

MCMC MTSFB TC G041:2023

TECHNICAL CODE

RADIOCOMMUNICATIONS NETWORK FACILITIES - COMPLIANCE AUDIT FOR RADIOCOMMUNICATIONS STRUCTURE

Developed by



Registered by



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Development of technical codes

The Communications and Multimedia Act 1998 (Laws of Malaysia Act 588) ('the Act') provides for a 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 requirements 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 Radio Network Facilities Working Group of the Malaysian Technical Standards Forum Bhd (MTSFB), which consists of representatives from the following organisations:

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Digi Telecommunications Sdn Bhd

Digital Nasional Berhad

edotco (M) Sdn Bhd

Maxis Broadband Sdn Bhd

REDtone Telecommunication Sdn Bhd

SIRIM QAS International Sdn Bhd

Telekom Malaysia Berhad

TIME dotcom Berhad

U Mobile Sdn Bhd

Webe Digital Sdn Bhd

YTL Communications Sdn Bhd

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Foreword

This technical code for Radiocommunications Network Facilities - Compliance Audit for Radiocommunications Structure ('this Technical Code') was developed pursuant to Section 185 of the Communications and Multimedia Act 1998 (Laws of Malaysia Act 588) by the Malaysian Technical Standards Forum Bhd (MTSFB) via its 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 -
COMPLIANCE AUDIT FOR RADIOCOMMUNICATIONS STRUCTURE**

0. Introduction

Safety risks posed by radiocommunications structures, given the change in the structure loadings, climate and other surrounding factors, are crucial concerns by the authority, regulator and the general public. There is a need for the industry to establish a proper and adequate compliance audit or inspection processes to ensure every radiocommunications structure is well assessed and complies with the relevant standards and regulations.

The objectives of compliance audit are to ensure:

- a) radiocommunications structures are compliant to the standards and regulations;
- b) radiocommunications structures are in good condition and at optimum performance; and
- c) radiocommunications structures are safe in order to prevent injuries and fatalities.

1. Scope

This Technical Code outlines the compliance matters relating to the upkeep of radiocommunications structures. This Technical Code specifies the compliance requirements for radiocommunications structures including its surrounding environment and provides guidance on auditing and inspection methods, as well as processes for the owners of such structures.

The 3 compliance areas are as follows:

- a) technical specifications
 - i) physical;
 - ii) structural; and
 - iii) electrical.
- b) safety
 - i) operational; and
 - ii) occupational.
- c) environment
 - i) water;
 - ii) soil;
 - iii) vegetation; and
 - iv) aesthetic.

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The Technical Code is intended as a reference for Network Facilities Providers (NFPs), Network Services Providers (NSPs), authorised consultants, regulator, local authorities, public and other concerned parties in performing radiocommunications structure inspections and audits.

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.

For the purposes of this Technical Code, the normative references in Annex A apply.

3. Abbreviations

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

AM	Amplitude Modulation
CAAM	Civil Aviation Authority of Malaysia
HIRARC	Hazard Identification, Risk Assessment and Risk Control
PE	Professional Engineer
NFP	Network Facilities Provider
NSP	Network Services Provider
RC	Residual Cartilaginous
SBC	State-Backed Company
UV	Ultra-Violet

4. Terms and definitions

For the purposes of this Technical Code, the following terms and definitions apply.

4.1 Active equipment

Electronic devices that actively generate, receive, or process signals, such as routers, switches, and modems which actively generate or process signals. Active equipment is critical for transmitting and managing data and voice traffic across telecommunications networks and plays a crucial role in ensuring the quality and reliability of communication services.

4.2 Base platform condition

It is defined as that part of the structure that transfers the load from the structure constructed on it as well as its weight over a large area of soil in such a way that the amount does not exceed the ultimate bearing capacity of the soil and the settlement of the whole structure remains within a tolerable limit.

4.3 Earthing continuity

Resistance to ensure the good connection between equipment and the earth or ground, which serves as a safety measure to prevent electrical shock or damage to the equipment.

4.4 Earthing system

A system that connects specific parts of an electric power system with the ground, typically the earth conductive surface for safety and functional purposes.

4.5 Electrical components

Any part of an electric circuit, includes but not limited to wires, switches, resistors and etc.

4.6 Events of risk

Any unforeseen or unexpected occurrence that could lead to a catastrophic effect to the radiocommunications structures.

4.7 Extreme risk

Risk that can cause extreme damages and/or high consequences but low probability i.e. natural disaster, war.

4.8 Fire incident

Unplanned event involving a fire, which can range in severity from minor to catastrophic which can lead to the risk of malfunction of equipment.

4.9 Force majeure

Unforeseeable and uncontrollable event that prevents or significantly disrupts the performance of a radiocommunication structure condition. This may cause by the extreme weather, natural disaster or created by human.

4.10 Functionality

Proper operation, process or performance and how it works.

