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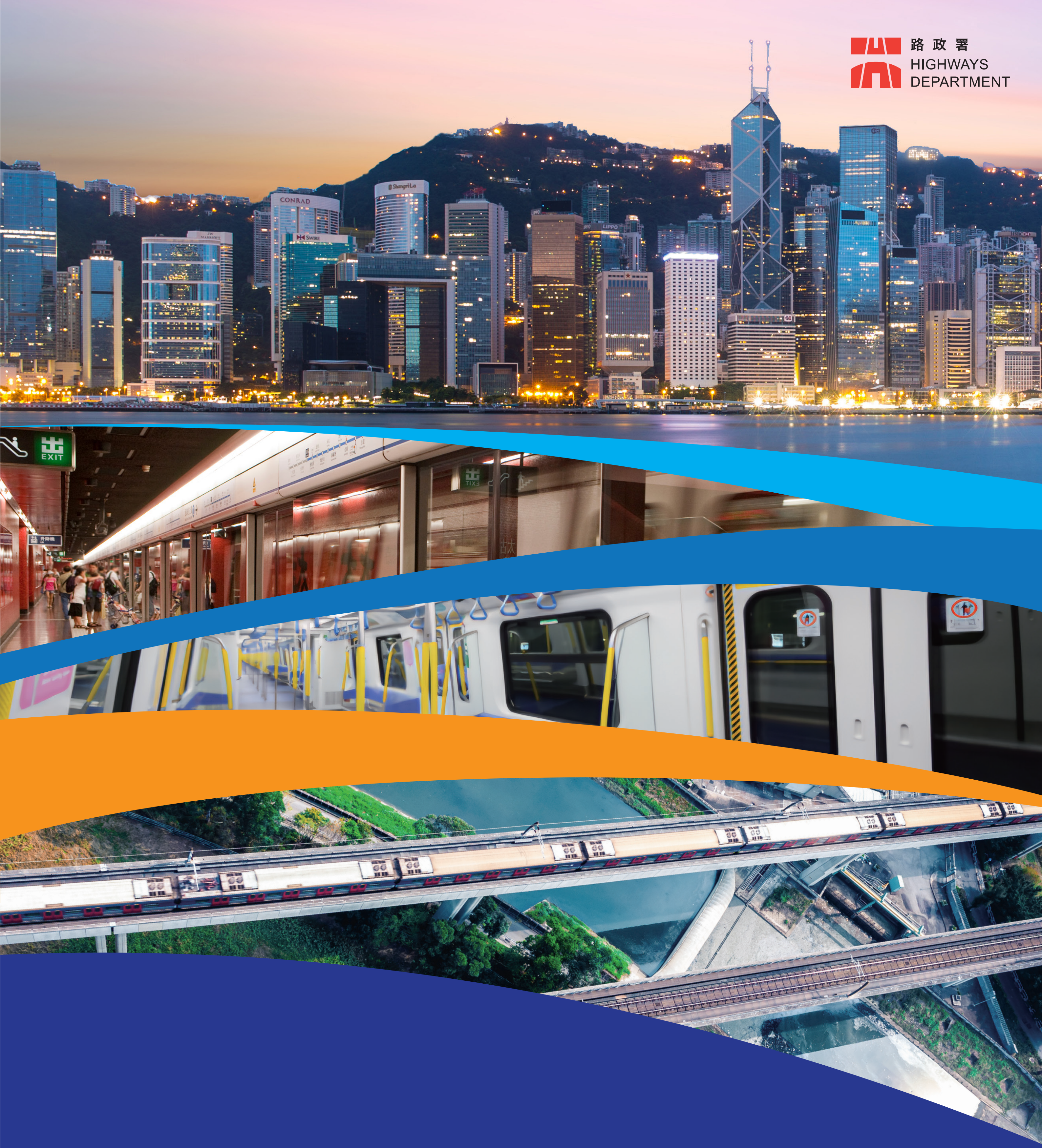

HONG KONG
RAILWAY STANDARDS

香港鐵路標準

English Version

路政署
HIGHWAYS
DEPARTMENT

Hong Kong Railway Standards

Hong Kong Railway Standards
2026 Edition

Revision	Date	Amendment Incorporated
-	-	-

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Departments

Buildings Department
Civil Engineering and Development Department
Drainage Services Department
Digital Policy Office
Electrical and Mechanical Services Department
Fire Services Department
Hong Kong Police Force
Planning Department
Transport Department
Water Supplies Department

Organisations

MTR Corporation Limited
Building Technology Research Institute
The Association of Hong Kong Railway Transport Professional

FOREWORD

Objective

The Hong Kong Railway Standards aims to provide a unified and well-defined set of technical references and guidance for the railway design, construction, as well as operations and maintenance (O&M) in Hong Kong, thereby fostering the safety, reliability and sustainability of railway projects. Through the formulation of the Hong Kong Railway Standards, the Government of the Hong Kong Special Administrative Region (the Government) not only strives to enhance the efficiency and quality in the construction of cross-boundary and local railways, but also envisages the Hong Kong Railway Standards to become a benchmark within the Greater Bay Area and to emerge as one of the new international standards, thereby further consolidating Hong Kong's position in the regional and global arenas of railway construction.

Background

Since the opening of the first 35-kilometre (km) Kowloon-Canton Railway in 1910, Hong Kong's railway network has undergone continuous expansion, encompassing a total route length exceeding 270 km as of 2025.

The railway construction in Hong Kong covers various fields, including civil and structural engineering works, electrical and mechanical (E&M) engineering works, railway systems, O&M, etc., with regulatory oversight currently distributed across different Government departments. Instead of a single consolidated document, the prevailing railway standards in Hong Kong are an integrated system comprising the Hong Kong laws and regulations, the engineering standards, technical guidelines and requirements of the Government departments, together with the corporate design and technical specifications developed by the MTR Corporation Limited. Predominantly founded upon British and European standards with adjustments made to suit local circumstances, this system has been in use for decades and undergone continuous updates alongside the implementation of various railway projects.

The Highways Department is always committed to staying abreast of times, optimising the implementation of railway projects, and striving to construct railways in an efficient and robust manner. Capitalising on the opportunities brought by the two cross-boundary railway projects, namely the Northern Link and the Hong Kong-Shenzhen Western Rail Link, the Highways Department formulated the Hong Kong Railway Standards in collaboration with relevant government departments and railway experts. In addition to retaining the prevailing railway standards in Hong Kong, the Hong Kong Railway

Standards have introduced suitable railway standards of the Nation and various places in the world with adaptation to local circumstances, as a result of detailed analyses and comparisons on the premise of ensuing railway safety, quality, and performance-based outcomes.

The Hong Kong Railway Standards could facilitate the use of a broader selection of advanced construction technologies, construction materials, equipment, and railway systems for new railway projects, provide clear technical specifications as the approval basis of the supervisory authorities, and also facilitate the development and optimisation of work processes by the industry. This move helps to leverage and introduce the extensive experience and world leading technologies in railway construction of our Nation, as well as the recognised standards in other parts of the world, with a view to driving the new railway projects of Hong Kong with enhanced speed and efficiency and striving for shorter construction time and lower costs.

Nature

The Hong Kong Railway Standards are a technical and guidance document. In practical applications, should circumstances arise that are not exhaustively covered by the Hong Kong Railway Standards, users may consult the Highways Department or other relevant authorities according to their project needs and nature of works. The Highways Department will review and update the Hong Kong Railway Standards from time to time to ensure its alignment with the latest industry standards and technological advancements.

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1 GENERAL

1.1 Structure

This document consists of six Chapters with the following structure:

Chapter 1 – General

This Chapter sets out the structure, principles and scope of application of the Hong Kong Railway Standards, and lists out the terminology and reference standards.

Chapter 2 – Civil and Structure

This Chapter covers the core elements of civil engineering and structural design, including design actions and load classifications, technical requirements for construction materials, the construction and safety control of geotechnical engineering works, design principles for elevated and underground structures, as well as professional design guidelines on seismic resistance, durability, waterproofing, etc. Relevant specifications of ground investigation are also covered.

Chapter 3 – Building Planning

This Chapter covers architectural planning and station design, including design standards, spatial and environmental requirements, and extends to station disposition, public service and commercial facilities, ancillary facilities, barrier-free design and fire safety requirements.

Chapter 4 – Electrical & Mechanical, Building Services, and Railway Systems

This Chapter covers the fundamental components of E&M engineering works, building services, and associated railway systems (such as trackwork, rolling stock, environmental control, power supply, communication and signalling systems) of railway infrastructure. It also covers the configuration of functions and equipment of depots and the requirements for environmental protection and energy-saving design.

Chapter 5 – Construction

This Chapter covers construction management, materials testing, quality acceptance and engineering supervision.

Chapter 6 – Operations and Maintenance

This Chapter covers the requirements for operational organisation design, operational safety assessment, and the management of O&M.

1.2 Terminology

(1) Railway

Railway refers to the collective term for public transport systems operating on fixed tracks and are electrically powered, high speed, high capacity, and high efficiency in providing passenger services to the public. Under this document, it specifically refers to those railways classified as metro rail, urban rapid rail transit, urban (suburban) rail and inter-city rail in accordance with the classification of the national railway standards.

(2) Maximum operating speed

The highest speed attained by a train under normal operating conditions.

(3) National railway standards

National railway standards refers to the relevant standards currently referenced in the implementation of railway projects in the Chinese Mainland.

(4) Prevailing railway standards in Hong Kong

The prevailing railway standards in Hong Kong are an integrated system comprising the current Hong Kong laws and regulations, engineering standards, technical guidelines and requirements of the Government departments, together with the corporate design and technical specifications developed by the MTR Corporation Limited. Details are provided in the Appendix.

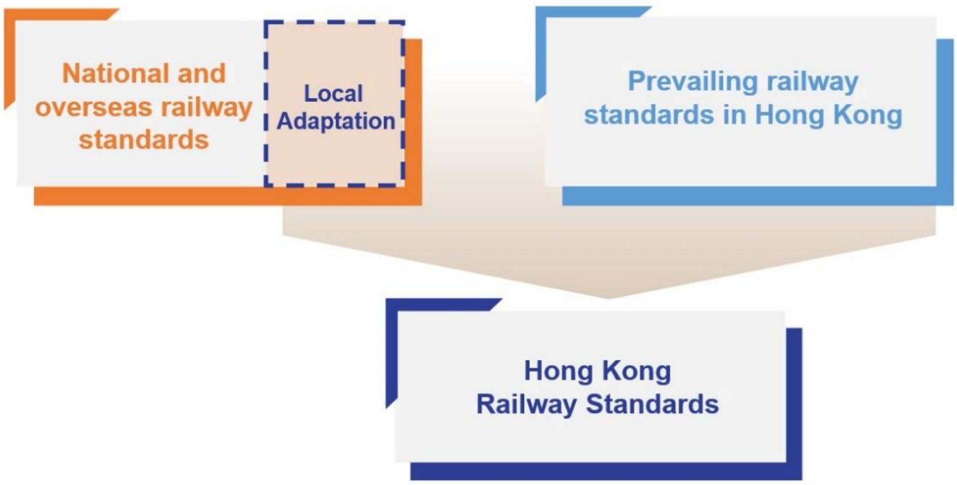
(5) Standards of MTR Corporation Limited

Standards of MTR Corporation Limited refers to the corporate design and technical specifications developed by the MTR Corporation Limited.

1.3 Principles of Application

This document provides technical guidance for the design, construction and O&M of railway infrastructure in Hong Kong. In addition to retaining the prevailing railway standards in Hong Kong, the Hong Kong Railway Standards have introduced the national railway standards as well as suitable standards in other places with adaptation to local circumstances, as a result of detailed analyses and comparisons on the premise of ensuring railway safety, quality, and performance-based outcomes.

As stated above, the Hong Kong Railway Standards retained the prevailing railway standards in Hong Kong, and, on this basis, introduced the national railway standards and other standards with adaptations. The prevailing railway standards, relevant laws and regulations, technical guidelines, and requirements in Hong Kong, are listed in the Appendix of this document and will not be elaborated in detail. The provisions for the application of the national railway standards and other standards with adjustments made are set out in detail in Chapters 2 to 6 of this document with respect to the disciplines.



This document adheres to the following principles:

(1) Compliance with the statutory requirements under local legislation, such as the Buildings Ordinance (Cap. 123), the Fire Services Ordinance (Cap. 95), the Electricity Ordinance (Cap. 406), the Environmental Impact Assessment Ordinance (Cap. 499), the Lifts and Escalators Ordinance (Cap. 618), the Noise Control Ordinance (Cap. 400), the Air Pollution Control Ordinance (Cap. 311) and their relevant subsidiary legislation;

(2) Adaptation to the local environmental conditions/circumstances, such as typhoon effects and geological condition; and

(3) Enhancement of the level of passenger experience in local railway travel, such as the quality of indoor environment (including illumination and noise levels and air temperature).

Under the Hong Kong Railway Standards, the industry could flexibly apply suitable standards to different railway projects on account of their individual needs and characteristics, after holistic consideration of factors such as cost-effectiveness, technical requirements, supply chain conditions, site environment and labour and machinery resources. The Standards encourages the use of innovative construction machinery, technologies and materials, as well as advanced equipment and construction specifications. To achieve safe, reliable and efficient engineering outcomes in the application of the Hong Kong Railway Standards, compliance with statutory and all current regulatory requirements in Hong Kong shall be ensured, with technical comparisons and suitable adjustments made.

This document is a living document which will be reviewed and updated from time to time for alignment with the latest industry best-practices and technological developments.

1.4 Scope of Application

The Hong Kong Railway Standards are generally applicable to new local and cross-boundary railways meeting the following criteria: (i) maximum operating speeds not exceeding 160km/h; and (ii) railway systems corresponding to those classified under the national railway standards as metro rail, urban rapid rail transit, urban (suburban) rail and inter-city rail. Subject to the agreement of relevant Government departments, users of the Hong Kong Railway Standards may also consider adopting the parts of the Hong Kong Railway Standards (such as civil and structural engineering works) for new local and cross-boundary railways not meeting criteria (i) and (ii) depending on the nature and circumstances of the individual railway project.

Any enquiries regarding the scope of application of the Hong Kong Railway Standards may be addressed to the Highways Department or other relevant authorities.

1.5 Reference Standards

The reference standards listed in this Section, that are broadly applicable to the subsequent Chapters, are those general in nature and serve as the fundamental basis for the technical requirements. Discipline-specific standards for individual Chapters will be listed and explained within the respective Chapters. Direct reference should be made to the provisions therein.

(1) Project Code for Engineering of Urban Rail Transit (GB 55033-2022)

(2) Code for Design of Metro (GB 50157-2013)

(3) Code for Design of Suburban Railway (TB 10624-2020)

(4) Design Standard of Urban Rapid Rail Transit (CJJ/T 314-2022)

(5) Standard for the Construction of Urban Rail Transit Engineering Projects Construction Standards (104-2008)

(6) Code for Design of Intercity Railway (TB 10623-2014)

1.6 Basic Provisions

(1) The basic provisions set out in this Section apply to new local and cross-boundary railways, which adopt the national railway standards and other standards with adjustment made in accordance with the principles of application in Section 1.3. Should a railway project elect not to follow the adjusted national railway standards and other standards with adjustments, the relevant requirements of the prevailing railway standards in Hong Kong should be followed.

(2) Railway tracks should adopt the standard gauge of 1435mm. The main lines should be double-track railway lines adopting left-hand running.

(3) Based on the line alignment method and the environmental protection requirements along the railway line, noise and vibration mitigation measures should be implemented at locations that are sensitive to noise and vibration.

(4) Railway works should possess defensive capabilities against various disasters. Engineering design for disaster prevention should be carried out with priority on defence, while taking the integration of defence, resistance, and rescue as the principle.

(5) This document is a technical engineering specification covering various professional disciplines. Its contents should not be interpreted unilaterally or in isolation to avoid misinterpretation.

(6) In the event of any discrepancy between the Chinese and English versions of this document, the Chinese version should prevail.

2 Civil and Structure

2.1 Ground Investigation

2.1.1 Reference Standards

Ground investigation shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislations

(1) Buildings Ordinance (Cap. 123)

(2) Building (Administration) Regulations (Cap. 123 sub. leg. A)

(3) Building (Planning) Regulations (Cap. 123 sub. leg. F)

(4) Building (Construction) Regulation (Cap. 123 sub. leg. Q)

Relevant Technical Standards

(5) Code of Practice for Foundations 2017 published by Buildings Department

(6) Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers published by Buildings Department

(7) Guide to Retaining Wall Design (Geoguide 1 (2nd Edition)) published by Civil Engineering and Development Department

(8) Guide to Site Investigation (Geoguide 2) published by Civil Engineering and Development Department

(9) Guide to Rock and Soil Descriptions (Geoguide 3) published by Civil Engineering and Development Department

(10) Guide to Cavern Engineering (Geoguide 4) published by Civil Engineering and Development Department

(11) Model Specification for Soil Testing (Geospec 3) published by Civil Engineering and Development Department

(12) Port Works Design Manual: Part 4 published by Civil Engineering and Development Department

(13) GEO Report No. 29 published by Civil Engineering and Development Department

(14) GCO Publication No. 2/90 published by Civil Engineering and Development Department

(15) GEO Publication No. 1/2023 published by Civil Engineering and Development Department

(16) GEO Technical Guidance Note No. 1 published by Civil Engineering and Development Department

(17) GEO Technical Guidance Note No. 12 published by Civil Engineering and Development Department

(18) GEO Technical Guidance Note No. 26 published by Civil Engineering and Development Department

(19) GEO Technical Guidance Note No. 50 published by Civil Engineering and Development Department

(20) GEO Technical Guidance Note No. 53 published by Civil Engineering and Development Department

(21) GEO Technical Guidance Note No. 54 published by Civil Engineering and Development Department

(22) General Code for Engineering Investigation (GB 55017-2021)

(23) Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012)

(24) Code for Investigation of Geotechnical Engineering (GB 50021-2001)

(25) Standard for Hydrogeological Investigation of Water-supply (GB/T 50027-2024)

(26) Code for Seismic Design of Buildings (GB/T 50011-2024)

(27) Standard for Geotechnical Testing Method (GB/T 50123-2019)

(28) Standard for Test Methods of Engineering Rock Mass (GB/T 50266-2013)

(29) Technical Code for Groundwater Control in Building and Municipal Engineering (JGJ 111-2016)

(30) Technical Specification for Engineering Geological Prospecting and Sampling of Constructions (JGJ/T 87-2012)

(31) Specification for Hydro Geologic Drilling and Well Construction of Water-supply (CJJ/T 13-2013)

(32) Test Methods of Soils for Highway Engineering (JTG 3430-2020)

(33) Code for Geophysical Prospecting of Railway Engineering (TB 10013-2013)

(34) Code for Water analysis of Railway Engineering (TB 10104-2003)

(35) Code for In-situ Testing of Railway Engineering Geology (TB 10018-2018)

(36) Code for Geological Drilling of Railway Engineering (TB 10014-2012)

(37) Code for Geotechnical Investigations of Urban Rail Transit in Guangdong Province (DBJ/T 15-241-2022)

2.1.2 General Requirements

(1) Standards for rock and soil classification and description shall be implemented in accordance with provisions of Clause 2.1.3 of this document.

(2) The determination of characteristic value of foundation bearing capacity shall be implemented in accordance with provisions of Clause 2.4.5 of this document.

(3) Ground investigation works within the Scheduled areas under Schedule 5 of the Buildings Ordinance (Cap. 123) and the designated areas specified in GEO Technical Guidance Note No. 12 published by Civil Engineering and Development Department shall comply with the requirements of the prevailing railway standards in Hong Kong.

2.1.3 Rock and Soil Classification and Description

(1) Rock classification, rock nomenclature, rock strength, rock mass integrity, rock mass basic quality grade, rock weathering grade, rock quality designation (RQD), as well as the genesis and classification nomenclature of Quaternary strata should comply with the provisions of the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012).

(2) The description of rock material, description of rock mass, determination of the basic quality grade of rock mass, and description of Quaternary strata should comply with the provisions of the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012).

(3) The classification of compactness and consistency of coarse-grained soils (gravel, sand, silt), the moisture classification of silt, and the consistency of cohesive soils should comply with the provisions of the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012).

(4) Surrounding rock should be classified into Grades I, II, III, IV, V and VI in accordance with Appendix E of the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012) based on the engineering geological conditions, the stability after excavation, and the elastic longitudinal wave velocity of the tunnel surrounding rock.

2.1.4 Underground Works

(1) The spacing and quantity of ground investigation stations should be determined based on a comprehensive consideration of site complexity, category of underground works, embedment depth and cross-sectional dimensions of the underground works. Requirements for the layout of ground investigation stations, depth of boreholes, sampling and in-situ testing, laboratory testing, and physico-mechanical parameters should comply with the provisions of the General Code for Engineering Investigation (GB 55017-2021) and the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012).

2.1.5 Elevated Works

(1) Ground investigation stations for elevated station structures should be arranged along the structural layout and column gridlines, whereas ground investigation stations for bridges should be provided at each pier. Requirements for the layout of ground investigation stations, depth of boreholes, sampling and in-situ testing, laboratory testing, and physico-mechanical parameters should comply with the provisions of the General Code for Engineering Investigation (GB55017-2021) and the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012).

2.1.6 Road Base, Bridge and Culvert Works

(1) The location and number of ground investigation stations for road base, bridges and culverts should be determined according to the characteristics of the foundation and slopes, together with the proposed engineering works. Requirements for the layout of ground investigation stations, depth of boreholes, sampling and in-situ testing, laboratory testing, and physico-mechanical parameters should comply with the provisions of the General Code for Engineering Investigation

(GB55017-2021) and Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012).

2.1.7 At-grade Stations and Depot

(1) Ground investigation for depot may be carried out separately according to different building types such as yard tracks, entry/exit lines, various buildings and ancillary facilities. The ground investigation for at-grade stations and depots should comply with the provisions of the General Code for Engineering Investigation (GB55017-2021) and the Code for Investigation of Geotechnical Engineering (GB 50021-2001).

2.1.8 Groundwater

(1) Where groundwater affects underground works, a certain quantity of hydrogeological test boreholes and long-term observation boreholes should be established in accordance with the actual engineering conditions and should comply with the provisions of the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012).

(2) Methodology and monitoring schedule of groundwater monitoring and pore-water pressure measurement should comply with the provisions of the Guide to Site Investigation (Geoguide 2) published by Civil Engineering and Development Department.

(3) Groundwater effects should be evaluated based on stratigraphy, lithology, permeability and project nature, and hydrogeological parameters and their determination methodology should be clearly defined. Testing methodology should comply with the provisions of the Standard for Hydrogeological Investigation of Water-supply (GB/T 50027-2024) and Technical Code for Groundwater Control in Building and Municipal Engineering (JGJ 111-2016).

(4) Calculation of hydrogeological parameters should adopt relevant formulae compatible with the site specific hydrogeological conditions

and should comply with the provisions of the Standard for Hydrogeological Investigation of Water-supply (GB/T 50027-2024) and Technical Code for Groundwater Control in Building and Municipal Engineering (JGJ 111-2016). Empirical parameters such as permeability coefficient and specific yield may be referenced from the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012).

(5) Determination of groundwater flow and velocity should comply with the provisions of the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012).

(6) The mechanical effects of groundwater on railway works and its evaluation method should comply with the provisions of the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012).

(7) Sampling requirements, testing items, testing methodologies, corrosivity grades and evaluation for water and soil corrosivity should comply with the provisions of the Code for Investigation of Geotechnical Engineering (GB50021-2001).

2.1.9 Adverse Geological Effects

(1) Foundation on liquefiable soil and soft soil should comply with the provisions of the Code for Seismic Design of Buildings (GB/T 50011-2024). Determination of seismic parameters should refer to Section 2.7 of this document.

2.1.10 Special Soils and Rock

(1) In accordance with the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012), common special soils and rocks in Hong Kong railway projects mainly include fill, soft clay, highly weathered rock, completely weathered rock and residual soil.

(2) The scope and requirements of ground investigation, determination of engineering indices, and geotechnical engineering analysis and

evaluation of fill should comply with the provisions of the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012).

(3) The scope and requirements of ground investigation, laboratory testing, and geotechnical engineering analysis and evaluation for soft soil should comply with the provisions of the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012).

(4) The scope and requirements of ground investigation, laboratory testing, and geotechnical analysis and evaluation of highly weathered rock, completely weathered rock and residual soil should comply with the provisions of the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012).

2.1.11 Engineering Geological Survey and Mapping

(1) Engineering geological survey and mapping contributes to the increase in geological data and guides the layout plan of subsequent ground investigation. Specialised engineering geological survey and mapping should be carried out for geological issues with significant impact on the works including faults, cavernous marbles, landslides, etc. The scope, mapping scale, accuracy, intervals and positioning of observation points, details and data for the engineering geological survey and mapping should comply with the provisions of the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012) and Code for Investigation of Geotechnical Engineering (GB50021-2001).

(2) Personnel involved in engineering geological survey and mapping should comply with the provisions of Sections 15.1 and 15.2 of Guide to Site Investigation (Geoguide 2) published by Civil Engineering and Development Department.

2.1.12 Investigation and Sampling

(1) Investigation and sampling requirements should comply with the provisions of the General Code for Engineering Investigation (GB55017-2021), Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012), the Code for Investigation of Geotechnical Engineering (GB50021-2001) and the Code for Geological Drilling of Railway Engineering (TB 10014-2012).

2.1.13 In-situ Testing

(1) In-situ tests, including the standard penetration test, static cone penetration test, vane shear test, flat dilatometer test, pressuremeter test, plate load test, and dynamic cone penetration test, should comply with the provisions of the Standard for Geotechnical Testing Method (GB/T 50123-2019).

(2) The geophysical survey methods adopted in the geotechnical investigation for railway works should comply with the provisions of the Code for Geophysical Prospecting of Railway Engineering (TB 10013-2013).

2.1.14 Laboratory Testing of Rock and Soil

(1) Triaxial test is generally the most commonly used test method to determine soil shear strength parameters, while direct shear test should only be adopted for specific site conditions and needs.

(2) Soil testing for physical parameters should comply with the provisions of the Standard for Geotechnical Testing Method (GB/T 50123-2019).

(3) Soil tests for thermophysical properties should comply with the provisions of the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012) and the Code for Geotechnical Investigation of Urban Rail Transit in Guangdong Province (DBJ/T 15-241-2022).

(4) Loss-on-ignition tests should comply with the provisions of the Test Methods of Soils for Highway Engineering (JTG 3430-2020).

(5) Rock tests should comply with the provisions of the Standard for Test Methods of Engineering Rock Mass (GB/T 50266-2013).

(6) Water and soil corrosivity tests should comply with the provisions of the Standard for Geotechnical Testing Method (GB/T 50123-2019) and the Code for Water Analysis of Railway Engineering (TB 10104-2003).

2.1.15 Results Analysis and Ground Investigation Report

(1) Ground investigation reports should include text, tables, and drawings. In addition to compliance of the texts and drawings with the provisions of the Code for Geotechnical Investigation of Urban Rail Transit (GB 50307-2012) and Code for Investigation of Geotechnical Engineering (GB50021-2001), the geological information, recommendations on construction methods, recommendations on monitoring instruments and layout of monitoring points, impact of historical site conditions on design and construction, references, site geological maps, and site history maps should comply with the provisions of the Guide to Site Investigation (Geoguide 2) published by Civil Engineering and Development Department.

(2) Ground investigation report should include original records of drilling, in-situ testing, geophysical survey, soil testing, rock testing, and rock/mineral identification. These records should comply with the provisions of the Guide to Site Investigation (Geoguide 2) published by Civil Engineering and Development Department.

2.2 Design Actions

2.2.1 Reference Standards

Design actions shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislations

(1) Building (Construction) Regulation (Cap. 123 sub. leg. Q)

Relevant Technical Standards

(2) Code of Practice for Structural Use of Concrete 2013 published by Buildings Department

(3) Code of Practice for Dead and Imposed Loads 2011 published by Buildings Department

(4) Code of Practice on Wind Effects in Hong Kong 2019 published by Buildings Department

(5) Code of Practice for Foundations 2017 published by Buildings Department

(6) Code of Practice for Precast Concrete Construction 2016 published by Buildings Department

(7) Code of Practice for Structural Use of Glass 2018 published by Buildings Department

(8) Code of Practice for the Structural Use of Steel 2011 published by Buildings Department

(9) Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers published by Buildings Department

(10) Structures Design Manual for Highways and Railways (2013 Edition) published by Highways Department

(11) General Code for Engineering Structures (GB 55001-2021)

(12) Load Code for the Design of Building Structures (GB 50009-2012)

(13) Unified Standard for Reliability Design of Engineering Structures (GB 50153-2008)

(14) Unified Standard for Reliability Design of Building Structures (GB 50068-2018)

(15) General Code for Seismic Precaution of Buildings and Municipal Engineering (GB 55002-2021)

(16) Code for Design of Metro (GB 50157-2013)

(17) Code for Design of Suburban Railway (TB 10624-2020)

(18) Code for Seismic Design of Urban Rail Transit structures (GB 50909-2014)

(19) Standard for Elevated Structure Design Loading for Urban Rail Transit (CJJ/T 301-2020)

(20) Technical Standard for Building Engineering Against Uplift (JGJ 476-2019)

(21) Code for Fire Resistance Design of Concrete Structures in Buildings (DBJ/T15-81-2022)

(22) Load Code for Harbour Engineering (JTS 144-1-2010)

2.2.2 General Requirements

(1) Design actions under this Section follow the principles of the national railway standards, with optimisation and adjustment in conjunction with prevailing railway standards in Hong Kong to meet local circumstances, ensuring safety, applicability and economic rationality.

(2) Design actions in this Section are applicable to underground structures and elevated station structures. Design actions for bridges should comply with the provisions for bridges in Section 2.5 of this document.

(3) Partial factors for design actions under this Section should comply with the provisions of the General Code for Engineering Structures (GB 55001-2021). For actions not specified in this document that may occur during construction and operation stages, the actions should be

determined based on the design service life, design reference period and return period.

(4) Structures should be designed using different structural safety categories based on the severity of potential consequences of failure. The classification of structural safety categories should comply with the provisions of the General Code for Engineering Structures (GB 55001-2021).

(5) Where the structural safety category or design service life of a structural component differs from that of the overall structure, it should be clearly indicated in the design documents.

2.2.3 Classification of Actions and Representative Values of Loads

(1) Actions on underground structures should comply with the provisions of the General Code for Engineering Structures (GB 55001-2021) and the Code for Design of Metro (GB 50157-2013).

(2) Actions on elevated station structures should comply with the provisions of the Code for Design of Suburban Railway (TB 10624-2020) and the Standard for Elevated Structure Design Loading for Urban Rail Transit (CJJ/T 301-2020).

(3) Representative values of various actions for structural design should comply with the provisions of Clause 2.4.1 of the General Code for Engineering Structures (GB 55001-2021).

(4) Design reference period adopted for determining the representative values of variable actions should comply with the provisions of Clause 2.4.3 of General Code for Engineering Structures (GB 55001-2021).

2.2.4 Action Combinations

(1) For the load-carrying capacity under the ultimate limit state (ULS), the design values of load combination should adopt either the fundamental

combination or the accidental combination which should comply with the provisions of Clause 3.2.2 of the Code for the Design of Building Structures (GB 50009-2012).

(2) Structural actions should comply with the provisions of the General Code for Engineering Structures (GB 55001-2021) based on the structural design requirements.

2.2.5 Permanent Actions

(1) Surcharge loads from buildings with shallow foundations should comply with provisions of the Code of Practice for Dead and Imposed Loads 2011 published by Buildings Department with a value of not less than 10 kPa per storey.

(2) To cater for the possibility of future developments to be constructed above or near underground railway structures, an additional horizontal pressure of 20kPa should be applied on the outer face of boundary walls of underground structures in the absence of planning conditions or existing data.

(3) Loads in equipment areas should adopt the values as specified in the Code for Design of Metro (GB 50157-2013). Loads from large equipment would be determined based on the actual loads with consideration of the influence zone of transportation route.

2.2.6 Variable Actions

(1) For underground structures beneath existing or proposed highways with a cover of less than 2m, live loads should be calculated based on the actual axle loads and vehicle arrangements including dynamic effects in accordance with the provisions of the Structures Design Manual for Highways and Railways (2013 Edition) published by Highways Department. Where the cover is not less than 2m, the equivalent uniformly distributed traffic live load are as follows：

(a) Type HA Loading: 12kPa; and

(b) 45 units HB Loading: 24kPa.

(2) Uniformly distributed crowd load on areas including station platforms, floors, stairs should be taken as 6.0 kPa. The effects due to loading of fire engines/equipment should also be considered.

(3) For areas with presence of crowds, horizontal crowd loads on walls, parapets or barriers should be considered and taken as follows：

(a) Horizontal load at the top edge of parapets or barriers: 3.0kN/m;

(b) Horizontal load on wall surfaces: 1.5kN/m^2; and

(c) Concentrated load on any part of the parapets or barriers: 1.5kN.

(4) Wind loads on elevated station and at-grade station structures should be calculated in accordance with the Code of Practice on Wind Effects in Hong Kong 2019 published by Buildings Department, with wind tunnel testing to be conducted if necessary.

(5) The design for components or equipment near trackside and air duct should consider the effects of pressures arising from tunnel piston effect and mechanical ventilation, with the design pressure values taken as follows: a nominal load of not less than ±1.5 kPa or the characteristic air pressure for the designated usage of the area, whichever is greater; or where partition walls are built between tunnels, the design of partition walls should consider both the worst scenario of maximum positive pressure on one side and maximum negative pressure from the other side.

(6) For areas near coastal areas, riverside, steep hillside, etc. with rapid and uneven fluctuations in groundwater levels, the unbalanced pressure arising from the potential difference in groundwater level between opposite sides of the completed structure should be determined based on the differences in groundwater level identified in hydrogeological monitoring data and seepage analysis.

(7) Surcharge on footpaths isolated from roads, cycle tracks and play areas should be taken as 5kPa in accordance with the Code of Practice for Dead and Imposed Loads 2011 published by Buildings Department.

2.2.7 Accidental Actions

(1) Where immersed tube tunnels or bridges/culverts are situated in navigation channels, the effects of accidental actions such as vessel anchoring, dragging anchors, vessel sinking and impact should be considered with values determined as follows：

(a) Loads arising from anchor impact should be determined based on the type, tonnage, speed and anchor configuration of the vessels in the corresponding navigation channel. Vertically and horizontally concentrated loads of not less than a nominal value of 700kN should be applied within 1m at the tunnel roof slab or side wall. The effects of an anchor being dragged along the tunnel should also be considered.

(b) Impact arising from vessel sinking may be assessed based on the fully loaded vessel acting as uniformly distributed load on the tunnel roof slab, with a minimum uniformly distributed load not less than 50kPa. The impact should be applied over the full width of the tunnel or the zone within 10m beside each side of the tunnel, as well as the zone within 30m longitudinally along the tunnel.

(c) Impact arising from vessel collision should be assessed by the equivalent static method in accordance with the displacement, speed and collision scenarios of representative vessel types. The impact forces arising from vessel collision should be determined in accordance with Clause 8.3.1 of the Load Code for Harbour Engineering (JTS 144-1-2010).

(2) Where pier may be subject to accidental traffic impact, the design requirements for bridges as specified in Clause 2.5.3 of this document should be complied with.

(3) Design of underground structures should take into account the load from transient groundwater rise such as “groundwater flow” and “groundwater level rise or sea-level rise under extreme weather events”. The high groundwater level should be assessed based on monitoring or hydrogeological assessment, with a return period not less than 200 years. Sufficient head should be allowed in the design of underground structures situated in areas of shallow cover, low-lying, coastal or reclaimed regions. The corresponding groundwater load should not be superimposed with other variable actions.

(4) Within the specified fire resistance rating, the load carrying capacity of members or structures should be designed with the load combination not less than that required under the fire load combination under accidental condition. For concrete members with concrete grade exceeding 60MPa, actions under the fire limit states must be verified with calculations carried out in accordance with the relevant requirements of the Code for Fire Resistance Design of Concrete Structures in Buildings (DBJ/T 15-81-2022).

2.3 Engineering Materials

2.3.1 Reference Standards

Engineering materials shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislations

(1) Building (Construction) Regulation (Cap. 123 sub. leg. Q)

Relevant Technical Standards

(2) Code for Design of Concrete Structures (GB/T 50010-2010)

(3) Standard for Design of Steel Structures (GB 50017-2017)

(4) Code for Fire Safety of Steel Structures in Buildings (GB 51249-2017)

(5) Common Portland Cement (GB 175-2023)

(6) Code for Fire Resistance Design of Concrete Structures in Buildings (DBJ/T 15-81-2022)

2.3.2 General Requirements

(1) There is no significant overall difference in the core design properties of engineering materials under the national railway standards and the prevailing railway standards in Hong Kong, and both could achieve engineering safety requirements. The national railway standards for materials are applicable in Hong Kong.

(2) The functional properties of the engineering materials adopted for the assessment under the fire limit states should comply with the provisions for material properties under high-temperature environments as specified in the Code for Fire Safety of Steel Structures in Buildings (GB 51249-2017) and the Code for Fire Resistance Design of Concrete Structures in Buildings (DBJ/T 15-81-2022).

(3) Subject to the overriding requirement of design and construction requirements being met, new engineering materials may be considered for adoption based on project needs to enhance the overall performance of the structure. The adoption of such materials should be based on project characteristics and requirements of the relevant standards, subject to approval by relevant authorities.

2.3.3 Concrete

(1) Concrete should be adopted in accordance with the Code for Design of Concrete Structures (GB/T 50010-2010).

(2) Cement materials should comply with the provisions of the Common Portland Cement (GB 175-2023).

(3) Subject to the overriding requirement of design and construction requirements being met, new materials, such as reactive powder concrete and ultra-high-performance concrete, may be considered for adoption to enhance the load-bearing capacity and overall performance of the structure. The adoption of such materials should be based on project characteristics and relevant standards (such as Ultra-High Performance Concrete (GB/T 31387-2025)), subject to approval by relevant authorities.

2.3.4 Steel Reinforcement

(1) Steel reinforcement for concrete structures should be adopted in accordance with the Code for Design of Concrete Structures (GB/T 50010-2010).

(2) Subject to the overriding requirement of design and construction requirements being met, new materials, such as high-strength reinforcement, may be considered for adoption to enhance the load-bearing capacity and overall performance of the structure. The adoption of such materials should be based on the project characteristics and relevant standards (such as Steel for Reinforced Concrete – Part 2: Hot Rolled Ribbed Bars (GB/T 1499.2-2024)), subject to approval by relevant authorities.

2.3.5 Structural Steel

(1) Structural steel should be adopted in accordance with the Standard for Design of Steel Structures (GB 50017-2017).

(2) (2)Subject to the overriding requirement of design and construction requirements being met, new materials, such as high-strength steel, may be considered for adoption to enhance the load-bearing capacity and overall performance of the structure. The adoption of such materials should be based on the project characteristics and relevant standards (such as Low Alloy High Strength Structural Steel (GB/T 1591-2018)

and Quenched and Tempered Steel Plates for High Strength Structures (GB/T 16270-2009)), subject to approval by relevant authorities.

2.4 Geotechnical Engineering

2.4.1 Reference Standards

Geotechnical engineering shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislations

(1) Buildings Ordinance (Cap. 123)

(2) Building (Administration) Regulations (Cap. 123 sub. leg. A)

(3) Building (Planning) Regulations (Cap. 123 sub. leg. F)

(4) Building (Construction) Regulation (Cap. 123 sub. leg. Q)

(5) Dangerous Goods Ordinance (Cap. 295)

Relevant Technical Standards

(6) Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers published by Buildings Department

(7) Project Administration Handbook for Civil Engineering Works published by Civil Engineering and Development Department

(8) Cavern Master Plan published by Civil Engineering and Development Department and Planning Department

(9) Geotechnical Manual for Slopes published by Civil Engineering and Development Department

(10) Guide to Retaining Wall Design (Geoguide 1 (1st Edition)) published by Civil Engineering and Development Department

(11) Guide to Retaining Wall Design (Geoguide 1 (2nd Edition)) published by Civil Engineering and Development Department

(12) Guide to Site Investigation (Geoguide 2) published by Civil Engineering and Development Department

(13) Guide to Rock and Soil Descriptions (Geoguide 3) published by Civil Engineering and Development Department

(14) Guide to Cavern Engineering (Geoguide 4) published by Civil Engineering and Development Department

(15) Guide to Slope Maintenance (Geoguide 5) published by Civil Engineering and Development Department

(16) Guide to Reinforced Fill Structure and Slope Design (Geoguide 6) published by Civil Engineering and Development Department

(17) Guide to Soil Nail Design and Construction (Geoguide 7) published by Civil Engineering and Development Department

(18) Model Specification for Prestressed Ground Anchors (Geospec 1) published by Civil Engineering and Development Department

(19) GEO Technical Guidance Note No. 1 published by Civil Engineering and Development Department

(20) GEO Technical Guidance Note No. 12 published by Civil Engineering and Development Department

(21) GEO Technical Guidance Note No. 15 published by Civil Engineering and Development Department

(22) GEO Technical Guidance Note No. 26 published by Civil Engineering and Development Department

(23) GEO Report No. 29 published by Civil Engineering and Development Department

(24) GEO Report No.138 published by Civil Engineering and Development Department

(25) GEO Publication No. 1/2006 published by Civil Engineering and Development Department

(26) GEO Publication No. 1/2009 published by Civil Engineering and Development Department

(27) GEO Publication No. 1/2023 published by Civil Engineering and Development Department

(28) Mines Division Guidance Note No. 10 published by Civil Engineering and Development Department

(29) Code of Practice for Foundations 2017 published by Buildings Department

(30) Environment, Transport and Works Bureau Technical Circular (Works) No. 4/2004

(31) General Code for Foundation Engineering of Building and Municipal Projects (GB 55003-2021)

(32) Unified Standard for Reliability Design of Building Structures (GB 50068-2018)

(33) Code for Design of Metro (GB 50157-2013)

(34) Technical Code for Building Slope Engineering (GB 50330-2013)

(35) Code for Design of Building Foundation (GB 50007-2011)

(36) Technical Code for Appraisal and Reinforcement of Building Slope (GB 50843-2013)

(37) Technical Code for Composite Soil Nailing Wall in Retaining and Protection of Excavation (GB 50739-2011)

(38) Technical Code for Engineering of Ground Anchorages and Shotcrete Support (GB 50086-2015)

(39) Technical Specification for Retaining and Protection of Building Foundation Excavations (JGJ 120-2012)

(40) Code for Design on Retaining Structures of Railway Subgrade (TB 10025-2006)

(41) Technical Code for Applications of Geosynthetics of Railway Earthworks (T/CRS C0601-2021)

(42) Technical Code for Ground Treatment of Buildings (JGJ 79-2012)

(43) Code for Building Pile Foundations (JGJ 94-2008)

(44) Technical Code for Testing of Building Foundation Piles (JGJ 106-2014)

(45) Technical Code for Groundwater Control in Building and Municipal Engineering (JGJ 111-2016)

(46) Code for Risk Management of Underground Works in Urban Rail Transit (GB 50652-2011)

2.4.2 General Requirements

(1) Geotechnical design should be conducted in accordance with the principles of application set out in Section 1.3 of this document. When applying national railway standards in Hong Kong, adjustments should be made based on local characteristics, including local engineering and hydrogeological conditions, environmental characteristics, as well as local engineering experience and practice. The prevailing railway standards in Hong Kong should be followed in circumstances where matters are not specified in the national railway standards. Furthermore, when applying national railway standards, geotechnical parameters and classifications obtained from investigations and tests conducted in accordance with national railway standards should be used. Conversely, when the prevailing railway standards in Hong Kong are applied, geotechnical parameters and classifications obtained from investigations and tests conducted in accordance with the prevailing railway standards in Hong Kong should be used.

(2) The geotechnical design parameters required for geotechnical engineering design should generally be obtained through site

investigation and laboratory testing. Meanwhile, local adjustments and adequate adaptations should be made with reference to the typical range of design parameters for common Hong Kong soils, rocks and construction materials, such as the typical values adopted in design of retaining walls given in Tables 8 to 15 of the Guide to Retaining Wall Design (Geoguide 1 (2nd Edition)) published by Civil Engineering and Development Department.

(3) Geotechnical parameters for geotechnical engineering design should be selected according to the properties of the strata and the requirements of the adopted calculation method. Their values and testing requirements should, in addition to satisfying the relevant requirements of Section 2.1 of this document, be compatible with the requirements of the relevant design code.

(4) Where blasting operations are involved in the execution of geotechnical works, they should comply with the relevant provisions of the Guide to Cavern Engineering (Geoguide 4) and the Mines Division Guidance Note No. 10 published by Civil Engineering and Development Department. The statutory requirements in Hong Kong, such as those of the Dangerous Goods Ordinance (Cap. 295) shall also be complied with.

(5) The planning, design and construction within the Scheduled areas under Schedule 5 of the Buildings Ordinance (Cap. 123) and the designated areas specified in GEO Technical Guidance Note No. 12 published by Civil Engineering and Development Department shall comply with the provisions of the prevailing railway standards in Hong Kong.

(6) For the design of underground structures, the classification of structural safety categories should comply with the provisions of Clause 2.2.1 of the General Code for Design of Engineering Structures (GB 55001-2021).

2.4.3 Excavation Works

(1) Design and construction of the excavation and lateral support (ELS) should comply with the provisions of the Technical Specification for Retaining and Protection of Building Foundation Excavations (JGJ 120-2012). Taking into account the engineering geological and hydrogeological conditions in Hong Kong, effects of surrounding environment on the safety level of the excavation, type of ELS, limit state design method, stability calculations, monitoring, alert-alarm-action mechanisms, local adaptations should be made in accordance with the GEO Publication No. 1/2023 published by Civil Engineering and Development Department and the Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers APP-24, APP-57, APP-115 and APP-137 published by Buildings Department.

(2) ELS systems should be designed according to the categories assigned for the consequence of failure. The safety level of the ELS system should be determined based on the following Table 2.4.3, combined with Table 3.1.3 of Technical Specification for Retaining and Protection of Building Foundation Excavations (JGJ 120-2012) in conjunction with the consequence-to-life in Table 5.2 and economic consequence in Table 5.3 in the Geotechnical Manual for Slopes published by Civil Engineering and Development Department, GEO Technical Guidance Note No. 15 published by Civil Engineering and Development Department and Appendix 4.25 of Project Administration Handbook for Civil Engineering Works published by Civil Engineering and Development Department.

Table 2.4.3 Safety Levels of ELS System

Safety Level	**Consequence of Failure**	**Remarks**
Level 1	Failure of ELS or excessive ground movement has a very serious impact on the surrounding environment of the ELS or the construction safety of	A "Very serious impact" means consequence-to-life (including workers) is Category 1 (high) or economic consequence is

Safety Level	Consequence of Failure	Remarks
	the main structure	Category A (high)
Level 2	Failure of ELS or excessive ground movement has a serious impact on the surrounding environment of the ELS or the construction safety of the main structure	"Serious impact" means consequence-to-life is Category 2 (low) or economic consequence is Category B (low)
Level 3	Failure of ELS or excessive ground movement has a minor impact on the surrounding environment of the ELS or the construction safety of the main structure	"Minor impact" means consequence-to-life is Category 3 (negligible) or economic consequence is Category C (negligible)

(3) Types of ELS system may be selected in accordance with Section 3.3 of the Technical Specification for Retaining and Protection of Building Foundation Excavations (JGJ 120-2012) as well as Sections 3.2 and 3.3 of the GEO Publication No. 1/2023 published by Civil Engineering and Development Department.

(4) ELS design should consider earth pressure, water pressure, and surcharges. Earth pressure, water pressure and surcharge should comply with the relevant requirements of Section 4.2 of the GEO Publication No. 1/2023 published by Civil Engineering and Development Department, Section 6.4 of the Guide to Retaining Wall Design (Geoguide 1 (2nd Edition)) published by Civil Engineering and Development Department and the Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers APP-57 published by Buildings Department.

(5) Structural capacity of the members of the ELS system under the ULS should comply with the provisions of Clause 3.1.5 in the Technical Specification for Retaining and Protection of Building Foundation Excavations (JGJ 120-2012).

(6) Stability checks for ELS system may adopt either the global safety factor method or the partial safety factor method. Where the global safety factor method is adopted, the overall stability, checking against base heave, and checking against hydraulic failure may be calculated in accordance with Section 4.2 of the Technical Specification for Retaining and Protection of Building Foundation Excavations (JGJ 120-2012), while the stability analysis methods and factors of safety should fulfil the requirements of the Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers APP-57 published by Buildings Department and Section 7.3 of the GEO Publication No. 1/2023 published by Civil Engineering and Development Department. The checking against overturning or toe instability should comply with the requirements of Section 7.3 of the GEO Publication No. 1/2023 published by Civil Engineering and Development Department. Where the partial safety factor method is adopted, the requirements of Clause 6.4.2 of the GEO Publication No. 1/2023 published by Civil Engineering and Development Department should be met. The stability analysis methods should be selected in accordance with the relevant requirements in Chapter 7 of the GEO Publication No. 1/2023 published by Civil Engineering and Development Department.

(7) Serviceability limit state (SLS) design for ELS system should consider deformations under different working conditions in accordance with the requirements in Chapter 8 of the GEO Publication No. 1/2023 published by Civil Engineering and Development Department. The monitoring should be strengthened during construction, with the monitoring items, monitoring control values, alert-alarm-action mechanisms satisfying the relevant requirements stipulated in the Chapters 9 and 10 of the GEO Publication No. 1/2023 published by Civil Engineering and Development Department and the GEO Technical Guidance Note No. 54 published by Civil Engineering and Development Department.

(8) Groundwater control should follow the requirements in Clause 2.4.6 of this document.

2.4.4 Slope Works

(1) Design and construction of slope works should comply with the requirements in the Technical Code for Building Slope Engineering (GB 50330-2013). Local adaptations should be made, taking into account the geological characteristics of Hong Kong, with respect to safety level, slope stability evaluation and analysis, limit state design methods, and other aspects.

(2) Slope works should be designed according to classification based on slope type, slope height, and potential consequence of failure. The safety level should be determined based on the following Table 2.4.4-1, combined with Table 3.2.1 of the Technical Code for Building Slope Engineering (GB 50330-2013), with determination of the consequence-to-life and economic consequence based on GEO Technical Guidance Note No. 15 published by Civil Engineering and Development Department, and Tables 5.2 and 5.3 of the Geotechnical Manual for Slopes published by Civil Engineering and Development Department and Appendix 4.25 of Project Administration Handbook for Civil Engineering Works published by Civil Engineering and Development Department.

