TAYLOR'S UNIVERSITY

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SCHOOL OF ARCHITECTURE, BUILDING & DESIGN

Centre for Modern Architecture Studies in Southeast Asia (MASSA)
Bachelor of Science (Honours) (Architecture)

BUILDING SERVICES (ARC 2423)

Project 2: Case Study and Documentation of Building Services Systems

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1.0 Introduction

Figure 1.1 Swiss Inn

Swiss-Inn Johor Bahru is located in the heart of Johor Bahru and is one of Malaysia's most important business and tourist spot. Offering up to 206 rooms which varies from Tatami style and standard rooms to family suites, the hotel gives the users choices of different rooms following their budgets. The hotel is also a mere 5-minute walk from Persada Johor and CIQ Johor. The strategic location of Swiss-Inn Johor Bahru allows Singaporeans to visit this place in 20 minutes whilst Legoland, Hello Kitty and Little Big Club Theme Park are just 25 minutes away.

1.1 Abstract

This research report will be based on the study of the basic building services in Swiss Inn, Johor Bahru such as fire protection system, air-conditioning system, mechanical ventilation system, and mechanical transportation system. A site visit was carried out for us to have a real-life experiential learning. This report will cover all the building services mentioned above in details and explains how each of the components function through photos from the site.

1.2 Acknowledgement

Figure 1.2 Group photo with Mr.Asrul

We would like to express our deepest appreciation to those who has provided us the possibility to complete this report. We would like to thank Mr. Asrul, the Security Manager of Swiss Inn, Johor Bahru who had provided good hospitality during our visit and sacrificed his time to bring us around the building, explained how each systems work. Besides, we would also like to thank Ir. Chan which gave us the opportunity to get Swiss Inn as our case study.

Furthermore, we would like to thank our tutor, Mr. Sivaraman in guiding us in this project. Lastly, of course we would like to thank each of the member in giving full cooperation and never hesitate to help each other in this project.

2.0 Fire Protection System

2.1 Introduction

In this chapter, fire protection system of Swiss Inn hotel, Johor Bahru will be analysed and will be further discuss about. Fire protection refers to measures taken to prevent fire from becoming destructive, reduce the impact of uncontrolled fire and save lives and property. It is a very important system especially in such big building as it ensures the user's safety and security.

Both active and passive fire protection systems are being studied here and explained in a detailed manner. It will be further discussed and will be compared to the rules and regulations from the UBBL. This research paper had concluded the analysis. Last but not least, recommendations and improvements are also suggested.

2.2 Literature review

2.2.1 Nature and Structure of Fire

Fire is a very important element in our daily life, but like any other things it has both positive and negative sides. If we do not understand it well and if it is not carefully taken care of it will threaten our assets, liability and even our life. So it is very crucial that we must understand it thoroughly and use it carefully to prevent accidents from happening.

Figure 2.1: Fire Diagram

In order to produce fire, there are three things that need to be present:

a. Fuel
b. Heat (High Temperature)
c. Oxygen

Fire started with the three elements stated above, when all three were gathered together, fire will ignite, and then it will grow rapidly. A rapid growth of

fire will cause development stage to happen, temperature at this stage increases slower but if it spreads to another area the cycle will begin again. Fire will only decay when it's lack of fuel and oxygen. But a sudden rush of oxygen like breaking a window can reignite the fire with explosive violence.

2.2.2 Active & Passive Fire Protection System

The reason fire protection system exist is for protecting human's life. Life safety should be the ultimate consideration in building design; therefore aspects such as means of escape, spreading of fire from one building to another, means of detection and extinguishment of fire must be taken care of.

There are two types of fire protection:

a. Active Fire Protection System

Active fire protection system is simply the method or the procedure of preventing a building from fire burning by using either manual or automatic operated fire mechanical system. This is to provide and ensure the safety of all users in that particular building.

Sone common functions every fire protection system shares are slowing down the burning process in a building, extinguishing the fire and to alert the fire and smoke condition.

It is also important to learn that some active fire protection systems actually require human to operate it manually. Without any signals or responses, active fire protection system will never function the way it should be.

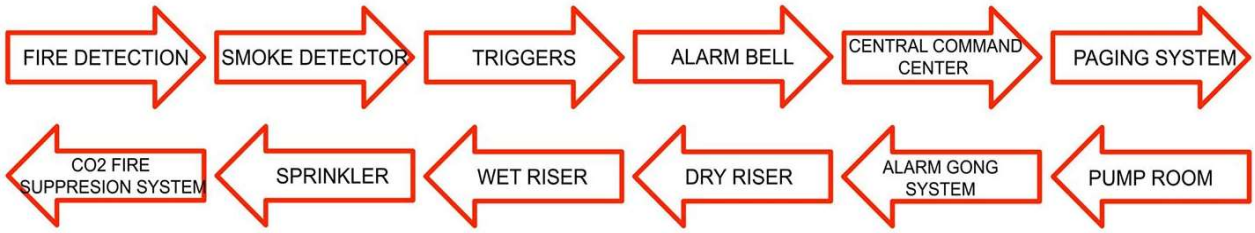
b. Passive Fire Protection System

Passive fire protection system on the other hand delays the speed of combustion and smoke spreading and at the same time protecting the escape routes in order to prolong the time taken to escape. This system can be done by modifying and altering the architectural elements with fire resistances characteristic.

