Quality products that help you protect our environment

Dutchland
INCORPORATED
engineered concrete environmental solutions

Precast Post-Tensioned Concrete Water & Wastewater Tanks

What is Post-tensioning and what are some of its uses and advantages?

prestressed concrete and how concrete can be either pre-tensioned or post-tensioned

History of Dutchland, Inc.

- **Founded in 1985, family owned & operated** – ***roots actually go back to 1970's when they started precast pkg wwtp's***
- **Headquartered in Gap, PA**
- **Approx. 150 employees**
- **Full service engineering, manufacturing & construction firm specializing in prestressed tanks**
- **Recognized by PCI as operating one of the highest quality manufacturing facilities in US**
- **Designed and built over 1,000 tanks in 16 states (PA, NY, NJ, MD, DE, VA, WV, CT, OH, NC, IN, MA,NH,GA, KY, AR)**

Some of our History and Experience

- Largest volume rectangular tank: 18 MG
- Largest volume circular tank: 8.5 MG
- Largest diameter tank: 206 ft
- Tallest circular tank: 52 ft
- Tallest rectangular tank: 36 ft

What types of Prestressed Concrete Tanks are available?

- Wire- and Strand-Wrapped (AWWA D110)
  - DN
  - Preload
  - Crom
- Internal Tendon (AWWA D115)
  - Dutchland (Precast in Northeast US)
  - Old Castle (Precast in Northwest US)
  - DuraStor (CIP throughout US)
  - General Contractor Design-Build (Throughout US)

Types of Prestressing

- Circular Tanks:
  - Horizontal Tendons are always bonded
  - Vertical tendons may be unbonded
  - Fully complies with the AWWA D115 standard
- Rectangular Tanks:
  - Unbonded tendons may be used horizontally and vertically
  - Fully Complies with ACI 350 for a post-tensioned structure

What types of Tendon Prestressed Concrete Tanks are available?

Precast Concrete

Cast-In-Place Concrete

Versatility – Safety walls

Traditionally for LNG Tanks and Nuclear Containment Vessels

When Stress Is Good: *Pre-stressed and Post-Tensioned Concrete*

Key Term

Pre-stressed Concrete

Concrete elements or structures in which internal stresses are induced by means of prestressed reinforcement.

Concrete in compression is in it's strongest state!

That's when Stressing is Good!

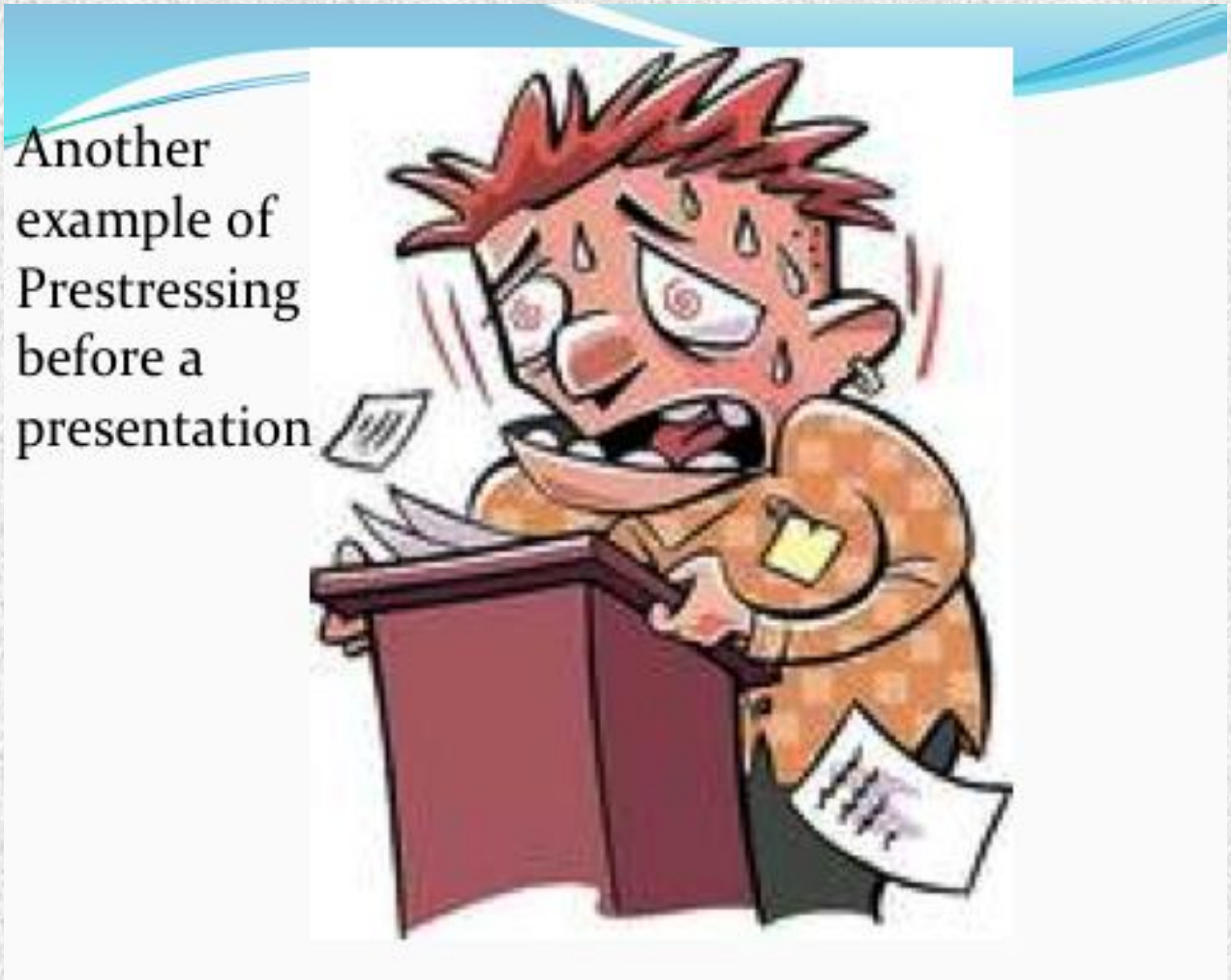
Key Term

Post-tensioned pre-stressed concrete

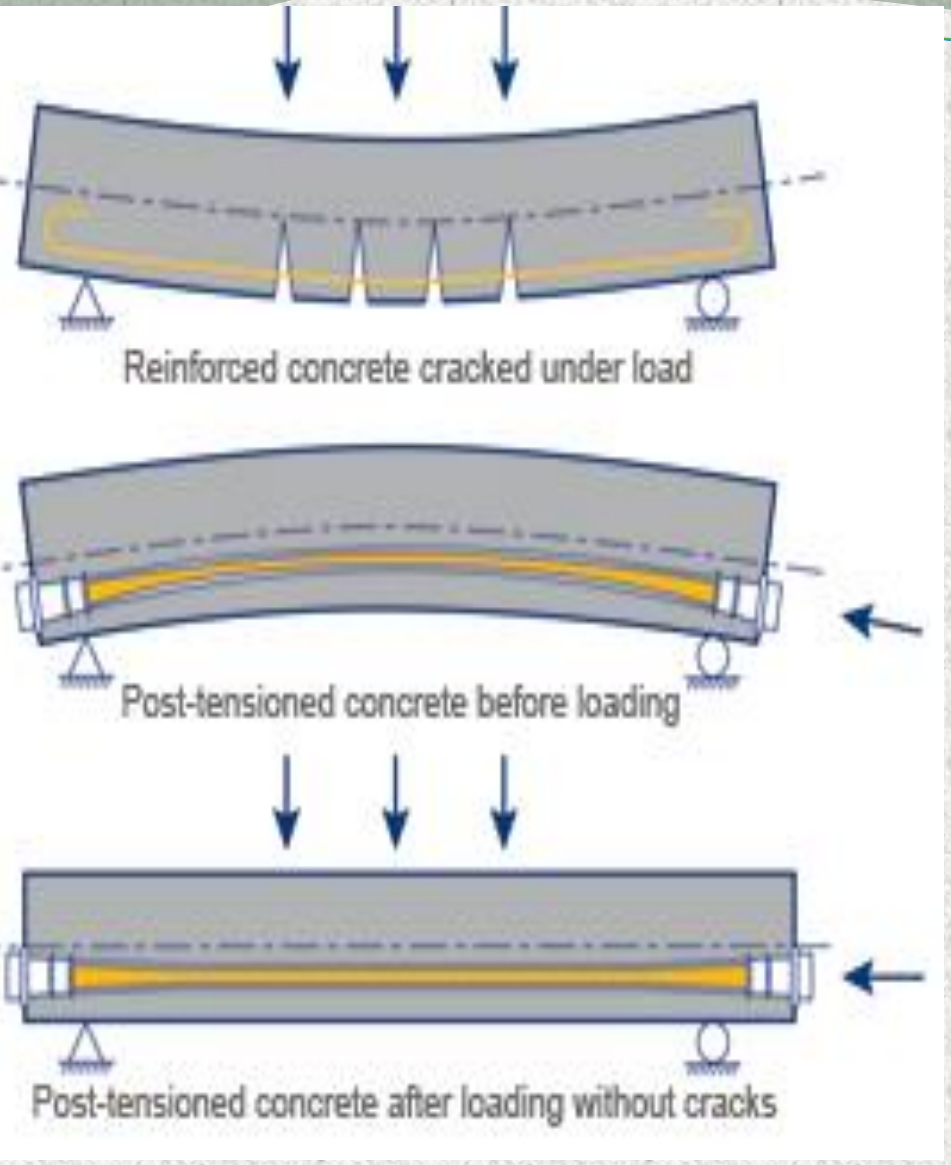
Steel tendons are stressed after the concrete has been placed and gained sufficient strength at the construction site.

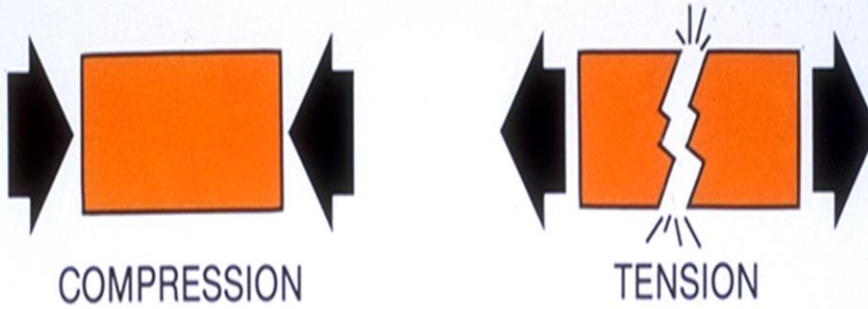
When stress is BAD!!!

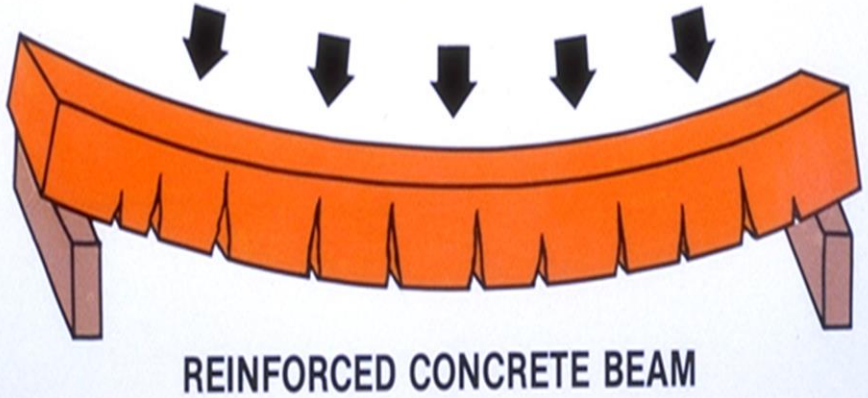
pre-stressed with internal forces!!



Best way to De-stress!!


Reinforced concrete cracked under load
Post-tensioned concrete before loading
Post-tensioned concrete after loading without cracks


COMPRESSION
TENSION


REINFORCED CONCRETE BEAM

Fundamentals of Prestressed Post-Tensioned Concrete Tanks

- Mix Designs
- Basics of Prestressing
- Selecting a Tank Configuration
- Base Design Options
- Wall Design Options
- Walkway Design (Upper Fixed Beam)
- Roof Design
- Building Integration

Advanced Concrete Mix Design

- Type I/II Portland Cement Meets the compressive strength requirements of Type I cement.
  - Provides the sulfate resistant properties of Type II cement.
- Self-Consolidating Concrete
  - Reduced viscosity (22-28 inch spread test vs slump test).
  - Homogenous suspension of course and fine aggregates. (reduced large aggregate size)
  - Less vibration required
  - Increased **impermeability**
  - Greater bonding to reinforcing
  - Substantially reduces surface defects and provides more uniform aesthetics
- Class F fly ash used at a 25% substitution rate.
  - Enhances sulfate resistance
  - Further reduces permeability
  - Environmentally friendly post-consumer product.
- Air entrainment & high range water reducing admixtures
- 0.34-0.38 water to cement ratio
- 5,000 psi minimum compressive strength (multiple accelerators used)
  - Breaks common between 7,000-9,000 psi. in 28 days.

