

Insulated Wall Panel Design Handbook



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Insulated Precast Concrete Wall Panels

Insulated precast concrete wall panels offer a modern construction solution, providing an efficient alternative to traditional building materials. Engineered for exceptional thermal performance, structural integrity, and aesthetic adaptability, these panels are essential components of large-scale projects, serving as structural, load-bearing, and insulated building envelope systems.

Manufactured by County Prestress & Precast, these insulated wall panels are a practical and cost-effective material choice suitable for various climates and large-scale projects, prioritizing installation efficiency and long-lasting performance with cost savings. Our PCI-certified production facilities are equipped to produce higher product volumes with shorter lead times to accommodate tight construction schedules.

This manual provides guidance on the usage, benefits, and applications of concrete insulated wall panels, empowering stakeholders to make informed decisions throughout the construction process.



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Insulated Wall Panel Advantages

Precast concrete wall panels provide exceptional energy efficiency, strength, and speed of construction.



Meets Construction Requirements and Schedules

- Meet project specifications and applicable building codes
- Minimize site disturbance
- Achieve specified R-value
- Large panel sizes mean fewer panels to be cast and erected, expediting construction timelines.
- Installation is quick for reduced on-site labor needs and costs
- Produced in a factory to ensure wall panels meet consistent quality standards
- Available in a full range of colors, textures, and finishes
- Provides a continuous air barrier, vapor retarder, and steady-state R values

Design Flexibility

- Precast wall panels offer unparalleled design flexibility with different sizes, depths, and the ability to accommodate various design requirements.
- Blockouts for windows, ductwork, entrances, and egress openings can be easily incorporated, providing adaptability to specific project needs.

Concrete insulated wall panels provide numerous advantages over conventional construction options. Their exceptional thermal insulation properties contribute to energy efficiency, reducing heating and cooling costs for building owners. The structural strength inherent in concrete ensures durability and longevity, making it a robust choice for various applications. Additionally, insulated wall panels' versatility allows for design customization, accommodating diverse architectural styles.

Aesthetically Versatile Exteriors

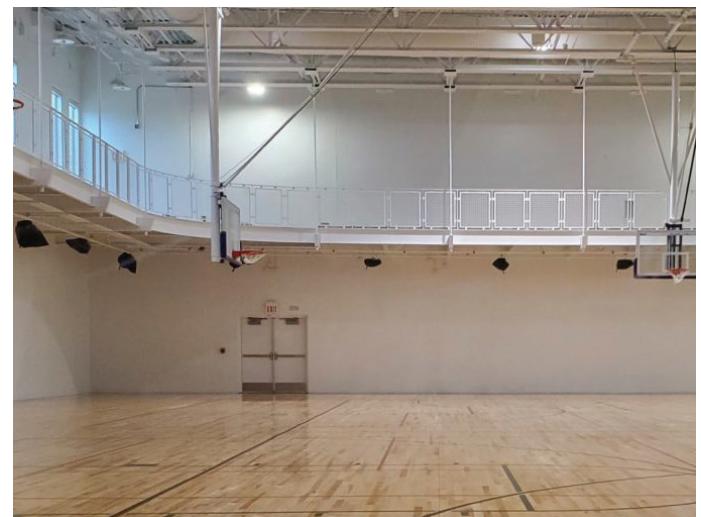
- Adaptable precast material allows for unlimited aesthetic options, complementing surrounding landscapes and existing structures.
- Formliners enable details such as reveal patterns, names, emblems, and symbols.
- Diverse textures and aggregates enhance architectural features, replicating the appearance of various materials.

Interior Surfaces

- Precast wall panels create a prefinished double-wall system, eliminating the need for additional surface treatments like drywall.
- Various finishes, including paint, can be applied, offering design flexibility and cost savings.
- The absence of intermediate bracing provides unobstructed use of the full interior height of the building.

Economical

- Our wall panels offer a budget-conscious choice without compromising quality.
- Fabrication on a permanent long-line facility decreases labor costs and accelerates project schedules.
- Facilitates building expansions, minimizing future construction costs.



Advantages (Continued)

Green Construction

- Precast wall systems are sustainable, thermally efficient, and have low life cycle costs.
- Plant fabrication reduces construction time, job-site waste, and environmental impact.
- Integral insulation in high-performance sandwich panels reduces energy consumption, meeting stringent energy requirements.



High Quality

- Plant casting ensures a predictable product with exceptional quality control, consistency, and finish.
- Prestressing reinforcement results in increased strength, ductility, crack control, and panel flatness.

Safety and Security

- Naturally fire-resistant, precast concrete inhibits fire spread and aids in compliance with building code requirements.
- Structural stability prevents seismic events, which is crucial for healthcare and research facilities.

Acoustic Properties

Insulated concrete wall panels effectively reduce noise transmission, making them ideal for environments requiring sound control. They typically achieve Sound Transmission Class (STC) ratings of 50 to 70.

The noise reduction properties of these panels are due to their high mass and density, multiple layers, and sound-damping materials. Dense concrete layers block low-frequency noises, while insulation layers absorb and dissipate sound waves. Additionally, the construction of these panels often includes air gaps that act as extra sound barriers.

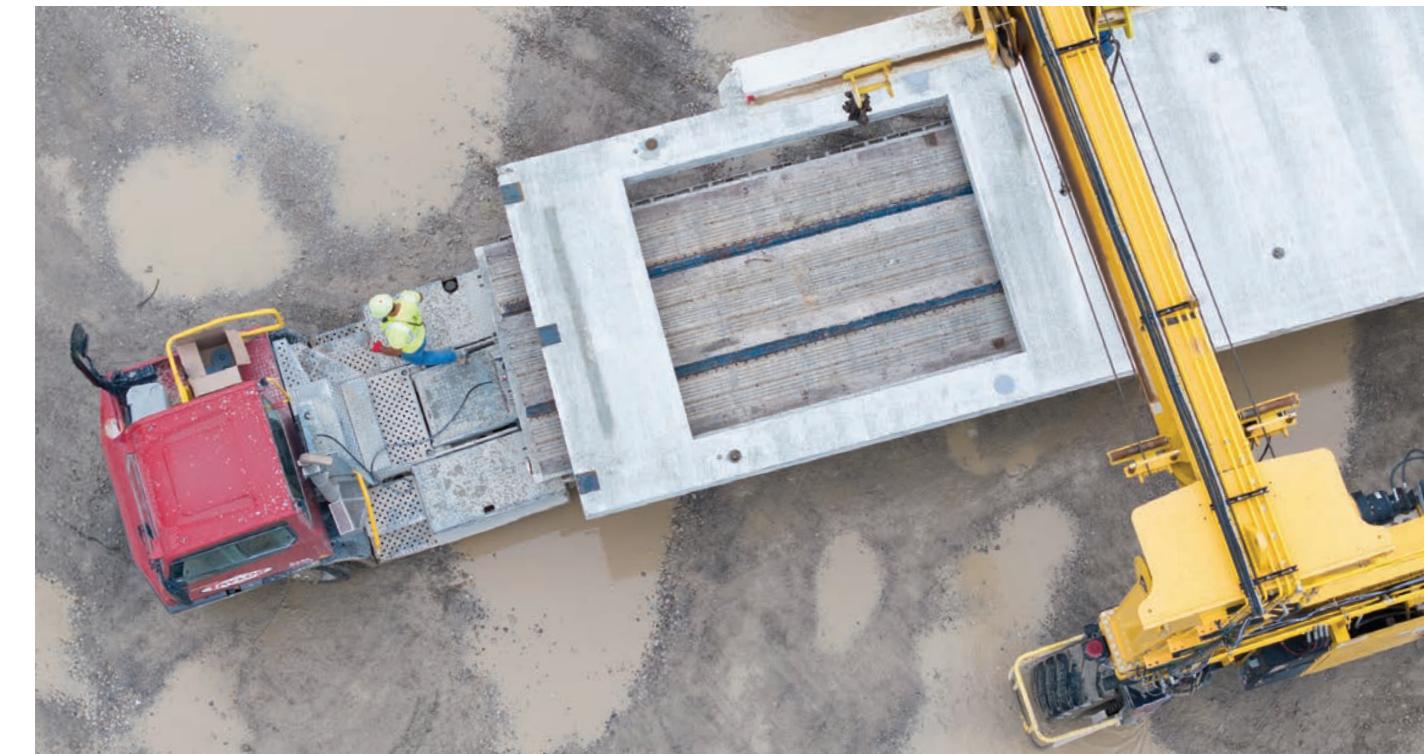
Fire Resistance

- Fire ratings are based on Rational Fire Design or IBC Prescriptive Fire Rating methods, providing a safe and fire-resistant solution.
- Precast wall systems offer varying fire ratings, with the ability to achieve higher ratings with additional materials or treatments.

Blast Resistance

Insulated wall panels demonstrate exceptional strengths and energy absorption characteristics, surpassing traditional building methods.

Concrete insulated wall panels present a versatile solution that makes them particularly advantageous in various applications.



End-Use Applications

Commercial Buildings

Concrete insulated wall panels find extensive use in commercial construction, serving as efficient shear walls, column covers, spandrels, mullions, and truss walls. These applications enhance both the functionality and aesthetic appeal of commercial structures, addressing the dual needs of durability and design flexibility.

Industrial Facilities

In industrial settings, where structural integrity and insulation are essential, concrete insulated wall panels excel. Their ability to withstand environmental conditions and provide thermal insulation makes them an ideal choice for warehouses, manufacturing plants, and other industrial facilities.

Institutional Facilities

Concrete insulated wall panels are well-suited for institutional buildings such as schools, hospitals, and government facilities. They offer a combination of durability, energy efficiency, and design versatility, meeting the diverse requirements of these structures.

Data Centers

Concrete insulated wall panels support the strict environmental control data centers require. Their strong thermal performance, fire resistance, and airtight construction help maintain stable interior conditions, protect sensitive equipment, and enhance long-term operational reliability.



Mixed-Use Developments

The adaptability of concrete insulated wall panels makes them an excellent choice for mixed-use developments, seamlessly integrating into projects that combine residential, commercial, and retail spaces. Their ability to serve multiple functions enhances the overall efficiency and aesthetics of mixed-use constructions.

Specialized Structures

Concrete insulated wall panels are valuable in constructing specialized facilities like laboratories, and food processing plants, where controlled environments and structural stability are critical. Their thermal insulation properties contribute to maintaining optimal conditions within these specialized structures.



Product Specifications

Panel Dimensions

Insulated Sandwich Wall Panels can be manufactured up to 15' wide and 50 ft – 55 ft long with greater depth for enhanced R-value.

These are typical dimensions. Different configurations may be used if required.

Component	Dimensions
Panel width	Up to 15' wide and 50 ft – 55 ft long
Panel thickness	To meet specifications
Warehouses	Typically 10" or 12" (3/4/3 or 3/6/3)
Foundations	Typically 12" (6/3/3 or 4/4/4)

Thermal Efficiency

Insulated concrete wall panels offer exceptional thermal efficiency, making them an excellent choice for energy-conscious building designs. By understanding and optimizing the factors that influence thermal performance, builders and architects can create structures that are not only comfortable and cost-effective but also environmentally friendly.

Benefits of Thermal Efficiency

Energy Savings: High thermal efficiency reduces the need for heating and cooling, leading to significant energy savings. Buildings with insulated concrete wall panels often experience lower energy bills due to reduced HVAC system usage.

Comfort: Improved thermal efficiency ensures that indoor temperatures remain stable and comfortable, regardless of external weather conditions. This is particularly important in regions with extreme temperatures.

Sustainability: Insulated concrete wall panels contribute to a building's overall sustainability by reducing energy consumption. Thermal efficiency can also prolong the lifespan of HVAC systems by reducing their workload, leading to fewer repairs and replacements.

