CITY OF NEW WESTMINSTER SPECIFICATIONS FOR UNDERGROUND ELECTRIC DISTRIBUTION STRUCTURES

Issue Date: 2011 11 26

1. SCOPE

This Specification describes the standard work requirements for the construction and installation of underground electrical ducts and structures in accordance with Contract Documents and any details, instructions, and drawings provided by the City.

All work is to be done in a substantial, complete, and workmanlike manner and no details necessary to the proper performance and completion of the work may be omitted even if specific mention of such details is not made in the project documents.

The clauses contained in this Specification shall form a part of any Specification of work or drawings to which they are attached.

2. WORK INCLUDED/NOT INCLUDED

The Contractor is required to furnish all supervision, labour, materials, bricks, tools, trucks and special equipment as may be required to install underground electric distribution plant in accordance with issued plans and specifications.

The contractor shall provide all expendable material items required, not listed in the Project Specifications as being supplied by the City. The Contractor shall be responsible for ensuring that adequate materials are on hand to complete the work.

Included are installation of pilasters, vaults, manholes, spliceboxes, service boxes and duct banks, including the full excavation, form and concrete work, bricking and setting vault, manhole and splicebox frames and covers, laying duct, backfilling, removing and disposal of excavated material, maintenance of backfill, temporary repairing and all other work shown on the drawings or as hereinafter specified.

The Contractor shall supply all duct and accessories, solvent, duct string and warning tape, gravel, sand, reinforcing steel, forming lumber, screws, nails, tape, and other miscellaneous expendable construction items, together with materials required to replace breakages.

The Contractor shall remove from the site, from time to time, all rubbish, debris, and scrap materials accumulating from the work. Upon completion of the work, the Contractor shall leave the site in a clean and presentable condition.

Temporary and permanent pavement and concrete sidewalk repair shall be completed, by the Contractor, in occordance with the master municipal construction documents.

3. MATERIALS SUPPLIED BY THE CITY

Unless otherwise indicated in the project specifications or drawings, the City will, without charge, supply the Contractor with cast iron frames and covers, pre-cast concrete manholes, counterpoise kits, ground rods and connectors, service boxes, and pilasters.

The Contractor shall be responsible for the sorting, bundling, handling and transporting of all material supplied by the City from the City store or other supply points to the job site. The Contractor shall be responsible for the care and safekeeping of all the City material from the time it is issued to the Contractor until all work is completed and any excess material is returned.

The Contractor shall be responsible for returning all excess new material supplied by the City to the City stores in good order within 72 hours of completion of the work. All new material returned will be documented and acknowledged by the City's Storekeeper.

The Contractor shall be responsible for returning all material salvaged from the project to the City stores. All salvaged material returned shall be sorted by the Contractor, and will be documented and acknowledged by the City's Storekeeper.

At all reasonable times the Contractor shall permit representatives of the City to inspect, audit and inventory all the City material in the Contractor's possession.

4. FIELD SURVEY AND INSPECTION

The Contractor will, unless otherwise indicated in the Project Specifications, set all stakes for running lines and grades for the underground structures. Typically, structures are placed at existing boulevard, sidewalk or pavement elevations. Changing grades for new sidewalks or pavement are available from the engineering plans. Setting of additional reference hubs or stakes that may be required by the Contractor shall be included in the contract price.

All work performed under the terms of the Project Specifications will be subject to continuous and rigid inspection by the City's representative, and the work will not be accepted as complete until final acceptance has been clearly given.

5. MUNICIPAL REGULATIONS

5.1 Utilization of Streets

The scope and extent to which public streets may be utilized or occupied by the Contractor for the purpose of carrying out the work under this contract will be determined by the City, who will also control the manner in which such streets may be used for such purposes in order to cause the least possible inconvenience to vehicular and pedestrian traffic on the streets, lanes and sidewalks affected.

A Street Occupancy Permit must be obtained from the City Engineering Department prior to the commencement of work. A traffic plan may be required at this time.

6. SAFETY AND THE ENVIRONMENT

6.1 General

The Contractor, as an independent Contractor, has the duty at all times to exercise due care, skill and diligence in connection with the work to protect against harm to human life or property of any person, or the natural environment.