4.11 High risk

Risk that is likely to result in failure, harm and injury i.e. major system and equipment failure, vandalism, incompetency of personnel.

4.12 Human and organisation competency

A competent person or organisation is someone that is appointed who has the necessary qualifications, skills, experience, and knowledge to manage, design, deliver, maintain the radiocommunication structure including health and safety.

4.13 Low risk

Risk that is not likely to cause serious harm or injury i.e. blockage of drainage, shrubs and bushes.

4.14 Members

Refer to the physical components of the structure.

4.15 Moderate risk

Risk that can cause a potential impact but not serious. i.e. bird nest, simple vandalism.

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4.16 Occupational safety

Occupational safety includes provisions for securing the safety, health, and welfare of persons at work, for protecting others against risks to safety or health in connection with the activities of persons at work.

4.17 Operational safety

The absence of unacceptable risks, injury, or harm to the health of humans, whether direct or indirect, resulting from damage to equipment or the environment.

4.18 Passive structure

Infrastructure that is not part of the active layer of a telecommunications network, including but not limited to, sites, buildings, room or shelters, towers, masts, poles, ducts, trenches, generators, electric power supply and associated electrical and air conditioning equipment.

4.19 Radiocommunications structure

Radiocommunications structure is defined as a structure on landed properties, rooftops, temporary Base Transceiver Station and etc. as provisioned in MCMC MTSFB TC G040.

4.20 Risk analysis and evaluation

Risk analysis and evaluation is an assessment done to examine the identified risks that could impact the functionality radiocommunications structure based on the available information.

4.21 Risk identification

Risk identification is an activity to identify associated risk to the radiocommunications structures compliance.

4.22 Risk treatment

Risk treatment refers to the selection and implementation of options in addressing risk either to eliminate or minimise the risk.

4.23 Seismic mapping

A process of mapping radiocommunications structures in seismic zones using a seismic map, related to vibrations of the earth i.e. earthquake, volcanic eruption etc.

4.24 Structural defects

Structural defects are defined as a fault or deviation from the intended structural performance of radiocommunications infrastructure and its elements. These defects are classified as 'low', 'moderate', 'high' and 'extreme' risk and can include anything from surrounding environment, base foundation, active and passive equipment and also overall functionality of the structure.

4.25 Structure owner

Organisation or individual that owns or has legal control over a particular radiocommunications structure and responsible for ensuring that the structure is constructed and maintained i.e. NFP, NSP and State-Backed Company (SBC).

4.26 Surrounding environment

Nearby objects to the radiocommunications structure but not limited to soil, tree, grass, fence, building strength for rooftop site and workers at site.

4.27 Type of structure

Type of radiocommunications structures as defined in MCMC MTSFB TC G040.

4.28 Vandalism

Vandalism is an action involving deliberate destruction and/or causing damage to public or private property.

5. Risk management

Risk management is a part of a decision-making process, and it entails having a full understanding of a known risk and/or necessary actions to reduce the effect and chances of the event of such risks.

There are 3 stages in managing risk in radiocommunications structures which are:

- a) risk identification;
- b) risk analysis and evaluation; and
- c) risk treatment.

The above processes shall cover 6 focus risk areas:

- a) passive structure;
- b) active equipment;
- c) base condition;
- d) functionality;
- e) surrounding environment; and
- f) human and organisation competency.

The goal of risk management process is not to completely remove all risks associated with a radiocommunications structure. It aims to produce an organised framework to manage structure risks, most importantly the crucial ones, in a more efficient and effective way.

5.1 Events of risk

Events of risk could lead to a catastrophic effect to the radiocommunications structures. The events of risk consist of the following but not limited to:

- a) structural defects;
- b) fire;
- c) force majeure; and

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d) vandalism.

5.2 Risk rating

Risk rating is used to indicate the level of risk. The recommended rating is as follows:

- a) low;
- b) moderate;
- c) high; and
- d) extreme.

6. Compliance areas

In general, compliance areas shall refer to the requirements as specified in MCMC MTSFB TC G040.

Compliance areas that need to be inspected and audited are as follows:

- a) technical specifications;
- b) safety; and
- c) environment.

