C I T Y O F D U R B A N

STANDARD ENGINEERING SPECIFICATION

PART "DB"

EARTHWORKS FOR PIPE TRENCHES

INDEX TO PART "DB" - EARTHWORKS TO PIPE TRENCHES

PART "DB" - EARTHWORKS FOR PIPE TRENCHES

DB.1 SCOPE

This specification covers earthworks for trenches for all types and sizes of pipes including excavation, preparation of trench bottom, bedding and backfilling.

It does not include bulk excavation and filling or earthworks for structures which are covered in Part DA : Earthworks : Bulk and Part DD : Earthworks for Structures.

DB.2 INTERPRETATIONS

DB.2.1 Definitions

Definitions for this specification are included in Part AB : General Specifications.

DB.2.2 Supporting Specifications

The following Standards are referred to in this specification :

S.A.B.S. 0102 - The Selection of Pipes for Buried 'Pipelines' : Part 2 - 1987 : Rigid Pipes.

as published by General Notice 141 dated 1 February 1985.

S.A.B.S. 1083 - Aggregates from Natural Sources

as published by General Notice 463 dated 9 July 1982.

DB.3 MATERIALS

DB.3.1 Classification for Excavation Purposes

DB.3.1.1 Method of Classification. The Contractor shall undertake the excavation of trenches in narrow trenching conditions with vertical sides necessitating the use of shoring, unless a relaxation allowing the use of open battered trench excavation is detailed in part AA of the Project Specification. The Contractor may use any method for excavating in any class of material, subject to certain blasting restrictions detailed in Part AA : Project Specification, but his chosen method of excavation shall not determine the classification of the excavation which shall be determined by the Engineer based on an inspection of the material to be excavated and the criteria given hereunder.

DB.3.1.2 Classification of Excavation

For the purpose of measurement and payment excavated material shall be classified under the following three headings :

DB.3 MATERIALS (CONT'D)

DB.3.1 Classification for Excavation Purposes (Cont'd)

DB.3.1.2 Classification of Excavation (Cont'd)

(a) Rock

Rock shall be held to be undecomposed boulders exceeding 0,2 m^3 in volume and solid rock occurring in bulk, banks or ledges, the excavation of which would normally necessitate the use of explosives and shall have a total rating in excess of 75, as defined in the following Table. In addition, when tested with a Type L Schmidt hammer, the rock shall have a rebound value above 30, when tested vertically downwards.

(b) Hard Material

Hard material shall be held to be material other than rock which needs to be loosened by pneumatic, hydraulic or mechanical breakers prior to being excavated and shall have a total rating of between 25 - 75 as defined in the following Table. In addition, when tested with a Type L Schmidt hammer, it shall have a rebound value in the range 5 - 30 when tested vertically downwards.

(c) Soft Material

Soft material will be held to be material not falling into the categories of rock and hard material such as gravel, earth, sand, silt, clay and completely weathered rock and shall have a total rating less than 25 as defined in the following Table. In addition, when tested with a Type L Schmidt hammer, it shall have a rebound value less than 5 when tested vertically downwards.

DB.3.1 Classification for Excavation Purposes (Cont'd)

DB.3.1.3 Rock Classification Table

CLASS	I	II	III	IV	V
DESCRIPTION	Very good rock	Good rock	Fair rock	Poor rock	Very poor rock
Seismic Velocity (m/s) Rating	2 150 26	2 150 - 1 850 24	1 850 - 1500 20	1 500 - 1 200 12	1 200 - 450 5
Rock Hardness Rating	Extremely hard 10	Very hard 5	Hard 2	Soft 1	Very soft 0
Rock Weathering Rating	Unweathered 9	Slightly weathered 7	Weathered 5	Highly weathered 3	Completely weathered 1
Joint Spacing (mm) Rating	3 000 30	3 000 - 1 000 25	1 000 - 300 20	300 -50 10	50 5
Joint Continuity Rating	Non continuous 5	Slightly continuous 5	Continuous - no gouge 3	Continuous some gouge 0	Continuous with gouge 0
Joint Gouge Rating	No separation 5	Slight separation 5	Separation 1 mm 4	Gouge - 5 mm 3	Gouge - 5 mm 1
Strike and Dip Orientation Rating	Very unfavourable 15	Unfavourable 13	Slight unfavourable 10	Favourable 5	Very favourable 3
Total Rating	100 - 90	90 - 70	70 - 50	50 -25	25

DB.3.2 Selected Granular Material

Selected granular material shall be material of a granular, non-cohesive nature, that is free draining, non deleterious to the pipe material, has a maximum aggregate size of 20 mm and a compactibility factor (C.F.) not exceeding 0,3 determined by the test given in appendix B of S.A.B.S. 0102 : Part II, 1987.

Acceptable materials are :

(1) coarse river sand : C.F. 0,3;

(2) stone chips graded between 0,6 mm and 19,0 mm : C.F. 0,15.

DB.3.3 Selected Fill

Selected fill shall consist of suitable material as defined in Part AB.1 and shall be free from vegetation, lumps and stones of diameter not exceeding 20 mm and with a compactibility factor not exceeding 0,6.

Acceptable materials are :

(1) selected granular materials as specified in clause DB.3.2;

(2) most river and Berea red sands.

