(ACMV) AIR-CONDITIONING, VENTILATION AND SMOKE CONTROL

ACMV AIR-CONDITIONING, VENTILATION AND SMOKE CONTROL		
N1	ANNEX ACMV_N1	Revisions_2021
Item	Provisions	Notes
1.0	**Scope and Purpose**	
1.1	This fire safety standard applies to natural and mechanical methods of smoke control where required by other fire safety standards of the Qatar Civil Defence Department. The purpose of this standard is to establish the minimum requirements in the design of smoke control system that are required to provide a tenable environment for escape, evacuation or relocation of occupants and compliment firefighting operations.	
2.0	**General Design Requirements**	
2.1	Buildings or structures or parts thereof that are required to have smoke control system shall be designed according to the latest edition of applicable NFPA codes/standard and this general fire safety requirements guidelines Annex ACMV_N1. The requirements of this guidelines annex shall be uphold in case of conflict with NFPA 92.	
3.0	**Applications**	
3.1	Smoke Control Systems are classified into two general categories as smoke containment and smoke management.	
3.1.1	Smoke Containment	
3.1.1.1	A smoke control method that employs mechanical equipment to produce pressure difference across smoke barriers.	
3.1.2	Smoke management	
3.1.2.1	A smoke control method that utilizes natural or mechanical systems to maintain a tenable environment in the means of egress from a large volume space or to control and reduce the migration of smoke between the fire area and communicating spaces.	
4.0	**Methods of Smoke Control**	

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4.1	Pressurization Method	
4.1.1	Controlling smoke by pressure differences across smoke barriers though the aid of mechanical means is one of the acceptable procedures in smoke control. This procedure does not require the maintenance of a tenable environment in the zone of fire origin. Design of pressurization system shall be in accordance with NFPA 92 and this standard.	
4.2	Airflow Method	
4.2.1	Engineering analysis which shall be performed to establish that usage of this procedure will not cause adverse effect to other portions of the smoke control system, further intensify the fire, disrupt flume dynamics and interfere with exiting. Design and application shall be in accordance with NFPA 92.	
4.3	Exhaust Method	
4.3.1	Smoke control systems employing the exhaust method shall be designed in accordance with NFPA 92 and this guideline/ standard. The minimum height to which the smoke layer interface shall be designed shall be 1.83 m (6 ft) above any walking surface that forms part of the required egress system within the smoke zone.	
4.4	Smoke Containment (Pressurization) Systems	
4.4.1	Zoned Smoke Control System	
4.4.1.1	The minimum pressure difference across a smoke barrier shall be 12.5 Pa (0.05 in.w.g.) in fully sprinklered building.	
4.4.1.2	In non-sprinklered and other than fully sprinklered buildings, the minimum pressure difference shall be equivalent to two times the calculated maximum pressure difference that can be produced by the fire.	
4.4.1.3	The maximum pressure difference across a smoke barrier shall be determined by required door opening forces which shall not exceed 110 N.	
4.4.1.4	Zoned smoke control may be through mechanical or natural means; e.g. pressurization of the non-fire zone/s, mechanical exhaust or venting of the fire or smoke zone.	
4.4.2	Smoke Zone Exhaust (Depressurization)	
4.4.2.1	Smoke zone exhaust shall discharge to outside of the building.	
4.4.2.2	Mechanical or natural ventilation may be used.	
4.4.3	Reserved.	
4.5	Smoke-proof Enclosure (Exit Staircases)	

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4.5.1	Mechanical Pressurization Alternative	
4.5.1.1	Pressurization system for the exit staircase shall be a system independent and dedicated to the staircase.	See requirements/ conditions where permitted to be in combined system.
4.5.1.2	Stairwell pressurization system shall be designed so that a minimum 12.5 Pa pressure difference between the stairwell and the occupant/accommodation area or smoke zone is maintained for buildings that are fully sprinklered.	Where the pressurized exit staircase is being approached via a pressurized smoke-stop/fire fighting lobby, the pressure of the staircase must be adjusted accordingly to ensure pressure in the staircase is higher than pressure in the lobby.
4.5.1.3	Stairwell pressurization system shall be designed so that a minimum 25 Pa pressure difference between the stairwell and the occupant/accommodation area or smoke zone is maintained for buildings that are non-sprinklered or other than fully sprinklered.	
4.5.1.4	Pressurization air supply shall account allowance for open doors. A minimum 1 m/s airflow velocity shall be maintained across opened doors with the pressure difference across the other closed doors and the smoke zone not be lower than 12.5 Pa.	
4.5.1.5	Minimum allowance of two (2) doors open shall be permitted for residential apartments and business occupancies that are not classified as high rise and with at least two (2) separate and remotely located exit staircases.	
4.5.1.6	Minimum allowance of three (3) doors open shall be accounted to all exit stairwells in high rise buildings.	
4.5.1.7	Adequate relief of leaked air out of the occupant area or adjacent non-pressurized space shall be provided to avoid build-up of pressure in these areas. The relief could be through perimeter leakages or purpose-built relief vent or extraction system.	
4.5.1.8	The maximum pressure differential between the stairwell and the fire zone shall be determined by the required door opening force which shall not exceed 110 N.	
4.5.1.9	Pressurization air shall be supplied such that uniform pressure inside the stairwell is attained.	
4.5.1.10	Single injection system shall be permitted where the exit stairwell connects not more than five (5) floor levels or depth of not more than 18 m, whichever is less, including basements.	

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4.5.1.11	Single injection system shall be permitted for exit stairwells connecting more than five (5) floor levels or depth of 18 m where engineering analysis confirms its applicability.	
4.5.1.12	Pressurization air can be supplied either at the top of the stairwell, the bottom, or at a location in between. Caution must be exercised when designing bottom injection system and consideration must be made with opened exterior doorways.	
4.5.1.13	Roof mounted propeller fans used for single injection stairwell pressurization systems should have tops that shield the fans from wind effects.	
4.5.1.14	Wall mounted propeller fans arrangement shall not be permitted in stairwell pressurization system installations.	
4.5.1.15	Pressurization air injection points in a multiple injection system shall be distributed not more than three (3) floor levels apart, but in no case shall exceed 11 m.	
4.5.1.16	Pressurization air supply intake shall be located away from building exhausts which can cause smoke from the building being injected to the exit stairwell. A minimum separation distance of five (5) meters, measured horizontally, shall be maintained between air intakes and exhausts.	
	Pressurization air supply intakes shall be oriented vertically by at least 1 m below building exhausts.	
4.5.1.17	Acceptable means for controlling the required pressure inside the stairwell shall be provided.	
4.5.1.18	Over-pressurization relief dampers, relief ducts, doors and the likes shall discharged directly to outside of the building.	
4.5.1.19	Analysis with the aid of network model must be performed for staircase in buildings with floor plans that vary much from floor to floor.	

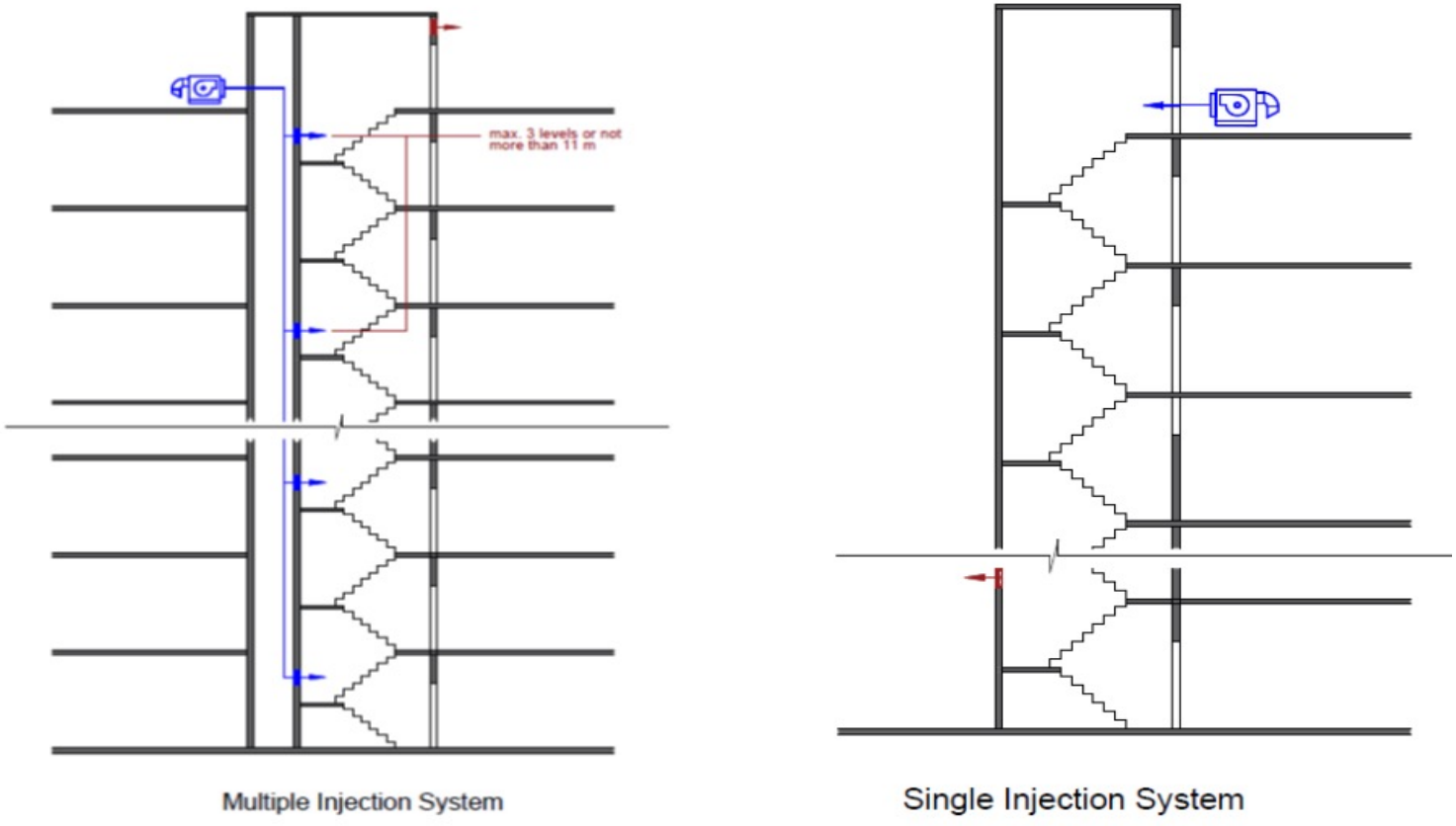


Figure 1. Example of Stairwell Pressurization System Arrangement

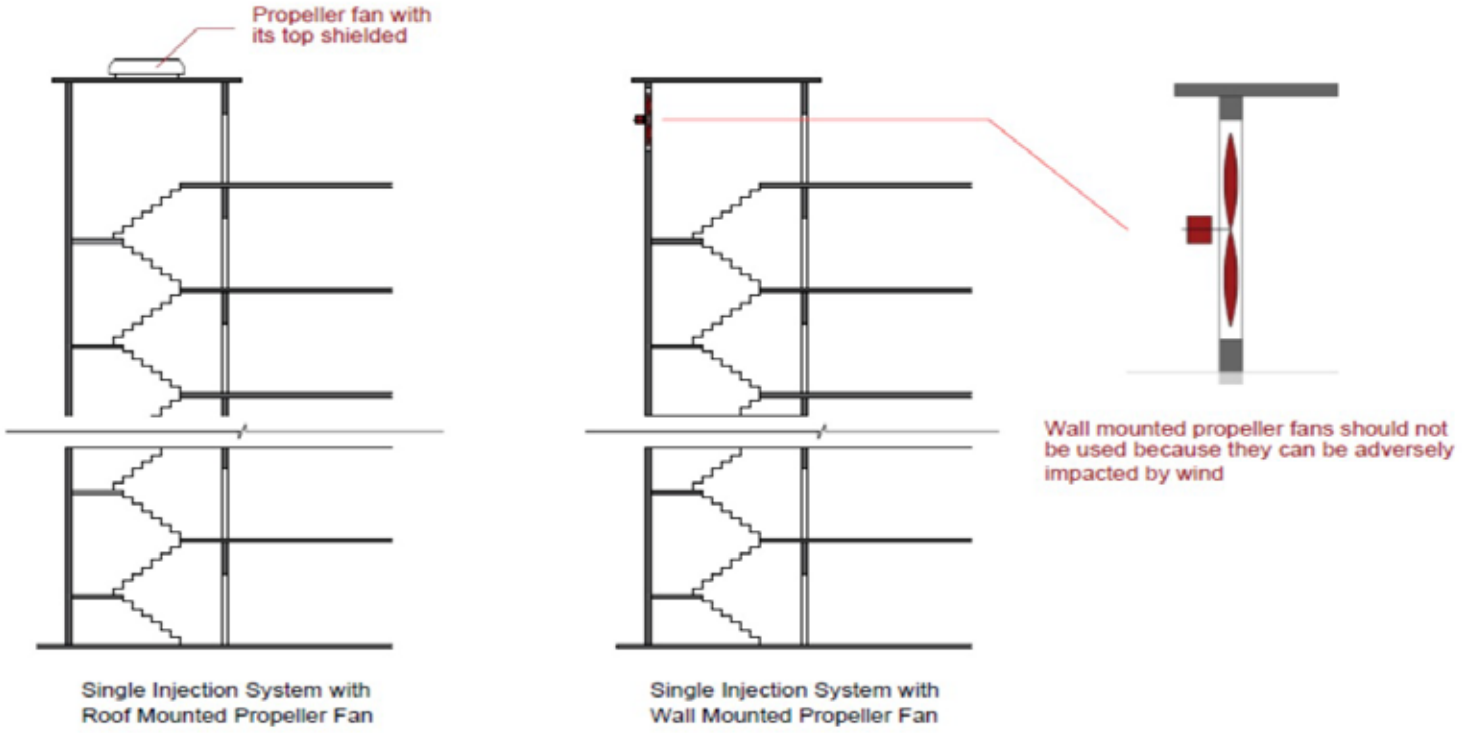
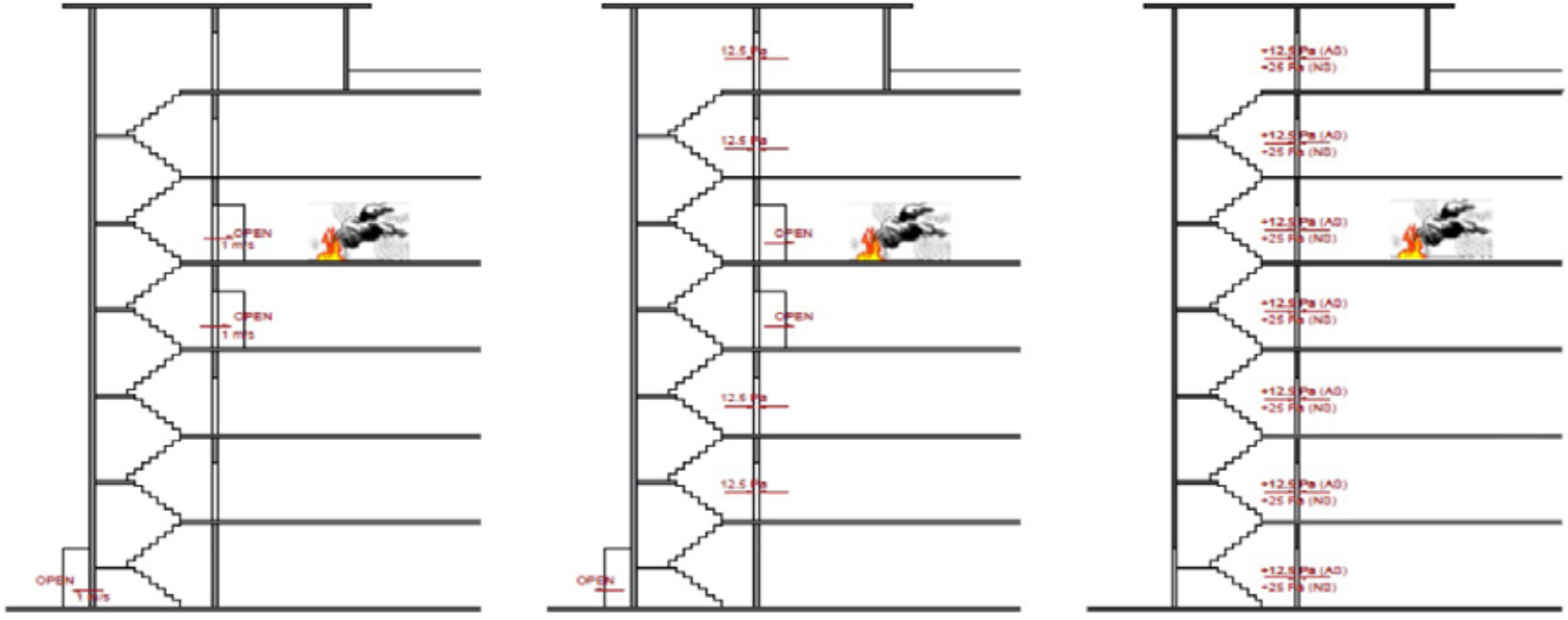


