## Prefabricated Bridge Elements and Systems (PBES) Conceptual Drawings

Prefabricated Bridge Elements and Systems (PBES) are structural components of a bridge built offsite or in a near site casting yard in order to reduce onsite construction time as compared to conventional construction methods. PBES components and details will vary from project to project. These drawings are not standards or preferred details; these drawings are concepts intended to assist the Designer in the development of project specific components and details. Notes to Designers have been provided as boxed text in the drawings. The information presented in this document should not be relied upon for specific application without competent professional examination and verification of accuracy, suitability, and applicability by a licensed Professional Engineer.

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### Referenced Manuals, Standards and Specifications

Florida Department of Transportation, 2015 Structures Manual
Volume 2, Chapter 25

Florida Department of Transportation, 2015 Design Standards
Index Drawings: 420, 423, 921, 925, and 2910

Florida Department of Transportation, 2015 Standard Specifications for Road and Bridge Construction
Sections: 400-9 and 926-1

AASHTO LRFD Bridge Design Specifications, Sixth Edition with 2013 Interims
Section 514.2.4.2

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**NOT FOR CONSTRUCTION CONCEPT ONLY**

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**STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION**

**PREFABRICATED BRIDGE ELEMENTS AND SYSTEMS (PBES) CONCEPTUAL DRAWINGS**
The Transfer Template is based on the Prefabricated Precast Pier Cap and provides orientation of bar placement in the C.I.P. Footings and orientation of Columns relative to each other for Multi-Column Piers. Use of the optional Closure Pour in the Precast Cap allows construction of the C.I.P. Footing prior to precasting the Pier Cap.

Require Contractor to supply three-dimensional transfer template for proper Footing-to-Column connection reinforcement placement within C.I.P. Footing.

Grouted Joint accommodates Capi-Column fabrication and construction tolerances.

Grouted Joint accommodates Column-to-Footing fabrication and construction tolerances.

Provide C.I.P. Footing flatness and elevation tolerances for Column interface.

Consider tolerances and means of adjustment for Precast Pedestals.

Notes:
1. For Detail "A" at Match-Cast Joint see Sheet 3 of 4.
2. For Detail "B" at ½" Grout Joint see Sheet 4 of 4.
3. For Precast Column Segments, see Sheet 3 of 4.
4. For Precast Pier Cap Details, see Sheet 4 of 4.
H-Section reduces lifting weights.

Key for alignment of adjacent Precast Column Section at Match-Cast Joint.

Oversize Couplers two bar sizes to provide ±0' construction tolerance.

Mechanical Couplers

Inside Face

Grout Tube (Typ.)

Couplers and Ties must meet cover requirements.

Match-Cast Joint

SECTION A-A

SECTION B-B (Typ. @ all Match-Cast Joints)

MATCH-CAST JOINT

SECTION C-C

DETAIL 'A' AT MATCH-CAST JOINT

Mechanical Coupler System See Detail 'A'.

Project Name: PREFABRICATED BRIDGE ELEMENTS AND SYSTEMS

Example 1 - Precast Two-Column Pier

Information shown is for concept only. Application is designer's responsibility. Notes to designer are shown as boxed text.
Size Cap elements for construction equipment and boom reach using site specific construction access assessment. For over-land projects, include haul route assessment for element sizing.

For over-land projects, include haul specific construction access assessment. Size Cap elements for construction reduces lifting weight.

See PBES Example 8 for closure pour concepts.

Grout Bed requires highly skilled workers in order to place grout properly.

Saturated Surface Dry (SSD) condition of both interfacing surfaces. Require surfaces and curing be prepared by Manufacturer's recommendations.

Specify API approved non-shrink Grout and non-metallic shims (left in place) and maximum shim height. Specialty Engineer is to provide shim placement and loads as part of the Erection Plan requirements.

Grout Bed requires highly skilled workers in order to place grout properly.

Stirrups and Couplers must meet cover requirements.

Mechanical Coupler System See Detail 'B'

Specify non-metallic shims (left in place) and maximum shim height. Specialty Engineer is to provide shim placement and loads as part of the Erection Plan requirements.