The compliance areas are depicted in Figure 1 below:

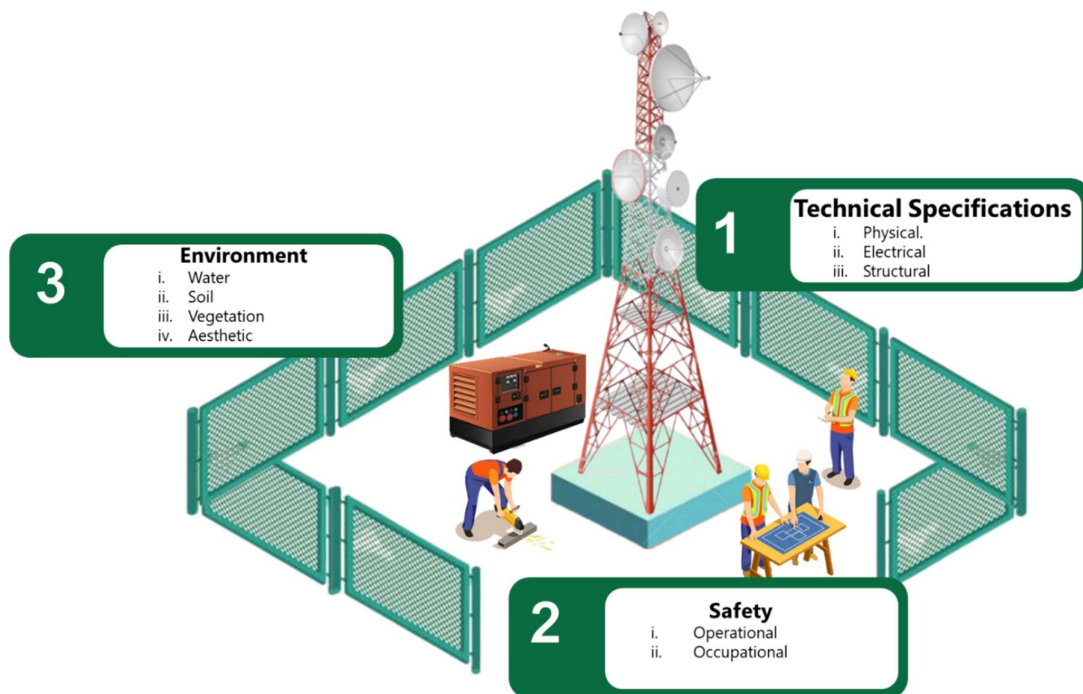


Figure 1. Illustration of respective compliance areas

6.1 Technical specifications

In general, the aspects of the technical specifications that are subjected to inspection or compliance audit are physical, structural, and electrical.

6.1.1 Physical

The inspection on physical aspect will include the following:

- a) structure conditions;
- b) finishing;
- c) lighting;
- d) foundation;
- e) appurtenances; and
- f) insulators.

6.1.2 Structural

The structural compliance depends on the load conditions which can be contributed by the external loading and the equipment mounted on the structure.

The calculation of the load conditions is as stipulated in MCMC MTSFB TC G040.

6.1.2.1 External loading

The external loading for every equipment shall consider the following.

- a) Wind speed.
- b) Terrain.

The external loading derivation and classification should be emphasized and in accordance with the technical specification recommendations in designing and ensuring the compliance of the radiocommunications structure.

6.1.2.2 Mounted equipment

The mounted equipment includes antennas, its accessories, and lines.

Load conditions for every mounted equipment shall consider the following:

- a) Requestor for upgrading works shall define the proposed antenna loading prior to desktop analysis; and
- b) Member legs stress level and performance characteristics need to be diagnosed under maximum design loading conditions. The stress ratios under existing condition of the structure shall be monitored in ensuring the strengthen of the member leg to support any additional of antenna to the structure.

The technical specifications vary according to the type of structure. Details of the inspection items covering each aspect are listed out under Annex B.

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6.1.3 Electrical

The inspection on electrical aspect shall include examination of the structure earthing system and electrical components to the radio equipment that might pose risk of fire to the structure.

6.1.3.1 Earthing

The maximum acceptable electrical resistance of the structure earthing system and continuity are as specified in 7.1.2.2.4 of MCMC MTSFB TC G040.

The inspection of the earthing system shall include the following aspect:

- a) connections between earthing electrodes and earth;
- b) corrosion of hot dip galvanised earthing rod; and
- c) presence of lightning protection rod at the top of structure.

6.1.3.2 Electrical components

The electrical components shall be inspected to ensure compliance with the specifications in 7.1.2.1.10 of MCMC MTSFB TC G040.

6.2 Safety

Additionally, compliance for safety shall refer to the requirements as specified in Section 15 of Occupational Safety and Health Act 1994 (OSHA) and Generic HIRARC for Telecommunication Industry and Airport Standards Directives 401/402/403.

6.2.1 Operational safety

Operational safety covers the following areas:

- a) climbing facilities;
- b) aviation regulation requirement;
- c) working platforms;
- d) surroundings; and
- e) signages.

6.2.1.1 Climbing facilities

Structure owner shall comply with the requirements of the design and construction of the climbing facilities used for climbing or working on their communications structures according to the type of tower and specification stipulated in MCMC MTSFB TC G040 including but not limited to:

- a) fixed ladders;
- b) safety devices;
- c) climber attachment anchorages;

- d) lifelines;
- e) cages; and
- f) electrical safety.