Compartment of space with fire rated building components and the design means of escaping are two crucial parts in this system. Compartments such as doors, walls and ceilings should be brought into consideration in order to avoid fire from spreading, using fire rated components in this case. By having fire proof elements for these compartments, fire will spread very slowly and the chances of people surviving will be much higher.

Fire escape as listed above is also one of the major design factors to determine the method and effectiveness of escaping out of the building during an event of emergency. Some of the ways to support it includes emergency exit signs, emergency staircase design and also the escaping distance.

2.3 Active Fire Protection System



2.3.1 Smoke Detector

Figure 2.2: Smoke Detector

According to UBBL 1984 Section 153: Smoke detectors for lift lobbies.

(1) All lift lobbies shall be provided with smoke detectors.

(2) Lift not opening into a smoke lobby shall not use door reopening devices controlled by light beam or photo-detectors unless incorporated with a force close feature which after thirty seconds of any interruption of the beam causes the door to close within a preset time.

A smoke detector is a device used to detect the existence of smoke. It is widely used in many places due to the fact that it is very useful as an active fire protection device and at the same time, very easy to obtain. There are two basic parts to a smoke detector: a sensor to sense the smoke and a very loud electronic horn to wake people up. Smoke detectors can run off of a 120-volt house current or a 9-volt battery, it all depends on how the devices are planned for the building.

Smoke detectors are used in almost every building because it is very important in case of a fire. There are two types of smoke detector, Ionization Detector & Photoelectric Detector:

1) In an Ionization smoke detector, there is an ionization chamber with two plates. The battery will then send voltage to these plates, charging one of them positive and the other one negative. When smoke enters in between these plates, it disrupts the ionization process between the 2 plates, cutting off the current between these two plates, triggering the alarm.

2) In a Photoelectric smoke detector, the alarm contains an Infrared LED and a Photodiode Light Receptor. The LED will then pulses a beam of light into the sensor chamber for every 10 seconds to check for smoke particles. When smoke enters, the smoke particles disrupts and scatters the light onto the Photodiode Light Receptor, signal will then sent to the integrated circuit that is connected to the alarm, triggering it and causing the alarm to go off.

2.3.2 Triggers

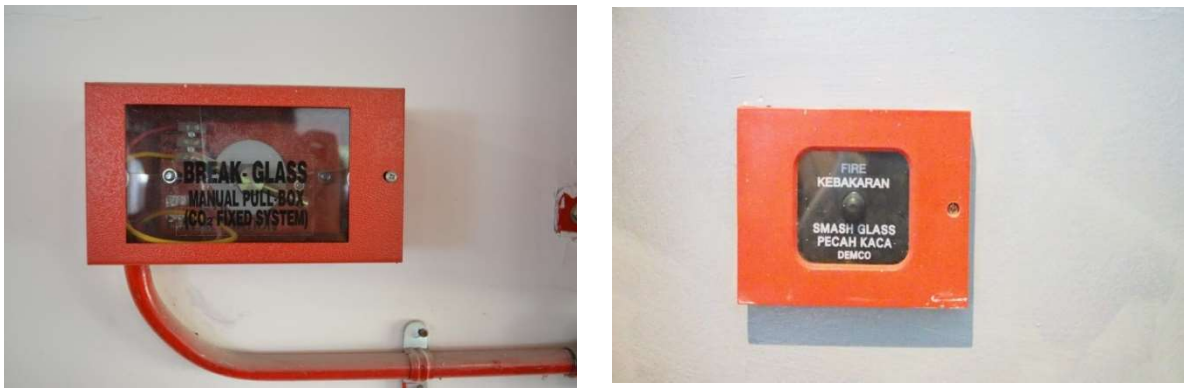


Figure 2.3: Break Glass Alarm

2.3.2.1 Manual Call Point

The Manual Call Point (a.k.a. Manual Pull Point or Break Glass Alarm) allows the occupants to signal other users in the building that a fire or emergency exist by triggering an alarm. First, the user has to break the protective glass. The glass is to prevent people from simply pulling, or activating the trigger, creating a false alarm. Creating a false alarm is a very irresponsible act to everyone in the building because it causes nuisance to people and may divert emergency responders away from genuine emergencies. After pressing the emergency button (sometimes a pulling pin trigger or a pull lever), the alarm will go off, alerting everyone in the entire building about the emergency.

Analysis

Break glass alarms are usually placed at the stairs to easily allow people to trigger the break glass when there is fire emergency. Especially on those hotel room floors, the fire alarm break glass are specially prepared in the emergency staircase.