Table 2.4.4-1 Safety Levels of Slope Works

<table>
<tr><th colspan="2">Slope Type</th><th>Slope Height</th><th>Consequence of Failure</th><th>Safety Level</th></tr>
<tr><td rowspan="10">Rock slope</td><td rowspan="5">Rock mass type is Type I or Type II</td><td rowspan="2">30m<H≤50m</td><td>very serious</td><td>Level 1</td></tr>
<tr><td>serious</td><td>Level 2</td></tr>
<tr><td rowspan="3">H≤30m</td><td>very serious</td><td>Level 1</td></tr>
<tr><td>serious</td><td>Level 2</td></tr>
<tr><td>minor</td><td>Level 3</td></tr>
<tr><td rowspan="5">Rock mass type is Type III or Type IV</td><td>30m<H≤50m</td><td>very serious</td><td>Level 1</td></tr>
<tr><td rowspan="2">15m<H≤30m</td><td>very serious</td><td>Level 1</td></tr>
<tr><td>serious</td><td>Level 2</td></tr>
<tr><td rowspan="2">H≤15m</td><td>very serious</td><td>Level 1</td></tr>
<tr><td>serious</td><td>Level 2</td></tr>
</table>

Slope Type	Slope Height	Consequence of Failure	Safety Level
		minor	Level 3
Soil slope	10m<H≤25m	very serious	Level 1
		serious	Level 2
	H≤10m	very serious	Level 1
		serious	Level 2
		minor	Level 3

Note:

1. Consequences of slope failure should be assessed based on the importance of surrounding structures and buildings, and the impact on the sensitivity of surrounding utilities.
2. For the categorisation of very serious, serious and minor impacts on surrounding structures and buildings, reference should be made to the relevant provisions on Categories 1, 2 and 3 of consequence-to-life and Categories A, B and C of economic consequence in the GEO Technical Guidance Note No. 15 published by Civil Engineering and Development Department, Tables 5.2 and 5.3 of the Geotechnical Manual for Slopes published by Civil Engineering and Development Department and Appendix 4.25 of Project Administration Handbook for Civil Engineering Works published by Civil Engineering and Development Department.
3. Critical utilities are those whose failure would have very serious consequences, such as gas supply, water supply, important communications, or high-voltage power cables.
4. When the height of a rock slope (H) > 50m or the height of a soil slope (H) > 25m, specialist examination should be conducted.

(3) Stability assessment of new slopes should adopt the corresponding factors of safety based on different design conditions. These factors of safety should be determined based on the following Table 2.4.4-2, incorporating the requirements for rainfall return periods stipulated in the Geotechnical Manual for Slopes published by Civil Engineering and Development Department and Appendix 4.25 of the Project Administration Handbook for Civil Engineering Works published by

Civil Engineering and Development Department and simultaneously satisfying the provisions of Section 5.3 of the Technical Code for Building Slope Engineering (GB 50330-2013).

Table 2.4.4-2 Factors of Safety for New Slope Stability

Slope Type \ Safety Level		Level 1	Level 2	Level 3
Permanent Slopes	General Conditions	1.4	1.2	1.05
	Predicted Worst Groundwater Conditions	1.1	-	-
	Seismic Conditions	1.15	1.1	1.05
Temporary Slopes	General Conditions	1.25	1.2	1.05

Note：

1. For permanent slopes under general conditions, the calculation should consider the groundwater hydrogeological conditions resulting from a 10-year return period rainfall. For temporary slopes under general conditions, the calculation may consider the most unfavourable groundwater conditions likely to occur during the construction period.
2. For slopes with “very serious” consequence of failure, in addition to the 10-year rainfall return period, a factor of safety of 1.1 should also be adopted for checks under the extreme groundwater condition.

(4) The slope stability should be verified using the global safety factor method. The method of stability analysis may be selected based on the potential failure mode in the Technical Code for Building Slope Engineering (GB 50330-2013) and Clause 5.3.5 of the Geotechnical Manual for Slopes published by Civil Engineering and Development Department. For seismic conditions, verification should be carried out in accordance with Clause 5.2.6 of the Technical Code for Building Slope Engineering (GB 50330-2013).

(5) Slopes constructed using the slope ratio method should comply with the relevant requirements of the GEO Publication No. 1/2009 published by Civil Engineering and Development Department.

(6) The design of existing retaining walls and new retaining walls should follow Guide to Retaining Wall Design (Geoguide 1 (1st Edition)) published by Civil Engineering and Development Department and the Guide to Retaining Wall Design (Geoguide 1 (2nd Edition)) published by Civil Engineering and Development Department respectively in accordance with the prevailing railway standards in Hong Kong.

(7) Reinforced fill structures and slopes should be designed in accordance with the Guide to Reinforced Fill Structure and Slope Design (Geoguide 6) published by Civil Engineering and Development Department based on the prevailing railway standards in Hong Kong.

(8) Design calculations for the retaining structural members for slopes under ULS should satisfy the relevant requirements of the Technical Code for Building Slope Engineering (GB 50330-2013).

(9) Slope drainage and slope surface protection measures should be designed in accordance with the relevant requirements of the Geotechnical Manual for Slopes and the GEO Technical Guidance Notes published by Civil Engineering and Development Department.

(10) Slopes and retaining walls should be managed and maintained in accordance with the relevant requirements of the Guide to Slope Maintenance (Geoguide 5) published by Civil Engineering and Development Department.

(11) Stability assessment of existing slopes should adopt the corresponding factors of safety based on different design conditions, and should be implemented in accordance with the requirements of Table 5.3 in the Technical Code for Building Slope Engineering (GB 50330-2013), Table 5.4 in the Geotechnical Manual for Slopes published by Civil Engineering and Development Department and Appendix 4.25 of Project Administration Handbook for Civil Engineering Works

published by Civil Engineering and Development Department as specified in the Table 2.4.4-3 below.

Table 2.4.4-3 Factors of Safety for Existing Slopes

<table>
<tr><th colspan="2">Safety Level
Slope Type</th><th>Level 1</th><th>Level 2</th><th>Level 3</th></tr>
<tr><td rowspan="2">Existing Slope</td><td>General Conditions</td><td>1.2</td><td>1.1</td><td>1.05</td></tr>
<tr><td>Seismic Conditions</td><td>1.1</td><td>1.05</td><td>1.05</td></tr>
<tr><td colspan="5">Notes:
1. The safety level of slopes may be determined based solely on the consequence-to-life.
2. For general conditions, the following points should be noted:
a) General conditions should be calculated considering the groundwater conditions caused by rainfall with a 10-year return period;
b) These factors of safety are appropriate only where rigorous geological and geotechnical studies (including comprehensive studies on the records of slope maintenance, groundwater and rainfall and any slope monitoring data) have been carried out, where the slope has been standing in a stable condition for a considerable time, and where the loading conditions, the groundwater regime and the basic form of the modified slope remain substantially the same as those of the existing slope;
c) The factors of safety given in this Table are recommended minimum values. Higher factors of safety might be warranted in particular situations in respect of loss of life and economic loss;
d) Should the back-analysis approach be adopted for the design of remedial or preventive works, it may be assumed that the existing slope had a minimum factor of safety of 1.0 for the worst known loading and groundwater conditions; and
e) For a failed or distressed slope, the causes of the failure or distress must be specifically identified and taken into account in the design of the remedial works</td></tr>
</table>

(12) Slope assessment and reinforcement should comply with the relevant requirements of the Technical Code for Appraisal and Reinforcement of

Building Slope Engineering (GB 50843-2013) with adaptations and appropriate adjustments based on local circumstances. The design of slope reinforcement measures, such as soil nails, should adhere to the relevant requirements of the Guide to Soil Nail Design and Construction (Geoguide 7) published by Civil Engineering and Development Department. Alternatively, local stabilization measures which are mature, reliable and effective in Hong Kong may be employed for slope stabilzation.

2.4.5 Foundation

(1) The design and construction of foundations should comply with the relevant provisions of the Code for Design of Building Foundations (GB 50007-2011), with local adaptations for allowable foundation deformation having regard to the engineering geological and hydrogeological conditions in Hong Kong, as well as the conditions of the surrounding environment. In cavernous marble areas (including Scheduled areas Nos. 2 and 4 under Schedule 5 of the Buildings Ordinance (Cap. 123) and the designated areas specified in GEO Technical Guidance Note No. 12), the design and construction of shallow and pile foundations should comply with the prevailing railway standards in Hong Kong, including the Code of Practice for Foundations 2017 published by Buildings Department, GEO Publication No. 1/2006 published by Civil Engineering and Development Department, Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers APP-18 & APP-61 published by Buildings Department, GEO Technical Guidance Notes No. 1, 12, 26 and 53 published by Civil Engineering and Development Department, GEO Report No. 29 published by Civil Engineering and Development Department, Environment, Transport and Works Bureau Technical Circular (Works) No. 4/2004, etc.

(2) The design provisions for slopes, retaining walls and ELS works set out in the Code for Design of Building Foundations (GB 50007-2011) are

not applicable to this document. Relevant designs should comply with Clauses 2.4.3 and 2.4.4 of this document.

(3) Stability analysis of slopes affected by shallow and pile foundations should comply with Clause 2.4.4 of this document.

(4) When selecting a ground treatment scheme, the interaction between the superstructure, foundation and ground should be considered. The selection of applicable ground treatment scheme should be carried out following comparison on technical and economic aspects of the schemes, taking into account the engineering geological and hydrogeological conditions in Hong Kong and the surrounding environment.

(5) Shaft resistance of piles may be calculated using the parameters and formulae in Section 5.3 of the Technical Code for Building Pile Foundations (JGJ 94-2008) and should be verified and confirmed by test piles. Testing of pile foundations should make reference to the Chapter 5 of this document.

(6) When calculating the additional stress at the base of the foundation, the load combinations for the vertical forces transmitted from the superstructure to the top of the foundation should comply with the provisions of the Unified Standard for Reliability Design of Building Structures (GB 50068-2018).

(7) The characteristic values of ground bearing capacity may be comprehensively determined by plate load tests, other in-situ tests, empirical formulae and practical engineering experience. The calculation method should comply with the provisions of Chapter 5 of the Code for Design of Building Foundations (GB 50007-2011). The presumed allowable bearing values adopted should make reference to Tables 2.1 and 2.2 in Section 2.2 of the Code of Practice for Foundations 2017 published by Buildings Department.

(8) Where foundation deformation is calculated in accordance with the Code for Design of Building Foundation (GB 50007-2011), the stress

distribution within the subsoil may be determined based on the theory of homogeneous isotropic linear elasticity.

(9) The allowable deformations of subsoil and foundations should comply with the relevant requirements in Clause 2.3.2 of the Code of Practice for Foundations 2017 published by Buildings Department. In particular, the maximum total settlement of the building foundation should not exceed 30mm, and the differential settlement between columns or adjacent vertical elements should not exceed 1/500. Acceptability of estimated settlement and rotation of foundations should be analysed according to specific working conditions, as allowable values for foundation displacement vary significantly across different structural systems. Accordingly, for specific engineering cases, acceptable settlement and rotation values of foundations should be determined according to the integrity, stability and functional requirements of the supported structure. Where differential settlement is anticipated, it should be assessed accurately or conservatively, and its effect on the supported structure should be checked to ensure acceptability in terms of strength and serviceability.

(10) The design, construction, and quality inspection of ground treatment schemes should comply with the relevant provisions of the Technical Code for Ground Treatment of Buildings (JGJ 79-2012).

(11) The selection of pile types, arrangement of piling layout and the relevant construction workmanship should comply with Section 3.3 and Table A.0.1 in Appendix A of the Technical Code for Building Pile Foundations (JGJ94 - 2008).

(12) The design grade of foundations should be determined in accordance with Table 3.0.1 of the Code for Design of Building Foundation (GB 50007-2011). The design grade of pile foundations should be determined according to the building types as stipulated in Clause 3.1.2 of The Technical Code for Building Pile Foundations (JGJ94 - 2008).

(13) The calculation of the characteristic value of the vertical load-carrying capacity of each pile should comply with the provisions in Clause 5.2.2 of The Technical Code for Building Pile Foundations (JGJ94 - 2008).

(14) In the design of the pile foundations, the vertical ultimate load-bearing capacity of each pile should be calculated in accordance with the parameters and formulae as specified in Section 5.3 of The Technical Code for Building Pile Foundations (JGJ94 - 2008).

(15) The calculation of the horizontal load-carrying bearing capacity of pile foundations should comply with the relevant provisions of Section 5.7 of The Technical Code for Building Pile Foundations (JGJ94 - 2008).

(16) The settlement calculation for pile foundation should follow the calculation methods listed in Section 5.5 of The Technical Code for Building Pile Foundations (JGJ94 - 2008).

(17) The construction of pile foundations should comply with the relevant provisions of Sections 4.1 and 4.2 of The Technical Code for Building Pile Foundations (JGJ94 - 2008).

2.4.6 Groundwater Control

(1) Groundwater control should be implemented in accordance with the technical requirements specified in the Technical Code for Groundwater Control in Building and Municipal Engineering (JGJ 111-2016), with local adaptations to be made in accordance with Sections 4.2, 4.3, 9.2 and 10.2 of GEO Publication No. 1/2023 published by Civil Engineering and Development Department and Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers APP-22 published by Buildings Department, taking into account the engineering geological and hydrogeological conditions in Hong Kong, the surrounding environment and other site-specific conditions. Methods and interval time between readings of groundwater monitoring as well as pore-water pressure measurement

should comply with the Guide to Site Investigation (Geoguide 2) published by Civil Engineering and Development Department.

(2) The general design requirements, dewatering methods, design calculations, system layout, construction technical requirements, acceptance criteria, and O&M of dewatering may be implemented in accordance with the relevant technical requirements of the Technical Code for Groundwater Control in Building and Municipal Engineering (JGJ 111-2016).

(3) In accordance with the Technical Code for Groundwater Control in Building and Municipal Engineering (JGJ 111-2016), measures to prevent seawater intrusion and pollution of freshwater resources should be proposed for dewatering in coastal areas. The duration of dewatering operations should meet the requirements of underground structure construction. Where the control against uplift is required, the dewatering operation period should be extended, and wells should be sealed in a timely manner after dewatering is completed.

(4) Where the groundwater level outside the excavation drops, calculations on the ground settlement caused by the groundwater drawdown should be carried out. Numerical analysis methods may be used for prediction where necessary. The calculation of the final settlement induced by dewatering should be carried out in accordance with Clauses 5.3.9 and 5.3.10 of the Technical Code for Groundwater Control in Building and Municipal Engineering (JGJ 111-2016), and the relationship between settlement and time in soft soil areas such as marine clay and reclamation areas should be taken into account.

(5) Where dewatering poses hazards to adjacent buildings/structures, underground utilities or roads, or produces long-term adverse environmental effects, a water cut-off curtain method may be adopted to control groundwater. General design requirements, type selection, design calculations, construction technical requirements, acceptance criteria, O&M of the water cut-off curtain may follow the relevant technical requirements of Technical Code for Groundwater Control in Building and Municipal Engineering (JGJ 111-2016). Where

permeation grouting by the Tube-A-Manchette (TAM) method is involved, reference may also be made to Section 5.5 of the GEO Publication No. 1/2023 published by Civil Engineering and Development Department.

(6) Effectiveness and impact of groundwater control works should be monitored in accordance with the relevant technical requirements of Technical Code for Groundwater Control in Building and Municipal Engineering (JGJ 111-2016). Local adaptations for groundwater control projects should be made in accordance with Sections 4.2, 9.2 and 10.2 of the GEO Publication No. 1/2023 published by Civil Engineering and Development Department and GEO Technical Guidance Note No. 54 published by Civil Engineering and Development Department, taking into account the engineering geological and hydrogeological conditions in Hong Kong, the surrounding environment and other site-specific conditions.

(7) The monitoring control values and alert-alarm-action mechanisms for deformation under different working conditions mentioned in Clause 2.4.3(7) of this document are also applicable to groundwater control, taking into account the actual site conditions.

2.5 Elevated Structure

2.5.1 Reference Standards

The design of elevated structures shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislations

(1) Building (Construction) Regulation (Cap. 123 sub. leg. Q)

(2) Building (Planning) Regulations (Cap. 123 sub. leg. F)

Relevant Technical Standards

(3) Structures Design Manual for Highways and Railways (2013 Edition) published by Highways Department

(4) Code of Practice for Structural Use of Concrete 2013 published by Buildings Department

(5) Code of Practice for Precast Concrete Construction 2016 published by Buildings Department

(6) Code of Practice for the Structural Use of Steel 2011 published by Buildings Department

(7) Explanatory Materials to Code of Practice for the Structural Use of Steel 2011 published by Buildings Department

(8) Code of Practice on Wind Effects in Hong Kong 2019 published by Buildings Department

(9) Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers published by Buildings Department

(10) Guidelines on Design of Noise Barriers published by Environmental Protection Department

(11) Code for Design of Metro (GB 50157-2013)

(12) Code for Design of Suburban Railway (TB 10624-2020)

(13) General Code for Design of Engineering Structures (GB 55001-2021)

(14) General Code for Seismic Precaution of Buildings and Municipal Engineering (GB 55002-2021)

(15) General Code for Steel Structures (GB 55006-2021)

(16) General Code for Concrete Structures (GB 55008-2021)

(17) Load Code for the Design of Building Structures (GB 50009-2012)

(18) Standard for Design of Steel Structures (GB 50017-2017)

(19) Code for Fire Safety of Steel Structures in Buildings (GB 51249-2017)

(20) Code for Seismic Design of Urban Rail Transit Structures (GB 50909-2014)

(21) Code for Design of Concrete Structures (GB/T 50010-2010)

(22) Code for Seismic Design of Buildings (GB/T 50011-2010)

(23) Standard for Design of Concrete Structure Durability (GB/T 50476-2019)

(24) Code for Seismic Design of Railway Engineering (GB 50111-2006)

(25) Standard for Elevated Structure Design Loading for Urban Rail Transit (CJJ/T 301-2020)

(26) Code for Design of Railway Bridge and Culvert (TB 10002-2017)

(27) Code for Design of Concrete Structures of Railway Bridges and Culverts (TB 10092-2017)

(28) Code for Design on Steel Structure of Railway Bridge (TB 10091-2017)

(29) Code for Design on Subsoil and Foundation of Railway Bridge and Culvert (TB 10093-2017)

(30) Pot Bearing for Urban Rail Transit Bridges (CJ/T 464-2014)

(31) Spherical Steel Bearing for Urban Rail Transit Bridges (CJ/T 482-2015)

(32) Technical Specifications of Urban Pedestrian Overcrossing and Underpass (CJJ 69-95)

(33) Code for Durability Design on Concrete Structure of Railway (TB 10005-2010)

(34) Technical Standard of Sound Barrier Structure (GB/T 51335-2018)

2.5.2 General Requirements

(1) Regarding the national railway standards for railway bridges, except for the requirement of the continuously welded rails (CWR) and train-specific loading on the bridges which should comply with the relevant requirements in the Code for Design of Metro (GB 50157-2013) and Code for Design of Suburban Railway (TB 10624-2020), all other aspects of bridge design should make reference to Clause 2.5.1 of this document.

(2) Where Hong Kong railway bridges are designed in accordance with the national railway standards, local design wind loads, accidental actions caused by road vehicles, and durability requirements should be adopted.

(3) For railway systems with the maximum operating speed $V \leq 100$ km/h, elevated structures should comply with the provisions of the Code for Design of Metro (GB 50157-2013) and the Standard for Elevated Structure Design Loading for Urban Rail Transit (CJJ/T 301-2020). For railway systems with the maximum operating speed $100\text{km/h} < V \leq 160$ km/h, elevated structures should comply with the provisions of the Code for Design of Suburban Railway (TB 10624-2020).

(4) The seismic design and analysis of bridges should comply with the provisions of the Code for Seismic Design of Urban Rail Transit Structures (GB 50909-2014) and the Code for Seismic Design of Railway Engineering (GB 50111-2006). The seismic design and analysis of elevated station structures should comply with the seismic design requirements specified in Section 2.7 of this document.

2.5.3 Bridge Design

(1) Non-replaceable components of bridges should be designed with the design service life of 100 years.

(2) Design actions of bridges should comply with the provisions of the Code for Design of Metro (GB 50157-2013) and the Code for Design

of Suburban Railway (TB 10624-2020). The design actions of Section 2.2 of this document are not applicable to bridges.

(3) The materials of bridges should comply with the provisions of the Code for Design of Concrete Structures of Railway Bridges and Culverts (TB 10092-2017). Section 2.3 of this document is not applicable to bridges.

(4) The limit values of bridge deformation and displacement specified in the Code for Design of Metro (GB 50157-2013) and Code for Design of Suburban Railway (TB 10624-2020) were formulated based on the Chinese Mainland vehicle and railway standards. When the elevated railway line adopts tracks and vehicles inconsistent with the national railway standards, and in the absence of relevant requirements in the prevailing railway standards in Hong Kong, the limit values of bridge deformation and displacement should be determined subject to further study on the coupling effects between vehicles and bridges.

(5) Where the bridge pier may be subject to accidental actions caused by road vehicles, collision protection facilities should be provided in accordance with the Code for Design of Urban Road Traffic Facility (GB 50688-2011). Where collision protection facilities cannot be provided, the accidental actions caused by road vehicles on the bridge pier should be assessed in accordance with Clause 3.6.2.2.2 of the Structures Design Manual for Highways and Railways (2013 Edition) published by Highways Department.

(6) Wind load on bridges should be assessed in accordance with the Structures Design Manual for Highways and Railways (2013 Edition) published by Highways Department.

(7) The structural design of noise barriers should comply with the provisions of the Technical Standard of Sound Barrier Structure (GB/T 51335-2018), and the wind load should be assessed in accordance with the Structures Design Manual for Highways and Railways (2013 Edition) published by Highways Department.

2.5.4 Elevated and At-grade Station Structures Design

(1) Design service life of the elevated station and at-grade structures should comply with Clause 5.1.3 of the Project Code for Engineering Urban Rail Transit (GB 55033-2022).

(2) Vertical natural frequency of footbridges should not be less than 3 Hz, and the lateral natural frequency should not be less than 1.5 Hz. Where these frequency requirements are not satisfied, verification of comfort taking into account the human-induced vibration should be carried out in accordance with Clause 3.7.3.3 of the Structures Design Manual for Highways and Railways (2013 Edition) published by Highways Department to ensure compliance with comfort requirements.

(3) Fire resistance and durability design of steel structure should be carried out in accordance with Chapter 12 and Section 5.5 of the Code of Practice for the Structural Use of Steel 2011 published by Buildings Department.

(4) Cantilevered reinforced concrete structures should comply with the provisions of Section 9.4 of the Code of Practice for Structural Use of Concrete 2013 and the Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers APP-68 published by Buildings Department.

2.5.5 Detailing Requirements

(1) Durability requirements for elevated structures should comply with the Code for Durability Design of Concrete Structures of Railway (TB 10005-2010). For elevated structures under the corrosive environment induced by chlorides from seawater, the limit values for crack widths and concrete cover should comply with the values for the corresponding environment as specified in Table 5.2 of the Structures Design Manual for Highways and Railways (2013 Edition) published by Highways Department.

2.6 Underground Structures

2.6.1 Reference Standards

Underground structures should make reference to the latest editions of the following standards:

Relevant Technical Standards

(1) Code of Practice for Structural Use of Concrete 2013 published by Buildings Department

(2) Code of Practice for Foundations 2017 published by Buildings Department

(3) Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers published by Buildings Department

(4) Guide to Cavern Engineering (Geoguide 4) published by Civil Engineering and Development Department

(5) Code of Practice for Structural Use of Concrete 2013 published by Buildings Department

(6) Environment, Transport and Works Bureau Technical Circular (Works) No. 15/2005

(7) GEO Technical Guidance Note No. 1 published by Civil Engineering and Development Department

(8) GEO Technical Guidance Note No. 25 published by Civil Engineering and Development Department

(9) GEO Report No.249 published by Civil Engineering and Development Department

(10) GEO Report No.298 published by Civil Engineering and Development Department

(11) General Code for Design of Engineering Structures (GB 55001-2021)

(12) General Code for Concrete Structures (GB 55008-2021)

(13) Code for Design of Concrete Structures (GB/T 50010-2010)

(14) Load Code for the Design of Building Structures (GB 50009-2012)

(15) Code for Design of Building Foundation (GB 50007-2011)

(16) Standard for Design of Shield Tunnel Engineering (GB/T 51438-2021)

(17) Code for Construction and Acceptance of Shield Tunnelling Method (GB 50446-2017)

(18) Code for Design of Railway Tunnel (TB 10003-2016)

(19) Technical Standard for Building Engineering against Uplift (JGJ 476-2019)

(20) Technical Standard for Top-down Method of Building Engineering (JGJ 432-2018)

(21) Technical Code for Protection Structures of Urban Rail Transit (CJJ/T 202-2013)

2.6.2 General Requirements

(1) Design of underground structures should be based on the national railway standards, taking account of the engineering geology and hydrogeological conditions in Hong Kong and the surrounding environment to achieve the design objectives of “safety, reasonableness, and economy”.

(2) Design of underground structures should be developed based on the ground investigation data. The applicable structural design codes and design method of underground structures should be selected based on their similarity to the characteristics of the underground structures, such as construction methods, types of structures / components, service conditions and loading characteristics. Design should also be carried out

during the implementation stage taking account of the monitoring data at the construction stage.

(3) This Section is applicable to the independent or adjoining underground structures. For the design of the underground structures integrated with railways, integrated analysis should be carried out with reference to the relevant standards published by Buildings Department, in addition to Chapter 2 of this document.

(4) Lining of cut-and-cover structures should comply with the provisions of Clause 11.5.3 of the Code for Design of Metro (GB 50157-2013).

(5) The design service life of underground structures should comply with the provisions of Clause 5.1.3 of the Project Code for Engineering of Urban Rail Transit (GB 55033-2022).

(6) For the design of underground structures, the classification of structural safety categories should comply with the provisions of Clause 2.2.1 of General Specification for Engineering Structures (GB 55001-2021).

(7) Crack width of reinforced concrete components of underground structures should comply with the limit values of crack width of the corresponding environment categories specified in the provisions of the Code for Design of Metro (GB 50157-2013), the Code for Design of Concrete Structures (GB/T 50010-2010), and the Standard for Design of Concrete Structure Durability (GB/T 50476-2019).

(8) The monitoring control values, alert-alarm-action mechanisms for deformation under different working conditions mentioned in Clause 2.4.3(7) of this document should also apply to the construction of underground structures, taking into account actual site conditions.

(9) Groundwater control, maximum permissible leakage and conditions for the use of pre-excavation grouting during construction of tunnels and cavern works should follow prevailing Hong Kong practice and past projects experiences.

(10) Cantilevered reinforced concrete structures should comply with the Clause 2.5.4(4) of this document.

2.6.3 Structures Formed by Bottom-up (Cut-and-Cover) Method

(1) Structural lining constructed by cut-and-cover method should comply with the provisions of Clause 11.5.3 of the Code for Design of Metro GB (50157-2013). Temporary retaining structures subject to permanent loads should comply with the provisions of Clause 11.1.6 of the Code for Design of Metro (GB 50157-2013).

(2) Earth pressure acting on the underground structures should comply with the provisions of Clause 11.2.2 of the Code for Design of Metro (GB 50157-2013).

(3) Water pressure acting on the underground structures should comply with the provisions of Clause 11.2.3 of the Code for Design of Metro (GB 50157-2013). In addition, the outer face of retaining structure of single or composite walls and the inner face of lining walls for composite walls should consider the effects arising from the potential difference in groundwater pressure on the two faces or the additional load from transient groundwater changes.

(4) Structural analysis for structures formed by cut-and-cover method should comply with the provisions of Clauses 11.6.1 and 11.6.3 of Code for Design of Metro (GB 50157-2013).

(5) Uplift resistance assessment and mitigation measures may make reference to the Technical Standard for Building Engineering against Uplift (JGJ 476-2019). However, the design groundwater level for uplift should comply with Clause 2.5.4 of the Code of Practice for Foundations 2017 published by Buildings Department. The factor of safety for uplift resistance should not be less than 1.1 when not accounting for the side frictional resistance, and should not be less than 1.15 when accounting for the side frictional resistance.

2.6.4 Structures Formed by Top-Down (Cover-and-Excavate) Method

(1) Top-down construction design should comply with the provisions of the Technical Standard for Top-down Method of Building Engineering (JGJ 432-2018).

2.6.5 Structures Formed by Mining Method

(1) Classification of surrounding rock mass and the structural design for mined tunnels should comply with the provisions of the Code for Design of Railway Tunnel (TB 10003-2016).

(2) For tunnels with a drained lining system, the external water pressure should comply with the provisions of the Guide to Cavern Engineering (Geoguide 4) published by Civil Engineering and Development Department.

2.6.6 Structures Formed by Tunnel Boring Method

(1) Selection of tunnel boring machine should be confirmed after technical and economical comparison based on the geological conditions and environmental conditions, and the principles may follow Clause 11.4.3 of the Code for Design of Metro (GB 50157-2013).

(2) Pressure on the shield face during construction should comply with the provisions of the Code for Construction and Acceptance of Shield Tunnelling Method (GB 50446-2017), with local adaptations made with reference to the prevailing railway standards in Hong Kong, including the GEO Report Nos. 249 and 298 published by Civil Engineering and Development Department.

(3) The headroom clearance of tunnel sections should satisfy requirements for structure gauge, functional use and construction processes. Tunnel segment linings should be selected based on the tunnel types, loading conditions and shield equipment, while meeting the requirements for economy, reliability and durability. Segment thickness should be

determined according to tunnel diameter, embedment depth, geological conditions and loads under various working conditions.

(4) Design and calculation of structures formed by tunnel boring method should follow the Standard for Design of Shield Tunnel Engineering (GB/T 51438-2021). For tunnels in rock strata, the design and loads should comply with the Code for Design of Railway Tunnel (TB 10003-2016).

(5) Deformation control indicators for structures formed by tunnel boring method should be divided into construction stage and operation stage. Construction-stage control indicators may make reference to the Standard for Design of Shield Tunnel Engineering (GB/T 51438-2021). Operational-stage control indicators should make reference to the Technical Code for Protection Structures of Urban Rail Transit (CJJ/T 202-2013).

(6) The cross passages may be constructed in accordance with the provisions of Clause 13.2.2 of Design Standard for Shield Tunnel Engineering (GB/T 51438-2021) using the mining method, tunnel boring method or pipe jacking method. Subject to suitable geological conditions, the tunnel boring method or pipe jacking method may be adopted.

2.6.7 Structures Formed by Pipe Jacking

(1) Pipe jacking method may be used for the construction of ancillary structures of stations and sections such as entrance/ exit passages, transfer passages, utility tunnels, and for cross passages in tunnels. Design of structures formed by pipe jacking may refer to the Full Face Tunnel Boring Machine - Rectangular Earth Pressure Balance Pipe Jacking Machine (GB/T 40122-2021) and the Technical Specification for Pipe Jacking Engineering with Rectangular Cross Section (T/CECS 716-2020).

2.6.8 Prefabricated Structures

(1) Prefabricated structures are suitable for station structures, sections, entrance/exit passages, transfer passages, ventilation ducts, etc.

(2) The design of prefabricated structures should coordinate and synergise with the entire process including design, production, transportation, construction assembly, equipment layout and installation, and architectural finishes. Application of prefabricated structures requires the collaboration among the architectural, structural, equipment, and finishing disciplines, and should comply with the overarching principles of generalisation, modularisation, standardisation, and efficient construction.

(3) Subject to the functional requirements or embedment depth of stations or section structures, cut-and-cover prefabricated structures may adopt a rectangular or arched frame structure, which may be an underground single-storey single-span or multi-storey multi-span box-type framework.

(4) Prefabricated linings may adopt reinforced concrete structures. The opening of linings may adopt reinforced concrete structures or steel-concrete composite structures. Prefabricated internal structures may adopt reinforced concrete structures, steel-concrete composite structures or steel structures.

(5) Connection joints in prefabricated structures should be designed with well-specified loadings and reliable detailing to achieve the requirements for load-bearing capacity, deformation, durability and constructability. Flexible or rigid joints and dry or wet connection techniques may be adopted. The joint locations should be reasonably determined based on the overall stability of the prefabricated structure, load characteristics, manufacturing, transportation, lifting and assembly processes of the components, etc.

(6) The structural analysis of prefabricated structures should be assessed based on the configuration and mechanical properties of the joints, and should take into account the transformation of the structural system

throughout the entire process (including manufacture, lifting, assembly, backfilling, etc.). Assessment on the ULS and SLS load-carrying capacities under all working conditions during construction and operation should be performed to verify the load-carrying capacity and deformation of the connections and structures. The overall structural analysis should account for the actual stiffness of the joints, and the computational model should be determined according to the actual loading conditions.

(7) Lightweight design may be achieved by considering the combination of assembly structures and individual prefabricated components. Various lightweight forms such as closed-cavity thin-walled components or ribbed slabs may be adopted.

(8) Internal headroom clearance and the ELS system for cut-and-cover prefabricated structures should cater for the requirements for lifting and erection during construction.

2.6.9 Detailing Requirements

(1) Deformation joints are generally avoided in cast-in-situ concrete underground structures, and should only be provided under special circumstances subject to approval by relevant authorities. At parts with changes in the structural stiffness, reliable structural measures should be adopted to satisfy the requirements for load-carrying capacity, stability and durability.

(2) Minimum reinforcement ratio of main reinforcement in the top slabs, floor slabs, base slabs and side walls of cast-in-situ reinforced concrete frame main structures should not be less than the values stipulated in the General Code for Concrete Structures (GB 55008-2021). The reinforcement ratio of distribution reinforcement should not be less than the value specified in the Clause 11.4.3 of Code for Design of Metro (GB 50157-2013).

2.7 Seismic Design

2.7.1 Reference Standards

Seismic design should make reference to the latest editions of the following standards:

Relevant Technical Standards

(1) Structures Design Manual for Highways and Railways (2013 Edition) published by Highways Department

(2) General code for Foundation Engineering of Building and Municipal Projects (GB 55002-2021)

(3) Code for Design of Metro (GB 50157-2013)

(4) Code for Seismic Design of Buildings (GB/T 50011-2010)

(5) Code for Seismic Design of Urban Rail transit Structures (GB 50909-2014)

(6) Standard for Classification of Seismic Protection of Building Constructions (GB 50223-2008)

(7) Standard for Seismic Design for Underground Structures (GB/T 51336-2018)

(8) Code for Design of Concrete Structures (GB/T 50010-2010)

(9) Seismic Ground Motion Parameters Zonation Map of China (GB 18306-2015)

(10) Standard for Design of Steel Structures (GB 50017-2017)

(11) Code for Seismic Design of Railway Engineering (GB 50111-2006)

2.7.2 General Requirements

(1) Seismic design should be carried out for the railway structures in Hong Kong, which should comply with the provisions of the General Code for

Seismic Precaution of Buildings and Municipal Engineering (GB 55002-2021)

(2) The seismic precautionary intensity for Hong Kong should be in the seismic precautionary intensity of 7 in accordance with the Appendix A.0.32 of the Code for Seismic Design of Buildings (GB/T 50011-2010). The design reference peak ground acceleration should comply with Section 4.3 of Structures Design Manual for Highways and Railways (2013 Edition) published by Highways Department.

2.7.3 Elevated and At-grade Structures

(1) Seismic design and analysis of elevated and at-grade structures should comply with the provisions of the Code for Seismic Design of Urban Rail Transit Structures (GB 50909-2014) and the Standard for Seismic Design of Buildings (GB/T 50011-2010).

2.7.4 Tunnel and Underground Station Structures

(1) Seismic design and analysis of tunnel and underground structures should comply with the provisions of the Standard for Seismic Design for Underground Structures (GB/T 51336-2018) and the Code for Seismic Design of Urban Rail Transit Structures (GB 50909-2014).

2.7.5 Subgrade

(1) Seismic design and analysis of subgrade structures should comply with the provisions of the Code for Seismic Design of Railway Engineering (GB 50111-2006).

2.7.6 Retaining Wall

(1) Seismic design and analysis of retaining wall should comply with the provisions of the Standard for Seismic Design for Underground Structures (GB/T 51336-2018) and the Code for Seismic Design of Urban Rail Transit Structures (GB 50909-2014).

2.8 Durability Design

2.8.1 Reference Standards

Durability design should make reference to the latest editions of the following standards:

Relevant Technical Standards

(1) Code of Practice for Structural Use of Concrete 2013 published by Buildings Department

(2) Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers published by Buildings Department

(3) Standard for Design of Concrete Structure Durability (GB/T 50476-2019)

(4) Unified Standard for Reliability Design of Engineering Structures (GB50153-2008)

(5) Code for Durability Design on Concrete Structure of Railway (TB10005-2010)

2.8.2 General Requirements

(1) The core principles for the durability design of concrete structures under the national railway standards and the prevailing railway standards in Hong Kong are consistent. Both provide specific requirements for concrete materials and detailing measures under different

environmental categories and design service lives. The environmental classification in the national railway standards is applicable to Hong Kong. Meanwhile, local adaptations have been made to concrete cover and crack width control taking into account the Hong Kong's specific coastal environment and fire resistance design requirements.

(2) The fire resistance design and durability design of steel structures should comply with the provisions of Clause 2.5.4(3) of this document.

2.8.3 Environmental Categories and Durability design

(1) Environmental categories and environmental action levels should comply with the provisions in Sections 3.2, 4.2, 5.2, 6.2 and 7.2 of the Standard for Design of Concrete Structure Durability (GB/T 50476-2019).

(2) According to the Clause 3.2.5 of Standard for Design of Concrete Structure Durability (GB/T 50476-2019), the durability design of concrete structures should be determined based on the actual service conditions, by taking into account the wear and tear on the concrete surface due to high-speed water stream, wind-blown sand and vehicle wheels. Durability design under abrasive conditions should comply with the provisions of the Code of Practice for Structural Use of Concrete 2013 published by Buildings Department.

(3) According to the Clause 3.2.2 of the Standard for Design of Concrete Structure Durability (GB/T 50476-2019), when members of the concrete structures are simultaneously subject to various environmental effects, the concrete structures should be designed in accordance with the durability requirements for higher environmental action levels.

(4) The concrete covers to main reinforcement, stirrups and distribution reinforcement under different environmental actions should satisfy the requirements for corrosion resistance of reinforcement, fire resistance and bond strength between reinforcement and concrete, and the design values of concrete covers should not be less than the nominal diameter

of the reinforcement. Provisions of Sections 3.4, 4.3, 5.3, 6.3 and 7.3 of the Standard for Design of Concrete Structure Durability (GB/T 50476-2019) should be adopted. For structural components with fire resistance rating requirements, the provisions on cover for fire protection of Section 4.3 of the Code of Practice for Structural Use of Concrete 2013 published by Buildings Department should be followed.

(5) The calculated limit values of crack width of the reinforced concrete structures under loading should not exceed the values specified in Table 3.5.4 of the Standard for Design of Concrete Structure Durability (GB/T 50476-2019).

(6) The strength grade, water-binder ratio and composition of raw materials of concrete materials should be determined by taking into account the environmental categories, environmental action levels and design service lives of the structures, and should follow the provisions of Sections 3.4, 4.3, 5.3, 6.3, 7.3 and Annexes B and D of the Standard for Design of Concrete Structure Durability (GB/T 50476-2019).

(7) For important reinforced concrete structures susceptible to chloride environment, the chloride-ion penetration resistance of concrete should be specified for design in accordance with Table 6.3.6 of the Standard for Design of Concrete Structure Durability (GB/T 50476-2019).

(8) Requirements for measurement of passed electric charge should comply with Table 5.4.2 of the Code for Durability Design on Concrete Structure of Railway (TB10005-2010).

2.9 Engineering Waterproofing

2.9.1 Reference Standards

Engineering waterproofing should make reference to the latest editions of the following standards:

Relevant Technical Standards

(1) Technical Code for Waterproofing of Underground Works (GB 50108-2008)

(2) Technical Code for Roof Engineering (GB 50345-2012)

(3) Technical Specification for Green Roof (JGJ 155-2013)

(4) Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials (GB 18242-2008)

(5) Atactic Polypropylene (APP) Modified Bituminous Sheet Materials (GB 18243-2008)

(6) Modified Bituminous Waterproof Sheet Using Polyethylene Reinforcement (GB 18967-2009)

(7) Self-Adhering Polymer Modified Bituminous Waterproof Sheet (GB 23441-2009)

(8) Wet Installed Waterproofing Sheets (GB/T 35467-2017)

(9) Pre-Applied Waterproofing Sheets (GB/T 23457-2017)

(10) Thermoplastic Polyolefin Sheets for Waterproofing (GB 27789-2011)

(11) Polyvinyl Chloride Plastic Sheets for Waterproofing (GB 12952-2011)

(12) Chlorinated Polyethylene Plastic Sheets for Waterproofing (GB 12953-2003)

(13) Polymer Water-Proof Materials - Part 1:Water-Proof Sheet (GB/T 18173.1-2012)

(14) Waterproof Sheet with Self-Adhering Layer (GB/T 23260-2009)

(15) Waterproofing Sheets of Resistance to Root Penetration for Green Roof (GB/T 35468-2017)

(16) Polyurethane Waterproofing Coating (GB/T 19250-2013)

(17) Spray Polyurea Waterproofing Coating (GB/T 23446-2009)

(18) Mono-Component Liquid Applied Polyurea Waterproofing Coating (JC/T 2435-2018)

(19) Polymer-Modified Cement Compounds for Waterproofing Membrane (GB/T 23445-2009)

(20) Acrylic Waterproof Coating for Metal Roof (JG/T 375-2012)

(21) Polymer Emulsion Architectural Waterproof Coating (JC/T 864-2023)

(22) Polymer Modified Cement Slurry for Waterproof (JC/T 2090-2011)

(23) Emulsified Asphalt Waterproof Coating (JC/T 408-2005)

(24) Waterproofing Coating for Concrete Bridge and Road Surface (JC/T 975-2005)

(25) Water Quality Asphalt Waterproof Coating for Highway (JT/T 535-2015)

(26) Non-Curable Rubber Modified Asphalt Coating for Waterproofing (JC/T 2428-2017)

(27) Hot-Melting Rubber-Modified Asphalt Waterproofing Coating (JC/T 2678-2022)

(28) Cementitious Capillary Crystalline Waterproofing Materials (GB 18445-2012)

(29) Code for Acceptance of Construction Quality of Underground Waterproof (GB 50208-2011)

2.9.2 General Requirements

(1) Waterproofing design of underground works should primarily rely on self-waterproofing, with a focus on joint waterproofing supplemented by external waterproofing layers to enhance the waterproofing performance. Waterproofing design should comply with the provisions of the Code for Design of Metro (GB 50157-2013).

(2) Grade of waterproof for underground works should be classified as Class II. Waterproofing classifications and standards should comply with the provisions of the Code for Design of Metro (GB 50157-2013).

(3) Construction and acceptance of waterproofing works should strictly follow the requirements specified in design deliverables and the Technical Code for Waterproofing of Underground Works (GB 50108-2008) and the Code for Acceptance of Construction Quality of Underground Waterproof (GB 50208-2011).

(4) Waterproofing for elevated and at-grade stations should comply with the provisions of the Code for Design of Metro (GB 50157-2013), the Technical Code for Roof Engineering (GB 50345-2012) and the Technical Specification for Green Roof (JGJ 155-2013).

2.9.3 Waterproofing of Underground Structure

(1) The waterproofing design of the underground structures, including stations constructed by bottom-up (cut-and-cover or cover-and-excavate) or top-down (cover-and-excavate) methods and sections constructed by cut-and-cover, tunnel boring or mining methods, should comply with the provisions of the Code for Design of Metro (GB 50157-2013) and the Technical Code for Waterproofing of Underground Works (GB 50108-2008). The functional properties of waterproofing materials should comply with relevant material standards.

(2) Waterproofing details at construction joints, deformation joints, late cast strips, pile heads, concealed conduits (box), embedded components, reserved opening connections and openings and other detailed nodes should comply with the provisions of the Technical Code for Waterproofing of Underground Works (GB 50108-2008) and the Code for Design of Metro (GB 50157-2013).

3 Building Planning

3.1 Reference Standards

Building planning shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Buildings Ordinance (Cap. 123)

(2) Building (Planning) Regulations (Cap. 123 sub. leg. F)

(3) Building (Construction) Regulation (Cap. 123 sub. leg. Q)

(4) Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations (Cap. 123 sub. leg. I)

(5) Building (Refuse Storage and Material Recovery Chambers and Refuse Chutes) Regulations (Cap. 123 sub. leg. H)

(6) Fire Services Ordinance (Cap. 95)

(7) Fire Service (Installations and Equipment) Regulations (Cap. 95 sub. leg. B)

(8) Dangerous Goods Ordinance (Cap. 295)

(9) Dangerous Goods (Control) Regulation (Cap. 295 sub. leg. G)

(10) Lifts and Escalators Ordinance (Cap. 618)

(11) Noise Control Ordinance (Cap. 400)

(12) Air Pollution Control Ordinance (Cap. 311)

(13) Environmental Impact Assessment Ordinance (Cap. 499)

Relevant Technical Standards

(14) Design Manual – Barrier Free Access 2008 published by Buildings Department

(15) Code of Practice for Fire Safety in Buildings 2011 published by Buildings Department

(16) Code of Practice on Access for External Maintenance 2021 published by Buildings Department

(17) Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers published by Buildings Department

(18) Practice Notes for Registered Contractors published by Buildings Department

(19) Joint Practice Notes published by Buildings Department, Lands Department and Planning Department

(20) Hong Kong Planning Standards and Guidelines published by Planning Department

(21) Transport Planning and Design Manual published by Transport Department

(22) Code of Practice for Building Works for Lifts and Escalators 2011 published by Buildings Department

(23) Code of Practice on the Design and Construction of Lifts and Escalators published by Electrical and Mechanical Services Department

(24) Code of Practice for Lift Works and Escalator Works published by Electrical and Mechanical Services Department

(25) Guidelines on Formulation of Fire Safety Requirements for New Railway Infrastructures published by Fire Services Department

(26) Codes of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment published by Fire Services Department

(27) Fire Services Department Circular Letters

(28) Guidance Notes on Design of Road Tunnel Structures and Tunnel Buildings to be Maintained by Highways Department published by Highways Department

(29) Structures Design Manual for Highways and Railways (2013 Edition) published by Highways Department

(30) Stormwater Drainage Manual published by Drainage Services Department

(31) Practice Note No. 2/2023 Guidelines on Flood Resilience published by Drainage Services Department

(32) Statutory Environmental Standards & Guidelines, Technical Memorandum published by Environmental Protection Department

(33) Code for Design of Metro (GB 50157-2013)

(34) Project Code for Engineering of Urban Rail Transit (GB 55033-2022)

(35) General Code for Fire Protection of Buildings and Constructions (GB 55037-2022)

(36) Standard for Fire Protection Design of Metro (GB 51298-2018)

(37) Code for Fire Protection Design of Buildings (GB 50016-2014)

(38) General Code for Civil Building (GB 55031-2022)

(39) General Codes for Accessibility of Buildings and Municipal Engineering Projects (GB 55019-2021)

(40) Codes for Accessibility Design (GB 50763-2021)

(41) General Code for Building Environment (GB 55016-2021)

(42) Standard for Lighting Design of Buildings (GB/T 50034-2024)

(43) Safety Rules for the Construction and Installation of Escalators and Moving Walks (GB 16899-2011)

(44) Uniform Standard for Design of Civil Buildings (GB 50352-2019)

(45) Code for Fire Prevention in Design of Interior Decoration of Buildings (GB 50222-2017)

(46) Code for Prediction of Urban Rail Transit Ridership (GB/T 51150-2016)

(47) Acoustical Requirement and Measurement on Station Platform of Urban Rail Transit (GB/T 14227-2024)

(48) Urban Rail Transit Lighting (GB/T 16275-2008)

(49) Technical Code for Urban Flooding Prevention and Control (GB 51222-2017)

(50) General Code for Fire Protection Facilities (GB 55036-2022)

(51) Technical Standard for Application of Firestop in Buildings (GB/T 51410-2020)

(52) Code for Design of Automatic Fire Alarm System (GB 50116-2013)

(53) Technical Code for Fire Protection Water Supply and Hydrant Systems (GB 50974-2014)

(54) Code for Design of Sprinkler Systems (GB 50084-2017)

(55) Code for Design of Gas Fire Extinguishing Systems (GB 50370-2005)

(56) Code for Design of Extinguisher Distribution in Buildings (GB 50140-2005)

(57) Technical Standard for Fire Emergency Lighting and Evacuate Indicating System (GB 51309-2018)

(58) Technical Standard for Smoke Management Systems in Buildings (GB 51251-2017)

(59) Guidelines for Service of Integrated Community Facilities (GB/T 45581-2025)

(60) Technical Requirements for Connecting Facilities of Urban Rail Transit (JT/T 1410-2022)

(61) Guidelines for Planning and Design of Areas Along Urban Rail Transit Lines (Ministry of Housing and Urban-Rural Development, November 2015)

3.2 Station Design Standards

3.2.1 General Requirements

(1) Design standards for stations should be based on the Code for Design of Metro (GB 50157-2013), with suitable adjustments made in accordance with local passenger flow characteristics, actual operational needs, and Hong Kong legislation and standards.

(2) The core principle of Crime Prevention Through Environmental Design should be integrated throughout the entire process of system design and implementation throughout all design stages of railway works.

(3) The throughput capacity of station elements such as concourses, platforms, entrance/exit passageways, staircases, escalators, ticket machines, automatic fare collection gates should comply with the provisions of Clause 9.1.3 of the Code for Design of Metro (GB 50157-2013), and shall also satisfy the requirements for safe evacuation and fire rescue as specified in Section 3.8 of this document.

3.2.2 Passenger Experience

(1) The maximum throughput capacity of escalators and moving walkways selected for stations should comply with the provisions in Table H.1 of the Safety Rules for the Construction and Installation of Escalators and Moving Walks (GB 16899-2011). The maximum throughput capacity of staircases, passageways, ticket machines and automatic fare collection gates of stations should comply with the provisions of Table 9.3.14 in the Code for Design of Metro (GB 50157-2013) and shall satisfy the requirements for safe evacuation and fire rescue specified in Section 3.8 of this document.

(2) Where level differences exist in the public areas of a station or where the public areas of the concourse and ground level are at different floor levels, vertical connections should be provided to meet the requirements for barrier-free access as specified in Section 3.7 of this document and should comply with the following provisions:

(a) Where the level difference between public areas of the station exceeds 2m, both up and down escalators should be provided. If site conditions do not permit this, staircases and barrier-free access facilities should be provided.

(b) Where the level difference between the public areas of the station concourse and ground level does not exceed 2m, staircases may be provided at the exits/entrances of the station.

(c) Where the level difference between the public areas of the station concourse and ground level is between 2m and 6m, both up and down escalators and staircases may be provided at the exits/entrances of the station. If site conditions do not permit this, up escalators and staircases should be provided.

(d) Where the level difference between the public areas of the station concourse and ground level exceeds 6m, both up and down escalators should be provided at the exits/entrances of the station.

(e) Where escalators are provided for both upward and downward travel between the platform level and concourse level and between the concourse level and ground level, additional staircases or standby escalators should be provided.

(3) The provision of moving walkways in stations should comply with the following:

(a) Moving walkways should be provided where the walking distance of the passageways exceeds 200m.

(b) The length of moving walkways should be between 25m and 50m, with a maximum length not exceeding 60m, and should not span across more than two smoke zones.