6.2 Pre-Job Conference

Prior to commencing the work the Contractor shall attend a Pre-Job Conference with the City's representative to discuss scheduling, material supply, safety rules, environmental requirements and Powerline Technician stand-by arrangements when working on structures containing energized cables. The Contractor employee who attends the Pre-Job Conference will be deemed by the City to be the Contractor Representative for the contract/project. A standardized Pre-Job Conference document will be used.

The discussion on material supply shall include the City project material list and the supply source. It shall be the Contractor's responsibility to review the list and advise within 24 hours of the Pre-Job Conference if modifications to the material list are required.

7. EXCAVATION

7.1 General

The Contractor shall make all machine and hand excavations necessary to install the underground structures and equipment to the alignment and depths indicated by the Project Specifications and the City's representative.

Before excavation through heavy asphaltic or concrete surfaces, the surface shall be cut in a straight line with abrasive wheel or pneumatic spade equipment to a nominal 150 mm outside of the limits of the excavation.

7.2 Proving Route

Grades of the trench, ducts, and structures shall be proven far enough along the route in advance of duct laying or forming and concreting that any relocation or redesign necessitated by unforeseen obstacles may be carried out.

It is essential that the Contractor prove the location of any existing utility by digging test holes or other equivalent method satisfactory to the City's representative. The Contractor shall not install a chamber until the next chamber has been fully excavated, and the intervening duct line proven feasible. Any ducts or chambers constructed by the Contractor in contravention of these requirements, and which have to be relocated or redesigned because of an unforeseen obstacle along the route, shall be demolished, removed from the site, and replaced at the Contractor's expense.

7.3 Basis of Tender

Unless otherwise specified in the Project Specification, the Contractor shall prepare Tenders on the basis that the entire excavation will be common excavation and will be immediately removed from the site.

The Contractor must also quote unit prices for rock excavation and extra common excavation as defined herein. These unit prices shall include removal of excavated material.

7.4 Material Definitions

All excavated material shall be classed as either "common excavation" or "rock excavation" as defined in the following paragraphs:

(a) Common Excavation

Common excavation will include such materials as are commonly called earth, loam, clay, muck, sand, gravel, gumbo, boulders each less than 1 m^3 in void, angular rock fragments, hardpan, pavement, and all other materials of every description not defined as "rock excavation".

(b) Rock Excavation

The term "rock" is hereby defined as:

(i) Solid formations of dense homogeneous sedimentary or igneous material which require, in the judgement of the City's representative, the continuous blasting, drilling or wedging for their removal. In order to qualify for payment under the unit price for rock excavation, material so removed shall measure at least 1 m^3 in void within the limits of excavation as defined herein.

(ii) Individual boulders of any type measuring at least 1 m^3. Payment for excavation of this type of material shall be based upon the amount in cubic metres of boulders removed within the limits of excavation as defined herein.

The breaking and removing of road or sidewalk pavements or frozen material, regardless of thickness, will in no case be taken as rock excavation.

7.5 Unit Price Excavation

The Contractor will be additionally compensated for any "rock excavation" or extra "common excavation" removed from the trench in accordance with the relevant Unit Price. Measurement for payment of additional or deleted quantities of excavation will be as defined in the "Basis of Measurement" clause below.

If, after obstructions have been proven or after any trench has been excavated, the City's representative should decide to change the depth or location of any trench or structure, the Contractor will be paid for any additional excavation (but not that excavation included in the "Basis of Tender" clause above) according to the volumes excavated, as defined in the "Basis of Measurement" clause below. However, no allowance will be made for any additional excavation unless the change in grade exceeds 150 mm.

Similarly, if the City's representative should change the depth or location of any trench or structure thereby reducing the necessary excavation, the cost of deleted excavation will be deducted from payments owing the Contractor; however, no deduction will be made for any deleted excavation unless the change in grade exceeds 150 mm.

7.6 Basis of Measurement

(a) Common Excavation

(i) Trench Work

Volume measured in void with the excavation limits set at 75 mm below the duct bank sub-grade and 150 mm outside each side of the duct bank, including any concrete encasement, as shown on the drawings, except that where the safety shoring recommendations of WorkSafe BC require additional width of trench to install such shoring, then the payment shall be based on these widths.

(ii) Chambers

Volume measured in void with the excavation limits set at 100 mm below sub-grade and 300 mm outside each side of the chamber outline as shown on the drawings.