Factors Influencing Thermal Efficiency

Insulation Material: The type and quality of insulation material used in the core significantly impact thermal efficiency. High-performance insulation materials like polyisocyanurate foam offer exceptional thermal resistance compared to traditional options.

Panel Thickness: Thicker panels provide better insulation, improving overall thermal efficiency. The thickness of both the insulation core and concrete layers can be adjusted based on specific thermal performance requirements.

Thermal Mass: The inner concrete layer acts as a thermal mass, absorbing and storing heat during the day and releasing it during cooler periods. This helps maintain a more consistent indoor temperature and reduces temperature fluctuations.

Loadbearing vs Non-Loadbearing

Loadbearing Wall Panels:

Loadbearing insulated wall panels serve a dual purpose by acting as both a structural loadbearing element and an outer architectural skin. This innovative design eliminates the necessity for supplementary support framing, contributing to streamlined and efficient construction. Integrating loadbearing capabilities into the wall panels enhances structural integrity, reduces construction complexity, and optimizes space utilization within the building envelope.

Non-Loadbearing

(Cladding or Architectural Wall Panels):

Non-loadbearing insulated wall panels, often referred to as cladding or architectural wall panels, primarily serve as a protective layer for insulation and an exterior architectural finish. Unlike their loadbearing counterparts, these panels do not support the structural load of the building. Instead, they provide thermal insulation, and weather resistance, and contribute to the visual appeal of the structure. Non-loadbearing panels offer versatility in architectural expression without bearing the structural burden of the building.

Color and Texture

Architectural precast concrete can be crafted in nearly any color, form, or texture, making it an economical choice to meet both aesthetic and functional requirements. The combination of complementary colors and textures can visually enhance any project, adding a unique and appealing finish.

Design Flexibility

Precast concrete offers extensive versatility in color and texture through variations in aggregate and matrix color, aggregate size, finishing processes, and the depth of aggregate exposure. Aggregate colors range from white and pastel to red, black, and green, with natural gravels providing rich earth tones and shades of gray. Combining color with texture highlights the natural beauty of these aggregates.

Color and Texture Selection

Specifying color and texture in precast concrete is straightforward with resources like the PCI Architectural Precast Concrete – Color and Texture Selection Guide, 2nd Edition. This guide, available at www pci.org, features hundreds of images and their associated mixture materials, serving as a comprehensive starting point for designers.

Factors Affecting Color Tone

Color tone in precast concrete is influenced by various factors, including light and shadow, intensity and time, and surrounding colors. For instance, deep-exposed opaque white quartz can appear slightly gray due to shadows between particles. Similarly, environmental factors like pollution can alter color tone over time. It's essential to consider these factors when selecting colors to ensure the desired appearance under real lighting conditions.

Pigments and Color Variations

Pigments can be added to the mix to achieve the desired matrix color, with common pigments including natural and synthetic iron oxides. Pigment amounts, expressed as a percentage of cement weight, produce various shades but must be controlled within strength and absorption limits to maintain concrete strength.



Colors and textures shown are samples from PCI. More options and details are available at [pci.org](http://www pci.org).

Finish Options

When designing insulated concrete wall panels, selecting the right architectural finish is crucial for both aesthetics and functionality. Here are several options to consider, each offering unique benefits and visual effects:

- **Cast-in Thin Brick:** Thin bricks are embedded directly into the concrete surface during casting. Combines the durability of concrete with the classic, aesthetic appeal of brick, creating a facade that is both robust and visually pleasing.
- **Formliners:** These molds are used to create textured patterns on concrete surfaces and are available in a wide range of designs. Formliners enable custom textures and unique visual effects, offering versatility in architectural expression. They enhance surface design, help reduce glare on large wall areas, and add linear texture and visual interest for a distinct, visually appealing finish.
- **Abrasive Blast:** The concrete surface is blasted with abrasive materials such as sand or grit. This technique creates a rough texture that adds visual interest. The level of coarseness can be customized to achieve the desired effect.
- **Acid Etch:** The concrete surface is chemically treated with acid to create a subtle, matte finish. Ideal for achieving a refined and sophisticated look, acid etching provides a smooth, understated texture.
- **Exposed Aggregate:** The top layer of concrete is removed to reveal the aggregate materials within (stones, pebbles, etc.). This finish offers a textured, natural appearance and can be used to create visually striking surfaces that showcase the inherent beauty of the aggregate.
- **Smooth Form:** The concrete surface is carefully finished to be smooth and even. Delivers a sleek, polished appearance that is modern and elegant, suitable for contemporary architectural styles.

Enhancing Designs with Architectural Details

In addition to surface finishes, incorporating architectural details can significantly enhance the overall design of insulated concrete wall panels.

Consider the following elements:

- **Reveals:** Narrow recesses or grooves in the concrete that create shadow lines and add depth.
- **Bands:** Horizontal or vertical elements that break up large surfaces and introduce visual rhythm.
- **Rustications:** Projected or recessed lines that add texture and detail.
- **Bullnoses:** Rounded edges that soften the appearance of the panels.
- **Cornices:** Decorative moldings that crown the top of the wall panels, adding a classical touch



As-Cast



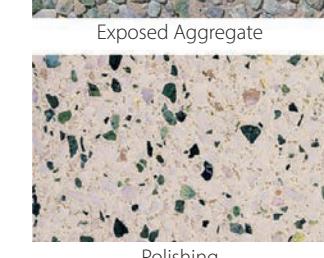
Acid-Etched



Abrasive Blasted



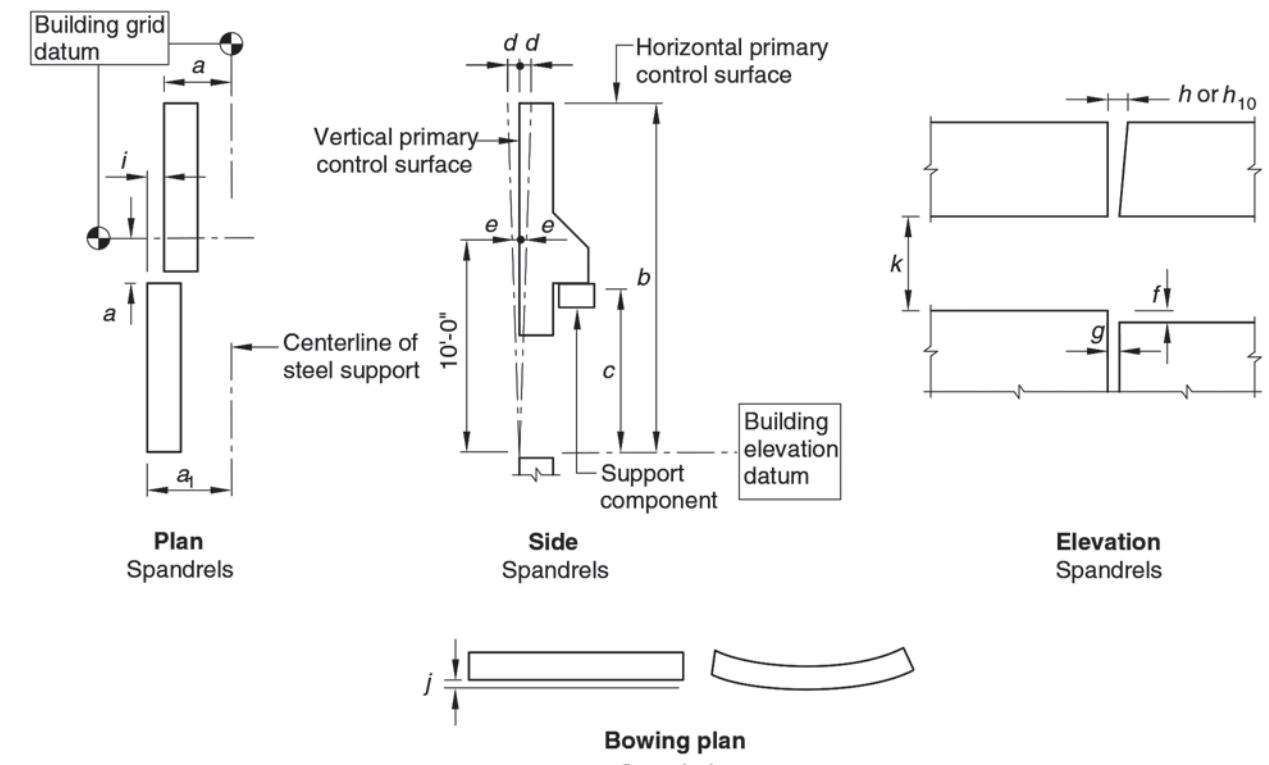
Exposed Aggregate



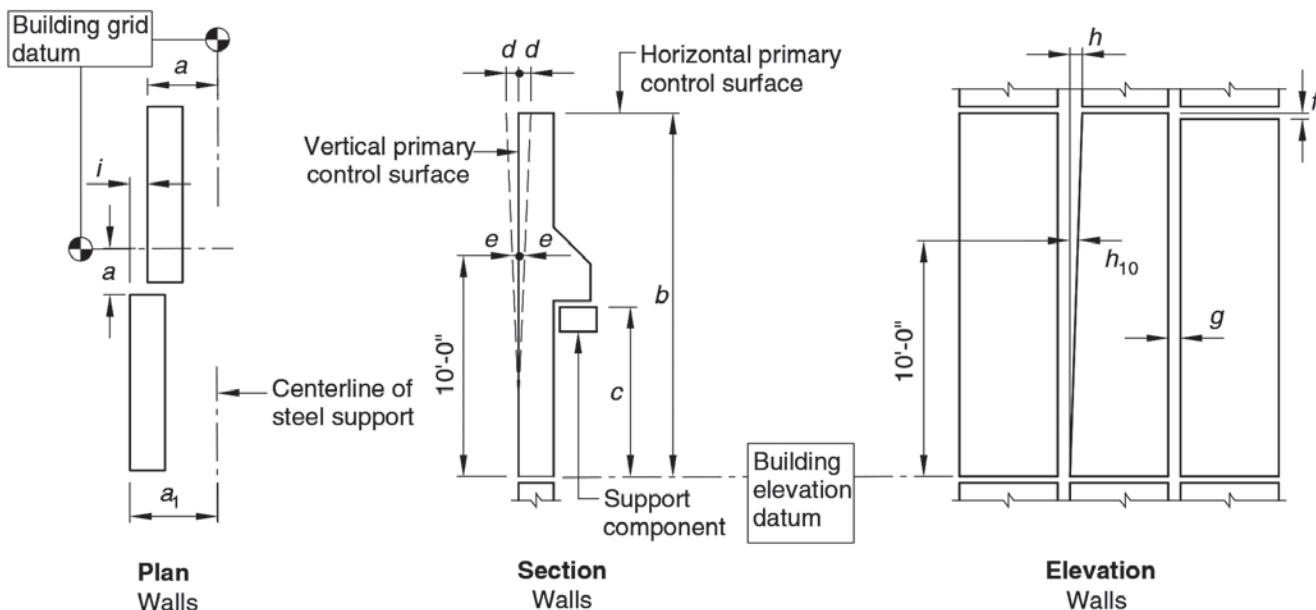
Polishing

Production Tolerances

Product tolerances	Products
Length	$\pm 1/2$ in.
Width	$\pm 1/4$ in.
Depth	$\pm 1/4$ in.
Position of tendons	$\pm 1/4$ in.



Architectural Walls/Spandrel Erection Tolerances



Architectural walls/spandrel erection tolerances

The primary control surfaces are usually as shown, although this needs to be confirmed on a job-by-job basis.

a = Plan location from building grid datum^a $\pm 1/2$ in.

a₁ = Plan location from centerline of steel support^b $\pm 1/2$ in.

b = Top elevation from nominal top elevation:

Exposed individual panel $\pm 1/4$ in.