(c) Where there are changes in direction or any obstruction in the path of passengers at either end of a moving walkway, a clear distance of not less than 8m should be maintained in front of the access/egress points of the moving walkway.

(d) A clear distance of not less than 8m should be maintained between moving walkways operating in the same direction, and not less than 10m for moving walkways operating in opposite directions.

(4) The provision of passenger staircases in station public areas should comply with the following:

(a) Tread width may range from 285mm to 340mm, and the riser height may range from 150mm to 165mm.

(b) Where staircases are provided independently, an inclination angle of 26°34′ may be adopted. Where it is provided adjacent to an escalator, an inclination angle of 30° may be adopted.

(5) Platform width should comply with the following requirements:

(a) Under normal service condition: Platform width should be determined by multiplying the quantity of the waiting (boarding) passengers in the peak minute by the waiting area of 0.5 m^2 per person and the headway (in minutes), divided by the calculated platform length. A 750mm wide passageway alongside the platform should also be added. The calculated platform length is defined as the distance between the two end doors of the platform screen doors.

(b) Under delayed service condition: Platform width should also cater for the needs of the delayed service condition. Under this condition, the platform width should be determined by the quantity of the waiting (boarding) passengers in the peak minute accumulated over a 6-minute delay period, assuming the area occupied to be 0.3 m^2 per person. For island platforms, the areas occupied by fixed obstructions on the platform, including columns, partition walls, staircases, lifts and seats, as well as the circulation areas between the two platform edges of the island platform, specifically including a 2.4m deep zone in front of lift car door and an 11m deep zone in front of the end point of the escalator truss, both with a width equivalent to the width of the respective facility, should be excluded from the platform width calculation.

(c) Under detrainment condition: When a train is taken out of service and detrained at a station, the platform width should also satisfy the need of this condition. In this case, the platform width should be determined by the sum of full train load and the waiting passengers in the peak minute (excluding the aforementioned occupied and circulation areas), assuming the area occupied to be 0.3 m^2 per person. This scenario does not apply to terminal stations.

(d) For terminal stations with island platform layout (i.e. equipped with two platforms for passenger boarding), under delayed service condition or detrainment condition, the total width of both platforms (excluding the aforementioned central circulation areas) may be included as the occupied area for waiting passengers in the calculation.

(e) Notwithstanding the above provisions, the minimum platform width should satisfy the following requirements: the clear distance from the inner surface of the fixed panel of the platform screen door to the finished wall surface should not be less than 3m. The minimum distance from the platform screen door to any isolated obstruction (e.g. columns) should not be less than 2.5m (the length of such isolated obstruction should not exceed 2m). The platform length should be determined by the train length.

(f) A dedicated zone for the installation of platform screen doors should be reserved along the platform edge. This zone should not be included in the calculation of the platform width.

(g) Where a direct current (DC) traction power supply system is adopted, a 2m wide strip along the platform edge, or in front of the platform screen doors / automatic platform gates (where installed) should be electrically insulated from the platform structure using specified insulating floor materials. No penetrations or floor openings are permitted within this platform insulation zone.

(6) Station design should be verified through computer modelling and simulation, with the level of service for different station zones/facilities assessed against the criteria specified in Table 3.2.2. Effective congestion mitigation measures should be taken if the level of service in Table 3.2.2 cannot be met.

Table 3.2.2 Level of Service for Station Zones/Facilities

<table>
<tr><th>Zone/Facility</th><th colspan="2">Measurement/Calculation Indicator (Passenger Flow should be Multiplied by an Uneven Factor of 1.2)</th><th>Desired Value</th><th>Tolerable Value</th><th>Intolerable Value</th></tr>
<tr><td>Platform under Normal Service</td><td colspan="2">Average area per person during peak period</td><td>>0.7 m^2/p</td><td>0.3-0.7 m^2/p</td><td><0.3 m^2/p</td></tr>
<tr><td>Platform under Delayed Service</td><td colspan="2">Average area per person during peak period</td><td>>0.5 m^2/p</td><td>0.3-0.5 m^2/p</td><td><0.3 m^2/p</td></tr>
<tr><td>Concourse</td><td colspan="2">Average area per person during peak period</td><td>>1.39 m^2/p</td><td>0.93-1.39 m^2/p</td><td><0.93 m^2/p</td></tr>
<tr><td rowspan="3">Escalators (at Concourse & Entrance Levels)</td><td>Headway < 3 mins</td><td rowspan="3">Average queuing time during peak period</td><td>No queuing</td><td>0-15 s</td><td>>15 s</td></tr>
<tr><td>Headway 3-5 mins</td><td>No queuing</td><td>0-22.5 s</td><td>>22.5 s</td></tr>
<tr><td>Headway > 5 mins</td><td>No queuing</td><td>0-30 s</td><td>>30 s</td></tr>
<tr><td rowspan="3">Escalators (at Platform Level)</td><td>Headway < 3 mins</td><td rowspan="3">Average queuing time during peak period</td><td>No queuing</td><td>0-30 s</td><td>>30 s</td></tr>
<tr><td>Headway 3-5 mins</td><td>No queuing</td><td>0-45 s</td><td>>45 s</td></tr>
<tr><td>Headway > 5 mins</td><td>No queuing</td><td>0-60 s</td><td>>60 s</td></tr>
</table>

Zone/Facility	Measurement/Calculation Indicator (Passenger Flow should be Multiplied by an Uneven Factor of 1.2)		Desired Value	Tolerable Value	Intolerable Value
Automatic Fare Collection Gates	Headway < 3 mins	Average queuing time during peak period	No queuing	0-10 s	>10 s
	Headway 3-5 mins		No queuing	0-15 s	>15 s
	Headway > 5 mins		No queuing	0-20 s	>20 s
Ticket Machines	Average queuing time during peak period		No queuing	0-30 s	>30 s
Lifts (at Entrances/Exits only)	Average queuing time during peak period		No queuing	0-30 s	>30 s
Journey Time from Entrance to Platform	Average travel time		0-3 mins	3-6 mins	>6 mins
Journey Time for Interchange			0-3 mins	3-6 mins	>6 mins

3.2.3 Dimensional Requirements for Various Components

(1) Headroom requirements for station components including concourse level, platform level, passageways and public staircases should comply with the following provisions:

(a) Concourse level, platform level and passageways: The minimum height from the finished floor level to the ceiling soffit should not be less than 3m. The minimum height from the finished floor level to the underside of any overhead obstruction (including signage, passenger information display screens, staircase landings, etc.) should not be less than 2.36m.

(b) Public staircases: The minimum vertical headroom, measured from the finished floor level of steps, should not be less than 2.7m. The minimum height from the finished floor level of steps to the underside of any overhead obstruction (including signage, passenger information display screens, staircase landings, etc.) should not be less than 2.36m.

(c) The minimum vertical clearance, measured from the steps of escalator, pallets or conveyor belts of moving walkway (including end zones and all accessible areas) should comply with the requirement of being not less than 2.3m as stipulated in the Code of Practice on the Design and Construction of Lifts and Escalators published by Electrical and Mechanical Services Department.

3.2.4 Indoor Environmental Standards

(1) The permissible limit for the A-weighted equivalent continuous sound pressure level of noise within station platform areas during train arrival and departure should be 75-80 dB(A).

(2) The interior lighting design standard of the station should comply with the provisions specified in Table 3.2.4.

Table 3.2.4 Standard Values for Station Interior Lighting

Location		Reference Plane & Height	Illuminance Standard Value (lx)	
			Normal	Emergency Evacuation
Platform	General	Floor	150	10
	Edge	Floor	200	10
Concourse		Floor	180	10
Public Staircase		Floor	200	10
Escalators	General	Floor	150	10
	Entrance and Exit	Floor	250	10

Location	Reference Plane & Height	Illuminance Standard Value (lx)	
		Normal	Emergency Evacuation
Public Passageways & Entrances/Exits	Floor	180	10
Public Toilets	Floor	150	10

Note: For those illuminance standard values not specified in this table, please refer to Chapter 4 of this document for the related provisions on power and lighting.

(3) The concentration limits of indoor air pollutants inside train compartments and indoor areas of railway facilities should comply with the provisions for “Class II Civil Building Engineering” specified in Clause 5.1.2 of the General Code for Building Environment (GB 55016-2021). The concentration limit of formaldehyde specified in Table 5.1.2 should be adjusted to be not more than 0.03 mg/m^3. The testing and acceptance methodology for indoor air pollutants inside train compartments and indoor areas of railway facilities should be carried out in accordance with the relevant provisions in the General Code for Building Environment (GB 55016-2021).

3.3 Overall Station Disposition

3.3.1 General Requirements

(1) The planning for the overall station disposition should be based on the Hong Kong Planning Standards and Guidelines published by the Planning Department and other relevant railway standards in Hong Kong, with provisions for a comprehensive pedestrian system and potential cycling network, supported by ancillary facilities such as parking and signage. In addition, it should incorporate requirements from national railway standards with adjustments made to adapt to local operational needs and environmental characteristics. Specialised and detailed design requirements should be proposed, focusing on key

elements including the overall coordination of the layout, planning for pedestrian environment and functional synergy of facilities.

(2) The core principle of Crime Prevention Through Environmental Design should be integrated into the overall station design. Specialised designs including the station layout planning, the layout planning for transport interchange facilities and road traffic design around the station should be developed based on the urban transport requirements catering the development needs. Through these specialised designs, the overall station design could implement various interchange and transfer facilities at the station, optimise the layout of station entrances/exits, and enhance the planning for pedestrian environment around the station. The specialised designs should include but are not limited to the following:

(a) Determination of station location and delineation of its catchment area;

(b) Siting of entrances/exits and ventilation shafts for underground stations, and their spatial relationship with the surrounding roads;

(c) Pedestrian system (multi-level pedestrian entrances, exits and connections including footbridges, subways, at-grade crossings and covered walkways, etc.)

(d) Bus stops, taxi stands, park-and-ride facilities, cycle parking and parking for the electric mobility device and storage facilities;

(e) Design of barrier-free access routes;

(f) Emergency evacuation and response design, specifying evacuation routes, access/egress path for emergency personnel, emergency egress points, placement locations of emergency equipment, signage provision for evacuation route, and parking spaces for emergency vehicles (including fire engines and works vehicles); and

(g) Spatial relationship between the station and adjacent buildings/structures, coordinated arrangement of structural piers/columns of elevated station with roads, and their corresponding relationship with the junction zoning.

(3) Various factors such as urban spatial form, population distribution characteristics and resident travel patterns, should be integrated in the station design. Further specialised designs, which are in line with the medium to long-term development objectives of the station area, should be conducted to ensure the reasonableness of the station location. The specialised designs should include, but not limited to the following:

(a) Density analysis of the population size and employment distribution within the station catchment area;

(b) Assessment of the functional types and diversity of public service facilities (including educational, medical, commercial and cultural facilities, etc.);

(c) Calculation on the combined construction rate of station ancillary facilities (including commercial amenities, public service facilities, equipment auxiliary rooms, etc.); and

(d) Forecast on the share of the rail transit mode within the 500m walking area from the station, and establishment of the corresponding medium-to-long-term target values.

3.3.2 Master Plan Principles

(1) In the planning for the station location, public activity hubs and major facilities generating and attracting passenger traffic should be located within the immediate vicinity of the station or within a 500m walking radius therefrom. High-density residential buildings, employment concentration areas and other associated land uses should be positioned in the surrounding area of the station. Where considerable passenger flow with actual walking distance to the station exceeding 1000m is anticipated, various types of auxiliary interchange facilities such as moving walkways and feeder bus stops should be planned.

(2) During the station design stage, convenient access should be achieved through integration of land use planning with major facilities generating and attracting passenger traffic. A comprehensive pedestrian network should be established by providing pedestrian walkways, dedicated pedestrian access (such as covered walkways, footbridges and subway systems), and providing landscaped decks and public open space where appropriate, thereby enhancing the quality of the walking environment. Where situation warrants, pedestrian networks and dedicated pedestrian links connecting the station with other transport hubs should be provided within development sites of large public buildings, comprehensive residential projects, etc. The design of pedestrian system for the station should conform to the relevant pedestrian planning requirements stipulated in Section 5 - Planning for Pedestrians under Chapter 8 - Internal Transport Facilities of the Hong Kong Planning Standards and Guidelines published by the Planning Department.

(3) The selection of station platform types should comply with the provisions of Clause 9.2.1 in the Code for Design of Metro (GB 50157-2013). Island platforms should be preferred where alignment and topographical conditions permit. Side platforms or other platform types may be adopted for stations subject to constrained conditions. Stations should generally be designed as straight-line stations integrated with the track geometry. Where there is genuine difficulty in complying with these provisions, curved stations with a compliant curve radius may be adopted based on the line design standards subject to approval by relevant authorities.

(4) Station layout design should mitigate the impacts on noise-sensitive areas. Adequate separation distance should be reserved between the station and noise-sensitive areas, complemented by noise control measures such as noise barriers and sound-absorbing devices. Noise levels and other environmental impacts generated by station operation shall comply with the requirements in the relevant Hong Kong environmental legislation and technical memorandums.

3.3.3 Transport Interchange

(1) During the planning stage for the land uses around the stations, the station should be treated as a core transport hub, equipped with appropriate transport interchange facilities as required including public transport interchanges, pick-up/drop-off areas, park-and-ride facilities, cycle parking facilities, and electric mobility device parking and storage facilities, so as to plan for a complete travel chain.

(2) The layout option and construction scale of station transport interchange facilities (including pick-up/drop-off areas, park-and-ride facilities, etc.) should be determined based on the findings of the Traffic Impact Assessment, ensuring compatibility with the capacity of the regional transport network. Stations located outside busy urban areas and adjoining major transport corridors (e.g. railways, expressways) should be provided with additional park-and-ride and pick-up/drop-off facilities.

(3) Location and orientation of entrances/exits of stations should be optimises to minimise pedestrian detour distances. Designated cycle parking facilities and electric mobility device parking facilities should be provided at stations in the vicinity of cycle tracks as required. The number of cycle parking spaces and layout dimensions of these facilities should comply with the requirements in Chapter 8 of the Hong Kong Planning Standards and Guidelines published by the Planning Department and the latest requirements of the Transport Department.

(4) The transport interchange facilities of the station may be designed according to the following priority: pedestrian links, cycling facilities, bus stops and public transport interchanges, pick-up/drop-off areas for taxis and other motorised vehicles, and parking areas for other motorised vehicles. The composition of station transport interchange facilities and the interchange distances should comply with the provisions in Table 3.3.3 of this document.

Table 3.3.3 Composition and Interchange Distance of Station Transport Interchange Facilities

Transport Interchange Facilities	Interchange Facility Type	Provision Requirement	Transfer Distance from Entrance/Exit of Station (Walking Distance)
Pedestrian Interchange Facilities	Pedestrian Area outside Station Entrance/Exit	Should be provided	--
	Pedestrian Crossing Facilities	Should be provided	--
Cycling Facilities	Non-Motorised Vehicle Parking Area	Should be provided	≤ 50 m
Bus Stops and Public Transport Interchange Facilities	Bus Stop	Should be provided	≤ 30 m under normal conditions; ≤ 50 m under difficult conditions
	Public Transport Interchange	To be provided subject to need and land use planning conditions	≤ 100 m
Motorised Vehicle Interchange Facilities	Pick-up / Drop-off Area	To be provided subject to need and land use planning conditions	≤ 100 m
	Park-and-Ride Facilities	To be provided subject to need and land use planning conditions	≤ 150 m

(5) Sufficient and clear directional signage should be provided at appropriate locations to guide passengers to the transport interchange facilities. Passenger information display screens and interactive panels should be provided at the station and along major routes to/from public transport facilities and parking facilities to show relevant passenger information such as routes, schedules, estimated time of arrival, etc.

3.4 Station Layout

3.4.1 General Requirements

(1) The station layout design should be based on the Code for Design of Metro (GB 50157-2013), with suitable adjustments made to adapt to local passenger flow characteristics, actual operational needs, and Hong Kong legislation and standards.

(2) The design, provision and construction of external maintenance access for railway-related structures (including but not limited to maintenance access for external walls, curtain walls, roofs, air-conditioner platforms, external drainage pipes, vertical greening and other projections) should comply with the requirements of the Code of Practice on Access for External Maintenance 2021 published by the Buildings Department.

3.4.2 Public Areas and Facilities

(1) The paid and unpaid area of the concourse should be segregated by automatic fare collection gates and barriers complying with the provisions of Clause 9.3.12 of the Code for Design of Metro (GB 50157-2013), and should also satisfy the requirements for operation management as well as the requirements for safe evacuation and fire rescue as stipulated in Section 3.8 of this document.

(2) The layout of ticket machines and automatic fare collection gates in the concourse should be integrated with the arrangement of station facilities

including entrance/exit passageways, staircases, escalators, lifts, ticket offices, etc., and should conform to the following provisions:

(a) The installation of ticket machines and automatic fare collection gates should align with passenger entry/exit flow lines, and passenger flows may not cross;

(b) The quantity and layout of ticket machines and automatic fare collection gates should be designed holistically based on the passenger flow projection for the ultimate design year. Provisions may be reserved for future expansion and phased implementation;

(c) For stations subject to significant differences in entry/exit passenger flow during different operational periods or potential sudden surge in passenger flows, additional bi-directional automatic fare collection gates may be installed in different directions. The specific quantity should be calculated based on the passenger flow projection for the ultimate design year; and

(d) The passage capacity of exit gates should not be less than the combined passage capacity of the associated exit escalators.

(3) Public toilets should be provided within stations. The configuration of sanitary fixtures in male and female public toilets should be determined with reference to the peak minute passenger flow data of the station (comprising alighting, boarding and transfer passengers) for the ultimate design year. The ratio of male to female users should be assumed as 4:6 in the calculation.

Table 3.4.2 Configuration Table for Public Toilet Facilities

		Number of Wash Basins	**Number of Water Closet Fitments**	**Number of Urinals**
Male Toilet	1–250 persons	2	2	2

		Number of Wash Basins	Number of Water Closet Fitments	Number of Urinals
	251–500 persons	2, plus 1 for every additional 125 male passengers (or part thereof)	2, plus 1 for every additional 125 male passengers (or part thereof)	2
	501 persons or more	4, plus 1 for every additional 250 male passengers (or part thereof)	4, plus 1 for every additional 250 male passengers (or part thereof)	2, plus 1 for every additional 250 male passengers (or part thereof)
Female Toilet	1–250 persons	2	4	Not applicable
	251–500 persons	2, plus 1 for every additional 125 female passengers (or part thereof)	4, plus 1 for every additional 100 female passengers (or part thereof)	Not applicable
	501 persons or more	4, plus 1 for every additional 250 female passengers (or part thereof)	7, plus 1 for every additional 100 female passengers (or part thereof)	Not applicable

3.4.3 Equipment and Management Rooms in Station

(1) A grouped control strategy should be adopted.

(2) Station equipment rooms and management rooms may follow the principles of professional integration, facility consolidation and resource sharing. Equipment rooms with identical or similar functional types should be arranged adjacently, in compliance with the following provisions:

(a) Substations should be located at one end of the equipment load centre;

(b) Wet rooms such as pump houses and toilets may be grouped in centralised arrangement and may not be located directly above electrical rooms or overhead line equipment. If site constraints do not permit this, adequate waterproofing measures should be implemented for such wet rooms;

(c) Communication and signalling equipment rooms should be categorised as either dedicated railway system rooms or public telecommunication rooms. Equipment layout should be planned according to the category for consolidation;

(d) Waterproofing, damp-proofing and rodent-proofing measures should be implemented for electrical equipment rooms in the stations;

(e) Air-conditioning & ventilation and electrical rooms may be integrated, provided that the workmanship and maintenance requirements are satisfied;

(f) The layout of management rooms may adopt such arrangement, which facilitates professional sharing, size integration and flexible partitioned arrangement, and may adopt open-plan and combined office layout; and

(g) The scale of equipment and management rooms in the stations may be reasonably determined based on the type of station, i.e., a centralised equipment station (master station) or non-centralised equipment station (satellite station).

(3) The standards for various room types are categorised by functions, with their respective minimum construction floor area proposed as follows:

Table 3.4.3 Station Equipment and Management Room Schedule

Type	Room Name	Area (m^2)	Remarks
Management Rooms	Station Master's Office	10	Provided at master stations only
	Customer Service Centre	4	Open style design

Type	Room Name	Area (m²)	Remarks
	Ticket Office	8	Provided at specific stations according to operational management mode, and located at the same end as the station control room, preferably near the public area
	Meeting Room	15	Preferably located close to the station control room
	Multi-purpose Room	20	Preferably located near the public area; as a room for comprehensive uses
	Male Locker Room	15	
	Female Locker Room	15	
	Integrated Maintenance Room	16	Provided with one room per station, and allocated and shared by operations
Management Rooms	Cleaning Equipment Room	8	
	Police Equipment Room	10	Located adjacent to the police room
	Police Room	20	Located at same end as the station control room, with its door facing the public area
	Spare Parts Room	20	
Electrical Rooms	Station Control Room	45	Equipment scale to be increased at interchange stations
	Lighting Distribution Room	40	Provided at both ends of concourse and platform
	Integrated Power Supply Room	45	Integrated with low voltage and backup power for lighting

Type	Room Name	Area (m²)	Remarks
	Police Communication Equipment Room	20	
	Low Voltage Integrated Equipment Room	100	Consolidated with integrated monitoring, ticket machines, specialised communications and signalling equipment; signalling equipment room provided separately at master stations
Electrical Rooms	Public Communication Equipment Room	40	Integrated with various operator equipment in a centralised layout
	Emergency Lighting	12	Provided at the platform level
	Electrical Control Room for Environmental Control	165	Located adjacent to the equipment rooms at both ends; the size is based on the scale of the actual control cabinet in equipment area
	Platform Screen Doors Control Room	20	Designed to provide control on the platform screen door system; recommended to have door facing platform public area
	35kV Switchgear Room	44	Adjusted according to system functional requirements
	High Voltage Control Room	30	Located adjacent to 35kV switchgear room
	0.4kV Switchgear Room	133	
	Substation	118	Provided based on load calculation to be carried out by power supply specialist according to the size of station and length of tunnel section
	Spare Parts Room	30	Provided separately according to

Type	Room Name	Area (m²)	Remarks
			work gangs, and for storage of various materials
	Distribution Room	4	Provided as needed
Wet Rooms	Gas Cylinder Room	60	Dedicated to gas extinguishing system; may be provided separately; specific size to be determined based on the number of fire compartments and maximum room area
	Wastewater Pump Room	8.5	Should be located at the lowest point of the platform
	Fire Pump Room	33	Located adjacent to access staircases for firemen
	Sewage Pump Room	19	Adjacent to the toilets, and provided in sunken slab when arranged on the same floor
	High-Pressure Water Mist Pump Room	34	Provided at the stations without gas extinguishing systems
	Public Toilet	Calculated based on the number of users	
Environmental System Control Rooms	Environmental Control System Equipment Room	460	Provided at both ends according to the station layout
	Dedicated Smoke Exhaust Equipment Room	30	Independently provided
	Dedicated Air Make-up Equipment Room	25	Independently provided

Type	Room Name	Area (m²)	Remarks
	Chiller Room	150	May be combined with the Environmental Control System Equipment Room
	Tunnel Ventilation Fan Room	700	Minimum scale; actual size to be determined based on the ducting layout of each station

(4) The design of new railway lines may make reference to and adopt the provisions in this Table based on the actual functional requirements and the conditions for room integration.

3.4.4 Finishes and Wayfinding

(1) Based on the usage scenario, the slip resistance of the flooring materials in the stations should achieve the pendulum test values below:

Table 3.4.4-1 Slip Resistance Requirements for Flooring Materials in Indoor Areas

Usage Scenario	**Pendulum Test Value Requirement**	
	Wet Condition	**Dry Condition**
Enclosed general paving at public area and back-of-house areas (Gradient 0 – 1:50)	Min. 40	Min. 51
Sloping floor (Gradient 1:50 – 1:20)	Min. 46	Min. 60
Ramps (Gradient 1:20 – 1:12)	Min. 46	Min. 60
Stair nosing (anti-slip inserts)	Min. 51	Min. 60
Stair treads	Min. 46	Min. 60
Arrow inserts, yellow strips for platform edge (where automatic platform gate installed) and boundary strips at self-service kiosk	Min. 40	Min. 51
Border tiles	Min. 40	Min. 51

Table 3.4.4-2 Slip Resistance Requirements for Flooring Materials in Outdoor or Semi-enclosed Areas

Usage Scenario	Pendulum Test Value Requirement	
	Wet Condition	**Dry Condition**
General paving at entrances from outside, public area and back-of-house area (Gradient 0 – 1:50)	Min. 46	Min. 60
Sloping floor (Gradient 1:50 – 1:20)	Min. 51	Min. 60
Ramp (Gradient 1:20 – 1:12)	Min. 51	Min. 60
Stair nosing (anti-slip inserts)	Min. 60	Min. 70
Stair treads	Min. 51	Min. 60
Arrow inserts, yellow strips for platform edge (where automatic platform gate installed) and boundary strips at self-service kiosk	Min. 46	Min. 60

(2) Roads or footpaths connecting to a station may make reference to the relevant requirements specified in Volume 6 Chapter 10 of the Transport Planning and Design Manual published by Transport Department for the provision of pedestrian wayfinding signage system to create easily identifiable pedestrian routes. If an entrance/exit of a station is connected to an adjacent commercial premise, the commercial premise should provide sufficient and clear directional signage indicating the route to the station.

3.5 Public Service and Commercial Facilities

3.5.1 General Requirements

(1) Public service and commercial facilities should be based on the Code for Design of Metro (GB 50157-2013), with suitable adjustments made in accordance with the conditions of Hong Kong railway operations and passenger needs.

3.5.2 Public Service Facilities

(1) Passenger seating should be provided on station platforms and should not obstruct passenger boarding, alighting, circulation, and evacuation.

3.5.3 Station Commercial Facilities

(1) Commercial facilities, including retail shops, self-service facilities, customer service centres, etc., may be provided at stations. Catering service areas may be incorporated based on the need and scale of the stations.

(2) Self-service facilities may include automated teller machines, automated external defibrillators, vending machines, self-service photo booths, drinking water dispensers, recycle bins, mobile charging stand, self-service kiosks, self-service lockers, etc. to meet passenger needs. Automated external defibrillators should be installed in every concourse and on every platform of each station.

3.6 Ancillary Facilities

3.6.1 General Requirements

(1) Station ancillary facilities should be based on the Code for Design of Metro (GB 50157-2013), with suitable adjustments made to adapt to local passenger flow characteristics, actual operational needs, and Hong Kong legislation and standards. Entrances and exits of stations, taking into account the projected pedestrian flow and where practicable, should achieve seamless pedestrian connection with surrounding transport facilities and commercial premises to provide all-weather pedestrian access.

(2) Based on the principle of Crime Prevention Through Environmental Design, station ancillary facilities should satisfy the following requirements:

(a) At-grade ancillary structures (including ventilation shafts, surface buildings, and ventilation ducts for underground stations) should preferably be sited along main flow direction of roads or within open areas, avoiding concealed spaces. Doors and windows of surface buildings should adopt anti-burglary measures to prevent unauthorised entry. Entrances/exits should face open spaces to reduce concealment risk and ensure that the surrounding of the facilities can be subject to natural surveillance (e.g., overlooking by shops, coverage by road closed-circuit television surveillance cameras).

(b) Within a 1.5-metre perimeter of at-grade ancillary structures (including ventilation shafts, surface buildings), obstructions that obstruct sightlines (e.g. tall shrubs, discarded materials) shall not be placed to ensure clear visibility and avoid creating “unmanned areas”.

(c) Emergency exits of stations should be connected to primary pedestrian routes and shall not be located at remote or blind spots. Exit signage should be made of fluorescent retro-reflective materials, be conspicuous and unobstructed, and be equipped with emergency lighting to ensure rapid identification and evacuation during crises and mitigate secondary risks.

(d) Pedestrian systems (including footbridges and underground passageways) connected to station entrances/exits and ancillary structures should conform to the following requirements: the transparency rate of footbridge parapets should not be less than 70%; the illumination levels in underground passages should not be less than 180 lx; pedestrian flow lines should be direct and physically segregated from vehicular lanes by barriers; and key nodes (e.g. turning points at entrances/exits) should be provided with additional surveillance devices and assistance call buttons to enhance active monitoring.

3.6.2 Station Entrances and Exits

(1) Where a group of lifts is provided as station entrances/exits for passenger use, the following provisions should be complied with:

(a) A smoke-proof staircase enclosure should be provided at the lift group to ensure evacuation of passengers from the passageway in a timely manner. The clear width of the stair flights should not be less than 1.2m.

(b) The lift lobby should be divided into two separate zones - a boarding area and an alighting area - using appropriate barriers and directional signage to achieve passenger flow separation. Its layout should satisfy the spatial requirements for lift access, queuing, and emergency evacuation.

(c) Intermediate emergency exits (shaft emergency access doors) should be provided in the lift shaft at vertical intervals not exceeding 11m to facilitate rapid access by rescue personnel to trapped persons in the lift car during an emergency.

(2) The design of station entrances/exits should take into account the relationship between the orientation of the surface structure and the direction of the prevailing summer wind in Hong Kong. The configuration of the passageways and surface structure should be reasonably determined to reduce the intrusion of outdoor hot and humid air into the station interior, and conform to the following requirements:

(a) Where differences in the surface environment and passenger flow directions are not significant, a single-turn layout for the entrance/exit may be adopted, complemented by active airflow blocking and thermal insulation measures within the passageways.

(b) Where the entrance/exit adopts a straight-through layout connecting directly to the concourse, the surface structures should deploy a side-exit configuration. Where a side-exit configuration for the surface structures is not feasible, airflow blocking and thermal insulation measures should be installed at suitable locations within the passageway.

(c) Where the public area at ground level is connected to a sunken plaza, the open area in between should be controlled with effective thermal insulation measures.

3.6.3 Ventilation Shafts and Cooling Towers

(1) Where combined side openings are adopted in ventilation shafts, the following provisions should be complied with:

(a) The horizontal clearance between an air intake and any other opening, such as an exhaust outlet, should not be less than 5m. Furthermore, air intakes and exhaust outlets should be arranged in staggered orientations. Where compliance with these requirements is not feasible, the air intake should be located lower than any exhaust outlet, with a vertical clearance of not less than 5m.

(b) Any ventilation opening should be at least 5m from any building or other opening. No obstructions impeding the ventilation airflow should be permitted within 5m from the opening.

(c) The elevation of the bottom edge of any ventilation opening should not be less than 3m above the street level. Where the ventilation opening is less than 6m above the street level, downward air discharge is not allowed.

(d) The bottom edge of any smoke exhaust outlet located within 5m from a carriageway should be at least 5m above the external ground level.

(2) Where top openings are adopted in ventilation shafts, the following provisions should be complied with:

(a) The horizontal clearance between air intake and exhaust outlet should not be less than 10m. The horizontal clearance between all other types of openings should not be less than 5m.

(b) Where the ventilation shaft is adjacent to a carriageway or pedestrian activity area, the edge of the ventilation opening should not be less than 3m above the design level of the external finished floor. Where the ventilation shaft is located within a landscaped buffer zone with a width not less than 3m, the bottom edge of the ventilation opening should not be less than 2m above the design level of the external finished floor, provided that flood protection requirements are also satisfied.

(c) Ventilation openings should be provided with anti-burglary and anti-fall protection devices. The bottom of the ventilation shaft should be provided with drainage facilities.

3.6.4 Design for Flood Protection

(1) Railway works should conduct flood risk assessments in accordance with Chapter 14 of the Structures Design Manual for Highways and Railways (2013 Edition) published by Highways Department and carry out protection design against waterlogging and flooding (and tidal) in the main station structures, ancillary and connection works, tunnels and depots. Enhanced anti-flooding design should be implemented at entrance/exit portals, utilizing robust anti-flooding equipment as protective measures. Such equipment should be mechanised and automated, with progressive implementation towards smart operation.

(2) The return period for protection design against waterlogging and flooding (and tidal) in railway works should not be less than 200 years.

(3) Drainage systems should be provided for open entrances/exits, ventilation shafts (shaft pits), tunnel portals, and structures, such as sunken plazas and underground pedestrian passages connected to railway stations. The drainage capacity of facilities including stormwater pumping stations, drainage channels, and drainage pipes should be calculated based on a rainstorm intensity of not less than the 1-in-200-year return period. The duration of the design rainstorm should be determined by calculation.

(4) The design for flooding protection for entrances/exits, emergency exits, and accessible lifts should comply with the following provisions:

(a) The design level of the landing platform at the opening of entrances/exits, emergency exits, and accessible lifts should not be less than 0.45m above the external ground level and should be higher than the design flood level.

(b) Flood boards should be installed at the openings of entrances/exits, emergency exits and accessible lifts. The height of the flood board should not be less than 0.75m, and the top of the flood board should not be less than 1.20m above the external ground level. The flood board should flush with the top of the solid concrete parapet wall.

(c) The top of the solid concrete parapet wall for entrances/exits, emergency exits and accessible lifts should not be less than 1.20m above the external ground level and should be higher than the design flood level. The height of the parapet wall should be verified against the probable maximum flood level resulting from typhoons and spring tides, and should be raised accordingly if necessary.

(5) The flooding protection design for ventilation shafts and light wells should comply with the following provisions:

(a) The bottom edge of the openings of ventilation shafts and light wells should not be less than 2.0m above the external ground level and should not be less than 1.0m above the design flood level.

(b) For open ventilation shafts, the above-ground section and the underground shaft section should be offset to facilitate the collection and discharge of rainwater.

(6) Where the railway works are connected to adjacent underground spaces or sunken plazas, the protection design against waterlogging and flooding (and tidal) for these adjacent spaces should, in principle, not be inferior to the requirements specified in sub-clauses (1) to (5) of this

Clause. A full-height flood door should be installed within the connecting passageways. An intercepting drain should be provided at the connection point, and the drainage gradient should not fall towards the railway works.

3.7 Barrier-free Facilities

3.7.1 General Requirements

(1) The design of barrier-free facilities of railway structures shall comply with the relevant provisions of the Buildings Ordinance (Cap. 123), Buildings (Planning) Regulations (Cap. 123 sub. leg. F) and the Design Manual: Barrier Free Access 2008 of Hong Kong published by the Buildings Department.

(2) All facilities serving passengers, including station plaza, transport interchange facilities, entrances/exits, public areas, transfer passageways, etc., should satisfy barrier-free access requirements and should interface seamlessly with urban barrier-free facilities.

3.7.2 Barrier-free Access Facilities

(1) The clear width of a barrier-free access should not be less than 2500 mm. Where there is genuine difficulty in complying with this provision, the clear width should not be less than 2000 mm.

(2) The clear width of a ramp should not be less than 1500 mm.

(3) Accessible Lifts

(a) For stations located along urban expressways or major trunk roads: and situated on one side of a road intersection, the entrances/exits of accessible lift may be provided on both sides of the road. Where the station spans over/underneath a road intersection, entrances/exits of accessible lifts may be arranged at opposite corners.

(b) The entrances/exits of accessible lifts may preferably be located on the main passenger flow direction of the station.

(c) A minimum of two passenger lifts should be provided to connect the concourse level and the platform level. For stations with side platforms, a minimum of two passenger lifts should be provided on each platform for connection with the concourse.

(d) The internal clear depth of the lift car should not be less than 1500 mm, and the clear width of the lift entrance should not be less than 850 mm.

(e) The distance from the door of an accessible lift to any obstruction should not be less than 2400 mm. Where there is genuine difficulty in complying with this provision, the lift doors may face towards the track area, provided that the waiting area in front of the lift doors does not encroach upon the width of the side platform within the calculated platform length.

3.7.3 Barrier-free Service Facilities

(1) Accessible toilets should be provided within stations and may adopt unisex toilets to serve this function. The provision of accessible unisex toilets should comply with the following provisions:

(a) It may be located near the public toilets of the stations, and should be easily accessible by persons with mobility difficulties. The wheelchair turning diameter should not be less than 1500 mm;

(b) Internal fixtures may include an adult water closet, an adult wash basin, a multi-purpose table, safety grab bars, coat hooks and an emergency call button, a child water closet, a child wash basin, and a child safety seat; and

(c) The multi-purpose table and the child safety seat should be foldable and equipped with safety belts.

(2) Each train compartment should contain a minimum of two multi-purpose areas, each with a width of at least 800mm and a length of at least 1200mm for the parking of wheelchairs, baby strollers and large items. Multi-purpose areas should be located near the central doorways of the train compartment and should be clearly marked both inside and outside the train.

(3) Each train compartment should provide a minimum of four priority seats. These seats should be arranged in pairs at the first and last doorways, located diagonally within the seating layout.

(4) The station concourse should be equipped with low-level service facilities, including a customer service centre, a service/information corner, self-service points, ticket machines (with functions accessible for the visually impaired persons) and tactile maps.

(5) A baby care room, incorporated with a dedicated lactation room, should be provided within the station. It should contain a clear operational space not less than 1500mm x 1500mm.

3.7.4 Barrier-free Information and Communication Facilities

(1) Stations should be equipped with accessible information and communication facilities, including but not limited to lift intercoms, emergency call buttons, assistance hotlines, public address systems, signage, and braille.

3.8 Fire Safety

3.8.1 General Requirements

(1) Fire safety design should be based on the Code for Design of Metro (GB 50157-2013), the Standard for Fire Protection Design of Metro (GB 51298-2018), and the national railway standards related to fire services system as listed in Chapter 4 of this document. It shall also comply with

the following Hong Kong legislation and the latest editions of the following standards:

(a) Buildings Ordinance (Cap. 123)

(b) Building (Planning) Regulations (Cap. 123 sub. leg. F)

(c) Building (Construction) Regulation (Cap. 123 sub. leg. Q)

(d) Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations (Cap. 123 sub. leg. I)

(e) Fire Services Ordinance (Cap. 95)

(f) Fire Service (Installations and Equipment) Regulations (Cap. 95 sub. leg. B)

(g) Dangerous Goods Ordinance (Cap. 295)

(h) Dangerous Goods (Control) Regulations (Cap. 295 sub. leg. G)

(i) Code of Practice for Fire Safety in Buildings 2011 published by Buildings Department

(j) Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers published by Buildings Department

(k) Guidelines on Formulation of Fire Safety Requirements for New Railway Infrastructures published by Fire Services Department (requirements pertaining to Fire Resisting Construction and Fire Resistance Rating)

(2) Where certain aspects of the fire safety design cannot satisfy the requirements of Clause 3.8.1(1) of this document, supplementary measures should be implemented in accordance with the latest versions of the following prevailing fire safety standards for Hong Kong railway:

(a) Guidelines on Formulation of Fire Safety Requirements for New Railway Infrastructures published by Fire Services Department

(b) Codes of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment published by Fire Services Department

(c) Fire Services Department Circular Letters

(3) To be in line with the requirements for local means of access and means of escape in trackside areas, in cases where a trackside emergency access point/ emergency egress point is not provided within underground or enclosed trackways, appropriate mitigation measures, such as cross-passages, emergency rail bus, and backup access vehicle, shall be provided.

(4) In case of special circumstances in individual projects, the Director of Fire Services may require additional fire safety requirements to be imposed to his satisfaction.

4 Electrical and Mechanical, Building Services and Railway Systems

This Chapter outlines only the fundamental requirements for E&M, Building Services and Railway Systems. On the basis of ensuring system safety, performance, and compatibility, railway projects may integrate different parts of this Chapter to develop system designs, and enhance the performance of individual system as necessary to satisfy the service levels of the railway corporation as well as the system requirements and performance indicators stipulated in the operating agreements of various railway lines. This approach not only ensures the integrity and safety of the overall railway system, but also helps to create a competitive procurement environment for railway systems, while allowing users of this Chapter the flexibility to select solutions that best fit the project circumstances under a performance-based framework.

4.1 Alignment

4.1.1 Reference Standards

Railway alignment design should make reference to the latest editions of the following standards:

Relevant Technical Standards

(1) Hong Kong Planning Standards and Guidelines published by Planning Department

(2) Code for Design of Metro (GB 50517-2013)

(3) Standard for Urban Rail Transit Network Planning (GB/T 50546-2018)

(4) Code for Design of Suburban Railway (TB 10624-2020)

(5) Standard for Design of Metro Express (CJJ/T 298-2019)

(6) Code for Design of Metropolitan Rapid Rail Transit System (T/CCES 2-2017) (T/CCES 2-2017)

4.1.2 General Requirements

(1) Railway lines should be classified, based on their functional positioning in operation, into main lines (comprising trunk lines and branch lines), auxiliary lines, and depot lines. Auxiliary lines include depot access/exit lines, connecting lines, turnback tracks, stabling tracks, crossovers, catch sidings, etc.

(2) The selection of route and station locations should comply with the following requirements:

(a) The route alignment should conform to the land use planning and railway development strategy.

(b) The alignment selection should consider factors such as vibration and noise, with an aim to minimising potential impact on the environmentally sensitive receivers along the alignment.

(c) Stations and interchange stations should be located in a 500m catchment area with major residential zones, employment centres, commercial and cultural centres, and other significant passenger traffic generators to facilitate public travel.

(3) Design parameters for new railway lines, such as circular curve radii and vertical curve radii, should comply with Chapter 6 of Code for Design of Metro (GB 50157-2013) for lines with a maximum operating speed V≤100 km/h, and Chapter 6 of the Code for Design of Metropolitan Rapid Rail Transit System (T/CCES 2-2017) or Chapter 8 of the Code for Design of Suburban Railway (TB 10624-2020) for lines with a maximum operating speed 100km/h <V≤160 km/h.

4.1.3 Horizontal and Vertical Profiles of Railway Lines and Auxiliary Lines

(1) The minimum horizontal curve radius for alignment should be determined based on the maximum operating speeds. For lines with a maximum operating speed of 100km/h <V≤160 km/h, Table 3.1.3-1 may be referred to. For liens with a maximum operating speed of V ≤

100 km/h, the minimum horizontal curve radius for alignment should be no less than 350m in normal sections; in case of practical difficulties, it should be no less than 300m.

Table 4.1.3-1 Minimum Horizontal Curve Radii (m)

Maximum Operating Speed (km/h)	**160**	**140**	**120**
Normal Section	1400	1100	800
Difficult Section	1300	1000	700

(2) Transition curves should be provided between circular curves and tangents on the horizontal alignment. For new projects, the transition curve should adopt a cubic parabolic curvature form.

(3) Station platforms should be located on straight sections. If the station and its adjacent sections are constrained by construction conditions, a horizontal curve radius of no less than 1500m may be permitted within the platform area subject to the approval by the relevant authorities of Hong Kong.

(4) For turnouts connecting at station ends, the distance from the stock rail joint at the front of the turnout to the end of the effective platform should not be less than 7.1 m. The distance from the fouling point or the departure signal at the rear of the turnout to the end of the effective platform should not be less than 5 m.

(5) For maximum operating speed V≤100km/h, the maximum gradient for main line sections should preferably be 30‰. In areas with special terrains, where justified by technical and economic comparison, the maximum gradient should not be greater than 50‰. For maximum operating speeds 100km/h＜V≤160km/h, the maximum gradient of the main line sections should not be greater than 30‰.

(6) Main lines with a maximum operating speed of 160 km/h, they should be connected by a vertical circular curve where the difference in gradient between adjacent slopes is ≥1‰. For main lines with a maximum operating speed below 160 km/h, a vertical circular curve should be used where the difference in gradient between adjacent slopes is ≥2‰. Vertical curves should not encroach upon the platform areas, and the radius of the vertical curve should not be less than the values specified in Table 4.1.3-2.

Table 4.1.3-2 Vertical Curve Radii (m)

<table>
<tr><th colspan="2">Line Type</th><th colspan="4">Normal Condition</th><th colspan="4">Difficult Condition</th></tr>
<tr><td colspan="2">Maximum Operating Speed (km/h)</td><td>160</td><td>140</td><td>120</td><td>≤100</td><td>160</td><td>140</td><td>120</td><td>≤100</td></tr>
<tr><td rowspan="2">Main Line</td><td>Section</td><td>10000</td><td>8000</td><td>6000</td><td>5000</td><td>6000</td><td>5000</td><td>4000</td><td>3000</td></tr>
<tr><td>Station</td><td colspan="4">3000</td><td colspan="4">2000</td></tr>
<tr><td colspan="2">Connecting Lines / Access/Exit Lines /Depot Lines</td><td colspan="8">2000</td></tr>
</table>

(7) Setting of Auxiliary Lines

(a) The calculated length of turnback lines and stabling tracks should be the length of maximum train formation during the operational period plus the safety overlap.

(b) The length of the safety overlap should comply with the provisions of Table 4.1.3-3.

Table 4.1.3-3 Safety Overlap

Auxiliary Line	Length Requirement
Turnback in front of Station	Should not be less than 50m
Turnback behind Station	Should not be less than 50m (No.12 turnout) Should not be less than 40m (No.9 turnout)
End of Stabling Track	Should not be less than 40m
Merging of Overtaking Line and Main Line at Express/Local Train Overtaking Station	Should not be less than 50m
Other Auxiliary Line	Should not be less than 40m

4.2 Gauge

4.2.1 Reference Standards

Gauge design should make reference to the latest editions of the following standards:

Relevant Technical Standards

(1) Code for Design of Metro (GB 50157-2013)

(2) Project Code for Engineering of Urban Rail Transit (GB 55033-2022)

(3) Code for Design of Suburban Railway (TB 10624-2020)

(4) Standard for Metro Gauges (CJJ/T 96-2018)

(5) Standard for Design of Metro Express (CJJ/T 298-2019)

4.2.2 General Requirements

(1) Railway gauges should be classified into vehicle gauge, equipment gauge and structure gauge, and should comply with the provisions of the national railway standards.

(2) For new railway works with a maximum operating speed V≤100km/h, vehicle gauge and equipment gauge should comply with the provisions of the Standard for Metro Gauges (CJJ/T 96-2018). For new railway works with maximum operating speed 100km/h＜V≤160km/h, vehicle gauge and equipment gauge should comply with the provisions of the Code for Design of Suburban Railway (TB 10624-2020).

(3) For adjacent lines without walls, columns, or equipment between them, the safety clearance between the two equipment gauges should comply with the provisions of Clause 3.0.6(1) of the Project Code for Engineering of Urban Rail Transit (GB 55033-2022).

(4) The minimum clearance between structure gauge and equipment gauge in areas free of utilities and equipment, and the safety clearance between equipment and utilities installed within the track zone and the equipment gauge should comply with the provisions of Clause 3.0.6(2) of the Project Code for Engineering of Urban Rail Transit (GB 55033-2022).

(5) Where an evacuation platform is provided in the section, its minimum width should not be less than 600 mm when open on one side. The longitudinal evacuation platform may also be used as maintenance access.

(6) Where the basic parameters of the selected rolling stock differ from those of Standard Type A Vehicles or Commuter Type A Vehicles specified in Section 4.4.2 of this document, the vehicle gauge, equipment gauge, and structure gauge should be re-evaluated.

4.2.3 Structure Gauge

(1) The structure gauge should be determined by comprehensively considering the gauge requirements, the space for trackside equipment and utilities installation, the height of track structures, the installation height of overhead line contact wires, the suspension height of the overhead line equipment, tunnel blockage ratio, and other relevant factors. For new railway works with maximum operating speed $V \leq 100km/h$, the determination of the structure gauge should comply with the provisions of the Code for Design of Metro (GB 50157-2013). For new railway works with maximum operating speed $100km/h < V \leq 160km/h$, the determination of structure gauge should comply with the provisions of the Code for Design of Suburban Railway (TB 10624-2020).

(2) For fillers installed at the edge of station platform, rigid components are strictly prohibited from intruding into the station area. With account of the kinematic envelope of the vehicle after a single fault condition, flexible components may partially intrude into the station area.

4.3 Track

4.3.1 Reference Standards

Trackwork design shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Environmental Impact Assessment Ordinance (Cap. 499)

Relevant Technical Standards

(2) Technical Specification for Ballastless Track of Urban Rail Transit (GB/T 38695-2020)

(3) Standard of Environmental Vibration in Urban Area (GB 10070-88)

(4) Standard for Design of Engineering Vibration Isolation (GB 50463-2019)

(5) Code for Design of Concrete Structures (GB/T 50010-2010)

(6) Standard for Design of Concrete Structure Durability (GB/T 50476-2019)

(7) Code for Design of Railway Track (TB 10082-2017)

(8) Code for Design of Railway Continuous Welded Rail (TB 10015-2012)

(9) Rails - Part 1: 43 kg/m - 75 kg/m Rails (TB/T 2344.1-2020)

(10) Railway Ballast (TB/T 2140-2008)

(11) Technical Guideline for Environmental Impact Assessment-Urban Rail Transit (HJ 453-2018)

4.3.2 General Requirements

(1) Track structure design should be based on the national railway standards, and should be optimised and adjusted in conjunction with Hong Kong legislation and engineering standards to ensure that the requirements for safety, stability, smoothness, durability, environmental protection, and insulation are met.

(2) Subject to the overriding requirement of fulfilling the intended functional purpose, the track structure type should be selected through technical and economic comparison with consideration to engineering conditions, environmental conditions, and maintenance requirements.

(3) The design service life for the main structure of ballastless track and concrete sleepers should not be less than 100 years, and the design service life of concrete sleepers for ballasted track should not be less than 50 years.

(4) Track structure design shall satisfy the requirements of the environmental impact assessment (EIA) for the project.

(5) Track structure design should incorporate necessary smart equipment for monitoring, inspection, and maintenance.

4.3.3 Basic Technical Requirements

(1) The rail cant should match with the profile of wheel tread. The rail cant may be 1 in 40, 1 in 30, or 1 in 20. In sections shorter than 50 m between two turnouts without rail cant, the rail cant may be omitted.

(2) When Standard Type A Vehicles or Commuter Type A Vehicles specified in Section 4.4.2 of this document are used, the value of gauge widening should comply with Table 4.3.3-1.

Table 4.3.3-1 Gauge Widening Values on Curved Sections

Curve Radius R (m)	**Widening Value (mm)**
200≤R＜250	5
150≤R＜200	10

(3) The maximum cant value on curved sections should comply with Table 4.3.3-2, and the allowable cant deficiency should comply with Table 4.3.3-3. Within the effective length of the station platform, the cant should not exceed 15 mm, and the allowable cant deficiency should not exceed 45 mm.

Table 4.3.3-2 Maximum Cant Values

Maximum Operating Speed V (km/h)	**Maximum Value (mm)**
80≤V≤100	120
100＜V≤160	150

Table 4.3.3-3 Allowable Cant Deficiency

Maximum Operating Speed V (km/h)	Normal Condition (mm)	Difficult Condition (mm)
80≤V≤100	61	--
100＜V≤160	61	90

(4) For ballastless track beds on curved sections within tunnel sections and U-shaped structures, the cant may be applied by raising the outer rail by half of the cant value and lowering the inner rail by half of the cant value, or by raising the outer rail by the full cant value. For elevated lines and at-grade lines, the cant may be applied by raising the outer rail by the full cant value. The same method of applying cant should be used throughout the same curve. The maximum cant gradient should comply with Table 4.3.3-4.

