

A public consultation document issued by the
Telecommunications Regulatory Authority of the
Kingdom of Bahrain

25 March 2008

TOD/0308/062

The address for responses to this document is:

The General Director

Telecommunications Regulatory Authority (TRA)

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Alternatively, e-mail responses may be sent to the

Authority's email address at consult@tra.org.bh

The deadline for responses is **4pm on 22 April 2008**

Purpose: To seek licensed operators', governmental bodies' and public infrastructure providers' views with respect to the conditions stipulated by the proposed Guidelines for Telecommunications Infrastructure Deployment.



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PUBLIC CONSULTATION
A Consultation on the Proposed Guidelines for
Telecommunications Infrastructure Deployment

1. Introduction and Background

- 1.1 This Consultation is issued pursuant to the Authority's Consultation Process Regulation issued by the Authority on 10 August 2003¹.
- 1.2 The Telecommunications Law, under Chapter 13, has granted authorization to the licensed operators of public telecommunications networks to construct any installation or install connections required for the construction, development or maintenance of their networks on, under, through or alongside public and private properties if certain conditions are satisfied.
- 1.3 The telecommunications industry has identified operators' access to public and private property for the purpose of constructing their physical network infrastructures as a major obstacle to the development of their services and networks.
- 1.4 The Telecommunications Regulatory Authority of the Kingdom of Bahrain ("TRA"), as part of its role to promote effective and fair competition among licensed operators, wishes to enable all licensed operators to install their infrastructure in public and private property.

2. Proposed Measure

- 2.1 TRA has therefore prepared a draft document to stipulate the necessary guidelines and specification conditions for all licensed operators of public telecommunications networks and other concerned parties for the design, deployment, operation and protection of telecommunications network infrastructure in public and private property.
- 2.2 TRA shall enforce the conditions stipulated by this document to ensure all future telecommunications infrastructure design, deployment, operation and protection works are carried out in accordance with to the conditions stipulated by this document.

3. Consultation

- 3.1 The Authority seeks licensed operators', governmental bodies' and public infrastructure providers' views with respect to the conditions stipulated by the proposed Guidelines for Telecommunications Infrastructure Deployment.

¹ Arabic and English versions of the Consultation Process Regulation can be found at <http://www.tra.org.bh/en/LegalRegulations.asp>. Note that only the Arabic version of Consultation Process Regulation may be relied upon for legal purposes. The English translation is published for information purposes only.

PUBLIC CONSULTATION
**A Consultation on the Proposed Guidelines for
Telecommunications Infrastructure Deployment**

- 3.2 All comments shall contain a brief statement explaining the interest of the party submitting the comments in relation to the draft guidelines. In addition, the interested party must include as part of its comments its:
1. name;
 2. name of principal contact person;
 3. physical address;
 4. telephone number;
 5. fax number; and
 6. email address.
- 3.3 Upon receipt of the comments from stakeholders TRA will consider such comments to assist in considering and determining the final version of the Guidelines for Telecommunications Infrastructure Deployment.
- 3.4 Comments should be provided to the Authority by no later than **4pm on 22 April 2008**.
- 3.5 The Authority may, but is not obliged to, make comments public. Please see article 10 of the Consultation Process Regulation (Regulation 1 of 2003) for further details.

Kingdom of Bahrain

Telecommunications Regulatory Authority

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Guidelines

for

Telecommunications Infrastructure Deployment

Issue "A" – March 2008

TOD/0308/062



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Table of Contents

No.	Description	Page
1	Part I – General Conditions	
1.1.	Introduction	1
1.2.	The Telecommunications Law	1
1.3.	The Telecommunications Regulatory Authority	2
1.4.	Central Planning Unit – CPU	3
1.5.	Telecommunications Technical Office	3
1.6.	Telecommunications Procedures Manual	8
1.7.	CPU Procedures Manual	8
1.8.	Telecomm. Infrastructure Deployment Basic Rules	33
1.9.	Code of Practice for Service Installation	24
1.10.	Telecommunications Rights of Way	25
1.11	Joint Infrastructure Installation	27
1.12	Excess Duct Space	28
1.13	Duct Type, Colour & Size	29
1.14	Jointing Chamber Type & Size	30
1.15.	Standard Depth of Duct Cover	31
1.16.	Marker Tapes	32
1.17.	Clearance from Other Telecommunications Services	32
1.18.	Clearance from Utilities Services	33
1.19.	Clearance from Electrical Plants	33
1.20.	Protection of Existing Telecom. and Utilities Plants	34
1.21.	Entry to Buildings	35
1.22.	Jointing Chamber Covers	36
1.23.	Development Plans and Drawings	36
1.24.	Road Crossings	38
1.25.	Site Tidiness	38
1.26.	Inspections	39
1.27.	Traffic Control	39
1.28.	Safety	40

No.	Description	Page
1.29.	Insurance	40
1.30.	Protection Of Public Property	41
1.31.	Disputes	42
1.32.	Revision	42
2	Part II – Technical Specifications	
2.1	Quality of Materials	44
2.1.1	Specifications	44
2.1.2	Cement	44
2.1.3	Reinforcement	44
2.1.4	Aggregates	45
2.1.5	Water	46
2.1.6	Additives	46
2.1.7	Admixtures	46
2.1.8	Concrete Mixing Ratio	47
2.1.9	Concrete Quality	47
2.1.10	Site Mixing	48
2.1.11	Placing & Cleanness	49
2.1.12	Concrete Testing	49
2.1.13	Cement Mortar	50
2.1.14	Stabilised Backfill	50
2.1.15	Filling & Restoration Materials	50
2.1.16	Filling Materials Testing	53
2.2	Excavations	55
2.2.1	General	55
2.2.2	Excavated Material	55
2.2.3	Excavations	55
2.2.4	Silencers	56
2.2.5	Protection of Paving	56
2.2.6	Pilot Holes & Trial Excavation	56
2.2.7	Excavation Support	57
2.2.8	Width of Trench	57
2.2.9	Depth of Trench	57

No.	Description	Page
2.2.10	Change of Trench Level	58
2.2.11	Ground Water Lowering	58
2.2.12	Trench around Jointing Chambers	59
2.2.13	Line of Trench	59
2.2.14	Access to Adjoining Premises	59
2.3	Duct & Cable Laying	61
2.3.1	Line of Duct	61
2.3.2	Duct Formation	61
2.3.3	Laying of Ducts	61
2.3.4	Duct Entry to Buildings	61
2.3.5	Variation of Duct	61
2.3.6	Duct in Tunnel	61
2.3.7	Covering of Duct	62
2.3.8	Rocky Soils	62
2.3.9	Cleaning & Testing	62
2.3.10	Deferred Jointing Chambers	62
2.3.11	Plugs	63
2.3.12	Draw Rope	63
2.3.13	Alignment Test of Disturbed Duct	63
2.3.14	Expansion Joints	63
2.3.15	Highly Secured External Above Ground Lead-in	63
2.3.16	Marker Posts	64
2.3.17	Laying of PVC Ducts	64
2.3.18	Pre-formed Duct Bends	67
2.3.19	Duct Seal	68
2.3.20	Slew and/or Raising of Ducts	70
2.3.21	Cleaning and Testing of Ducts	72
2.4	Jointing Chambers	73
2.4.1	General	73
2.4.2	Types of Jointing Chambers	73
2.4.3	Protection of Cables and Associated Equipment	73
2.4.4	Duct Entries	74
2.4.5	Jointing Chamber Fittings	75

No.	Description	Page
2.4.6	Iron and Steel work	75
2.4.7	Sumps	75
2.4.8	Concreting	76
2.4.9	Joints in Concrete	76
2.4.10	Wet Situations	77
2.4.11	Compaction and Tamping of Concrete	77
2.4.12	Shuttering	77
2.4.13	Concrete Quality and Finish	78
2.4.14	Concrete Curing Times	79
2.4.15	Painting of Manholes	80
2.5	Filling & Restoration of Roads	81
2.5.1	Backfilling	81
2.5.2	Surface Preparation Prior to Asphaltting	86
2.5.3	Reinstatement of Asphalt Concrete Surface	86
2.5.4	Reinstatement of Concrete Paving Blocks	90
2.5.5	Reinstatement of Kerb Lines, Edging Kerbs, etc.	92
2.5.6	Reinstatement of Medians, Verges, Parks, etc.	93
2.5.7	Completion of Works	93
2.5.8	Notification of Completion to Roads DPCU	94
2.5.9	Maintenance	94

Part I

General Conditions

Part I – General Conditions

1.1. Introduction

The Telecommunications Law has granted authorization to the licensed operators of public telecommunications networks to construct any installation or install connections required for the construction, development or maintenance of their networks on, under, through or alongside public and private properties if certain conditions are satisfied.

The telecommunications industry in the Kingdom of Bahrain has been liberalized since 2002. Although many services have been liberalised since then, the telecommunications industry has identified operators' access to public and private property for the purpose of constructing their physical network infrastructures as a major obstacle to the development of their services and networks. The Telecommunications Regulatory Authority of the Kingdom of Bahrain ("TRA"), as part of its role to promote effective and fair competition among licensed operators, wishes to enable all licensed operators to install their infrastructure in public and private property.

This document provides the necessary guidelines and specification conditions for all licensed operators of public telecommunications networks and other concerned parties for the design, deployment, operation and protection of telecommunications network infrastructure in public and private property.

1.2. The Telecommunications Law

The basic framework for the construction of ducts is established under Chapter 13 of the Telecommunications Law, which grants public telecommunications network providers access to public and private property for the purpose of construction, development or maintenance of their networks. Besides other conditions placed upon the exercising of this right, the operator must obtain the necessary approvals and permits from competent authorities before commencing any works.

Also, due regard should be given to the international obligations of the Kingdom of Bahrain. Article 12.10 (1) of the Agreement between the Government of the United States of America and the Government of the Kingdom of Bahrain on the Establishment of a Free Trade Area ("US FTA") stipulates that "each Party shall administer its procedures for the allocation and use of rights of way in an objective, timely, transparent, and non-discriminatory manner". The US FTA expressly states that "rights of way" according to this Agreement shall mean rights of use as provided under Chapter 13 of the Telecommunications Law of Bahrain.

1.3. The Telecommunications Regulatory Authority

The Telecommunications Regulatory Authority of the Kingdom of Bahrain (TRA) was established by Legislative Decree No. 48 of 2002 promulgating the Telecommunications Law. According to Section 3(b)(2) of the Law, TRA has the duty to promote effective and fair competition among new and existing licensed operators. Nondiscriminatory and fair treatment in the process of the planning, building, maintenance and protection of a telecommunications network infrastructure is an inevitable element of a regulatory framework designed to promote effective and fair competition.

It is the TRA's intention to enable all suitably licensed operators of public telecommunications networks to install their infrastructure by providing this document detailing the design, deployment, operation and protection of telecommunications network infrastructure in public and private property.

1.4. Central Planning Unit – CPU

The Central Planning Unit (CPU) was established in 1982 and was directly attached to the office of H.E. the Minister of Works, Power and Water. The main undertaking of the CPU was to set up a national infrastructure planning and implementation system.

The coordination of the planning, construction, maintenance and plant protection works in the Kingdom of Bahrain is currently performed by the CPU. It operates a business model, which consists of collective decision making, i.e., every public utility (infrastructure provider) is involved in approving each other's work. This system involves interactive consultation between all the public utilities before the commencement of work and allows any of them to object to works that any other public utility wishes to execute. In case of disagreements, CPU acts as a mediator with a view to reaching a mutually acceptable solution.

The Central Planning Unit ("CPU") is responsible for the following main issues related to the construction of telecommunications facilities:

- Granting of planning permissions that accord the right to plan the envisaged construction;
- Granting of wayleaves (including processing General Service Notifications) that accord the right to execute actual construction work;
- Co-ordination of maintenance work concerning underground and overhead infrastructure; and
- Protection of the rights of way through consultations on land planning, boundary adjustments and the sale of public land.

1.5. Telecommunications Technical Office

1.5.1. Introduction

In the present CPU model, every public utility interfaces with all other public utilities through a single point of contact for each industry. In most cases, this system does not present any conundrums as only a single provider is operating in most of the industries related to public utilities. The present model of CPU operations would be substantially complicated if the number of stakeholders in the process (infrastructure providers interfacing through CPU) were to increase substantially.

Therefore, it is most important to set up a single telecommunications industry interface to interact with the present model of CPU operation. The single interface shall ensure that the number of infrastructure providers working within the CPU model does not increase. This will help to avoid disturbance and hold backs to the planning and execution of utilities infrastructure in Bahrain.

The creation of a single telecommunications interface shall ensure the following for the industry:

- All public telecommunications network providers can obtain the necessary approvals and consents through the CPU system to plan and construct their infrastructure.
- All public telecommunications network providers can protect their infrastructure when some other infrastructure provider wants to execute works that could damage a specific telecommunications network or hinder its operation.
- Maintain an interface system on a 24/7 basis for the whole telecommunications industry that would be capable of responding to requests in case of emergency.
- Provide the Telecommunications Infrastructure Providers with information about major roads, other utilities, real estate development projects, etc., in Bahrain, to enable efficient and effective planning of telecommunications infrastructure.
- Provide technical recommendations to the telecommunications industry representatives in the CPU policy forums.
- Work as a single point of contact with CPU, other infrastructure providers and large developers in regard to granting and protecting the telecommunications industry's rights of way in public and private roads.
- Encourage joint work for the infrastructure deployment which shall help to reduce the front cost of network deployment and better utilize the telecommunications industry's rights of way.

1.5.2. Main Guidelines & Setup

- a. The function of a Telecommunications Technical Office is executed by TRA. The Telecommunications Technical Office is an interface for the telecommunications industry with the current CPU model. Its main roles and responsibilities shall include the consulting and coordinating of the telecommunications infrastructure providers' works within the

telecommunications industry and with other utilities infrastructure providers and vice versa.

- b. The Telecommunications Technical Office shall be the focal point to receive and route the various consultation and approval forms from/to all Telecommunications Infrastructure Providers to/from all other utilities infrastructure providers.
- c. All existing public Telecommunications Network Providers shall register with the Telecommunications Technical Office within 30 days of these Guidelines becoming effective, in order to place them within the consultations process.
- d. In order to ensure harmony with the present CPU model, it is most important to ensure that all administrative and operational procedures for the new Telecommunications Technical Office are designed and implemented in line with the current CPU manual procedures.
- e. The framework for granting licensed operators of public telecommunications networks access to rights of way shall consist of two stages, as follows:

Stage One – The Telecommunications Consultation:

- i. A Telecommunications Infrastructure Provider wishing to lay new infrastructure or to upgrade the existing infrastructure shall complete a telecommunications infrastructure deployment notification form to inform other telecommunications providers, via the Telecommunications Technical Office, of his intention to access the assigned telecommunications right of way. The detailed process shall be outlined in the operational procedures manual.
- ii. When one or more of the other providers declare their firm intent, within the timescale specified by TTO, to lay infrastructure at the same time and location, all interested telecommunications operators shall establish a *bona fide* dialogue in order to reach a commercial agreement to jointly carry out the work and proportionally distribute the cost of work, as specified in other parts of this document. Only upon commercial agreement shall the process move to the next stage.
- iii. If no other Telecommunications Infrastructure Provider has a desire to lay infrastructure at the same time and location, the process may move to the next stage.

Stage Two – The CPU Consultation:

- i. After the procedures of stage one are completed, the telecommunications consultations and approval forms shall be submitted to the CPU system.
 - ii. The Telecommunications Infrastructure Provider shall complete the necessary forms and submit them to the Telecommunications Technical Office along with the necessary drawings and information as the Telecommunications Technical Office may require.
 - iii. The Telecommunications Technical Office shall be responsible for inserting the forms into the CPU consultation cycle.
 - iv. Upon receiving the forms from other utilities providers the Telecommunications Technical Office shall pass them on to the originator for his follow-up.
- f. The following categories of telecommunications works shall fall outside the two-stage framework and shall directly proceed to stage two:
- i. All minor works qualified for the General Service Notification (GSN) procedure as stated in Paragraph 1.7.2 of this document.
 - ii. All telecommunications infrastructure of duct laying and associated works with total length less than 100 meters and total estimated cost less than the threshold as advised by the Telecommunications Technical Office. (Normally at the beginning of each year the Telecommunications Technical Office shall decide upon and advertise a threshold cost of which works with cost less than the threshold cost will not require stage one process.
 - iii. All telecommunications infrastructure works which will not require intrusion on either public or private property.

1.5.3. Registration

- a. All Telecommunications Infrastructure Providers shall register with the Telecommunications Technical Office within thirty (30) days from the effective date of this document. Any Operator who wishes to become a Telecommunications Infrastructure Provider, after obtaining the necessary operator license(s) from TRA, at a later stage from the effective date of this document must first register with the Telecommunications Technical Office before deploying telecommunications infrastructure on public and private property.

- b. No Telecommunications Infrastructure Provider shall be authorized to use the telecommunications rights of way without registering with the Telecommunications Technical Office and obtaining all necessary permits.
- c. The Telecommunications Infrastructure Provider shall report any changes in its registration within thirty (30) days of the change.
- d. The Telecommunications Infrastructure Provider shall request a valid registration by submitting a letter to the Telecommunications Technical Office. The letter must, at a minimum, include the following:
 - i. Identity and legal status of the Telecommunications Infrastructure Provider;
 - ii. Name, address, telephone number, fax number and e-mail address of the employee of the Telecommunications Infrastructure Provider legally responsible for the accuracy of the registration statement;
 - iii. Name, address, telephone number, fax number and e-mail address of the employee of the Telecommunications Infrastructure Provider responsible for the technical interface with the Telecommunications Technical Office. Such employee shall be the person to whom notices shall be sent, and shall be responsible for facilitating all necessary operational activities;
 - iv. Name, address, telephone number, fax number and e-mail address of the employee of the Telecommunications Infrastructure Provider who shall be available at all times (24/7) to act on behalf of the Telecommunications Infrastructure Provider in the event of an Emergency;
 - v. Proof copy of any necessary telecommunications license(s) issued by TRA which allows the Telecommunications Infrastructure Provider to provide telecommunications infrastructure on public and/or private property within the Kingdom of Bahrain; and
 - vi. A list of authorised staff, agents, contractors or subcontractors eligible to obtain permits on behalf of the Telecommunications Infrastructure Providers.

1.5.4. Fees

- a. The Telecommunications Technical Office shall charge fees for processing all types of consultations and permissions to cover the cost of operating the Telecommunications Technical Office.
- b. The Telecommunications Technical Office shall on a quarterly basis send an invoice to each Telecommunications Infrastructure Provider pertaining to their share of the cost. The invoice should be settled in a period not exceeding 30 days.