Figure 2. Single Injection System and Propeller Fan Application

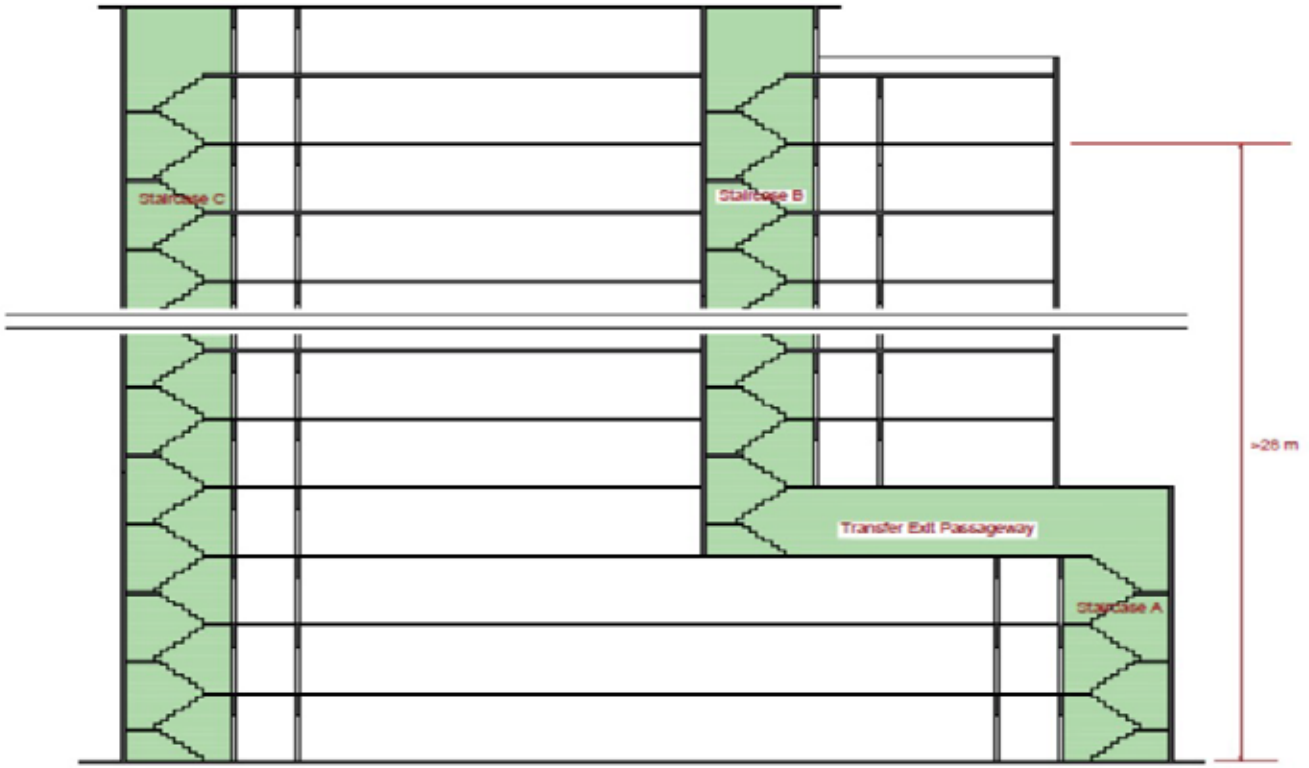


Velocity (Door/s Open) Criterion

Pressure Differential Criterion (With Doors Open)

Pressure Differential Criterion (All Doors Closed)

Figure 3. Manifestation of the Stairwell Pressurization System Criteria



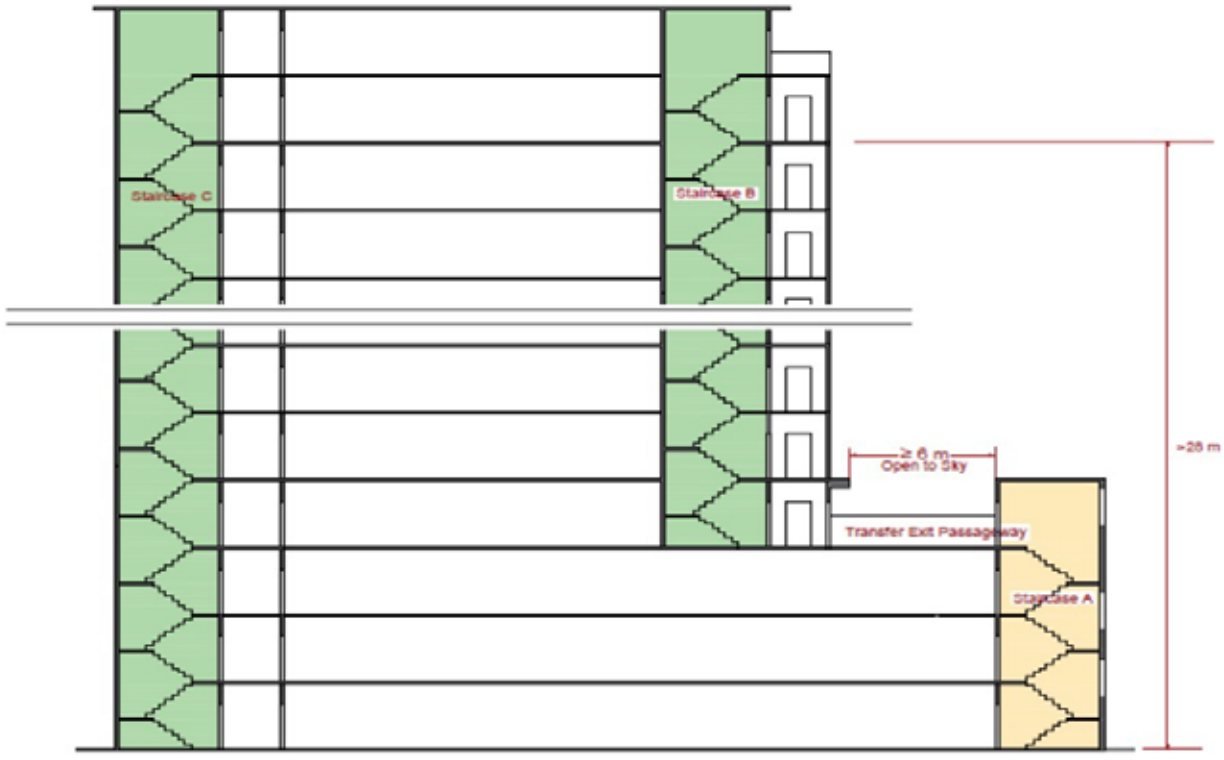
Interconnecting Staircases and Transfer or Connecting Passageway

Situation 1. Internal staircase, enclosed transfer/connecting exit passageway and enclosed external staircase

* Staircase B and staircase A shall be considered as a single staircase sharing a common protected shaft. As staircase B is required to be pressurized, pressurization shall be extended to the transfer exit passageway and staircase A as well. Staircase A, though it is low, and along the external wall, cannot be naturally ventilated.

* Partial pressurization by pressurizing staircase B only and introducing a door across the transfer passageway so that staircase A is separated and be naturally ventilated is not acceptable. The level of protection throughout the shaft shall be the same.

Figure 4. Exit Staircases Connected by Enclosed Transfer Passageway



Interconnecting Staircases and Transfer or Connecting Passageway

Situation 2. Enclosed Staircase, Open to Sky Transfer Exit Passageway and Naturally Ventilated or Pressurized Staircase

* Staircase B, transfer exit passageway and staircase A is not considered as a single staircase.
* Staircase B is pressurized.
* Passageway open to the sky and the distance or length of the connecting open passageway from the discharge point of the first staircase to the next staircase is not less than 6 m.
* Staircase A can be naturally ventilated or pressurized depending on the requirement for the type or classification of the staircase.

Figure 5. Exit Staircases Connected by Open Exit Passageway

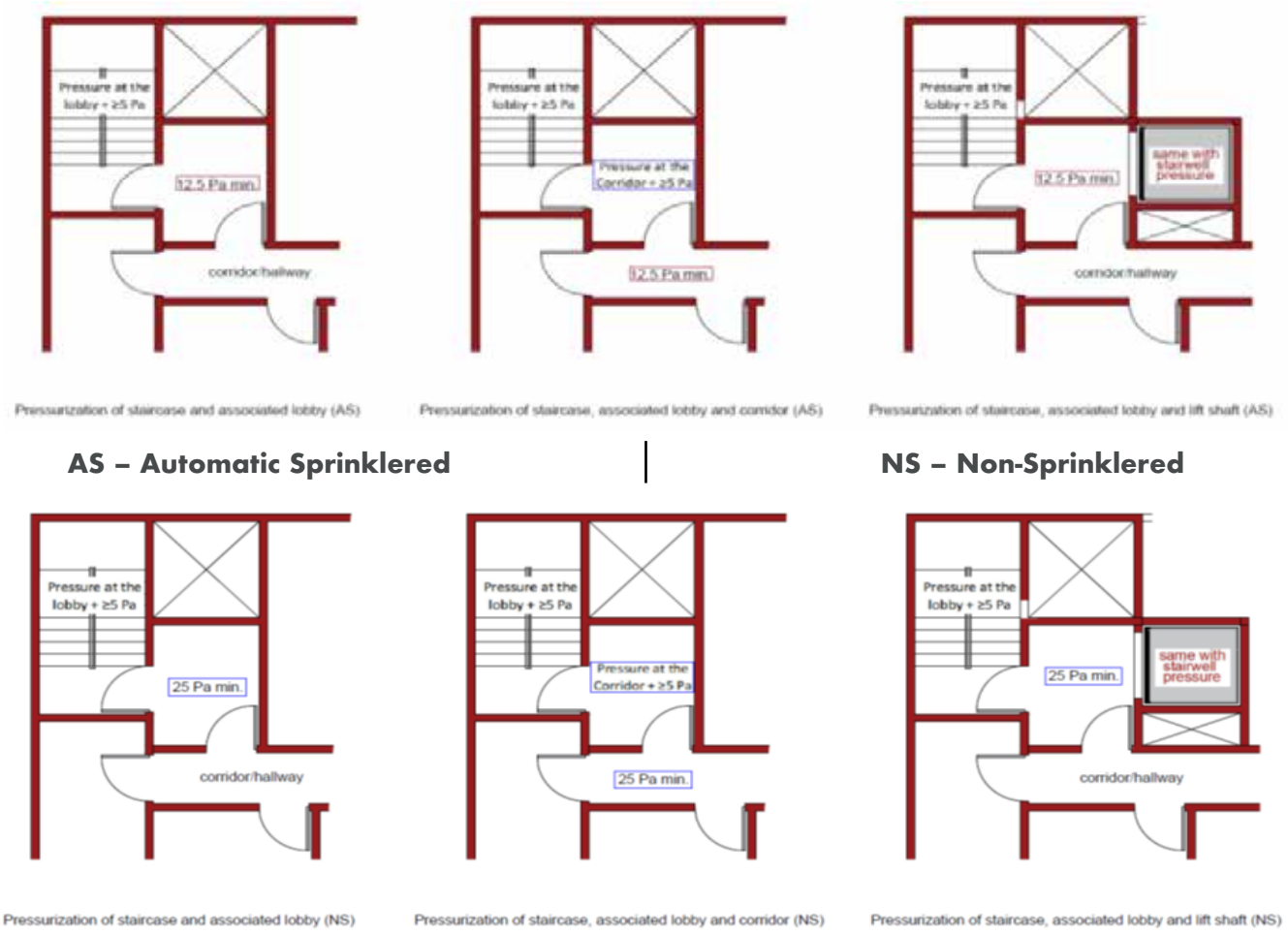


Figure 6. Pressurization of Staircase, Lobby, Lift Shaft and Corridor: Minimum ΔP Requirements

Figure 7. PRESSURIZATION OF ESCAPE ROUTES

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	- Minimum pressure difference of 12.5 Pa for building protected with automatic sprinkler system shall be maintained between the pressurized exit access closest to the smoke zone and a minimum increment of 5 Pa between each succeeding pressurized exit accesses along the escape route leading to the staircase.	
	- Minimum pressure difference of 25 Pa for building not protected with automatic sprinkler system shall be maintained between the pressurized exit access closest to the smoke zone and an a minimum increment of 5 Pa between each succeeding pressurized exit accesses along the escape route leading to the staircase.	
	* Calculation shall take into account the required number of doors to be opened simultaneously.	

