

SECTION R4

Pipes and general drainage

R4 01 Scope

The work covered by this Section of the Specification consists in furnishing all plant, equipment, materials and labor, and in performing all operations in connection with constructing all sewage and surface water pipe drains and gullies complete, subject to the terms and conditions of the Contract, and in strict accordance with this Section of the Specification and the applicable Drawings.

R4 02 General drainage pipes

All pipes and joints for use in surface water drainage and pipe drains shall comply with the requirements of Clauses R4 03 to R4 10 inclusive unless otherwise approved by the Engineer's Representative. Pipes for service ducts shall comply with the requirements of Clause R4 11.

R4 03 Concrete pipes

Concrete pipes for general drainage use shall be of the spigot and socket or ogee jointed type and shall be of approved manufacture and design and comply with the requirements of BS556 Part 2 (1972) except that they may be supplied complete with flexible joints, as supplied by the manufacturer. Unless otherwise described in the Contract, they shall be Standard pipes. Prestressed concrete pipes shall comply with the requirements of BS4625 (1970). The cement used in the manufacture of pipes shall be sulphate resistant Portland cement, according to AASHTO M85 Type (v) unless otherwise provided in the Special Specification of Particular Application. Flexible joints shall be so constructed as to tolerate 2cm of longitudinal movement without breaking the seal. They shall also tolerate deviations in any direction from a straight line not less than those given in Table R4/ 1.

TABLE R4/1
CONCRETE PIPE FLEXIBLE JOINT MOVEMENT TOLERANCES

Pipe Diameter		Angle
Cm	inches	
15 to 60	6 to 24	2°
60 to 120	27 to 48	1°
over 120	over 48	0' 6°

Pipes for use in French drains shall be porous pipes of approved manufacture and design with rebated or butt joints as specified in AASHTO M176-73.

The Contractor shall submit to the Engineer's Representative for his approval samples of the aggregate with which the pipes are manufactured and certificates as to compliance with Section R3. The date and manufacture shall be stamped on each pipe in respect of each

consignment of pipes delivered on the Site. Each batch of pipes intended to be delivered to the Site shall be available for inspection by the Engineer's Representative at the place of manufacture and such tests as the Engineer's Representative may require shall be carried out. Pipes which are not approved by the Engineer's Representative shall be immediately removed from the Site.

R4 04 Clay pipes

Pipes to be used for sewage or surface water shall be of approved manufacture and design or "British Standard" pipes manufactured in accordance with the requirements of BS65 and 540 Part I (1971) with Type 1 sockets and supplied complete with the manufacturer's flexible joint or with Type 2 sockets for cement mortar.

Flexible joints shall provide for an angular deflection of not less than 5° for diameters up to 30cm and 2½° for diameters of 37·5cm or greater, the deflection being measured as deviation in any direction from a straight line. They shall provide for a draw of 2cm of longitudinal movement without breaking the seal.

Pipes for use in the construction of French drains shall be of approved manufacture and design. Agricultural tiles or pipes shall be best well-burnt earthenware, sound, true, circular in bore, with plain ends suitable for laying with open or butt joints.

R4 05 Cast or spun iron pipes

Pipes shall be of approved manufacture and design with spigot and socket joints and shall comply with the requirements of BS437 Part 1 (1970) or BS1211 (1958).

R4 06 Corrugated metal pipes

Pipes for general drainage use shall comply with the Standard Specification for Zinc Coated (Galvanized) Corrugated Iron or Steel Culverts and Underdrains AASHTO M36-74.

The pipes shall be manufactured from steel complying with AASHTO M218-74.

Pipes for use in French drains shall comply with the Standard Specification for Zinc Coated (Galvanized) Corrugated Iron or Steel Culverts and Underdrains, AASHTO M36-74 with the exceptions stated above for pipes for general drainage use. All corrugated metal pipes of 15cm nominal internal diameter shall be manufactured from sheet of 1·2mm minimum thickness (18 gauge). Pipes of nominal internal diameter greater than 15cm, but not greater than 60cm, shall be manufactured of sheet 1·6mm minimum thickness (16 gauge). If the Contractor wishes to use corrugated metal pipes of larger diameter than 60cm, he shall provide the diameter and gauge of pipe required by the Engineer to suit the now characteristics and metal gauge requirements of the design.

