

THE REPUBLIC OF THE UNION OF MYANMAR

MINISTRY OF CONSTRUCTION



MYANMAR

NATIONAL

BUILDING

CODE -

2020

PART 5 BUILDING SERVICES

PART 5A - LIGHTING

PART 5B - ELECTRICAL AND ALLIED INSTALLATIONS

PART 5C - INSTALLATION OF LIFTS AND ESCALATORS

PART 5E - HEATING, MECHANICAL VENTILATION AND

AIR-CONDITIONING SERVICES

PART 5F - FIRE PROTECTION SYSTEMS

MYANMAR NATIONAL BUILDING CODE – 2020

**PART 5E – HEATING, MECHANICAL VENTILATION AND
AIR-CONDITIONING SERVICES
(HVAC SERVICES)**

(SPEAKER)

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18th MARCH 2023

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5E.1 SCOPE

- 5E.1.1 This code of practice supplies general guidance in the design, installation, selection, requirements, energy saving, environmental control, testing & commissioning, servicing & maintenance and fire mode requirements.
- 5E.1.2 This code shall serve as a minimum requirement of Heating, Mechanical Ventilation and Air-Conditioning System of all buildings to enhance the aspect of Environmental, Occupational Health and Safety.

5E.1.3 However if deviation from the code is necessary for the particular nature of the buildings and functionality of business, relevant codes / guidelines / standards from (ANSI), (AHRI), (ASHRAE), (AREA), (ISO), (IEC), (NFPA), (UL), (WSC) shall be applied.

5E.2 DEFINITIONS

5E.3 RULES AND REGULATIONS TO COMPLY

The heating, mechanical ventilation and air-conditioning system shall be designed and carried out to comply the relevant acts, regulations, laws, codes and associated documents issued by the following authorities and organizations.

- A) Relevant Ministries
- B) Myanmar Engineering Council
- C) Federation of Myanmar Engineering Societies
- D) High-Rise and Public Building Projects Committee (HPBC)
- E) Myanmar Fire Services Department

5E.4 HEATING SYSTEM

5E.4.1 Space Heating System

5E.4.2 Air Heating Coils

5E.4.3 Electric Unit Heaters

5E.4.4 Fireplaces

5E.4.1 Space Heating System

5E.4.1.1 The space heating system should be provided for northern cities of Myanmar with low temperature condition. The interior spaces should be intended for human occupancy and maintain minimum indoor temperature of 20°C at a point 900 mm above floor on the design heating day.

5E.4.2 Air Heating Coils

- 5E.4.2.1. Electric Duct Heaters or Electric Heating Coils shall be installed in accordance with the manufacturer's installation instructions and MNBC Part 5B Electrical and Allied Installation.
- 5E.4.2.2 The coil assembly shall comply with UL 1996 or equivalent safety standards. The coils shall be made of corrosion resistant heating elements.

5E.4.3 Electric Unit Heaters

5E.4.3.1 Electric Unit Heaters shall be installed in accordance with the manufacturer's installation instructions. Unit heaters shall meet all requirements of UL listing standard 1025 and relevant standards.

5E.5 MECHANICAL VENTILATION SYSTEM

5E.5.1 Deliberations of Design

5E.5.2 Ventilation Rates

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5E.5.4 Kitchen

5E.5.5 Ventilation Duct System

5E.5.6 Equipment Selection

5E.5.1 Deliberations of Design

5E.5.1.1 General

- 5E.5.1.1.1 The purpose of the ventilation is to maintain the acceptable indoor air quality by changing the air in an enclosed space.
- The required amount of air in the space should be continuously withdrawn and replaced by the fresh air drawn from the external sources.

5E.5.1.2 Fire Damper Installation.

5E.5.1.2.1 Fire dampers shall not be fitted in the following Locations.

- Opening in the walls of a smoke extract shaft or return air shaft which also serves as smoke extract shaft.
- Openings in the walls of protected shaft where the openings have a kitchen exhaust duct passing through it.
- Anywhere in an air pressurizing system.
- Air outlet at exit staircases / internal exit passage way.

5E.5.1.2.2 Fire dampers shall be fitted in the following locations.

- Ventilation duct passing directly through a fire compartment wall or floor.
- Where the ventilation duct forms a protected shaft or is contained within a protecting structure, the duct shall be fitted with fire dampers at the inlets to the shaft and outlets from it.