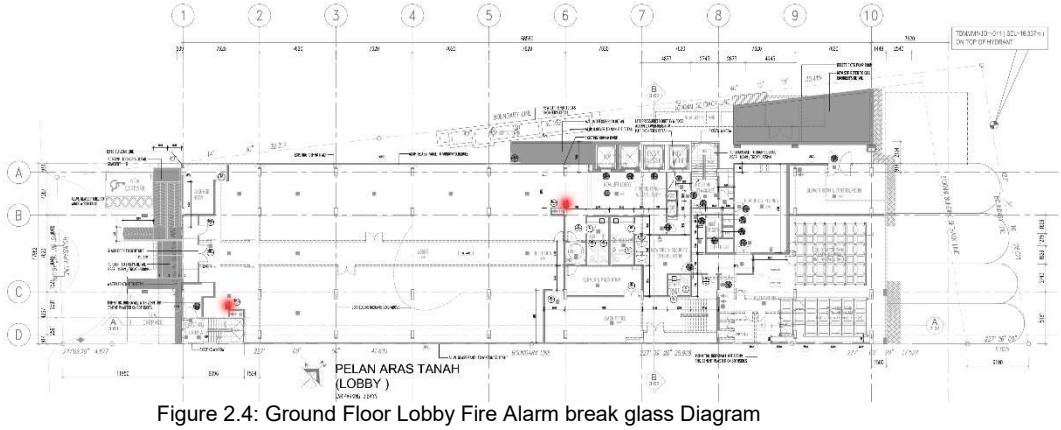


Figure 2.4: Ground Floor Lobby Fire Alarm break glass Diagram

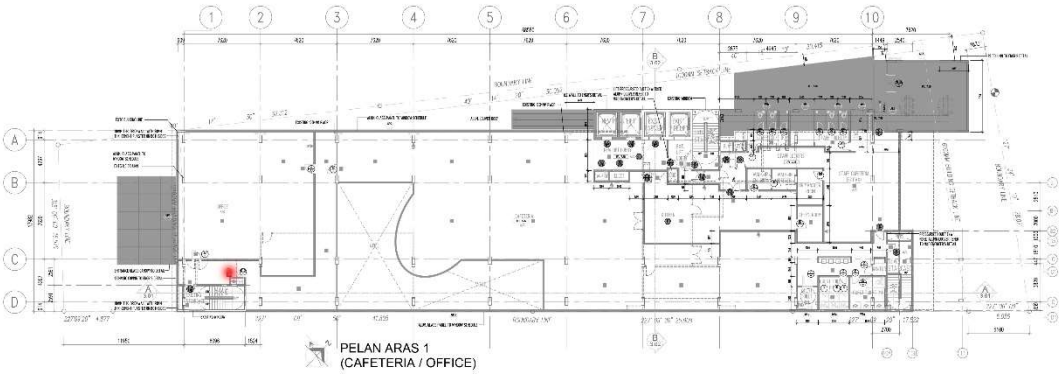


Figure 2.5: First Floor Café Fire Alarm break glass Diagram

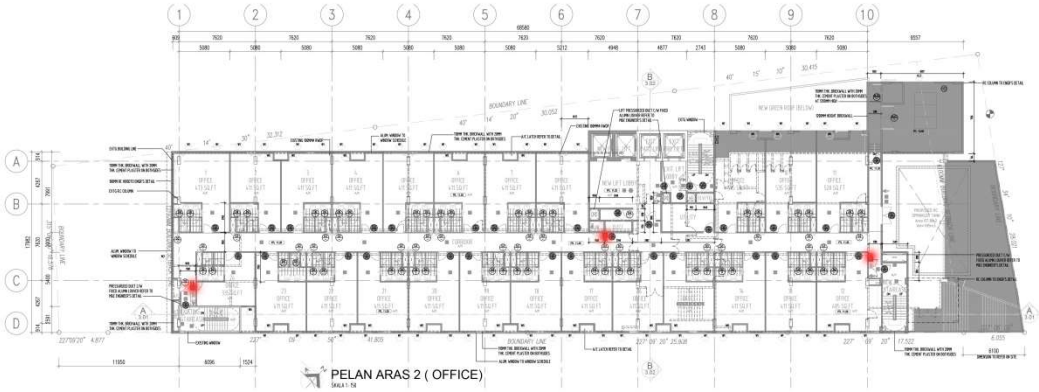


Figure 2.6: Second Floor Office Fire Alarm break glass Diagram

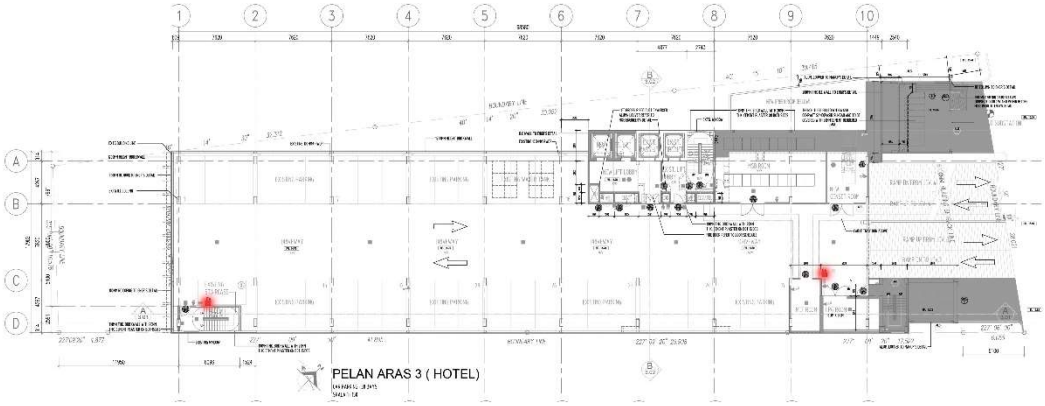


Figure 2.7: Third Floor Parking Lot Fire Alarm break glass Diagram

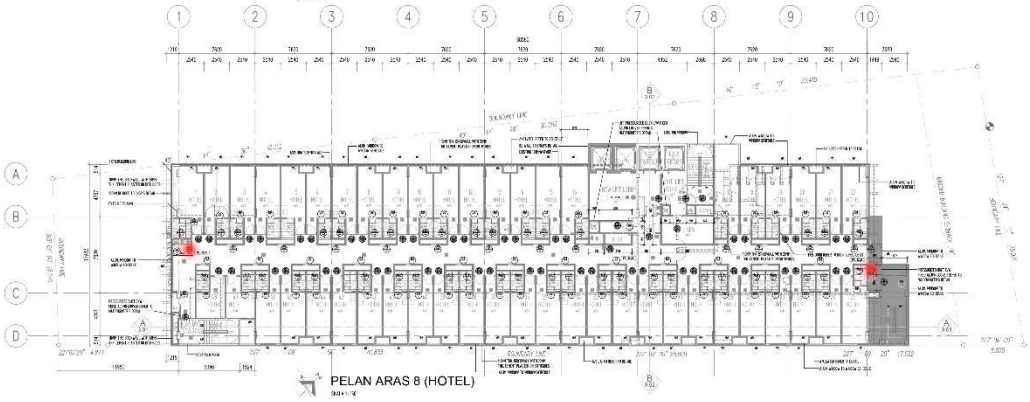


Figure 2.8: Eight Floor Hotel Room Fire Alarm break glass Diagram

Figure 2.9: Fire Intercom

2.3.2.2 Fire Intercom System

The Fire Intercom System must be built on every single floor of the building. All the intercom systems are linked to a Master Console (a.k.a. Remote Handset Station or Central Command Centre). The fire control room will usually have a Master Control Panel and a Remote Handset to the system. When the Fire Intercom System receives a call, the alert lamp will flash at the Master Control Panel and an audible signal can also be heard. To turn off the audible signal, simply lift the Remote Handset. There is also a Fault Indicator Unit which is used to indicate the type of fault from the Master Control Panel.

Analysis

The fire intercom system are mostly placed at the staircase too so in any case of emergency, immediate alert can be sent to the master console, so the occupants does not have to run all the way to the security room to announce the emergency.