(b) Rock Excavation

(i) Trench Work

As excavated - with the excavation limits set at 75 mm below the duct bank sub-grade and 150 mm outside each side of the duct bank, including any concrete encasement, as shown on the drawings, except that the maximum allowance for width shall be in accordance with WorkSafe BC recommended practices.

(ii) Chambers

As excavated - with the excavation limits set at 100 mm below sub-grade and 300 mm outside each side of the chamber outline as shown on the drawings.

Where rock excavation is required above the sub-grade of the duct banks or chambers, as shown on the drawings, the Contractor will be paid only at the unit rock excavation price quoted in the Tender. Where rock excavation is required below the aforementioned sub-grades, the Contractor will also receive the unit common machine excavation price quoted.

7.7 Subsurface Structures

The drawings show the available information on the type and location of existing surface and subsurface structures and utilities. Neither the accuracy nor the completeness of this information is guaranteed.

If the location of such a utility is not as shown on the drawings, but requires that the underground structures be installed either above or below the utility, then the only unit price adjustments allowable will be those for additional excavation and backfill.

The Contractor shall be responsible for locating and exposing all buried utility services; building around, under, or over these services, and taking proper precautions against accidental damage; temporary supporting where required and removing such supports upon completion; and maintaining specified clearance between services and the underground structures.

7.8 Removal of Obstructions

After the excavation is opened and all pipes and other obstructions are exposed, the City's representative shall be notified that the excavation is ready for examination. Should the City's representative decide any pipes or other structures excluding pavement at the same elevation as the trench require moving, the expense of such moving will be borne by the City, but the Contractor will have no charge against the City by reason of delay so occasioned, nor shall the Contractor be held responsible for any delay in completion of the work due solely to the above cause.

If the Contractor wishes to temporarily remove, disconnect, or relocate service pipes crossing the excavation to facilitate installation of the underground structures, they shall make their own arrangements with the owners of the service pipes and shall bear all costs of such temporary work. The City will neither guarantee that such temporary work may be done nor bear any cost of such temporary work. Payments for all such temporary work shall be made directly by the Contractor.

Disconnected or abandoned utilities shall not be removed or salvaged without the permission of the City's representative.

7.9 Irregularities in Excavation

All irregularities and cavities in the bottom of the trench or excavation shall be filled up to the required sub-grade with approved backfill material properly tamped in place.

7.10 Adjacent Structures and Properties

Prior to excavation, the Contractor shall consult and cooperate with owners of adjacent structures which may be endangered, or whose gardens, trees, tree roots, and shrubs require protection or alteration during construction, to eliminate future dispute and litigation over that which may already be in a damaged condition. Under no circumstances shall the Contractors permit their forces, materials, and/or equipment to encroach on private properties adjacent to the work, without the express consent of the City's representative. Any survey pins displaced during the construction work shall be reinstalled by a legal surveyor at the Contractor's expense.

7.11 Drainage and Shoring

The Contractor shall, without additional charge, construct such temporary drains or do such dewatering of the trench and chamber excavations as may be necessary to keep water away from concrete work until the concrete has thoroughly set.

Without additional charge, the Contractor shall provide and place adequate shoring as required by WorkSafe BC and as required to protect adjacent paving and structures, and to prevent any sloughing in of material that is under adjacent sections of sidewalk, road pavement, pipes, or ducts.

8. UNDERGROUND DUCTS, CHAMBERS, AND TRANSFORMER PADS

The location, number, and arrangement of ducts, chambers, transformer pads, and service boxes shall be as shown on the drawings. Ducts may be directly buried, concrete encased, or a combination of both as specified on the drawings. The size, shape, routing, and concrete encasement of ducts between terminations may be varied by the City's representative according to space available in the street or the obstructions encountered as may be determined after the trench is excavated.

9. PROTECTION OF FOREIGN UTILITIES

In the performance of the work, care shall be taken not to move, without consent of the proper parties, any structure, and in crossing or running parallel with any structures they shall be secured in place until the work is completed. Any damage to structures of any kind, caused by neglect to attend to such structures, shall be paid by the Contractor.

The Contractor shall build around, under, over, or through pipes, sewers, culverts, catch basins, or any other structure encountered in the line of the work, or shall divide the ducts so as to lay part on each side either horizontally or vertically or both, of any such structure, as required by the City's representative, and shall supply such materials and make such alterations, substitutions and repairs as may be required for such work. Whenever concrete duct bank is so divided, each part must have a full concrete envelope 75 mm in thickness.

