REPUBLIC OF THE UNION OF MYANMAR

COMMITTEE FOR QUALITY CONTROL OF HIGH-RISE BUILDING CONSTRUCTION PROJECTS

GUIDELINES FOR HIGHRISE BUILDING CONSTRUCTION PROJECTS (MECHANICAL VENTILATION)

February , 2017

Contents

Clauses		Page
1.	Basic Concepts	1
2.	Design Considerations	1
3.	Car Parks Ventilation	2
4.	Kitchen Exhaust Systems	5
5.	Bathrooms, Toilets and Locker Rooms	7
6.	Exit Staircase, Internal exit passage way, Smoke-stop and fire fighting lobbies	8
7.	Outdoor Air Intake	9
8.	Duct Work Design / Fabrication and Installation	9

1. Basic Concepts

1.1 Ventilation is the intentional introduction of air from the outside into a building. It can be classified into Natural Ventilation and Mechanical Ventilation.

1.2 Ventilation Air is used to provide acceptable Indoor Air Quality (IAQ).

2. Design Considerations

2.1 The air from the occupied space should be continuously withdrawn and replaced by Outside Air.

2.2 "Environmental Tobacco Smoke (ETS) free" areas within the Building are to be isolated from ETS areas.

2.3 Smoking is not allowed in Mechanically Ventilated spaces, except in ETS areas.

2.4 Outdoor Air Supply rates to Normal Buildings by Mechanical Ventilation in non-air-conditioned buildings or parts of buildings without natural ventilation are shown in Table 1.

2.5 For Special buildings or rooms, which are not specified in Table 1, the ventilation rate shall be determined by a qualified professional.

2.6 A minimum ventilation rate of 2.5 Litres/sec/sqm shall be applied for Refrigeration Machinery room areas under normal conditions. (SS553,13.3.3)

Table 1 – Outdoor air supply for mechanical ventilation in non-air-conditioned buildings or parts of buildings without natural ventilation

Type of building/ Occupancy	Minimum outdoor air supply air-change/hr
Offices	6
Restaurants, canteens	10
Shops	6
Workshops, factories	6
Classrooms	8
Car parks(Normal mode)[(i)]	6
Toilets, bathrooms (private)	10
Public Toilets (NEA /SG, 2.6-a)	15
Lobbies, concourse, corridors, staircases and exits[(ii)]	4
Kitchens (commercial, institutional and industrial)	20[(iii)]

NOTES:

(i) Where the ceiling height exceeds 2.5 m, the air change rate will be calculated based on a 2.5m ceiling height.

(ii) Lobbies up to an area of 10 m^2 are exempted from being mechanically ventilated.

(iii) Air supply may be reduced to 10 air-change/hr when a kitchen hood exhaust system is not in operation.

3. Car Parks Ventilation

3.1 Basic concepts

3.1.1 The mechanical ventilation system in commercial car parks may be operated at a lower rate at times when CO concentration is maintained below 25ppm averaged over an hour period.

3.1.2 The mechanical ventilation system in residential car parks may be switched off if the CO concentration is below 25ppm averaged over an hour period.

3.1.3 At least 50% of the exhaust air shall be extracted at a low level not exceeding 650mm above the finished floor, as measured from the top of the grille to the finished floor for the exhaust part of the Mechanical Ventilation System.

3.1.4 The supply air shall be drawn directly from the external surroundings and its intake shall not be less than 5m from any exhaust discharge openings. Grilles for the supply air shall be uniformly distributed over the car park area.

3.1.5 Exhaust discharge shall not face in the direction of any adjacent residential building and shall not directly or indirectly discharge to the street at ground level.

3.2 Above Ground Level Car Park

3.2.1 No mechanical ventilation is required for the Car Park where opening natural ventilation area is more than or equal to 15% of the floor area. The naturally ventilated part of the car park shall be within 12m from the ventilation opening.

3.2.2 Natural ventilation must be ensured and at least two opposite walls must be provided with permanent openings that cannot be closed or blocked.