- c. The fees shall be revised on an annual basis by the Telecommunications Technical Office and advised in writing to all registered Telecommunications Infrastructure Providers.

1.6. Operational Procedures Manual

- a. It is the intention of TRA to establish and chair a Technical Committee consisting of suitable technical representatives from licensed operators of public telecommunications networks. Every eligible operator who has registered with the Telecommunications Technical Office will be invited to nominate a representative to this Committee. The objective of the Committee is to prepare an Operational Procedures Manual to ensure smooth and efficient day-to-day operation of the Telecommunications Technical Office.
- b. The Operation Procedures Manual shall be in line with these Guidelines.
- c. It shall be at the discretion of TRA to fully or partially endorse the recommendations of the Technical Committee.

1.7. CPU Procedures Manual

1.7.1. Introduction

The stage of consultation and approval through which projects must go is dependent on the size and complexity of the projects. As shown below, there are three basic paths which projects should follow. Minor works, such as house connections, erection of telephone poles, etc., (as defined below) do not require wayleave approval. Instead they are notified to other utilities through the General Service Notification (GSN) procedure. Only public telecommunications network operators with connections to buildings and houses will be notified of these types of works.

Other small jobs such as small lengths of duct laying, construction of jointing chambers etc. which do not qualify for the GSN procedure require wayleave approval (as defined in Paragraph 1.7.3).

All medium and large projects (e.g. telecommunications networks development works, major duct-laying works, etc.) or any small projects which are anticipated to have serious implications for other services are required to go through the planning permission procedure (as defined in Paragraph 1.7.4) in advance of being submitted for wayleave approval.

One other approval which is required for a small number of projects is the

approval of H.E. the Minister of Works to cut certain prescribed roads/footpaths as specified by the Road Projects & Maintenance Directorate; or the approval of the Undersecretary of the Ministry of Works to cut footpaths on specific important roads in Bahrain.

1.7.2. Procedure for General Service Notification (GSN)

- a. All minor telecommunications works which meet the following conditions are not qualified for stage one of the consultation process (as defined in Paragraph 1.5.2). They shall directly proceed to stage two.
- b. The following categories of works and conditions should be considered as service works for which wayleave approval will not be required:
 - Individual house connections, telephone pole erections, etc., where:
 - the total length of excavation is less than 50 meters;
 - the excavation is in the verge;
 - works are not likely to affect traffic movement;
 - all excavation is done by hand; and
 - the excavation does not cross the full width of a lane of an asphalted road.
- c. The procedure shall not be used for service reinforcement.
- d. Poles shall be removed at the owner's expense if this is requested by any utility. Advance clearance shall be obtained from the [Roads Traffic Planning Department of Roads Planning and Design Directorate for the location of poles and aboveground structures.
- e. The procedure has been automated by CPU since 1996. All public telecommunications operators shall be able to follow the electronic procedure except for those who are off-line only. The application shall be submitted through TTO.
- f. In any instances where any of the works on the list are undertaken within a distance of 20 meters from either side of a BAPCO oil and/or gas transmission pipeline (the locations may be obtained from BAPCO and/or CPU), the Telecommunications Infrastructure Provider should submit a copy of the list of all works to be undertaken to the Telecommunications Technical Office which shall arrange to pass it on to the Wayleave Coordinator on his weekly visit.

On the list of the works referred to in the paragraph above, the work(s) of which BAPCO is notified should be highlighted. The copy need only be accompanied by A4-size photocopied plans of those works which affect

BAPCO. The copy of the list and the accompanying plan(s) will be handed over to the Wayleave Coordinator, who will visit as required.

- g. The list of GSNs containing estimates of any areas of asphalt which are to be cut, should be forwarded by the telecommunications operator or his appointed contractor to the Manager Roads and Bridges Maintenance Department. Permanent reinstatement should be carried out by the GSN promoter with a defect liability period of one year.
- h. All staff and contractors must be strictly instructed to take adequate precautions and to notify the relevant utility, in the event of any damage or suspected damage to underground plants (pipes, cables, culverts, junctions, boxes, etc.)
- i. The normal permit from the Traffic & Licensing Directorate of Public Security will still be required before any excavation of public roadways can commence. Any contractor or director operator supervisor visiting the Traffic & Licensing Directorate to obtain a permit must carry a letter signed by the responsible Manager or Director confirming that the works for which the permit is sought qualify as service works which do not require wayleave approval. If possible, the letter should be written in Arabic.
- j. GSN will be valid for three months from the date of approval of the notice.
- k. All contractors carrying works under GSN must liaise with the Road Damage Prevention Unit of the Road Projects and Maintenance Directorate of the Ministry of Works before starting work on site.

1.7.3. Wayleave Approval System

a. Introduction

A wayleave is the what, where and when approval for works on public land and road reservations. All utilities or public and private agencies, including Telecommunications Infrastructure Providers, which propose to undertake any works in, on, under or over a road reservation or public space (except those works specifically excluded under the GSN Procedure) must obtain a wayleave approval from all other utilities.

An officer is appointed within the Central Planning Unit who is responsible for circulating Wayleave Applications. He/she is referred to as the Wayleave Coordinator.

Each Telecommunications Infrastructure Provider will nominate one or more specific persons (plus substitute) who will be responsible for

coordinating with the Telecommunications Technical Office for submitting, receiving and processing all wayleave applications. He/she is referred to as each Telecommunications Provider's Wayleave Officer.

b. Circulation

- i. Wayleave applications will be circulated regularly on a weekly cycle.
- ii. Applications will be conveyed from stakeholder to stakeholder within the CPU model by the Wayleave Coordinator at the times and dates specified in the Wayleave Circulation Schedule. Times and dates might change from time to time depending on circumstances.
- iii. On the day specified for the telecommunications industry, applications will be collected and returned by the various Telecommunications Infrastructure Providers, within the specified time, from/to the Telecommunications Technical Office.
- iv. Only in very urgent circumstances, a Telecommunications Operator can hand-deliver a wayleave to the Telecommunications Technical Office or concerned authorities for their immediate approval. The hand-circulation shall be carried out by the design/construction engineer, the consultant or the operator's wayleave coordinator.
- v. Contractors appointed by telecommunications operators are not allowed to hand-circulate urgent wayleaves.

c. Application

- i. All applications by the Telecommunications Infrastructure Providers should be submitted to the Telecommunications Technical Office at least one day before the specified telecommunications wayleave cycle day.
- ii. The Telecommunications Technical Office shall submit the applications on the wayleave cycle day to the Wayleave Coordinator on his weekly visits. However, urgent applications will be accepted by the Telecommunications Technical Office at any time and will be introduced to the CPU cycle at soon as possible.
- iii. All applications should be fully completed in quadruplicate on the standard Application Form Pads of no-carb-required forms which are made available to each telecommunications infrastructure operator from the Telecommunications Technical Office and the Central Planning Unit.

One copy (Yellow) of the application will be retained by the Telecommunications Technical Office. One copy (Pink) will be filed in a

central register (in CPU). Two copies will be circulated for approval. The White copy will be retained by the Telecommunications Infrastructure Providers after wayleave approval is completed while the Blue copy will be retained by CPU.

- iv. Each application should be allocated a wayleave number by the applicant, comprising three elements:

Stakeholder/serial number/year, e.g., TRA/243/08 (please note the sequence).

- v. The location of works should be specified on the form by reference to the National Addressing Project Code (NAP block No.).
- vi. Each application should contain a realistic estimate of the wayleave width required (i.e., width of strip reserved, within which no other service may be laid).
- vii. In the case of wayleave applications for works which have already received planning permission, the application should state the relevant planning permission number and date. In these cases, only two copies of the location plan (one to be designated to Roads) will be required to accompany the wayleave application, since the detailed plan will have been received and filed by all the other Stakeholders at the planning permission stage.

However, a copy of the plans should be attached to the wayleave application indicating any changes to the original planning permission.

d. Outside Agencies

- i. Outside agencies are infrastructure authorities which do not appear on the standard wayleave form but have existing and planned infrastructure in specific areas of Bahrain.
- ii. If the works proposed to be undertaken by an applicant might affect infrastructure belonging to outside agencies (as listed by CPU), it is the responsibility of the wayleave applicant to ensure that the wayleave has been sent, through the Telecommunications Technical Office and then CPU, to all relevant outside agencies where the proposed works may have an impact on those agencies outside the weekly cycle. CPU can advise on any questions or doubts as to the additional destinations required. Lists of Outside Agencies are available from CPU.
- iii. In outside agency cases, the applicant will also complete the outside agency application form for wayleave. Two copies of the outside agency application will be submitted to the Telecommunications Technical Office which will pass it on to the Wayleave Coordinator on the wayleave cycle

day.

- iv. Any wayleave application to an outside agency must have the same application number as the main wayleave application.

e. Plans

- i. If planning permission has not been received for a project, seven copies of all plans plus a copy of these plans for each "Outside Agency" to which an application will be made, should be supplied.
- ii. These plans should be in the A-size series folded to A4, with the wayleave number, Land Survey & Registration Bureau sheet number, street number, scale and NAP block number clearly visible on the outside.
- iii. Where possible, all plans should be on an NSD base at scale 1:500 (if available and practicable) or otherwise at 1:1000.
- iv. Each plan should also clearly show:
 - North point.
 - Grid with coordinates.
 - Street names/numbers where practicable.
- v. A location plan of an appropriate scale shall also be included either as a separate plan or on the same detailed design plan.

f. Response to Wayleave Application

- i. On arrival at the Telecommunications Technical Office the Wayleave Coordinator will deliver a set of seven files (one for each stakeholder). The file for the Telecommunications Technical Office will contain the telecommunications operators' applications from the previous week, as approved (or otherwise) by the other authorities. The other six files will contain the applications from all other authorities.
- ii. All completed and associated plans should then be taken out of the system by the Telecommunications Technical Office and handed over to the applicant for examination and filing. The Wayleave Coordinator will take his copy (blue copy) of the completed approval for the Central Register.
- iii. All applications by the other stakeholders will be distributed by the Telecommunications Technical Office to each public telecommunications operator registered with TTO, and should then be examined and responded to within the allotted time period.

- iv. Where a project has already received planning permission, the wayleave approval should be regarded as virtually automatic, unless unforeseen events have altered the circumstances. Minimum comments and approval to proceed should be inserted on the application form and signed by a responsible officer/s nominated by the registered public telecommunications operators.
- v. Removing an application from the cycle is strictly prohibited.
- vi. Comments such as "check with the drawing office" are not permissible on a wayleave application. Comments should be restricted to either outright approval or appropriate comments.
- vii. Unless service records have already been provided at planning permission stage, each public telecommunications operator should either mark up the application plan or provide a copy of his own service records for each application.
- viii. In exceptional circumstances where a difficulty cannot be resolved in the allotted time, a Telecommunications Infrastructure Provider may request the Telecommunications Technical Office to delay the telecommunications approval for one week. The Wayleave Coordinator will take the uncompleted form for onward transmission through the cycle and will return it the following week.
- ix. Where a stakeholder or telecommunications operator objects to an application, the applicant is responsible for dealing directly with the objector to resolve the difficulty. If the solution requires a material change in the proposed works, then a new Wayleave Application is required.
- x. If the difficulty cannot be resolved by the end of the second weekly cycle, then the application will be removed from the system by the concerned utility or telecommunications operator for referral to either the Telecommunications Technical Office, CPU or to a higher level within the concerned ministry. The Telecommunications Technical Office may override comments/objections from any public telecommunications operator.

g. Further to Wayleave Approval

- i. The relevant area's Municipal Council and General Directorate of Traffic will not form part of the wayleave approval cycle. It will be the responsibility of the contractor (or the Direct Labour Supervisor) of any Telecommunications Infrastructure Provider to collect the stamp of the Area Municipality once wayleave approval has been received and pay the appropriate municipality fees.

- ii. The contractor of a Telecommunications Infrastructure Provider will be responsible for obtaining a permit from the General Directorate of Traffic before starting work.
- iii. Also, before work is started, any utility or Telecommunications Infrastructure Provider which has requested on-site consultation must be given the opportunity to attend the trial excavations and other on-site activities carried out by the contractor, to agree on the exact location of existing services, clearance requirements, etc.
- iv. During the excavation work, any affected utility or Telecommunications Infrastructure Provider which has so stipulated in the approval, should be given the opportunity to inspect the work, to ensure continuing clearance form existing plant.
- v. A wayleave can be processed subject to a Consultation Clearance Certificate which is the formal attachment of conditions relating to a joint site inspection.
- vi. A copy of wayleave approval should be available for inspection on site at all times.
- vii. In the event of damage occurring to a plant, the affected utility and/or Telecommunications Infrastructure Provider should be informed accordingly and no further work should be carried out until it has been approved by the affected body.
- viii. On completion of the works, the telecommunications operator should notify the Telecommunications Technical Office, the Wayleave Coordinator and the Roads by submitting the Standard Notice of Completion Form.

h. Validity of Wayleave

- i. Wayleave approval TO PROCEED will be valid for three months from the issue date. In the event of work not having commenced within that period, or if the completion date is likely to be more than one month later than that stated in the application, a fresh application for wayleave will be required unless extended by the Executive Coordinator of CPU. All stakeholders and telecommunications operators should be informed of the extension as well as the reason for the extension.
- ii. Renewal shall be issued using the same wayleave number stamped "RENEWAL" at the top right corner of the application.
- iii. If the scope of the works has changed or if the location has changed then a

new wayleave is required.

i. CPU Wayleave

- i. CPU may issue a wayleave application on behalf of public or private agencies which are not on the wayleave cycle nor registered as outside agencies as may be required.
- ii. CPU wayleaves are subject to the same conditions that are applicable to all other wayleaves.
- iii. CPU will allocate a wayleave number comprising three elements: CPU/serial number/year.

k. Wayleave Cancellation

- i. Each stakeholder or telecommunications operator is required to submit to CPU an end-of-year list of wayleaves indicating the ones that they would like to cancel or have cancelled and state the reasons for the cancellation.
- ii. CPU will then circulate the composite list to all authorities, including the Telecommunications Technical Office, for their reference.

1.7.4. Planning Permission Procedure

a. Introduction

All medium and large projects or any small projects which it is envisaged may create difficulties for other services should be subject to a planning application to all other authorities. The planning application should be made at the planning stage of the project, prior to seeking wayleave approval.

b. Submission of Application

- i. Each telecommunications operator, upon finalizing its proposals for a project internally, will complete a standard application for planning permission form.
- ii. The planning permission number will consist of three elements as follows:

Year/Serial No./Applicant No., e.g., 2008/243/TRA.

Note: This numbering system is a reversal of the wayleave numbering system and should not be confused with it.

- iii. Drawing numbers to which an application refers should be quoted on the form.
- iv. One copy of the form together with two copies of all drawings will be sent to all stakeholders, via the Telecommunications Technical Office, and to any outside agencies affected, if the work is to be undertaken within an outside agency clearance zone and to each such other agency as may be deemed appropriate in the particular case. The "Planning Permission Application Circulation List" may serve as a check-list for all agencies involved.
- v. The applying telecommunications operator shall submit applications for planning permission to the Telecommunications Technical Office, and subsequently to the Wayleave Coordinator on his weekly visit. The Wayleave Coordinator will then deliver them to the appropriate authorities in the wayleave cycle at the appropriate day in the cycle.
- vi. In urgent situations the applicant may request the Telecommunications Technical Office to urgently process a planning permission. TTO will arrange a special coordination meeting with the CPU in order to reduce the approval period.
- vii. On receipt of all comments the applicant will be expected to review the initial proposal, resolve any issues and finalise the design. If the final design does not differ from the initial one, the form needs to be resubmitted only to those authorities that have not granted planning permission on Part 4 of the form.

If the final design differs from the initial one, it should be submitted to all stakeholders, outlining the revisions on Part 3 of the form. All utilities should then sign or countersign in Part 4, thereby granting permission on the basis of the revised plan.

c. Response to Application

- i. Each telecommunications operator will have a period of Two (2) weeks in which to return the form to the Telecommunications Technical Office with initial comments on Part 2. The issuing stakeholder will have Four (4) weeks to reply to the initial comments.
- ii. When a resubmission is made in response to initial comments, each telecommunications operator will have One (1) week from receipt of the design for a Final response to the planning permission in Part 4 of the Form.

- iii. The returned Form should be accompanied by one set of the application drawings duly marking any existing or proposed plant. Prints of service record drawings at 1:1000 or 1:500 scale are also acceptable provided details of any new proposals are also furnished.
- iv. The granting of planning permission in Part 4 should be signed only by an authorised officer of each replying utility or telecommunications operator.
- v. Even where a telecommunications operator has no comments to make on an application, Part 4 of the application form should be completed and signed and the form should be returned to the Telecommunications Technical Office.
- vi. The Cadastral Survey Directorate under the Survey and Land Registration Bureau is the only exception to the planning permission response procedure as the planning application will be returned with cadastral and topographical information only with alerts to the applicant as to any conflicts with private land.
- vii. Where possible, Part 4 should be completed immediately (subject to conditions, if necessary) in order to avoid unnecessary resubmission.
- viii. Each authority or telecommunications operator which has granted planning permission will be responsible for filing the final design drawings for future reference (such as at the wayleave approval stage).
- ix. Failure to process applications within the allotted time will automatically confer the right on the applicant to raise the case with the Telecommunications Technical Office for a final decision.
- x. When planning permission has been granted by all telecommunications operators and stakeholders, the applicant will retain the set of completed forms until just before work is due to commence. At that time, a wayleave application will be submitted, accompanied by copies of the completed planning permission and copies of the drawings.

d. Validity and Cancellation

- i. The validity of any planning application is two years. If for any reason the project under the planning application cannot be started within two years from the date of initial application then a renewal is required.
- ii. The renewal should be issued using a new planning permission number but indicating the old number on the application form if the scope of the work has not changed.

- iii. Each Telecommunications Infrastructure Provider is required to submit to the Telecommunications Technical Office a list of all cancelled planning permissions with reasons for their cancellation.
- iv. The Telecommunications Technical Office shall send a list of all cancelled planning permissions to the CPU for circulation to all other stakeholders.

e. Planning Permission Issued by CPU

- i. CPU may issue planning permissions from time to time on behalf of agencies of the private sector that are not on the CPU list of Outside Agencies.
- ii. CPU will allocate a planning permission number comprising three elements as follows:

Year/serial number/CPU

- iii. CPU planning permissions are subject to the same conditions that are applicable to all other planning permissions.

1.7.5. Ministerial Permission to Cut Roads

a. Origins

The procedure was introduced by Ministerial Order in 1982 (ref: Ministerial Order H1/186/82).