10. DUCT INSTALLATION

10.1 URD/UD Class Ducts

It is recommended that excavation for transformer pads be completed and trenching extended from the respective pads. This permits duct bends to be secured and tamped in the pad subsurface and duct laying can proceed therefrom in the excavated trench.

In locations other than where native soil is a fine sandy material completely devoid of rocks or small stones, a 75 mm layer of sand shall be placed in the bottom of the trench.

The plastic duct shall be either direct buried or encased in concrete as shown on the drawings. All joints shall be cemented and joined in an approved manner. Duct runs except stubbed off sections shall be terminated with preformed bell ends and plugs. The caps installed on stubbed off service ducts shall not be cemented, however, caps shall be cemented on main runs intended for future extension.

10.2 Feeder Ductbanks

The Contractor shall build complete forms to the full height of, and on each side of every duct bank, before pouring concrete or laying duct. Forms shall be made rigid and shall be adequately braced to prevent bulging or movement. All duct banks shall be poured on a minimum 50 mm thick bed of 40 mm minus drain rock, supplied and placed by the Contractor without additional compensation.

Duct banks shall be installed in accordance with the following procedure:

(a) After the grade of the trench has been checked by the City's representative, a 75 mm base of stiff concrete shall be poured in sufficient quantity that the bottom row of ducts may be laid before the concrete has attained its initial set.
(b) The duct shall be checked for defects in material and structure before being placed in the trench. Any field-cut ducts or bends shall have their inside edges bevelled smooth by sanding. The bottom row of ducts shall then be laid, with open ends

closed with plugs secured to prevent removal by hand. Any work done to repair or connect to existing transite ducts must comply with approved methods and regulations for working with asbestos cement duct.

(c) For 4-inch and 5-inch ducts, a separation of 45 mm, both vertically and horizontally, shall be maintained between ducts by the use of approved separators of the correct dimensions. However, vertical separation shall be increased to 115 mm before entering a manhole, unless otherwise noted on the drawings. Increase in vertical separation shall begin a minimum of 6 m back from the outside face of the manhole.

(d) The duct joints shall be staggered at least 150 mm from neighbouring duct joints in both the vertical and horizontal rows.

(e) After the alignment has been checked by the City's representative, the concrete sheathing and fill shall be poured around the ducts to the level set by the City's representative. The Contractor shall ensure that the correct duct separations and thicknesses of concrete are maintained at all times.

(f) The separators shall then be removed and the holes filled with concrete.

(g) The next horizontal row of ducts shall then be laid and the same procedure repeated until the required section is obtained and the top 75 mm concrete sheathing is complete.

(h) The ends of ducts in a run, which will be extended later, shall be staggered and shall extend at least 300 mm beyond the end of the concrete envelope. The open ends of these ducts shall be closed with caps cemented in place.

10.3 Mandrelling and Duct String

(a) URD/UD Class Ducts:

The ducts shall be proven clean and free of obstructions or faulty joints by use of a Greenlee Piston or an acceptable combination of mandrell, swab, and wire brush to the satisfaction of the City's representative.

(b) Feeder Class Ducts:

When the duct work is completed and the concrete and mortar thoroughly set, a test mandrel shall be drawn through each duct in the presence of the City's representative. The test mandrel will be comprised of a wire brush, cutter and disc type mandrel (General Machine Products attachment Part No. 25, Cat. No. G-1011, followed by Part No. 27 or equivalent, sized according to the duct). The minimum diameter of such mandrels shall be 0.5 inch below the nominal duct size.

After test-mandrelling, an approved light waterproof cord shall be left through all ducts or as designated by the City’s representative.

10.4 Feeder Duct Measurements

Duct measurement shall be from centre to centre of chamber covers, or centre of chamber cover to centre of terminal poles, measured horizontally, less the distance from centre of chamber cover to face of duct where it enters each chamber.

11. CHAMBERS

11.1 General

Chambers are vaults, manholes, spliceboxes, and similar structures. Some chambers are prefabricated and will be designated as such on the drawings and supplied from the City stores or manufacturer's plant depending upon size.

11.2 Chambers Built on Site

Chambers built on site shall be in accordance with the contract drawings except where changes to location and shape are authorized by the City's representative.