DB.3.4 Backfill Material

(a) Except as provided for in (b) below, excavated material shall be used as backfill in all areas provided that it falls within the Group A1 to A6 of the A.A.S.H.T.O. Classification of Soils, it excludes materials of average dimension greater than 150 mm and it can be compacted in accordance with clause DB.5.7. Material containing more than 10% by mass of rock or hard fragments that are retained on a sieve of nominal aperture size 50 mm, and material containing large clay lumps that do not break up under the action of the compaction equipment being used, will be regarded as unsuitable for use in backfilling.

(b) In areas subject to loads from road traffic and in other areas if specified in PART AA : Project Specification, backfill material shall comply with the specification for "suitable material" as defined in Departmental Specification Part AB.1.

DB.3.5 Cement Stabilised Backfill Material

Backfill material shall be stabilised by the addition of 2 pockets of cement per cubic metre of backfill (approx 1:25 mix by volume). In order to produce a homogeneous mixture the backfill material shall either be mixed using a suitable mixer or mixed by hand before placing the material in the trench. Sufficient water must be added, without saturating the mixture, to achieve uniform mixing and compaction. The processing, placing and compaction must be completed within a period of 6 hours from the time the cement is first added to the material.

DB.3.6 Bedding

Bedding for rigid pipes shall be Class A, B or C. Details of these bedding classes together with the bedding to flexible pipes are shown on drawing No. DB.1 which forms part of this specification.

The material for the bedding cradles shall be -

Class A - Grade 20/26 concrete.
Class B - Selected granular material complying with clause DB.3.2.
Class C - Selected fill complying with clause DB.3.3.
Flexible pipes - Selected fill material complying with clause DB.3.3.

DB.3 MATERIALS (CONT'D)

DB.3.6 Bedding (Cont'd)

The material for any selected fill blanket shall comply with the requirements of Clause DB.3.3.

DB.3.7 Stone Mat

Material used in a stone mat shall consist of 19 mm coarse aggregate conforming to Table 7 of S.A.B.S. 1083.

DB.3.8 Sand for Sub-soil Drains

Sand for sub-soil drains shall be coarse clean sand with a fineness modulus between 2,8 and 3,5.

DB.3.9 Expansion Joints

Material for expansion joints shall consist of 12 mm thick polystyrene or similar approved.

DB.4 PLANT

(a) In general, the Contractor may use whatever plant he considers appropriate to construct the work to the required specification with due regard to the site limitations.

(b) Machine compaction shall not be used directly above the pipe until sufficient backfill has been placed to ensure that the compaction loads transmitted to the top of a pipe shall have no detrimental effect on the pipe or bedding.

(c) Where the work is in a servitude and the Contractor, to gain access to the servitude with his plant, chooses to pass through private property then he shall be fully responsible for obtaining the necessary permission from the property owner and shall, at his own expense, rectify any damage that may be caused.

DB.5 CONSTRUCTION

DB.5.1 Precautions

DB.5.1.1 Stormwater, Seepage and Dewatering of Excavations

The Contractor shall, throughout the works, properly and adequately protect the works from flooding and damage by stormwater, flow from springs and seepage. The excavation shall be kept dry by pumping and/or dewatering.

DB.5.1 Precautions (Cont'd)

DB.5.1.2 Pilot Trenching for Providing Underground Services

In all cases where other services are shown on the drawings either crossing or adjacent to the pipe or where ordered by the Engineer, the Contractor shall carefully excavate by hand to expose and prove the position of such service prior to the commencement of any main trenching operations in the area.

Such exploratory work shall at all times be carried out well in advance of normal construction so that any possible changes to the design of the works necessitated by the proving of services, can be carried out without delay to the construction programme.

In all cases where underground power or telephone cables, water mains or other services are shown on the drawings, either crossing or adjacent to the pipe, or where from site observations it can reasonably be accepted that such services are likely to exist where excavations are to take place, the Contractor shall, without instructions from the Engineer, carefully excavate by hand, to expose and prove the position of such prior to the commencement of the main trenching operations in the area. The cost of this pilot trenching shall be included under payment clause DB.8.5(1) - Excavation and Backfilling in All Materials. However, where any buried service is not located by the excavation of pilot trenches in the expected position the Contractor shall immediately report such a circumstance to the Engineer who will decide what further searching or other necessary action is to be carried out and instruct the Contractor accordingly. The cost of this additional searching shall be to the Council's cost and will be paid for under Item DB.8.19 - Proving Existing Services.

Should any service be damaged by the Contractor in carrying out the works and should it be found that the procedure laid down in this clause has not been followed then all costs in connection with the repair of the service will be to the Contractor's account.

DB.5.2 Site Clearance

DB.5.2.1 General

In addition to the requirements of Departmental Specification Part B : Site Clearance, the Contractor shall clear an area of sufficient width, as specified in the schedule of quantities, along the route of the pipeline to ensure that his operations of selection are not hampered, the minimum width being 1,5 m. Where trenches are in servitudes or wayleaves of specified width, the Contractor shall ensure that clearing and damage to plant growth is restricted to the servitude or wayleave area.

DB.5.2.2 Removal of Trees

Generally where trees or roots are within 1,5 m of the centreline of the pipe, they shall be felled and the stumps completely removed as directed by the Engineer. It is reiterated that no trees shall be removed without the Engineer's approval.