R4 07 Pitch fiber pipes

Pipes for general drainage use shall comply with the requirements of BS2760 (1973). The pipes shall not be used for unsupported or exposed pipelines.

Pipes for use in French drains shall be perforated and shall comply with the requirements of BS2760 (1973).

R4 08 Steel pipes

Unless otherwise described in the Contract, steel pipes may be of any of the types and with any of the types of joint specified in BS 534.

R4 09 Pipes of synthetic materials

Pipes for general drainage use shall be approved pipes of polythene, polypropylene or polyvinylchloride.

Pipes for French drains shall be perforated or slotted with slots not wider than 1mm and holes not greater than 8mm dia., but otherwise shall comply with BS3506 (1969).

R4 10 Asbestos cement pipes

Asbestos cement pipes shall comply with the requirements of AASHTO M217-73.

R4 11 Service ducts

Service ducts shall have a smooth internal bore and joined so that no silt, grit, grout or concrete surround is able to enter the duct. Pipes with push-fit joints shall have a register to ensure that the joint is fully pushed home. They shall be constructed of:

1. Unplasticised polyvinylchloride pipes complying with Class B or C of BS3506 (1969), bedded and surrounded in Class E concrete as specified in Clause B8 09 to the dimensions shown on the Drawings, when the pipe is laid in an excavated trench.
2. Steel pipes and joints complying with BS534 (1966).
3. Internally glazed vitrified clay ducts with plastic flexible sleeve joints. When tested in accordance with Appendix B of BS65 and 540 Part 1 (1971) the ducts shall conform to the extra strength requirements of Table 5 of BS65 and 540 Part 1 (1971).
4. Glazed earthenware pipes with Type 1 sockets with flexible joints, manufactured in accordance with the requirements of BS65 and 540 Part 1 (1971), and shall conform to the extra strength requirements of Table 5 of BS65 & B5540 Part 1.

R4 12 Gullies

Precast concrete gullies shall be round, unreinforced, made from sulphate resistant Portland cement, and shall comply with the requirements of BS556 Part 2 (1972) unless otherwise specified in the Special Specification of Particular Application. Each pot shall have an internal diameter of 45cm, an internal depth of 90cm and a 15cm diameter outlet: a rodding eye, stopper and chain shall be fitted to each pot. Gullies leading into foul sewers or combined foul and surface water sewers shall be trapped.

Sail glazed ware gullies shall be of approved manufacture and design or comply with the requirements of BS539 (1971) in respect of round street gullies.

Cast iron gullies shall be of approved manufacture and weights described in the Contract.

The gully pot shall be set on a foundation of 15cm of Class 150 sulphate resistant concrete and this shall be haunched up about the bottom of the pot to a height of 45cm above the bottom of the chamber and to a minimum thickness of 15 cm. A surround of

sound brickwork 12cm thick shall be formed about the top of the gully pot to form a base to receive the frame, which shall be set in cement mortar at the correct level.

Junction pipes which are laid, but not immediately connected to gullies, shall be fitted with temporary earthenware stoppers or seals, and the position of all such junctions shall be clearly defined by means of stakes or training wires properly marked and labelled.

R4 13 Gully covers and frames

Gully covers and frames shall be of approved manufacture and design.

R4 14 Excavations

Excavation for culverts, pipelines and drains shall be carried out in trenches and be straight and true to the lines and levels shown on the Drawings. All trenches shall be excavated to such width as will give adequate room in the trench for the proper support of the pipe, and shall be excavated to a sufficient depth and width to enable the pipe and any specified or agreed joint, bedding, haunching and surround to be accommodated. Trenches shall be of width not exceeding the outside diameter of the pipe plus 30cm up to a level 30cm above the top of the pipe barrel, but the width of trenches for lines of flexible pipes shall not be less than the outside diameter of the pipe plus 30cm.