Design of Precast Post-Tensioned Tanks

- In existence since the **1920's**.
- Design and construction of prestressed circular tanks (ACI 344) first published in 1970
- AWWA's standard for circular tanks with internal tendons (AWWA D115) first published in 1996.
- AWWA D115 standard is revised to include rectangular tanks, and rectangular tanks with rounded corners in 2006.
- **Post-Tensioning enhances concrete strength under both compressive and tensile stresses.** This process introduces both compressive forces in the concrete and stresses that counterbalance service loads. The benefits are substantial.

Circular Tank examples

Categories of Post-Tension System:

- Bonded Multi-Strand:
  - Tendons are inserted into a corrugated plastic duct that is embedded in the concrete
  - Duct is then filled with cementitious grout, creating a bond with the surrounding duct
  - Primarily used for horizontal prestressing on circular tanks

- Un-Bonded Mono-strand
  - Tendon is coated with corrosion-inhibitiing grease & encapsulated in a seamless plastic sheathing
  - Anchor has a “wedge cavity” where the wedge set seats down and bites into the strand
  - Primarily used for horizontal prestressing on rectangular tanks and vertical prestressing on circular tanks

Construction Sequence

Step 1:

Step 2:

Produce precast concrete panels while site work is performed

Place cast-in-place base slab

Construction Sequence

Transport, erect and brace panels

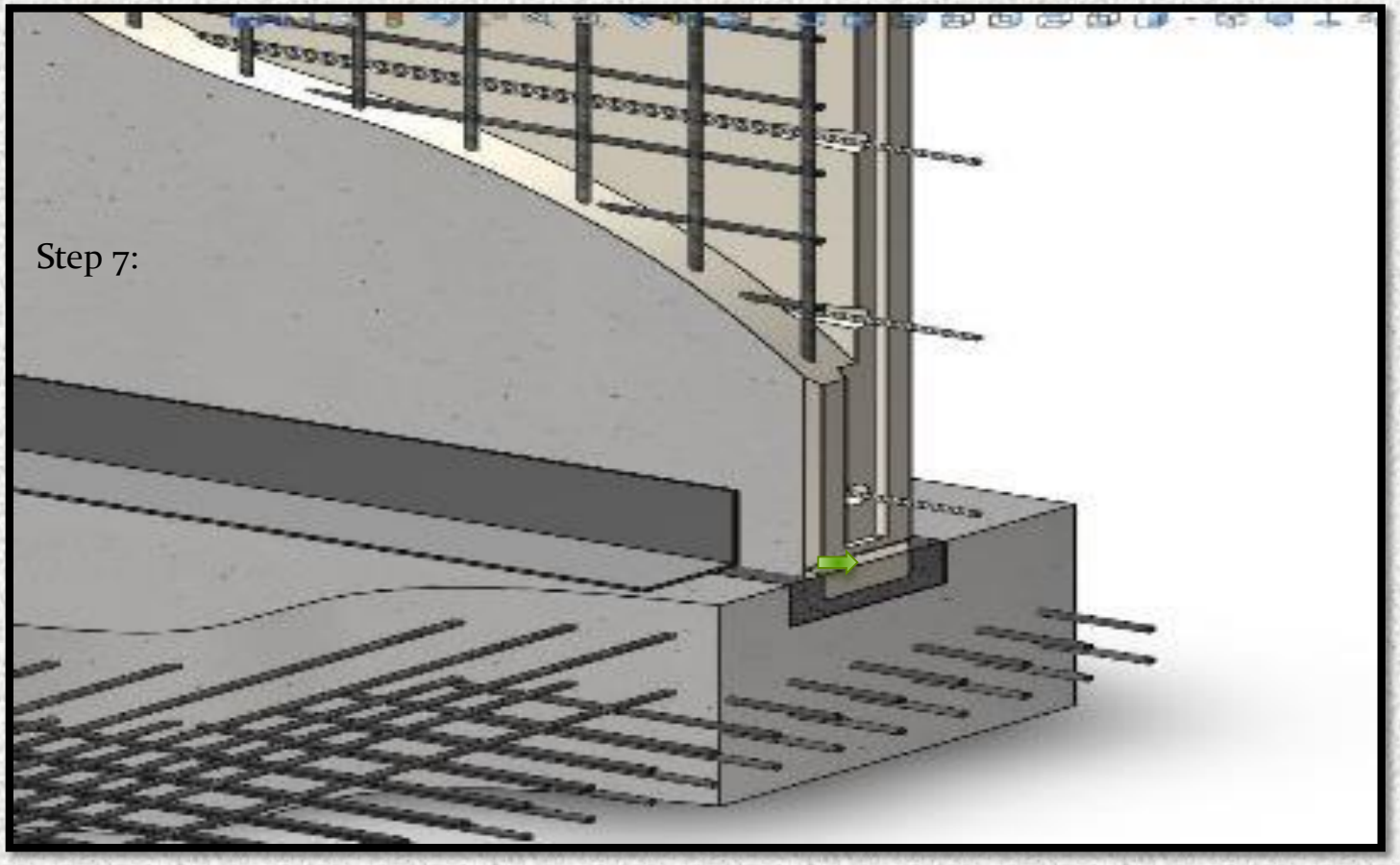
Install post-tensioning strands & anchors

Construction Sequence

Seal and grout wall joints

Stress post-tensioning tendons

Construction Sequence

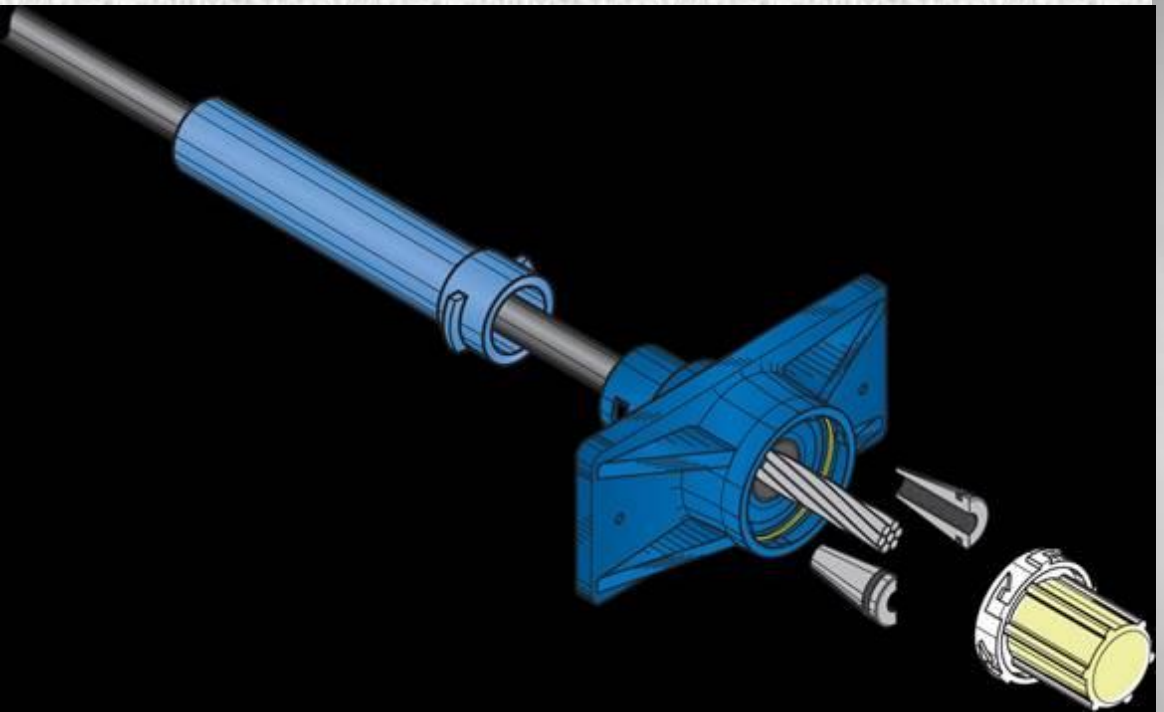


Grout base-to-wall joint
then apply sealants

Sheathed monostrand tendon - for unbonded Post tensioned systems

Long Term Durability – Tendon Tanks

Triple Corrosion Protection of critical prestressing strands



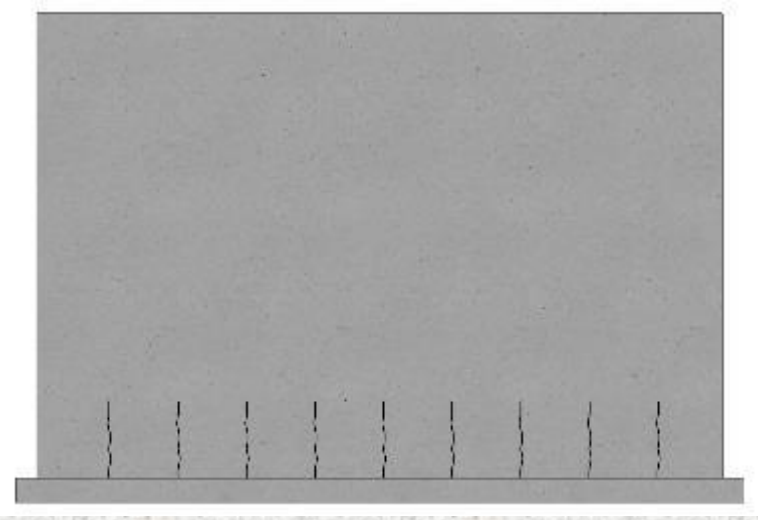
ENCAPSULATED POST-TENSIONING SYSTEM

Anchor system with cut tendon and grease cap

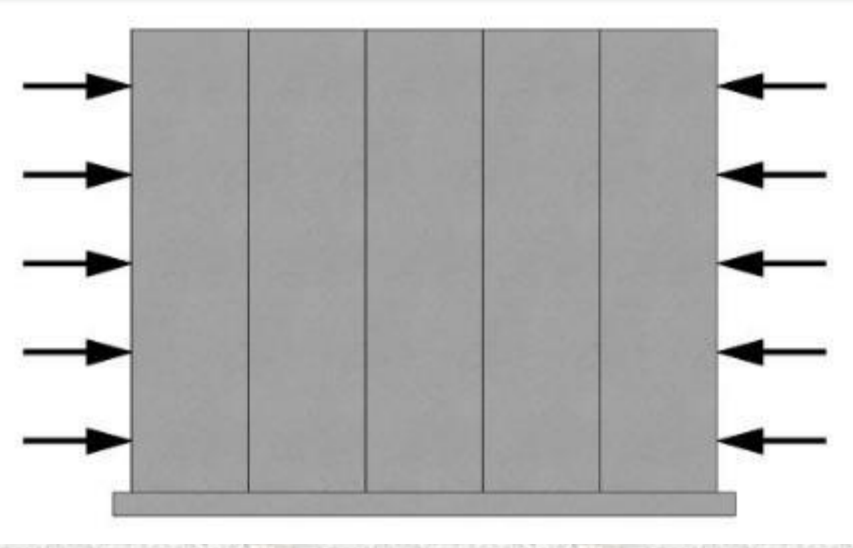
Tendon Termination:

Precast PT/prestressed Advantage: Durability

- Dense, low-permeability concrete
- Individual precast panels allow for unrestrained curing & shrinking
- Active reinforcing produces pre-compression
- Internal tendons well-protected against corrosion



Conventionally-reinforced CIP wall - cracks due to concrete shrinkage



Precast Post-tensioned Wall – no shrinkage cracking

Precast PT/prestressed : Provides

Versatility & Schedule advantages

- Partially or fully buried
- Open top or covered
- Circular, rectangular, oval-shaped
- Future expansion & modification

- Circular, rectangular, oval-shaped
- Design-Build format allows for quicker precast tank design
- Off-site production during site work
- Production not affected by weather
- Installation possible in adverse weather conditions