3.2.3 Smoke Purging Systems can be installed where required.

3.2.4 For Car Parks without cross ventilation, where additional natural ventilation openings of not less than 15% of the floor areas beyond 12m of the opening is provided, a reduced mechanical ventilation system in the form of fume extraction may be provided to these areas as follows:

(a) The extraction system shall be able to provide 1.2AC/hr.

(b) The supply part may be omitted.

(c) All extract grilles shall be located at a low level not exceeding 650mm above the finished floor, as measured from the top of the grille to the finished floor.

3.2.5 Where natural ventilation openings equivalent to not less than 2% of the mechanically ventilated area is provided; the supply part may be omitted.

3.2.6 In a large car park, a combination of natural and mechanical ventilation may be provided as illustrated in the following table:

Table 2-Mode of ventilation for aboveground car park

Size of ventilation opening (% of floor area)	Mode of ventilation to be provided (Natural 'NV', Mechanical 'MV', or fume extract)	
	Zone 'A'	Zone 'B'
15% of A + 15% of B	NV	Fume extract
15% of A + 2% of B	NV	MV without supply
15% of A	NV	MV
2% of A + 2% of B	MV without supply	MV without supply
2% of A	MV without supply	MV

Zone 'A' refers to part of car park within 12 m of natural ventilation opening
Zone 'B' refers to part of car park beyond 12 m of natural ventilation opening

3.3 Basement Level Car Park

3.3.1 The mechanical ventilation system shall be designed in such a way that the quantity of supply air shall not exceed that of the exhaust air.

3.3.2 All mechanical ventilation systems shall not be operated with only a single section (supply or exhaust sections).

3.3.4 In the event of breakdown, the capacity of each section in operation should remain more than or equal to half the total required air for the storey.

3.3.5 All mechanical ventilation system sections may operate through a common duct.

3.3.6 The exhaust and supply parts fans of each section shall be electrically interlocked such that failure of any section of the exhaust part shall automatically shut-down the corresponding section of the supply part.

3.3.7 The exhaust and supply parts fans shall be provided with a secondary power supply such that they can continue to run automatically in the event of a failure of normal electrical supply.

3.3.8 For the first basement level;

(a) Where the natural ventilation opening provided is not less than 15% of the car park area served, a reduced mechanical ventilation system in the form of fume extractions described in Above Ground Level Car Park may be provided.

(b) Where natural ventilation opening equivalent to not less than 2% of the mechanically ventilated area is provided the supply part may be omitted.

3.3.9 In a large basement car park, a combination of different modes of mechanical ventilation may be provided as shown in Table 3:

Table 3-Mode of ventilation for basement car park

Size of ventilation opening (% of floor area)	Mode of ventilation to be provided (Mechanical 'MV' or fume extract)	
	Zone 'A'	Zone 'B'
15% of A + 15% of B	Fume extract	Fume extract
15% of A + 2% of B	Fume extract	MV without supply
15% of A	Fume extract	MV
2% of A + 2% of B	MV without supply	MV without supply
2% of A	MV without supply	MV

Zone 'A' refers to part of car park within 12 m of natural ventilation opening
Zone 'B' refers to part of car park beyond 12 m of natural ventilation opening

3.4 Smoke Purging System

3.4.1 For Car parking areas in basements with total floor area exceeding 1900 m^2, a smoke purging system which is independent of any systems serving other parts of the building shall be provided to give a purging rate not less than 9AC/hr.

3.4.2 Supply shall be drawn directly from the external surroundings and its intake shall not be less than 5m from any exhaust discharge openings.

3.4.3 The smoke purging system shall be activated automatically by the building fire alarm system.

3.4.4 Exhaust fans shall be rated at a minimum of 250° C.

3.4.5 No fire damper shall be fitted in either supply or exhaust duct in both mechanical ventilation systems and smoke purging systems.

3.5 Ductless Jet Fan Systems

3.5.1 The basement car park shall be divided into smoke control zones with each zone space not more than 2000m^2.

3.5.2 Each smoke control zone shall have its own fresh air supply fans , exhaust air fans and jets fans.

3.5.3 The exhaust fan system in each zone should be designed to run in at least two parts, such that the total exhaust capacity does not fall below 50% in the event of failure of any one part.

