

West Virginia Shaft Bottom Cleanliness Specifications

Because of the relatively shallow bedrock geology, the use of drilled shafts has become a standard practice for the West Virginia Department of Highways (WVDOH) in West Virginia, the “Mountain State”. According to the Drilled Shaft Guidelines provided by the WVDOH, having an assessment of bottom cleanliness is required for excavation approval. The DOH requires inspection results to meet the following requirements, “...no more than 2 hours have elapsed between the inspection and startup of concrete placement. The base rock is to be considered clean if no more than ½ inch depth of material exists on 75% of the bottom and the remaining 25% has no particles or material more than 1-1/2 inches in thickness”.

In the days before the Occupational Safety and Health Administration (OSHA), workers may have been lowered into the excavation to inspect the drilled shaft bottom. Today, this type of assessment would not occur due to safety considerations. Some workers have lowered weighted tape measurers into excavations to “feel” if any debris is at the base, but the weighted tape may not penetrate the material and no measurement is possible. Current technology utilizes a camera to see into the excavation, but the interpretation is often difficult, and a lack of clarity can impede the assessment of the base condition.

GRL Engineers utilize the [Shaft Quantitative Inspection Device \(SQUID\)](#) to assess shaft bottom cleanliness prior to concrete pours. During the test, data is collected with three penetrometers that measure force and displacement. The displacement plates remain on top of any debris material present at the excavation base, while the penetrometers penetrate any debris or soft material and record force as a function of displacement. The test is then repeated at multiple locations within the excavation base area to provide a complete, objective, and quantitative assessment of debris or soft material thickness and bearing material conditions, in a relatively short period of time.

This test method has been utilized by GRL Engineers to assess drilled shafts for bridges, building foundations, highways, and railroad bridges. WVDOH has embraced SQUID technology and included the device in their standards for drilled shaft construction. The SQUID has been used on many projects throughout the state, including the replacement of the Cairo Bridge in Cairo, the I-79 Widening Project in Fairmont, the Rock Creek Interchange Replacement in Boone County, and the Upper Gassaway Bridge Replacement project to name a few.

In **Figure 1**, penetrometer force-displacement results are shown from a test for a drilled shaft bearing in shale bedrock (Hannigan et al. 2021). The shaft excavation had been left open and filled with drilling fluid for four days prior to the testing. Due to degradation of bedrock over time, over 123.5 mm (4.86 in) of displacement occurred crossing the specification limits of 1.25” of thickness. The shaft was subsequently drilled 0.3 m (11.8 in) deeper, followed by cleaning with an airlift, and

Project Details

Client: West Virginia DOH

Location: West Virginia

GRL Office: Ohio

GRL Services

- Drilled Shaft Bottom Cleanliness Evaluation



immediate SQUID retesting. The re-test results, shown in **Figure 2**, indicated from 11.5 m (0.45 in) to 19.9 mm (0.78 in) of debris, which was below the project specification limits.

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Figure 1. SQUID results from shale bedrock exposed to drilling fluid for four days.

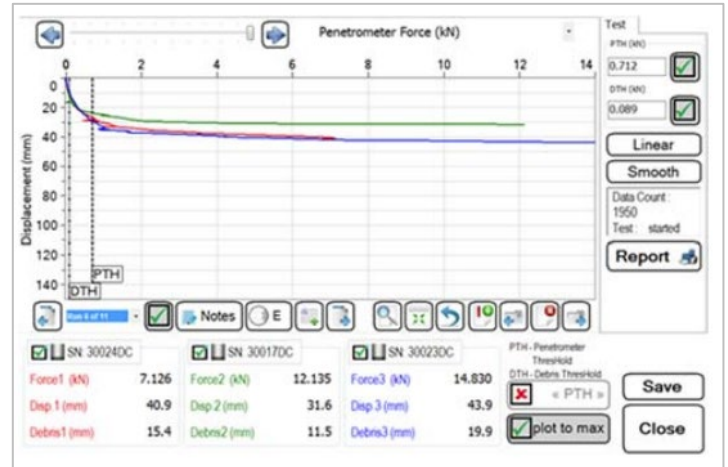


Figure 2. SQUID results from shale bedrock redrilled and cleaned by air lifting.