Floor slabs shall be poured on a minimum 50 mm thick bed of 40 mm minus drain rock supplied, placed, and compacted by the Contractor.

After formwork is completed care, shall be taken in placing concrete for wall cavities. Concrete lifts for such cavities shall not exceed 300 mm and concrete for such lifts shall be first placed on the manhole roof form or a pouring deck before placing into wall cavities. Concrete shall not be poured directly into wall cavities. Wall pours must be continuous until completed.

The top of the chamber roof and the chamber casting shall be set to conform to the line of the street or as otherwise determined by the City's representative. Manhole openings shall have a 75 mm chamfer at the bottom. Manholes are normally built with a brick chimney, cement rendered inside and out, extending from the chamber roof slab to the underside of the cover castings to allow for any subsequent lowering of street grade. Cement bricks or equivalent materials are to be supplied and installed by the Contractor for this purpose as required by the City's representative. The Contractor shall also install a 250mm ventitaliton hose casting in a manner similar to the manhole lid.

11.3 Precast Chambers

(a) Base Preparation

(i) The excavation shall be completed and roughly leveled to the proper elevation.

(ii) Timber screeds shall then be set to the elevation of the base of the precast chamber. The screeds shall be leveled to a tolerance of ±6 mm.

(iii) 150 mm of 40 mm minus drain rock or sand shall be placed, leveled, compacted to 90% Modified Proctor, and struck-off level with the top of the timber screeds.

(iv) During this base preparation the precast sump and drainage duct shall be installed. If not connected immediately, drainage duct shall stubbed off at least 600 mm beyond the manhole wall in the direction indicated by the City's representative.

(v) Under wet conditions, at the discretion of the City's representative, the above 150 mm layer of drain rock shall be increased to 200 mm.

(b) Placing

(i) Manhole sections shall be placed with great care. The responsibility of off-loading and placing manholes (or sections) into excavations shall be the Contractor's. Care shall be taken to maintain adequate clearances from hoist booms to overhead conductors.

(ii) Gaskets - Care shall be taken to place precast sections so that gaskets between sections are totally contained and compressed.

(iii) Sumps - A suitable sealing grout shall be placed, at the the City representative's direction, between sump and base of manhole.

11.4 Duct Terminations

The Contractor shall terminate all ducts with bell ends installed 75 mm back from the inside face of chamber walls when poured in place (25 mm back when precast), and shall finish the recesses with chamfered edges in a clean and workmanlike manner. For precast manholes any wall openings shall be filled with concrete to the satisfaction of the City's representative.

Where the drawings indicate a future duct bank on any face of a chamber, a brick window 100 mm thick, cement rendered both sides, shall be provided.

11.5 Chamber Designations

Each manhole lid shall be permanently identified by the Contractor with the letters CNWE and the manhole number (MHXXX).

Secondary service boxes shall be identified with the letters CNWE only.

11.6 Irons, Hooks, Rods, and Inserts

The Contractor shall set pull-in irons, hooks, and inserts as shown on the contract drawings or as specified by the City's representative.

The Contractor shall install in each manhole and vault, at points designated by the City's representative, suitable grounding rods about 9 feet long, driven at a 45° angle downward into the ground so that the upper ends shall project into the manhole about 100 mm.

11.7 Drainage

(a) All manholes and vaults shall be provided with a sump. Manholes and vaults shall be drained as shown on the drawings or as required by the City's representative. Drain pipes shall be of approved grade of vitrified clay, or PVC. Backwater valves and P-traps with cleanout and strainers shall be installed as shown on the drawings or as required by the City's representative.

(b) All drainage pipe, valves and P-traps shall be provided by the Contractor.

(c) Connection of drains to City sewers or catch basins will normally be done by the Contractor. Drainage excavations shall then be back-filled to the same standards as set for duct excavation. All costs of installing and backfilling drains shall be included in the lump sum bid price. Under no circumstances will laying of drains as shown on construction drawings be considered as unit price or extra work.

11.8 Removal of Forms and Traffic Loading

Inside roof forms of poured-in-place chambers will not be removed for a minimum of 14 days if the chamber is in the sidewalk and 21 days if in the travelled road.

Poured-in-place chambers shall not be subjected to traffic loading for 21 days unless otherwise directed by the City's representative.