DB.5 CONSTRUCTION (CONT'D)

DB.5.3 Excavation

DB.5.3.1 Selection

(a) The Contractor shall not wastefully dispose of excavated materials that conform to the requirements of clauses DB.3.2 and DB.3.3.

(b) The Contractor shall take positive steps to avoid burying or contaminating materials which otherwise would be suitable and required for use as -

(i) selected fill or selected granular material for pipe bedding, etc.; or

(ii) topsoil; or

(iii) road materials for reuse in terms of Part S : Reinstatement.

(c) When otherwise suitable material from a trench is contaminated, the Contractor shall make up any shortfall by obtaining (at his own expense if the contamination is due to his methods of working) suitable material from other excavations on the site or by opening up borrow pits or by importing from commercial or other sources.

(d) Subject to the provisions of clause DB.3.4, hard rock and boulders from the trench excavation, shall be used for backfilling and where necessary shall be mixed with other backfill material to reduce the percentage of rock to acceptable levels.

(e) Where the material from the trench excavation is considered by the Engineer suitable for bedding or backfilling, the Engineer shall order such material to be used.

DB.5.3.2 General

(a) Excavation shall be undertaken in whatever material is encountered and to such levels and widths as are indicated on the drawings, in the specification or as instructed by the Engineer. Trench excavation shall be undertaken in narrow trenching conditions with vertical sides necessitating the use of shoring and open battered trench excavation will not be permitted unless otherwise stated in Project Specification : Part AA.

(b) Control of the dimensions of the excavations shall be by means of boning rods and sight rails, an acceptable laser beam device or other approved method. It the first method is used the Contractor shall erect sight rails over the centre of each manhole and along the length of the excavation with a maximum distance of 30 m apart and with a minimum number of 3 for any one length of excavation being undertaken. The centre line of the pipeline shall be denoted on each sight rail both back and front by a single vertical line and either side of the centre line painted with contrasting colours.

DB.5 CONSTRUCTION (CONT'D)

DB.5.3 Excavation (Cont'd)

DB.5.3.2 General (Cont'd)

(c) The Contractor shall place a reference peg alongside each sight rail, take the levels and give their values to the Engineer.

(d) Unless otherwise approved by the Engineer the excavation of trenches shall commence from the lower reaches of the trench system and proceed uphill. The total length of open trench in advance of the backfilled trench shall be restricted to a maximum of 200 m.

(e) Should the Contractor excavate to a greater depth than specified he shall, at his own expense, replace the excess material so removed with selected fill compacted to 93% Mod. A.A.S.H.T.O. density, or grade 10/26 concrete if the use of selected fill is not practical.

(f) Where site conditions permit, all materials excavated and required for backfilling shall be removed and neatly stacked where possible along the higher side of the trench, care being taken to restrict the area so occupied so as to cause the minimum of obstruction. Care shall be taken to protect existing structures such as walls, fences, gateways and also hedges, trees, gardens, etc., from damage by material so stacked.

DB.5.4 Trench Bottom

(a) For welded steel pipes, the trench shall be widened and deepened over a suitable length at the joints to provide a minimum clearance of 500 mm on each side of and beneath the pipe to allow working space for the jointing.

(b) Material which the Engineer considers to be unsuitable for the bottom of the trench shall be excavated to depths as instructed and disposed of as surplus material. The resultant space shall be refilled, as ordered, with approved material and compacted to a 93% Mod. A.A.S.H.T.O. density.

(c) The trimming and grading of the trench bottom shall be such that the barrel of each length of pipe to be laid can be uniformly supported for its full length, free at the joints and at the correct grades and levels.

(d) Until the pipeline has been laid and backfilled it is essential that the bottom of the trench should be kept free from water to enable the bedding to be prepared. The Contractor must take suitable precautions to achieve this requirement.

(e) Except where the trench is in rock, hard objects and boulders that may affect the uniformity of the foundation shall be removed to a depth of 100 mm below the trench bottom. The voids formed shall be filled with selected fill and compacted to 93% Mod. A.A.S.H.T.O. density.

(f) Where the bottom of the trench has been loosened due to the Contractor’s method of work it shall be compacted, at the Contractor's expense, to 93% Mod. A.A.S.H.T.O. density to a depth of 150 mm prior to pipelaying and bedding.

DB.5 CONSTRUCTION (CONT'D)

DB.5.5 Bedding

DB.5.5.1 General

(a) Bedding classes are detailed on drawing DB.1 which forms part of this specification.

(b) No bedding shall be laid until the Engineer has approved the trench and authorised pipelaying to proceed.

(c) Except in the case of Class A bedding, the joint holes shall be refilled with fine granular material and lightly compacted to prevent the migration of adjacent pipe bedding material into the holes and to obviate the production of hard spots under joints.

(d) In the placing of bedding, all voids under the overhang of the pipes shall be filled and the compaction shall be carried out uniformly on each side of the pipe so as not to cause any damage, deflection or lateral or vertical displacement of the pipe.

(e) Special attention shall be given to the compaction and ramming of fill material under and around the pipes using suitable hand rammers and/or pneumatic tampers. Care shall be exercised to prevent the compaction equipment coming into contact with and damaging the protective coatings of the pipe or ducts.

(f) Except for the concrete bedding cradle and the first 100 mm of selected fill layer above the crown of the pipe, bedding shall be compacted to 93% Mod. A.A.S.H.T.O. density in layers not exceeding 100 mm.

