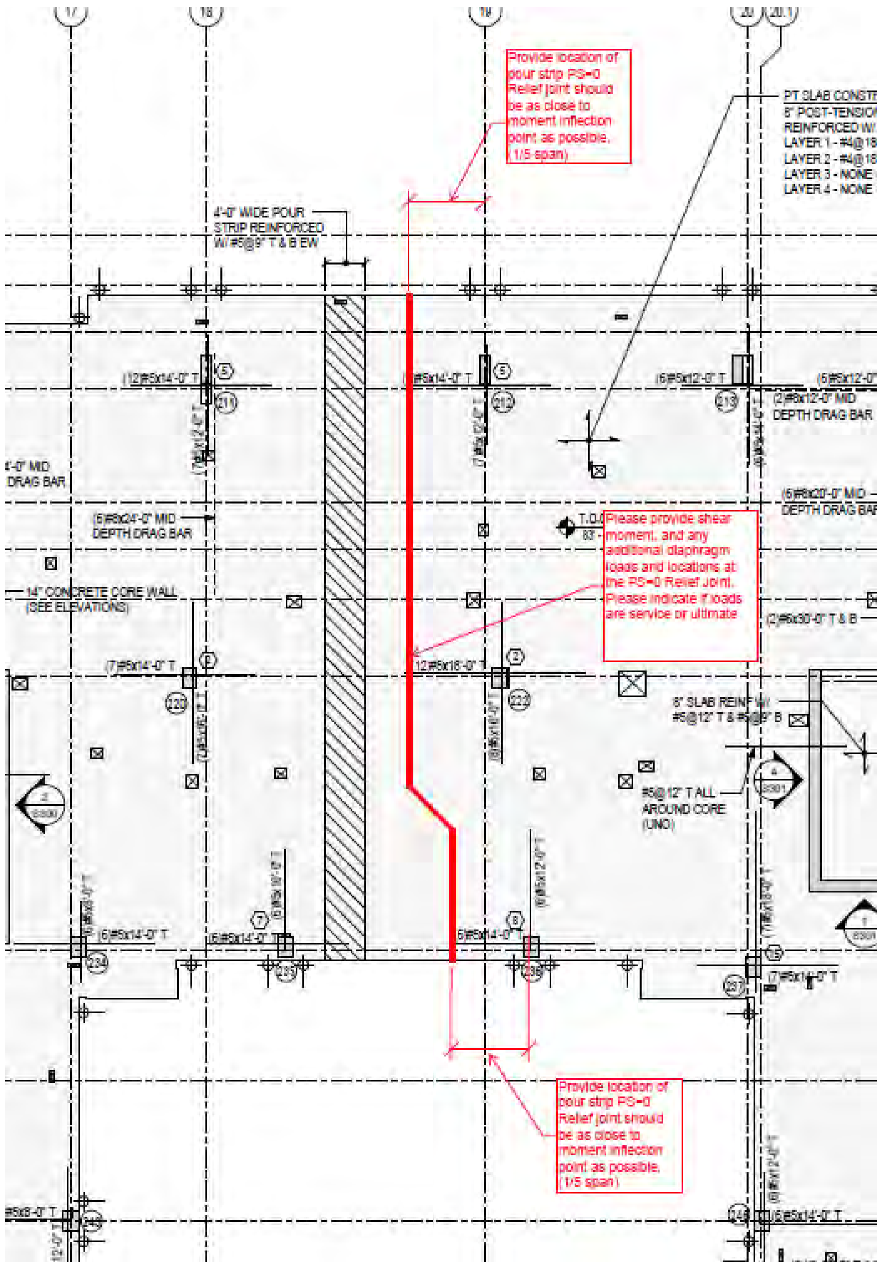


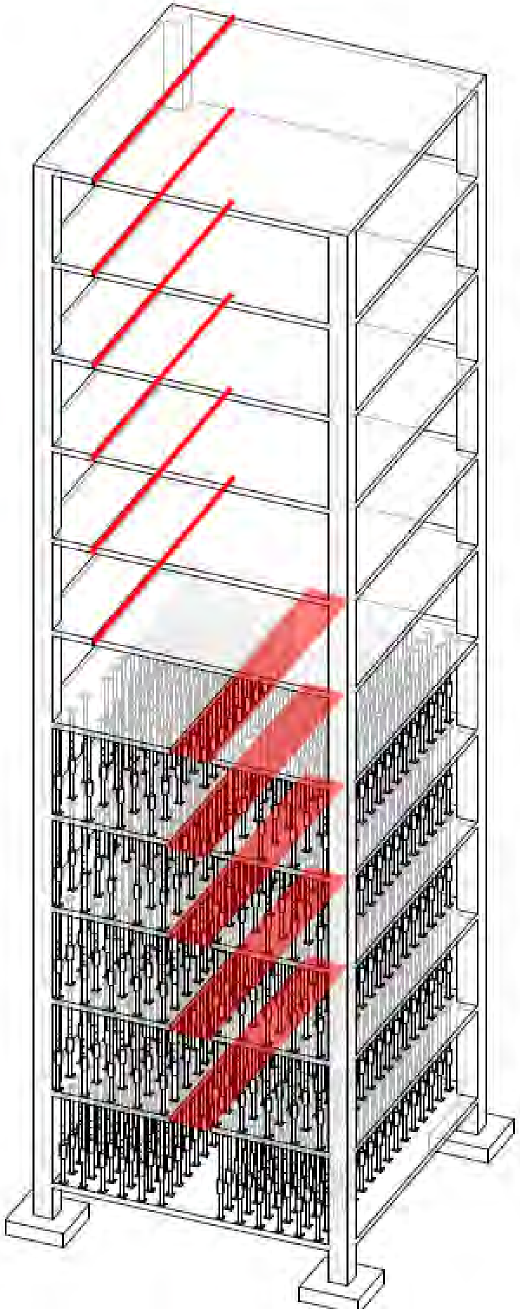
THE SMITH – BOSTON, MA

- 12-Story two-way PT
- Mid-span not self-supporting
- 45-day leave-out
- 2-Month schedule delay
- $1M liquidated damages

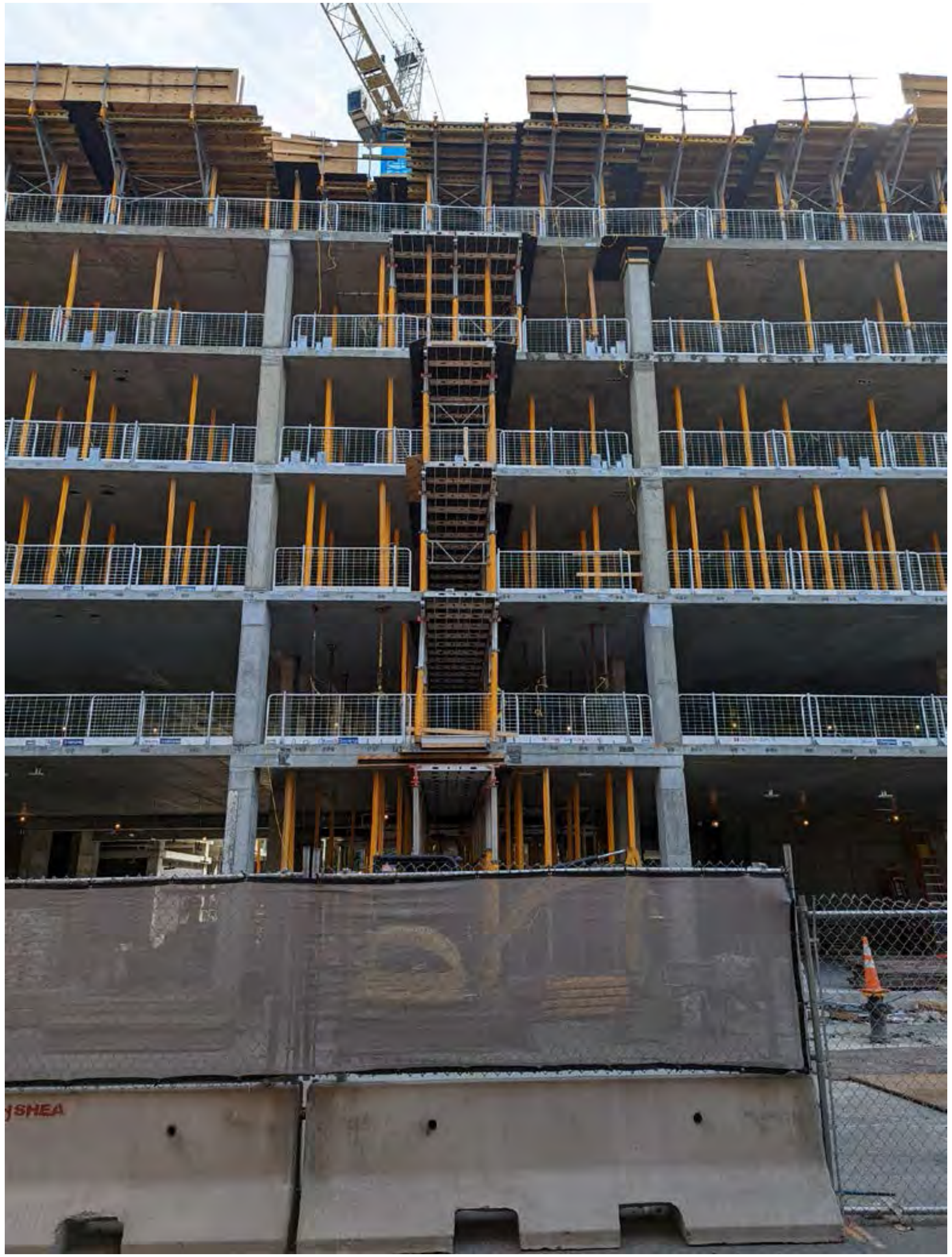
- PS=Ø® last 6 floors
- Savings
  - $160K/floor
  - 2-Months