How precast Post-tension works

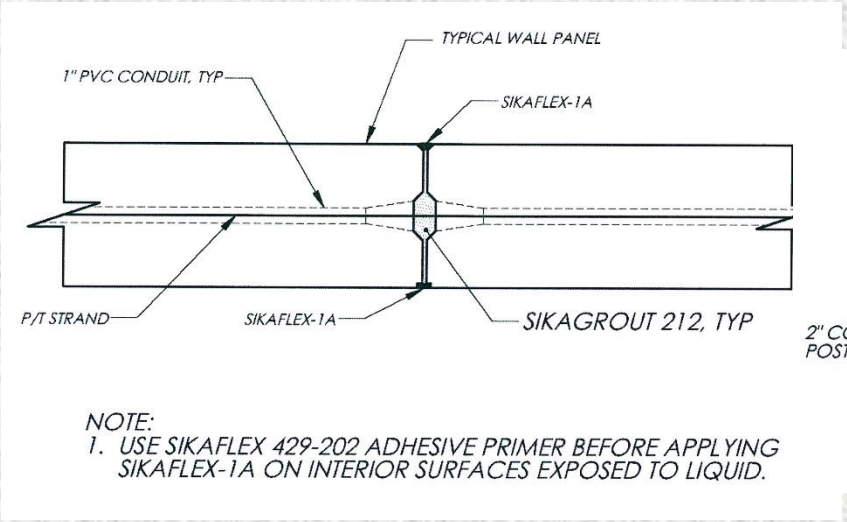
Rectangular, Circular, Elliptical, Structures

- **Options:**
  - Sequential Batch Reactors
  - Membrane Bio Reactors
  - Oxidation ditches
  - CSO tanks
  - Extended Aeration Systems
- **Considerations:**
  - Utilization/Process
  - Economics
  - Site availability
  - Size /Capacity

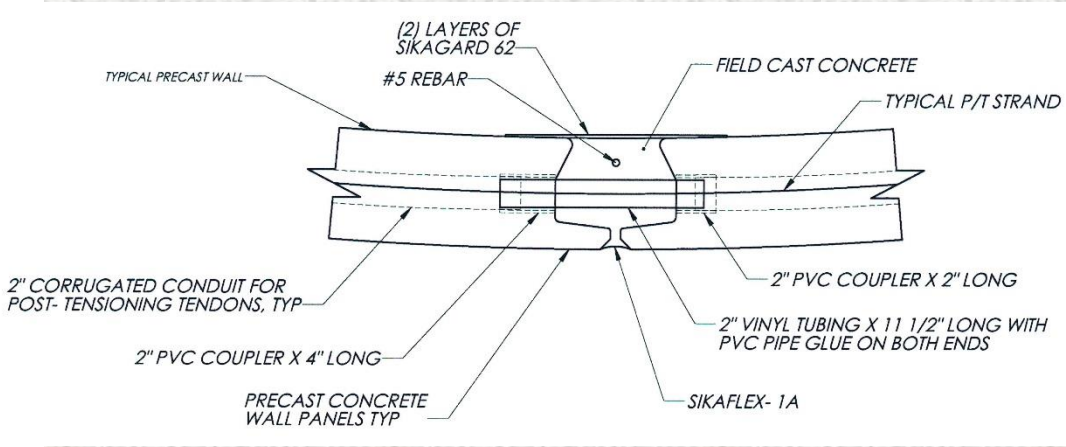
Typical Post-Tensioned Wall Details

Typical Joint Details

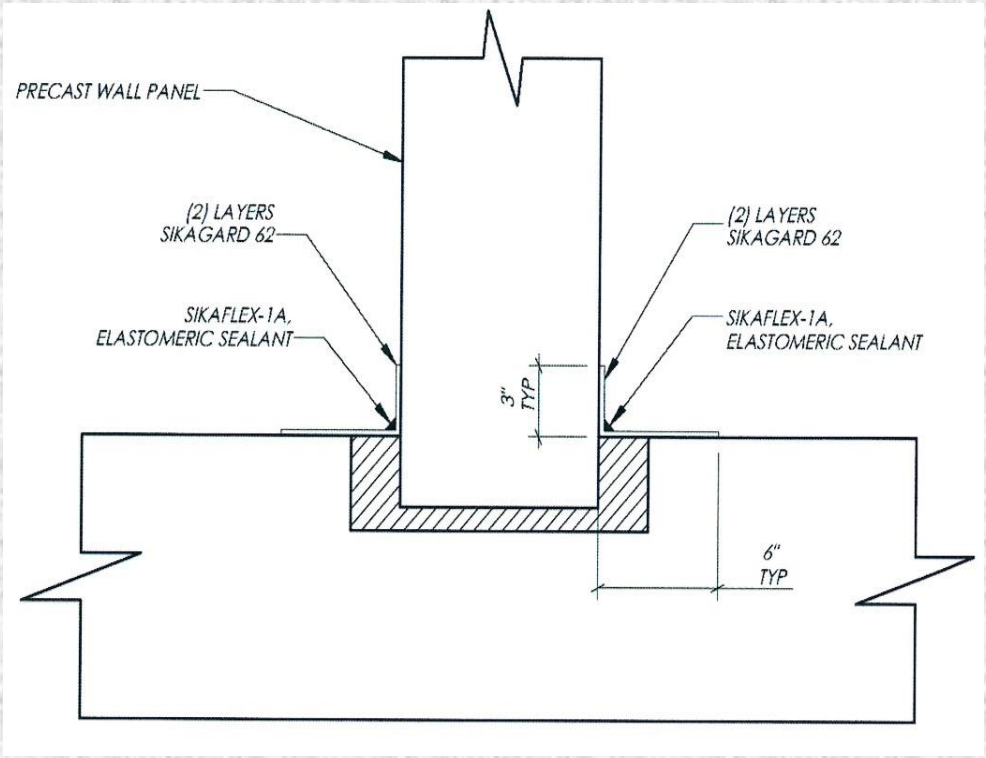
Wall Panel Joint Details



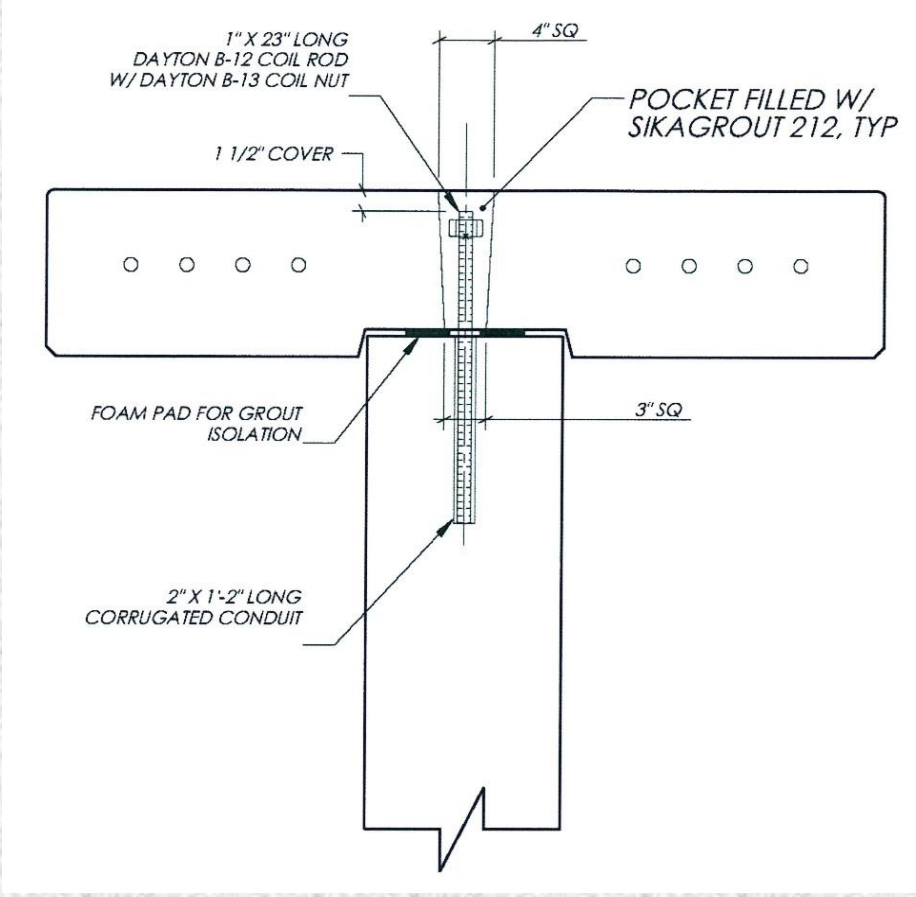
Vertical Grouted Wall Panel Joint Details



Typical Joint Details

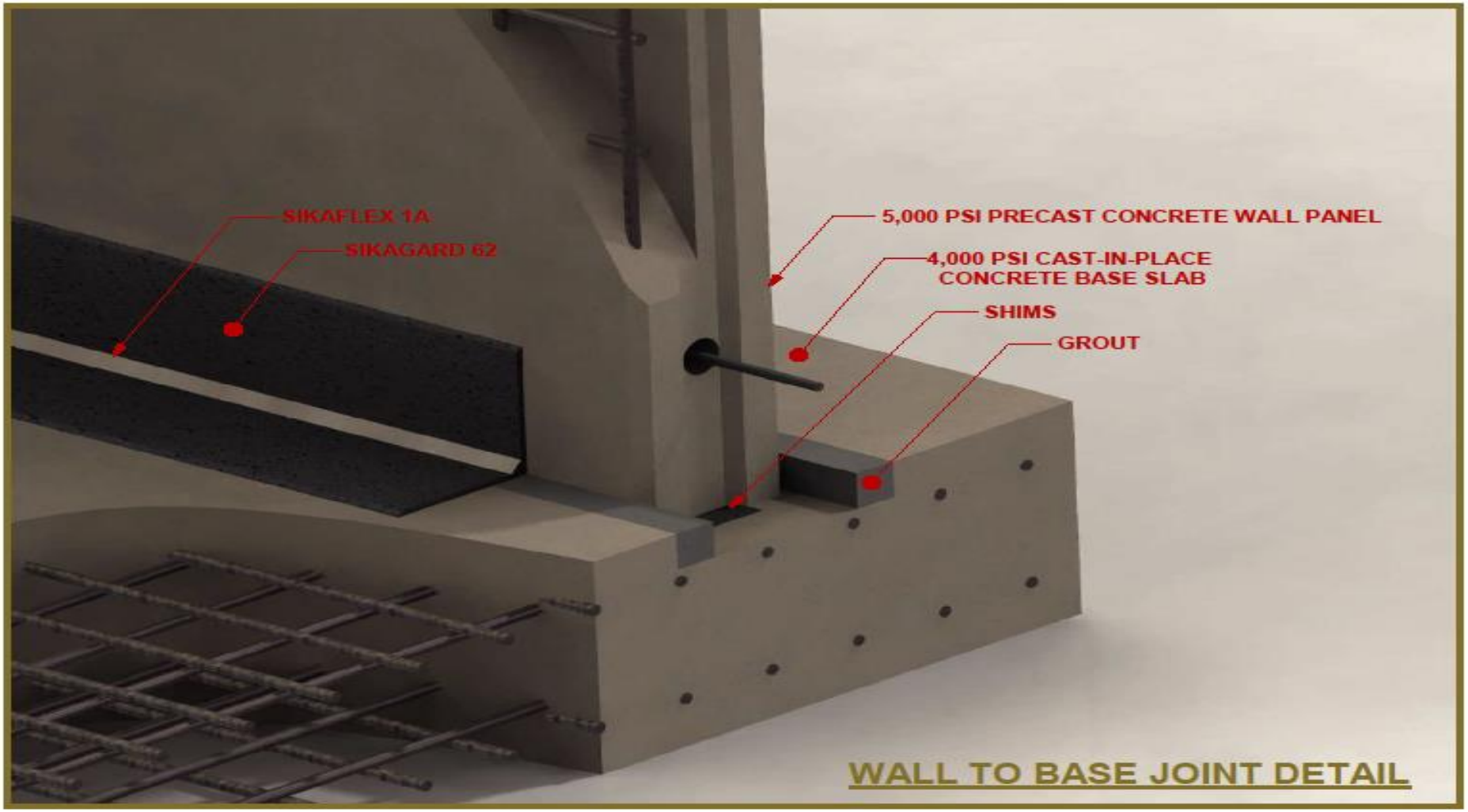


Typical Interior Base/Wall Sealant Detail



Wall to Walkway Connection

Precast Post-Tensioned Concrete Wall to Base Detail



Base Slab Design Options:

Process Starts With Base Design

INSTALLATION SEQUENCE

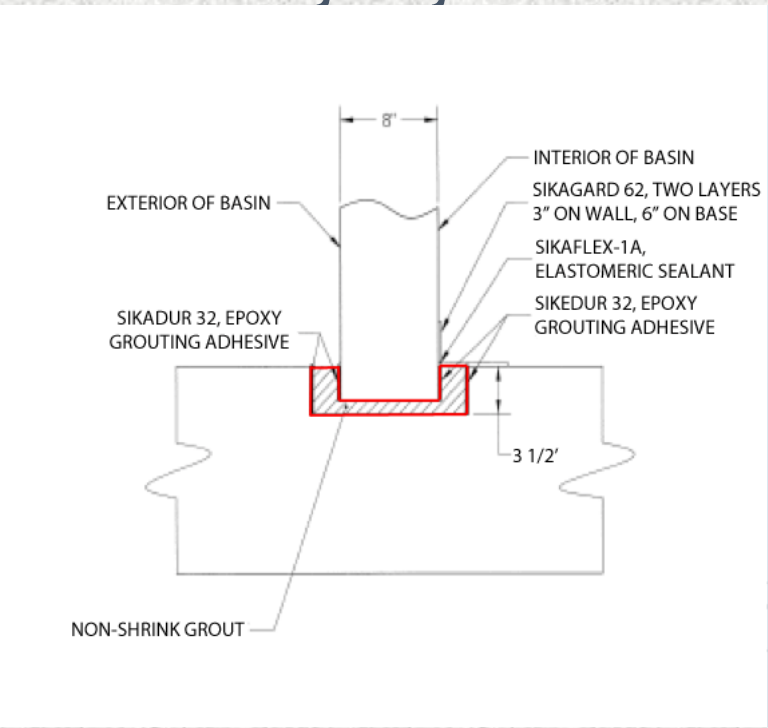
Prepare and pour the post-tensioned concrete base slab on-site

Circular and rectangular base systems

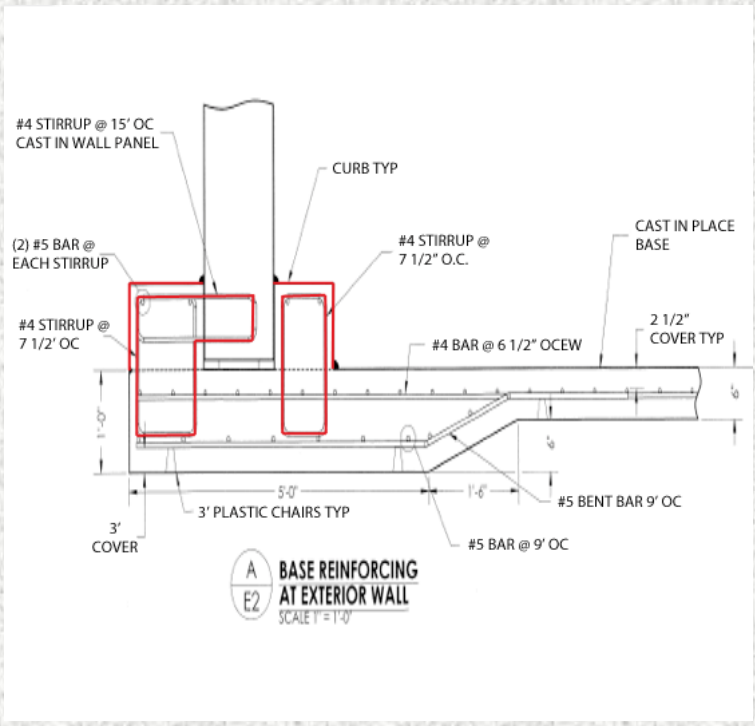
Rectangular Base Design

Recessed Keyway vs. Curbs

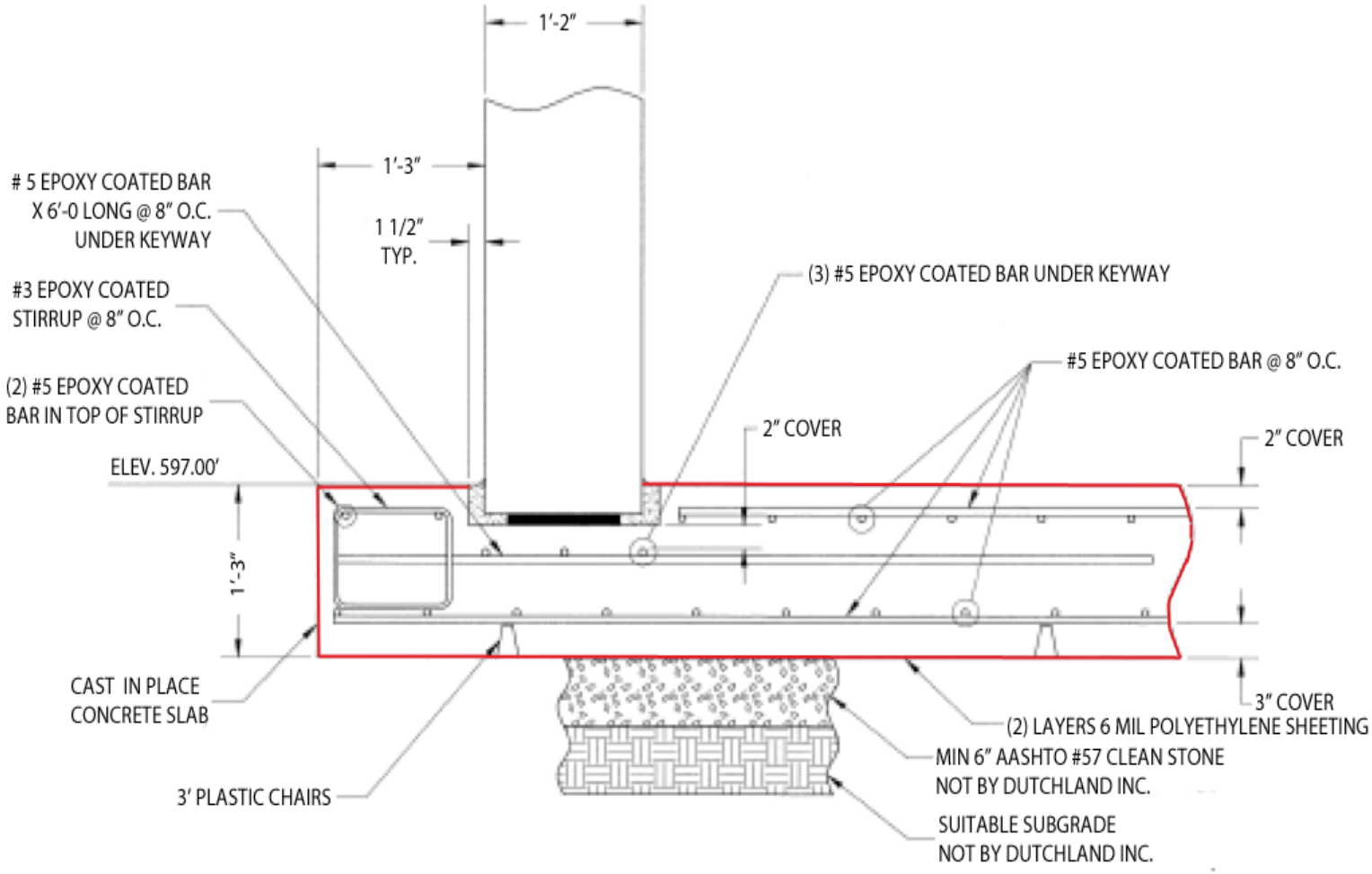
Recessed Keyway:



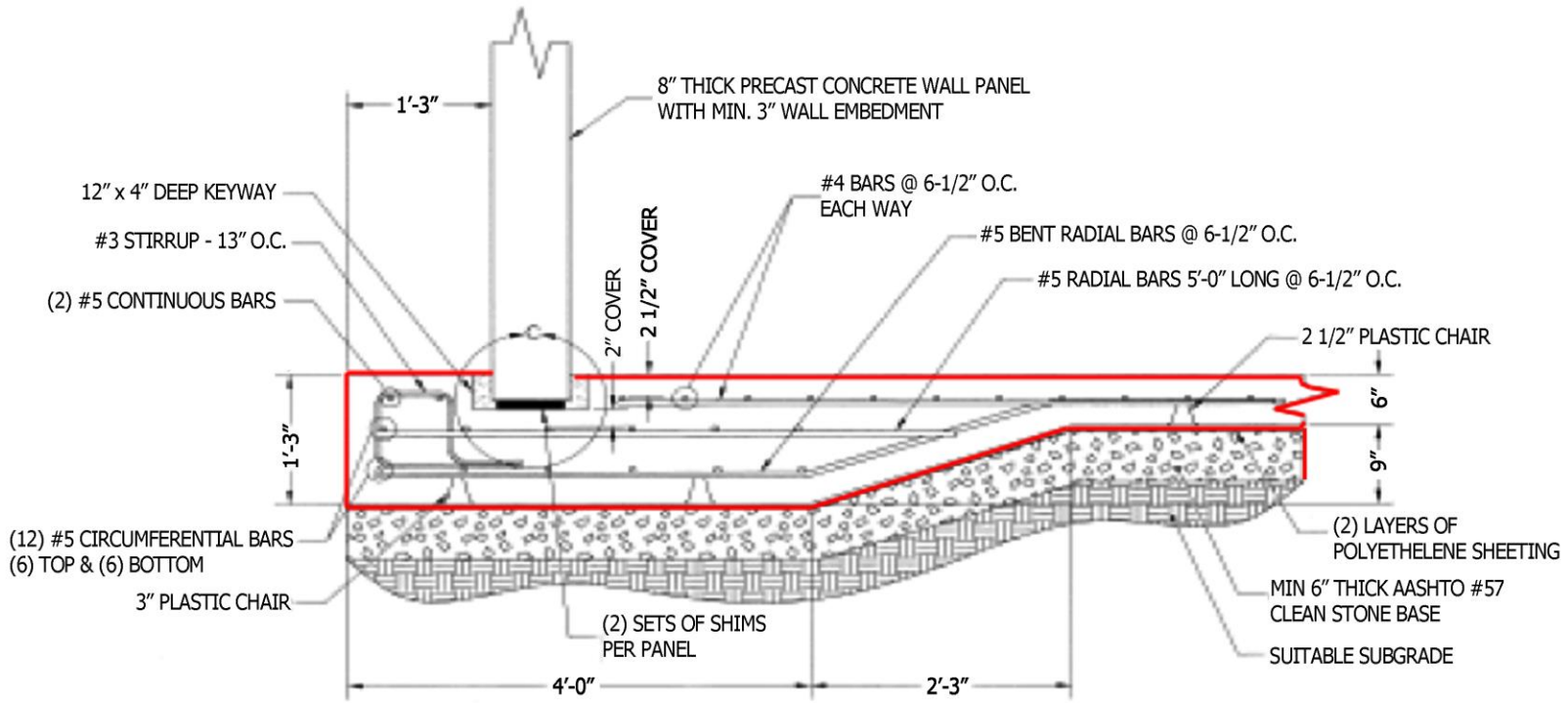
Curbs:



Structural Floor Slab:

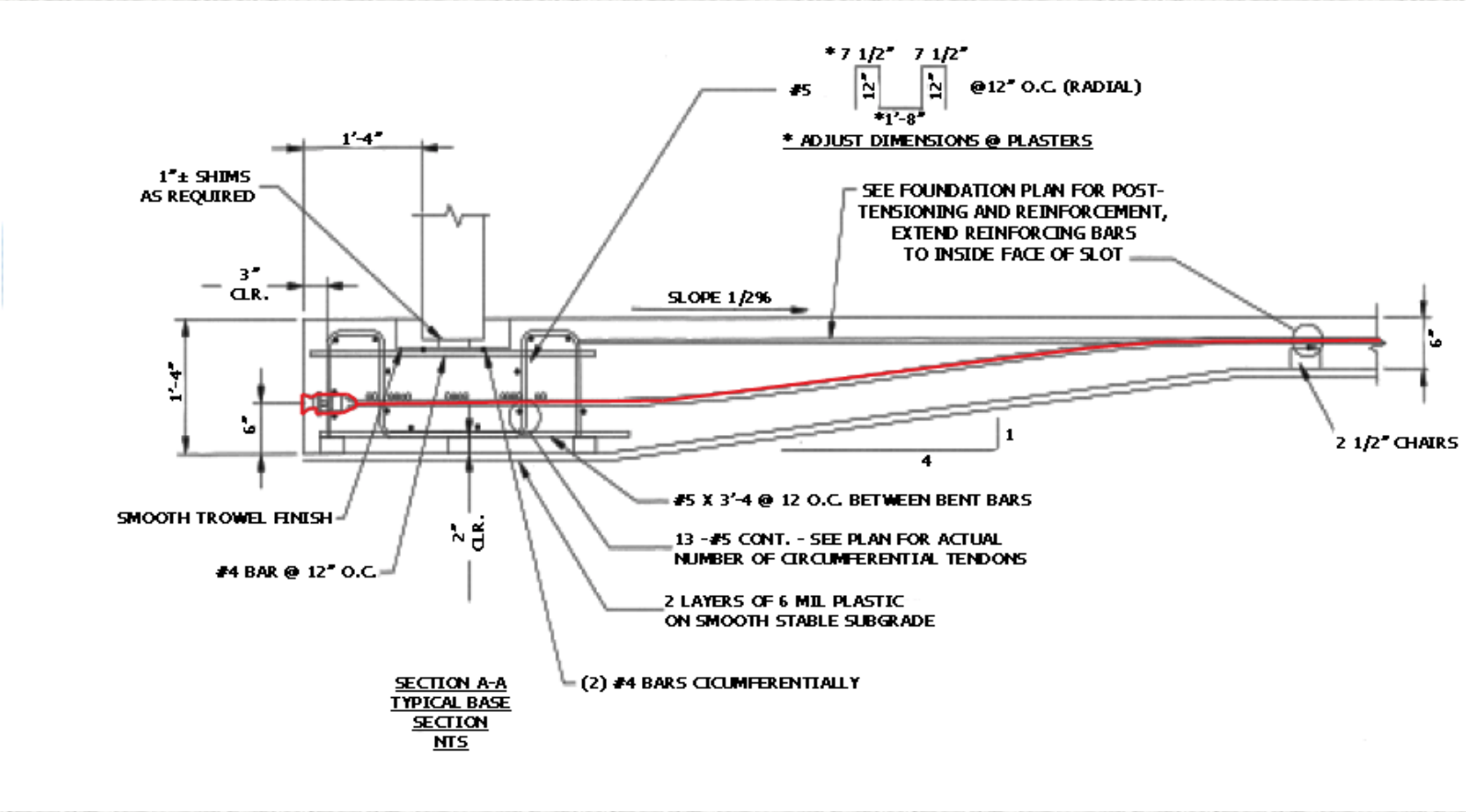


Membrane Floor Slab:

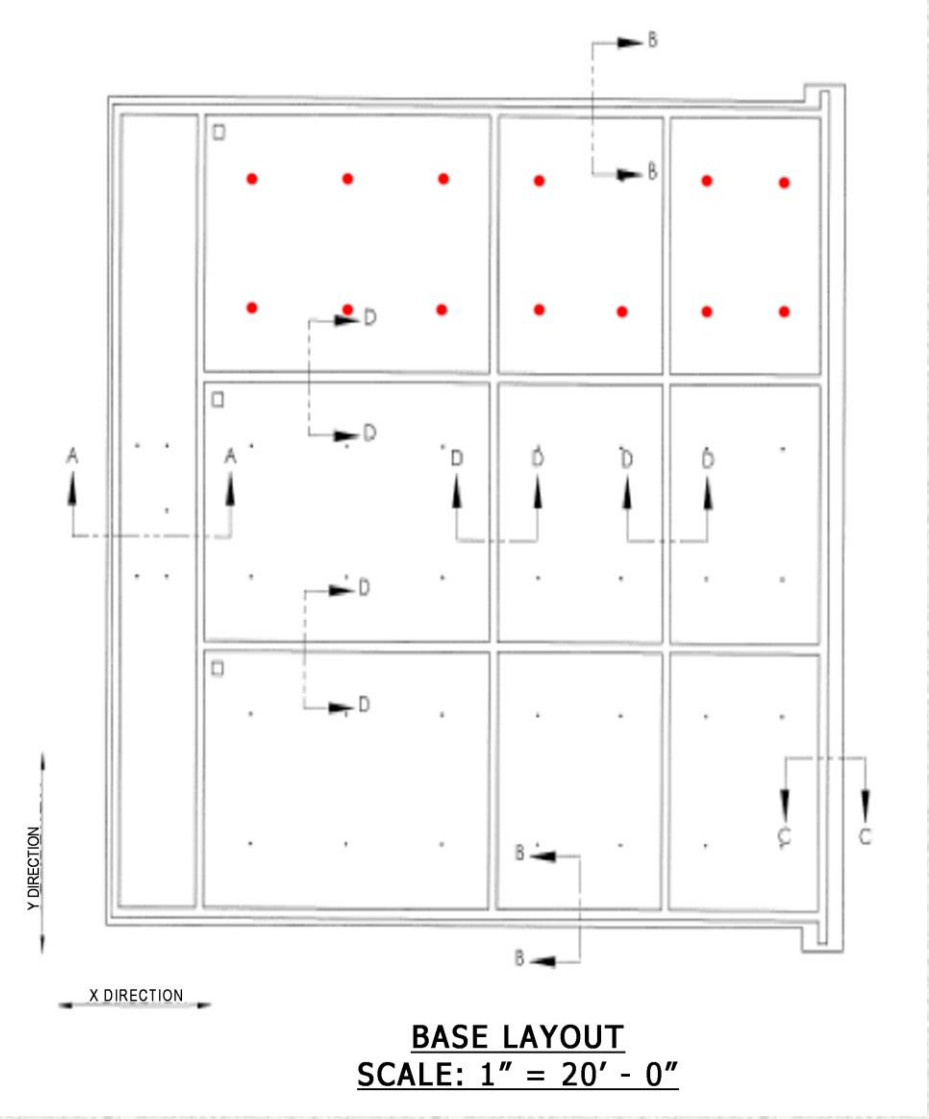


SECTION B-B
PERIMETER BASE SLAB/WALL PANEL
CONNECTION/REINFORCING DETAIL
SCALE 1"-1'-0"

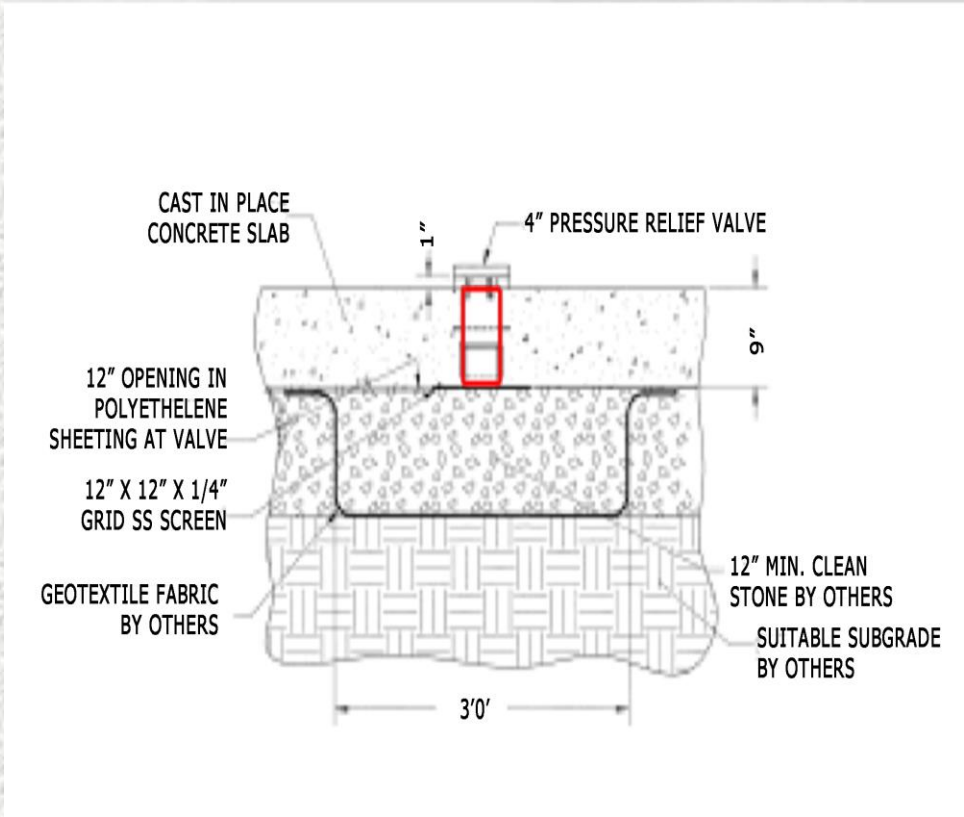
Prestressed Floor Slab:



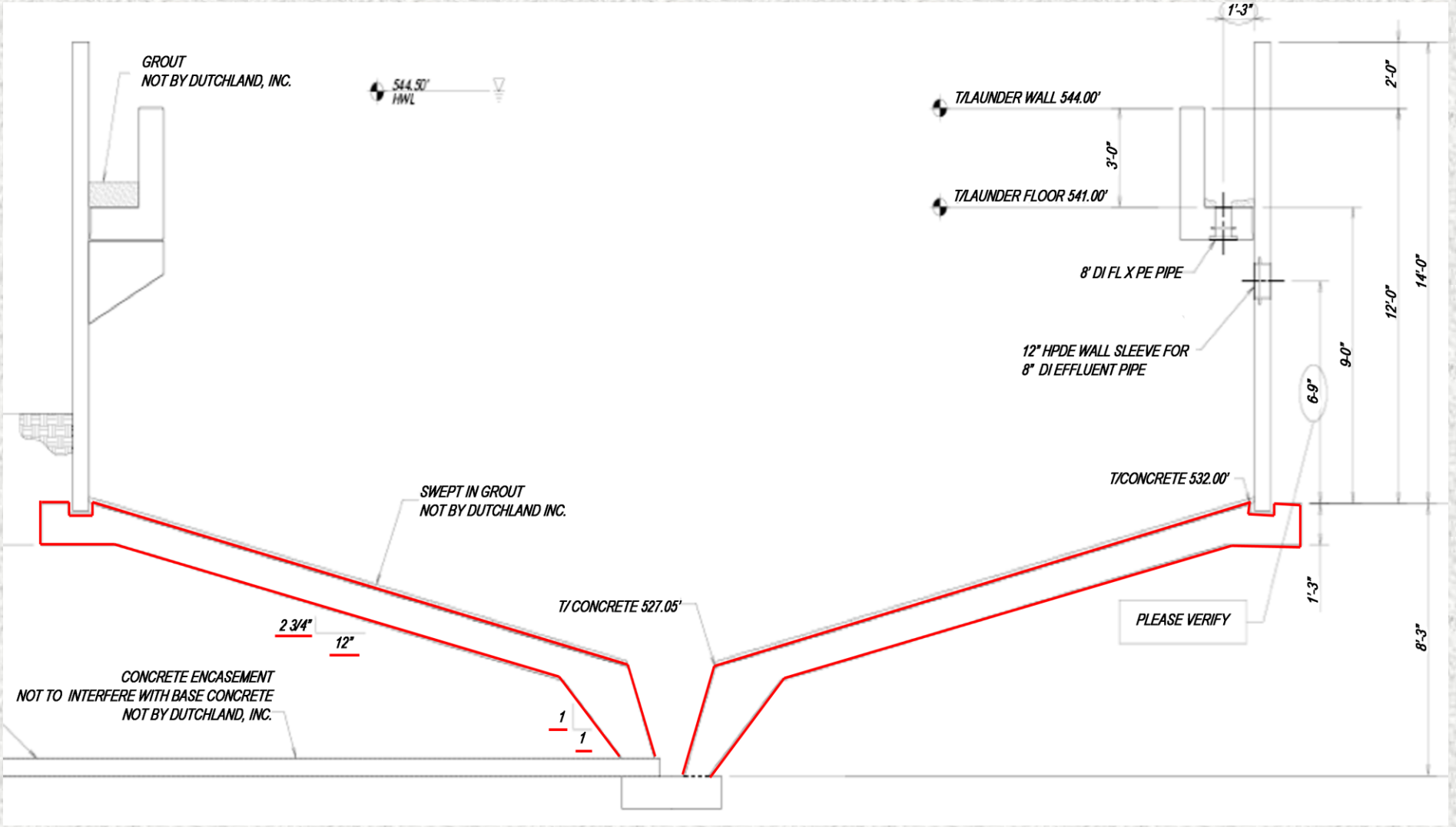
Floor with Pressure Relief Valves:



BASE LAYOUT
SCALE: 1" = 20' - 0"