(g) Any material that is used temporarily to support a pipeline or duct during the construction of the bedding that does not comply with the requirements for the bedding material shall be removed before the selected fill blanket is placed.

(h) Except in the case of concrete class A bedding, the bedding must be completed immediately after laying and testing the pipes as required by the Engineer.

DB.5.5.2 Class A Bedding

(a) The pipes shall be supported on a continuous cradle of compacted grade 20/26 concrete.

(b) During pipelaying and before placing the concrete bedding the pipes shall be suitably supported on temporary supports sufficient to enable the concrete to be placed under the pipes from one side only so that no voids remain.

(c) Care shall be taken during the placing of the concrete to prevent movement or flotation of the pipe.

DB.5 CONSTRUCTION (CONT'D)

DB.5.5 Bedding (Cont'd)

DB.5.5.2 Class A Bedding (Cont'd)

(d) In the case of pipes with flexible joints concrete shall not be allowed to enter the joints and a positive vertical 12 mm expansion joint shall be constructed in the bedding cradle at each pipe joint.

(e) The selected fill blanket shall not be placed until a period of 24 hours has elapsed after the placement of the concrete bedding cradle.

DB.5.5.3 Class B. C and Flexible Pipe Bedding

(a) The pipes shall be bedded on a continuous bed of either selected granular material or selected fill dependant on the class of bedding.

(b) To ensure that each pipe will be fully supported throughout the length of its barrel on the bedding cradle, joint holes shall be formed in the bedding cradle for pipe sockets and couplings.

(c) No temporary supports of the pipes are to be used in the bedding for flexible pipes.

(d) After the pipes have been laid and inspected by the Engineer the remainder of the bedding cradle shall be placed and compacted in uniform layers on both sides of the pipe. The selected fill blanket or granular material should then be placed in 100 mm layers and compacted to 93% Mod. A.A.S.H.T.O. to a height of 300 mm above the top of the pipe.

DB.5.5.4 Bedding for Cable Ducts at Road Crossings

Cable ducts shall be encased with a minimum of 75 mm of grade 10/26 concrete which shall be evenly compacted in such a manner that the duct is not damaged, deflected or displaced.

DB.5.5.5 Concrete Encasement

Where pipes are to be encased, compacted grade 20/26 concrete shall be used to form a square encasement the sides of which shall be equal to the outside diameter plus 300 mm, having a minimum distance from the outside of the pipe to the edge of the encasement of 150 mm. A 12 mm thick expansion joint shall be placed at each joint and at right angles to the pipeline to ensure that the joint remains flexible and that the concrete is not continuous. In the case where a rigid pipe with rigid collars and flexible joints or plastic sleeve joints are used, the space around the collar or sleeve between the two 12 mm expansion joints shall be filled with compacted selected fill.

DB.5.6 Backfilling

(a) Backfilling of pipe trenches shall only commence after the pipe has been laid and firmly bedded in the specified bedding cradle and the selected fill blanket placed and compacted as specified around, under the overhang, and over the top of the pipe to a height of 300 mm and the Engineer is satisfied that the works therein have been completed, tested and are ready for backfilling.

(b) The main backfill shall not be placed in any section until the concrete bedding cradle and concrete encasement in that section has achieved a compressive strength of at least 15 MPa.

(c) Backfilling shall be carried out to the standards specified hereunder over the full extent of the actual trench excavation and to original ground level, except where otherwise directed by the Engineer.

(d) Unless approved, no filling shall be placed in water.

(e) Unless the Contractor is authorised by the Engineer to use other material, material for backfilling shall be obtained from trench excavations.

(f) In areas subject to road traffic loads and where the available backfill has a plasticity index higher than 12, the Contractor shall obtain specific instructions from the Engineer before proceeding with backfilling.

(g) Where the quantity of hard material or rock exceeds that which the Engineer allows to be incorporated in the backfill, the surplus shall be disposed of as specified in clause DB.5.8.

(h) Any deficiency of backfill material resulting from excessive quantities of organic material or clay, the removal of unsuitable material from the trench bottom, or excessive quantities of hard or rock material, shall be made up from suitable surplus material from other excavations on the site. If, in the opinion of the Engineer, insufficient or no suitable material is available for this purpose from such excavations, and the shortage of such material was not caused by the methods used by the Contractor, he shall authorise the Contractor to import sufficient suitable material. The Contractor shall so arrange his work that the importation of backfill material is kept to a minimum in respect of both quantity and overhaul.

(i) Where trenches are in road reserves or paved areas, the Contractor shall clean the road surface or paved area (as applicable) adjacent to the trench.

DB.5.7 Compaction

(a) Except as provided in clause DB.5.7(b) each trench shall be backfilled in layers not exceeding 300 mm in thickness and the material shall be compacted to 93% Mod. A.A.S.H.T.O. density.

DB.5 CONSTRUCTION (CONT'D)

DB.5.7 Compaction (Cont'd)

(b) In road reserve areas subject to vehicular traffic and in such other areas as are specified in Part AA : Project Specification, trenches shall be backfilled in layers not exceeding 150 mm in thickness and the material shall be compacted to 95% Mod. A.A.S.H.T.O. density.

DB.5.8 Disposal of Displaced Material

(a) Unless otherwise stated in Part AA : Project Specification, material becoming surplus because of bulking or displacement by the pipeline and unsuitable material shall be disposed of at the tip site and the Contractor must comply with any relevant requirements for disposal of material at the tip site.

