2.5 EXCAVATION AND BACKFILL FOR STRUCTURES

2.5.1 Description

This work shall consist of excavation in any material for the foundation of structures, other than for pipe culverts, not otherwise provided for in the Specifications; constructing and removing cofferdams, sheeting; pumping, dewatering and bailing; backfilling of completed structures with suitable material and disposal of excavated material. Pipes and manholes shall be excavated and backfilled in accordance with Sections 6.2 and 6.3.

Filling of areas above the natural ground level or above the limits of road excavation or channel excavation is described in Section 2.6.

2.5.2 Materials

2.5.2.1 Foundation Fill Material

Material for foundation fill shall consist of suitably graded sand to one of the grading envelopes A to C of Section 2.8.2, gravel or stone as shown on the Drawings or as required by the Engineer, or concrete. Concrete for foundation fill shall conform to the general requirements of Section 5.1. Concrete to be placed under water shall conform to the requirements of Section 5.1.3.14. Concrete used as foundation fill in dry excavation shall be class 15.

2.5.2.2 Backfill Material

Backfill materials below top level of pile caps shall consist of sand with not more than 10% of material passing the 75 micron sieve, if not otherwise directed by the Engineer or stated on the Drawings.

Backfill above top level of pile caps but outside embankment and road areas shall be excavated material if suitable and approved by the Engineer.

2.5.3 Construction Methods

2.5.3.1 Clearing

Prior to starting excavation operations in any area, all necessary clearing and grubbing shall have been performed.

2.5.3.2 Excavation

A) General

The Contractor shall notify the Engineer sufficiently in advance of the beginning of any excavation so that cross section elevations and measurements may be taken of the undisturbed ground. The natural ground adjacent to the structure shall not be disturbed without permission of the Engineer.

Trenches and foundation pits for structures and structure footings shall be excavated to the lines, grades and elevations shown on the Drawings or as directed by the Engineer. The elevations of the bottoms of footings shown on the Drawings are approximate only and the Engineer may order in writing such changes in the dimensions or elevations of footings as may be deemed necessary to secure a satisfactory foundation.
Boulders, logs and other objectionable material encountered in excavation shall be removed. After each excavation is complete the Contractor shall notify the Engineer to that effect and no footings, bedding material or structure shall be placed until the Engineer has approved the depth of excavation and the character of the foundation material.

The foundation material shall be cleared of all loose material and cut to a firm surface, either level or stepped or serrated, as specified or shown on the Drawings or directed by the Engineer.

B) Foundation Directly on the Ground

When the footing is to rest on the ground and not on piles, special care shall be taken not to disturb the bottom of the excavation, and excavation to final grade shall be deferred until just before the footing is to be placed. When, in the opinion of the Engineer, the foundation material is soft or otherwise unsuitable, the Contractor shall remove the unsuitable material and insert foundation fill material or concrete as specified or shown on the Drawings or directed by the Engineer. If foundation fill material is required, it shall be placed and compacted in layers not more than 150 mm thick to the degree of compaction as specified in Section 2.6.

C) Foundation on Piles

When the ground between piles is too soft to support green foundation concrete, the Contractor shall submit his proposals for a bottom form to the Engineer for his approval. Extra excavation and foundation fill or concrete fill in such cases will not be paid for separately.

If the bottom form is achieved by such strengthening of the ground, the Contractor shall, if requested, submit calculations showing that the pile cap will not be harmed during hardening due to differential settlements between the piles and the strengthened ground.

2.5.3.3 Disposal of Excavated Material

Excavated material classified as suitable by the Engineer shall generally be utilised as backfill or embankment fill. Surplus suitable material shall be stockpiled on Site as described in Section 2.2.3.4 of these Specifications. Excavated suitable material for use as backfill shall be deposited by the Contractor in spoil heaps at points convenient for re-handling of the material during the backfilling operation and approved by the Engineer.

Excavated material classified as unsuitable as backfill by the Engineer shall be carried to waste as described in Section 2.2.3.3 of these Specifications.

Excavated material shall be deposited in such places and in such a manner as not to cause damage to roads, services or property either within or outside the right-of-way and so as to cause no impediment to the drainage of the site or surrounding area. The location of spoil heaps shall be subject to the approval of the Engineer who may require that the reference lines and the traverse lines of any part of the structure be kept free of obstruction.