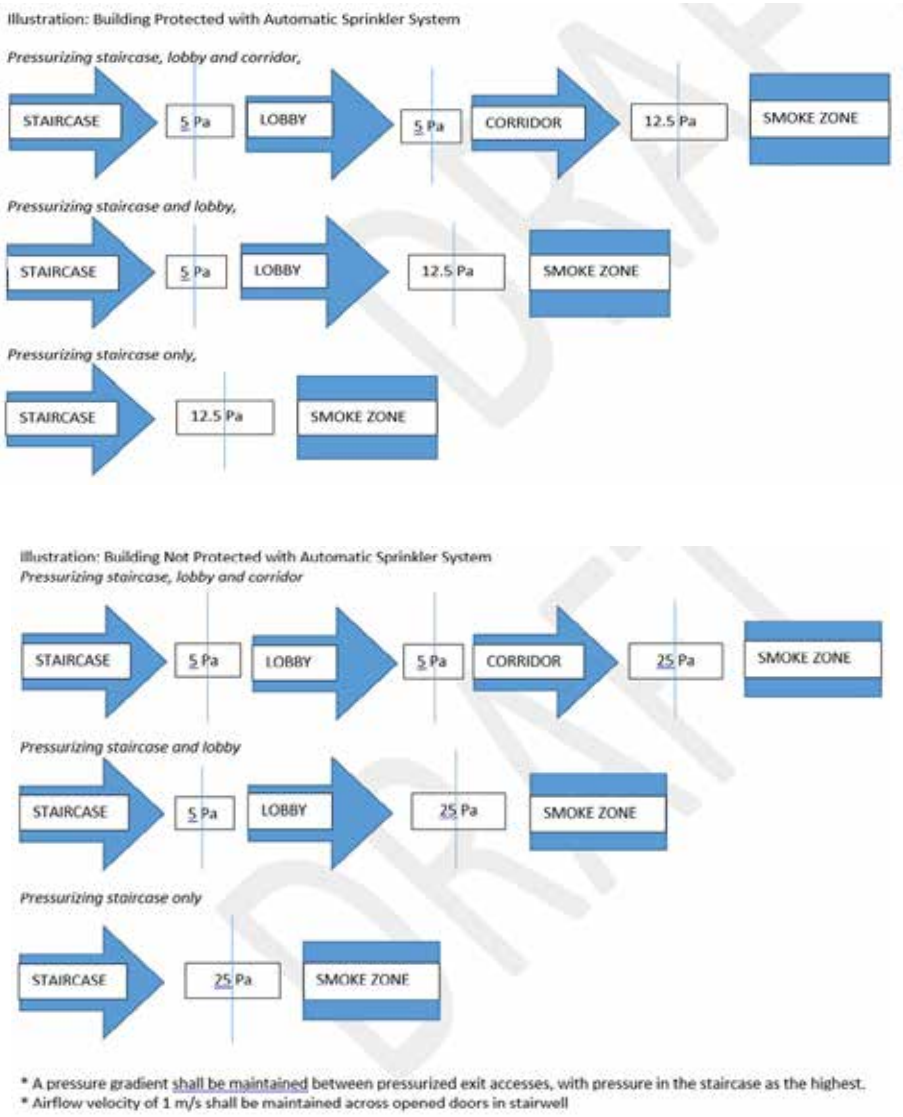

Figure 7. PRESSURIZATION OF ESCAPE ROUTES

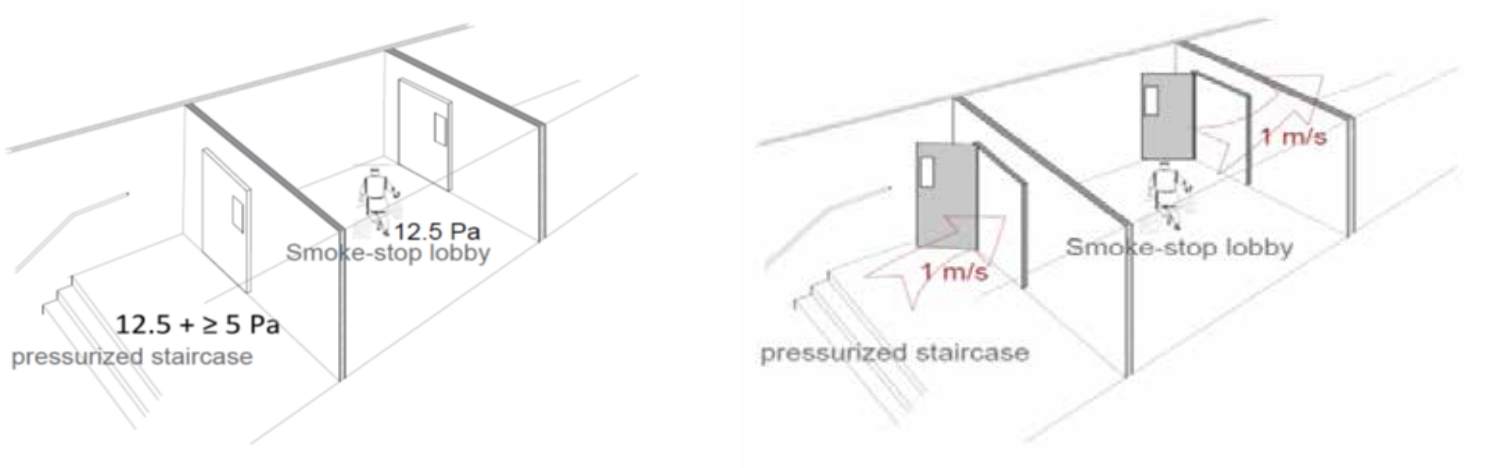

Figure 8. Pressure Differential and Velocity Criterion

4.5.2	Natural Ventilation Alternative	
4.5.2.1	Exit staircases accessed through open and externally located vestibules or exterior balcony are deemed to satisfy natural ventilation alternative.	
4.5.2.2	Exit staircases accessed through lobby or vestibule having openings with minimum net area of 1.5 sq. m (16 sq. ft.) or 25% of the floor area of the lobby or vestibule, whichever is greater, in a wall facing an outer yard, court or public way that is at least 6.1 m (20 ft) wide are deemed to satisfy natural ventilation alternative. The opening/s in the vestibule shall be located such that no portion in the space is farther than 9 m to an opening. The ventilation openings shall also be positioned such that its top is no farther than 300 mm from the slab of the landing or floor above; or the bottom part be at least 1.83 m (6ft)above the walking surface. Side hung windows opening outward a minimum of 30° capable of being opened automatically through remote control switch linked to the building fire alarm system is an acceptable arrangement.	

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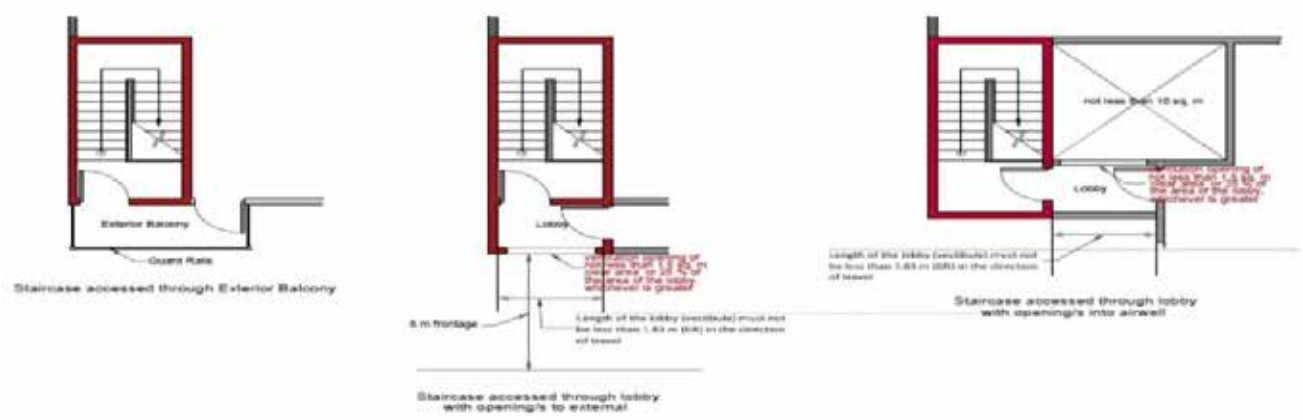
4.5.2.3	Exit staircase with fixed or automatic ventilation opening at each floor/storey level in exit staircases located along perimeter walls of the building facing an outer courtyard or public way that is at least 6.1 m (20 ft) wide. Minimum dimension of the ventilation opening at each floor level shall be not less than 1.5 m^2 (16 ft^2) located at the side of the stairwell exposed to external. The ventilation openings shall also be positioned such that its top is no farther than 300 mm from the slab of the landing or floor above; or the bottom part be at least 1.83 m (6ft)above the walking surface.	Permitted for staircases in non-high-rise building that connect one below ground or basement level
4.5.2.4	Exit staircases with fixed or automatic opening having a minimum net area of 1.5 m^2 (16 ft^2) at the top of the stairwell shaft. For opening/s located along the external stair wall, the ventilation openings shall be positioned such that its top is no farther than 300 mm from the slab of the landing or floor above or be lower than 1.83 m (6 ft)above the walking surface.	Permitted for: 1) staircases that connects six (6) storeys or 15 m habitable height, whichever is less, from ground level to above. 2) staircases the connects up to two floor levels below ground (but not exceeding 6m) and up to four floor levels (but not exceeding 9m habitable height). G+5, 2B+G+3 or less



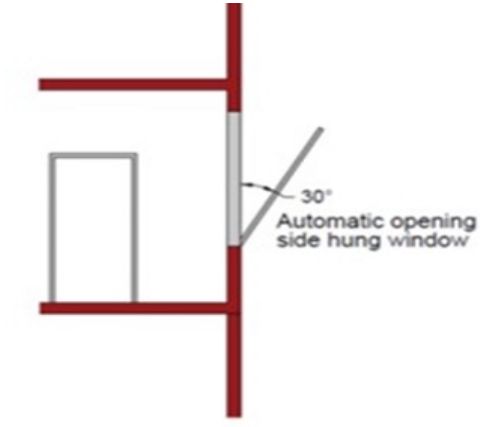


Figure 9A. Natural Ventilation Alternatives

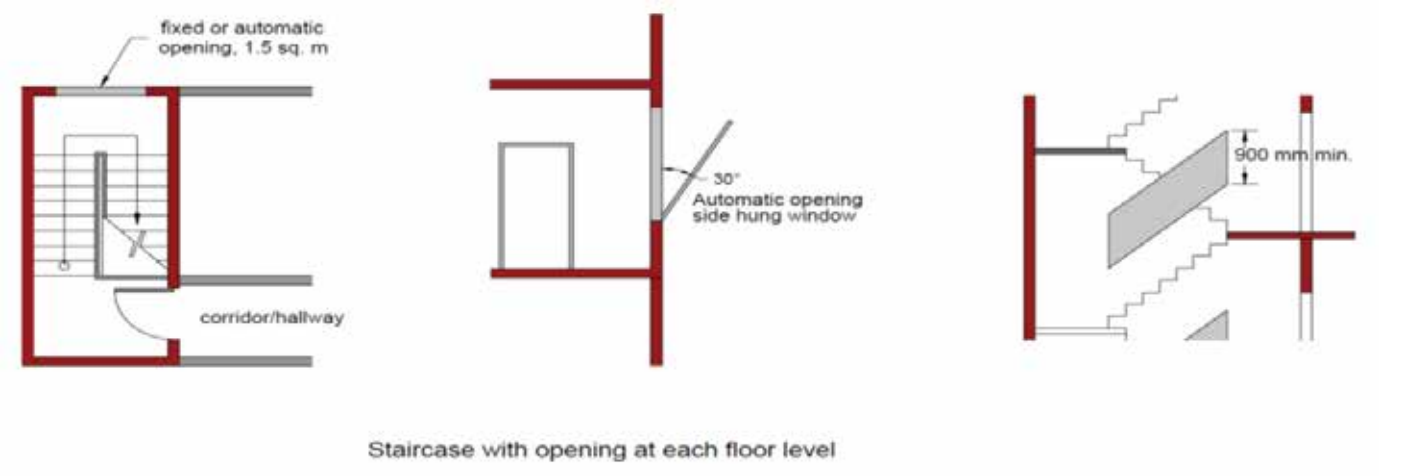
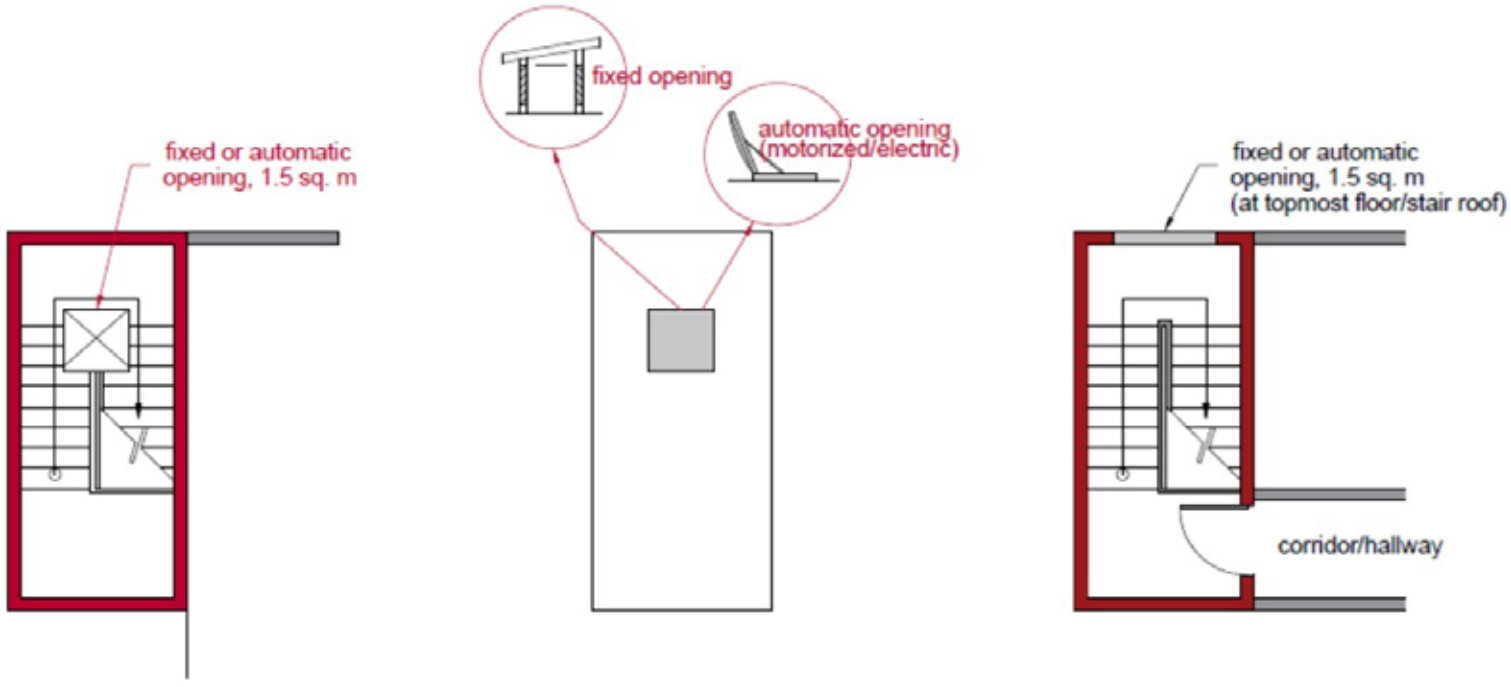


Figure 9B. Natural Ventilation Alternatives



Staircase with opening at the top

Figure 9C. Natural Ventilation Alternatives

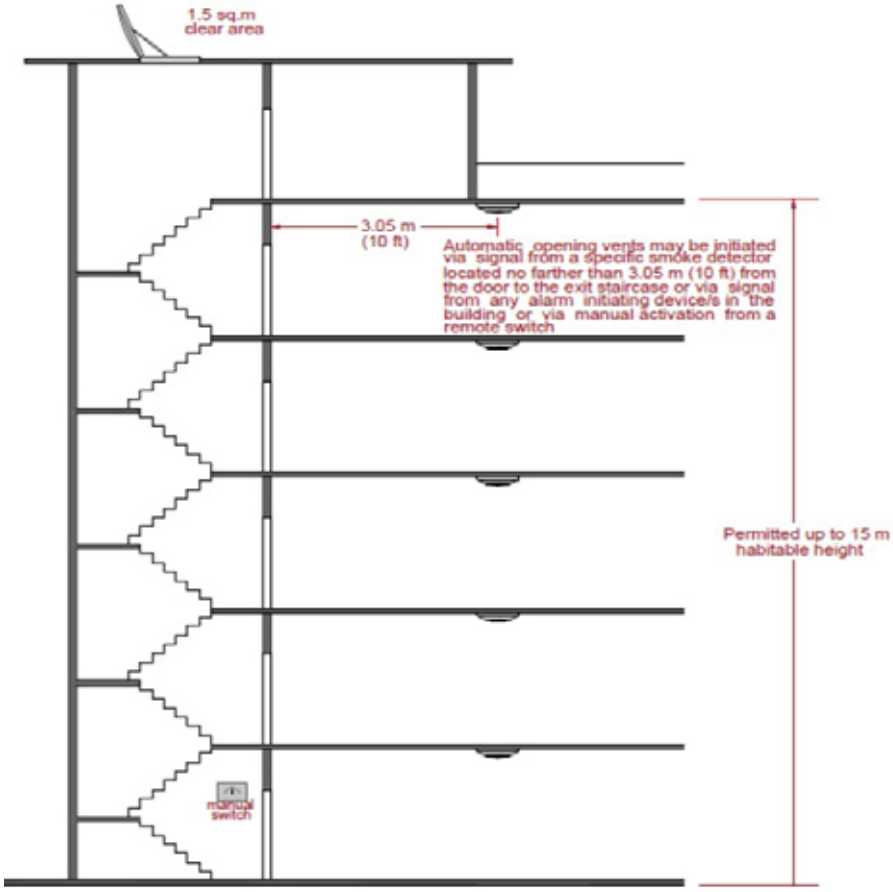


Figure 10. Staircase with Automatic Opening Vent (AOV), Arrangement and Controls

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4.6	Smoke-stop and Fire Fighting Lobbies, Fire Lift Shaft, Lift Shaft	
4.6.1	Mechanical Pressurization Alternative	
4.6.1.1	Pressurization system for smoke stop and fire fighting lobbies shall be a system independent and dedicated to these lobbies.	Note: See requirements/ conditions where permitted to be in combined system.
4.6.1.2	Pressurization of the smoke stop/fire fighting lobby shall be designed such that same is capable of maintaining a minimum 12.5 Pa (0.05 in. w.g.) pressure difference between the smoke-stop/firefighting lobby and the occupant/accommodation area or smoke zone.	
4.6.1.3	The pressure in the smoke stop/fire fighting lobby shall in no case be higher than the pressure in the stairwell. Minimum pressure difference between the pressurized stairwell and pressurized lobby shall be 5 Pa.	
4.6.1.4	Air-conditioning and ventilation ducts shall not pass through smoke stop or fire fighting lobby. Where unavoidable, portion of the duct within the lobby shall be enclosed in construction having at least the same protection rating to that of the elements of the structure.	
4.6.1.5	Any part of the pressurization air supply duct not enclosed in protective shaft or running outside of the smoke stop or fire fighting lobby which it serves shall either be enclosed or constructed to provide a fire protection rating equal to that of the enclosure which it serve.	
4.6.2	Natural Ventilation Alternative	
4.6.2.1	Open and externally located lobbies are deemed naturally ventilated lobbies satisfying natural ventilation alternative.	
4.6.2.2	Lobbies having openings on external wall meeting all of the following conditions are deemed naturally ventilated lobbies satisfying natural ventilation alternative:	
a.	A minimum net area of 1.5 sq. m (16 sq. ft.) or 25% of the floor area of the lobby, whichever is greater	
b.	Openings are located as near as practicable to the ceiling with the top of the opening at least 0.3 m (1 ft) below the ceiling of the lobby	
c.	Openings are located not more than 9 m from any part of the lobby	
d,	Openings are facing an outer court, yard or public way that is at least 6.1 m (20 ft) width; or	

