5 CUT AND COVER STRUCTURES SPECIFICATIONS

5.1 GENERAL PRINCIPLES

5.1.1 General

1 Cut-and-cover structures includes all box stations, station entrances/exits, U-shaped troughs emergency exits, vent shafts, switchboxes, pedestrian subways, utilities, services and structures (other than bored tunnels) that are constructed below ground.

2 Cut and cover structures shall be designed in accordance with the following standards:

(a) QCS

(b) Euronorms (EN)

5.2 DESIGN PRINCIPLES

1 The Contractor shall include the following as a minimum:

(a) Method of construction, materials and workmanship, including temporary and permanent works, as well as construction sequence,

(b) Geotechnical conditions including the zone of influence of the excavation,

(c) Short and long term ground water regime

(d) Geometry and slope support to achieve stability within the excavation

(e) Control of heave, swell, piping and associated ground movements,

(f) Soil / structure interaction including effects by the temporary support

(g) Earth pressures and all loads combinations, shear force and bending distribution during construction and in the long term

(h) Dewatering or water cut off systems required to maintain dry and stable conditions within all excavations required,

(i) Waterproofing of final structures

(j) The magnitude of ground and existing building structures settlements, movements, distortions and changes in loading conditions existing building structures expected as a result of the Works and how these shall be mitigated to comply with the Contract; existing building structures

5.3 TEMPORARY WORKS

5.3.1 General Principles

1 In general Temporary Works shall be designed in accordance with the same design standards as the Permanent Works. However, the Temporary Works design may take into account the limited duration over which such temporary works are expected to function. The calculations and drawings shall make clear where provision for limited duration has been allowed for, particularly where this may have a substantial influence on the stability of the Temporary Works.

2 The design of Temporary Works shall take account of all the applied external forces and imposed structural deformations and, where applicable, the effects of the removal of load from the ground.

3 The Temporary Works shall minimise the effects (such as settlement, movement and distortion of the ground) on adjacent structures and ensure the stability and safety of the cut slopes. Where necessary the Contractor shall provide additional support for these adjacent structures.

4 Any ground treatment before, during, or after construction of the Works (e.g., groundwater recharge) which is required to stabilise the ground and existing building structures (EBS) shall be included in the design.

5.3.2 Design of Temporary Excavation Support

1 The excavation lateral support design shall be based on the accepted geotechnical interpretation report, and shall examine stability conditions within the excavations and shall determine the type of suitable retaining measures, where necessary, with full step-by-step analyses of the progressive change in the loading and required temporary support conditions as the excavation proceeds.

2 The design shall include adequate precautions against any failure of the excavation's temporary of final invert caused by heave or piping.

3 Braced or anchored excavations shall be analysed by established numerical methods, in which the changes in ground stresses are properly related to the deflections which occur in the structural elements..

4 Calibration of the Design assumptions shall be carried out by means of analysis of results from an appropriately designed instrumentation and monitoring programme of the temporary excavation elements and adjacent structures,

5 Temporary Works shall be designed as far as possible to be removed when no longer required, and shall not be left in the ground. Temporary Works which are viewed as being impossible to remove on completion of the Permanent Works shall be dismantled to a minimum depth of 2 metres below the finished ground surface and designed so that there will be no risk of ground settlement or other deleterious effects as a consequence of decay and/or collapse of these Temporary Works.

5.3.3 Ground Movements – Instrumentation and Monitoring

1 The Temporary and Permanent Works designs shall aim to limit ground movement and distortions inside the excavation and the zone of influence, so as to ensure safety within the excavation and avoid damage to adjacent existing building structures and utilities.

2 The design shall provide for instrumentation and monitoring method, measurement tools, measurement programme, alert procedures and reporting.

3 Prior to commencing any excavations the Contractor shall carry out a risk assessment for all existing building structures and utilities within the zone of influence of the Works. The analyses for the Temporary Works shall be properly related to the conclusions of this risk assessment and shall be an integral part of the Instrumentation and Monitoring design.

5.3.4 Construction Dewatering

1 Temporary dewatering of construction excavations will be required to provide an undisturbed, stable and dry subgrade to permit construction and backfilling of the Permanent Works under dry conditions.

2 The Contractor shall prepare and submit the design of the construction dewatering system to the Engineer for a SONO. The construction dewatering design shall include determination of subsurface conditions and geotechnical design parameters, analyses to establish feasible methods and system definition in sufficient detail to demonstrate that the general objectives can be achieved without adverse effect on adjacent existing building structures and utilities. The selected system shall generally provide for continuous (24-hour-per-day) operation, adequate reserve equipment, and standby power.

