



GUIDELINE ON
THE PROVISION OF BASIC CIVIL WORKS FOR COMMUNICATIONS
INFRASTRUCTURE IN NEW DEVELOPMENT AREAS

(SKMM/G/01/09)

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Notice:

The information contained in this document is intended as a guide only. For this reason it should not be relied on as legal advice or regarded as a substitute for legal advice in individual cases. Parties should still refer to the legislative provisions contained in the law.

Suruhanjaya Komunikasi dan Multimedia Malaysia

Malaysian Communications and Multimedia Commission

Off Persiaran Multimedia

63000 Cyberjaya

Selangor Darul Ehsan

Tel: +60 3 86 88 80 00

Fax: +60 3 86 88 10 00

Website: www.skmm.gov.my

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**GUIDELINE ON
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1. INTRODUCTION

This guideline is intended as a reference for developers and others who are responsible for planning and developing new areas for residential and/or business. It's served to assist developers to meet the requirements of end users on fixed network communications services requirements by providing the civil works phase of deploying fixed network communications infrastructure at an earlier stage, as this phase is complex and resource-intensive. In addition, a successful rollout requires all the necessary preparations to be carried out as early as possible to ensure easy deployment of communication cabling and equipment minimizing disruptions to the services offered by the service providers in the future. This guideline provides requirements of civil works necessary for the deployment of fixed network communications services.

This guideline also serves as recommendations to developers in support of the Uniform Building By-Laws (UBBL). The civil works for fixed network communications infrastructure stated here will cover designing and constructing network sites and preparing them for the installation of network equipment and cables. The civil works provides a solution for the detailed design and construction of the required environment and surrounding infrastructure and for providing utilities for network equipment.

The civil works is regional-specific and accommodates local factors, such as local conditions and regulations, topography, geology, building codes, environmental, health and safety regulations and infrastructure. The service leverages the competence and experience of third parties, including partners, consultants, contractors and suppliers. The civil works will not be treated as a stand-alone service.

The civil works will provide:

- A turnkey solution - provides for the design and construction of fixed network sites; ready for installation of fixed network equipment;
- Low cost and market adapted civil works - enable cooperation with partners and local sub-contractors, to provide a market-adapted solution to fit with environmental, climatic and legislative conditions;
- Designed and constructed quality sites - provides the detailed design and construction of a network site to meet the requirements of the telecom equipment and cables, the constructional requirements and local regulations; and
- Meeting needs and minimizing costs - implementing civil works with the best of quality for workmanship and materials will enable to fulfil requirements including coverage and minimized lifecycle cost.

This guideline should be read together with the Communications and Multimedia Act 1998 (CMA), the relevant subsidiary legislations, instruments, codes and guidelines that have been issued by the Suruhanjaya Komunikasi dan Multimedia Malaysia (SKMM) pursuant to the CMA.

This guideline is also crossed referred to other documents namely;

- (a) Malaysian Communications and Multimedia Commission; Technical Standards and Infrastructure Requirements (TSIR) – Part 1: Fixed Network Infrastructure (Doc no. : MTSFB 008 : 2005)
- (b) Syarikat Telekom Malaysia Berhad; Specification Lines WE 0304 – Construction of Manholes, Joint Boxes and Laying of Ducts (Doc no. : Specification Lines WE 0304 Issue TK 1983)

2. DEFINITIONS

In this specification the following words and expression shall be the meaning hereby assigned to them except where the content otherwise requires:-

Building	: Shall have the same meaning provided for the National Land Code 1965, and shall mean to include any structure erected on land.
Building owner	: The actual proprietor of a building, or its agents or its authorized personnel.
Civil Infrastructure	: Basic communications infrastructure installation needed for the establishment of fixed network communications network services such as pits, ducts, manholes and etc. but does not include a line.
CMA	: Communications and Multimedia Act 1998.
Communications	: Any communication, whether between persons and persons, things and things, or person and things, in the form of sound, data, text, visual images, signals or any other form of any combination of those forms.
Concrete fill	: A minimal depth concrete pour to encase single level under floor duct.
Conduit	: A raceway or circular cross-section of the type permitted under the appropriate electrical code.
Cross over	: The junction unit at the point of intersection of two cable trays, raceways, or conduit on different planes.
Developer	: Any person, body of person, company, firm or society (by whatever name described), who or which engages in or carries or undertakes or causes to be undertaking housing development.
Duct	: Means a single or multi-way duct made of P.V.C. or other materials. An enclosed raceway for wires or cables usually used in soil or concrete an enclosure in which air is moved.

Jointing Chamber	: Means any manhole, joint box, or other underground vault or chamber at which ducts are terminated.
Network Facilities	: Any element or combination of elements of physical infrastructure used principally for, or in connection with, the provision of network services, but does not include customer equipment.
Network Facilities Provider	: A person who owns or provides any network facilities
Network Service	: A service for carrying communications by means of guided and/or unguided electromagnetic radiation such as fixed network communications services
Network Service Provider	: A person who provides network services such as fixed network communications services
Pilot Hole	: Means an excavation taken out in order to determine the position of plant, obstructions, etc. and shall be carried out by manual labour using hand tools and if any damage is caused to such plant, the Contractor or Developer shall be held liable for and shall indemnify Government or Local Authority or the site owner concerned. The usual form of a pilot hole for a duct trench is across the line of the trench, and for jointing chamber, etc., at any position necessary to indicate a clear excavation space for the proposed structure.
Rock	: The definition of rock is divided into the following types:- <ul style="list-style-type: none"> (a) Soft rock; Means a bed of Virgin Rock (i.e. un-worked rock) which may consists of a mass of soft stone or a mass of hard stone containing fissures or seams, it being possible, in either case, to excavate by using an ordinary pick-axe, but if so excavated would result in a very uneconomical rate of progress, necessitation the use of compressor and pneumatic tools for economical excavation. (b) Hard rock; Means a solid mass of Virgin Rock which may have seams but is virtually unaffected by a blow from a pick-axe and requires pneumatic tools for economical excavation. (c) Boulder rock; Means a solid stone in boulder formation similar in character to hard rock having a measurement exceeding 246 centimetres cube.
Shuttering	: Means all formwork used in concrete construction.

Communications Network : A system or series of systems for carrying, conveying or transmitting telecommunications i.e. a set of physical devices, denominated infrastructure, or the electro-magnetic means that support the transmission, reception and emission of signals.

3. BASIC TELECOMMUNICATIONS INFRASTRUCTURE REQUIREMENTS

3.1 Manhole

Manhole(s) on the road side outside the building/compound must be provided so that the Service Provider can connect their underground (manholes and ducts) network.

Developer is strongly advised to consult the Service Provider on the appropriate selection of the location and size of manhole to be allocated.

Figure 1 below shows the typical manhole design and Figure 2 shows the typical civil infrastructure for multiple road access. The typical Manhole Specifications is shown in the Table 1.