The sides of the trenches shall at all times be adequately supported by means of waling, struts and runners or sheet piling of sufficient number and dimension to prevent the falling in, movement or slipping of the ground, injury to workmen and damage to the Works or adjacent property.

Before any pipes are laid, or concrete bed placed in the trench, the base of the excavation shall be trimmed true in cross-section and gradient and hand-rammed solid. Any part of the formation which is disturbed or damaged shall be excavated to such additional depth as may be required by the Engineer's Representative and be made up to the proper level with normal Class E Concrete as Clause B8 09 at the Contractor's expense.

Where solid rock is encountered, it shall be removed below grade and the trench backfilled with compacted sand, gravel or bedding material as specified under Bedding in Clause R3 04-4 so as to provide a compacted soil cushion with a thickness under the pipe of not less than 3cm per meter of height of fill over the top of the pipe, with a minimum allowable thickness of 20cm. Where a firm foundation is not encountered, due to soft, spongy or other unsuitable material, all of such unsuitable material under the pipe and for a width of not less than one diameter on each side of the pipe shall be removed and the space backfilled with gravel or bedding material properly compacted to provide adequate support for the pipe.

Unless otherwise specified in the Special Specification of Particular Application, where pipes are installed in new embankments, the embankment shall be constructed to a minimum height equal to the outside diameter of the pipe plus 60cm and to a width of not less than five times the diameter of the pipe. The trench shall then be excavated with vertical sides as specified above for normal pipe trenches.

R4 15 Excavation to be kept free from water

The Contractor shall keep the trenches and other excavations quite free from water, whether affected by floods, storms or otherwise, so that the works may be constructed in dry conditions. He shall construct, as may be required by the Engineer or Engineer's

Representative, such grips or channels or sub drains at levels lower than the bottom of the permanent works to convey the water to sumps which he shall construct in positions convenient for the disposal of the liquid drained thereto. The grips, channels, sub-drains and sumps shall be constructed clear of the permanent works and shall be filled solid with Class E concrete as Clause B8 09, as the permanent work proceeds to the satisfaction of and as may be ordered by the Engineer's Representative.

The sub-drains shall be formed with agricultural pipes of adequate diameter and laid in trenches not more than 30cm wide and the trenches shall then be filled with approved filling material as Clause R4 22. Immediately before the construction of any permanent work is commenced these trenches shall be covered with approved waterproof paper which shall lap both sides of such trenches by at least 15cm.

The Contractor shall also provide, fix, maintain and work such engines, pumps, hoses, chutes and other appliances as are necessary to keep the sub-soil or accumulated water at a level lower than the bottom of the permanent works for such periods as the Engineer's Representative shall direct. After raising the water herein referred to, the Contractor shall immediately convey it away from the Works in such a manner as not to cause any nuisance or Injury.

No water shall be discharged into any watercourse or sewer without the permission in writing of the Engineer, and such permission shall not be granted unless the Contractor shall have provided to the satisfaction of the Engineer an efficient settling basin or sand trap through which all such water shall pass before discharge into the said watercourse or sewer.

The Contractor shall take care to avoid undermining any part of the Works or other properties by pumping, but should undermining occur he shall immediately make good the same to the satisfaction of the Engineer's Representative.

The costs incurred by the Contractor in complying with the requirements of this clause shall be borne by the Contractor and included in the price rates for excavation or other appropriate items.

R4 16 Laying and bedding

Pipe sewers and drains shall be correctly laid in the position indicated on the Drawings, or to such other alignment as ordered by the Engineer's Representative.

All pipes shall be laid true to line and level, each pipe being separately boned between sight rails.

Reinforced Concrete Pipes shall be laid and bedded as Section R3 unless otherwise shown on the Drawings or directed by the Engineer's Representative.

