

TO: All Design Staff
FROM: Bijan Khaleghi
DATE: September 22, 2013
SUBJECT: Requirements for Partially filled steel Piles and Shafts

This design memorandum supplements the memorandum issued on October 7, 2012 on the Structural Design Recommendations of CFT and RCFT for bridge foundation. This memorandum defines the design and construction requirements for bridge foundations built with partially filled piles and shafts with a combination of steel casing, CFT and RCFT.

The use of partially filled steel piles and shafts for bridge foundations requires the approval of the Bridge Design Engineer, and could be used only if the conventional fully-filled piles/shafts wouldn't work.

Design and construction of partially filled steel piles and shafts shall be as shown in Figure 1, and conform to the following:

- End bearing resistance of pile foundations shall be neglected, unless the piles/casings are driven or proof tested with impact hammer methods.
- Partially filled steel piles and shafts shall be filled with class 4000P concrete
- Crosshole sonic log (CSL) tubes conforming to Standard Specification Section 9-36.4 shall extend to the bottom of concrete. CSL testing shall be performed in accordance with Standard Specification Section 6-19.3(9).
- Longitudinal reinforcement, and spiral and hoop confinement reinforcement, shall extend to the first point of zero moment along pile or shaft plus the required development length of the longitudinal steel. The minimum longitudinal reinforcement in the splice zone of single column/single shaft connections and beyond the splice zone shall be in accordance with the October 7, 2012 design memorandum.
- Shaft construction shall be in accordance with Standard Specifications Section 6-19.
- Steel pipe piling shall conform to one of the following:
 - API 5L Grade X42 or X52 material may be used for longitudinal seam welded or helical (spiral) seam submerged-arc welded pipe piles of any diameter.
 - ASTM A 252 Grade 2 or 3 material may be used for longitudinal seam welded or helical (spiral) seam submerged-arc welded pipe piles of any diameter
 - ASTM A 572 or ASTM A 588 material may be used for longitudinal seam welded piles of any diameter.

- The grade of pipe piling shall meet or exceed the grade specified above or as shown in the Plans.
- For the fabrication of helical (spiral) seam submerged-arc welded pipe piles, the maximum radial offset of strip/plate edges shall be 1/8 inch. The offset shall be transitioned with a taper weld and the slope shall not be less than a 1 in 2.5 taper. The weld reinforcement shall not be greater than 3/16 inches and misalignment of weld beads shall not exceed 1/8 inch.
- Welding for ASTM A 252 pipe shall conform to AWS D1.1/D1.1M, latest edition, Structural Welding Code, except that all weld filler metal shall be low hydrogen material selected from Table 4.1 in AASHTO/AWS D1.5M/D1.5:2010 Bridge Welding Code. All seams and splices shall be complete penetration welds.
- Welding and joint geometry for the seam shall be qualified in accordance with AWS D1.1/D1.1M, latest edition, Structural Welding Code. The Contractor may submit documentation of prior qualification to the Engineer to satisfy this requirement.
- Nondestructive inspection (NDE) requirements for field welded splices shall be identified on the plans. The location of splices and NDE requirements shall be divided into 3 possible zones as determined by the Engineer:
 1. No splices permitted – high stressed areas
 2. Splices permitted with 100% UT inspection – moderately stressed areas
 3. Splices with no UT required – visual inspection only – low stressed areas
- Resistance factors for Strength and Extreme Event Limit States shall be in accordance with the October 7, 2012 design memorandum.

Background:

Partially filled steel pipes and shafts have been used in WSDOT bridges such as Nooksack project, Ebey Slough project, etc. Until now we don't have a design and construction policy for this type of foundation and they are addressed on a case-by-case basis. This memorandum provides design and construction guidelines for bridge foundations built with partially filled Piles and Shafts with combination of steel casing, CFT and RCFT as shown in Figure 1.