6.2.1.2 Aviation regulation requirement

Structures owner shall comply with the Civil Aviation Authority of Malaysia (CAAM) aviation regulation requirement, i.e. aviation light and finishing under Airport Standards Directive 401/403/404, where telecommunications structures are defined as an obstacle that could constitute a hazard to aircraft.

With regards to the directive, the telecommunication structures shall be appropriately marked and/or lighted so as to be clearly visible to pilots in all weather and visibility conditions. Marking and lighting of the telecommunication structures are intended to reduce hazards to aircraft by indicating the presence of structure. Installation and maintenance of required marking and lighting shall be done by the structure owners.

6.2.1.3 Working platforms

Structure owners shall maintain the working platforms based on the approved design and specification.

6.2.1.4 Surroundings

Structure owner shall ensure the telecommunication structures surroundings are safe and appropriate control measures are taken to minimise the risk at site (i.e., vegetation, ground stability, housekeeping, etc.).

6.2.1.5 Signages

Structure owner shall display appropriate site safety signages, including emergency contact number.

6.2.2 Occupational safety

Occupational safety covers the following areas:

- a) resources;
- b) permit to work;
- c) training and competency;
- d) emergency response; and
- e) pre-job inspection.

6.2.2.1 Resources

Structure owners, service providers and vendors shall determine and provide adequate resources for establishment, implementation, maintenance, and continual improvement of the safety requirements.

6.2.2.2 Permit to work

Permit to work shall be obtained prior to commencement of any work on site from relevant service providers or/and structure owners. The permit requester shall provide all necessary supporting documents (i.e., OSH Risk Assessment, competency record, worker name list, etc.).

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6.2.2.3 Training and competency

Structure owners, service providers and vendors shall ensure appropriate training and competencies for workers to meet safety requirements with regards to any activities at radiocommunications structures (i.e., working at height, safety induction, chargeman, etc.) based on type of activity of work performed at site.

6.2.2.4 Emergency response

Structure owners, service providers and vendors shall establish an emergency preparedness and response in case of unexpected incidents related to telecommunications structures.

6.2.2.5 Pre-job inspection

Structure owners, service providers and vendors involved in any works on site shall comply with site maintenance recommendation as specified in Section 15 of OSHA1994 to avoid safety hazard.

6.3 Environment

Additionally, compliance for environment aspect shall refer to the requirements as specified Section 2 of Environmental Quality Act 1974 (Act 127), Section N.4 of JKR20800-132-23 and JKR 21500-0011-10.

This compliance area is essential in preventing unfortunate incidents towards the radiocommunication structures due to the environment factors as well as minimising environmental impact that might be caused by the structure itself in the absent of proper management of environment elements.

The environment aspect is categorised into 4 elements:

- a) water;
- b) soil;
- c) vegetation; and
- d) aesthetic.

6.3.1 Water

The structure owners shall ensure:

- a) a proper drainage system at site to avoid potential flash flooding, landslides, etc.;
- b) no blockage at site compound drainage system; and
- c) smooth water flow from compound drainage system to soak away pit or water disperse point.

6.3.2 Soil

The structure owners shall ensure:

- a) a proper schedule or preventive maintenance on soil condition checking;
- b) no major cracks inside structure compound such as land subsidence;

- c) no spring water or water ponding inside site compound;
- d) provide slope analysis study during site audit; and
- e) a proper management of the diesel or engine oil for generator to avoid scheduled waste.

6.3.3 Vegetation

The structure owners shall ensure:

- a) a good site turfing especially on slope area with appropriate material according to the site condition with proper laying process; and
- b) a proper grass cutting maintenance about 1 m outside perimeter compound and fencing.

6.3.4 Aesthetic

The structure owners shall ensure a proper housekeeping of the structure by minimizing visual intrusion or obstruction of views within a particular area to reduce the risk of theft and vandalism.

7. Compliance audit methods and processes

Compliance audit methods and processes outline the mode and arrangement on how this audit will be performed. The processes include the following and is illustrated in Figure 2:

- a) plan the inspection;
- b) identify type of inspection;
- c) report and findings;
- d) risk management; and
- e) recommendation and corrective action.