Figure 1: Typical Manhole Design

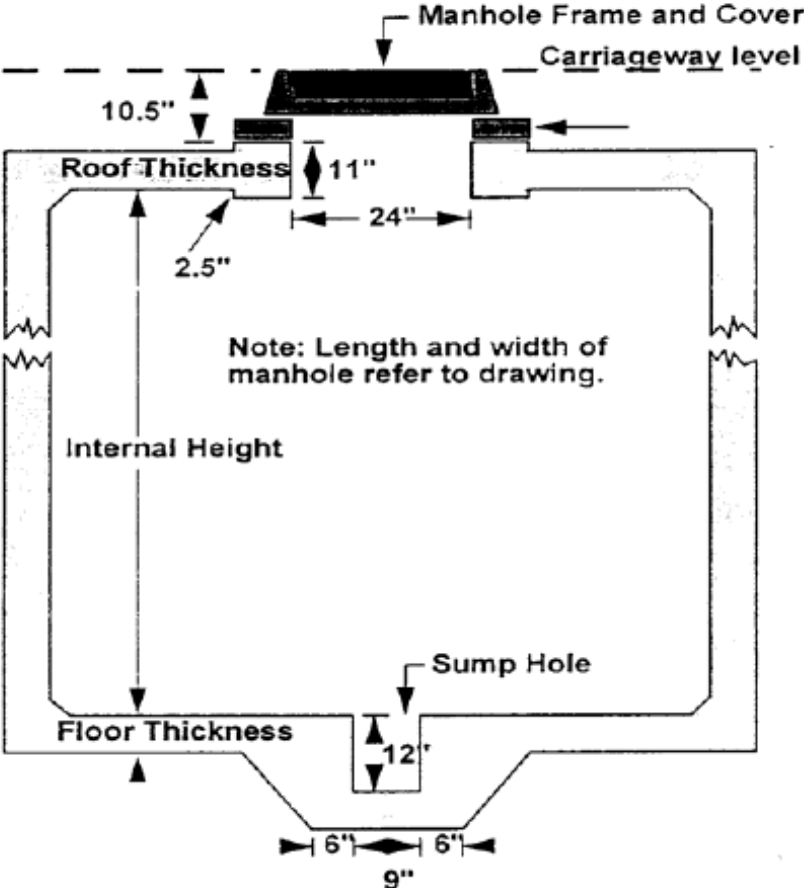
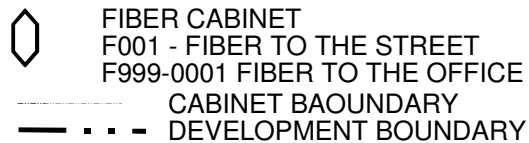
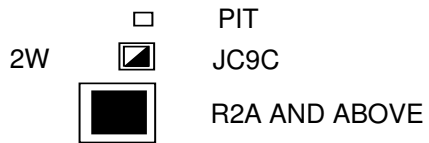
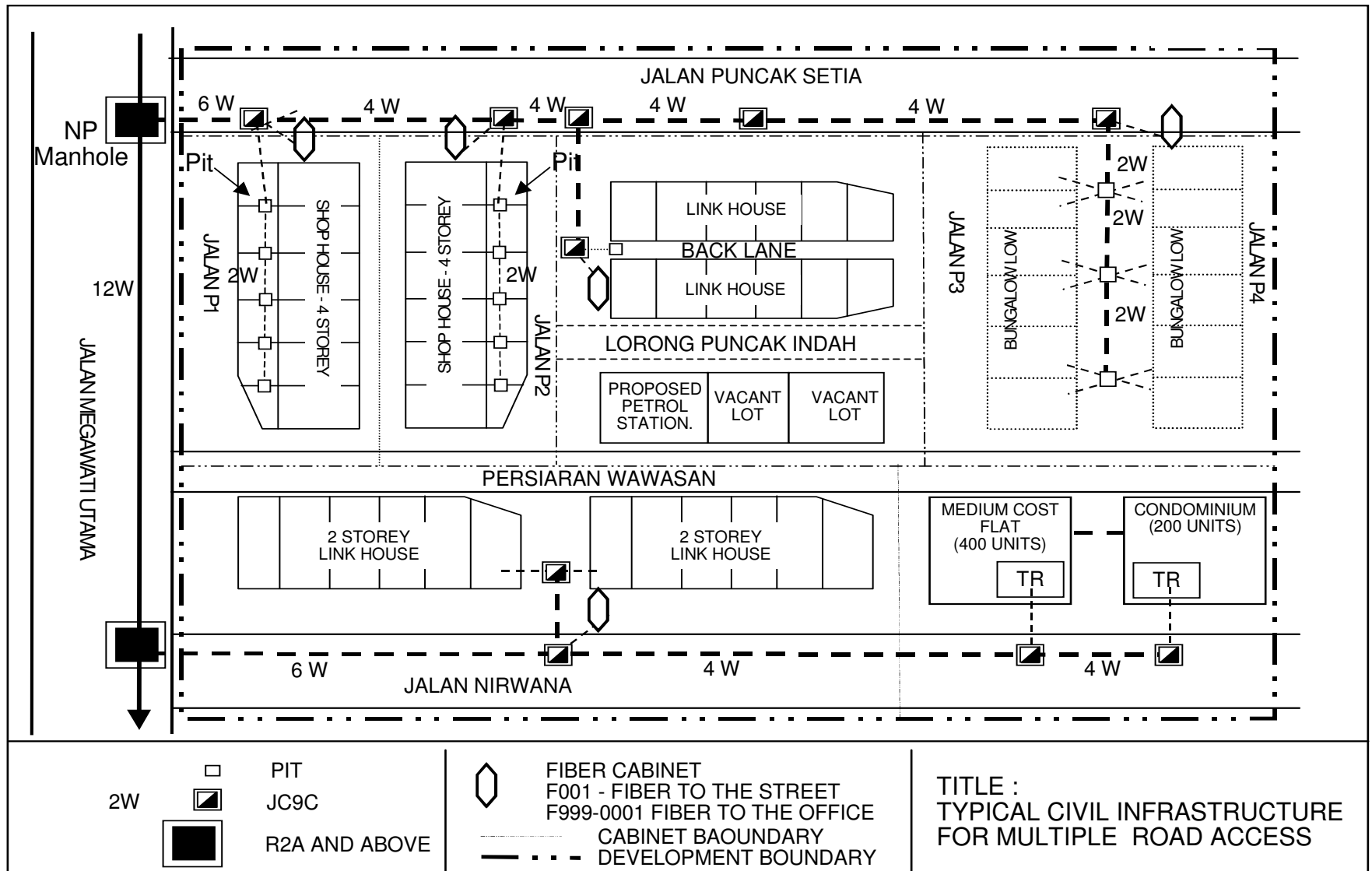


Table 1: Typical Manhole Specifications

No.	Manhole Type	Size: L x W x H (mm)	Manhole strength SIRIM Std w/safety Factor x2	Total no. of Duct Way 50+50 100 mm PVC & 3HDPE							Manhole Cover, Existing size	Ladder/ Hook/ Step		
					No.	Qty	No.	Qty	Qty	Qty			Qty	
1	JB30-PIT	950 x 625 x 450	22.5 metric ton	2 - way	-	-	-	-	-	-	-	1 - hole	3E	-
2	JRC7	1280 x 975 x 800	22.5 metric ton	2 - way	1	2	8	4	4	1	-	1 - hole	3E	-
3	JC9 (M)	1570 x 660 x 1070	22.5 metric ton	4 - way	1	2	8	4	4	2	1	1 - hole	7E	existing
4	JC9C (M)	1820 x 970 x 1440	22.5 metric ton	4 - way	1	4	8	8	8	1	1	2 - hole	3E	existing
5	RIB (M)	1820 x 1220 x 1970	22.5 metric ton	6 - way	2	4	18	8	8	2	1	2 - hole	3E	existing
6	R2A	3050 x 1220 x 1820	22.5 metric ton	12 - way	2	6	12	12	12	6	1	2 - hole	3E	existing
7	R2A (M)	3660 x 1520 x 1820	22.5 metric ton	12 - way	2	6	18	12	12	6	1	2 - hole	3E	existing

Figure 2: Typical civil infrastructure for multiple road access



TITLE :
TYPICAL CIVIL INFRASTRUCTURE
FOR MULTIPLE ROAD ACCESS

3.2 Duct Way

Underground duct ways are required to connect the manholes from one to another and to the nearest fixed network communications access points either communication cabinet, communication room, local exchange and etc. The number of duct ways is dependent upon the size and types of connection and number of potential users/customers in the development areas.

Developer is strongly advised to consult the Fixed Network Service Provider on the appropriate selection of the number of duct ways to be provided as to accommodate their requirements in the deployment of the communications facility in the development area.

4. DUCTS LAYING

4.1 Line of Ducts

The line of ducts shall be kept as straight as possible.

4.2 Duct Formations

The groupings to be adopted, and the size of trenches, shall be subject to best practise; the character of the duct to be laid shall be varied to suit special requirements.

4.3 Break Joint

In the case of ducts 4-ways or more, the lines shall break joint by approximately half the duct length in alternate lines, horizontally and vertically.

4.4 Supervision

On no account shall any duct laying be done without supervision by the contractor's or developer's supervisor.

4.5 Clearance from other Services

All ducts, whether asbestos-cement, PVC, iron or steel laid direct in the ground shall be kept well clear of water mains and service pipe, sewers and subways, and manholes and joint boxes belonging to other undertakers. In order to permit the use of "*Tapping*" machines on water mains at least 152 mm clearance shall be given wherever possible. This clearance shall also be given, if practicable, to the other classes of plant mentioned above. In no case shall the clearance be less than 25 mm; where the two sets of plant cross each other the minimum vertical clearance shall be 50 mm, provided the approval has been obtained from the authority concerned.

4.6 Obstructions

When any water or electric supply main, drain or other plant which has seemingly been abandoned, constitutes an obstruction to the works, all efforts must be made to

ascertain who are the owners; with a view to consulting them before the obstruction is disturbed in any way. In no circumstances must electric supply mains be interfered without the sanction of the owners concerned.

4.7 Clearance from Electricity Supplies

4.7.1 As much clearance as is practicable shall be given to the basis of electric lamp standards, electricity supply pillars, traffic signal posts, etc. Where it is impossible to provide a clearance of more than 150 mm, a layer of concrete Quality B (refer para 6.2), not less than 50 mm thick, shall be placed between the two sets of plant.

4.7.2 In the case of electricity supply cables, the following minimum separating distance between the two sets of plant shall be provided:-

(a) High-Voltage Single-Core Cables (exceeding 650 volts)

Standard minimum clearance 460 mm

No exception to this requirement will be permitted.

(b) High-Voltage Multi-Core Cables (exceeding 650 volts)

Standard minimum clearance 300 mm

In difficult cases a reduced clearance will be permitted.

4.7.3 Where it is impossible to provide a greater clearance than 150 mm, a layer of concrete Quality B, not less than 50 mm thick and of a width to overlap the power plant by 50 mm on each side, shall be placed between the two sets of plant. Where the two sets of plants cross each other, the length of the layer of concrete shall be not less than the width of the telecommunication plant.

Low and Medium-Voltage Cables (not exceeding 650 volts)

Standard minimum clearance 50 mm

4.7.4 Where the two sets of plant cross each other, no exception to this requirement will be permitted. At other points a clearance down to 25 mm may be allowed in difficult cases. Wherever the clearance is 50 mm or less, the space between the two sets of plant shall be filled with a layer of concrete Quality B.

4.7.5 In all cases the concrete must overlap the power plant by 50 mm on each side, and, at crossings, the length of the layer of concrete shall not be less than the width of the fixed network plant.

4.8 Ducts under Railway

In laying ducts under railway tracks galvanised iron ducts will invariable be used and there shall be a minimum distance of 1070 mm between the surface of the road and

the top of the body or barrel of the uppermost duct. A gradual fall shall be given from the centre of each side of the track to prevent water accumulating in the duct.

4.9 Duct in Tunnel

When ducts are to be laid in a tunnel all spaces around and in between the ducts shall be completely filled in with concrete Quality B, unless otherwise stated.

4.10 Cutting, Bending of Ducts

Any necessary cutting and bending of ducts shall be done according to the requirements of the work. Inside edges of cut ducts, etc. shall be thoroughly rounded off or so dressed before being put into position that there can be no possibility of damage to cables from the edges.

4.11 Trench Bottom

The trench bottom shall be filled with a layer of sand 50 mm thick and holes shall be taken out of the bottom of the trench at all points where sockets occur so that the barrels of the ducts rest on solid ground.

4.12 Rocky Soil

In rocky soils, sand shall be spread over the trench bottom and rammed to afford a bedding 80 mm thick on which to lay the ducts.

4.13 Cleaning and Testing

4.13.1 On completion of the duct line between any two jointing chamber or sites thereof a cylindrical brush connected to the following end of a mandrel shall be passed twice through each 'way' to clean the duct and to remove any foreign matter which may have entered. The size of the mandrel shall be as specified in the paragraph relating to the particular type of duct.

4.13.2 All tests shall be carried out and if any obstruction or other defect be discovered it shall be rectified forthwith to his satisfaction.

4.14 Plugs

A hardwood plug or equivalent shall be inserted at the ends of each 'way' in a line of ducts until the lengths has been tested and passed. The plug shall be sufficiently hard to ensure the roundness of the duct during construction.

4.15 Alignment Test for Disturbed Ducts

When jointing chambers are provided on an existing duct route or when any disturbance takes place which may effect the alignment of the ducts, a test mandrel of appropriate dimensions shall be drawn through each of the spare 'ways'.

4.16 Protection of Paving

All reasonable steps shall be taken to prevent damage to paving and to protect paving from contamination by fuel and/or oil from his equipment.

4.17 Galvanised Iron Pipes

4.17.1 General

All pipes shall be provided in nominal lengths of 6 meter and provided with screwed socket at one end and shall comply to the standard specifications.

4.17.2 Laying

The condition detailed in paragraph 4.1 to 4.16 shall be applied. Where one line of ducts is laid over another in the same trench, sand shall be filled in over the lower line of ducts and carefully rammed to form a bedding 50 mm in thickness for the top ducts. Sand shall also be rammed between the ducts laid side by side in the same trench. The ducts shall break joint by approximately half the length in alternate lines, horizontally and vertically.

4.17.3 Jointing

Joints shall be made by positioning the threaded end of the pipes to the screwed socket of the other pipe end. Turn one of the pipes until it cannot turn anymore and ensure that the thread of the threaded end cannot be seen.

4.17.4 Cutting

Pipes shall be cut when necessary at right angle to the bore only. The inside edges being afterwards filed so that there can be no possibility of damages to cables from the edges.

4.17.5 Alignment Test

To ensure the alignment of the ducts a working mandrel 457 mm in length and 83 mm in diameter shall be drawn through as the ducts are laid.

4.17.6 Cleaning and Testing

The test mandrel used for testing shall be 457 mm in length and 83 mm in diameter, the cylindrical brush shall be 108 mm in diameter.

4.18 P.V.C. Duct

4.18.1 General

These ducts are supplied in 6 meter lengths. These ducts should be stored away from the direct rays of the sun, as they tend to deteriorate and go out of shape. Solvent cement is used for the joint.

4.18.2 Trench Bottom

The trench shall be scooped out at all points where the spigot rest, so that the body of the duct lie upon rammed sand.

4.18.3 Duct Laying

The condition detailed in paragraph 4.1 to 4.16 shall be applied. Where one line of ducts is laid over another in the same trench, sand shall be filled in over the lower line of ducts and carefully rammed to form a bedding 50 mm in thickness for the top ducts. Sand shall also be rammed between the ducts laid side by side in the same trench. The ducts shall break joint by approximately half the duct length in alternate lines, horizontally and vertically.

4.18.4 Deflection

If it be necessary to deflect from a straight line or to vary the depth, sets may be given to the joints but deflections shall not be greater than 12 mm per 610 mm run of the single ducts. Short ducts not less than 610 mm in length, shall be built into the track in order to secure the required deviation, but, the deflection must not be greater than will admit of the tests hereinafter specified being carried out.