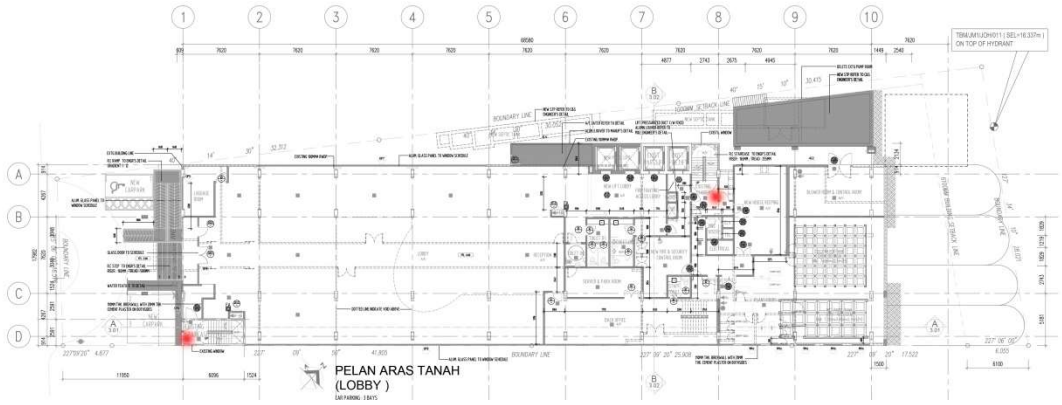


Figure 2.10: Ground Floor Lobby Fire Intercom Diagram

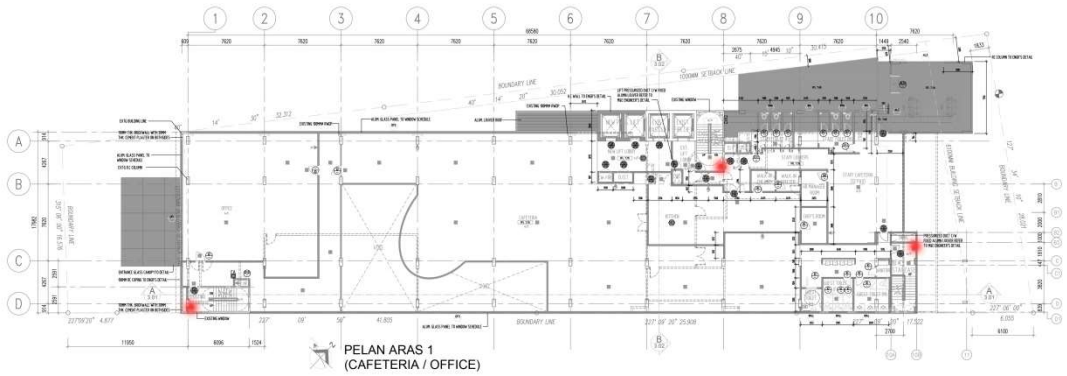


Figure 2.11: First Floor Lobby Fire Intercom Diagram

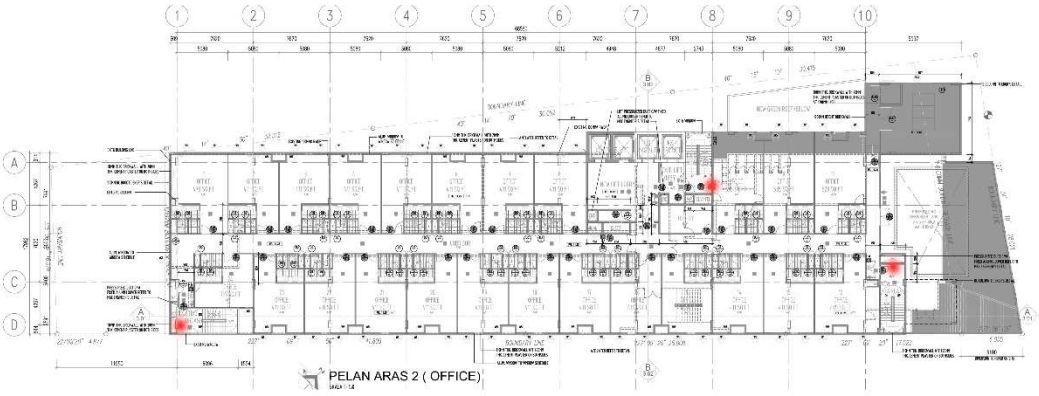


Figure 2.12: Second Floor Office Fire Intercom Diagram

Figure 2.13: Third Floor Parking Lot Fire Intercom Diagram

Figure 2.14: Eight Floor Hotel Room Fire Intercom Diagram

2.3.3 Alarm Bell

Figure 2.15: Alarm Bell

According to UBBL 1984 Section 237: Fire alarms.

(1) Fire alarms shall be provided in accordance with the Tenth Schedule to these By-laws.
(2) All premises and buildings with gross floor area excluding car park and storage areas exceeding 9290 square metres or exceeding 30.5 metres in height shall be provided with a two-stage alarm system with evacuation (continuous signal) to be given immediately in the affected section of the premises while an alert (intermittent signal) be given in adjoining section.
(3) Provision shall be made for the general evacuation of the premises by action of a master control.

The alarm bell is a device that creates loud alert noise when triggered. It functions by means of an electromagnet, consisting of coils of insulated wire wound round iron rods. Once electric is applied, the current will flow through the coils. The rods will then become magnetic and attract a piece of iron attached to a clapper. Once the clapper hits the bell, it will create a repetitive loud ringing sound.

2.3.4 Central Command Center (Fire Alarm Panel)

Figure 2.16: Fire Alarm Panel

According to UBBL 1984 Section 238: Command and control centre.

Every large premises or building exceeding 30.5 metres in height shall be provided with a command and control centre located on the designated floor and shall contain a panel to monitor the public address, fire brigade communication, sprinkler, waterflow detectors, fire detection and alarm systems and with a direct telephone connection to the appropriate fire station by-passing the switchboard.

The Central Command Center (a.k.a. Fire Alarm Control Panel or Fire Alarm Control Unit) is the controlling component of a fire alarm system in a building. The Command Center collects data from all the sensors designed to identify changes related to fire, monitors their functioning integrity and provides for automatic control of equipment, and transmission of data needed to prepare the facility for fire based on a programmed order. The center can also supply electricity to activate any connected sensor, transmitter, control or relay.