2.5.3.4 Cofferdams

A) The term “cofferdam” denotes any temporary or removable structure, constructed to hold the surrounding earth, water or both, out of the excavation, whether such structure is constructed of earth, timber, steel, concrete or any combination of these. The term includes earth dikes, timber cribs, sheet piling, removable steel
shells and all bracing; and it shall be understood to include excavation enclosed by pumping wells and well points.

The cost of cofferdams is always to be included in the tender rates/prices for the permanent work.

B) The term “caisson” denotes a permanent part of the substructure so constructed as to sink gradually into place as material is excavated within the area protected by its side walls. Where the term “well” is used it shall be taken to have the same meaning as “caisson”.

C) When no provision for caissons is shown on the Drawings, it shall be the intent of the Contract that suitable cofferdams shall be provided for all excavations where cofferdams may be necessary in order to control water to preclude sliding and caving of the walls of the excavation.

D) The Contractor shall submit upon request, drawings showing his proposed method of cofferdam and caisson construction. Approval of the drawings by the Engineer will not in any way relieve the Contractor of the responsibility for the adequacy of the design for strength and stability or for the safety of the people working therein.

E) The interior dimensions of cofferdams shall be such as to give sufficient clearance for the construction and removal of any required forms and the inspection of the interior and to permit pumping.

F) If possible, cofferdams shall be so designed that no cross bracing shall be left in place. If this is not possible, bracings left in place shall be of structural steel. The end of such structural members that would be exposed when the structure is completed shall be boxed back at least 50 mm behind the concrete face. The resulting holes shall be completely filled with concrete.

G) In general, sheet piling cofferdams shall extend well below the bottom of the footing and shall be well braced and as watertight as possible.

H) When foundation piles are to be driven inside a cofferdam and it is judged impossible to de-water the cofferdam before placing a concrete seal, the excavation may be extended below the designed level to a depth sufficient to allow for swell of the material during pile driving operations. Any material that rises to a level above the design level shall be removed.

I) Where it is possible to de-water the cofferdam, the foundation material shall be removed to exact grade after the foundation piles are driven.

J) Backfilling in a foundation to compensate for excavation, which has been extended below the required grade, shall be at the expense of the Contractor. Backfilling shall be with concrete or foundation fill material as indicated on the Drawings, or as directed by the Engineer.

If no material is indicated, backfilling shall be concrete of the same kind as required for the structure to be constructed in the excavation. Unless otherwise permitted no excavation shall be made outside of caissons or cribs or cofferdams or sheet piling and the natural streambed adjacent to the structure shall not be disturbed without permission from the Engineer.

If any excavation or dredging is made at the site of the structure before caissons, cribs, or cofferdams are in place, the Contractor shall after the foundation is in place, backfill all such excavation to the original ground surface or stream bed with material satisfactory to the Engineer.
Material deposited within the stream area from foundations or other excavations or from the filling of cofferdams shall be removed and the stream area freed from obstruction.

K) Caissons and cofferdams, which have tilted or moved laterally during construction, shall be corrected as necessary at the expense of the Contractor.

L) Unless otherwise provided cofferdams shall be removed after the completion of the sub-structure. The removal shall be effected in such a manner as not to disturb or mar the finished work. The Engineer may order the Contractor to leave any part or the whole of the cofferdam in place.

M) When conditions which, in the opinion of the Engineer, render it impossible to de-water the foundation before placing the footing are encountered, the Engineer may require the construction of a concrete foundation or seal of such dimensions as he may consider necessary, and of such thickness as to resist any possible uplift. The concrete for such seal shall be placed as shown on the Drawings or required by the Engineer. The foundation shall then be de-watered and the footing placed. When weighted cribs are used and the weight is used to overcome partially the hydrostatic pressure acting against the bottom of the foundation seal, special anchorages such as dowels or keys shall be provided to transfer the entire weight of the crib to the foundation seal. When a foundation seal is placed under water the cofferdam shall be vented at low water as directed.

Cofferdams shall be constructed so as to protect newly cast concrete from sudden rising of the water and to prevent damage to the foundation by erosion.

2.5.3.5 Pumping and Bailing

Pumping and bailing from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of the movement of water through or alongside any concrete being placed. No pumping or bailing will be permitted during the placing of concrete and for a period of at least 24 hours thereafter unless it is done from a suitable pump separated from the concrete work by a watertight wall or from well points.

Excavations shall be as dry as possible prior to and during placing concrete. Placing concrete under water will only be permitted if indicated on the Drawings or approved by the Engineer.

2.5.3.6 Backfilling

All spaces excavated under these Specifications and not occupied by the permanent structure shall be backfilled. Backfilled material shall fully comply with this Specification and adequate provision shall be made for drainage. No backfilling shall commence until permission has been given by the Engineer.

