Evaluation Report CCMC 13556-R
Foundation Supportworks® Helical Foundation Systems and Devices

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1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that "Foundation Supportworks® Helical Foundation Systems and Devices," when used as an auger-installed steel pile in a foundation system in accordance with the conditions and limitations stated in Section 3 of this Report, complies with the National Building Code (NBC) of Canada 2015:

- Clause 1.2.1.1.(1)(a) ofDivision A, using the following acceptable solutions from Division B:
  - Clause 4.2.3.8.(1)(e), Steel Piles
  - Sentence 4.2.3.10.(1), Corrosion of Steel
  - Sentence 4.2.4.1.(1), Design Basis
  - Subclause 9.4.1.1.(1)(c)(i), General (Structural Requirements)

This opinion is based on CCMC's evaluation of the technical evidence in Section 4 provided by the Report Holder.

Ruling No. 12-05-275 (13556-R), authorizing the use of this product in Ontario, subject to the terms and conditions contained in the Ruling, was made by the Minister of Municipal Affairs and Housing on 2012-05-17 pursuant to s.29 of the *Building Code Act*, 1992 (see Ruling for terms and conditions). This Ruling is subject to periodic revisions and updates.

2. Description

The shaft is manufactured into lead sections with helical plates and extension sections either with helical plates (helical extension) or without helical plates (plain extension). Lead sections are available in lengths of 1 524 mm, 2 134 mm or 3 048 mm and extension sections are available in net lengths of 762 mm, 1 372 mm, 1 981 mm or 2 896 mm. The leads and extensions are connected together with a welded coupling and two bolts. One or more blades, up to a maximum of four blades, can be used for the lead sections. The coupling compression capacity is designed for end-to-end contact of the shaft sections. The helical pile central shaft consists of a pipe with an outside diameter of 73 mm and a 7.0-mm wall. The welded coupling consists of a tube with an outside diameter of 89 mm and a 7.1-mm wall thickness. The pile sections are coupled together with two 19.1-mm diameter bolts and nuts. The bolts and nuts are zinc coated in accordance with ASTM A 153/A 153M-09, "Zinc Coating (Hot-Dip) on Iron and Steel Hardware."

The helical plates are cut into a circular shape from 9.4-mm-thick steel plates and are formed into a true helix shape with outer diameters of 203 mm, 254 mm, 305 mm or 356 mm and are welded to the shaft lead and extension sections. Figure 1 shows a diagram of the product.

The steel shaft, blades and accessories for the product conform to CSA G40.21-04(R2009), "Structural Quality Steel," while their galvanic coating with a minimum thickness of 610g/m^2 that meets the requirements of CAN/CSA-G164-M92(R2003) , "Hot Dip Galvanizing of Irregularly Shaped Articles."

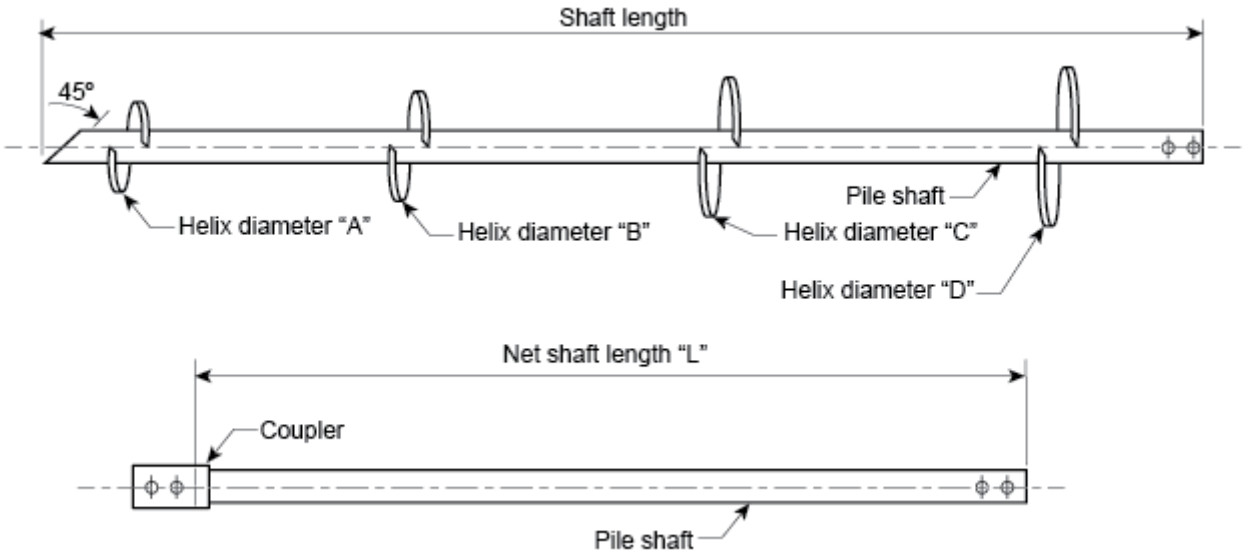

Figure 1. General diagram of the product

3. Conditions and Limitations

CCMC's compliance opinion in Section 1 is bound by the "Foundation Supportworks® Helical Foundation Systems and Devices" being used in accordance with the conditions and limitations set out below.

- The product may be used as a foundation system to support various constructions, provided that it is installed according to the manufacturer's current instructions and within the scope of this Evaluation Report.
- When the product is installed in undisturbed or uniformly placed and well-engineered fill soils there is a direct relationship between the applied torque and the allowable compressive and tensile load. Table 3.1 indicates the allowable compressive and tensile loads as a function of the applied torque. Note: For additional information and system capacity tables, refer to Foundation Supportworks® Technical Manual dated July 2014.
- When the auger-installed steel pile is installed in bedrock, the relationship between the applied torque and the allowable compressive and tensile load is not predictable. As a result, the allowable compressive and tensile loads have to be confirmed by on-site load tests. These load tests are also required if the allowable loads need to be greater than those stated in Table 3.1. The tests must be conducted under the direct supervision of a professional geotechnical engineer skilled in such design and licensed to practice under the appropriate provincial or territorial legislation.
- In all cases, a registered professional engineer skilled in such design and licensed to practice under the appropriate provincial or territorial legislation must determine the number and spacing of the auger-installed steel piles required to carry the load. A certificate attesting to the conformity of the installation and the allowable loads for the piles must be provided.
- The installation of the auger-installed steel pile must be carried out as per the manufacturer's instructions. The anchors must be screwed into the ground using mechanized equipment. The anchor must be rotated into the ground with sufficient pressure applied downward (crowd) to advance the anchor one pitch distance per revolution. The anchor must be advanced until the applied torque value attains a specified value. Extensions must be added to the central shaft as needed. The applied loads may be tensile (uplift) or compressive (bearing). They are immediately ready for loading after installation.
- When the product is installed in a soil where the conditions are corrosive to steel, adequate protection to the exposed steel must be provided.
- To be permitted to install auger-installed steel piles for the product, the installer must be certified by Foundation Supportworks®. Using approved equipment, the installer must meet the uses and limitations specified in this Report. Each installer must carry a manufacturer approved card bearing their signature and photograph.
- Each auger-installed steel pile for the product must be identified with a label containing the following information: manufacturer's identification and the phrase "CCMC 13556-R."

Table 3.1 Allowable Compressive and Tensile Loads for the Product[(1)]

Applied Torque		Torque Correlated Allowable Soil Capacity			
		Compression		Tension	
N-m	(lbf-ft)	kN	(lb)	kN	(lb)
678	500	10	2 250	10	2 250
1 356	1 000	20	4 500	20	4 500
2 034	1 500	30	6 750	30	6 750
2 712	2 000	40	9 000	40	9 000
3 390	2 500	50	11 250	50	11 250
4 067	3 000	60	13 500	60	13 500
4 745	3 500	70	15 750	70	15 750
5 423	4 000	80	18 000	80	18 000
6 101	4 500	90	20 250	90	20 250
6 779	5 000	100	22 500	100	22 500
7 457	5 500	110	24 750	110	24 750
8 135	6 000	120	27 000	120	27 000
8 813	6 500	130	29 250	130	29 250
9 491	7 000	140	31 500	140	31 500
10 169	7 500	150	33 750	150	33 750
10 711	7 900	158	35 550	158	35 550

Note to Table 3.1:

(1) The allowable loads identified in this Table are only valid when the product is installed in undisturbed or uniformly placed and well-engineered fill soils. Special attention is required when the auger-installed steel piles are installed in recently backfilled sites or in bedrock soils. In these cases, Table 3.1 does not apply and the allowable loads must be determined by on-site confirmatory testing.

4. Technical Evidence

The Report Holder has submitted technical documentation for CCMC's evaluation. Testing was conducted at laboratories recognized by CCMC. The corresponding technical evidence for this product is summarized below.

4.1 Performance Requirements

The product's auger-installed steel piles were tested in accordance with ASTM D 1143/D 1143M-07e1, "Standard Test Methods for Deep Foundations Under Static Axial Compressive Load," and ASTM D 3689-07, "Standard Test Methods for Deep Foundations Under Static Axial Tensile Load." Testing was conducted on two different sites: the first had bedrock and clay soil and the second had only bedrock and sand soil. A series of 16 tests were performed at the two sites, 8 tension tests and 8 compression tests. The intent of the testing was to determine a correlation between the torque applied during installation and the allowable loads.

In both cases (compression and tension), the load tests for test piles founded in bedrock did not always provide adequate correlation to the actual maximum capacities for piles installed in bedrock. Based on this result, correlation should only be applied to piles installed in undisturbed soils or uniformly placed and well-engineered fill soils. The correlation may not be applicable in uncontrolled fill situations. In such conditions it will be necessary to perform load tests to determine the capacity of the piles.

The correlation between the torque applied during installation and the allowable loads for compressive and tensile loads is noted in Table 3.1. The factor of safety used was 2.0.

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