The general requirements for fire control room are:

A) Have a minimum floor area of 102, can be larger depending on the equipment required

B) Be sited near the main entrance to the building's main lobby in a designated room

C) Preferably be adjacent to a fire lift lobby or any other location as designated by the relevant authority

D) Be accessible via 2 paths of travel. One form the front entrance and the other form a public place or fire-isolated passageway, which leads to a public space and has a two-hour fire rated door

E) Have an independent air handing system if mechanical ventilation is provided throughout the building

F) Be adequately illuminated to not less than 400 lux

G) Provide the ability to communicate (e.g. via telephones and loudspeaker) with all parts of the building, and with fire and other emergency services

H) Be provided with insulation from ambient building noise

I) Be under the control of the chief fire warden (or similar appointed person)

A fire control room must contain the following facilities:

A) Automatic fire alarm and sprinkler indicator board with facilities for sounding and switching off alarms and visual status indication for all relevant fire pumps, smoke control fans, air-handling systems, generators and other required fire safety equipment installed in the building depending on the circumstances and the system present in each building

B) A telephone connected directly to the external exchange.

C) The control console of the Emergency Warning and Intercommunication System (EWIS)

D) A blackboard or whiteboard not less than 1200mm

E) A pin board not less than 1200mm wide x 1000mm high

F) A raked plan layout table of a size suitable for laying out the building plans

G) A repeater panel of the lifts position indicator board

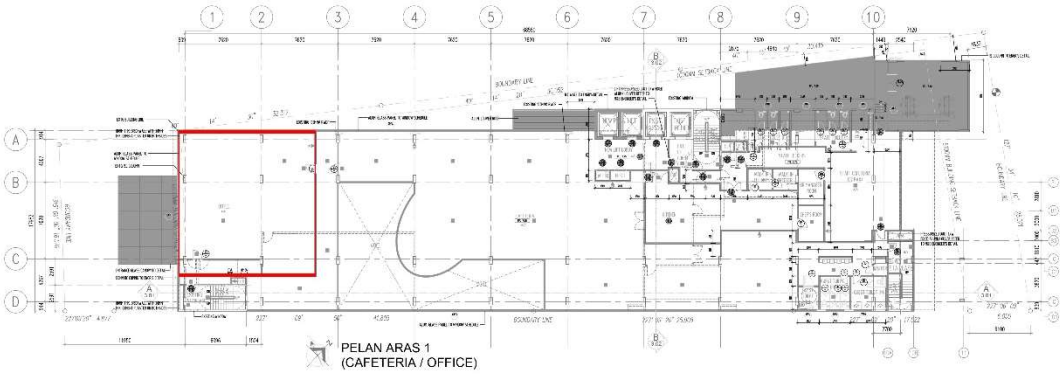


Figure 2.17: Fire Alarm Panel Location

2.3.5 Digital Alarm Communicator

Figure 2.18: Digital Alarm Communicator

A Digital Alarm Communicator allows the user to directly communicate with the Fire Department. This communicator will only be used when there is a fire or a related emergency, where the user will directly dial to the Fire Department Headquarters, and they will then connect the user to the closest Fire Department available, noting them about the emergency, allowing them to reach the fire within the shortest time available. This device does not only save time, but also many lives that are in thread.