12. BACKFILL

12.1 General

The Tenderer shall allow for the supply and placement of backfill materials in accordance with these Tender Documents, and the clean-up after backfill.

Backfill will normally be imported granular or sand material (see below). However, native materials may be used, at the City representative's discretion, if location and soil conditions are considered satisfactory, and/or if specified in the Project Specifications.

12.2 Backfill Materials

Unless otherwise specified in the Project Specifications or by the City's representative, the excavation shall be backfilled as follows:

(a) To 150 mm above direct buried ducts or 200 mm above concrete encased ducts with approved sand, hand tamped. A portable plate vibrator may be used at the discretion of the City's representative.

(b) From the point specified in (a) above to the point specified in (c) below with any of the following materials, providing all materials are compacted in accordance with the compaction clause below. Backfill shall be done in maximum lifts of 300 mm (loose) for imported material or 150 mm to 200 mm (loose) for native material unless otherwise specified by the City's representative. Warning tape reading, as a minimum, "Caution Buried Electric Line Below" shall be supplied and installed by the Contractor at a depth of 300mm below finished grade.

(i) **Sand**

Sand shall be free of organic materials, clay or silt. 100% shall pass a 5 mm sieve, 90 – 100% shall pass a 2 mm sieve and not more than 5% shall pass a 75 μm mesh sieve by mass. Fraser River pump sand is acceptable.

(ii) **Combined Crushed Aggregate Fill**

This fill shall be free from organic materials, clay or silt. The fraction retained on a 10 mm sieve shall be at least 50% crushed. The fraction passing a 75 μm mesh sieve shall be not more than 5% by mass.

(iii) **Select Backfill**

This material shall be essentially granular and shall not contain stones larger than 75 mm, organic material, silt or clay. The fraction passing a 75 μm mesh sieve shall not be more than 5% by mass.

(iv) **Native or Random Backfill**

This material may be used, if the required compaction can be obtained. Compaction ability is very dependent upon water content and to obtain approval for use of this material the Contractors may be called upon to demonstrate their methods and machinery to prove to the City's representative that the compaction requirements can be met. In any event, all stones larger than 150 mm must be removed.

(c) The top zone of the excavation shall be backfilled with 300 mm of 20 mm minus combined crushed aggregate fill where the excavation is situated in a paved or travelled road; 150 mm of 20 mm minus combined crushed aggregate where the excavation is situated in a sidewalk; 150 mm of black loam where the excavation is situated in a developed grass boulevard. All these materials shall be thoroughly compacted after placement.

(d) In all locations where road paving or sidewalk has been removed for trench excavation the Contractor shall, unless otherwise directed, supply and place a temporary tamped asphalt patch within 24 hours of backfilling to facilitate the movement of traffic and pedestrians until permanent repairs are made. Compacted thicknesses shall be 50 mm for roads and 25 mm for sidewalks.

(e) In all locations where the excavation is located in developed grass boulevards, the Contractor shall neatly cut the grass sod and store it in a suitable location. After backfill is completed the black loam shall be leveled off, raked clear of stones and debris and the grass sod replaced. If the Contractors damage the adjacent grass, or are unable to preserve the grass sod, they shall resod the boulevard. The Contractor shall be responsible for maintaining sod until it has grown to a condition similar to that existing before excavations were begun. If, in the opinion of the City's representative, the time of year is not suitable for resodding, the Contractor will be required to carry out this work at a more seasonable time.

(f) Backfilling of all voids around chambers shall be done with river sand or other approved material.

The supply and placement of all the above backfill materials including the supply and placement of sand for the minimum cover over all ducts, and the disposal of any native excavated backfill materials, shall be the responsibility of the Contractor, and shall be included in the Contractor's lump sum tender.

12.3 Compaction of Backfill

All excavations shall be backfilled with specified materials, placed in layers, and compacted to the following requirements unless otherwise indicated in the project specifications:

		Minimum Corrected Dry Density**
(a)	Trench in boulevards (assuming that excavated trench is greater than excavated depth distance from roadway, sidewalk, curbs, walls, or structures)	85%
(b)	Trench in all other areas:	
	Within 1.2 m of the surface	95%
	Depths below 1.2 m from surface	85%

** In accordance with ASTM D1557-66T (Modified Proctor) and shall be corrected for material retained on No. 4 Sieve according to the following formula:

$$D = \frac{Pf \times Df}{100} + \frac{Pt \times 0.90 \times 62.4G}{100}$$

Where: D = corrective maximum dry density in pounds per cubic foot for total sample,

Pf = percent of total sample passing the No. 4 sieve,

Df = maximum dry density in pounds per cubic foot (ASTM D1557-66T) for material passing the No. 4 sieve,

Pt = percent of total sample retained on the No.4 sieve,

G = bulk specific gravity (dry basis) of material retained on the No. 4 sieve (ASTM C127-59).

