

FOUNDATION DESIGN APPLICATIONS OF CPTU AND DMT TESTS IN ATLANTIC COASTAL PLAIN VIRGINIA

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ABSTRACT

Sedimentary soils in the Atlantic Coastal Plain region of Virginia are well suited to insitu testing methods. Local deposits of the Quaternary Period are interbedded and normally to lightly over consolidated. In some areas, the thickness of normally consolidated soils exceeds 30 meters. Accordingly, detailed profiling of stratigraphy and engineering parameters is essential for settlement and stability analyses. Cone penetration and flat dilatometer tests provide reliable, accurate, and detailed records of stratigraphy, soil modulus, and other parameters integral to foundation or embankment design. Several project profiles illustrate practical applications and comparisons of stratigraphic profiling and engineering parameters determined by conventional test borings, laboratory soil tests (classification and oedometer), cone penetration and flat dilatometer tests from several investigations in the Coastal Plain region. This paper does not present a “State of the Art” or emerging trends. Rather, it provides examples of basic foundation design applications for engineers who do not regularly use CPT or DMT tests.

INTRODUCTION

Traditionally, geotechnical investigations for heavy or sensitive structures or embankments require time-intensive and costly subsurface explorations, and laboratory strength and compressibility tests. Insitu tests provide greater detail for stratigraphic profiling and engineering parameters than conventional test borings and laboratory tests. Often, a careful evaluation of thin layers of soft soils is a critical element of cost-effective foundation design. Thin layers of soft soil are much easier to detect with CPT or DMT soundings. In many cases, the insitu tests are the more appropriate primary profiling tool. The insitu test profiles should be evaluated to determine where to collect samples for laboratory testing or complete further analyses. In some instances, quality samples are not easily obtained and insitu tests are the only practical alternative.

laboratory testing methods. Insitu tests were not frequently used to supplement standard geotechnical investigations.

After several years incorporating numerous successful applications of insitu tests, the authors frequently rely on CPTU and DMT soundings as a primary or complimentary site investigation tool. During the last three years, the authors' collective experience totals dozens of geotechnical investigations that incorporate insitu tests. For each site described, the CPTU tests were made with a standard 10 square-centimeter, 90 kN (10-ton) Type 2 piezocone. The DMT tests were completed using a standard "Marchetti" type flat dilatometer. The equipment, procedures, and calculations based on DMT data are those presented by Marchetti⁷, and reported by Briaud for the FHWA.³

For most projects, the authors do not have adequate data to develop local shear strength or compressibility factor correlations for CPTU data. As a result, the CPTU data is primarily used for profiling and with direct methods for design of axially loaded pile foundations. The combination of SPT, CPTU, DMT and laboratory data at a site near Tappahannock, Virginia enabled the necessary correlation between the field and laboratory data, as described in the following section.

The following list summarizes the authors subjective rating of the relative value of CPTU and DMT tests for several design applications in the Atlantic Coastal Plain of Virginia.

Table 1
Applications of Insitu Tests in Virginia Coastal Plain Sediments of the Quaternary Period

DESIGN APPLICATION	CPTU Relative Value	DMT Relative Value
Profiles for Identification of Interbedded Soils	Excellent	Excellent
Profiles to Plan Sampling Locations	Excellent	Excellent
Settlement Analysis of Sand Soils	Good	Excellent
Settlement Analysis of Soft Clay Soils	Fair*	Excellent
Estimation of Time Rate of Consolidation	Good	Good