

BRIDGE TECHNICAL DIRECTION BTD2011/02

USE OF CFA PILES ON BRIDGES

Background

Continuous Flight Auger (CFA) piles are constructed by screwing a hollow stem continuous flight auger into the ground and then pumping concrete into the ground as the auger is withdrawn. A reinforcement cage is then inserted into the wet concrete.

The RTA has permitted the use of CFA piles on a limited basis as set out in BPC 2004/05.

RTA QA Specification B63 covers the construction of CFA piles.

In recent years there have been considerable improvements in the capability of CFA piling rigs, piling instrumentation and concrete mixes suitable for CFA piles.

Information

Following a trial of CFA piling carried out on the Tarcutta Hume Alliance a review of the conditions and limitations of use of CFA has been carried out and are set out below.

It is intended that RTA QA Specification B63 will be revised in the future to incorporate the construction requirements specified below.

CFA piles can be constructed with a maximum diameter of 1200mm.

Bridge Technical Direction

This Bridge Technical Direction replaces BPC 2004/05, which is withdrawn.

The scope of this Bridge Technical Direction shall apply to the pile foundations of bridges. It does not apply to soil supporting structures including retaining walls.

CFA piles can be founded in cohesive and non-cohesive soils and rock.

CFA piles are suitable for uniform soil profiles, cohesive soil formations, and cohesive soil formations overlaying granular soil formations and granular soil formations where the soil density index of the soil layers generally increases with depth.

CFA piles are not suitable for use in complex soil profiles with cohesive soil formations inter-bedded with granular soil layers and with hard layers overlying soft layers. This is because the relative small penetration of the auger per revolution can result in excessive "draw-in" of surrounding granular material causing contamination of the concrete.

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The length of socket into rock that can be achieved is dependent on the torque of the piling rig, the strength of the rock and the nature of the overlying soils. Reasonable socket length can be achieved in very low to medium strength rock ($UCS < 10\text{MPa}$) overlain by cohesive soils. However, only a short rock socket will be possible where medium to high strength rock is overlain by granular soils due to the risk of excessive draw-in. A trial pile installation will be required to demonstrate construction suitability in marginal ground conditions.

In addition to ensuring suitable geological/ geotechnical conditions the following limitations of use and construction details for CFA piles shall apply:

1. The length of the pile from the top of pile at installation to the toe of the pile shall not exceed the limit of a single continuous auger with no breaking or unscrewing of the auger permitted and with reinforcement to be provided over the full length of the pile.
2. CFA piles shall only be installed vertical and shall not be used as end bearing piles, where the toe of the pile is located on the top of bedrock with a slope steeper than 1 vertical to 4 horizontal.
3. The designer shall specify a minimum of one geotechnical borehole at a pile location in each pile group supporting each Pier Column or Abutment. Additional bore holes shall be specified at each pile group if the distance from the borehole to the pile exceeds 4 m. The bore holes shall be drilled prior to the construction of CFA piles with adequate laboratory and/or in-situ testing for geotechnical parameter determination. Additional geotechnical boreholes shall be specified where the ground conditions are complex. All of these boreholes shall be cement grouted upon completion.
4. To ensure the workability of the concrete to allow the reinforcement cage to be inserted, CFA piles shall only be used at sites where an uninterrupted supply of concrete can be ensured for each pile and where travel time of the concrete agitator to site is less than 45 minutes after adding cement to the aggregates and discharge of the concrete into the pile is completed within 90 minutes of adding cement to the aggregates. The reinforcement cage shall be inserted immediately after concreting.
5. The minimum nominal cover to the reinforcement shall be 100 mm but the cover spacers provided on the reinforcement cage shall be 25 mm less than the nominal cover to facilitate insertion of the cage. For durability purposes the cover shall be taken to be the nominal cover minus 25mm.
6. A suitably experienced Geotechnical Engineer representing the design consultant is required to be present during the construction of the first CFA pile group for each representative geological condition.
7. A copy of the monitoring records of the parameters specified in Specification B63 shall be made available to the Geotechnical Engineer within 24 hours of the completion of the pile, where mobile phone reception is available at the site and within 48 hours otherwise. Apart from the automatic depth reported in the records, the drilling frame shall be marked clearly at half metre intervals for independent visual verification.
8. The amount of required concrete over-supply during concreting shall be determined prior to any contract pile installation and appropriate to the ground conditions. The target value shall be calculated so that the tip or toe of the auger always remains encased within the concrete.
9. All piles shall be integrity tested and representative piles that are founded in low or less strength rock shall be load tested at the frequency nominated in BTD 2010/05.
10. The concrete volume reported by the piling instrumentation shall be checked against the volume of concrete delivered to the pump to confirm the calibration factor for the concrete supply.

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11. To ensure the base of the pile socket is clean, a multi-pass technique with a minimum of two passes shall be adopted. After commencement of the discharge of concrete the auger shall be withdrawn 500 mm. The auger shall then be drilled back down to the toe of the pile to pick up any contaminated concrete before re-commencing to concrete the pile while withdrawing the auger. The construction/monitoring records need to show evidence of verification of the multi pass technique.

References: BPC 2004/05, BTD 2010/05

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DISTRIBUTION:

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