None of the following roads/footpaths shall be cut unless approved by H.E. the Minister of Works:

- Those major roads and their surfaced footpaths as published by the Road Projects & Maintenance Directorate.
- Any roads or footpaths which have been surfaced or resurfaced within the last two years before the date of the proposed cutting for laying the services.

The objective is threefold; firstly, to protect the historical investment in Bahrain road networks; secondly, to control working on strategic roads and VIP routes; and, thirdly, to encourage better planning of infrastructure to ensure all installations are in place or appropriate ducting is in place prior to the asphaltting of roads.

b. Procedure

- i. All requests to H.E. the Minister of Works for permission to cut the above roads/footpaths should be made on the standard form published by CPU. The forms may be obtained from the TTO.
- ii. Before submitting a request to H.E. the Minister, wayleave approval for a project should be obtained from all utilities including the telecommunications industry (except Roads Section which will normally withhold approval pending ministerial approval).
- iii. The information on the Form will be verified by the Executive Coordinator and usually the site will be visited and photographed prior to recommending approval to H.E. the Minister.
- iv. The application must include the following:
 - Mapping project details;
 - General site location plan of a suitable scale highlighting the crossing location;
 - Traffic management information;
 - An assessment of whether non-disruptive technologies are appropriate for the crossing proposed;
 - Reasons/justification of the required crossing/asphalt cutting;
 - Date of applicant's connection request, particularly for roads that are less than two years old;
 - A completed Road Crossing Consultation (RCC) Form, if the application is for cutting across the road (see separate procedure), indicating if any other utility wishes to cross the same road at the same location;
 - Copy of the wayleave;
 - Contact name (responsible engineer) and telephone number.
- v. Part 1 of the Form shall be filled in and submitted to the Road Projects and Maintenance Directorate by the Telecommunications Infrastructure Provider applying to cut a road, including all the above required information.
- vi. The applicant must categorise the cutting as a category A - traffic diversions on site - or a category B - traffic rerouting. If category B, then General Directorate of Traffic and Directorate of Road Planning & Design approval of the traffic diversion is required.
- vii. The Road Maintenance Department will fill in part 2, which will state the conditions to be attached to the permit.

- viii. The Form is returned to the applicant and the concerned Manager must sign confirming/pledging that they shall comply with all the conditions and requirements specified by the Roads Directorates as stated on the Form and return the Form to the Roads Wayleave Coordinator.
- ix. The Roads Wayleave Coordinator will forward the Form to CPU for presentation to H.E. the Minister of Works and Housing.
- x. The application must have a recommended approval signed by the Executive Coordinator prior to presentation to H.E. the Minister. This recommendation usually occurs after a site visit with CPU and with a representative from the applying Telecommunications Infrastructure Provider.
- xi. The Executive Coordinator, CPU, will submit the application to H.E. the Minister in person for a final decision.
- xii. When the Form is signed by H.E. the Minister it is returned from CPU with a covering memo to the Road Projects & Maintenance Directorate for dating and issue to the applicant.
- xiii. If the application is not approved by H.E. the Minister, the Road Projects and Maintenance Directorate shall write informing the applying Telecommunications Technical Office of his refusal together with any reasons for refusal.
- xiv. See RCC Procedure: where there is a multiple crossing as requested on the RCC Form, the following actions shall be taken:
 - (a) Coordinate with the other crossing(s) to agree timing and traffic controls.
 - (b) Cost sharing (if any) for reinstatement.

c. Advice

- i. All requests must be submitted early enough to allow time for proper consideration of the request and the timely adoption of alternatives should the request not be approved.
- ii. The clearer the application, the less risk of delay in processing. Care should be taken to provide a high standard of mapping, particularly the site location plan, and if possible the application should be supported by photographs of the site. It should always be remembered that the material provided is ultimately for presentation to H.E. the Minister and the quality of the material submitted should reflect this fact.

The question of the exploration of alternative means of crossing must be

taken very seriously. If no effort is made to seriously investigate alternatives either for routing or for non-disruptive methods, then the application may be rejected.

1.7.6. Road Crossing Consultation (RCC)

a. Origins

In order to ensure that an opportunity is given to all utilities to cross a road when one utility is given permission to cut and cross a ministerial route or a newly asphalted road.

b. Procedure

- i. The applicant must alert all telecommunications operators and other utilities within the wayleave cycle, through the Telecommunications Technical Office, that there is an intention to obtain a ministerial permission to cross. The question is asked if any other operator and/or utility wants to cross at the same location with a project or a duct.
- ii. The RCC application form together with a location map is submitted to the Wayleave Coordinator through the Telecommunications Technical Office and is circulated within the wayleave cycle.
- iii. Any utility or telecommunications operator wishing to cross at the same time must declare it on the space available on the RCC form. If the utility does not declare a need to cross and makes a subsequent application to cross, that application will be refused.
- iv. Where there is a multiple crossing as requested on the RCC Form, the following actions shall be taken:
 - (a) Coordinate with the other crossing(s) to agree timing and traffic controls.
 - (c) Cost sharing (if any) for reinstatement.
- v. If any question regarding the technical management, traffic management or the cost sharing for reinstatement arises, then the issue is referred to the Telecommunications Technical Office and subsequently to the CPU for arbitration, prior to submission for ministerial permission.

1.8. Telecommunications Infrastructure Deployment Basic Rules

1.8.1. Basic Distribution System

A network of underground ducts and cables may be constructed to enable the connection of any customer to the operator's network using fibre, copper and/or other systems, in order to provide services from simple telephony to high-speed data.

For new access networks sufficient duct and jointing chambers should be constructed for all the foreseeable service requirements. Where the network already exists, the route should be surveyed to determine if additions or alterations are required.

Due consideration should be given at the planning stage to the location of underground plants to ensure the safety of both the public and other operators' networks. Consideration should also be given to the present and future provision of other utilities and future road works schemes.

1.8.2. Consumers' Connection

The standard consumers' connection to operators' networks should be through a suitable underground method. In the long run this will result in saving on maintenance costs and will provide much more reliable networks. However, there are instances where this cannot be achieved instantly due to unavoidable circumstances or the logistics of provision. In these cases overhead connection will be adopted as a temporary solution.

In all cases consumers should be advised to make provision for overhead and underground service connection to avoid any delays when the service is required.

1.8.3. Design Parameters

In order to establish consistency in the design and delivery of plants and networks, each telecommunications operator should ensure that the following basic guidelines are adhered to when designing and constructing an access network.

a. Forecasting

Each telecommunications operator should employ suitable service and line plant forecasting systems to ensure the provision of the correct plant

and network elements in the right place at the right time. Suitable Penetration Factors (PF) for the various types of tenancies and services may form the basis of a customer demand forecast, while the accuracy of the demand forecast depends on the accuracy of the PF and its application in deriving future network design and planning requirements. The PF factor should be applied carefully to the type of tenancy, taking into consideration the growth and the local knowledge.

b. Duct Infrastructure

All duct infrastructure should be based on provision forecasts of not less than 20 years, as this policy may help in reducing delays for customers whenever new cable provisions are required, as well as saving on cost of provision and minimising disturbance to public footpaths.

c. Primary Cable Network

The provision policy for Fibre and Primary Cable Networks should be based on a 7-year forecast period at a minimum.

d. Secondary Cable network

Secondary cable network provision is largely dependent on the Penetration Factor (PF) for each distribution area, but as a general guideline the provision policy may be based on a 5-year forecast period.

1.9. Code of Practice for Service Installation

A Code of Practice was issued by the Ministry of Works, which has governed the use of all land corridors. It was designed to set down firm guidelines for all public authorities, consultants and contractors involved in the installation of underground services.

These guidelines are aimed at assisting in the most efficient and economical installation of services while providing adequate safeguards for protection of the plants of others and for general public safety.

Every effort should be made by the Telecommunications Operators to ensure compliance with the provisions of the Code. However, the Code does not supersede or remove any requirements contractual, legal or otherwise which may be imposed upon contractors.

1.10. Telecommunications Rights of Way

- a. The Telecommunications Law, in Chapter 13, grants public telecommunications network operators access to public and private property, i.e. Rights of Way, for the purpose of construction, development or maintenance of their telecommunications networks.
- b. The telecommunications industry has been granted, by the relevant governmental bodies, a one meter corridor on each side of public roads for the construction of telecommunication infrastructure.
- c. It is the intention of TRA to enable the various licensed Telecommunications Infrastructure Providers to utilize the assigned Rights of Way with equal rights.
- d. It is most important to regulate the use of the limited space to ensure it will be utilized to its maximum in a sensible manner by the various licensed Telecommunications Infrastructure Providers.
- e. For public roads constructed earlier than 1982, where there was no appropriate allocation of Rights of Way, i.e., corridors for the various utilities infrastructure providers in line with the current Code of Practice for Service Installation, the new telecommunication infrastructure shall be installed as per the following arrangement:
 - i. All new telecommunications ducts shall be installed close to any existing telecommunications ducts with a minimum separation of 100mm, edge to edge.
 - ii. If the distance from one side of the existing duct to the proposed duct position exceeds 350mm, the new duct shall be installed on the other side of the existing duct.
 - iii. If the distance from both sides of the existing duct to the proposed duct position exceeds 350mm, the matter might be discussed with the adjacent utility for site compromise.
 - iv. Where there is corridor scarcity for laying new telecommunications infrastructure on one side of a road and a compromise on clearance could not be reached with the concerned utilities, the telecommunications infrastructure provider may revise his plan to consider the other side of the road reservation.
- f. For public roads constructed in accordance to the current CPU Code of Practice for Service Installation and where appropriate corridors have already been granted to the various utility providers including the telecommunications sector, the new telecommunications infrastructure shall be installed according to the following arrangements:

- i. Where there is existing telecommunications infrastructure, the conditions in Paragraph “e” above shall apply.
- ii. Where there is no existing telecommunications infrastructure, the following conditions shall apply:
 - a. The new telecommunications infrastructure, i.e. duct, shall be installed in the appropriate corridor assigned for the telecommunications industry. The Telecommunications Infrastructure Provider shall expend every reasonable effort to obtain the necessary drawings detailing the corridors allocation from the Roads Directorate or any other responsible body. The Telecommunications Technical Office may assist the operators in obtaining these drawings in case of difficulty.
 - b. The new telecommunications infrastructure, i.e. duct, shall be installed at the extreme edge of the telecommunications corridor furthest from the adjacent side of the carriageway.
 - c. Subsequent telecommunications infrastructure shall be installed between the adjacent side of the carriageway and existing telecommunication infrastructure with 100mm distance from the existing telecommunications infrastructure.
- g. If the assigned corridor for the telecommunications industry has already being utilised by another utility infrastructure provider, the Telecommunications Infrastructure Provider undertaking the work may agree, under the direction of the Telecommunications Technical Office, with the concerned utility for a swap of corridors.
- h. The new telecommunications infrastructure shall be installed at standard depths as specified in the related paragraph of this document.
- i. The maximum number of ducts in any row of a single duct formation should be two. For large duct formations, the Telecommunications Infrastructure Provider shall excavate deeper to maintain two ducts in a row.
- j. For duct formations where it is not practically or economically possible to maintain two ducts in a row, the Telecommunications Infrastructure Provider should obtain the written approval of the Telecommunications Technical Office.
- k. Where new ducts pass existing jointing chambers, they should bypass either underneath or by the side. In all circumstances, the telecommunication infrastructure provider shall ensure that the specified standard clearances are maintained from the existing infrastructures.

- l. The Telecommunications Technical Office may limit the number of ducts that may be installed by each telecommunications infrastructure provider to ensure that no one provider unreasonably consumes a disproportionate amount of the available corridor.
- m. For the construction of jointing chambers, the telecommunications infrastructure provider shall ensure that the entirety of a jointing chamber does not consume more than 75% of the telecommunications-allocated corridor, except for manholes, where the protrusion shall be in line with the related paragraph of this document.
- n. Where the infrastructure provider experiences site or other obstruction to implementing any of the above conditions, the matter may be raised with the Telecommunications Technical Office for a final decision.

1.11. Joint Infrastructure Installation

- a. Telecommunications operators are required to adopt joint infrastructure installation methods when more than one operator wishes to lay telecommunications infrastructure at the same location and within a timeframe not exceeding one year. This method of joint work shall reduce the upfront capital cost for constructing networks and shall help in effectively utilising the available telecommunications corridor space.
- b. The concerned telecommunications operators shall establish a commercial agreement on a pro-rata cost basis between themselves if one or more of the operators have shown a desire to lay telecommunications infrastructure simultaneously with the operator undertaking the work. As a result, a detailed work plan and price schedule shall be agreed between the concerned operators. Also, the concerned providers shall designate a leading provider to coordinate the work with other agencies. The leading provider shall be responsible for completion of all the procedures, which according to these Guidelines, are the responsibility of the single Telecommunications Infrastructure Provider, when the work is not shared.
- c. Where a commercial agreement between the concerned operators cannot be reached within 30 calendar days, the matter should be raised with the Telecommunications Technical Office for mediation and/or a final decision.
- d. No telecommunications infrastructure works shall be permitted in an area where another telecommunications infrastructure work was carried out during the previous twelve months, except for emergency and urgent works. If any Telecommunications Infrastructure Provider wishes to install new infrastructure in such areas, as part of his normal development works, he shall submit a request to the Telecommunications Technical

Office indicating in detail the reasons of his intended works. The Telecommunications Technical Office may approve or reject his work request depending on the justification offered.

- e. Telecommunications Infrastructure Providers shall submit to the Telecommunications Technical Office their annual infrastructure deployment plans at the beginning of each year. The plans shall be made available to the Telecommunications Technical Office by no later than 31 January of each year. The Telecommunications Technical Office will make these plans available to the other Telecommunications Infrastructure Providers.
- f. The joint infrastructure deployment policy shall be enforced from the date of issuing these guidelines.

1.12. Excess Duct Space

- a. It is TRA's intention to encourage the sharing of existing telecommunications infrastructure in order to maximize the utilization of existing infrastructure, minimize the up-front capital cost of network deployment and reduce the number of public road interruptions.
- b. When a Telecommunications Infrastructure Provider installs new conduits, it shall reserve an area corresponding to at least 20% of the usable internal area in each conduit section for the future use of other Telecommunications Infrastructure Providers. This free area shall be reserved in addition to any other necessary area for the purpose of future maintenance and cable installations. This reserved area may not be used by the Telecommunications Infrastructure Provider who reserved this area, except when the Telecommunications Technical Office expressly permits it to do so.
- c. The Telecommunications Infrastructure Provider shall not install cables or other equipment in ducts, sub-ducts, jointing chambers, etc., that do not correspond to its current or feasible needs as outlined in other parts of this document and that may hinder or limit access to infrastructure by other Telecommunications Infrastructure Providers.
- d. The Telecommunications Infrastructure Provider shall expend every reasonable effort to immediately remove any cable, equipment or any other associated plant that has been abandoned or become obsolete.
- e. The cost of the reserved space shall be borne in total by the Telecommunications Infrastructure Provider installing the duct. The reserved space is rented to other infrastructure providers in line with any other applicable requirements.

- f. The related conditions of excess duct space shall be applicable to any existing or new duct, at the time of issuing this guideline, where the total free occupancy has not yet reached the specified reserve percentage, i.e. 20%.
- g. Where it is either physically or technically unfeasible for any Telecommunications Infrastructure Provider to adhere to the above conditions, it shall write to the Telecommunications Technical Office with supporting reasons requesting it to temporarily repeal the related conditions. The Telecommunications Technical Office may approve or reject the request depending on the justification offered.

1.13. Duct Type, Colour & Size

- a. The standard ducts and bends shall be made from material consisting of polyvinyl chloride in accordance with internationally recognized standards. For the use of any other type of material the telecommunications infrastructure provider must obtain the Telecommunications Technical Office's written approval in advance.
- b. The standard sub-ducts shall be made from High Density Polyethylene (HDPE), in accordance with internationally recognized standards. The sub-ducts shall be ribbed inside and outside and used to accommodate fibre optic cables or act as lead-ins to customer premises where PVC lead-ins cannot be installed. For the use of any other material the telecommunications infrastructure provider must obtain the Telecommunications Technical Office's written approval in advance.
- c. Each telecommunications infrastructure provider shall select and use a different colour of duct and sub-duct for future easy identifications of ducts, especially in case of damage. Each provider shall select a suitable colour and submit it to the Telecommunications Technical Office for its approval, which shall be granted on a first-come-first-served basis. The black colour shall be reserved for the use of Batelco.
- d. The following size and length of ducts shall be used for all new telecommunications infrastructure provision:

DUCT NAME	D110	D96	D38	SD
Standard duct length (meters)	6	6	3	2000/ Drum
Socket length (mm)	100	100	40	N/A
Wall thickness (mm)	3.25±0.2	3.25±0.2	2±0.1	3±0.1
Outside diameter of duct (mm)	110±0.2	96.5±0.2	38±0.1	33±0.1
Inside diameter of socket at entry (mm)	111±0.2	97.0±0.1	38.2±0.1	N/A
Inside diameter of socket at shoulder (mm)	109.5±0.2	96.0±0.1	37.8±0.1	N/A

- e. The ducts and bends shall be suitably marked at an interval of not more than one meter with the duct number, the infrastructure provider's name, the date of manufacturing and the manufacturer's name or code.
- f. The duct laying shall be done in accordance to the technical standards of this document.
- g. The line of ducts installed in the ground shall be kept as straight as possible and in parallel to the centre line of the road.
- h. All ducts should be sufficiently flexible to provide a minimum bending radius of 5 meters. Tighter bends should not be attempted with straight lengths of duct otherwise kinking of the duct may result.
- i. The duct formation shall be maintained between chambers.
- j. All ducts leading into buildings and customer premises shall be sealed against the entry of gas, water and vermin into the building premises.
- k. Unless otherwise specified a draw rope shall be threaded through and left in every "way of duct" following duct-laying operations and satisfactory tests. The draw rope shall not be joined for the purpose of conserving lengths shorter than 50 metres.

1.14. Jointing Chamber Type & Size

- a. Each telecommunications infrastructure provider shall ensure that all jointing chambers are designed in accordance to the Standard Specifications for Building Works of the Ministry of Works and/or the relevant internationally recognized standards.
- b. Jointing chambers may be made of concrete or other suitable material, capable of withstanding vehicular load.

