

PROJECT SPECIAL PROVISIONS**GEOTECHNICAL****PILE DRIVING CRITERIA****(9-18-12)**

Revise the *2012 Standard Specifications* as follows:

Page 4-72, Subarticle 450-3(D)(3) Required Driving Resistance, lines 26-30, delete first paragraph and replace with the following:

The Engineer will determine if the proposed pile driving methods and equipment are acceptable and provide the blows/ft and equivalent set for the required driving resistance noted in the plans, i.e., "pile driving criteria" except for structures with pile driving analyzer (PDA) testing. For structures with PDA testing, provide pile driving criteria for any bents and end bents with piles in accordance with Subarticle 450-3(F)(4).

Page 4-73, Subarticle 450-3(F) Pile Driving Analyzer, lines 45-48, delete third paragraph and replace with the following:

The Engineer will complete the review of the proposed pile driving methods and equipment within 7 days of receiving PDA reports and pile driving criteria. Do not place concrete for caps or footings on piles until PDA reports and pile driving criteria have been accepted.

Page 4-75, Subarticle 450-3(F) Pile Driving Analyzer, add the following:

(4) Pile Driving Criteria

Analyze pile driving with the GRL Wave Equation Analysis Program (GRLWEAP) manufactured by Pile Dynamics, Inc. Use the same PDA Consultant that provides PDA reports to perform GRLWEAP analyses and develop pile driving criteria. Provide driving criteria sealed by an engineer approved as a Project Engineer (key person) for the same PDA Consultant.

Analyze pile driving so driving stresses, energy transfer, ram stroke and blows/ft from PDA testing and resistances from CAPWAP analyses correlate to GRLWEAP models. Provide pile driving criteria for each combination of required driving resistance and pile length installed for all pile types and sizes. Submit 2 copies of pile driving criteria with PDA reports. Include the following for driving criteria:

- (a) Project information in accordance with Subarticle 450-3(F)(3)(a)
- (b) Table showing blows/ft and equivalent set vs. either stroke for multiple strokes in increments of 6" or bounce chamber pressure for multiple pressures in increments of 1 psi
- (c) Maximum stroke or blows/ft or pile cushion requirements to prevent overstressing piles as needed
- (d) GRLWEAP software version information
- (e) PDF copy of all pile driving criteria and executable GRLWEAP input and output files

Page 4-76, Article 450-4 MEASUREMENT AND PAYMENT, add the following:

The contract unit price for *PDA Testing* will also be full compensation for performing GRLWEAP analysis and developing and providing pile driving criteria.

STANDARD SHORING:

(1-17-12)

Description

Standard shoring includes standard temporary shoring and standard temporary mechanically stabilized earth (MSE) walls. At the Contractor's option, use standard shoring as noted in the plans or as directed. When using standard shoring, a temporary shoring design submittal is not required. Construct standard shoring based on actual elevations and shoring dimensions in accordance with the contract and Standard Drawing No. 1801.01 or 1801.02.

Define "standard temporary shoring" as cantilever shoring that meets the standard temporary shoring drawing (Standard Drawing No. 1801.01). Define "standard temporary wall" as a temporary MSE wall with geotextile or geogrid reinforcement that meets the standard temporary wall drawing (Standard Drawing No. 1801.02). Define "standard temporary geotextile wall" as a standard temporary wall with geotextile reinforcement and "standard temporary geogrid wall" as a standard temporary wall with geogrid reinforcement. Define "geosynthetics" as geotextiles or geogrids.

Provide positive protection for standard shoring at locations shown in the plans and as directed. See *Temporary Shoring* provision for positive protection types and definitions.

Materials

Refer to the *Standard Specifications*.

Item	Section
Anchor Pins	1056-2
Concrete Barrier Materials	1170-2
Flowable Fill, Excavatable	1000-6
Geotextiles	1056
Neat Cement Grout	1003
Portland Cement Concrete	1000
Select Material	1016
Steel Beam Guardrail Materials	862-2
Steel Sheet Piles and H-Piles	1084
Untreated Timber	1082-2
Welded Wire Reinforcement	1070-3
Wire Staples	1060-8(D)

Provide Type 6 material certifications for shoring materials. Use Class IV select material (standard size No. ABC) for temporary guardrail.

For drilled-in H-piles, use nonshrink neat cement grout or Class A concrete that meets Article 1000-4 of the *Standard Specifications* except as modified herein. Provide concrete with a slump of 6" to 8". Use an approved high-range water reducer to achieve this slump.

Based on actual shoring height, positive protection, groundwater elevation, slope or surcharge case and traffic impact at each standard temporary shoring location, use sheet piles with the minimum required section modulus or H-piles with the sizes shown in Standard Drawing No. 1801.01. Use untreated timber with a thickness of at least 3" and a bending stress of at least 1,000 psi for timber lagging.

(A) Shoring Backfill

Use Class II, Type 1, Class III, Class V or Class VI select material or material that meets AASHTO M 145 for soil classification A-2-4 with a maximum PI of 6 for shoring backfill except do not use the following:

- (1) A-2-4 soil for backfill around culverts,
- (2) A-2-4 soil in the reinforced zone of standard temporary walls with a back slope and
- (3) Class VI select material in the reinforced zone of standard temporary geotextile walls.

(B) Standard Temporary Walls

Use welded wire reinforcement for welded wire facing, struts and wires with the dimensions and minimum wire sizes shown in Standard Drawing No. 1801.02. Provide Type 2 geotextile for separation and retention geotextiles. Define “machine direction” (MD) and “cross-machine direction” (CD) for geosynthetics in accordance with ASTM D4439. Do not use more than 4 different reinforcement strengths for each standard temporary wall.

