MCMC MTSFB TC G035:2022

TECHNICAL CODE

RADIOCOMMUNICATIONS NETWORK FACILITIES - MINOR COMMUNICATIONS INFRASTRUCTURE

Developed by

Malaysian Technical Standards Forum Bhd

Registered by

MCMC

Registered date: 15 September 2022

MCMC MTSFB TC G035:2022

Development of technical codes

The Communications and Multimedia Act 1998 ('the Act') provides for Technical Standards Forum designated under section 184 of the Act or the Malaysian Communications and Multimedia Commission ('the Commission') to prepare a technical code. The technical code prepared pursuant to section 185 of the Act shall consist of, at least, the requirement for network interoperability and the promotion of safety of network facilities.

Section 96 of the Act also provides for the Commission to determine a technical code in accordance with section 55 of the Act if the technical code is not developed under an applicable provision of the Act and it is unlikely to be developed by the Technical Standards Forum within a reasonable time.

In exercise of the power conferred by section 184 of the Act, the Commission has designated the Malaysian Technical Standards Forum Bhd ('MTSFB') as a Technical Standards Forum which is obligated, among others, to prepare the technical code under section 185 of the Act.

A technical code prepared in accordance with section 185 shall not be effective until it is registered by the Commission pursuant to section 95 of the Act.

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Committee representation

The Technical Code was developed by Radiocommunications Network Facilities (External) Sub Working Group under the supervision of Radio Network Facilities Working Group of the Malaysian Technical Standards Forum Bhd (MTSFB), constituted by representatives from the following organisations:

Celcom Axiata Berhad

Digi Telecommunications Sdn Bhd

edotco Malaysia Sdn Bhd

International Islamic University Malaysia

Maxis Broadband Sdn Bhd

Measat Broadcast Network System Sdn Bhd

Telekom Malaysia Berhad

Tele System Electronics (M) Sdn Bhd

TIME dotCom Berhad

U Mobile Sdn Bhd

Webe Digital Sdn Bhd

YTL Communications Sdn Bhd

Foreword

This technical code for Radiocommunications Network Facilities - Minor Communications Infrastructure ('Technical Code') was developed pursuant to section 185 of the Act 588 by the Malaysian Technical Standards Forum Bhd ('MTSFB') via its Radiocommunications Network Facilities (External) Sub Working Group of the Radio Network Facilities Working Group.

This Technical Code shall continue to be valid and effective from the date of its registration until it is replaced or revoked.

RADIOCOMMUNICATIONS NETWORK FACILITIES - MINOR COMMUNICATIONS INFRASTRUCTURE

1. Scope

This Technical Code provides the following:

a) the provisions of Minor Communications Infrastructure (MCI) which incorporates the facilities contained in the *Garis Panduan Perancangan Infrastruktur Komunikasi (GPP-I)* and provides for the development of further communications facilities that complying with the developments;

b) the principles for the design, siting, construction and operation of communications facilities that apply to all proposed MCI; and

c) the information to assist the relevant stakeholders to understand the planning and legislative requirements for communications facilities.

2. Normative references

The following normative references are indispensable for the application of this Technical Code. For dated reference, only the edition cited applies. For undated references, the latest edition of the normative reference (including any amendments) applies.

See Annex A.

3. Abbreviations

For the purposes of this Technical Code, the following abbreviations apply.

BEM	Board of Engineers Malaysia
CME	Civil, Mechanical and Electrical
EMF	Electromagnetic Field
FRP	Fibre Reinforced Panels
GPP-I	*Garis Panduan Perancangan Infrastruktur Komunikasi*
IoT	Internet of Things
JPEG	Joint Photographic Experts Group
LIF	Low Impact Facilities
MCI	Minor Communications Infrastructure
MICC	Mineral-Insulated Copper-clad Cable
NFP	Network Facilities Provider
O&M	Operations and Maintenance
PVC	Permanent Virtual Circuit
RF	Radio Frequency
Tx	Transmission

4. Terms and definitions

4.1 Minor Communications Infrastructure (MCI)

MCI is defined as a small-scale structure that satisfies the 3 principles stated in the GPP-I. MCI may comprise of communications equipment and network facilities required for the provision of communications network services. It is adapted from the internationally accepted definition of Low Impact Facilities (LIF).

The 3 principles deal with the following aspects:

a) the dimension of antenna and microwave dish unit;

b) by retrofitting or using the existing structure; and

c) the application of aesthetic value to minimize the visual impact on the surrounding area.

4.2 Local authority

State government, federal government, any city council, municipal council or district council, as the case may be, and in relation to the Federal Territory means the Commissioner of the City of Kuala Lumpur appointed under section 4 of the Federal Capital Act 1960 [Act 190].

5. Overview

The development of mobile technologies and Internet of Things (IoT) will require a greater number of telecommunication transmitter sites to support the required quality of mobile and IoT services in the future.

The telecom industry is seeking to deploy tens of thousands of antenna systems to support next-generation 5G wireless broadband system which is expected to deliver low-latency connections for the IoT, artificial intelligence and autonomous vehicles. These transmitter sites will have to be closer apart from each other as compared to existing installations. To support the deployment of transmitter sites for mobile communications, IoT applications and enabling 5G will likely be low-power antennas known as small scale equipment and antenna system which can be mounted on existing structures, buildings and street furniture.

The radiocommunications network forms an important and very large part of the service providers' network infrastructure. There are various design methods, each being adopted by individual service providers. The intention of this Technical Code is to gather common best practices from the industry and compiled into a comprehensive set of requirements.

The use of MCI for transmitter sites installation represents an option for communications facility providers, local authorities, property developers and other relevant bodies to adopt for a greater installation density of transmitters in applicable geographic areas. These MCI are installed on existing structures or retrofitted to the structures that are in public or private areas and shall meet the criteria as set out in the GPP-I. Because of their size and location, MCI are considered to have a low visual impact and would not likely to be significant.

A Network Facilities Provider (NFP) may, for purposes connected with the provision of network services, carry out the installation of MCI to enhance existing coverage or network capacity. Therefore, the structure shall be owned and managed by individuals or companies with a valid NFP license granted by the Malaysian Communications and Multimedia Commission (MCMC).

