PCI MIDWEST
A Chapter of Precast/Prestressed Concrete Institute

PRECAST FOCUS

CONNECTIONS FOR PRECAST CONCRETE

The purpose of a connection is to transfer loads, restrain movement, and/or provide stability to a component or an entire structure. The design of connections is one of the most important aspects in the design, engineering, and construction of precast concrete structures. In the precast concrete structures industry, it is common for the architect and engineer of record to show connection loads and locations on the contract documents and allow the successful precast concrete producer's engineering department to provide the final design and details of the connections. These connection details and design calculations, along with detailed erection drawings, are subsequently submitted to the architect and engineer of record for approval.

Precast concrete connections must meet a variety of design and performance criteria, but not all connections are required to meet the same criteria. The basic criteria include:

- Strength: A connection must have the strength to avoid failure.
- Ductility: A connection must be able to undergo relatively large deformations without failure.
- Volume Change Accommodation: Allow for some movement due to creep, shrinkage, and temperature change.
- Durability: When the connection is exposed to weather, steel elements must be adequately protected.
- Fire Resistance: Connections may need additional fire protection.
- Constructability: Use standardized connection types whenever possible.
- Tolerances: Allow for normal production and erection tolerances.

A wide variety of connection hardware and devices are used in the precast concrete industry including:

- Headed Concrete Anchors (Studs): Are round bars with an integral head typically welded to steel plates to provide anchorage to the plate.
- Steel Shapes: Including wide flange beams, structural tubes, channels, plates, and angles.
- Reinforcing Bars: Typically welded to steel sections to provide anchorage to the steel.
- Reinforcing Bar Couplers: Are typically proprietary splice-sleeves filled with non-shrink grout.
- Deformed Bar Anchors (DBA): Typically welded to steel shapes to provide anchorage.
- Bolts and Threaded Connectors: Are used in many precast concrete connections.
- Specialty Inserts: Include standard and coil threaded inserts and slotted inserts.
- Bearing Pads: Are used for structural applications to support beams and double tees.
- Shims: Can be hard plastic or steel and are used to provide adjustment.
- Grout: Typically, non-shrink structural grout is used to support column base plates, splice-sleeve connections, hollow-core slab shear keys and butt joints.
- Adhesives: Typically epoxy resins are used for post-installed threaded rod anchors.

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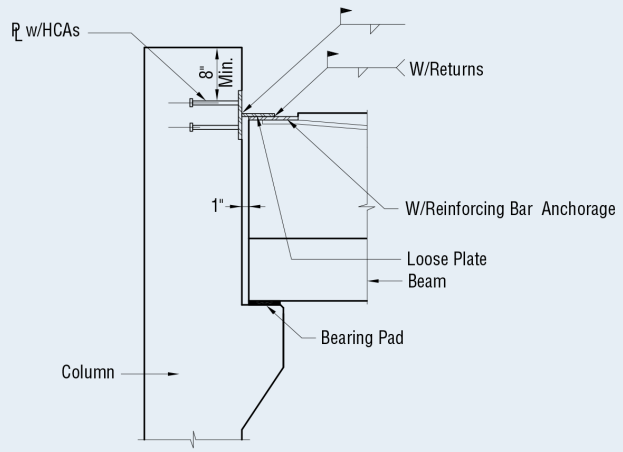
- Joints: Between precast wall panels and double tee slabs are typically filled with backer rod and elastomeric urethane or silicone sealants.
- Field-placed concrete is often used as a structural topping on double tee and hollow-core slabs.

Welded connections are the most common and typical connection used in the erection of precast concrete. They are structurally efficient and adjust easily to varying field conditions. The connections are usually made by placing a loose plate between two structural steel plates that are embedded in either the cast-in-place or precast concrete and welded together. Typical connection types include:

- Column Base Plate: Typically anchored to four corner cast-in foundation anchor bolts and supported on a minimum 2" thick non-shrink grout.
- Panel to Footing: A loose steel plate is welded to embedded plates in the precast wall panel and footing and supported continuously by a minimum 1" thick non-shrink grout.

BEAM TO BEAM WITH CORBEL



- Beam to Column with Corbel or Haunch: The beam is supported on a corbel or haunch with a bearing pad and welded top connection between the column and beam.
- Spandrel L-Beam or Inverted-Tee Beam to Double Tee: The double tee stem is supported by a bearing pad on the beam ledge and a welded top connection between the beam and double tee flange.
- Spandrel to Column: The spandrel is supported by a notch in the column with a bearing pad and connected to the face of the column with threaded rods passing through oversized sleeves and bolted to threaded inserts in the spandrel.

COLUMN BASE PLATE