3.5.4 The smoke discharge points should be located such that the smoke extracted from the smoke exhaust fans does not affect any occupied area or means of escape at the level where smoke is discharged.

3.5.5 The supply fans, smoke exhaust fans, jet fans, duct works and wiring shall be capable of operating effectively at 250º C for 2 hours.

3.5.6 The car park shall be provided with at least 12 air-change per hour during fire conditions.

3.5.7 The exhaust fans, supply fans and jet fans shall be provided with a secondary power supply such that they can continue to run automatically in the event of power failure.

3.5.8 The jet fans shall be distributed at a spacing of two-thirds of the tested effective range of the particular jet fan. The tested effective range of the jet fan shall be taken at a distance of up to 0.2 m/s of the air-velocity distribution profile.

3.5.9 The minimum headroom for the installation of the jet fans system is 3m.

4. Kitchen Exhaust Systems

4.1 Basic Concepts

4.1.1 Mechanically ventilated kitchens shall be designed for a ventilation rate of not less than 20AC/hr. When kitchen hoods are in operation, the exhaust air through the hoods can be considered as contributing to the exhaust ventilation requirement.

4.1.2 Whether or not the kitchen hood is in operation, the kitchen area ventilation shall be provided in accordance with Table-1.

4.1.3 Kitchen exhaust discharge shall not impinge on obstacles such as parapets, overhangs, and any other equipment or higher parts of building.

4.1.4 Kitchen Area mechanical exhaust systems shall be independent of any systems serving other parts of the building.

4.1.5 Kitchen Areas shall maintain negative pressure whether the kitchen hood is in operation or not.

4.1.6 Appliances of heating capacity more than 8kw shall be installed with kitchen-exhaust hoods above the appliances. Grease filters shall be used where necessary.

4.1.7 The exhaust flow rate Q (m^3/s) for kitchen exhaust hood shall not be less than that given in the following equation;

$$Q = 1.4V \times 2(L+W)H \times F$$

V =Velocity not less than 0.3 m/s for commercial kitchen
L =Length of cooking surface; m
W =Width of cooking surface; m
H = Distant of Hood to emitting surface; m
F = 1.0 (heavy duty), 0.7 (light duty)

4.2 Design Considerations

4.2.1 Exhaust Air from kitchen areas and hoods shall be discharged directly outside of the building without any obstacles in front of the air outlet.

4.2.2 Industrial or commercial kitchen exhaust ducts shall be designated as separate systems.

4.2.3 Exhaust air discharge outlets shall not be less than 5m from any air intake openings.

4.2.4 Kitchen Exhaust Air discharge shall not face in the direction of any adjacent buildings and shall not discharge directly or indirectly to the street at ground level.

4.2.5 Kitchen Exhaust ducts shall be enclosed in a structure where the exhaust duct runs outside the kitchen area.

4.2.6 Fire dampers shall not be fitted in kitchen exhaust ducts.

4.3 Exhaust Duct Structure

4.3.1 Kitchen Exhaust ducts shall be sized and installed for the flow rate of air necessary to remove the effluent.

4.3.2 Exhaust duct systems for kitchen areas shall be fabricated and installed from
(a) Mild steel or Galvanized steel of at least 1.5mm thickness.
(b) Stainless steel of at least 0.9mm thickness.
(c) Other approved materials.

4.3.3 For cleaning of all the duct work, access doors or large openings shall be provided at suitable intervals. A drain shall be provided at the lowest point of each run of ducting.

4.4 Exhaust Hoods

4.4.1 Kitchen exhaust hoods shall be manufactured from mild steel, galvanized steel, stainless steel or aluminum.

4.4.2 Washable grease filters shall be fitted in the hood in positions enabling convenient removal, replacement and installed so as to prevent no leakage of air around the filters.