The purpose of this Technical Code is:

a) to provide a consistent and robust framework that addresses the local community's interests in the effective, efficient and suitable provision of communications network facilities so that it achieves environmental, economic and social sustainability in the short, medium and long term;

b) to provide a consistency of approach which assists NFPs, local community and local authority to balance the needs of different stakeholders;

c) to provide guidance and reference to developers about local authority regulations and requirements of the relevant legislation; and

d) to enable the stakeholders and local authorities to embrace new and emerging technologies and effectively manage any future installation of MCI within the public domain deemed under the control of local authorities.

This Technical Code also provides the general requirements and the Operations and Maintenance (O&M) of MCI for base station sites. The design requirements for construction, structural, mechanical, and electrical aspects of the MCI are elaborated. Aesthetic and safety aspects of the implementation of the MCI with consideration to the public and community are also emphasised. Sample drawings and pictures are provided to enhance visualisation of the various types of infrastructures.

This Technical Code must be read in conjunction with GPP-I and other relevant acts, guideline and technical codes.

6. Provision of Minor Communications Infrastructure (MCI)

This Technical Code will ensure the effective, efficient and suitable provision of communications network facilities so that it achieves social, environmental and economic sustainability.

6.1 Social

The social objectives of this Technical Code are:

a) to apply a precautionary approach to the deployment of communications network facilities;

b) to minimise EMF exposure to the public;

c) to consider community sensitive locations e.g. heritage, health institution or educational institution;

d) to ensure that the general public and local communities have access to communications technology; and

e) to achieve equity for the various stakeholders by endeavouring to balance their various needs;

6.2 Environmental

The environmental objectives of this Technical Code are:

a) to assist implement principles of quality urban design in respect to communications network facilities;

b) to ensure infrastructure is visually compatible with surrounding character and locality or visual context with particular regard to heritage buildings or areas and cultural icons;

c) to minimise adverse impacts on the natural environment; and

d) to assess whether the proposed infrastructure is consistent with the amenity of the area;

6.3 Economic

The economic objectives of this Technical Code are:

a) to identify the type of land use or area suitable for this type of infrastructure in a local government area;

b) to accommodate the planning requirements of new communications technology;

c) to assess whether the proposed infrastructure is consistent with the permitted development in adjacent areas; and

d) to ensure reasonable access to communications technology;

7. Design control

7.1 Visual amenity

The application should consider the following design controls.

a) Antennas and supporting infrastructure should be designed to minimise or reduce the visual and cumulative visual impact from the public domain and adjacent areas.

b) Within the local context, the infrastructure design should take account of:

   i) colour;

   ii) texture;

   iii) form;

   iv) bulk; and

   v) scale.

c) Infrastructure should:

   i) be well-designed;

   ii) be integrated with the existing building facade or structure, unless otherwise justified in writing to local authorities;

   iii) have concealed or hidden cables as key features where practical and appropriate;

   iv) be unobtrusive where possible;

   v) be consistent with the character of the surrounding area;

   vi) minimise the visual impact of a communications network facility by any one or more of the following:

1) by integrating the facility with the design and appearance of any building or structure on or within which it is located;

2) by screening any equipment associated with the facility so as to reduce its visibility;

3) by avoiding the obstruction of views of significant vistas, significant landmarks or items of environmental heritage;

4) by ensuring that the facility as installed is in keeping with the streetscape;

5) by ensuring that the colour and finish of the facility are in keeping with the locality; and

6) by ensuring that the scale of the facility is in keeping with the locality, bearing in mind that the scale may be affected by the intended coverage of the facility.

vii) be removed when no longer being used. The site should be reasonably restored to the condition as agreed by the local authorities and/or property owner.

d) Location

The MCI may be located at the following locations:

i) residential areas;

ii) industrial areas;

iii) commercial centres;

iv) rural areas; and

v) other areas such as university, hospital and port.

7.2 Heritage

Infrastructure proposed for areas of environmental significance (as defined in GPP-I) require development consent under the related authorities. The applicant shall:

a) demonstrate how the proposed facility avoids or minimises the visual impact on the heritage significance of heritage items and conservation areas;

b) provide a heritage impact report or statement if the proposal involves a heritage item or is located within a heritage conservation area; and

c) demonstrate how the proposed facility avoids or minimises the physical impact on any endemic flora and fauna.

8. Minor Communications Infrastructure (MCI) design principles

This section details the generic MCI design principles and requirements for the deployment of MCI, which is designed to provide street level coverage or ‘gap filler’ for capacity and/or coverage for blind spots that is not able to be addressed by conventional macro sites.

The MCI shall co-exist with existing macro sites and it is not meant to replace the macro sites. Continuous demands towards better experience for the cellular communications have brought the MCI into the market with its main objectives to resolve capacity, blind spot issues and assist the rollout of 5G infrastructure and other communications network facilities.

With the above objectives in mind, MCI are expected to be built in areas where typical structure for macro site is hard to build, such as by the roadside, building facade and public spaces in urban areas to improve the operations of the telecommunications deployment framework.

8.1 Small scale radio apparatus

The operator needs to install facilities that will extend and support existing coverage footprints. In some cases, this could involve increasing the size of existing or new equipment, or it may involve the installation of smaller equipment in closer density in some locations.

Under special circumstances (especially the radio antennas and microwave dishes), MCI are required to blend in with its surrounding or to be aesthetically pleasing to the sight. The antenna and its supporting structures, as well as associated equipment, should be designed or constructed with minimal visual impact. It should not harm the city skyline or have a minimal effect on the size of the equipment, the load of the structure, the minimum size and properly finished to blend in with the surroundings through the use of colour and camouflaging architectural treatments.

MCI is designed to carry parabolic microwave dishes, flat panel antenna, cabinet size, RF and Tx cables of various combinations with the detail allowable protrusion height of antenna, diameter or length size of radiocommunications dishes are elaborated in this technical code.

For the purpose of design, the parameters as shown in Table 1 shall be used.