5E.5.1.2.3 An inspection access door shall be provided for each fire damper installation either upstream or downstream as appropriate. The minimum dimension of the access door shall be 450mm (width) x 450mm (length). The dimension may be reduced for the smaller ducts according to width or depth of the duct.

5E.5.2 Ventilation Rates

5E.5.2.1 Outdoor Air Supply for Mechanical Ventilation

5E.5.2.1.1 The values given in Table 5E.5.2.1 is the minimum requirement of the air change per hour rate for non air-conditioning area. Designers shall make the judgment to further increase depending on the location of the building, the environmental condition, the outdoor air quality and the type of activities carried out in the building.

Table 5E.5.2.1

Outdoor Air Supply for Mechanical Ventilation in Non Air-conditioned Building or parts of Building with No Natural Ventilation

Building / Occupancy Category	Minimum Outdoor Air Supply air-change / hour (ACH)
Office	6
Workshop	6
Shopping Center	6
Market	6
Corridor	4
Lift Lobby	4
Restaurant & Canteen	10
General Store *	4
Electrical Rooms, Mechanical Rooms	6 or Room temperature not more than 5 Deg C from outdoor whichever is higher

Table 5E.5.2.1 (Continued)

Outdoor Air Supply for Mechanical Ventilation in Non Air-conditioned Building or parts of Building with No Natural Ventilation

Building / Occupancy Category	Minimum Outdoor Air Supply air-change / hour (ACH)
Private Toilet	10
Public Toilet	15
Smoke Stop Lobby (during normal operation)	4
Fire Fighting Lobby (during normal operation)	4
Internal Exit Stair Case (during normal operation)	4

- * Where hazardous gas/liquids are used or stored, Qualified Person's advice shall be sought on the ventilation rate and means of ventilation in the event of emergency situation and as advised by relevant authority.

5E.5.2.1.2 If the requirement is not provided in [Table 5E.5.2.1](#), the ventilation rate shall be further referred to the ASHRAE standard or it shall be determined by the Qualified Person (QP) subject to the approval of relevant authorities.

5E.5.3 Car Parks

5E.5.3.1 General Requirements.

5E.5.3.1.1 Mechanical Ventilation System shall be provided for the car parking areas in the building to remove carbon monoxide and other gases emitted from the combustion of materials from these areas.

- 5E.5.3.1.2 Minimum of six air-change per hour is required for the mechanical ventilation system (supply and exhaust) for car parking areas in the building if natural ventilation is not available.
- 5E.5.3.1.3 Carbon monoxide sensor / detector shall be installed at car parking areas including the driveway.

5E.5.3.1.4 If Carbon monoxide concentration level is below 25 ppm averaged over a one-hour duration, the mechanical ventilation system may be switched off (for residential building car parking areas) and may be operated at lower rate (for commercial building car parking areas).

5E.5.3.1.5 Minimum 50% of the exhaust air shall be extracted at low level (highest level is 650mm from finished floor level to top edge of the exhaust air grille).

5E.5.3.1.6 Exhaust air shall not be discharged to the face of any adjacent building and public walkways.

5E.5.3.1.7 Exhaust air discharge point shall not be less than five meters away from any fresh air intake points.

5E.5.3.1.8 Supply air shall be withdrawn directly from the outer surface of the building.

5E.5.3.2 Aboveground Car Park

5E.5.3.2.1 Mechanical ventilation system shall be provided as per

Table 5E.5.3.1

Table 5E.5.3.1

Mechanical Ventilation Requirements for Above ground Car Park

Natural Ventilation Opening *	Mode of Ventilation to be provided	Distance between natural ventilation opening and car parking areas
Not less than 15%	NV **	Within 12 m
Not less than 15%	Fume Extract (1.2 ACH)	Beyond 12 m
Not less than 2%	MV without supply	Within or beyond 12 m
Less than 2%	MV ***	Within or beyond 12 m

* % of the floor area served, ** Natural Ventilation, *** Mechanical Ventilation

5E.5.3.2.2 When a smoke purging system for the aboveground car park is required, it shall comply with the requirements of the Myanmar Fire Safety Code (MFSC).

5E.5.3.3 Basement Car Park

5E.5.3.3.1 It shall be maintained under negative pressure all the time to prevent the spread of poisonous gases into the adjacent areas.

5E.5.3.3.2 The quantity of replacement air shall not exceed that of exhaust air.

5E.5.3.3.3 The system shall be designed with minimum of two sections to comply the following requirements.

- a) In the event of a failure of another section, the other section shall continue to operate and should be able to provide half of the total required air quantity for the areas.
- b) In the failure of any section of the exhaust part, the relevant section of the supply part shall shut-down automatically and vice versa.
- c) Secondary source of electrical power supply shall be provided to the exhaust and the supply parts to continue the operation automatically in the event of a failure in principal source of electrical power supply.

5E.5.3.3.4 Independent mechanical ventilation system shall be provided for individual different level of the car park.

5E.5.3.3.5 Mechanical ventilation system shall be provided as per **Table**
5E.5.3.2

Table 5E.5.3.2
Mechanical Ventilation Requirements for Basement Car Park

Natural Ventilation Opening *	Mode of Ventilation to be provided	Distance between natural ventilation opening and car parking areas
Not less than 15%	Fume Extract (1.2 ACH)	Within 12 m
Not less than 15%	Fume Extract (1.2 ACH)	Beyond 12 m
Not less than 2%	MV without supply	Within or beyond 12 m
Less than 2%	MV **	Within or beyond 12 m

* % of the floor area served, ** Mechanical Ventilation.

5E.5.3.3.6 When a smoke purging system for the basement car park is required, it shall comply with the requirements of the Myanmar Fire Safety Code (MFSC).

5E.5.4 Kitchen

- 5E.5.4.1 Kitchen areas shall be mechanically ventilated. If the conditioned air supplied is required for the replacement of the kitchen exhaust, the energy saving requirement shall comply with the requirement stated in part of this code.
- 5E.5.4.2 Mechanical exhaust system for the kitchen shall be stand alone and independent. The system shall be designed, installed and operated in such a way that kitchen area shall always maintain in negative pressure.

5E.5.4.3 Grease filters shall be incorporated in kitchen hood wherever grease is present.

5E.5.4.4 The minimum ventilation rate required for the kitchen is 20 Air Change per Hour. However, it shall be higher than 20 Air Change per Hour depending on the type of hood, size of hood, type of appliances and usage of the kitchen.

5E.5.4.5 The ventilation rate may be reduced to 10 Air Change per hour when the kitchen hood is not in operation.

5E.5.4.10 Ducts for the kitchen exhaust system shall be made from the below materials:

- a) Mild steel of thickness not less than 1.2 mm ; (or)
- b) Stainless steel of thickness not less than 0.9 mm.

5E.5.6 Equipment Selection

5E.5.6.1 Mechanical Ventilation Fan

5E.5.6.2 Sound Control Devices

5E.5.6.3 Vibration Control Devices

5E.5.6.1 Mechanical Ventilation Fan

5E.5.6.1.1 The followings shall be considered as minimum requirement for the selection of the fans. The fans shall be entirely suitable to their particular application.

- Volume flow rate
- Developed pressure (friction loss due to the air movement through convey medium such as ducting, filters, intake, outlet, etc.)
- Efficiency for both motor and fan
- Noise level
- Type of application
- Special attention for kitchen exhaust, corrosive fume, abrasive particles in the air stream, flammability or other hazardous application.

5E.5.6.1.5 The full details but not limited to the followings shall be fitted with engraved identification. It shall be mechanically fixed where they can be easily seen and not prone to potential damage.

- Type
- Speed
- Power, Phase, Hz
- Pulley and Belt Size
- Type of grease required

5E.6 AIR-CONDITIONING SYSTEM

5E.6.1 Deliberations of Design

5E.6.2 Outdoor Air Requirement for Comfort Air-Conditioning

5E.6.3 Air Quality Control

5E.6.4 Equipment Selection

5E.6.1 Deliberations of Design

- 5E.6.1.2 The objective of air-conditioning system implementing in the building is to provide safe and comfort environment for the building occupants.
- 5E.6.1.5 The indoor design temperature for comfort air-conditioning should be 24±1 °C and relative humidity should not exceed of 65%.
- 5E.6.1.6 The air speed within the occupied space should be designed not to exceed 0.30 m/s measured at the occupants' level 1500mm from the floor.

5E.6.2 Outdoor Air Requirement for Comfort Air-Conditioning

5E.6.2.1 The values given in Table 5E.6.2 is the minimum requirement of the outdoor air supply for the comfort air-conditioning.

Designers shall make the judgment to further increase depending on the location of the building, the environmental condition, the outdoor air quality and the type of activities carried out in the building.

Table 5E.6.2 Minimum requirement of the outdoor air supply for the comfort air-conditioning

Building/Occupancy Category	Occupancy Load	Minimum Outdoor Air Supply base on People (l/s per person)	Minimum Outdoor Air Supply base on floor area (l/s per m ²)
Office	10 m ² /person	6	0.6
Conference/Seminar Room	2.5m ² /person	6	0.3
Hotel Guest Room	-	-	50 m ³ / hr per room
Workshop	10 m ² /person	3.5	-
Night Club	1.5m ² /person	10	7.0
Shopping Center	5 m ² /person	3.5	1.1
Market	5 m ² /person	3.5	1.1

Table 5E.6.2 (Continued)
**Minimum requirement of the outdoor air supply for
the comfort air-conditioning**

Building/Occupancy Category	Occupancy Load	Minimum Outdoor Air Supply base on People (l/s per person)	Minimum Outdoor Air Supply base on floor area (l/s per m²)
Lobbies and Corridor	-	-	0.3
Class rooms	2 m ² /person	3.8	0.6
Restaurant & Canteen	1.5m ² /person	6	3.4
Theatres, Auditorium and Cinemas	-	3 l/s per seat	2.0

5E.6.3 Air Quality Control

5E.6.3.1 Deliberation of Design

5E.6.3.1.4 Air Classifications.

- a) Class 1 – Air with low contaminant concentration, low sensory-irritation intensity and inoffensive smell.
- b) Class 2 – Air with moderate contaminant concentration, mild sensory-irritation intensity or mildly offensive smell.
- c) Class 3 – Air with significant contaminant concentration, significant sensory-irritation intensity or offensive smell.
- d) Class 4 – Air with highly objectionable fumes or gases or with potentially dangerous particles, biological aerosols, or gases, at concentration high enough to be considered dangerous.

5E.6.3.1.5 Limitation for Air Recirculation

- a) Class 1 air is allowed to recirculate or convey to any space.
- b) Class 2 air is allowed to recirculate within the space of origin.
It is allowed to convey to other class 2 or 3 spaces provided for the same usage and similar purpose with same pollutant sources. Class 2 air is not allowed to recirculate or convey to class 1 spaces.
- c) Class 3 air is allowed to recirculate within the space of origin.
Class 3 air is not allowed to recirculate or convey to any other space.
- d) Class 4 air is not allowed to recirculate within the space of origin and not allowed to convey to any other space.

5E.6.3.1.6 Air from toilets, bathrooms, kitchen, storage areas for flammable and toxic gases and where dust and smell likely to be presented shall not be recirculated.

5E.6.3.1.7 Filtration of particles shall be provided for outdoor air and recirculated indoor air before convey to the space.

5E.6.3.1.8 The double stage air filtration shall be provided for supply, re-circulated and mixed air.

a) Primary Air Filtration – 6 or better of Minimum Efficiency Reporting Value (MERV)

b) Secondary Air Filtration – 12 or better of Minimum Efficiency Reporting Value (MERV)

5E.6.3.1.9 For pre-cooled Air Handling Unit (PAHU), 9 of MERV air filtration shall be provided.

- 5E.6.3.1.10 Suitable air treatment should be considered when the outdoor air introduced into the building at Air-conditioning & Mechanical Ventilation design. Minimum Efficiency Reporting Value (MERV) of 6 or better rated air filters should be provided to clean the outdoor air before introduction into the indoor environment.
- 5E.6.3.1.11 The number of people at occupancy space should be considered when designing the outdoor air requirement for Air-conditioning & Mechanical Ventilation system.
- 5E.6.3.1.12 Differential pressure sensor could be installed in the ACMV system to monitor the condition of air filters and to accurately determine when the filters should be replaced.

- 5E.6.3.1.13 Smoking areas should be separated from non-smoking areas and smoking areas should be at negative pressure with respect to any adjacent non-smoking areas.
- 5E.6.3.1.14 Recirculation or transferring of air from smoking areas to non-smoking areas is strictly prohibited.
- 5E.6.3.1.15 Exhaust ducts that convey potentially harmful contaminants shall be negatively pressurized relative to spaces through which they pass, so that exhaust air cannot leak into occupied spaces; supply, return or outdoor air ducts or plenums.