Non-exposed individual panel $\pm 1/2$ in.

c = Support elevation from nominal elevation:

Maximum low $1/2$ in.

Maximum high $1/4$ in.

d = Maximum plumb variation over height of structure or 100 ft, whichever is less^a 1 in.

e = Plumb in any 10 ft of element height $1/4$ in.

f = Maximum jog in alignment of matching edges:

Exposed relative to adjacent panel $1/4$ in.

Non-exposed relative to adjacent panel $1/2$ in.

g = Joint width (governs over joint taper) $\pm 1/4$ in.

h = Joint taper maximum $3/8$ in.

h₁₀ = Joint taper over 10 ft length $1/4$ in.

i = Maximum jog in alignment of matching faces $1/4$ in.

j = Differential bowing as erected between adjacent components of the same design:

Exposed relative to adjacent panel $1/4$ in.

Non-exposed relative to adjacent panel $1/2$ in.

k = Opening height between spandrels $\pm 1/4$ in.

a. For precast concrete buildings in excess of 100 ft tall, tolerances a and d can increase at the rate of 1/8 in. per story to a maximum of 2 in.

b. For precast concrete components erected on a steel frame, this tolerance takes precedence over tolerance on dimension a.

Thermal and Moisture Management

Effective thermal and moisture management is crucial for the performance and longevity of precast architectural insulated concrete wall panels. The dense nature of precast concrete provides excellent moisture resistance, protecting against water penetration, mold, and mildew.

Insulation Continuity and Thermal Bridging Prevention

Maintaining insulation continuity is essential to preserve the thermal efficiency of a building. Gaps in insulation can create thermal bridges, leading to heat loss and condensation issues.

Continuous Insulation (CI): Ensure insulation layers are continuous across the entire panel, including joints and connections. Use rigid foam or spray-applied polyisocyanurate to fill any gaps.

Thermal Breaks: Use plastic or thermal isolators at points where metal fasteners or structural elements penetrate the insulation layer to minimize heat transfer.

Layering Techniques: Apply multi-layered insulation systems with staggered joints to reduce thermal bridging.

High-Performance Materials: Choose high-R-value insulating materials that offer excellent thermal resistance and can withstand environmental conditions.

Moisture Control Strategies

Managing moisture is critical to prevent mold growth, structural damage, and degradation of thermal performance.

Vapor Barriers: Install vapor barriers on the warm side of the insulation in climates where moisture migrates from inside out, and on the outside in climates where it moves inward to prevent condensation within the wall assembly.

Drainage Systems: Design panels with integrated drainage systems, including weep holes and channels, to manage water infiltration and allow water to exit the wall system.

Moisture-Resistant Materials: Use materials like extruded polystyrene (XPS) or closed-cell spray foam to reduce water absorption and damage.

Proper Sealing: Meticulously seal all joints and penetrations with high-quality, compatible sealants to prevent water ingress.

Detailing for Weatherproofing and Air Sealing

Weatherproofing and air sealing are essential to protect the building envelope from environmental elements and maintain indoor air quality and energy efficiency.

Weatherproofing Details: Use flashing, sealants, and proper overlaps at joints and transitions to protect exposed edges from water ingress.

Air Barriers: Install continuous air barriers to prevent uncontrolled air leakage, which can cause heat loss and moisture problems. Integrate air barriers with vapor barriers where applicable.

Joint Detailing: Design joints to accommodate thermal expansion and contraction while maintaining a tight seal. Use flexible sealants and gaskets.

Penetration Sealing: Properly seal all utility and fastener penetrations with appropriate sealing compounds and gaskets to prevent air and water leaks.

Insulation Types

Precast concrete wall panels offer a robust and versatile building solution. However, selecting the optimal insulation type is crucial for maximizing performance. Here's a breakdown of three commonly used rigid foam insulation options for precast insulated wall panels:

Expanded Polystyrene (EPS)

- Cost-effective and lightweight, making it a good choice for projects with minimal moisture exposure.
- Offers good thermal resistance for consistent insulation.

Extruded Polystyrene (XPS)

- Provides exceptional moisture resistance compared to EPS, making it ideal for applications with potential water exposure.
- Delivers good thermal performance for energy efficiency.

Polyisocyanurate (ISO)

- Boasts the highest thermal resistance among the three options, leading to significant energy savings.
- Well-suited for demanding applications where maximizing thermal efficiency is critical.

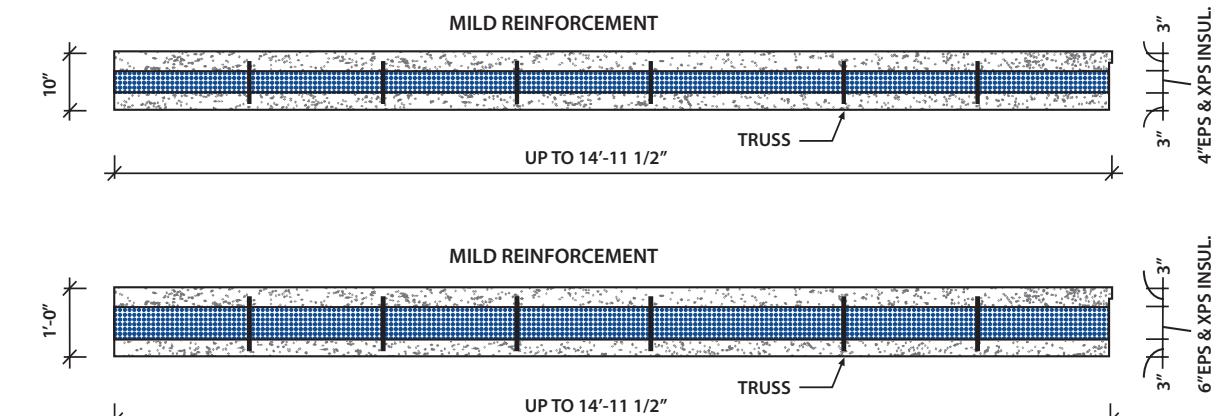
Selecting the most suitable insulation depends on your specific project requirements:

- Budget: EPS is generally the most cost-effective option.
- Moisture Exposure: For high-moisture environments, XPS offers exceptional protection.
- Thermal Performance: ISO provides the best thermal resistance for maximizing energy efficiency.

* Unfaced and felt-faced polyisocyanurates should not be used in insulated precast wall panels due to the expansion caused by moisture absorption.

	Polystyrene						Polyisocyanurate*
	Expanded (EPS)			Extruded (XPS)			
Density, lb/ft ³	0.7-0.9	1.1-1.4	1.8	1.3-1.6	1.8-2.2	3.0	2.0-6.0
Water absorption, % volume	< 4.0	<3.0	<2.0	<0.3			1.0-2.0
R-Value per inch at 75°F (ft ² .°F.hr/Btu)	3.125-3.57	3.85-4.0	4.35	5.0			10-6.67

10" -thick walls with 4" XPS insulation and 12"-thick walls with a 6" XPS insulation	
The R-Value is based on the location of the insulation. Solid areas will be required due to structural connections such as panel-to-panel, joist/deck bearing, etc.	
R-Value for 10" -thick walls with 4" XPS insulation	23.70
R-Value for 12" -thick walls with 6" XPS insulation	34.90



System Variations

Envelope Systems

Within construction, architectural or non-loadbearing panels, commonly referred to as cladding or curtain walls, find widespread application in building envelopes. These panels seamlessly integrate with diverse structural frameworks, including precast concrete, cast-in-place concrete, or steel. Architectural wall panels serve the purpose of enclosing spaces without assuming vertical load-bearing functions. Specifically engineered to withstand wind and seismic forces inherent to their weight, these precast components encompass a range of elements—from wall panels featuring or lacking windows to spandrels, mullions, and column covers.

Loadbearing Systems

Loadbearing panels play a vital role in transferring gravitational or vertical loads, significantly contributing to a structure's overall strength and stability. These include solid wall panels as well as composite and non-composite insulated panels.

Dock Door Integration and Retaining Capability

Precast insulated wall panels can be designed to accommodate both active dock door openings and future dock door locations, offering flexibility for evolving operational needs. Panels can be engineered to provide limited soil retention where grade differentials occur, eliminating the need for separate retaining structures in many cases.

Additionally, these panels can be detailed to support vehicle impact loads and trailer restraint systems at loading docks. Integrating these functions into the wall system streamlines construction, enhances thermal efficiency, and maintains the clean aesthetic of the building envelope.

Lateral Force Resisting Systems

Shear walls are pivotal structural components within a building's lateral resistance system, designed to withstand forces from wind, blast, or earthquakes. These walls can be either loadbearing or non-loadbearing and may incorporate both solid and window panels into their design.

Precast concrete shear wall panels are crucial for providing lateral load resistance. When combined with the diaphragm action of the floor construction, these walls effectively withstand horizontal forces such as wind and seismic loads. Architects and structural engineers collaborate to ensure that precast panels can resist these lateral forces by considering factors like panel shape, connection points, and overall stability.

A common configuration for architectural precast concrete involves story-tall panels with punched windows. These panels feature vertical load-carrying elements at the window jambs and horizontal members that contribute to lateral resistance.

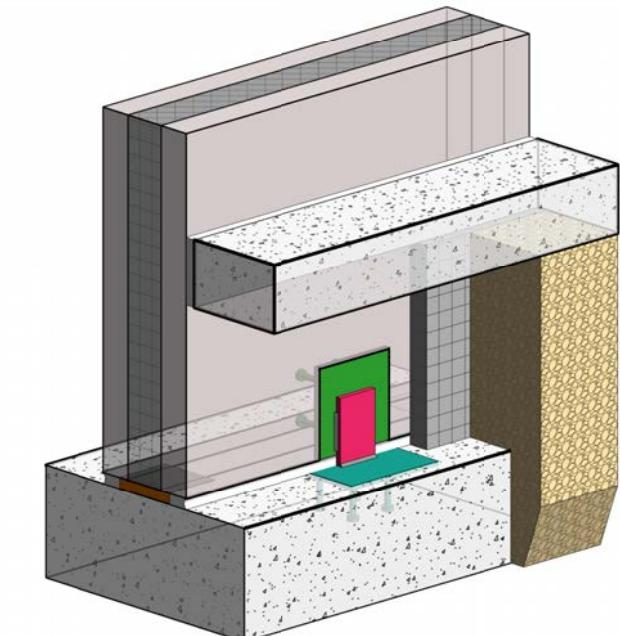
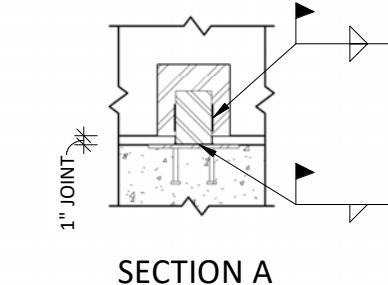
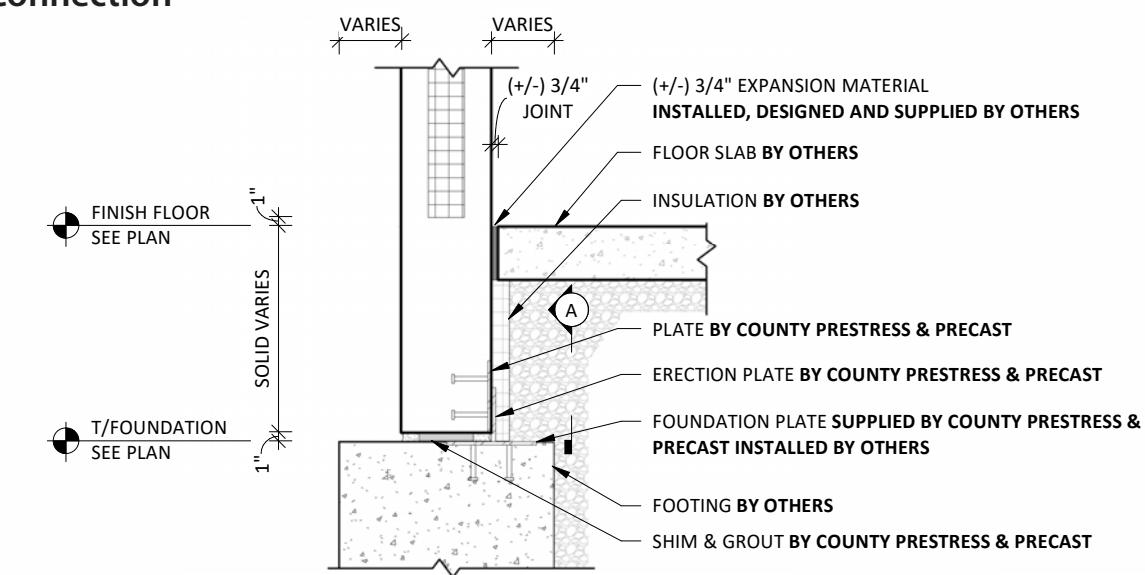