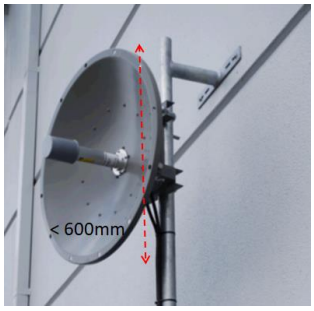
Table 1. Parameters included to enhance visualization

Type	Type of Apparatus	Description
A/A1	Microwave dish	Radiocommunications microwave dish mounted at new or existing structure and also referred as A1. Microwave dish mounted to new retrofit or existing structure: a) microwave dish size not more than 600 millimetres in diameter; b) flush mounted to the structure (e.g. street poles; gantry, bridge, billboard, road signage, traffic light or any street furniture etc); c) if attached to a supporting structure or any bracket mounted to the existing structure, the total length of the pole/boom is not more than 1000 millimetres; and d) colour-matched to its background or surrounding. Example of apparatus for Type A1 is shown in Figure 1.
A/A2	Microwave dish	Radiocommunications microwave dish installation on the building wall facade and also referred as A2: a) microwave dish size not more than 600 millimetres in diameter; b) colour-matched to its background or surrounding; and c) bracket flush mounted on the wall facade, the total length of 1 000 millimetres of the pole or boom and the arm bracket should not more than 300 millimetres. Example of apparatus for Type A2 is shown in Figure 1.

Table 1. Parameters included to enhance visualization (*concluded*)

Type	Type of Apparatus	Description
B/B1	Antenna	Panel, yagi or other type of antenna mounted at retrofit or existing structure and also referred as B1: Antenna flush mounted to new retrofit or existing structure (e.g. street pole; gantry, bridge, billboard, road signage, traffic light or any street furniture. a) antenna size not more than 1 000 millimetres in length; b) flush mounted to retrofit or existing structure; c) colour-matched to its background; and d) if pole or boom attached to a supporting structure or any bracket mounted to the existing structure, the total length of the pole or boom structure by not more than 2 000 millimetres. Example of apparatus for Type B1 is shown in Figure 2.
B/B2	Antenna	Panel, yagi or other type of antenna installed at the building wall façade and also referred as B2: a) antenna size not more than 1 000 millimetres in length; b) pole or boom flush mounted on the existing building wall facade; c) colour-matched to its background in a colour; and d) bracket flush mounted on the wall facade, the total length of 1 000 millimetres of the pole or boom and the arm bracket should not more than 300 millimetres. Example of apparatus for Type B2 is shown in Figure 2.
C	Cabinet	Feeder pillar or outdoor cabinet: a) dimension of not more than (1 200 H x 900 W x 900 D) millimetres; b) with a base area of not more than (1 200 x 1 200) millimetres; and c) to blend with surrounding environment. Example of apparatus for Type C is shown in Figure 3.

Type A1 - microwave dish mounted at new retrofit or existing structure



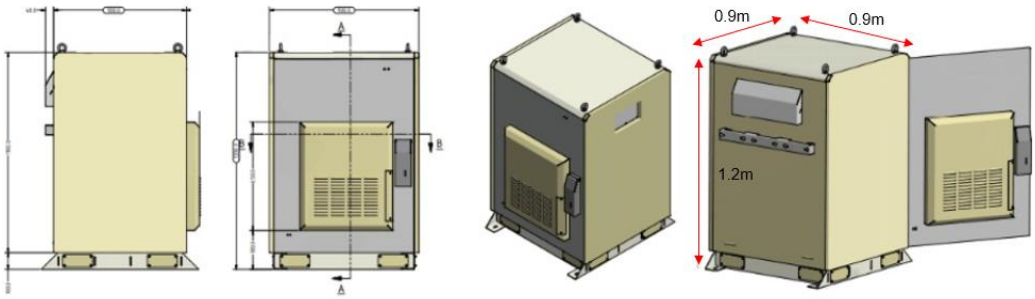
Type A2 - microwave dish installed at building wall facade

Figure 1. Examples of Type A1 and A2 installation

Type B1 - panel antenna mounted at retrofit or existing structure

Type B2 - panel antenna mounted at the building wall facade

Figure 2. Examples of type B1 and B2 installation



Type C - Feeder pillar or outdoor cabinet

Figure 3. Examples of Type C installation

8.2 Integrated structure

Service providers use smaller wireless communications equipment to make their networks denser, bringing the network closer to their customers. Small cells typically have a range varying from 10 m to a few hundred metres and are used by service providers, either to offload traffic from the macro cellular network in a high-density, short-range environment or to strengthen the range and efficiency of a mobile network. Wireless hardware can be integrated with street furniture.

Integrated structure, in the context of wireless infrastructure, is a term used to define objects in public spaces that house small-cell units in boxes and are considered visually commonplace and acceptable to the public. Common examples of street furniture outfitted for small-cell networks include billboards, lamp posts, phone booths, pylon signage board, flood light poles, traffic signals and other structures in the public right-of-way.

In accordance to the MCI principles, integrated structure shall be able to accommodate power, antenna and associated backhaul and other cabling equipment. In addition, good design and engineering are crucial to successful integrated structure on street furniture.

Radiocommunications network facilities on existing or new street furniture shall be in compliance with the Civil, Mechanical and Electrical (CME) requirements as stipulated in this clause.

The specifications of equipment cabinet and integrated structure to cater for the installation of radiocommunications network facilities are as defined in Table 2.

Table 2. Specification of equipment cabinet and street lighting pole

Type	Type of coverage	Type of street integrated pole	Cabinet dimension (H x W x D) (mm)	Pole height (m)	Antenna size (mm)	Pole diameter (mm)
C1	Micro	Street lighting or smart pole with equipment inside the pole (≤ 3 radio technology)	Zero footing cabinet	≤ 18	≤ 1 000	Top section ≤ 180, bottom section ≤ 600
C2	Micro	Street lighting pole with cabinet on ground (≤ 3 radio technology)	1 200 x 900 x 900	≤ 18	≤ 1 000	Top section ≤ 180, bottom section ≤ 400

The examples and requirements of Type C1 and C2 are shown in Figure 4 and 5 respectively.

