WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
Division of Highways
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Byrd E. White, III
Secretary of Transportation/
Commissioner of Highways

Jimmy Wriston, P. E.
Deputy Secretary/
Deputy Commissioner

August 30, 2019

MEMORANDUM

TO: All Division and District Design Engineers

FROM: Jimmy Wriston, P. E.
Deputy Secretary
Deputy Commissioner

THRU: DD, HD, CH

SUBJECT: Technical Engineering Memo – Concreted-in Pile Substructures
DISCIPLINES: Structure and Geotechnical Designs

The purpose of this memorandum is to provide direction on applicable situations when concreted-in piles can be used. Their application for bridge substructures has been incorporated into standard practice for a small set of conditions. These conditions provide for a unique solution for integral and semi-integral abutment foundations. Please see the attachment. This substructure type should only be used in the following situations:

- for simple spans;
- bridges with two lanes or less;
- when depth from bottom of stub to top of rock is less than 15 feet for integral;
- when depth from bottom of stub to top of rock is less than 10 feet for semi-integral; and
- heights between seat elevation and bottom of stub are five feet or less.

This criterion allows for economical designs not requiring footer or caisson construction. Concreted-in piles are not to be used in pier design/construction due to biaxial bending issues or as replacement for pile walls.

Approval for use of concreted-in piles shall be requested from the State Bridge Engineer or their designee. Approval should occur shortly after the Span Arrangement Review, or within 30 days of award of any one-step Alternate Project Delivery project, or during a proprietary meeting for a two-step process.

In addition to the design criteria, the construction of the rock socket portion of the drilled shaft was meant to be visually inspected per Section 625 of the Standard Specifications. In situations where the depth of predrilled borehole is greater than what could be visually inspected, caisson or spread footers should be used.

The following is a list of guidelines for designing concreted-in piles. These guidelines are meant to represent the maximum extents to which concreted-in piles may be used:

- Integral Abutment – Concreted-in piles may be used for integral abutment when rock is shallower than what will allow for the required 15 feet free length.

- Semi-integral – Concreted-in piles may be used for pile lengths less than 10 feet.

- Rock socket requirements – Rock sockets will be used for integral and semi-integral concreted-in piles. Sockets will have a minimum diameter of 36 inches and a minimum three-foot length in competent rock.

- Shear studs – One row of 7/8-inch diameter, 4-inch length inch shear studs, minimum 3 studs, shall be placed at one-foot intervals along the outside of each flange in the concrete zone.

- Concreted-in construction and inspection – Portion of the predrilled bore hole above the rock socket shall be excavated using casing to prevented excavated walls from collapsing. The drilled shaft rock socket shall be visually inspected. The bottom of hole shall be visible to the inspector by normal means from the surface elevation.

- Pile alignment -- The pile shall be placed per specification Section 616 and braced against movement during concreting.

- Concrete placement – Concrete shall be placed within 24 hours of excavation. The shaft shall be inspected immediately prior to placement. If the shaft is dry, then concrete may be placed by free falling not to exceed 5 feet. If the shaft is wet, concrete shall be tremied in accordance to Section 625 of the specification to the top of rock socket. The zone above the concrete is to be backfilled with clean, dry sand to provide the required free length.

- **Design requirements – The geotechnical engineer is to provide end bearing, side resistance, when needed, and associated resistance factors in accordance with the "Drilled Shaft Guidelines". If the structural capacity of the pile controls, a resistance factor of 0.6 may be used. When geotechnical resistance controls, resistance factors of 0.45 and 0.55 shall be used for end bearing and side resistance, respectively.**

- **Integral substructure analysis - When integral piles have less than 15 feet of free length, axial and flexure loading shall be analyzed in accordance with Section 6.9.2.2 of LRFD. Lpile analysis showing that total pile stress less than 45 ksi in the strength limit state may be used in lieu of Section 6.9.2.2 analysis. The cap shall be analyzed as a free head for anticipated thermal movement. Partially fixed or fully fixed may be used for analyzing thermal movement if the pile is embedded three feet into cap.**