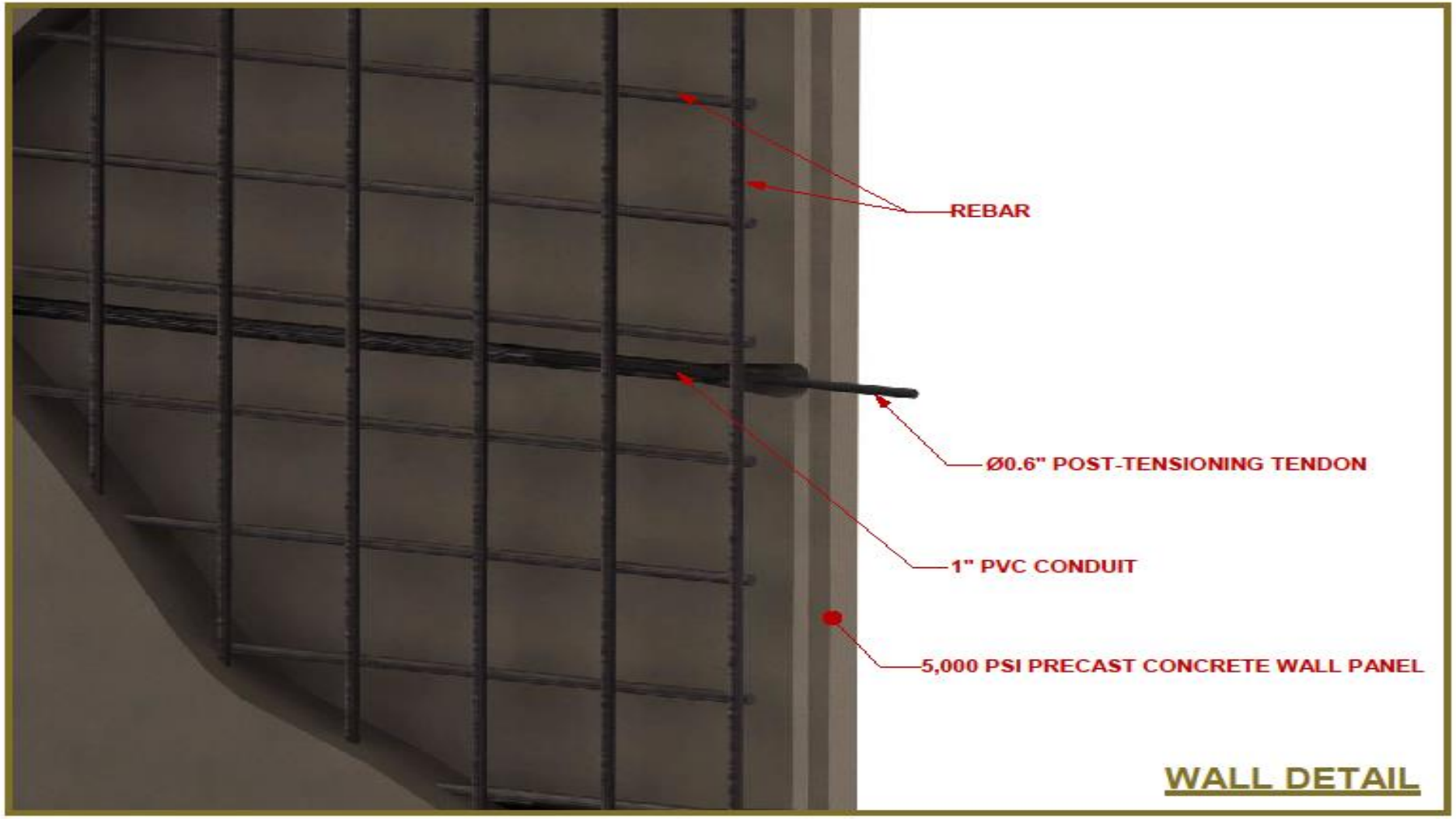


Floor Sloped to Sump:

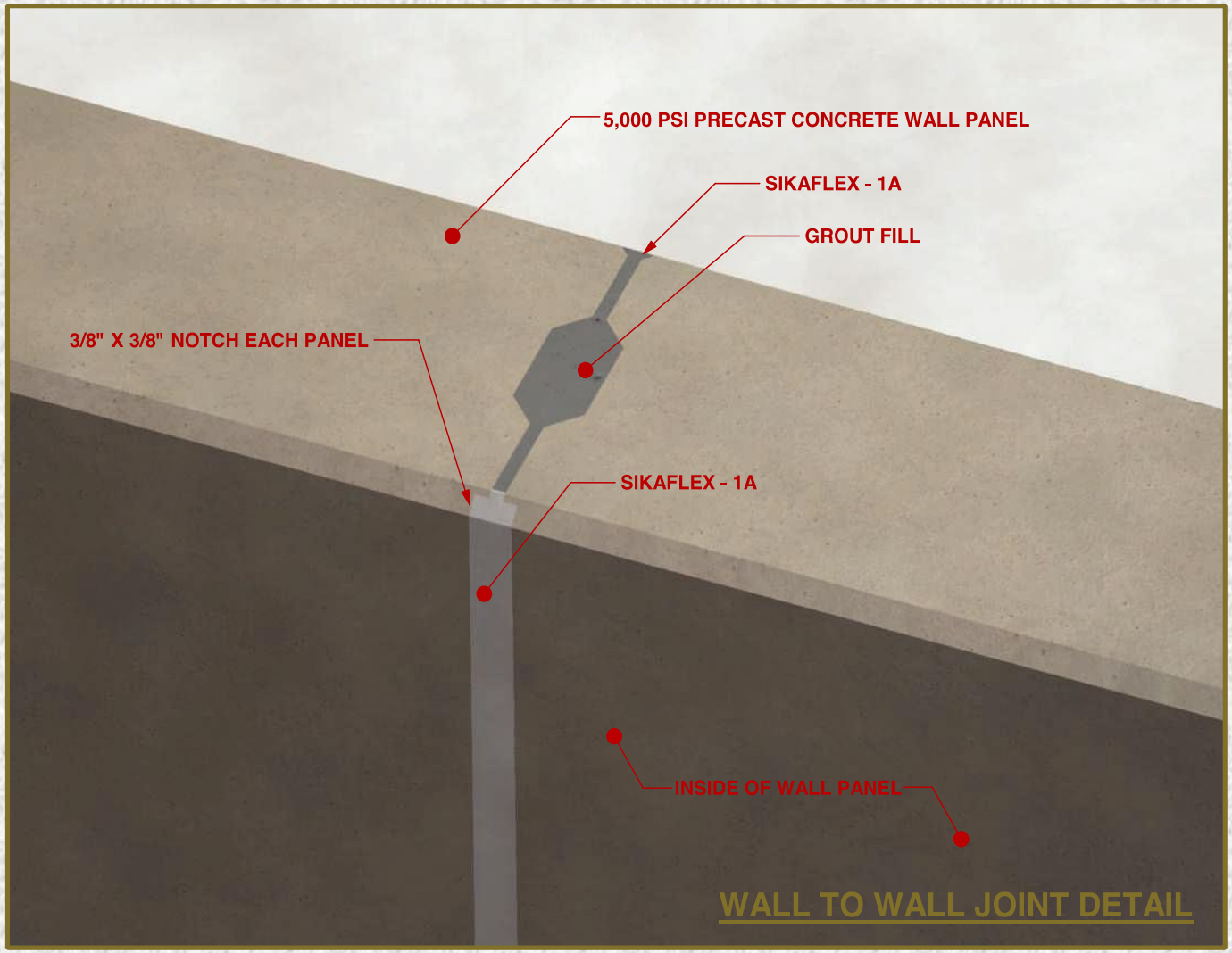


Wall Design Options:

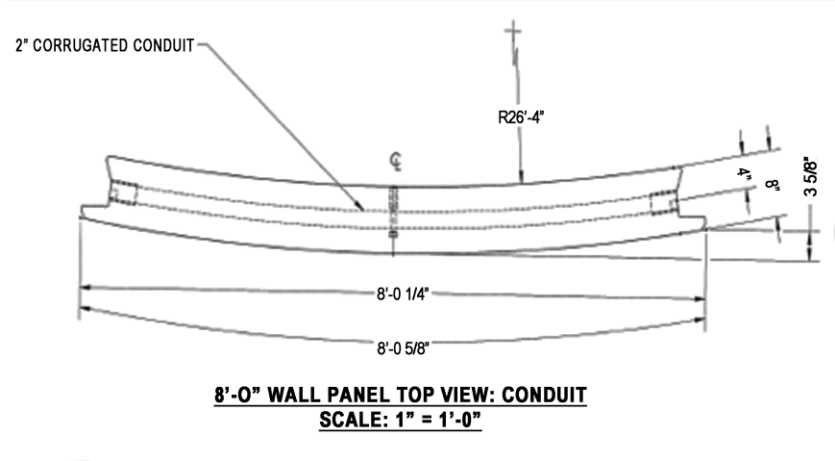
PPT Wall Section Wall panel detail showing mild and active reinforcing



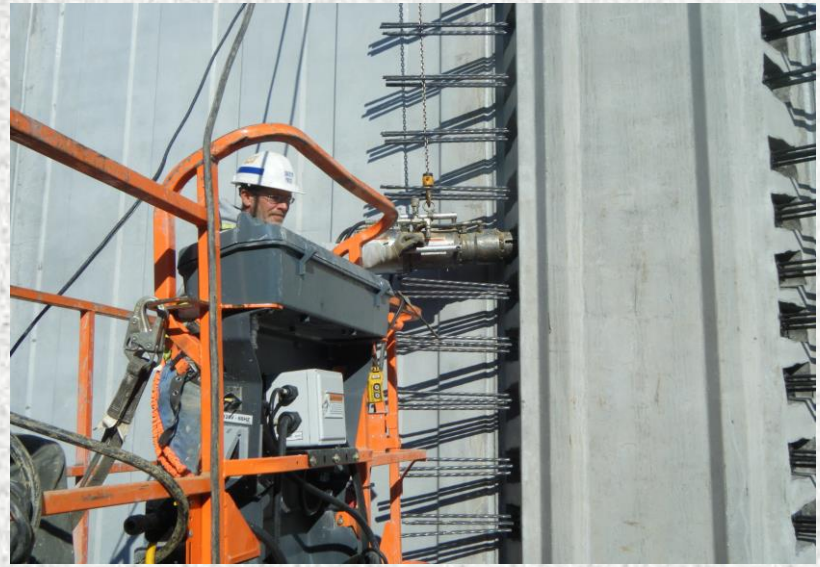
Typical Post-Tensioned Wall grout and joint Details

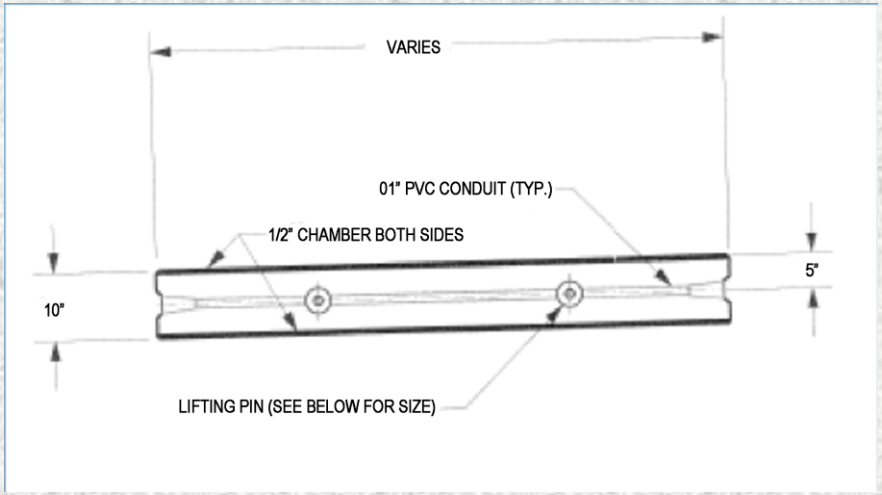


Wall Types:



8'-O" WALL PANEL TOP VIEW: CONDUIT
SCALE: 1" = 1'-0"





Interior Wall Attachments:

Exterior Wall Attachments:

INSTALLATION SEQUENCE

Wall Panel Erection

Threaded Tendons await to be cut

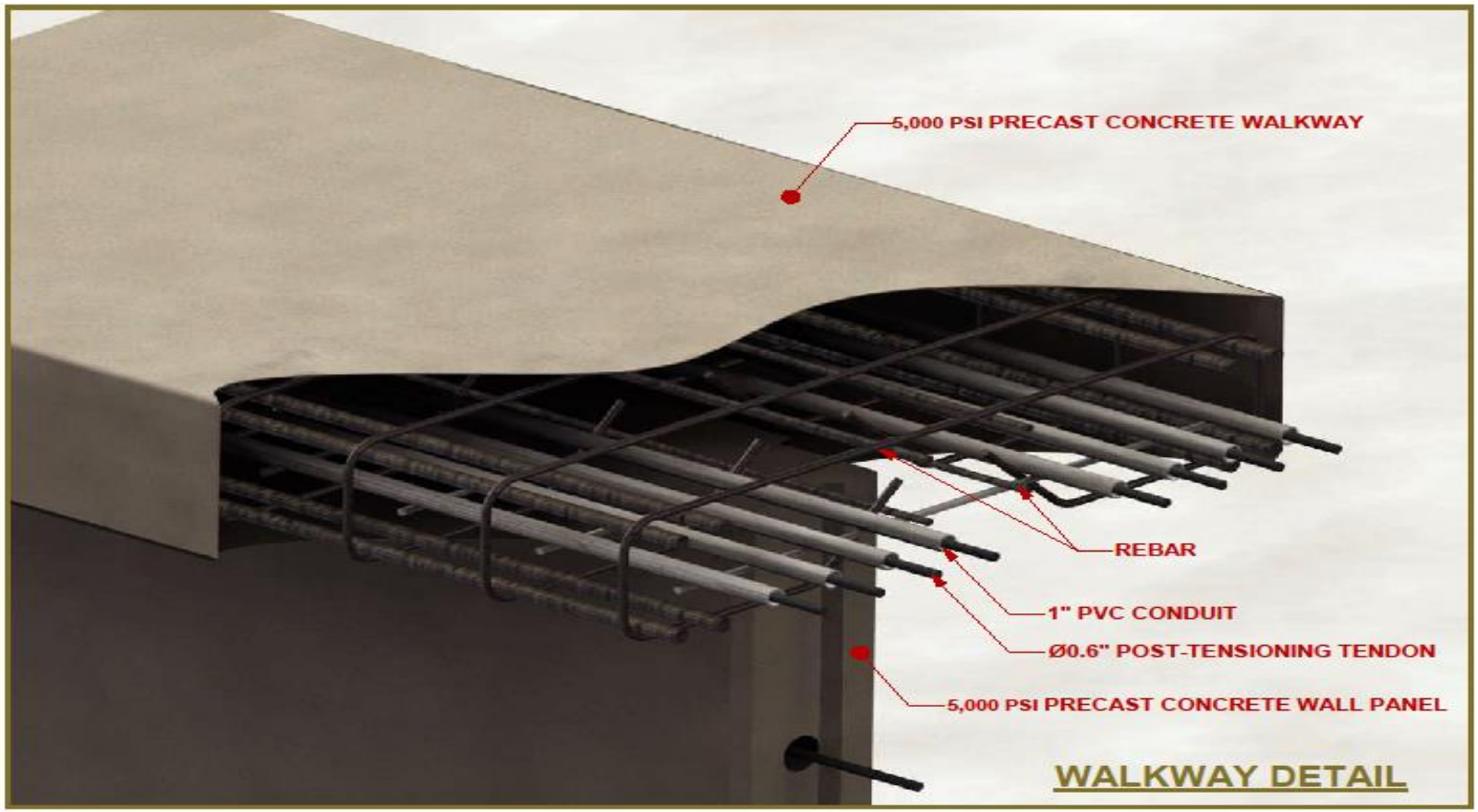

S-65


4x4

Brodhead Creek SBR

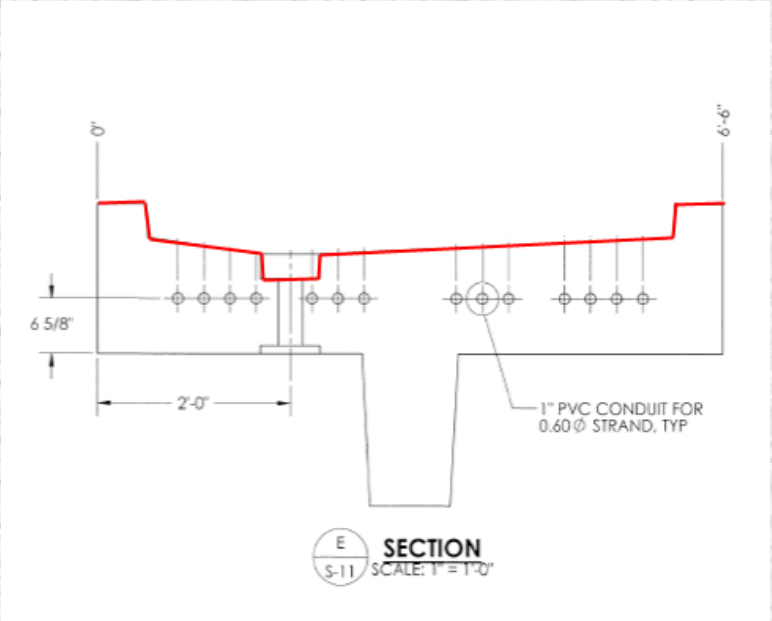
Tank volume approx. 7.3 MG holding capacity

PPT Rectangular Tank Walkway Detail



Walkways:

Curbs for Cover Attachment

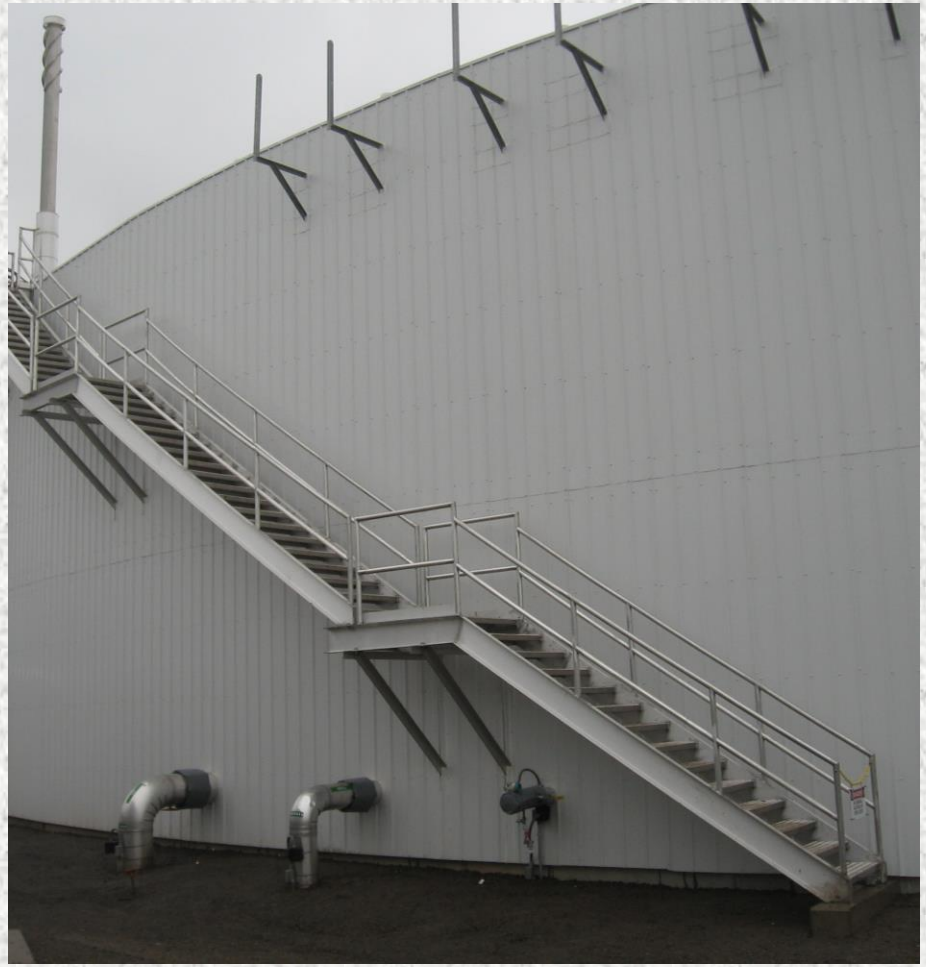


Moorefield WV project

Moorefield WV project

Salisbury MD

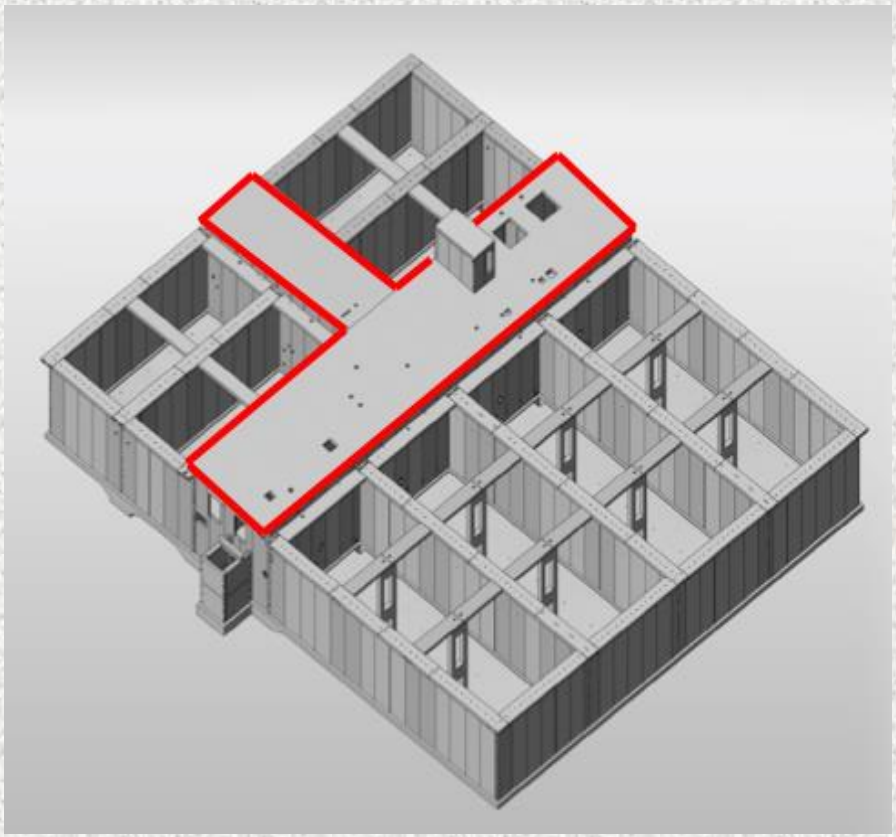
Furmano Foods 7 MG tank



Common-walled Utility Room and building options:

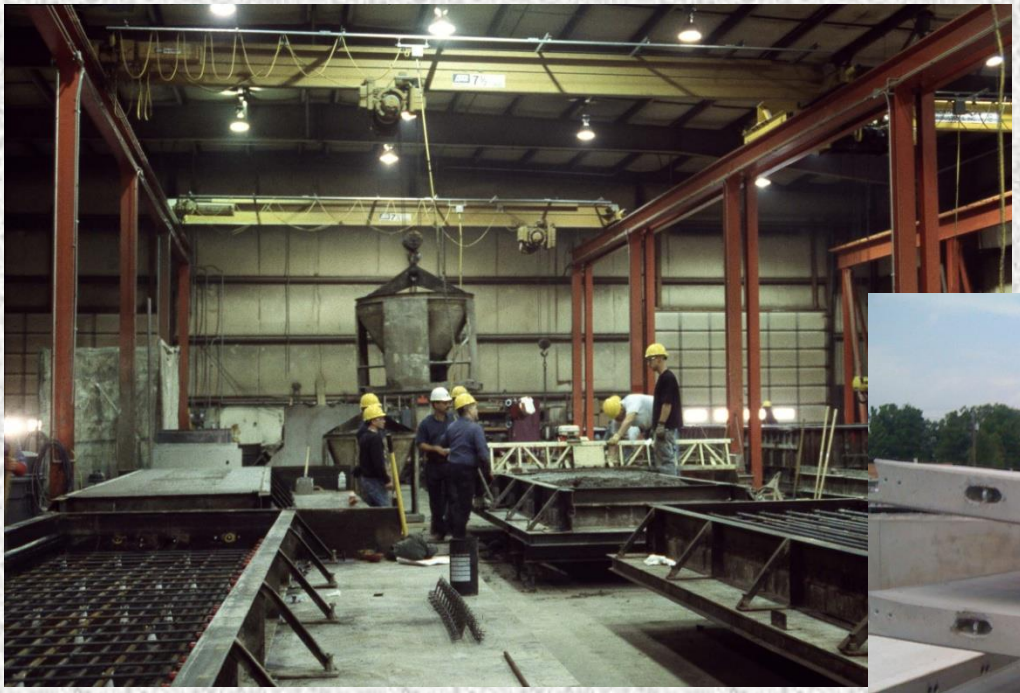
Buildings by Others:

Precast Buildings:



Jonestown under construction

PCI Certified Plant



Aesthetics on Tanks

Colors and More

Imprinting a Logo

Hey……It could Happen!!!