5E.6.3.1.16 Outdoor air intake for ventilation system shall be complied with the [Table 5E.6.3.1](#)

Table 5E.6.3.1 – Air Intake Minimum Separation Distance

Descriptions	Minimum Distance (meter)
Class 2 air exhaust / relief outlet	3
Class 3 air exhaust / relief outlet	5
Class 4 air exhaust / relief outlet	10
Cooling Tower Intake or basin	5
Cooling Tower exhaust	7.5
Driveway, street, or parking place	1.5
Garbage storage / pick up area, dumpsters	5
Thoroughfare with high traffic volume	7.5

Table 5E.6.3.1 (Continued)
Air Intake Minimum Separation Distance

Descriptions	Minimum Distance (meter)
Plumbing vents terminating less than 1 m above the level of the outdoor intake	3
Plumbing vents terminating at least 1 m above the level of the outdoor intake	1
Vents, chimneys and flues from combustion appliances and equipment	5
Truck loading area or dock, bus parking / idling area	7.5

5E.6.4 Equipment Selection

5E.6.4.1 Chiller

5E.6.4.2 Cooling Tower

5E.6.4.3 Water Pump

5E.6.4.4 Air Handling Unit (AHU, Chilled Water Type)

5E.6.4.5 Fan Coil Unit (FCU, Chilled Water Type)

5E.6.4.6 Water Treatment System

5E.6.4.7 Chilled Water Expansion Tank

5E.6.4.8 Air Cooled Split Air-conditioning Unit

5E.6.4.1 Chiller

5E.6.4.1.1 General

- a) The chiller shall be single piece factory-assembled equipment. Each chiller shall consist of compressor, motor, evaporator, condenser, lubrication system, initial oil and refrigerant operating charges, user friendly microprocessor control system with LCD display panel, unit mounted starter and a fully modulated capacity control from 20% to 100%.

5E.6.4.1.1 General (Continued)

- b) The refrigerant shall be non-CFC type and acceptance to HCFC and HFC only. The refrigerant chosen shall not impose any potential health or safety hazard to the occupants in the building. OSHA non-hazardous refrigerant is acceptable.
- c) Chiller shall bear firmly attached metal plates which state name of manufacturer, chiller unit model number, compressor type and the refrigerant used.

5E.7 DUCT WORKS

5E.7.1 Deliberations of Design

5E.7.2 Selection of Materials

5E.7.3 Installation and Construction

5E.7.4 Testing of Duct Leakage

5E.7.1 Deliberations of Design

5E.7.1.2 Selection of materials, fabrication of the ducts and optimum in ducts air velocities, etc. shall be taken into consideration when designing the duct work and air distribution system.

5E.7.2 Selection of Materials

- 5E.7.2.1 All metallic ducts shall be constructed as specified in the SMACNA HVAC Duct Construction Standards-Metal and Flexible.
- 5E.7.2.2 All air-conditioning or other ventilation ducts including framing thereof, shall be constructed of steel, aluminium, mineral wool batt or other approved material.

5E.7.3 Installation and Construction

- 5E.7.3.10 Minimum sheet thickness for duct construction shall comply with SMACNA, HVAC Duct Construction Standards – Metal & Flexible.
- 5E.7.3.11 The requirement of the duct reinforcement and spacing shall follow in accordance with SMACNA duct construction schedule.
- 5E.7.3.12 Hangers and brackets for supporting ducts shall be of galvanized iron or metal and shall be strongly supported to the ducts.

5E.8 PIPE WORKS

5E.8.1 Deliberations of Design

5E.8.2 Deliberations of Installation

5E.8.3 Deliberations of Thermal Insulation

5E.8.4 Refrigerant Pipe Work

5E.8.1 Deliberations of Design

5E.8.1.1 The following parameters should take into consideration for designing and planning for piping system.

- Flow rate
- Materials used
- Pressure Drop caused by fluid friction (pipes, fittings, valves and accessories)
- Velocity
- Location (Above ground / underground)
- Noise Transmission
- Vibration

5E.8.1.1 (Continued)

- Corrosion
- Leaking
- Water Hammer
- Water Turbulence
- Expansion and Contraction of Fluid
- Air Lock
- Servicing & Maintenance
- Other required parameters relating to piping system

5E.9 ELECTRICAL AND CONTROL WORKS

5E.9.1 Electrical Works

5E.9.2 Control Works

5E.9.1 Electrical Works

All electrical works for this section shall comply with the following guides.

