

STRUCTURAL DRAWINGS AND DETAILS
Instructional Memorandum 704-PCP
Prestressed Concrete Piles
June 26, 2024

General

The prestressed concrete pile details are available for 18-inch, 20-inch, and 24-inch square piles, with and without steel points.

Design Criteria and Assumptions

Design Specifications: AASHTO LRFD Bridge Design Specifications, 9th Edition | 2020
(herein referred to as BDS)

The number of strands shown on the drawings provide a uniform compressive stress, after losses, that is greater than the 0.7 ksi minimum compressive stress on the pile cross section that is required by BDS Article 5.12.9.4.3. The Engineer must determine if the number of strands shown on the drawing is sufficient to meet the project specific design demands and the driving stresses during installation.

Prestress losses are calculated in accordance with BDS Article 5.9.3 for pretensioned members. The prestress loss calculations include the following assumptions:

- Relative humidity is 70%
- Initial concrete strength at the release of the strands is 3.5 ksi
- Final 28-day concrete strength is 5.0 ksi
- Unit weight of concrete is 145 pcf
- Modulus of elasticity of prestressing strand is 28,500 ksi
- Grade 270, Low-Relaxation prestressing strand
- Long-term loss calculations are based on approximate methods in accordance with BDS Article 5.9.3.3

For pick-up, storage and transportation, the support locations and corresponding maximum pile lengths are based on the following criteria:

- The loading is 1.5 times the self-weight of the pile
- Allowable tensile stress in the precast, prestressed concrete is $0.158 \cdot \text{SQRT}(f'_c)$ ksi
- Allowable compressive stress in the precast, prestressed concrete is $0.60 \cdot f'_c$ ksi
- Allowable bending stress in steel pile points is 20 ksi

For the piles without steel points, the maximum allowable pile lengths for construction and handling are provided on the drawings based on 1, 2, and 3 pick-up point options. For the piles with steel points, the Contractor is required to determine the allowable pick-up point locations for the project specific pile details.

The required pile embedment depth into cast-in-place concrete bent caps or footings is approximately equivalent to 1.3 pile widths. If the embedment depth is less than the required embedment minus 3 inches, piles must be built-up to achieve acceptable embedment. If a pile



build-up is required, the junction of the cast-in-place build-up and precast pile must be located outside of the plastic hinge zone.

A pile orientation detail is included to improve the performance of the pile-to-pile cap connection. Research has found that the prestressing strands located near the top surface of the pile, in relation to how it is poured in the casting bed, have less bond strength than the other strands. Therefore, the pile should be oriented such that these “top” strands are on the side of the pile that has less moment demand. For a typical pile supported trestle type bent, the “top” side of the pile should be placed parallel to the centerline of the bent where the moment demand is less. An optional detail is also provided, which includes the top side of the pile orientated perpendicular to the centerline of the bridge bent. The designer must determine the most appropriate orientation of the “top side” of the pile such that it is placed on the side that has the least moment demand.

Instructions to Designer

At a minimum, the following items need to be considered:

- Verify the effective stress meets design and driving requirements.
- Wherever “X” or “#” is used, replace with project specific values.
- The drawing includes a detail for the “top side” of the pile to be placed parallel to the centerline of bent. Verify that this pile orientation is correct. If necessary, update the detail or replace it with the optional pile orientation detail.
- For the Build-Up Detail, input the minimum dimension required between the top of the chipped pile and the bottom of the cap. Specify this minimum dimension as required by design to keep dowel anchorages out of the plastic hinge region.
- For Prestressed Concrete Piles without Points, verify the required pile length is less than the maximum allowable lengths shown for the three pick-up point options. If necessary, revise the pile design and/or eliminate any unacceptable pick-up point options.
- For Prestressed Concrete Piles with Points, input the dimension for the pile point and eliminate Note 3 if the length extending from the concrete portion of the pile is five feet or less.
- For Prestressed Concrete Piles with Points, remove the option to use grade 36 for designs that require grade 50.



South Carolina
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Applicable Drawings

DGN File Name	Drawing Number	Sheet Title
704-PCP	704-PCP.18	18" Square Prestressed Concrete Pile
	704-PCP.20	20" Square Prestressed Concrete Pile
	704-PCP.24	24" Square Prestressed Concrete Pile
	704-PCPP.18	18" Square Prestressed Concrete Pile with Point
	704-PCPP.20	20" Square Prestressed Concrete Pile with Point
	704-PCPP.24	24" Square Prestressed Concrete Pile with Point
	704-PCP.SUP	Pile Orientation Details, Supplemental

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