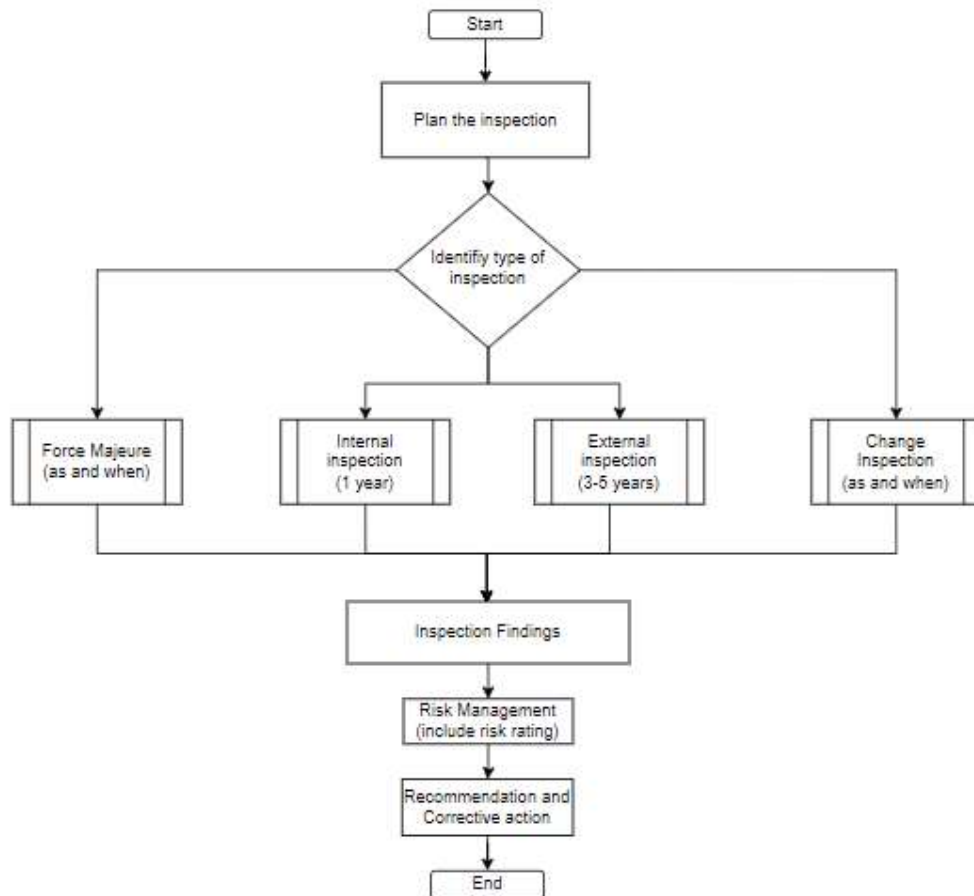


Figure 2. Compliance audit process flow

7.1 Plan the inspection

Structure owner shall plan the inspection based on the requirement as per stated in Table 1.

7.2 Identify type of inspections

There are 4 types of inspections to be identified which are:

a) Internal inspection

Routine inspection shall be performed by the structure owner only by way of self-inspection based on the checklist as specified in Annex B to ensure the radiocommunications structures are always in good condition.

A sample audit checklist of the internal inspection is in Annex C.

b) External inspection

Structure owners shall perform major or comprehensive inspection by appointing authorised consultant. Inspection report shall be endorsed by Professional Engineer (PE) upon the completion of the inspection. The checklist is available in Annex B.

The comprehensive inspection report include:

- i) visual inspection and engineering assessment, which include load conditions, tower analysis, RC stump and base plate;
- ii) detailed plans or technical drawings of the current tower structure;
- iii) tower assessment using engineering simulation software;
- iv) demarcation and land survey drawing; and
- v) soil investigation report.

A sample audit report of the external inspection is in Annex D.

c) Change inspection

Existing structures shall be evaluated regardless of the design of the original structure should there be any changes under the following change conditions:

- i) a change in load type, size, or number of the apparatus such as antenna, radios, transmission lines, mounting platforms and ladders;
- ii) a change of risk category of the structure;
- iii) a change in service availability requirements i.e., more stringent twisting or torsional load that affects the structure due to change involving microwave antenna; and
- iv) a change to the geometry or to the strength of structural components i.e., extension height of the structure, change in guyed configuration, change to structural member.

PE to provide detailed report specifically on loading analysis only.

d) Force majeure inspection

Force majeure inspection is used to inspect the potential risk due to force majeure effects including but not limited to:

- i) soil condition;
- ii) corrosion at structure;
- iii) structure twist;
- iv) base footing or foundation condition;
- v) earthquake effects where the structure owners should plot the radiocommunications structures in seismic mapping;
- vi) flood effects;

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- vii) tornado or tsunami effects;
- viii) landslide; and
- ix) sinkhole.

Table 1 summarises the compliance audit requirements.

Table 1. Compliance audit requirements

Type of inspection	Responsible party	Authorised party	Frequency	Method	Volume	Validity	Liability
Internal inspection	Structure owner	Structure owner	Annually	Visual inspection	All Structures	1 year	Structure owner
External inspection	Structure owner	PE/consultant	Max every 3 - 5 years	Comprehensive assessment and appraisal	<ul style="list-style-type: none"> • Structure aging • Exceptional circumstances 	3 - 5 years	PE/consultant
Change inspection	Structure owner	PE/consultant/s tructure owner	As and when	Comprehensive assessment and appraisal for additional load (antenna)	Particular structure	Until next inspection	PE/consultant/structure owner
Force majeure inspection	Structure owner	PE/consultant	As and when/ ad-hoc/post force majeure event	Comprehensive assessment and appraisal	Particular structure	Until next inspection	PE/consultant

7.3 Inspection findings

Findings shall be produced after the inspection.