- Building Electrical Wiring Installation
- Guidelines for Electrical Works
- Myanmar National Building Code, Part 5B, Building Services, Electrical and Allied Installations

5E.9.1.1 Deliberations of Design

The following conditions should be taken into consideration for designing and planning for electrical system.

- Fans at Air Handling System should shut down in the event of fire for safety reason.
- Fire mode requirements mentioned at Section 5E.13 of this code.
- Fire mode requirements mentioned at Myanmar Fire Safety Code (MFSC).

5E.9.1.2 Secondary source of Power Supply

5E.9.1.2.1 Secondary source of power supply should be provided for equipment those are required to serve mechanical ventilation system during the fire mode to the following:

- Basement Carparks
- Exit Staircases Pressurization
- Exit Passageways
- Fire Fighting Lobbies
- Smoke Stop Lobbies
- Carpark Smoke Purging System
- Engineered Smoke Extraction System
- Flammable Liquid / Gas Storage Rooms
- Sprinkler Pump Room
- Emergency Generator Room
- Fire Command Center

5E.9.1.2.2 The electrical circuit cables for such equipment shall be fire resistant cables or protected along their entire length with fire rated enclosure.

5E.9.1.3 Essential Fans Remote Control Panel

- 5E.9.1.3.1 Essential fans remote control panel should supply and install at the fire command center.
- 5E.9.1.3.2 It should be installed at the guard house in the absence of fire command center in the building.

5E.9.1.3.3 Essential fans remote control panel should include start-stop control and indication light of operation for the following mechanical ventilation system.

- Basement Carparks
- Carpark Smoke Purging System
- Exit Staircases Pressurization
- Fire Fighting Lobbies
- Smoke Stop Lobbies

5E.9.2 Control Works

5E.9.2.1 Deliberations of Design

5E.9.2.2 Requirements for the System

5E.9.2.1 Deliberations of Design

- a) Each equipment or system shall operate with control system.
The control system shall be designed to have energy efficient operation while maintaining the desired indoor conditions.
- b) Areas with different cooling requirements served by single air-conditioning system shall be divided into sufficient number of zones.
- c) Every air handling system and zone shall have at least one thermostat with suitable operating range to regulate or control the space temperature.
- d) The system shall be able to shut off or partially restrict the cooling provided to each zone by accessible manual or automatic devices.

5E.10 ENERGY SAVING AND ENVIRONMENTAL CONTROL

5E.10.1 Energy Saving

5E.10.2 Environmental Control

5E.10.3 Noise and Vibration Control

5E.10.1 Energy Saving

This section specifies energy related requirements. It shall be applicable to all buildings with floor area greater than 3000m² and aggregate air-conditioned area greater than 1500m².

5E.10.1.8 Energy Efficient Air-conditioned Equipment

Energy efficient air-conditioned equipment shall design to reduce energy consumption. Water Cooled Chiller Plant, Air Cooled Chiller Plant and Unitary Air-conditioners efficiency shall meet the minimum requirements prescribed in **Table 5E.5.10.1.3a and 5E.10.1.3b.**

Table 5E.10.1.3a Water Cooled Chiller Plant

Prerequisite	Peak Building Cooling Load	
	≥ 500 RT	< 500 RT
Minimum Design System Efficiency for Central Chilled Water Plant	0.7 kW/RT	0.8 kW/RT

Table 5E.10.1.3b Air Cooled Chiller Plant and Unitary Air-conditioners

Prerequisite	Peak Building Cooling Load	
	≥ 500 RT	< 500 RT
Minimum Design System Efficiency for Central Chilled Water Plant	0.9 kW/RT	1.0 kW/RT

5E.10.2 Environmental Control

Air-conditioning systems are one of the most energy intensive components of the base building. The energy efficient air-conditioned equipment with the least environmental impact possible should be selected.

5E.10.2.1 Refrigerant

All air-conditioning system in the buildings should use refrigerants with a low potential for causing ozone depletion and climate change. Zero use of chlorofluorocarbon (CFC)-based refrigerant in new base building heating, ventilation, air-conditioning and refrigeration systems. [Table 5E.10.2.1](#) below shows the ozone depletion and global warming potentials of refrigerants.