- c. The size of jointing chambers shall be kept as small as it is practically possible to efficiently utilize the available right of way. The width of any jointing chamber, except manholes, shall not exceed 750mm.
- d. Design calculations must be approved by a certified civil or structural engineer, who is a member of the Committee for Organizing Engineering Professional Practices in Bahrain, and has sign off responsibility for the company.
- e. One copy of all design calculations and two prints of all drawings of the jointing chambers must be submitted to the Telecommunications Technical Office for approval.
- f. Each jointing chamber and underground structure must have a general arrangement drawing supported by reinforcing detailed drawings to ensure construction is carried out in accordance with the requirements of the design calculations. The general arrangement drawing must clearly indicate the positions of all duct entry points, cable bearers, sump, and anchor irons, manhole steps and manhole entry points.
- g. The frame and cover of a jointing chamber shall be installed flush and level with the surrounding ground, provided that the fall across the shortest side of the cover shall not exceed 100mm. All covers shall be located so that they may be removed safely with the operator's standard equipment.
- h. During the cutting of duct entries into an existing structure, or during the demolition or building of jointing chambers, the Telecommunications Infrastructure Provider or his appointed contractor shall take all reasonable measures to protect cables and associated equipment.
- i. All manholes should be provided with access shafts not less than 1200mm in length from the finishing surface to the top of the manhole roof. This is to allow telecommunications ducts to pass on top of the roof. The size of the access shaft shall be 600 x 600mm.
- j. Any telecommunications infrastructure provider wishing to construct non-standard structures must submit an approval request to the Telecommunications Technical Office supported by design calculations and construction drawings.

1.15. Standard Depth of Duct Cover

The Telecommunications Infrastructure Provider shall ensure all ducts are laid at standard depth of covers as indicated in the table below. Where the following depths are not achievable, it is the Telecommunications

Infrastructure Provider’s responsibility to ensure that compaction and reinstatement comply with the appropriate Roads Directorate specification.

Type of Duct	Type of Pavement		
	Verge	Footway	Carriageway
PVC Duct No. 101	400	350	600
PVC Duct No. 96	400	350	600
PVC Duct No. 38	350	300	600
Sub-Duct (SD)	350	300	600
Note: Standard depth of cover to top of uppermost barrel of duct or to top of concrete for ducts laid in concrete.			

1.16. Marker Tapes

- a. A green-coloured plastic tape of 0.1 mm thickness and a minimum width of 300mm should be laid in a continuous manner above each operator duct at a depth of 300mm below ground level or in the middle of the distance if it is less than 300mm.
- b. The tape should be continuously and indelibly marked in English and Arabic with appropriate wording, such as:

CAUTION CAUTION CAUTION
TELECOM CABLE BELOW
EMERGENCY CONTACT NUMBER # # # # # # # #

The lettering should be in suitable font size and colour.

- c. Care should be taken to ensure complete continuity of such tape and to avoid displacement of the tape during backfilling.

1.17. Clearance from Other Telecommunications Services

- a. The following conditions should be read in conjunction with the related condition of the “Protection of Existing telecommunications and Utilities Plants” of this document.
- b. The standard horizontal and vertical clearance from any existing telecommunication ducts and buried cables shall be 100mm.

- c. The standard horizontal and vertical clearance from any telecommunications jointing chambers or other concrete infrastructures shall be 50mm. This distance may be reduced in case of scarcity or site obstructions.
- d. If the above specified clearances cannot be maintained, the Telecommunications Infrastructure Provider undertaking the work may discuss the matter with the telecommunications infrastructure owner for site conciliation. If the involved providers cannot reach an agreement, the matter may be raised with the Telecommunications Technical Office for a final decision.

1.18. Clearance from Utilities Services

- a. All types of ducts and cables laid directly in the ground shall be kept well clear of water mains, service pipes, sewers, subways, manholes, joint boxes or other plants belonging to other undertakers.
- b. The standard clearances as specified in the Code of Practice for Service installation shall be strictly followed.
- c. Where the minimum separation cannot be achieved, the operator or its contractor may approach the concerned utility for further clearance relaxation.

1.19. Clearance from Electrical Plants

The operator or its appointed contractor shall, before commencing any site works, consult the Electricity and Water Authority, Damage and Prevention Control Unit, to find out the exact position of any underground services.

Clearances of Telecommunications plants from electricity supplies shall be as follows:

- a. **Low Voltage Cables**

Low voltage cables for supply systems not exceeding 650 Volts shall have a standard minimum clearance of 450mm. Where difficulties arise, a reduced clearance down to 250mm will be permitted. For further reduction of clearance the matter should be discussed with the Electricity DPCU. In case of approval, the telecommunications duct shall be surrounded with a minimum of 50mm concrete cover.

b. High Voltage Cables

- i. High voltage cables not exceeding 11KV shall have a standard minimum clearance of 1000mm. Where difficulties arise, a reduced clearance down to 450mm will be permitted. For further reduction of clearance the matter should be discussed with the Electricity DPCU. In case of approval, the telecommunications duct shall be surrounded with a minimum of 50mm concrete cover.
- ii. High voltage cables of 33KV and 66KV shall have a standard minimum clearance of 1000mm. For further reduction of clearance the matter should be discussed with the Electricity DPCU.
- iii. High voltage cables of 220KV shall have a standard minimum clearance of 1500mm. For further reduction of clearance the matter should be discussed with the Electricity DPCU.

1.20. Protection of Existing Telecommunications and Utilities Plants

- a. Before commencing any excavation for the work, the Telecommunications Infrastructure Provider undertaking the work shall ensure that a layout plan with the relevant details has already been forwarded to other Telecommunications Infrastructure Providers and utilities at the consultation stage. The plan should contain at least the ducts, jointing chambers, poles, cabinets and other details necessary for the safe execution of the project.
- b. Any Telecommunications Infrastructure Provider with a plant in the vicinity shall make all reasonable effort to submit relevant telecommunications records to the Telecommunications Infrastructure Provider undertaking the work. The plan should contain at least the ducts, jointing chambers, poles, cabinets and other details necessary for the safe execution of the project.
- c. For “Urgent Works” approved by the TTO, the Telecommunications Infrastructure Provider undertaking the work shall obtain the record plans of underground services and installations from other Telecommunications Infrastructure Providers and utilities before commencement of excavation as far as reasonably practicable.
- d. Before any excavation commences, including excavation for trial pits, the Telecommunications Infrastructure Provider undertaking the work shall use suitable non-destructive underground services detectors, in conjunction with any available plans, to determine as accurately as possible the position of underground services in or near the proposed excavation area.

- e. The Telecommunications Infrastructure Provider undertaking the work shall carry out any suitable investigation, e.g., hand-dug trial pits, to ascertain the exact positions and levels of underground services prior to commencing any excavation.
- f. The Telecommunications Infrastructure Provider undertaking the work shall ensure that site-supervising personnel are provided to oversee the operation of the mechanical plant, and excavation close to or around underground services and installations is carried out by hand-digging or in accordance with the guidelines and codes of practice issued by the relevant authorities.
- g. Where underground installations or services are exposed, the Telecommunications Infrastructure Provider undertaking the work shall ensure that safe working practices are adopted to prevent damaging the installations and services, in accordance with the guidelines and codes of practice issued by the relevant authorities.
- h. Where necessary, the Telecommunications Infrastructure Provider undertaking the work shall take all reasonably practicable steps to find out whether any existing underground installations owned by private parties (e.g. Bapco, building owners, etc.) and laid under wayleave granted by CPU will be affected by the work.

1.21. Entry to Buildings

a. Entry Boxes

Entry Boxes are underground joint boxes built to allow the installation of an underground cable network to the customer's premises. They should be capable of shared access, or alternatively separate boxes should be provided for multiple service providers within the boundaries specified.

- i. The location of the entry box depends on the location of the existing/proposed External Line Plant.
- ii. The Entry box shall be constructed at a minimum distance of 1 meter from the plot line.
- iii. Due to the variables involved, it is recommended to consult with the Ministry of Municipalities at the design stage, to decide the location of the Entry Box and Entry Pipe. The operator shall not deviate from the stipulated location.
- iv. Where applicable, an earth rod must be provided at the Entry Box. The required earth resistance should not exceed 5 Ohms.

- v. The size and type of the box shall largely depend on the number of entry ducts to the building.

b. Entry Ducts (Lead-ins)

- i. All ducts leading into operator and customer buildings shall be sealed against the entry of gas, water and vermin into the building premises.
- ii. Entry pipes should be laid at a depth of 300 to 600mm to protect them from damage, and may be protected with concrete.
- iii. The location of Entry pipes shall be clearly marked above ground for ease of locating.
- iv. No right-angled sharp bends shall be installed throughout the duct length, except one wide-angle, long radius bend (factory made) at the terminating end of the duct, inside the main Telecommunications room.
- v. Entry pipes shall be assigned exclusively for telecommunications services.
- vi. Entry pipes shall be provided with a draw rope made of nylon of minimum 6 mm diameter.

1.22. Jointing Chamber Covers

The jointing chamber covers should carry clear wording in English and Arabic consisting of the word "Telecom" and the operator's name.

1.23. Development Plans and Drawings

- a. The Telecommunications Infrastructure Provider shall ensure that suitable drawings are produced and provided to the execution teams to ensure works are carried out in accordance to this document and other internationally recognized practices.
- b. The Telecommunications Infrastructure Provider shall produce the following technical drawings, where applicable, and ensure inclusion in consultations as well as provision to the site execution team:

Site Location Plan:

- i. The Telecommunications Infrastructure Provider shall produce a suitable location plan in a suitable scale to indicate the boundary of the proposed works.
- ii. The plan should indicate road names or numbers, block numbers and any major landmark within the area.

Main Duct Plan:

The duct plan or ordinance map shall include the following information:

- i. Number and type of existing and proposed ducts.
- ii. Types of jointing chambers and their orientation with regard to duct entries.
- iii. Distance between salient points.
- iv. Distribution Point (DP) location, reference number and type.
- v. Ducts and jointing chambers to be recovered, if any.
- vi. Duct space record.
- vii. Other details, such as road names or numbers, block numbers, etc.

Main Cable Plan:

The cable plan or ordinance map shall include the following information:

- i. Size and gauge of existing and proposed cables.
- ii. Type of jointing chambers.
- iii. Location of joint closures.
- iv. Cable pulling location and cable winch configuration.
- v. Distribution point location, reference number and DP type.
- vi. Cables and other plants to be recovered, if any.
- vii. Other details, such as road names or numbers, block numbers, etc.

Cable Pair Distribution Plan:

The cable pair distribution plan shall include the following information:

- i. Cable size, gauge, sectional length and pairs utilised.
- ii. Distribution points number and DP type.
- iii. Pairs distributed.
- iv. Joint closures type.
- v. Plants to be recovered, if any.

- c. All technical drawings should clearly show the map base, i.e., cadastral and topographic information.
- d. The size of the drawings may vary from A0 to A4 in size depending on the design requirements and size of the work.
- e. In addition to the technical details, the drawings should contain the following general information at a minimum:

Project owner's name and logo, project title, drawing title, drawing number, issue number, designer's name & contact, legends and any special notes.
- f. All drawings shall be approved by suitably certified engineers.

1.24. Road Crossings

- a. The Telecommunications Infrastructure Provider shall attempt to use non-disruptive methods to cross all VIP and ministerial routes and other major roads as defined by the Road Projects and Maintenance Directorate.
- b. Only when the site's circumstances do not allow the adoption of non-disruptive methods will the Telecommunications Infrastructure Provider be allowed, by the Road Projects and Maintenance Directorate, to use traditional methods of cutting and crossing roads.
- c. It is the responsibility of the Telecommunications Infrastructure Provider to ensure that all cutting and backfilling works are carried out in accordance to the Road Projects and Maintenance Directorate specifications.

1.25. Site Tidiness

- a. The telecommunications infrastructure provider shall carry out excavation work in such a manner as to avoid unnecessary inconvenience to the general public and occupants of neighboring properties.
- b. The telecommunications infrastructure provider shall ensure that litter and waste generated from the work or otherwise is removed from the site and properly disposed of daily.
- c. The telecommunications infrastructure provider shall ensure that overspill or wash-away of excavation and construction materials onto adjacent land be prevented as far as reasonably practicable. The telecommunications infrastructure provider shall remove and clean up immediately the

overspill or wash-away materials in the event of such an occurrence arising from the execution or as a consequence of his work.

- d. The telecommunications infrastructure provider shall take adequate measures, such as use of screens, dust sheets, tarpaulins, water spraying or other dust-suppression methods approved by the [Roads and Municipalities Something missing here?] to prevent dust generated from the execution or as a consequence of his Work. Materials, including earthwork materials, from which dust will be generated when being transported must be adequately covered with suitable sheets.

1.26. Inspections

- a. The Telecommunications Technical Office shall make inspections as are reasonably necessary for the enforcement of these guidelines and other rules and regulations issued by other authorities.
- b. The Telecommunications Technical Office may order such actions as it deems necessary to ensure that these guidelines and other rules and regulations issued by other authorities are not violated.
- c. The Telecommunications Infrastructure Provider shall be responsible at his own cost to provide the necessary workforce, equipment, tools and any other necessary material to enable the Telecommunications Technical Office to make inspections in an effective and efficient manner.
- d. In the event that a dispute arises as to the amount, nature, or scope of the work required under these guidelines, the decision and judgment of the Telecommunications Technical Office shall be final and binding.

1.27. Traffic Control

- a. Work shall not commence until appropriate steps have been taken to warn and safeguard vehicular and pedestrian traffic. Temporary signs, barriers, etc., shall be in accordance with the booklet "Traffic Control at Roadworks" published and regularly amended by the Ministry of Works.
- b. Traffic signs, barriers, etc., shall be maintained in good and clean condition throughout the works. If continuing works require amended or extended signing, this shall be subject to the provisions of this clause.
- c. Permanent road signs shall not be removed or covered without the specific permission of the Traffic Engineering Section of the Road Planning and Design Directorate (RPDD). Where such permission is granted, the road signs shall, if required by RPDD, be temporarily re-sited in an approved manner. On completion of the works, any temporarily re-sited signs shall

be restored to their original location unless the works render this impossible and it is agreed to by RPDD.

- d. The telecommunications infrastructure provider shall establish and maintain pedestrian and vehicular access, or any temporary diversions, in accordance with temporary traffic arrangement plans approved by the Road Planning and Design Directorate (RPDD) and the General Directorate of Traffic.
- e. The telecommunications infrastructure provider shall keep clear of and maintain unobstructed access to all emergency exits and accesses for emergency vehicles at all times.
- f. In the case of excavation along building frontages, the telecommunications infrastructure provider shall provide temporary pedestrian crossings so as to maintain access to adjoining premises.

1.28. Safety

- a. At all times the Telecommunications Infrastructure Provider and his associates shall adhere to and abide by all safety and security rules, decrees, laws, ministerial orders, rules and regulations applicable in the Kingdom of Bahrain.
- b. In connection with the work and at his own cost the Telecommunications Infrastructure Provider shall be responsible for the implementation, observance and performance by himself and his contractor or agents of all safety precautions for the protection of himself, his or their employees and any other person, and of all property as may be affected by the execution of the work, whether required by any rule, order, regulation or by-law or is otherwise necessary or desirable.
- c. The Telecommunications Infrastructure Provider and/or his appointed contractor should test for the presence of gas before entering into any jointing chamber. The Telecommunications Infrastructure Provider and his appointed contractor shall be responsible for the provision of gas testers certified by a competent body.
- d. The Telecommunications Infrastructure Provider or his appointed contractor shall have posted at the site, the name and address of a responsible representative who can be contacted in an emergency.

1.29. Insurance

- a. The Telecommunications Infrastructure Provider shall have in force and shall require any contractor to have in force:

- i. Employer's liability insurance, and
 - ii. Public liability insurance for such sum and range of cover as it deems to be appropriate but not less than BD 500,000 for any one event or series of linked events.
- b. All such insurance shall be extended to indemnify the Telecommunications Infrastructure Provider against any claim for which the contractor or subcontractor may be legally liable.
 - c. Fire insurance equating to the total contract value plus an on-cost to cover professional fees shall be maintained.
 - d. The policies of insurance must be issued by a registered insurance company operating in Bahrain.
 - e. Any damage whatsoever caused by the Telecommunications Infrastructure Provider, its employees, contractors, agents or associates to any third party's plant or to public property or to private property howsoever caused shall be at the sole liability of the Telecommunications Infrastructure Provider.

1.30. Protection Of Public Property

- a. A Public Telecommunications Network operator shall, during the construction, development or maintenance of its telecommunications network, comply with the legal and regulatory provisions relating to the protection of the environment and historical and tourist sites.
- b. The Telecommunications Infrastructure Provider shall not remove, even temporarily, any trees or shrubs which exist in a public place without first obtaining the consent of the appropriate department within the Ministry of Municipalities or any other department having control of such property.
- c. Any monument set for the purpose of locating or preserving the lines of any street or property subdivision, or any precise survey reference point, or any permanent survey benchmark within a public or private road, shall not be removed or disturbed or caused to be removed or disturbed without first obtaining permission in writing from the owning utility to do so. Permission to remove or disturb such monuments, reference points or benchmarks shall be granted only when no alternate route for the proposed substructure or conduit is available. If the Roads Directorate is satisfied that no alternate route is available, permission shall be granted only upon condition, by an agreement in writing, that the person or utility applying for such permission shall pay all expenses incident to the proper replacement of this monument by the Roads Directorate.

1.31. Disputes

- a. The Telecommunications Technical Office shall resolve any dispute between Telecommunications Infrastructure Providers in respect of the implementation of these guidelines if no agreement has been reached by the parties within one month.
- b. The Telecommunications Technical Office shall have the power to intervene, and request and receive all necessary information from all parties as may be required to reach a decision.
- c. The decision of the Telecommunications Technical Office shall be final and shall be notified in writing to all parties.

1.32. Revision

These Guidelines may be reviewed from time to time, and as necessary, from whatever source is considered appropriate. TRA reserves the right to add new or interim conditions to these Guidelines. Such new or interim conditions will be notified to interested parties in writing.

Part II

Technical Specifications

2.1. Quality of Materials

2.1.1 Specifications

Where Ministry of Works standard specifications, British Standards, European Standards or other specifications are quoted these will be the current standards adopted by the issuing Authority.

All materials not otherwise specified shall be in accordance with the conditions above.

2.1.2 Cement

- a. Cement shall be from an authorised source approved by the Ministry of Works.
- b. Cement shall be sulphate resisting Portland cement complying with the requirements of BS 4027.
- c. The use of High Alumina (RA) cement shall not be permitted.
- d. Rapid hardening Portland cement may be employed in lieu of sulphate resisting Portland cement for the convenience and acceleration of progress.
- e. Cements of different types shall not be mixed with one another.
- f. Where cement is kept on site it shall be stored according to BS EN 197.
- g. No cement shall be used which has been manufactured more than 6 months before its proposed date of use on site, or which has been stored on site for more than 3 months, unless it is tested before use and found to comply with BS 4027.