(b) Surplus material where permitted to be disposed of on site shall be neatly spread in areas and thickness of layers as approved by the Engineer. In depositing spoil care shall be taken to avoid damage to adjoining buildings, fences, drains, furrows, gutters, culverts, etc., and any claims in this respect shall be settled by the Contractor.

DB.5.9 Settlement

Should any subsidence take place in any trench after filling and should the Contractor fail to attend to such settlement within 4 hours of being instructed to do so by the Engineer, then the Council may take whatever steps are necessary such as erection of barricades, importing fill material, etc., at the Contractor's expense and without relieving him of any of his responsibilities under this contract.

DB.5.10 Damage to Road Surfaces

Where, during the executive of the Works, any road or paved surface adjacent to a trench has been damaged in any way whatsoever by the Contractor's equipment or settlement, the Contractor shall, at his own expense and as soon as practicable, repair and restore such surface to a condition at least equivalent to that previously existing.

DB.6 TOLERANCES

DB.6.1 Maximum Trench Width

The trench width to a height of 300 mm above the pipe shall not exceed the values within the depth ranges as given in the following table :

Pipe Nom. Diam. mm	Max. Trench Width mm	Transition Depth m	
100	700	5,0	Note
150	750	4,0	
225	825	2,4	1. At depths less than the
300	900	3,0	transition depth there is no
375	1 050	3,0	restriction on the maximum
450	1 150	2,5	width of trench.
525	1 200	2,0	
600	1 350	1,8	2. The restriction on the
675	1 450	1,5	maximum trench width only
750	1 550	1,5	applies to the trench
825	1 650	1,5	between the invert and
900	1 900	2,3	300 mm above the top of
1 050	2 050	2,1	the pipe.
1 200	2 300	2,3	

Should the Contractor exceed the maximum trench width without the Engineer's approval he shall accept responsibility for all costs incurred in strengthening the relevant pipe line.

DB.6.2 Minimum Trench Width

The minimum trench width shall be regarded as that width as defined in clause DB.8.3.3 except that the minimum base width for pipes, excluding cable ducts, of nominal internal diameter up to 100 mm and laid at a depth of 1,5 m or less shall be 600 mm. Cognisance shall also be taken of the requirements for widening at joints as required in clause DB.5.4.(a), for working space and for shoring.

DB.6.3 Alignment and Level

Trenches shall be excavated such that at least half of the minimum trench width is on each side of the designated centreline of the pipe. The invert level of the trench shall be such that the pipe may be laid and bedded in the trench within the tolerances specified for the pipeline as detailed in the relevant departmental specification.

DB.6.4 Densities

No densities below those specified shall be accepted.

DB.6.5 Compactibility Factor

The compactibility factor for selected granular material may be less than but shall not exceed, the approved value.

DB.7 TESTING

The compaction control testing shall be carried out by the Contractor.

Density

Position	Roadways, Sidewalks	Other Locations
Trench formation	1 No. per 30 lin m	1 No. per 100 lin m
Bedding Cradle & Selected Fill Blanket	2 No. per 30 lin m	1 No. per 100 lin m
Backfill	1 No. per layer per 15 m^2 or part thereof	1 No. per 2 layers per 50 m^2 or part thereof

The positions of the tests shall be selected by the Engineer.

The cost of all control testing is covered under the Preliminary and General section of the Schedule of Quantities.

Acceptance testing is undertaken by the relevant Durban Corporation Department at the discretion of the Engineer after reviewing the results of the control testing.

DB.8 MEASUREMENT AND PAYMENT

DB.8.1 General

(a) Excavations will be measured either by length or by volume as indicated in the Schedule of Quantities.

(b) Separate items shall be scheduled for excavation to accommodate differing pipe sizes when measured by length and also for each length of trench with various depth horizons starting with 0 to 1,5 m depth and thereafter in 0,5 m increments.

(c) Where the Contractor elects to excavate in headings instead of in normal shored, narrow trench, the length or volume of trench that will be measured for payment shall be based on the assumption that normal shored, narrow trench excavation has been carried out. The length or volume in the undisturbed prism of material between the top of the tunnel and ground level, shall be classified as soft excavation in terms of clause DB 3.1.2.(c). No additional payment shall be made for such headings and no deductions shall be made for reduced excavation quantities.

(d) Extra over items shall be provided for excavation in rock and hard material but separate items shall not be provided for depth increments. Volumes shall be computed from the width determined in accordance with clause DB.8.3.3 and the depth from the top of the rock or hard excavation, as the case may be, to the bottom of the same materials or to the bottom of the trench as specified in clause DB.8.3.2, whichever is the lesser.

DB.8 MEASUREMENT AND PAYMENT (CONT'D)

DB.8.1 General (Cont'd)

(e) An extra over item shall be provided for the cement stabilisation of the backfill but separate items shall not be provided for depth increments. Volumes will be computed from the width determined in accordance with clause DB.8.3.3 and the depth to be stabilised as required by the Engineer.

(f) Bulk earthworks if scheduled will be specified in Part DA : Earthworks : Bulk.

(g) The measurement for additional excavation for manholes, valve chambers etc. over and above the trench pay-width is NOT included in trench excavations but is covered in Part PH : Manholes.

(h) No separate measurement or payment shall be made for any necessary deepening or widening of the trench to enable any jointing or inspection to be undertaken.