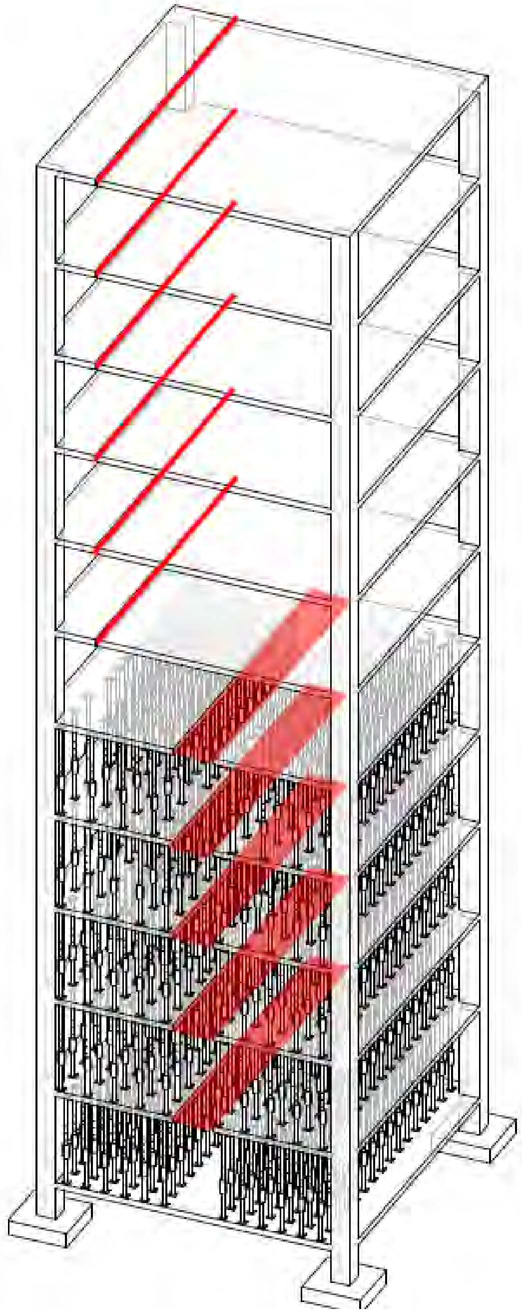

Provide location of pour strip PS=0 Relief joint should be as close to moment inflection point as possible. (1/5 span)
Please provide shear moment, and any additional diaphragm loads and locations at the PS=0 Relief Joint. Please indicate if loads are service or ultimate
Provide location of pour strip PS=0 Relief joint should be as close to moment inflection point as possible. (1/5 span)
PT SLAB CONSTRUCTION:
8" POST-TENSIONED SLAB REINFORCED W/
LAYER 1 - #4@18" B
LAYER 2 - #4@18" B
LAYER 3 - NONE (UNO)
LAYER 4 - NONE (UNO)
4'-0" WIDE POUR STRIP REINFORCED W/ #5@9" T & B EW
CONC BM CB1-7
14" CONCRETE CORE WALL (SEE ELEVATIONS)
8" SLAB REINF W/ #5@12" T & #5@9" B
#5@12" T ALL AROUND CORE (UNO)
14" CONCRETE SHEAR WALL (SEE ELEVATIONS)
CONC KNEE WALL
PRECAST STAIR SUPPORT EMBEDS, BY OTHERS
STAIR 7
STAIR 8


17
18
19
20
20.1
Provide location of pour strip PS=0 Relief joint should be as close to moment inflection point as possible. (1/5 span)
PT SLAB CONSTR
8" POST-TENSION
REINFORCED W/
LAYER 1 - #4@18
LAYER 2 - #4@18
LAYER 3 - NONE
LAYER 4 - NONE
4'-0" WIDE POUR STRIP REINFORCED W/ #5@9" T & B EW
(12)#5x14'-0" T
(6)#5x12'-0" T
(2)#8x12'-0" MID DEPTH DRAG BAR
(6)#8x24'-0" MID DEPTH DRAG BAR
(6)#8x20'-0" MID DEPTH DRAG BAR
14" CONCRETE CORE WALL (SEE ELEVATIONS)
Please provide shear, moment, and any additional diaphragm loads and locations at the PS=0 Relief Joint. Please indicate if loads are service or ultimate
(2)#6x30'-0" T & B
(7)#5x14'-0" T
8" SLAB REINF W/ #5@12" T & #5@9" B
#5@12" T ALL AROUND CORE (UNO)
(6)#5x14'-0" T
(7)#6x14'-0" T
(6)#5x14'-0" T
Provide location of pour strip PS=0 Relief joint should be as close to moment inflection point as possible. (1/5 span)