2.3.6 Paging System

Figure 2.19: Paging Machine

According to UBBL 1984 Section 239: Voice communication system.

There shall be two separate approved continuously electrically supervised voice communication systems; one a fire brigade communications system and the other a public address system between the central control station and the following areas:
(a) Lifts, lift lobbies, corridors and staircases;
(b) In every office area exceeding 92.9 square metres in area;
(c) In each dwelling unit and hotel guest where the fire brigade system may be combined with the public address system.

The Paging System works as a telecommunication device. It is used to announce voice messages to the entire building through the speakers around the building. Not only that it can also control and trigger the sirens. During an emergency, the people in charge will activate the siren and announce the supposed information to the occupants in the building to safety.

2.3.7 Fire Switch

Figure 2.20: Fire Switch

According to UBBL 1984 Section 253: Emergency power system.

(1) Emergency power system shall be provided to supply illumination and power automatically in the event of failure of the normal supply or in the event of accident to elements of the system supplying power and illumination essential for safety to life and property.
(2) Emergency power systems shall provide power for smoke control systems, illumination, fire alarm systems, fire pumps, public address systems, fire lifts and other emergency systems.
(3) Emergency systems shall have adequate capacity and rating for the emergency operation of all equipment connected to the system including the simultaneous operation of all fire lifts and one other lift.
(4) All wiring for emergency systems shall be in metal conduit or of the fire resisting mineral insulated cables, laid along areas of least fire risk.
(5) Current supply shall be such that in the event of failure of the normal supply to or within the building or group of buildings concerned, the emergency lighting or emergency power, or both emergency lighting and power will be available within 10 seconds of the interruption of the normal supply. The supply system for emergency purposes shall comprise one or more of the following approved types:
(a) Storage Battery
Storage battery of suitable rating and capacity to supply and maintain at not less than 87 1/2 percent of the system voltage the total load of the circuits supplying emergency lighting and emergency power for a period of at least 1 1/2 hours;
(b) Generator set
A generator set driven by some form of prime mover and of sufficient capacity and proper rating to supply circuit carrying emergency lighting or lighting and power with suitable means for automatically starting the prime mover on failure of the normal service.

The Fire Switch is a dedicated switch isolator or disconnector. These switches can usually be seen on the outside wall of shops, industries or commercial buildings, and usually placed in the fire staircase area for high rise buildings. The Fire Switches are used by firemen to turn off neon lighting or other electrical devices in case of fire outbreak to prevent the overheated equipment from blowing up.

2.3.8 Fire Hydrant

Figure 2.21: Fire Hydrant

According to UBBL 1984 Section 225: Detecting and extinguishing fire.

(1) Every building shall be provided with means of detecting and extinguishing fire and with fire alarms together with illuminated exit signs in accordance with the requirements as specified in the Tenth Schedule to these By-laws.
(2) Every building shall be served by at least one fire hydrant located not more than 91.5 metres from the nearest point of fire brigade access.
(3) Depending on the size and location of the building and the provision of access for fire appliances, additional fire hydrant shall be provided as may be required by the Fire Authority.

The Fire Hydrant allows firefighters to gain water supply for firefighting purposes. Firefighters will first connect a hose to the hydrant, and then open the valve of the hydrant to allow high pressured water to blast out. To increase the water pressure even more for water to shoot higher, firefighters will connect the hose to a firetruck which contains pump, the pump will then boost the water pressure, causing pressurized water to shoot out from the hose attached to the truck.

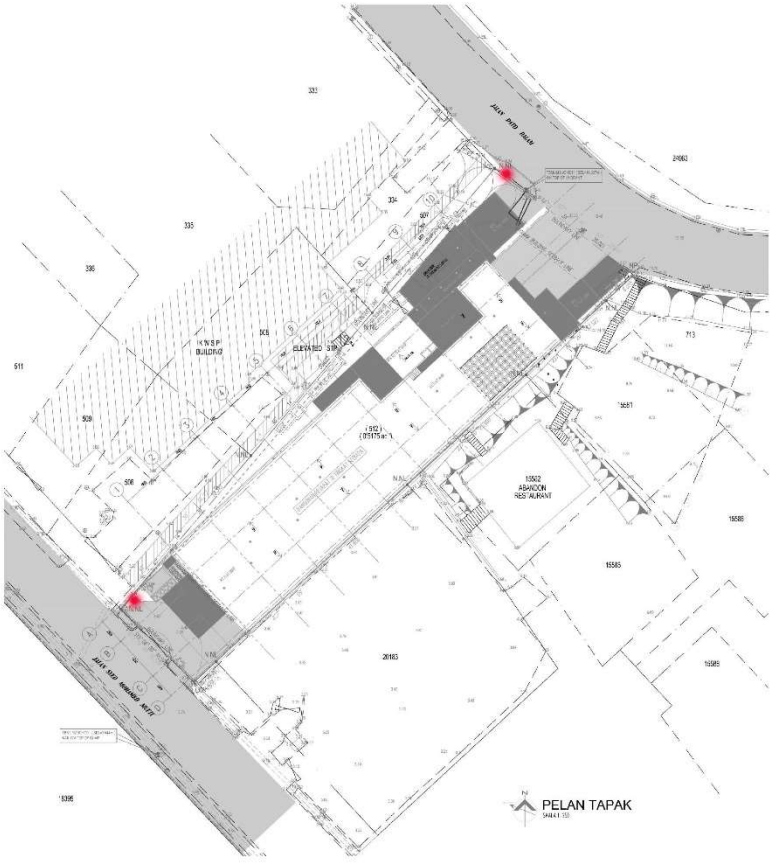


Figure 2.22: Fire Hydrant Location from Site Plan

2.3.9 Water Tank & Suction Tank

Figure 2.23: Water Tank

According to UBBL 1984 Section 247: Water storage.

