2022 Footprint Engineering Inc.

FeCMPile FePatent RSS QA and Details

Key Footprint Engineering Contacts:

Martin Halliwell - President

Email: martinh@footprintengineering.ca (c): (519)-240-6334

Robert Topham - Vice President of Engineering robertt@footprintengineering.ca (c):

(902)-629-5830

Sarah Taylor - Vice President of Administration saraht@footprintengineering.ca (c):

(905)-483-6497

Section 1.0: FeCMPile (M.H. Rating 8/10 Very Good Revenue Potential)

The Footprint Engineering Combined Modulus Pile (FeCMPile) is a method of forming an elongated support column in the ground. Specifically, our method comprises of drilling a hole of a predetermined depth and diameter.

The bottom of the drilled hole is then filled with 3 to 8 feet of gravel. A hollow driving tube with several pre-cut holes at the bottom near a welded end cap is then used to compress the ground below the gravel as it is inserted into the drilled hole with the gravel below the column to secure the driving tube in place. Essentially, the base and shaft friction are mobilized together in “drill open soil” conditions. Once the driving tube is secured in place and plumbed, liquid concrete is then poured into the top end of the driving tube. The concrete that accumulates at the bottom end of the driving tube then passes through the radial apertures onto exposed gravel and into a space between a wall of the drilled hole and the exterior wall of the driving tube.

This then unifies the driving tube and gravel, thus allowing it to be considered as a single entity which is friction fit into the hole. As such, the pile is robust to pull-out, and superior in down load resistance as greater shearing forces at the hole/pile, and pipe/gravel interfaces combine to move as one combined modulus unit. This then ensures that capacities in the range of 100-250 tons are achieved.

Section 1.1: FeCMPile RSS

The recommended procedure for the implementation and forming of an elongated support column in the ground, otherwise known as the FeCMPile is outlined below.

1-Drilling

First, a hole that is 2 feet plus the pipe diameter (12-18 inches) is to be drilled into dry ground. The extra 2 feet is so that gravel can be inserted into the hole so that, when tapped and compressed, the gravel will secure the pipe in place and have it plumb (correctly oriented) as it's forced against the walls and bottom of the hole as the pipe is inserted.

2-Clean Hole

Using auger set to high rpm spinning, clean the bottom of the hole.

3-Hole Filling

With pipe pre-prepared and hole drilled, fill hole with 3-6 feet of self-compacting gravel.

4-Preparing Pipe

Before placing the 12-18 inch (with 0.3-0.5 inch wall thickness) pipe in the ground the following must be done:

4-1. Using a cutting torch, cut 3-5 round holes into the pipe near the bottom 8-12 inches of the pipe. These holes are cut to allow for the slump (wet concrete) to be poured into the unit. Depending upon the length of the pipe, and environmental considerations, holes can be cut all the length up the pipe.

4-2. Weld flat plate end cap (14-20 inch diameter range) to bottom of the pipe.

5-Placing Pipe in Ground:

5-1. Secure pre-prepared (holes cut, end cap welded on) pipe to crane to lower it into the hole.

5-2. Using the crane, and the end cap+pipe weight, tap the pipe into the gravel, allowing it to go about 2 feet into the hole with each tap and ensuring it remains properly oriented each tap. Repeat until the pipe is securely in place, with the gravel being tightly packed against the walls and bottom of the hole. Level out the pipe and plumb it. It is recommended that wooden wedges be used to to fix the top of the unit in place.

6-Concrete Mixing

With the pipe secured in place, using concrete mix selected by the project engineer, mix dry components of the concrete mix in the back of a concrete mixing truck, and pour in liquid constituents that have been mixed separately until desired concrete composition is achieved. Though the concrete mixture is up to the discretion of the on-site engineer, we recommend using a 30 MPa (megapascal) concrete mix.

7-Tremi

Once the pipe is securely in place in the hole and plumbed, the pipe can be released from the crane. Once the pipe has been released from the crane, back mixing truck up to pipe with desired concrete

mixture such that slump (wet concrete) can be poured directly into the top of the pipe. For this step, we recommend pouring in 6 inches of a wet 30 MPa (megapascal) concrete mix though the amount, and concrete mixture are up to the engineer overseeing the project. When pouring the slump (wet concrete) into the pipe, ensure that minimal to no contact is made between the hole walls and concrete mix and it is recommended that manual shoveling be used to divert any of the slump (wet concrete) that makes contact, or appears as though it will make contact with the walls of the hole.

8-Soil

Once concrete has been poured to the desired level in the pipe, allow for concrete to dry. Once the concrete has dried, it is recommended that two load tests be performed, using a hydraulic jack, to gauge how secure the pipe is in the hole through the friction fitting with the pipe relative to the compacted gravel, and the compacted gravel relative to the walls of the hole. The following procedure is recommended to determine the loading values to use for the two tests:

1. Calculate perimeter area of the shaft from bottom of gravel to top of the concrete (since this area should be circular, the area should be calculated according to Area = pi x radius^2)

2. Determine the anticipated live, and dead loads (this will be determined by the project engineer). Here, we recommend that the dead loads be determined according to:

A) For installations in engineered fills: Dead Load = 500 pounds/square foot x Combined Shaft Area (measured in square feet)

B) For installations in native soils: Dead Load = 1500 pounds/square foot x Combined Shaft Area (measured in square feet)

3. With the live and dead loads and area now determined, test load the combined shaft (pipe, concrete, gravel embedded in hole) for the live, and dead load cases according to:

A) Live Load Test: Load = Live Load Value x 1.5

B) Dead Load Test = Dead Load Value x 1.3

Section 1.2: FeCMPile CAD Illustrations

A sketch depicting a typical FeCMPile unit can be seen below.