Unless otherwise directed all concrete pipes shall be laid on a concrete bed of finished thickness of at least 15cm below the barrel of the pipe and a width of at least 7.5cm greater than the external diameter of the pipe barrel. In such cases, a concrete mat at least 7.5cm thick shall first be laid on the bottom of the trench and shall be allowed to set before pipe-laying is commenced. Where the bottom of the pipe socket is liable to touch the concrete bed, the concrete should be cut out under the pipe socket before hardening. The Contractor shall include in his prices for providing bricks or rectangular blocks composed of Class 230 concrete made in approved moulds at least 14 days before use and approved hardwood folding wedges. Two blocks shall be provided for each pipe, one behind the socket, and shall be set and boned in to the correct level on the formation bottom and the pipe shall be laid on them and properly centered and socketed. Two hardwood folding wedges of width

equal to the width of the concrete block shall then be inserted between the body of the pipe and the block and shall be driven together until the pipe is brought to the exact level required. Blocks and wedges shall then be left undisturbed while the pipes are being jointed, the pipeline tested and the concrete surround is being placed in position.

The Contractor shall be responsible for ensuring that all blocks and wedges are of sufficient size and strength to prevent settlement of the pipes and any settlement shall be made good at his own expense.

The trenches shall only be bottomed up immediately in advance of pipe laying but no pipes shall be laid until a distance of at least 10m along the trench has been prepared and bottomed up to receive the pipes, unless specially permitted otherwise by the Engineer's Representative. The trenches and joint holes shall be kept free from water until the pipes are laid, jointed and surrounded with concrete.

At every point of loading or unloading pipes or castings must be handled by approved lifting tackle. Unloading by rolling down planks or any other form of inclined ramp will not be allowed unless the written consent of the Engineer's Representative to the method proposed has been obtained.

R4 17 Jointing pipes

The general specification requirements for jointing concrete pipes shall be as Clause R3 04-5.

1. In the jointing of spigot and socket concrete pipes a ring or gasket of twisted tarred rope yarn, in one continuous piece, shall be wound tightly and uniformly round the spigot end of the pipe, to ensure the bores coinciding all round, then inserted in the socket of each pipe previously laid and lightly caulked with a wooden caulking tool and wooden mallet. The yarn, composed of hemp, twisted jute or oakum, when in position shall not occupy more than one quarter of the total depth of the socket. The socket shall then be carefully and completely filled with mortar made with the consistency of putty and consisting of one part of sulphate resistant cement to three parts of sand and the joint leveled off and finished smooth at an angle of 45° outside the top end of the socket.
2. Individual lengths of clay pipe to BS 65 and 540 Part] (1971) and of concrete pipe to BS 556 Part 2 (1972) shall, unless specified to be laid with open joints, be coupled together by means of flexible joints of a type recommended by the manufacturer of the pipe and fitted in the manner recommended by the manufacturer of the joints.

Alternatively, spigot and socket joints may be caulked as for concrete pipes.

All pipe lines jointed in the last mentioned manner shall be tested by water pressure as Clause R4 19.

3. For cast (spun) iron pipes each pipe shall be driven well home so that the spigot enters the socket to its full extent. Yarn shall then be tightly caulked into the socket leaving a uniform space round for lead, and the joint shall then be run with molten lead according to the manufacturer's instructions.

The lead shall be melted near where the joint is to be made and shall be at an adequate temperature when poured. The metal of the pipe shall be carefully cleaned and thoroughly dried, immediately before the joint is run, and an asbestos rope or jointed clasp ring used to retain the lead. The whole of the lead shall be packed into each joint in one running.

As soon as the lead is cool, the joints shall be properly caulked with a 2kg hammer and suitable caulking tools and brought flush with the face of the socket. The caulking of the lead is not to cease when the lead is flush with the face of the socket, unless the lead be solid and perfectly tight in the joint. The jointing of pipes before lowering into the trench will not be permitted.

The jointing of spun-cast-iron pipes with proprietary joints shall be carried out to the instructions issued by the manufacturer of the joints which shall be deemed to form part of this Specification.