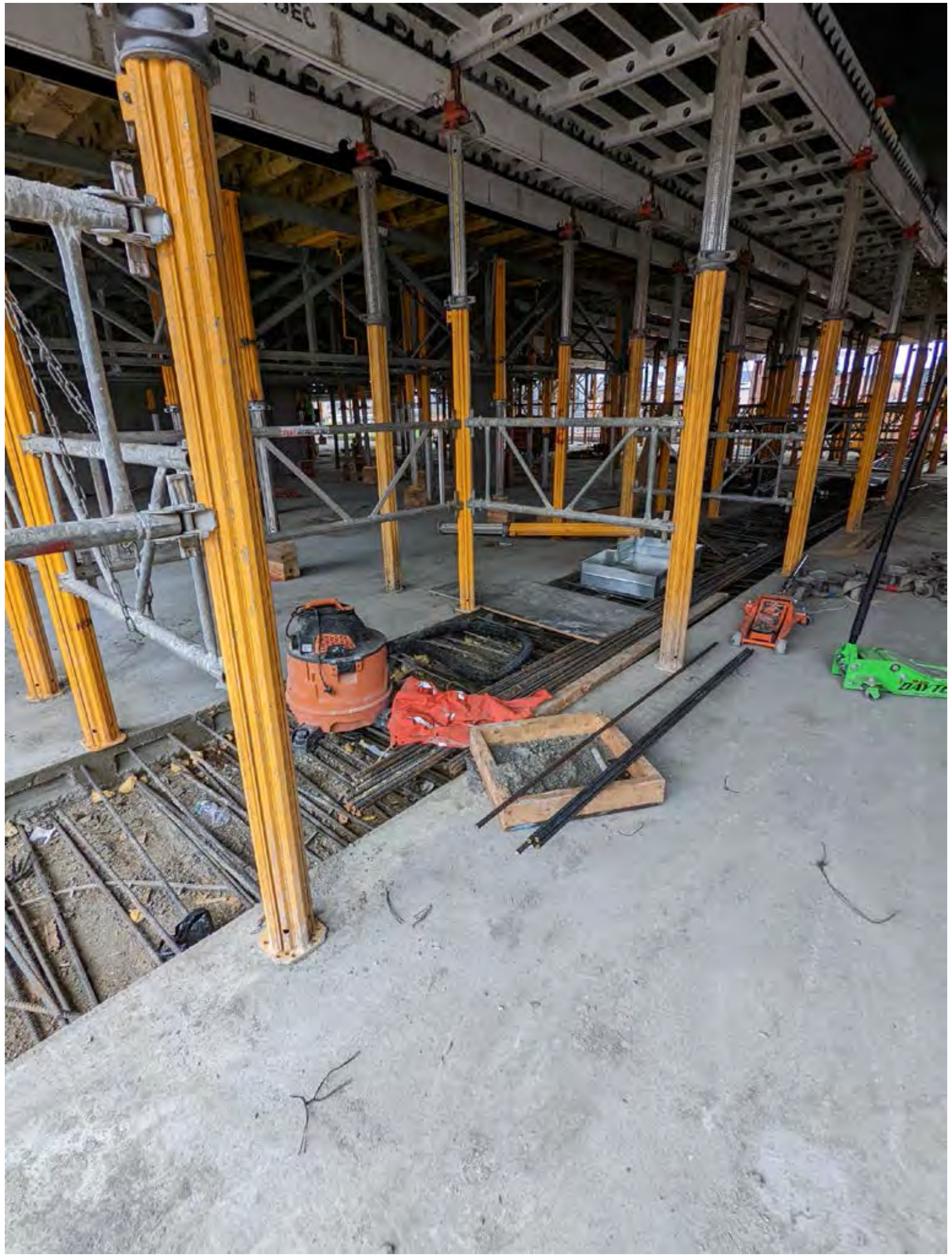
LEVELS 1-6

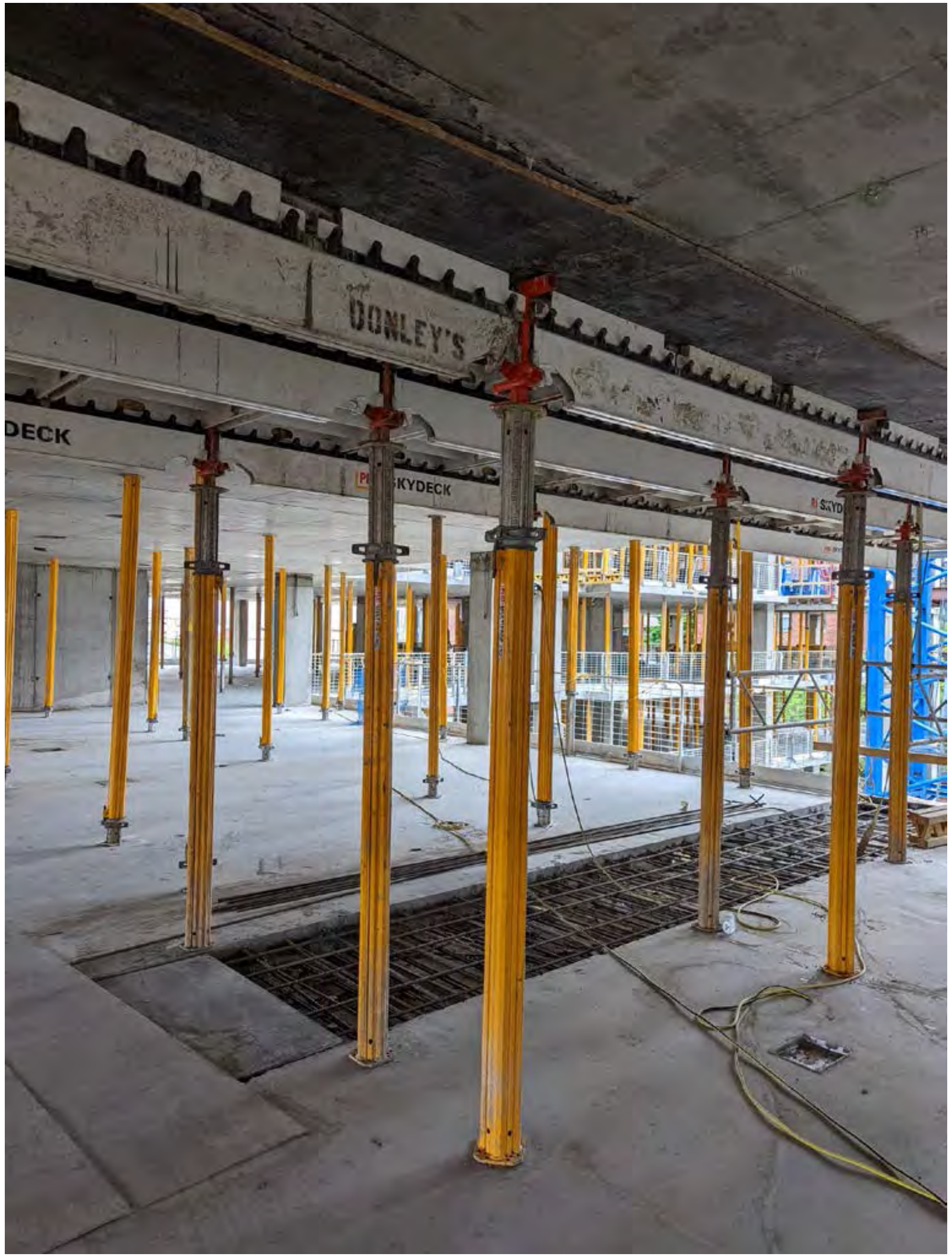




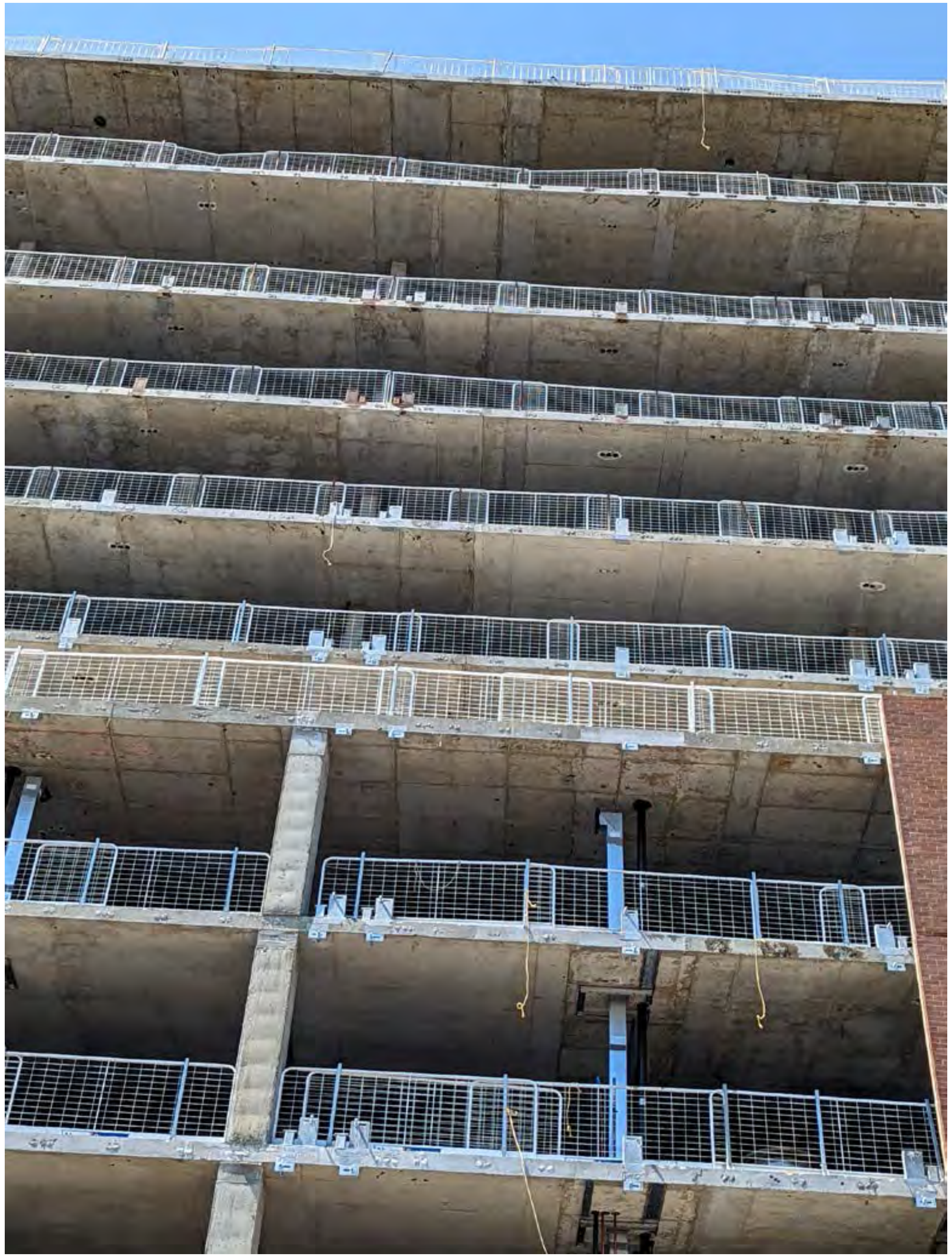

SKYDECK

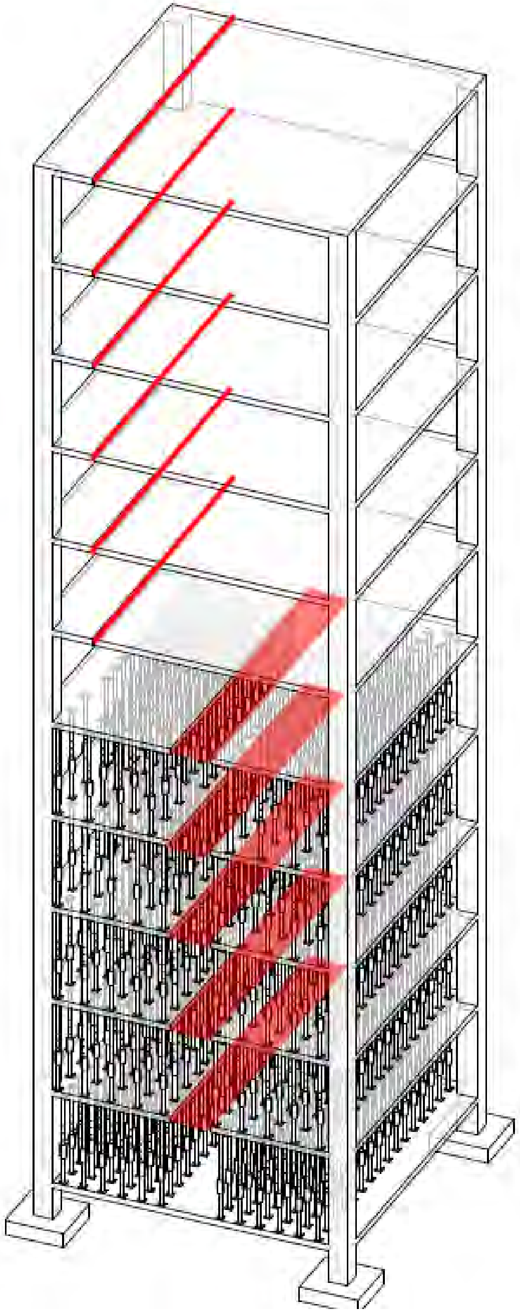

PERI SKYDECK
PERI SKYDECK
PERI SKYDECK

