

I n t e r n a t i o n a l T e l e c o m m u n i c a t i o n U n i o n

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

L.71

(01/2008)

SERIES L: CONSTRUCTION, INSTALLATION AND
PROTECTION OF CABLES AND OTHER ELEMENTS OF
OUTSIDE PLANT

**Design, construction, and installation of
network cables for broadband access including
metallic networks connected to optical fibre
networks**

Recommendation ITU-T L.71

Recommendation ITU-T L.71

Design, construction, and installation of network cables for broadband access including metallic networks connected to optical fibre networks

Summary

Recommendation ITU-T L.71 deals with the design, construction and installation of network cables for broadband access. To design the network of metallic cables for broadband access, firstly the number of lines to be provided, the type of access system such as xDSL to be installed, and the availability of existing copper networks may be considered. This Recommendation includes a design process and construction examples.

Source

Recommendation ITU-T L.71 was approved on 8 January 2008 by ITU-T Study Group 6 (2005-2008) under Recommendation ITU-T A.8 procedure.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure e.g. interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at <http://www.itu.int/ITU-T/ipr/>.

© ITU 2008

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

CONTENTS

	Page
1 Scope	1
2 References.....	1
3 Definitions	1
4 Abbreviations and acronyms	1
5 Conventions	2
6 Design	2
6.1 Design principles	2
6.2 Flow of copper network design	2
7 Construction and installation	6
Appendix I – Korean experience on the construction and installation of outdoor structures for broadband access.....	7
I.1 BB-C (cabinet for broadband service).....	7
I.2 BB-S (shelter for broadband service)	9
I.3 BB-M (manhole for broadband service).....	10
Bibliography.....	13

Recommendation ITU-T L.71

Design, construction, and installation of network cables for broadband access including metallic networks connected to optical fibre networks

1 Scope

This Recommendation discusses networks of metallic cables for broadband access including those used to connect to optical fibre networks.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T K.26] Recommendation ITU-T K.26 (2008), *Protection of telecommunication lines against harmful effects from electric power and electrified railway lines.*
- [ITU-T L.1] Recommendation ITU-T L.1 (1988), *Construction, installation and protection of telecommunication cables in public networks.*
- [ITU-T L.19] Recommendation ITU-T L.19 (2003), *Multi-pair copper network cable supporting shared multiple services such as POTS, ISDN and xDSL.*
- [ITU-T L.44] Recommendation ITU-T L.44 (2000), *Electric power supply for equipment installed as outside plant.*
- [ITU-T L.63] Recommendation ITU-T L.63 (2004), *Safety procedures for outdoor installations.*

3 Definitions

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CAPEX	Capital Expenditure
CO	Central Office
DSLAM	Digital Subscriber Line Access Multiplexer
FTTx	Fibre to the x (C: Curb, O: Office, B: Building, N: Node, P: Premises, H: Home)
MDF	Main Distribution Frame
NIU	Network Interface Unit
ODF	Optical Distribution Frame
OPEX	Operating Expenses
PON	Passive Optical Network
STB	Set-Top Box

5 Conventions

None.

6 Design

Copper networks should be designed to be resilient to environmental conditions such as rain, snow and windstorms since they are installed mainly in outdoor environments. Also, other construction information such as power induction and electrical corrosion should be taken into account based on the collaborative investigations with other related organizations. Especially, topographical characteristics by city and road planning, facilities belonging to other organizations, and transportation conditions also have to be considered because copper networks are widely distributed according to various customers' demands.

6.1 Design principles

6.1.1 Technical condition

In order to provide fast, accurate and reliable services to the customers, transmission loss and DC resistance limits should be addressed to ensure compliance with related standards.

6.1.2 Economics

The shortest routes, existing outside plant facilities, materials, etc., shall be considered. In case of FTTx deployment, the location of outdoor cabinets shall be taken into account because copper network designs need huge capital expenditure and existing copper networks between outdoor cabinets and subscribers can be used.

6.1.3 Preservation

Copper networks should be designed considering natural environmental conditions since their facilities are installed mainly in outdoor environments. Additionally, the configuration for easy maintenance as well as OPEX and CAPEX shall be taken into account from the viewpoint of network topology such as cable route decisions.

6.1.4 Reliability

Reliability should be considered in order to meet the customers' needs. Especially, the capacity of transmission lines, mechanical properties of structures, regional conditions and city evolution trends have to be taken into account.

6.1.5 Construction

The total construction period considering material delivery and work procedures, including cross-connection of operating pairs, shall be also examined.

6.2 Flow of copper network design

Copper network designs comprise "preliminary design" and "final design". Figure 1 shows the work flow of copper network design.

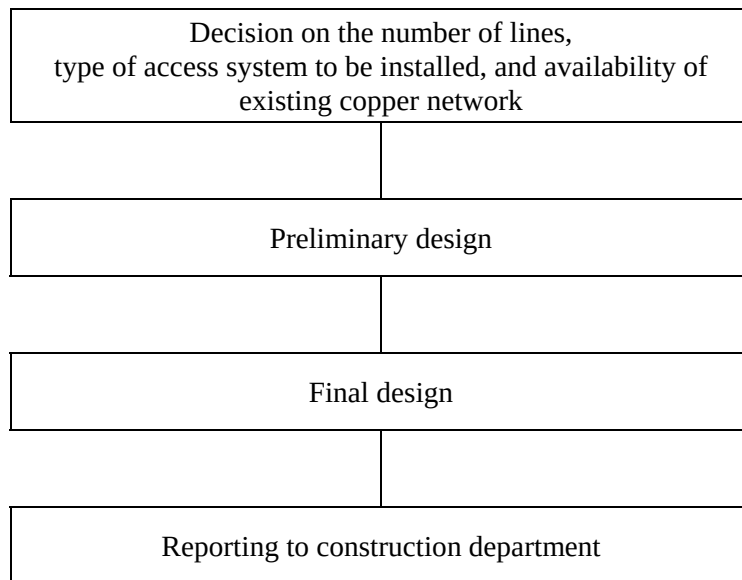


Figure 1 – Flow for copper network design

6.2.1 Preliminary design

6.2.1.1 Flow for preliminary design

Figure 2 shows the flow chart for preliminary design. To design a copper network for broadband access, the type of access technology shall be decided first. Copper networks may be deployed variously according to the access technology. Technology development makes the access loop to deep fibre architectures that shorten or eliminate copper loop length as shown in Figure 3. FTTx technologies replace the copper loop with fibre running all the way to the subscriber residence, or extend DSL access equipment to within hundreds of metres of the home, the distance at which copper drops can deliver tens of Mbit/s. In case of ADSL deployment, digital subscriber line access multiplexers (DSLAMs) may be located at optical nodes where outdoor cabinets shall be used, 1 to 2 km from the customer premises to provide the higher speed of service. The special digital cables that have high crosstalk performance can be used when installing new copper cables.

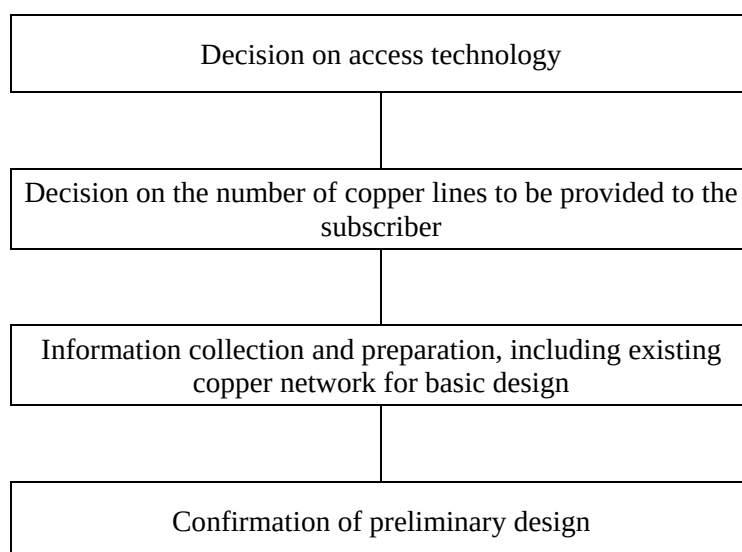
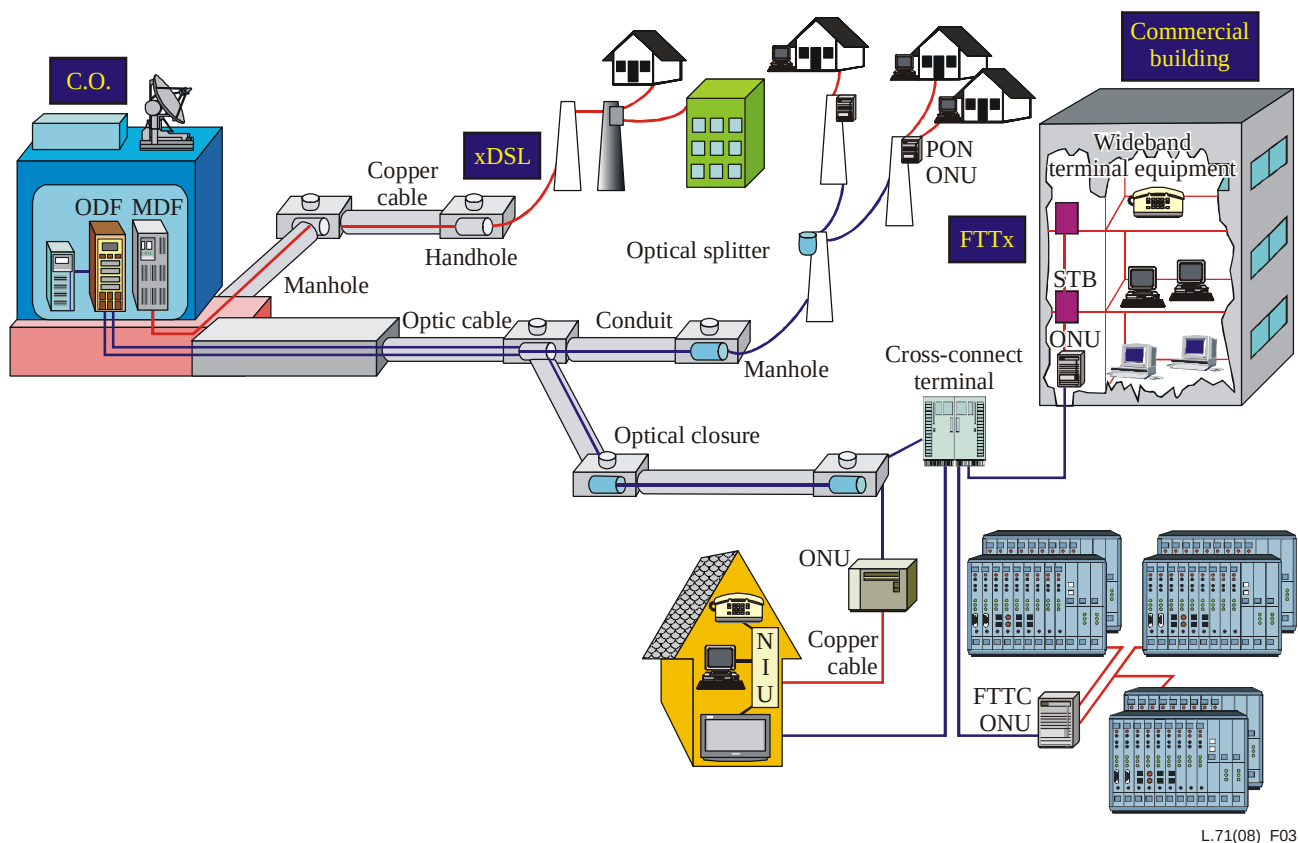


Figure 2 – Flow of preliminary design



L.71(08)_F03

Figure 3 – FTTx access network configuration

6.2.1.2 Information collection

a) Telecommunication facilities:

- District map
- Demanded number of lines and existing lines for fixed distribution area
- Map of cable lines including underground conduits or ducts
- Drawing of main distribution frame (MDF)
- Status of distribution area

b) Others:

- Other underground facilities such as gas or water pipes
- Plans to build roads, watercourses, sewers, housing complexes, railways, power lines, waterworks, bridges, etc.
- Effects from power line, lightning, electrical corrosion
- Harmful effects from sea wind or environmental pollution
- Gas leakage and lack of oxygen in manholes
- Weather statistics

6.2.1.3 Preparation of preliminary design specification

a) Cables networks:

- Boundary of residential area
- Boundary of fixed distribution area
- Conductor diameter and feeder cable counts

- Demanded cable counts for fixed distribution area
- ONU location
- b) Ducts:
 - Usage status of manholes
 - Existing duct or conduit routes
 - Sections to be enlarged or improved
- c) Central office facilities:
 - Configuration of terminating cables
 - Drawing of operating rooms
- d) Preparation of the design drawing

6.2.1.4 Contents of preliminary design

- Purpose
- Summary of construction expenses
- Main resources list and amounts
- Main processes for construction
- Construction methods
- Construction period
- Meeting records of discussions with related agencies
- Preliminary design drawing
- Others

6.2.2 Final design

6.2.2.1 Flow for final design

The flow for final design is shown in Figure 4.

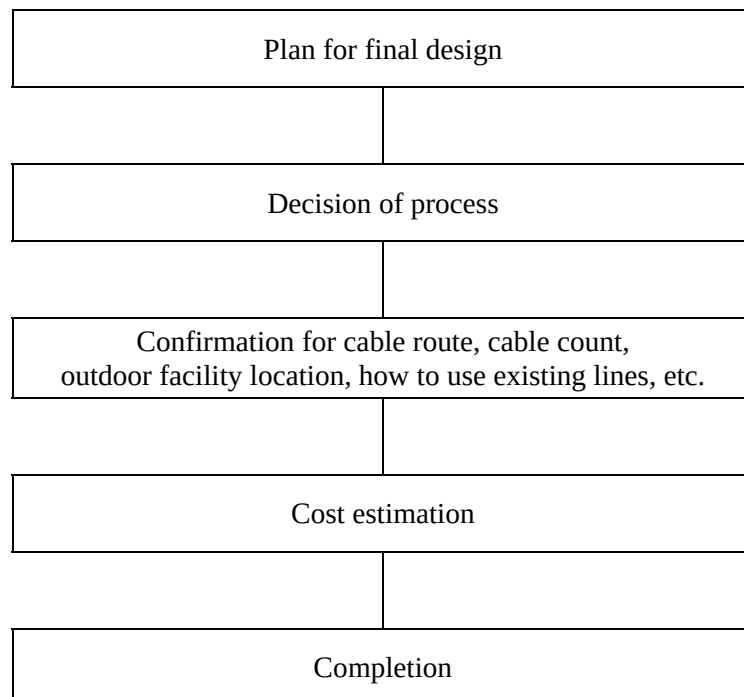


Figure 4 – Flow for final design

6.2.2.2 Basic rules for final design

Before completion of the final design, the following items shall be considered:

- Final number of lines to meet demand
- Confirmation of whether the fixed distribution areas are allocated appropriately
- Changes after preliminary design
- Others

6.2.2.3 Final design

a) *Decision of optical node location*

If copper cable is connected to an optical fibre network, the optimal location of optical nodes should be selected. To construct the optical nodes such as ONU, outdoor cabinets can be used. The outdoor cabinets should be installed considering the size of the cabinet, occupation area and the risk of flood damage. Also, it can be considered whether to purchase or rent the place to install outdoor cabinets. A series of these processes can minimize the OPEX for environmental damage or moving of cabinets in future. If existing copper cables are used, testing may be needed.