Specify API approved non-shrink Grout and Saturated Surface Dry (SSD) condition of both interfacing surfaces. Require surfaces and curing be prepared by Manufacturer's recommendations.

INFORMATION SHOWN IS FOR CONCEPT ONLY. APPLICATION IS DESIGNER'S RESPONSIBILITY. NOTES TO DESIGNER ARE SHOWN AS BOXED TEXT.
A Modified Special Provision is required for top-of-shaft elevation tolerances and C.I.P. connection reinforcement placement tolerances.
A Modified Special Provision is required for top-of-shaft elevation tolerances and reinforcement placement tolerances.

Oversize Couplers two bar sizes to provide a 1/2" construction tolerance.

Precast Column
Grout Ports (Typ.)
Grouted Splice Coupler (Typ.)
Foundation
Shim
Dowels

Grout Manufacturer's recommendations.

Specify APL approved non-shrink Grout and Saturated Surface Dry (SSD) condition for both interfacing surfaces. Require surfaces be prepared and cured according to Grout Manufacturer's recommendations.

Grout Bed requires highly skilled workers to place grout properly.

NOTE:
Reinforcement shown as are connected to Drilled Shaft or Footing.

COLUMN ELEVATION
(INSIDE FACE OF COLUMN SHOWN)

DETAIL A
FOUNDATION TO COLUMN CONNECTION

SECTION A-A
PRECAST COLUMN

Grouted Splice Coupler Detail

Shim for Grade Control

Erection Plan requirements.

Specialty Engineer to provide shim placement and loads as part of

Drilled Shaft or Footing.
Length

The Cap segments allows the Foundation to be cast prior to fabrication of the Precast Cap. Using a C.I.P. Cap or segmenting the Precast Cap between Columns and using an optional closure pour to connect the Cap segments allows the Foundation to be cast prior to fabrication of the Precast Cap.

Drilled Shaft diameter sized to accommodate Inner Column Reinforcement placed inside Drilled Shaft Reinforcement Cage. Specify tolerances in Modified Special Provisions.

A Modified Special Provision is required for top-of-shaft elevation tolerances and reinforcement placement tolerances.

NOTES TO DESIGNER ARE SHOWN IN BOXED TEXT.

APPLICATION IS DESIGNER'S RESPONSIBILITY.

INFORMATION SHOWN IS FOR CONCEPT ONLY.

NOTES TO DESIGNER ARE SHOWN IN BOXED TEXT.
NOTE: For Pseudo Match-Cast Process, see Sheet 5 of 7.

PIER DETAILS

EXAMPLE 3 - HYBRID C.I.P./PRECAST HAMMERHEAD PIER
PREFABRICATED BRIDGE ELEMENTS AND SYSTEMS
See Pseudo Match-Cast Process on Sheet 5 of 6.

Incorporate Transfer Template into Pseudo Pier Head form for proper reinforcement placement within C.I.P. Head. See Sheet 5 of 6 for Guide locations.

Pseudo Match-Cast Surface
Size Precast Pier Wing for construction equipment and boom reach using site specific construction access assessment. For over-land projects, include haul route assessment for element sizing.

Temporary Framing (Strongback or similar) for alignment of Pier Wing during placement to minimize damage to reinforcing bar extensions.

Temporary PT System (Temporary PT Bars shown) provides a compressive stress across the Pseudo Match-Cast Joint until the epoxy has cured. See LRFD 5.14.2.4.2 for requirements.

Oversize Couplers two bar sized to allow ± 1/2" construction tolerance.

A Temporary PT System (Temporary PT Bars shown) provides a compressive stress across the Pseudo Match-Cast Joint until the epoxy has cured. See LRFD 5.14.2.4.2 for requirements.
The PT Bars shown are temporary and used for maintaining a compressive stress across the joint until the epoxy has cured. Additional temporary PT Bars may be required in the lower section of the Joint to meet AASHTO LRFD 5.14.2.4.2 requirements.

Additional temporary PT Bars may be required in the lower section of the Joint to meet AASHTO LRFD 5.14.2.4.2 requirements.

