

concrete in the casing high enough to displace the drilling slurry between the outside of the casing and the edge of the hole while removing the casing.

The Contractor may use special casing systems in open water areas, when approved, which are designed to permit removal after the concrete has hardened. Design special casings so that no damage occurs to the drilled shaft concrete during their removal.

455-15.8 Slurry and Fluid in Excavation at Time of Concrete Placement:

455-15.8.1 Mineral Slurry: When mineral slurry is used in an excavation, use only processed attapulgite or bentonite clays with up to 2% (by dry weight) of added polymer. Use mineral slurry having a mineral grain size such that it will remain in suspension and having sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system. Use a percentage and specific gravity of the material to make the suspension sufficient to maintain the stability of the excavation and to allow proper placement of concrete. Ensure that the material used to make the slurry is not detrimental to concrete or surrounding ground strata. During construction, maintain the level of the slurry at a height sufficient to prevent caving of the hole. In the event of a sudden significant loss of slurry such that the slurry level cannot practically be maintained by adding slurry to the hole, backfill the excavation and delay the construction of that foundation until an alternate construction procedure has been approved.

Thoroughly pre-mix the slurry with clean fresh water prior to introduction into the shaft excavation. Ensure that the percentage of mineral admixture used to make the suspension is such as to maintain the stability of the shaft excavation. The Engineer will require adequate water and/or slurry tanks when necessary to perform the work in accordance with these Specifications. The Engineer will not allow excavated pits on projects requiring slurry tanks without the written permission of the Engineer. Take the steps necessary to prevent the slurry from "setting up" in the shaft, including but not limited to agitation, circulation, and/or adjusting the composition and properties of the slurry. Provide suitable offsite disposal areas and dispose of all waste slurry in a manner meeting all requirements pertaining to pollution.

Provide a CTQP qualified drilled shaft inspector to perform control tests using suitable apparatus on the mineral slurry mixture to determine the following parameters:

(a) Freshly mixed mineral slurry: Measure the density of the freshly mixed mineral slurry regularly as a check on the quality of the suspension being formed using a measuring device calibrated to read within plus or minus 0.5 lb per cubic foot.

(b) Mineral slurry supplied to the drilled shaft excavation: Perform the following tests on the mineral slurry supplied to the shaft excavation and ensure that the results are within the ranges stated in the table below:

Item to be measured	Range of Results at 68°F	Test Method
Density	64 to 73 lb/ft ³ (in fresh water environment) 66 to 75 lb/ft ³ (in salt water environment)	Mud density balance: FM 8-RP13B-1
Viscosity	30 to 50 seconds	Marsh Cone Method: FM 8-RP13B-2
pH	8 to 11	Electric pH meter or pH indicator paper strips: FM 8-RP13B-4
Sand Content	4% or less	FM 8-RP13B-3

The Contractor may adjust the limits in the above table when field conditions warrant as successfully demonstrated in a Test Hole or with other methods approved by the Engineer. The Engineer must approve all changes in writing before the Contractor can continue to use them.

Perform tests to determine density, viscosity, and pH value to establish a consistent working pattern, taking into account the mixing process and blending of freshly mixed mineral slurry and previously used mineral slurry. Perform a minimum of four sets of tests to determine density, viscosity, and pH value during the first 8 hours mineral slurry is in use.

When the results show consistent behavior, discontinue the tests for pH value, and only carry out tests to determine density and viscosity during each four hours mineral slurry is in use. If the consistent working pattern changes, reintroduce the additional tests for pH value for the time required to establish consistency of the test values within the required parameters.

(c) The Department may perform comparison tests as determined necessary during the mineral slurry operations.

During construction, maintain the level of mineral slurry in the shaft excavation within the excavation and at a level not less than 4 feet above the highest expected piezometric water pressure along the depth of a shaft.

At any time the wet construction method of stabilizing excavations fails, in the opinion of the Engineer, to produce the desired final result, discontinue this method of construction, and propose modifications in procedure or alternate means of construction for approval.

455-15.8.2 Polymer Slurry For Shafts For Miscellaneous Structures:

Materials manufactured expressly for use as polymer slurry for drilled shafts may be used as slurry for drilled shaft excavations installed to support mast arms, cantilever signs, overhead truss signs, high mast light poles or other miscellaneous structures. A representative of the manufacturer must be on-site or available for immediate contact to assist and guide the construction of the first three drilled shafts at no additional cost to the Department. This representative must also be available for on-site assistance or immediate contact if problems are encountered during the construction of the remaining drilled shafts as determined by the Engineer. The Engineer will not allow polymer slurries during construction of drilled shafts for bridge foundations. Use polymer slurry only if the soils below the casing are not classified as organic, and the pH of the fluid in the hole can be maintained in accordance with the manufacturer's published recommendations. Submit the MSDS for the product, the

manufacturer's published mixing procedures, and the manufacturer's published range of values for pH and viscosity of the mixed slurry. Certify that the polymer slurry and components meet the following requirements:

a. The polymer slurries to be used on the project and their waste products are classified as non-hazardous as defined by Resource Conservation and Recovery Act (RCRA) Subpart C rules, Table 1 of 40 CFR 261.24 Toxicity Characteristic.

b. Pull out tests demonstrate the bond between the bar reinforcement and the concrete is not materially affected by exposure to the slurry under typical construction conditions, over the typical range of slurry viscosities to be used.

c. Load tests demonstrate the bond between the concrete and the soil is not materially affected by exposure to the polymer slurry under typical construction conditions, over the typical range of polymer slurry viscosities to be used for the project versus affect of exposure to mineral slurry.

d. The method of disposal meets the approval of all federal, state and local regulatory authorities.

Perform the following tests on the polymer slurry in the shaft excavation and ensure that the results are maintained within the ranges stated in the table below:

Mixed Polymer Slurry Properties		
Item to be measured	Range of Results at 68°F	Test Method
Density	62 to 64 lb/ft ³ (fresh water) 64 to 66 lb/ft ³ (salt water)	Mud density balance: FM 8-RP13B-1
Viscosity	Range Published By The Manufacturer for Materials Excavated	Marsh Cone Method: FM 8-RP13B-2
pH	Range Published By The Manufacturer for Materials Excavated	Electric pH meter or pH indicator paper strips: FM 8-RP13B-4
Sand Content	0.5% or less	FM 8-RP13B-3

Polymer slurry may be mixed in the cased portion of the shaft in accordance with the manufacturer's published procedures.

During construction, maintain the level of the slurry at a height sufficient to prevent caving of the hole. At any time the wet construction method of stabilizing excavations fails, in the opinion of the Engineer, to produce the desired final result, discontinue this method of construction, and propose modifications in procedure or alternate means of construction for approval.

455-15.8.3 Fluid In Excavation At Time Of Concrete Placement: When any fluid is present in any drilled shaft excavation, including shafts to support miscellaneous structures, the applicable test methods and reporting requirements described in 455-15.8.1 apply to tests of fluid in the shaft prior to placing the concrete.

Take samples of the fluid in the shaft from within 1 inch of the base of the shaft and at intervals not exceeding 10 feet up the shaft, using an approved sampling tool designed to sample over a depth range of 12 inches or less. Take whatever action is necessary