(1) Geotextile Reinforcement

Provide Type 5 geotextile for geotextile reinforcement with a mass per unit area of at least 8 oz/sy in accordance with ASTM D5261. Based on actual wall height, groundwater elevation, slope or surcharge case and shoring backfill type in the reinforced zone at each standard temporary geotextile wall location, provide geotextile reinforcement with wide width tensile strengths at ultimate in the MD as shown in Standard Drawing No. 1801.02. Also provide geotextile reinforcement with wide width tensile strengths at ultimate in the CD as shown in Standard Drawing No. 1801.02 if reinforcement is installed with the MD parallel to the wall face.

(2) Geogrid Reinforcement

Handle and store geogrids in accordance with Article 1056-2 of the *Standard Specifications*. Based on actual wall height, groundwater elevation, slope or surcharge case and shoring backfill type in the reinforced zone at each standard temporary geogrid wall location, provide geogrids for geogrid reinforcement with short-term design strengths in the MD as shown in Standard Drawing No. 1801.02. Also provide geogrids for geogrid reinforcement with short-term design strengths in the CD as shown in Standard Drawing No. 1801.02 if reinforcement is installed with the MD parallel to the wall face.

Use geogrids with a roll width of at least 4 ft and an “approved” or “approved for provisional use” status code. Geogrids are approved for short-term design strengths for a 3-year design life in the MD and CD based on material type. The list of approved geogrids with short-term design strengths is available from:
www.ncdot.org/doh/operations/materials/soils/gep.html

Define material type from the website above for shoring backfill as follows:

Material Type	Shoring Backfill
Borrow	A-2-4 Soil
Fine Aggregate	Class II, Type 1 or Class III Select Material
Coarse Aggregate	Class V or VI Select Material

If an approved geogrid does not list a short-term design strength in the MD for the shoring backfill used, do not use the geogrid for geogrid reinforcement. If an approved geogrid does not list a short-term design strength in the CD for the shoring backfill used, do not install the geogrid with the MD parallel to the wall face.

Preconstruction Requirements

(A) Concrete Barrier

Define “clear distance” behind concrete barrier as the horizontal distance between the barrier and edge of pavement. The minimum required clear distance for concrete barrier is shown in the plans. At the Contractor’s option or if the minimum required clear distance is not available, set concrete barrier next to and up against traffic side of standard shoring except for barrier above standard temporary walls. Concrete barrier with the minimum required clear distance is required above standard temporary walls.

(B) Temporary Guardrail

Define “clear distance” behind temporary guardrail as the horizontal distance between guardrail posts and standard shoring. At the Contractor’s option or if clear distance for standard temporary shoring is less than 4 ft, attach guardrail to traffic side of shoring as shown in the plans. Place ABC in clear distance and around guardrail posts instead of pavement. Do not use temporary guardrail above standard temporary walls.

(C) Standard Shoring Selection Forms

Before beginning standard shoring construction, survey existing ground elevations in the vicinity of standard shoring locations to determine actual shoring or wall heights (H). Submit a standard shoring selection form for each location at least 7 days before starting standard shoring construction. Standard shoring selection forms are available from:
www.ncdot.org/doh/preconstruct/highway/geotech/formdet/

(D) Preconstruction Meeting

The Engineer may require a shoring preconstruction meeting to discuss the construction and inspection of the standard shoring. If required, schedule this meeting after all standard shoring selection forms have been submitted. The Resident, District or Bridge Maintenance Engineer, Bridge or Roadway Construction Engineer, Geotechnical Operations Engineer, Contractor and Shoring Contractor Superintendent will attend this preconstruction meeting.

Construction Methods

Construct standard shoring in accordance with the *Temporary Shoring* provision.

(A) Standard Temporary Shoring Installation

Based on actual shoring height, positive protection, groundwater elevation, slope or surcharge case and traffic impact at each standard temporary shoring location, install piles with the minimum required embedment and extension for each shoring section in accordance with Standard Drawing No. 1801.01. For concrete barrier above and next to standard temporary shoring and temporary guardrail above and attached to standard temporary shoring, use "surcharge case with traffic impact" in accordance with Standard Drawing No. 1801.01. Otherwise, use "slope or surcharge case with no traffic impact" in accordance with Standard Drawing No. 1801.01. If refusal is reached before driven piles attain the minimum required embedment, use drilled-in H-piles with timber lagging for standard temporary shoring.

(B) Standard Temporary Walls Installation

Based on actual wall height, groundwater elevation, slope or surcharge case, geotextile or geogrid reinforcement and shoring backfill type in the reinforced zone at each standard temporary wall location, construct walls with the minimum required reinforcement length and number of reinforcement layers for each wall section in accordance with Standard Drawing No. 1801.02. For standard temporary walls with pile foundations in the reinforced zone, drive piles through reinforcement after constructing temporary walls.

For standard temporary walls with interior angles less than 90°, wrap geosynthetics at acute corners as directed by the Engineer. Place geosynthetics as shown in Standard Drawing No. 1801.02. Place separation geotextiles between shoring backfill and backfill, natural ground or culverts along the sides of the reinforced zone perpendicular to the wall face. For Class V or VI select material in the reinforced zone, place separation geotextiles between shoring backfill and backfill or natural ground on top of and at the back of the reinforced zone.

Measurement and Payment

Standard shoring will be measured and paid in accordance with the *Temporary Shoring* provision.