

Ground Anchors & Pile Dowels

Rosyth Dock Yard

Scotland, U.K.



Installation of Steel Dowels into Secondary Secant Piles and Temporary Ground Anchors

Introduction

Bachy Soletanche Ltd were awarded a contract to design and construct a temporary hard/ firm secant pile retaining wall to facilitate the remodelling of an existing dock entrance.

The 1300mm diameter secant wall piles were expected to terminate in the top of the Dolerite. The excavation within the wall was to extend down to the top of rock at an approximate depth of 26.5m. The solution, developed by Bachy Soletanche and the Main Contractor, involved the installation of steel dowels through the bases of the hard piles to provide restraint at the toe of the wall.

Ground anchors were also installed through the existing mass concrete gravity retaining wall to ensure its stability. The anchor safe working load was 3000kN.

Design

The secant wall, dowels and ground anchors were designed by Bachy Soletanche Ltd to provide a single composite solution.

The dowels were modelled in different ways in a series of WALLAP analyses for the design of the secant pile wall to determine the effective 'prop' load to be provided by the dowels. A number of potential failure mechanisms were considered in the design of the dowel, with the dowels checked in shear and in tension.



Stressing of Ground Anchors

CLIENT: Rosyth Dock Yard

MAIN CONTRACTOR: BAM Nuttall

CONSULTING ENGINEER: BAM Nuttall Design Dept.

DURATION OF WORKS: 5 weeks for AGM works

Scope of Works

51no. 1280mm dia. Secant piles up to 26.5m long
22no. 210mm diameter steel dowels in pile base
13no. Temporary ground anchors

Sustainability Innovations



✓ Steel Dowel developed to provide a rock key, avoiding heavy drilling and larger amounts of concrete.

Reservation tubes were built into the reinforcement cages for the male piles, see below. The design required that a 240mm diameter bore be extended 2.0m into the Dolerite at the pile toe to accommodate a 210mm diameter x 4.0m long steel dowel.



Secant Pile Reinforcement Cage with Reservation tube

Each ground anchor comprised a 16 strand tendon installed in a 240mm diameter bore within the existing mass concrete of the wall. The full anchor length of up to 23.5m was located entirely within the existing wall as required by the Engineer.

A key factor to consider in the design was the interaction amongst anchors in the same group in terms of the cone pull-out resistance. As the ground anchors were temporary, corrosion protection was not required.

Ground Conditions

The secant pile wall was installed through 26m of made ground into the top of the Dolerite rock. The dowels then extended 2m into the strong Dolerite.



Steel Dowels prior to installation

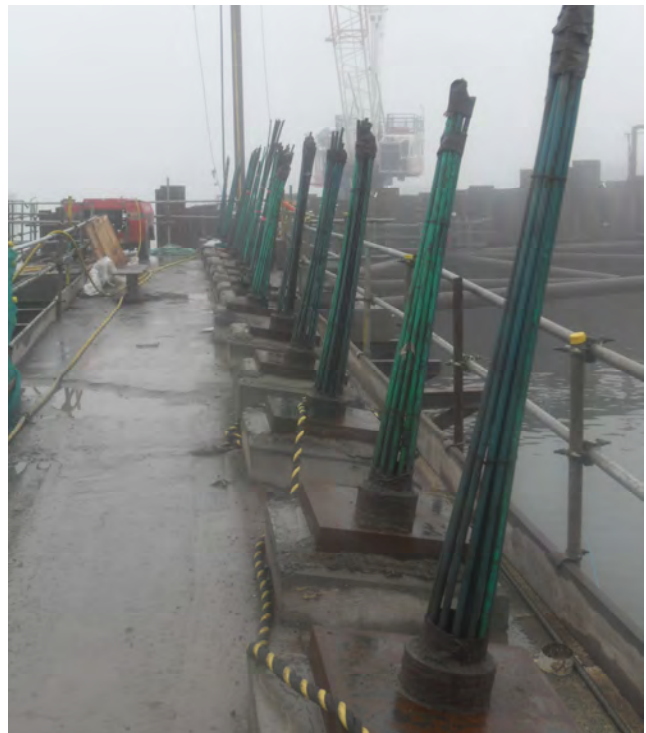
Construction – Steel Dowels

The 273mm diameter steel reservation tubes were fixed into the reinforcement cages installed in the male/secondary wall piles.

A Casagrande M6A rig fitted with a down the hole hammer (DTHH) was used to extend a 240mm diameter bore out of the bottom of the pile and 2m into the strong Dolerite. The bore was filled with grout, introduced via a tremmie from the base of the hole. The steel dowel was then lowered into position with 2.0m in the rock and 2.0m as an anchorage length inside the pile. The grout was topped up as necessary and a packer fitted into the top of the reservation tube to allow a pressure of 2.0bar to be applied to the grout.

Construction – Ground Anchors

The 240mm diameter anchor bores were drilled using the down hole hammer (DTHH) through the concrete wall at the specified angle of 10° to the vertical. Once the required bore length had been reached the DTHH was withdrawn and the anchor was lowered into the hole using an attendant crane.



Testing and Stressing of Anchors

All of the anchors were tested to 125% of the working load. 3 No. anchors were subjected to suitability testing and the remainder to acceptance testing. The anchors were then locked off at 100% of the working load.