DRILLED-IN DISPLACEMENT MICROPILE (DDM) DESIGN GUIDELINES

STRUCTURAL CAPACITY:

Design using the structural capacity of the full-length steel tube and the predictable interior, confined grout column (Refer to table 1).

> NOTE: The exterior grout column is somewhat variable in different soil types. Therefore, we recommend the conservative approach of excluding the exterior grout column in the structural design for axial loads. 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. When working with highly plastic soils, consultation with the Ideal design team is recommended. These soils may require special design consideration and alternate pile fabrication.

GEOTECHNICAL CAPACITY:

Design DDM’s as a displacement pile using the diameter of the deformation, not the displacement, for the bond. The area of the drive plate may also be used for end bearing capacity as is appropriate for the particular application. 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.

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 their geotechnical capacity or to determine the pile’s ultimate geotechnical capacity. As in all pile types, the load test establishes the depths, grout take, and capacity for production piles in the job specific soil. Depth and grout take prediction is useful but is superseded by information gained by the test pile program. It has been consistently 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 is approximately two times the viscosity of water, no alteration of STELCOR design or installation is required when being used below water table.

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 kept consistent through
    - The action of the reverse auger which acts a ‘screw pump’ driving the grout down at 3 times the installation rate.
    - The hydraulic pressures of the grout column increase as the overburden pressures of the water and soil increase.

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

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)	STRUCTURAL TEST LOAD (KIPS)
11	6.61	3.50	0.300	16,000	124	211
12	17.93	5.50	0.361	38,000	248	422
12	16.25	5.50	0.476	60,000	308	525
14	17.93	5.50	0.361	38,000	248	422
14	16.25	5.50	0.476	60,000	308	525
16	17.93	5.50	0.361	38,000	248	422
16	16.25	5.50	0.476	60,000	308	525
16	30.04	7.00	0.408	70,000	366	622
16	28.31	7.00	0.498	120,000	428	728

NOTES:

1. Structural capacities displayed above are based on micropile manual -(per manual, do not include the exterior, or surrounding, grout column). Capacities are calculated using the 80ksi steel shaft with internal 4 ksi grout.
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. (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	11	8	12	20,000	15+
12	5.50	12	9	14	50,000	25+
12	5.50	12	9	14	70,000	35+
14	5.50	14	11	16	50,000	25+
14	5.50	14	11	16	70,000	35+
16	5.50	16	13	18	50,000	20+
16	5.50	16	13	18	70,000	25+
16	7.00	16	13	18	80,000	35+
16	7.00	16	13	18	130,000	50+

NOTES:
1. Design using the Grout O.D. 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.