Garrett County MD – McHenry tank

WEST HANOVER

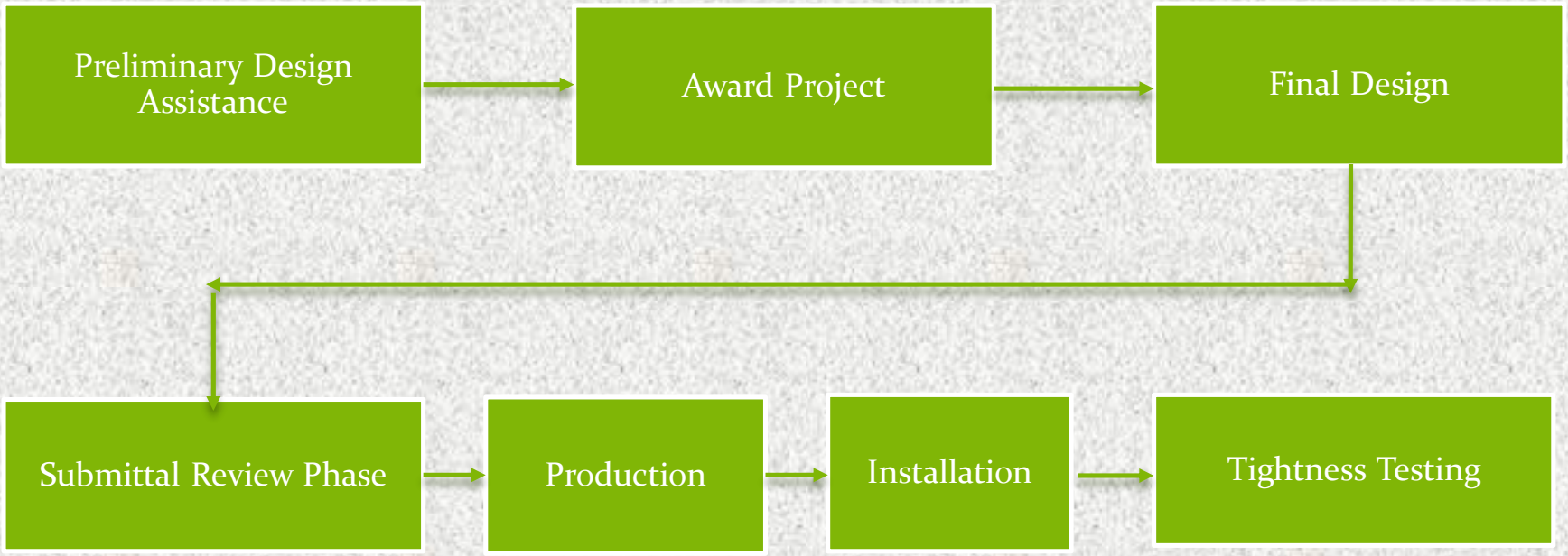
CMU BLOCK FORM

Benefits of Tank Structures

Precast Concrete Post-Tensioned Tank

- ***Virtually maintenance free***
- ***Longevity*** (50-100 year life expectancy)
- ***Usually less expensive than poured in place***
- ***Thinner walls and base than poured in place***
- ***Produced in a controlled PCI certified plant***
- ***5000 PSI self consolidating concrete with fly ash***
- ***Active Reinforcing for PT tanks***

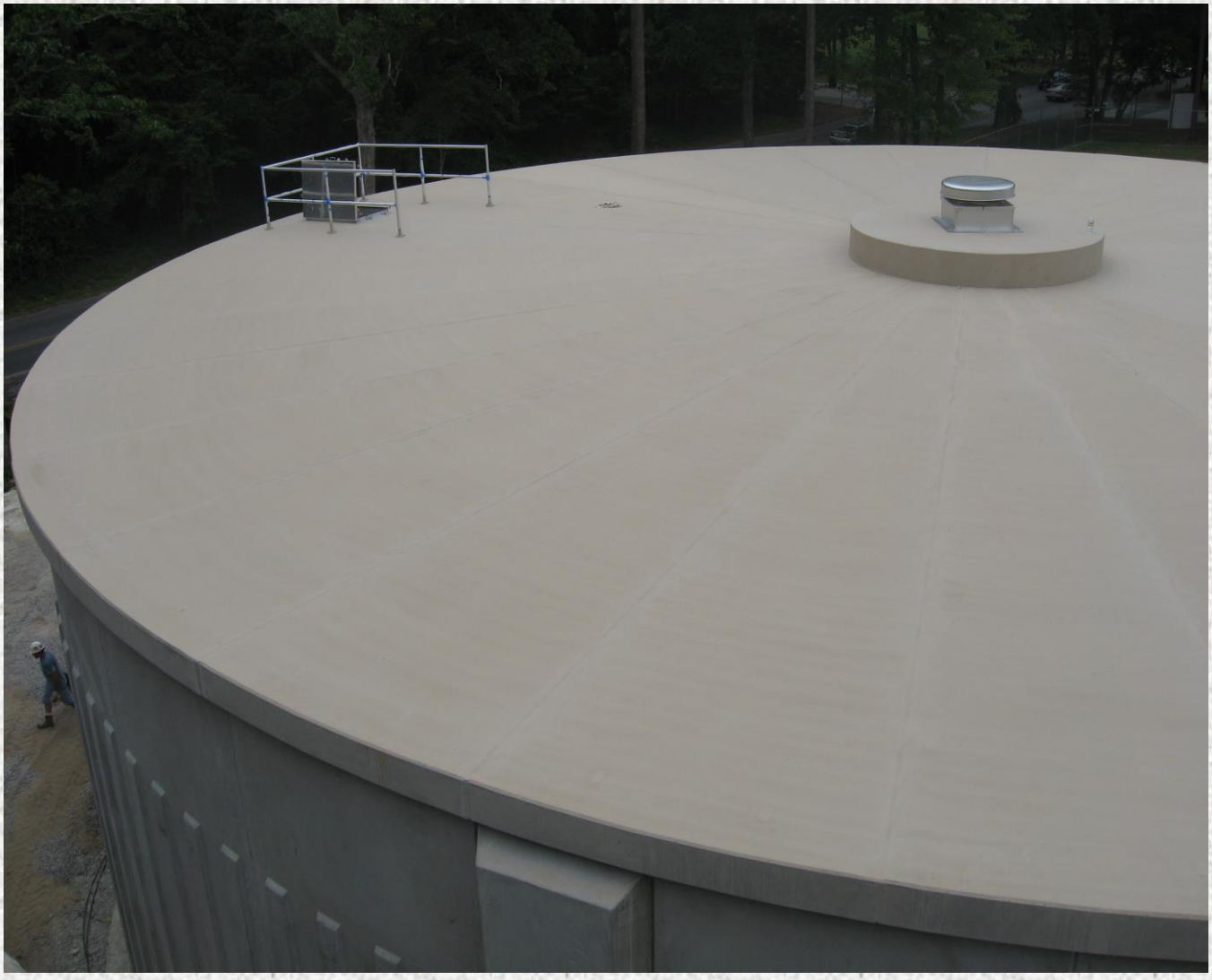
Typical Design & Delivery Process



Precast PT/prestressed: Reduced Environmental Impact

- Noise
- Truck traffic
- Pollution/waste/ debris
- Site presence
- Safety concerns

Two-Year Structural Warranty



THE PREFERRED METHOD OF TANK CONSTRUCTION

- All Post Tensioned tanks are warranted for structural integrity for 2 years.
- All concrete for the precast walls, and roof consists of 5000 PSI concrete.
- Base slabs that are post-tensioned, designed to resist cracking (minimum 6" thick).
- Meeting the high standards of:
  - American Water Works Association (AWWA D-115) standards, the most recent and stringent for concrete tank construction
  - ***PCI certified and Produced in a controlled PCI certified plant***
  - American Concrete Institute (ACI) 318 and 350
  - American Standard Testing Methods ASTM and ACI
- Installation personnel are certified by the Post-Tensioning Institute.
- *The most cost-effective short term and long term solution*.

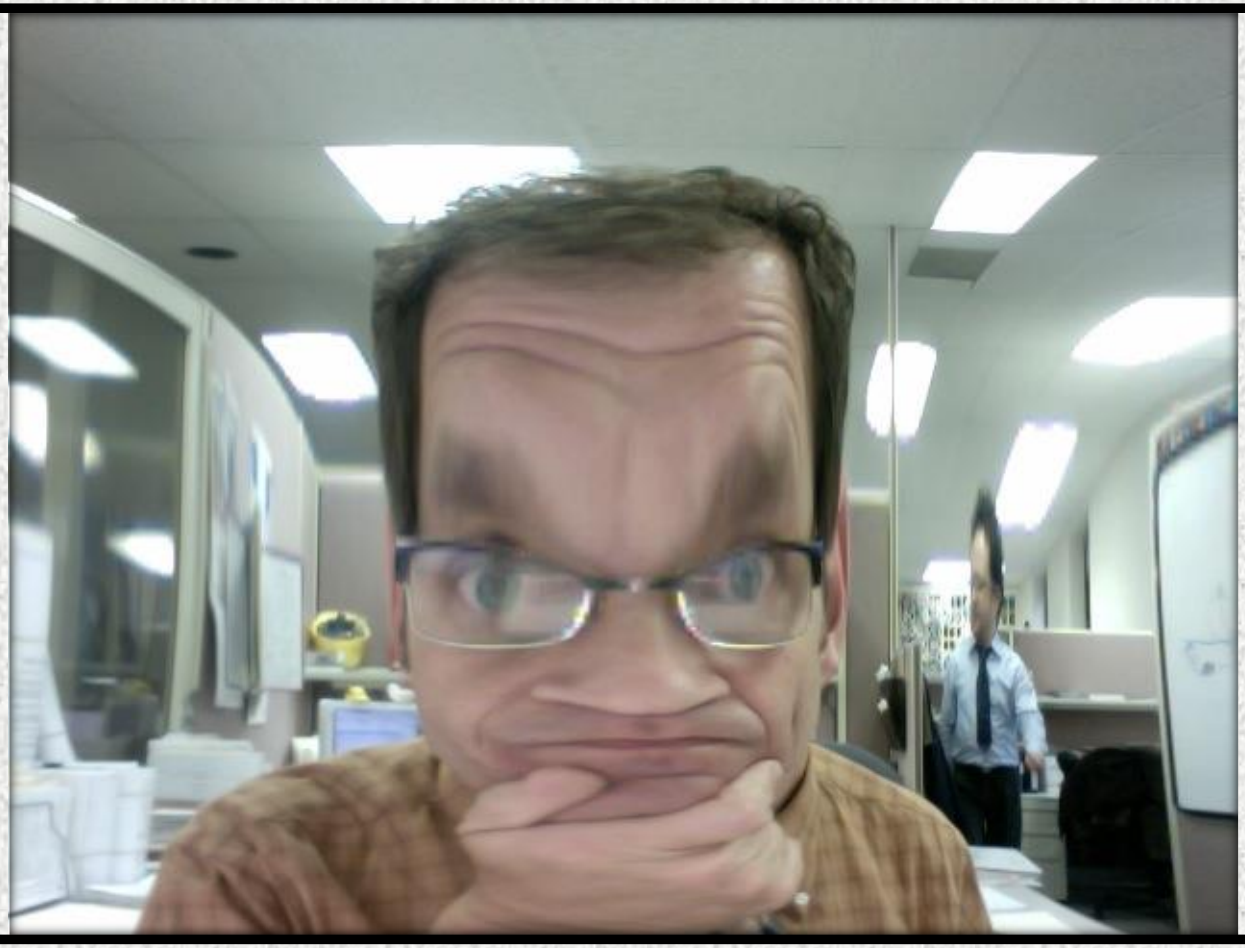
Reasons to Consider Post-Tensioning

- Increased span to depth ratio resulting in a reduction in construction materials and a subsequent reduction in overall cost.
- Positive deflection control and greater crack control, and Improved crack control also improves durability; especially if exposed to aggressive environments
- Designers are offered design flexibility with post-tensioning.
- Effective use of high strength materials.
- Low maintenance costs.
- Precast post-tensioned structures can be erected more quickly than other types of tanks, reducing construction schedules and overall project costs.
- Structures are manufactured at a precast facility and are mostly unaffected by inclement weather.

POST-TENSIONING: ADVANTAGES AND BENEFITS

- *Post-tensioning frequently solves design and construction challenges that other construction methods simply cannot with design flexibility. Some key advantages include:*
- **MATERIAL SAVINGS**
- Increased span to depth ratio resulting in a reduction in construction materials and a subsequent reduction in overall cost.
- Thinner concrete member sizes; reduction in concrete.
- Rebar in floor elements is reduced. (when utilizing PT base slabs)
- **QUICKER CONSTRUCTION**
- Potential short pour cycle – less days to accomplish same end results.
- PT structures can be erected more quickly than other types of tanks, , reducing construction schedules
- Coordination with embeds and MEP openings
- **INCREASED PERFORMANCE**
- Improved seismic behavior
- Reduced deflection and vibration
- Positive deflection control, greater crack control and waterproofing properties—especially beneficial for parking garages and tank systems.
- **REDUCED LIFETIME COSTS**
- Greater crack control improves durability for longer life spans, especially when exposed to aggressive environments
- Lower overall maintenance and lifecycle costs of the structure
- Structures are manufactured at a precast facility and are mostly unaffected by inclement weather.

Questions???



THE END