Street lighting or smart pole with equipment inside the pole (≤ 3 radio technology)

Maximum height 18 m with zero footing cabinet

Street lighting pole with cabinet on ground (≤ 3 radio technology)

Maximum height 18 m with roadside cabinet

Figure 4. Requirements and examples of Type C1 installation

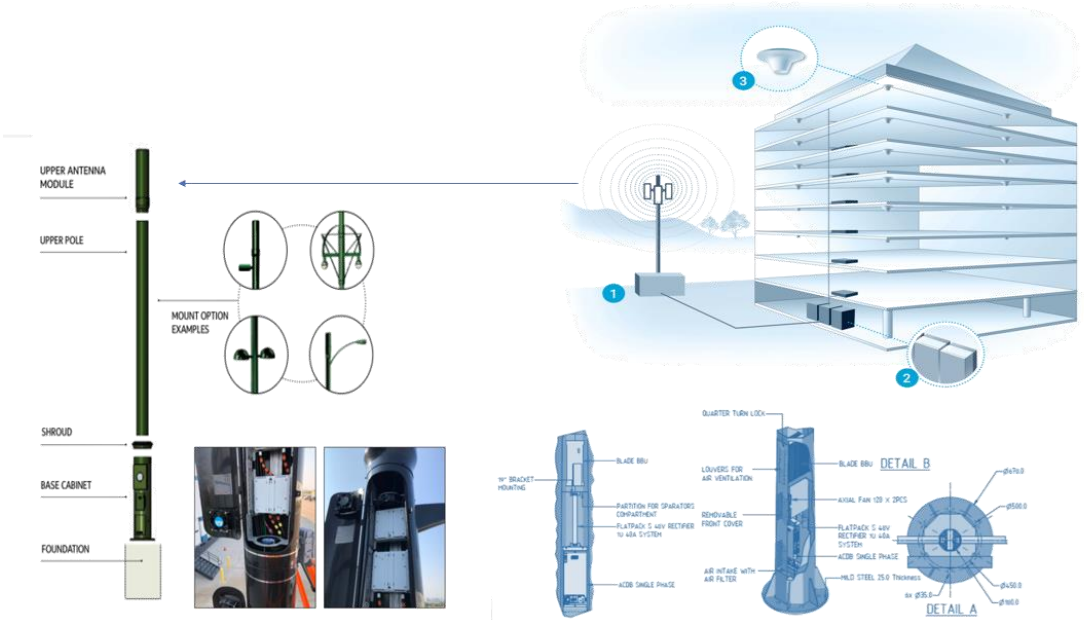


Figure 5. Requirements and examples of Type C2 installation

The specifications of equipment cabinet and street furniture other than street lighting pole are as defined in Table 3.

Table 3. Specifications of equipment cabinet and street furniture other than street lighting pole

Type	Type of coverage	Type of street integrated pole	Cabinet dimension (H x W x D) (mm)	Antenna size (mm)	Type of cable
D1	Micro	Road signage, pylon signage board, overhead gantry pole, flood light, traffic light or pedestrian flyover	1 200 x 900 x 900	≤ 1 000	All cables to be installed and concealed with proper type of material
D2	Micro	Taxi stands or bus stop	Requirements depend on demand and necessity		

The examples of Type D1 and D2 are shown in Figure 6 and Figure 7 respectively.

Road gantry

Billboard

Road signage or traffic light

Signage pylon

Figure 6. Example of Type D1 installation

Figure 7. Example of Type D2 installation

8.3 Aesthetic value

The MCI structure shall have aesthetic value to minimise visual impact on the surrounding areas, preserving the existing aspects of the area and shall not affect the facade of the building where it is installed.

Designing and implementing aesthetic installations require a lot of creativity on the part of the designer and any site can have varied design from one to another.

A concealment or camouflage shall have minimal visual impact and be compatible with, and not adversely affect, the city skyline or have any negative effect on surrounding residents and businesses. Antenna, antenna support structures and related equipment must be designed, constructed and suitably finished to blend into the surrounding environment through the use of screening materials and camouflaging architectural treatments. Details about the types of aesthetics are described in Table 4.

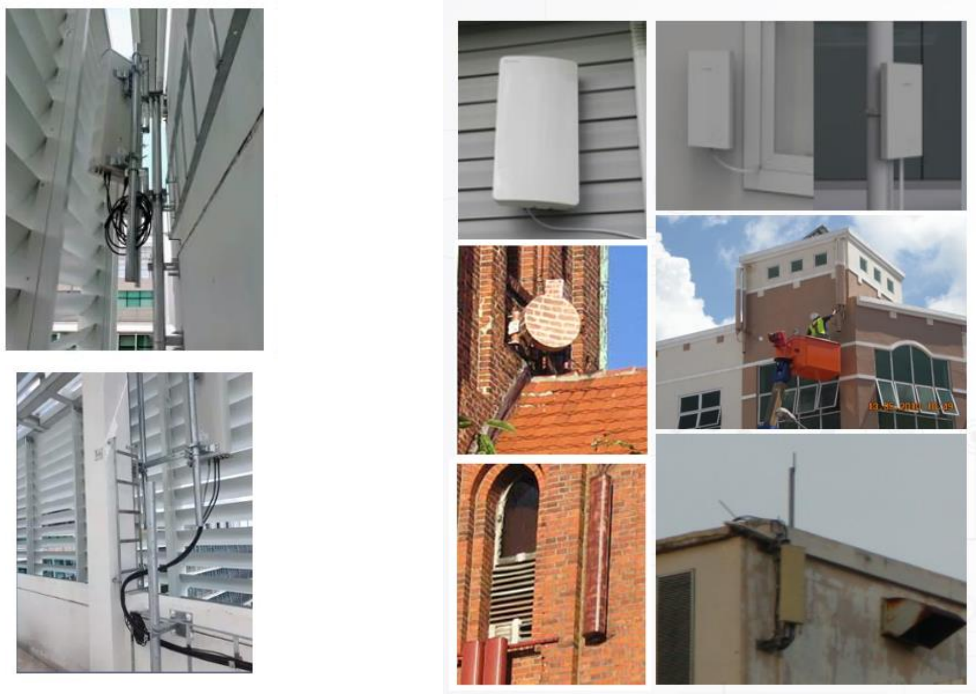
Table 4. Types of aesthetics installation

Types of aesthetics	Description
Concealment or screening material	a) Concealment used to minimise adverse visual effects of structure and antennas through careful design, siting, landscape screening and innovative techniques of concealment using Fibre Reinforced Panels (FRP), acrylic and radome canvas. Concealment design can be customised to blend with the environment that is appealing to local community and meet coverage requirement at public areas. b) Screening materials should be compatible with the architectural style, materials and colour scheme of the existing building or structure on which it is mounted, in order to blend in with the general surroundings. When this is not possible, colour selection shall be designed to minimise the visual impact of the antenna arrays.

Table 4. Types of aesthetics installation *(concluded)*

Types of aesthetics	Description
Stealth camouflage	a) If the antenna will be generally visible to the public, the antenna and supporting electrical and mechanical equipment must be of a neutral colour that is identical to, blends with, or is closely compatible with the colour of the supporting structure so as to make the antenna and related equipment as visually unobtrusive as possible. b) Antennas and related equipment shall be designed to blend into the surrounding environment by painting facade mounted antennas or treating them as architectural elements designed to blend in with the existing building.

The examples of aesthetic design are shown in Figure 8.



Concealment or screening material Stealth camouflage

Figure 8. Examples for aesthetic design

The planning and installation of such radiocommunications infrastructures are based on the following rationale:

a) Awareness to highlight the need to maintain the overall integrity (or intactness) of the particular landscape or surroundings.

b) The need to minimise visual intrusion or obstruction of views within a particular area.

c) The design shall endeavour to minimise public tendency to complain from the aspects of unsightly structures especially in urban or sub-urban areas. Similarly, antennas and associated equipment may be concealed within the structural elements of an existing building or hidden behind or within

parapet walls, building column, louvers, flagpoles, flues, monuments, spires, water towers and tanks, heating and ventilation units, air conditioning units and similar mechanical equipment.

d) Any aesthetic design structure should not degrade the quality of the communication services.

In general, any concealment or camouflage design is subject to availability of physical space and structural integrity of the aesthetic structure (loading factor).

When a camouflage or full concealment structure is independent of an existing building, it should fit the context of its surroundings and look as though it could serve the purpose of a real structure, with any related equipment cabinets or storage building being integrated into the structure or located in similar structures.

Concealment screening or stealth camouflage features of the structures shall be treated as appropriate ancillary or appurtenance subject to the definition and use per the relevant and applicable standards, procedure and design parameters contained in 8.1, 8.2 and 8.3.

9. Design requirement

9.1 Design codes

All designs, materials and workmanship shall, wherever relevant, comply with and be tested to the requirement of the latest editions of the standards listed below together with all the current amendments unless otherwise stated.

a) BS 499-1;

b) BS EN ISO 1461;

c) BS 2901;

d) BS 3692;

e) BS 4360;

f) BS 5135;

g) BS 5950;

h) BS EN 1993-3-1;

i) BS EN 1992-1-1;

j) BS 4592-2;

k) BS 5493;

l) ASCE Manual 72;

m) TIA/EIA-222-G; and

n) AS 3995

9.2 Basic design wind speeds

The MCI structure and its equipment shall be designed, for the purpose of assessing its structural strength to a basic design wind speed of 33.33 m/s (120 km/h), 3 second gust speed or 22.22 m/s mean hourly wind speed for all sites. This corresponds to a return period of 1 in 50 years. The MCI structure shall undergo compliance check for maximum deflection (sway) and twist once in every 20 years (1:20).

9.3 Design load

The structures shall be designed so that no failure or permanent distortion shall occur on any part of the structures during simultaneous application of the loads in their specified loading configuration as summarised in Table 5.

The length of the new arm bracket structure shall be within 100 mm to 300 mm. The length of bracket structure may differ from one area to another. Therefore, all installer or operator shall consult on this matter with professional engineer of the area prior to any installation.

For details on design load, please refer to the MTSFB 001:2009 and the scope of this Technical Code.

These antenna elements and all related cables shall be arranged in such a manner that the resulting bending moment and shear forces are the greatest, and that the deflection under the relevant design wind speed shall be maximum irrespective of the direction of antenna and/or the direction of incident wind and shall not be limited to any pattern or direction of antenna arrangement.

Appropriate shielding of antenna may be used if justifiable by established means. The dynamic characteristic of the smart pole structure shall be assessed using established methods, and any instance of instability and vortex shedding shall be explicitly dealt with in the analysis of the pole structure. In this regard, the disposition of platform elements and antenna outstand shall be taken into account when deriving the natural frequency of the smart pole.

9.4 Galvanizing

The galvanising coating shall be at least 610 g of zinc per square meter of surface and shall not be less than 0.086 mm (86 microns) thick and shall be able to withstand the test set out in BS EN ISO 1461.

9.5 Bolt and Nuts

All connection bolts, nuts and spring washers that are to be used for member connections shall conform to BS 3692. All nut and bolt heads shall be of hexagonal shape. Bolt holes shall not be more than 1.5 mm larger in diameter than the corresponding bolt diameter and free from burrs. The tolerance for location of centres of bolt holes shall be ± 2 mm. All connection bolts and anchor bolts shall be galvanised including the threaded portion. All nuts shall be galvanised with the exception of the threads, which shall be oiled. When in position, each connection bolt shall project through its nut for at least a full turn but not exceeding 10 mm. Each connection bolt shall be supplied as a set, complete with one nut, one spring washer and one flat washer. Nuts shall be finger tight on the bolt and will be rejected if they are, in the opinion of the telco, considered to have excessively tight or loose fit.

The minimum distance from the centre of the bolt holes to a rolled edge shall be 1.25 x bolt diameter. The minimum distance between holes for multi-bolted joints shall be 3 x bolt diameter. The minimum distance from the centre of the bolt holes to a sheared edge shall be 1.5 x bolt diameter.

9.6 Erection marking

All members shall be marked with distinguishing numbers and alphabets corresponding to the erection drawings or bill of materials. The erection marks shall be done before galvanising and shall be clearly legible afterwards. The erection marks shall be at least 12 mm high, clearly legible and shall be stamped at easily locatable positions.

9.7 Material

All designs shall be such that no trouble shall arise in service from vibration or excessive deflection due to the use of a very light section.

Rolled steel sections, flats, plates, bolts, nuts and bars shall, unless otherwise approved be of steel in accordance to BS 4360 or its latest equivalent British Standards Grade 43A and/or Grade 50C and shall be manufactured and rolled in approved mills.