4. Pitch fiber pipes shall be jointed with tapered collars of pitch fiber or approved flexible joints and synthetic pipes jointed with approved synthetic sleeves.
5. Corrugated metal pipes shall be jointed with connecting bands of a type recommended by the manufacturer of the pipe. The connecting bands shall be of the same gauge of metal as the pipe being used.
6. Socketed pipes shall be laid with a space of about 10mm between the spigot and the inner end of the socket. Ogee jointed porous concrete pipes and perforated clay pipes with rebated joints shall be dry jointed.
7. Perforated pitch fiber pipes may be jointed with any of the joints specified in BS2760 (1973).
8. The jointing of other types of perforated pipes shall be as specified in this clause.

R4 18 Concreting pipes

The concrete used for bedding, haunching and surrounding the pipe shall be made with Type V Sulphate Resistant Cement and be Class E unless otherwise provided in the Special Specification of Particular Application or unless otherwise ordered by the Engineer or Engineer's Representative.

The concrete shall be thoroughly worked into the joint holes and underside of the pipes, and shall be thoroughly compacted during the operation of placing. The Contractor shall include in his price tendered for this work the cost of any extra excavation required, for the disposal of the same and for all necessary shuttering.

Bedding concrete shall be rectangular in cross section.

Concrete pipes shall be concreted as specified below, unless otherwise ordered by the Engineer or Engineer's Representative.

1. Any pipes laid in heading shall be completely surrounded with concrete to a minimum thickness of 15cm outside the barrel of the pipe.
2. All pipes and rubes laid in trench with 6m or more of cover shall be completely surrounded with concrete, as in (1) above.
3. All pipes having less than 1.1 m of cover, shall be completely surrounded with concrete as in (1) above.
4. All pipes laid in trench with more than 4m of cover but less than 6m of cover shall be bedded on concrete at least 15cm thick, and shall be haunched with concrete at least 15cm thick to the horizontal diameter of the pipe, and the haunching shall be splayed above that level to meet the outside of the pipe tangentially.
5. All pipes and tubes of 45cm internal diameter and over shall, except where surrounded, be bedded on and haunched with 15cm of concrete as in (4) above.

6. Unless otherwise directed any pipe which is not surrounded or bedded and naunched shall be bedded on concrete as specified in Clause R4 16.
7. All pipes under carriageways shall be completely surrounded as in (1) above.

R4 19 Testing and cleaning

1. Sealed jointed drains for foul water and cement mortar jointed pipes for surface water up to and including 45cm diameter shall be tested in sections (e.g. between manholes) immediately prior to backfilling of trenches, by filling with water under a head of not less than 1.2m above the crown of the pipe at the high end and not more than 6m above the crown of the pipe at the low end. Steeply graded pipelines shall be tested in sections so that the above maximum head shall not be exceeded. Unless otherwise agreed by the Engineers Representative the test shall commence one hour after filling the test section at which time the level of water at the vertical feed pipe shall be made up to produce the required 1.2m minimum test head. The loss of water over a 30 minute period shall be measured by adding water at regular 10 minute intervals to maintain the original water level and recording the amounts so added. The drain will have passed the test if the volume of water added does not exceed 1 liter per hour per 30m of drain per 2.5cm of nominal internal diameter. Drains failing to pass the test shall have the defects made good and be retested.
2. Drains for foul water and cement mortar jointed pipes for surface water exceeding 45cm in diameter shall be tested by means of a smoke test before they are covered up. Both ends of the length of drain to be tested shall be sealed to the satisfaction of the Engineer's Representative and smoke shall then be pumped into the section from an approved smoke machine. Should any joint in the section show an escape of smoke the defects shall be made good and the drain retested.
3. The bore, linearity and jointing of all drains and service ducts less than 30cm diameter shall be checked by drawing through each completed length of pipe a mandrel 75cm long and 6mm less in diameter than the nominal bore of the pipe unless an alternative method of checking is agreed by the Engineer's Representative.
4. On completion of the Works, or earlier if the Engineer's Representative agrees, all pipes, manholes and drains other than French drains shall be flushed from end to end with water and left clean and free from obstructions.
5. French drains shall at all times be kept free of obstructions, both as regards the pipes and the filter material.