b) *Conductor diameter of copper cable*

The minimum conductor diameter may be used within the range of acceptable maximum line loss according to the broadband access systems. The acceptable maximum insertion loss of ISDN/xDSL systems, typical DC resistance and line loss on copper pairs, and typical reach for ISDN/xDSL services, are shown in Tables 3, 4 and 5 of [ITU-T L.19], respectively. If a new copper cable is connected to an existing copper cable, the total line loss should be evaluated. The number of bridged taps may be also minimized.

c) *Power influence calculation*

Induced voltage and noise on copper pairs running parallel to power lines shall be calculated and countermeasure should be established according to the related regulation.

d) *Preparation of final design drawing*

6.2.2.4 Contents of final design

- Cover and contents
- Introduction
- General specification (if needed, include exceptional specification)
- Time schedule
- Number of persons
- Estimated cost of construction
- List of construction materials
- Design drawing
- Others

7 Construction and installation

Construction and installation of copper networks are shown in [ITU-T L.1], which is a placeholder pointing to [b-ITU-T Handbook]. If there is some equipment (e.g., ONU or remote-deployed xDSL) needing a power supply, [ITU-T L.44] contain provisions. For safety procedures applicable to outdoor installations, refer to [ITU-T L.63].

Appendix I

Korean experience on the construction and installation of outdoor structures for broadband access

(This appendix does not form an integral part of this Recommendation)

Introduction

This appendix contains information about the construction and installation of outdoor structures containing electronic equipment installed at the roadside or underground to provide high-speed broadband access in an FTTC network.

I.1 BB-C (cabinet for broadband service)

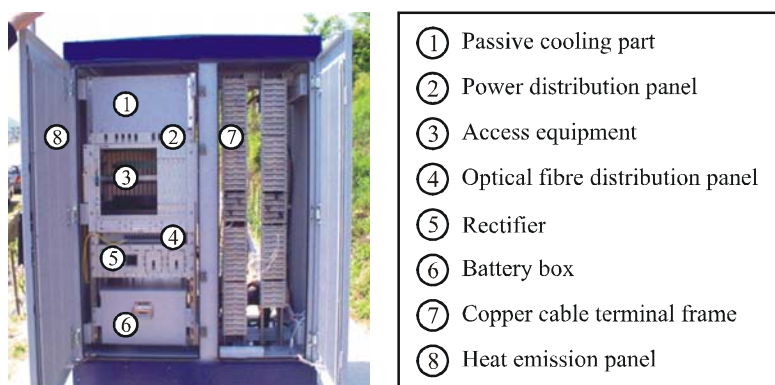
I.1.1 Structure

A BB-C can provide broadband access to a maximum of 1'200 subscribers and is installed on the ground. A BB-C may consist of a passive cooling system, power distribution panel (PDP), ODF, broadband access equipment, rectifier, battery, copper pair distribution frame, grounding bar, protector, splitter, and heat emission panel. The shape and structure of a BB-C is shown Figures I.1 and I.2.



L.71(08)_FI.1

Figure I.1 – BB-C



L.71(08)_FI.2

Figure I.2 – Structure of BB-C

I.1.2 Construction and installation

The process for construction and installation of a BB-C is as follows:

- Installation of a duct between BB-C and manhole, grounding rod and power line
- Installation of a concrete base plate
- Installation of cables
- Installation of the cabinet
- Protection from moisture
- Cabling of copper cable and optical fibre cable
- Equipment installation and wiring
- Grounding and bonding

Figures I.3 and I.4 show examples of construction and installation of a BB-C.



L.71(08)_F1.3

Figure I.3 – Construction of BB-C



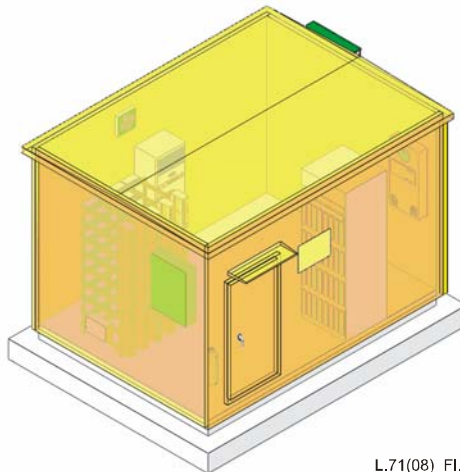
L.71(08)_F1.4

Figure I.4 – BB-C installed on the sidewalk

I.2 BB-S (shelter for broadband service)