Common Details

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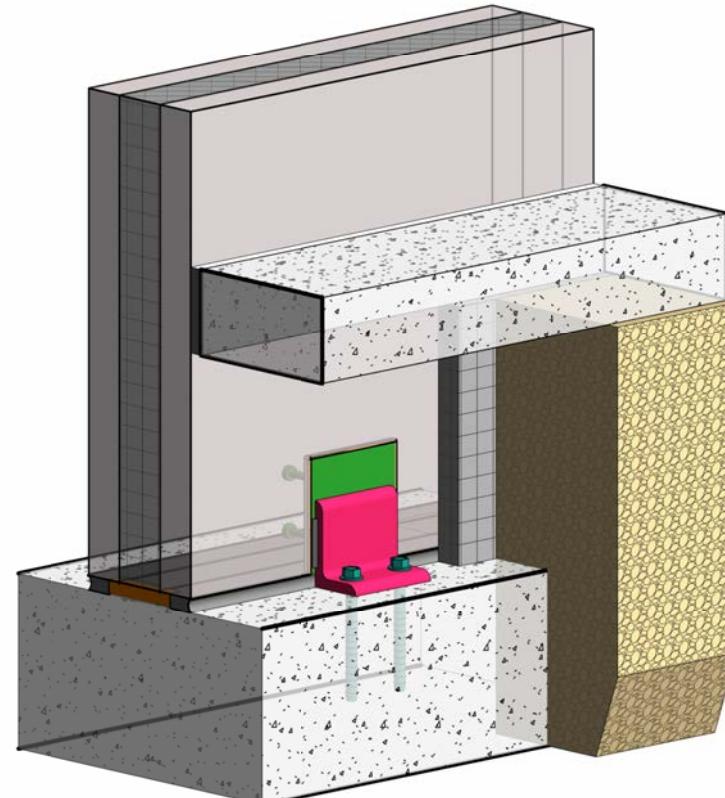
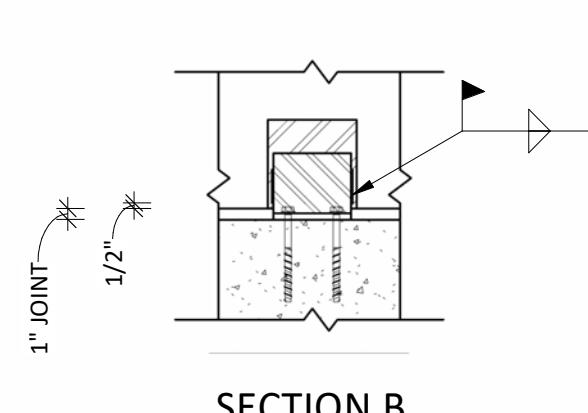
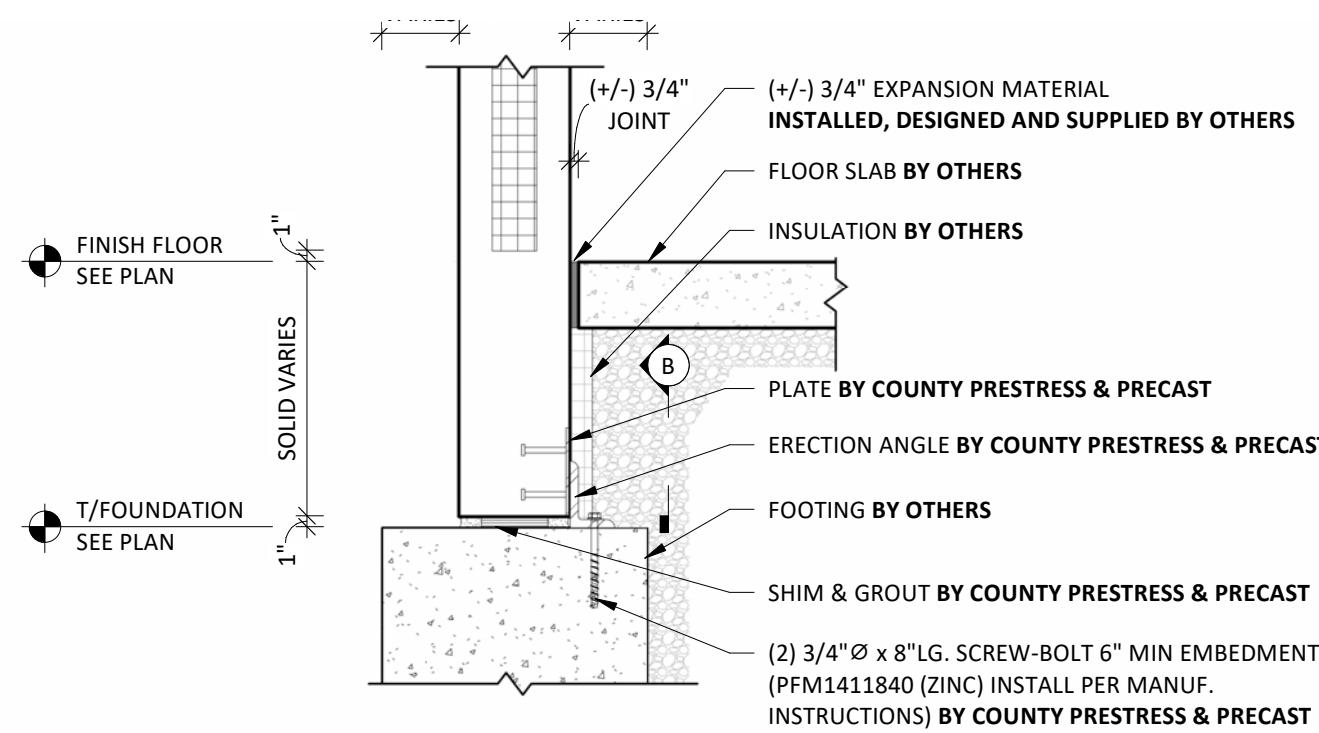
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Typical Base Connection

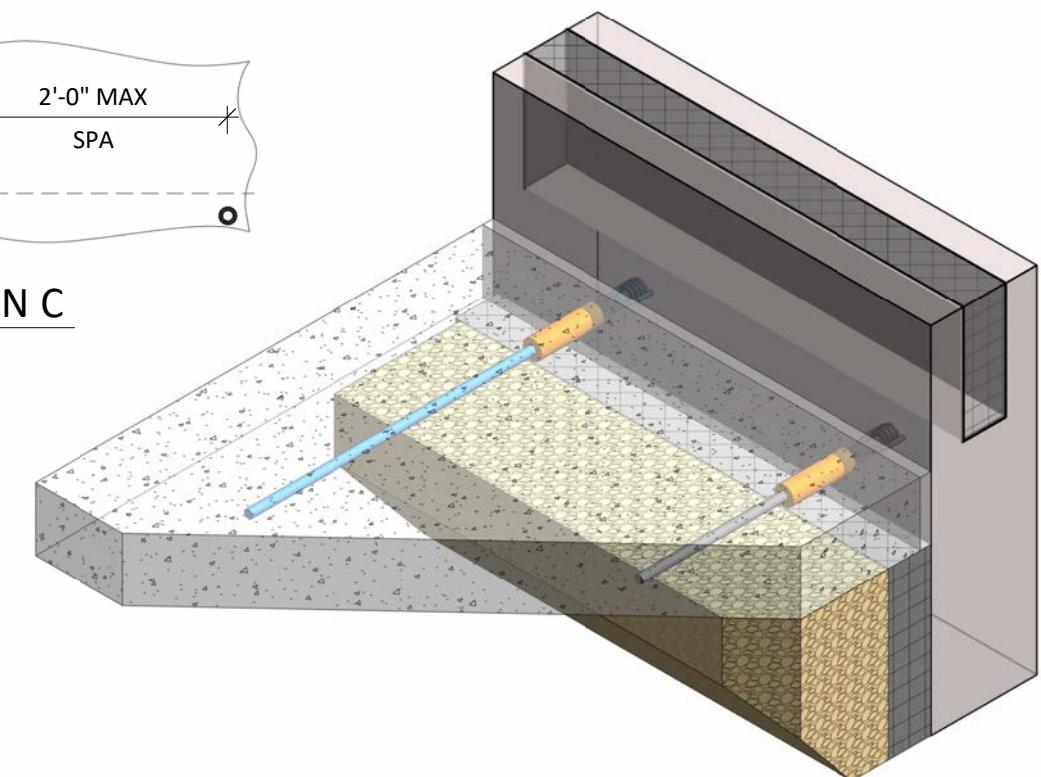
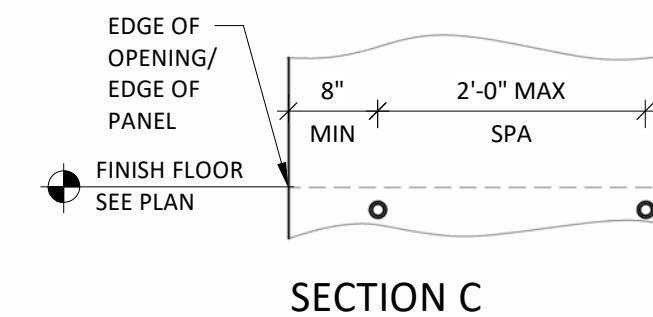
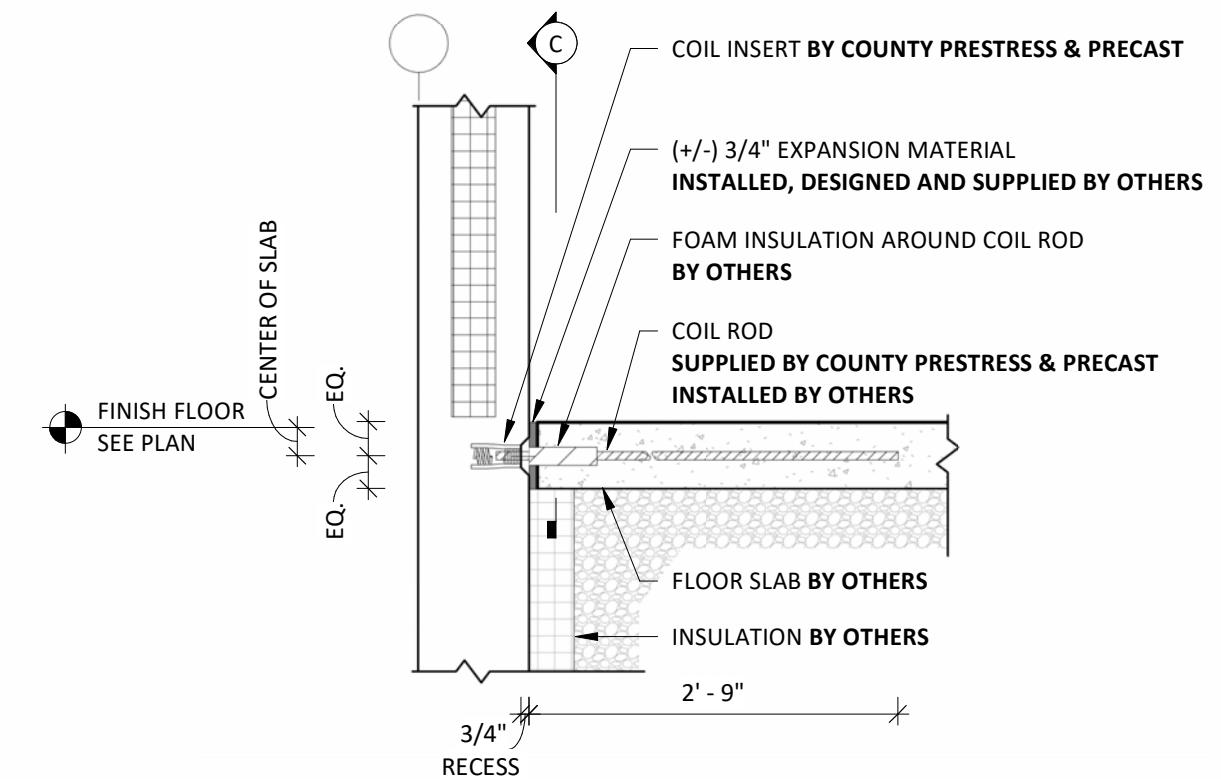