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d1.	When facing an air/light well, the well should be totally open to the sky and have an area of not less than 10 m^2 with no sides less than 3 m	
Note (d.1)	Permitted in non-high rise building having no floor levels below ground. Air/light well starts from ground level only.	
4.6.2.3	Lobbies located one floor level and not more than 3.5 m below ground, may be ventilated through unobstructed openings having a minimum cross-sectional area of 1 m^2 provided at the ceiling of the lobby and discharging directly to external of the building. Duct and/or shafts required to ventilate the lobby to external shall be constructed of materials having minimum 1 hr fire protection rating or equivalent rating of the lobby enclosure, whichever or greater.	
4.6.2.4	Smoke-stop or firefighting lobbies approached via cross ventilated corridors having openings of not less than 50 % of the superficial wall of the corridor located in at least two of its externally opposing walls and with no part on the floor space of the corridor is farther than 12 m from the ventilation openings are deemed to satisfy natural ventilation alternative.	Openings could be of fixed or automatic opening type
4.6.3	Reserved.	
4.7	Corridor Smoke Control System	
4.7.1	Corridor Mechanical Smoke Control System	
4.7.1.1	Smoke control system where required for internal corridor shall either be by means of mechanical or natural ventilation system.	
4.7.1.2	Mechanical smoke control for internal corridors shall either be by pressurization or smoke exhaust ventilation system, depending on which type designer deemed to be most favorable for the building.	
4.7.1.3	Corridor pressurization system shall be designed such that a minimum 12.5 Pa (0.05 in. w.g.) for sprinklered building and 25 Pa for non-sprinklered building, differential pressure is achieved between the corridor and the smoke zone. Pressure in adjacent pressurized escape accesses shall be adjusted accordingly such that pressure gradient with reference from the pressurized exit staircase as the highest down to the pressurized corridor is achieved.	
4.7.1.4	All doors opening into pressurized corridor shall be self-closing doors.	
4.7.1.5	Means for controlling pressure in the corridor must be provided.	

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4.7.1.6	Smoke exhaust ventilation system for internal corridors must be designed for a minimum exhaust rate of 10 ACH with provisions for make-up/replacement air supply 80%-90% of exhaust flow rate. Natural means for make-up/replacement air supply via fixed or automatic openings from external shall be permitted.	
4.7.1.7	Air supply outlets and smoke exhaust inlets shall be distributed on the opposite sides of the corridor strategically situated such that a sweeping motion of smoke being directed to the inlets is achieved effectively.	
4.7.1.8	Arrangement of the air supply outlets and smoke exhaust inlets shall be such that a smoke exhaust outlet is within 15 m (49.2 ft) distance from an air supply outlets when measured parallel and horizontally along the corridor. When located in the different direction in an intersecting corridor, distance of a smoke exhaust inlet to an air supply outlet must not exceed 10 m (32.8 ft) measured along the path.	
4.7.1.9	Smoke exhaust inlets shall be located having its lower part at least 1.83 m (6 ft) above the finished floor line.	
4.7.1.10	Air supply outlets must be located at elevation below smoke exhaust inlets. The lower part of an air supply outlet shall at least be 300 mm (1 ft) above the finished floor line with its higher part not exceeding 1 m (3.28 ft) above finished floor line.	
4.7.1.11	Exhaust inlets must be located at least 5 m away from fire stop doors or entrance to exits.	
4.7.1.12	Operation of the corridor smoke exhausts system shall be initiated by subsequent activation of smoke detectors within the corridor or sprinkler flow switch dedicated to the group of sprinklers serving the corridor only.	
4.7.1.13	The provision of corridor smoke exhaust ventilation system must take cognizance the possible effect to pressure differential and door opening force requirements of an adjacent pressurized escape access, such as a lobby or exit staircase.	

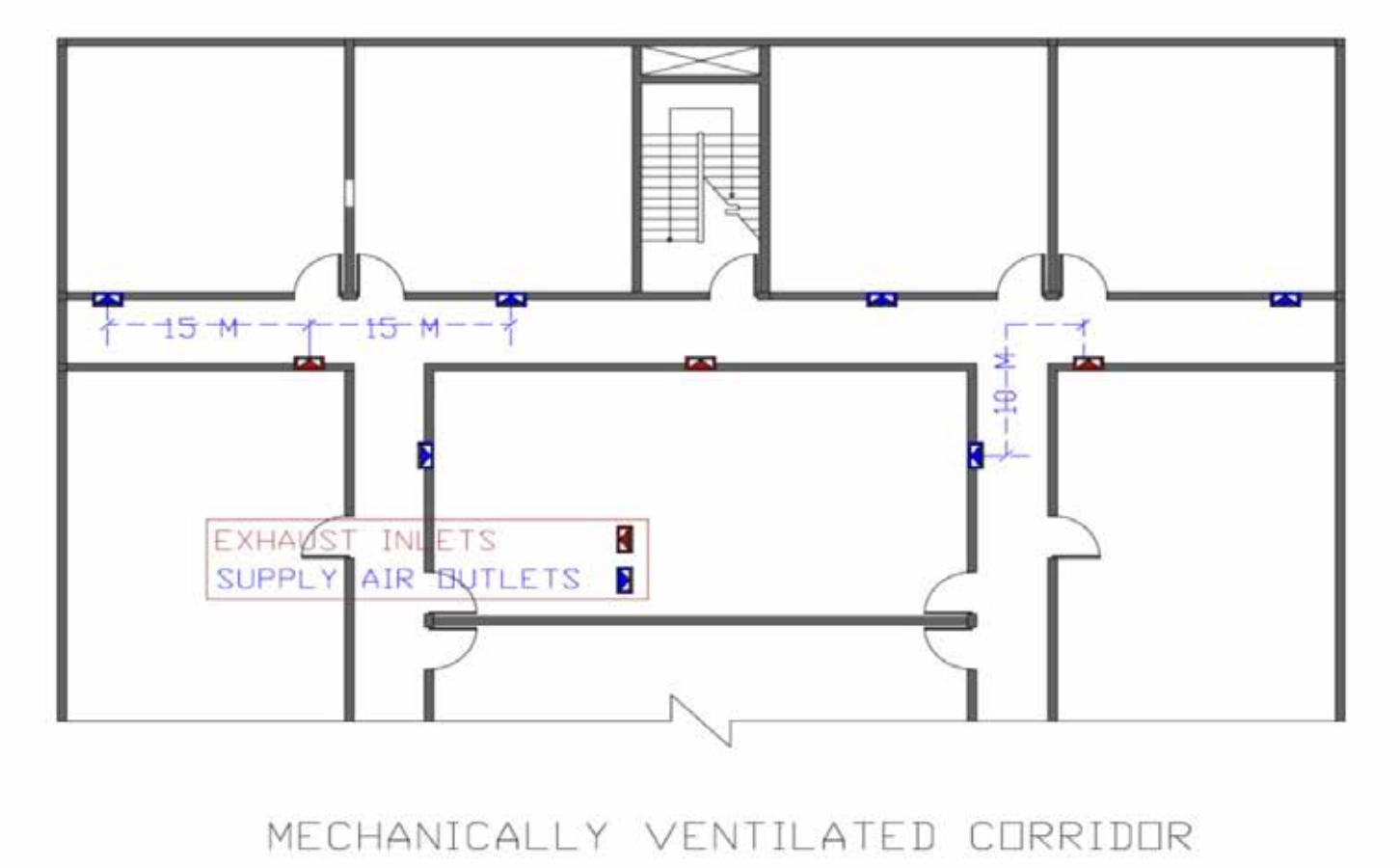
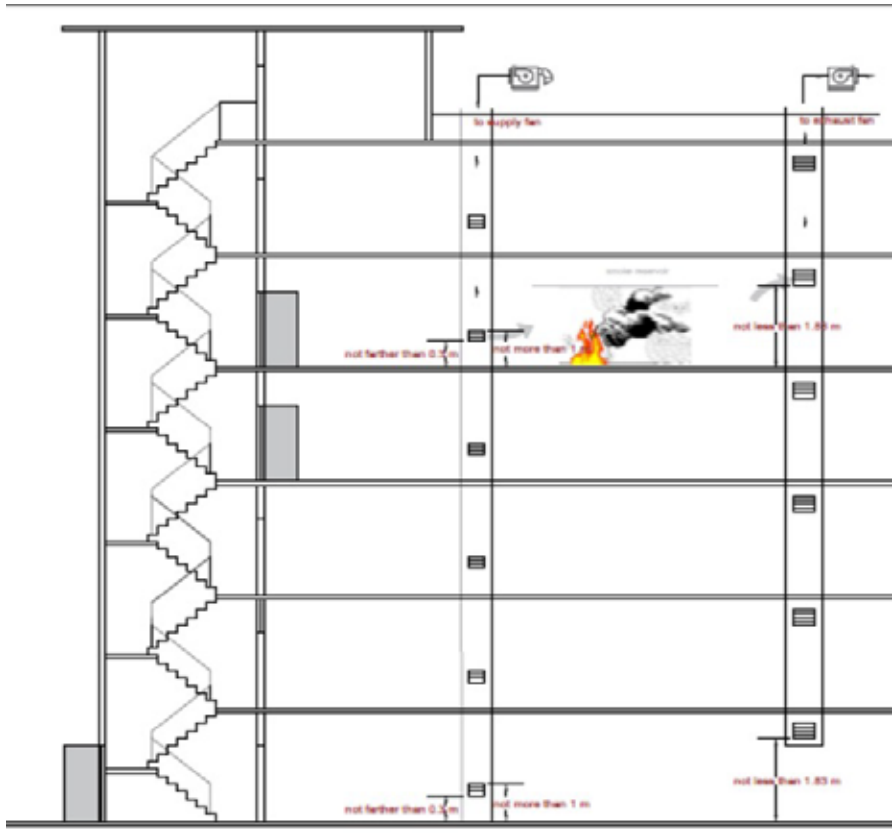


Figure 11A. Corridor Ventilation Arrangement



Sample Layout of Corridor Smoke Ventilation System

Figure 11B. Corridor Ventilation Arrangement

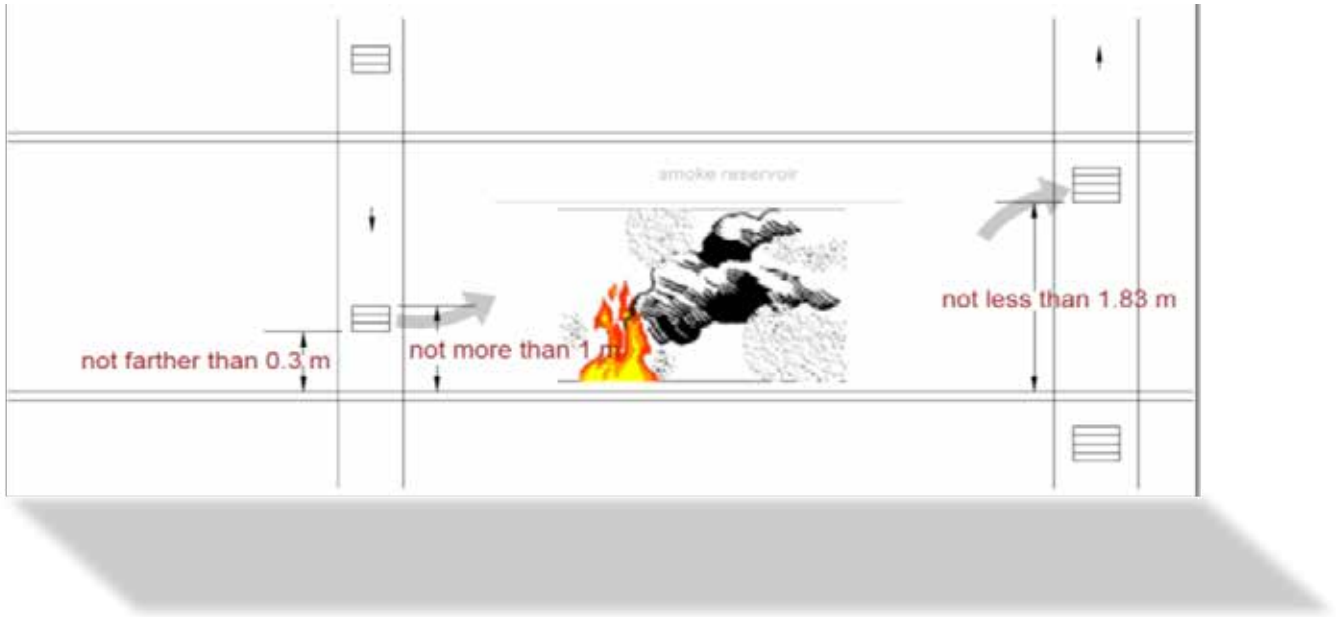


Figure 11C. Corridor Ventilation Arrangement

4.7.2	Natural Ventilation Alternative	
4.7.2.1	Naturally ventilated corridors with ventilation openings having an area of not less than 50 % of the superficial wall of the corridor located in at least two of its externally opposing walls and with no part on the floor space of the corridor is farther than 12 m from the ventilation openings are deemed to satisfy natural ventilation alternative.	Openings could be of fixed or automatic opening type
4.7.2.2	Ventilated corridor through openings having an area of not less than 1.5 m^2 (16 ft^2), with the top of the opening located within 300 mm from the corridor ceiling, opening into a dedicated air shaft not less than 10 m^2 cross sectional area that is open to sky shall be permitted in non-high rise buildings. No dimension of the sides of the air shaft shall be less than 3 m.	
4.7.2.3	No part on the floor space of the corridor shall be farther than 12 m from a ventilation opening.	