I.2.1 Structure

A BB-S provides a broadband access service for up to 2'400~14'400 subscribers and is bigger than the BB-C. A BB-S may consist of an air-conditioner, ODF, broadband access equipment (e.g., DSLAM), rectifier, battery and main distribution frame (MDF) for copper pair, and a grounding system. The shape and structure of a BB-S is shown Figure I.5.



L.71(08)_F1.5

Figure I.5 – Structure of BB-S

I.2.2 Construction and installation

The process for construction and installation of a BB-S is as follows:

- Installation of a duct between BB-S and manhole, grounding rod and power line
- Installation of a concrete base plate
- Installation of the structure
- Installation of cables
- Protection from moisture

- Cabling of copper cable and optical fibre cable
- Equipment installation and wiring
- Grounding and bonding

Figures I.6 and I.7 show examples of construction and installation of a BB-S.



L.71(08)_Fl.6

Figure I.6 – Construction of base structure and duct



L.71(08)_Fl.7

Figure I.7 – Installation of BB-S

I.3 BB-M (manhole for broadband service)

I.3.1 Structure

A BB-M is a structure installed underground. In case of large types, more than 3'600 lines can be contained or, for medium-sized types, less than 2'400 lines. A BB-M may consist of a hatch, UPS, battery, grounding system, lighting, water sink, water pump, fire extinguisher, cooling system, power distribution panel, cable tray, ventilation fan, exhaust pipe, cable distribution frame, environment monitoring system, etc. The shape and structure of a BB-M is shown in Figure I.8.



a) Large type



b) Medium type

L.71(08)_F1.8

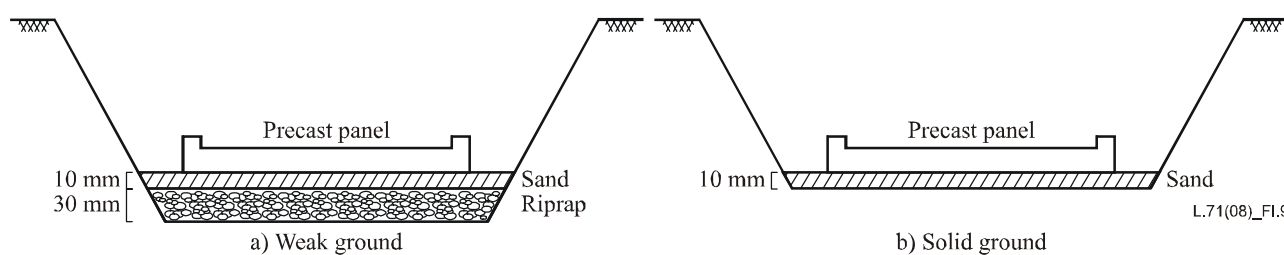
Figure I.8 – Structure of BB-M

I.3.2 Construction and installation

The process for construction and installation of a BB-M is as follows:

- Digging and land-side protection wall
- Foundation work
- Installation of a grounding rod
- Installation of the structure
- Protection from moisture
- Installation of exhaust pipe and water pipe
- Cabling of copper cable and optical fibre cable
- Equipment installation and wiring
- Grounding and bonding

Figures I.9 and I.10 show examples of construction and installation of a BB-M.



L.71(08)_F1.9

Figure I.9 – Foundation work



a) Installation of structure



b) Installation of air supply and exhaust pipe



c) Backfill



d) Completion

L.71(08)_Fl.10

Figure I.10 – An example of BB-M construction

Bibliography

[b-ITU-T Handbook] ITU-T Handbook (1991), *Outside plant technologies for public networks*.

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	Global information infrastructure, Internet protocol aspects and next-generation networks
Series Z	Languages and general software aspects for telecommunication systems