DRILLED-IN DISPLACEMENT MICROPILE (DDM) DESIGN GUIDELINES

STRUCTURAL CAPACITY:

Design using the structural capacity of the full-length steel tube and the interior, confined grout column (Refer to table 1). The exterior grout column may be used in calculating lateral loads due to the limited variabilities installing the first 10' below grade.

Another factor in determining the central shaft is the torque required to advance the pile to the required depth. The torque required is a function of the type of soil and volume of soil that is being displaced (Refer to table 2). Little to no torque is required for shaft friction since the diameter of the annulus created by the displacement head exceeds the diameter of both the central shaft and the reverse auger. Also, the shaft is 'lubricated' by the grout that fully encapsulates the steel shaft and reverse auger.

GEOTECHNICAL CAPACITY:

Design DDM's as a displacement pile using the diameter of the deformation, not the displacement, for the bond. Several methods are available to estimate the ultimate geotechnical capacity of the DDM. The Federal Highway Administration's "Micropile Design and Construction Reference Manual", December, 2005 (FHWA NHI-05-039) provides guidance on analyzing the bond strength of the pile. Naval Facilities Engineering Command manual (NAVFAC) " DM 7.02." provides methods to analyze both bond and end bearing. AllPile design software is one program that is often used.

> NOTE: Empirical evidence has proven that the jagged, irregular grout to ground interface created by the deformation structure typically produces greater results than these calculation methods provide. However, Ideal recommends using the conservative approach outlined above until the designing engineer becomes familiar with the enhancement that the 'unique interweave' provides in different soil types. For design in highly plastic soils, consultation with the Ideal design team will prove beneficial for both capacity calculation and for possible modification of pile configuration to address the unique characteristics of this soil type.

The area of the drive plate may be used for end bearing capacity as is appropriate for the particular application.

LOAD TEST ESTABLISHES STANDARD FOR PRODUCTION PILES:

DDM's are typically load tested in accordance with applicable ASTM standards (i.e., D3689 for tension, D1143 for compression, and / or D3966 for lateral loading) to verify or determine their geotechnical capacity. As in all pile types, the load test establishes the installation parameters including depth, grout take, and capacity for production piles in the job specific soil. Therefore depth and grout take prediction is useful but is superseded by information gained from the test pile program. Empirical evidence has proven that the mechanical method used to displace soil and the immediate grout occupancy of space created provides for a high degree of repeatability of the test pile throughout similar soils at the jobsite.

WATER TABLE:

Since the viscosity of the grout mix is approximately two times the viscosity of water, no alteration of STELCOR design or installation is required with high water table.

Table 1: CENTRAL SHAFT SELECTION GUIDE (STRUCTURAL)

GROUT		CENTRAL SHAFT			CENTRAL SHAFT (80ksi) & INTERNAL GROUT (4ksi)
GROUT O.D. (in)	SHAFT INTERIOR GROUT VOLUME (sq. in)	O.D. (in)	WALL THICKNESS (in)	MAX TORQUE (FT-LBS)	ALLOWABLE STRUCTURAL CAPACITY (KIPS)
11	6.61	3.50	0.300	17,000	105.2
12	17.93	5.50	0.361	40,000	210.2
12	17.13	5.50	0.415	60,000	234.8
14	17.93	5.50	0.361	40,000	210.2
14	17.13	5.50	0.415	60,000	234.8
16	17.93	5.50	0.361	40,000	210.2
16	17.13	5.50	0.415	60,000	234.8
16	30.04	7.00	0.408	70,000	310.0
16	29.17	7.00	0.453	110,000	336.7

NOTES:
1. Structural capacities displayed above are in accordance with the 2014 New York City Building Code (NYCBC 2014) and the 2012 & 2015 International Building Code (IBC 2012 & IBC 2015).
2. This table is a guide only. Additional sizes and various wall thicknesses can be utilized for specific projects

Table 2: STELCOR CONFIGURATION GUIDE (GEOTECHNICAL)

GROUT		STEEL COMPONENTS			INSTALLATION	
GROUT O.D. (IN)	CENTRAL SHAFT O.D. x W.T. (IN)	DEFORMATION STRUCTURE O.D. (IN)	DISPLACMENT PLATE O.D. (IN)	DRIVE PLATE O.D. (IN)	DRIVE MOTOR REQUIRED (FT-LBS)	BPF THAT MAY REQUIRE PRE-AUGURING
11	3.50 x 0.300	11	8	14	20,000	15+
12	5.50 x 0.361	12	9	14	50,000	25+
12	5.50 x 0.415	12	9	14	70,000	35+
14	5.50 x 0.361	14	11	16	50,000	25+
14	5.50 x 0.415	14	11	16	70,000	35+
16	5.50 x 0.361	16	13	18	50,000	20+
16	5.50 x 0.415	16	13	18	70,000	25+
16	7.00 x 0.408	16	13	18	80,000	35+
16	7.00 x 0.453	16	13	18	130,000	50+

NOTES:
1. For geotechnical design use the Grout O.D. column which is the diameter of the Deformation Structure.
2. Installation parameters can vary depending on site specific soils.
3. This table is a guide only. Additional configurations can be utilized for specific projects.

Key Concepts:

- The pile shaft provides unbroken structural integrity from the tip to the top of the pile
- The interior, confined grout column is pure grout and can be calculated as such
- The exterior grout column is dependably created due to:
  - The ‘screw pump’ action of the reverse auger driving the grout down at 3 times the pile installation rate.
  - The increase in hydraulic pressure of the grout column as the overburden pressures of the soil and water increase.

The STELCOR Drilled-In Displacement Micropile has been likened to an ‘epoxied screw.’
Exhumed STELCOR in loose granular soil below: