CONSTRUCTION

Evaluation Report CCMC 13675-R
HELICAL PILE

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1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that "HELICAL PILE", when used as an augered 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 2010:

- Clause 1.2.1.1.(1)(a), Division 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.

2. Description

The product is an earth anchor constructed of helical-shaped circular steel blades that are welded to a steel shaft. The blades are constructed as a helix with a carefully controlled pitch.

The anchors come in four types: Type 1, 2, 3 and 4. The Type 1 anchor has an outside diameter of 48 mm and a wall thickness of 3.9 mm. The helix blade has a diameter of 203 mm with a thickness of 9.5 mm. The Type 2 anchor has an outside diameter of 60 mm and a wall thickness of 3.9 mm. The helix blades are available with diameters of 228 mm, 279 mm or 330 mm, and a thickness of 9.5 mm. The Type 3 anchor has an outside diameter of 73 mm and a wall thickness of 6.3 mm. The helix blades are available with a diameter of 279 mm or 330 mm, and a thickness of 9.5 mm. The Type 4 anchor has an outside diameter of 89 mm and a wall thickness of 6.3 mm. The helix blades are the same as those with the Type 3 anchor. All types come with a single blade.

The anchor type and blade diameter are chosen based on the bearing capacity of the soil and the load the auger-installed steel pile is designed to support. The central shaft is used to transmit torque during installation and to transfer axial loads to the helical plates. The central shaft also provides most of the resistance to lateral loading. The foundation system comes with various other accessories, such as support plates to adapt to the building structure, extension shafts and connectors.

The steel shaft, blades and accessories conform to CSA G40.20-13/G40.21-13, "General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel," 260 MPa. They have a galvanic coating that meets the requirements of ASTM A123/A123M-13, "Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products," 610 g/m^3.

Figure 1 shows a typical steel pile with a single helical blade.

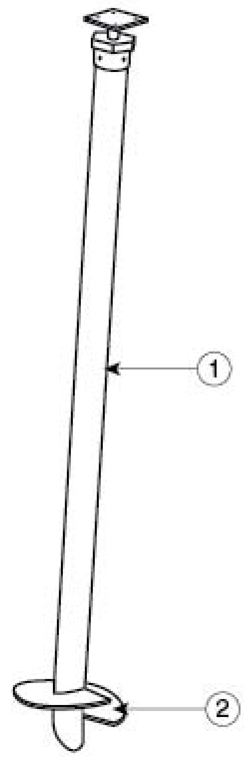

Figure 1. “HELICAL PILE”

1. **Strut**
2. **Helical blade**

3. Conditions and Limitations

CCMC's compliance opinion in Section 1 is bound by the “HELICAL PILE” being used in accordance with the conditions and limitations set out below.

- The product may be used as part of 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 Report.
- When the product is installed in granular soil or silt, there is a direct relationship between the applied torque and the allowable compressive and tensile loads. Table 1 indicates the allowable compressive and tensile loads as a function of the applied torque.
- When the auger-installed steel pile is installed in a cohesive soil, such as clay or a soil with granular material that exceeds 200 mm in diameter, the relationship between the applied torque and the allowable compressive and tensile loads is not as predictable. When it is installed in such soils, 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 1. The tests need to 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.

Table 1. Allowable Compressive and Tensile Loads for the Proposed Auger-installed Pile in Granular Soil or Silt[1]

Applied Torque		Allowable Loads			
		Compression		Tension	
Nm	(lbf)	kN	(lb)	kN	(lb)
678	500	20	4 500	12	2 700
1 017	750	23	5 175	15	3 375
1 356	1 000	27	6 075	18	4 050
1 695	1 250	30	6 750	20	4 500
2 034	1 500	33	7 425	23	5 175
2 373	1 750	37	8 325	26	5 850
2 712	2 000	40	9 000	29	6 525
3 051	2 250	44	9 900	32	7 200
3 390	2 500	47	10 575	34	7 650
3 728	2 750	51	11 475	37	8 325
4 067	3 000	54	12 150	40	9 000
4 406	3 250	57	12 825	42	9 450
4 745	3 500	61	13 725	45	10 125
5 084	3 750	64	14 400	48	10 800
5 423	4 000	68	15 300	51	11 475
5 762	4 250	71	15 975	54	12 150
6 101	4 500	74	16 650	57	12 825
6 440	4 750	78	17 550	59	13 275
6 779	5 000	81	18 225	62	13 950
7 457	5 500	88	19 800	67	15 075
8 135	6 000	95	21 375	72	16 200

Note to Table 1:

[1] The allowable loads identified in this table are only valid when the product is installed in granular soil or silt. The applied torque is the average of the values attained within the last 600 mm of installation. Special attention is required when the auger-installed steel piles are installed in a recently backfilled site or where the granular material exceeds 200 mm in diameter or in cohesive soils. In these cases, Table 1 does not apply and the allowable loads need to be determined by on-site confirmatory testing.

- 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 to below the frost line using mechanized equipment. The anchor is rotated into the ground with sufficient applied downward pressure (crowd) to advance the anchor one pitch distance per revolution. The anchor is advanced until the applied torque value attains a specified value. Extensions are added to the central shaft as needed. The applied loads may be tensile (uplift), compressive (bearing), shear (lateral), or a combination thereof. Helical anchors are rapidly installed in a wide variety of soil formations using a variety of readily available equipment. 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.
- The installer of the proposed auger-installed steel piles must be certified by GoliathTech Inc. Using approved equipment, the installer must follow the manufacturer's installation instructions and the uses and limitations specified in this Report. Each installer shall carry a certification card bearing their signature and photograph.
- Each auger-installed steel pile must be identified with a label containing the following information:
  - manufacturer's identification; and
  - the phrase "CCMC 13675-R."

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 proposed auger-installed steel piles were tested to ASTM D 1143/D 1143M-07(2013), "Standard Test Methods for Deep Foundations Under Static Axial Compressive Load," ASTM D 3689/D 3689M-07(2013)e1, "Standard Test Methods for Deep Foundations Under Static Axial Tensile Load," and ASTM D 3966/D 3966M-07(2013)e1, "Standard Test Methods for Deep Foundations Under Lateral Load."

Testing was conducted on a site with granular soil. A series of 32 tests were performed. The intent of the testing was to determine a correlation between the torque applied during installation and the allowable loads. In the granular and silt-based soil there was a good correlation between the torque applied during installation and the allowable loads. For the compressive loads noted in Table 1, the factor of safety varied from 2.0 to 3.0. For the tensile loads, the factor of safety varied from 2.0 to 2.7. For the lateral loads, no correlation was possible. For a cohesive soil, such as clay, the correlation between the applied torque and the allowable loads was not as predictable.

Report Holder

GoliathTech Inc.
1350 Boulevard Industriel
Magog, QC J1X 5R9

Telephone: 819-847-4777

Email: info@goliathtechpiles.com

Web: www.goliathtechpiles.com

Plant(s)

Magog, QC

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