4.4.3 All internal hood surfaces shall be vertical or sloped at an angle not greater than 40˚ from vertical. The face of filters shall be vertical or sloped at an angle not greater than 30˚ from vertical.

4.4.4 Gutters shall be located at the lower edge of filters. Internal gutters not greater than 50mm or less than 35mm wide and not less than 10mm deep shall be located around the lower edge of hoods. Plugged drain holes shall be provided at intervals not greater than 6m along the gutter.

4.4.5 The lower edges of canopy type exhaust hoods shall not be higher than 1.2m above the cooking surface not lower than 2m above floor level and extend not less than 150mm outside the plane perimeter of the appliance over which the hood is installed.

5. Bathrooms, Toilets and Locker Rooms

5.1 Bathrooms, toilets, locker rooms or similar rooms shall be mechanically ventilated when natural ventilation is not provided.

5.2 Supply air shall be supplied through a ventilation duct directly from outdoors, air- conditioned rooms or from natural ventilated rooms through louvers in the doors or under cutting the doors or by other openings.

5.3 The exhaust system shall discharge directly to the outdoors.

5.4 The quantity of the makeup air shall not exceed the exhaust air.

6. Exit Staircase, Internal exit passage way, Smoke-stop and firefighting lobbies

6.1 Exit Staircases, Internal exit passageways, Smoke stop lobbies, and Firefighting lobbies shall be provided with Mechanical Ventilation at a rate of 4AC/hr at normal supply mode.

6.1.1 Staircase Mechanical Ventilation fans for normal supply mode shall be separately installed from Pressurization Fans.

6.1.2 Smoke-stop and fire fighting lobbies shall supply outside air at not less than 10 AC/hr at fire mode.

6.2 All internal exit staircases without natural ventilation in any building of which the height exceeds 24 m shall be pressurized to comply with the following requirements:

6.2.1 **The** pressure difference between the pressurized exit staircase and occupied areas shall be maintained at not less than 50 Pa, when the pressurization system is in operation.

6.2.2 If a smoke-stop lobby is pressurized, the pressure at the smoke-stop lobby shall be lower than the staircase pressure.

6.2.3 The force required to open any door shall not exceed 110N.

6.2.4 The air velocity shall be not less than 1.0m/s averaged over the full area of each door opening when a combination of any two doors and the Main escape door are fully open.

6.2.5 The amount of supply air to the staircase and lobbies area shall be sufficient to make up for the loss through doors and other leakages.

6.2.6 Distribution of supply air to the pressurization area should ensure an even pressure in staircases.

6.2.7 Fresh air intake shall be drawn directly from the outside of the building not less than 5m from any exhaust discharge.

6.2.8 Pressurization systems shall be activated via fire **detection** alarm systems. Manual start-stop switches shall be installed at the fire command **center**.

6.2.9 Pressurization systems shall be connected to the emergency power supply.

6.2.10 To prevent the buildup of excessive pressures in staircase and **lobby areas** it is necessary to provide an over-pressure relief control system.

6.2.11 The installed over-pressure relief system shall be capable of ensuring that the pressurization level within the protected space (with all door closed) is maintained at or at above the design pressurization level but below the maximum pressure determined by the **door-opening** force requirement.

6.2.12 Variable **bypass** damper or variable pressurization fans controlled by differential pressure Sensors shall not be used unless the system can achieve over 90% of the new air supply requirement within 3 **seconds** of a door being opened or closed (pg39-BSEN)

6.2.13 Openings for Natural Ventilation for staircase and smoke-stop lobbies shall comply with the following requirements:

(a) The external staircase shall be provided with uninterrupted openings having minimum 50% of the staircase plan area (Louvre is not allowed)

(b) The smoke stop lobby shall be provided with **a minimum of** 15% of **the lobby area opening.**

7. Outdoor Air Intake

7.1.1 Air-Conditioning and all Mechanical Ventilation System outdoor air intakes shall be located at external walls or at roof level, arranged to get outside air free of contamination or odors.