4.18.5 Cutting

Ducts shall be cut when necessary, at right angles to the bore only, preferably with a saw in a simple cutting guide, the inside edges being afterwards so trimmed that there can be no possibility of damages to cables from the edges.

4.18.6 Jointing

The spigot of the ducts shall be wiped clean. The solvent cement shall be applied to the spigot as well as the end of another conduit. The end of the conduit where the solvent cement was applied shall be positioned and pressure applied for the two conduits to be jointed. In no circumstances shall dirt or grit be allowed to enter the joints.

4.18.7 Alignment Test

To ensure the alignment of the ducts a working mandrel 457 mm in length and 83 mm in diameter shall be drawn through as the ducts are laid.

4.18.8 Jointing Chamber Deferred

When the building of the jointing chamber is deferred until after the completion of a section of duct included in the work, the last joint of each duct shall be tested on completion of the jointing chamber by means of the working mandrel mentioned above.

4.18.9 Testing

The test mandrel used for testing shall be 457 mm in length and 83 mm in diameter, the cylindrical brush shall be 108 mm in diameter.

4.19 Encasing In Concrete

4.19.1 Method

The method of encasing ducts in concrete is the layer by layer method where each duct is completely surrounded by concrete.

4.19.2 Installation around curves

- (i) Rigid P.V.C. duct may be bent to avoid obstacles or to negotiate curves. The conduit may be cold bent around stakes for radii above 10.6 meter. To provide favourable cable hauling conditions the bend radii should be as large as possible. Cold bending in situ to the curve required is achieved by provision of stakes to form the conduit to the required shape. The stake must be spaced at intervals not greater in length than 1/20th of the radius of curvature or alternatively as indicated in the Table below.

Bend Radius	10.6 m - 12.2 m	12.2 m - 15.2 m	15.2 m - 18.2 m	18.2 m - 21.3 m	21.3 m - 24.3 m	24.3 m - 27.4 m	27.4 m - 30.4 m
Support Spacing	53.3 cm	61.0 cm	76.2 cm	91.5 cm	106.7 cm	122.0 cm	137.2 cm

Concrete cover above the top duct of a completed tier is to be a minimum of 50 mm.

- (ii) After the initial set of the concrete has occurred and before it sets hard, withdraw all stakes by applying a lifting and turning action to the stakes. Where additional conduits are to be installed above the first nest, withdraw the stakes until approximately 305 mm remain embedded.

4.19.3 Installation in Straight Runs

- (i) Open trench to required length. Minimum opening is approximately 1½ times length of conduits being used.
- (ii) Place a 50 mm thick bed of concrete on the trench floor.
- (iii) In unstable ground or locations where high security is required, place a wire mesh vertically on either side of nest of ducts. The concrete when poured should fully cover the reinforcement which shall be 150 mm x 150 mm x 6 mm welded meshes.

- (iv) Install a layer of conduits along the trench keeping them evenly spaced by using wooden combs at intervals of 1.5 meter.
- (v) Place a layer of concrete over the conduits and compact in so as to fill the spaces between the conduits. Provide an approximate 50 mm covering above the conduits to form a bed for the second layer.
- (vi) Repeat the process for the next and subsequent layer of conduits, raising the spacing comb as each layer is completed.
- (vii) Remove spacing comb and wash in a suitable cleaning agent.
- (viii) Concurrently with the conduit laying in the first section of the trench, excavate the second section so that sufficient trench is opened to continue conduit laying on completion of the first section.
- (ix) UNDER NO CIRCUMSTANCES shall any batch of concrete be off-loaded from wheel barrow, bucket, dumper, chute or similar equipment, directly onto the assembled duct nest. It should first be off-loaded onto suitable boards prior to placing around the ducts. Spades or shovels used for placing must not be pushed into the placed concrete.
- (x) To assist in the placing of subsequent rows of spades and ducts, and concrete, a 'walkway' shall be used when access within the trench or from the surface is restricted. UNDER NO CIRCUMSTANCES MUST THE DUCT ALREADY LAID BE USED AS A WALK- WAY.

4.20 Fixing Ducts to Bridges

4.20.1 Methods

Two methods should be used (i) fixing to steel RSJ (Rolled Steel Joist) or fabricated beams. (ii) fixing to reinforced concrete bridge beams and masonry walls.

4.20.2 Care

It should be noted that the extra care shall be taken when it is necessary to make holes for fixing bolts in existing bridge beams. All bridge fittings shall be thoroughly cleared and painted with one coat bituminous paint.

4.20.3 Through Abutment Walls

Where it is necessary for duct to pass through abutment walls, the masonry or brickwork shall be arched over the pipe, the diameter of the hole thus formed being at least 13 mm more than the external diameter of the duct. The space

between the masonry or brickwork and the pipe shall then be filled with bitumen to provide a cushion of bitumen to the perimeter of the pipe at least 13 mm thick.

4.21 Dummy Ducts Method

4.21.1 One length of P.V.C. duct shall be positioned, in a wall of the chamber or above the row of ducts terminated at a jointing chamber. See Section 5 paragraph 5.5.

4.21.2 Later on when it is necessary to increase the number of ways, the new ducts shall be jointed to the dummy ducts and the ducts can be made available by breaking the mortar seal that was set previously in position when the ducts and chamber were constructed.

4.22 Slewing and/or Lowering or Raising of Duct

4.22.1 Excavation

The size of the excavation for slewing and/or lowering or raising a duct line shall be as agreed to by the authorised officer.

Where lowering only is necessary the duct line shall be suspended and the required excavation taken out down the side and under the duct line. When this method is impracticable the duct line shall be slewed and raised or lowered temporarily for a distance which is just sufficient to allow access for carrying out the excavation.

With the exception of making slight adjustments to the duct line after slewing and lowering the duct line shall not be moved in any way without adequate reinforcement in the form of a strongback being firmly lashed to it.

4.22.2 Strongback

The strongback shall be lashed to the duct line, with ends of each duct firmly held, using separate lashings or a continuous rope. The lashing shall be tightened, by driving wedges between the ducts and the strongback or otherwise.

Any forces which it is necessary to apply to the duct line to move it in any way shall be applied not directly to the duct line but to the strongback lashed to it. Such forces shall be applied at points whose spacing is sufficiently close to keep the bending of the duct line and strongback the points to a negligible amount.

4.22.3 Suspension

When the duct line is to be lowered, the complete length shall be suspended from suitable beams spanning the excavation. When the duct line is to be slewed whilst suspended in this way, the suspending ropes shall be fastened to sling poles resting on the supporting beams and running parallel to the duct

line and strongback, and free to move across the beams. All suspending ropes shall be so arranged that the duct line can be raised or lowered as required, smoothly and continuously, and can be tied off firmly at any stage.

4.22.4 Slewing Only

When the duct line is to be slewed only, it may be moved without suspending it, provided that:-

- (i) The surface across which the duct line is to be slid shall be reasonably level and regular, made so if necessary by setting boards on the surface.
- (ii) Grooves shall be cut across the surface in positions to allow the socket of each duct to remain in a groove throughout its movement.
- (iii) The strongback shall be firmly lashed to the side of the duct line.
- (iv) The moving force shall be applied to the strongback by rope, jack or other method to allow the duct line to be moved smoothly and without jerking.
- (v) In the final position of the duct line the holes for the duct sockets shall be made large enough to allow access to the underside of each joint for the purpose of making the seal. Such holes shall be subsequently filled with soft cement mortar.

4.22.5 Movement

The slewing and/or lowering of the duct line shall be carried out by making a succession of very small movements of the duct line, each made progressively along the affected length. The curvature of the duct line at any intermediate stage between the initial and final positions shall not exceed the deviation limits laid down for laying new duct of the same type.