2.1.3 Reinforcement

- a. All reinforcement shall comply with the requirements of BS4449 - Specification for carbon steel bars for the reinforcement of concrete.
- b. All reinforcement material supplied must be supported by test certificates, which certify compliance to BS4449.
- c. All reinforcement steel scheduling, bending and cutting shall comply with the requirements of BS8666.

2.1.4 Aggregates

All aggregates used shall comply with the requirements of BS EN 12620 - Aggregates for concrete.

Coarse Aggregates

- a. Coarse aggregates shall be in accordance with the requirements of BS EN 12620, Table 2. Unless otherwise stated, grading should be up to and including 20mm.
- b. Coarse aggregates for concrete shall be crushed, hard durable stone with at least 90% of the particles having one or more fractured faces.
- c. The maximum permitted content of chlorides and sulphates is 0.05% by weight of aggregate (expressed as NaCl) and 0.4% by weight of aggregate (as acid soluble S03) respectively.
- d. The Flakiness Index shall not be more than 30%.
- e. Coarse aggregates shall contain less than 1 % by weight of friable particles when determined in accordance with ASTM C-142.
- f. Aggregates for each of the qualities of mix included in Para. No. 2.1.8 shall be graded as follows:

Quality of Concrete	Size of Aggregates
A	10-20 mm (mixed)
B	20 mm
C	Any size suitable for work
F	10 mm
LEAN	20 - 40mm

- g. All aggregates supplied must be supported by supplier information as defined within sections 7, 8 & 9 of BS EN 12620.

Fine Aggregates

- a. Fine aggregates shall be in accordance with the requirements of BS EN 12620, Table 4.
- b. All fine aggregates shall be double washed and shall not contain more than 5% voided shells.

- c. The maximum permitted concentration of chlorides and sulphates expressed as % by weight of dry sand are 0.10% (as equivalent NaCl) and 0.4% (as acid soluble SO₃) respectively.

2.1.5 Water

- a. Water obtained from an approved source shall be clean and free from harmful matter in such quantities as would affect the properties or appearance of the concrete, in the plastic or hardened state, or affect the properties of the reinforcement.
- b. Water shall be clean de-mineralized, blended or unblended with a PH between 6.5 and 8.0 and shall meet the general requirements of BS 3148.

In particular, the following limits shall not be exceeded:

Chloride as NaCl	800 ppm
Sulphate as SO ₃	1000 ppm
Alkali HCO ₃ /CO ₃	1000 ppm
Total dissolved solids	2000 ppm
Suspended solids	2000 ppm

- c. Water shall be tested and comply with the requirements of BS 3148. All other testing shall be by an approved standard analysis technique.
- d. Water shall be stored in approved clean containers, shaded from the sun and protected against contamination by windblown dust or other materials.

2.1.6 Additives

- a. The use of additives in cement or concrete for works carried out exclusively under these Guidelines may only be employed in ready mixed concrete and guaranteed by the ready mix concrete supplier. Placing times must be adjusted to suit suppliers' recommendations.
- b. The use of additives in cement or concrete shall not be permitted.

2.1.7 Admixtures

Admixtures may only be used with prior approval in writing from the Telecommunications Infrastructure Provider's Engineer.

2.1.8 Concrete mixing ratio

- a. Concrete, when site-mixed, shall be of the quality required by these Guidelines, or as directed by the Telecommunications Infrastructure Provider's Engineer. The qualities to be used are as follows (Proportions by volume):

	A	B	C	F	Dry Lean Mix
Cement	1	1	1	1	1
Sand	1.5	2	3	2	-
Aggregate	3	6	6	3	-
All in-Aggregate	-	-	-	-	15

NOTE: Mixing water added to the mix shall be reduced by the volume of free water contained in the fine and course aggregates so as to give the requisite slump value. This reduction shall be determined by the Contractor prior to mixing.

- b. Where the concrete is used for road reinstatement the proportions shall be as agreed between the Telecommunications Infrastructure Provider and the Roads Directorate Engineers.

2.1.9 Concrete quality

- a. All concrete used shall comply with the specifications in this document and the requirements of BS EN 206 - Part 1: Concrete. Specification, performance, production and conformity BS5328 – Concrete.

Where test results indicate that the concrete is non-compliant, the contractor may, at the discretion of the Telecommunications Infrastructure Provider's Engineer, be instructed to remove all non-compliant material and to replace it with material of suitable quality according to these specifications.

- b. Unless otherwise specified, all concrete used for the construction of Concrete Jointing Chambers and other structures shall be ready mixed type "A" to mix grade 45 n/mm² as defined in BS5328 and BS EN 206.
- c. Concrete quality 'B' shall be used for insertion between electricity supplies and the Telecommunications Infrastructure Provider's plant where normal minimum separation cannot be obtained unless otherwise specified.

- d. Concrete quality "C" shall be used where coarse concrete is required for supporting or protecting buried plants and the provision of concrete surrounds under road crossings, unless otherwise stated.
- e. Concrete quality 'F' shall be used for the concrete surround in which ducts are laid, where the number of ducts laid exceeds 9.
- f. Ready Mix concrete cement content is as follows:

Quality A	Cement content 360 KG/m ³
Quality B	Cement content 230 KG/m ³
Quality C	Cement content 200 KG/m ³
Quality F	Cement content 390 KG/m ³
Dry Lean Mix Concrete	Cement content 180 KG/m ³

2.1.10 Site mixing

- a. Concrete mixing must be done by machine.
- b. The ingredients shall be put into the machine dry without prior mixing. The water may be inserted first or last. Such machines shall, however, be used only as long as they ensure thorough mixing and are maintained in clean condition.
- c. All ingredients for the mix shall be batched, using a gauge box.
- d. Ensure the mixing machine is on level ground and firmly in position so it will not move around when it is being used.
- e. The mixer shall be tested to see if it will dump the mixture easily into a wheelbarrow or directly onto the prepared foundations.
- f. The best order of loading depends on the type of mixer and the number or size of the aggregates being used, but it is better if some of the coarse aggregate and part of the water is added first.
- g. The mixer shall be clean before use to ensure that previously mixed concrete is not being mixed with the new.
- h. Water shall be added until the correct consistency is achieved.
- i. Mix for an average of 1.5 minutes or until the concrete is thoroughly mixed and is a uniform colour. Each batch should look the same as the

previous batch. The concrete mix is ready to pour out of the mixer when it falls cleanly off the blades inside the mixer.

- j. Clean the mixer straight away after use. Turn off the machine and add a little coarse aggregate and some water. Turn the machine on and let the water and the coarse aggregate turn for a few times. Dump this and clean the blades by hand.

2.1.11 Placing & cleanness

- a. The Concrete shall be deposited in its intended position as quickly as possible after being mixed and all concrete footings and foundations shall be tamped and carefully leveled.
- b. Concrete that has become hard, dry or dirty after being mixed shall not be used. If any soil falls on top of any concrete after laying and before the work is completed, it shall be carefully removed.
- c. Cleanliness shall be observed in all operations and in relation to all materials.
- d. In no circumstances shall concrete be re-mixed for further use.
- e. It is important that the concrete be placed in its final position before the cement reaches its initial set. Any concrete where initial set has taken place shall not be used.
- f. The concrete shall be placed within 30 minutes of being mixed and once placed it should not be disturbed.
- g. The concrete shall be placed carefully - not thrown or dropped - into position and spread evenly. This will avoid the separation of the large aggregate from the cement.

2.1.12 Concrete testing

For assessment of uniformity and quality, concrete samples shall be taken from randomly selected batches of concrete and controlled tests shall be done. The contractor shall carry out the tests in the presence of the Telecommunications Infrastructure Provider's Engineer. The adopted tests are slump and cube tests.

2.1.13 Cement mortar

- a. Mortar shall be as designated in BS 5628; Part 1, - Requirements for Mortar, Table 1.
- b. Cement Mortar shall consist of one measure of sulphate resistant cement and three measures of double washed sand.
- c. The materials, after being gauged, shall be thoroughly mixed in a dry state on a clean mixing board, and then thoroughly mixed with sufficient water to form a stiff mortar.
- d. Water shall not be added after mortar has once been mixed, and mortar, once it has begun to set, shall not be used or mixed with other cement and sand.

2.1.14 Stabilised Backfill

Stabilised backfill shall consist of excavated soil mixed with cement. The ratio of excavated soil to cement shall be 10 to 1, or as otherwise specified, for the backfilling of trenches. Mixing may be carried out by hand or machine, but in either case the mixing shall be sufficient to give an even colour throughout.

2.1.15 Filling & Restoration Materials

a. **Hard Fill Type A**

- i. Granular Type A fill material shall be good, hard, well-graded material, screened and crushed as necessary to lie within the grading envelope given in the Table below when tested in accordance with Method 9 (clause 9.2) of BS 1377: Part 2: 1990. The material shall not have a plasticity index (PI) of more than 6%.

BS Sieve Size	37.5 mm	20 mm	5 mm	600 micron	75 micron
Percentage passing by weight	95 – 100	50 – 75	25 – 50	8 – 30	0 – 10

- ii. The CBR of the material when tested at field density and in accordance with Method 7 of BS 1377: Part 4: 1990 shall not be less than 80%.

- iii. The water-soluble salt content shall not exceed 2% (or 2 g of sulphate per liter).
- iv. The material shall be delivered in trucks covered by heavy tarpaulin or other suitable covers and must be securely fastened to prevent dust nuisance in transit.

b. **Hard Fill Type B**

- i. Type B fill shall be clean, hard, granular material free from clay and deleterious substances. The total soluble salts shall not exceed 2% and the grading of the fill shall lie within the envelope given in the Table below when tested in accordance with Method 9 (clause 9.2) of BS 1377: Part 2: 1990. The fine portion of the material passing the 75 micron sieve shall not have PI of more than 8%.

BS Sieve Size	10 mm	5 mm	75 micron
Percentage passing by weight	100	15 - 50	0 - 15

- ii. The material shall have a CBR of not less than 20% when tested at field density and in accordance with Method 7 of BS 1377: Part 4: 1990.

c. **Excavated Materials**

- i. Excavated materials dug out from trenches/pits are categorized as either suitable or unsuitable for use as backfill materials.
- ii. Suitable excavated materials shall lie within the gradation envelope of the Table above (Hard Fill Type B) and shall be sorted out during digging operations so as to be free from asphalt chunks, concrete chunks, building debris and/or organic matter.
- iii. Unsuitable excavated materials shall include, but not be limited to:
 - d. Materials from swamps, running silt, dark organic materials, logs, stumps, perishable materials, slurry or mud; or
 - e. Materials that are highly plastic clay; or
 - f. Materials that are highly organic clay or silt; or
 - g. Materials that contain an unacceptable quantity of soluble salts (> 2%); or
 - h. Materials that have high moisture content (> 3% of material optimum moisture content).

- iv. All unsuitable excavated materials, i.e. soft materials, asphaltic chunks, stones larger than 37.5mm, organic materials, metals, debris, plastic materials, etc., shall not be used for backfilling and shall be promptly removed from the site.

e. **Tack Coat**

The tack coat shall be bituminous emulsion complying with BS 434, either anionic class A 1-40 or cationic class K1-40, or shall be cut-back bitumen conforming to BS 434. Road Oil is not to be used as tack coat.

f. **Prime Coat (Road Oil)**

The road oil shall be medium cutback bitumen conforming to BS 3690.

g. **Asphalt Surfacing**

Asphalt concrete surfacing materials include all material constituents and mixes conforming to the Road Projects and Maintenance Directorate's code of practice that are used to reinstate the asphalt surface layer(s) to its original condition prior to cutting and excavation. Asphalt Surfacing materials should comply with the parameters and conditions laid out in the Road Projects and Maintenance Directorate's code of practice (Appendix I).

h. **Dry Lean Concrete**

Dry lean concrete materials should comply with the parameters laid down in the Roads Directorate Specifications.

i. **Precast Concrete Kerbs and Edgings**

- i. Precast concrete kerbs and edgings shall comply with BS 7263 and the requirements set out in the Road Projects and Maintenance Directorate's code of practice.
- ii. Straight kerbs and edgings shall be hydraulically pressed by employing pressure, over the entire surface receiving the press, of not less than 7 mpa.
- iii. The cement used in the manufacture of kerbs shall be sulphate-resisting Portland cement complying with BS 4027. The minimum

cement content shall be 370 kg/m³.

- iv. Coarse aggregates used in the manufacture of kerbs shall be obtained from Ras Al Khaimah or other similar and approved sources, and all aggregates shall meet the requirements of these guidelines for aggregates for concrete except in respect of grading.

j. **Precast Concrete Paving Flags**

Precast concrete paving flags shall comply with BS 364. The cement used in the manufacture shall be sulphate-resistant Portland cement complying with BS 4027. The minimum cement content shall be 370 kg/m³. The dimensions of the precast concrete paving flags shall be as follows:

Width	500mm
Length	500mm
Thickness	50mm

k. **Precast Concrete Paving Blocks**

- i. Concrete paving blocks shall comply in all respects with the requirements of the "Standard Specification for Concrete interlocking paving blocks 2001/01" issued by Material Testing and Research, Ministry of Works (See also *clause 1427* of General Specifications for Roadworks, August 1978, revised September 1997, pp. 71 – 74). In addition, only blocks from manufacturers on the Ministry of Works' approved list shall be used.
- ii. The bedding layer shall consist of washed sand complying with the general requirements of BS 882 (for fine aggregates) except that not more than 15% shall be retained on a 2.36mm sieve. The sand shall be obtained from a single source and shall have uniform moisture content. If necessary, the sand shall be stockpiled and allowed to drain before use and sheeted to allow moisture content to stabilize.

2.1.16 Filling materials testing

At the discretion of the Telecommunications Infrastructure Provider's Engineer and/or the Roads Engineer, the required quantity of a sample of each consignment of the material supplied by the Contractor (cement, water, aggregate, Type B, Type A, etc.) which is proposed to be used, may be taken and tested by the independent lab approved by the Ministry of Works. Work will not normally be delayed in anticipation of the result of

the test, but should the said material prove unsatisfactory under test, the unused portion of the consignment will be rejected and the Telecommunications Infrastructure Provider's Engineer shall have the power to reject any work for which the particular materials have been used.

2.2. Excavation

2.2.1 General

- a. The Telecommunications Infrastructure Provider shall excavate in carriageways and/or footways in accordance with the conditions specified in the code of practice issued by the Ministry of Works.
- b. The Telecommunications Infrastructure Provider shall arrange to notify all the affected members of the public at least 48 hours before the commencement of work.

2.2.2 Excavated material

- a. Excavated subsoil shall be protected from weathering action that would cause a damaging increase or decrease in the natural moisture content of the soil, leading to the formation of voids and/or settlement after backfilling.
- b. Normally a certain amount of subsoil, roughly equivalent to the volume of duct being laid, is surplus and carted to tip. Subsoil that is damaged or unsuitable shall be selected for cartage to tip and, if required, suitable undamaged subsoil shall be brought from a newly excavated length, or imported to site to replace the subsoil carted away.
- c. The amount of excavated soil left exposed above ground overnight shall be kept to a minimum.
- d. Trenches shall be backfilled on the same day, wherever possible. No trenches shall be left open overnight without advance approval from the Telecommunications Infrastructure Provider's Engineer and the appropriate safety precautions shall be maintained.

2.2.3 Excavations

- a. **Mechanical Excavation.** Any mechanical excavator must be capable of allowing for, and should be used in such a manner as to fulfill, the requirements of segregation /separation of materials and width of trench obtainable by using manual excavation, or any other requirements of these Guidelines.
- b. **Excavation.** Excavation shall be carried out in a controlled manner using equipment and methods appropriate for the task.

- c. **Excavation in the vicinity of trees.** Special care must be taken when excavating in the proximity of trees to ensure that damage to primary roots or the body of the tree does not occur. Hand excavation, wherever possible, is to be carried out in such locations. When the following guidelines cannot be followed, advice must be sought from the Directorate of Agriculture of the Ministry of Municipalities.
- i. Where the diameter of the tree trunk is 150mm or less, roots of 12mm diameter or more should not be cut.
 - ii. Where the diameter of the tree trunk is greater than 150mm, roots of 25mm diameter or more should not be cut.

Where damage has been proved to be a direct result of excavation or reinstatement works, the Telecommunications Infrastructure Provider or his appointed contractor shall bear all costs incurred for any remedial action required.

2.2.4 Silencers

The appointed contractor shall comply with any national or local regulation or by-law, to ensure that the equipment used during works is fitted with suitable silencing devices, which minimize or eliminate undue noise.

2.2.5 Protection of paving

The appointed contractor shall take all necessary steps to prevent damage or contamination to pavings by his plant and equipment.

2.2.6 Pilot holes and trial excavation

- a. The Contractor shall excavate pilot holes or trial excavations in carriageways or footways as he may be directed to by the Telecommunications Infrastructure Provider's, to meet the requirements of these Guidelines.
- b. The usual form of a pilot hole for a duct or cable trench is across the line of the trench. Although there is no standard size for a pilot hole, the usual width follows the minimum width of trench, which is 350mm.
- c. Pilot holes need to extend a minimum of 600mm on either side of the trench or jointing chamber excavation, to ensure clearance from other services.

- d. Pilot holes for jointing chambers or cabinets and pillar bases shall be at any position necessary to indicate a clear excavation space for the proposed structure and are usually dug in a cross shape.

2.2.7 Excavation support

- a. The excavation shall include all necessary timbering, sheet piling and shoring to maintain the stability of the excavation.
- b. The supports of an excavation shall be designed and placed to prevent loss of any ground and to permit, wherever practicable, withdrawal of such supports and consolidation of the space occupied. Prior written agreement must be obtained from the Telecommunications Infrastructure Provider’s Engineer and formally recorded where the withdrawal of supports is considered impractical.
- c. Existing mains and other services shall be adequately supported by temporary slinging or strutting, or by brick or concrete piers.

2.2.8 Width of trench

In no case shall the width of trench excavated be greater than is reasonably necessary for satisfactory execution of the work.

Duct Formation	Width of Trench
1 way to 4 ways	350mm
6 ways to 8 ways	450mm
9 ways to 12 ways	500mm
Above 12 ways	To be approved by TTO

2.2.9 Depth of trench

- a. Where the following depths are not achievable it is the Telecommunications Infrastructure Provider’s responsibility to ensure that compaction and reinstatement comply with the Road Projects and Maintenance Directorate’s Code of Practice and that bore clearances of the duct route are maintained allowing future cabling works to be carried out.

Type of Duct	Standard Depth of Cover		
	No Vehicular Access	Footway mm	Carriageway mm
PVC Duct No. D101	300	350	600
PVC Duct No. D96	300	350	600
PVC Duct No. D38	300	350	600
PVC Sub-Duct	300	350	600
Direct Buried Cable	300	350	600

Note: Standard depth of cover is from the surface level to the top of the uppermost duct.

- b. **Standard Shaft for Manholes.** A vertical access man entry shaft to an underground chamber commences from a minimum point, 1200mm for footway shafts and 1500mm for carriageway shafts, below the appropriate surface level down to the top of the manhole roof. The maximum depth of a standard shaft is 3000mm, measured from the top side of the manhole roof to the surface level including the Frame and Cover.

2.2.10 Change of trench 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 the level, the bottom of the trench shall rise or fall gradually. There should be no abrupt changes in level.

2.2.11 Ground water lowering

The Contractor shall take all reasonable measures to keep all excavations in dry condition and:

- a. Supply all necessary equipment and temporary drainage as required.
- b. Ensure that no fumes, silt or other soils are drawn from the existing soil through the riser pipes in order to eliminate subsidence due to soil migration or shrinkage.
- c. Provide settlement tanks where necessary before the water is pumped into the public sewer or drainage system. The Contractor must obtain any prior approval necessary from the Sanitary Engineering department of the Ministry of Works for the discharge of water into their system.

- d. Where de-watering is used, all care shall be taken to prevent the loss of ground during the de-watering process.
- e. All extracted water shall be properly disposed of.

2.2.12 Trench around jointing chambers

a. Minimum Clearance

There shall be a minimum clearance of 500mm around jointing chambers in carriageways or footways to allow mechanical compaction for backfilling.

b. Unsuitable Material

When any unsuitable material naturally occurs in the bottom of a trench it shall be excavated to a depth of not less than 300mm or as directed by the Telecommunications Infrastructure Provider's Engineer. Any unsuitable material shall be removed from site.

c. Rocky Soils

In rocky or stony soils, earth free from stones shall be spread over the trench bottom and rammed to afford a bedding of a minimum of 75mm thickness, or as directed by the Telecommunications Infrastructure Provider's Engineer. In such cases 75mm of extra excavation of the trench will be necessary to achieve the required depth of cover.

d. Wet Situations

In wet or unstable situations, the Telecommunications Infrastructure Provider's Engineer may direct the Contractor to use methods to prevent damage to freshly placed concrete or mortar and to ensure a waterproof jointing chamber. These methods include providing a rubble bottom, an independent sump or the use of heavy-duty polythene sheeting.

2.2.13 Line of trench

The line of trench shall be kept as straight as possible and is to be agreed by the Telecommunications Infrastructure Provider's Engineer.

2.2.14 Access to Adjoining Premises

While excavation work is in progress, the Contractor shall ensure that adjoining residents have access to their houses by providing bridges across the trench. Each bridge shall be at least one metre wide and be made of 18mm plywood or steel and have suitable timber supports underneath. Barriers shall be placed on either side of the bridge, secured by using sandbags.

2.3. Duct and Cable Laying

2.3.1 Line of duct

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

2.3.2 Duct formation

- a. The duct formation shall be maintained between chambers and shall be either as specified for the type of duct concerned or as detailed in the Schedule of Work.
- b. The number of horizontal ducts in any duct formation shall not exceed two ducts.
- c. For more than two horizontal ducts in any duct formation, the telecommunications infrastructure provider shall approach the Telecommunications Technical Office for a written approval.

2.3.3 Laying of ducts

Duct laying shall be done only in accordance with these Guidelines.

2.3.4 Duct entry to buildings

All ducts leading into operator and customer premises shall be sealed against the entry of gas, water and vermin into the building premises.

2.3.5 Variation of Duct

If so directed by the Telecommunications Infrastructure Provider's Engineer, the type of duct may be varied for the good and sufficient execution of the work.

2.3.6 Duct in Tunnel

Where a duct is laid in a tunnel or carrier pipe, and placed by trenchless methods or cut and cover, all voids within the tunnel or carrier pipe and all spaces around the duct shall be completely filled with well-compacted grade "C" concrete.

2.3.7 Covering of Duct

All ducts not laid in concrete shall be covered by a layer of "Earth, Free from Stones" and compacted in layers - providing a finished thickness of not less than 75mm. Any spaces between the duct and the sides of the trench shall be filled with well compacted "Earth, Free from Stones". Compaction shall be by hand or mechanical methods, to suit site conditions.

2.3.8 Rocky Soils

In rocky or stony soils, "Earth, Free from Stones", shall be spread over the trench bottom and compacted to afford bedding of up to 75mm thickness on which to lay the duct. In such cases extra excavation of the trench will be necessary to achieve the required depth of cover. Stones protruding more than 75mm from the bottom of the trench shall be removed. Compaction shall be by hand or mechanical methods, to suit site conditions.

2.3.9 Cleaning and Testing

- a. On completion of the duct line (including compaction of the backfill) between any two jointing chambers, or sites thereof, an approved cylindrical brush followed by a UPVC mandrel is passed once through each "way" to test the installed duct and to remove any foreign matter that may have entered. The size of the brush shall be as specified.
- b. If the duct formation is not maintained between chambers or as directed in the schedule of works, or any defect is discovered during cleaning and testing operations, the contractor will be expected to make good the defect.
- c. The Telecommunications Infrastructure Provider's representative may be present during the cleaning and testing operations.

2.3.10 Deferred Jointing Chamber

When the building of a jointing chamber is deferred until after the completion of a section of duct, the last 2 metres of each "way" shall be tested, on completion of the jointing chamber, by means of the brush specified for the particular duct. A visual check shall first be made to ensure that no foreign matter or materials are likely to be pushed up the duct.

2.3.11 Plugs

A suitable plug may be inserted in the end of each "way" of a duct route to prevent the ingress of water and/or other foreign matter, until all work has been completed on that section and the length tested and accepted by the concerned Telecommunications Infrastructure Provider's Engineer.

2.3.12 Draw Rope

Unless otherwise specified, a draw rope shall be threaded through and left in every "way" following duct laying operations and satisfactory tests. Jointing together lengths of draw rope to make up the necessary length between jointing chambers may be carried out as directed by the Telecommunications Infrastructure Provider's Engineer. Draw rope shall not be joined for the purpose of conserving lengths shorter than 50 metres.

2.3.13 Alignment Test of Disturbed Duct

When jointing chambers are provided on an existing duct route or when any disturbance takes place which may affect the alignment of the duct, a brush of appropriate dimensions shall be drawn through each of the spare "ways" in a similar manner to that detailed in a previous paragraph of this document, and on completion of the test a draw rope shall be left in each spare "way".

2.3.14 Expansion Joints

Where ducts pass through bridge decks, it may be required, due to bridge construction methods, for the duct route to have expansion joint arrangements in place. This may be achieved by using duct collars, where a suitable compound fixes one duct to the collar, with the second duct free to move within the collar. Where this method is not suitable the Telecommunications Infrastructure Provider or the bridge constructor may propose a non-standard method, subject to the written approval of the Telecommunications Technical Office.

2.3.15 Highly Secure External Above-Ground Lead-In

Where it is not possible to construct an underground duct lead-in, a suitable bore steel tube with a 45° bend shall be used to provide a highly secure, external above-ground lead-in.

2.3.16 Marker Posts

When required by the Telecommunications Technical Office or other authorities, a marker post or other suitable form of identification shall be placed to locate an underground plant.

2.3.17 Laying of PVC Ducts

- a. General.** PVC ducts are manufactured from Unplasticised Polyvinyl Chloride (PVC-V). They may be supplied in various lengths and diameters as specified in this document. Each duct length has a tapered socket at one end that will accept the barrel of the duct.

Suitable collar ducts may also be used with short lengths of duct which have no socket.

- b. Trench.** The trench shall be excavated to the required width and depth, to allow a minimum of 75mm between the sides of the duct and the sides of the trench and allow the trench bottom to be free from stones, level and well compacted. The duct shall be laid at standard depths as specified in this document.

- c. Formations.** Ducts may be laid as a single duct or in a multi-way formation as follows:-

- i. Up to and including 9 ways in rectangular formation, with a maximum of two ducts in one row.
- ii. Over 9 ways in rectangular formation with concrete surround. The duct formation shall be agreed with the Telecommunications Technical Office.

- d. Laying and Jointing.**

- a. Single Way**

- i. The open starting end of the trench shall be blanked off with a board or boards, to act as an anvil against which the duct can be driven home.

- ii. The duct shall be laid on the trench bottom and the spigot end and the inside of the socket of the ducts to be jointed shall be thoroughly cleaned.
- iii. The spigots and sockets of a duct are so designed that, taking into account all manufacturing tolerances, the spigot will start to engage with the socket at some point between 1/3 and 2/3 of the socket depth. Two spigot markings are provided on the duct to show the maximum and minimum insertion depths. The minimum marking must be level with, or inside the socket. In most cases of satisfactory engagement, due to manufacturing tolerances, the maximum spigot marking shall still be visible at the socket end.
- iv. When jointing short lengths of duct together with a Collar Duct, both spigot ends and the inside of the collar shall be thoroughly cleaned. The spigot ends should be given a liberal coating of a suitable compound and then fitted into the collar so that they butt together at the midpoint.

b. Multi-way up to and including 9 ways

- i. The preparatory work and jointing shall be as outlined above.
- ii. The first layer of ducts shall be laid on the prepared trench bottom so that their outer surfaces touch each other and a minimum gap of 75mm remains between the outside of the ducts and the sides of the trench, or trench timbering where used. Wooden stakes or an approved alternative shall be driven into the ground at 3 metre intervals along the trench to keep the ducts in the correct position. "Earth, Free from Stones" shall be placed to fill the spaces between the ducts and the next layer of duct when the latter is bedded down. The second and subsequent layers of duct shall be laid between the wooden stakes so that they are vertically above and then bedded down to touch the ducts in the layer below, the spaces between the ducts being filled in the same way with "Earth, Free from Stones".
- iii. At approximately 5 metres from the jointing chamber at each end of the track, the duct formation shall open out to provide a gap between each duct, both vertically and horizontally, of 25mm using Spacers. Over this 5-metre section all spaces between the ducts and the trench wall shall be filled with well-compacted "Earth, Free from Stones", as will all spaces between the ducts.

c. Multi-way over 9 ways, with concrete surround

- i. The preparatory work and jointing shall be as outlined above.

- ii. The first layer of ducts shall be laid on the prepared trench bottom so that their outer surfaces touch each other and a minimum gap of 75mm remains between the outside ducts and the sides of the trench, or trench timbering where used. To maintain the duct formation, wooden stakes or mild steel bars, of the required length, shall be driven into the ground at 3.0 metre intervals along the trench. The second and subsequent layers of duct shall be laid between the mild steel bars so that they are vertically above and touching the ducts below. The joints shall be staggered so that no joint touches any other joint. On completion of the assembly of the duct nest, the apparatus surround shall be filled with concrete of quality “F” as specified by this document.
- iii. Where the total number of layers of duct in any one formation exceeds 8 and the number of ducts in each layer exceeds 2, the following shall apply: Between the two layers of duct, midway or approximately midway, from the top and bottom of the duct nest, an intermediate layer of reinforced concrete, 75 mm in depth and with 12mm mild steel reinforcing bars, shall be placed across the duct nest. The additional reinforcing required by this sub-paragraph shall not be required in the 5-metre sections detailed in sub-paragraphs below.
- iv. At approximately 5 metres from the jointing chambers at each end of the track, the duct formation shall open out to provide a gap between each duct, both vertically and horizontally, of 25mm. Banks of spacers shall be placed at 325mm and 1325mm from the jointing chamber wall to provide this spacing. Each spacer bank shall enclose all the ducts except those in the bottom layer on which the spacer bank shall rest. Where sub-paragraph (iii) applies, the 75 mm intermediate layer shall be reduced over the 5-metre sections to provide the required 25 mm spacing at the jointing chambers.
- v. Where the total number of layers of ducts exceeds three, concreting of spaced formations shall be in stages such that the number of layers of ducts laid and concreted at each stage shall not exceed three. The concrete shall be brought to a level that shall not interfere with the laying of subsequent layers of ducts and spacers.
- vi. Concrete made with Rapid Hardening Portland cement may be used. The concrete shall be evenly placed around the duct to give a finished minimum thickness of 75mm on both sides and to a depth of 130 mm above the top layer of ducts. Care must be taken to ensure that each batch, as it is placed, is properly compacted without creating unbalanced side thrust against the ducts. Each batch shall be vibrated; the poker shall be lowered into the concrete between the wall of the trench and the outside of the duct nest and shall not touch the duct. In spaced formation sections care must be taken to ensure that

the gaps between the ducts are properly filled with concrete of quality "F".

vii. With formations of four or more ducts, wide, mild steel reinforcing bars shall be placed and wired in position before placing concrete over the uppermost ducts of the completed nest.

viii. In the case of column entry manholes, the duct formation shall open out to enter the manhole at right angles of the entry wall. The distance over which the transformation is made shall be no greater than is necessary to satisfy the 5-metre minimum bending radius for a PVC duct. The ducts shall be secured in position during concreting with suitable spacers built up to the required centers or by reinforcing rods which may be encased in the concrete.

e. Alternative Method of Jointing & Laying. Provided space permits, ducts may be jointed above ground and fed into the trench from one end.

f. Bends and Duct Tees. Ducts are sufficiently flexible to provide a minimum bending radius of 5 metres. Tighter bends should not be attempted with straight lengths of duct, otherwise kinking of the duct may result.

g. Backfill.

i. Backfilling of trenches where a PVC duct has been laid shall be carried out in accordance with these Guidelines.

ii. Where a duct has been laid, any end shuttering and trench supporting timber, if used, shall be removed not less than 12 hours after the concrete has been placed. Backfilling of the trench, in accordance with these Guidelines, shall not be carried out until a further 48 hours have elapsed.

2.3.18 Pre-formed duct bends

90° pre-formed bends should be used for all types of ducts. These pre-formed duct bends shall only be used at the end of duct lengths for building or cabinet entries or house lead-ins. 30° 'easy' bends may be used for duct routes between jointing chambers at the discretion of the Telecommunications Infrastructure Provider's Engineer.

2.3.19 Duct seal

a. General

- i. Where a duct seal is provided to a new structure, the first 1.5 metres of duct leading into a structure will be included in the construction of the structure. The remaining lead-in duct shall then be connected to the 'starter' duct and laid to the next jointing chamber.
- ii. Alternatively, when directed by the Telecommunications Infrastructure Provider's Engineer, specified individual holes may be 'Core Drilled' in the wall at a minimum distance of 150mm centers to centre. Each length of duct shall be assembled and sealed into the holes.
- iii. Breakthrough into customers' premises shall be performed carefully, in compliance with good engineering practices and any wayleave conditions or specifications or works instructions issued.
- iv. When a duct seal is provided all ducts shall be sealed within the structure, to prevent the ingress of water between the outside of the duct and the structure and the ingress of gas, water and vermin through the duct.
- v. When an in-situ duct seal is disturbed and cannot be resealed using the existing materials, then the end shall be cleaned out and the appropriate Duct Seal and associated accessories shall be used to complete the seal.

b. Installation

- i. The template for the duct end shall be positioned on the inner wall of the cable chamber/trench, reinforced and braced as necessary to ensure that it will remain flat and in position during the subsequent operations.
- ii. As the ducts are fixed to the template they shall be temporarily supported to prevent damage to the duct or duct joint. The Contractor shall ensure that all ducts are parallel and, except for an angled lead-in, at right angles to the templates and so maintained during the subsequent concreting operations.
- iii. For multi-way ducts installed to an existing structure, the lead-in duct outside of the structure shall be spaced and concrete grade "F", with maximum 10mm aggregate, shall then be carefully placed to completely fill the interstices of the duct nest and to provide a minimum cover of 150mm on the top and sides of the duct. Steel reinforcement shall be supplied at the top.

- iv. When at least 2 days have elapsed after placing the concrete, the front template shall be removed and the concrete examined. Small voids shall be filled and rendered flush with the existing face, providing they do not extend beyond two adjacent ducts or do not exceed 50mm in depth. If larger voids than this exist, the concrete will be regarded as substandard and must be completely removed and replaced.

c. Lead-in Track

- i. All lead-in sections between a building and the first chamber of the provider's network shall be gas-tight and watertight, and irrespective of the number of ways, shall be laid in accordance with this specification, terminating with duct flush with the inside face of the jointing chamber.
- ii. The spigot end of the duct shall be thoroughly cleaned. Suitable compound shall be liberally applied to the full circumference of the outside 100mm length of the spigot. The spigot shall then be correctly fitted into the socket. Surplus adhesive shall be wiped around the spigot end to form a sealing fillet.

d. Sealing

- i. On completion of the cleaning and testing of the lead-in duct route and acceptance by the concerned Telecommunications Infrastructure Provider's Engineer, a rope shall be inserted and secured in each bore with sufficient surplus to enable future cabling operations. The rope shall be attached to the Duct Seal Rope Anchor or the Plug Pressure Anchor Eye.
- ii. Under no circumstances shall a rope be fitted through a duct seal.
- iii. Unless otherwise required by a further specification or drawing, ducts, conduits and pipes into customers' premises, call offices, kiosks, cabinets, posts, etc., shall be sealed at the end within the structure or customers' premises as follows:
 - 1. The duct shall be sealed in a similar manner to that detailed in this document.
 - 2. Where a cabled duct enters a cabinet suitable Resin Pack shall be used.
 - 3. Where an uncabled duct enters a cabinet a suitable plug shall be used.
 - 4. Smaller conduits and pipes shall be sealed by pressing a clean rag into the aperture and facing off with a layer of suitable compound.