Steel shall be cleaned and free from blisters, rust and scale or other defects before hot dipping process. Minimum thickness of structural members (angle sections) shall be 5 mm. The ultimate design stresses in tensile members shall not exceed the elastic limit strength of the material, whereas the ultimate stresses in the compression members shall not exceed a figure calculated from an approved formula (refer Material strengths as in Table 5).

9.8 Deflection limit

The maximum twist and sway (deflection) at any specified elevation of the fully loaded MCI structure and its equipment (inclusive of all the designed antenna, accessories and radio feeders) shall not exceed 1 degree at a 1:20 year return period wind speed of 30 m/s 3 second gust or 20 m/s mean hourly wind speed. The gustiness of wind loading shall be included in the deflection assessment. A wind speed partial safety of 1.0 may be used.

9.9 Fabrication tolerances

The length of a member shall not deviate from its specified length by more than ± 3 mm. Straightness of a member shall not exceed 3 mm for all non-hollow sections and 2.5 mm for all other sections.

9.10 Design criteria and code

Table 5 described the summary of design criteria and code for infrastructure installation.

Table 5. Summary of design load criteria and code

<table>
<tr><th>No</th><th>Item</th><th>Description</th></tr>
<tr><td>1.</td><td>Steel design</td><td>Mild steel. BS5950: 2000 Part 1 - Code of practice for design of rolled and welded sections.</td></tr>
<tr><td>2.</td><td>Ancillary loading parameters</td><td>
<table>
<tr><th>Loading type</th><th>Weight (kg)</th><th>Wind resistance area (m^2)</th></tr>
<tr><td>600 m microwave</td><td>15</td><td>0.28</td></tr>
<tr><td>(1 000 H x 500 W x 210 D) mm flat antenna</td><td>33</td><td>1.05</td></tr>
</table>
</td></tr>
<tr><td>3.</td><td>Design wind speed</td><td>a) 33.33 m/s (120 km/h) 3 second gust wind speed or 22.22 m/s mean hourly wind speed.

b) 30 m/s 3 second gust or 20 m/s mean hourly wind speed for the purpose of deflection compliance check.</td></tr>
</table>

Table 5. Summary of design criteria and code *(continued)*

No	Item	Description
4.	Partial safety factors in design	Appropriate factors correspond to the quality and importance of the pole shall be obtained from BS 8100. A minimum material factor of 1.10 (corresponds to Class A quality) and a minimum wind speed factor of 1.20 (corresponds to site near to main trunk road and railway or any other major public utilities such as reservoir, power transmission lines, residential housing etc.) shall be adopted. The definition of near shall mean the radial coverage of the height of the pole plus a buffer of 10 m.
5.	Terrain category	The horizontal forces imposed by the wind on the structure shall be derived based on the provisions and guidance of EIA/TIA-222-G Standards with the following load magnification effects: a) Exposure Category C; Open terrain with scattered obstructions having heights generally less than 9m. This category includes flat, open country, grasslands and shorelines in hurricane prone regions. b) Topographic Category 1; No abrupt changes in general topography, i.e. flat or rolling terrain, no wind speed-up shall be required. Structures located vertically on the lower of half of an escarpment or horizontally beyond 8 times the height of the escarpment from its crest shall also be considered covered by this category. c) Structure Classification 2; Structures that due to height, use or location represent a high hazard to human life and/or damage to property in the event of failure and/or used for services that may be provided by other means. Alternatively, BS 8100-1 Standards may also be used in terrain characteristics the equivalent of the design load generated in EIA/TIA-222-G Standards above. The partial factors to be adopted as follows; Dead load, gdl = 1.05, Wind Load, gv = 1.20, Design Strength, gm= 1.10
6.	Loadings (Dead and Imposed)	Loadings (Dead and Imposed) BS6399: Design loading for buildings. Part 1: 1996 - Code of practice for dead and imposed loads. Part 3: 1988 - Code of practice for imposed roof loads. Floor Usage Design Imposed Load Roof with no public access 0.75 KPA Roof with public access 1.50 KPA
7.	Concreate design	BS8110: 1997 Part 1 - Code of practice for design and construction. Gamma factor for steel stress shall be 1.15 for ultimate load design and 1.60 for service stress design.

Table 5. Summary of design criteria and code *(continued)*

<table>
<tr><th>No</th><th>Item</th><th>Description</th></tr>
<tr><td>8.</td><td>Wind loading code</td><td>Wind loads may be derived using BS 6399: Part 2 or BS 8100: Part 1. BS 6399: Part 2 may be used if detailed derivation in accordance with Annex C of the Code, that factor Kb, building type factor, and the resulting dynamic augmentation factor, Cr, falls within the Code applicability limit of 0.25. Otherwise, BS 8100 shall be used.

CP3: Chapter V: Part 2 shall not be used as it had been superseded by BS 6399: Part 2.</td></tr>
<tr><td>9.</td><td>Analysis and derivation of design forces</td><td>Equivalent static method of analysis may be used. Appropriate wind gust factors and force coefficients for antenna, branches and poles and ancillaries shall be taken into account in deriving the design wind loading. For cases whereby the natural frequency of the smart pole (calculated using established software, with due consideration of weight and disposition of platform and antenna away from the pole structure centre-line) being less than 2 Hz, dynamic analysis using spectral analysis or time history analysis shall be carried out to assess the pole response to wind excitation. In this regard, all mode shapes below 2 Hz shall be assessed. The more critical resulting forces derived from equivalent static method and dynamic method shall be use for detailed design</td></tr>
<tr><td>10.</td><td>The following force coefficient shall be used in the absence of more accurate information</td><td><table><tr><th>Diameter of antenna</th><th>Force coefficient</th></tr><tr><td>600 mm microwave dish</td><td>1.40</td></tr><tr><td>(1000 H x 500 W x 210 D) mm flat antenna</td><td>1.0</td></tr><tr><td>(300 H x 300 W x 210 D) mm flat or omni antenna</td><td>2.0</td></tr></table>
The wind resistance across the thickness of antenna due to diagonal wind incident direction shall be accounted for.</td></tr>
<tr><td>11.</td><td>Analysis and design of pole foundation</td><td>The minimum factor of safety for overturning under un-factored design wind speed of 33.33 m/s 3 second wind gust or 22.22 m/s mean hourly wind speed shall be at least 2 without wind gust effect and 1.5 when wind gust is included. A safety factor 1.05 shall be used if factored wind speed is used with full wind gust effects applied.