4.22.6 Trench Bottom

Prior to final placing the duct, the trench bottom shall be prepared in the same way as is specified for duct laying.

4.22.7 Irregularities

After the duct line has been finally lowered into its required position and the strongback has been removed, any slight irregularities in the general line of the ducts shall be corrected.

4.22.8 Repairing PVC Ducts

Damaged empty ducts shall be replaced by similar good ducts, or split ducts, and damage occupied ducts shall be replaced with split ducts. Minor damage to ducts shall be repaired in situ with a mixture of cement. Split ducts shall be

surrounded with 50 mm of cement mortar, carried over the joints and held in position by forms. The entry of mortar into the ducts shall be prevented by the use of building paper or similar effective means.

4.22.9 Pulled Joints

Where, following slewing and/or lowering or raising operations, a duct joint or joints have pulled apart, short length or ordinary or split duct way be inserted in the duct line and satisfactory joint effected.

4.22.10 Inspection

After all operations are completed, the joints of all ducts shall be inspected to ensure that they are forming an effective seal, any defects shall be made good.

4.22.11 Testing

All spare bores of the duct line shall be cleaned and tested as specified for the particular duct concerned.

5. JOINTING CHAMBERS

5.1 Type of Manholes

The standard types and sizes of manholes with the code reference employed in this Guideline are as follows:-

Table 2 : Manhole Type and Size

Reinforced Concrete Construction Throughout	Internal Dimensions				
	Code	Figure	L (cm)	W (cm)	H (cm)
	RO	Rectangular	182	106	152
	R1A	Rectangular	182	122	168
	R1B	Rectangular	182	182	198
	R2B mod. from R1B	Rectangular	305	305	198
	R1B mod.	Rectangular	182	122	182
	R2A	Rectangular	305	122	182
	R2B	Rectangular	305	122	198
	R2A - E	Rectangular	305	122	182-244
	R2A mod.	Rectangular	366	152	182
	R4	Rectangular	610	182	182
	R6	Rectangular	610	305	182

Reinforced Concrete Construction Throughout	Internal Dimensions			
	Code	Figure	L (cm)	W (cm)
R7	Rectangular	610	213	305
SM. No 1	Rectangular	244	122	182
SM. No 2		305	132	213
SM. No 3		305	244	213
R3	Assorted shapes and sizes.			
R5	Assorted shapes and sizes.			
R9	Assorted shapes and sizes.			
R9 mod.	Assorted shapes and sizes.			
R10	Assorted shapes and sizes.			
R10 mod.	Assorted shapes and sizes.			
R11	Assorted shapes and sizes.			
R12	Assorted shapes and sizes.			
R13	Assorted shapes and sizes.			
R14	Assorted shapes and sizes.			
R15	Assorted shapes and sizes.			
R16	Assorted shapes and sizes.			
RT8	Rectangular	A = 117 cm 182 cm B = 107 cm D = 244 cm F = 274 cm		

5.2 Type of Joint Boxes

The standard types and sizes of Joint Boxes are as follows:-

Item	Code	L (cm)	W (cm)	Internal Depth* (cm)
Carriageway Joint Box	JC9 mod.	157	66	107
Carriageway Joint Box	JC9C mod.	182	97	144

***Note:** Normal depths are indicated and shall be measured from the carriageway or footway surface to the top of the floor in each case. They may however be varied to suit the depths of the ducts.

5.3 Waterproof Construction

All jointing chambers shall be of waterproof construction, whether built of brick or reinforced concrete.

5.4 Clearance around Conduits

Conduits shall enter manholes at such a depth to ensure a clearance of at least 460 mm between the top of the barrel of the uppermost conduits and the underside of the roof of the manhole. Except where a duct seal is provided, when a clearance of 203 mm is required, clearance of 152 mm depending on type of manhole, shall be given between the outside of the barrel of the conduits and the adjacent wall, and a minimum clearance of 460 mm between the underside of the barrel of the lowest conduit and the floor.

5.5 Space for Duct Growth

Where the duct capacity of any proposed manhole is not fully utilised the space shall be fitted with dummy ducts for future duct growth by laying in initially at standard depth, see Section 4 paragraph 4.21. The dummy ducts shall be sealed with cement mortar inside the chamber wall.

5.6 Duct Terminations

To ensure that cables can easily be housed in manholes with a minimum of bending, the conduits should be splayed over the last length to enter the manhole equally on either side.

5.7 Manhole Construction

5.7.1 Excavation

The ground shall first be excavated to the required dimensions, the sides of the excavation being supported by poling boards or by other means if there is any likelihood of the earth falling-in. The foundations shall then be levelled and rammed. Soft places shall be dug out, filled-in with hardcore, and consolidated.

5.7.2 Templates

Two light wooden templates, slotted (not drilled) to receive the reinforcing bars, shall now be set up. The lower template shall be fitted about 305 mm above the foundation and shall be supported on four small pegs at its corners. The upper template shall be fixed to correspond with the lower template, but about 305 mm below the position at which the roof of the manhole will be.

5.7.3 Erection of Floor

Shuttering for the sump hole shall now be set up and concrete laid over the foundation to the thickness of 38 mm. The mixing and placing of the concrete shall be done in accordance with Section 6.5 - 6.7 of this Specification.

The end of side-wall-to-floor corner reinforcement shall now be placed so that horizontal portions are just covered by the concrete. The vertical portions shall pass through the slots in the template and be set as to obtain 19 mm cover from the outside faces of the walls when these are erected. Additional concrete shall next be laid until the level is 19 mm less than the concrete level for the floor. This shall be done as soon as possible after placing the first layer of concrete, so that the two layers unite thoroughly. Anchor irons shall now be set in the floor in accordance with the relative drawings.

The interior wall-reinforcement shall now be placed with the horizontal portions flush with the surface of the concrete in the floor and the vertical portions passing through the slots of both templates so as to obtain 19 mm cover from the interior face of the walls when these are erected. The remaining 19 mm layer of concrete is then laid to reach the specified floor level.

5.7.4 Erection of Walls

When the floor has been left for at least 12 hours, the erection of the walls shall be commenced. The portion of the floor on which the walls will be erected shall be cleaned and rendered with a 7 mm thickness of neat cement, well trowel and placed in position, just before wall concreting is commenced. The wall shall, as far as possible be erected continuously to their full height, but if during erection a break of 2 hours or more is unavoidable, the existing work shall be cleaned and rendered as previously described before proceeding.

The horizontal bars and side-to-end-wall corner reinforcement shall be placed as walls are built up. It is unnecessary to wire-up this reinforcement, since there is no tendency for these bars to move once placed. "*Steps Manhole*" and "*Bolts Cable Bearers*", shall be set in the walls as described in paragraph 5.7.9 (c), (e) and (f) respectively. The templates shall be removed when the work reaches such a stage that they impede the placing of the concrete.

5.7.5 Erecting of Roof

When the walls have been built to the requisite height, shuttering for the roof shall be set up, the boards being arranged to form a recess at the position of the roof beams. A 26 mm thickness of concrete shall then be laid throughout the roof area, including the recess of the beams. The beam reinforcement which have been previously assembled by threading and the wiring the stirrups to the bars, may now be laid at one movement, the main reinforcing bars being set to obtain 26 mm cover. The remainder of the roof reinforcement shall be laid and, to give the correct cover of 19 mm, the rods shall be just visible above the surface of the concrete.

The alternate bent bars may be conveniently supported by a single-wired fixing at the point where they enter the beam reinforcement. The concrete in the roof-to-wall corner reinforcement embedded. The correct cover of 19 mm to the roof can be checked by a wood spike and, when correct at each end of the horizontal part of the rod, will ensure that the vertical portion has the correct cover throughout its length. The upper face of the beams shall be spade-

finished, and the roof given a slight slope to the sides to avoid accumulation of water on the roof.