Table 4.3.3-4 Maximum Cant Gradient

Maximum Operating Speed V (km/h)	Normal Condition	Difficult Condition
80⩽V⩽100	2‰	2.5‰
100＜V⩽160	1/(9V)	1/(7V), and should not exceed 2‰

(5) The track bed structure type should comply with the following requirements:

(a) Ballastless track beds may be adopted for underground and elevated railway lines. For at-grade railway lines, either ballasted track bed or ballastless track bed may be selected after technical and economical comparisons considering subgrade conditions.

(b) Ballastless track beds may be adopted for tracks inside depot buildings. Ballasted track beds may be adopted for at-grade tracks outside depot buildings, while ballasted track beds or ballastless track beds may be used for elevated or underground tracks outside depot buildings.

(c) Ballastless track beds may be cast-in-place or prefabricated track structures.

(6) Track structure height is related to the type of track bed structure. The track structure height for different locations may meet the following requirements:

(a) For section with ballastless track on the main lines, the track structure height may comply with Table 4.3.3-5.

Table 4.3.3-5 Track Structure Height for Ballastless Track Sections

Structure Type	**Track Structure Height for Cast-in-Place Track (mm)**		**Track Structure Height for Prefabricated Track (mm)**	
	Normal, Resilient Fastener & Sleeper	**Track Bed Vibration Isolation**	**Normal, Resilient Fastener & Sleeper**	**Track Bed Vibration Isolation**
Rectangular Tunnel, Twin-track Horseshoe Tunnel (Invert Backfilled)	560	750	650	750
Single-track Horseshoe Tunnel (Invert Unbackfilled)	650	840	650	840
Single-track Circular Tunnel	760	850	800	850
Bridge	520	650	650	650

Notes:

(i) Values above are based on a circular tunnel of 5.5m internal diameter. Track structure height may be adjusted based on engineering conditions for different internal diameters of tunnels.

(ii) Track structure height for prefabricated track may be adjusted according to the type of prefabricated track structure.

(b) The minimum thickness of the ballasted track bed should comply with the provisions of Clause 7.2.5 of the Code for Design of Metro (GB 50157-2013).

(c) The track structure height for depot lines should comply with Table 4.3.3-6.

Table 4.3.3-6 Track Structure Height for Depot Lines

Structure Type	**Track Structure Height (mm)**
Depot Lines (excluding Test Lines), Ballasted	625
Access/Exit Lines & Test Lines, Ballasted	850
Cast-in-Place Track Bed Structure at Depot	500

Notes:

(i) The heights of the ballasted track structure for access/exit & test lines above are calculated based on consideration of a double-layer track bed. For single-layer track bed, the height should be calculated based on ballast thickness requirements.

(ii) Where prefabricated ballastless tracks are used in depot lines, the value should be adjusted based on the type of prefabricated track bed structure.

(7) The number of fasteners to be installed should comply with Table 4.3.3-7.

Table 4.3.3-7 Quantity of Fasteners Installed

Track Bed Type	**Main Line, Test Line, Access/Exit Lines (pairs/km)**		**Other Auxiliary Lines (pairs/km)**	**Depot Lines (excl. test lines) (pairs/km)**
	Tangent & R>400m, Grade i<20‰	**R≤400m or Grade i≥20‰**		
Ballastless Track Bed	1600～1680	1680～1760	1600～1680	1440
Ballasted Track Bed with Concrete Sleepers (Ordinary)	1600～1680	1680～1760	1600～1680	1440
Ballasted Track Bed with Concrete Sleepers (Continuously Welded Rails)	1680～1760	1760～1840	-	-

Note: "R" is the curve radius; "i" is the line gradient

4.3.4 Track Components

(1) Rails should comply with the following requirements:

(a) 60 kg/m rails should be used for main lines, auxiliary lines, and test lines. 50 kg/m rails should be used for depot lines (excluding test lines).

(b) The tensile strength grade of rails should not be less than 880 MPa, and the rail hardness should not be less than 260 HBW.

(c) For maximum operating speeds not exceeding 100 km/h, heat-treated rails may be used on curved sections of main lines and access/exit lines with radius not exceeding 400 m. For maximum operating speeds exceeding 100 km/h, heat-treated rails may be used on curved sections of main lines and access/exit lines with radius not exceeding 1200 m.

(2) Fastener systems should comply with the following requirements:

(a) Technical requirements for fasteners should comply with Clause 7.3.2 of the Code for Design of Metro (GB 50157-2013) and Clause 9.2.2 of the Code for Design of Suburban Railway (TB 10624-2020).

(b) The types and products of fasteners should be standardised as much as possible for each railway line.

(3) Precast reinforced concrete sleepers should be used in ballastless track bed sections. Prestressed concrete sleepers should be used in ballasted track bed sections.

(4) Turnout structures should comply with the following requirements:

(a) Turnout number should be determined comprehensively based on operational organisation and relevant professional requirements.

(b) Turnouts should preferably be No. 7, No. 9, No. 12 and No. 18 series. Other types of turnout may be chosen according to the project needs.

(c) The types and products of turnouts should be standardised as much as possible for each railway line.

4.3.5 Track Bed Structure

(1) Track bed structures should comply with the provisions of Section 7.4 of the Code for Design of Metro (GB 50157-2013) and Sections 9.3 - 9.5 of the Code for Design of Suburban Railways (TB 10624-2020).

(2) If prefabricated track structures are used for ballastless track beds, the following requirements should be met:

(a) The requirements for standardised design, factory production, construction assembly, and information management should be satisfied.

(b) The track bed structure may comprise precast slabs, an isolation layer, a filling layer, a base slab, restraining structure, etc. The base slab may be omitted for underground and elevated railway lines.

(c) The concrete strength grade for precast concrete slabs should not be lower than C50, prestressed or non-prestressed structures may be used.

4.3.6 Continuously Welded Rail (CWR) Line

(1) CWR line design should comply with Section 7.5 of the Code for Design of Metro (GB 50157-2013) and Section 9.7 of the Code for Design of Suburban Railways (TB 10624-2020).

(2) CWR line extending across track sections may be used for main lines. The connection between the straight stock rail of turnouts, between turnouts and standard rails, and between standard rails and CWR should use insulated joints (freezing) or welding.

(3) Flash-butt welding should be the primary method for rail welding on main lines. Thermit welding may be used within turnouts and for compromise joints.

4.3.7 Vibration Mitigation Track Structures

(1) The locations and schemes of vibration and noise mitigation track structures shall be determined based on the EIA report for the project.

(2) Track vibration mitigation measures are generally categorised into three types: fastener-based mitigation, sleeper-based mitigation, and track bed-based mitigation. The appropriate measure should be selected according to the requirements of the EIA report for the project.

4.3.8 Track Safety and Auxiliary Equipment

(1) The requirements for installation of guard rails for anti-derailment of elevated railway lines should comply with Clause 7.7.1 of the Code for Design of Metro (GB 50157-2013).

(2) Buffer stops should be provided at the end of tracks and should comply with the following requirements:

(a) Sliding hydraulic buffer stops should be used at the ends of main lines, auxiliary lines, test lines, and shunting lines. The allowable impact speed is 25 km/h. The length of track occupied by the buffer stop should be precisely configured based on both loaded and unloaded vehicle conditions. In special cases, this may be determined by calculations according to the requirements for vehicles, signalling and other systems.

(b) Fixed hydraulic buffer stops or friction wheel stops should be used at the ends of tracks inside depots. Fixed hydraulic buffer stops should be used at the ends of track outside depots. The allowable impact speed for buffer stops outside depots should not be less than 5 km/h. The allowable impact speed for buffer stops inside depots should not be less than 3 km/h.

(3) The installation of trackside and signalling signage should comply with Clause 7.7.3 of the Code for Design of Metro (GB 50157-2013).

4.4 Rolling Stock

4.4.1 Reference Standards

The design of rolling stock shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Telecommunications Ordinance (Cap.106)

Relevant Technical Standards

(2) Practice Note for Managing Air Quality in Air-conditioned Public Transport Facilities - Railways published by Environmental Protection Department.

(3) General Technical Specification for Metro Vehicles (GB/T 7928-2025)

(4) General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019)

(5) Rules for Inspecting and Testing of Urban Rail Transit Vehicles after Completion of Construction (GB/T 14894-2025)

(6) Railway Applications - Environmental Conditions for Equipment - Part 1: Equipment on Board Rolling Stock (GB/T 32347.1-2015)

(7) Bodyside Entrance Systems for Urban Rail Transit Vehicle (GB/T 30489-2024)

(8) Acoustics - Measurement of Noise Inside Railbound Vehicles (GB/T 3449-2011)

(9) Acoustics-Measurement of Noise Emitted by Railbound Vehicles (GB/T 5111-2024)

(10) Railway Applications - Rolling Stock Equipment-Shock and Vibration Tests (GB/T 21563-2018)

(11) Railway applications - Testing of Rolling Stock on Completion of Construction and before Entry into Service (GB/T 44991-2025)

(12) Railway Applications - Environmental Conditions for Equipment - Part 1: Equipment on Board Rolling Stock (IEC 62498-1)

(13) Railway Applications - Ride Comfort for Passengers - Measurement and Evaluation (EN 12299)

(14) Railway Applications - Vehicle Reference Masses (EN 15663)

(15) Railway Applications - Electrical Lighting for Rolling Stock in Public Transport Systems (EN 13272)

(16) Railway Applications - Electromagnetic Compatibility - Part 3-1: Rolling Stock - Train and Complete Vehicle (EN 50121-3-1)

(17) Railway Applications - Electromagnetic Compatibility - Part 3-2: Rolling Stock – Apparatus (EN 50121-3-2)

(18) Railway Applications - Fire Protection on Railway Vehicles (EN 45545)

(19) Railway Applications - Welding of Railway Vehicles and Components (EN 15085)

(20) Railway Applications - Bodyside Entrance Systems for Rolling Stock (EN 14752)

(21) Railway Applications - Rolling Stock Equipment - Shock and Vibration Tests (IEC 61373)

4.4.2 Terminology

(1) Standard Type A Vehicles:

Vehicles for medium/short-haul rapid transit systems for passenger transportation, with a basic width of 3000mm and a maximum operating speed below 120 km/h.

(2) Commuter Type A Vehicles:

Vehicles for medium/long-haul rapid transit systems for passenger transportation. Basic width is 3000mm, with a maximum operating speed between 120 km/h and 160 km/h.

4.4.3 General Requirements

(1) The maximum operating speeds for railway lines and vehicles in Hong Kong should be set at 80 km/h, 100 km/h, 120 km/h, 140 km/h, or 160 km/h. When adopting other maximum operating speeds, the relevant technical requirements shall be separately determined with the manufacturer as appropriate.

(2) The vehicle type for new railways in Hong Kong should be determined through comprehensive comparison based on predicted passenger flow, environmental conditions, line conditions, transport capacity, etc. so as to confirm the technical specifications of the vehicles (including dimensions, carrying capacity, maximum operating speed, etc.). Reference may be made to the General Technical Specification for Metro Vehicles (GB/T 7928-2025) and General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019) in selecting the most suitable vehicle type. This document sets out the relevant technical parameters for reference based on vehicle types similar to those currently in use locally (namely Standard Type A Vehicles and Commuter Type A Vehicles). If a different vehicle type is selected, appropriate adjustments may be made following a comprehensive assessment of the relevant factors.

(3) This Section specifies the general technical requirements for complete vehicles (including all vehicles types used in the Hong Kong railway system) and major components. Specific technical requirements and applicable standards for complete vehicles and individual components should be separately agreed in the contract between users and manufacturers.

4.4.4 Environmental Conditions

(1) The operating environmental conditions of the vehicles should comply with Railway Applications - Environmental Conditions for Equipment - Part 1: Equipment on Board Rolling Stock (GB/T 32347.1-2015) or the Railway Applications - Environmental Conditions for Equipment - Part 1: Equipment on Board Rolling Stock (IEC 62498-1).

(2) Ambient temperature should comply with the Railway Applications - Environmental Conditions for Equipment - Part 1: Equipment on Board Rolling Stock (GB/T 32347.1-2015), or air temperature class T5 and reference temperature class TR2 of the Railway Applications -

Environmental Conditions for Equipment - Part 1: Equipment on Board Rolling Stock (IEC 62498-1).

(3) Users and manufacturers may specify the environmental conditions separately in the contract.

4.4.5 Vehicle Type and Train Formation

Vehicle type and train formation should comply with the requirements of Clauses 7.1 and 7.2 of the General Technical Specification for Metro Vehicles (GB/T 7928-2025) and Clauses 7.1 and 7.2 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

4.4.6 Design Life

The design life of the carbody should comply with the requirements of Clause 6.25 of the General Technical Specification for Metro Vehicles (GB/T 7928-2025) and Clause 7.1 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

4.4.7 Major Specifications and Dimensions

(1) The major specifications and dimensions of Standard Type A Vehicles should comply with the technical specifications in Table 1 of the General Technical Specification for Metro Vehicles (GB/T 7928-2025).

(2) The major specifications and dimensions of Commuter Type A Vehicles should comply with the technical specifications in Table 1 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

(3) If the user selects other vehicle types, the main specifications and dimensions should be agreed in the contract between the user and

manufacturers.

4.4.8 Vehicle Loads

(1) Vehicles should fulfil the following load requirements (assuming an average passenger weight of 65 kg):

Table 4.4.8 Vehicle load requirements

Load	Definition	Applicable Scenario
AW0	Tare load	Traction train load for rescue condition
AW1	Rated load: AW0 + Seated load + Standing load (4 persons/m²)	Calculation of vehicle load for fleet size
AW2	Rated peak load: AW0 + Seated load + Standing load (6 persons/m²)	Rated structural load; Failed train load in rescue condition; Train evacuation; Air-conditioning and ventilation calculation; Traction calculation; Thermal capacity of frictional brake
AW3	Crush load: AW0 + Seated load + Standing load (8.4 persons/m²)	Axle load; Structural failure calculation; Emergency braking; Gauge calculation; Dynamic performance calculation

(2) The calculation of standing area within passenger compartments should be performed in accordance with Railway Applications - Vehicle Reference Masses (EN 15663).

4.4.9 Traction and Braking Performance

(1) The vehicle performance of the railway lines with a maximum operating speed below 120 km/h should comply with the requirements of Clauses 6.10 - 6.13 of the General Technical Specification for Metro Vehicles (GB/T 7928-2025).

(2) The vehicle performance of the railway lines with a maximum operating speed of 120 km/h to 160 km/h should comply with the requirements of Clauses 6.2.1 - 6.2.4 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

4.4.10 Operation Capability of Failed Train

On dry tracks and within allowable adhesion limits, the operation capability of failed train is classified into four conditions as follows:

(1) Under AW2 load, the trains should be able to complete a one-way trip with power loss of not more than 1/4.

(2) Under AW2 load, for trains with a motor-to-trailer ratio (M:T) of 1:1 and a power loss of 1/2, the trains should be able to start on a ramp of 30‰ gradient and travel to the nearest station.

(3) Under AW2 load, for trains with a M:T ratio ≥ 2:1 and a power loss of 1/2, the trains should be able to start on a ramp of 35‰ gradient and travel to the nearest station.

(4) Under AW0 load, the trains should be able to start on a ramp of 35‰ gradient and return to the depot with a power loss of not more than 1/2.

4.4.11 Train Rescue Capability

On dry tracks and within allowable adhesion limits, the rescue capability on ramp is classified into three conditions as follows:

(1) One train under AW0 load with a motor-to-trailer ratio (M:T) of 1:1 should be able to move another unpowered train under AW2 load with identical formation on a ramp of 30‰ gradient to the nearest station.

(2) One train under AW0 load with a M:T ratio ≥ 2:1 should be able to move another unpowered train under AW2 load with identical formation that is stopped on a ramp of 35‰ gradient to the nearest station.

(3) One train under AW0 load should be able to move another unpowered train under AW0 load with identical formation that is stopped on a ramp of 35‰ gradient back to the depot.

4.4.12 Noise Level Requirements

(1) Interior Noise Levels

(a) Testing of interior noise should be carried out in accordance with the provisions of the Acoustics - Measurement of Noise Inside Railbound Vehicles (GB/T 3449-2011) or the Railway Applications – Acoustics - Noise Measurement Inside Railbound Vehicles (ISO 3381).

(b) Noise Level under Stationary Condition:

(i) The noise level measured in a passenger compartment of a stationary train in a free sound field with all auxiliary equipment in normal operation should not exceed 65 dB(A).

(c) Noise Level of Train Operating on Above-ground Tracks:

(i) The noise level measured in passenger compartment of a train under normal acceleration, coasting (not more than 80 km/h) or braking should not exceed 70 dB(A). When the train speed exceeds 80 km/h, the noise level should be determined in accordance with project requirements through agreement between the user and the manufacturer.

(d) Noise Level of Train Operating on Underground Track:

(i) The noise level measured in passenger compartment of a train under normal acceleration, coasting (not more than 80 km/h) or braking should not exceed 79 dB(A). When the train speed exceeds 80 km/h, the noise level should be determined in accordance with project requirements through agreement between the user and the manufacturer.

(2) Exterior Noise Levels

(a) Testing of exterior noise should be carried out in accordance with the provisions of the Acoustics - Measurement of Noise Emitted by Railbound Vehicles (GB/T 5111-2024) or the Acoustics - Railway Applications - Measurement of Noise Emitted by Railbound Vehicles (ISO 3095).

(b) The noise level of a stationary train should not exceed 65 dB(A).

(c) For trains with a maximum operating speed of 80 km/h, the exterior noise level at maximum speed should not exceed 80 dB(A).

(d) For trains with maximum operating speeds of 100 km/h, 120 km/h, 140 km/h, and 160 km/h, the exterior noise level should comply with the requirements in Table 6.1.10 of the Code for Design of Suburban Railway (TB 10624-2020).

4.4.13 Operating Quality

(1) The testing for the average comfort index of an operating train should follow the Railway Applications - Ride Comfort for Passengers - Measurement and Evaluation (EN 12299).

(2) When air springs are inflated, the average comfort index should reach 2.5 for all operating conditions of trains operating at the maximum operating speed.

(3) When air springs fail on one bogie of a single train car, the average comfort index should reach 2.5 for all operating conditions of trains operating at a speed up to 80 km/h.

(4) When air springs fail on both bogies of a single train car, the average comfort index should reach 2.5 for all operating conditions of trains operating at a speed up to 50 km/h.

4.4.14 Vehicle Air Tightness

(1) For non-airtight trains with doors, windows and air-conditioning external openings closed, the time taken for a change in the internal air pressure by 1000 Pa should not be less than 1 s. For a change of 1600Pa, the time should not be less than 4 s. For a change of 2000Pa, the time should not be less than 10 s.

(2) The requirements for airtight train should comply with the requirements of Clause 6.1.11 of the Code for Design of Suburban Railways (TB 10624-2020).

4.4.15 Lighting for Passenger Compartment

(1) All lighting should be LED fixtures.

(2) Normal lighting requirements: The average illuminance at 800 mm above the floor should be between 350 lx and 450 lx, and the minimum illuminance should not be less than 300 lx.

(3) Emergency lighting requirements: The illuminance at floor level should not be less than 60 lx.

(4) In addition to the above requirements, the lighting of passenger compartment should also comply with the requirements of the Railway Applications - Electrical Lighting for Rolling Stock in Public Transport Systems (EN 13272).

4.4.16 Electromagnetic Compatibility (EMC)

(1) Train EMC should comply with the requirements of Chapter 15 of the General Technical Specification for Metro Vehicles (GB/T 7928-2025), and Chapter 18 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

(2) Based on actual needs, users may also adopt standards set out in the Railway Applications - Electromagnetic Compatibility - Part 3-1: Rolling Stock - Train and Complete Vehicle (EN 50121-3-1) and the Railway Applications - Electromagnetic Compatibility - Part 3-2: Rolling Stock – Apparatus (EN 50121-3-2).

4.4.17 Vibration and Shock

The vibration and shock tests for all vehicle equipment should comply with the provisions of the Railway Applications-Rolling Stock Equipment-Shock and Vibration Tests (GB/T 21563-2018) or the Railway Applications - Rolling Stock Equipment - Shock and Vibration Tests (IEC 61373).

4.4.18 Safety Requirements

(1) Fire Protection:

(a) The fire protection measures and requirements of vehicles should comply with the Railway Applications - Fire Protection on Railway Vehicles (EN 45545).

(2) Emergency Evacuation:

(a) Standard Type A Vehicles should be equipped with emergency end doors. The technical requirements of end doors should comply with the requirements of the Project Code for Engineering of Urban Rail Transit (GB 55033-2022).

(3) Safety facilities should comply with the requirements of Chapter 16 of the General Technical Specification for Metro Vehicles (GB/T 7928-2025) and Chapter 17 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

4.4.19 General Technical Requirements for Major Components

(1) Carbody

(a) The technical requirements of carbody should comply with the requirements of Clause 8.1 of the General Technical Specification for Metro Vehicles (GB/T 7928-2025), Clauses 6.2.12 and 8.1 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

(b) The welding of carbody should comply with the requirements of the Railway Applications Welding of Railway Vehicles and Components (EN 15085).

(2) Passenger Compartment

(a) The passenger compartments of all railway vehicles, regardless of operating speed, should comply with the requirements of Clause 8.3 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

(3) Side Doors of Passenger Compartment

(a) The side doors of passenger compartments of all railway vehicles , regardless of operating speed, should comply with the requirements of Clauses 8.4.1 - 8.4.3 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

(b) The classification, usage conditions, requirements, test methods, inspection rules, etc. for the side doors of passenger compartment should comply with the Bodyside Entrance Systems for Urban Rail Transit Vehicle (GB/T 30489-2024) or Railway Applications - Bodyside Entrance Systems for Rolling Stock (EN 14752).

(4) Gangways

(a) The gangways of all railway vehicles, regardless of operating speed, should comply with the requirements of Clause 8.5 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

(5) Bogies

(a) The bogies of all railway vehicles, regardless of operating speed, should comply with the requirements of Chapter 9 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

(6) Couplers

(a) The couplers of all railway vehicles, regardless of operating speed, should comply with the requirements of Clause 7.3 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

(7) Traction System

(a) The traction system of all railway vehicles, regardless of operating speed, should comply with the requirements of Chapter 10 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

(8) Auxiliary Power Supply System

(a) The auxiliary power supply system of all railway vehicles, regardless of operating speed, should comply with the requirements of Chapter 11 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

(9) Train Control and Management System

(a) The train control and management system of all railway vehicles, regardless of operating speed, should comply with the requirements of Chapter 12 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

(10) Braking and Air Supply System

(a) For railway vehicles with a maximum operating speed below 120 km/h, the braking and air supply systems should comply with the requirements of Chapter 10 of the General Technical Specification for Metro Vehicles (GB/T 7928-2025).

(b) For railway vehicles with a maximum operating speed between 120 km/h - 160 km/h, the braking and air supply systems should comply with the requirements of Chapter 13 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

(11) Environmental Control System

(a) The cooling capacity of vehicles should maintain an indoor temperature of cabin of ≤25°C ±2°C and a relative humidity of ≤65%. These requirements should be met under the following design ambient conditions: a temperature of 32°C and a relative humidity is 75%for at-grade or elevated sections; and a temperature of 35°C and a relative humidity is 65% for tunnel sections.

(b) The environmental control system of all railway vehicles, regardless of operating speed, should comply with the requirements of Clauses 14.2 – 14.7 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

(c) The design of the environmental control system should comply with the requirements of the Practice Note for Managing Air

Quality in Air-conditioned Public Transport Facilities - Railways published by Environmental Protection Department.

(12) In-train Public Address System & Passenger Information System

(a) The public address system and passenger information system of all railway vehicles, regardless of operating speed, should comply with the requirements of Chapter 15 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

4.4.20 Inspection and Acceptance

(1) The testing and inspection of vehicles should comply with the requirements of the Railway applications - Testing of Rolling Stock on Completion of Construction and before Entry into Service (GB/T 44991-2025).

(2) The vehicle should complete all necessary testing and inspections, and should also comply the requirements of relevant Government departments including the Electrical and Mechanical Services Department.

4.4.21 Other

(1) With a view to controlling the whole-life cycle costs, reducing the provision of the maintenance facility, and lowering the maintenance costs of vehicles, it is recommended to equip the trains with smart facilities such as Train Health Management Systems, Overhead Catenary Inspection Devices, Track Inspection Devices, and Pantograph-Catenary Interaction Monitoring Devices. The user and manufacturer should agree on the details of implementation in the contract.

(2) Vehicle identification, transportation, and quality assurance for all railway vehicles, regardless of operating speed, should refer to Chapter

20 of the General Technical Specification for 120 km/h ~ 160 km/h Commuter Express of Urban Rail Transit Vehicles (GB/T 37532-2019).

4.5 Environmental Control System

4.5.1 Reference Standards

The design of environmental control system shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Fire Service Ordinance (Cap. 95)

(2) Buildings (Energy Efficiency) Regulation (Cap. 123 sub. leg. M)

(3) Buildings (Construction) Regulation (Cap. 123 sub. leg. Q)

(4) Public Health and Municipal Services (Cap. 132)

(5) Air Pollution Control Ordinance (Cap. 311)

(6) Energy Efficiency (Labelling of Products) Ordinance (Cap. 598)

(7) Buildings Energy Efficiency Ordinance (Cap. 610)

(8) District Cooling Services Ordinance (Cap. 624)

Relevant Technical Standards

(9) Code of Practice for Fire Safety in Buildings 2011 published by Buildings Department

(10) Circular Letter 3/2025 - Fire Safety Requirements for Battery Rooms and Electrical Charging Facilities published by Fire Services Department

(11) Code of Practice for Energy Efficiency of Building Services Installation published by Electrical and Mechanical Services Department

(12) Code of Practice for Building Energy Audit published by Electrical and

Mechanical Services Department

(13) Technical Guidelines on Code of Practice for Energy Efficiency of Building Services Installation published by Electrical and Mechanical Services Department

(14) Technical Guidelines on Code of Practice Building Energy Audit published by Electrical and Mechanical Services Department

(15) Technical Guidelines on Connection to District Cooling System published by Electrical and Mechanical Services Department

(16) Code of Practice for Prevention of Legionnaires' Disease published by Committee on Prevention of Legionnaires' Disease

(17) General Code for Energy Efficiency and Renewable Energy Application in Buildings (GB 55015-2021)

(18) General Code for Building Environment (GB 55016-2021)

(19) General Code for Fire Protection Facilities (GB 55036-2022)

(20) General Code for Fire Protection in Buildings and Constructions (GB 55037-2022)

(21) Standard for Fire Protection Design of Metro (GB 51298-2018)

(22) Code for Fire Protection Design of Buildings (GB 50016-2014)

(23) Design Standard for Energy Efficiency of Public Buildings (GB 50189-2015)

(24) Technical Standard for Smoke Management Systems in Buildings (GB 51251-2017)

(25) Design Code for Heating Ventilation and Air Conditioning of Civil Buildings (GB 50736-2012)

(26) Standard for Design of Ventilation, Air Conditioning and Heating of Urban Rail Transit (GB/T 51357-2019)

(27) Safety Performance Test and Assessment Method for Metro Disaster

Prevention System (GB/T 43392-2023)

4.5.2 General Requirements

(1) This Section applies to the design of environmental control systems for concourses, platforms, equipment and management rooms, entrance/exit passages, interchange passages, and tunnel sections in new local and cross-boundary railways.

(2) The environmental control system should ensure that the temperature, humidity, airflow velocity, air quality, pressure variations, airflow organisation, and operational noise levels meet the requirements for personnel comfort and normal operation of equipment.

(3) The functions of environmental control system should comply with the following provisions:

(a) During normal operation, the environmental control system should control the indoor air environment within prescribed range of standards.

(b) In the event of a fire, the environmental control system should be able to fulfil the functional requirements for smoke prevention and smoke extraction.

(c) In the event of a train congestion in the tunnel, the environmental control system should provide effective ventilation to the congested section.

(4) This Section takes the national railway standards as the main basis and benchmark, with optimisation and adjustment with Hong Kong legislation, Government documents and engineering standards to suit the needs of Hong Kong railway, and comply with the principles of safety and applicability, economic rationality, and technical advancement.

4.5.3 Air-conditioning and Ventilation

(1) Air-conditioning and ventilation system design should take the Code for Design of Metro (GB 50157-2013), the Standard for Design of Ventilation, the Air Conditioning and Heating of Urban Rail Transit (GB/T 51357-2019), and the Design Code for Heating Ventilation and Air Conditioning of Civil Buildings (GB 50736-2012) as the baseline requirements, with local adaptations to comply with the requirements of various regulations and codes of the Government.

(2) The design outdoor air temperature standard for tunnel ventilation should comply with the requirements of Clause 3.2.1 of the Standard for Design of Ventilation, Air Conditioning and Heating of Urban Rail Transit (GB/T 51357-2019).

(3) The outdoor air design parameters for underground station public areas should comply with the requirements of Clause 3.2.2 of the Standard for Design of Ventilation, Air Conditioning and Heating of Urban Rail Transit (GB/T 51357-2019).

(4) The outdoor air design parameters for station equipment and management rooms, and above-ground station public areas should comply with the requirements of Clause 3.2.3 of the Standard for Design of Ventilation, Air Conditioning and Heating of Urban Rail Transit (GB/T 51357-2019) and Clauses 4.1.3, 4.1.6 - 4.1.9 of the Design Code for Heating Ventilation and Air Conditioning of Civil Buildings (GB 50736-2012).

(5) Indoor Air Design Parameters for Tunnel Sections

(a) The maximum summer daily average air temperature inside tunnel sections should not exceed 35°C.

(b) The winter average air temperature inside tunnel sections should not exceed the natural temperature of the local stratum, but the minimum air temperature should not be lower than 5°C.

(6) Indoor Air Design Parameters for Station Public Areas

(a) Summer indoor design parameters for public areas in underground stations and enclosed air-conditioned stations:

(i) Concourse: Indoor air dry-bulb temperature ≤ 26°C, relative humidity < 65%

(ii) Platform: Indoor air dry-bulb temperature ≤ 25°C, relative humidity < 65%

(b) Winter maximum indoor temperature for station public areas should not exceed 21°C.

(7) Indoor Air Design Parameters for Station Equipment and Management Rooms

(a) Summer indoor dry-bulb air temperature for staff rooms may be 25°C, relative humidity 45-65%.

(b) Summer indoor dry-bulb air temperature for electrical rooms except substations may be 25°C, relative humidity 45-65%.

(c) Summer indoor design temperature for substation equipment rooms may be 40°C.

(d) Air change rate for ventilated rooms except toilets and refuse chambers may not be less than 8 Air Change per Hour (ACH).

(e) Air change rate for refuse chambers should not be less than 15 ACH.

(f) Air change rate for toilets should not be less than 20 ACH.

(g) Standby air-conditioning systems should be provided for critical equipment rooms (e.g., communications, signalling), station control room, critical electrical control rooms (e.g. substations, various equipment control rooms, etc.). The standby air-conditioning systems should ensure that the system can continue to operate at full capacity in the event of a failure of any one equipment.

(8) Fresh Air Standards

(a) Fresh air volume per passenger in tunnel sections should not be less than 20 m^3/h.

(b) Fresh air volume per passenger in station public areas should not be less than 20 m^3/h.

(c) Air-conditioned fresh air volume per staff member in equipment and management rooms should not be less than 30 m^3/h.

(9) Indoor Air Quality Standards

(a) Hourly average CO_2 concentration in tunnel sections and station public areas should be less than 0.15%.

(b) Hourly average CO_2 concentration in station equipment and management rooms should be less than 0.10%.

(c) Daily average PM_{10} concentration in station public areas should be less than 0.25 mg/m^3.

(d) Daily average PM_{10} concentration in equipment and management rooms should be less than 0.15 mg/m^3.

(e) Annual average $PM_{2.5}$ concentration in station public areas and equipment and management rooms should be less than 12 $\mu g/m^3$.

(10) When air temperature in the track area cannot support the normal operation of air-conditioning in trains, underground stations may consider the installation of an exhaust system with air-balance adjustment capability above heat-emitting components of trains stopped at the station, and the installation of air supply system in the track area may not be necessary.

(11) If freshwater cooling towers are proposed as heat rejection devices for chiller plants, a comprehensive assessment on criteria including the availability of freshwater source, approval procedures of relevant authorities, noise impact, equipment space, and water treatment requirements must be conducted. The use of freshwater cooling towers

in a project can only be confirmed for use after obtaining formal approval from the relevant authorities.

4.5.4 Smoke Prevention, Smoke Extraction, and Emergency Ventilation

(1) Unless otherwise specified in Clause 4.5.4 of this document, smoke prevention and extraction design should comply with the requirements of the Code for Design of Metro (GB 50157-2013), the Standard for Fire Protection Design of Metro (GB 51298-2018), and the Code of Practice for Fire Safety in Buildings 2011 published by Buildings Department.

(2) During the application process of the national railway standards in the smoke prevention and extraction design, a comprehensive risk assessment should be conducted if any areas of the fire safety in the national railway standards could not be put into application. Optimised solutions should be proposed to ensure that the fire safety level is not affected and the integrity of the fire safety design is maintained. Only upon the approval of the relevant authorities, the optimised solutions can be put into implementation.

(3) The smoke prevention and smoke extraction design for a single line, an interchange station, and its adjacent sections may consider a single fire event occurring at a single location at any one time, and should comply with the requirements of Clause 1.0.3 of the Standard for Fire Protection Design of Metro (GB 51298-2018).

(4) Locations requiring the provision of smoke extraction facilities should comply with the requirements of Clause 8.1.1 of the Standard for Fire Protection Design of Metro (GB 51298-2018).

(5) Locations requiring the provision of smoke prevention facilities should comply with the requirements of Clause 8.1.2 of the Standard for Fire Protection Design of Metro (GB 51298-2018) and Clauses 3.1.4 and 3.1.6 of the Technical Standard for Smoke Management Systems in Buildings (GB 51251-2017).

(6) Mechanical smoke prevention systems and mechanical smoke extraction systems may be combined with normal ventilation systems, but the combined systems should comply with the provisions of Clause 8.1.4 of the Standard for Fire Protection Design of Metro (GB 51298-2018).

(7) The airflow rate for smoke extraction fans and ducts should comply with the following provisions:

(a) For spaces with clear height ≤ 6m, calculations should be based on the construction floor area of a smoke zone with 60 $m^3/(m^2 \cdot h)$. For station public areas with clear height > 6m, calculation of smoke extraction rate should be based on the design fire size.

(b) Where a smoke zone includes the track area, calculation of smoke extraction rate should be based on the design fire size of the trains.

(c) Platform areas in underground stations should be treated as a single smoke zone. The smoke extraction rate at the platform, besides meeting sub-clauses (a) and (b) above, should ensure a downward airflow velocity of not less than 1.5 m/s at the stair/escalator openings between the concourse and platform.

(8) Smoke extraction fans, makeup air fans, and pressurisation fans should be located in separate plant rooms and should comply with the provisions of Clause 8.4.1 of the Standard for Fire Protection Design of Metro (GB 51298-2018).

(9) Smoke extraction ducts and their connectors should maintain structural integrity for 1 hour at 250°C.

(10) Smoke extraction fans for underground stations should be able to operate continuously for not less than 1 hour in an environment of not less than 250°C. Smoke extraction fans for underground sections should be able to operate for not less than the maximum passenger evacuation time required for the section, and continuously for not less than 1 hour in an environment of not less than 250°C. Auxiliary equipment in the smoke extraction system with smoke passing through (including the

dampers, silencers, flexible connectors, etc.) should possess temperature resistance not inferior to that of the smoke extraction fans.

(11) Tunnel ventilation fans, smoke extraction fans, pressurisation fans and make-up air fans may not be provided with standby fans. A single smoke extraction fan or make-up air fan may serve multiple smoke zones, provided these zones should belong to the same fire compartment.

(12) In the event of a train congestion in the tunnel, the ventilation requirements should comply with the provisions of Clause 4.2.4 of the Standard for Design of Ventilation, Air Conditioning and Heating of Urban Rail Transit (GB/T 51357-2019).

4.6 Water Supply and Drainage System

4.6.1 Reference Standards

The design of water supply and drainage system shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Fire Services Ordinance (Cap.95)

(2) Buildings (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulation (Cap.123 sub. leg. I)

(3) Water Pollution Control (Sewerage) Regulation (Cap. 358 sub. leg. AL)

(4) Waterworks Ordinance (Cap.102)

(5) Waterworks Regulations (Cap.102, Sub. A)

Relevant Technical Standards

(6) Technical Requirements for Plumbing Works in Buildings published by Water Supplies Department

(7) Sewerage Manual published by Drainage Services Department

(8) Stormwater Drainage Manual published by Drainage Services Department

(9) Structures Design Manual for Highways and Railways (2013 Edition) published by Highways Department

(10) Code of Practice for Fire Safety in Buildings 2011 published by Buildings Department

(11) Guidelines on Formulating Fire Safety Objectives for New Railway Infrastructures published by Fire Services Department

(12) Circular Letter 3/2025 - Fire Safety Requirements for Battery Rooms and Electrical Charging Facilities published by Fire Services Department

(13) Project Code for Urban Water Supply Engineering (GB 55026-2022)

(14) Project Code for Urban and Rural Sewerage (GB 55027-2022)

(15) General Code for Fire Protection Facilities (GB 55036-2022)

(16) General Code for Fire Protection in Buildings and Constructions (GB 55037-2022)

(17) General Code for Design of Building Water Supply and Drainage and Water Saving (GB 55020-2021)

(18) General Code for Energy Efficiency and Renewable Energy Application in Buildings (GB 55015-2021)

(19) Standard for Fire Protection Design of Metro (GB 51298-2018)

(20) Code for Fire Protection Design of Buildings (GB 50016-2014)

(21) Standard for Design of Outdoor Water Supply Engineering (GB 50013-2018)

(22) Standard for Design of Outdoor Wastewater Engineering (GB 50014-2021)

(23) Standard for Design of Building Water Supply and Drainage (GB 50015-2019)

(24) Technical Code for Fire Protection Water Supply and Hydrant Systems (GB 50974-2014)

(25) Code for Design of Sprinkler Systems (GB 50084-2017)

(26) Technical Code for Water Mist Fire Protection Systems (GB 50898-2013)

(27) Code for Design of Gas Fire Extinguishing Systems (GB50370-2005)

(28) Code for Design of Extinguisher Distribution in Buildings (GB 50140-2005)

(29) Technical Standard for Water Supply and Drainage System of Urban Rail Transit (GB/T 51293-2018)

4.6.2 General Requirements

(1) This Section takes the national railway standards as the main basis and benchmark, with optimisation and adjustment with Hong Kong legislation, Government documents and engineering standards to suit the needs of Hong Kong railway, and comply with the principles of safety and applicability, economic rationality, and technical advancement.

(2) During the application process of the national railway standards in the water supply design for firefighting, a comprehensive risk assessment should be conducted if any areas of the fire safety in the national railway standards could not be put into application. Optimised solutions should be proposed to ensure that the fire safety level is not affected, and safeguard the integrity of the fire safety design. Only upon the approval of the relevant authorities, the optimised solutions can be put into implementation.

(3) The water supply and drainage systems may preferably be designed for automated management.

4.6.3 Water Supply

(1) Water supply systems should fully utilise the water pressure from the water supply network for direct water supply. Where the water pressure and/or flow from the water supply network are insufficient, means of water storage regulation and pressurised water supply should be adopted based on the principles of hygienic safety, economy, and energy efficiency.

(2) Protection measures against backflow pollution in water supply systems should comply with the provisions of Section 3.3 of the Standard for Design of Building Water Supply and Drainage (GB 50015-2019) and Clause 4.2.3 of the Technical Requirements for Plumbing Works in Buildings published by Water Supplies Department.

(3) The water consumption demand for the water supply systems of stations and sections should comply with the provisions of Clause 14.2.1 of the Code for Design of Metro (GB 50157-2013). The water consumption demand for water supply systems of depot should comply with the provisions of Clause 14.4.1 of the Code for Design of Metro (GB 50157-2013).

(4) The installation of pipes and fittings should comply with the following provisions:

(a) For indoor domestic and service water supply pipes, ductile iron pipes, steel-plastic composite pipes, copper pipes, thin-wall stainless steel pipes, etc. may be used. For outdoor domestic and service water supply pipes, ductile iron pipes may be used. The materials of valves and fittings on the pipeline network may be compatible with the pipe materials.

(b) Pipes, valves, and fittings for flushing water should be suitable for saltwater.

(c) For provisions not specified in this Section, reference may be made to the requirements of the Technical Requirements for Plumbing Works in Buildings published by Water Supplies Department.

4.6.4 Drainage

(1) Drainage flow demand should comply with the following provisions:

(a) The standards for production and domestic wastewater discharge, as well as washwater and firefighting wastewater discharge for stations and sections, should comply with the provisions of Clause 14.3.1 in the Code for Design of Metro (GB 50157-2013).

(b) The standards for production and domestic wastewater discharge, as well as washwater and firefighting wastewater discharge for depots, should comply with the provisions of Clause 14.4.10 in the Code for Design of Metro (GB 50157-2013).

(c) The design return period and rainfall duration for roof drainage pipelines of at-grade and elevated stations, as well as the drainage capacity of stormwater pumping stations, drainage ditches, and drainage channels for elevated sections, open entrances/exits, open ventilation shafts, and tunnel portals, should comply with the provisions of Clause 14.3.1 in the Code for Design of Metro (GB 50157-2013).

(d) The design return period for roof drainage pipelines of depots should comply with the provisions of Clause 14.4.10 in the Code for Design of Metro (GB 50157-2013).

(e) For other above-ground facilities, unless otherwise specified, where a gravity drainage system is adopted for site rainwater drainage, the design return period adopted in the drainage pipelines works for site stormwater should comply with the provisions of Section 6.6 in the Stormwater Drainage Manual published by Drainage Services Department.

(2) Selection of Pipe Materials should comply with the following provisions:

(a) For gravity flow drainage pipes in stations, tunnels and depots, flame-retardant rigid unplasticized polyvinyl chloride (uPVC) drainage pipes and fittings, or flexible cast iron drainage pipes and fittings may be used. For pressure drainage pipes, hot-dip galvanised steel pipes or steel-plastic composite pipes may be used. For siphonic pressure flow drainage pipes, pressure-rated plastic pipes or stainless steel pipes may be used. For outdoor buried drainage pipes, reinforced concrete pipes or buried plastic pipes may be used.

(b) Drainage pipes, valves, and fittings for flushing water should be suitable for saltwater.

(c) For provisions not specified in this Section, reference may be made to the requirements to the Sewerage Manual and the Stormwater Drainage Manual published by Drainage Services Department.

(3) The selection of the model and construction requirements for the septic tanks in the drainage system should comply with the provisions of Section 4.10 of the Standard for Design of Building Water Supply and Drainage (GB 50015-2019).

4.6.5 Water Supply for Firefighting and Extinguishing

(1) The installation locations of outdoor fire hydrant systems should comply with the provisions of Clause 7.2.1 in the Standard for Fire Protection Design of Metro (GB 51298-2018).

(2) The installation locations of indoor fire hydrant systems in stations and sections should comply with the provisions of Clause 7.3.1 in the Standard for Fire Protection Design of Metro (GB 51298-2018). The installation locations of indoor fire hydrant systems in depots should comply with the provisions of Section 8.2 in the Code for Fire Protection Design of Buildings (GB 50016-2014).

(3) Where the water supply, consisting of dual water sources with sufficient flow rate and pressure, fulfils fire protection requirements, the fire hydrant system may be directly supplied by the water supply network. Otherwise, pressurisation equipment and water storage facilities should be provided.

(4) The calculation of water demand for the fire hydrant system, the calculation of the effective volume of the fire storage tank, the layout of indoor fire hydrants, and other related aspects should comply with the provisions of Chapter 7 in the Standard for Fire Protection Design of Metro (GB 51298-2018).

(5) The layout of indoor water supply pipework for firefighting should comply with the following provisions:

(a) Water supply pipework for indoor fire hydrants should be arranged in a ring configuration;

(b) A water supply pipe for firefighting should be extended from the underground station to the tunnel for each up track and down track. These pipes should be connected to the ring pipeline network at the station ends; and

(c) Indoor water supply pipework for firefighting should be divided into independent sections by valves. The arrangement of valves should ensure that not more than five fire hydrants are deactivated during pipework maintenance.

(6) The installation of fire pump adapters should comply with the provisions of Clause 5.4.3 in the Technical Code for Fire Protection Water Supply and Hydrant Systems (GB 50974-2014).

(7) The installation of outdoor fire hydrants at stations should comply with the following provisions:

(a) The spacing between fire hydrants should not exceed 100m, and they should be arranged in a staggered manner on both sides of the road.

(b) The distance between a fire hydrant and the station entrance/exit may not be less than 5m and may not exceed 40m.

(c) Not less than 2 sets of outdoor fire hydrants should be provided around each station.

(8) The installation of automatic sprinkler system for stations should comply with the Guidelines on Formulation of Fire Safety Requirements for New Railway Infrastructures published by Fire Services Department. The installation of automatic sprinkler system in other areas including depots and warehouses should comply with the provisions of Clause 7.4.1 of the Standard for Fire Protection Design of Metro (GB 51298-2018).

(9) Premises with the automatic fire extinguishing system should comply with the provisions of Clause 7.4.2 of the Standard for Fire Protection Design of Metro (GB 51298-2018), and may use high-pressure water mist and gas fire extinguishing systems.

4.7 Power Supply System

4.7.1 Reference Standards

The design of power supply system shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Fire Service Ordinance (Cap. 95)

(2) Telecommunications Ordinance (Cap. 106)

(3) Electricity Ordinance (Cap. 406)

(4) Mass Transit Railway Ordinance (Cap. 556)

(5) Energy Efficiency (Labelling of Products) Ordinance (Cap. 598)

(6) Buildings Energy Efficiency Ordinance (Cap. 610)

(7) Protection of Critical Infrastructures (Computer Systems) Ordinance (Cap. 653)

(8) Mass Transit Railway Regulations (Cap. 556 sub. leg. A)

Relevant Technical Standards

(9) Code of Practice for the Electricity (Wiring) Regulations published by Electrical and Mechanical Services Department

(10) Code of Practice for Energy Efficiency of Building Services Installation published by Electrical and Mechanical Services Department

(11) Guidelines for the Electrical Products (Safety) Regulation published by Electrical and Mechanical Services Department

(12) Technical Guidelines on Grid Connection of Renewable Energy Power Systems published by Electrical and Mechanical Services Department

(13) Guidelines on Formulation of Fire Safety Requirements for New Railway Infrastructures published by Fire Services Department

(14) Code for Design Electric Power Supply Systems (GB 50052-2009)

(15) Code for Design of 20kV and below Substations (GB 50053-2013)

(16) Code for Design of Low Voltage Electrical Installations (GB 50054-2011)

(17) Code for Design of Electric Distribution of General-purpose Utilization Equipment (GB 50055-2011)

(18) Code for Design Protection of Structures against Lightning (GB 50057-2010)

(19) Code for Design of 35kV ~ 110kV Substations (GB 50059-2011)

(20) Code for Design of High Voltage Electrical Installation (3 ~ 110kV) (GB 50060-2008)

(21) Standard for Design of Cables of Electric Power Engineering (GB 50217-2018)

(22) Standard for Design of Fire Protection for Fossil Fuel Power Plants and Substations (GB 50229-2019)

(23) Technical Code for Protection of Building Electronic Information System (PIS) Against Lightning (GB 50343-2012)

(24) Technical Standard for Fire Emergency Lighting and Evacuate Indicating System (GB 51309-2018)

(25) Fire Emergency Lighting and Evacuate Indicating System (GB 17945-2024)

(26) Standard for Electrical Design of Civil Buildings (GB 51348-2019)

(27) Railway Applications - Supply Voltages of Traction Systems (GB/T 1402-2010)

(28) DC Traction Power Supply System for Urban Rail Transit (GB/T 10411-2005)

(29) Urban Rail Transit Lighting (GB/T 16275-2008)

(30) Railway Applications - Fixed Installations - Electrical Safety, Earthing and the Return Circuit (GB/T 28026-2018)

(31) Standard for Lighting Design of Buildings (GB/T 50034-2024)

(32) Code for Design of Relaying Protection and Automatic Device of Electric Power Installation (GB/T 50062-2008)

(33) Code for Design of Overvoltage Protection and Insulation Coordination for AC Electrical Installations (GB/T 50064-2014)

(34) Code for Design of Electrical Installations Earthing (GB/T 50065-2011)

(35) Power Transformers – Insulation Levels, Dielectric Tests and External Clearances in Air (GB/T 1094.3-2003)

(36) Energy Conservation Requirements for Electromechanical Equipment of Urban Rail Transit (GB/T 35553-2017)

(37) Quality of Electric Energy Supply Harmonics in Public Supply Network (GB/T 14549-1993)

(38) Power Quality - Three-phase Voltage Unbalance (GB/T 15543-2008)

(39) Common Specifications for High-voltage Alternating-current Switchgear and Controlgear Standards (GB/T 11022-2020)

(40) Dry Traction Rectifier Transformer for Urban Rail Transit (JB/T 10693-2022)

(41) Urban Rail Transit – Ground System for Vehicle Braking Regenerative Energy Utilization (GB/T 36287-2018)

(42) Urban Rail Transit Inverter for Regenerative Braking Energy Absorption (GB/T 37423-2019)

(43) Code for Design of Railway Traction Power Supply (TB 10009-2016)

(44) Technical Standard of Stray Current Corrosion Protection for Metro (CJJ/T 49-2020)

(45) General Code for Fire Protection in Buildings and Constructions (GB 55037-2022)

(46) Classification for Burning Behavior of Electric and Optical Fibers (GB 31247-2014)

(47) Standard for Fire Protection Design of Metro (GB 51298-2018)

(48) Power Transformers (IEC 60076)

(49) Railway Applications - Fixed Installations - Traction Transformers (EN 50329)

4.7.2 General Requirements

(1) This Section takes the national railway standards as the main basis and benchmark, with optimisation and adjustment with Hong Kong legislation, Government documents and engineering standards to suit

the needs of Hong Kong railway, and comply with the principles of safety and applicability, economic rationality, and technical advancement.

(2) The layout of power supply equipment in substations should reserve space for equipment maintenance, transportation, and asset replacement.

4.7.3 Systems

(1) All types of substations should have dual power sources. For main substations (AC and DC systems) and power switching stations (DC system), the two power sources should be originated from different upstream substations.

(2) The capacity of each incoming power source to a substation should fulfil the requirements for the Grade I and II loads of the substation.

(3) The external power supply configuration should adopt a centralised supply method. The high voltage level should be 275kV or 132 kV; the level of medium voltage in the distribution network should be 35kV or 33kV; and the low voltage level should be 380V or 220V. The power supply to the equipment of tunnel environment control system may adopt 660V. The traction voltage level should be DC1500V or AC25kV.

(4) The voltage drop at the end of a medium voltage ring circuit in the power supply system may not exceed 5%.