(i) The trench width required for proving of services need only be of sufficient width to enable the service to be exposed.

(j) The disposal of excavated material that has become surplus because of bulking or displacement by the pipe will not be measured separately and the Contractor shall include in his rates under the relevant scheduled item for its disposal to tip or elsewhere if stated in Part AA : Project Specification. The disposal of excavated materials that have become surplus due to importation of material and cannot be disposed of within the free haul distance will be scheduled separately.

(k) Freehaul for all earthwork material in Part DB unless stated otherwise in Part "AA" : Project Specification will be 0,1 km.

DB.8.2 Bedding

(a) No separate payment will be made for the provision of selected materials for bedding or for backfill where suitable material is available from scheduled excavations within the free haul distance.

(b) The provision alongside the trench of bedding materials from the scheduled excavations in excess of the freehaul distance, designated borrow areas or commercial sources that comply with the relevant requirements of the specification will be measured separately.

(c) Items shall be provided to cover the cost of placing and compacting bedding materials up to the underside of the backfill for the various pipe diameters and classes of bedding.

(d) The supply of the concrete for the Class A bedding cradle will be measured separately and in addition to the supply, the rate shall also include for its placing, formwork and provision of flexible joints for all diameters of pipes regardless of the methods of construction.

DB.8 MEASUREMENT AND PAYMENT (CONT'D)

DB.8.2 Bedding (Cont'd)

(e) The commercial or offsite source from which the Contractor obtains the materials for both the bedding cradle and the selected fill blanket is his sole responsibility.

DB.8.3 Measurement Definitions

DB.8.3.1 Trench Length

The measurement for excavation shall be the total through length along the centre line of a pipeline measured HORIZONTALLY without any deductions for manholes, catchpits, valves and valve boxes. The measurement for branch lines shall be taken from the intersection of the centre line of the branch pipeline with the nearside of the main trench to the end of the branch line.

DB.8.3.2 Trench Depth

Trench depth shall be measured VERTICALLY on the centre line of the pipeline to the underside of the specified bedding cradle from whichever is the least of the following :

(a) the existing ground level where existing ground level is not lowered;

(b) the formation level under the carriageway in cuttings or on embankments;

(c) the finished earthworks level prior to pavement construction or placement of topsoil on verges or central reserves;

(d) the finished earthworks level prior to placement of topsoil on side slopes;

(e) the level of construction reached, which should not be less than 300 mm above crown of pipe should the Contractor elect to excavate for the pipe trench before completion of the embankment to formation level.

DB.8.3.3 Pay Trench Width

For payment purposes only, where measurement is specified by volume and a pipe is to be laid, the pay trench width shall be as indicated in the table below which is based on the excavation having vertical sides. Wherever the pay width is used to compute the measurement of volume in the following measurement and payment items provision shall be allowed in the rates for additional excavation necessary to either shore or batter back, the trench sides, if open battered trench excavations is permitted.

DB.8.3 Measurement Definitions (Cont'd)

DB.8.3.3 Pay Trench Width (Cont'd)

PAY TRENCH WIDTH		
Nominal Diam. (mm)		**Trench Width mm**
over	**up to**	
-	100	700
100	700	nominal internal diameter plus 600
700	1 000	" " " plus 800
1 000	2 000	" " " plus 1 000
2 000	-	" " " plus 1 200

For combined trenches, pay trench width shall be half the width of trench for each pipe determined above plus 300 mm plus the sum of half the nominal internal diameter of each pipe.

For cable ducts, pay trench width shall be the width of the pipes laid side by side plus 75 mm between each pipe plus 150 mm.

DB.8.4 Removal of Topsoil

The unit of measurement shall be square metres (m^2) with the depth stated. The area will be computed from the length of the pipeline route from which removal is specified or ordered and the trench width determined in accordance with clause DB.8.3.3.

The unit rate for the removal of topsoil shall include for -

(1) stripping of soil to stated depth;
(2) stockpiling in suitable area on site regardless of distance;
(3) prevention of dust nuisance; and
(4) allowance for bulking and wastage

DB.8.5 Excavation and Backfilling in All Materials

The unit of measurement shall be either the linear metre (m) or the cubic metre (m^3).

The unit rate for excavation and backfilling in all materials shall include for -

(1) excavating for trenches including working space, upholding of the sides and roof (in the case of headings), complying with the safety and protection requirements, keeping the excavation free of water and taking precautions to avoid damage to existing sewers, drains and services including providing temporary supports;

(2) trimming and compacting to 93% Mod. A.A.S.H.T.O. density of trench bottom where loosened;

DB.8 MEASUREMENT AND PAYMENT (CONT'D)

DB.8.5 Excavation and Backfilling in All Materials (Cont'd)

(3) the removal of hard material 100 mm below the trench bottom, its backfilling and compaction in accordance with clause DB.5.4(e);

(4) additional excavation to accommodate jointing of welded steel pipes;

(5) backfilling with material from the trench excavation or imported material including mixing if necessary with rock or hard material;

(6) moving and deposition in the trench, material from the trench excavation that is suitable for bedding;

(7) compacting backfill to 93% Mod. A.A.S.H.T.O. density;

(8) disposing of surplus material due to bulking or displacement by the pipe;

(9) allowing for bulking or shrinkage of material upon excavation and wastage.