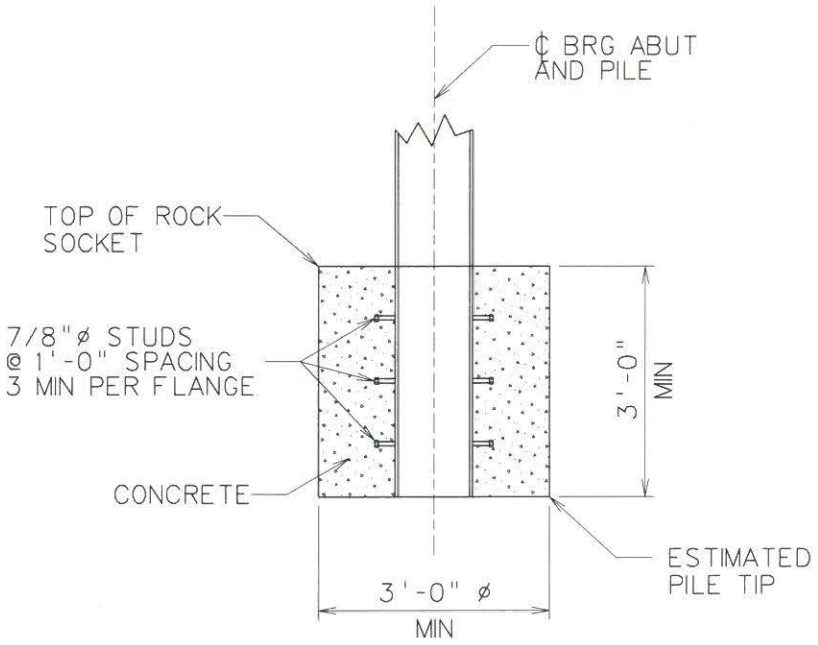
If there are any questions regarding the location or criteria for which concreted-in piles can be used, please contact the State Bridge Engineer.

JW:Sb

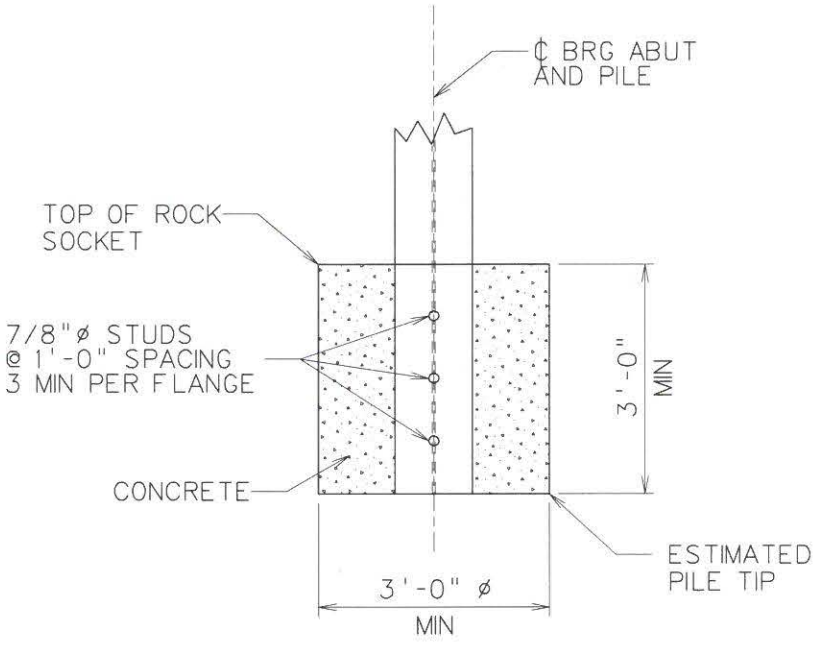
Attachment

cc: DD, HD, CH, CC, SC, State Bridge Engineer

WEST VIRGINIA DIVISION OF HIGHWAYS
ENGINEERING DIVISION



ROCK SOCKET DETAIL



ROCK SOCKET DETAIL

NOT TO SCALE

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY
		DETAIL TO ACCOMPANY INITIAL POLICY MEMO	8/12/19	

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CONCRETED-IN PILES