(5) The nominal voltage and acceptable limits of traction power supply system should comply with the relevant provisions in Table 1 of the Railway Applications - Supply Voltages of Traction Systems (GB/T 1402-2010).

(6) The configuration and supply capacity of the DC traction power supply system should comply with the provisions of Sections 2.3 and 6.1 of the Project Code for Engineering of Urban Rail Transit (GB 55033-2022) and Chapter 15 of the Code for Design of Metro (GB 50157-2013), and

may specify the maximum number of vehicles that can be started up simultaneously.

(7) The configuration and normal power supply capacity of the AC traction power supply system should comply with the provisions of the Code for Design of Railway Traction Power Supply (TB 10009-2016). The cross-boundary power supply capacity should be determined comprehensively based on technical and economic factors, taking into account the transportation demand, line conditions, and network planning. The cross-boundary power supply capacity of a traction substation should at least ensure that 50% of the trains corresponding to the minimum headway within that section can be operated at the design speed in a balanced manner. Transformers within the traction substation should adopt a fixed standby configuration. Under normal operation, one unit (or set) of traction transformer should be in operation while the other unit (or set) should be on standby.

4.7.4 Substations

(1) The voltage deviation on the high-voltage side of transformers should be such that the sum of the absolute values of the positive and negative deviations for supply voltages of 33 kV or 35kV does not exceed 10% of the nominal voltage. The voltage deviation for a 220V single-phase supply on the low-voltage side should be within +7% to -10% of the nominal voltage.

(2) The technical parameters of transformers should comply with the provisions of the Power Transformers (GB/T 1094) series of standards.

(3) The normal service life of transformers should not be less than 30 years. The service life of secondary equipment should be 15 to 20 years.

(4) The capacity of the distribution transformer should be configured based on the forecasted load demand.

(5) Transformer efficiency should comply with the provisions of the Code of Practice for Energy Efficiency of Building Services Installation published by Electrical and Mechanical Services Department.

(6) Distribution transformers may adopt energy-efficient equipment such as amorphous alloy or wound core technology.

(7) The load characteristics of traction rectifier units should comply with the provisions of Clause 15.2.9 of the Code for Design of Metro (GB 50157-2013).

(8) The traction rectifier transformer can be a dry-type transformer or an oil-immersed transformer. If a dry-type transformer is used, it should comply with the provisions of the Dry Traction Rectifier Transformers for Urban Rail Transit (JB/T 10693-2022). If an oil-immersed transformer is used, it should comply with the provisions of the Power Transformers (IEC 60076) and Railway Applications - Fixed Installations - Traction Transformers (EN 50329).

(9) DC traction power supply systems may be equipped with ground-based utilisation system for regenerative braking energy, and medium-voltage regenerative braking energy absorption inverters or bidirectional converter type devices may be used.

(10) The parameter indicators for high-voltage switchgear should comply with the provisions of the Common Specifications for High-voltage Switchgear and Controlgear Standards (GB/T 11022-2011).

(11) Power quality, including negative phase sequence, harmonics, and power factor, should meet the following requirements:

(a) Negative phase sequence should not exceed 2% of the positive phase sequence over any 1-minute period, and should not exceed 1% over any 30-minute period.

(b) The total harmonic content of the load current should not exceed 5% of the rated current.

(c) The power factor (PF) at each traction substation should comply with the requirements of the power company. Otherwise, PF correction equipment should be installed.

(12) The layout of substation should comply with the provisions of Chapter 2 of the Code for Design of 35kV ~ 110kV Substations (GB 50059-2011) and the Code for Design of High Voltage Electrical Installation (3 ~ 110kV) (GB 50060-2008). The equipment layout of the incoming substation should comply with the design requirements as specified by the relevant power company.

(13) Each substation should be equipped with at least two sets of batteries and chargers. The battery capacity should ensure continuous power supply for not less than 5 hours in the event of a complete AC power failure in the entire substation.

(14) The input power of the DC power supply for the substation should adopt three-phase supply with a rated voltage of 380V. The DC output voltage may be DC220V or DC110V.

(15) Valve-regulated sealed lead-acid batteries or valve-regulated nickel-cadmium batteries may be used for the DC power supply batteries.

4.7.5 Traction Power Network

(1) The height of the working suspension point of the contact wire above the track surface should be comprehensively determined based on factors such as vehicle height, air insulation clearance, trackwork maintenance, construction tolerances, and the working range of the pantograph. In a DC 1500V system, the minimum height of the contact wire should not be less than 3900mm. In an AC 25kV system, the minimum height of the contact wire should not be less than 4500mm.

(2) For train speeds V≤100km/h, where changes occur in the working support of the contact wire of Overhead Catenary System (OCS), its maximum gradient and gradient variation should comply with the provisions of Clause 15.3.22 of the Code for Design of Metro (GB

50157-2013). For train speeds V＞100km/h, when changes occur in the working support of the contact wire of OCS, its maximum gradient and gradient variation should comply with the provisions of Clause 5.1.6 of the Code for Design of Railway Traction Power Supply (TB 10009-2016). The maximum gradient and gradient variation for the contact wire of Overhead Rigid Conductor Rail System (ORCR) should comply with the provisions in Clause 13.6.3(5) of the Code for Design of Suburban Railway (TB 10624-2020).

(3) The strength safety factors for the design of overhead contact lines should comply with the provisions in Clause 5.1.8 of the Code for Design of Railway Traction Power Supply (TB 10009-2016).

(4) The layout of the overhead contact line should ensure uniform wear of the pantograph. The setup of the stagger for 25kV overhead contact lines should comply with the provisions in Clause 5.4.6 of the Code for Design of Railway Traction Power Supply (TB 10009-2016). The setup of the stagger for DC1500V overhead contact lines should comply with the provisions in Clause 15.3.23 of the Code for Design of Metro (GB 50157-2013).

(5) The minimum air insulation clearance between live parts of the DC1500V contact line and earthed bodies, as well as the vehicle body, should comply with the provisions in Clause 15.3.2(2) of the Code for Design of Metro (GB 50157-2013). The air insulation clearance values for AC25kV contact lines should comply with the provisions in Clause 5.3.2 of the Code for Design of Railway Traction Power Supply (TB 10009-2016).

(6) The earthing resistance of surge arresters should comply with the provisions in Clause 5.3.3 of the Code for Design of Railway Traction Power Supply (TB 10009-2016).

4.7.6 Cables

(1) Wires and cables used in the power supply system should comply with the relevant provisions of Section 15.4 of the Code for Design of Metro (GB 50157-2013), Clause 10.2.2 of the General Code for Fire Protection in Buildings and Constructions (GB 55037-2022), and Chapters 4 - 6 of the Classification for Burning Behavior of Electric and Optical Fibers (GB 31247-2014). Wires and cables should comply with the following provisions:

(a) For underground stations, underground sections, and depots with topside development, power cables and optical fibres should be halogen-free, flame-retardant, low-smoke, and low-toxicity copper-core power wires and cables. The burning performance of cables and optical fibres should not be lower than Grade B_1, in which, the smoke toxicity rating may be t_0, the burning droplets/particles level may be d_0, and the corrosivity level may be a_2; or

(b) For above-ground stations, above-ground sections, and depots without topside development, power cables and optical fibres may use low-halogen, flame-retardant, low-smoke, and low-toxicity copper-core power wires and cables. The burning performance of cables and optical fibres may be Grade B_1; in which, the smoke toxicity rating may be t_1, the burning droplets/particles level may be d_1, and the corrosivity level may be a_3.

(2) The selection of wires and cables for power distribution circuits of electrical equipment for firefighting should comply with the provisions of Clause 11.3.4 of the Standard for Fire Protection Design of Metro (GB 51298-2018).

(3) When cables are laid within sections and stations, all relevant dimensions and separations for cable installation should comply with the relevant provisions of Clause 15.4.3 of the Code for Design of Metro (GB 50157-2013).

(4) The working and standby cables for important circuits should be laid on different cable containments. Where there is genuine difficulty in laying conditions, one of the following methods may be adopted:

(a) Separating the working and standby cables with a fire rated board.

(b) Laying on containments at different levels.

(5) When power cables are laid exposed outdoors, the cables should possess weather and UV resistance, and sun shading measures such as covers or protective enclosure may be provided.

(6) The cable installations should be located with maintainability. Intermediate joints for medium-voltage cables should not be located under station platform slabs. Intermediate joints should not be provided for DC power cables.

4.7.7 Power Monitoring & Control and Smart Maintenance

(1) When a main control system is provided, the power monitoring & control system should be integrated into the main control system.

(2) The monitoring & control units of the integrated automation system for station-level substation should be configured according to the dual-redundancy principle.

(3) A smart O&M system for power supply may be installed to conduct smart inspection and online monitoring of power supply equipment.

4.7.8 Power and Lighting

(1) Unless otherwise specified in Clause 4.7.8 of this document, power and lighting design should comply with the relevant requirements of the Code of Practice for Fire Safety in Buildings 2011 published by Buildings Department.

(2) During the application process of the national railway standards in the power and lighting design, a comprehensive risk assessment should be conducted if any areas of the fire safety in the national railway standards could not be put into application. Optimised solutions should be proposed to ensure that the fire safety level is not affected, and safeguard the integrity of the fire safety design. Only upon the approval of the relevant authorities, the optimised solutions can be put into implementation.

(3) The classification of electrical loads should comply with the provisions of Clause 15.5.1 of the Code for Design of Metro (GB 50157-2013), and Clauses 3.1.1, 3.1.2, and 3.1.3 of the General Code for Building Electricity and Intelligence (GB 55024-2022).

(4) The power supply and installation of electrical control cabinets for smoke prevention and extraction fans should comply with the following provisions:

(a) For the power supply of smoke prevention and extraction fans, an automatic transfer switch should be provided at the final-level distribution cabinet/panel of their distribution circuit. Two independent power sources should be connected respectively to the automatic transfer switch;

(b) The fan electrical control cabinet may be installed inside the smoke prevention and extraction fan room, or in an environmental control electrical room within the same fire compartment as the fan room, shared with electrical control cabinets of other fans;

(c) If the electrical control cabinet of fan is installed inside the fan room, the distribution panel may be combined with the electrical control cabinet; and

(d) If the electrical control cabinet of fan is not installed inside the fan room, a local start/stop button and a maintenance disconnection point for the fan should be provided locally within the fan room.

(5) The passageways for low-voltage distribution equipment should comply with the provisions of Clauses 4.2.5 and 4.2.6 of the Code for Design of Low Voltage Electrical Installations (GB 50054-2011).

(6) The allowable voltage deviation at the terminals of electrical equipment should comply with the provisions of Clause 15.5.2(7) of the Code for Design of Metro (GB 50157-2013) and Clause 5.0.4 of the Code for Design Electric Power Supply Systems (GB 50052-2009).

(7) Power supply facilities for maintenance, sockets for cleaning purposes, and sockets for general use should comply with the provisions of the Guidelines for the Electrical Products (Safety) Regulation and the Code of Practice for the Electricity (Wiring) Regulations published by Electrical and Mechanical Services Department.

(8) Emergency lighting should comply with the following provisions:

(a) Emergency lighting includes backup lighting and evacuation lighting. Emergency lighting should be supplied by a dual power source with battery backup.

(b) In the event of failure of all normal AC power sources, the backup lighting battery should provide continuous power supply for not less than 60 min.

(c) The battery for evacuation lighting in underground railway lines should provide continuous power supply for not less than 90 min. The battery for evacuation lighting in above-ground railway lines should provide continuous power supply for not less than 60 min. The battery supply duration for evacuation lighting in other buildings and structures should comply with the requirements of Clause 3.2.4 in the Technical Standard for Fire Emergency Lighting and Evacuate Indicating Systems (GB 51309-2018).

(d) The illuminance of backup lighting should comply with the following provisions:

(i) Backup lighting should be provided in fire control rooms, station control rooms, fire pump rooms, standby generator rooms, electrical rooms, environmental control electrical rooms, smoke prevention and extraction equipment rooms, station manager rooms, and other premises requiring continuous operation during a fire. The minimum illuminance on the operational surfaces should not be lower than normal lighting illuminance.

(ii) Backup lighting should be provided in low-voltage equipment rooms such as communication equipment rooms and signalling equipment rooms. The minimum illuminance on the operational surfaces should not be lower than 50% of the normal lighting illuminance.

(iii) Unless otherwise specified, the standard value of backup lighting illuminance in other areas should not be lower than 10% of the normal lighting illuminance in that area.

(e) The illuminance values for evacuation lighting should comply with the following requirements:

(i) The illuminance values for evacuation lighting in sections should comply with the requirements of the Guidelines on Formulating Fire Safety Objectives for New Railway Infrastructures published by Fire Services Department;

(ii) Not lower than 18 lx in public transport interchanges;

(iii) Not lower than 15 lx in electrical plant rooms and equipment rooms;

(iv) Not lower than 3 lx in storage rooms;

(v) Not lower than 5 lx in cable tunnels, culverts, and interstitial spaces; and

(vi) For other premises not specified in the above items of this Clause, the illuminance should not be lower than 10 lx.

(f) The system composition of evacuation lighting should comply with the provisions of Technical Standard for Fire Emergency Lighting and Evacuate Indicating System (GB 51309-2018).

(9) The standard values for lighting illuminance should comply with the provisions in the Table 4.7.8 below.

Table 4.7.8 Standard Values for Illuminance

Room or Location	**Reference Plane and its Height**	**Standard Illuminance Value (lx)**
Staff Staircase	Floor	150
Corridor connecting to Offices	Floor	200
Corridor connecting to Outdoors	Floor	100
Automatic Fare Collection Gates, Passageway and Vertical Shaft	Floor	180
Atrium	Floor	180
Retail Shop	Floor	300
Integrated Commercial Area	Floor	300
External Road	Floor	50
Internal Road	Floor	75
Public Transport Interchange	Floor	150
Lift and Escalator Equipment Room	Floor	200
Electrical Plant and Equipment Room	Floor	150
General Plant and Equipment Room	Floor	150
Automatic Fare Collection Room	Floor	150
Storage Room	Floor	100
Office (including Customer	Floor	300

Room or Location	Reference Plane and its Height	Standard Illuminance Value (lx)
Service Centre)	Desk	500
Station Manager's Office	Floor	300
	Desk	500
Station Control Room	Floor	300
	Desk	500
	Desk	500
Police Room	Floor	300
	Desk	500
Janitorial Room	Floor	200
Rest Room	Floor	150
Staff Toilet	Floor	150
Cable Tunnel/Culvert / Interstitial Space	Floor	50
Track Level	Rail Surface	5
Tunnel Evacuation and Access Passageway	Floor	5
Tunnel Ramp and Cross Passage	Floor	10
Tunnel Fire Hydrant Location	Floor	10
Tunnel Signage Location, Point Zone	Floor	20

(10) The values of lighting power density and lighting control methods for various areas should comply with the provisions of the Code of Practice for Energy Efficiency of Building Services Installation published by Electrical and Mechanical Services Department.

4.7.9 Stray Current and Earthing

(1) The corrosion protection indicators for stray currents should comply with Clause 2.3.6 of the Project Code for Engineering of Urban Rail Transit (GB 55033-2022).

(2) The transition resistance of each newly laid track should be not less than 250 Ω·km for sections with concrete track beds, and should not be less than 150 Ω·km for sections with ballasted track beds.

(3) Within the stray current drainage system, the stray current collection net buried under the track bed should comply with the following provisions:

(a) The collection net should use prefabricated welded steel mesh or its equivalent material and should be galvanised;

(b) The specifications of the prefabricated welded steel mesh should meet the following requirements:

Table 4.7.9 Specifications of the Prefabricated Welded Steel mesh

Type of Reinforcement	**Minimum Diameter** d_{min}	**Maximum Centre Spacing** s_{max}	**Additional Conditions**
Longitudinal Reinforcement	6mm	100mm	$s_{max} \leq 2s_{cs}$
Transverse Reinforcement	5mm	400mm	---

s_{cs}: The distance between the top surface of the Class 2 concrete and the bonded longitudinal reinforcement.

(c) The collection net should occupy the full width of the concrete track bed and extend not less than 750mm beyond the outer side of the running rails;

(d) The collection net should be terminated at every expansion joint and structural discontinuity in the concrete track bed. At these discontinuities, copper bars with a cross-sectional area of not less than 70 mm² should be transversely welded or brazed across the full width of the collection net on both sides of the discontinuity and should protrude from the concrete;

(e) At locations away from the tracks where the copper bars protrude from the concrete, the two copper bars should be connected using a 70 mm² copper core cable to ensure electrical continuity of the collection net; and

(f) The total resistance of the collection net should not exceed 10 Ω/km.

(4) The structural reinforcement of tunnels and bridges should under no circumstances be electrically connected to the stray current drainage net.

(5) The system earthing, protective earthing, and lightning protection earthing for the power supply system and its equipment should utilise an integrated earthing system. Its earthing resistance should not be greater than 0.5 Ω.

(6) The earthing grid should comply with the following provisions:

(a) The earthing grid should be buried at 300mm or more below the floor or base slab of the station and ancillary buildings.

(b) The earthing grid should be provided with at least eight earthing electrodes. The earthing electrodes should be made of copper with a cross-sectional area not less than 160 mm².

(c) The earthing electrodes should be interconnected below the floor or base slab by two bare stranded copper conductors or bare copper bars. The cross-sectional area of the connecting conductor should not be less than 75 mm².

(d) The installation of earthing conductors should comply with the following provisions:

(i) Two separately routed vertical main earthing conductors should be installed to connect the equipment system rooms to the integrated earthing grid. These earthing conductors should penetrate every floor of the station or ancillary buildings.

(ii) A earthing busbar should be installed on each floor of the station or ancillary buildings to form a ring connection with the vertical main earthing conductors. The earthing busbar should pass through the high-voltage electrical room, low-voltage distribution room, and the motor control centre room.

(iii) For floors containing a high-voltage electrical room, low-voltage distribution room, and the motor control centre room, the minimum cross-sectional area of the earthing busbar and the earthing conductors connecting to the high-voltage electrical rooms, low-voltage power distribution room and motor control centre room should be 300 mm^2. For all other floors, the minimum cross-sectional area of the earthing busbar and the earthing conductors connecting to the equipment earthing busbars in other rooms should be 150 mm^2.

(7) The maximum permissible touch potential and step potential in the substation should comply with the following provisions:

(a) The maximum permissible hand-to-hand touch potential within a duration of 1 second should be 116 V.

(b) The maximum permissible hand-to-foot touch potential within a duration of 1 second should be:

$$0.116 * (1000 + 1.5\rho_s)\text{(V)}$$

(c) The maximum permissible step potential within a duration of 1 second should be:

$$0.116 * (1000 + 6\rho_s)\text{ (V)}$$

In the formula, ρ_s is the resistivity of the surface layer material in contact with the earth electrode.

4.8 Communication System

4.8.1 Reference Standards

The design of communication system shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Fire Services Ordinance (Cap. 95)

(2) Telecommunications Ordinance (Cap. 106)

(3) Electricity Ordinance (Cap. 406)

Relevant Technical Standards

(4) Code of Practice for Fire Safety in Buildings 2011 published by Buildings Department

(5) Code of Practice for the Electricity (Wiring) Regulations published by Electrical and Mechanical Services Department

(6) General Code for Building Electricity and Intelligence (GB 55024-2022)

(7) General Code of Security Engineering (GB 55029-2022)

(8) General Code for Fire Protection in Buildings and Constructions (GB 55037-2022)

(9) Code for Construction Quality Acceptance of Urban Rail Transit Communication Engineering (GB 50382-2016)

(10) Code for Design of Data Centers (GB 50174-2017)

(11) Standard for Fire Protection Design of Metro (GB 51298-2018)

(12) General Rules for Flame Retardant and Fire Resistant Wires and Cables or Optical Fiber Cables (GB/T 19666-2019)

(13) Technical Requirements for Information Transmission, Switch and Control in Video Surveillance Networking System for Public Security (GB/T 28181-2022)

(14) General Technical Specification of Fully Automatic Operation System for Urban Rail Transit (GB/T 46097-2025)

(15) Code for Design of Automatic Fire Alarm System (GB 50116-2013)

4.8.2 General Requirements

(1) This Section takes the national railway standards as the main basis and benchmark, with optimisation and adjustment with Hong Kong legislation, Government documents and engineering standards to suit the needs of Hong Kong railway, and comply with the principles of safety and applicability, economic rationality, and technical advancement.

(2) The communication system may comprise transmission system, telephone system, radio system, closed-circuit television (CCTV) system, public address system, clock system, office automation system, passenger information system, voice recording system, central alarm system, public communication system, power supply system and earthing.

(3) Optical fibres and cables of the communications system should comply with the requirements under Clause 4.7.6 of this document. Furthermore, optical fibres and cables in trackside areas should fulfil fire resistance requirements.

(4) Where group station control is adopted, the telephone system, radio system, CCTV system, public address system, and passenger information display system may fulfil functional requirements for group station control, enabling integrated control and management of systems and terminals of the satellite stations by staff at master stations.

(5) For railway lines employing fully automatic operation (FAO), the communication system should comply with the provisions of the General Technical Specification of Fully Automatic Operation System for Urban Rail Transit (GB/T 46097-2025). Where FAO is employed, key equipment of systems directly related to train operation commands, such as the radio system and telephone system, should be configured with a geographically redundant setup.

(6) Subsystems of the communication system may be hosted on a cloud platform according to their own system architecture.

4.8.3 Transmission System

(1) The technical specifications of the transmission system should comply with the provisions of Clause 16.2.2 of the Code for Design of Metro (GB 50157-2013). It may adopt optical communication transmission networks such as Optical Transport Network (OTN), Slicing Packet Network (SPN), or Multi-Protocol Label Switching (MPLS) networks.

(2) Based on the planning and construction requirements for railway networks, the transmission system may adopt a two-layer scheme comprising the rail network layer and the line layer. The configuration and capacity of the transmission system should be subject to the requirements of each system and service for the transmission system. When the transmission system carries information critical for operation, it should be configured with network redundancy.

(3) For cross-boundary railway lines, the transmission system network should enable the transmission and centralised management of services between the two regions such as voice, data, and image.

4.8.4 Radio System

(1) The wireless communication system should use dedicated frequency bands, and may select broadband trunking systems based on LTE or 5G

technology, or other digital trunked radio systems. The specific operating frequency bands and frequencies should be assigned by the relevant authorities. For cross-boundary railway lines, wireless terminals should comply with the wireless network access requirements of different regions.

(2) The construction of the rail transit wireless network should integrate the transmission requirements for communication and signalling service information between the train and the ground. When carrying train control information, dedicated frequency bands should be used. Two independent networks should be established in conjunction with the signalling network design. Trunking service information, onboard PIS information, onboard video information, train operation status information, and other operational management information should be integrated and carried comprehensively.

(3) The technical specifications, coverage areas, and frequency use for the police and fire services wireless systems should comply with the relevant requirements of the Hong Kong Police Force and the Fire Services Department. For cross-boundary railway lines, the police wireless, fire services wireless, and other police/fire communication systems should be compatible with the systems established by the local police and fire services departments.

4.8.5 Telephone System

(1) Based on operational management and construction requirements, the telephone system may utilise integrated telephone exchange equipment to uniformly implement functions such as official telephone system, wired dispatching telephone, and intercom system.

(2) Trackside emergency telephones should be installed at station emergency access points, trackside emergency rescue access points, and critical locations in long tunnels. Their specific installation locations should comply with the relevant provisions of the Hong Kong Fire Services Department.

(3) For cross-boundary railway lines, the telephone system should adopt a hybrid architecture featuring local breakout and dedicated network interconnection. The official telephone systems of the two regions should be connected to local telephone exchanges of their respective public networks and integrated into the local public network's standardised numbering plan.

4.8.6 CCTV System

(1) The arrangement and technical scheme for playback terminal equipment in stations and along the tracks should strictly adhere to the relevant requirements of the Hong Kong Police Force and the Fire Services Department.

(2) The network arrangement of different CCTV platforms should comply with the provisions of the Technical Requirements for Information Transmission, Switch and Control in Video Surveillance Networking System for Public Security (GB/T 28181-2022).

(3) For cross-boundary railway lines, the retention periods of footages from CCTVs in stations and on-board CCTVs shall follow respective local regulations and ordinances.

(4) On-board video equipment should be interconnected with the CCTV system to enable control centre operators to conduct centralised remote viewing and management of real-time on-board monitoring and onboard video recordings.

4.8.7 Public Address System

(1) The public address system should comply with the provisions of Clause 10.0.7 of the Standard for Fire Protection Design of Metro (GB 51298-2018). Under fire conditions, the station public address system should interface with the automatic fire alarm system and automatically switch to fire emergency public address mode.

(2) Based on operation requirements, an independent or group of variable digital loudspeakers may be installed at key locations in stations to fulfil fire evacuation and passenger service needs.

4.8.8 Clock System

(1) The clock system should comply with the provisions of Clause 16.8 of the Code for Design of Metro (GB 50157-2013).

4.8.9 Office Automation System

(1) The office automation system should comply with the provisions of Section 16.9 of the Code for Design of Metro (GB 50157-2013). Data user terminals can be connected via wired, wireless, or hybrid methods.

4.8.10 Passenger Information System

(1) The passenger information system may provide personalised and diverse multimedia information via display boards and interactive panels within stations, including train crowdedness, passenger flow density, and station vicinity information. The system may also provide information such as estimated time of arrival of train and dynamic route map.

4.8.11 Voice Recording System

(1) Voice recording devices should be installed at each station to record important telephone conversations, public address announcements, and wireless communications as required by operational management requirement.

4.8.12 Central Alarm System

(1) The setup of the central alarm system should comply with the provisions of Clause 16.11.4 of the Code for Design of Metro (GB 50157-2013). It should incorporate smart means to enhance communication network reliability, operational management efficiency, and user experience.

4.8.13 Public Communication System

(1) The public communication system should provide wireless coverage in areas of stations, depots, and underground sections, and achieve interconnection with signal source equipment of local telecommunications operators. For cross-boundary railway lines, the setup of the public communication system should comply with the relevant provisions for implementation interfaces and O&M of the respective local telecommunications operators.

4.8.14 Power Supply System and Earthing Requirements

(1) The power supply of communications system may be integrated into the station's uninterruptible power supply (UPS) for a centralised power supply.

(2) The power supply of communications system may be centrally configured with a DC power supply system to provide centralised power supply for various types of communication equipment.

(3) The battery capacity for the power supply of each communication subsystem (except passenger information system) should comply with the provisions of Clause 16.10.6 of the Code for Design of Metro (GB 50157-2013). The backup time of battery capacity for passenger information display system should not be less than 30 min.

(4) The earthing for the communication system should comply with the provisions of Clause 16.10.8 in the Code for Design of Metro (GB

50157-2013), and its integrated earthing resistance should not be greater than 0.5Ω.

4.8.15 Communication Room Requirements

(1) Requirements for communication equipment rooms should comply with the provisions of Clause 16.14.1 of the Code for Design of Metro (GB 50157-2013). Communication equipment may be housed in an integrated low-voltage equipment room together with other systems such as main control system, environmental monitoring system, automatic fare collection, signalling (satellite station), etc. Space for future expansion should be considered.

4.9 Signalling System

4.9.1 Reference Standards

The design of signalling system should make reference to the latest editions of the following standards:

Relevant Technical Standards

(1) Code of Practice for the Electricity (Wiring) Regulations published by Electrical and Mechanical Services Department.

(2) General Specification of Signal System for Urban Rail Transit (GB/T 12758-2023)

(3) General Technical Specification of Fully Automatic Operation System for Urban Rail Transit (GB/T 46097-2025)

(4) Code for Design of Railway Signaling (TB 10007-2017)

(5) Code for Design of Railway CBTC Signalling (TB 10521-2024)

(6) Computer Based Interlocking Technical Specifications (TB/T 3027-2015)

(7) Computer Based Interlocking Safety Principles (TB/T 3482-2017)

(8) Fail-Safe Principles for Railway Signalling (TB/T 2615-2018)

(9) Railway Applications - Communication, Signalling and Processing Systems - Software for Railway Control and Protection Systems (GB/T 28808-2021)

(10) Railway Applications - Communication, Signalling and Processing Systems - Safety-related Electronic Systems for Signalling (GB/T 28809-2012)

(11) Railway Applications - Specifications and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) (GB/T 21562-2008)

(12) Railway Applications - Electromagnetic Compatibility - Part 3-2: Rolling stock - Apparatus (GB/T 24338.4-2018)

(13) Railway Applications - Electromagnetic compatibility - Part 4: Emission and Immunity of the Signalling and Telecommunications Apparatus (GB/T 24338.5-2018)

(14) Switch Machines for Railways—Part 1:General Specification (GB/T 25338.1-2019)

(15) General Specification of LED Light Signals for Railway (TB/T 3242-2010)

(16) Technical Specification for Balise Transmission System (TB/T 3485-2017)

(17) Railway Signalling Axle Counter (TB/T 2296-2019)

(18) Power Supply System Equipment for Railway Signalling (TB/T 1528-2018)

(19) Group Standard: Interoperability of Communication Based Train Control (CBTC) System for Urban Rail Transit (T/CAMET 04010～04013-2018)

(20) Ministry of Transport: Technical Specification for Operation of Urban Rail Transit Signalling System (Trial) (Annex to Document (2022) No. 1 of the General Office of the Ministry of Transport)

(21) Recommended Practice for Communications-Based Train Control (CBTC) System (IEEE 1474)

4.9.2 General Requirements

(1) This Section takes the national railway standards as the main basis and benchmark, with optimisation and adjustment with Hong Kong legislation, Government documents and engineering standards to suit the needs of Hong Kong railway, and comply with the principles of safety and applicability, economic rationality, and technical advancement.

(2) The signalling system should possess high reliability, high availability, and high safety, and should fulfil the needs of train service pattern and operational management for the railway project.

(3) The signalling system should adopt a Communication-Based Train Control (CBTC) system. Its configuration should fulfil the required Grade of Automation (GoA) for the railway line. Train control information transmission and architecture may utilise train-to-wayside or intra-train methods.

(4) The signalling system may adapt to the requirements of new technological developments in rail transit, incorporating functions such as smart dispatching and flexible train formation. The flexible train formation function should comply with the provisions of Clause 7.4.11 of the General Technical Specification of Fully Automatic Operation System for Urban Rail Transit (GB/T 46097-2025).

(5) The signalling system may possess interoperability and compatibility and comply with the relevant provisions of the group standard Interoperability of Communication Based Train Control (CBTC) System for Urban Rail Transit (T/CAMET 04010～04013-2018).

4.9.3 System Composition

(1) The composition of the signalling system should comply with the provisions of Clause 6.2.1 of the General Specification of Signal System for Urban Rail Transit (GB/T 12758-2023).

(2) For railway lines adopting Fully Automatic Operation (FAO), the signalling system may incorporate with central level backup equipment at remote configuration, based on operational management model.

(3) The signalling system should be equipped with centralised maintenance and monitoring equipment, configured with smart maintenance functions, and should remotely monitor the operational status of the signalling systems/equipment in real-time.

(4) The configuration of the signalling system for the test track should comply with the provisions of Section 8.5 of the General Specification of Signal System for Urban Rail Transit (GB/T 12758-2023), and should share the signalling equipment of depot subject to the line conditions.

(5) The training equipment configured in the training room and the Operations Control Centre (OCC) should comply with the provisions of Clause 17.6.6 of the Code for Design of Metro (GB 50157-2013).

(6) The wired backbone network for the Automatic Train Protection/Automatic Train Operation (ATP/ATO) and Automatic Train Supervision (ATS) systems should adopt redundant channels. The ATP/ATO system channel may adopt a dedicated transmission channel with an independent network approach. The ATS and maintenance monitoring system may utilise communication transmission channels.

(7) The signalling system may fulfil the requirements for group station control when group station control mode is adopted. Push buttons for emergency close of satellite stations, platform screen door open/close buttons (if applicable), personnel protection switches (if applicable), and other equipment should be provided on the Integrated Backup Panel (IBP) in the station control room of the master station to meet emergency response requirements for group station control.

4.9.4 System Functions

(1) The functions of the signalling system should comply with the provisions of Chapter 7 of the General Specification of Signal System for Urban Rail Transit (GB/T 12758-2023).

4.9.5 System Performance

(1) The safety integrity level and RAMS indicators of the signalling system should comply with the provisions of Chapter 8 of the General Technical Specification of Fully Automatic Operation System for Urban Rail Transit (GB/T 46097-2025). The platform stopping accuracy should comply with the provisions of Clause 13.1.3.10 of the General Specification of Signal System for Urban Rail Transit (GB/T 12758-2023).

(2) The performance and functional testing of the signal system should also comply with the Recommended Practice for Communications-Based Train Control (CBTC) System (IEEE 1474).

4.9.6 Other

(1) Signalling system interfaces should comply with the provisions of Chapter 10 of the General Technical Specification of Fully Automatic Operation System for Urban Rail Transit (GB/T 46097-2025).

(2) The occupancy detection of trains may be measured using axle counters.

(3) For the signalling system of satellite stations, the equipment room may be shared with other systems such as the communication system.

(4) The configuration of the signalling power supply system should comply with the provisions of Section 10.1 of the Technical Specification for Operation of Urban Rail Transit Signalling System (Trial) (Annex to Document (2022) No. 1 of the General Office of the Ministry of Transport). The backup time of UPS battery should comply with the

provisions of Clause 17.7.3 of the Code for Design of Metro (GB 50157-2013).

(5) The earthing of signalling equipment should comply with the following requirements:

(a) For railway lines using AC traction power supply, the earthing of signalling system earthing should comply with the provisions of Section 11.3 of the Code for Design of Railway CBTC Signalling (TB 10521-2024).

(b) For railway lines using DC traction power supply, the earthing of signalling system earthing should comply with the provisions of Clause 17.7.6 of the Code for Design of Metro (GB 50157-2013).

(6) The wires and cables used in the signalling system should comply with the provisions of Clause 4.7.6 of this document. For railway lines using AC traction power supply, signalling cables should be of aluminium-sheathed type.

4.10 Automation Fare Collection System

4.10.1 Reference Standards

The design of automation fare collection system shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Fire Services Ordinance (Cap. 95)

(2) Electricity Ordinance (Cap. 406)

Relevant Technical Standards

(3) Code of Practice for the Electricity (Wiring) Regulations published by Electrical and Mechanical Services Department

(4) General Code for Fire Protection in Buildings and Constructions (GB 55037-2022)

(5) General Code for Building Electricity and Intelligence (GB 55024-2022)

(6) Technical Specification for Operation of Urban Rail Transit Automatic Fare Collection System (Trial) (Document No. (2022) 27 of the General Office of the Ministry of Transport)

(7) Standard for Construction Quality Acceptance of Urban Rail Transit Automatic Fare Collection System Engineering (GB/T 50381-2018)

(8) Technical Specification for Automatic Fare Collection System of Urban Rail Transit (GB/T 20907-2024)

(9) Code for Design of Data Centers (GB 50174-2017)

(10) Code for Design of Low Voltage Electrical Installations (GB 50054-2011)

(11) Technical Specification for Test Technology of Urban Rail Transit Automatic Fare Collection System (CJJ/T 162-2011)

4.10.2 General Requirements

(1) This Section takes the national railway standards as the main basis and benchmark, with optimisation and adjustment with Hong Kong legislation, Government documents and engineering standards to suit the needs of Hong Kong railway, and comply with the principles of safety and applicability, economic rationality, and technical advancement.

(2) Fare interoperability should comply with the provisions of Section 5.3 in the Technical Specification for Automatic Fare Collection System of Urban Rail Transit (GB/T 20907-2024).

(3) Fire alarm linkage should comply with the provisions of Clause 18.1.9 in the Code for Design of Metro (GB 50157-2013).

(4) Both the software and hardware of terminal equipment should adopt a modular design to ensure maintainability and expandability.

(5) The automatic fare collection system may be hosted on a cloud platform according to its system architecture, with the cloud platform providing computing, storage, and network resources.

(6) The system design capacity should comply with the provisions of Clause 18.1.4 in the Code for Design of Metro (GB 50157-2013). Each array of automatic fare collection gates should have no less than two operable gates, including at least one bi-directional wide gate.

4.10.3 Fare Management and Operation Mode

(1) The automatic fare collection system may fulfil the requirements for group station control when the group station control mode is adopted. The centralised control and monitoring of passenger services, equipment and ticketing service of satellite stations within the group shall be carried out in the master station of the group.

(2) Fare media should include both physical and virtual types. Physical fare media should include contactless integrated circuit (IC) cards and QR code tickets. Virtual fare media include near field communication (NFC) and QR based media.

4.10.4 System Composition and Functions

(1) The system composition, functions, and network should comply with the provisions of Chapter 6, Chapters 8 to Chapter 11, and Section 7.1 of the Technical Specification for Automatic Fare Collection System of Urban Rail Transit (GB 20907-2024), and should fulfil the usage requirements of the contactless payment systems in Hong Kong. Automatic fare collection backend ticketing service may be configured at station terminals.

(2) The automatic fare collection system may possess functions such as smart service and smart O&M. Smart O&M should comply with the provisions of Section 3.13 in the Technical Specification for Operation of the Urban Rail Transit Automatic Fare Collection System (Trial), issued under Document No. (2022) No. 27 of the General Office of the Ministry of Transport.

4.10.5 Power Supply and Earthing

(1) The Uninterruptible Power Supply (UPS) should comply with the requirements of Clause 9.1.3 in the Technical Specification for Automatic Fare Collection System of Urban Rail Transit (GB/T 20907-2024). The UPS backup time for the station computer system should be 15 minutes, and the UPS backup time for terminal equipment should be 5 minutes.

(2) The electrical wires and cables used in the automatic fare collection system should comply with the provisions of Clause 4.7.6 of this document.

(3) In addition to the above requirements, the system shall also comply with the requirements of Electricity Ordinance (Cap. 406).

4.10.6 Other

(1) The equipment room for the automatic fare collection system should be combined with systems such as communication system, main control system to form integrated low-voltage equipment room. Ticket offices should be set up at master stations only. Tickets and cash may be stored in the station control room.

(2) The interfaces of automatic fare collection system should comply with the requirements of Clause 18.7.1 of the Code for Design of Metro (GB 50157-2013).

4.11 Automatic Fire Alarm System

4.11.1 Reference Standards

The design of automation fire alarm system shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Fire Services Ordinance (Cap. 95)

(2) Electricity Ordinance (Cap. 406)

Relevant Technical Standards

(3) Design Manual – Barrier Free Access 2008 published by Buildings Department

(4) Code of Practice for Fire Safety in Buildings 2011 published by Buildings Department

(5) Code of Practice for the Electricity (Wiring) Regulations published by Electrical and Mechanical Services Department

(6) General Code for Fire Protection in Buildings and Constructions (GB 55037-2022)

(7) General Code for Fire Protection Facilities (GB 55036-2022)

(8) Standard for Fire Protection Design of Metro (GB 51298-2018)

(9) Code for Fire Protection Design of Buildings (GB 50016-2014)

(10) Code for Design of Automatic Fire Alarm System (GB 50116-2013)

(11) Code for Design of Gas Fire Extinguishing Systems (GB 50370-2005)

(12) Technical Code for Water Mist Fire Extinguishing Systems (GB 50898-2013)

(13) Standard for Installation and Acceptance of Fire Alarm System (GB 50166-2019)

4.11.2 General Requirements

(1) This Section takes the national railway standards as the main basis and benchmark, with optimisation and adjustment with Hong Kong legislation, Government documents and engineering standards to suit the needs of Hong Kong railway, and comply with the principles of safety and applicability, economic rationality, and technical advancement.

(2) When the group station control mode is adopted, the fire alarm system at the master station, other than monitoring the equipment and facilities within its own station and its control zone, may also monitor the equipment and facilities of its satellite stations and their control zones. The fire alarm systems at satellite stations should possess independent operational capability.

(3) During the application process of the national railway standards in the design of the automatic fire alarm system, if any Chinese Mainland fire safety standards cannot be adopted, a comprehensive risk assessment should be conducted to identify optimisation proposals to ensure that the fire safety level is not affected, so as to safeguard the integrity of the fire safety design. The optimisation proposals shall only be implemented upon the approval of the relevant authorities.

4.11.3 System Composition and Functions

(1) When the group station control mode is adopted, the fire alarm control panels at the master station and satellite stations may possess networking capabilities. Other than the functions of displaying fire alarm information and the operational status of fire services equipment/facilities for the master station itself and its control zones, controlling the start/stop of fire protection equipment and facilities for the master station itself and its control zones, and initiating linkage control to switch relevant systems to fire operation mode, the fire alarm system at the master station may also possess the following functions:

(a) Display all fire alarm signals and linkage control status signals from satellite stations and their control zones, and control critical fire services equipment at satellite stations such as fire pumps and dedicated smoke extraction fans.

(2) The composition and system network of fire alarm systems at the control centre, station, depot, and field levels should comply with the provisions of Clauses 19.2.2 - 19.2.6 of the Code for Design of Metro (GB 50157-2013) and Clauses 9.2.4 and 9.2.7 of the Standard for Fire Protection Design of Metro (GB 51298-2018).

(3) The functions of fire alarm systems at the control centre, station, and depot levels should comply with the provisions of Clauses 19.2.3 and 19.2.4 of the Code for Design of Metro (GB 50157-2013) and Clauses 9.2.1 - 9.2.3 of the Standard for Fire Protection Design of Metro (GB 51298-2018). When the fire alarm system is integrated into the main control system (MCS), its control centre level functions may be implemented by the MCS.

4.11.4 Fire Alarm Linkage Control

(1) The confirmation and triggering of fire alarm linkage control should fulfil the requirements of Clauses 4.1.1, 4.1.4, and 4.1.6 of the Code for Design of Automatic Fire Alarm System (GB 50116-2013), in addition to prevailing requirements.

(2) The objects of fire alarm linkage control and the integrated requirements should comply with the provisions of Section 19.3 of the Code for Design of Metro (GB 50157-2013) and Section 9.5 of the Standard for Fire Protection Design of Metro (GB 51298-2018). The linkage control for fire hydrant systems, audio and visual advisory system and public address system should also comply with the requirements of Clause 4.3.1 and Section 4.8 of the Code for Design of Automatic Fire Alarm System (GB 50116-2013).

(3) The linkage control for lifts and escalators should be designed compatibly with their designated fire mode actions.

4.11.5 System Equipment Installation

(1) The installation of fire detection and alarm devices should comply with the provisions of Clauses 19.4.1 - 19.4.10 of the Code for Design of Metro (GB 50157-2013) and Clauses 9.3 and 9.4 of the Standard for Fire Protection Design of Metro (GB 51298-2018).

(2) Short-circuit isolators should be installed on the system bus. The installation requirements for bus short-circuit isolators should comply with the provisions of Clause 3.1.6 of the Code for Design of Automatic Fire Alarm System (GB 50116-2013).

(3) Aspirating smoke detectors may be used in the concourse, platform public areas, and equipment room corridors with dense cabling/piping in underground stations. Smoke detectors should be installed in public toilets and staff toilets. Smoke detectors in concealed areas such as within closed ceilings or lift shafts should have LED indicator lights installed in conspicuous locations.

(4) Zone indication panels should be installed in conspicuous and easily accessible locations, such as entrance corridors of station ancillary buildings.

(5) The fire telephone system may be integrated with the communication telephone system or set up independently. When set up independently, it should comply with the provisions of Section 6.7 of the Code for Design of Automatic Fire Alarm System (GB 50116-2013) and Clause 10.0.4 of the Standard for Fire Protection Design of Metro (GB 51298-2018).

4.11.6 Other

(1) The power supply, lightning protection, earthing, and wiring of the system should comply with the provisions of Sections 10 and 11 of the Code for Design of Automatic Fire Alarm System (GB 50116-2013) and Sections 19.6 and 19.7 of the Code for Design of Metro (GB 50157-2013).

(2) The requirements of system cables should comply with the provisions of Clause 4.7.6 of this document.

(3) In addition to the above requirements, the system shall also comply with the requirements of Electricity Ordinance (Cap. 406).

4.12 Main Control System

4.12.1 Reference Standards

The design of main control system shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Electricity Ordinance (Cap. 406)

Relevant Technical Standards

(2) Code of Practice for the Electricity (Wiring) Regulations published by Electrical and Mechanical Services Department

(3) General Code for Building Electricity and Intelligence (GB 55024-2022)

(4) General Code for Fire Protection in Buildings and Constructions (GB 55037-2022)

(5) Technical Standard for Urban Rail Transit Integrated Supervision and Control System (GB/T 50636-2018)

(6) Code for Design of Data Centers (GB 50174-2017)

(7) General Technical Specification of Fully Automatic Operation System for Urban Rail Transit (GB/T 46097-2025)

(8) Classification for Burning Behavior of Electric and Optical Cables (GB 31247-2014)

(9) General Rules for Flame Retardant and Fire Resistant Wires and Cables (GB/T 19666-2005)

4.12.2 General Requirements

(1) This Section takes the national railway standards as the main basis and benchmark, with optimisation and adjustment with Hong Kong legislation, Government documents and engineering standards to suit the needs of Hong Kong railway, and comply with the principles of safety and applicability, economic rationality, and technical advancement.

(2) The main control system may be hosted on a cloud platform according to its system architecture, with the cloud platform to provide computing, storage, and network resources.

(3) For railway lines adopting FAO, the main control system should comply with the provisions of the General Technical Specification of Fully Automatic Operation System for Urban Rail Transit (GB/T 46097-2025).

(4) For railway lines adopting FAO, the main control system may configure remote backup equipment for the OCC, based on the operational management model.

4.12.3 System Configuration Principles

(1) The configuration principles for the main control system should comply with the provisions of Section 20.2 of the Code for Design of Metro (GB 50157-2013).

(2) Where group station control is adopted, the main control system may fulfil the functional requirements for group station control. The station-level main control system may be installed at the master station to manage the entire group of stations, while maintenance workstation may be set up in fire control room of satellite stations.

(3) The network management system, training management system, and training simulator system should comply with the provisions of Clause 20.2.6 of the Code for Design of Metro (GB 50157-2013).

4.12.4 System Basic Functions

(1) The overall functions of the main control system should meet the requirements of Section 20.3 of the Code for Design of Metro (GB 50157-2013).

(2) The integration and interconnection of main control system with subsystems should comply with the provisions of Clauses 20.1.3 and 20.1.4 of the Code for Design of Metro (GB 50157-2013), including but not be limited to the following subsystems: power remote control system, environmental control systems, equipment monitoring control system, platform screen doors system, public address system, CCTV system, passenger information system, clock system, automatic fare collection system, access control system, flood gate, communication system central alarm, automatic train supervision, and automatic fire alarm system.

(3) The main control system may be capable of acquiring train information to provide assistance to dispatchers to ensure implementation of FAO. This includes providing alarms for train door status, cab door status, fire information, alarm such as power loss, and enabling integration with CCTV system.

(4) The main control system may possess smart station management and control functions, such as single-command station on/off function, to fulfil smart operational demands.

(5) A track intrusion detection system may be installed. It should detect the following intrusions and report alarms to the supervisory management system:

(a) The open/close status of any track access door or gate.

(b) Intrusion of foreign objects hazardous to train operations, if corresponding hazards have been identified for the track area.

4.12.5 Hardware and Software Basic Requirements

(1) The basic requirements for hardware and software should comply with the provisions of Sections 20.4 and 20.5 of the Code for Design of Metro (GB 50157-2013).

4.12.6 System Performance Indicators

(1) The system performance indicators should comply with the provisions of Section 20.6 of the Code for Design of Metro (GB 50157-2013).

(2) The development of operation safety-related main control system software should comply with the technical specifications and measures of safety integrity level 2 (SIL 2).

(3) The system availability should be greater than 99.99%, with a service life of not less than 20 years.

4.12.7 Other

(1) The requirements for main control system equipment rooms should comply with the provisions of Clause 20.7.4 of the Code for Design of Metro (GB 50157-2013). It is advisable to combine the main control system with other low-voltage systems, such as communications, environmental monitoring, and automatic fare collection in an

integrated low-voltage equipment room, and to reserve space for future expansion with holistic consideration.

(2) Equipment installation should comply with the provisions of Clause 4.3.4 of the Code for Design of Data Centers (GB 50174-2017). The distance behind the cabinet (rack) to any obstruction should not be less than 0.8m.

(3) The system power supply, lightning protection, and earthing should comply with the provisions of Clauses 20.7.2 and 20.7.3 of the Code for Design of Metro (GB 50157-2013).

(4) The use of wires and cables should comply with the provisions of Clause 4.7.6 of this document, and should also comply with the provisions of Clause 20.7.1 of the Code for Design of Metro (GB 50157-2013).

(5) In addition to the above requirements, the system shall also comply with the requirements of Electricity Ordinance (Cap. 406).

4.13 Building Automation System

4.13.1 Reference Standards

The design of building automation system shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Fire Services Ordinance (Cap. 95)

(2) Electricity Ordinance (Cap. 406)

Relevant Technical Standards

(3) Design Manual – Barrier Free Access 2008 published by Buildings Department

(4) Code of Practice for Fire Safety in Buildings 2011 published by Buildings Department

(5) Code of Practice for the Electricity (Wiring) Regulations published by Electrical and Mechanical Services Department

(6) General Code for Fire Protection in Buildings and Constructions (GB 55037-2022)

(7) General Code for Building Electricity and Intelligence (GB 55024-2022)

(8) Standard for Fire Protection Design of Metro (GB 51298-2018)

(9) Standard for Design of Intelligent Building (GB 50314-2015)

(10) Standard for Electrical Design of Civil Buildings (GB 51348-2019)

(11) Railway applications - Electromagnetic compatibility (GB/T 24338-2018)

4.13.2 General Requirements

(1) This Section takes the national railway standards as the main basis and benchmark, with optimisation and adjustment with Hong Kong legislation, Government documents and engineering standards to suit the needs of Hong Kong railway, and comply with the principles of safety and applicability, economic rationality, and technical advancement.

(2) The disaster relief mode of the building automation system should comply with the provisions of Clause 21.1.4 of the Code for Design of Metro (GB 50157-2013) and Clauses 6.6.7, 6.6.8, and 6.6.9 of the Project Code for Engineering of Urban Rail Transit (GB 55033-2022). The interface and control requirements with the automatic fire alarm system should comply with the provisions of Clauses 21.2.4 and 21.2.5 of the Code for Design of Metro (GB 50157-2013).

(3) Where group station control is adopted, the building automation system at the master station may monitor the equipment and facilities of both the master station itself and its control zones, as well as those of the satellite stations and their control zones. The building automation

system at each satellite station should possess independent operational capability.

(4) During the application process of the national railway standards in the design of monitoring and control system for environment and equipment, if any national railway standards in respect of fire safety cannot be adopted, a comprehensive risk assessment should be conducted to identify optimisation proposals, to ensure that the fire safety level is not affected, so as to safeguard the integrity of the fire safety design. The optimisation proposals shall only be implemented upon the approval of the relevant authorities.

4.13.3 System Functions

(1) The basic functions of the building automation system should comply with the provisions of Section 21.3 of the Code for Design of Metro (GB 50157-2013) and Section 6.6 of the Project Code for Engineering of Urban Rail Transit (GB 55033-2022).