R4 20 Connections to existing pipelines

1. Where shown on the Drawings or directed by the Engineer's Representative, existing sewers and drains shall be properly extended, connected and jointed to new sewers, culverts, drains or channels. All such connections shall be made during the construction of the main sewer, drain or other work and their positions recorded by the Contractor who shall daily hand to the Engineer's Representative a copy of the record of the connections made the previous day. Where pipe connections are made to a brick sewer, concrete culvert, stone built or lined channel, the pipes shall be well and tightly built into the concrete, brick or masonry work and be so placed as to discharge at an angle not greater than 60 degrees to the direction of the flow of the main sewer, drain or channel and with the end of the pipe carefully cut to the necessary angle. Where the connections are between pipe sewers or drains, special

connecting pipes as shown on the Drawings shall be laid true and properly jointed.

2. Where a pipe of 22.5cm diameter or larger is to be joined to an existing brick manhole the opening and the pipe shall be protected by the construction of a brick arch of two rings of bricks on edge.
3. Before entering or breaking into an existing sewer or drain, the Contractor shall give notice of his intention to the authority responsible for the pipe line to which the connection is to be made.

R4 21 Backfilling of trenches

Backfill material shall be approved by the Engineer's Representative and shall be free from stones or lumps exceeding 8cm in largest dimension, vegetable matter and other unsatisfactory material.

If the Contractor allows material which, on excavation, is suitable for reuse to become unsuitable and it is in this Condition when required for backfilling, he shall make good by running it to spoil and replacing with other suitable material, or when directed by the Engineer's Representative, the moisture content of the backfilling material shall be adjusted, before depositing in the trench, to facilitate compaction in accordance with Clause RS 11-4 so that after compaction its dry density is not less than that of the soil in the trench sides.

Backfilling shall wherever practicable be undertaken immediately the specified operations preceding it have been completed, and the works have been inspected and approved by the Engineer's Representative so as to reduce the lengths of trenches open at anyone time. When concrete haunches or surround have been placed, compaction by mechanical means shall not be commenced until at least four days have elapsed from the placing of the concrete.

The material shall be deposited in layers each not exceeding 15cm thickness and each compacted as specified in Clauses RS 11-3 and 4 using, unless other compacting equipment is required or agreed, power rammers or vibrating plate compactors. Where bedding material is specified just above the top of the pipes, then unpowered hand tools shall be used.

Regardless of the method of compaction, no traffic or heavy loads shall be allowed over the backfilled surfaces until the four days for the setting of concrete have elapsed.

Movement of construction equipment over a culvert or pipe shall be at the Contractor's risk. Any pipe injured thereby shall be repaired or replaced at the opinion of the Engineer's Representative and at the Contractor's own expense.

R4 22 Backfill material for french drains

The filling around porous concrete, clay, pitch fiber or any pipes used as a French drain shall be Type A or Type B material as Table R4/2 or other filling described in the Contract.

Type A or Type B material shall consist of hard, clean, crushed rock, or gravel and sand, having a grading within the limits of Table R4/2. The aggregate crushing value of the material shall not exceed 30 per cent. The material passing the 0.425mm sieve shall be non-plastic when tested in accordance with AASHTO T90-70 or BS1377 (1975) Test3.

TABLE R4/2
RANGE OF GRADING

US Sieve Size		Percentage Passing by Weight	
mm	Imperial	Type A	Type B
63.0	2½in	-	100
37.5	1½in	100	85-100
19.0	¾in	-	0-20
9.5	⅜in	45-100	0-20
3.35	No. 6	25-80	-
0.600	No. 30	8-45	-
0.150	No. 100	0-10	-
0.075	No. 200	0-5	-

When Type A material is used with perforated pipes, not more than 85 per cent shall be smaller than the diameter of the hole or 4/5ths of the width of slot in the pipe.

The fill material shall be deposited in layers each not exceeding 25cm loose depth and each layer shall be lightly compacted.