5.7.6 Striking of Shuttering

Finally, after the lapse of time indicated in paragraph 5.7.8 the shuttering shall be struck and the floor given a 19 mm rendering of cement mortar, with a fall to the sumphole on all sides, and the manhole frame fitted in accordance with section 5.7.10 - 5.7.12.

5.7.7 Arrangement of Reinforcement

The arrangements of reinforcement for each type of manhole shall necessarily be done in accordance to best practise and normal specifications.

5.7.8 Concrete Curing Times for Jointing Chambers

5.7.8.1 The minimum periods after completion of concreting.

- (a) for which shuttering must remain in position.
- (b) which must elapse before reinstatement of the paving of surfaces may be commenced, and
- (c) which must elapse before traffic is allowed to pass is given in Table 3 below.

5.7.8.2 When the shuttering is removed the concrete should present a reasonable smooth surface. Any projection shall be removed and exposed cavities filled-in with cement mortar.

Table 3: Manholes Built in the Carriageway/Footway

Type of Cement used	Minimum period from completion of concreting		
	(a) to remove of shuttering	(b) before commencing reinstatement	(c) before allowing passage of traffic
Portland cement or its equivalent	5 days 5 days	7 days 5 days	7 days 7 days
Rapid-hardening cement	2 days 2 days	3 days 2 days	3 days 3 days
High Alumina cement	10 hours 10 hours	24 hours 24 hours	24 hours 24 hours

Note: Because high alumina cement generates heat, the striking of the shuttering shall be commenced before the expiration of 12 hours and the concrete prevented from becoming dry at any time within 24 hours of mixing, by watering it.

5.7.9 Jointing Chamber Fittings

The following fittings supplied shall be hot-dip galvanised:-

- (a) Grating for sumpholes shall be fitted to the sumpholes of all manholes.
- (b) Anchor iron shall be fitted accordingly
- (c) Steps manhole shall be installed in the position shown in the relative drawings for the manholes. The steps shall also be used in entrance shafts for all manholes.
- (d) Steel ladders shall be used in all types of manholes. The ladders shall be fixed to suit the different heights of the manholes.
- (e) Bolts for the attachment of Cable Bearers. In all type of manhole, the bolts required for the walls shall be fixed temporarily in the shuttering during the construction of the manhole, to ensure that they will remain in their correct position while the concrete is setting. The positions for holes in the shuttering shall be obtained by using the cable bearer as a template.
- (f) Cable Bearers Wall type. The bearers shall be fixed to the walls as described in (e).
- (g) Cable Bearers (Brackets) shall have the initial provision of two per cable bearer, e.g. in a R2A type manhole, where the cable bearers are fitted 3 to a wall making a total of 6 cable bearers, the number of brackets provided shall be 12.
- (h) Pins for Locking Cable Bearer are designed to facilitate the removal of brackets.

5.7.10 Fitting of Manhole Cover

Manhole cover No. 3E shall be fitted in all classes of. Manhole cover No. 7E shall be fitted in all classes of Joint Boxes in accordance with the relative drawings.

- (a) Where the manhole is to be set at the minimum depth one course of brickwork shall be laid between the manhole roof and frame.
- (b) Where due to anticipated alterations in level, the manhole is to be set at an increased depth; one or more additional course of brickwork shall be laid. This particularly important in the case of manholes built in the footway where there is possibility of the frames and covers being installed to carriageway level at a later date. Cement mortar shall be used both for setting the brickwork and for bedding the manhole frame.

- (c) 24 hours must elapse after the building of a jointing chamber before the frame and cover are installed. The water used in the concrete shall not exceed 643 litres per cubic metres.
- (d) The frame shall be positioned accurately in relation to the cover before being filled so that the cover is flush and level with the surrounding carriageway. Two methods of filling and setting may be employed:-
 - (i) In-situ Filling - The frame shall be embedded on a layer of stiff cement mortar, care being taken to ensure that the frame is fully supported along all four sides. The level of the frame shall be adjusted to the level of the surrounding road surface by pieces of mild-steel packing approximately 152 mm x 51 mm and of appropriate thickness. The cover shall then be placed in the frame.

When the cover is correctly suited, the edges of the frame and the cover shall be at the same level, if any irregularity can be felt, by running the finger along the joint, or if the cover rocks, the frame shall be packed up until the edges are at the same level and the cover is free from rock. The cover and the frame shall then be filled with concrete Quality A or an asphalt and granite mixture.

Great care shall be taken when filling the frame to ensure that no voids are left; the concrete in each pocket shall be thoroughly tamped with the reinforcing rod. Finishing shall be done with a trowel, the concrete in the cover compartments being left slightly proud but not more than 3.2 mm at the edge to 6.4 mm crown in the centre of the cover to allow for shrinkage, wear and to protect the metal wedges.

- (ii) Where in-situ filling is not possible, the frame shall be placed on a level surface with a piece of building paper beneath it to prevent concrete adhering to the floor. The levelling of the frame and cover, and the concrete filling shall then be done as described in method (i). The frames and covers must be left undisturbed for a minimum of 3 days. When the frame is installed, it shall be bedded on stiff 1:3 cement mortar.

5.7.11 Concrete Curing Times for Manhole Covers

The minimum period which shall elapse:-

- (a) Before disturbing the frame or cover where in-situ filling is not employed.
- (b) Before removing the cover or covers from the frame after the complete installation including cement mortar bedding.
- (c) Before allowing the passage of traffic after the complete installation including cement mortar bedding is as follows:

Type of concrete	Before disturbing when in-situ filling is not used	Before removing cover from frame	Before allowing the passage of traffic
Ordinary cement	5 days	3 days	7 days
Rapid hardening cement	3 days	2 days	3 days
High alumina cement	10 hours	10 hours	24 hours

5.8 Construction of Joint Boxes

5.8.1 Excavation

The ground shall first be excavated to the required dimensions, the sides of the excavation being timbered if necessary. The foundations shall then be levelled and rammed.

5.8.2 Floor

Concrete of Quality A for the floor shall next be laid level to the required thickness; Irons Anchor reinforcing bars shall be inserted where specified on the relative drawings. The fall of 25 mm shown in the drawings for the floor, can be achieved by rendering with cement mortar with a smooth finish.

5.8.3 Walls

Brickwork for the walls shall be laid in cement mortar, and flush pointed. The bricks shall be dipped in water before they are laid. Brackets for joint box shall be fitted as the walls are erected.

5.8.4 Roof

Roof shuttering shall be set up; concrete of Quality A for the roof shall be laid to a depth of 25 mm and reinforcement set to give the correct cover. Additional concrete shall then be placed to the specified thickness for the roof.

5.8.5 Striking of Shuttering

Shuttering shall be struck as follows:-

- (i) For carriageway joint boxes, after the lapse of time given in Table 3 of paragraph 5.7.8 in this section.
- (ii) For footway joint boxes, after 24 hours, irrespective of the type of cement used. A 20 mm cement mortar rendering shall be applied to level the floors or they shall be built up to give the 25 mm drainage fall where required.

5.8.6 Fitting of Frames and Covers to Joint Boxes

Manhole Cover No. 7E shall be fitted to all joint boxes and the method as described in paragraph 5.7.10 - 5.7.12 of this Section shall apply.