2.3.20 Slewing and/or raising of ducts

a. Excavation

- i. The size of the excavation for slewing and/or lowering or raising a duct line shall be of a size only of that is practicable to carry out the work.
- ii. 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 that is just sufficient to allow access for carrying out the excavation.
- iii. 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 on it.

b. Strongback

- i. The strongback shall be lashed to the duct line, with both ends of each duct firmly held, using separate lashings or a continuous rope. The lashings shall be tightened by driving wedges between the ducts and the strongback.
- ii. Any forces that 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 between the points to a negligible amount.

c. Suspension

When the duct line is to be lowered, the complete length shall be suspended from suitable beams or tripods and/or approved winching devices 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.

d. 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 in the surface.
- ii. For self-aligning ducts, 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 sockets of self-aligning ducts 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 cement mortar.

e. 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 effected 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. Where no information is available a maximum deviation of 1:50 is permissible.

f. Trench Bottom

Prior to finally placing the duct, the trench bottom shall be prepared in the same way as is specified for duct laying. The holes for self-aligning duct collars shall not be taken out until the duct line is sufficiently near its required position in order to ensure accurate location.

g. 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.

h. Pulled Joints

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

i. Inspection

After all operations are completed, including the repair of the duct where necessary, the joints of all ducts shall be inspected to ensure that they are forming an effective seal. Any defects shall be made good.

j. Testing

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

2.3.21 Cleaning and testing of ducts

- a. A cylindrical cleaning brush shall be 95mm in diameter and when compressed not less than 83mm in diameter.
- b. When a section of Duct 96 track contains a pre-formed bend with a radius of less than 3000mm, the cleaning shall be carried out with a suitable rag mop.
- c. Prior arrangements shall be made to enable the telecommunications infrastructure representative to be present while cleaning and testing operations are in progress.

2.4. Jointing Chambers

2.4.1 General

- a. Jointing Chambers shall conform to the conditions specified in Part I of this document.
- b. All Jointing chambers should be approved by the Telecommunications Technical Office in line with the conditions specified in Part I of this document.
- c. The frame and cover of a jointing chamber shall be installed flush and level with the surrounding ground, provided that the fall across the shortest side of the cover shall not exceed 100mm. All covers shall be located so that they may be removed safely with suitable standard equipment.

2.4.2 Types of jointing chambers

- a. The jointing chambers may be made of concrete or any other suitable material. All types of jointing chambers shall be approved by the Telecommunications Technical Office before construction commences.
- b. The approval procedure shall be as outlined in Part I of this document.
- c. All jointing chambers should be designed to support dead and live loads as specified by the related British Standards.

2.4.3 Protection of cables and associated equipment

During the cutting of duct entries into an existing structure, or during the demolition or building of jointing chambers, the Contractor shall take all reasonable measures to protect cables and associated equipment. Such measures shall include any or all of the following requirements:

- a. All movement of cables shall be carried out in a controlled manner such that all cables are evenly supported throughout their length.
- b. For access into and out of manhole excavations a ladder shall be provided by the Contractor. Under no circumstances may cables, joints and equipment be used for climbing, standing or sitting on.

- c. 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.
- d. All cables shall be protected at duct entries by shielding as necessary against mechanical damage.
- e. During demolition of the roof of a manhole, the Contractor shall erect a deck of timber between the cables and the roof of the manhole, to protect the accommodated plant.
- f. Contractors' plants or materials shall not be supported on cables or associated equipment at any time.
- g. On completion all cables shall be left adequately supported on the new ironwork.

2.4.4 Duct entries

a. Clearance of Ducts

- i. Ducts shall enter manholes as shown on the relevant drawings. The ducts shall enter a manhole at such depths that will ensure a minimum clearance of 350 mm above the floor, 450 mm below the roof and 100mm from any adjacent wall.
- ii. Ducts shall enter joint boxes as shown on the relevant drawings. The ducts shall enter the joint box at a minimum of 150mm above the floor, and 75mm from any adjacent wall.

b. Duct Entries Into Existing Structures

- i. **General** - Existing structures, such as jointing chambers, telephone exchanges, repeater stations or any other building shall have all new duct entries cut by core drilling techniques only. Where the duct enters the chamber the finish shall be flush and smooth. The gap around the duct shall be filled for the full depth of the wall with cement grout, cement mortar or suitable mastic or silicone, with no protrusions that may cause damage to cables.
- ii. **Position of Entry** – It shall be as specified in a schedule of work or relevant drawing. Any departure from this position must be agreed with the Telecommunications Infrastructure Provider's Engineer prior to the commencement of work. Where practicable the structural reinforcement shall not be cut or exposed. If steel bars are cut or exposed they shall be treated with a rust inhibitor.

- iii. **Protection** - The Contractor shall protect cables and/or equipment, prior to drilling operations.

c. Duct Entries Into New Structures

The concrete around all ducts where they enter jointing chambers shall be carefully flushed up and, where necessary, rendered in cement mortar. Where the duct enters the chamber the duct shall enter flush with the wall and the finish shall be smooth, with no protrusions that may cause damage to cables.

2.4.5 Jointing chamber fittings

- a. Cable bearers, ladders, steps and other fittings shall be fixed according to the relevant drawings or in such other positions as to ensure safety for personnel and plants.
- b. Anchor irons shall be buried to the underside of the depth plate, in the structural concrete of walls and floors.

2.4.6 Iron and steel work

- a. All iron and steel work which has not been galvanized by an approved method shall be free from mill scale and treated with a suitable preservative after delivery and two coats of an approved bituminous paint after fixing.
- b. Any ungalvanised iron or steel which is to be embedded in concrete shall be free from mud, oil, loose rust, loose mill scale, grease or any other substance which can be shown to adversely affect the steel or concrete chemically, or reduce the bond. Normal handling prior to embedding in the concrete is usually sufficient for the removal of loose rust and scale from reinforcement.
- c. All reinforcement in the floor, walls, roof and shaft shall be secured together by means of approved ties, sufficient to prevent displacement of the reinforcement during the placing and compaction of the concrete.

2.4.7 Sumps

- a. Where a sump is provided, the floor shall have a slight fall thereto. The grating shall be located squarely over the sump, adequately fitted and easily removable from a pre-formed recess in the floor or floor screed, in the position indicated on the relevant drawing.

- b. The sump in a jointing chamber shall have a depth of 70mm ± 10mm.

2.4.8 Concreting

- a. Concrete for jointing chambers shall not be mixed, or placed, when the air temperature is over 50°C. Concrete already laid shall be protected from drying when the air temperature rises or is likely to rise above 50°C at any time during the period before the removal of shuttering. The period of time that the temperature remains above 50°C shall be added to the minimum periods quoted in the shuttering removal paragraph of this document. During hot summers concreting should be avoided between 11.00am and 2.00pm.
- b. Handling from the mixer to the workplace must, regardless of the method that is adopted, ensure that the mix remains cohesive and that segregation does not occur.
- c. Placing of concrete must be carried out in a manner such that the concrete is deposited as close as practicable to its final position. The use of chutes or tremmie pipes must be adopted throughout the placing process to ensure that segregation does not occur.
 - i. Concrete must be placed in even layers and must not be moved into position with the poker or vibrator.
 - ii. Layer thickness must be compatible with the tools and methods employed to remove entrapped air, and each layer must be thoroughly compacted before the placing of the next layer.
 - iii. Formwork must be filled with concrete in such a manner as to avoid the formation of cold joints.

2.4.9 Joints in concrete

- a. For jointing chamber construction, in order to bond the existing base concrete with new wall concrete, the base concrete shall be made rough while still wet, in the areas where the joint will be. When the walls are to be constructed, a rich mix of cement and water is poured to help bond the two sections together. There shall not be any sand added to the mix.
- b. Special construction joints shall be provided as indicated on the relevant construction drawing. A minimum of 12 hours shall elapse between the construction stages thus indicated. The construction joint shall be made by cleaning the existing concrete, wetting it and covering it with a 5mm layer of well-trowelled cement mortar before the new concrete is placed in position.

- c. Whenever possible, concrete walls shall be completed in one operation. Where this is not practicable, construction joints shall be made after the existing concrete has set but not hardened, the joint being cleaned with a stiff brush to remove the mortar skin and to expose, but not disturb, the larger aggregate. The new concrete shall be well compacted but care shall be taken during its placing close to the joint. Such construction joints shall be sited at least 150mm from any anchor iron position.

2.4.10 Wet situation

In wet situations the Contractor must implement such methods as are necessary to prevent damage to freshly placed concrete or mortar and to ensure a correctly constructed jointing chamber.

2.4.11 Compaction and tamping of concrete

- a. For the construction of concrete or reinforced concrete jointing chambers, the concrete shall be thoroughly worked and tamped into all parts of the moulds or forms and around the reinforcement in order for it to achieve maximum density.
- b. All concrete shall be compacted by the use of a 45mm poker type vibrator until a dense solid mass without voids is obtained.
- c. Care shall be taken not to touch reinforcement steel with the poker during compaction.
- d. When inserting the vibrator, it should be held upright as it is put in and dropped slowly to an angle. This way the largest possible area can be vibrated at one time.
- e. The vibrator shall not be held in the same position for too long, which may result in the concrete being over-vibrated.
- f. The vibrator shall be pulled out of the concrete slowly to ensure that the hole is properly closed up.

2.4.12 Shuttering

- a. Timber shuttering shall not be left in the road structure. Where it is impractical to remove timber shuttering after the completion of excavation works, the timber shall be cut off below the road structure and removed. Only suitably treated timber may be left in, below the road structure.

- b. Subject to compliance with the drawings as regards dimensions, the Contractor shall be at liberty to adopt any arrangement he may think fit for the make-up of the shuttering, it being understood that on completion of the chamber, the whole of the internal shuttering material shall be removed.
- c. In all cases the shuttering used shall be of such dimensions, and so constructed, as to remain rigid and unyielding to weight and vibration during the laying and tamping of the concrete. No shaking or jarring shall be permitted during setting.
- d. Design, size and general arrangement of the chamber shall be in accordance with the appropriate drawing, suitably modified by the following variations:
 - i. Plastic sheeting, 1000 or 1200 gauge, shall be positioned between the excavation or rear shuttering and the concrete of the jointing chamber. It shall also be placed over the roof before commencing the back-fill. Where the floor of the excavation has been well compacted and a blinding placed to prevent the contamination of the structural concrete, there is no requirement for the plastic sheet to be laid on the floor.
 - ii. Duct entries into a jointing chamber may be fitted with a duct seal.
- e. The contractor must ensure that no soil or other deleterious material is allowed to collect between the inner faces of the internal and external shuttering or contaminate the structural concrete. Where this has been shown to occur the operator will be responsible for the complete renewal of the structure. Repair of the affected area will not be accepted.

2.4.13 Concrete quality and finish

- a. All concrete used for the construction of jointing chambers shall be ready-mixed Grade 45 N/mm².
- b. Where ready-mixed concrete is used the telecommunications infrastructure provider should ask to see and retain a copy of the delivery certificate supplied with the concrete.
- c. Where site-mixed concrete is used the contractor should supply a certificate of compliance for all material used.
- d. Two Test Cubes will be taken from any concrete used for jointing chamber construction; otherwise 2 cubes shall be taken from every 20m³ or 20 batches. The equipment necessary for the making of the test cubes shall be provided by the Contractor. The cubes shall be tested by a Testing

Laboratory approved by the Ministry of Works and the Contractor shall supply a copy of the test report to the operator within 14 days of the cubes being tested. Work will not normally be delayed in anticipation of the result of the test. The making, curing and testing of all cubes of concrete for compressive strength tests shall be in accordance with BS 1881, Parts 108, 111, 114 and 116, and the results shall satisfy the following tables:

Age of Concrete	Strength of Concrete
7 Days	28 N/mm ²
28 Days	45 N/mm ²

- e. Test cores may be required whether test cubes have been taken or not. [The Telecommunications Infrastructure Provider’s Engineer, as a result of inspection or tests, requires cores to be taken and tested Is this correct?] in accordance with BS 6089 and BS 1881 Part 120. The cores shall be examined and tested by an approved independent laboratory and the estimated in-situ strength ascertained. The Contractor shall provide the telecommunications infrastructure provider with a copy of the test report as soon as it is available and, if this indicates that the quality of the concrete in the structure is unsatisfactory, the jointing chamber shall be demolished and replaced with a new structure. The core-drilled hole shall be made good with cement mortar.
- f. On completion, the walls of concrete jointing chambers shall have a smooth finish; any slight cavities exposed when the shuttering is removed shall be made good with cement mortar, and any projections removed.
- g. Under no circumstances shall the walls be coated with cement or cement sand wash to enable concealment of poor workmanship.

2.4.14 Concrete curing times

The minimum concrete strength or curing periods after completion of any construction or modification work using cement mortar or concrete, which must elapse before:

- i. The shuttering of jointing chambers is removed;
- ii. The restoration of pavings or surfaces may be commenced; and
- iii. Traffic is allowed to pass,

are as follows:

Type of Paving	Removal of shuttering	Commencing of paving restoration	Allowing traffic passage
Manholes and Joint Boxes Built in Carriageway	5 days or 20 N/mm ²	7 days or 24 N/mm ²	7 days or 24 N/mm ²
Manholes Built in Footway	5 days or 20 N/mm ²	5 days or 20 N/mm ²	7 days or 24 N/mm ²
Joint Boxes Built in Footway	Shuttering shall not be struck in less than 24 hours or 10 N/mm ² .		

2.4.15 Painting of manholes

On completion of all construction works, in the case of all manholes, the shaft and underside of the roof and the top third of the manhole walls shall be cleaned and the surface prepared to be coated with a water resistant, non-toxic, white reflective coating. Mixing and application of the material shall be strictly in accordance with the Manufacturers' instructions.

2.5. Filling & Restoration of Roads

2.5.1 Backfilling

a. General

- i. For verges, medians and graded (unpaved) roads, backfilling of trenches shall be brought up to ground level. Where the ground surface on the line of the trench consists of sweet soil, the upper section of the backfill shall be sweet soil of the thickness described, or the same thickness and quality of soil as the surrounding ground.
- ii. For trenching in carriageways or other paved areas, backfilling operations involve the refilling of the excavated cut from the level of duct bedding and surround to just below the underside of the bottom asphalt concrete layer.
- iii. Backfilling shall, wherever practical, be undertaken immediately after the specified operations preceding it have been completed. The materials specified in other Paragraphs of this document shall be deposited in layers and compacted in accordance with the procedures of refilling excavations detailed below. Care should be taken to compact the material evenly without displacing or damaging the installed ducts.
- iv. Procedures that govern backfilling of pits and trenches in roadway corridors are dictated by two factors:
 - Category of road in which trenching was performed (major versus minor roads).
 - Size of cut/trench (wide versus narrow).

b. Duct Bedding

- i. Immediately following the inspection of the excavated trench, suitable bedding material conforming to the specifications set in this document shall be laid and compacted to 95% maximum dry density (MDD) as determined in accordance with method 3 of BS 1377: Part 4: 1990.
- ii. After the duct has been laid on the bedding material and the duct is tested, the completion of the bedding and surrounding of the duct is to be carried out immediately. The bedding and surround shall be brought up equally on both sides of the pipe, ensuring that it is in contact with the underside of the duct barrel, and be carefully compacted in layers not exceeding 150mm in thickness.

- iii. The compacted surround backfill shall be taken up to a height of 300mm above the top of the duct barrel.
- iv. All ducts laid in normal ground, not surrounded by concrete, shall be covered by a layer of site-screened material and be hand-punned to a thickness of not less than 150mm, unless otherwise directed by the site Telecommunications Infrastructure Provider's Engineer.

c. Major Roads

Backfilling of trenches made in roads designated as major roads shall adhere to the following procedure:

- i. The first 600mm immediately below the underside of the asphalt surface shall be backfilled with Dry Lean Mixed Concrete placed in layers not exceeding 150mm per layer and compacted to 95% of the Standard Wet Density.
- ii. The next 300mm shall be backfilled with Type A Fill (as specified in this document) watered to its optimum water content and compacted in layers not exceeding 150mm per layer to achieve 98% MDD.
- iii. The remaining depth up to the duct surround shall be backfilled with approved Type B Fill (as specified in this document), placed in layers not exceeding 200mm loose lift thickness and compacted to achieve a final thickness of 150mm. Each compacted layer shall achieve a field density equal to or greater than 95% MDD.
- iv. Compaction of all backfill layers shall be certified by a representative of the telecommunications infrastructure provider. Upon request, a copy of this certificate may be presented to the inspecting Roads Engineer prior to asphalt reinstatement.
- v. When working around jointing chamber structures, adequate working space of a minimum of 500mm must be maintained at all times for ease of compaction operations. If this is not feasible, the whole area shall be backfilled with Wet Lean Mixed Concrete, which should be watered to its optimum water content and then discharged at the site as slurry that compacts under its own weight.

d. Minor Roads

Backfilling of excavated trenches in minor roads shall proceed as follows:

- i. The first 300mm immediately below the underside of the asphalt surface shall be backfilled with Type A Fill (as specified in this document) watered to its optimum water content, placed in layers not exceeding 200mm loose lift thickness and compacted to achieve a final thickness of 150mm. Each compacted layer shall achieve a field density equal to or greater than 98% MDD as determined in accordance with method 3 of BS 1377: Part 4: 1990.
- ii. The remaining depth up to the duct surround shall be backfilled with approved Type B Fill (as specified in this document) watered to its optimum water content, placed in layers not exceeding 200mm loose lift thickness and compacted to achieve a final thickness of 150mm. Each compacted layer shall achieve a field density equal to or greater than 95%.
- iii. Use of excavated materials in backfill operations will only be permitted as a substitute for Type B Fill if the excavated material is tested and found to conform to the specifications set for Type B Fill (as specified in this document). In such a case, the Contractor should submit test results showing conformance prior to the use of the material.
- iv. Compaction of all backfill layers shall be certified by a representative of the telecommunications infrastructure provider originating the works. A copy of this certificate may be presented to the inspecting Roads Engineer prior to asphalt reinstatement.
- v. When working around jointing chamber structures, adequate working space of a minimum of 500mm must be maintained at all times for ease of compaction operations. If this is not feasible, the whole area shall be backfilled with Wet Lean Mixed Concrete, which should be watered to its optimum water content and then discharged at the site as slurry that compacts under its own weight.
- vi. For narrow trenches (width \leq 350mm), the full depth of the trench shall be backfilled with Wet Lean Mixed Concrete.

e. Footway

- i. The first 150mm immediately below the underside of the asphalt surface shall be backfilled with Type A Fill (as specified in this document) watered to its optimum water content, placed in one layer and compacted to achieve a final thickness of 150mm. Each compacted layer shall achieve a field density equal to or greater than 98% MDD as determined in accordance with method 3 of BS 1377: Part 4: 1990.