Common Details

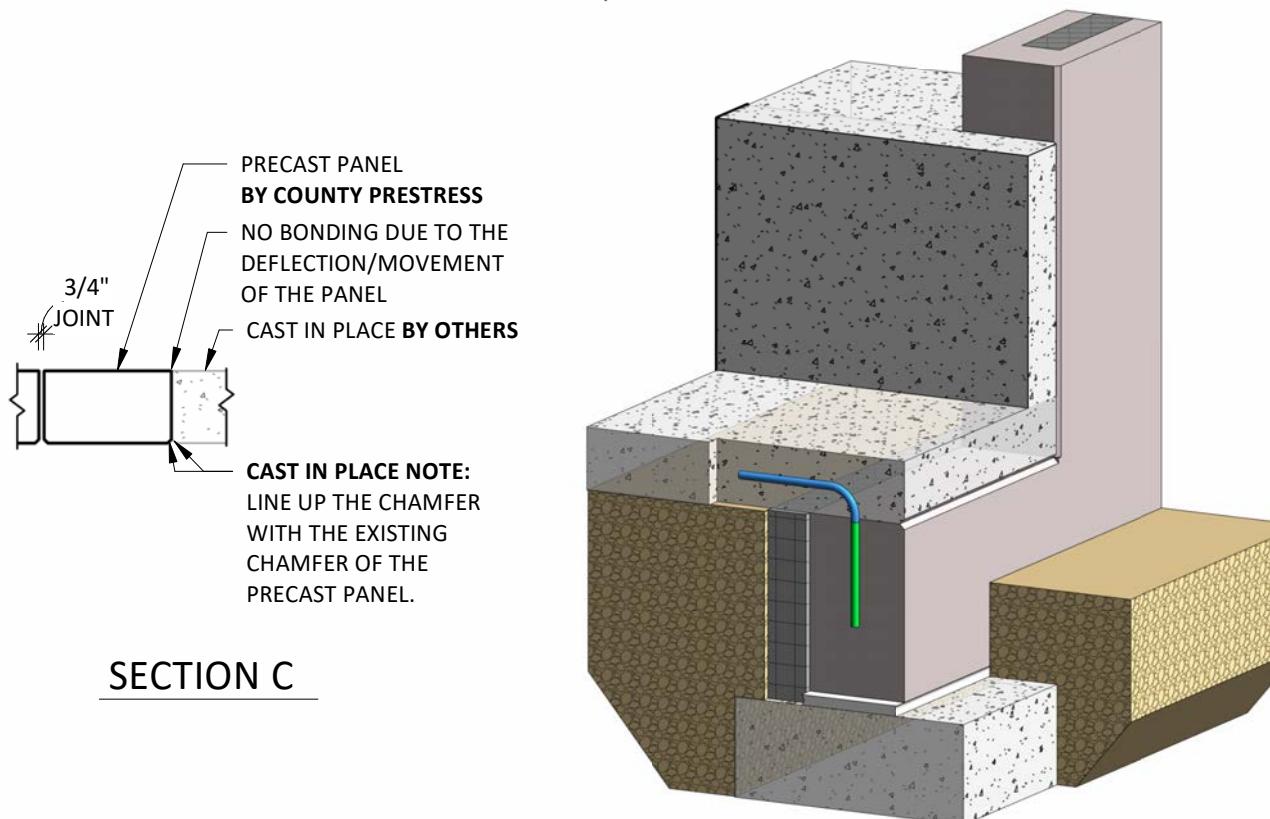
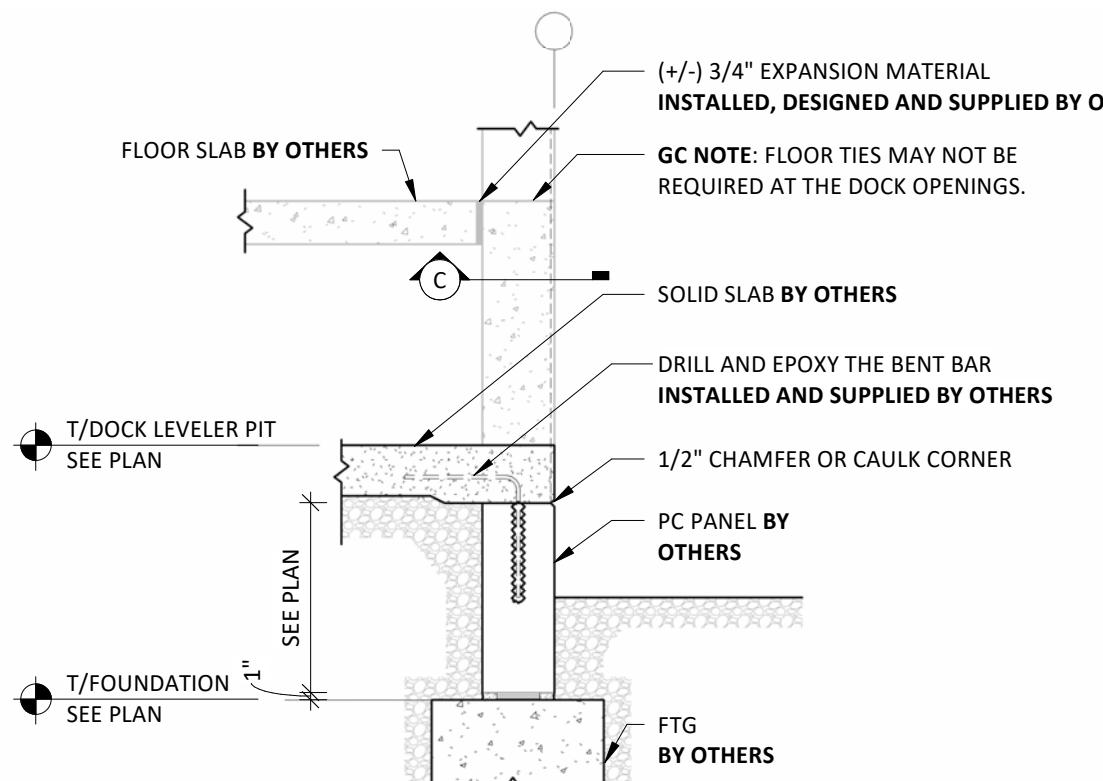
Screw Bolt Base Connection



Floor Tie Detail

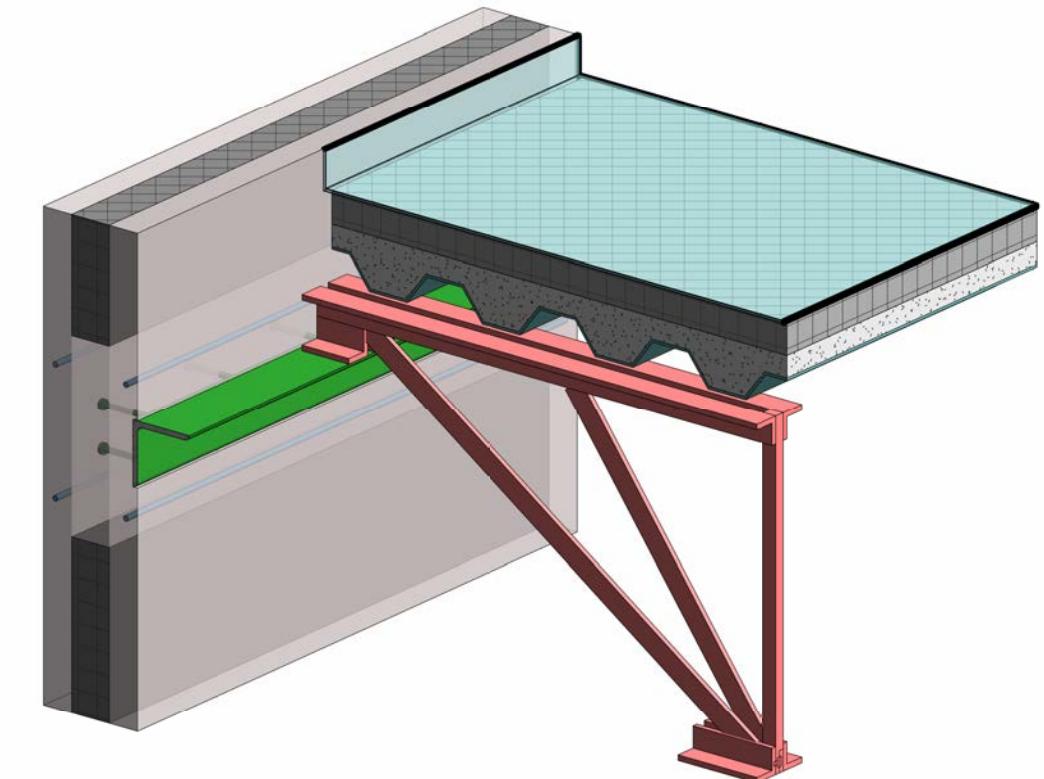
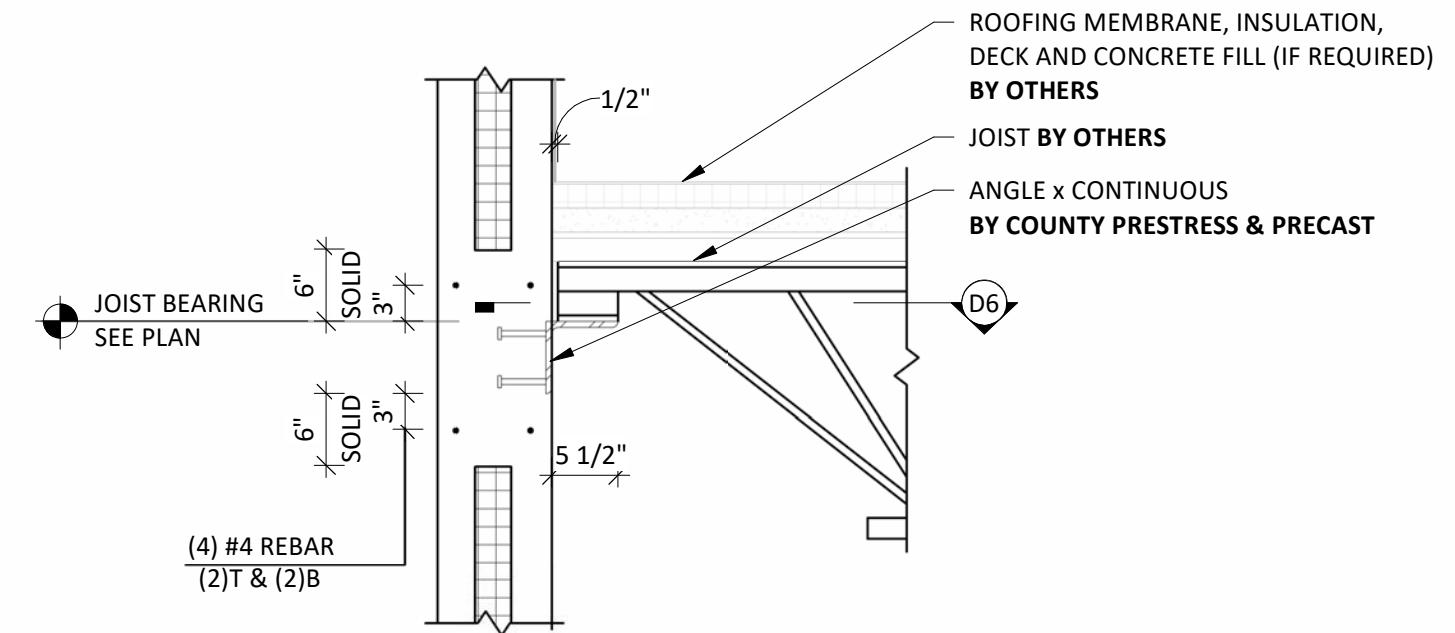