DB.8.6 Excavation in Hard Material and/or Rock - (Provisional)

The unit of measurement shall be cubic metres (m^3) and shall be measured as an Extra Over to item DB.8.5.

The unit rate for excavation in hard material and/or rock shall also include for -

(1) the additional cost of excavation and handling the material;

(2) the provision of material and backfilling of any overbreak greater than the pay trench width.

DB.8.7 Excavation in Road and Paved Areas

The unit of measurement shall be the cubic metre (m^3) and shall be measured Extra Over to clause DB.8.5.

The volume shall be computed from the trench length, the pay trench width and the depth of bituminous or cement bound surfacing materials only.

Unbound materials such as crusher run or road stones will not be included in this measurement or paid for separately. The unit rate for excavation in road and paved areas shall also include for -

(1) the additional cost of excavation;

(2) cutting through and trimming edges of surfacing;

(3) disposal to tip of material unsuitable for re-use; and

(4) selection and storage or existing materials suitable for possible re-use in trench reinstatement as required in clause DB.5.3.1.(b).

DB.8.8 Excavation of Unsuitable Material from Trench Bottom - (Provisional)

The unit of measurement shall be the cubic metre (m^3) which will be computed from the pay trench width and the additional depth ordered.

The unit rate for excavation of unsuitable material from trench bottom shall include for -

(1) items (1), (2), (5), (6) and (9) in clause DB.8.5;

(2) the extra costs of the excavation; and

(3) compacting fill material to 93% Mod. A.A.S.H.T.O. density.

DB.8.9 Provision of Bedding Materials Excluding Concrete - (Provisional)

Separate items will be provided for the provision of the various types of bedding materials from three sources -

(a) scheduled excavation in excess of the freehaul distance;

(b) designated borrow areas; and

(c) commercial or off site source selected by the Contractor.

Except in the case of supply of bedding materials from a commercial or off site source selected by the Contractor, haulage in excess of freehaul distance will be measured separately as overhaul.

The unit of measurement shall be the cubic metre (m^3), which shall be computed from the pay trench width, the length of bedding and the depth of bedding with the volume of the pipe being deducted, measurement being at the position of its final placement.

(a) The unit rate for the provision of bedding materials from excavations on site in excess of the freehaul distance shall include for -

(1) selecting bedding materials of stated types;

(2) loading, haulage within the freehaul distance, deposition of the material on the work site to suit the Contractors method of working;

(3) adjustment of moisture content of material as necessary for bedding material; and

(4) allowing for bulking or shrinkage or material and wastage.

(b) The unit rate for the provision of bedding materials from designated borrow areas shall include for -

(1) excavating, loading, haulage within the freehaul distance, deposition of the material on the work site to suit the Contractor's method of working;

DB.8.9 Provision of Bedding Materials Excluding Concrete - (Provisional) (Cont'd)

(2) excavating, separating from bedding material, loading, hauling and depositing and spreading of unsuitable material to spoil in tip off site, or on site where permitted by the Engineer.

(3) constructing and maintaining haul routes;

(4) selecting bedding material of stated types;

(5) loosening or breaking up unexcavated material before or in the process of excavation;

(6) allowing for bulking or shrinkage of material upon excavation and wastage;

(7) keeping the borrow area free of water; and

(8) adjusting moisture content as necessary for bedding material.

(c) The unit rate for the provision of bedding material from a commercial or off site source selected by the Contractor shall include for -

(1) cost of acquisition of the material including all royalties;

(2) all transportation costs regardless of distance; and

(3) deposition of the material on the work site to suit Contractor's method of working.

DB.8.10 Operation of Placing and Compacting Bedding Materials Excluding Concrete

The unit of measurement shall be the linear metre (m).

Over and above the item coverage requirements of clause DB.8.5, the unit rate for the operation of placing and compacting bedding materials excluding concrete shall also include for -

(1) additional cost of placing the bedding materials under and around the pipe up to the underside of the backfill and working in restricted conditions; and

(2) compacting the bedding materials.

DB.8.11 Concrete Bedding Cradle - (Provisional)

The unit of measurement shall be the cubic metre (m^3) and the volume shall be computed as detailed on Drawing DB.1, from the pipe-details, the pay trench width and length of class A bedding required.

The unit rate for concrete bedding cradle shall include for -

(1) provision of concrete to place of deposition;

DB.8.11 Concrete Bedding Cradle - (Provisional) (Cont'd)

(2) placing and forming bedding cradle;

(3) all formwork if required;

(4) provision and construction of joints;

(5) testing of concrete (see Department Specification Part 'C' : Concrete Work clause C.7); and

(6) disposal of surplus material.

DB.8.12 Encasing of Pipes in Concrete - (Provisional)

The unit of measurement shall be the cubic metre (m^3) and the volume of concrete shall be computed from a square encasement of sides equal to the outside diameter of the pipe plus 300 mm minus the volume of pipe.

The unit rate for encasing pipes in concrete shall include for -

(1) provision of concrete to place of deposition;

(2) placing and compaction of concrete;

(3) all formwork;

(4) provision and construction of joints;

(5) additional excavation in all materials including the disposal of surplus material; and

(6) testing of concrete.

DB.8.13 Imported Backfill Materials - (Provisional)

Such material shall be obtained from either -

(a) scheduled excavations in excess of the freehaul distance;

(b) a designated borrow area; and/or

(c) a commercial or off site source selected by the Contractor.