7.4 Risk assessment

Risk assessment shall be performed after the completion of inspection findings and concluded with the following risk rating:

- a) low;
- b) moderate;
- c) high; and
- d) extreme.

7.5 Recommendation and corrective action

Internal Inspection shall be concluded with the general recommendation and corrective action in a single checklist template as per sample specify in Annex C, based on the findings captured and risk assessment done to the findings while other type of inspection shall apply the same but in a single comprehensive report as per sample specify in annex D.

Annex A
(normative)

Normative references

Act 133, Street, Drainage and Building Act 1974, Section 85A, Pemeriksaan Berkala Bangunan

OSHA, Occupational Safety and Health Act 1994

EQA, Environmental Quality Act 1974

MCMC MTSFB TC G040, Radiocommunications Network Facilities - External Infrastructure Specifications

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

ANSI/TIA-222-H Structural Standard for Antenna Supporting Structures and Antennas and Small Wind Turbine Support Structures

Generic HIRARC for Telecommunication Industry

JKR20800-132-23, Standard Specification for Building Work

JKR 21500-0011-10, Guidelines for Slope Design

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Annex B (normative/informative)

Audit checklist and report

B.1 Audit checklist

B.1.1 Technical specifications-physical/structural/electrical

The checklist covers inspection items for radiocommunications structure as defined in MCMC MTSFB G040. Some of the inspection items may not be applicable to certain type of structure.

- a) Structure condition
 - i) Damaged members (legs and bracing).
 - ii) Loose members.
 - iii) Missing members.
 - iv) Loose and/or missing bolts and/or nut locking devices.
 - v) Visible cracks in welded connections including cracks underneath canister mounts for flag poles and other similar connections.
 - vi) Pole flange and base plate cracks visible in base metal or at ends of plate stiffeners (cracks in base metal may only be visible on the inside surface of a pole).
 - vii) Record temperature.
- b) Finishing (paint, galvanised, ICAO/CAAM colour markings)
 - i) Paint and/or galvanising condition.
 - ii) Rust and/or corrosion condition including mounts and accessories.
 - iii) CAAM or ICAO colour marking conditions.
 - iv) Water collection in members (to be remedied. e.g. unplug drain holes. etc.).
- c) Lighting
 - i) Conduit, junction boxes, and fasteners (weather tight and secure).
 - ii) Drain and vent openings (unobstructed).
 - iii) Wiring condition.
 - iv) Light lenses.
 - v) Bulb condition.
 - vi) Controllers:
 - 1. Flasher.

- 2. Photo control.
- 3. Alarms.
- vii) Obstructions to lighting system
- d) Foundations
 - i) Ground condition
 - 1. Settlement, movement or earth cracks.
 - 2. Erosion.
 - 3. Site condition (standing water, drainage, trees, etc.).
 - ii) Anchorage condition
 - 1. Top and bottom base plate nuts tight.
 - 2. Nut locking device.
 - 3. Grout condition.
 - 4. Anchorages.
 - 5. Anchor rods.
 - iii) Concrete condition
 - 1. Cracking, spalling or splitting.
 - 2. Chipped or broken concrete.
 - 3. Honeycombing.
 - 4. Low spots to collect moisture.
- e) Appurtenances such as mounts, antennas, and lines
 - i) Antenna and mount condition
 - 1. Proper tie-back of microwave dishes.
 - 2. Damage to supporting structure at connections.
 - 3. Defects, deformations, loose or missing members, etc.
 - 4. Loose or missing hardware.
 - 5. Condition of antenna covers.
 - ii) Feed line condition
 - 1. Flanges, seals, dents, jacket damage, grounding, etc.

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2. Properly secured/supported on the structure and mount.
 3. Hanger condition (snap-ins, bolt on, kellum grips, etc.).
 4. Secured to structure (waveguide ladder).
- f) Other appurtenances (walkways, platforms, climbing facilities, sensors, floodlights, etc.)
- i) Condition.
 - ii) Obstructions to climbing path or safety climb systems.
 - iii) Defects, deformations, loose or missing members, etc.
 - iv) Loose or missing hardware.
 - v) Secured to structure.
- g) Insulators (base insulator, Amplitude Modulation (AM) detuning kits, fiberglass rods, porcelain insulator, non-metallic guys, etc.)
- i) Cracking and chipping.
 - ii) Cleanliness of insulators.
 - iii) Spark gaps.
 - iv) Isolation transformer.
 - v) Bolts and connections.
 - vi) Delamination, Ultra-Violet (UV) degradation, rod slippage.
- h) Access to the telecommunication structure compound (site).
- i) General site condition/requirement.
 - ii) Logbook.
 - iii) Proper process and availability of personnel in charge of the site access.