R4 23 Restoration of surfaces

After filling and compacting the excavations in the manner specified, the Contractor shall carry out the reinstatement of all damage and disturbed surfaces.

In cases where the top soil does not, in the opinion of the Engineer's Representative, differ from the sub-soil, the excavations shall be backfilled slightly proud of the adjacent undamaged surfaces, and so that the natural consolidation of the backfilled material will produce a surface flush with the adjoining undisturbed surface. Should the backfilling settle to a level lower than that of the adjoining surfaces the Contractor shall top-up the depressions as necessary or ordered by the Engineer's Representative: Should the Contractor have allowed too much surcharge or upstand in his backfilling so that after natural consolidation and settlement has occurred the backfilled material is still above the adjoining undisturbed surfaces, the Contractor shall take such measures as the Engineer's Representative may direct to rectify the condition.

In all cases where the top soil differs from the sub-soil and in the cases of roads and other similar structures where the surface material differs from the sub-stratum, the Contractor shall immediately after the completion of his backfilling and compacting operation, form a temporary surface flush with or slightly above the adjoining undisturbed surfaces, as the Engineer's Representative may direct. The nature of the temporary surfaces shall be similar to the nature of the adjoining undisturbed surfaces and the use to which it will be put, and the Contractor shall abide by the instructions of the Engineer's Representative in this regard. After natural consolidation and settlement have occurred, the Contractor shall top-up and make good any resulting depression and he shall maintain all temporary surfaces for as long as the Engineer's Representative may direct. When the Contractor considers that the backfilled material has consolidated sufficiently to permit the placing of the permanent reinstatement on the surface, he may apply to the Engineer's Representative

for permission, and should the Engineer's Representative agree to the Contractor's proposals, the Contractor shall thereupon carry out the permanent reinstatement of the surfaces in such manner that the Engineer's Representative may direct

In all cases the standard of the final surface shall be not less good than that pertaining prior to the Contractor's entry upon the various sites.

Any permission given by the Engineer's Representative to the Contractor to carry out the permanent reinstatement of surfaces shall not absolve the Contractor from liability for reconstructing such permanent reinstatement as may be necessary should further settlement of the surface or damage thereto occur.

R4 24 Measurements

The unit of measurement for drainage pipe excavation shall be the cubic meter divided into stages, i.e. 0-2m deep, 2-4m deep, 4-6m deep, etc. The width of the trench shall be measured as 30cm greater than the external diameter of the pipe barrel and the Contractor shall allow in his rates for excavation for any width of trench in excess of these dimensions he may require. Depth of excavation for sewers is measured as the difference in level between the invert level of the pipe and the surface of the ground as it exists at the time when the trench excavation is started, but not higher than the ground level immediately prior to the commencement of the Works.

The unit of measurement for pipework shall be the linear meter. The length of pipelines shall be measured to the inside faces of the walls of the manholes.

All bedding, haunching and surrounding shall be measured separately per linear meter.

R4 25 Payment

The prices for excavation shall include for working in such a manner as not to interfere with the stability of adjacent structures and properties; for the cost of all timbering or other support required; for the cost of all timber or other support left in place unless ordered or approved to be left in place by the Engineer's Representative; for making good slips and falls and excess excavations; for ground stabilization by means of dewatering, chemical processes - or other approved method; for pumping and dealing with water whether affected by floods, storms or otherwise; for the provision and sealing of temporary grips, channels, sub-drains and sumps; for temporarily storing excavated materials required for back fill or other purposes; for temporarily supporting, protecting, diverting and maintaining utility services; for maintaining nows in sewers and watercourses; for all work incidental contingent or found necessary for the proper execution and safety of the works; and for all other contingencies whatsoever.

The price for pipework shall include for provision of the pipes, delivering to the site and all site handling, storage and transport; all cutting and waste; all laying and jointing including all labor and jointing materials and incidentals to complete the work in accordance with the Specification.

The price for bedding, haunching and surrounding will include all necessary work, labor, materials and shuttering necessary for completion of the Works in accordance with the Specification.