- ii. The first 50mm immediately below the underside of a bricked surface shall be backfilled with sand bedding free from stones (as specified in this document) watered to its optimum water content, placed in one layer and compacted to achieve a final thickness of 50mm. The second 150mm below the underside of the sand bedding shall be backfilled with Type A Fill (as specified in this document) watered to its optimum water content, placed in one layer and compacted to achieve a final thickness of 150mm.
- iii. The remaining depth up to the duct surround shall be backfilled with approved Type B Fill (as specified in this document) watered to its optimum water content, placed in layers not exceeding 200mm loose lift thickness and compacted to achieve a final thickness of 150mm. Each compacted layer shall achieve a field density equal to or greater than 95%.
- iv. Use of excavated materials in backfill operations will only be permitted as a substitute for Type B Fill if the excavated material is tested and found to conform to the specifications set for Type B Fill (as specified in this document). In such a case, the Contractor should submit test results showing conformance prior to the use of the material.
- v. Compaction of all backfill layers shall be certified by a representative of the telecommunications infrastructure provider originating the works. A copy of this certificate may be presented to the inspecting Roads Engineer prior to asphalt reinstatement.

f. Test of Backfill

- i. The Contractor shall provide testing apparatus and carry out tests as is necessary for the monitoring of backfilled soil properties. He shall maintain a daily log of tests carried out and provide the site Telecommunications Infrastructure Provider's Engineer with a copy of the log to be countersigned by the Roads Engineer.
- ii. Tests to determine the dry density/moisture content relationship (as per method 3 of BS 1377: Part 4:1990) and in-situ density and moisture content (as per method 2.2 or 2.5 of BS 1377: Part 9: 1990) shall be carried out as directed on site by the Telecommunications Infrastructure Provider's Engineer. The frequency of testing will depend on the consistency of material and test results, but unless otherwise instructed or agreed to shall be as follows:

Dry density/moisture content relationship	One test per 150m of trench
Dry density and moisture content of compacted soil	10 tests per 150m of trench per compacted layer of 150mm.

- iii. When testing for field density for each compacted layer, at least 9 out of every 10 locations tested shall achieve the target density (whether 98% or 95% MDD).
- iv. Prior to the commencement of excavation, the Contractor shall submit to the Telecommunications Infrastructure Provider's Engineer for approval a method statement for testing backfill. This statement shall include details of:
 - a. the methods and equipment proposed for measuring density/moisture content relationship, in-situ density and moisture content (including sources of pouring sand where required for the sand replacement method);
 - b. the name and address of any proposed independent testing laboratory.

g. Backfilling Below Formation Level

- i. When excavation work extends below the top level of formation (i.e. bottom of road structure), a geotextile filter fabric shall be used to separate the new backfilled material from the material that naturally exists at that level.
- ii. The depth through which the use of the filter fabric is deployed shall extend from the bottom of the trench and up to 300mm above the top level of formation.
- iii. The required physical, mechanical and hydraulic properties of filter fabrics shall be as specified by Roads specifications.
- iv. The geotextile material shall be supplied in rolls, at widths that suit the work.
- v. After excavation and trimming to the required profile, the filter fabric shall be unrolled over the prepared formation and care should be taken to ensure that the material is dressed well into the sides and bottom of the trench so that subsequent placement of the backfill material does not impose a strain on the fabric or cause it either to tear or pull away from the trench sides leaving voids. Joints or laps

between successive sheets of the geotextile material shall be formed in accordance with the manufacturer's instructions.

- vi. Continuation of backfilling above the depth at which the fabric filter is installed shall then follow the procedures described above.

2 Surface preparation prior to asphaltting

- a. Prior to reinstating the asphalt concrete surface, the edges of the existing surface shall be cut back to give a regular-shaped, straight-sided area free of deformed or cracked surfacing that was affected by trenching work. The cut back shall be at least 150mm outside all edges of the excavation. The surfacing shall be cut by a saw or by a pneumatic or hydraulic breaker to give a vertical clean edge. The edges of reinstated areas are required to be either parallel or perpendicular to the direction of traffic flow.
- b. The area to be reinstated shall then be shaped and compacted to 98% MDD as determined in accordance with method 3 of BS 1377: Part 4: 1990. Any excess fines, loose materials and windblown dust shall be removed and the surface cleaned.
- c. The prepared surface shall be treated with a prime coat of Road Oil (as per this specification), sprayed at a rate of between 0.7 – 1.0 l/m². The Road oil is to be applied uniformly by the use of a hand-operated pump spray apparatus.
- d. Care shall be taken to protect the surfaces of all structures such as kerbs from being marred or defaced during the application of the prime coat.
- e. On completion of the spraying operation, the area primed shall be closed to traffic for a period sufficient to allow for proper penetration and curing.
- f. Exposed faces of existing asphalt surfacing and all exposed concrete surfaces within the excavated trench shall be painted with hot bitumen or tack coat.

3 Reinstatement of Asphalt Concrete surface

a. General

- i. The asphalt pavement is to be reinstated to its original thickness as per the guidelines given in Table 1 below. The process requires one layer of 50mm thick wearing course of TM5 and an appropriate

number of base course layers of B28 mix (as per Roads specification). Asphalt should be obtained only from the Ministry of Work's approved supplier(s). Mix types are subject to regular amendment and up-to-date mix designs must be obtained from [Roads??] before the commencement/tendering of projects.

Original Thickness	Reinstated thickness
Less than 50mm	50mm
50mm to 75mm	75mm
Above 75mm (for major roads)	Original thickness.
Above 75mm (for minor roads)	Original thickness to a maximum of 125mm

- ii. For major roads and minor roads less than five years old, the laying of the asphalt concrete wearing course shall extend over the full width of all affected traffic lanes by cold milling the additional pavement areas and placing asphalt using a mechanical paver.
- iii. For minor roads older than five years, irregular-shaped (stepped or L-shaped) reinstatement is not permitted unless the length of each step is not less than 15 meters and the offset of each step is not less than 300mm (except around manhole structures).
- iv. For minor roads older than five years, the reinstatement area should be located at a minimum clearance of 500mm from the edge of the kerb line/asphalt edge, building line, or adjacent reinstatement. If minimum clearance cannot be maintained then the reinstatement should be extended to the edge. All manholes to be constructed in the carriageway shall be reinstated at full lane width, or if the trench affects both lanes full road width reinstatement is required. Manhole levels shall be kept flush with the road level.
- v. Trenches made in car park areas of major roads and minor roads less than 5 years old shall be reinstated over the full width of the affected area and asphalt shall be placed using a mechanical paver machine only.
- vi. Trenches in footways shall be reinstated over the full width of the affected length of the footway and by using paving blocks only if the length of excavation exceeds 10 meters. For lengths less than 10 meters, full width reinstatement with asphalted concrete matching the existing thickness is required.

- vii. All street furniture, including road marking, studs, etc., removed during the course of the works shall be replaced immediately upon completion of the reinstatement.
- viii. Disturbed kerb-lines, edging kerbs, etc., shall be reinstated using the procedure described in this document.
- ix. Disturbed medians, verges, etc., shall be reinstated using the procedure outlined in this document.

b. Laying and Compaction

- i. Asphalt surfacing shall be laid at a temperature in accordance with the Roads specification.
- ii. Asphalt mixes, prepared as per the Roads specifications, shall be placed in layers of thickness not exceeding those specified and shall be spread using a mechanical paver. The use of manual methods (heated shovels and rakes) will only be permitted for trenches made in minor roads older than five years and where the width of the reinstatement is less than the full width of the traffic lane.
- iii. Where manual (hand) spreading and tamping is allowed in accordance with the foregoing clause, the mixed material is to be dumped on delivery upon an existing hard clean surface or on approved metal sheets outside the area where it is to be spread and distributed into place immediately by means of a hot shovel. It is to be spread with hot rakes in a uniformly loose layer to the full depth required. Raking shall be minimized to avoid segregation of the asphalt mix constituents.
- iv. Each course of bituminous material is to be adequately and uniformly compacted at temperatures not less than those specified by Roads.
- v. The compaction of asphalt concrete layer courses shall be carried out using approved compaction equipment which has been shown capable of obtaining density of not less than 98% of the "Job Standard Mix Density" defined as described in the Roads specification. The use of Nuclear Density gauges (as per Method 2, Clause 2.5 in BS 1377: Part 9: 1990) shall be adopted to ensure the achievement of the required density.
- vi. In multi-layer construction of asphalt concrete surfacing, tack coat is to be applied uniformly by vehicular, mechanical, tank-spraying pressure units complying with BS 1707 as appropriate, at a spread

rate of 0.2 – 0.5 l/m². Tack coat shall not form ponds in hollows and shall be allowed to break before the next layer of asphalt is laid.

Where the shape or size of the area of the reinstated trench precludes vehicular access, with the approval of the Roads Engineer hand-pressure spraying equipment will be permitted.

- vii. With the exception of necessary construction vehicles, traffic is not to be allowed on the tack coat.
- viii. Care shall be taken to protect the surfaces of all structures such as kerbs from being marred or defaced during the application of the tack coat.
- ix. If instructed by the Roads Engineer, the Contractor shall submit for approval a certificate of testing from an independent test authority not more than three months old, demonstrating that the uniformity of distribution from the spray bar of each vehicular mechanical tank-spraying unit meets the requirements of the appropriate British Standard. If instructed by the Roads Engineer, the distributor shall be subject to checks at least once a month to ensure consistent rates of spread, and the certificates shall be submitted to the Roads Engineer.

c. Joints

In reinstating trenches over the full-width of one or more traffic lane(s), treatment of longitudinal and transverse joints should follow the procedure described below:

- i. The width of spread shall be such as to provide for the off-setting of longitudinal joints in multi-layer construction by a minimum of 300mm.
- ii. Longitudinal joints of asphalt concrete base and wearing courses shall be trimmed as vertical as possible by mechanical or manual means to be approved by the Roads Engineer.
- iii. Transverse joints of both asphalt concrete base and wearing courses shall be cut back sufficiently to ensure correct profile, thickness and compaction of the joint. This will also apply to joints of existing pavements. Base courses and wearing courses are to be laid to break transverse joints by at least 600mm.

The exposed edges of the frames of manhole covers, gully gratings, kerbs and similar projections against which the new pavement will abut, are to be thoroughly cleaned and coated with bitumen. The new pavement is

then to be tamped around and against the projection to such a depth that, on completion of compaction, the finished surface of the wearing course is level with the top of the projection. Paved areas are to be dished to the frames of gully gratings, etc., with the dishing being formed in both courses of two-course construction.

d. Opening Road to Traffic

- i. Asphalt layers shall not be opened to traffic until the asphalt temperature of the final layer, measured at the surface, is 40^o C or less.
- ii. Traffic shall not be permitted on the asphalt until the reinstallation of all road markings that were disturbed due to trenching works has been completed at the expense of the promoter of the excavation.

e. Surface Finish

The completed surface of the asphalt reinstatement shall not deviate by more than 5mm from a straight line between the edges of the adjacent existing asphalt.

4 Reinstatement of Concrete Paving Blocks used in Footways

Where excavations are made in footways, reinstatement of the affected paving blocks area shall be carried out as per the following procedure (this is to be implemented after backfilling the trench as per the conditions outlined in this document, while keeping the compacted thickness of Type A material at 150mm instead of 300mm):

- a. Care should be exercised not to damage any blocks while removing them, and any damaged block is to be replaced with a new one of matching pattern, quality, size and color. The blocks shall be removed by hand.
- b. Each paving block shall be cleaned individually to remove sand and other foreign materials deposited on its surface, especially at the bottom surface, before reusing. The edges of the existing block-paved surface shall be cleaned thoroughly of any foreign materials, sand, etc.
- c. Immediately prior to preparing the sand bed for the reinstatement of the blocks, two additional rows of blocks shall be removed from the edge of the excavated area. The remaining sand bed shall be cut back and carefully removed and the caked sand shall be scraped from the exposed blocks' edges.

- d. Fresh sand shall be laid to approximately two thirds of the target finished thickness and fully compacted with a plate compactor to a level which is below the adjacent existing compacted sand. The plate compactor shall have a plate area of not less than 0.25m² and be capable of transmitting an effective force of 75 KN/m of plate at a frequency of vibration in the range 75 – 100 Hz.

Additional un-compacted sand shall then be spread over the area and trimmed to stand slightly proud of the underside of the adjacent existing blocks. A notched screed board may be used for this purpose. Where the blocks lie in the carriageway, a slightly cambered profile shall be formed to counter any tendency for the laying course to settle with trafficking. Generally, the loose sand will be higher by 6mm at the edges and 12mm at its centre where a cambered profile is used.

- e. The blocks shall then be put into place in the bond pattern of the surrounding area ensuring that the joints remain wide enough for sand filling. As a guideline, a space of 2mm between each two adjacent blocks is to be left to enable penetration of the joint filling sand. The blocks will be placed in position and not tamped down in any way except when the final blocks are laid, when a rubber hammer may be used to lightly tap them into place. Only whole blocks may be used. Cut blocks will not be permitted except adjacent to obstructions or projections.
- f. Where pavement areas abut to kerbs, edge restraints, iron works, road signs, etc., the blocks shall be cut to fit any resultant spaces. Any residual gap less than one third the plan area of a whole block may be filled with matching mason's mortar of matching color and with chamfers shaped to suit. Cut edges of blocks shall have appropriate matching chamfers formed prior to incorporation in the works.
- g. When the blocks have been re-laid and bonded to the existing pavement on either side of the trench, the surface course shall be fully compacted using a plate compactor as described above. The compaction must be carried out as soon as possible after laying but not within one meter of any unrestrained edge of the pavement. Apart from this edge strip, no paving block will remain un-compacted at the end of any day's work.
- h. After compaction of the surface course, dry silica sand complying with the grading for jointing sand shall be spread over the surface and brushed into the joints. No material which would stain the block must be used. The block paving area shall then be re-vibrated using the plate compactor and the surface sanding and vibration repeated until complete filling of the block-to-block joints is achieved. Surplus sand shall only be removed prior to trafficking.

- i. The final surface shall be within $\pm 5\text{mm}$ of the true surface level when measured under a 3m straight edge and the surface of the adjacent blocks shall not show any difference in level in excess of 2mm.

At suitable intervals during the contract period, to be decided upon by the Telecommunications Infrastructure Provider’s Engineer, and also at the end of the defects liability period, extra sand shall be spread on the surface and shall be vibrated to ensure that the joints remain filled.

2.5.2 Reinstatement of Kerb lines, Edging Kerbs, etc.

Where excavations cross kerb lines the following procedures should be observed:

- a. Kerbs shall be removed carefully and stored for reuse.
- b. Concrete backing and foundation shall be broken out over the extent of the works.
- c. On completion of backfilling, the kerb foundation shall be recast using concrete class C45/20, and incorporating 12 mm diameter dowel bars 150 mm long, equally spaced, two behind each kerb.
- d. Kerbs shall be re-laid and bedded in a layer of specified mortar, not less than 10mm and not more than 40mm thick.
- e. Any expansion joint encountered should be made good as found and all other joints should be pointed with specified mortar if the existing kerbs were so pointed.
- f. Kerbs shall be backed with concrete class C45/20.
- g. For radii of 1.0m, 3.0m and 5.0m, curved kerbs shall be used.
- h. For radii of 12m or less, kerbs of appropriate length shall be used as follows:

12m – 3m	half kerb
Less than 3m	one third kerb
- i. Any unit of kerbs and edging deviating more than 3mm in 3m length from line and level shall be made good by lifting and relaying correctly.
- j. On completion of reinstatement of kerbs, all exposed rear surfaces shall be treated with two coats of approved bituminous paint.

2.5.3 Reinstatement of Medians, Verges, Parks, Un-surfaced Graded Roads, etc.

- a. When part of the trenching work involves medians, verges, un-surfaced graded roads and/or park areas, the excavation shall be backfilled up to the surface level/underside of sweet soil level.
- b. Where verges, medians, etc., are cultivated, no plants, shrubs or trees shall be removed without the explicit permission of the Ministry of Municipalities and Agriculture.
- c. In cultivated areas and parks, topsoil and sweet sand dug during excavation shall be carefully laid aside to be reused upon completion of the reinstatement work. The surface to be topsoiled shall be loosened to a depth of 200mm and topsoil replaced on it to the specified depth without compaction. The Contractor shall import any additional topsoil required to make up any deficiency.

Areas where grass is to be sown shall be worked to a fine tilt, leveled, graded and rolled with a light roller. The seed shall be sown evenly at the specified rate of application in the proper season and in suitable weather conditions. Restoration and re-seeding of any areas where the new grass is unsatisfactory or inadequate shall be carried out by the Contractor as instructed. Newly-sown grass shall be regularly watered and shall receive at least one cutting.

2.5.4 Completion of works

- a. All reinstatement works shall proceed expeditiously and immediately upon completion of service installation. All reinstatement works including backfilling and final layer surfacing must be completed within the time limits indicated in the following table:

Length of the excavation	Maximum time to be taken for reinstatement
1 to 10 Meters	One day
11 to 50 Meters	Three days
Above 50 Meters	In stages with prior approval from Roads DPCU

- b. No part of the trench shall be opened to traffic prior to the completion of the final layer reinstatement. Where this is not practicable due to traffic

requirements, it may be opened to traffic provided that the trench section shall be covered with steel plates of sufficient thickness to safely bear the traffic load. Steel plates shall firmly be fixed to the ground to prevent movement under the wheels and final layer reinstatement shall be completed within the time limits specified above.

- c. Written permission from the Roads Damage Prevention Control Unit (DPCU) shall be required for the temporary opening of un-surfaced trenches to traffic.
- d. The time limits listed in this document must be complied with for all excavation works in public roads. The following punitive measures will be taken against violators of these requirements:
 - i. Issuance of warning letter upon first violation.
 - ii. Temporary suspension for a month from doing any excavation in public roads if violation is repeated.
 - iii. Recommendation to the concerned Operator to permanently suspend the contractor if repeated violations are observed.

2.5.5 NOTIFICATION OF COMPLETION TO ROADS DPCU

- a. On completion of the reinstatement work following a project, the Telecommunications Infrastructure Provider's Engineer or his appointed Contractor shall notify the Roads Damage Prevention Control Unit (DPCU) by submitting a standard asphalt inspection form.
- b. On submission of the asphalt inspection form, work on the project shall be deemed to be complete and no further excavation/reinstatement work shall be allowed under this wayleave. Any further work, including rectification, shall be considered a new work and hence a new inspection form will have to be issued.
- c. No final payment shall be made to the contractor without satisfactory initial inspection of the reinstatement by the Roads Engineer.

2.5.6 MAINTENANCE

- a. The reinstatement work described in these Guidelines shall be placed under a defects liability period of one year starting from the day of completion of the reinstatement. During this period, the operator who carried out the work will be retained as the sole party responsible for conducting all maintenance activities (at his own cost) related to the completed work. Upon satisfactory completion of the defects liability period, the Road Projects and Maintenance Directorate will adopt the reinstatement work and will take over any future maintenance

responsibilities, except for large-scale failures due to non-adherence to specifications in relation to materials and workmanship.

- b. No retention money at the end of the defects liability period shall be released without final adoption of the reinstatement work by the Roads Engineer.