Evaluation Report CCMC 13608-R
Pro Post Foundation Screw Piles

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1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that "Pro Post Foundation Screw Piles," 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 (NBC) of Canada 2015:

- 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 the CCMC evaluation of the technical evidence in Section 4 provided by the Report Holder.

Ruling No. 14-17-313 (13608-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 2014-10-27 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 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.

Table 2.1 "Pro Post Foundation Screw Piles" Physical Characteristics

Outside Diameter of Anchor	Wall Thickness of Anchor	Diameter of Helix Blade	Thickness of Helix Blade
48 mm	3.7 mm	200 mm	8 mm
		250 mm	
60 mm	3.9 mm	200 mm	8 mm, 9.5 mm or 12.7 mm
		250 mm	
		300 mm	
		350 mm	
		400 mm	
		450 mm	
		500 mm	
		600 mm	

Table 2.1 "Pro Post Foundation Screw Piles" Physical Characteristics (cont.)

Outside Diameter of Anchor	Wall Thickness of Anchor	Diameter of Helix Blade	Thickness of Helix Blade
73 mm	4.8 mm	250 mm	8 mm, 9.5 mm or 12.7 mm
		300 mm	
		350 mm	
		400 mm	
		450 mm	
		500 mm	
		600 mm	
		750 mm	
89 mm	5.5 mm	250 mm	8 mm, 9.5 mm or 12.7 mm
		300 mm	
		350 mm	
		400 mm	
		450 mm	
		500 mm	
		600 mm	
		750 mm	
		900 mm	
101 mm	5.7 mm	300 mm	8 mm, 9.5 mm or 12.7 mm
		350 mm	
		400 mm	
		450 mm	
		500 mm	
		600 mm	
		750 mm	
		900 mm	
114 mm	6.0 mm	300 mm	8 mm, 9.5 mm or 12.7 mm
		350 mm	
		400 mm	
		450 mm	
		500 mm	
		600 mm	
		750 mm	
		900 mm	
141 mm	6.6 mm	350 mm	9.5 mm or 12.7 mm
		400 mm	
		450 mm	
		500 mm	
		600 mm	
		750 mm	
		900 mm	
168 mm	7.1 mm	350 mm	9.5 mm or 12.7 mm
		400 mm	
		450 mm	
		500 mm	
		600 mm	
		750 mm	
		900 mm	

The choice of anchor type and blade diameter is 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 several 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 G40.21-13, "General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel," 330 MPa. They have a galvanic coating that meets the requirements of CAN/CSA-G164-M92 (R2003), "Hot Dip Galvanizing of Irregularly Shaped Articles," 610 g/m^2.

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

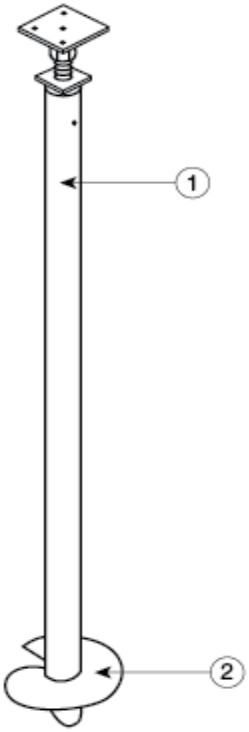

Figure 1. "Pro Post Foundation Screw Piles"

1. **shaft**
2. **helical blade**

3. Conditions and Limitations

The CCMC compliance opinion in Section 1 is bound by "Pro Post Foundation Screw Piles" 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 structures and must be installed according to the manufacturer's current instructions.
- The structural application of this product must be in strict accordance with the design analyses prepared for Pro-Pieux Inc.by Labo S.M. Inc. and included in Reports No./Ref. F129038-001 and No./Ref. F1626403-001, which are dated May 2013 and March 2017, respectively. Table 4.1 is reproduced from No./Ref. F129038-001 and Table 4.2 is reproduced from No./Ref. F1626403-001.
- When the product is installed in granular soil, silt, cohesive soil, such as clay, or in soil with granular material that does not exceed 200 mm in diameter, there is a direct relationship between the applied torque and the allowable compressive and tensile loads. Table 4.1 indicates the allowable compressive and tensile loads for granular soil and silt as a function of the applied torque and Table 4.2 indicates the same for cohesive soil.
- When the product is installed in a cohesive soil 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 must be confirmed by on-site load tests. These load tests are also required if the allowable loads are to be greater than those stated in Tables 4.1 or 4.2. 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 product required to carry all the loads. A certificate attesting to the conformity of the installation and the allowable loads for the product must be provided by a certified installer.