7.1.2 Outdoor air intakes shall not be within 5m of exhaust discharge from any buildings, kitchen, toilets, car parks, cooling tower, laundries, rubbish dumps or plant rooms. The distance from a cooling tower is measured from the base of the cooling tower.

7.1.3 Outdoor air intake shall be covered with an insect screen and protected from rain entrainment and water droplets emitted by equipment such as cooling towers.

7.2 Screening shall be of corrosion resistant material not larger than a 10mm mesh.

7.3 The bottom of the outdoor Air Intake shall not be less than 2.1m from the floor level.

8. Duct Work Design/ Fabrication and Installation

8.1 Basic Concepts

8.1.1 This section covers design, fabrication and installation of relevant air duct systems including fittings and accessories for Ventilation or Air-Conditioning.

8.2 Design Consideration

8.2.1 In designing the duct work for an air distribution system, design consideration should be given to the air velocities in ducts, duct fabrication methods, and choice of ducting material.

8.2.2 A concealed space between the ceiling and floor above it, or a raised floor or a structural space of a building may be used as a plenum provided that the space is free of obstruction to permit free flow of air.

8.2.3 Air ducts shall be made airtight.

8.2.4 Residential kitchens and toilet exhaust ducts shall not be connected to any other exhaust duct systems except at the inlet of the exhaust fan. Devices shall be installed to prevent exhaust air circulation when the fan is not operating.

8.2.5 The location of the exhaust air discharge shall not be less than 2.1m above the external floor level.

8.2.6 Ducts shall be suitably protected where damage or rupture is a possibility.

8.2.7 Return Air Ducts shall be routed away from toilets, kitchens and places where odors are expected, which may re-circulate into the supply air stream.

8.3 Fabrication and Ducting Material

8.3.1 Supply and Return air duct inner surfaces should be smooth and resistant to abrasion to reduce dust accumulation.

8.3.2 Ceilings and side-walls should be properly plastered and painted where ceiling space is used as a return air plenum. Concrete duct shafts should be finished in a similar manner.

8.3.3 Ducts shall be fabricated from steel, galvanized steel, aluminum and other approved materials.

8.3.4 Ducts shall be suitably protected to prevent erosion of fibers or wool where exposed to the air stream in glass-fibrebatt or mineral wool ducts.

8.3.5 Duct supporting material shall be of metal and sturdily supported.

8.3.6 All ducting material such as duct covering, duct lining, and flexible connection should not be combustible.

8.3.7 Flexible duct connections at the extremities of duct work terminal units, extract units and grille shall not exceed 2 meters.

8.3.8 Flexible joints shall not exceed 250 mm in length.

8.3.9 All ducts shall be provided with access points or openings at suitable intervals and locations to enable cleaning of ducts.

8.3.10 Duct fabrication, construction and installation shall conform to the appropriate standards contained in ASHRAE Hand Book or SMACNA Manuals.

8.3.11 Duct work and plenums shall be sealed with sealants and tape. All sealants and tape shall be subject to the approval of the relevant authority.

8.3.12 Pressure-sensitive tape shall not be used as primary sealant in supply and return duct transverse joints, longitudinal seams and penetrations in duct walls.

Ref : -

1. BS EN 12101-6:2005
   Smoke and heat Control systems

2. SS 553/ 2009
   Code of Practice for Air-Conditioning and Mechanical Ventilation in Buildings.

3. SS 554/ 2009
   Code of Practice for Indoor Air Quality for Air-Conditioned Buildings.

4. ANSI/ ASHRAE Standard 62.1 – 2016
   Ventilation for Acceptable Indoor Air Quality.

5. Singapore Civil Defence Force / Mechanical Ventilation and Smoke control System

6. Code of Practice on Environmental Health / National Environment Agency (NEA) Singapore, November 2013

Shwe Yu Kyaw P.E 0236 (Electrical B.S) Member/CQHP	Dr. Mya Mya Khaing P.E 0178 (Mechanical B.S) Member/CQHP	Tin Oo P.E 0286 (Electrical B.S) Technical Consultative Group(ACMV)/CQHP