The rotational characteristic of footing onto the pole shall be taken into account when assessing the deflection limit of the pole. A sub grade reaction of 12 000 kN/m3 may be used for this purpose. In no case shall tension be allowed in any piles when a piled foundation is used.</td></tr>
<tr><td>12.</td><td>Load configuration</td><td>1 nos. 600 mm diameters parabolic dish and 3 nos. of flat panel. These shall be positioned such that maximum wind resistance is achieved.</td></tr>
<tr><td>13.</td><td>Cable configuration</td><td>12 nos. of 7/8” RF feeder cable stacked in 1 row and 2 nos. of ¼” Tx cable. Or 12 Nos of 12mm CPRI cables and DC power cables 14mm</td></tr>
</table>

Table 5. Summary of design criteria and code *(concluded)*

No	Item	Description
14.	Design codes	a) Smart pole structure - BS 5950 b) Tower foundation - BS 8110 c) concreate or brick wall - BS EN 1992-1-1
15.	Material codes	a) Steel works - BS 4360. b) Galvanising - BS EN ISO 1461. c) Bolts and nuts - BS 4190, BS 3692 and BS 4320. d) Welding - BS 5135.
16.	Material strengths	All structural steel used are to be as follows: a) grade 43 with a yield strength, f_y = 275 N/mm^2; b) grade 50 with a yield strength, f_y = 355 N/mm^2; and c) welded sections: maximum ultimate weld strength of 215 N/mm^2 may be used. Grade 55 with a yield strength, f_y = 450 N/mm^2 shall not be used when pole sections were being make up of welded pieces unless fatigue analysis in accordance with BS 8100 is carried out. All structural bolts used are to be of grade 8.8 with the following properties: a) yield strength f_y = 627 N/mm^2; and b) shear strength P_s = 375 N/mm^2
17.	Physical characteristics	Maximum tilt of the top of the structure is not to exceed 0.5° from centre under a design wind speed of 30 m/s 3 second gust wind speed or 20 m/s mean hourly wind speed, which corresponds to 1:20 years return period. Wind gust effects shall be included in the analysis for deflection compliance.

10. General requirement

10.1 Site compound

Site compound of MCI structure and its equipment incorporates attributes required for fast and affordable deployment, while at same time blending the pole or equipment cabinets into its surrounding environment. In general, no fencing is required for MCI structure and its equipment including cabinets.

10.2 Backhaul transmission

Suitable backhaul transmission can be used as a backhaul of MCI structure and its equipment to ensure better internet and data services for consumer.

10.3 Earthing and lightning protection

Earth continuity conductors and earth leads shall be of high-conductivity copper or any other type of conductor treated with anti-corrosive material, which are continuous throughout their whole lengths and without joints, except by means of approved mechanical clamps. Where connections are made at switchgear and such items of electrical equipment, the conductors shall terminate in soldered or compression-type sockets.

If the case of Mineral-Insulated Copper-clad Cable (MICC) or Permanent Virtual Circuit (PVC) cables are used, the copper outer sheaths of the cables may be utilised as earth continuity conductors. The termination of each cable-run the copper sheaths (or sheaths in the case of single-core, multiple runs of MICC or PVC cables) shall be effectively bonded to earth.

Every circuit of a switchboard, distribution board, control board, tap-off unit and splitter switch-fuse unit shall be provided with its own earth-continuity conductor.

In hazardous locations, additional earth continuity conductor networks with their own earth electrode systems shall be provided for bonding metalwork to earth. Such networks, when required, shall be indicated on relevant layout drawings.

The impedance measured at any of the earth chambers connected as part of the earth grid shall not exceed 10 Ω.

For earth electrode system, electrodes shall comprise 16 mm diameter, 1.6 m long, extensible-type, copper-steel-cored rods (‘copper weld’ or approved equivalent make), driven into the ground at an interval of at least twice the driven length of any two electrodes. Electrodes shall be driven into ground by means of a ‘KANGO’ or similar type electric or pneumatic hammer. Every connection clamp shall be provided with regulation-type concrete inspection chamber and cover.

The number of electrodes installed shall be 3 to 5 earth points at each site. Each earthing point shall consist of 2 rods and the minimum length of each electrode shall be 1.5 m. The length between each point shall be 6 m, which is 2 times the earth points vertical length. The numbers of earthing points indicated in the drawings are indicative only and shall in no way imply that the earthing points are sufficient to obtain the value of less than 10 Ω.

The contractor shall increase the driven length or number of earth electrodes and if necessary, non-soluble earth enhancing compound to be considered to obtain the required earth resistance, subject to the approval of service providers. In exceptionally bad areas, the contractor shall propose the use of extra copper earth grids and earth enhancing compound to achieve the desired earth resistance value.

A lightning protection air termination or lightning rod shall be fitted to the top of each MCI structure and its equipment. As long as the structure is located nearby buildings which have its own or sufficient lightning protection system, it might not be compulsory for the said structure to be installed with its own lightning protection system.

11. Installation

11.1 Basic procedures

Prior to the installation of MCI structure and its equipment, operator or installer shall:

a) identify a location; and

b) obtain relevant permission from the landlord, owner or caretaker of the property, but not limited to a formal written approval permit.

Safety measures shall be taken into serious consideration at the construction site during installation to prevent accidents, both to the workers and the general public.

Proper coordination is critically essential prior to any installation. The relevant consent and interest of all parties, including but not limited to the local authorities, service providers, consultants, contractors and land owner shall be considered.

The installer or operators shall observe and adhere to existing guidelines and laws set by the local authorities.

The following is the list of laws and existing guidelines that shall be referred to:

a) Department of Safety and Health (DOSH's) Regulations, Codes of Practice & Guidelines (e.g. JKKP DP/G 127/379/4-1).

b) NIOSH (National Institute for Occupational Safety and Health Safety) *Arahan Pematuhan Akta Keselamatan Dan Kesihatan Pekerjaan* 1994 (Akta 514) *Dan Peraturan-Peraturan Di Bawahnya*.