To eliminate mild reinforcing at the Joint and improve fit-up, consider utilizing Permanent Post Tensioning such that zero tension is maintained at the Joint in the final configuration.
**Stage 1 Notes:**
1. Manufacture two identical Steel Bulkheads (left and right).
2. Pour a Precast Template using a Steel Bulkhead.
3. Precast Template to remain in casting yard for Stage 2.
4. Steel Bulkheads go to the erection site for forming the C.I.P. Hammerhead Pier Column.

Provide Shear Keys per AASHTO LRFD Bridge Design Specifications 5.14.2.4.2.

**Stage 2 Notes:**
1. Precast the required number of Match-Cast Wings using a Pseudo Pier Head Form.
2. Submit a Pseudo Match-Casting Process and Mock-Up Test Procedure to the Engineer for review and approval. A Mock-Up Test of the Joint shall be performed successfully prior to beginning installation. The Mock-Up shall consist of the following:
   a. Same surface area and shear keys as depicted in the final constructed Joint.
   b. Two-faced epoxy.
   c. Provide a stress of 40 psi uniform compression across Joint.
   d. Measure stress at joint interface (6 locations) using pressure cells.
   e. All measured stresses shall be between XXX psi and XXXX psi. Provide a report documenting the process and results. If measured stress falls outside of the XXX-XXXX psi range, resubmit revised Pseudo Match-Casting Process and Mock-Up Test Procedure to the Engineer for review and approval. Repeat the process on a new test specimen until test requirements are met.

Shear Key

Temporary PT Bar Ducts

Permanent PT Tendon Ducts

Grouted Rebar Coupler Guides (Typ.)

Pseudo Pier Head Form

Formwork

Steel Bulkhead

Precast Template

STAGE 1
(PSEUDO MATCH-CAST PROCESS)

STAGE 2
(PSEUDO MATCH-CAST PROCESS)

LEFT PRECAST CANTILEVER SHOWN; RIGHT PRECAST CANTILEVER SIMILAR
Coordinate work operations with Temporary Traffic. Control Plans to eliminate over-traffic work.

Pour C.I.P. Pier using Steel Bulkheads.

Install Second Match-Cast Wing

Couple and Stress Temporary PT Bars

Match-Cast Joints

Couplers at Grout Rebar Sleeve

Match-Cast Joints

Couplers at Grout Rebar Sleeve

Contractor may utilize 2 ft. closure pours in lieu of pseudo match-cast joints.


Size Precast Cap Wing for construction equipment and boom reach using Site Specific Construction Access Assessment.

Notes to Designer are shown as boxed text. Application is Designer's responsibility. Information shown is for concept only.
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EXAMPLE 4 - PRECAST PIER FOOTING
PREFABRICATED BRIDGE ELEMENTS AND SYSTEMS
NOTES:
1. Remove forms after concrete obtains a minimum strength of XXX psi.
2. Use high range water reducer and X" max. aggregate size for Class V Concrete (Spec).
3. Locate pick-up points symmetrical about center lines of Column and Pier (Footing).

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- Use non-metallic shims (to be left in place). Specify maximum shim height. Specialty Engineer to provide shim placement and loads as part of the erection plan requirements.

- Specifications for concrete:
  - Use Class VI Concrete w/silica fume (XXXX psi) (Min.)

- Vent pipe to minimize potential for trapped air and honeycombing.

- Inclined surface typical to minimize potential for trapped air and honeycombing. Also facilitates concrete infill placement around Pile.

- Horizontal area for Shims provides bearing area for Cap.

- Size hole diameter for ≤7 pile placement tolerance.

- Form Shear Key with removable corrugated pipe for transfer of shear without need for reinforcement through plug-cap interface. Use hard pocket former with compressible (e.g. rubber) liner to reduce shrinkage cracks.

- Grout and cover Vents after use.

- Specify minimum gap between top of Pile and Cap to ensure concreting of oversized pocket and to accommodate ±3" pile placement tolerance.

- Vents after use. Grout and cover Vents after use.

- See Pile Collar Detail

- Vertical area for Shims to reduce shrinkage cracks.

