Hollow Piles

Foundations are routinely overlooked when designers take sustainability into consideration during construction. However, Balfour Beatty Ground Engineering are looking at changing this and have joined forces with City University to develop Hollow Piles.

KEY DETAILS

DEVELOPED BY

City University in conjunction with Balfour Beatty Ground Engineering.

BASIC CONCEPT

Central section of pile is hollow, but outside diameter and length remain the same.

UNIQUE SELLING POINT

Increased sustainability due to a reduction in the amount of concrete required and their reusable nature.

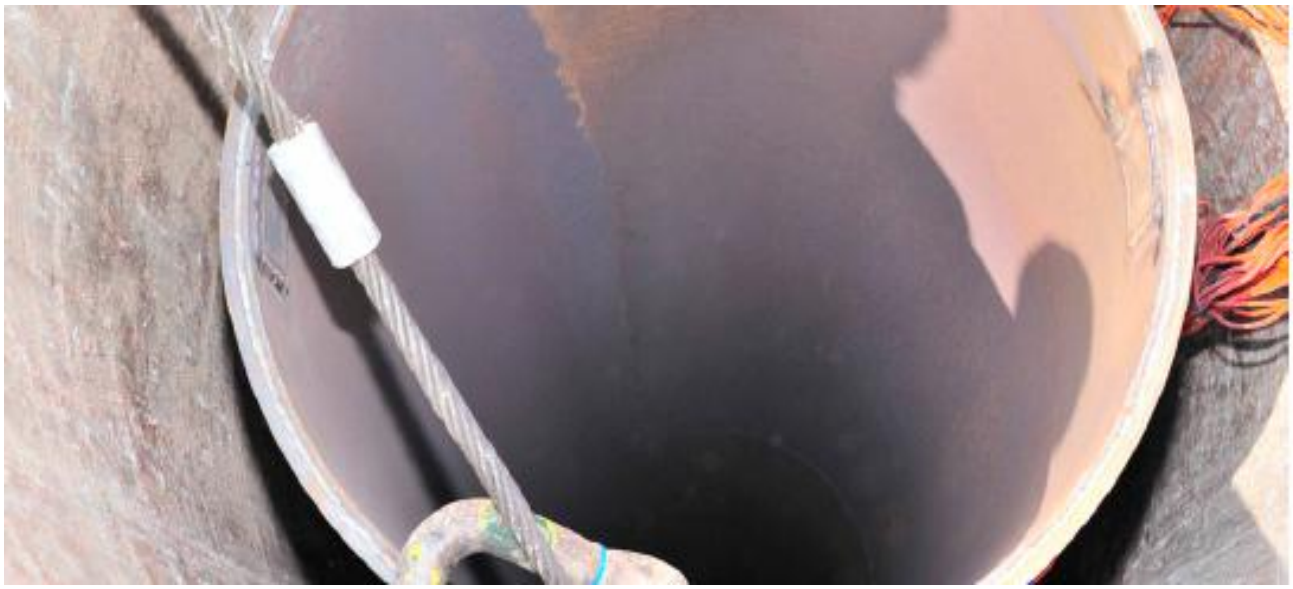
INTRODUCTION

It was evident to Balfour Beatty Ground Engineering (BBGE) that its main contributor to carbon output was concrete and therefore any way to reduce the amount used would be of benefit to individual schemes, and of course the environment.

BBGE approached its long term collaborator City University which developed the concept of the City SuRe Pile ™ (Sustainable / Reusable), a hollow pile. The concept is simple, the size and shape of the pile remain the same, but the central section is hollow.

Not only would creating a hollow pile have advantages on the concrete savings but there are also other advantages.

> “By having a void, in the future, the pile can be opened up and inspected should the site be redeveloped. Also the void could be adapted for other uses such as rainwater storage or to create some form of geothermal pile connected to a ground source heat pump.”



CONSTRUCTION PROCESS

The process starts out in the same way as a solid pile with a temporary casing sunk through the upper layers of unstable ground into the clay below. The casing is then drilled out to the required depth. Once this is complete a steel tube is dropped down into the hole to create the void at the centre of the pile and a 1m-deep plug of concrete is placed at the foot to provide the pile's end-bearing capacity.

Concrete is then carefully poured in the void between the steel tube and surrounding earth using a specially fabricated tremmie; this approach was used to ensure the concrete completely filled the narrow void. Once this is complete a specially designed pile cap is cast in order to distribute the load into the hollow section.

Currently the inner tube remains in place once the concrete has set, however, future developments may allow for this tube to be removed with the concrete having further reinforcement.

PERFORMANCE

Testing was carried out on a 1200mm diameter solid pile and a 1200mm diameter hollow pile that had an 800mm diameter central void. The test results came out in the hollow pile's favour. Under the design load of 4500kN the settlement of the solid pile was 3.9mm compared to 4.3mm for the hollow pile, well within the tolerances.

As the loads increased the hollow pile outperformed the solid version. At 1.5 times the working load the solid pile sunk 11.9mm compared to 8.5mm for the hollow version, and when tested to failure the ultimate load carried by the hollow pile was 9,000kN, about 1,150kN higher than the solid pile.

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