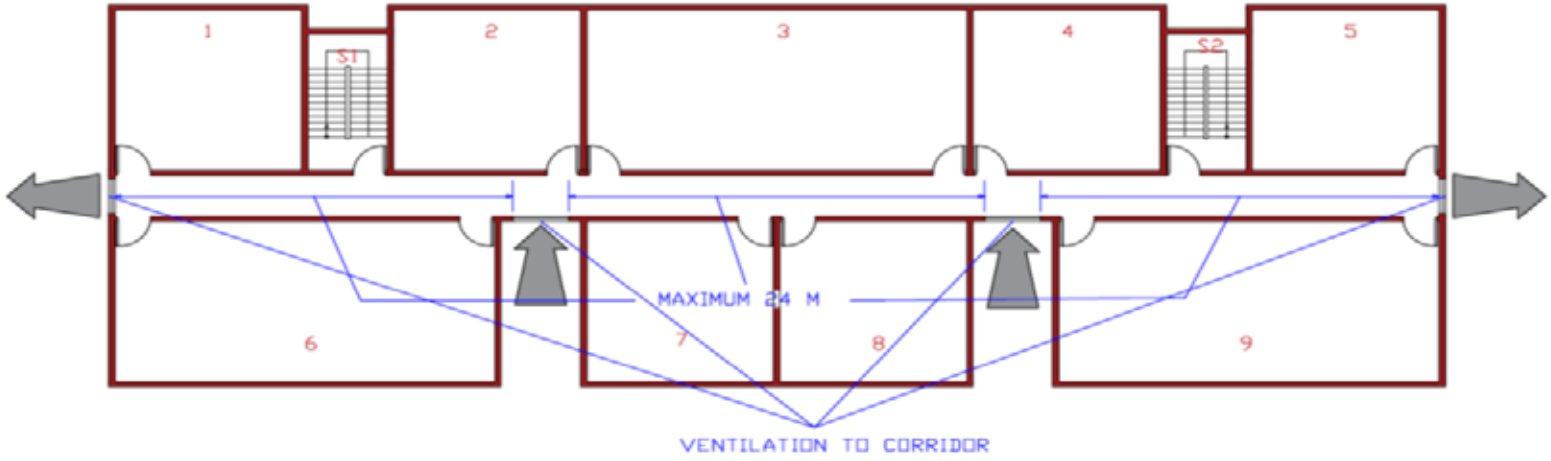


Figure 12A. Corridor Natural Ventilation

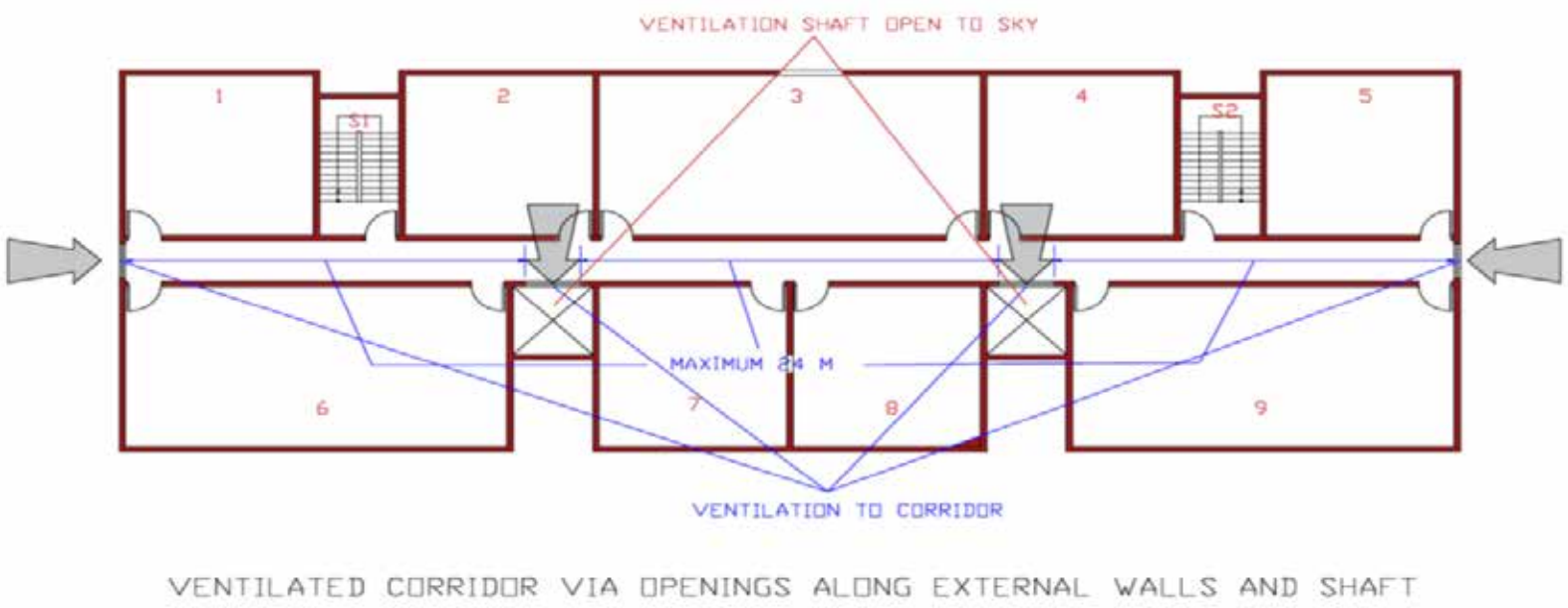


Figure 12B. Corridor Natural Ventilation

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4.8	Refuge Floor Areas Smoke Control	
4.8.1	Pressurization of Refuge Floor Holding Areas	
4.8.1.1	A minimum differential pressure of 12.5 Pa shall be provided between the refuge floor holding area and the accommodation area or fire zone.	
4.8.1.2	A pressurized refuge floor holding area shall be adjacent to pressurized stair and/or lobby. The pressure in the refuge area shall in no case be greater than the pressure in the stair or lobby.	
4.8.1.3	A dedicated air supply system or the building HVAC system may be used as means for supplying the required airflow to pressurize the space. The HVAC system layout where used shall be coordinated with the compartmented refuge area.	
4.8.2	Natural Ventilation Alternative	
4.8.2.1	The refuge floor holding area may be ventilated naturally through permanent openings on at least two sides of external walls. The height of the opening shall not be less than 1200 mm and the total area of the openings not be less than 25 % of the floor area of the holding area. The openings shall be arranged such that no part of the holding area is farther than 9 m to any ventilation opening.	
4.8.2.2	Ventilation openings shall be located at least 1.5 m horizontally from and 3 m vertically above adjoining unprotected opening.	
4.9	Elevator Hoistway Pressurization	
4.9.1	Elevator shafts in high rise buildings not served by an enclosed simple lobby and opening into an internal common hallway or corridor shall be pressurized to provide a minimum 25 Pa pressure difference between the lift shaft and the occupant/accommodation area or smoke zone for buildings that are non-sprinklered or other than fully sprinklered.	
4.9.2	Elevator shafts in high rise buildings not served by an enclosed simple lobby and opening into an internal common hallway or corridor shall be pressurized to provide a minimum 12.5 Pa pressure difference between the lift shaft and the occupant/accommodation area or smoke zone for buildings that are fully sprinklered.	
4.9.3	Where permitted to have no fire lift lobby (or such as in existing building where the provision of fire lift lobby has not been explicitly required under the previous local codes), fire lift shafts opening into an internal common hallway or corridor shall be pressurized to provide a minimum 25 Pa pressure difference between the lift shaft and the occupant/accommodation area or smoke zone for buildings that are non-sprinklered or other than fully sprinklered.	

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4.9.4	Where permitted to have no fire lift lobby (or such as in existing building where the provision of fire lift lobby has not been explicitly required under the previous local codes), fire lift shafts opening into an internal common hallway or corridor shall be pressurized to provide a minimum 12.5 Pa pressure difference between the lift shaft and the occupant/accommodation area or smoke zone for buildings that are fully sprinklered.	
4.10	Carparks	
4.10.1	Conventional Mechanical Smoke Extract System/Smoke Purging System	
4.10.1.1	Mechanical ventilation/smoke control shall be provided for car parks located below ground or enclosed having floor area of more than 2000 m^2.	
4.10.1.2	Conventional mechanical smoke extract system or smoke purging system shall be designed for purpose of smoke clearance with the following objectives:	
1.0	Maintain smoke layer within the smoke zone to not lower than 1.8 m from the floor.	
2.0	Contain the within the smoke zone or an area not more than 1000 m^2 from the center of the fire.	
4.10.1.3	Conventional mechanical smoke extract system or smoke purging system shall be designed in accordance with NFPA 88A and ASHRAE Handbook.	
4.10.1.4	Conventional Mechanical Smoke Extract System or smoke purging system shall be independent from any other system in the building and be designed to provide minimum exhaust rate of 6 ACH for general ventilation and 10 ACH under smoke mode.	
4.10.1.5	Each smoke control zone of the cark shall have its own extract fan or purging system. The system shall be arranged such that the required rate of extract for the smoke zone does not fall below 50% in the event of failure of any fan or group of fans in the system.	
4.10.1.6	Smoke exhaust inlets or extract points shall be arranged such that 50% of the exhaust capacity is at high level and 50% is at low level and evenly distributed over the whole car park.	
4.10.1.7	The system shall be designed and calculated such that velocity of air within escape routes and ramps does not exceed 5 m/s.	
4.10.1.8	Fresh or make up air supply shall be drawn directly from external with its intake located at least 5 m away from any exhaust discharge openings. Natural ventilation openings of at least 2.5 % of the floor area of the car park and equally distributed in at least two of its opposing sides may be deemed satisfactory substitute for the supply air requirement of the smoke purging system.	

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4.10.1.9	Supply air outlets and smoke exhaust inlets shall be distributed adequately over the car park. No portion in the car park must be farther than 12 m to a smoke exhaust inlet.	
4.10.1.10	Smoke exhausts shall be discharged directly to external and shall be located at least 5 m away from any air intake openings into the building.	
4.10.1.11	Smoke exhaust discharge openings/outlets termination points shall be located at least 3 m from property lines and operable openings into buildings.	
4.10.1.12	Where located on roofs and adjacent to exterior walls, smoke exhaust discharge openings/outlets termination points shall be located at least 1 m above exterior walls and roofs.	
4.10.1.13	Ventilation exhaust fans shall be suitable for operating at minimum 250 °C for a period of 2 hrs (120 minutes) or 300 °C for a period of 1 hr (60 minutes) .	
4.10.1.14	Exhaust ducts for the car park smoke purging system shall be fabricated from a minimum 1.2 mm thick, heavy gauge steel .	
4.10.2	Impulse Ventilation or Jet/Thrust Fans Assisted Car Park Smoke Exhaust Ventilation System	
4.10.2.1	Car park ventilation systems employing thrust fans shall be confirmed through performance based design approach. The use of computational fluid dynamics (CFD) fire modeling and the following input parameters shall be considered in the design.	
4.10.2.2	System must be designed with due consideration on the usage and condition in the car park. Design of the car park ventilation system shall be based on either of the objective of smoke clearance or smoke control, whichever is best appropriate for the type of car park. Acceptance criteria shall be based on the following:	
	System Designed as Smoke Clearance:	Purpose: * Assist fire service in clearing smoke * Reduce risk of flashover by ensuring smoke is kept at reasonably low temperature
a.	System designed and sized to clear the space once the fire has been brought under control within twenty (20) minutes	
b.	Visibility on area/s upstream of the fire of not less than 10 m	
c.	Maximum air/smoke temperature of 400 °C along path to exhausts	
d.	At least one viable route for fire fighters from external is available within the smoke logged area	

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Item	Provisions	Notes
	System Designed as Smoke Control: At 1.8 m above the floor level and within 10 m radius of the design fire, the following shall be attained during the first twenty (20) minutes	Purpose: * Control smoke movement * Protect means of egress from the car park to aid occupant escape or fire service in approaching the fire * Compensate for other requirements which were not met; e.g. provisions of automatic sprinkler system
a.	Minimum 10 m visibility upstream of the fire	
b.	Smoke is contained within the defined zone boundaries or not more than 50% of the equivalent zone width is encroached by smoke on the adjacent smoke control zone where fire is located across a zone boundary	
c.	Visibility on all other areas or zones outside the defined smoke path between fire source and extract points are more than 10 m	
d.	Maximum air/smoke temperature of 250 °C along path to exhausts; all other areas outside the smoke logged area not exceeding 60°C	
4.10.2.3	The space in the car park shall be divided into smoke control zones with each zone not larger than 2500 m^2 (excluding plant rooms, stair/lobby/elevator shaft and other circulation spaces) for purpose of smoke containment and faster location of fire.	
4.10.2.4	Each smoke control zone shall have its own exhaust system (jet fans, fresh air supply fans, smoke exhaust fans) designed to extract smoke from the fire affected zone.	
4.10.2.5	The exhaust rate of the fans must not be less than the bulk air movement from the jet fans in the particular smoke zone.	
4.10.2.6	Minimum design fire size for enclosed parking structures that permits only passenger cars shall be according to anticipated fuel load of one car but in no case be less than	
a.	4 MW (14 m perimeter) for car parks protected by supervised automatic sprinkler system	
b.	8 MW (20 m perimeter) for car parks not protected with supervised automatic sprinkler system	
4.10.2.7	Minimum design fire size for enclosed car parking structures that permits goods carrying vehicles shall consider the combined fuel load of the car and the goods.	
4.10.2.8	Assumed design fire for a car shall be flaming polyurethane.	
4.10.2.9	The design fire must be considered to be in the most onerous location, preferably the most remote location from the exhaust points and at a point in-between two zones for zoned systems.	
4.10.2.10	Duration of CFD simulation must be a minimum of 30 minutes. Grid size must be a maximum of 0.2 m x 0.2 m x 0.2 m within 10 m of the design fire and maximum 0.4.m x 0.4 m x 0.4 m for other areas.	

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4.10.2.11	The model or analysis shall assume no sprinkler activation for the design fire considered.	
4.10.2.12	Design shall include a margin of safety considering possible loss of thrust fans. The analysis shall include a sensitivity study that shows that even with the loss of a thrust fan nearest the fire, the acceptance criteria are still met.	
4.10.2.13	Exhaust fans must be configured such that failure of any single fan will not result in more than 50% reduction of air flow.	
4.10.2.14	Smoke exhausts shall be discharged directly to external and shall be located at least 5 m away from any air intake openings into the building.	
4.10.2.14	Smoke exhaust discharge openings/outlets termination points shall be located at least 3 m from property lines and operable openings into buildings.	
4.10.2.16	The smoke exhaust ventilation system fans shall have alternate source of power in accordance with Section 10 hereof.	
4.10.2.17	Where multiple levels of enclosed car parks are protected by the same ventilation system, the size of the equipment as well as the inlets and outlets for the make-up and exhaust air must be adequately designed to allow for simultaneous CO dilution of adjacent zones and other levels at the minimum rate of 6 ACH.	
4.10.2.18	The commissioning and acceptance testing of smoke control systems must be carried out in the presence of a QCDD inspector The procedure must consists hot smoke test prepared and carried out in accordance with AS 4391. For jet fans, BS 7346- Part 7 may be used as a guide.	
	Reserved.	