- Use hard pocket former with compressible (e.g. rubber) liner to reduce shrinkage cracks.

- Vent pipe to minimize potential for trapped air and honeycombing.

- Two-phase pour consisting of grouting to seal, then monolithic concrete pour.

- Square Pile with circular hole provides bearing area for Cap.

- Size hole diameter for ≤7 pile placement tolerance.

- Square Prestressed Concrete Pile

- Class VI Concrete w/silica fume (XXXX psi) (Min.)

- Plug

- See Pile Collar Detail

- Rebar Cage

- Seal

- Prepare interfacing concrete surfaces prior to concrete pour:
  1. Sand or water blast interfacing surfaces.
  2. Seal and fill void with potable water for 4 to 5 hours.
  3. Remove water to achieve SSD condition prior to pouring concrete.
Step 1: Cut Piles to prescribed elevations (Modified Special Provision)

Step 2: Set Pre-Cast Cap on bed of grout and friction collar at desired elevation, displacing excess grout.

Step 3: Insert Cage/Plug

Step 4: Field Bend Pedestal Bars

Step 5: Presoak 5 hours to SSD condition. Cast Plug and Pedestal.

Friction Collar not shown. Require friction collars on piles to support cap prior to grouting. Do not use shims to support cap due to the small bearing area they provide and because they tend to block the flow of grout resulting in an insufficiently grouted interface.

INFORMATION SHOWN IS FOR CONCEPT ONLY. APPLICATION IS DESIGNER'S RESPONSIBILITY. NOTES TO DESIGNER ARE SHOWN AS BOXED TEXT.

Pre-Cast Cap

Pedestal Cast Monolithically with Plug Closure

1/2" Grout Joint

Rebar Cage

Plug

High Capacity Square Prestressed Concrete Piles

CENTER OFFICE
605 Suwannee Street, MS 33
Tallahassee, Florida 32399-0450
Cap installation procedure:
1. Cast piles to top of pile elevations.
2. Insert rebar cage in Cap and Pile.
3. Erect Cap on Temporary Supports or Friction Collar to appropriate elevations. Install Form around top of Pile and under Cap (if necessary). Ensure the surface of Cap and Pile are prepared in accordance with Specification 400-9.
4. Use high range water reducer and X" Max. aggregate size for Class V Concrete (Spec).
5. Remove Forms at top of Pile after concrete obtains a minimum strength of XXXX psi.

Aligning Beams and Piles allows Pedestals to be cast monolithically with plug. Monolithically cast Pedestals also offer protection against water intrusion through Cap/Pile interface.

Preparation of Pedestal:
1. Prepare all interfacing concrete surfaces prior to concrete pour as follows:
   - Sand or water blast interfacing surfaces.
   - Remove water to a SSD condition prior to pouring concrete.
   - Seal and fill void with potable water for 4 to 5 hours.
2. Remove water to a SSD condition prior to pouring concrete.
3. Insert rebar cage in Cap and Pile.
4. Cut piles to top of pile elevations.

Section A-A:
- Cast-In-Place Pedestal (Typ.)
- See Detail 1

Section B-B:
- Cast-In-Place Pedestal (Typ.)

Detail 1:
- ⅛ Grout Joint
- Class V Concrete (Spec) (6000 psi)
- Two-Phase Grout Joint/Concrete Plug placement consisting of (1) a grout bed using APL approved non-shrink grout and (2) a monolithic concrete pour.

Information shown is for concept only. Application is designer's responsibility. Notes to designer are shown as boxed text.
Use hard pocket former with a compressible liner (e.g., rubber) to minimize shrinkage cracks.

Shear Key is formed with a removable corrugated pipe. Shear is transferred without need for reinforcement through C.I.P./Precast interface. Use hard pocket former with a compressible liner (e.g., rubber) to minimize shrinkage cracks.

Require friction collars on piles to support cap prior to grouting. Do not use shims to support cap because they tend to block the flow of grout resulting in an insufficiently grouted interface.