Table 5E.10.2.1 Ozone Depletion and Global Warming Potentials of Refrigerants (100 Years Values)

Chlorofluorocarbons	ODP	GWP	Common Building Applications
CFC-11	1.0	4,680	Centrifugal chillers
CFC-12	1.0	10,720	Refrigerators, chillers
CFC-114	0.94	9,800	Centrifugal chillers
CFC-500	0.605	7,900	Centrifugal chillers, humidifiers
CFC-502	0.221	4,600	Low-temperature refrigeration
Hydrochlorofluorocarbons			
HCFC-22	0.04	1,780	Air-conditioning, chillers
HCFC-123	0.02	76	CFC-11 replacement
Hydrofluorocarbons			
HFC-23	~ 0	12,240	Ultra-low-temperature refrigeration
HFC-134a	~ 0	1,320	CFC-12 or HCFC-22 replacement
HFC-245fa	~ 0	1,020	Insulation agent, centrifugal chillers
HFC-404A	~ 0	3,900	Low-temperature refrigeration
HFC-407C	~ 0	1,700	HCFC-22 replacement
HFC-410A	~ 0	1,890	Air conditioning
HFC-507A	~ 0	3,900	Low-temperature refrigeration
Natural Refrigerants			
Carbon dioxide (CO ₂)	0	1.0	
Ammonia (NH ₃)	0	0	
Propane	0	3	

5E.11 TESTING AND COMMISSIONING

5E.11.1 Objectives

5E.11.2 Pre Testing and Commissioning

5E.11.3 Testing and Commissioning

5E.11.4 Post Testing and Commissioning

5E.11.1 Objectives

Upon completion of system and equipment installation, testing and commissioning shall be carried out to ensure equipment is performed according to the design intent. Testing and commissioning shall be carried out by competent person who has knowledge in design, installation and testing and commissioning. The factory trained personnel should be engaged as necessary.

5E.11.2 Pre Testing and Commissioning

Pre commissioning procedure shall be carried out in accordance to OEM (Original Equipment Manufacturer) recommendation. Proper procedure, method statement, check list, flow chart and coordination with various trades should be established to ensure smooth and safe commissioning.

5E.11.3 Testing and Commissioning

- a) Prior to actual commissioning, the competent person shall establish operational risk assessment to prevent incidents and accidents during commissioning. The operational risk assessment shall be jointly reviewed and endorsed by OSHE (Occupational, Safety, Health and Environment) officer and the Mechanical & Electrical project manager.

Actual onsite installation such as equipment location, electrical and control panel location, duct/pipe layout shall be checked and verified against as built drawing prior to the commissioning.

5E.11.3 Testing and Commissioning (Continued)

- b) The Calibrated instruments shall be used to measure temperatures, pressures, rotational speeds, electrical characteristics, velocities, and air and water quantities for an evaluation of equipment and system performance.
- c) The final setting of balancing devices such as dampers and valves, adjusting fan speeds and pump impeller sizes, in addition to automatic control devices such as thermostats and pressure controllers shall be carried out to achieve maximum specified system performance and efficiency during normal operation.

5E.11.3 Testing and Commissioning (Continued)

- d) The balancing of fluid flows (air or water) through the use of acceptable procedures should be carried out to achieve the desired or specified airflow or water flow.
- e) The Testing and commissioning methods established by following organization are recommended:
 - 1) ASHRAE guide line 1.1
 - 2) NEBB (National Environmental Balancing Bureau)

5E.11.4 Post Testing and Commissioning

- a) The Testing and commissioning records shall be compiled in Operation and Maintenance Manual and handed over to facility (maintenance) team deployed by the owner / client.
- b) The training to the facility team shall be conducted to ensure personnel maintaining the system and equipment have adequate knowledge on the real time operation and to deal with system trouble shooting.
- c) Daily monitoring of equipment operating data and periodic review of equipment performance shall be done to ensure system and equipment are operating within acceptable control range.

5E.11.4 Post Testing and Commissioning(Continued)

- d) The contact of supplier and vendor, as-built drawing, operation and maintenance manual shall be readily available at facility department.
- e) The emergency response plan shall be established to take immediate action in the event of emergency whether equipment break down or human incidents.

5E.12 SERVICING AND MAINTENANCE

5E.12.1 General Requirements

5E.12.2 Maintenance Frequencies

5E.12.3 Maintenance Check Lists

5E.12.1 General Requirements

- 5E.12.1.1 In order to maintain efficient operation, energy saving and useful life of equipment, genuine and well ordered servicing and maintenance shall carry out for equipment and associated system.
- 5E.12.1.2 Well-trained maintenance staffs shall carry out for servicing and maintenance for equipment and system.