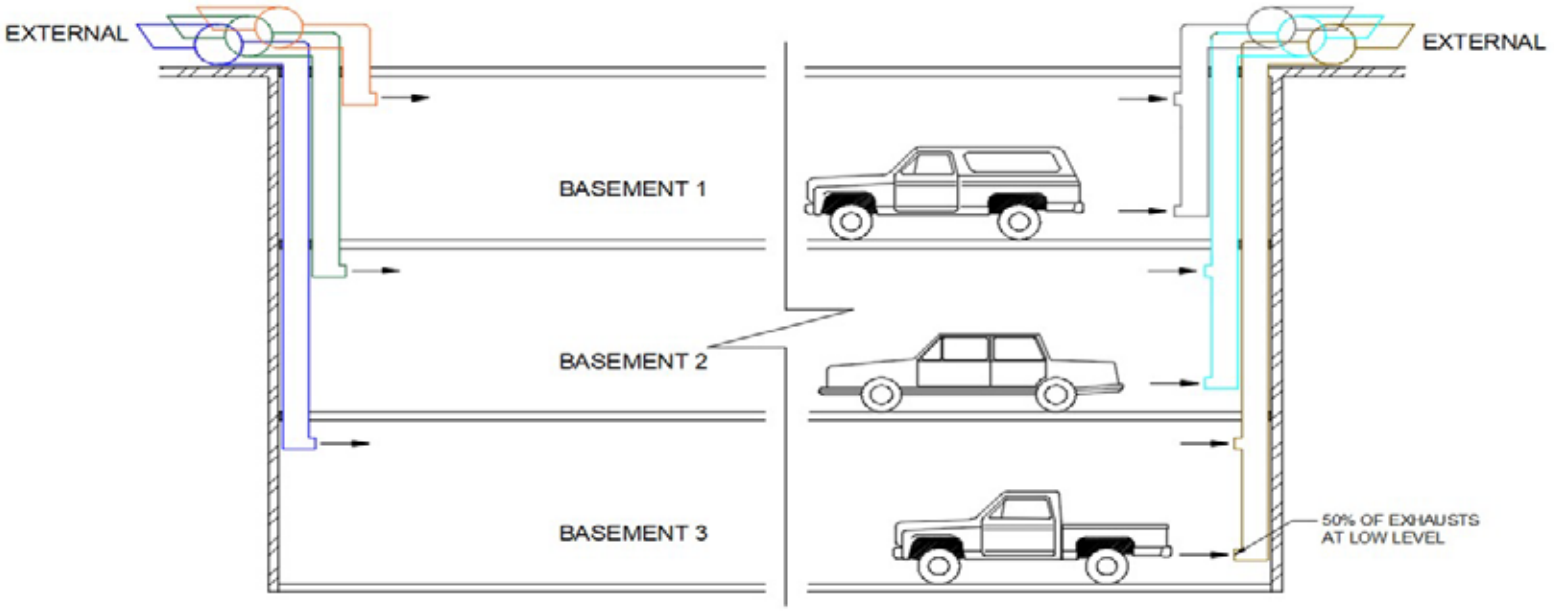
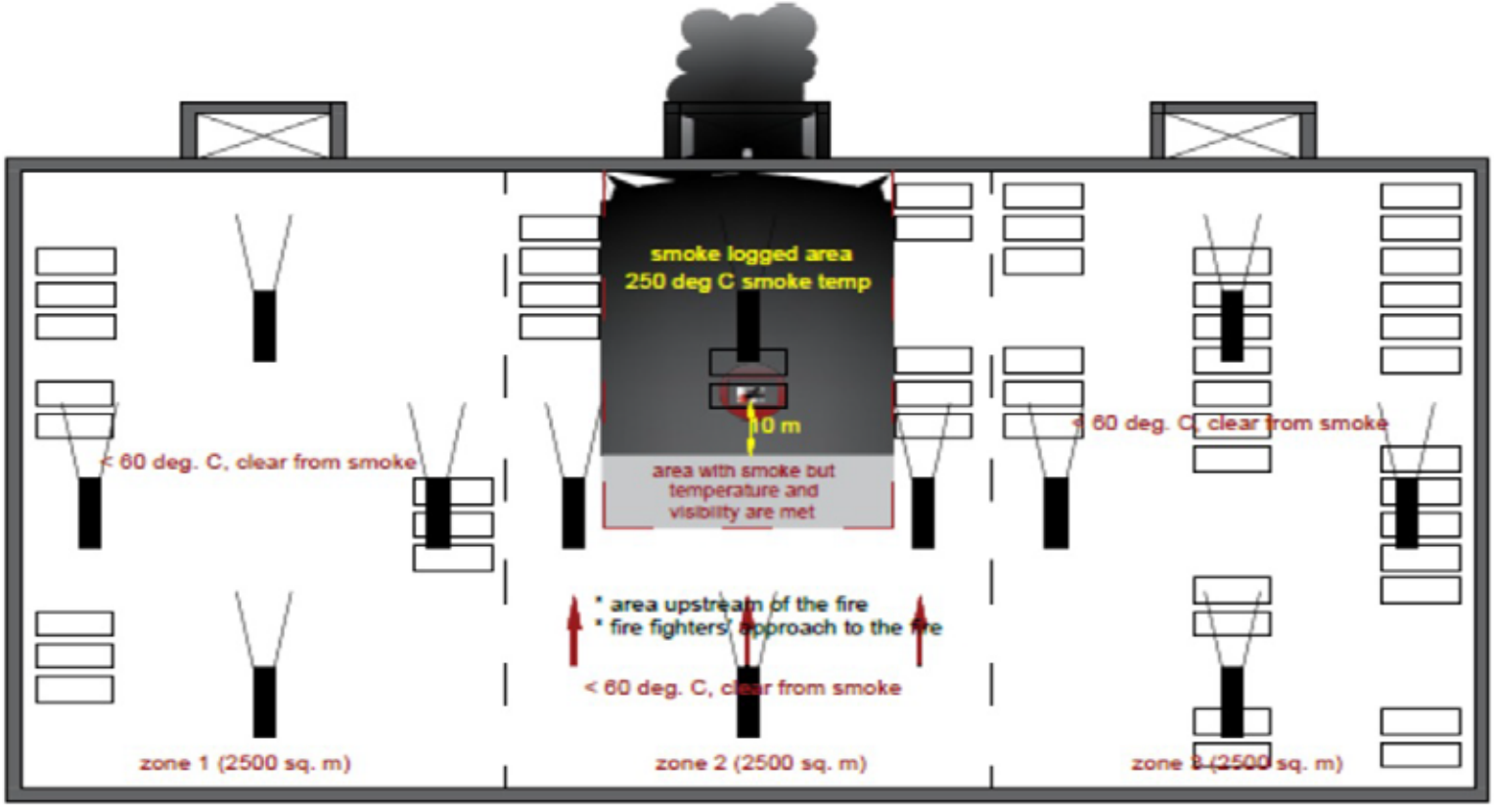


Figure 13. Ducted Below Ground Car Park Ventilation



Basement Car Park Smoke Control Zoning

Figure 14A. Jet Fan Assisted Car park Ventilation

Figure 14B. Jet Fan Assisted Car park Ventilation

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Item	Provisions	Notes
4.10.3	Natural Ventilation Alternatives	
4.10.3.1	Car parks classified as open parking structure or those meeting the openness requirements are not required to have mechanical ventilation system where all points on the car park is within 15 m to an opening; otherwise a CFD analysis proving that smoke stagnation would not result from the far distance of openings.	
4.10.3.2	Above ground car park ventilation through the cross ventilation approach shall have the opposing openings at distance not more than five (5) times the ceiling height. The aggregate opening area shall be at least 4% of the floor area of the car park with half of the required openings equally arranged between the two opposing sides.	
4.10.3.3	Use of Smoke Vents for Natural Dispersal of Smoke	
4.10.3.4	Provisions of smoke vents shall be permitted for car parks 2000 sq m or less that is enclosed or located not more than two (2) levels or 6 m below ground level, whichever is less.	
4.10.3.5	Smoke vents shall either be fixed open or automatically operable type.	
4.10.3.6	Number and sizes of vents shall be such that aggregate vent openings are equivalent to not less than 2.5% of the area of the floor being served. No smoke vent shall be smaller than 610mm (2 ft) in diameter or any of its sides.	
	(Note: The 2.5 % requirement is only for smoke dispersal in naturally ventilated car park. To cater for both general ventilation and smoke dispersal requirement, the aggregate vent openings must account to at least 5% of the floor area of the car park or a mechanical exhaust system providing 3 ACH may be added to supplement the general ventilation requirement with only having 2.5% openings).	
4.10.3.7	Vents shall be distributed along the perimeter, on the sides (e.g. below ground partially sunken car park) or ceiling level of the car park with the vents spaced no farther than 30 m from each other and that no portion on the floor is farther than 15 m to a vent.	
4.10.3.8	Venting may be through shafts or ducts that leads directly to outside. Where smoke ventilation shaft is used, or ducts are required to connect vents to discharge outlets, the shaft or duct should at least have one (1) hour fire resistance rating.	
4.10.3.9	Separate vent outlets shall be provided for each floor level.	
4.10.3.10	Vents shall discharge directly to external with its outlet located at least 5 m from any air intakes into the building.	
4.10.3.11	For aboveground installation, the bottom or lowest smoke inlet point/s of a smoke ventilation shaft or duct shall not be farther than four (4) floors to its discharge outlet/s to outside.	

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4.10.3.12	The smoke ventilation shaft or duct discharge outlet shall be located at least 1.5 m above the roof, 3 m away from building exit discharge or any other operable opening to the building.	
4.10.3.13	Smoke vents which are kept closed during normal or non-fire condition shall be designed to operate automatically.	
4.10.3.14	In car parks provided with automatic sprinklers, the provision of smoke vents shall be designed such that it does not affect the sprinkler activation.	
	Reserved.	

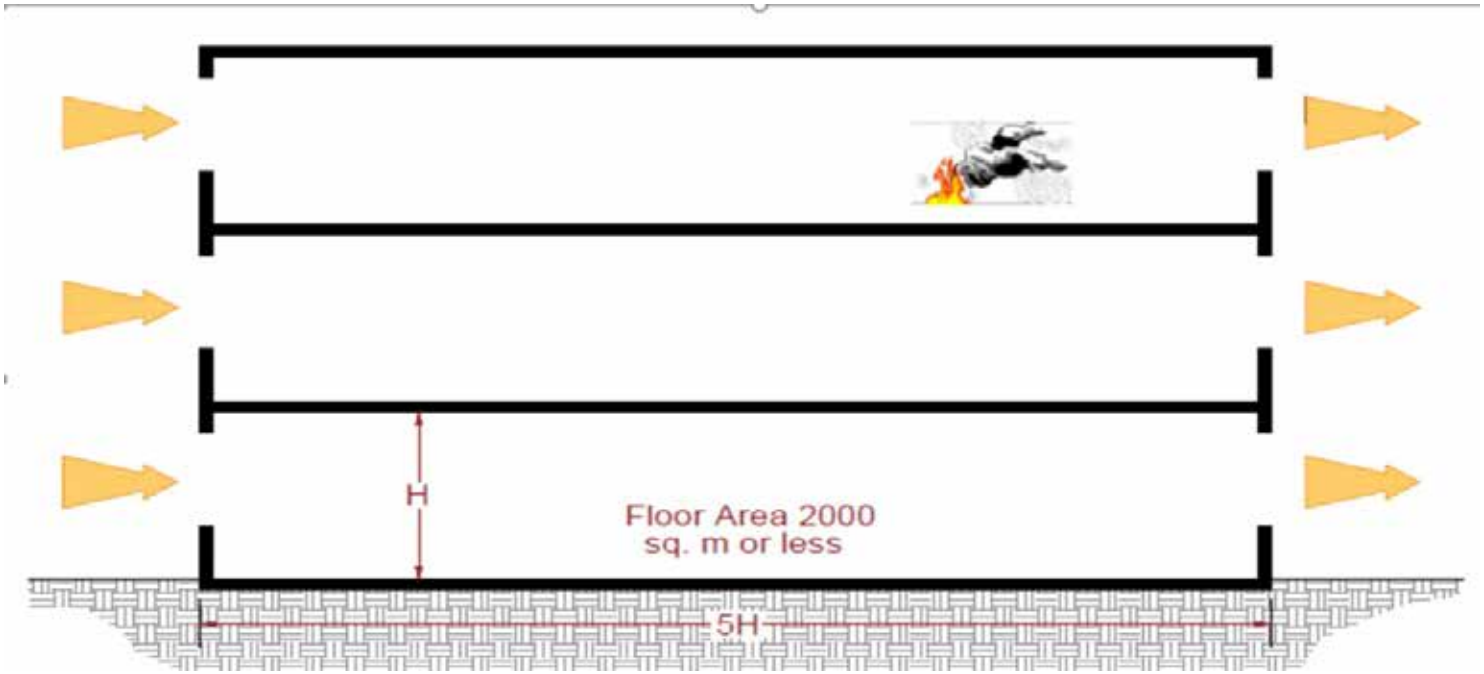

Figure 15A. Naturally Ventilated Car Park

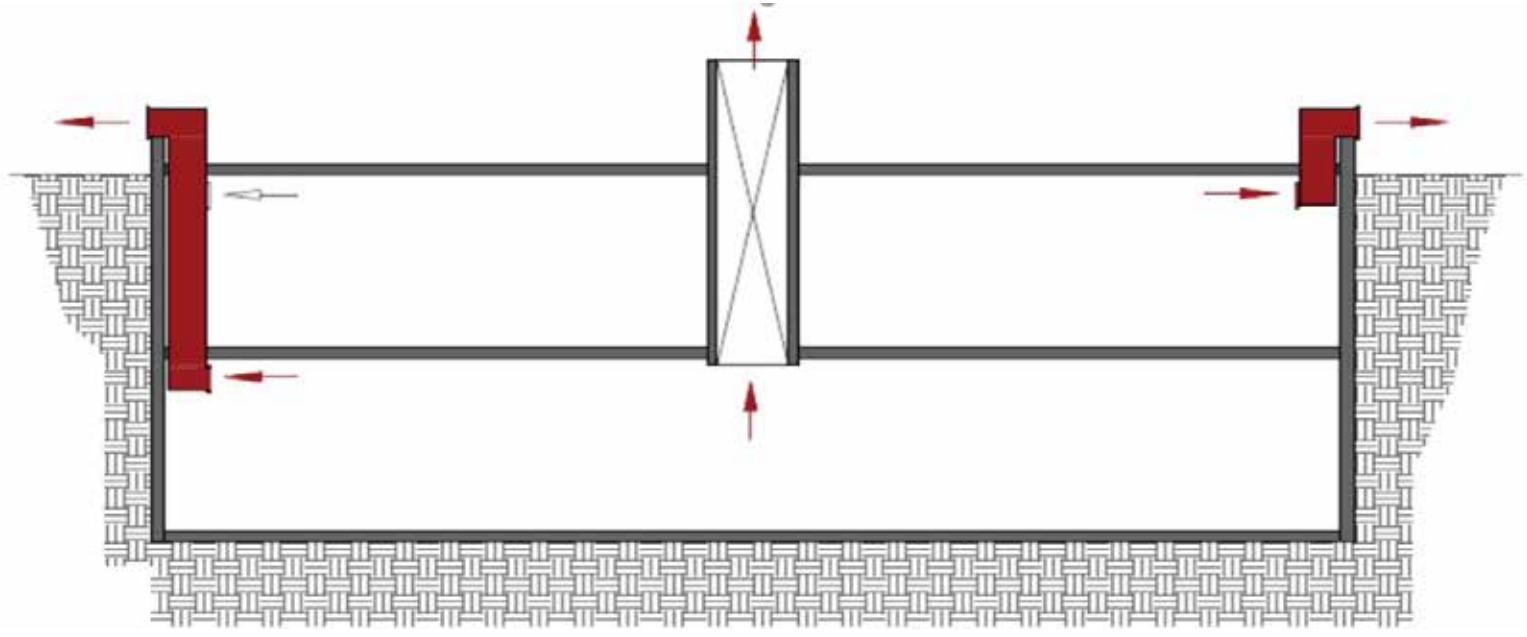

Figure 15B. Natural Ventilation of Employing Exhaust Shafts/Ducts

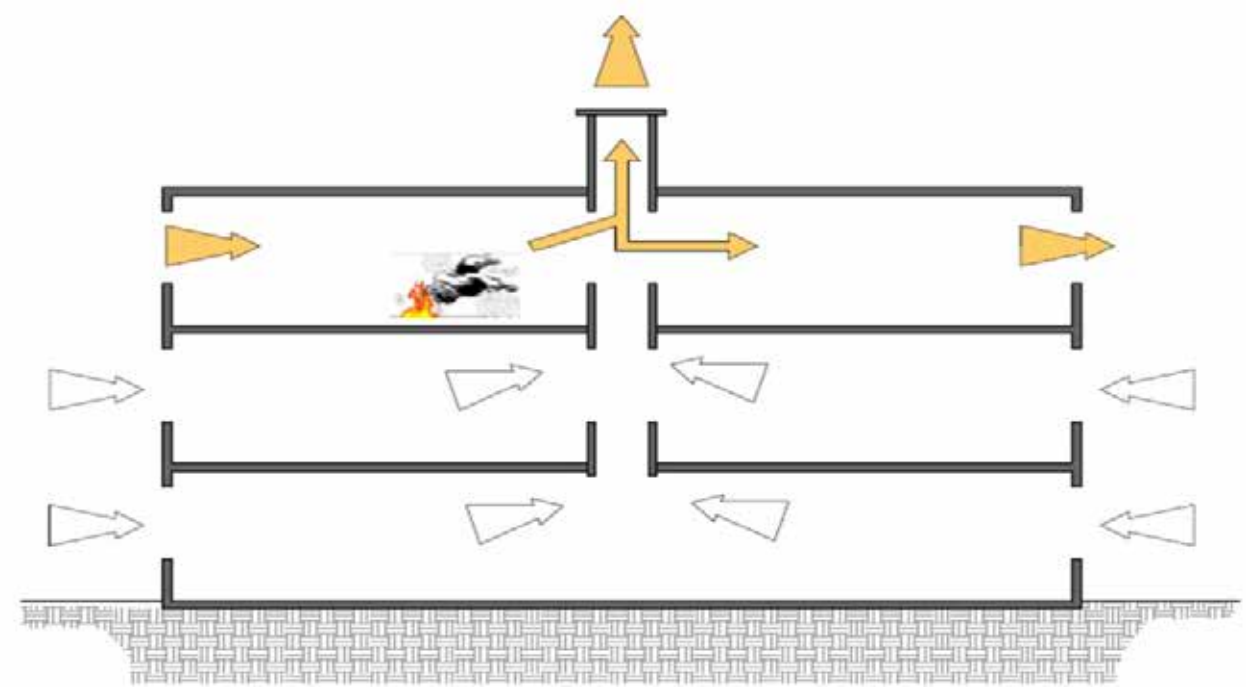

Figure 15C-1. Natural Ventilation with Exterior Openings and Interior Exhaust Shafts