(2) Where group station control is adopted, the building automation system at the master station and satellite stations may possess networking capabilities. Other than the functions of monitoring the mechanical and electrical equipment and facilities of the master station itself and its control zones, the building automation system at the master station may also possess the following functions:

(a) Monitor the mechanical and electrical equipment and facilities of the satellite stations and their control zones.

(b) Receive fire alarm signals, perform linkage control of E&M equipment and facilities within the master station, and issue commands to the building automation system of satellite stations for linkage control of E&M equipment and facilities within their respective control zones.

4.13.4 System Configuration Requirements

(1) Programmable Logic Controllers (PLC) or Distributed Control Systems (DCS) may be selected as the control equipment for the building automation system. To meet the deployment requirements of smart operations, industrial Edge Intelligent Controllers (EIC) may be selected. The EICs should support functions such as ubiquitous Internet of Things (IoT) access, converged computing power, and intrinsic security.

(2) The hardware equipment for the station environmental control system (ECS) and the building services control system (BCS) may be integrated and provided by the building automation system.

(3) The building automation system should establish reliable interfaces with equipment and facilities such as air-conditioning and ventilation, water supply and drainage, power supply and lighting, and escalators. The electromagnetic radiation emitted by interface devices, connecting wires, and connecting cables should comply with the provisions of the Railway Applications - Electromagnetic Compatibility (GB/T 24338-2018).

4.13.5 Other

(1) The system power supply should comply with the provisions of Clause 10.1.5 of theGeneral Code for Fire Protection in Buildings and Constructions (GB 55037-2022) and Clause 4.6.5 of the General Code for Building Electricity and Intelligence (GB 55024-2022).

(2) The system's lightning protection, earthing, and wiring should comply with the provisions of Section 27.7 of the Code for Design of Metro (GB 50157-2013), Chapter 6, Clauses 7.1.5, 7.1.6, and 7.2.6 of the General Code for Building Electricity and Intelligence (GB 55024-2022), and Section 12.9 of the Standard for Electrical Design of Civil Buildings (GB 51348-2019).

(3) The requirements for the wires and cables used in the system should comply with the provisions of Clause 4.7.6 of this document.

(4) In addition to the above requirements, the system shall also comply with the requirements of Electricity Ordinance (Cap. 406).

4.14 Access Control System

4.14.1 Reference Standards

The design of access control system shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Electricity Ordinance (Cap. 406)

Relevant Technical Standards

(2) Code of Practice for the Electricity (Wiring) Regulations published by Electrical and Mechanical Services Department

(3) General Code for Building Electricity and Intelligence (GB 55024-2022)

(4) General Code of Security and Engineering (GB 55029-2022)

(5) Technical Standard for Security Engineering (GB 50348-2018)

(6) Technical Code for Public Security Prevention System of Urban Rail Transit Engineering (GB 51151-2016)

(7) Code for Design of Data Centers (GB 50174-2017)

(8) Code of Design for Access Control Systems Engineering (GB 50396-2007)

(9) Classification for Burning Behavior of Electric and Optical Cables (GB 31247-2014)

(10) General Rules for Flame Retardant and Fire Resistant Wires and Cables (GB/T 19666-2005)

4.14.2 General Requirements

(1) This Section takes the national railway standards as the main basis and benchmark, with optimisation and adjustment via incorporation of Hong Kong legislation, Government documents and engineering standards to suit the railway demands in Hong Kong, while complying with the principles of safety and applicability, economic rationality, and technical advancement.

(2) The access control system may be hosted on a cloud platform according to its system architecture, with the cloud platform to provide computing, storage, and network resources.

4.14.3 Security Levels and Monitored Targets

(1) Security levels and monitored targets should comply with the provisions Section 23.2 of the Code for Design of Metro (GB 50157-2013).

(2) For railway lines adopting FAO, access control should be provided at separation doors between staffed and unstaffed areas within depots. The entry side should be equipped with a card reader. The exit side should be equipped with a card reader and an emergency exit button.

(3) A staff security alarm button or kick bar should be provided at each operator console. These buttons or kick bars should form an integral part of the console design. Buttons should be readily operable by the operator but concealed from normal view. Staff security alarm buttons or kick bars should also be provided at customer service centres, automatic fare collection audit/revenue rooms, travel service centres, lost & found offices, and other critical locations.

4.14.4 System Composition

(1) The overall composition of the access control system should comply with the provisions of Section 23.3 of the Code for Design of Metro (GB 50157-2013).

(2) Where group station control is adopted, the access control system may fulfil the requirements for group station control. The control and monitoring of access for the group of stations, including master station and satellite stations, may be carried out through the computer at the master station. Additionally, each satellite station may be equipped with a computer serving as a local backup to support its own control and monitoring functions in case of failure at the group control level.

4.14.5 System Basic Functions

(1) The basic functions of the system should comply with the provisions of Section 23.4 of the Code for Design of Metro (GB 50157-2013).

4.14.6 Other

(1) Equipment installation requirements should comply with the provisions of Section 23.5 of the Code for Design of Metro (GB 50157-2013).

(2) System interfaces should comply with the provisions of Clause 23.6.1 of the Code for Design of Metro (GB 50157-2013).

(3) The system power supply, earthing, and lightning protection should comply with the provisions of Clause 23.6.2 of the Code for Design of Metro (GB 50157-2013).

(4) The access control system and its equipment should be capable of operating uninterrupted 7x24 hours. The system should be powered by an uninterruptible power supply with a backup time of not less than 2 hours.

(5) The requirements for the wires and cables used in the system should comply with the provisions of Clause 4.7.6 of this document.

(6) In addition to the above requirements, the system shall also comply with the requirements of Electricity Ordinance (Cap. 406).

4.15 Information System

4.15.1 Reference Standards

The design of information system shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Telecommunications Ordinance (Cap. 106)

(2) Electricity Ordinance (Cap. 406)

(3) Protection of Critical Infrastructures (Computer Systems) Ordinance (Cap. 653)

Relevant Technical Standards

(4) Code of Practice for Electricity (Wiring) Regulations published by Electrical and Mechanical Services Department

(5) General Code for Building Electricity and Intelligence (GB 55024-2022)

(6) Code for Design of Data Centers (GB 50174-2017)

(7) Code for Design Protection of Structures against Lightning (GB 50057-2010)

(8) Technical Code for Protection of Building Electronic Information System (PIS) Against Lightning (GB 50343-2012)

(9) Code for Engineering Design of Generic Cabling System (GB 50311-2016)

(10) Intelligent Urban Rail Transit - Information Technology Architecture and Cybersecurity Specification - Part 1: General Requirements (T/CAMET 11001.1-2019)

(11) Intelligent Urban Rail Transit - Information Technology Architecture and Cybersecurity Specification - Part 2: Technical Architecture (T/CAMET 11001.2-2019)

(12) Intelligent Urban Rail Transit - Information Technology Architecture and Cybersecurity Specification - Part 3: Cybersecurity (T/CAMET 11001.3-2019)

(13) Technical Specification for Cloud Platform Network Architecture of Urban Rail Transit (T/CAMET 11004-2020)

(14) Technical Specification for Cloud Platform Cybersecurity of Urban Rail Transit (T/CAMET 11005-2020)

(15) Technical Specification for Cloud Platform Construction of Urban Rail Transit (T/CAMET 11002-2020)

(16) Technical Specification for Big Data Platform of Urban Rail Transit (T/CAMET 11003-2020)

(17) Technical Specification for Rail Network Operation Command Center System of Urban Rail Transit (T/CAMET 11006-2020)

(18) Code for Design of Urban Rail Transit Informatization Engineering (T/CAMET 11007-2022)

4.15.2 General Requirements

(1) This Section takes the national railway standards as the main basis and benchmark, with optimisation and adjustment with Hong Kong legislation, Government documents and engineering standards to suit the needs of Hong Kong railway, and comply with the principles of safety and applicability, economic rationality, and technical advancement.

(2) An information system may be established for the railway. This system may include foundational platforms such as cloud platform, big data platform, artificial intelligence (AI) platform, internet of things (IoT) platform, as well as functional applications like network-wide operation command, enterprise management, and passenger service.

(3) The information system should be compatible with the operational management models and operational demands of railways in Hong Kong.

(4) The information system should adhere to the principles of unified planning, unified standards, resource sharing, and should comply with the requirements of being secure, reliable, advanced, and expandable.

(5) The design of the information system may adopt standardised and open architecture and interface designs, and should make provisions for future system upgrades and expansions.

(6) The design of the information system may achieve resource sharing in physical resources, data resources, and application resources. The physical and data resource services required by various specialised systems across the railway network and individual lines should be uniformly provided by the foundational platforms of the information system.

4.15.3 System Basic Functions

(1) The information system may possess basic functions such as line operation command, enterprise management, and passenger services. Cross-disciplinary, comprehensive application systems should be developed within the information system, while discipline-specific application systems should be developed within their respective specialised systems.

(2) Line operation command may include functions such as network operation scheduling, network emergency command, network decision support, and network information release.

(3) Enterprise management may include functions such as office automation management, operation management, construction management, and resource management.

(4) Passenger services may include functions such as portal websites, mobile terminal services, customer service hotlines, and convenience services.

(5) The information system may rely on the internet of things platform to achieve data collection and data standardization. Based on foundational platforms such as cloud platform and big data platform, it should utilise data storage, computing, analysis, and sharing capabilities to develop and integrate functions related to smart railways. It may also utilise AI platform to enable features related to large model management and smart applications.

(6) The Information System should be able to collect real-time transport information, such as pedestrian flows, passenger queuing information, etc. The information should be shared with the Government at such time and intervals agreed by the Government. At the request of the Government, selected information should also be published on the Government data-base (e.g. data.gov.hk) or shared with other Government departments and operators. The Information System should also be able to incorporate real-time transport and other relevant information provided by the Government and nearby sites with public transport and parking facilities.

4.15.4 Basic Requirements of System Construction

(1) The information system may be constructed based on foundational platforms such as the cloud platform, big data platform and, IoT platform and AI platform, along with application systems. The scale of the information system should be configured according to demand, while reserving conditions for upgrade and expansion.

(2) The information system may establish a cloud platform to provide a centralised foundational environment, including computing, storage, networking, and security, as well as platform services such as database, middleware, and containers for specialised and information system applications. It may deploy based on security production domains, internal management domains, and external service domains. The specific design should refer to the Code for Design of Urban Rail Transit Informatization Engineering (T/CAMET 11007-2022).

(3) The information system may establish a unified big data platform to provide data sharing and data services for the information system, various specialised systems, and external systems. The specific design should refer to the Code for Design of Urban Rail Transit Informatization Engineering (T/CAMET 11007-2022).

(4) It may accommodate an IoT platform that has a control platform for unified access of multi-source heterogeneous devices, protocol interpretation, and full lifecycle management functions, supporting higher-level services through standardised data interfaces. Front-end sensing devices should connect to the platform via direct connections or edge gateways, achieving comprehensive awareness of infrastructure status, real-time data aggregation, and interconnectivity between systems.

(5) A unified AI platform may be established for the entire network, capable of heterogeneous computing power to mask underlying hardware differences. The platform should also have the capability for unified integration of multimodal large models and standardised data set construction and management. Additionally, it should provide a model development and operational environment to support the customised development, orchestration deployment, and business applications of AI agents.

(6) The network operation command should refer to the Technical Specification for Rail Network Operation Command Center System of Urban Rail Transit (T/CAMET 11006-2020).

4.15.5 Power Supply, Lightning Protection and Earthing

(1) The power supply for the information system should comply with the following provisions:

(a) The grade of power supply load should be grade 1.

(b) Uninterruptible power supply equipment and maintenance-free battery equipment should be used. The battery bank should ensure a continuous power supply duration that meets the backup power requirements of the systems hosted on the cloud platform.

(2) The incoming lines of low-voltage power supply system should follow the lightning protection measures in the Code for Design Protection of Structures against Lightning (GB 50057-2010) and the Technical Code for Lightning Protection of Electronic Information System of Buildings (GB 50343-2012).

(3) The earthing system for information system equipment should comply with the following provisions:

(a) The information system should be connected to the integrated earthing system, with an earth resistance not greater than 1 Ω.

(b) Equipotential bonding should be applied to the metal casings, cabinets, racks, conduits, and trays of information system equipment.

4.15.6 System Cabling and Room Requirements

(1) The wires and cables for the information system should comply with the provisions of Clause 4.7.6 of this document.

(2) Rooms for the information system may be configured to include a main computer room, power room, battery room, network management room, wiring closets, and auxiliary rooms. Rooms for network-level and line-level functions may be set up in a centralised and shared manner and can be shared with rooms for to other low-voltage systems. The

computer room standards and room environment should comply with the provisions of the Code for Design of Data Centers (GB 50174-2017). Central equipment rooms should meet at least tier B standards.

(3) The design of information system computer rooms should follow the principles of environmental protection and energy saving.

4.16 Cyber Security

4.16.1 Reference Standards

The design of cyber security shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Protection of Critical Infrastructures (Computer Systems) Ordinance (Cap. 653)

(2) Telecommunications Ordinance (Cap. 106)

Relevant Technical Standards

(3) General Code for Building Electricity and Intelligence (GB 55024-2022)

(4) Information Security Technology - Baseline for Classified Protection of Cybersecurity (GB/T 22239-2019)

(5) Information Security Technology - Classification Guide for Classified Protection of Cybersecurity (GB/T 22240-2020)

(6) Information Security Technology - Technical Requirements of Security Design for Classified Protection of Cybersecurity (GB/T 25070-2019)

(7) Information Security Technology - Evaluation Requirement for Classified Protection of Cybersecurity (GB/T 28448-2019)

(8) Information Security Technology - Testing and Evaluation Process Guide for Classified Protection of Cybersecurity (GB/T 28449-2018)

(9) Information Security Technology - for Disaster Recovery Specifications for (GB/T 20988-2007)

(10) Information Security Technology - Testing and Evaluation Technical Guide for Classified Cybersecurity Protection (GB/T 36627-2018)

(11) Information Security Technology - Security Guidance for Cloud Computing Service (GB/T 31167-2023)

(12) Information Security Technology - Baseline for Information System Cryptography Application (GB/T 39786-2021)

(13) Information Security Technology - Security Technical Requirements and Testing Assessment Approaches for Firewall (GB/T 20281-2020)

(14) Code for Information Technology Engineering Design of Urban Rail Transit (T/CAMET 11007-2022)

(15) Technical Code for Cybersecurity of Urban Rail Transit Cloud Platform (T/CAMET 11005-2020)

(16) Intelligent Urban Rail Transit - Information Technology Architecture and Cybersecurity Specification - Part 3: Cybersecurity (T/CAMET 11001.3-2019)

4.16.2 General Requirements

(1) This Section applies to the cyber security design of systems, including but not limited to the power supervisory control system, communication system, signalling system, automatic fare collection system, main control system, access control system, CCTV system, telephone system, passenger information system and information system, for new and cross-boundary railway projects within Hong Kong.

(2) This Section takes the national railway standards as the main basis and benchmark, with optimisation and adjustment with Hong Kong legislation, Government documents and engineering standards to suit the needs of Hong Kong railway, and comply with the principles of

safety and applicability, economic rationality, and technical advancement.

(3) The cyber security protection level for each system should be determined in accordance with requirements stipulated in standards, such as the Information Security Technology - Baseline for Classified Protection of Cybersecurity (GB/T 22239-2019), the Information Security Technology - Classification Guide for Classified Protection of Cybersecurity (GB/T 22240-2020), the Information Security Technology - Evaluation Requirement for Classified Protection of Cybersecurity (GB/T 28448-2019), and the Information Security Technology - Technical Requirements of Security Design for Classified Protection of Cybersecurity (GB/T 25070-2019). Corresponding security configurations for the determined level should be implemented. The classification of cyber security levels for various specialised systems of Hong Kong railways should comply with the following provisions:

(a) The power supervisory control system should comply with the requirements of National Classified Protection Level 3 requirements for cyber security.

(b) The signalling system should comply with the requirements of National Classified Protection Level 3 requirements for cyber security.

(c) The network-level automatic fare collection system and the clearing house system should comply with the requirements of National Classified Protection Level 3 requirements for cybersecurity. The line-centre-level system and line-station-level system should not be lower than the National Classified Protection Level 2 requirements for cyber security.

(d) The cyber security of the main control system should comply with the requirements of National Classified Protection Level 3 requirements for cyber security.

(e) CCTV systems deployed within external service networks should comply with the requirements of video security level protection requirements stipulated by public security authorities and should not be lower than the national classified protection level 2 requirements for cyber security.

(f) The telephone system should not be lower than the national classified protection level 2 requirements for cyber security.

(g) The passenger information system should not be lower than the national classified protection level 2 requirements for cyber security.

(h) The access control system should not be lower than the national classified protection level 2 requirements for cyber security.

(i) The information system should comply with relevant requirements for the classification of cyber security protection requirements. Specifically, the internal production network within its cloud platform should comply with the requirements of national classified protection level 3 requirements for cyber security, while the management network and service network should not be lower than the national classified protection level 2 requirements for cyber security.

(j) Other business application systems should not be lower than the national classified protection level 2 requirements for cyber security.

(k) For cross-boundary railway lines, cyber security certification and testing shall fulfil the respective legal and regulatory requirements of all involved jurisdictions.

4.17 Platform Screen Doors

4.17.1 Reference Standards

The design of platform screen doors should make reference to the latest editions of the following standards:

Relevant Technical Standards

(1) Railway Applications - Electrical System for Platform Screen Door (PSD) (GB/T 36284-2018)

(2) Urban Rail Transit Platform Screen Door System (GB/T 46749-2025)

(3) Technical Code for Platform Screen Door of Urban Railway Transit (CJJ 183-2012)

(4) Urban Rail Transit Platform Screen Door System (CJ/T 236-2022)

4.17.2 General Requirements

(1) The mechanical motion and dynamic performance of the platform screen door actuators should comply with the provisions of Clause 9.3.3 in the Urban Rail Transit Platform Screen Door System (GB/T 46749-2025).

(2) The crowd-induced static load-bearing capacity of the platform screen door structural assembly should comply with the provisions of Item 3 of Clause 26.2.7 in the Code for Design of Metro (GB 50157-2013).

(3) The impact load that the platform screen door structural assembly should withstand from crowd impact is defined as a force of 2.8 kN, applied over an area of 100mm × 100mm at a height of 1.2m at-grade level, with a duration of 0.08 seconds.

(4) Platform screen doors for FAO lines should comply with the provisions of Clause 5.6.20 in the Urban Rail Transit Platform Screen Door System (CJ/T 236-2022).

4.18 Operations Control Centre

4.18.1 Reference Standards

The design of operations control centre (OCC) should make reference to the latest editions of the following standards:

Relevant Technical Standards

(1) Code for Design of Data Centers (GB 50174-2017)

4.18.2 General Requirements

(1) To ensure the safe, efficient, and reliable operational command of Hong Kong railway traffic, and to facilitate dispatchers and operators in implementing comprehensive centralised monitoring and dispatching command over the entire operational process, an operations control centre (OCC) should be established, and a backup control centre may be set up based on the operation and business needs. The scale can be configured for a single line or shared by multiple lines. The location should be determined based on local conditions, following the principles of facilitating line monitoring, operational management, emergency command, safety, and reliability.

(2) The OCC should possess functions for daily operational management and emergency rescue command during disaster incidents. It should be responsible for the centralised command, dispatching, coordination, and management of operating trains, stations, depots, and substations, and should monitor and control various E&M equipment systems. When the OCC fails and cannot monitor the railway line, the backup control centre should possess corresponding remote control and data backup functions.

(3) The OCC should possess functions for operational information interconnection and emergency incident coordination with relevant Government departments such as the Transport Department, Fire Services Department, and Hong Kong Police Force. For cross-boundary railways, the OCC should possess functions for video surveillance

interoperability, capacity matching, passenger flow statistics calculation, passenger flow guidance, emergency incident coordination, and centralised release of operational service information with Chinese Mainland rail transit authorities.

4.18.3 Workmanship Design

(1) The OCC and backup control centre may provide dispatch and command rooms, equipment rooms, and management rooms. The OCC may offer corresponding rooms and facilities according to operational monitoring areas, operations management areas, equipment areas, maintenance areas, and auxiliary equipment areas. The backup control centre may provide corresponding rooms and facilities according to operations monitoring areas, operations management areas, and equipment areas.

(2) Dispatch categories and workstations may be configured according to the actual needs of the railway operator. With the increasing intelligence of various systems and the promotion of information technology, dispatch categories and workstations may be set up in a more integrated manner.

(3) The workmanship requirements for relevant equipment rooms in the OCC and backup control centre should be configured in accordance with the provisions of Code for Design of Data Centers (GB 50174-2017) and may be designed to fulfil tier B requirements.

(4) The OCC should provide and maintain adequate and efficient means of communication between OCC and the monitoring system on the patronage data at the automatic fare collection gates, the trains in service, station, depot and such other places that are essential to the proper, efficient and safe operation of the railway.

4.19 Station Facilities for Passengers

4.19.1 Escalators and Moving Walkways

(1) Reference Standards

The design of escalator and moving walkway shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(a) Lifts and Escalators Ordinance (Cap. 618)

Relevant Technical Standards

(b) Code of Practice for Lift and Escalator Works published by Electrical and Mechanical Services Department

(c) Code of Practice on the Design and Construction of Lifts and Escalators published by Electrical and Mechanical Services Department

(d) Code of Practice for Building Works for Lifts and Escalators 2011 published by Buildings Department

(e) Safety Rules for the Construction and Installation of Escalators and Moving Walks (GB 16899-2011)

(f) Technical Specification for Escalators Used in Metro Systems (T/CEA 301-2023)

(2) Main Technical Requirements

(a) Escalators and moving walkways should be of the public transport heavy-duty type.

(b) The nominal speed of escalators and moving walkways should not be less than 0.5 m/s, and may adopt a speed of 0.75 m/s. They should be equipped with variable speed drive for energy-saving purposes.

(c) The nominal width of escalator steps may be 1 m. The nominal width of moving walkway pallets may not be less than 1.2 m. The nominal widths of escalators and moving walkways should also comply with the requirements concerning safe evacuation and fire service rescue.

(d) The angle of inclination for escalators should not exceed 30°. The angle of inclination for moving walkways may not exceed 2.3°.

(e) The number of horizontal steps at the upper and lower landings of escalators should comply with the provisions of Clause 6.9.3 of Project Code for Urban Rail Transit Engineering (GB 55033-2022).

(f) Smart O&M management systems for escalators and moving walkways may be installed. Specific arrangements should be agreed upon by the user in the contract.

4.19.2 Lifts

(1) Reference Standards

The design of lift shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards.

Hong Kong Legislation

(a) Lifts and Escalators Ordinance (Cap. 618)

Relevant Technical Standards

(b) Code of Practice for Lift and Escalator Works published by Electrical and Mechanical Services Department

(c) Code of Practice on the Design and Construction of Lifts and Escalators published by Electrical and Mechanical Services Department

(d) Code of Practice for Building Works for Lifts and Escalators 2011 published by Buildings Department

(e) Code of Practice for Fire Safety in Buildings 2011 published by Buildings Department

(f) Design Manual: Barrier Free Access 2008 published by Buildings Department

(g) Safety Rules for the Construction and Installation of Lifts - Part 1: Passenger and Goods Passenger Lifts (GB/T 7588.1-2020)

(h) Safety Rules for the Construction and Installation of Lifts - Part 2: Design Rules, Calculations, Examinations and Tests of Lift Components (GB/T 7588.2-2020)

(i) Safety Rules for the Construction and Installation of Firefighters Lifts (GB/T 26465-2021)

(j) Code for Accessibility Design (GB 50763-2012)

(k) General Code for Accessibility of Buildings and Municipal Engineering Projects (GB 55019-2021)

(2) Main Technical Requirements

(a) Machine-room-less lifts may be adopted for stations. Lifts with machine rooms may be adopted for depots and OCCs.

(b) Machine-room-less lift shafts exposed outdoors may be constructed using concrete.

(c) The rated speed of lifts should not be less than 1 m/s.

(d) The rated load of lifts may not be less than 1000 kg. If different parameters are required due to special circumstances, an evaluation should be conducted based on actual operational needs and safety requirements, and approval should be obtained from the relevant authorities

(e) Requirements for lift shaft and car dimensions should comply with the relevant provisions of Code of Practice for Building Works for Lifts and Escalators 2011 published by Buildings Department.

(f) Accessibility requirements for lifts should comply with the relevant provisions of Design Manual: Barrier Free Access 2008 published by Buildings Department.

(g) The functionality of fireman's lift should comply with the relevant provisions of the Code of Practice for Fire Safety in Buildings 2011 published by Buildings Department.

(h) Smart O&M management systems for lifts may be installed. Specific arrangements should be agreed upon by the user in the contract.

4.20 System Assurance

4.20.1 Reference Standards

System assurance should make reference to the latest editions of the following standards:

Relevant Technical Standards

(1) Railway Applications - Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) (GB/T 21562-2008)

(2) Railway Applications - Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 2: Guide to The Application for Safety (GB/T 21562.2-2015)

(3) Railway Applications - Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 3: Guide to The Application for Rolling Stock RAM (GB/T 21562.3-2015)

(4) Railway Applications - Communication, Signalling and Processing Systems - Safety-related Electronic Systems for Signalling (GB/T 28809-2012)

(5) Railway Applications - Communication, Signalling and Processing Systems - Software for Railway Control and Protection Systems (GB/T 28808-2021)

(6) Programmes for Reliability Growth (GB/T 15174-2017)

(7) Reliability Growth - Statistical Test and Estimation Methods (GB/T 39844-2021)

(8) Ergonomic Principles in The Design of Work Systems (GB/T 16251-2023)

4.20.2 General Requirements

(1) The system assurance activities and the requirements of specific analysis document in each phase of the project liftcycle should comply with the requirements of standards in this Section.

(2) System assurance should be implemented in accordance with the documentation submission checklist requirements for project safety reviews stipulated by Electrical and Mechanical Services Department.

4.21 Depot

4.21.1 Reference Standards

The design of depot shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulation (Cap. 59 sub. leg. J)

(2) Dangerous Goods Ordinance (Cap. 295)

(3) Waste Disposal Ordinance (Cap. 354)

(4) Air Pollution Control Ordinance (Cap. 311)

Relevant Technical Standards

(5) Hong Kong Planning Standards and Guidelines published by Planning Department

(6) Code of Practice for Fire Safety in Buildings 2011 published by Buildings Department

(7) Standard for Pollution Control on Hazardous Waste Storage (GB 18597-2001)

(8) Rail Car Heavy Duty Rail Motor Car (GB/T 10082-2024)

(9) Limits and Measurement Methods for Exhaust Pollutants from Diesel Engines of Non-road Mobile Machinery (GB 20891-2014/XG1-2020)

(10) Technical Specification for Underfloor Wheel Sets Lathe of Locomotive and Rolling Stock (TB/T 3136-2006)

(11) 25t Electric Rack Car Technical Conditions (TB/T 1686-2000)

(12) Regulation on Safety Technology for Lifting Appliances (TSG 51-2023)

(13) Vehicle Lifts (EN 1493)

4.21.2 General Requirements

(1) The building services and track configuration within the depot should be set based on its functional positioning and should comply with the provisions of Clause 27.1.1 of the Code for Design of Metro (GB 50157-2013).

(2) The functional configuration and resource-sharing requirements of the depot should comply with the provisions of Clause 27.1.2 of the Code for Design of Metro (GB 50157-2013).

(3) The site selection requirements for the depot may comply with the provisions of Clause 27.1.4 of the Code for Design of Metro (GB 50157-2013) and should comply with the requirements of Hong Kong Planning Standards and Guidelines published by Planning Department.

(4) A smart management and control system utilizing a common software platform may be established for the depot.

4.21.3 Function, Scale, and General Layout

(1) Functional Positioning and Scale

(a) Vehicle Maintenance Regime

(i) The maintenance regime for vehicles with a maximum operating speed not exceeding 100 km/h may comply with the provisions of Table 27.2.3 in the Code for Design of Metro (GB 50157-2013).

(ii) The maintenance regime for vehicles with a maximum operating speed not exceeding 160 km/h may comply with the provisions in Table 25.1.1-1 in the Code for Design of Suburban Railway (TB 10624-2020).

(iii) Users and manufacturers should adaptively adjust the vehicle maintenance regime based on the vehicle technology platform, whole-life-cycle quality indicators, and operational maintenance experience.

(b) The design of work scope for depot should comply with the provisions of Clause 27.2.4 of the Code for Design of Metro (GB 50157-2013).

(2) General Layout

(a) The general layout of the depot may comply with the provisions of Clause 27.2.13 of the Code for Design of Metro (GB 50157-2013).

(b) The depot should have at least two vehicular access points to ensure alternative routes for emergency rescue vehicles to reach the site. CCTVs should be installed at each access point, and the system should be connected to the depot dispatch centre for real-time monitoring. Separate and independent vehicular access points should be established for the depot, stations, and property development areas wherever feasible.

(c) The general layout of the depot should accommodate FAO requirements, with separate zones designated for FAO areas and Non-FAO areas. Enclosure facilities should be provided, complying with the provisions of Clauses 27.2.17 and 27.2.20 of the Code for Design of Metro (GB 50157-2013). Protective measures such as access control should be installed at the entrance to FAO areas, and excessive detours for drivers, attendants, and related personnel should be avoided. Public access to non-FAO areas may be permitted after obtaining safety authorization.

(d) The depot FAO area should include entry/exit tracks, pull-out tracks, train wash tracks, stabling tracks, and associated connecting tracks. The non-FAO area should include major/heavy repair tracks, light repair tracks, cleaning bays, static test tracks, underfloor wheel lathe tracks, works train tracks, materials tracks, maintenance pull-out tracks, test tracks, and associated connecting tracks. A transition track should be provided either before the pull-out track or in front of the repair shed to connect the FAO and non-FAO areas.

(e) The design of the geometric alignment (both horizontal and vertical) for depot entry/exit tracks may comply with the provisions of Clauses 27.2.7, 27.2.10, and 27.2.11 of the Code for Design of Metro (GB 50157-2013).

(f) The track design within the depot may comply with the provisions of Clause 27.2.12 of the Code for Design of Metro (GB 50157-2013).

4.21.4 Vehicle Operational and Maintenance Facilities

(1) Facility Configuration

(a) The depot should be equipped with vehicle operational and maintenance facilities as required for production needs, including operational preparation facilities and maintenance facilities.

(b) Operational preparation facilities include stabling and inspection sheds, preventive maintenance sheds, washing sheds, tread and pantograph inspection sheds, auxiliary production buildings, etc.

(c) Maintenance facilities include major/heavy repair sheds, light repair sheds, carbody sheds, painting sheds, bogie maintenance sheds, component repair shops, static test sheds, cleaning sheds, underfloor wheel lathe sheds, test tracks, and auxiliary production buildings, etc.

(2) Vehicle Operational Preparation Facilities

(a) Relevant requirements for operational preparation facilities should comply with the provisions of Section 27.3 of the Code for Design of Metro (GB 50157-2013).

(b) The stabling and inspection shed may implement zoning management compatible with FAO. Groups of 2 to 3 tracks may form one protected zone, with access passages provided to each zone. Safety interlocked access control should be installed at the entry point to each zone and integrated into the smart management and control system.

(3) Vehicle Maintenance Facilities

(a) Relevant requirements for vehicle maintenance facilities should comply with the provisions of Section 27.4 of the Code for Design of Metro (GB 50157-2013).

(b) Minimum dimensions for relevant parts of various operational and maintenance facilities may comply with the provisions in Table 4.21.4.

Table 4.21.4 Minimum Dimensions for Various Depot Sheds

Depot Type / Measurements	Parking Shed	Routine Maintenance Shed	Heavy/Light Maintenance Shed	Breakdown Repair Shed	Works Vehicle Shed	Painting Shed	Cleaning Shed
Distance between Carbodies	1.2m	2.9m	4.5m	3.9m	2m	2.5m	4m
Distance between Carbody and Column Edge	1.2m	3m	3.2m	3m	1.5m	2.2m	2.7m
Internal Clear Height	5.65m/7m(DC1500V/AC25KV)						
Clear Width of Access Passage at Depot Ends	3m						
Clear Door Opening Width	B+0.6m						
Clear Door Opening Height	H+0.4m						

Note: 'B' represents the vehicle width; 'H' represents the vehicle height.

4.21.5 Supporting Facilities

(1) Materials Warehouse

(a) Relevant requirements for the materials warehouse should comply with the provisions of Section 27.7 of the Code for Design of Metro (GB 50157-2013).

(b) Specific layout requirements for the materials warehouse should comply with the following provisions:

(i) Located near the main material demand areas.

(ii) External road systems suitable for heavy truck passage should be provided.

(iii) Flooring materials should be clean, slip-resistant, wear-resistant, and easy to maintain.

(2) Dangerous Goods Storage

(a) The setup of hazardous waste storage rooms should comply with the provisions of Chapter 6 of the Standard for Pollution Control on Hazardous Waste Storage (GB 18597-2001).

(b) Fire protection requirements for flammable goods stores shall comply with the provisions of Dangerous Goods Ordinance (Cap. 295) and the usage 6c (storage, manufacturing of hazardous/ dangerous goods premises) of the Code of Practice for Fire Safety in Buildings 2011 published by Buildings Department.

4.21.6 Major Vehicle Maintenance Equipment

(1) Lifting Jacks

(a) The technical requirements, inspection, installation, and operational use of fixed lifting jacks should comply with the provisions of the Vehicle Lifts (EN 1493).

(b) The production, testing, installation, and operational use of mobile lifting jacks should comply with the provisions of the Specifications for 25t Electric Rack Car Technical Conditions (TB/T 1686-2000).

(2) Train Washing Machine

(a) The train washing machine should be capable of operating in both fully automatic driverless washing mode and manual driving washing mode.

(3) CNC Underfloor Wheel Lathe

(a) The technical requirements, test methods, accuracy inspection, and inspection rules for CNC underfloor wheel lathes should comply with the provisions of the Technical Specification for Underfloor

Wheel Sets Lathe of Locomotive and Rolling Stock (TB/T 3136-2006).

(4) Cranes

(a) Standards related to the installation, use, maintenance, and inspection of cranes should comply with the provisions of Chapters 4 - 6 of the Regulation on Safety Technology for Lifting Appliances (TSG 51-2023).

(5) Other Maintenance Equipment

(a) Trackside integrated inspection equipment may be configured along the inbound tracks to collect critical train data in real-time, providing a decision-making basis for the maintenance of key vehicle components.

(b) Smart inspection robots may be configured in the depot to achieve automatic information collection for trains, providing a decision-making basis for vehicle maintenance. The quantity of robots should be determined based on routine maintenance plans and fleet size.

4.21.7 Engineering Vehicles

(1) General Provisions

(a) The depot should be equipped with diesel shunting locomotives for shunting operations within the depot, which may also serve for mainline train rescue and towing of unpowered works vehicles.

(b) Battery-powered electric works trains may be equipped for depot shunting, mainline patrol/inspection/repair, transportation of equipment/materials, and towing other unpowered works vehicles.

(c) Large-scale engineering vehicles such as track geometry cars, rail grinding trains, and rail flaw detection cars should be configured for sharing across the railway network.

(2) Basic Technical Requirements

(a) Self-propelled engineering vehicles may be equipped with an on-board safety monitoring system to automatically monitor operational status.

(b) Emission standards for diesel shunting locomotives should comply with the provisions of the Limits and Measurement Methods for Exhaust Pollutants from Diesel Engines of Non-road Mobile Machinery (China stages III and IV), Amendment No.1 (GB 20891-2014/XG1-2020).

(3) Main System Technical Requirements

(a) The operating conditions, technical requirements, structural characteristics and parameters, testing and acceptance, and marking of diesel shunting locomotives should comply with the provisions of the Rail Car Heavy Duty Rail Motor Car (GB/T 10082-2024).

(b) For battery-powered electric works trains, traction batteries should be environmentally friendly types suitable for sustained high-current discharge, with high capacity, maintenance-free operation, and recyclability. Battery capacity should meet the operational scenario demands of the corresponding railway line(s), and a battery management system is recommended.

4.21.8 Other

(1) The design elevation of the track shoulder within the depot should not be less than the sum of the tidal water level for the 1-in-200-year flood frequency standard, the wave run-up value, and a safety allowance.

(2) A safe, comfortable, and efficient working environment should be provided within the depot to ensure employee’s occupational safety.

(3) Environmental design within the depot should comply with the following requirements:

(a) The depot should minimise the impact of noise on the working environment.

(b) Architectural finishes within the depot should be suitable for industrial facilities, easy to construct, and contribute to providing a safe, clean, efficient, and motivating working environment.

(4) An identification system comprising fire safety signs, safety signs, warning signs, locational signs, and position signs should be installed throughout the depot according to production safety requirements.

(5) Barrier-free facilities should be provided in non-operational areas of the depot.

4.22 Environmental Protection

4.22.1 Reference Standards

The design of environmental protection shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Environmental Impact Assessment Ordinance (Cap. 499)

(2) Air Pollution Control Ordinance (Cap. 311)

(3) Water Pollution Control Ordinance (Cap. 358)

(4) Noise Control Ordinance (Cap. 400)

(5) Waste Disposal Ordinance (Cap. 354)

Relevant Technical Standards

(6) Technical Memorandum published by Environmental Protection Department

(7) Guidelines on Design of Noise Barriers published by Highways Department and Environmental Protection Department

(8) Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites published by Environmental Protection Department

(9) Ambient Air Quality Standards (GB 3095-2012)

(10) Environmental Quality Standard for Noise (GB 3096-2008)

(11) Control Limits for Electromagnetic Environment (GB 8702-2014)

(12) Emission Standard for Industrial Enterprises Noise at Boundary (GB 12348-2008)

(13) The Reuse of Urban Recycling Water - Water Quality Standard for Urban Miscellaneous Use (GB/T 18920-2020)

(14) Standard of Environmental Vibration in Urban Area (GB 10070-88)

(15) Technical Guidelines for Environmental Impact Assessment - Urban Rail Transit (HJ 453-2018)

(16) Technical Specifications for Environment Vibration and Noise Control Engineering of Urban Rail Transit (HJ 2055-2018)

(17) Standard for Limit and Measuring Method of Building Vibration and Secondary Noise Caused by Urban Rail Transit (JGJ/T 170-2009)

4.22.2 General Requirements

(1) Railway engineering design should meet the pollutant emission standards of Chinese Mainland and Hong Kong, and should comply with the requirements of urban environmental functional zoning and relevant environmental quality standard requirements.

(2) Railway projects during the construction and operation stages shall be implemented in compliance with Hong Kong legislation such as the Environmental Impact Assessment Ordinance (Cap. 499). Where specified otherwise in an environmental permit or environmental impact

assessment report, the relevant provisions of the said permit or report shall prevail.

4.22.3 Environmental Standards and Requirements

(1) Environmental protection measures for railway engineering shall include measures for noise control, air quality, visual and landscape impact, biodiversity, and sewage treatment, among others.

4.22.4 Noise Control Measures

(1) Exterior Train Noise

(a) The exterior train noise should comply with the provisions of Clause 4.4.12(2) of this document.

(2) Noise Sensitive Receivers

(a) Train noise limits for sensitive receiver areas along the railway should be implemented according to the relevant provisions in the Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites published by Environmental Protection Department.

(3) Ground-borne Noise at Sensitive Receivers

(a) Limits for ground-borne noise at sensitive receivers along the railway should be implemented according to the relevant provisions in the Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites published by Environmental Protection Department.

(4) Noise Barriers

(a) The noise reduction effect of noise barriers should achieve the Acceptable Noise Levels of day, evening and night for the corresponding types of areas as stipulated in the Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites published by Environmental Protection Department.

(b) Noise barrier design should simultaneously comply with the relevant measurement and design requirements in both Guidelines on Design of Noise Barriers published by Highways Department and Environmental Protection Department, and the Norm on Acoustical Design and Measurement of Noise Barriers (HJ/T 90-2004).

4.22.5 Wastewater Control Measures

(1) The wash-water treatment system for depot washing facilities should comply with the relevant requirements of The Reuse of Urban Recycling Water - Water Quality Standard for Urban Miscellaneous Water Consumption Use (GB/T 18920-2020) and should also comply with relevant Environmental Protection Department's requirements.

4.23 Energy Saving Design

4.23.1 Reference Standards

Energy saving design shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Buildings (Energy Efficiency) Regulation (Cap. 123 sub. leg. M)

(2) Electricity Ordinance (Cap. 406)

(3) Energy Efficiency (Labelling of Products) Ordinance (Cap. 598)

(4) Buildings Energy Efficiency Ordinance (Cap. 610)

Relevant Technical Standards

(5) Code of Practice for Energy Efficiency of Building Services Installation published by Electrical and Mechanical Services Department

(6) Code of Practice for Building Energy Audit published by Electrical and Mechanical Services Department

(7) Technical Guidelines on Code of Practice for Energy Efficiency of Buildings Services Installation published by Electrical and Mechanical Services Department

(8) Technical Guidelines on Connection of Renewable Energy Power Generation System to Grid published by Electrical and Mechanical Services Department

(9) General Code for Energy Efficiency and Renewable Energy Application in Buildings (GB 55015-2021)

(10) Design Standard for Energy Efficiency of Public Buildings (GB 50189-2015)

(11) Energy Conservation Requirements for Electromechanical Equipment of Urban Rail Transit (GB/T 35553-2017)

(12) Urban Rail Transit Lighting (GB/T 16275-2008)

(13) Urban Rail Transit – Ground System for Vehicle Braking Regenerative Energy Utilization (GB/T 36287-2018)

(14) Minimum Allowable Values of the Energy Efficiency and Energy Efficiency Grades for Heat Pumps and Water Chillers (GB 19577-2024)

(15) Minimum Allowable Values of Energy Efficiency and Values of Efficiency Grades for Motors (GB 18613-2020)

(16) Minimum Allowable Values of Energy Efficiency and Energy Efficiency Grades for Fans (GB 19761-2020)

(17) The minimum Allowable Values of Energy Efficiency and Evaluating Values of Energy Conservation of Centrifugal Pumps for Fresh Water (GB 19762-2007)

(18) Minimum Allowable Values of the Energy Efficiency and Energy Efficiency Grades for Multi-connected Air-condition (Heat Pump) Units (GB 21454-2021)

(19) Minimum Allowable Values of Energy Efficiency and Energy Efficiency Grades for Unitary Air Conditioners (GB 19576-2019)

(20) Minimum Allowable Values of the Energy Efficiency and Energy Efficiency Grades for Room Air Conditioners (GB 21455-2019)

(21) General Technical Specification for Metro Vehicles (GB/T 7928-2013)

(22) Minimum Allowable Values of Energy Efficiency and the Energy Efficiency Grades for Power Transformers (GB 20052-2024)

4.23.2 General Requirements

(1) Railway design should adopt comprehensive energy-saving measures encompassing operational organisation, vehicles, trackwork, buildings, and equipment systems to reduce railway operational energy consumption, and should incorporate energy management functionalities.

(2) The energy efficiency values for power supply & lighting equipment, communication & signalling equipment, operational display equipment, environmental control equipment, water supply & drainage equipment, lifts, escalators, moving walkway, power equipment, automatic fare collection equipment, and platform screen doors selected for railway projects should not be lower than the energy efficiency (minimum allowable values) required by the Energy Conservation Requirements for Electromechanical Equipment of Urban Rail Transit (GB/T 35553-2017).

4.23.3 Energy Saving for Building

(1) When glass curtain wall systems are used in station design, the use of coated glass (Low-E glass) should be considered and should comply with relevant Hong Kong legislation.

(2) For at-grade and elevated stations, at least 75% of the roof surface material should have a solar reflectance index (SRI) equal to or greater than the values specified in Table 4.23.3.

Table 4.23.3 Roof Surface Material Solar Reflectance Index (SRI) Limits

Roof Type	Slope	SRI
Low-sloped Roof	≤2:12	78
Steep-sloped Roof	＞2:12	29

(3) When metal roofs are used for at-grade and elevated stations, roof insulation materials with low thermal conductivity should be installed.

(4) Where external lift shafts are provided at ground level for stations, opaque civil structure shafts may be adopted. If glass lift shafts are used, the use of insulated glazing units (IGU) should be considered to reduce ventilation requirements.

4.23.4 Energy Saving for Environmental Control System

(1) Energy saving design for environmental control systems should be based on the General Code for Energy Efficiency and Renewable Energy Application in Buildings (GB 55015-2021), the Design Standard for Energy Efficiency of Public Buildings (GB 50189-2015), and the Energy Conservation Requirements for Electromechanical Equipment of Urban Rail Transit (GB/T 35553-2017), with local adaptations to comply with the requirements of various Government regulations and code requirements.

(2) When the airflow rate of air-conditioning and ventilation systems exceeds 10,000 m^3/h, the unit power consumption for the ductwork system may not exceed the limit specified in Clause 4.2.2 of the Design Standard for Energy Efficiency of Public Buildings (GB 50189-2015). When the airflow rate is less than 10,000 m^3/h, if the total fan power of the system exceeds 2.5 kW or the power of a single fan exceeds 1 kW, the unit power consumption for the system should comply with the requirements of Section 6.7 in the Code of Practice for Energy Efficiency of Building Services Installation published by Electrical and Mechanical Services Department.

(3) When selecting circulating pumps for chilled water systems in air-conditioning, the electricity consumption to transport cooling (ECTC) ratio of the chilled water system should be calculated. The ECTC ratio should comply with the requirements of Clause 4.3.9 in the Design Standard for Energy Efficiency of Public Buildings (GB 50189-2015).

(4) When using motor-driven vapour compression cycle water chillers, their Coefficient of Performance (COP) under nominal cooling conditions and specified circumstances, and Integrated Part Load Value (IPLV), should comply with the following requirements:

(a) For selected water-cooled or air-cooled constant-speed chillers, their COP should not be lower than the value for the Hot Summer & Warm Winter Zone in Table 3.2.9-1 of the General Code for Energy Efficiency and Renewable Energy Application in Buildings (GB 55015-2021). Their IPLV should not be lower than the value for the Hot Summer & Warm Winter Zone in Table 3.2.11-1 of the General Code for Energy Efficiency and Renewable Energy Application in Buildings (GB 55015-2021).

(b) For selected water-cooled or air-cooled variable-speed chillers, their minimum coefficient of performance should not be lower than the values in Table 6.12b of the Code of Practice for Energy Efficiency of Building Services Installation published by Electrical and Mechanical Services Department. Their IPLV should not be lower than the value for the Hot Summer & Warm

Winter Zone in Table 3.2.11-2 of the General Code for Energy Efficiency and Renewable Energy Application in Buildings (GB 55015-2021).

(5) When using motor-driven air-cooled unitary air conditioners, their Seasonal Energy Efficiency Ratio (SEER) under nominal cooling conditions and specified circumstances should not be lower than the value for the hot summer & warm winter zone in Table 3.2.13-1 of the General Code for Energy Efficiency and Renewable Energy Application in Buildings (GB 55015-2021). When using motor-driven water-cooled unitary air conditioners, their minimum coefficient of performance should not be lower than the values in Table 6.12a of the Code of Practice for Energy Efficiency of Building Services Installation published by Electrical and Mechanical Services Department. Their IPLV should not be lower than the value for the hot summer & warm winter zone in Table 3.2.13-3 of the General Code for Energy Efficiency and Renewable Energy Application in Buildings (GB 55015-2021).

(6) When using air-cooled or water-cooled Variable Refrigerant Flow (VRF) multi-split air-conditioning units, their minimum cooling coefficient of performance should not be lower than the values in Table 6.12a of the Code of Practice for Energy Efficiency of Building Services Installation published by Electrical and Mechanical Services Department. Concurrently, the IPLV for water-cooled VRF units should not be lower than the value for the hot summer & warm winter zone in Table 3.2.12-1 of the General Code for Energy Efficiency and Renewable Energy Application in Buildings (GB 55015-2021).

4.23.5 Energy Saving for Water Supply and Drainage System

(1) Water supply system design may utilise supply water pressure for supply as far as practicable.

(2) Clean energy sources should be used for hot water systems, with priority given to solar water heating systems.

4.23.6 Energy Saving for Power Supply System

(1) Energy saving design for power supply systems should be based on the Energy Conservation Requirements for Electromechanical Equipment of Urban Rail Transit (GB/T 35553-2017), with localised adaptive adjustments to comply with the requirements of various Government regulations and code requirements.

(2) Transformer efficiency should comply with the requirements of the Code of Practice for Energy Efficiency of Building Services Installation published by Electrical and Mechanical Services Department. Energy-efficient distribution transformers such as amorphous alloy or wound core types are recommended.

(3) DC traction power supply systems should be equipped with regenerative braking energy absorption devices, with Medium Voltage Feedback (Energy Recovery) type or bidirectional converter-type devices may be adopted.

(4) The installation of solar photovoltaic systems should comply with the requirements of Clauses 5.2.1 and 5.2.3 of the General Code for Energy Efficiency and Renewable Energy Application in Buildings (GB 55015-2021).

4.23.7 Other Energy Saving Measures

(1) Based on energy saving principles and specific conditions, energy-saving gradients should be provided in the track sections at both ends of station platforms, with appropriate entry/exit gradients and gradient lengths set.

(2) The energy efficiency values for lifts, escalators, and moving walkways should not be lower than the requirements of the Energy Conservation Requirements for Electromechanical Equipment of Urban Rail Transit (GB/T 35553-2017). Requirements for electrical power, application of electrical power, total harmonic distortion rate, metering, and monitoring facilities should comply with the requirements of Chapter 8

of the Code of Practice for Energy Efficiency of Building Services Installation published by Electrical and Mechanical Services Department.

5 ENGINEERING CONSTRUCTION

5.1 Construction Management

5.1.1 Reference Standards

Construction management shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Buildings Ordinance (Cap.123)

(2) Road Traffic Ordinance (Cap. 374)

(3) Noise Control Ordinance (Cap.400)

(4) Water Pollution Control Ordinance (Cap. 358)

(5) Dumping at Sea Ordinance (Cap. 466)

(6) Construction Sites (Safety) Regulations (Cap. 59 sub. leg. I)

(7) Air Pollution Control (Construction Dust) Regulation (Cap. 311 sub. leg. R)

Relevant Technical Standards

(8) Code of Practice for Site Supervision 2009 published by Buildings Department

(9) Technical Memorandum for Supervision Plans 2009 published by Buildings Department

(10) Project Administration Handbook for Civil Engineering Works published by Civil Engineering and Development Department

(11) Model Specification for Prestressed Ground Anchors (Geospec 1) published by Civil Engineering and Development Department

(12) Geotechnical Manual for Slopes published by Civil Engineering and Development Department

(13) Guide to Retaining Wall Design (Geoguide 1 (2nd Edition)) published by Civil Engineering and Development Department

(14) General Specification for Civil Engineering Works published by Civil Engineering and Development Department

(15) GEO Publication No. 1/2023 published by Civil Engineering and Development Department

(16) GEO Technical Guidance Note No. 54 published by Civil Engineering and Development Department

(17) Guide to Site Investigation (Geoguide 2) published by Civil Engineering and Development Department

(18) Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers published by Buildings Department

(19) Mines Division Guidance Note No. 10 published by Civil Engineering and Development Department

(20) Code for Monitoring Measurement of Urban Rail Transit Engineering (GB 50911-2013)

(21) Standard for Engineering Surveying (GB 50026-2020)

(22) Technical Standard for Monitoring of Building Excavation Engineering (GB 50497-2019)

(23) Safety Regulations for Blasting (GB 6722-2014)

(24) Code for Urban Rail Transit Engineering Survey (GB/T 50308-2017)

(25) Specifications for Operational Monitoring of Urban Rail Transit Facilities - Part 4: Track and Earthworks (GB/T 39559.4-2020)

(26) Technical Code for Groundwater Monitoring (GB/T 51040-2014)

(27) Track Detection – Dynamic Detection of Track Geometric State (TB/T 3355-2023)

(28) Code for Deformation Measurement of Building and Structure (JGJ 8-2016)

(29) Technical Code for Groundwater Control in Building and Municipal Engineering (JGJ 111-2016)

5.1.2 General Requirements

(1) Monitoring and measurement for pile foundation works and excavations by bottom-up or top-down methods should comply with the Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers APP-24 and APP-137 published by Buildings Department and Section 9.2 of the GEO Publication No. 1/2023 published by Civil Engineering and Development Department.