(1) Water storage capacity and water flow rate for firefighting systems and installations shall be provided in accordance with the scale as set out in the Tenth Schedule to these By-laws.

(2) Main water storage tanks within the building, other than for hose reel systems, shall be located at ground, first or second basement levels, with fire brigade pumping inlet connections accessible to fire appliances.

(3) Storage tanks for automatic sprinkler installations where full capacity is provided without need for replenishment shall be exempted from the restrictions in their location.

The Water Tank stores water enough for all the existing sprinklers and wet risers in the building. During a fire emergency, when the sprinklers are triggered, water will be transferred from the suction tank to the pumps and the pumps will pressurize the water to all the sprinklers. Similarly, the wet riser tank also stores water enough for all the wet risers. When the wet risers are turned on, the water will flow to the pumps, pressurized upwards to the wet riser, supplying water to those that are activated.

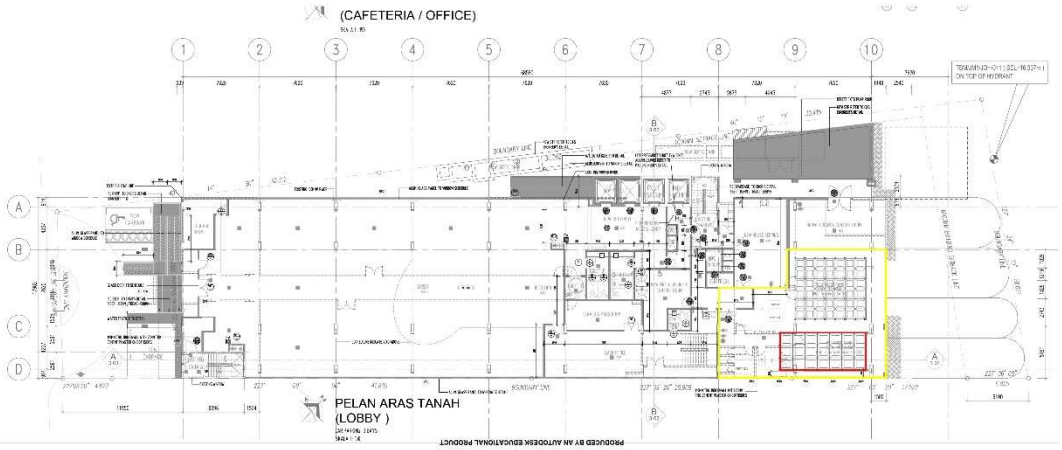


Figure 2.24: Water Tank and Pump Room in Ground Floor Lobby

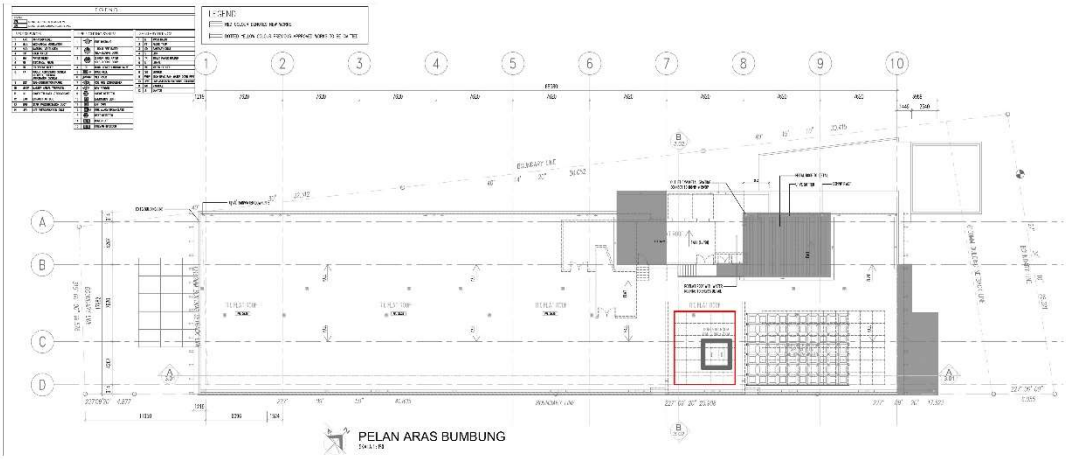


Figure 2.25: Water Tank on Roof

2.3.10 Jockey Pump, Duty Pump, Standby Pump

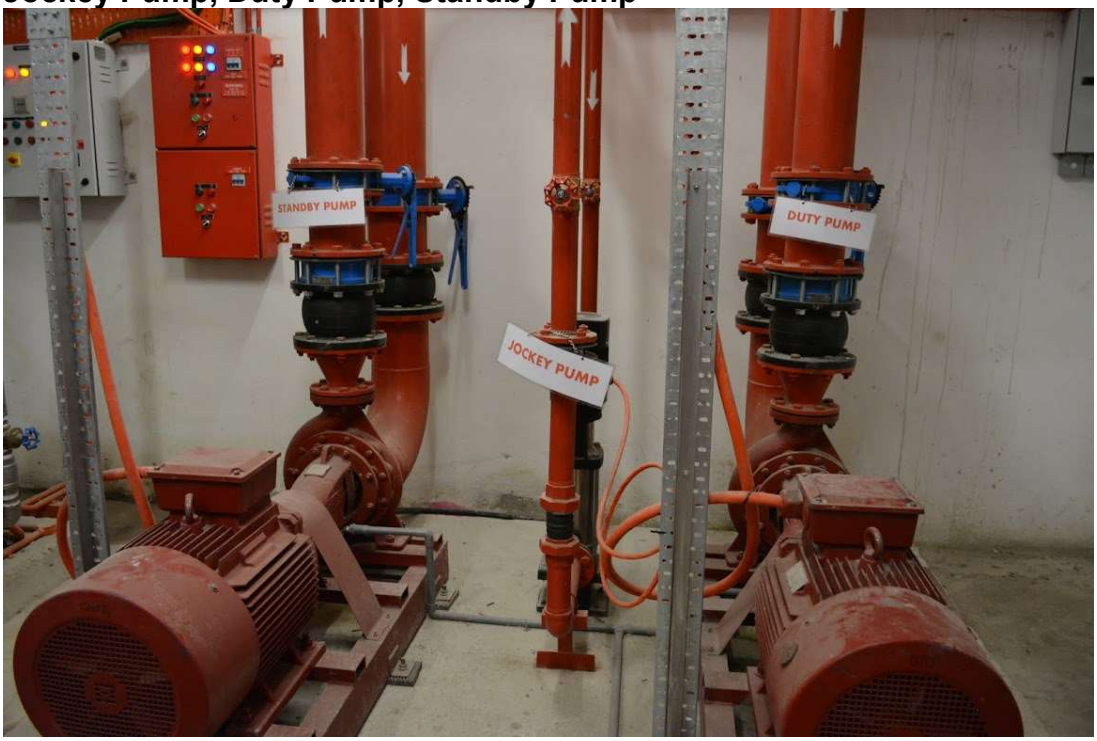


Figure 2.26: Standby Pump, Jockey Pump, Duty Pump

2.3.10.1 Jockey Pump

The Jockey Pump usually works together with a Fire Pump, being part of the fire protection system. To avoid the Fire Pump from running all the time, Jockey Pump is there to maintain and control the amount of pressure by elevating it to a specific level when not in used, at the same time preventing the system from going off out of the sudden. The Jockey Pump will prevent water drainage during a fire emergency when water rushes into the pipe.