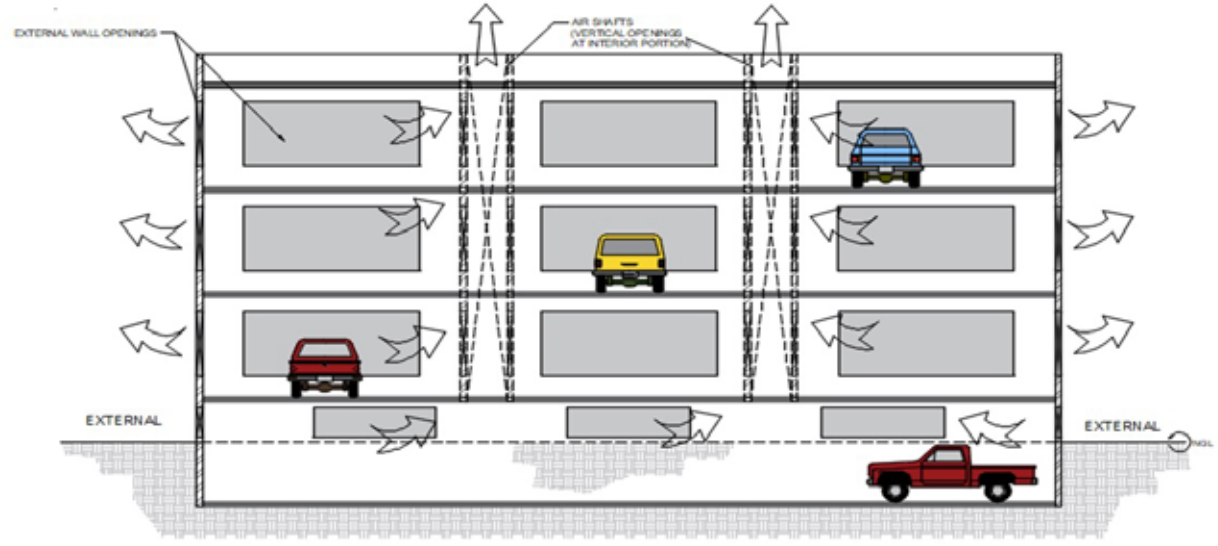

Figure 15C-2. Natural Ventilation with Exterior Openings and Interior Exhaust Shafts

4.11	Atrium and Large Volume Spaces	
4.11.1	Smoke control system designed in accordance with NFPA 92 and this guideline shall be provided for atriums or floor openings in building that connects more than three (3) floor levels.	
	Exemption: Atrium or floor openings in Malls in which provision is required for more than two (2) floor levels.	
4.11.2	Smoke control system where required shall be either by natural means, mechanical or a combination thereof.	
4.11.3	Smoke control system shall be designed based on the following considerations:	
i.	appropriate design fire size	
ii.	maintaining the smoke layer interface above the highest unprotected opening to adjoining spaces, or 1.83 m (6 ft) above the highest walking surface open to the atrium	
iii.	make-up/replacement air supply limited to 1 m/s (200 ft/min) unless a high velocity is supported by an engineering analysis	
iv.	capable to operate for a min. period of twenty (20) minutes or 1.5 times the required safe evacuation time, whichever is less.	

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4.11.4	Design of smoke control systems for spaces with non-uniform cross-sections or complex geometries must be confirmed with the aid of computational fluid dynamics (CFD) programs.	
4.11.5	Natural smoke filling where adopted as means for smoke control shall be accompanied by engineering analysis justifying its viability or application in the building.	
4.11.6	Smoke control and ventilation must be designed according to NFPA 92, ASHRAE and other applicable engineering codes or standards.	
4.12	Machine Rooms, Fuel Tanks Rooms, Rooms Containing and/or Involving Use of Flammable and Explosive Substances	
4.12.1	Mechanical ventilation system designed for general ventilation shall be provided for all areas containing machines, fuel tanks, furnaces, forges, battery charging, storage and use of flammable and explosive substances, and other processes where flammable and explosive gases, fumes, dust or particles are likely to be produced. Ventilation system for these areas may be connected to emergency power supply system but need not be required to be connected to the building's fire alarm system.	
4.12.2	Mechanical ventilation system for rooms containing and/or involving the use flammable and explosive substances shall be independent and dedicated to the room only.	
4.12.3	Ventilation rate shall be as per ASHRAE or manufacturer's recommendation.	
4.12.4	Exhausts shall be direct to external and not less than 5 m away from any air intake openings.	
4.12.5	Ducts running outside the room shall either be enclosed by a structure or be constructed to provide at least the same protection rating as of the room being served or the room where it passes through, whichever is higher.	
4.12.6	Where duct risers are contained in a protective shaft containing ducts for other services, provisions shall be made to compartment the shaft to separate these ducts from the other service installations.	
4.12.7	Emergency ventilation ducts and ducts serving other areas in the building shall not pass through rooms containing or involving use of flammable and explosive substances.	

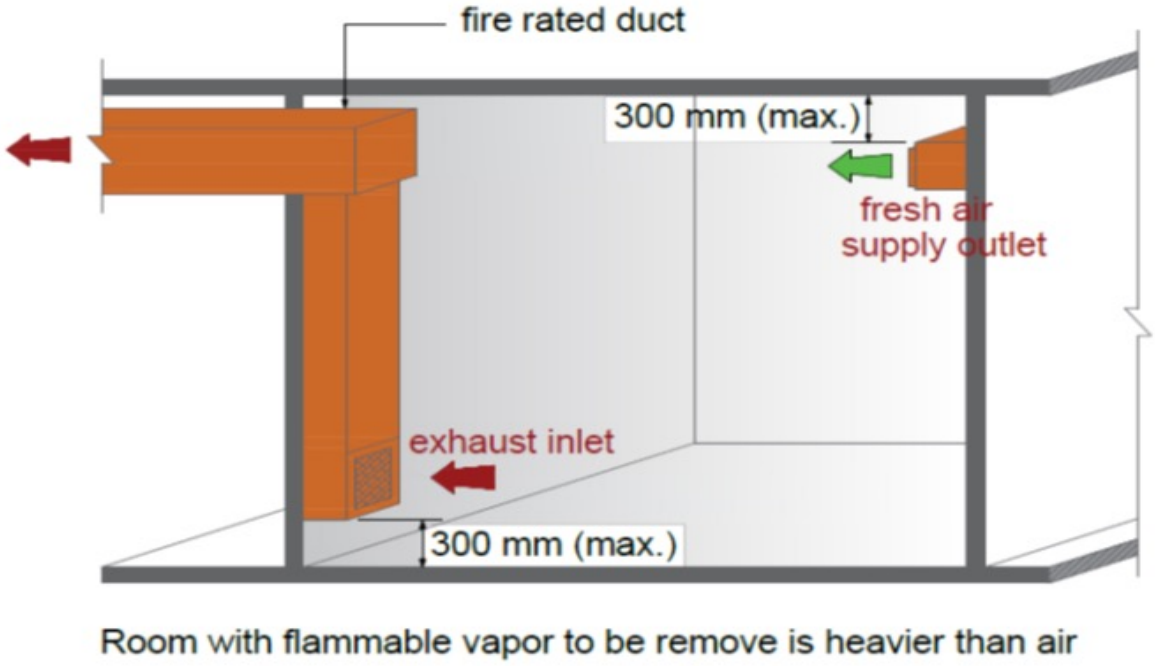

Figure 16. Ventilation for Hazardous Vapor Removal

N1	ANNEX ACMV_N1	Revisions_2021
Item	Provisions	Notes
4.13	Industrial and Storage Buildings	
4.13.1	Smoke control using mechanical ventilation system shall be provided for industrial and storage buildings protected by automatic sprinkler system. Table 4.13A shall be consulted of the type of mechanical system required.	
4.13.2	Open space industrial and storage buildings with large areas shall be divided into separate zones using high level smoke barriers or draft curtains. Smoke control zones shall not exceed 2000 m^2 if naturally ventilated and 2500 m^2 if mechanically ventilated.	
4.13.3	Roof mounted automatic opening vents shall be permitted for industrial and storage buildings protected by automatic sprinkler system where justification through engineering analysis is made that operation of the vents will not cause any disadvantage effect in the sprinkler operation.	
4.13.4	Smoke control for industrial and storage buildings shall be designed to meet the requirement of maintaining the smoke layer at or more than 1.83 m (6ft) above any walking surface in the building. A higher clear layer may be selected where limiting smoke damage to stocks is also desired.	
4.13.5	Fixed openings on roof and external walls for natural dispersal of smoke shall not be permitted in buildings protected by automatic sprinkler system.	
4.13.6	Fixed openings either along the external walls or roof shall be permitted for natural dispersal of smoke in buildings not protected by automatic sprinkler system	
4.13.7	Vents either of the fixed or automatic opening type shall be arranged such that no portion in the building or smoke control zone is farther than the distance specified in Table 4.13B to a vent/opening measured horizontally or projected vertically in the case of roof mounted vents.	
4.13.8	Minimum clear area of openings for the vent shall not be less than 1.5 m^2 with no dimension less than 610 mm (2 ft).	
4.13.9	Supply points for the make-up air shall be located beneath the smoke layer interface. Minimum design depth of smoke layer shall be either of the following:	
i.	Twenty (20) percent of the floor-to-ceiling height	
ii.	Based on engineering analysis	

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Item	Provisions	Notes
4.13.10	For natural ventilation and for combined natural supply-mechanical exhaust ventilation system, make-up or replacement air supply either from openings along external walls or adjacent non-fire zones in a multi-zoned space shall be permitted.	
4.13.11	Smoke control system must be capable of being operated automatically and manually. In buildings protected with automatic sprinkler system, means of initiation shall be such that sprinklers operate first prior to heat or smoke removal in the building.	

TABLE 4.13A. MINIMUM SMOKE CONTROL PROVISIONS FOR INDUSTRIAL AND STORAGE OCCUPANCIES

Location and Compartment Size	BUILDING HEIGHT, CATEGORIES AND CONFIGURATIONS				
	Fire Protection	Hazard Classification			Minimum Requirement
		Low	Ordinary	High	
Aboveground Buildings					
Less Than or Equal to 100 m^2					No Requirement
> 100 to ≤ 500 m^2	Non-Sprinklered	Not Required	Not Required	Required	Smoke Vent of minimum % openings according to Table MV7-2B
	Sprinklered	Not Required	Not Required	Not Required	Smoke Vent of minimum % openings according to Table MV7-2B
> 500 to ≤ 1115 m^2	Non-Sprinklered	Not Required	Required	Not Permitted	Smoke Vent of minimum % openings according to Table MV7-2B
		Not Required	Permitted	Required	Purging System
	Sprinklered	Not Required	Required	Required	Smoke Vent of minimum % openings according to Table MV7-2B
		Not Required	Permitted	Permitted	Purging System
> 1115 to ≤ 2500 m^2	Non-Sprinklered	Not Required	Required	Not Permitted	Smoke Vent of minimum % openings according to Table MV7-2B
		Not Required	Permitted	Required	Purging System
	Sprinklered	Not Required	Required	Not Permitted	Smoke Vent of minimum % openings according to Table MV7-2B
		Not Required	Permitted	Required	Purging System
> 2500 to ≤ 4000 m^2	Non-Sprinklered	Required	Required	Not Permitted	Smoke Vent of minimum % openings according to Table MV7-2B
		Permitted	Permitted	Required	Purging System
	Sprinklered	Required	Required	Not Permitted	Smoke Vent of minimum % openings according to Table MV7-2B
		Permitted	Permitted	Required	Purging System
> 4000 m^2	Non-Sprinklered	Required	Not Permitted	Not Permitted	Purging System
		Permitted	Required	Required	Engineered Smoke Control System
	Sprinklered	Required	Required	Not Permitted	Purging System
		Permitted	Permitted	Required	Engineered Smoke Control System
Belowground Buildings					
Less Than or Equal to 100 m^2					No requirement
> 100 to ≤1115 m^2	Non-Sprinklered	Required	Required	Not Permitted	Smoke Vent of minimum % openings according to Table MV7-2B
		Permitted	Permitted	Required	Purging System
	Sprinklered	Not Required	Required	Required	Smoke Vent of minimum % openings according to Table MV7-2B
		Not Required	Permitted	Permitted	Purging System
> 1115 m^2	Non-Sprinklered	Required	Required	Required	Engineered Smoke Control System
	Sprinklered	Required	Required	Required	Engineered Smoke Control System

Note : Refer to Annex ACMV_N1 for the design and installation requirements of identified smoke control/ventilation provisions.

TABLE 4.13B. VENT SIZES AND DISTANCES

Table MV7-2B. Smoke Vent Sizes and Distance Requirements	
Minimum Total Area of Vents/Openings (% of Floor Area)	*Horizontal Distance from Any Part on the Space to a Vent/Opening (m)
5	15
10	18
15	21
≥ 20	24

Note :

* No portion in the space shall be farther that indicated distance to a vent for a particular vent size.
* Minimum clear area of openings for vent shall not be less than 1.5 m^2 with no dimension (sides or diameter) smaller than 600 mm.
* In building protected by automatic sprinkler system, automatic opening vents (fusible link, motorized/electric) shall be used

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Item	Provisions	Notes
4.14	Basement Smoke Control (Occupancies Other than Car Park)	
4.14.1	Fixed or automatic smoke vents shall be provided where the aggregate floor area of each of the basement storey does not exceed 2000 m^2 and consists of not more than two floor levels only.	
4.14.2	Engineered smoke control system shall be provided where the aggregate floor area of each of the basement storey exceeds 2000 m^2 or consisting more than two floor levels.	
4.14.3	Plant and equipment room, car and equipment storage area, commercial cooking and workshops with floor area not exceeding 280 m^2, compartmented from the rest of the basement floor and have adequate access for fire fighting, shall not be required to have provisions for smoke control.	
4.14.4	Plant and equipment room, car and equipment storage area, commercial cooking and workshops with floor area exceeding 280 m^2 but not exceeding 2000 m^2 shall be provided smoke vents or smoke purging system at the minimum rate of 10 ACH.	
4.14.5	Smoke venting or smoke purging at the rate of 10 ACH shall be acceptable in lieu of an engineered system for compartmented service areas such as laundries, office and store rooms (restricted to occupants or staff).	
4.14.6	Purging system shall be activated by the building fire alarm system. Provision for remote manual activation/ deactivation shall be provided at the fire command center or location approved by QCDD.	
4.14.7	Number and sizes of vents shall be such that aggregate vent openings are equivalent to not less than 2.5% of the area of the floor being served. No smoke vent shall be smaller than 610mm (2 ft) in diameter or any of its sides.	
4.14.8	Vents shall be distributed along the perimeter, on the sides (e.g. below ground partially sunken basement) or ceiling level with the vents spaced no farther than 30 m from each other and that no portion on the floor is farther than 15 m to a vent.	
4.14.9	Where ducts are required to connect vents to discharge outlets, the duct shall either be enclosed in structure or constructed to give at least one (1) hour fire resistance.	
4.14.10	Separate vent outlets shall be provided for each floor level.	
4.14.11	Vents shall discharge directly to external with its outlet located at least 5 m from any air intakes into the building.	
4.14.12	Smoke vents which are kept closed during normal or non-fire condition shall be designed to operate automatically.	
4.14.13	Basement protected by approved automatic sprinkler system, the provision of smoke vents shall be designed such that it does not affect the sprinkler activation.	
	Reserved.	