(2) Groundwater control should comply with the requirements stipulated in Clause 5.1.4 of this document.

(3) Smart safety risk identification system should be set up at construction site.

5.1.3 Monitoring and Measurement

(1) Requirements for monitoring, influence zones due to construction, scope of monitoring, classification of engineering monitoring measurement levels, and determination of surrounding environmental risk levels should comply with the provisions of the Code for Monitoring Measurement of Urban Rail Transit Engineering (GB 50911-2013).

(2) Subject to the overriding requirement of ensuring the structural safety of ELS and protection of the surrounding environment, the selection of monitoring objects should be comprehensively determined based on the design scheme of ELS, geological conditions, and surrounding environmental conditions under different construction methods.

(3) Monitoring items and requirements for engineering structures, geological condition, and the surrounding environment should comply with the provisions of the Code for Monitoring Measurement of Urban Rail Transit Engineering (GB 50911-2013).

(4) The methodology, scope, and requirements for site inspections of cut-and-cover excavation works should comply with the GEO Publication No. 1/2023 published by Civil Engineering and Development Department. The methodology, scope, and requirements for site inspections of tunnel engineering and the surrounding environments should comply with the provisions of Code for Monitoring Measurement of Urban Rail Transit Engineering (GB 50911-2013).

(5) The layout and quantities of monitoring points for the ELS systems and surrounding geotechnical condition should be comprehensively determined based on construction methods, engineering monitoring measurement levels, geological conditions, and the requirements of monitoring method, and should satisfy the requirements for reflecting the actual state, displacement, and the distribution of internal stress of the monitored objects, and enabling the analysis of their safety condition. Specific provisions of the Code for Monitoring Measurement of Urban Rail Transit Engineering (GB 50911-2013) should be complied with.

(6) The layout and quantities of monitoring points should be comprehensively determined based on the current status of the foundation (structure) form, age of construction, material, burial method, etc. of the monitored objects, as well as risk levels, influence zones due to construction, monitoring items, and the requirements of the monitoring method, and should satisfy the requirements for reflecting variation patterns of buildings (structures) and analysing their safety status. Specific provisions of the Code for Monitoring Measurement of Urban Rail Transit Engineering (GB 50911-2013) should be complied with.

(7) The monitoring benchmarks, installation of monitoring reference points, monitoring methods, and quantity should comply with the provisions of

the Standard for Engineering Surveying (GB 50026-2020) and Code for Urban Rail Transit Engineering Survey (GB/T 50308-2017).

(8) The selection of monitoring equipment, monitoring methods, technical indicators, and calculation requirements for vertical displacement, horizontal displacement, subsurface horizontal displacement, clearance convergence, cracks, support axial force, tensile stress of anchor (cable), earth pressure, and track geometry measuring should comply with the provisions of the Code for Monitoring Measurement of Urban Rail Transit Engineering (GB 50911-2013), Code for Deformation Measurement of Building and Structure (JGJ 8-2016), Specifications for Operational Monitoring of Urban Rail Transit Facilities - Part 4: Track and Earthworks (GB/T 39559.4-2020), and Track Detection – Dynamic Detection of Track Geometric State (TB/T 3355-2023). The monitoring methods, technical indicators, and installation technical requirements for prestressed ground anchors (cables) should also comply with the Model Specification for Prestressed Ground Anchors (Geospec 1) published by Civil Engineering and Development Department.

(9) The selection of inclinometer monitoring equipment, monitoring methodology, technical indicators, installation techniques, calculation requirements, and accuracy requirements should comply with the Code for Monitoring Measurement of Urban Rail Transit Engineering (GB 50911-2013), the Standard for Engineering Surveying (GB 50026-2020), and the Code for Deformation Measurement of Building and Structure (JGJ 8-2016).

(10) When inclinometers are installed for monitoring of slope movement, the installation requirements, monitoring methodology, and environmental protection requirements should comply with the Geotechnical Manual for Slopes published by Civil Engineering and Development Department.

(11) The selection of groundwater level monitoring equipment, equipment technical indicators, and calculation requirements should comply with the provisions of the Code for Monitoring Measurement of Urban Rail Transit Engineering (GB 50911-2013) and the Technical Standard for

Monitoring of Building Excavation Engineering (GB 50497-2019). Groundwater level measurement methods, measurement frequency, and pore water pressure measurement should comply with the Guide to Site Investigation (Geoguide 2) published by Civil Engineering and Development Department.

(12) The locations for flow monitoring points should be selected at typical discharge points, with direct measurement through flowmeters. Monitoring data should be analysed in conjunction with amount of precipitation. Relevant specific requirements of the Guide to Retaining Wall Design (Geoguide 1 (2nd Edition)) published by Civil Engineering and Development Department and the GEO Publication No. 1/2023 published by Civil Engineering and Development Department should be complied with.

(13) The vibration monitoring of blasting method should comply with the relevant requirements in the Guide to Cavern Engineering (Geoguide 4) published by Civil Engineering and Development Department and the Mines Division Guidance Note No. 10 published by Civil Engineering and Development Department.

(14) Monitoring frequency should be determined according to construction methods and progress, monitored objects, monitoring items, geological conditions, and local engineering experience. The monitoring frequency and termination conditions for cut-and-cover excavation, subsurface excavation, tunnel boring works, rock and soil mass, and surrounding environment should comply with the provisions of the Code for Monitoring Measurement of Urban Rail Transit Engineering (GB 50911-2013).

(15) The frequency of site inspections should comply with the provisions of the Code for Monitoring Measurement of Urban Rail Transit Engineering (GB 50911-2013).

(16) The control values for monitoring should be determined based on the characteristics of different construction methods, properties of surrounding rock and soil mass, environmental protection requirements,

and local engineering experience, and should ensure reasonable and effective control of the safe condition of the monitored objects.

(17) The control values for monitoring on the ELS systems for pile foundation works and excavations by bottom-up or top-down methods, surrounding rock and soil mass, and surrounding environment should comply with the provisions of the Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers APP-24 and APP-137 published by Buildings Department, and Section 9.2 of the GEO Publication No. 1/2023 published by Civil Engineering and Development Department.

(18) The control values for monitoring on the ELS systems for tunnel boring method and mined tunnelling method and surrounding rock and soil mass should be determined based on engineering geological conditions, design parameters for the excavation or tunnel, the engineering monitoring levels, and local engineering experience, and should comply with the provisions of the Code for Monitoring Measurement of Urban Rail Transit Engineering (GB 50911-2013).

(19) The alert-alarm-action mechanism on the monitoring of the ELS systems for pile foundation works and excavations by bottom-up or top-down methods, surrounding rock and soil mass, and surrounding environment should comply with the provisions of the Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers APP-24 and APP-137 published by Buildings Department, and the GEO Publication No. 1/2023 published by Civil Engineering and Development Department.

(20) The alert-alarm-action mechanism on the monitoring of the ELS systems for tunnel boring method and mined tunnelling method and the surrounding rock and soil mass should comply with the provisions of the Code for Monitoring Measurement of Urban Rail Transit Engineering (GB 50911-2013). The management of alert-alarm-action system for bored tunnels should also comply with Chapter 9 of GEO Publication No. 1/2023 published by Civil Engineering and

Development Department and the GEO Technical Guidance Note No. 54 published by Civil Engineering and Development Department.

(21) The feedback of monitoring information, including objects, content, timing, procedures, and requirements should comply with the provisions of the Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers APP-24 and APP-137 published by Buildings Department.

5.1.4 Groundwater Control

(1) The construction management of groundwater control should be carried out in accordance with Section 2.4.6 of this document.

(2) The monitoring control values, alert-alarm-action mechanisms for deformation under different working conditions as specified in the Clause 2.4.3(7) of this document should also be applied to groundwater control, taking into account the actual site conditions.

5.1.5 Due Diligence Checking

(1) General Requirements

In all stages of procurement and contract management, project personnel should exercise their professional judgement and utmost sensitivity, adopt a prudent approach and act proactively in (i) avoiding and detecting any potential fraudulent acts of contractors/sub-contractors/suppliers; (ii) identifying the adverse records of contractors/sub-contractors/suppliers; and (iii) mitigating the associated risks in these processes.

This clause is not meant to be exhaustive as it is not possible to cover all scenarios including those that may be unique to individual contracts. Due diligence is risk-based. Project personnel may exercise their own judgement whether additional measures or alternative verification/checking methods are required based on the actual circumstances of each case. As a general principle, more extensive due diligence checks should be conducted for higher-risk cases, such as contracts involving newcomers, of high value, or involving works or services of a sensitive nature.

Following the provisions below, project personnel should, among others, conduct such due diligence checks as are necessary to verify the authenticity of the documents/samples submitted or processed in the discharge of their duties in procurement and contract management.

(2) Declaration on Conflict of Interest

Project personnel, who is involved in conducting due diligence checks, should declare their actual, potential or perceived conflict of interest, if any, upon their taking up such responsibilities and as soon as they become aware of such conflict.

(3) Approach of Due Diligence Checks

Project personnel should follow the approach as stated in the provisions below to conduct due diligence checks:

(a) The project personnel who is responsible for receiving and inspecting the materials should have knowledge on the materials to be received/inspected and the associated technical specifications. The project personnel should watch out for warning signs, such as discrepancies in the manufacturer's name, model and / or place of origin displayed on the label from the specifications for compliant materials under the contract and legislation.

(b) If sub-standard or non-conforming materials are identified, the project personnel should reject the materials and should take appropriate action including requesting for replacement and issuing notice of contravention.

(c) The project personnel should compare the submitted materials and associated documentation with information available from publicly accessible official sources, open-source information, or databases to watch out for any discrepancies.

(d) The project personnel, or his appointed independent inspection body, should make site visits to the premises, yard or factory of contractors/sub-contractors/suppliers to verify operational situation and its capabilities where necessary.

(e) If there is doubt on the quality of delivered materials (which cannot be verified through inspection), the project personnel may submit the materials to an independent testing party (e.g. laboratories of the Government department or private sector) to ascertain their compliance with the contract specifications and statutory requirements.

(4) Key Items for Due Diligence Checks

Project personnel is suggested to cover the items below in the due diligence checks and make such adjustments as appropriate to suit individual circumstances:

(a) Legal status of contractors/sub-contractors/suppliers

(i) Verify the authenticity of company documents of the contractors/sub-contractors/suppliers (such as Certificate of Incorporation, Business Registration Certificate, Articles of Association), and the authority of the signatory and the supporting board resolution against the copies downloadable from the online platform of Companies Registry, or in case of overseas contractors/sub-contractors/suppliers, the relevant Government websites in the corresponding place of incorporation, formation or establishment.

(ii) Contact the company secretary of the contractors/sub-contractors/suppliers for direct verification or conduct a company visit if necessary.

(iii) Request additional documentation (such as documentary evidence proving the latest business activities) to conduct a more comprehensive assessment on the company capacity.

(b) Documents

(i) Verify the authenticity of documents by directly contacting the issuing parties without going through the contractors/sub-contractors/suppliers, or through official websites of relevant Government departments, certification validation websites, etc.

(ii) Obtain and check details/information of contractors/sub-contractors/suppliers through multiple sources, such as Government websites, and watch out for any discrepancies in the document submissions.

(iii) Contact the manufacturer direct to verify the documents for business undertaking/engagement, contractual relationship, etc. with the contractors/sub-contractors/suppliers.

(iv) Check the test reports, ISO certificates and accreditation, licenses, etc., for:

- the confirmation with the originals or certified true copies from the issuing parties/licensing authorities;
- the compliance with the requirements for the validity periods, issue dates, scope of accreditation/qualification, etc.;
- the authenticity through verification means not shown on the document submissions; and
- their conformance with the copies separately provided by the issuing parties.

(v) seek written consent from the company to facilitate the verification with the issuing party if necessary.

(c) Security and surety, and insurance policies

(i) check the submitted performance bond to ensure its compliance with the contract requirements;

(i) check whether the insurance policies or certificates comply with the contract requirements; and

(ii) verify with the bondsmen/insurers/insurance brokers directly by using the contact information obtained from reliable resources without going through the Contractor if there is any doubt about the authenticity of the submitted performance bond/insurance policies or certificates.

(d) Qualifications and experience of contractor's personnel and management team

(i) for lower-risk cases (e.g. staff who are renowned or well known in the construction industry, or personnel previously approved based on records), checks are normally not required unless there is a concern with any new qualification or specialised experience stipulated in a "curriculum vitae" (CV) that is critical to the contract; and

(ii) for higher-risk cases (e.g. new comers taking up key positions), spot check should be conducted on their academic qualification, professional qualification and experience. During the process, project personnel should verify the qualifications and experience of the key personnel directly with the issuing bodies (i.e. universities or professional bodies) and the relevant employer(s) respectively.

(e) Intellectual property rights

(i) verify the evidence of the rights of the contractors/sub-contractors/suppliers to use trademarks, patents, or designs against relevant official records; and

(ii) contact the trademark or patent owner direct by using the contact information obtained from reliable sources for further verification.

(f) Construction materials / samples

(i) Inspect the construction materials / samples against technical specifications and watch out for discrepancies;

(ii) verify that the materials delivered to sites (or designated storage locations) are provided from the manufacturers or suppliers as proposed in the submissions;

(iii) check the authenticity of certificates and test reports provided in the submissions directly with the respective manufacturers, suppliers or issuing bodies, without going through the contractors/sub-contractors/suppliers;

(iv) check the date and place of manufacture for materials where such requirements are specified in the contract;

(v) submit the samples for laboratory testing in accordance with the testing criteria; and

(vi) retain the samples properly as control sample for comparison/monitoring.

(g) Construction plant/equipment/instrument

(i) verify the authenticity of the calibration certificates directly with the respective issuing bodies, without going through the contractors/subcontractors/suppliers; and

(ii) check the proof of ownership, change of title and/or the right to use for construction plant/equipment/instrument, the project personnel should verify the information directly with suppliers without going through the contractors/ subcontractors/suppliers if there is any doubt about the authenticity of the documents.

(h) Submissions of check certificates for the permanent works and temporary works

(i) verify the authenticity of the check certificates directly with the independent engineer concerned, without going through the contractors/subcontractors/suppliers.; and

(ii) spot checks to verify that the independent engineer has inspected the temporary works before confirming that the temporary works have been constructed in accordance with the certified design, the project personnel should request the independent engineers to provide relevant site records for validation if there is any doubt regarding the work of the independent engineers.

(i) Adverse records & background

(i) during the course of the contract, project personnel should stay alert to any adverse information, records or reports regarding the contractors/subcontractors/suppliers involved in the contract; and

(ii) verification of adverse records and background information of the contractors/sub-contractors/suppliers and its signatory, directors and shareholders, including checks for poor performance, major non-compliances with regulatory requirements, allegations of malpractices, serious site incidents, major quality issues in construction works, as well as involvement in illegal activities, convictions, bankruptcy, liquidation, or serious financial problems, national security issues, etc. by:

- searching the record of the contractors/sub-contractors/suppliers on the online platform of Companies Registry;
- internet search (including on social media platforms) for news and other publicly available information;

- making use of Scameter search engine, such as "WHOIS lookup" website;
- checking the official websites of relevant authorities or their relevant documents/notices;
- checking court cases through Judiciary's website; and
- checking the status of the contractors / sub-contractors / suppliers against the records of bankruptcy, individual voluntary arrangement, and compulsory winding-up in Hong Kong through the online platform of Official Receiver's Office.

(5) Documentation

Project personnel should maintain full and proper records of all verification actions undertaken, including sources consulted, dates, methods used, results obtained, details of any discrepancies or issues identified, and the rationale for decisions made.

In case of any abnormal or dubious issues are identified or suspected fraudulent acts or breaches of laws (involving false information/documents/records, counterfeit goods, etc.) or adverse records / information about the company, the project personnel should consider reporting the issue to the relevant authorities, and the relevant law enforcement departments, if applicable.

5.2 Materials Testing

5.2.1 Reference Standards

Materials testing shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Building (Construction) Regulation (Cap. 123 sub. leg. Q)

Relevant Technical Standards

(2) Standard for Quality Control of Concrete (GB 50164-2011)

(3) Common Portland Cement (GB 175-2023)

(4) Limit of Radionuclides in Building Materials (GB 6566-2010)

(5) Concrete Admixtures (GB 8076-2008)

(6) General Code for Concrete Structures (GB 55008-2021)

(7) Code for Quality Acceptance of Concrete Structure Construction (GB 50204-2015)

(8) General Code for Building Environment (GB 55016-2021)

(9) Safety Technical Requirements for Building Decorative Stone (GB 46028-2025)

(10) Safety Technical Requirements for Safety Glazing Materials in Building (GB 46030-2025)

(11) Sealed Insulating Glass Unit (GB/T 11944-2002)

(12) Safety Glazing Materials in Building - Part 1: Fire-Resistant Glass (GB/T 15763.1)

(13) Safety Glazing Materials in Building - Part 2: Tempered Glass (GB/T 15763.2)

(14) Safety Glazing Materials in Building - Part 3: Laminated Glass (GB/T 15763.3)

(15) Safety Glazing Materials in Building - Part 4: Heat Soaked Thermally Tempered Glass (GB/T 15763.4)

(16) Moderate-heat Portland Cement, Low-heat Portland Cement (GB/T 200-2017)

(17) Expansive Agents for Concrete (GB/T 23439-2017)

(18) Standard for Test Method of Performance on Ordinary Fresh Concrete (GB/T 50080-2016)

(19) Standard for Test Methods of Concrete Physical and Mechanical Properties (GB/T 50081-2019)

(20) Standard for Test Methods of Long-term Performance and Durability of Concrete (GB/T 50082-2024)

(21) Test Methods of Steel for Reinforcement of Concrete (GB/T 28900-2022)

(22) Log Inspection (GB/T 144-2024)

(23) Stainless Steels - Designation and Chemical Composition (GB/T 20878-2024)

(24) Wrought Aluminium and Aluminium Alloy Plates, Sheets and Strips for General Engineering - Part 2: Mechanical Properties (GB/T 3880.2-2024)

(25) Wrought Aluminium and Aluminium Alloy Plates, Sheets and Strips for General Engineering - Part 3: Tolerances on Forms and Dimensions (GB/T 3880.3-2024)

(26) Wrought Aluminium and Aluminium Alloys Extruded Profiles for General Engineering (GB/T 6892-2023)

(27) Test Methods for Properties of Glassfibre Reinforced Cement (GB/T 15231-2023)

(28) Rolling Bearings - General Technical Regulations (GB/T 307.3-2017)

(29) Standard for Technical Requirements and Test Method of Sand and Crushed Stone (or Gravel) for Ordinary Concrete (JGJ 52-2006)

(30) Concrete Anti-freezing Admixture (JC 475-2004)

(31) Standard of Water for Concrete (JGJ 63-2006)

(32) Couplers for Rebar Mechanical Splicing (JG/T 163-2013)

5.2.2 General Requirements

(1) A plan for the site delivery of materials, components, and fittings should be prepared based on the design documents prior to the commencement of works.

(2) Materials, components, and fittings should be tested upon delivery to site, records should be established, stored and identified by category.

(3) The radioactivity limits of inorganic non-metallic main building materials used in construction works, such as sand, stone, brick, solid block, cement, concrete, and precast concrete components, should comply with Section 5.3 of the General Code for Building Environment (GB 55016-2021).

5.2.3 Concrete

(1) The selection of cement type and strength grade should be determined based on design, construction requirements, and the project environment, and should comply with Section 2.1 of the Standard for Quality Control of Concrete (GB 50164-2011).

(2) Cement should comply with the relevant provisions of the Common Portland Cement (GB 175-2023) and the Moderate-heat Portland Cement, Low-heat Portland Cement (GB/T 200-2017).

(3) Coarse aggregate and fine aggregate should comply with the relevant provisions of the Standard for Technical Requirements and Test Method of Sand and Crushed Stone (or Gravel) for Ordinary Concrete (JGJ 52-2006).

(4) The radioactivity of mineral admixtures should comply with the relevant provisions of the Limit of Radionuclides in Building Materials (GB 6566-2010).

(5) Admixtures should comply with the Concrete Admixtures (GB 8076-2008), the Concrete Anti-freezing Admixture (JC 475-2004), and the Expansive Agents for Concrete (GB/T 23439-2017).

(6) Water used for concrete should comply with the Standard of Water for Concrete (JGJ 63-2006).

(7) In-situ tests of concrete raw materials, and the mechanical properties, long-term performance, and durability of concrete should comply with the relevant provisions of the Standard for Quality Control of Concrete (GB 50164-2011).

(8) Test methods for fresh concrete should comply with the relevant provisions of the Standard for Test Method of Performance on Ordinary Fresh Concrete (GB/T 50080-2016).

(9) Test methods for the physical and mechanical properties of concrete should comply with the relevant provisions of the Standard for Test Methods of Concrete Physical and Mechanical Properties (GB/T 50081-2019).

(10) Test methods for the long-term performance and durability of concrete should comply with the relevant provisions of the Standard for Test Methods of Long-term Performance and Durability of Concrete (GB/T 50082-2024).

5.2.4 Steel Reinforcement and Mechanical Coupler

(1) The properties of steel reinforcement should comply with the relevant provisions of Section 3.2 of the General Code for Concrete Structures (GB 55008-2021).

(2) The raw materials for mechanical splice couplers should comply with the relevant provisions of Section 4.1 of the Couplers for Rebar Mechanical Splicing (JG/T 163-2013). The appearance, dimensions, and tolerances of couplers should comply with the provisions of Sections 5.2 and 5.3 of the Couplers for Rebar Mechanical Splicing (JG/T 163-2013).

(3) The site acceptance test of steel reinforcement and prefabricated reinforcement assemblies should comply with the relevant provisions of

Section 5.2 of the Code for Quality Acceptance of Concrete Structure Construction (GB 50204-2015).

(4) Retest of steel products should include mechanical property tests and chemical composition analysis. Sampling, specimen preparation, and test methods should comply with the relevant provisions of the Test Methods of Steel for Reinforcement of Concrete (GB/T 28900-2022).

5.2.5 Stone

(1) The limits for radionuclides, panel thickness, flexural strength, and frost resistance of decorative building stones should comply with the relevant provisions of the Chapters 3 and 4 of the Safety Technical Requirements for Building Decorative Stone (GB 46028-2025).

5.2.6 Glass

(1) Safety glazing material for building including heat strengthened glass, laminated glass, tempered glass, insulating glass unit, and fire-rated glass should comply with the provisions of the Safety Technical Requirements for Safety Glazing Materials in Building (GB 46030-2025), Sealed Insulating Glass Unit (GB/T 11944-2002), the Safety Glazing Materials In Building - Part 1: Fire-Resistant Glass (GB/T 15763.1), the Safety Glazing Materials in Building - Part 2: Tempered Glass (GB/T 15763.2), the Safety Glazing Materials in Building - Part 3: Laminated Glass (GB/T 15763.3), and the Safety Glazing Materials in Building - Part 4: Heat Soaked Thermally Tempered Glass (GB/T 15763.4).

5.2.7 Timber

(1) Timber should comply with the provisions of the Log Inspection (GB/T 144-2024).

5.2.8 Stainless Steel

(1) Stainless steel materials should comply with the provisions of the Stainless Steels - Designation and Chemical Composition (GB/T 20878-2024).

5.2.9 Aluminium

(1) Aluminium products should comply with the provisions of the Wrought Aluminium and Aluminium Alloy Plates, Sheets and Strips for General Engineering - Part 2: Mechanical Properties (GB/T 3880.2-2024), the Wrought Aluminium and Aluminium Alloy Plates, Sheets and Strips for General Engineering - Part 3: Tolerances on Forms and Dimensions (GB/T 3880.3-2024), and the Wrought Aluminium and Aluminium Alloys Extruded Profiles for General Engineering (GB/T 6892-2023).

5.2.10 Glass Fibre Reinforced Concrete

(1) Glass fibre reinforced concrete should meet the requirements of the Test Methods for Properties of Glassfibre Reinforced Cement (GB/T 15231-2023).

5.2.11 Mechanical Bearings

(1) The performance of mechanical bearings should comply with the provisions of Rolling Bearings - General Technical Regulations (GB/T 307.3-2017).

5.3 Quality Acceptance

5.3.1 Reference Standards

Quality acceptance shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Buildings Ordinance (Cap. 123)

(2) Dangerous Goods Ordinance (Cap. 295)

(3) Waterworks Ordinance (Cap. 102)

(4) Waterworks Regulations (Cap. 102 sub. leg. A)

(5) Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations (Cap. 59 sub. leg. J)

Relevant Technical Standards

(6) Code of Practice for Foundations 2017 published by Buildings Department

(7) Code of Practice for Structural Use of Concrete 2013 published by Buildings Department

(8) Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers published by Buildings Department

(9) Model Specification for Prestressed Ground Anchors (Geospec 1) published by Civil Engineering and Development Department

(10) Technical Requirements for Plumbing Works in Buildings published by Water Supplies Department

(11) Sewerage Manual published by Drainage Services Department

(12) Stormwater Drainage Manual published by Drainage Services Department

(13) Code for Quality Acceptance of Concrete Structure Construction (GB 50204-2015)

(14) Code for Construction of Concrete Structures (GB 50666-2011)

(15) Standard for Acceptance of Construction Quality of Steel Structures (GB 50205-2020)

(16) Code for Construction of Steel Structures (GB 50755-2012)

(17) Code for Welding of Steel Structures (GB 50661-2011)

(18) Code for Construction of Masonry Structures Engineering (GB 50924-2014)

(19) Standard for Construction Quality Acceptance of Building Decoration (GB 50210-2018)

(20) General Code for Foundation Engineering of Building and Municipal Projects (GB 55003-2021)

(21) Standard for Acceptance of Construction Quality of Building Foundation (GB 50202-2018)

(22) Standard for Geotechnical Testing Method (GB/T 50123-2019)

(23) Code for Acceptance of Construction Quality of Roof (GB 50207-2012)

(24) Code for Construction and Acceptance of Shield Tunnelling Method (GB 50446-2017)

(25) Standard for Construction of Mass Concrete (GB 50496-2018)

(26) Technical Code for Waterproofing of Underground Works (GB 50108-2008)

(27) Code for Construction and Acceptance of High-voltage Electric Equipment Installation Engineering (GB 50147-2010)

(28) Code for Construction and Acceptance of Power Transformers Oil Reactor and Mutual Inductor (GB 50148-2010)

(29) Code for Construction and Acceptance of Busbar Installation of Electric Equipment Installation Engineering (GB 50149-2010)

(30) Standard for Construction and Acceptance of Cable Line Electric Equipment Installation Engineering (GB 50168-2018)

(31) Code for Construction and Acceptance of Switchboard, Outfit Complete Cubicle and Secondary Circuit Electric Equipment Installation Engineering (GB 50171-2012)

(32) Code for Construction and Acceptance of Battery Electric Equipment Installation Engineering (GB 50172-2012)

(33) Code for Construction and Acceptance of Power Conversion Equipment Electric Equipment Installation Engineering (GB 50255-2014)

(34) Code for Construction and Acceptance of Low-voltage Apparatus Electric Equipment Installation Engineering (GB 50254-2014)

(35) Code for Acceptance of Construction Quality of Building Electrical Engineering (GB 50303-2015)

(36) Code for Construction Quality Acceptance of Urban Rail Transit Communication Engineering (GB 50382-2016)

(37) Standard for Installation and Acceptance of Fire Alarm System (GB 50166-2019)

(38) Code for Acceptance of Quality of Intelligent Building Systems (GB 50339-2013)

(39) Technical Standard for Security Engineering (GB 50348-2018)

(40) Code of Acceptance for Construction Quality of Ventilation and Air Conditioning Works (GB 50243-2016)

(41) Code for Acceptance of Construction Quality of Water Supply Drainage and Heating Works (GB 50242-2002)

(42) Standards for Drinking Water Quality (GB 5749-2022)

(43) General Code for Building Electricity and Intelligence (GB 55024-2022)

(44) Unified Standard for Constructional Quality Acceptance of Building Engineering (GB 50300-2013)

(45) Code for Construction and Quality Acceptance for Lightning Protection Engineering of Structures (GB 50601-2010)

(46) Steel Tube Scaffold Coupler (GB/T 15831-2023)

(47) Plywood for Concrete Form (GB/T 17656-2018)

(48) Anchorage, Grip and Coupler for Prestressing Tendons (GB/T 14370-2015)

(49) Ready-mixed Concrete (GB/T 14902-2012)

(50) Non-destructive Testing of Welds - Ultrasonic Testing - Techniques, Testing Levels and Assessment (GB/T 11345-2023)

(51) Non-destructive Testing of Welds - Radiographic Testing - Part 1: X- and Gamma-ray Techniques with Film (GB/T 3323.1-2019)

(52) Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018)

(53) Standard for Construction of Metro Engineering (GB/T 51310-2018)

(54) Standard for Construction Quality Acceptance of Urban Rail Transit Signal Engineering (GB/T 50578-2018)

(55) Environmental Test and Severities for Fire Electronic Products (GB/T 16838-2021)

(56) Technical Standard for Urban Rail Transit Integrated Supervision and Control System (GB/T 50636-2018)

(57) Railway Applications - Rolling Stock Equipment - Shock and Vibration Tests (GB/T 21563-2018)

(58) General Technical Specification for Metro Vehicles (GB/T 7928-2003)

(59) Railway Applications - Electromagnetic Compatibility (GB/T 24338.1-2018 ~ GB/T 24338.6-2018)

(60) Code for Design Protection of Structures against Lightning (GB 50057-2010)

(61) Technical Code for Safety of Forms in Construction (JGJ 162-2008)

(62) Technical Specification for Mechanical Splicing of Steel Reinforcing Bars (JGJ 107-2016)

(63) Specification for Welding and Acceptance of Reinforcing Steel Bars (JGJ 18-2012)

(64) Unbonded Prestressing Steel Strand (JG 161-2016)

(65) Technical Code for Testing of Building Foundation Piles (JGJ 106-2014)

(66) Technical Requirements of Building Glass Skylight System (JG/T 231-2018)

(67) Code for Construction and Quality Acceptance of Bridge Works in City (CJJ 2-2008)

(68) Technical Code of Blasting for Port and Waterway Engineering (JTS 204-2023)

(69) Standard for Constructional Quality Acceptance of Railway Noise Barrier (TB 10428-2024)

(70) Code for Acceptance of Construction Quality of Underground Waterproof (GB 50208-2011)

(71) Technical Code for Platform Screen Door System of Urban Railway Transit (CJJ 183-2012)

(72) Urban Rail Transit Platform Screen Door System (CJ/T 236-2022)

(73) Standard for Metro Gauges (CJJ/T 96-2018)

(74) Technical Standard for Stray Current Corrosion Protection in Metro (CJJ/T 49-2020)

5.3.2 General Requirements

(1) The construction site should have a robust quality management system and corresponding construction technical standards, and should comply

with the quality management provisions of the prevailing railway standards in Hong Kong.

(2) Unless otherwise specified in this Chapter, the materials, semi-finished products, finished products, components, appliances, and equipment used in the works should follow the quality acceptance standards and construction specifications corresponding to the design standards and requirements.

(3) The calibration and accuracy requirements of testing equipment, measuring equipment, instruments, etc., used in the quality acceptance of works should comply with the relevant provisions of the national railway standards.

(4) Concrete cantilevered structures should comply with the requirements of Section 9.4 of the Code of Practice for Structural Use of Concrete 2013 published by Buildings Department and the Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers APP-68 published by Buildings Department.

(5) The compressive static load test for pile foundations should be carried out in accordance with the Clause 5.3.5 of this document.

(6) Where blasting operations are involved in the tunnel works, they shall comply with relevant requirements in the Guide to Cavern Engineering (Geoguide 4) published by Civil Engineering and Development Department and the Mines Division Guidance Note No. 10 published by Civil Engineering and Development Department. The statutory requirements in Hong Kong, such as those of the Dangerous Goods Ordinance (Cap. 295) shall also be satisfied.

5.3.3 Concrete Structures

(1) The scaffolding materials for falseworks should preferably be steel. The joint pin should comply with the provisions of the Steel Tube Scaffold Coupler (GB/T 15831-2023).

(2) The tree species for formwork structures or components should meet the requirements of the Technical Code for Safety of Forms in Construction (JGJ 162-2008).

(3) Plywood formwork should comply with the Plywood for Concrete Form (GB/T 17656-2018).

(4) Formwork installation should comply with Section 4.2 of the Code for Quality Acceptance of Concrete Structure Construction (GB 50204-2015).

(5) The standard for inspecting internal bending radius, fabrication shape, and dimensions for steel reinforcement bending should comply with the provisions of the Code for Quality Acceptance of Concrete Structure Construction (GB 50204-2015).

(6) Where mechanical coupler is used as connector for steel reinforcement, the process inspection of reinforcement splices should comply with the relevant provisions of the Technical Specification for Mechanical Splicing of Steel Reinforcing Bars (JGJ 107-2016). Where welding is used for steel reinforcement connection, the process inspection of welded joint of reinforcement bars should comply with the relevant provisions of the Specification for Welding and Acceptance of Reinforcing Steel Bars (JGJ 18-2012).

(7) The performance of anchors, grips, and couplers for prestressing tendons should comply with the relevant provisions of the Anchorage, Grip and Coupler for Prestressing Tendons (GB/T 14370-2015).

(8) Upon site delivery of unbonded prestressed steel strands, the amount of anticorrosive lubricant and the thickness of the protective sleeving should be inspected, and the test results should comply with the provisions of the Unbonded Prestressing Steel Strand (JG 161-2016).

(9) The inspection standards for the appearance quality of prestressing tendons, the category, grade, specification, quantity, and installation position of prestressing tendons, the control points for vertical positions of prestressing tendons or duct holes, and the properties of cement

grouting should meet the requirements of Section 6.2 of the Code for Quality Acceptance of Concrete Structure Construction (GB 50204-2015).

(10) Upon site delivery of ready-mixed concrete, its quality should comply with the Ready-Mixed Concrete (GB/T 14902-2012).

(11) Pumping is the preferred method for concrete conveyance. The placement of pumped concrete, the position and dimensions of cast in-situ structures, and the position and dimensions of the foundations for the cast in-situ equipment should meet the requirements of Section 8.3 of the Code for Construction of Concrete Structures (GB 50666-2011). Concrete compaction should meet the requirements of Section 8.4 of the Code for Construction of Concrete Structures (GB 50666-2011).

(12) The fabrication of precast components, the location of construction joints and late-cast strips should meet the requirements of the Code for Construction of Concrete Structures (GB 50666-2011).

(13) Concrete cantilevered structures should comply with the requirements of Section 9.4 of the Code of Practice for Structural Use of Concrete 2013 published by Buildings Department and the Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers APP-68 published by Buildings Department.

(14) The quality acceptance of concrete works should comply with the provisions of the Code for Quality Acceptance of Concrete Structure Construction (GB 50204-2015).

5.3.4 Steel Structures

(1) Structural steelworks should meet the requirements of the Standard for Acceptance of Construction Quality of Steel Structures (GB 50205-2020).

(2) Welders should work within their approved scope and comply with the provisions of the Code for Construction of Steel Structures (GB 50755-2012).

(3) The category, specification and performance of welding consumable should comply with the design requirements and the Code for Welding of Steel Structures (GB 50661-2011).

(4) For Grades 1 and 2 full penetration butt welds, ultrasonic testing should be check for internal defects. The defect classification and testing methods should comply with the provisions of the Non-destructive Testing of Welds - Ultrasonic Testing - Techniques, Testing Levels and Assessment (GB/T 11345-2023) or the Non-destructive Testing of Welds - Radiographic Testing - Part 1: X- and Gamma-ray Techniques with Film (GB/T 3323.1-2019).

(5) The preparation grade of steel surfaces before application of anti-corrosion coating should meet the relevant requirements of the Standard for Acceptance of Construction Quality of Steel Structures (GB 50205-2020).

5.3.5 Pile Foundation Works

(1) Quality acceptance of pile foundation works should comply with the provisions of General Code for Foundation Engineering of Building and Municipal Projects (GB 55003-2021) and Standard for Acceptance of Construction Quality of Building Foundation (GB 50202-2018).

(2) Acceptance of foundation bearing capacity should comply with the provisions of the Standard for Acceptance of Construction Quality of Building Foundation (GB 50202-2018). Static load tests and in-situ tests should comply with the provisions of the Standard for Geotechnical Testing Method (GB/T 50123-2019).

(3) The testing methods, quantities, and procedures for test piles should comply with the provisions of Chapter 3 of the Technical Code for Testing of Building Foundation Piles (JGJ 106-2014).

(4) Testing of pile foundations should comply with the provisions of the Technical Code for Testing of Building Foundation Piles (JGJ 106-2014). The load of vertical compressive static load tests should be maintained at twice the design pile-carrying capacity for at least 72 hours. The allowable settlement at pile top should comply with the provisions of Section 8.4 of the Code of Practice for Foundations 2017 published by Buildings Department.

5.3.6 Masonry Structures

(1) The quality acceptance of masonry structure works should meet the requirements of the Code for Construction of Masonry Structures Engineering (GB 50924-2014).

5.3.7 Decoration and Finishing

(1) The quality acceptance of decoration and finishing works should meet the requirements of the Standard for Construction Quality Acceptance of Building Decoration (GB 50210-2018).

5.3.8 Cut-and-cover Station (Section)

(1) The quality acceptance of cut-and-over station (section) works mainly includes the acceptance of pile foundation, soil nail wall, ground anchor (cable), sprayed concrete with wire mesh between piles, lateral bracing support freezing method, excavation and backfilling, foundation works, reinforcement fabrication, formwork and falsework, concrete structure works, structural steelworks, works in special areas, and internal structures.

(2) The quality acceptance of tunnels, station main structures and ancillary structures, and working shaft works constructed by the cut-and-cover

method should meet the requirements of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018).

(3) The corrosion protection, acceptance, and monitoring of prestressed ground anchors used in temporary support structures for excavations should comply with the provisions of the Model Specification for Prestressed Ground Anchors (Geospec 1) published by Civil Engineering and Development Department.

5.3.9 Stations Formed by Cover-and-Excavate Methods

(1) The quality acceptance of station works using cover-and-excavate methods mainly includes the acceptance of vertical support piles, walls and columns, cover plate system, earthwork and support, and cut-and-cover structure.

(2) The quality acceptance of station main structures and ancillary structures constructed using the cover-and-excavate methods should comply with the provisions of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018).

5.3.10 Underground Excavation Stations (Sections)

(1) The quality acceptance of the underground excavation stations (sections) works mainly includes the acceptance of groundwater control, stratum pre-support and reinforcement, earthwork excavation, steel pipe columns, initial support, secondary lining, masonry works, and structural waterproofing.

(2) The quality acceptance of underground excavation station (section) works should comply with the provisions of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018).

5.3.11 Elevated and At-grade Station Works

(1) The quality acceptance of foundation works should meet the requirements of Section 4.1 of the Standard for Acceptance of Construction Quality of Building Foundation (GB 50202-2018) and the requirements in Clause 5.3.5 of this document.

(2) The quality acceptance of formwork and falsework, reinforcement bar, concrete, and prestressing for foundation structures should meet the requirements for concrete structures in Clause 5.3.3 of this document.

(3) The quality acceptance of reinforced concrete structures should meet the requirements for concrete structures in Clause 5.3.3 of this document.

(4) The testing of raw materials, fabrication and installation, stressing and destressing, grouting and anchorage sealing for prestressing works should comply with the provisions for concrete structures in Clause 5.3.3 of this document.

(5) The quality acceptance of structural steel works should comply with the provisions in Clause 5.3.4 of this document.

(6) The quality acceptance of roof works should comply with the provisions of the Code for Acceptance of Construction Quality of Roof (GB 50207-2012).

(7) The fabrication of skylight glazing and glazing assemblies should comply with the provisions of the Technical Requirements of Building Glass Skylight System (JG/T 231-2018).

5.3.12 Sections Constructed Using Tunnel Boring Method

(1) When using the tunnel boring method for tunnel construction, the type of tunnel boring machine should be determined after technical and economic comparison based on the engineering geology for the tunnels, hydrogeology, surrounding environment, and the dimensions of tunnel structures.

(2) Tunnel boring construction should also comply with the Code for Construction and Acceptance of Shield Tunnelling Method (GB 50446-2017).

(3) After the completion of the assembly of the tunnel boring machine on site, commissioning of entire machine should be carried out after commissioning of individual systems. Upon completion of system commissioning, on-site inspection and test of the tunnel boring machine should be carried out. Construction may only commence after inspection report is signed off and after quality of machine is accepted. The acceptance should comply with the provisions of Section 11.1 of the Standard for Construction of Metro Engineering (GB/T 51310-2018).

5.3.13 Bridge Works

(1) The construction of mass in-situ concrete structures should comply with the provisions of the Standard for Construction of Mass Concrete (GB 50496-2018).

(2) The construction of arch bridges, cable-stayed bridges, suspension bridges, etc., should comply with the Code for Construction and Quality Acceptance of Bridge Works in City (CJJ 2-2008).

(3) The quality acceptance of elevated structures should comply with the provisions of Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018).

5.3.14 Immersed Tube Method

(1) Prior to the construction of immersed tube tunnel, the geological and hydrological information along the tunnel alignment should be verified. A construction programme and schedule should be established based on meteorological and hydrological forecasts, navigation channel conditions, and maritime information.

(2) Any blasting works adopted in the excavation for the tunnel foundation trenches should comply with the provisions of Clause 2.4.2(4) of this document. Blasting works should comply with the relevant provisions of the Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers APP-72 published by Buildings Department, and the local approval requirements.

(3) The steel reinforcement prefabrication, formwork and falsework, and concreting for precast tube sections should comply with the provisions of Clauses 5.3.3 and 5.3.4 of this document. For concrete with anti-seepage requirements, it should comply with the provisions of the Chapter 16 of the Standard for Construction of Metro Engineering (GB/T 51310-2018).

5.3.15 Road Subgrade

(1) The construction of road curb and embankments should comply with the requirements of the Standard for Construction of Metro Engineering (GB/T 51310-2018).

5.3.16 Track

(1) Track works should be carried out in zones and sections. Before track construction, structural breakthrough survey should be completed. If the centreline, elevation, and structural cross-sectional clearance do not meet the design requirements, the centreline elevation of the railway line should be adjusted according to the design.

(2) Track works should comply with the provisions of the Standard for Construction of Metro Engineering (GB/T 51310-2018).

5.3.17 Noise Barrier Works

(1) The quality acceptance of railway noise barriers should comply with the requirements of the Standard for Constructional Quality Acceptance of Railway Noise Barrier (TB 10428-2024).

5.3.18 Depot

(1) The quality acceptance of depot should comply with the provisions of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018).

5.3.19 Waterproofing

(1) Waterproofing works should comply with the provisions of the Code for Acceptance of Construction Quality of Underground Waterproof (GB 50208-2011).

5.3.20 Power Supply Works

(1) The location, quantity, and dimensions of the equipment foundation, cable holes within the substation and between sections, and integrated earthing terminals should be inspected and confirmed, and handover procedures should be completed. The earthing resistance value should meet the design requirements. A test report on the earthing resistance value provided by a qualified body should be available. The fabrication and installation of the embedded parts in foundation should be inspected and accepted before electrical equipment can be installed.

(2) The transportation routes for electrical equipment and materials and the construction of the power supply system should comply with the provisions of the Clause 23.1.2 of the Standard for Construction of Metro Engineering (GB/T 51310-2018).

(3) The quality acceptance of main substations and their high-voltage AC distribution equipment should comply with the provisions of the Code for Construction and Acceptance of High-voltage Electric Equipment Installation Engineering (GB 50147-2010), the Code for Construction and Acceptance of Power Transformers Oil Reactor and Mutual Inductor (GB 50148-2010), the Code for Construction and Acceptance of Busbar Installation of Electric Equipment Installation Engineering (GB 50149-2010), the Standard for Construction and Acceptance of Cable Line Electric Equipment Installation Engineering (GB 50168-2018), the Code for Construction and Acceptance of Switchboard, Outfit Complete Cubicle and Secondary Circuit Electric Equipment Installation Engineering (GB 50171-2012), the Code for Construction and Acceptance of Battery Electric Equipment Installation Engineering (GB 50172-2012), the Code for Construction and Acceptance of Power Conversion Equipment Electric Equipment Installation Engineering (GB 50255-2014), and the Code for Construction and Acceptance of Low-voltage Apparatus Electric Equipment Installation Engineering (GB 50254-2014).

5.3.21 Communication Systems

(1) The acceptance of communication works may include the dedicated communication system, public communication introduction system, and police communication system.

(2) The quality acceptance of communication works should comply with the provisions of Clause 3.2.3 of the Code for Construction Quality Acceptance of Urban Rail Transit Communication Engineering (GB 50382-2016).

5.3.22 Signalling Works

(1) The construction acceptance of signalling works should include electricity (optical) cable lines, fixed signals, departure indicators and push-button devices, point machines, train detection and train-to-wayside communication equipment, on-board equipment, indoor equipment, test track equipment, computer-based monitoring, lightning protection, earthing installation, wiring, system function and performance acceptance.

(2) The quality acceptance of the signalling works should comply with the requirements of the Standard for Construction Quality Acceptance of Urban Rail Transit Signal Engineering (GB/T 50578-2018).

5.3.23 Automatic Fire Alarm System

(1) Automatic fire alarm system works should include electricity (optical) cable lines, automatic fire alarm and linkage system, fire emergency broadcast system, power supply, and earthing works.

(2) The electromagnetic compatibility protection function of the automatic fire alarm system should comply with the provisions and design requirements of Environmental Test and Severities for Fire Electronic Products (GB/T 16838-2021) and the design requirements.

(3) The quality acceptance of automatic fire alarm system works should comply with the provisions of Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018), the Code for Acceptance of Quality of Intelligent Building Systems (GB 50339-2013), and the Standard for Installation and Acceptance of Fire Alarm System (GB 50166-2019).

5.3.24 Main Control System

(1) The quality acceptance of the main control system should include conduit/cable laying, equipment installation, commissioning, and functional acceptance.

(2) The quality acceptance of the main control system should comply with the provisions of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018).

(3) The acceptance of the main control system should comply with the provisions of the Technical Standard for Urban Rail Transit Integrated Supervision and Control System (GB/T 50636-2018).

5.3.25 Passenger Information System

(1) The quality acceptance for passenger information system works should include electrical (optical) cable laying, equipment installation, and system commissioning, etc.

(2) The quality acceptance of passenger information system works should comply with the provisions of Chapter 25 of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018).

5.3.26 Access Control System

(1) The quality acceptance of the access control system should include electrical (optical) cable lines, equipment installation and wiring, power supply and earthing works, and adjustment testing.

(2) The acceptance of the access control system should comply with the provisions of the Technical Standard for Security Engineering (GB 50348-2018) and the Code for Acceptance of Quality of Intelligent Building Systems (GB 50339-2013).

(3) The functional testing of the access control system should meet the requirements of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018).

5.3.27 Automatic Fare Collection System

(1) The quality acceptance of the automatic fare collection system should comply with the provisions of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018).

5.3.28 Environment and Equipment Monitoring System

(1) Environment and equipment monitoring system works should include electrical (optical) cable lines, environmental control system, power supply, and earthing works.

(2) The type, specification, and quality of delivered materials and software should comply with the requirements of the Code for Acceptance of Quality of Intelligent Building Systems (GB 50339-2013).

(3) The quality acceptance of the environment and equipment monitoring system should comply with the provisions of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018) and the Code for Acceptance of Quality of Intelligent Building Systems (GB 50339-2013).

5.3.29 Environmental Control System

(1) The quality acceptance of ventilation duct and equipment installation should comply with the provisions of the Code of Acceptance for Construction Quality of Ventilation and Air Conditioning Works (GB 50243-2016).

(2) The quality acceptance of installation of steam pipes used for ventilation or air-conditioning should comply with the provisions of the Code for

Acceptance of Construction Quality of Water Supply Drainage and Heating Works (GB 50242-2002).

5.3.30 Platform Screen Doors

(1) Handover inspection of control benchmarks should comply with the provisions of the Technical Code for Platform Screen Door System of Urban Railway Transit (CJJ 183-2012).

(2) The quality acceptance of the platform screen door system should comply with the provisions of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018), the Technical Code for Platform Screen Door System of Urban Railway Transit (CJJ 183-2012) and the Urban Rail Transit Platform Screen Door System (CJ/T 236-2022).

5.3.31 Water Supply and Drainage System

(1) Water supply and drainage pipes penetrating through the external wall structure of station tunnels should be provided with waterproof sleeves. Pre-formed openings or pre-embedded sleeves may be used where those pipes pass through internal structures. These works should comply with the provisions of Clause 18.1.6 of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018).

(2) The materials involved in the domestic water supply system should comply with the provisions of the Standards for Drinking Water Quality (GB 5749-2022), and shall comply with the requirements in Waterworks Ordinance (Cap. 102) and Waterworks Regulations (Cap. 102 sub. leg. A).

(3) The quality acceptance of water supply and drainage systems should comply with the provisions of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018), the Clauses 14.0.1, 14.0.2 and 14.0.3 of the Code for Acceptance of Construction

Quality of Water Supply Drainage and Heating Works (GB 50242-2002), and shall comply with the requirements in Waterworks Ordinance (Cap. 102) and Waterworks Regulations (Cap. 102 sub. leg. A).

(4) For provisions not specified in this Section, requirements in the Technical Requirements for Plumbing Works in Buildings published by Water Supplies Department, Sewerage Manual published by Drainage Services Department and Stormwater Drainage Manual published by Drainage Services Department should be referred to.

5.3.32 Vehicle Operation and Maintenance

(1) The installation process for depot maintenance equipment primarily includes foundation construction, equipment installation, equipment wiring, and commissioning.

(2) Foundation construction should comply with the provisions of Section 28.2 of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018).