Dock Section Detail

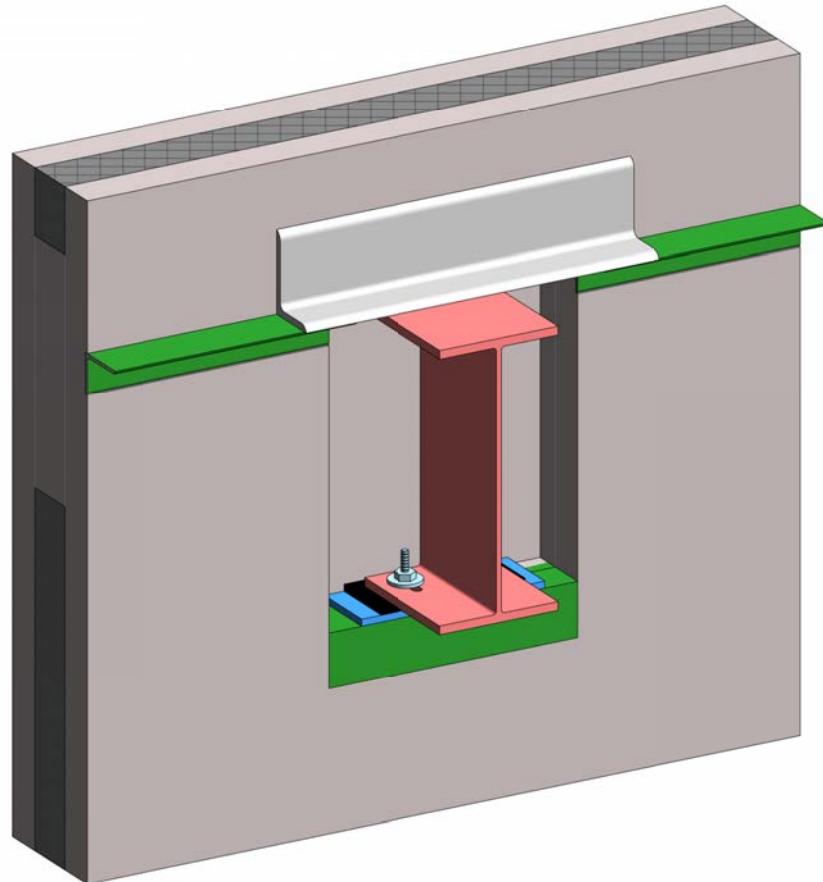
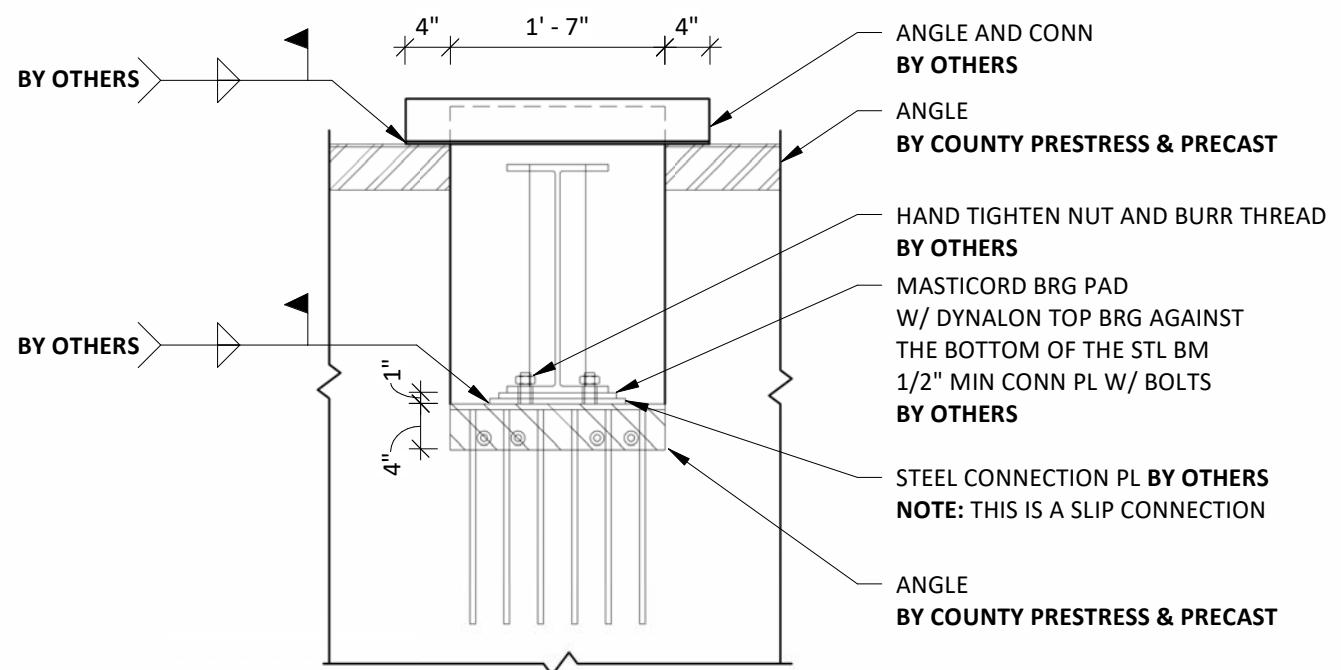


SECTION C

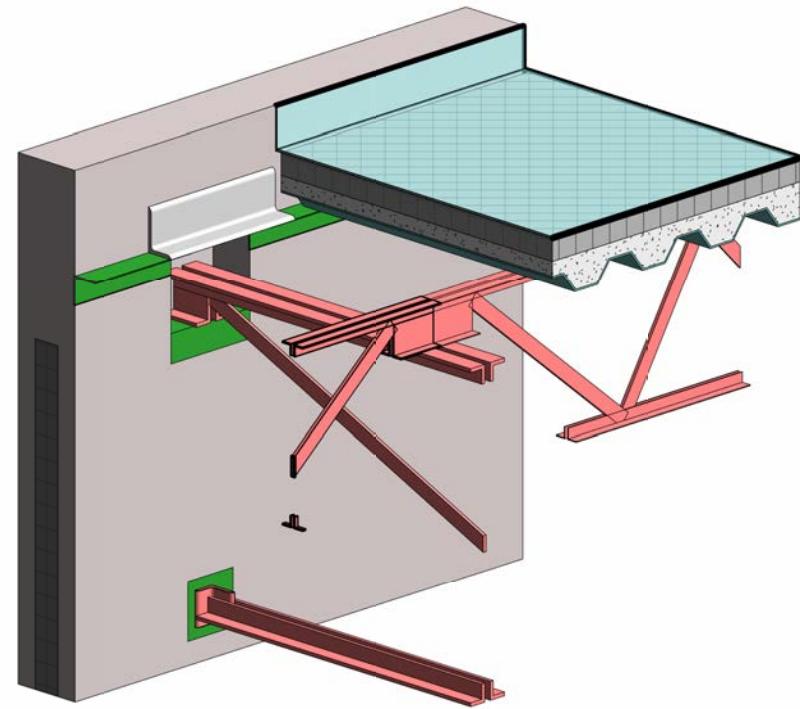
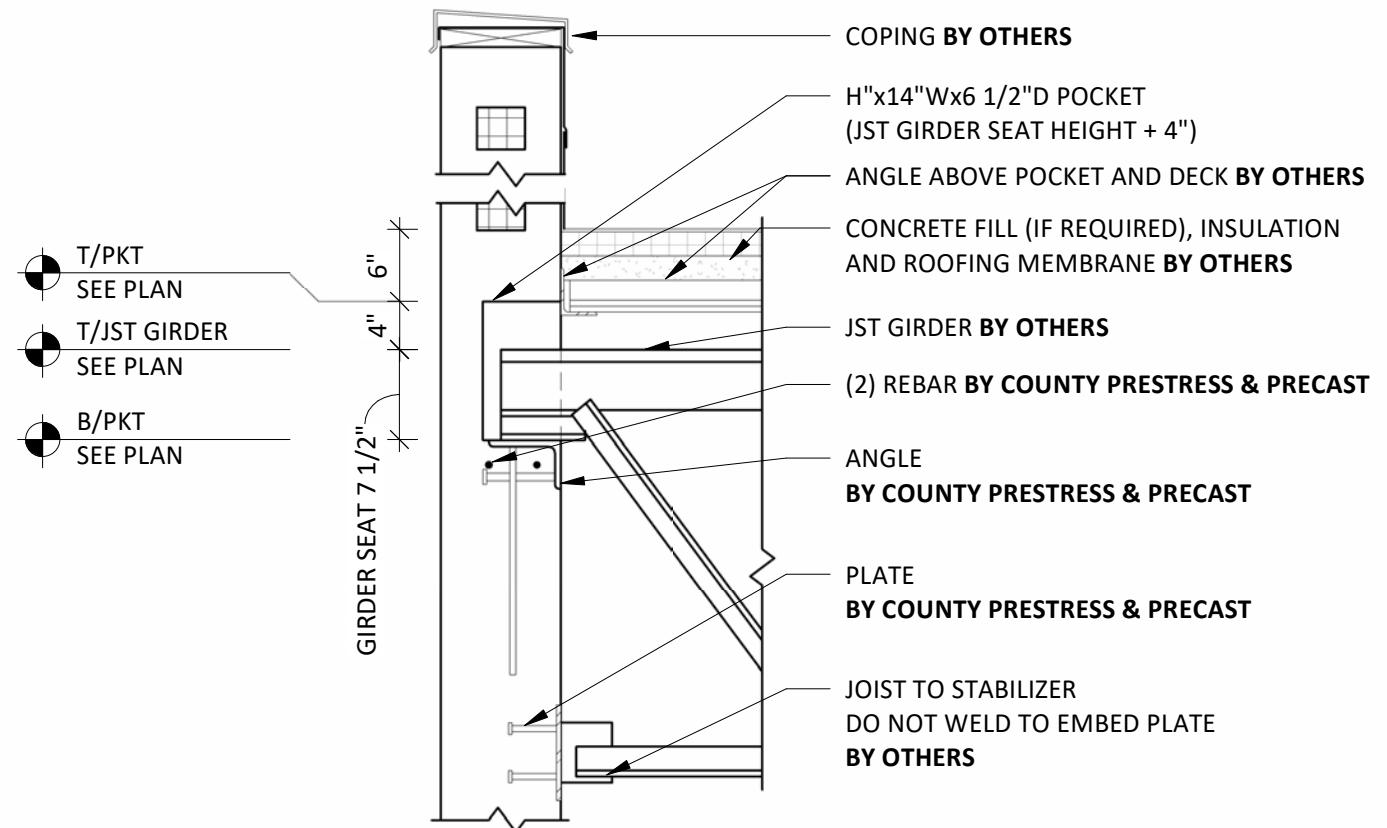
Joist Bearing Detail