SECTION A-A

SECTION B-B

VIEW C-C
PLOT PILE INTERFACE REINFORCEMENT NOT SHOWN FOR CLARITY

VIEW D-D
STIRRUPS AND CAP/PILE INTERFACE
REINFORCEMENT NOT SHOWN FOR CLARITY

NOTE: Work this sheet with Bent Details Sheet 2 of 2.

ELEVATION

NOTES TO DESIGNER ARE SHOWN AS BOXED TEXT.
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EXAMPLE 6 - PRECAST BENT CAP
PREFABRICATED BRIDGE ELEMENTS AND SYSTEMS
Cap installation procedure:
1. Cut piles to Top of Pile Elevations.
2. Insert rebar cage in Cap and Pile.
3. Erect Cap on temporary supports to appropriate elevations. Install Form around top of Pile and under Cap (if necessary). Ensure the surface of Cap and Pile are prepared in accordance with Specification 400-9.
4. Use two-phase pour sequence.
   Phase one - use grout and friction collar to level Cap.
   Phase two - place concrete in Cap and Pile.
5. Contractor shall vibrate concrete to reduce the potential of trapping air in concrete.
6. After concrete reaches a strength of XXXX psi, remove Form at top of Pile.
7. Place zero slump grout at all locations not fully concreted in previous operations. All concrete surfaces shall be wetted to Saturated Surface Dry (SSD) conditions prior to grouting.

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INFORMATION SHOWN IS FOR CONCEPT ONLY.
32" F-Shape Traffic Railing - Index 429 (Modified) & Pedestrian/Bicycle Railing w/Post "C" Index 921

Provide adequate Hooked-Bar development length.

Prefabricated Bridge Elements and Systems

EXAMPLE 7 - PRECAST SLAB UNITS WITH TOPPING

PREFABRICATED BRIDGE ELEMENTS AND SYSTEMS

Provide adequate Hooked-Bar development length.

Add connection reinforcing to eliminate conflicts during Unit placement.

C.I.P. Composite Topping

Detail Bars to avoid conflict with adjacent Units and for vertical placement of Unit.

2. Prestressed Strands

3. C.I.P. Composite Topping

4. Prestressed Slab Beam (PSB) (Typ.)

5. Construction Joint

6. Poured Joint

7. Bearing Pad

8. £ Bearing

9. $ Bearing

10. Bearing Pad

11. C.I.P. Concrete Beam Seat

12. Traffic Railing Reinforcement (Typ.)

13. Traffic Railing w/Post "C" - Index 821

14. Pedestrian/Bicycle Railing - Index 420 (Modified) & Pedestrian/Bicycle Railing w/Post "C" - Index 921

15. Inset Bearing and Include End Pour to facilitate Expansion Joint fit-up

16. Expandable Foam and Backer Rod

17. Space Units and provide flexibility in Bearing Design to better accommodate shrinkage of Topping. Specify gap distance greater than combined construction plus fabrication tolerances.
Headed Bars facilitate placement

Staggered Hooks to facilitate placement

Lapped "U" Bar Stirrups

Corrugated Metal Forms

Shear Keys formed by

Closure Pour tolerance dictated by Hook Length and Hook Development Lengths

READY FOR CLOSURE
STEP 1 Install "U" shaped Rebar (Top and Bottom).
STEP 2 Install "U" Bar Stirrup Pairs (Lapped).

Hooked Bars are used in conjunction with Link Bars and Double Couplers in order to develop several planes of reinforcement across the closure pour. If all bars are developed with Hooked Bars, the heads and hook tails will conflict when elements are lowered vertically into place.

Dowels. Quality control of Coupler positioning is required. Secure Coupler according to Manufacturer's recommendations. See sketch below.

Dowels for Coupler Connection

Hooked Bars

Coupler Connections

Link Bar

"U" Shaped Rebar (Top and Bottom)

"U" Bar Stirrup Pairs (Lapped)

Tolerance of Closure Pour determined by gap between Hooked Bars, Hook Bar development length, and fit of "U" Shaped Rebar.

Combination of Hooked Bars and Couplers reduce bar congestion at closure pour.
Double Coupler Splice

Overlap Splice

Section A-A

Section B-B

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