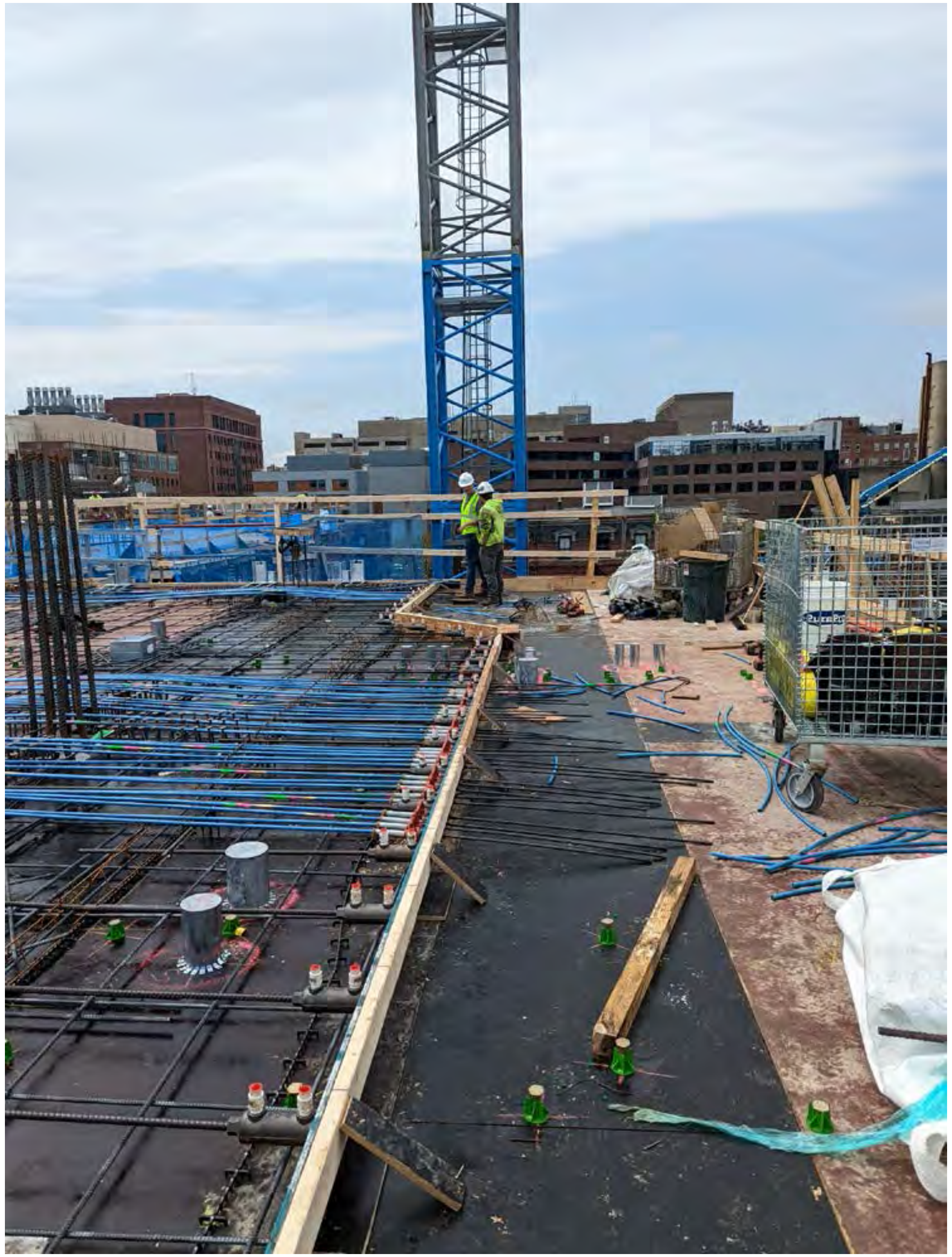


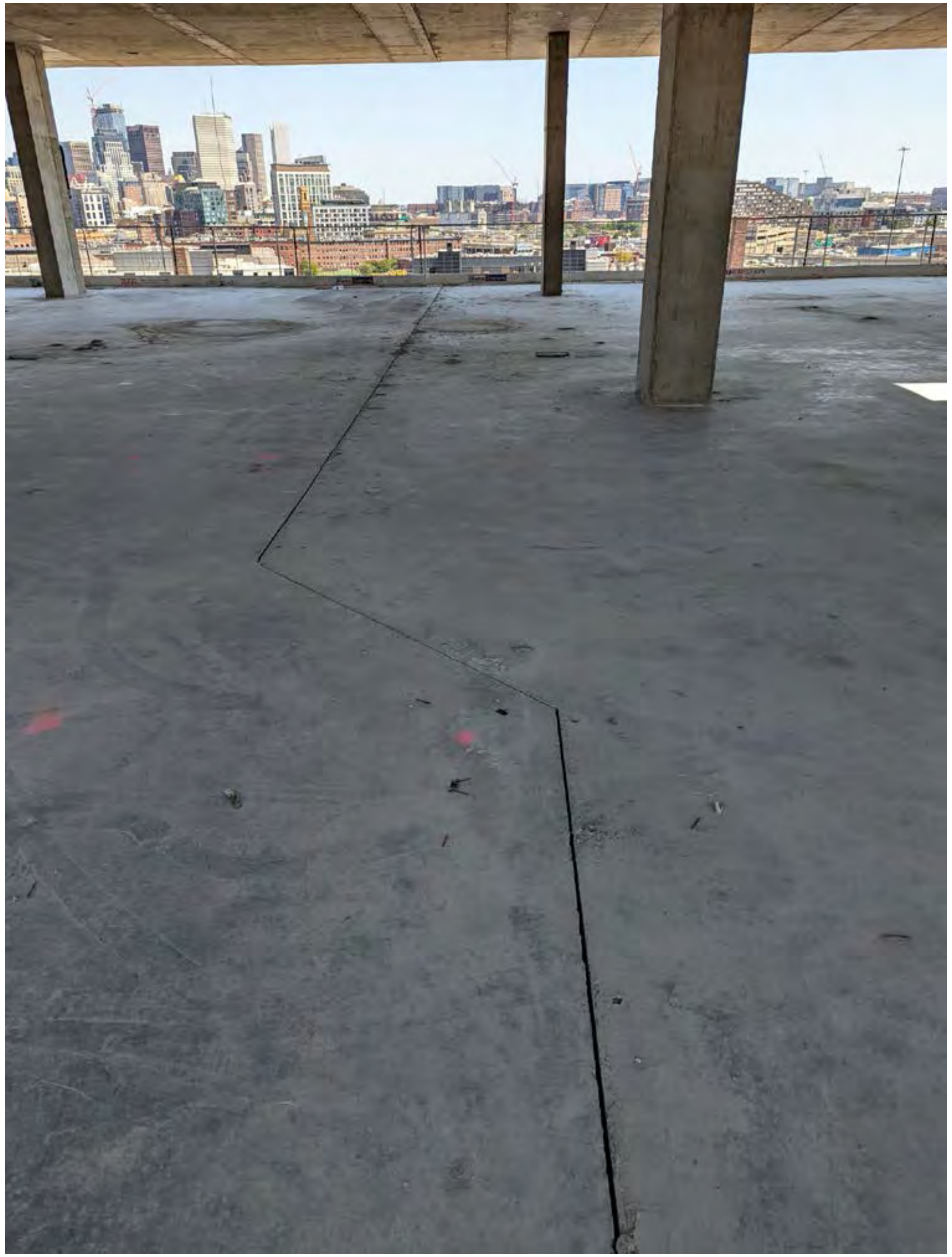

DONLEY'S
DECK
SKYDECK

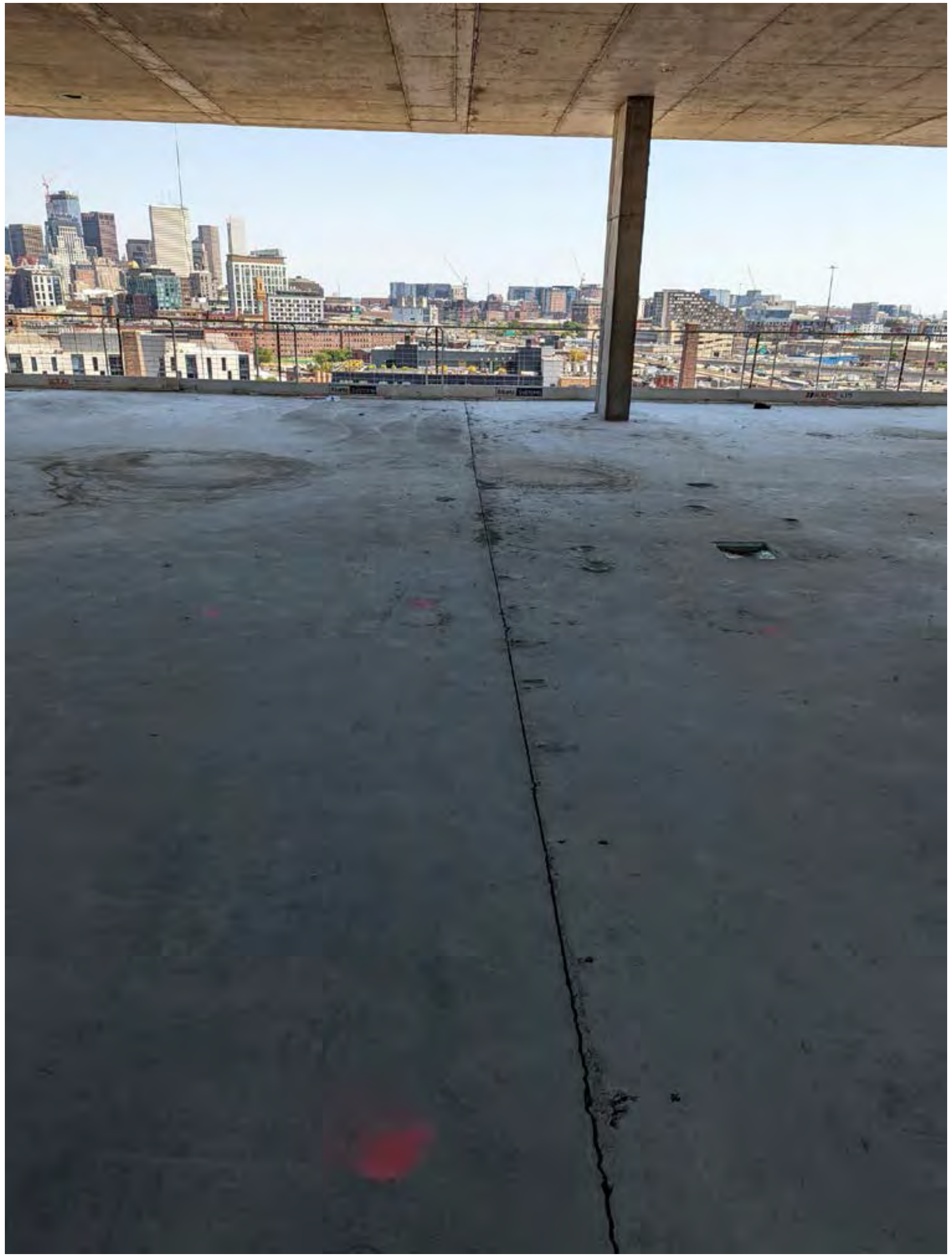
LEVELS 7-12



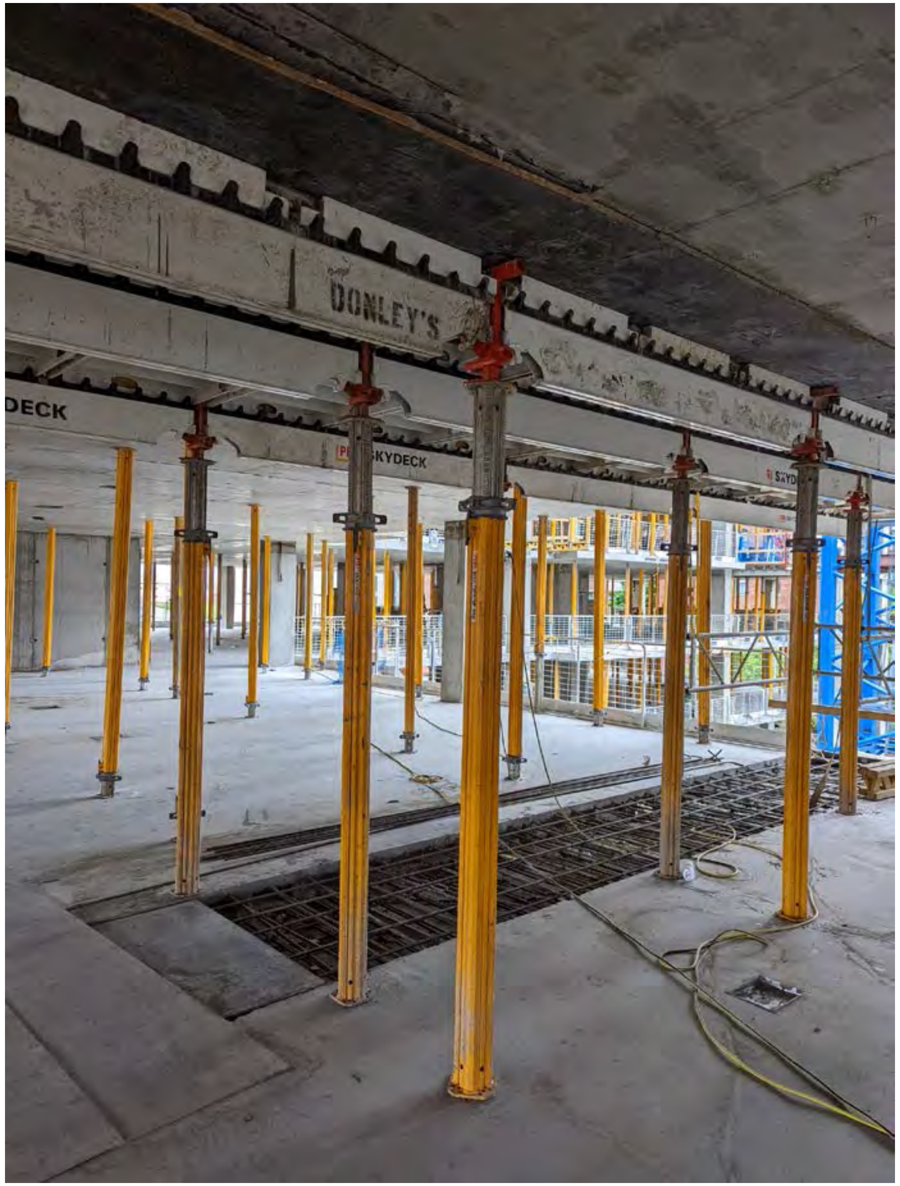




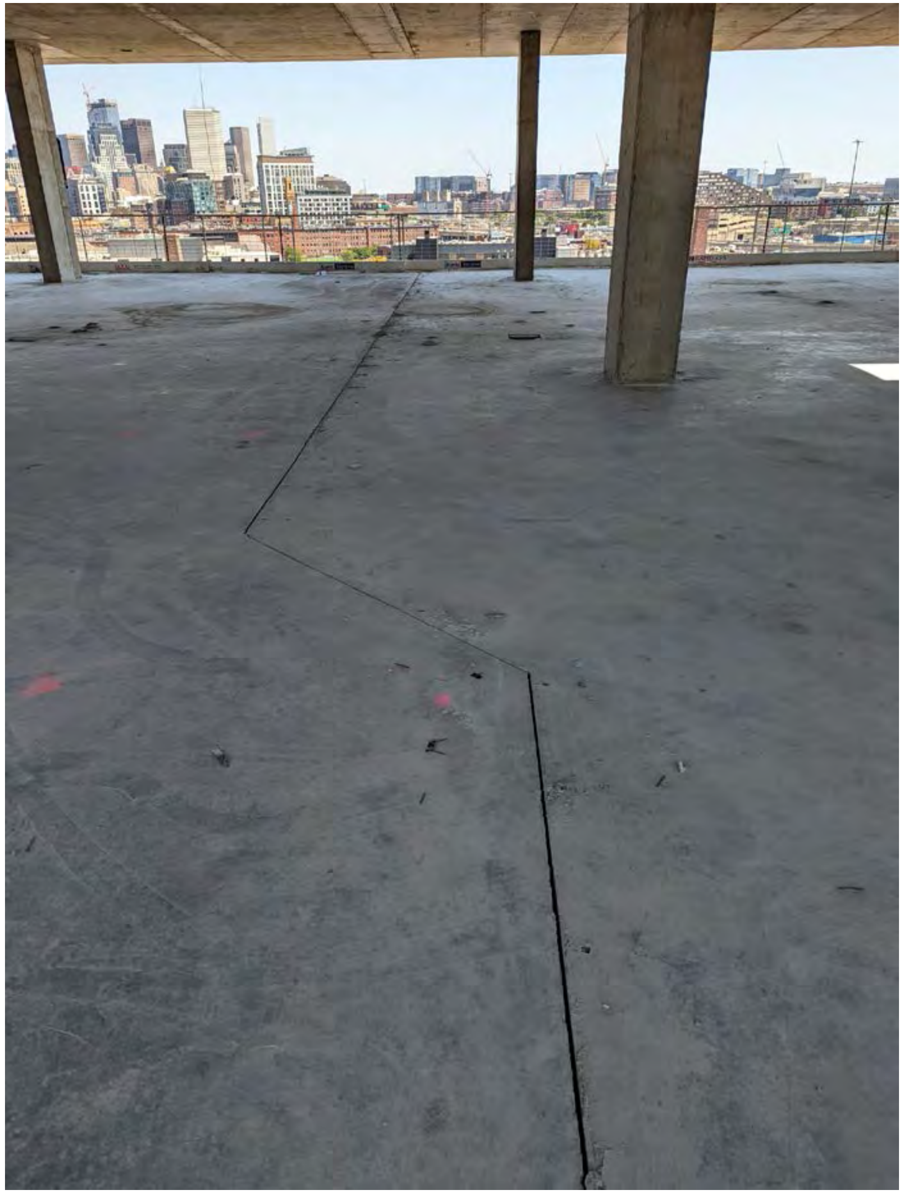