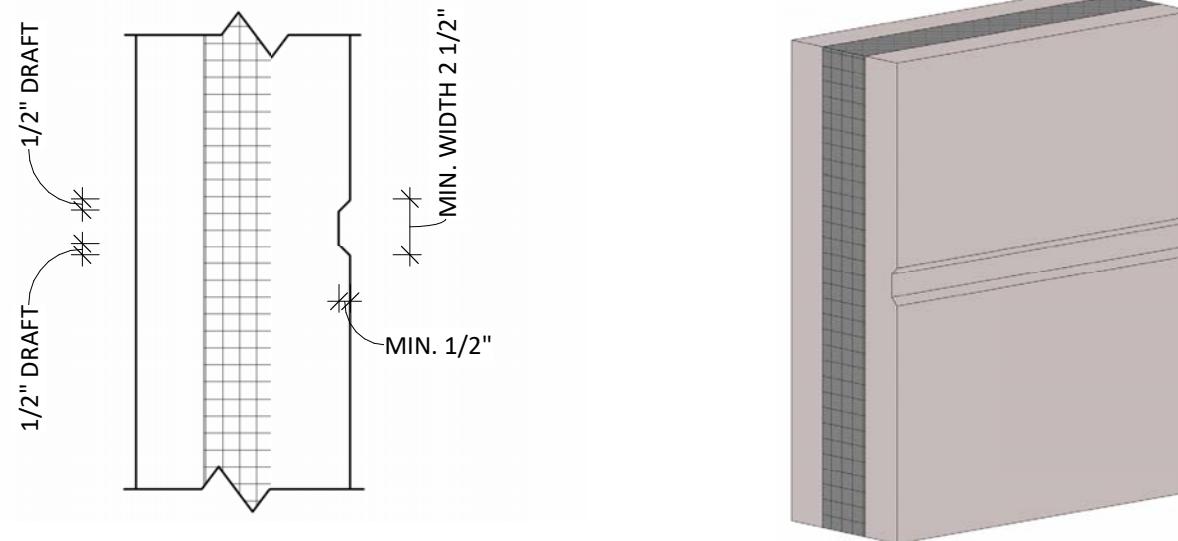
Deck/Girder Bearing Detail



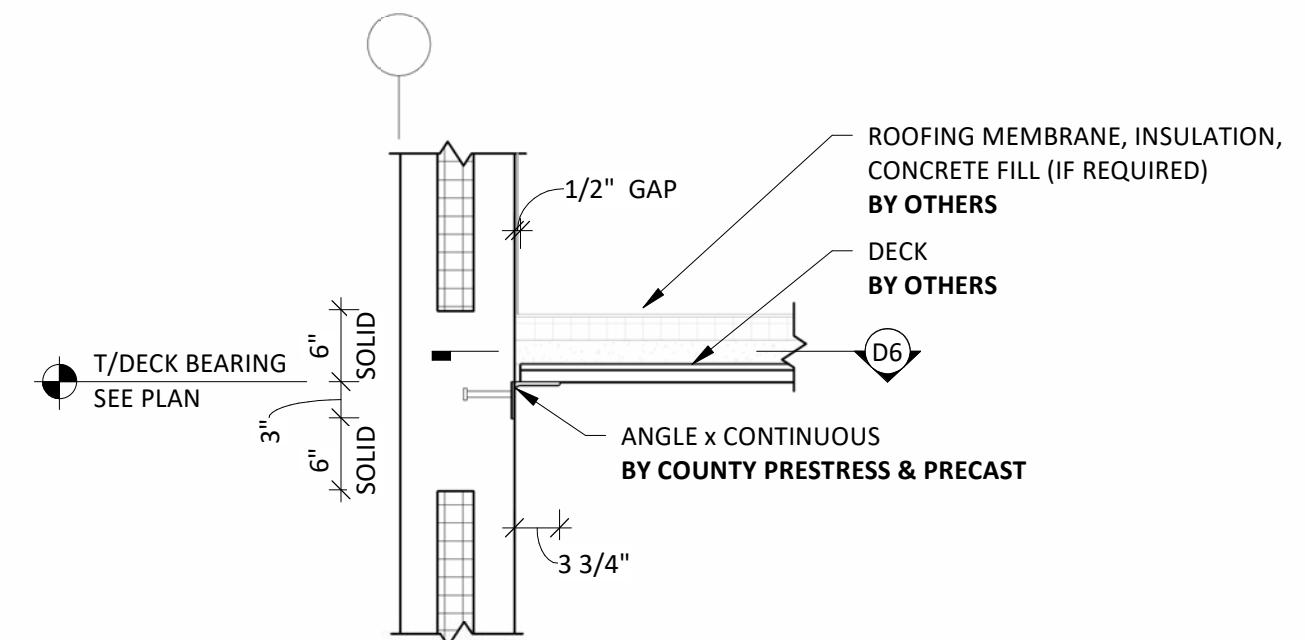
Beam Pocket Detail



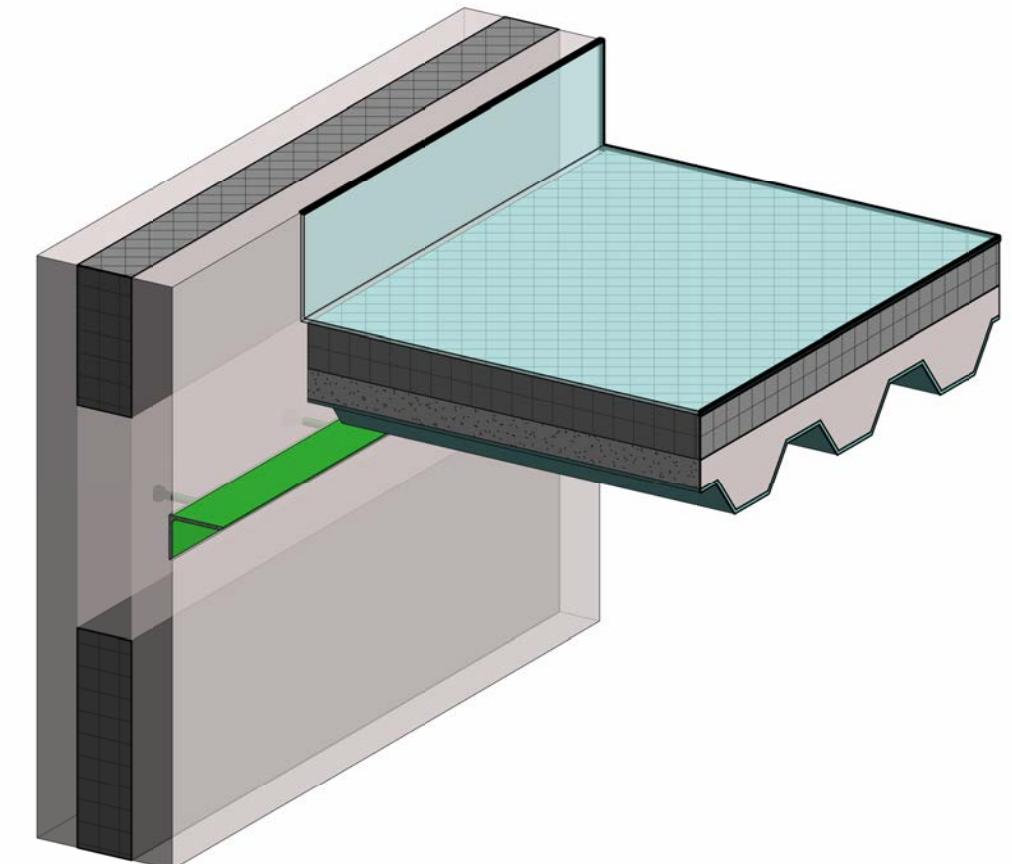
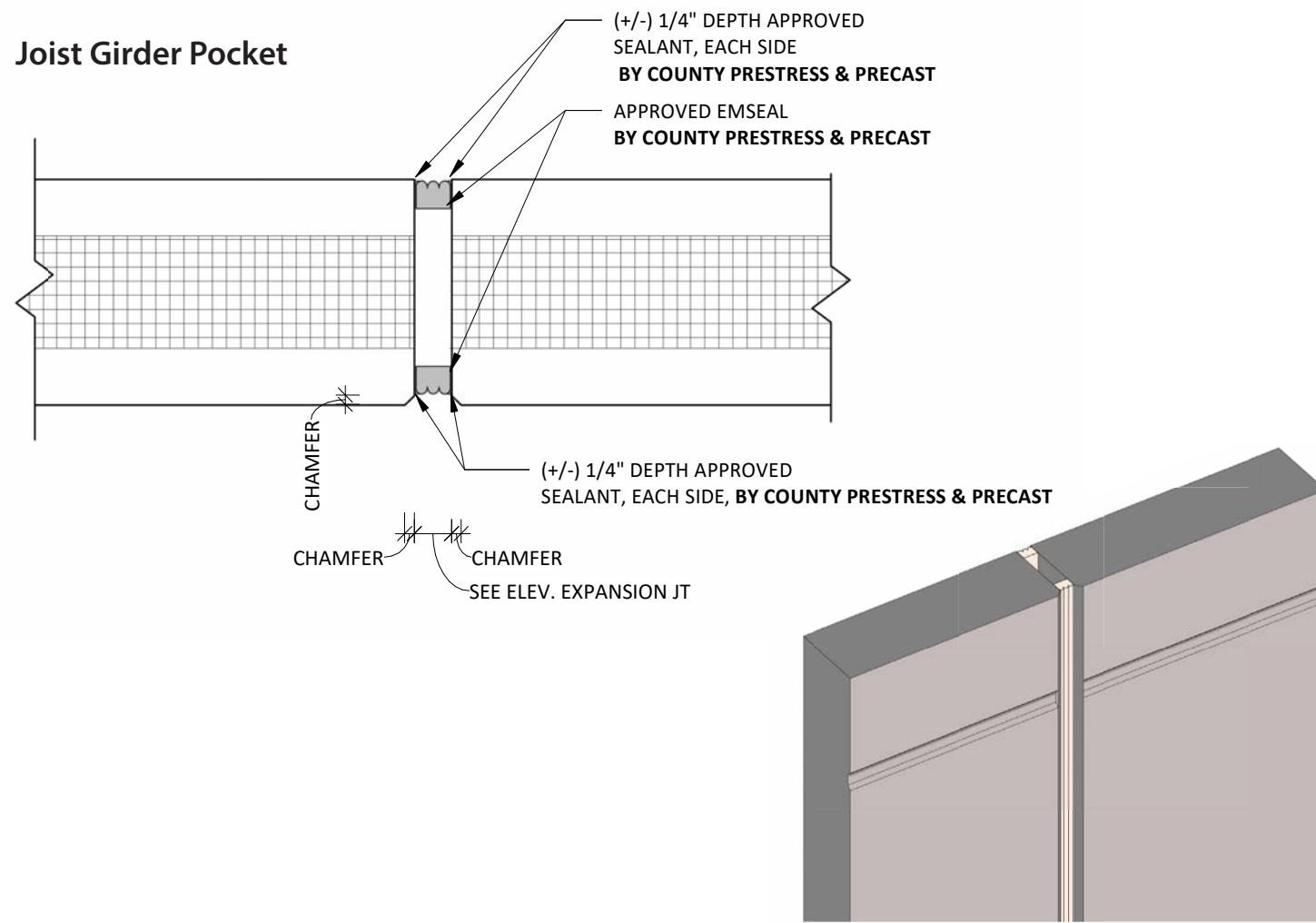
Isometric View Detail