Upon request of the City's representative, the Contractors shall, at their own expense, provide certified test results demonstrating that the above compaction requirements have been met.

12.4 Unit Price Work - Backfill

Additional unit price excavation shall be backfilled with material specified by the City's representative. Unit prices for such materials shall be provided by the Contractor; measurement shall be in accordance with the Basis of Measurement clause above.

12.5 Acceptability of Backfill Material

Notwithstanding the backfill materials herein specified, all materials must be satisfactory to the City.

12.6 Maintenance of Backfill

As part of the work the Contractors shall maintain the backfilled excavation at their own expense until all settlement has ceased, except that on paved streets they shall maintain the backfilled trenches and temporary surfaces for 45 days after completion of backfill. This "completion" will be done on a section-by-section basis and the 45-day period will not commence until the the City representative's written approval has been obtained that the backfill of a particular section is completed.

12.7 Liability

In accepting the responsibility for maintenance of backfill, the Contractor shall be fully responsible for any damage or accident to persons and/or property resulting from the condition of the backfilled trench.

13. PLAIN AND REINFORCED CONCRETE AND MORTAR

13.1 Applicable Standard Specifications

Except as otherwise specified or shown on drawings, concrete shall comply with the current A-23 Canadian Standard for Concrete and Reinforced Concrete;
A-23.1 Concrete Materials and Methods of Concrete Construction and A-23.2 Methods of Test for Concrete.

13.2 Gravel

Stone or gravel used in normal concrete for underground construction shall include all the aggregate too large to pass through a 5 mm mesh and that which will pass through a 20 mm mesh. Stone or gravel shall be clean, hard, durable, and well graded.

13.3 Concrete

All concrete shall be proportioned to have a compressive strength of not less than 20 MPa at 28 days. Slump shall be maximum 80 mm and minimum 20 mm. Concrete for manholes to be compacted by mechanical vibration shall have the following maximum and minimum slump:

Floors and roofs -- 50 mm maximum, 20 mm minimum.
Walls -- 80 mm maximum, 20 mm minimum.

13.4 Mortar

Mortar shall be composed of one part cement and three parts sand by volume, and water, all as previously specified. Mortar that has been mixed over ½ hour or that has commenced to set shall not be used. The mortar shall be as dry as practicable to obtain adhesion. Not more than 5% of Mason's Hydrated Lime shall be added to the mortar.

13.5 Admixtures

The use and choice of concrete admixtures will be subject to the approval of the City's representative, but the expense of using admixtures shall be borne by the Contractor.

Air-entraining admixtures if used, shall conform to the requirements of ASTM designation C-260-Current. A cement dispersant may be used at the option of the supplier, with the approval of the City's representative.

13.6 Air Entrainment

The total air content of the concrete at the time of placing shall be 6% ± 1%.

13.7 Concrete Inspection

To ensure that these requirement are met, test results on concrete shall be supplied to the City's representative upon request.

14. COMPLETION TIME

Within 5 days of receipt of purchase order, the Contractor shall submit to the City's representative for approval, a progress schedule showing the proposed dates of the commencement and completion of the project in the time specified.

15. PERMANENT REPAVING

Unless otherwise specified in the Project Specifications the Contractor will be required to complete the permanent repaving of excavated areas. The work will normally be done as follows, unless otherwise specified in the Project Specifications:

Cut (saw cut if necessary) pavement to nominal 150 mm outside of trench width including adjacent extremities of surface damage, settlement or cracking.

Remove temporary patch and sufficient backfill to replace with a minimum of 75 mm compacted hot asphaltic material to the elevation of the existing road grade.

No permanent repaving shall be done at air temperatures below -1°C or when the subgrade is frozen.
In addition to the above, other work including permanent sidewalk and curb and gutter restoration will, if required by the Project Specification, be completed to the satisfaction of the City.