5.8.7 Protection of Cables and Associated Equipment

Measures shall be taken to protect cables and associated equipment during the cutting of duct entries into existing structures or the demolition and rebuilding of jointing chambers. Such measures may include any or all of the following:-

- (a) A ladder must be provided for access in and out of manhole excavations. Under no circumstances may cables, joints and associated equipment be used for climbing, standing or sitting on.
- (b) Sufficient pumping capacity shall be made available and operated to ensure that when cables are removed from their bearers they shall not be immersed in water at any time.
- (c) All cables shall be protected at duct entries by packing with foam rubber to act as a cushion when any movement occurs.
- (d) During demolition of the roof of a manhole a deck of timber between the cables and the roof of the manhole shall be erected to protect the fixed network communications outside plant from falling debris in the following manner:-
 - (i) A minimum of three 229 mm x 76 mm timber upright shall be evenly spaced against each long wall of the manhole with the 229 mm side against the wall. The length of the upright shall be such that they terminate approximately midway between the uppermost cables and the roof. Further length of 229 mm x 76 mm timber shall be placed horizontally on top of the uprights and secured, and between the uprights at the bottom, all positions to be wedged and blocked to the satisfaction of the authorised officer. Lengths of poling boards or other similar timber shall then be placed on top of the horizontal supports.
 - (iii) When the manhole roof and walls have been demolished down to the level of the timber decking and all debris and decking removed, the cables and other associated equipment shall be suspended from beams on the surface of the ground to the satisfaction of the authorised officer.
 - (iv) Cables and joints and other equipments shall be protected by wrapping (not tying) with several layers of sacking while timber decking is being erected or dismantled

- (e) During rebuilding operations, cables shall be supported on wooden benches with cushions of sacking or similar material once the floor has been laid and the concrete allowed to set.

5.9 Plinth for Cabinet

5.9.1 Site

The plinth shall be constructed on a suitable site where it shall not:-

- (i) be an obstruction to pedestrians.
- (ii) be damaged by vehicles.
- (iii) spoil the appearance of the surroundings.

5.9.2 Construction

The foundation of the plinth is dug to the standard dimensions and the 152 mm PVC 762 mm radius bend is located. 762 mm radius bends are necessary to obtain variations in depths of cover and to accommodate the number of tail cables associated with the cabinet to be installed. The top of the bend may be shortened where necessary. The concrete shall be Quality A mix. Normally Portland cement is used, but if it is necessary to accelerate the hardening of concrete, rapid-hardening cement may be used.

5.9.3 Template

A simple 3.2 mm thickness aluminium or any other metal template made locally must be used to ensure correct setting of the bend and bolts in the concrete foundation. Place a 254 mm diameter gasket with 165 mm diameter centre hole and appropriate bolt holes over the concrete footings.

5.10 Bonding at Jointing Chambers for Earthing Facilities

5.10.1 Method

Where metal pipes are laid and terminated at jointing chambers the break in continuity shall be made good by embedding 51 mm x 3.2 mm G.I. strips of required lengths in the walls of the jointing chamber during construction, and welding the ends to the pipes.

6. QUALITY OF MATERIALS

6.1 Specification

All materials not otherwise specified to be use for the civil works construction are to be in accordance with the specifications of the Malaysian Standards or its equivalent, in so far as those specifications apply.

6.2 Concrete

Concrete shall be of quality A, B and C as provided by this specification and the proportions of the ingredients shall be as follows:-

Concrete	Parts by Measure			Users
	Cement	Sand	Aggregate	
Quality A	1	2	4	All Jointing Chambers, Filling in Covers manhole 3E and 7E, Plinth, Concrete troughs.
Quality B	1	3	6	Placed between two sets of plant if separation clearance is 152 mm or less; For supporting, protecting or filling in purposes.
Quality C	1	4	3	Encasement of Conduits.
Cement Mortar	1	3		Plastering, Sealing dummy ducts in Jointing Chamber, Repairing damage or split ducts.

6.3 Concrete for Encasing Conduits

The concrete used for encasing conduits shall relatively be dry having the consistency of wet sand. In no circumstances shall the water content be increased appreciably as this will result in a weak concrete. Rapid-hardening cement shall be used.

6.4 Quality

6.4.1 The Jointing chambers and concrete troughs shall be constructed throughout of Quality A concrete.

6.4.2 Where a coarse concrete is required for supporting or protecting or for filling-in purposes, Quality B concrete shall be used, unless otherwise specified.

6.5 Mixing

6.5.1 Concrete mixing may be done manually or by machine. Ready mixed shall be the first preference for concreting manholes if available within reasonable distance from work site. When mixed manually the ingredients shall be sand, cement and aggregate repeatedly turned over and mixed in a dry state on mixing boards, after which water from the rose of a watering can shall be added, and the materials shall then again be turned over sufficiently to ensure thorough mixing.

6.5.2 The mixing boards shall be sufficiently large to give ample room for turning over the ingredients entirely from one place to another and

shall be so arranged or constructed that liquid cement shall not escape through the joints.

- 6.5.3** When mixed by machine the ingredients shall be put into the machine dry without prior mixing. The water shall be poured in first. Such machines shall, however, be used only so long as they ensure thorough mixing and are maintained in clean condition. They shall be of the "batch" type.

6.6 Water

The standard of cleanliness of water for mixing is that it shall be fit for drinking. The quantity used shall be sufficient, but not more than sufficient, to effect the proper hydration of cement to obtain a plastic mixture. The authorised officer may reject concrete which is, in his opinion, so over watered that it would be deficient in ultimate strength.

6.7 Compaction of Concrete

The concrete shall be deposited carefully in its intended position as quickly as possible after being mixed, and all concrete footings and foundations shall be tamped and carefully levelled. All concrete shall be compacted by the use of a poker type vibrator until a dense solid mass without voids is obtained. Under no circumstances must have vibrator be used longer than is necessary to obtain compaction nor left unattended in the concrete, otherwise segregation of the mixture will occur.

6.8 Rejection

Concrete which has become hard, dry, dirty or not placed within 30 minutes after being mixed shall not be used, and if any earth fall on top of any concrete after laying and before the work is completed it shall be carefully removed.

6.9 Cleanliness

Cleanliness shall be observed in all operations and in relation to all materials.

6.10 Cement

All cement used shall be of the best Malaysian or other approved manufacture and shall comply with all the requirements of BS 12 or the Malaysian Standard equivalent. The cement shall be fresh, fine, smooth, loose and warm tested by hand, and the authorised officer may order that any bag of cement, a portion of the contents of which has hardened, or found unsatisfactory by the hand sampling test be removed from the site forthwith.

6.11 High Alumina Cement

Before work with high alumina cement is commenced, all tools and plant shall be cleaned of all other types of cement residue and at no stage of the work shall any

other type of cement be mixed or allowed to come into contact with high alumina cement, HIGH ALUMINA CEMENT MUST NOT BE USED WITH P.V.C. DUCT.

6.12 Rapid-Hardening or High Alumina Cement

It is possible to employ generally rapid-hardening Portland cement or high alumina cement in lieu of ordinary Portland cement for his convenience and acceleration of progress.

6.13 Protection

All cement shall be ensured to be protected adequately against moisture while being transported and stored.

6.14 Cement Aids

The use of cement aids where an additive is added to ordinary Portland cement to render it rapid-hardening is not recommended and permission for its use shall first be obtained from the authorised officer who shall also determine the amount of additive to be used.

6.15 Sand

All sand shall be clean, sharp, gritty, river sand, free from loam or other impurities and from an approved source. If upon test by washing a sample, the sand is found to contain more than 5 percent by volume of silt, the sand shall not be used. This sand used shall be coarse, the grains graded is size to 5 mm.