5E.12.1 General Requirements(Continued)

- 5E.12.1.3 All the necessary documents such as as-built drawings, operation & maintenance manuals, manufacturers' instruction, catalogues, single line and control circuit diagrams of electrical and control system shall be recorded and maintained systematically for future references for servicing and maintenance.
- 5E.12.1.4 All records and reports of faults, breakdown, repairs, trouble shooting, overhaul etc., shall maintain for future references.

5E.12.2 Maintenance Frequencies

5E.12.2.1 The following equipment shall be maintained monthly.

- Chillers
- Cooling Towers
- Pumps
- Air Handling Units
- Fan Coil Units
- Condensing & Indoor Unit (DX System)
- Water Treatment System
- Auto Tube Cleaning System

5E.12.2 Maintenance Frequencies(Continued)

5E.12.2.2 The following equipment shall be maintained quarterly.

- Mechanical Ventilation System Fans
- Local Control Panels for Equipment
- DDC Panels (For ACMV System)
- MIMIC Panels (For ACMV System)

5E.12.2 Maintenance Frequencies(Continued)

5E.12.2.3 The following equipment shall be maintained yearly.

- Motor Control Centre (MCC)
- Overhauling of Pumps if necessary
- Overhauling of Air Handling Units
- Overhauling of Condensing Units (DX System)
- Overhauling of Fan Coil Unit if necessary
- Chilled Water Expansion Tank if necessary
- Cooling Tower Make-up Water Tank if necessary

5E.13 FIRE MODE REQUIREMENTS

5E.13.1 Requirements for Mechanical Ventilation System

5E.13.2 Requirements for Air-Conditioning System

5E.13.1 Requirements for Mechanical Ventilation System

5E.13.1.1 Exit Staircase and Internal Exit Passage Way

5E.13.1.2 Pressurization in Internal Corridors in Hotel

5E.13.1.3 Smoke Stop Lobby and Fire-Fighting Lobby

5E.13.1.4 Pressurization System for Exit Staircase

5E.13.1.5 Fire Command Centre

5E.13.1.6 Fire Pump Room

5E.13.1 (Continued)

5E.13.1.7 Emergency Power Generator Room

5E.13.1.8 Kitchen

5E.13.1.9 Room Contains Flammable/Gas Substances

5E.13.1.10 Room Stores Flammable Liquids

5E.13.1.11 Basement Car Parks

5E.13.1.12 Basement Occupancies Other Than Carparks

5E.13.1.13 Engineered Smoke Control System

5E.13.1.14 Design and operation of pressurization systems for exit facilities shall comply with the requirements of Myanmar Fire Safety Code (MFSC).

5E.13.2 Requirements for Air-Conditioning System

Smoke detectors shall automatically stop their respective AHU on detecting the presence of smoke in the return air stream.

Smoke detectors listed for use in air distribution system shall be located at prior to return system of air handling unit meeting one of the following conditions:

- a) AHU serving more than one storey or fire compartment
- b) AHU flowrate of greater than 15,000 cmh
- c) Any AHU as may be required by the authority.

Probe type or spot detector are suitable for AHU with high air flowrate.

5E.14 MISCELLANEOUS

5E.14.1 References

5E.14.2 Symbols

5E.14.3 Color Codes for Services

5E.14.4 Appendixes

5E.14.1 References

The following documents are referred for the application of this code.

1. ANSI / ASHRAE Standard 62.1 Ventilation for Acceptable Indoor Air Quality.
2. ANSI / ASHRAE Standard 90.1 Energy Standard for Buildings Except Low Rise Residential.
3. SS 530 : 2006 Code of Practice for energy efficiency standard for building services and equipment, Singapore.

5E.14.1 References (Continued)

4. SS 532 : 2007 Code of practice for the storage of flammable liquids, Singapore.
5. SS 553 : 2016 Code of Practice for Air-conditioning and Mechanical Ventilation in Buildings, Singapore
6. SS 554 : 2016 Code of Practice for Indoor Air quality for air-conditioned building, Singapore
7. Fire Code 2013, Singapore Civil Defense Force
8. BCA Green Mark, Building & Construction Authority, Singapore
9. LEED Guidelines, U.S.A

THANK YOU
FOR YOUR ATTENTION