(3) Equipment installation, piping, and wiring should comply with the provisions of Section 28.3 of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018) and the General Code for Building Electricity and Intelligence (GB 55024-2022). Among these, the installation of reclaimed water system equipment in the building should comply with the provisions of Section 12.2 of the Code for Acceptance of Construction Quality of Water Supply Drainage and Heating Works (GB 50242-2002). The exhaust system in paint shop equipment installation should comply with the provisions of the Code of Acceptance for Construction Quality of Ventilation and Air Conditioning Works (GB 50243-2016). Before crane equipment installation, the equipment foundation should be treated according to Clause 5.0.3 of the Unified Standard for Constructional Quality Acceptance of Building Engineering (GB 50300-2013). Lifting machinery operations shall comply with the provisions of Factories and

Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations (Cap. 59 sub. leg. J).

(4) The commissioning of depot maintenance equipment should comply with the provisions of Section 28.4 of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018).

(5) Subsystem commissioning should comply with the provisions of Clause 28.4.4 of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018).

5.3.33 Lightning Protection and Earthing Installation

(1) The installation and quality acceptance of lightning protection and earthing devices should comply with the requirements in Chapter 5 of the Code for Design Protection of Structures against Lightning (GB 50057-2010).

5.3.34 Integrated Commissioning and Trial Operation

(1) The quality acceptance of integrated commissioning and trial operation should comply with the provisions of Section 29.1 of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018).

(2) The integrated commissioning of vehicles, power supply system, communication system, passenger information system, signalling system, environmental control system, water supply and drainage system, automatic fire alarm system, environment and equipment monitoring system, access control, automatic fare collection system, station facilities for passengers, platform screen doors and flood gates should comply with the provisions of the Section 29.2 of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018), the Standard for Metro Gauges (CJJ/T 96-2018), the Railway Applications - Rolling Stock Equipment - Shock and Vibration

Tests (GB/T 21563-2018), the Technical Standard for Stray Current Corrosion Protection in Metro (CJJ/T 49-2020), and the Standard for Construction Quality Acceptance of Urban Rail Transit Signal Engineering (GB/T 50578-2018).

(3) The functional and technical parameters for the matching of vehicles with the communication, signalling, and power supply systems should comply with the provisions of the General Technical Specification for Metro Vehicles (GB/T 7928-2003).

(4) The electromagnetic compatibility of vehicle electrical equipment should comply with the provisions of Railway Applications - Electromagnetic Compatibility (GB/T 24338.1-2018 - GB/T 24338.6-2018).

(5) The integrated commissioning requirements for the power supply system and other systems should comply with the provisions in Section 29.3 of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018).

(6) Trial operation is divided into two main parts: (I) System Capability Commissioning and (II) Operational Drills, both of which should comply with the provisions of Section 29.4 of the Standard for Construction Quality Acceptance of Metro Engineering (GB/T 50299-2018).

5.3.35 Final Inspection by the Electrical and Mechanical Services Department

(1) The Railways Branch (RB) of the Electrical and Mechanical Services Department and the railway corporation should agree on an inspection scheme with demonstrations and tests to be participated by the Inspector [Note 1]. The railway corporation should ensure that the works under respective contracts are substantially completed to its satisfaction prior to the inspection by RB of the Electrical and Mechanical Services Department. The final inspection checklist is provided at Table 5.3.35 for reference as appropriate.

(2) Due to the potential differences in design and operation scenarios among various railways, the Inspector[Note 1] may, where necessary, require the railway corporation to conduct additional tests or inspection on additional items within the examination scope of inspection (to be agreed between the RB of the Electrical and Mechanical Services Department and the railway corporation as appropriate) to demonstrate the safe operation of the new systems / facilities.

(3) The railway corporation should be responsible for verifying the safety of all aspects of the new systems/facilities and should demonstrate its capability to safely operate and maintain the systems/facilities.

Note 1: The term "Inspector" in this Clause shall be interpreted with reference to the Mass Transit Railway Ordinance (Cap. 556) and any new railway legislation enacted and in force at the relevant time.

Table 5.3.35 - RB of the Electrical and Mechanical Services Department Final Inspection Checklist

1	General inspection of stations, ancillary buildings and depots
2	Inspection of station electrical and mechanical equipment
3	Pre-energisation inspection of overhead line (OHL) system
4	Inspection of rolling stock
5	Inspection of signalling system
6	Integrated inspection of rolling stock and signalling system
7	Integrated tests with platform screen doors (PSD) (including automatic platform gates (APG)) / rolling stock / signalling system
8	Additional tests for FAO – rolling stock / signalling system/ PSD (including APG) / operations control centre (OCC) / depots (applicable to FAO)
9	Integrated inspection of rolling stock / signalling / environmental control system
10	Integrated inspection of flood gates / signalling / traction power supply system (where applicable)

11	Inspection of tunnel environmental control system (ECS)
12	Inspection of main control system (MCS) and communication system at OCC

5.4 Engineering Supervision

5.4.1 Reference Standards

Engineering supervision shall comply with the following Hong Kong legislation, and should make reference to the latest editions of the following standards:

Hong Kong Legislation

(1) Buildings Ordinance (Cap. 123)

(2) Waste Disposal Ordinance (Cap. 354)

(3) Environmental Impact Assessment Ordinance (Cap. 499)

(4) Builders' Lifts and Tower Working Platforms (Safety) Ordinance (Cap. 470)

(5) Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations (Cap. 59 sub. leg. J)

(6) Construction Sites (Safety) Regulations (Cap. 59 sub. leg. I)

(7) Lifts and Escalators (General) Regulations (Cap. 618 sub. leg. A)

Relevant Technical Standards

(8) Code of Practice for Site Supervision 2009 published by Buildings Department

(9) Technical Memorandum for Supervision Plans 2009 published by Buildings Department

(10) Code of Practice on the Design and Construction of Tower Working Platforms published by Electrical and Mechanical Services Department

(11) Code of Practice on the Design and Construction of Builders' Lifts published by Electrical and Mechanical Services Department

(12) Project Administration Handbook for Civil Engineering Works published by Civil Engineering and Development Department

(13) Construction Site Safety Manual published by Development Bureau

(14) Risk Management for Public Works - Risk Management User Manual published by Development Bureau

(15) Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers published by Buildings Department

5.4.2 General Requirements

(1) Engineering supervision, including site supervision, building plans approval, submission of the certificate of completion of building works, and environmental related regulations must comply with the prevailing railway standards in Hong Kong to fulfil local railway engineering supervision needs.

6 Operations and Maintenance

6.1 Basic Provisions

This Chapter sets out the framework requirements for new railway projects to satisfy the broad requirements of the relevant authorities for the service and safety of the railway systems. Apart from the requirements stipulated in this Chapter, the railway corporation should comply with the levels of service and performance indicators specified in the operating agreements for each railway line, and should meet the "safe and sound" requirements and related procedures set by the relevant authorities for the railway system, ensuring long-term railway safety.

For newly built cross-boundary railway projects, if any requirements stated in this Chapter (such as asset management, passenger service requirements, safety management, contingency arrangements, external audits, etc.) are not fully applicable or not exhaustive in nature, the railway corporation should comply with the requirements determined by or otherwise agreed with relevant authorities from both Hong Kong and the Chinese Mainland.

The relevant authorities should ensure that the railway corporation has carried out safety assessment for the railway project, covering key railway systems which include trackwork, rolling stock, traction power supply, signalling systems, and building services and equipment, etc. Detailed requirements in relation to design, construction, safety assessment, inspection and testing (including final inspection) are detailed in the corresponding Chapters of this document.

6.2 Operational Organisation Design

6.2.1 Reference Standards

The operational organisation design should make reference to the latest editions of the following standards:

Relevant Technical Standards

(1) General Technical Specification of Fully Automatic Operation System for Urban Rail Transit (GB/T 46097-2025)

6.2.2 General Requirements

(1) New railway projects in Hong Kong may adopt a FAO system with Grade of Automation (GoA) 3 or GoA4. The relevant technical requirements should comply with the requirements of the General Technical Specification of Fully Automatic Operation System for Urban Rail Transit (GB/T 46097-2025).

(2) The operational organisation design should commence at the stage for the study on the functional requirements of the railway, which forms an important component of scheme studies (feasibility studies) and scheme design (preliminary design). Based on the functional positioning and patronage forecast of the project, service needs, design speed, carrying capacity, train formation as well as service pattern for the railway line, and should specify the requirements for station track layout.

(3) The operational organisation design should in principle be carried out in accordance with the national railway standards, with adaptations or supplementary provisions to cater for specific operation scenarios and operating modes in Hong Kong.

6.2.3 Operating Design Requirements

(1) The standard density of standing passengers on the effective clear floor space within the train car should be determined comprehensively based on the line characteristics, passenger demographics, average journey times, the sustained range of the high passenger flow, etc., and may base on 4 passengers per square metre (ppsm) for calculating the design carrying capacity, and should not exceed 6 ppsm.

(2) The design carrying capacity should satisfy the maximum passenger flow at peak hour per direction for the corresponding design year, and may make additional allowance in the forecast for the line scale. The allowance should be subject to agreement with the relevant authorities.

(3) The train formation should meet the required design carrying capacity for each design year. Where there are significant differences in patronage forecast amongst different design years, a differential train formation may be adopted. Where the patronage forecast varies significantly across different sections of the same railway line, or where different train formations operate across railway lines, a mixed fleet operation with different train formations may be adopted. Where there are significant differences in the sections of the railway line or hourly passenger flow, an operating mode with variable train formations may be adopted subject to technical and economical comparisons, allowing flexible configuration of carrying capacity through de-organisation and re-organisation of trains.

(4) The design capacity of railway line system should comply with Clause 3.2.2 of the Code for Design of Metro (GB 50157-2013) and Clause 5.2.2 of the Code for Design of Suburban Railway (TB 10624-2020).

(5) The operating speed efficiency of all-stop railway lines may not be lower than 45%. For railway lines operating express and local services, the operating speed efficiency of express trains may not be lower than 60%, while that of local trains may not be lower than 40%.

(6) The intervals of train services should comply with Clause 3.2.6 of the Code for Design of Metro (GB 50157-2013) and Clause 4.0.5 of the Design Standard of Urban Rapid Rail Transit (CJJ/T 314-2022).

6.2.4 Operating Mode

(1) The trains should run on a double-track line with left-hand operation.

(2) The operating speeds of the trains should comply with the following requirements:

(a) The maximum operating speed of trains on a section should be comprehensively determined based on conditions and operational requirements of the railway line. Where the station interval and conditions of the railway line permit, it should reach the maximum allowable operating speed in the design; and

(b) non-stop trains may run through stations at unrestricted speed; when approaching platforms, the speed should be restricted to meet the clearance and technical requirements of the platform screen doors.

6.2.5 Station Sidings

(1) The layout of station sidings should comply with requirements stipulated in Clauses 3.4.1 to 3.4.6 and Clauses 6.4.1 to 6.4.5 of the Code for Design of Metro (GB 50157-2013), Clauses 5.4.1 to 5.4.4 of the Code for Design of Suburban Railway (TB 10624-2020) and Clauses 4.0.11 to 4.0.14 of the Design Standard of Urban Rapid Rail Transit (CJJ/T 314-2022).

6.3 Safety Assessment for Operation

6.3.1 Reference Standards

The safety assessment for operation should make reference to the latest editions of the following standards:

Relevant Technical Standards

(1) Rules for the Administration of Urban Rail Transport Operation, Order No. 8 (2018) of the Ministry of Transport

(2) Specification for Operational Safety Assessment of Urban Rail Transit, Regulation No. 3 (2023) from the Ministry of Transport

(3) Specifications for Safety Assessment before Initial Operation of Urban Rail Transit, Document No. 56 (2023) of the General Office of the Ministry of Transport

6.3.2 General Requirements

(1) New railway projects should meet the prerequisites stipulated in Clause 6 of the Specification for Operational Safety Assessment of Urban Rail Transit, Regulation No. 3 (2023) from the Ministry of Transport before commencing the safety assessment for initial operation. The service performance indicators for operation during trial run should meet the requirements in Clause 6.4.11 of this document.

(2) The content and requirements of the system functional verification and system integration testing, which are covered in the safety assessment before initial operation, should satisfy the inspection, testing and acceptance requirements of the relevant Chapters of this document (including trackwork, rolling stock, traction power supply, signalling systems, and building services and equipment, etc.), and comply with the requirements as specified in Clause 5.3.35 of this document, and the inspection, testing and acceptance requirements specified by the Electrical and Mechanical Services Department.

(3) The issues identified during the safety assessment before initial operation should be rectified and reported to the relevant authorities.

6.4 Operation and Maintenance Management

6.4.1 Reference Standards

The O&M management should make reference to the latest editions of the following standards:

Relevant Technical Standards

(1) Service Specification for Urban Rail Passenger Transport (GB/T 22486-2022)

(2) Measures for Passenger Transport Organisation and Service Management of Urban Rail Transit, Regulation No. 3 (2025) from the Ministry of Transport

(3) Guidelines for Enterprises to Develop Emergency Response Plan for Work Place Accidents (GB/T 29639-2020)

(4) Specifications for Developing Response Plan to Urban Rail Transit Operation Emergency (JT/T 1051-2016)

(5) Specification for Safety Assessment during Operation of Urban Rail Transit, Document No. 58 (2023) of the General Office of the Ministry of Transport

(6) Regulations for Operation Management of Urban Rail Transit (GB/T 30012-2013)

(7) Skills and Competency Requirements for Station Administrator of Urban Rail Transit – Part 1: Metro, Light Rail and Monorail (JT/T 1002.1-2015)

(8) Skills and Competency Requirements for Train Driver of Urban Rail Transit – Part 1: Metro, Light Rail and Monorail (JT/T 1003.1-2015)

(9) Skills and Competency Requirements for Train Dispatcher of Urban Rail Transit – Part 1: Metro, Light Rail and Monorail (JT/T 1004.1-2015)

6.4.2 Technical Requirements for Operation

(1) Carrying Capacity Requirements

(a) The carrying capacity should be determined based on the analysis of patronage forecast, with holistic considerations on factors such as the land-use planning along the railway line, the passenger travel characteristics, the distribution characteristics of passenger flow, and the risks associated with patronage fluctuations. It should also satisfy the required maximum passenger flow at peak hour per direction for the corresponding design year.

(b) The fleet size of trains should be determined based on the requirements for corresponding carrying capacity with transport volume and the requirements for the maintenance and spare trains, and should be configured according to the initial operational requirements.

(2) Line Safety Requirements

(a) The line design should minimise potential incident and danger to passengers and staff in the railway premises and the public in the vicinity as much as possible, and should systematically identify the hazards to passengers, staff and the public, and minimise the risks to the level as low as reasonably practicable (ALARP).

(b) The layout, materials, and components of the line facilities and equipment should comply with fire safety regulations.

(c) All electrical and mechanical systems and building service facilities that are critical to safety and services should be equipped with backup power supplies.

(d) All critical system design should adhere to the "fail-safe" principle and should take into account safety considerations of failures, anomalies, degradation and emergency operations, as well as under normal operating conditions.

(3) Infrastructure Requirements

(a) The underground structures and architectural design should adhere to “form-follows-function” principle, and should meet the requirements of urban planning, train operation, environmental protection, seismic resistance, water resistance, fire resistance, preventive protection, corrosion-proof, and constructability, etc., and should also ensure structural safety and durability, while incorporating advanced technology and cost-effectiveness.

(b) The internal clearance of underground structures should meet the gauge requirements of railway structures as well as operating need and construction workmanship requirements. In addition, the effects of construction tolerances, structural deformation and displacement, etc. should be taken into account.

(c) The operating speed of trains on horizontal curves should be calculated based on the curve radius, while the maximum speed limit should be determined to ensure railway safety.

(4) Environmental Impact Requirements

(a) The overall alignment of the railway line should meet requirements of the overall urban planning, comprehensive transportation planning, environmental protection, and urban landscape. Appropriate arrangement should be made on the interfaces with at-grade buildings, urban roads, underground utilities, underground structures, and construction traffic management.

(b) During the design and construction stages, as well as the subsequent O&M stages, the environmental impact of all potential aspects of pollution should be assessed separately. Wetland affected by the project should be compensated.

(5) Transportation Integration Requirements

(a) The station should be designed to facilitate integration with other transport modes and should consider the need of interchange for future railway network expansion.

(6) Compatibility Requirements with Existing Railway Lines

(a) Service continuity: during the installation, testing and commissioning, trial run, or trial operation of the new railway line, there should be no adverse impact on the operation of the existing railway lines. The normal service of existing railway lines should be maintained as far as practicable, and the disruption to passengers of these railway lines minimised as much as possible.

(b) The remote control and monitoring functions for all systems of the railway lines should be centralised at the OCC.

(c) Dual power feeds should be supplied to stations, depots, and ancillary buildings.

(7) Service Reliability Requirements

(a) The railway system should adopt a modular configuration. In the event of a failure, backup or degraded operations should be available through the changeover to the redundant key components to maintain the basic functioning of the system.

(b) Through life cycle cost assessment, the railway corporation may provide the equipment/systems of the railway line with monitoring function on the performance condition, so as to identify degradation before a failure occurs.

(c) The railway corporation should monitor the service reliability of the railway line throughout the entire project life cycle. For systems with potential significant impact on the reliability performance of the train services, reliability growth planning should be included and completed before the commencement of trial operation.

(8) Economic Operation Requirements

(a) The line design should ensure economical operations. The availability, operability, maintainability and life cycle cost of systems and equipment should be thoroughly taken into account at the design stage. The use of new materials and technology is encouraged to reduce the O&M cost of the railway lines.

(9) Training Requirements

(a) Training facilities of the railway line (including training simulators with user-defined scenarios) meeting the actual operational needs should be provided. The existing training facilities should be utilised as much as possible.

(10) Requirements for Future Mobility

(a) Energy sustainability: adopt energy-efficient station design, emerging technologies and maximum use of natural resources and renewable energy to enhance infrastructure design and energy utilisation.

(b) Customer-centric approach: adopt initiatives such as mobile payment and smart customer service, to deliver a more people-oriented service, offer dynamic, real-time, on-demand and personalised information and provide hassle-free experience to passengers.

(c) Technological and innovative enhancement on infrastructure: provide robust and reliable infrastructure and enhance system expandability and durability, through monitoring on asset condition, asset life and health analysis as well as preventive maintenance.

(d) Enhanced operation efficiency and effectiveness of O&M by technological innovation: adopt emerging technologies and process optimisation to enhance the efficiency and effectiveness of O&M regime.

6.4.3 Operation Management Requirements

(1) Operating Mode

(a) Based on the design carrying capacity and the patronage demand, the start and end stations (terminus), train formations, and train service patterns of the railway line should be determined with comprehensive considerations of technical criteria of railway facilities, interchange compatibility of the railway network and other factors.

(b) The new railway line may adopt FAO, where movement of trains is fully automatic without any operating staff on board. On FAO lines, at least one train attendant should be assigned to each train in service. The attendant should provide assistance to passengers and other staff during emergencies and maintain communication with the OCC.

(2) Operating Hours

(a) The operating hours of the first and last train services should be clearly specified for each railway line. The train timetable should be timely adjusted and optimised during special holidays and major events.

(3) Service Levels

Operations should be commenced in accordance with the requirements, with considerations on the following quantitative indicators:

(a) Peak-hour passenger flow;

(b) Maximum line carrying capacity; and

(c) Train service reliability.

(4) Station Operating Requirements

(a) Barrier-free requirements: station should be equipped with barrier-free facilities. All station entrances and exits should be designed as barrier-free accesses.

(b) Circulation requirements: platforms, passageways, stairways, escalators, lifts, concourses and other public areas within the stations should ensure smooth passenger circulation and safe evacuation under any normal and emergency situations. The design should possess sufficient passage capacity under the worst scenario of emergency situation for safe evacuation of passengers and staff.

(c) Signage and passenger information: the railway corporation should compile a corporate signage manual, which establishes a guiding signage system for both the public and non-public areas of each station. Statutory signs, exit signs and directional signs at non-public areas should meet the requirements of latest codes of practice and circulars issued by the Fire Services Department, Buildings Department and any other relevant authorities.

(d) Automatic ticketing: the station should set up paid and non-paid areas, and should be equipped with fixed ticket machines and portable ticketing equipment to handle the ticketing works of the station.

(e) Station control: when a group station control (GSC) practice is adopted, master station and satellite stations should be provided. All satellite stations should be equipped with a fire control room (FCR).

(f) Station and trackside equipment and systems

(i) To ensure safe and efficient operation of the stations and trackways, the equipment and systems for stations and tracks of new railway projects should be provided in accordance with the design functional requirements specified in Chapter 4 of this document.

(g) Station emergency facilities

(i) Emergency access and facilities: emergency entrances and auxiliary emergency entrances should comply with fire safety and rescue requirements.

(ii) Fire installations: Fire services equipment rooms should not be occupied. The station should be equipped with fire service installations in accordance with fire safety requirements as specified in Chapter 4 and Section 3.8 of this document.

(iii) Station evacuation: the railway corporation should prepare fire safety instructions and measures to detail fire compartmentation and evacuation arrangement, including the integrated use of escalators, lifts, broadcasting, passenger information display, ticket machines and automatic fare collection gates, etc. during fire emergencies.

(iv) Flooding precautions: the station should be equipped with adequate drainage facilities to meet the design requirements. The railway corporation should establish and implement reliable measures to prevent flooding of the railway premises to such extent as it is reasonably practicable and controllable.

(h) Station service levels

(i) Qualitative and quantitative indicators should be set for facilities which affect the service environment and service quality, such as lighting, temperature/relative humidity of the stations (including all enclosed and open stations), escalators, lifts, ticket machines and automatic fare collection gates, etc. Operation should be implemented in accordance with the corresponding service level requirements.

(5) Train Operating Requirements

(a) Train fleet size, train formation, and train service pattern should meet the design carrying capacity of the railway line.

(b) Train Facilities Configuration

(i) The train formation, train signage, train seating, standing space, and the train compartment environment should comply with the design requirements.

(ii) The trains should be equipped with communication facilities. The function of the broadcasting system, information display screens, passenger alarm device, intercom systems, closed-circuit television (CCTV) system, and on-board video storage device, etc. should comply with the design requirements.

(iii) Onboard fire equipment: Dry powder fire extinguishers should be equipped in each train compartment and driver cab.

(c) The train design requirements should possess the functions of normal operation, degraded operation, and emergency operation, etc.

(d) Operations control: operations control centre (OCC) is responsible for train control, train service scheduling and line control functions. The design and layout of OCC equipment should accommodate the requirements of the normal operations and the operations during incidents.

(e) Event recording: To support the investigation and analysis of emergency situation, each train should be equipped with an incident recorder which will record continuously all the important control signalling status and train operating conditions. The record may be able for remote downloading from maintenance terminal in depot.

(f) Train service levels: qualitative and quantitative assessment of service performance indicators for train appearance, train capacity, seating design, interior environment, lighting, noise, and the coverage rate of the mobile communication signals, etc. should be carried out for newly procured trains, and operation should be implemented in accordance with the corresponding indicators.

(6) Depot Operating Requirements

(a) On FAO lines, the depot should be divided into FAO and non-FAO zones based on functional requirements. Transition platforms should be provided between the zones. Under FAO mode, the OCC or depot control centre should be able to remotely wake up stabled trains, activating them from the sleeping mode to the completion of self-checking.

(b) Depot facilities configuration

(i) The depot should be equipped with access control, surveillance, alarm, and security functions. Production, living, and administrative areas should be separated.

(ii) The stabling area of the depot should be capable of accommodating all trains of the railway line. The configuration of depot facilities should meet the requirements for train operation, maintenance, and emergency repairs.

6.4.4 Maintenance Management Requirements

(1) Maintenance Requirements

(a) The railway corporation should formulate effective maintenance management system with manual and maintenance operation procedures to ensure the operational reliability of the facilities, equipment, railway systems and trains, and reduce safety risks as far as possible. The maintenance staff should meet the skill requirements of the corresponding positions.

(b) Modular design: all equipment design should minimise on-site maintenance work. The equipment should be installed in modules so as to facilitate equipment replacement with minimum use of tools.

(c) Standardised design: All modules of similar functions should adopt a standardised design to minimise the number of spare parts in storage.

(d) Access: Access to machine rooms, substations and other facilities should allow transportation of the largest replaceable parts to railway or highway.

(e) Condition monitoring: the operating conditions of all equipment should be continuously monitored. Maintenance suggestions and strategies should be provided in a timely manner in case of identification of any degradation in performance. High voltage, traction power supply and key low-voltage switchgear should be equipped with real-time condition monitoring system.

(2) Maintainability Requirements

(a) Scheduled maintenance should be the prioritised form of maintenance of all railway systems / equipment. Railway system /

equipment should be designed with ease of access and maintenance.

(3) Maintenance Procedures

(a) The railway corporation should determine the appropriate maintenance methods based on the features of different railway equipment.

(4) Emergency Maintenance

(a) The railway corporation should establish a quick response team to restore infrastructure systems and equipment during emergency, and a maintenance team to handle station maintenance and repair work. Except for emergency repair, track and tunnel maintenance should not be arranged during the operating hours.

(b) For emergency maintenance and repair during the operating hours, the railway corporation should formulate an emergency maintenance and repair management system to reduce the impact of breakdown on train operations and passenger services while ensuring safety of staff personnel.

(5) Station Maintenance

(a) The railway corporation should establish a management system for station maintenance and repair works which should not disrupt normal operation of station staff area nor adversely affect passengers.

6.4.5 Asset Management Requirements

(1) The railway corporation should establish an asset management system conforming to prevailing international standards for the efficient and effective management of its railway assets in relation to their acquisition, operation, maintenance, renewal, replacement, enhancement and

disposal. The content and implementation approach of the asset management system should comply with the Asset Management (ISO 55001) and should be accredited by the third party.

(2) Without prejudice to the powers conferred on the Inspector by Section 27 of the Mass Transit Railway Ordinance (Cap. 556) and any authority conferred by the new railway ordinance then enacted and implemented, the railway corporation should provide the Inspector with information on the procedures and copies of documentation regarding the life assurance, upgrade, renewal and replacement of the key railway assets. Key railway assets include but are not limited to rolling stock, signalling systems, traction power supply systems, permanent-way and other key railway infrastructure.

(3) In undertaking any life assurance project for extending the operation life of certain key railway asset, the railway corporation should assess the asset condition to identify areas requiring upgrade, renewal or replacement taking into account the design life and any associated safety risks.

(4) Following the completion of the assessment and confirmation on the technical feasibility of railway asset life assurance, the railway corporation should consult the Inspector on the scope and plan of the life assurance in relation to rolling stock and signalling systems.

6.4.6 Passenger Service Requirements

(1) In case of train service interruption, the railway corporation should begin passenger service by meeting the following requirements:

(a) Maintain train operation and service as far as possible;

(b) Report information according to the notification and alert protocol set out by the relevant authorities; and

(c) Obtain approval from the relevant authorities before implementing new operating arrangements with potential adverse implications.

(2) The train service arrangement provided by the railway corporation should meet the following requirements:

(a) Provide the required train service arrangement within the specified timeframe; and

(b) Submit the information on train service arrangement to the relevant authorities in the prescribed program and format. The submission materials include but not limited to train service operation time, train service passenger capacity, etc. The calculation of train service passenger capacity is shown in formula (1).

$$A = N_1 * N_2 * N_3 \quad (1)$$

where: A - train service passenger capacity, measured in unit passenger;

N_1 - car capacity, measured in passengers per car;

N_2 - cars per train, means the number of train cars comprised in a train that is operating on that line of the railway; and

N_3 - train frequency, means the number of trains operating in each direction on that line of the railway per hour.

(3) The level of railway cleanliness maintained and passenger environment provided by the railway corporation should comply with guidance notes, practice notes and other recommendations as issued by the relevant authorities from time to time, and the requirements as stipulated in Section 7.1 of the Service Specification for Urban Rail Passenger Transport (GB/T 22486-2022).

(4) The railway corporation should provide and maintain sufficient and efficient communication channels to ensure that the OCC can communicate with the railway corporation's internal key facilities of running train, premises, and can interact with external facilities and units, and meet the following requirements:

(a) Key facilities of running train, premises including but not limited to rolling stock, stations, depots, and others;

(b) External facilities and units include but not limited to communication with designated police facilities, firefighting, power supply, traffic coordination centre and other external facilities and units; and

(c) The railway corporation should grant necessary access right to the relevant authorities for operational services, so as to assure that the inspection personnel for operational services can access to the control centres and such other railway premises as are necessary for conducting inspection activities during emergency incidents.

(5) The railway corporation should ensure that the noise and vibration arising from railway operation should be kept to a minimum at all times with the proper maintenance and safe operational practices.

(6) The railway corporation should provide sufficient personnel and a reliable ticketing system. Ticketing facilities and equipment should comply with the provisions of Section 5.4 of the Service Specification for Urban Rail Passenger Transport (GB/T 22486-2022), and Clause 24 of Measures for the Passenger Transport Organisation and Service Management of Urban Rail Transit, Regulation No. 3 (2025) from the Ministry of Transport.

(7) The railway corporation should, as far as reasonably practicable, ensure that all tickets, smart cards and cash handling facilities are at all times safe and secure.

(8) The railway corporation should provide reliable escalators and lifts, for efficient transportation of passengers within stations.

(9) The railway corporation should establish and maintain a system for handling passenger complaints and recommendations, and should submit complaints and recommendations and the corresponding measures related to railway services within the time limit prescribed by the relevant authorities.

(10) The installation, content, improvement and other provisions of guiding signs and passenger information display should meet the following requirements:

(a) Guiding signs and passenger information display should be illuminated and presented in Chinese and English. The railway corporation is encouraged to actively introduce smart and technological facilities and equipment, and provide mobile application for passengers to check real-time train arrival times, journey fares, estimated travel times, station facilities, and other relevant information;

(b) Guiding signs and passenger information display should be installed with a view to providing information and direction to the public and enabling passengers to proceed with their trips efficiently and safely, and meet the requirements of Clause 8 of the Measures for Passenger Transport Organisation and Service Management of Urban Rail Transit, Regulation No. 3 (2025) from the Ministry of Transport;

(c) Guiding signs and passenger information display should display content, including, but not limited to, the Mass Transit Railway Ordinance (Cap. 556) (or any other railway related by-laws as appropriate) and any other new railway ordinances then enacted and implemented, directional signs and fare table, as well as yearly data in relation to the operating hours of daily train services and the train frequency for peak and off-peak hours; and

(d) The railway corporation should conduct review on the conditions, content and other related issues provided guiding signs and passenger information display of any station, line, or train, according to the requirements of the relevant authorities for the operating services. In respect of any specific recommendations on the changes to railway service operations put forward by the relevant authorities, the railway corporation should provide a response within the prescribed time limit.

6.4.7 Safety Management

(1) The railway corporation should establish, operate and maintain a safety management system and continue to improve for minimising safety risks as far as reasonably practicable.

(2) The railway corporation should prepare, in accordance with the requirements from the relevant authorities and the potential types of disasters that may occur on the operating railway lines, a comprehensive contingency plan. The formulation of the contingency plan should meet the requirements of the Guidelines for Enterprises to Develop Emergency Response Plan for Work Place Accidents (GB/T 29639-2020) and the Specifications for Developing Response Plan to Urban Rail Transit Operation Emergency (JT/T 1051-2016). The contingency plan should include at least the following contents:

(a) Contingency plan for operating emergencies: contingency plan for facilities and equipment failure, fire, train derailment, train collision, etc.;

(b) Contingency plan for natural disasters: contingency plan for earthquakes, typhoons, rainstorm, geological hazards, etc.;

(c) Contingency plan for public health events: contingency plan for public health events; and

(d) Contingency plan for public order and public security: contingency plan for terrorist attacks such as arson, explosion, poisoning and chemical, biological, radiological and nuclear (CBRN) attacks, or other events that may cause riots, mass evacuation and station area defence.

(3) The railway corporation should engage an independent safety expert to regularly review the safety management system at least once every three years, or at other times as agreed with the relevant authorities for operational safety from time to time. The contents and methods of review on the safety management system should comply with the Specification for Safety Assessment during Operation of Urban Rail

Transit, Document No. 58 (2023) from the Ministry of Transport. The safety management system should meet the requirements of the Occupational Health and Safety Management System (ISO 45001) and be accredited by a third party. Before engaging the independent safety expert and ascertaining its terms of services (including the terms specified in item (b) below), the railway corporation should:

(a) Prepare a list of candidates which it considers appropriate for selection for the review service;

(b) Draft a review service contract covering the following requirements:

(i) Scope of work for the review service;

(ii) Review methodology;

(iii) Tentative work programme;

(iv) Qualification and composition of the review team assisting the independent safety expert; and

(v) Review report, for submission following the completion of review service.

(c) Consult the relevant authorities for operational safety in relation to the list of candidates referred to item (a) above; and

(d) Consult the relevant authorities for the operational safety on the requirements as specified in the draft review service contract referred to item (b) above.

(4) Following the issuance of the final review report by the independent safety expert, the railway corporation should:

(a) Submit a copy of such report to the relevant authorities for operational safety within two weeks following the receipt of such report by the railway corporation; and

(b) Give due consideration to any suggestions made by the relevant authorities for operational safety on the improvement of the safety management system maintained by the railway corporation. Following receipt by the railway corporation of any such suggestions, the railway corporation should respond on how to address such suggestions and, where appropriate, reasons for not implementing any such suggestions within the prescribed time limit .

(5) The railway corporation should put in place a mechanism to ensure that the assessment findings of the final review report will be suitably addressed and, where appropriate, reported to the senior management of the railway corporation in a timely manner.

(6) The staff of the railway corporation should meet the following requirements:

(a) The railway corporation should deploy staff meeting its operational needs;

(b) The railway corporation should organise the staff to acquire skills and safety training and education in relation to the operation requirements; the staff for key positions should be assessed and certified;

(c) The railway corporation should establish a system requiring staff to carry staff identity cards while on duty;

(d) The railway corporation should ascertain the qualification and experience requirements for staff positions, as well as staff monitoring systems, and adjust the positions of the staff who do not meet the requirements in a timely manner;

(e) The skills and qualification of the staff as train attendant, train driver, traffic coordinator should meet the requirements as stipulated in Chapters 5 to 8 of the Skills and Competency Requirements for Station Administrator of Urban Rail Transit – Part 1: Metro, Light Rail and Monorail (JT/T 1002.1-2015), Chapters 5 to 8 of the Skills and Competency Requirements for Train Driver of Urban Rail Transit – Part 1: Metro, Light Rail and

Monorail (JT/T 1003.1-2015) and Chapters 5 to 8 of the Skills and Competency Requirements for Train Dispatcher of Urban Rail Transit – Part 1: Metro, Light Rail and Monorail (JT/T 1004.1-2015) respectively;

(f) Equipment maintenance staff should acquire the relevant professional skills, and should be familiar with the operational procedures and work requirements of their positions; and

(g) Staff trainees of train driver, controller of signalling system or key equipment and administrator of train operation, should deliver their duties under supervision of the designated instructor.

6.4.8 Response Mechanism for Railway Incidents

(1) According to the prevailing reporting mechanism for railway incident, the railway corporation should notify the Transport Departments within 8 minutes of any railway incident which has caused, or is expected to cause, train service disruption of 8 minutes or more. A railway incident refers to a temporary delay or stoppage of service for a section of a railway line or a serious incident that would affect one or more railway lines. Upon receiving notification, the Transport Department would liaise closely with the railway corporation to provide assistance as necessary. Whether emergency services would need to be mobilised would depend on the seriousness of the incident, the length of service disruption period and the availability of parallel services.

(2) Apart from notifying the Transport Department, the railway corporation should also notify the Electrical and Mechanical Services Department of those events taken place in any parts of the railway premises with direct relation to the operational safety of the railway. The railway corporation should also disseminate at the same time the temporary service disruption messages to passengers on the affected train and in the stations within 8 minutes.

(3) As regards the alert system, in case of major railway incident, the railway corporation should issue an amber or red alert to the relevant authorities (including Transport Department), other public transport operators and the mass media according to the seriousness of the railway incident. Upon receiving notification from the railway corporation, other public transport operators will provide appropriate supporting services under the coordination of Transport Department as far as possible. The mechanism of the alert system is as follows:

(a) Amber alert: prior to the issuance of a red alert, the railway corporation may issue an amber alert, as an early warning in respect of an incident which may lead to a serious disruption of services. Other public transport operators, after receiving this alert message, should alert their emergency unit to get prepared for possible emergency actions on short notice and keep close contact with the railway corporation.

(b) Red alert: a signal to indicate that a serious disruption has continued or is expected to continue for over 20 minutes, and emergency support services from other public transport operators are required. Upon receipt of the red alert, other operators should urgently mobilise their resources to provide appropriate support services as quickly as possible.

6.4.9 Customer Service Pledges

(1) For each operating period, the railway corporation should establish and publish, on an annual basis, customer service pledges.

(2) The railway corporation should publish:

(a) On a quarterly basis, the data of measurement on its actual performance against the customer service pledges, together with explanation;

(b) On a quarterly basis, the numbers of passenger complaints;

(c) On a yearly basis, the numbers of accidents, serious injuries and fatalities on the railway and major service delays; and

(d) On a yearly basis, data in relation to the daily operation hours of train services and the frequency of train services for peak and off-peak services.

(3) The customer service pledges should cover aspects listed under Clause 6.4.11 of this Chapter, and any other aspects as agreed between the relevant authorities and the railway corporation from time to time.

(4) In each operating period, the railway corporation should strive to meet the customer service pledges which are voluntary targets and are not themselves service performance requirements or obligations relating to service performance.

6.4.10 Operation Report

The railway corporation should submit monthly operation reports on its service performance level and applicable service performance requirements for that reporting month.

6.4.11 External Audit

(1) The railway corporation should submit to the relevant authorities for service operation at least annually a report prepared by its external auditors. The report should include but is not limited to the following:

(a) Whether the railway corporation had in place internal control system and procedures which were adequate to enable, as far as practicable, its compliance with the service performance requirements;

(b) Whether the railway corporation is capable of measuring and recording, in all material respects, its compliance with the service performance requirements; and

(c) The calculation method of the service performance indicators in the customer service pledges.

(2) The service performance for operation should be evaluated qualitatively and quantitatively. The service performance indicators for operation should include, but not limited to the followings (The formulae of each indicator are listed in Table 6.4.11):

(a) Train service delivery;

(b) Passenger journeys on time;

(c) Train punctuality;

(d) Train service reliability;

(e) Ticket reliability;

(f) Add value machine reliability;

(g) Ticket machine reliability;

(h) Ticket gate reliability;

(i) Escalator reliability;

(j) Passenger lift reliability;

(k) Temperature and ventilation;

(l) Railway cleanliness; and

(m) Passenger enquiry response time within 6 working days.

(3) If the external auditors consider that the control systems and procedures have any shortcomings, they should elaborate on its nature and extent. Any such report should be binding on the railway corporation and the relevant authorities.

Table 6.4.11 Formulae for Service Performance Indicators for Operation

Service Performance Indicators for Operation	Formula
(a)Train service delivery	$\frac{\text{actual train trips in a month}}{\text{scheduled train trips in a month}} \times 100\%$
(b)Passenger journeys on time	$\frac{\text{incoming patronage in a month} - \text{passengers in a month delayed by at least y mintues}}{\text{incoming patronage in a month}} \times 100\%$ where y should refer to the requirement specified for each individual railway line
(c)Train punctuality	$\frac{\text{actual train trips in a month} - \text{train trips in a month delayed by at least y minutes}}{\text{actual train trips in a month}} \times 100\%$ where y should refer to the requirement specified for each individual railway line
(d)Train service reliability	$\frac{\text{actual distance travelled by loaded vehicles in km}}{\text{train failures causing delay } \geq \text{ y minutes in a month}}$ where y should refer to the requirement specified for each individual railway line
(e)Ticket reliability	$\frac{\text{actual smart ticket transactions in a month}}{\text{replacement due to ticket failure in a month}}$
(f)Add value machine reliability	$\frac{\text{total operating hours in a month of the facility} - \text{total non} - \text{operating hours in a month for the facility}}{\text{total operating hours in a month of the facility}} \times 100\%$
(g)Ticket machine reliability	$\frac{\text{total operating hours in a month of the facility} - \text{total non} - \text{operating hours in a month for the facility}}{\text{total operating hours in a month of the facility}} \times 100\%$
(h)Ticket gate reliability	$\frac{\text{total operating hours in a month of the facility} - \text{total non} - \text{operating hours in a month for the facility}}{\text{total operating hours in a month of the facility}} \times 100\%$
(i)Escalator reliability	$\frac{\text{total operating hours in a month of the facility} - \text{total non} - \text{operating hours in a month for the facility}}{\text{total operating hours in a month of the facility}} \times 100\%$

Service Performance Indicators for Operation	**Formula**
(j)Passenger lift reliability	$$\frac{\text{total operating hours in a month of the facility} - \text{total non} - \text{operating hours in a month for the facility}}{\text{total operating hours in a month of the facility}} \times 100\%$$
(k)Temperature and ventilation	Trains: To maintain a cool, pleasant and comfortable train environment generally at or below x ºC Trains: $$\frac{\text{measurments of temperature within train complying with the standard (i.e. maintaining temperature at or below x °C) in a month}}{\text{measurements of temperature within train in a month}} \times 100\%$$ where x should refer to the requirement specified for each individual railway line Stations: To maintain a cool, pleasant and comfortable environment generally at or below y ºC for platforms and z ºC for station concourses (except on very hot days) $$\frac{\text{measurements of temperature within station complying with the standard to maintain temperature at or below y °C and z°C for station platform and concourse respectively; and temperature lower than the outdoor temperature by at least 3°C for very hot days (32°C or above) in a month}}{\text{measurements of temperature within station in a month}} \times 100\%$$ where y and z should refer to the requirement specified for each individual railway line
(l)Railway cleanliness	A. Train compartment: cleaned daily B. Train exterior: washed every 2 days (on average) Train compartment: $$\frac{\text{number of trains with compartment cleaned before release for a.m. service in a month}}{\text{number of trains release for a.m. service in a month}} \times 100\%$$ Train exterior: $$\frac{\text{average number of cleaning records per 2 days in a month}}{\text{average number of trains in service per day for a.m. service in a month}} \times 100\%$$

Service Performance Indicators for Operation	**Formula**
(m)Passenger enquiry response time within 6 working days	$\frac{\text{passenger enquiries responded within 6 working days in a month}}{\text{passenger enquiries received in a month}} \times 100\%$

Appendix A – Details of the Prevailing Railway Standards in Hong Kong

The prevailing railway standards in Hong Kong is an integrated system comprising the Hong Kong laws and regulations, the engineering standards, technical guidelines and requirements of the Government departments, together with the corporate design and technical specifications developed by the MTR Corporation Limited, which include, but are not limited to:

1. Prevailing Hong Kong laws and regulations
   (1) Air Pollution Control Ordinance (Cap. 311)
   (2) Buildings Energy Efficiency Ordinance (Cap. 610)
   (3) Buildings Ordinance (Cap. 123)
   (4) Builders' Lifts and Tower Working Platforms (Safety) Ordinance (Cap. 470)
   (5) Construction Sites (Safety) Regulations (Cap. 59)
   (6) Dangerous Goods Ordinance (Cap. 295)
   (7) District Cooling Services Ordinance (Cap. 624)
   (8) Dumping at Sea Ordinance (Cap. 466)
   (9) Electricity Ordinance (Cap. 406)
   (10) Energy Efficiency (Labelling of Products) Ordinance (Cap. 598)
   (11) Environmental Impact Assessment Ordinance (Cap. 499)
   (12) Fire Services Ordinance (Cap. 95)
   (13) Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations (Cap. 59)
   (14) Lifts and Escalators Ordinance (Cap. 618)
   (15) Mass Transit Railway Ordinance (Cap. 556)
   (16) Noise Control Ordinance (Cap. 400)
   (17) Protection of Critical Infrastructures (Computer Systems) Ordinance (Cap. 653)
   (18) Public Health and Municipal Services (Cap. 132)
   (19) Road Traffic Ordinance (Cap. 374)

(20) Telecommunications Ordinance (Cap. 106)

(21) Waste Disposal Ordinance (Cap. 354)

(22) Water Pollution Control Ordinance (Cap. 358)

(23) Waterworks Ordinance (Cap. 102)

and their subsidiary regulations;

2. Engineering standards, technical guidelines and requirements of the Government departments

(1) Buildings Department – Code of Practice for Site Supervision 2009

(2) Buildings Department – Technical Memorandum for Supervision Plans 2009

(3) Buildings Department – Code of Practice for Building Works for Lifts and Escalators 2011

(4) Buildings Department – Code of Practice for Fire Safety in Buildings 2011

(5) Buildings Department – Code of Practice for the Structural Use of Steel 2011

(6) Buildings Department – Code of Practice for Structural Use of Concrete 2013

(7) Buildings Department – Code of Practice for Structural Use of Glass 2018

(8) Buildings Department – Code of Practice on Access for External Maintenance 2021

(9) Buildings Department – Code of Practice for Dead and Imposed Loads 2011

(10) Buildings Department – Code of Practice on Wind Effects in Hong Kong 2019

(11) Buildings Department – Code of Practice for Foundations 2017

(12) Buildings Department – Design Manual – Barrier Free Access 2008

(13) Buildings Department – Practice Notes for Registered Contractors

(14) Buildings Department – Code of Practice for Precast Concrete Construction 2016

(15) Buildings Department – Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers

(16) Buildings Department, Lands Department and Planning Department – Joint Practice Notes

(17) Civil Engineering and Development Department – Guide to Reinforced Fill Structure and Slope Design (Geoguide 6)

(18) Civil Engineering and Development Department – Guide to Soil Nail Design and Construction (Geoguide 7)

(19) Civil Engineering and Development Department – Model Specification for Prestressed Ground Anchors (Geospec 1)

(20) Civil Engineering and Development Department – Model Specification for Soil Testing (Geospec 3)

(21) Civil Engineering and Development Department – GEO Publication No. 1/2006

(22) Civil Engineering and Development Department – GEO Publication No. 1/2009

(23) Civil Engineering and Development Department – GEO Publication No. 1/2023

(24) Civil Engineering and Development Department – GEO Publication No. 2/90

(25) Civil Engineering and Development Department – GEO Technical Guidance Note No. 1

(26) Civil Engineering and Development Department – GEO Technical Guidance Note No. 12

(27) Civil Engineering and Development Department – GEO Technical Guidance Note No. 15

(28) Civil Engineering and Development Department – GEO Technical Guidance Note No. 25

(29) Civil Engineering and Development Department – GEO Technical Guidance Note No. 26

(30) Civil Engineering and Development Department – GEO Technical Guidance Note No. 50

(31) Civil Engineering and Development Department – GEO Technical Guidance Note No. 53

(32) Civil Engineering and Development Department – GEO Technical Guidance Note No. 54

(33) Civil Engineering and Development Department – GEO Report No. 29

(34) Civil Engineering and Development Department – GEO Report No. 138

(35) Civil Engineering and Development Department – GEO Report No. 249

(36) Civil Engineering and Development Department – GEO Report No. 298

(37) Civil Engineering and Development Department – General Specification for Civil Engineering Works

(38) Civil Engineering and Development Department – Guide to Rock and Soil Descriptions (Geoguide 3)

(39) Civil Engineering and Development Department – Guide to Cavern Engineering (Geoguide 4)

(40) Civil Engineering and Development Department – Port Works Design Manual: Part 4

(41) Civil Engineering and Development Department – Geotechnical Manual for Slopes

(42) Civil Engineering and Development Department – Guide to Slope Maintenance (Geoguide 5)

(43) Civil Engineering and Development Department – Guide to Site Investigation (Geoguide 2)

(44) Civil Engineering and Development Department – Guide to Retaining Wall Design (Geoguide 1 (1st Edition))

(45) Civil Engineering and Development Department – Guide to Retaining Wall Design (Geoguide 1 (2nd Edition))

(46) Civil Engineering and Development Department – Mines Division Guidance Note No. 10

(47) Civil Engineering and Development Department and Planning Department – Cavern Master Plan

(48) Drainage Services Department – Practice Note No. 2/2023 Guidelines on Flood Resilience

(49) Drainage Services Department – Sewerage Manual

(50) Drainage Services Department – Stormwater Drainage Manual

(51) Development Bureau – Risk Management for Public Works - Risk Management User Manual

(52) Development Bureau – Construction Site Safety Manual

(53) Electrical and Mechanical Services Department – Code of Practice for Lift and Escalator Works

(54) Electrical and Mechanical Services Department – Code of Practice on the Design and Construction of Lifts and Escalators

(55) Electrical and Mechanical Services Department – Technical Guidelines on Connection of Renewable Energy Power Generation System to Grid

(56) Electrical and Mechanical Services Department – Code of Practice for Energy Efficiency of Building Services Installation

(57) Electrical and Mechanical Services Department – Code of Practice on the Design and Construction of Builders' Lifts

(58) Electrical and Mechanical Services Department – Technical Guidelines on Code of Practice for Energy Efficiency of Building Services Installation

(59) Electrical and Mechanical Services Department – Code of Practice for Building Energy Audit

(60) Electrical and Mechanical Services Department – Technical Guidelines on Code of Practice Building Energy Audit

(61) Electrical and Mechanical Services Department – Technical Guidelines on Connection to District Cooling System

(62) Electrical and Mechanical Services Department – Code of Practice on the Design and Construction of Tower Working Platforms

(63) Electrical and Mechanical Services Department – Code of Practice for the

Electricity (Wiring) Regulations
(64) Electrical and Mechanical Services Department – Guidelines for the Electrical Products (Safety) Regulation
(65) Environmental Protection Department – Practice Note for Managing Air Quality in Air-conditioned Public Transport Facilities - Railways
(66) Environmental Protection Department – Guidelines on Design of Noise Barriers
(67) Environmental Protection Department – Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites
(68) Environmental Protection Department – Statutory Environmental Standards & Guidelines, Technical Memorandum
(69) Environment, Transport and Works Bureau – Technical Circular (Works) No. 4/2004
(70) Environment, Transport and Works Bureau – Technical Circular (Works) No. 15/2005
(71) Fire Services Department – Circular Letter 3/2025 - Fire Safety Requirements for Battery Rooms and Electrical Charging Facilities
(72) Fire Services Department – Codes of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment
(73) Fire Services Department – Guidelines on Formulation of Fire Safety Requirements for New Railway Infrastructures
(74) Fire Services Department – Circular Letters
(75) Highways Department – Guidance Notes on Design of Road Tunnel Structures and Tunnel Buildings to be Maintained by Highways Department
(76) Highways Department – Structures Design Manual for Highways and Railways (2013 Edition)
(77) Highways Department and Environmental Protection Department – Guidelines on Design of Noise Barriers

(78) Planning Department – Hong Kong Planning Standards and Guidelines

(79) Committee on Prevention of Legionnaires' Disease – Code of Practice for Prevention of Legionnaires' Disease

(80) Transport Department – Transport Planning and Design Manual

(81) Water Supplies Department – Technical Requirements for Plumbing Works in Buildings

3. Corporate design and technical specifications developed by the MTR Corporation Limited

(1) New Works Design Standards Manual

(2) Documents outlining service requirements and functional requirements for specific projects (e.g. Service Requirement Document)