- 6.15.1** Sand for concrete mixture shall be hard, clean, well graded natural sand free from harmful quantities of clay and silt, saline and vegetable impurities, and other deleterious matter.
- 6.15.2** When river sand is not available, mining sand may be used for concreting provided it is washed with fresh water (clean and free from organic or inorganic matter in solution or in suspension) at least twice. The bed of sand for each washing shall be not more than 60 cm deep in the container.
- 6.15.3** However, where river and mining sand are not available shore sand may be used for concreting provided it is washed with fresh water (clean and free from organic or inorganic matter in solution or in suspension) at least twice. The bed of sand for each washing shall be not more than 60 cm deep in the container.
- 6.15.4** Mining and shore sand may be used for backfilling of duct trenches. It shall be hard, clean, well graded natural sand free from harmful quantities of clay and silt and vegetable impurities and other deleterious matter.
- 6.15.5** All sand except sand for cement mortar shall be within the following grading limits:-

Sieve Test	Percentage by weight passing Sieves						
	10 mm	5 mm	2.36 mm	1.18 mm	0.6 mm	0.3 mm	0.15 mm
% passing	100	95-100	70-95	45-95	25-60	5-30	0-10

6.15.6 Sand for cement mortar shall be within the following grading limits:-

Sieve Test	Percentage by weight passing Sieves					
	4.75 mm	2.36 mm	1.18 mm	0.6 mm	0.3 mm	0.15 mm
Sand for General Purpose Mortars	100	90-100	70-100	40-100	5-70	0-15
Sand for reinforced work mortars	100	90-100	70-100	40-80	5-40	0-10

6.15.7 Sand shall be stored at the site in such a manner that it is not contaminated by coarse aggregate, earth or other foreign matter.

6.16 Aggregate

6.16.1 The aggregate for concrete mixture shall be sound, hard, clean, roughly cubical-shaped particles free from harmful quantities of clay, crusher dust, organic impurities or other deleterious matter.

6.16.2 Aggregate containing an excessive proportion of flakish materials shall not be used.

6.16.3 Brick clinker or other porous stone shall not be used.

6.17 Size of Aggregate

6.17.1 For concrete mixture of Quality A, B and C the grading of aggregate shall be within the following limits:-

Sieve Test	20 mm	10 mm	5 mm
% Passing	100	22-55	Not more than 10

6.17.2 For encasement of conduits, the maximum size of aggregate shall be 6 mm.

6.18 Bricks

The bricks used shall be best quality hard burned common bricks, either wire cut or plastic pressed, or selected hard hand-made stock bricks or other hard or over-burned hand-made bricks of comparable quality. They shall be of good shape, free from visible particles or lime and from serious cracks, and shall not absorb more than 12 percent of their weight when immersed in water for 24 hours (*5 bricks from each*

batch delivered on site shall be tested and all shall be required to pass the test). The dimensions of bricks described as types 2 and 3 in BS 657 or the Malaysian Standard equivalent shall be regarded as standard.

6.19 Cement Mortar

6.19.1 The cement mortar shall consist of:-

One measure of cement; Three measure of sand.

6.19.2 The materials after being gauged shall be thoroughly mixed in a dry state, and then thoroughly mixed with sufficient water to form a stiff mortar.

6.19.3 On no account shall water be added after mortar has once been mixed, and mortar after it has once begun to set shall not be used or mixed with other cement and sand.

6.19.4 An excess of water shall in no case be used for mixing, and if more water than is necessary be used, such mortar after it has once begun to set shall not be mixed with further quantity of sand and cement, but the whole shall be condemned.

6.20 Steel

6.20.1 All steel shall be in accordance with BS 15 or the Malaysian Standards equivalent for structural steel. All invoices for steel shall be open to inspection by the Superintending Officer or his representative.

6.20.2 If it is not possible to procure such reinforcing steel in the imperial sizes, then steel in the metric sizes approximating to those in accordance with the following table shall be used:-

Imperial size (inch)	1/4	5/16	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2
Metric size (mm)	6	8	10	12	16	20	22	25	28	32	40

6.21 Ironwork

Bolts, nuts, rivets and other accessories shall be in accordance with the relevant Malaysian Standards. All bolts, nuts, and screws shall be in accordance with the relevant Malaysian Standards. All invoices for iron shall be open to inspection by the authorised officer or his representative.

6.22 Hardcore

All hardcore shall consist of hard brick, concrete or stone graded down to a minimum of 80 mm.

Note: *When provided for use in trenches sufficient hardcore material less than 80 mm shall be added up to fill voids and aid consolidation.*

7. EXCAVATION

7.1 Protection of Excavated Material

During excavation, the Contractor or Developer shall carefully segregate the surface and foundation materials from the lower sub-soil. Sub-soil shall be protected, whilst above ground, from weathering action which could cause a damaging increase or decrease in the natural moisture content of the soil leading to the formation of voids and/or settlement after back-filling. Sub-soil which is damaged shall be selected for cartage to tip and undamaged sub-soil brought from a newly excavated length to replace the sub-soil carted away. Except where otherwise provided, the excavation shall include all necessary timbering and shoring.

7.2 Mechanical Excavators

Any mechanical excavator must be capable of allowing for, and should be used in a manner as to fulfil the requirements as in Para 7.1 and 7.6 in respect of segregation of materials and width of trench obtainable by using manual excavation. A timber base support or platform shall be placed under the feet of the excavation machine as a protection to prevent the carriageway surface being marked with scares and blemishes when the machine is in operation. Failure to comply with this protection and requirement in paragraph 7.6 will result in the Contractor or Developer being held liable for any road reinstatement charges incurred.

7.3 Silencer

Where pneumatic drills or other power driven road breaking appliances are used, they shall be fitted with efficient silencing devices and the compressor machine shall be maintained in an efficient condition so as to avoid undue noise.

7.4 Pilot Holes and Excavation of Trenches

Prior approval of the Local Authority or the owner of the site shall be obtained to dig pilot holes and excavation of trenches. Pilot holes shall be dug at positions selected by the authorised officer, normally one per sectional length to ascertain the most suitable positions for the work.

7.5 Timbering of Excavations

Timber supports for excavations shall be so designed and placed as to permit wherever possible withdrawal of such timber and consolidation of the space it occupied.

7.6 Width of Trench

In no case shall the width of trench excavated be greater than is necessary for satisfactory execution of the work. The line of the excavated trench shall be as straight as possible and any bends or curves must be of the maximum radius

possible. The line of trench shall be marked out. Line enclosing a suitable width of trench shall be marked by aid of a chalked cord. Where ducts are to be encased in concrete the width of trench is dependent upon the number of conduits to be laid in a horizontal direction. In unstable ground timbering may be necessary to support the trench and to act as a former for the concrete. To avoid excessive use of concrete the width of the trench shall be no greater than is reasonably necessary for the satisfactory execution of the work.

7.7 Depth of Trench

The depth of trenches shall be such that the average depth below the surface is according to the respective specification and as required by the authorised officer. The floor of the trench must be level and not follow surface irregularities. The bottom of every trench shall be normally levelled with 50 mm of sand and rammed.

7.8 Change of Level

In passing from footway to carriageway and vice versa or where ducts enter jointing chambers below standard depth or in any other circumstances where it is necessary to change level, the bottom of the trench shall rise or fall gradually as the authorised officer may direct.

7.9 Dewatering

The disposal of water shall be dealt with so as to prevent any risks of the ducts, cables and other materials to be laid in the trenches being detrimentally affected. All pumps and appliances required shall be provided to carry out the necessary pumping and bailing.

8. EFFECTIVE DATE AND REVISION

This guideline shall come into effect on **26 February 2008** and shall continue to be effective until modified, varied or revoked by SKMM.

SKMM CONTACT

For any queries and further information, please contact:

Infrastructure Development Division
Malaysian Communications and Multimedia Commission
63000 Cyberjaya
Selangor Darul Ehsan

Attention: En Norsam Mohd Yusoff
Tel: +60 3-8688 8023
Fax: +60 3-8688 1005
Email: norsam@cmc.gov.my