  Following the manufacturer's instructions, the anchors must be screwed into the ground to below the frost line using mechanized equipment. The anchor is to be rotated into the ground with sufficient applied downward pressure (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 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.
- Where conditions (soil and environmental) are determined to be corrosive to steel, protection of the steel shall be provided. The determination of the presence of corrosive conditions and the specification of the corrosion protection shall be carried out by a registered professional engineer licensed to practice under the appropriate provincial or territorial legislation". If the determination of the presence of corrosive conditions is not completed before installation, the product, including all its accessories, is required to be hot-dipped galvanized meeting the requirements of CAN/CSA-G164 (ASTM A123/A123M-17) with a minimum thickness of 610 g/m^2, or another method that provides an equivalent level of protection and abrasion resistance deemed acceptable by CCMC

- The installer of the proposed product must be certified by Pro Pieux Inc., use approved equipment, follow the manufacturer's installation instructions and respect the conditions and limitations specified in this Report. Each installer must carry a certification card bearing their signature and photograph.
- Each auger-installed steel pile must be identified with a label that contains the manufacturer's identification and the phrase "CCMC 13608-R."

4. Technical Evidence

The Report Holder has submitted technical documentation for the CCMC 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 in accordance with the requirements of ASTM D 1143/D 1143M-07, "Standard Test Methods for Deep Foundations Under Static Axial Compressive Load," ASTM D 3689/D 3689M-07, "Standard Test Methods for Deep Foundations Under Static Axial Tensile Load," and ASTM D 3966/D 3966M-07, "Standard Test Methods for Deep Foundations Under Lateral Load."

Testing was conducted at four different sites. Two sites had granular soil and two sites had clay soil. A series of 30 tests was performed. The intent of the testing was to determine a correlation between the torque applied during installation and the allowable loads. For testing conducted in granular and silt-based soils, there was a good correlation between the torque applied during installation and the allowable loads; the compressive and tensile loads are noted in Table 4.1; the factor of safety varied from 2.0 to 2.5. For testing conducted in cohesive soil (such as clay), there was a good correlation between the torque applied during installation and the allowable loads; the compressive and tensile loads are noted in Table 4.2; the factor of safety was 2.0. For lateral loads in each soil condition, no correlation was possible.

Table 4.1 Allowable Compressive and Tensile Loads[(1)] for the Proposed Auger-Installed Pile in Granular Soil[(2)] or Silt[(3)]

Applied Torque		Allowable Load[(4)]			
		Compression		Tension	
N·m	(lbf)	kN	(lb)	kN	(lb)
678	500	16	3 600	10	2 250
1 017	750	22	4 950	15	3 375
1 356	1 000	28	6 300	20	4 500
1 695	1 250	34	7 650	25	5 625
2 034	1 500	40	9 000	30	6 750
2 373	1 750	46	10 350	35	7 875
2 712	2 000	52	11 700	38	8 550
3 051	2 250	58	13 050	40	9 000
3 390	2 500	64	14 400	42	9 450

Notes to Table 4.1:

(1) These allowable loads are only valid when the product is installed in granular soil or silt. Special attention is required when the auger-installed steel piles are installed in a recently backfilled site, where the granular material exceeds 200 mm in diameter or in cohesive soils. In these cases, Table 4.1 does not apply and the allowable loads need to be determined by on-site confirmatory testing.

(2) Granular soils (coarse-grained soil) are non-cohesive soils (e.g., sand, gravel or silt with little or no clay content and little to no cohesive strength).

(3) Silt is that portion of soil material passing through a No. 200 (75-µm) U.S. standard sieve that is non-plastic or very slightly plastic and exhibits little or no strength when air-dried.

(4) The load values in this table include a minimum safety factor of 2.0.

Table 4.2 Allowable Compressive and Tensile Loads for the Proposed Auger-Installed Pile in Cohesive Soil[1]

Applied Torque		Allowable Load[2]			
		Compression[3]		Tension[4]	
N·m	(lbf)	kN	(lb)	kN	(lb)
678	500	9	2 025	3	675
1 017	750	15	3 375	8	1 800
1 356	1 000	21	4 725	12	2 700
1 695	1 250	27	6 075	16	3 600
2 034	1 500	32	7 200	20	4 500
2 373	1 750	38	8 550	25	5 625
2 712	2 000	44	9 900	29	6 525
3 051	2 250	50	11 250	33	7 425
3 390	2 500	55	12 375	37	8 325

Notes to Table 4.2:

(1) These allowable loads are valid only when the pile is installed in a cohesive (clay) soil. Always check the nature of the soils in place before using this table.
(2) If the granular material exceeds 200 mm in diameter, the permissible load capacity listed above will be an overestimate. Table 4.2 does not apply in such a case and the allowable loads need to be determined by on-site confirmatory testing.
(3) The load values in this table include a minimum safety factor of 2.0.
(4) The tightening torque corresponds to the torque measured on the manometer when screwing the last centimeters of the pile.
(5) The tightening torque corresponds to the average measured on the gauge when screwing the last 50 cm of the pile.

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