11.2 Power supply

Power supply of the MCI structure and its equipment shall only be supplied by:

a) Tenaga Nasional Berhad (TNB) for Peninsular Malaysia;

b) Sabah Electricity Sdn Bhd (SESB) for Sabah;

c) Sarawak Electricity Supply Company Berhad (SESCO) for Sarawak; or

d) other electrical power distribution licensees. Other power supply mode such as generator set shall only be considered on case-by-case basis and subject to approval by relevant authorities.

12. Maintenance

Maintenance of the sites shall remain the responsibility of the operator i.e. the NFP licence holder. Regular site inspections are required to ensure the MCI structure and its equipment is structurally sound. This is preventive maintenance where any deterioration can be highlighted ahead of time and corrective work be done to prevent further degradation to the structure. Failure to observe a regular maintenance schedule can create a potentially hazardous working and operating conditions.

A regular check of the structural integrity of all add-on assemblies is recommended to be carried out by trained personnel from the facilities operator. It also identifies the deficiencies, the defective items and recommends solutions to keep the structure in good condition and optimum performance.

Structure owner is to adhere to the maintenance obligations as stipulated in paragraph 5.12 of Commission Determination on the Mandatory Standard on Access (Determination No. 3 of 2016).

12.1 Site access

It is important to ensure that there is 24-hour access to the site. However, for highly sensitive area for example '*Sasaran Penting Negara*', prior approval shall be obtained for site access. Site access should be made available:

a) during office hours; and

b) as and when required in the event of emergency.

Any arrangement on the site access should be commercially agreed by both parties as spelled out in the Commission Determination on the Mandatory Standard on Access (Determination No.3 of 2016). The service provider's employees, contractor, vendor and/or agent are responsible to ensure that access members do not violate any service provider's policies, do not perform illegal activities, and do not use the access to property for outside business interests.

The service provider's employees, contractor, vendor and/or agent bear responsibility for the consequences should the access be misused.

For any other access permission request that the service provider's employees, contractors, vendors and/or agents may deem would lead to the violation of access given, the service provider's employees, contractors, vendors and/or agents shall directly refer to the relevant authorised department or personnel of the service provider for further verification.

The service provider's employees, contractor, vendor and/or agent shall provide the relevant documentation for accessing the site as requested by site owner.

Any personnel that have access to the property shall fill in the visitor's log book as per detailing requirement.

Service provider's employee shall not provide their access identification data and/or pass card, access key and/or access password to anyone, not even service provider's members.

Any personnel that have accessed to the property shall strictly follow the code of conduct as may be outlined while on the property premises.

12.2 Inspection

The interval between site inspections should not be greater than 1 year and should be maintained in accordance with the findings from the inspection.

12.3 Inspection procedures

Workers shall adhere to the basic safety requirements set by DOSH while doing maintenance works at site e.g. wearing proper safety gears. The visual inspection works begin when the field operations approach to the sites. Visually inspect and report on the findings shall follow the items below but not limited to:

a) visually inspect the compound from a distance;

b) visually inspect the paint condition of the structure;

c) external environmental condition (i.e. slope erosion, soil settlement or movement, adjacent development, drainage system, etc.);

d) site surroundings are clear of debris;

e) ground rod present at top of the MCI structure and equipment; and

f) visually inspect whether structure is plumb (straight) and free of twists.

Physical inspection of the structure and its ancillaries, i.e. structure members, bolt and nut, paint, climbing and cable ladder and gantry, platform, antennas, electrical components, waveguide, guys, and all associated structure hardware shall be evidenced with colour photographs of each structure being taken and incorporated into each report.

Antennas should be repainted, if required, with specially formulated RF transparent paint. The use of sky-lifts, elevated platforms or devices is recommended for accessing the antenna and devices installed on the pole. Other unsafe methods for accessing the devices are strictly discouraged.

It is crucial to check and report the structure condition in relation to external environmental condition duly supported with photographical evidence, at least from 4 critical angles.

Photographic documentation of any deficiencies detected in the inspection shall be highlighted together with clear descriptions, which will trigger repairs, modifications or replacement. Hardcopy and Joint Photographic Experts Group (JPEG) images are required. Photographs should be labelled with site identification details and date, and position and nature of problem should be stated clearly

The inspection findings shall include comments of the condition as:

a) satisfactory (in accordance with standards and no maintenance works required);

b) not satisfactory (not to standard and maintenance works required);

c) critical (immediate response, public health and life-threatening situation); and

d) not applicable (not relevant to this site).

The inspector will complete and safe keep a hard copy and an electronic version of the following documents:

a) inspection checklist for routine maintenance; and

b) photographic records.

Annex A
(normative)

Normative references

Act 514, *Arahan Pematuhan Akta Keselamatan Dan Kesihatan Pekerjaan* 1994 (Akta 514) *Dan Peraturan-Peraturan Di Bawahnya*

Communications and Multimedia Act 1998, Determination No.3 of 2016, *Commission Determination on the Mandatory Standard on Access*

*Garis Panduan Perancangan Infrastruktur Komunikasi (*GPP-I*)*, Malaysian Communications and Multimedia Commission

MTSFB 001:2009, *Technical Standards and Infrastructure Requirements: Radiocommunications Network Infrastructure (External).*

ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods*

AS 3995, *Design of Steel Lattice Towers and Masts*

BS 499-1, *Welding terms and symbols Part 1: Glossary for welding, brazing and thermal cutting*

BS 3692, *ISO metric precision hexagon bolts, screws and nuts. Specification*

BS 4190, *ISO metric black hexagon bolts, screws and nuts. Specification*

BS 4320, *Specification for metal washers for general engineering purposes. Metric series*

BS 4360, *Specification for weldable structural steels*

BS 4592-2, *Industrial type flooring and stair treads. Expanded metal gratings. Specification*

BS 5493, *Code of practice for protective coating of iron and steel structures against corrosion.*

BS 6399-2, *Loading for buildings. Part 2 Wind loads*

BS 8100, *Lattice towers and masts* (all parts)

BS EN 1993-3-1, *Eurocode 3. Design of steel structures. Towers, masts and chimneys. Towers and masts*

BS ISO 5950, *Electrolytic tin-coated cold-reduced carbon steel sheet of commercial and drawing qualities*

ANSI/TIA-222-G, *Structural Standard for Antenna Supporting Structures and Antennas*

ASCE Manual 72, *Design of Steel Pole Transmission Structures*

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Acknowledgements

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