Aluma Systems



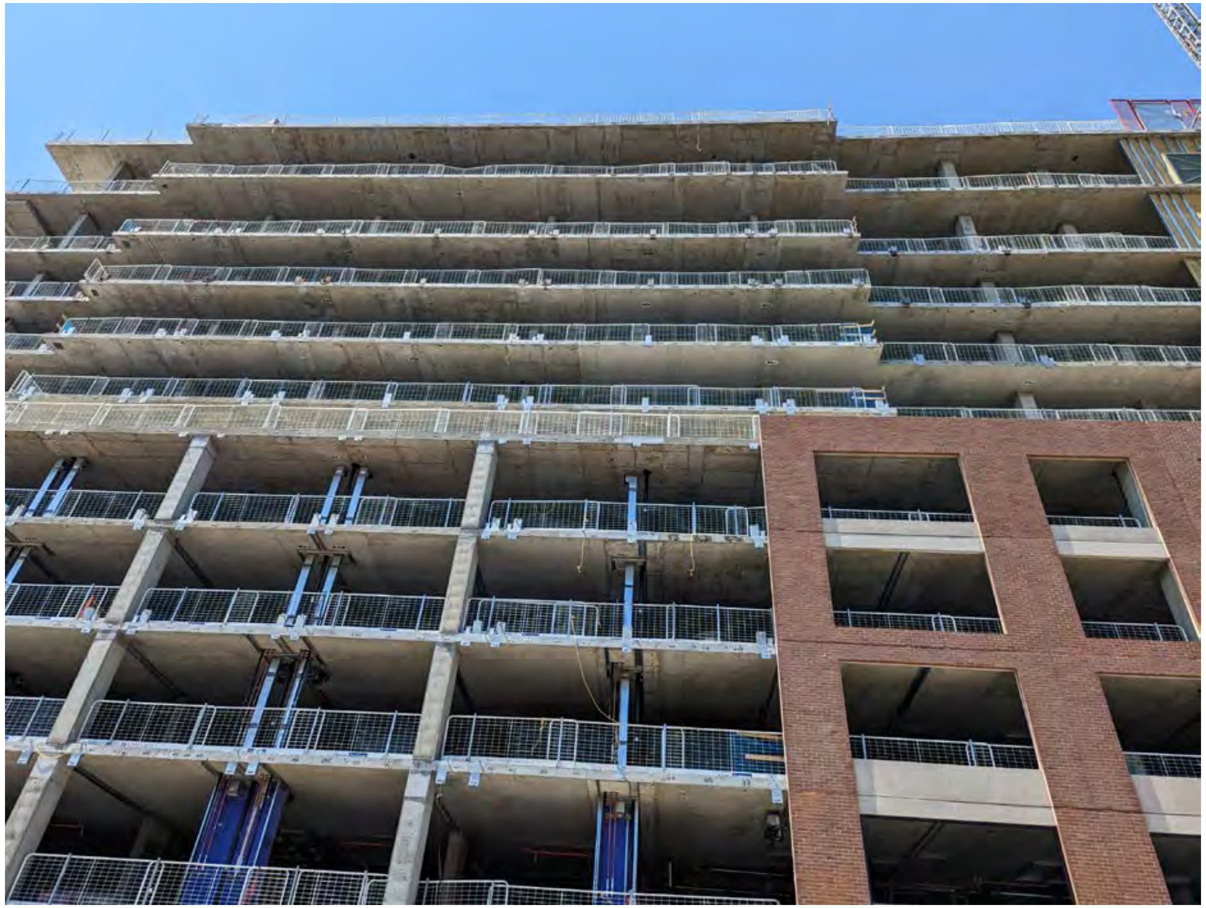
Cost: $150 - $200/SF

VS.



Cost: $130/SF

- Mid-span not self-supporting
- 2-Month schedule delay
- $1M liquidated damages



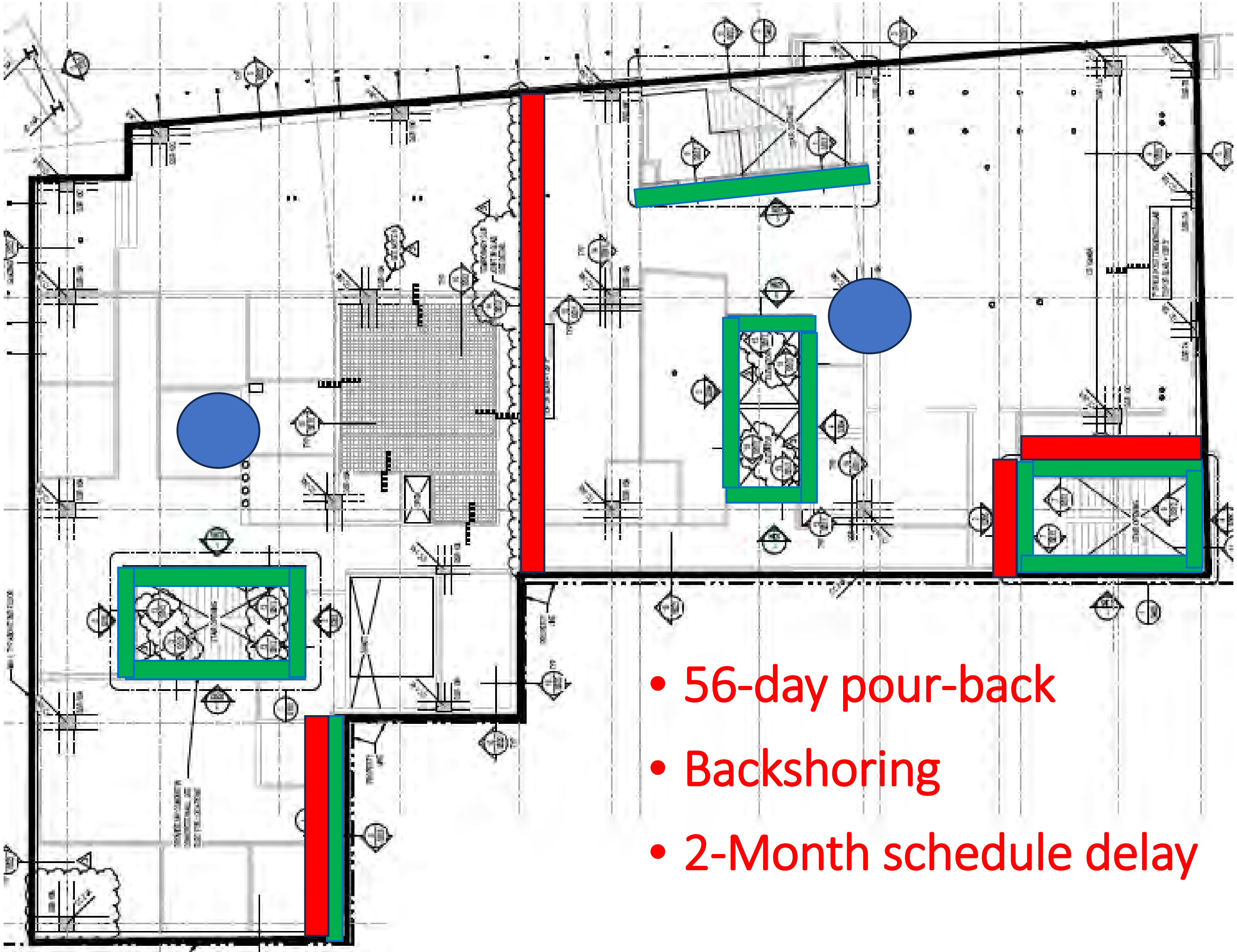
- 1/5-span self-supporting
- 2-Month schedule saving
- $1M saved

MILL CREEK CITY HALL – MILL CREEK, UT

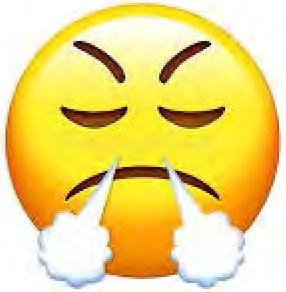
- 6-Levels two-way PT
- Inflection point
- 56-day leave-out
- Wall releases