3 In general, the groundwater within the excavations shall be maintained at a level that permits achievement of the above and avoids any failure of the excavation.

4 The Contractor shall ensure that the groundwater level inside the excavation pit is at least 1000 mm below the current excavation level at any time during the relevant construction stages.

5 The effects of settlements, distortion or loss of ground due to dewatering shall be considered in the design. For adjacent existing building structures these effects shall be considered in the assessment of impact on these existing building structures.

5.3.5 Dewatering and Groundwater Control Systems

1 Description

(a) This specification refers to the design of dewatering, pressure relief systems and of seepage cut offs for all open deep excavations as well as tunnel excavations for the Project.

(b) According to the local groundwater conditions, the Contractor shall design, install and monitor a dewatering system or other groundwater control systems.

(c) The design of these systems shall consider at a minimum:

(i) The in-situ groundwater conditions and the related types of seepage flow;

(ii) The stratification and permeability characteristics of the geomaterials below the groundwater table into which the excavation extends or which are underneath the excavation;

(iii) The location and the geometrical characteristics of the excavation;

(iv) The type of the excavation (i.e. open-cut or tunnel); and

(v) The existence of nearby structures and especially their current serviceability conditions and foundation systems.

(d) The design of dewatering or water control systems, shall propose measures for controlling the risk of damage that may occur to the excavations, in the event of failure of the dewatering system or other water control systems during the construction period.

5.3.6 Design Methodology

1 The Contractor shall submit to the Engineer for a SONO, the design of dewatering or other water control systems.

2 The design shall include but not be limited the following:

(a) A brief description of anticipated geological - geotechnical conditions. The geotechnical design models to be adopted shall be compatible with the GIRs;

(b) The groundwater or piezometric pressure characteristics, which shall include but not be limited to the groundwater and artesian pressure levels, the elevation of the groundwater table and its variation with changes in seasonal effects, pumping from other nearby wells;

(c) The permeability of the geomaterials which shall be determined by field and laboratory tests;

(d) The availability, reliability and capacity of the power system at the site;

(e) Consideration of nearby construction activities of the Contractor and of third parties;

(f) Settlement calculations for all structures inside the influence zone of the drawdown curve. The settlement values resulting from these calculations shall be added to those for the excavations, the total of which shall meet the requirements of the Design Specification.

(g) A detailed description of the necessary monitoring and instrumentation program;

(h) Calculations, which shall fully account for any variability in geotechnical parameters and groundwater conditions;

(i) Construction drawings; and

(j) All other technical information required for safe construction works.

5.4 GROUNDWATER MANAGEMENT

5.4.1 Minimum Requirements

1 This section includes the control of groundwater during execution of the Works.

2 Where required the Contractor shall design, provide, install, maintain, operate and remove a complete temporary dewatering system for lowering and controlling groundwater levels and hydrostatic pressures to permit excavation, construction and backfilling to be performed in dry conditions.

3 Before commencing dewatering, the Contractor shall submit the method statement, including installation details of the dewatering system including testing to the Engineer for his SONO.

4 The Contractor shall install a pumping system that is available for use at all times and which shall be connected to the dewatering system to allow immediate use.

5 The Contractor shall obtain all necessary permits from the appropriate authorities independently and at his own expense. This also includes compliance with all requirements given by the authorities including but not limited to discharge.

6 The control of groundwater shall be such that softening of the bottom of excavations does not occur.

7 The dewatering system shall be designed and operated so as to prevent removal of the natural soils.

8 The dewatering system shall maintain the groundwater level at 1000 mm below the excavation level.

9 The Contractor shall implement a dewatering system that shall have the necessary capacity and backup.

10 The dewatering system shall be able to dewater and dispose of water without causing damage to public or private property and without causing a nuisance or danger.

11 The dewatering system shall be designed, installed and operated so that the groundwater level outside the pit is not reduced to an extent which would cause damage to or endanger adjacent structures or buildings.

12 The Contractor shall supply, install and monitor observation wells/piezometers to monitor and observe the groundwater level outside the pit. For location and length of the wells/piezometers the Contractor shall consider the requirements given in the geotechnical report.

13 The Contractor shall keep the Site free from flood water.

5.4.2 Execution

1 The dewatering system shall only be decommissioned after obtaining a SONO from the Engineer.

2 Records shall be maintained containing elevation readings and groundwater water levels in the observation wells and piezometers.

3 Observation wells and piezometers that become inactive, damaged or destroyed, shall be repaired or replaced within 24 hours.

4 Observation wells/piezometers shall be removed and/or backfilled when no longer required, only after permission of the Engineer has been requested and received.

5 Sumps and settling basins shall be backfilled with suitable materials when no longer required.

END OF PART