

Geological Controls on Constructability – An Excavation Guide for New York City

Charles Merguerian, PhD, PG

Duke Geological Laboratory, 55 Spongia Road, Stone Ridge, NY 12484

CharlesM@Dukelabs.com

J. Mickey Merguerian

DukelabsDSC, 33 Angela Drive, Carmel, NY 10512

mickey@dukelabsdsc.com

Abstract

In New York City (NYC), the ultimate success of both TBM and traditional drill and blast tunneling efforts as well as top-down mechanical excavations through regolith and into bedrock is fundamentally governed by the geology of the ground. Installation of caissons and other forms of support-of-excavation (SOE) for shallow construction efforts through regolith and for shafts or secant piles into rock is governed by top-of-rock (TOR) conditions including the absence or presence of Cretaceous sediment strata, the weathering profile at TOR, groundwater flow patterns within regolith aquifers and through open fractures at or near the TOR. These conditions can inhibit efficient drilling, installation and proper seating of caissons, secant piles and rock socket concrete pours. What is more, since the region has experienced a number of superposed Pleistocene glacial flow paths from at least two contrasting directions, NYC regolith commonly consists of a glacial drift blanket composed of intercalated layers of outwash, lake deposits and till with or without boulders. Such layers show rheologic differences produced by the loading of subsequent (younger) glacial ice flow and associated depositional processes. Clearly, a full understanding of the Cretaceous and Pleistocene stratigraphy is paramount in creating winning bids where overburden conditions are present.

Regarding the Proterozoic and Paleozoic bedrock substrate, the hardness and density of the bedrock are controlled by lithology, mineralogy, intergranular texture, metamorphic grade and geological structure. These parameters are generally characterized through pre-bid subsurface investigations including drilling and targeted analyses of recovered core. Such analyses should include core recovery (REC %) and rock quality designation (RQD %), detailed petrographic evaluation, unconfined compressive strength (UCS) testing and other allied rock mass strength laboratory tests. Less readily understood controls on tunneling and excavation advance rates include both regional and site-specific structural dislocations including fault- and joint types, their orientations and spacings. Such subsurface conditions have proven to be significant impediments to profitable construction and collectively provide geographical guidance for potential site issues specific to the New York City metropolitan area. This report outlines expectations for predicting the basic underpinning of NYC construction sites.