- Savings
  - 2-Months
  - $1.2M
  - $200K/floor

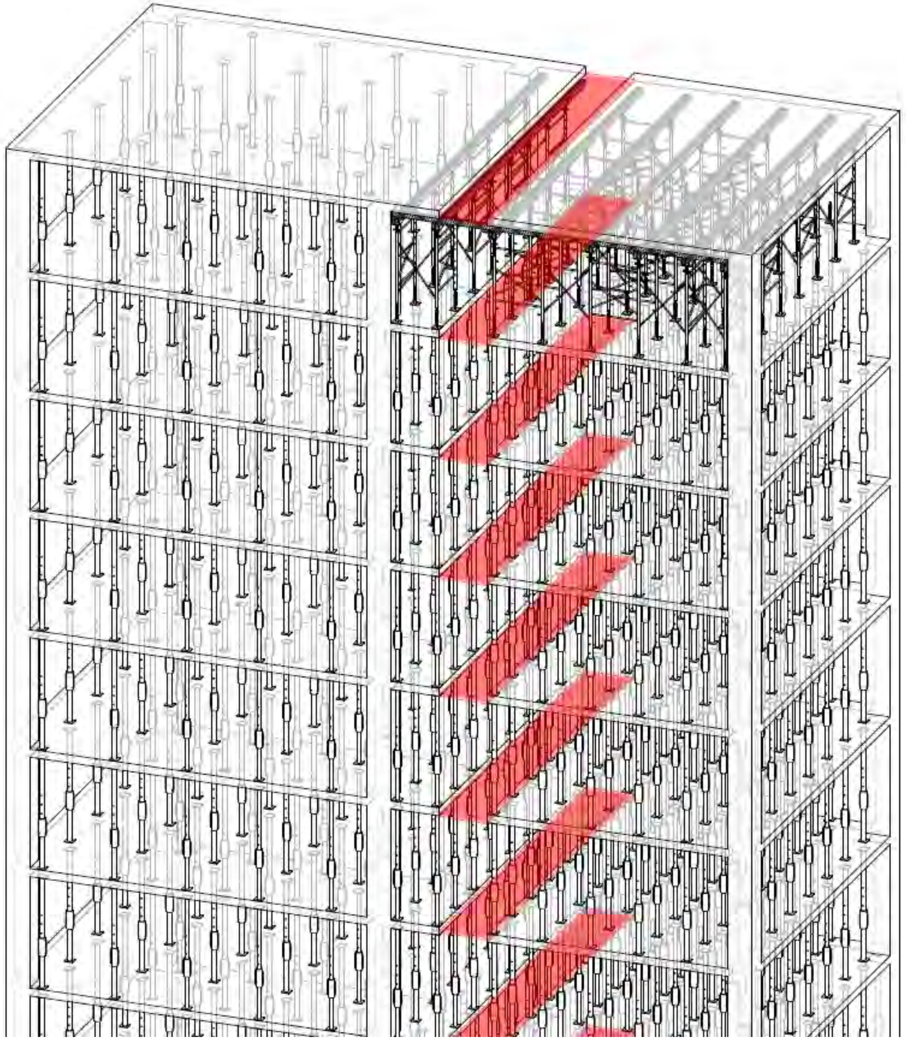
EOR



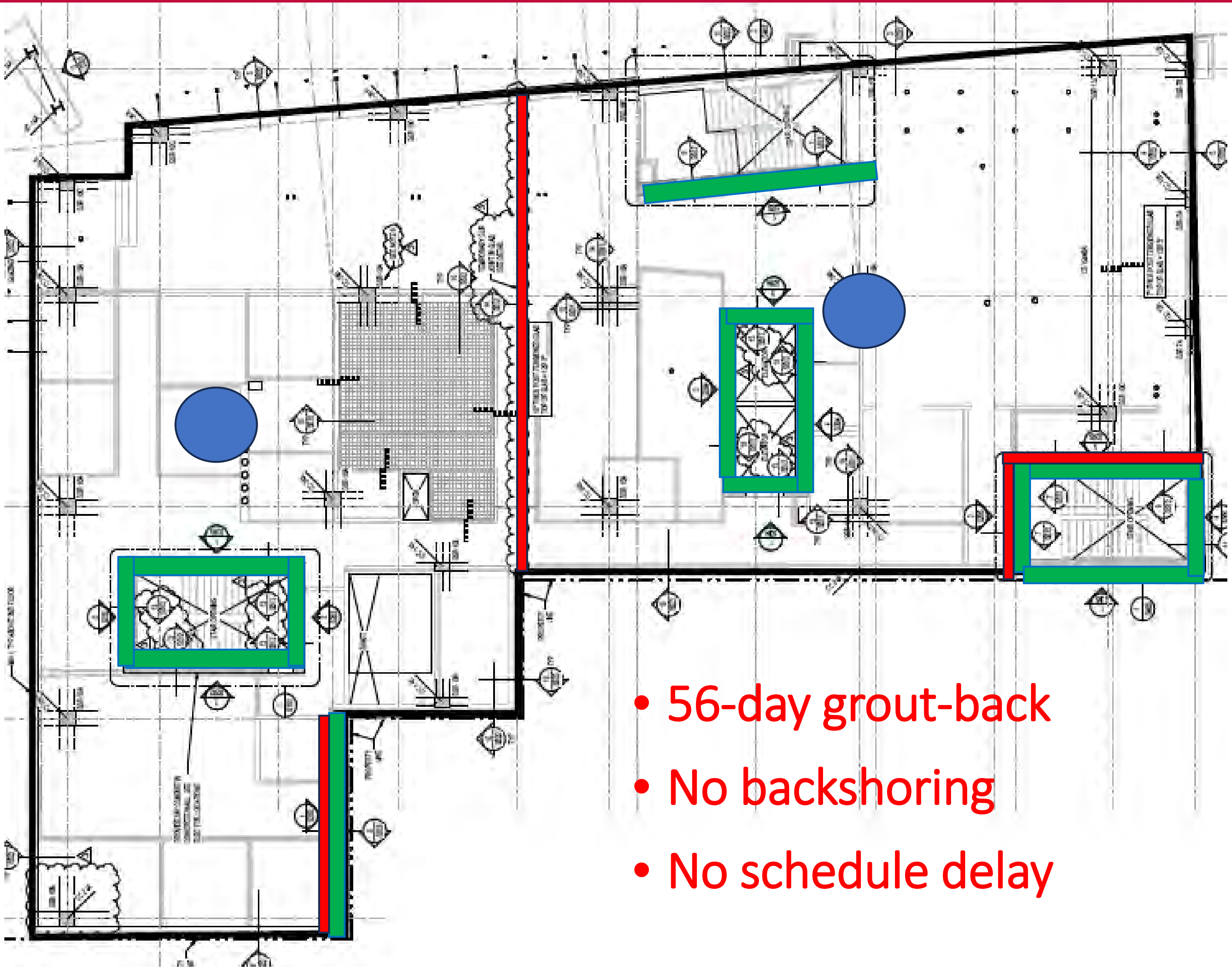
GC



- 56-day pour-back
- Backshoring
- 2-Month schedule delay

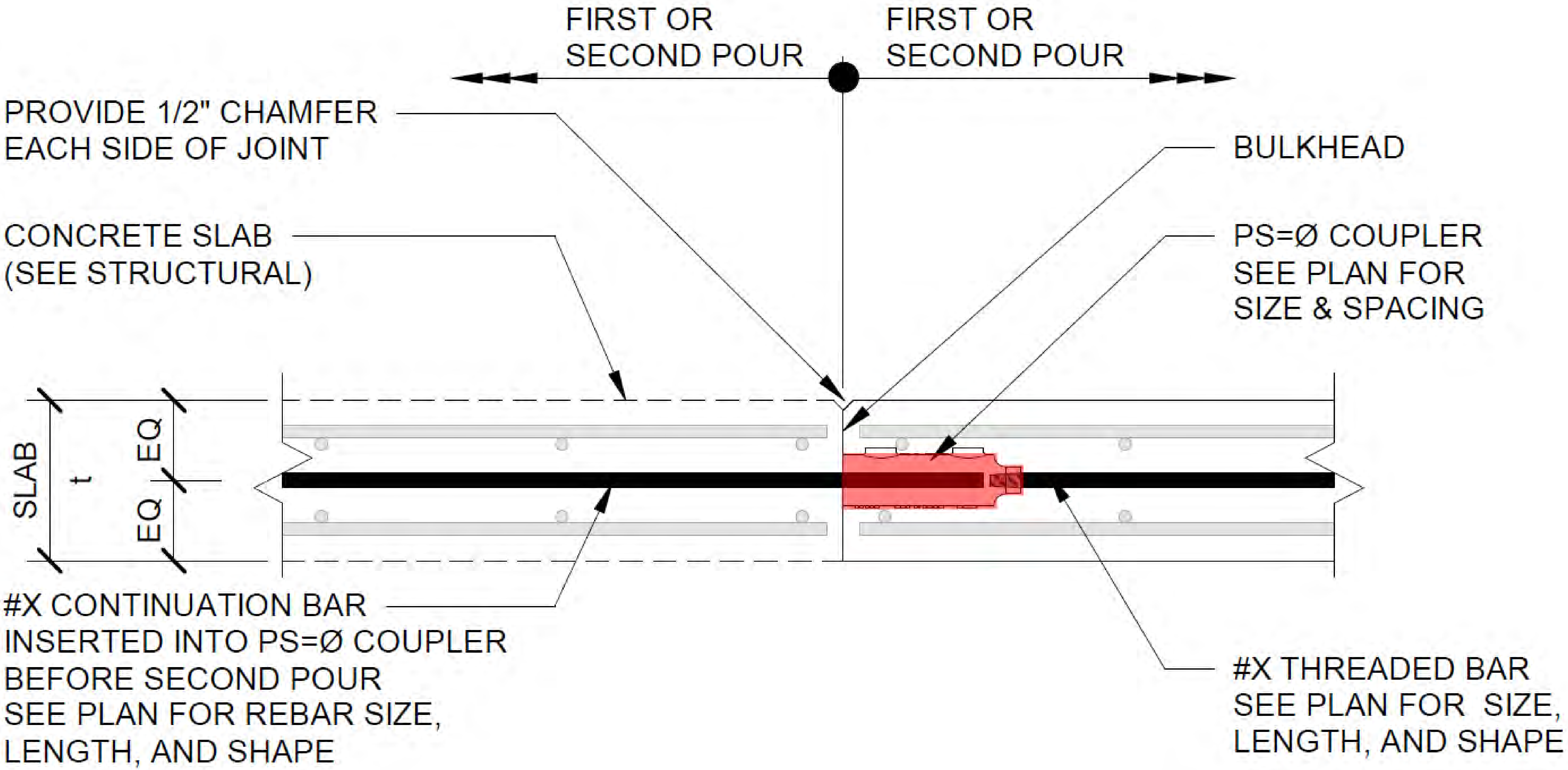


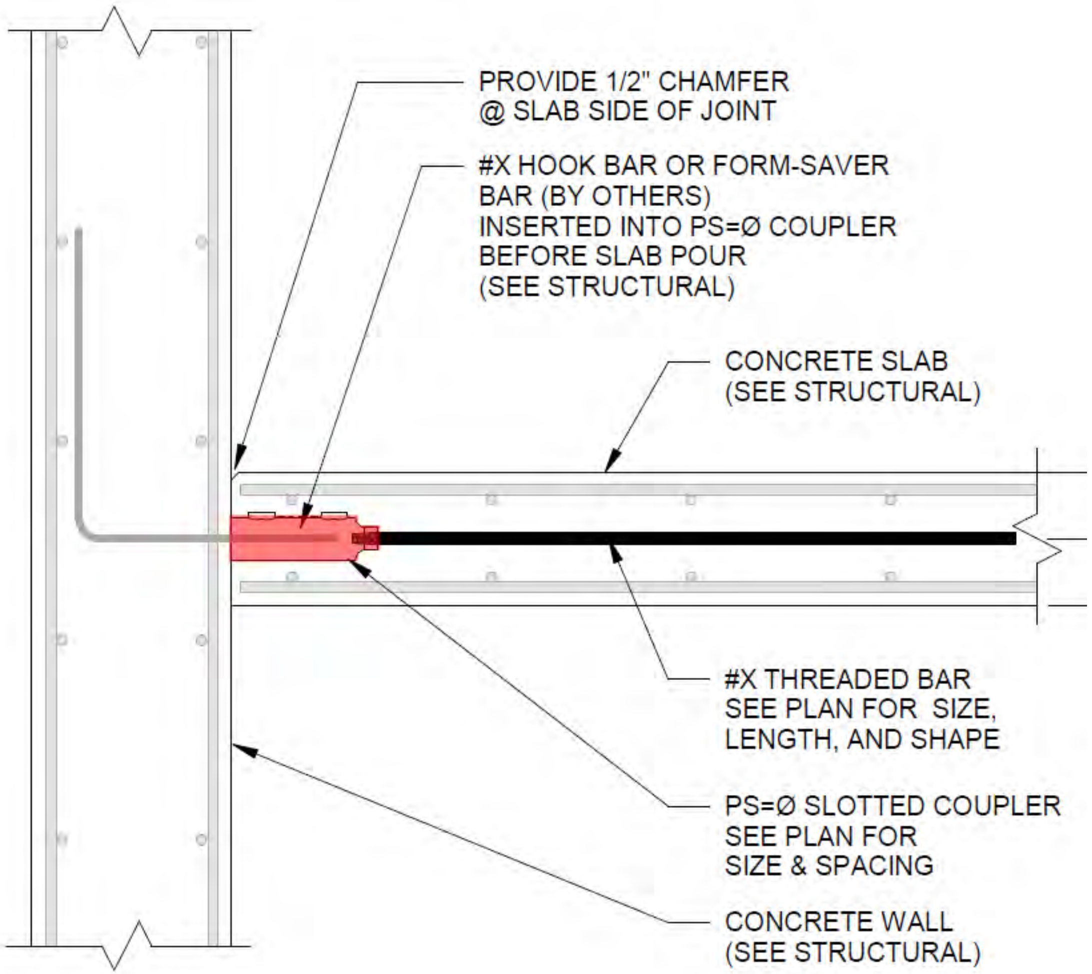
EOR

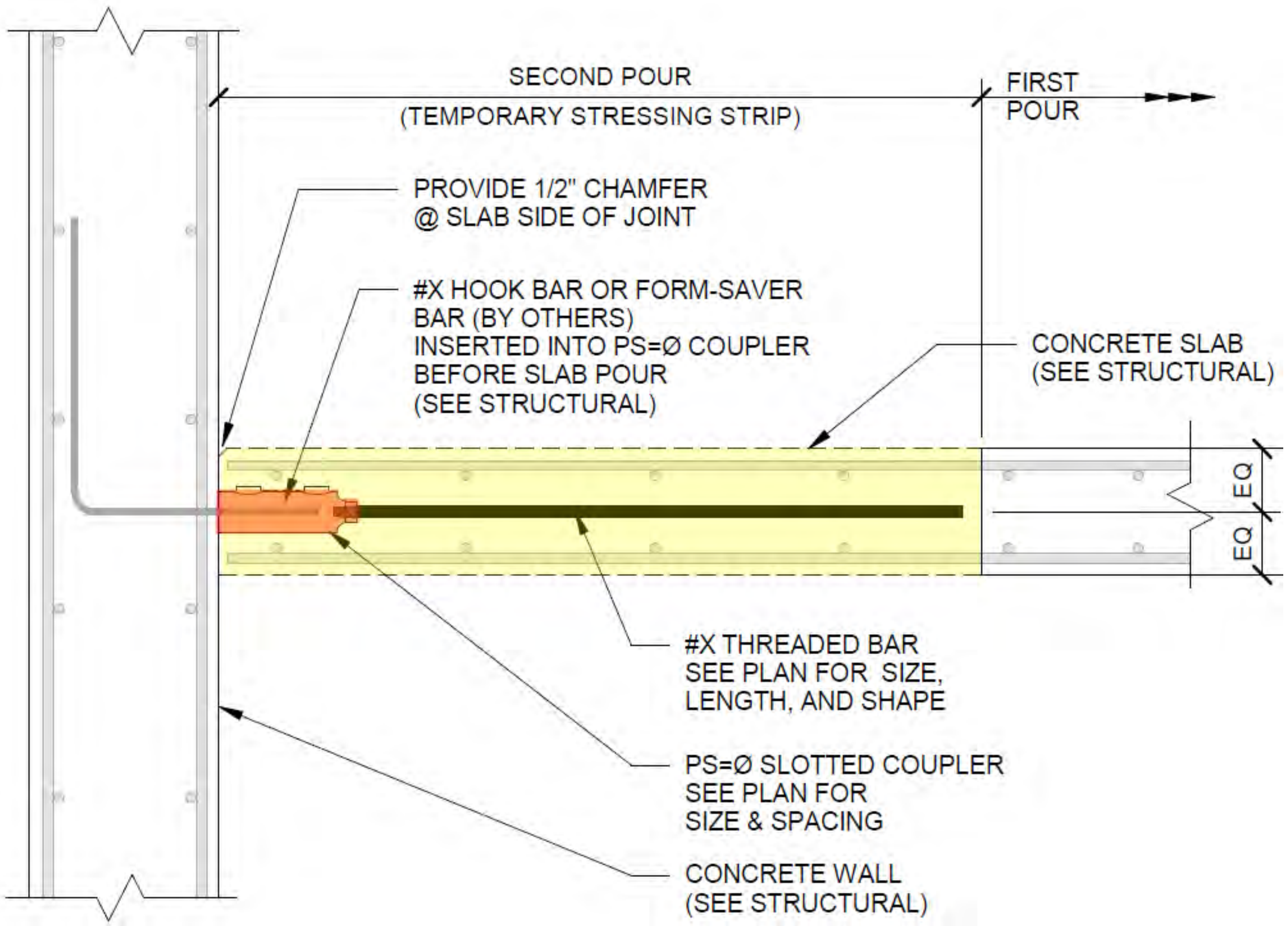


GC

- 56-day grout-back
- No backshoring
- No schedule delay


FIRST OR
SECOND POUR
FIRST OR
SECOND POUR
PROVIDE 1/2" CHAMFER
EACH SIDE OF JOINT
BULKHEAD
CONCRETE SLAB
(SEE STRUCTURAL)
PS=Ø COUPLER
SEE PLAN FOR
SIZE & SPACING
SLAB
t
EQ
EQ
#X CONTINUATION BAR
INSERTED INTO PS=Ø COUPLER
BEFORE SECOND POUR
SEE PLAN FOR REBAR SIZE,
LENGTH, AND SHAPE
#X THREADED BAR
SEE PLAN FOR SIZE,
LENGTH, AND SHAPE


PROVIDE 1/2" CHAMFER
@ SLAB SIDE OF JOINT
#X HOOK BAR OR FORM-SAVER
BAR (BY OTHERS)
INSERTED INTO PS=Ø COUPLER
BEFORE SLAB POUR
(SEE STRUCTURAL)
CONCRETE SLAB
(SEE STRUCTURAL)