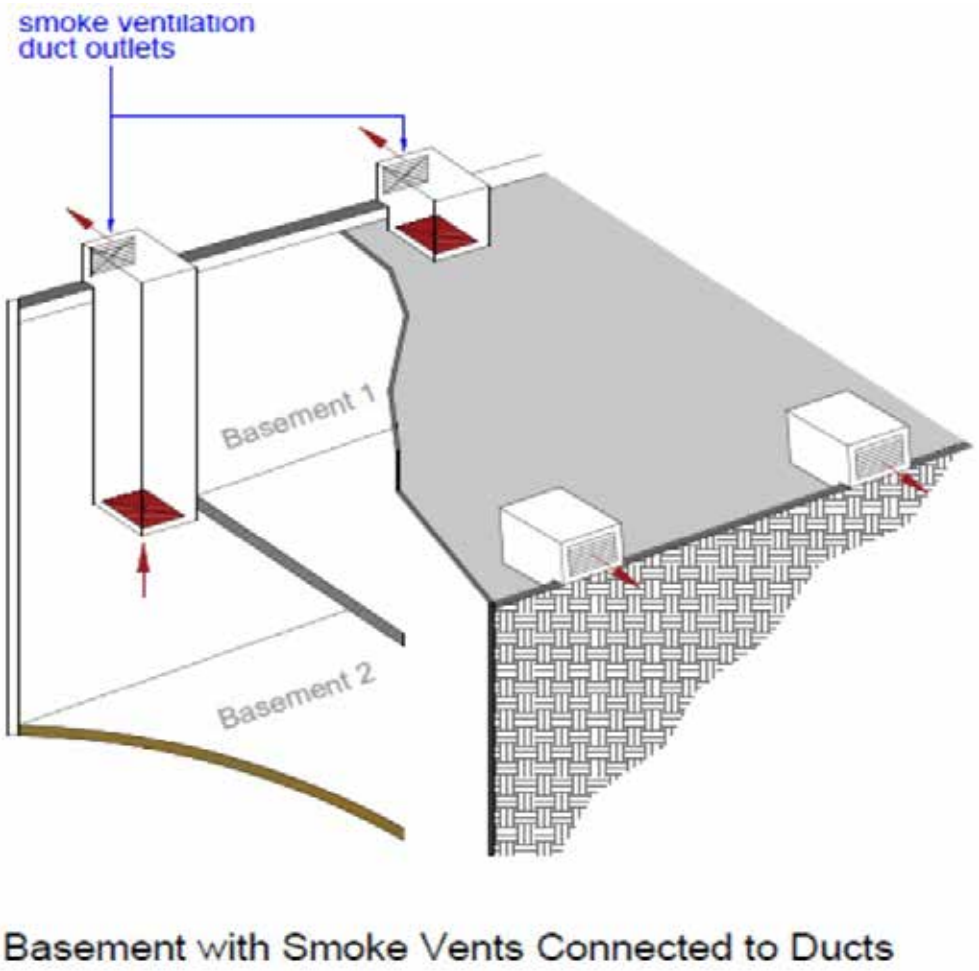

Figure 17. Basement with Smoke Vents Connected to Ducts

N1	ANNEX ACMV_N1	Revisions_2021
Item	Provisions	Notes
5.0	**Fire Command Center, Fire Pump and Generator Room**	
5.1	Fire Pump Room and Generator Room	
	Where located within the building, independent and dedicated ventilation system shall be provided for the fire pump room and generator room.	
5.1.1	Where provided, mode of mechanical ventilation of the fire pump room and generator room shall comply with the following:	
i.	Continuous or intermittent ventilation at the rate of 6 ACH during which fire pump or generator is not operating.	
ii.	Ventilation at the rate of 10 ACH when the fire pump or generator is operating	
5.1.2	Exhaust fans shall be rated for hot gases at minimum of 250 °C for 2-hrs.	
5.1.3	Supply air shall be drawn directly from external with its intake point located at least 5 m from any exhaust discharge openings.	
5.1.4	Mechanical ventilation system ductworks shall be independent of any system ductworks serving other parts of the building. Any part of the of the system ductworks that runs outside room being served shall either be enclosed or constructed to provide fire protection rating of at least 2-hrs.	
5.1.5	Where duct risers are required to be contained in a protected shaft, they shall be separated or provisions shall be made to compartment them from other ducts or service installations within the shaft space.	
5.1.6	Emergency ventilation ducts, air-conditioning and general ventilation ducts serving other areas in the building shall not pass through the fire pump room or generator room	
5.1.7	Mechanical ventilation system for the generator and fire pump room shall have provisions for secondary or emergency power supply.	
	Reserved.	
5.2	Fire Command Center (FCC)	
5.2.1	Air-conditioning and ventilation system where required for the Fire Command Center (FCC) shall have ductworks independent of any system ductworks serving other parts of the building. Any part of the of the system ductworks that runs outside of the FCC being served shall either be enclosed or constructed to provide fire protection rating of at least 2-hrs.	
5.2.2	Where required, mechanical ventilation of the fire command center shall either be one of the following:	
i.	pressurizing the room through supply mode only at 10 ACH	

N1	ANNEX ACMV_N1	Revisions_2021
Item	Provisions	Notes
ii.	ventilation at the minimum rate of 6 ACH with both supply and exhaust directly from and to external of the building	
5.2.3	Mechanical ventilation shall be independent and dedicated to the room only.	
5.2.4	No other ventilation ducts, except those for the protection of the room shall pass through the fire command center room.	
5.2.5	Reserved.	
6.0	**Kitchen Exhaust System**	
6.1	Exhaust system for kitchens in hotels, food courts, restaurants and the likes shall be independent of those serving other parts of the building and shall comply with the following requirements	
i.	Hoods and ducts for exhausts shall be installed no closer than 500 mm from any unprotected combustible materials or items in the space	
ii.	Ducts for kitchen exhaust system shall have at least 1 hour fire protection rating.	
iii.	Exhausts shall discharge directly to external far from any air intake openings by at least 5 m.	
iv.	Exhausts ducts that runs outside of the kitchen shall either be enclosed in a structure or be constructed to provide at least the same fire protection rating as of the kitchen enclosure or that of the space where its passes through, whichever is higher.	
v.	Where exhaust duct risers are required to be contained in a protected shaft, they shall be separated or provisions shall be made to compartment them from other ducts or service installations within the shaft space.	
vi.	Fire damper shall not be fitted in kitchen exhaust ducts.	
6.2	Common kitchen exhaust system shared by number of small restaurants, food and beverage outlets and the likes shall be permitted provided the following requirements and conditions are meet:	
i.	The kitchens are located within the same storey or floor level.	
ii.	The aggregate floor area of the restaurant, food and beverage does not exceed 1000 m^2.	
iii.	The aggregate area or zone served by the common kitchen exhaust system does not exceed 2000 m^2. The length of the zone containing the group of restaurants, food and beverage outlets does not exceed 50 m	
6.2.1	Sharing of kitchen exhaust system in food courts shall be permitted where the food court is under a single ownership/operator. This is ensure that no confusion arises as to who is responsible for the maintenance of the whole system or any part thereof.	

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6.3	Kitchen exhaust ducts that runs outside of the building shall be located with a minimum horizontal separation distance of 3 m to an unprotected opening that is oriented perpendicular to the duct. A minimum separation distance of 1.5 m shall likewise be provided where the exhaust duct and unprotected opening are on the same plane.	
6.3.1	The kitchen exhaust duct shall be shielded with a construction having at least 1/2 hr fire protection rating where the above separation distance requirements are not meet.	
6.4	Kitchen exhaust ducts shall be located from unprotected LPG cylinders with a separation distance of at least 3m. Similarly, kitchen exhaust ducts shall be located no less than 600 mm from vaporizer or any liquid phase LPG pipeline	
6.4.1	Above separation distances shall be permitted to be decreased where kitchen exhaust ducts have fire protection rating of not less than 2-hrs or the LPG cylinders are enclosed in a construction of minimum 2-hrs protection rating.	
6.5	Maintenance, cleaning and degreasing of kitchen hood and exhaust ducts shall be performed on a regular basis at least once every year.	
6.6	Reserved.	
7.0	**Substation.**	
7.1	Control rooms, switchgear rooms and cable spreading rooms should have provisions for smoke venting or dispersal.	
7.2	Smoke exhaust ventilation shall be provided in belowground or basement levels.	
7.3	Fire damper shall be provided at location where ducts passes through fire rated walls, partitions and floors.	
7.4	Ducts shall not pass through designated exit staircase.	
	Reserved.	
8.0	**Battery Rooms.**	
8.1	Battery rooms shall be provided ventilation to limit concentration of hydrogen to below 1 percent of the volume of air in the room. Related air inlets and outlets of the ventilation system shall be located and adequately distributed so that no stagnant regions in the space being ventilated occurs.	
8.2	Adequate hydrogen gas detectors shall be provided inside the room for monitoring hydrogen concentration and activating ventilation system when necessary to ensure the allowable hydrogen concentration in the room is not exceeded. Display panels showing status and readings of detectors shall be located outside near entrance to the room.	

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8.3	Fire damper shall not be fitted in the essential ventilation system ducts. Ducts that have to pass through other compartment shall have 2-hrs protection rating.	
8.4	Essential fans and associated electrical controls shall have provisions for secondary power supply.	
8.5	Air-conditioning and general ventilation system for the battery room should be independent and dedicated for the room only. Where inevitable and to be derived or shared from system serving other areas in the building, only supply of the needed air requirement shall be sourced from the shared unit/s. No provisions for return or air recirculation shall be made where air-conditioning and ventilation is derived from shared units. .	
	Reserved.	
9.0	**Smoke Control Panel.**	
9.1	The fire fighter's control panel shall provide control capability over the equipment of the smoke control system in the building by:	
i.	ON-AUTO-OFF control over individual equipment of the smoke control system that can also be controlled from other sources in the building	
ii.	OPEN-AUTO-CLOSE control over individual dampers relating to smoke control system that can also be controlled from other sources in the building.	
iii.	ON-OFF or OPEN-CLOSE or START-STOP control over smoke control system and other critical equipment associated with fire or smoke emergency and that can only be controlled from the fire fighter's control panel	
9.2	Switch for manual control of the system shall be of rotary selector type	
	Reserved.	
10.0	**Equipment.**	
10.1	Equipment such as, but not limited to, fans, ducts, dampers, control units and devices shall be listed, suitable for its intended use and approved by QCDD.	
10.2	All smoke control system equipment shall be installed in accordance with its listing and manufacturer's recommendations.	
10.3	Equipment, control wiring, power wiring and ductwork for smoke proof enclosure protection must be located in accordance with one of the following:	

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i.	Exterior to the building and directly connected to the smoke proof enclosure or connected to the smoke proof enclosure by ductwork enclosed by 2 hours fire barriers or horizontal assemblies.	
ii.	Located in the smoke proof enclosure with the intake or exhaust directly from and to external or through ductwork enclosed in 2-hours fire barriers or horizontal assemblies.	
iii.	Located within the building, separated from the remainder of the building by 2-hours fire barriers or horizontal assemblies.	
10.4	Any duct that are part of the pressurization system must be protected with at least the same fire resistance rating as required for the space being served.	
10.5	Smoke exhaust fans shall be capable of operating effectively at 250 °C for 2 hours or 300°C for 1 hour.	
10.6	Mechanical smoke control systems that are designed as a combined system or which are used to serve multiple smoke control zones (e.g. stairwell and its associated smoke-stop lobby) shall have both a standby power supply and equipment, such as standby fan.	
i.	One additional fan is required as standby fan for each system feed by a single fan.	
i.i	Where a particular control zone is being protected by a mechanical smoke control system having two or more fans of equal capacity, the system could be backed up by an additional fan having the same capacity of the other fans.	
iii.	Where a particular control zone is being protected by a mechanical smoke control system having more than one fan of different capacities, the system could be backed up by an additional fan having the same capacity as of the largest fan.	
10.7	Variable supply fans or dampers used in controlling airflow to meet pressure differential requirements shall have the capability of achieving between 90% and 110% of the new volumetric requirements within five (5) seconds of a door being opened or closed.	
10.8	Wiring and cables to be used for smoke control application shall be fire rated with minimum fire resistance rating of 2-hrs.	
	Reserved.	
11.0	**Fire Dampers, Smoke Dampers, Combination Fire-Smoke Dampers**	
11.1	Only listed and approved fire dampers, smoke dampers and combination fire-smoke dampers shall be used for fire protection applications. Its application shall include the following :	
i.	Fire Walls	

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ii.	Fire Barriers	
iii.	Fire Partitions	
iv.	Smoke Barriers	
v.	Smoke Partitions	
	*Fire dampers are required where ducts penetrates fire barrier (have 2hrs or higher fire resistance ratings).	
	*Smoke dampers are required where ducts penetrate fire partitions or smoke barriers (normally have 1 hr fire resistance ratings)	
	*Combination fire smoke dampers are required where ducts penetrates barriers serving both purpose as fire barrier and smoke barrier; e.g. shaft enclosure	
11.2	Fire damper installation shall be as follows:	
i.	Walls, partitions or floors with less than 3 hrs fire resistance ratings : (*2 hrs fire damper where available), 1 ½ hr fire damper.	
ii.	Walls, partitions or floors with 3 hrs or more fire resistance ratings : 3 hrs fire damper	
11.3	Modification of fire or smoke damper in the field shall not be allowed unless the same is determined suitable by the testing and approving authorities.	
11.4	Installed fire dampers, smoke dampers or fire-smoke dampers shall be accessible for inspection and servicing.	
	Reserved.	
12.0	**Detection and Control Systems**	
12.1	Fire detection systems required to provide control signals to mechanical smoke control systems or elements thereof shall conform with NFPA 72. Such detection systems together with its control units shall be listed for smoke control applications and its specific use.	
	Reserved.	
13.0	**Smoke Control System Activation**	
13.1	Automatic activation of smoke control systems shall be through one or more of following initiating methods:	
a.	Sprinkler water flow switch	
b.	Smoke detection system	

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c.	Heat detection system	
	Analysis on the possible effect of the smoke control (ventilation) system on the sprinkler system response shall be considered in the design.	
13.2	Provisions for manual activation/deactivation or override shall be provided for all smoke control systems. Manual switches shall be of rotary selector type and shall be located in the fire command center or location agreed with the authority having jurisdiction.	
	Reserved.	
14.0	**Power Supply System**	
14.1	Smoke control systems shall be supplied with two (2) power sources. Primary power shall be from the normal building power supply system but shall have separate or independent connection from the building non-fire safety related installations. Secondary power supply shall be from an approved standby power supply system complying with NFPA 101.	
14.2	Transfer from the normal to full standby power shall be automatic and within 60 seconds of failure of the primary power supply.	
14.3	Wiring for operation and control of smoke control systems shall be connected ahead of the main disconnect and protected against possible exposure to fire.	
15.0	**Inspection and Acceptance Testing**	
15.1	The acceptance testing of smoke control systems must be carried out in the presence of a QCDD inspector. Each smoke control system shall be inspected and tested in accordance with NFPA 92, ASHRAE Guideline 1.5 and other relevant standards acceptable to QCDD.	
	Reserved.	