With the exception of imported backfill material from commercial or offsite source selected by the Contractor, the haulage in excess of the freehaul distance will be measured as overhaul.

The unit of measurement shall be the cubic metre (m^3) and the volume shall be computed from the pay trench width and the length and depth of material ordered in writing by the Engineer as being unsuitable for the backfilling of the trench.

DB.8.13 Imported Backfill Materials - (Provisional) (Cont'd)

(a) The unit rate for the supply of imported backfill material from surplus material from scheduled excavations in excess of the freehaul distance shall include for -

(1) loading, haulage within the freehaul distance, deposition of the material on the work site to suit the Contractors method of working; and

(2) allowance for bulking or shrinkage of material and wastage.

(b) The unit rate for imported backfill material from a designated borrow area shall include for -

(1) excavating, loading, haulage within the freehaul distance, deposition on the work site to suit the Contractors method of working;

(2) excavating, separating from suitable material, hauling and depositing and spreading of unsuitable material to spoil in tip off site or on site where permitted by the Engineer;

(3) constructing and maintaining haul routes;

(4) selecting suitable material of stated types;

(5) loosening or breaking up unexcavated material before or in the process of excavation;

(6) allowing for bulking or shrinkage of material upon excavation and wastage;

(7) keeping the borrow pit free of water; and

(8) adjusting moisture content of material as necessary to achieve the specified density for backfill material.

(c) The unit rate for imported backfill material from commercial or off site source selected by the Contractor shall include for -

(1) cost of acquisition of the material including all royalties;

(2) all transportation costs regardless of distance; and

(3) deposition on the work site to suit the Contractor's method of working.

DB.8 MEASUREMENT AND PAYMENT (CONT'D)

DB.8.14 Cement Stabilised Backfill - (Provisional)

The unit of measurement shall be the cubic metre (m^3) and shall be measured Extra Over to item DB.8.5. The unit rate for cement stabilisation of the backfill shall also include for -

(1) supply of cement;

(2) all mixing and processing of the backfill material; and

(3) complying with the time restriction of 6 hours.

DB.8.15 Disposal of Unsuitable Material or Surplus Material caused by the Importation of Suitable Backfill or Bedding Materials - (Provisional)

The unit of measurement shall be the cubic metre (m^3) and the volume of material shall be measured in the trench and computed from the pay trench width, the depth of unsuitable material excavated and the length specified.

Haulage in excess of the freehaul distance will be paid as overhaul. The unit rate for the disposal of unsuitable material or surplus material caused by importation shall include for -

(1) loading, haulage, deposition at disposal site and spreading; and

(2) allowing for bulking or shrinkage of material and wastage.

DB.8.16 Opening Up and Closing Down of the Designated Borrow Area

The unit of measurement shall be - Sum

The unit rate for opening up or closing down of a designated borrow pit shall include for -

(1) site clearance of the borrow site area;

(2) excavating topsoil and stockpile for re-use;

(3) excavating to controlled design levels supplied by the Engineer including forming all faces to a stable slope of maximum grade 1 : 2;

(4) keeping borrow area free from standing water; and

(5) taking topsoil from stockpile and spreading over borrow site to a uniform thickness as directed by the Engineer;

DB.8 MEASUREMENT AND PAYMENT (CONT'D)

DB.8.17 Overhaul - (Provisional)

The haulage of material within the freehaul distance will not be measured.

The overhaul distance will be the distance between the centre of the overhaul volume of the material prior to excavation, borrow or stockpile and its authorised position of placing less the freehaul distance measured to the nearest 0,1 km.

The unit of measurement shall be cubic metres-kilometre (m^3Km)

The volume of material to be hauled from site or designated borrow area shall be that measured in the trench at its place of deposition, computed from the pay trench width and the depth of backfill or bedding specified.

The unit rate for overhaul shall include for -

(1) haulage and return journey; and

(2) bulking of material.

DB.8.18 Compaction in Road Reserves

The unit of measurement shall be the cubic metre (m^3) measured Extra Over to the unit rate specified under clause DB.8.5 and the volume shall be computed from the pay trench width and the depth of trench as specified in clause DB.8.3.2 from the finished road formation level to 300 mm above the top of the pipe.

The unit rate for compaction in road reserves shall include for additional compactive effort as specified in clause DB.5.7.(b).

DB.8.19 Proving Existing Services - (Provisional)

The unit of measurement shall be the cubic metre (m^3) with various depth horizons starting with up to 1,5 m depth and thereafter in 0,5 m increments.

The unit rate for proving existing services shall include for -

(1) all as items (1), (5), (7), (8), and (9) of clause DB.8.5;

(2) extra over cost of permanent reinstatement as specified in Part S : Reinstatement;

(3) extra over cost of compaction in road reserves for work in small areas;

(4) for proving services anywhere within the contract area and in advance of the main excavation; and

(5) special care in excavation by hand in vicinity of services.

DB.8 MEASUREMENT AND PAYMENT (CONT'D)

DB.8.20 Trench Shoring to Remain in the Excavation - (Provisional)

The unit of measurement shall be the square metre (m^2) and both sides of the trench shall be measured.

The unit rate for trench shoring to remain in the excavation shall include for -

(1) the supply and placing of trench shoring and other support measures;

(2) maintenance; and

(3) additional costs for backfilling and compaction with trench supports left in trench.