B.1.1.1 Additional inspection items for Guyed Mast only

- a) Strand condition (corrosion, breaks, nicks, kinks, etc.)
- b) Guy hardware conditions
 - i) Footing based (concrete counterweight).
 - ii) Turnbuckles or equivalent.
 1. Thread extended past body.
 2. Secured with safety cable or equivalent.
 3. Cracks, defects, damage, etc.

iii) Cable thimbles.

1. Ice clips.
2. Cable connectors (end fittings).
 - i. Cable clamps applied properly and bolts tight.
 - ii. Wire serving.
 - iii. Slippage or damaged strands.
 - iv. Dead-end grips - fully wrapped. end sleeve or ice clips (on anchor end).
 - v. Poured sockets - signs of separation, twisting. etc.
 - vi. Shackles, bolts, pins and cotter pins.
 - vii. Inspect tension rods or anchor rods welded to fan plates for fatigue cracks.

c) Guy tensions

- i) Measure guy tensions.
- ii) Record temperature, wind speed and wind direction.

Note: Minor variations in guy tensions are to be expected due to temperature, wind speed conditions, anchor elevation differences, etc.

d) Guyed mast anchors

- i) Settlement, movement, or earth cracks.
- ii) Grade sloped away from anchors.
- iii) Anchor shaft condition below grade.
- iv) Corrosion control measures (galvanising, coating, concrete encasement, cathodic protection systems, etc.).
- v) Anchor heads above grade, clear of vegetation, obstructions, etc. and turnbuckles free to articulate.

B.1.1.2 Additional inspection items for rooftop only

Rebound hammer test.

B.1.2 Safety

B.1.2.1 Operational safety

- a) Climbing facilities.
- b) Electrical safety.
- c) Aviation regulation requirements.

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- d) Working platform.
- e) Surrounding.
- f) Signage.

B.1.2.2 Occupational safety

- a) Resources.
- b) Permit to work.
- c) Training and competency.
- d) Emergency preparedness and response.
- e) Pre-job inspection.

B.1.3 Environment

- a) Water.
- b) Soil.
- c) Vegetation.
- d) Aesthetic.

B.2 Additional report

- a) Visual inspection and engineering assessment report include load conditions. Tower analysis, Residual Cartilaginous (RC) stump and base plate.
- b) Existing tower and strengthening drawings.
- c) Tower assessment using engineering simulation software.
- d) Demarcation and land survey drawing.
- e) Soil investigation report.

Note: Recommended retention period for the report is up to 10 years.

Annex C

Sample audit checklist of internal inspection

Organisation/Telco Logo	RADIOCOMMUNICATIONS STRUCTURE AUDIT CHECKLIST
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STATE		DATE	
STRUCTURE NAME/ID		TOWER HEIGHT (meter)	
STRUCTURE TYPE		LAT/LONG	

NO	DESCRIPTION	REQUIREMENT	TICK [√]			REMARKS
			YES	NO	N/A	
1	Member					
	a. Members (legs and bracing)	Any bent				
	b. Spice plates	In tag and secure				
	c. Base plate	Free of rust at welding joints				
	d. Members	Any loose				
	e. Members	Any missing				
	f. Climbing facilities and platform	Secured				
	g. Climbing cage	In tag and secure				
	h. Bolts	Any loose				
	i. Bolts	Any missing				
	j. Galvanising condition	Good condition				
2	Finishing					
	a. Paint and/or galvanising condition	Good condition				
	b. Existence of rust/corrosion	Rust-free or corrosion-free				
	c. CAAM or ICAO colour bands	Good condition				
	d. Existence of water collection in member	To be remedied e.g. unplug drain hole				

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NO	DESCRIPTION	REQUIREMENT	TICK [√]			REMARKS
			YES	NO	N/A	
3	Aviation light					
	a. Bulb	Good condition and functional				
	b. Wiring (armoured cable)	In tag and secure				
	c. Fasteners	Tight and secure				
	d. Photo cells	Functional				
	e. Control panel	Functional				
4	Earthing system					
	a. Copper tape	Corrosion-free				
	b. Fasteners	Tight and secure				
	c. Connections	Tight and secure				
	d. Existence of corrosion	To be remedied				
	e. Air rod and multi point	Secure				
	f. Lightning arrestor	In tag				
	5 Base condition					
	a. Nuts and lock nuts	Tight				
	b. Grout	Good condition				
	6 Concrete condition					
	a. Existence of cracking, stalling or splitting	To be remedied				
	b. Existence of chipping or broken concrete	To be remedied				
	c. Existence of honeycombing	To be remedied				
	d. Existence of low spots to collect moisture	To be remedied				
	e. Anchor bolt	Corrosion-free				
	f. Concrete pedestals/tie beams	Carbonation-free				