Backfill under top level of pile caps shall always be made with compacted sand fill free from chemical contamination. Over top level of the pile cap but outside embankment and road areas, the backfill shall be excavated material if suitable and free from chemical contamination, and approved by the Engineer. If the excavated material is not suitable, the Engineer may order sand filling.

Backfill within the embankment and road areas shall be made in accordance with Section 2.6 of these Specifications.

Special care shall be taken to prevent any unduly high pressure against the structures. In placing backfill and embankment, the material shall be placed insofar as possible to
approximately the same height on both sides of the structure at the same time. If conditions require backfilling appreciably higher on one side, the additional material on the higher side shall not be placed until permission is given by the Engineer that the structure has enough strength to withstand any pressure created.

Jetting of fill or other hydraulic methods involving, or likely to involve, liquid or semi-liquid pressure is prohibited. Backfill and embankment fill shall not be placed behind the walls of bridges or box culverts until the top slab has been placed for at least three days.

The placing of embankment and the benching of slopes shall continue in such a manner that at all times there will be a horizontal berm of thoroughly compacted material for a distance at least equal to the height of the abutment or wall to be backfilled.

2.5.4 Measurement

The volume of excavation and backfill shall be measured in cubic metres of excavated undisturbed material.

The quantity of excavation for structures to be measured for payment shall include excavation for all structures except pipe culverts, which will be in accordance with Section 6.2. The measured volume shall be the excavation plan outline, bounded on the bottom by the plane of the underside of the brick flat soling to the blinding concrete under the reinforced concrete footing and on the top by the surface of the existing ground and on the sides by vertical planes of the footings.

Backfilling with previously excavated material shall not be measured or paid for separately but shall be deemed included in the rate for excavation.

Backfill with concrete or sand where directed by the Engineer including concrete seals shall be measured separately as the volume within the plan outline and top and bottom surfaces. Concrete or sand placed to backfill excavation beyond the excavation required will not be measured for payment. The plan outline referred to is the excavation plan outline as defined above.

If sand fill is ordered over top level of pile cap, the fill shall be the specified filling volume measured on the Drawings up to profiles agreed upon in writing by the Engineer.

In the case of structures for which a lump sum price is called for, the volume of excavation as stated above for the work as shown on the Contract Drawings, shall be subtracted from the volume measured as above, and the price to be paid or deducted shall be based on the measured increase or reduction of the excavation shown on the Drawings.

Removal of slides, cave-ins, siting or filling shall not be measured nor paid for.

2.5.5 Payment

This work measured as provided in Section 2.5.4 shall be paid for at the Contract unit prices per cubic metre for each particular item. The payment shall be full compensation for all excavation, stockpiling, backfilling and disposal including compaction; constructing and removing all cofferdams; all dewatering, pumping and bailing; and for furnishing all materials, labour, equipment, tools, sheeting, bracing, cofferdams, pumps, and incidentals necessary to complete the work.
Should it be necessary, in the opinion of the Engineer, to lower the footings to an elevation below the level shown on the Drawings, payment for the “Excavation and Backfill for Structures” required below plan level down to and including an elevation 1.5 metres below plan level for any individual footing will be made at a unit price equal to 115% of the Contract unit tender price. Payment for the excavation from an elevation greater than 1.5 metres below plan level down to and including an elevation 3 metres below plan level will be made at a unit price equal to 125% of the Contract unit tender price for “Excavation and Backfill for Structures”. No additional extra compensation will be allowed for any required cofferdam adjustments made necessary by such lowering of footings.

In case where the extra depth required for any footing or footings exceeds 3 metres, a supplementary agreement shall be made covering the quantities removed from depths in excess of 3 metres below plan grade.

Payment for backfilling shall be included in the pay item for “Excavation and Backfill for Structures” except for sand backfill and concrete backfill. These backfill types shall be measured as provided in Section 2.5.4 and paid for at the concerned Contract unit prices, but no compensation in the pay item “Excavation and Backfill for Structures” shall be made for less backfilling with excavated material or more surplus to waste.

All payment for the backfilling and compaction of those areas which were removed, as structural excavation shall be included in the appropriate unit rates below. Filling or backfilling of areas above the natural ground level or above the limits of road excavation or channel excavation section shall be paid for under Section 2.6.

Cofferdams for structures without excavation, for example for pile caps over water shall be deemed to be included in the unit prices for the concerned pile cap.

Pay items shall be:

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<th>Pay Item</th>
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