#X THREADED BAR
SEE PLAN FOR SIZE,
LENGTH, AND SHAPE
PS=Ø SLOTTED COUPLER
SEE PLAN FOR
SIZE & SPACING
CONCRETE WALL
(SEE STRUCTURAL)


SECOND POUR
(TEMPORARY STRESSING STRIP)
FIRST
POUR
PROVIDE 1/2" CHAMFER
@ SLAB SIDE OF JOINT
#X HOOK BAR OR FORM-SAVER
BAR (BY OTHERS)
INSERTED INTO PS=Ø COUPLER
BEFORE SLAB POUR
(SEE STRUCTURAL)
CONCRETE SLAB
(SEE STRUCTURAL)
EQ
EQ
#X THREADED BAR
SEE PLAN FOR SIZE,
LENGTH, AND SHAPE
PS=Ø SLOTTED COUPLER
SEE PLAN FOR
SIZE & SPACING
CONCRETE WALL
(SEE STRUCTURAL)


WSM

HISTORICAL DATA - SAVINGS

Schedule Savings Range

- 2 to 4-Months

Cost Savings Range

- $100k/floor to $350k/floor

INCREASE PRODUCTIVITY

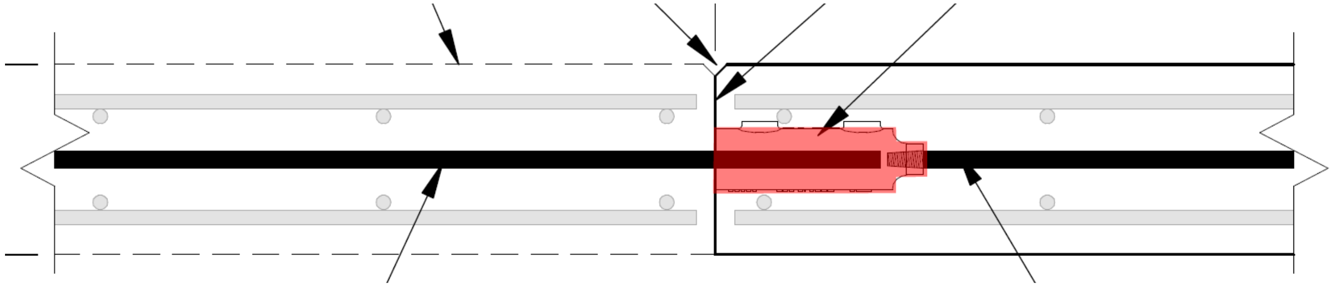
REDUCE COSTS

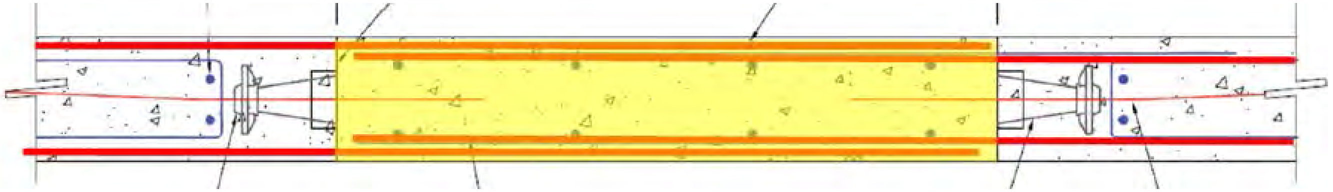
ACCELERATE CONSTRUCTION

IMPROVE SAFETY

HIGHER QUALITY CONCRETE


1 2 3
4 5 6
7 8 9
* 0 #





Questions?

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651-248-0593