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NO	DESCRIPTION	REQUIREMENT	TICK \checkmark			REMARKS
			YES	NO	N/A	
7	Ground condition					
	a. Existence of settlement or movement	To be remedied				
	b. Existence of erosion	To be remedied				
	c. Site condition (drainage, tree etc)	To record				
	d. Existence of water ponding	To be remedied				

INSPECTED BY:		VERIFIED BY:	
Name :		Name :	
Designation :		Designation :	
Date :		Date :	

Risk Rating:

Level of Risk	Please Tick \checkmark	Remark
Low		
Moderate		
High		
Extreme high		

Recommendation: _____

EVALUATED BY:		VERIFIED BY:	
Name :		Name :	
Designation :		Designation :	
Date :		Date :	

NOTE:

1. The list of activities to be done shall follow the inspection items listed above.
2. Acknowledgement sections for inspection and risk assessment shall be separated as specified above.

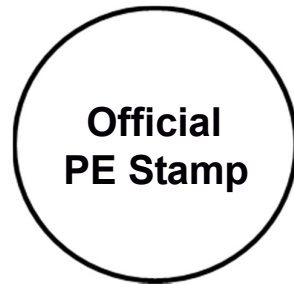
Annex D

Sample audit report of external inspection

PROPOSED EXERCISE OF TOWER/MAST STRUCTURAL INTEGRITY ANALYSIS FOR (TELCO NAME)

(Site Name: _____)

ANALYSIS OF (structure height in meter) (Structure/Tower Type)



TOWER OWNER:	CONSULTANT ENGINEER:

1.0 EXECUTIVE SUMMARY

Subject:
 Site Name:
 Tower Type:

To insert the summary of the report.

2.0 INTRODUCTION

To include the following:

- Requestor name.
- PE/Company name who carried out the analysis.
- Describe on the intent of the analysis.
- Standards reference on the requirements.

3.0 SITE INFORMATION

3.1 Tower Information

Site Name	
Region	
Site Address	
Height and Type	
Latitude and Longitude	

3.2 Existing Antenna Information

Existing Antennas					
No.	Elevation (m) From ground	Leg/Face	Qty	Antenna Description	Antenna Size (m)
1		B		i.e.Microwave Drum	
2		A		i.e. Panel Antenna	
3		C			
4		C			
5		B			
6		A			

4.0 INSPECTION RESULTS

To describe on the performance of the structure based on the inspection result. This include recommendation on type of maintenance required or recommendation for parts replacement if any.

5.0 LOAD CONDITIONS

To include the appropriate standards and specifications (if necessary).

5.1 Climatic conditions and Design Standards

Design Standard	BS8100:Part 4:1995	Description
Design/Analysis Wind Speed	As specified in MCMC MTSFB G040	As specified in MCMC MTSFB G040
Partial Safety factor for wind load	As specified in MCMC MTSFB G040	As specified in MCMC MTSFB G040

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Design Standard	BS8100:Part 4:1995	Description
Partial safety factor for material	As specified in MCMC MTSFB G040	As specified in MCMC MTSFB G040
Partial safety factor DL increasing wind load affect	As specified in MCMC MTSFB G040	As specified in MCMC MTSFB G040
Partial safety factor DL reducing wind load affect	As specified in MCMC MTSFB G040	As specified in MCMC MTSFB G040
Terrain category	As specified in MCMC MTSFB G040	As specified in MCMC MTSFB G040
Terrain Roughness, Kr	As specified in MCMC MTSFB G040	As specified in MCMC MTSFB G040

- To indicate pre-requisites (i.e. worst case condition) prior to performing analysis.
- To indicate the software computer program used in the analysis if any.

6.0 ANALYSIS AND RESULTS

6.1 EXISTING STRUCTURE ANALYSIS

To describe on the analysis result and recommendation to strengthen the mast if any

6.2 STRENGTHENING STRUCTURE ANALYSIS

To obtain stress levels and performance characteristics under maximum design loading conditions assuming the structure is in good, undamaged, non-corroded condition. To table out the stress ratios for strengthening of the structure:

6.2.1 Structural Member Stress Levels (Existing + New Loadings)

Panel no.	% STRESS RATIO			
	Legs	Diagonals	Horizontals	Redundants
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

*Highlighted members are overstressed to more than acceptable value of 100%.

6.2.2 Deflection Results

To describe on the structure deflection results

7.0 RC STUMP & BASE PLATE

To describe on the condition of the foundation connection and base plate

8.0 RECOMMENDATIONS

To provide recommendations based on analysis and results.

9.0 CONCLUSION

To conclude overall findings and recommendations to the structure owner.

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- [1] JKPP DP/G 127/379/4-1, *Guidelines for Public Safety and Health at Construction Sites*, 2007
- [2] ISO 3100, *Risk Management*
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- [6] Classifying key risk factors in construction projects, *Buletinul Institutului Politehnic din Iasi. Sectia Constructii, Arhitectura*, 58(2), 27, Rezakhani, P. (2012)

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