If you have any questions regarding this policy, please contact Rich Zeldenrust at 360-705-7196 (ZeldenR@wsdot.wa.gov). Anthony Mizumori at 360-705-7228 (MizumoA@wsdot.wa.gov), Geoff Swett at 360-705-7157 (SwettG@wsdot.wa.gov), Mike Bauer at 360-705-7190 (BauerM@wsdot.wa.gov), or Bijan Khaleghi at 360-705-7181 (khalegB@wsdot.wa.gov).

cc: Mark Gaines, Bridge Construction - 47354

Craig Boone, Bridge and Structures – 47340

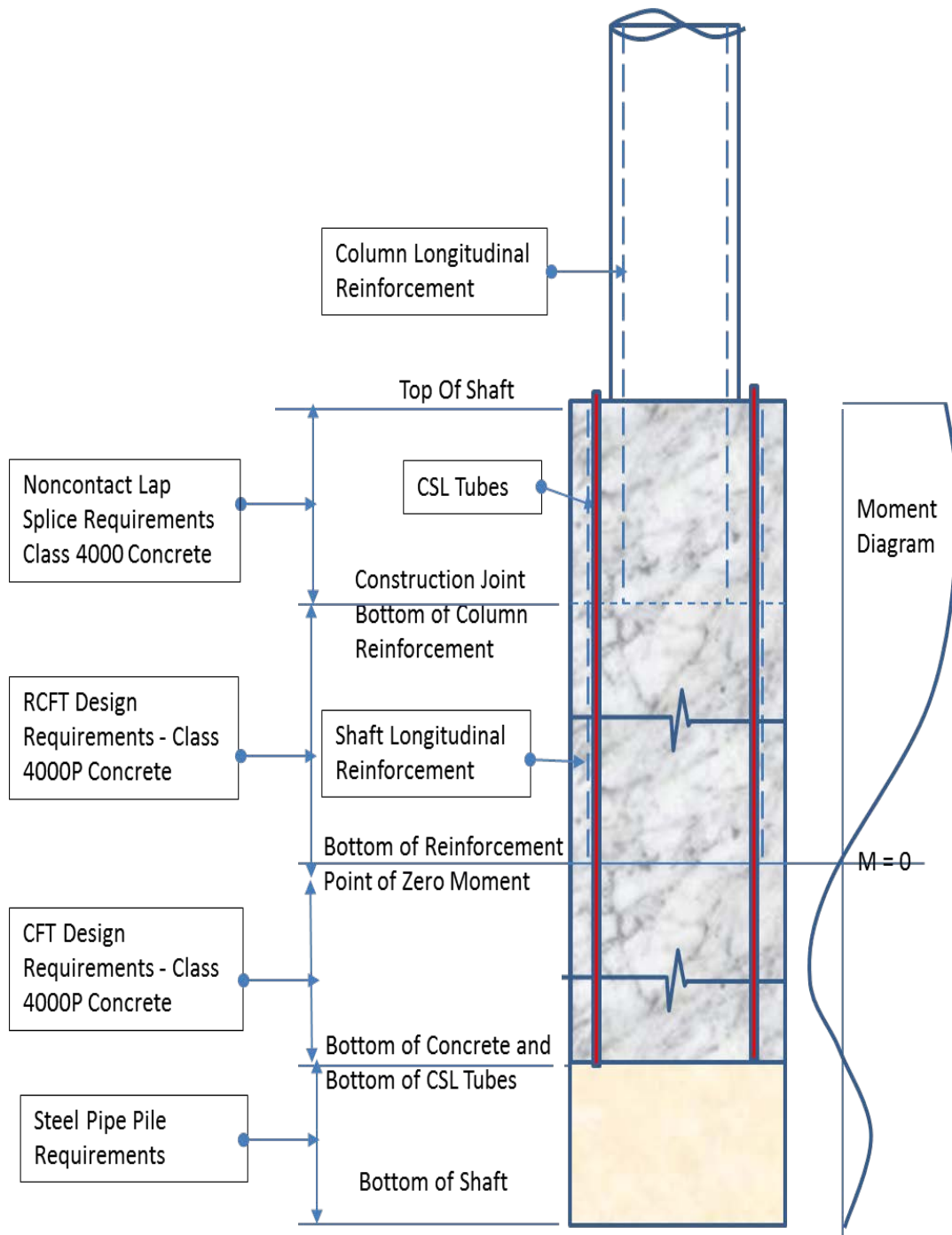


Figure 1 Partially Filled Shaft
Transverse Reinforcement not shown

BDM Revisions:

7.11 Partially Filled Steel Piles and Shafts

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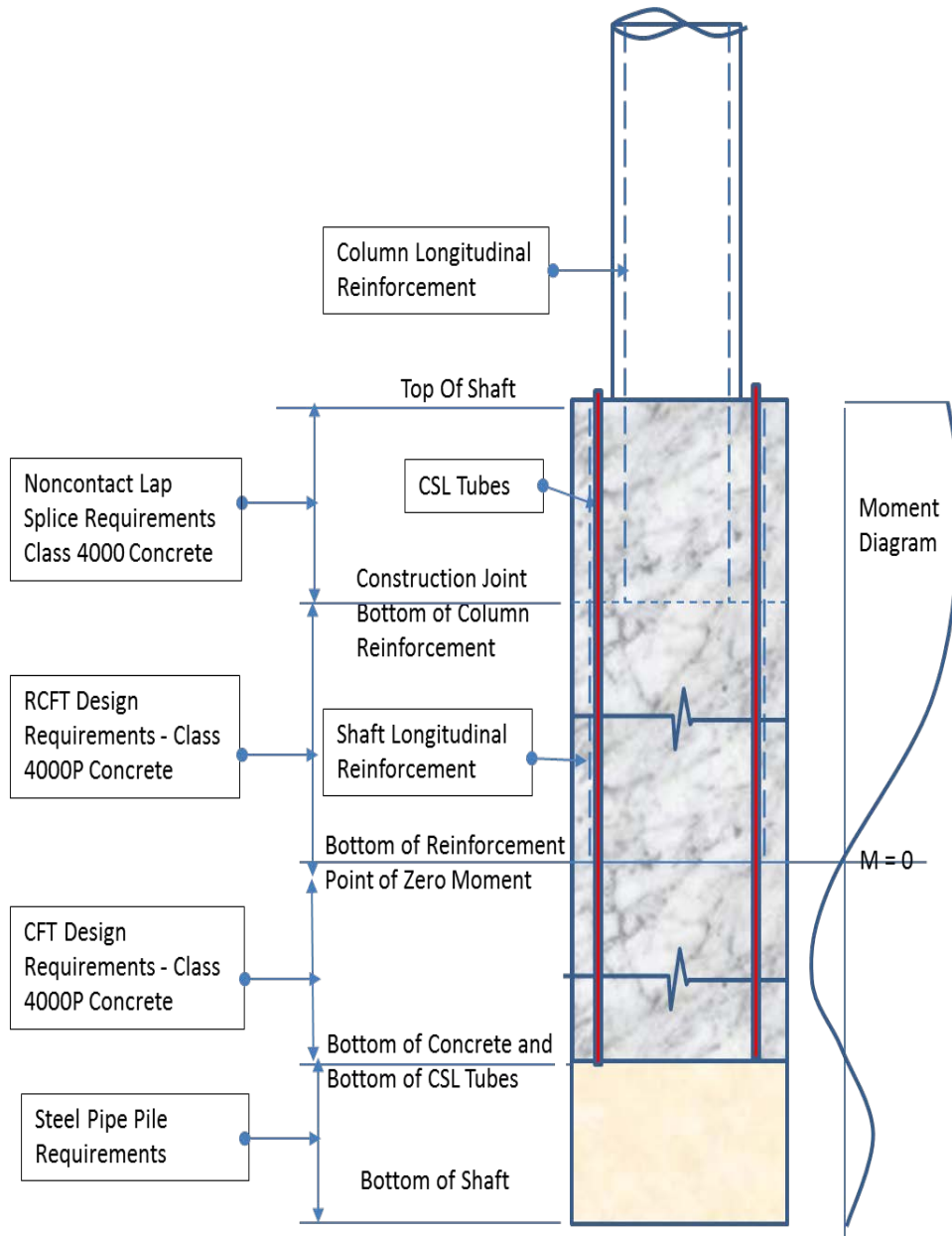


Figure 7.11-1 Partially Filled Shaft
 Transverse Reinforcement not shown