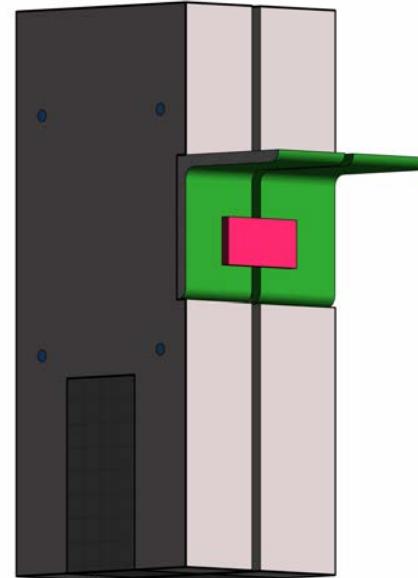
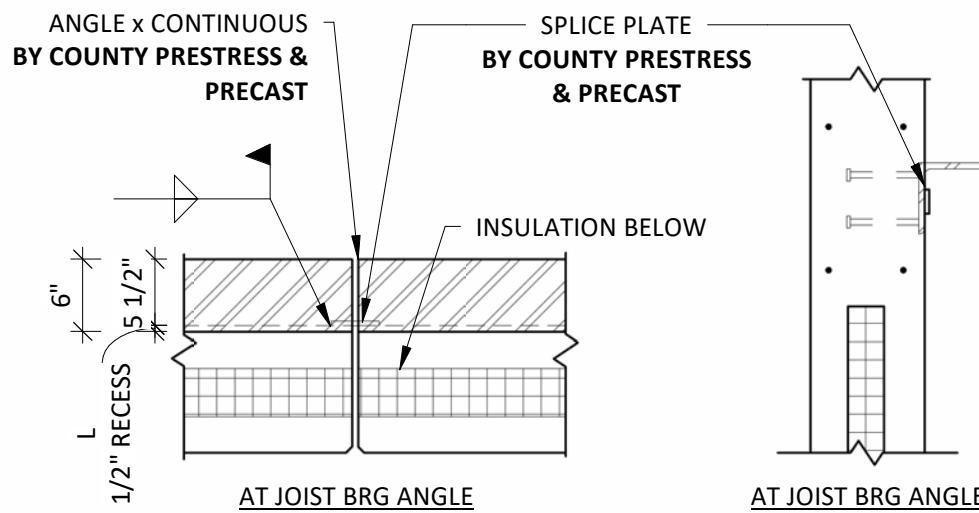
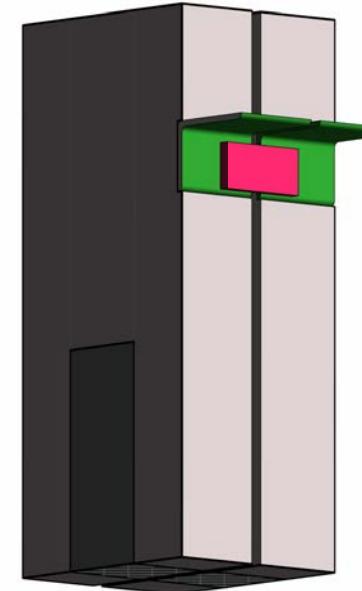
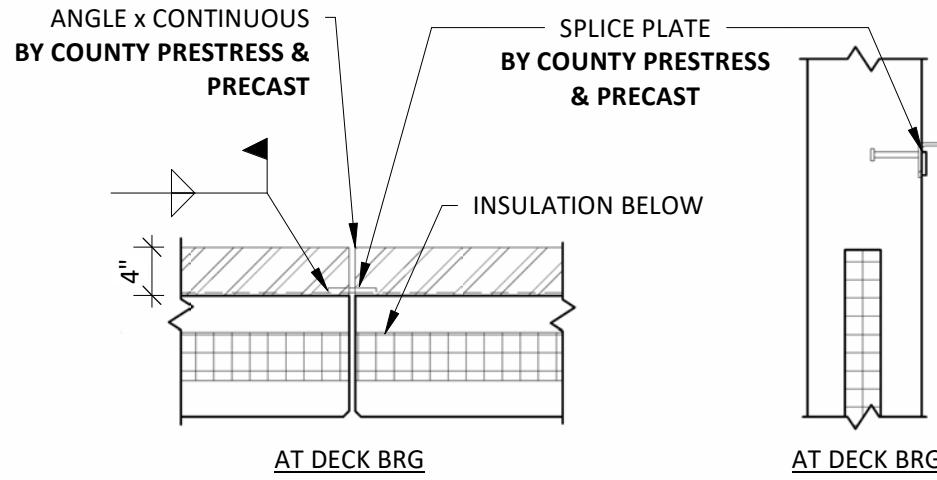
Typical Reveal



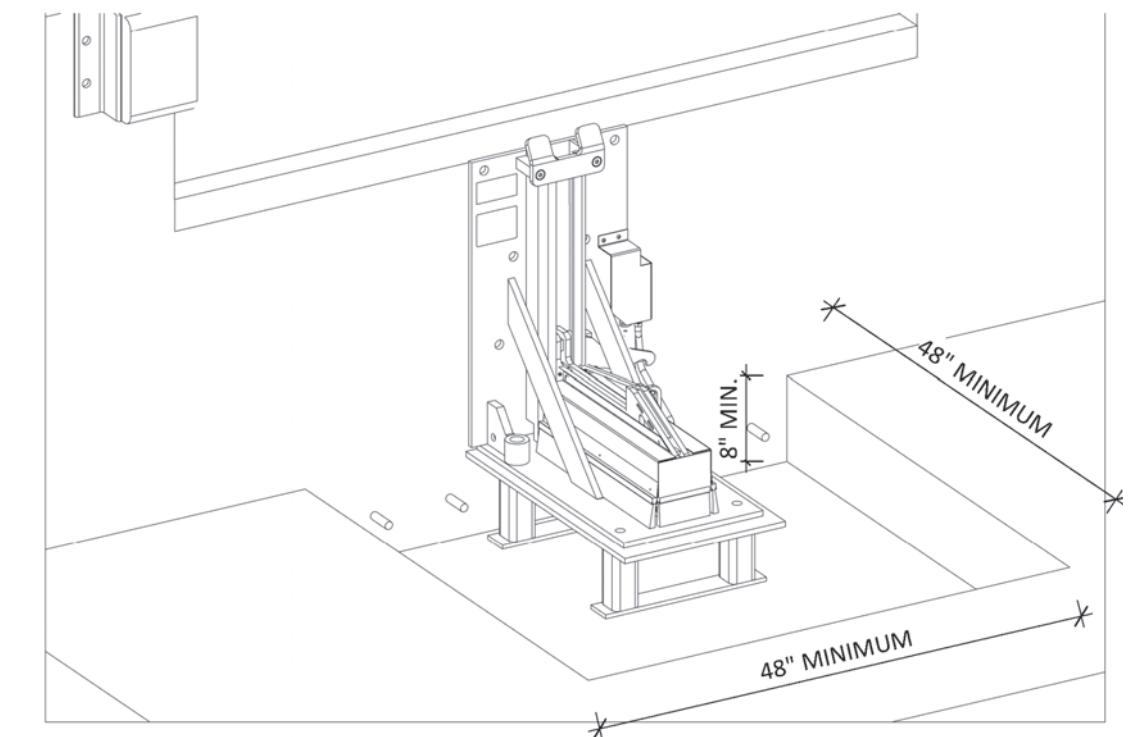
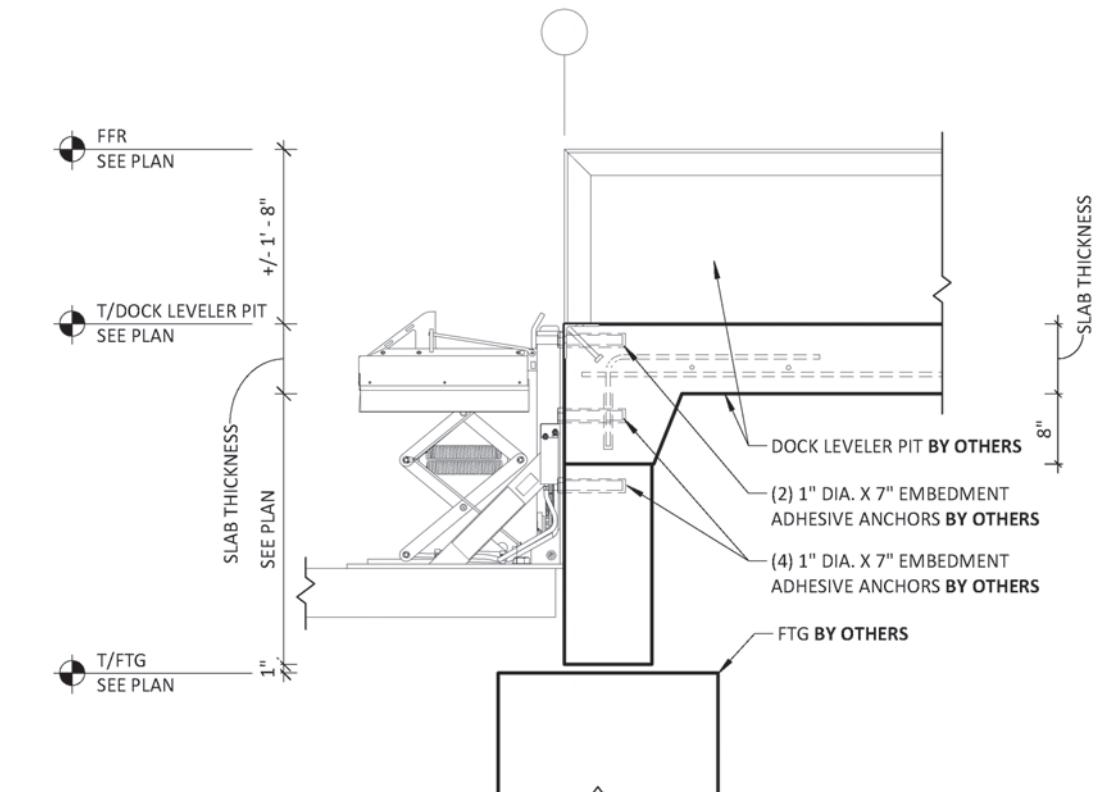
Joist Girder Pocket



Expansion Detail



Vehicle Restraint Detail



Insulated Wall Panels



Your Full-Service Partner

County Prestress & Precast is your full-service partner for high-quality prestressed concrete solutions, supporting construction professionals through every phase of a project.

With experienced teams based in Westmont, Illinois, and Astatula, Florida, we assist with everything from design to production, delivery, and erection coordination.

Our experts prepare detailed submittal drawings to ensure safe, reliable, and visually appealing results, and we back our products with rigorous quality assurance testing. Supplying insulated sandwich walls and other concrete solutions across the greater Midwest—including IL, IN, IA, KY, MI, MN, MO, OH, TN, and WI—we're committed to making even the most complex projects simple.

