A63 Castle Street Improvements, Hull
Environmental Statement

Volume 3 Appendix 2.1

THE SCHEME – GEOTECHNICAL WORKS

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Subject	Description of geotechnical works for the Environmental Statement		

1 Introduction

Scope of this note is to provide a short description of the geotechnical works required for the construction of the A63 Castle Street Improvement scheme. This note is solely intended to provide a brief description of the geotechnical works for inclusion in the Environmental Statement.

The geotechnical works considered in this note are related to: the construction of the underpass structure & pumping station; the retaining wall to support the west-bound off slip; and foundations for the bridges.

2 Description of the geotechnical works

The underpass will be constructed using parallel embedded retaining walls with a concrete base slab. The form of construction and design of the embedded walls and base slab is undertaken in order to reduce ground movement behind the underpass and minimise water ingress. The embedded retaining walls may be formed using a combination of diaphragm walls, secant piles and sheet piles. Tension piles are likely to be required beneath the base slab in order to resist buoyancy uplift.

Due to the local ground conditions and the necessity to limit the ground movements associated with the wall construction and the excavation, ground improvement may be required. The ground improvement may take the form of a combination of deep soil mixing and jet grouting.

Temporary steel props are likely to be required in order to support the embedded walls in some locations during excavation and construction.

3 Techniques

The following is a brief description of the different geotechnical elements which may be employed on the scheme.

3.1 Embedded retaining walls

3.1.1 Diaphragm Wall

An embedded retaining wall can be constructed using a diaphragm wall, which consists of a series of embedded reinforced concrete panels. A diaphragm wall is constructed with the following sequence:

1) Install concrete guide walls to control the diaphragm wall alignment.
2) Excavate for a single panel from ground level using a grab. A support fluid, typically bentonite slurry, is pumped into the panel excavation to maintain stability.
3) Placement of panel stop ends, water bars (if used) and reinforcement cage within the excavation.
4) Pump concrete using tremie pipes from the bottom of the excavated panel. The support fluid is displaced during concreting and then collected, filtered and re-circulated.
5) Move to another panel location and repeat while concrete in previous panel gains strength.
6) Panel excavation sequence to be determined based on space availability and time for strength gain being sufficient to excavate adjacent panels.
7) On completion of wall, capping beam is constructed to tie discrete panels together.

3.1.2 Secant piled wall

The secant piles wall consists of a series of overlapping bored piles in order to form a continuous embedded retaining wall. In a secant piled wall primary piles are reinforced concrete piles which are designed structurally to accommodate the forces acting on the wall. Secondary piles are typically formed using unreinforced concrete and serve to provide wall continuity to reduce water ingress. Secondary piles are typically constructed using a reduced strength concrete in order to allow primary piles to be bored with an interlock into the secondary piles. The construction of a secant piled wall is typically done in the following phases:

1) Construction of concrete guide walls to control the wall position and alignment.
2) Bore the secondary piles, using temporary casings to support the bore if required.
3) Pumping of lower strength concrete using tremie pipes from the bottom of the bore. Extract temporary casing.
4) When secondary piles have gained sufficient strength, form the bore for the primary piles, cutting into the two adjacent secondary piles.
5) Place the reinforcement cage within the bore.
6) Pump concrete using tremie pipes to the bottom of the bore. Extract temporary casing.
7) Once sufficient strength achieved break head of piles back to expose reinforcement and construct capping beam.

3.1.3 The sheet pile wall

The sheet pile wall consists in a series of steel sections driven into the ground from ground level. Each section is connected to the adjacent to provide wall continuity and limit water ingress.

3.2 Bored Piles

Bored piles will also be required for the foundations of the bridges and to resist the water pressure uplift on the underpass base slab. The construction method for the bored piles will be the same as used for one of the primary piles in the secant pile wall as described above. Since the piles will be constructed from existing ground level, the length between ground level and finished pile head level will be filled with low strength cement and sand mix. The detailed sequence of construction and methodology will be confirmed following detailed design.

3.3 Ground Improvement

Due to the local ground conditions and the necessity to limit the ground movements associated with the wall construction and the excavation, ground improvement may be required. This can take the form of deep soil mixing and jet grouting.
Deep soil mixing is an in-situ method to improve the ground by mechanically combining the existing soil with cementitious material. Different techniques are possible, but they all include the insertion of a mixing tool into the ground while a cement mix is released from the cutting head. The cement mix is then blended with the soil by the mixing tool. The quantity of binder introduced is determined based on the soil chemistry, moisture content and the required performance of the improved soil.
Jet grouting consists of the insertion of drill probe, then a cement grout is injected at pressure into the ground while the drill string rotates. The injection pressure breaks down the in-situ soil, soft in-situ material is extracted and preplaced with a grout, which once set forms a column of improved ground. The arisings from the process are a mixture of water, soil and cementitious material, which need to be collected at surface.

Injection points are repeated on a close grid such that the columns overlap resulting in a layer of material with much higher strength than the original soil.

DOCUMENT CHECKING (not mandatory for File Note)

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