2.3.10.2 Duty Pump

Duty Pump pressurizes the water in the system in order to maintain the system in running order when the pressure pipe goes down. However, in case of a fault where duty pump fails to work, the Standby Pump will be activated automatically.

2.3.10.3 Standby Pump

Functions the same as the Duty Pump. When the Duty Pump is under maintenance or stop working, the Standby Pump will act as a backup. Usually the Standby Pump can be controlled by a control panel where it can be switched off manually.

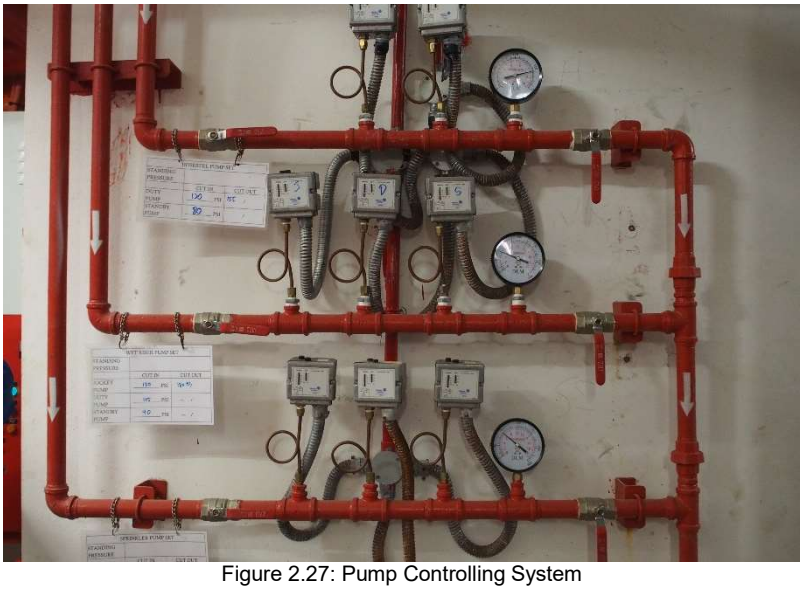


Figure 2.27: Pump Controlling System

The pump system in Swiss Inn Hotel uses diesel to run and operate instead of electricity because electricity might not work during a fire. The pumps will then pump the water stored in the tank to all sprinklers and wet risers (hose rail).

2.3.11 Alarm Gong System

Figure 2.28: Alarm Gong System

During a fire, the water pressure in the fire system will increase as long as the pumps are working. Once the water pressure reaches a certain point, the Alarm Gong that is connected to the system will detect it, and then it will send an alarm to alert the nearest Fire Station about the fire.

2.3.12 Wet Riser and Hose Reel system

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Figure 2.29: Wet Riser and Hose Reel System

According to UBBL 1984 Section 231: Installation and testing of wet rising system.

(1) Wet rising systems shall be provided in every building in which the topmost floor is more than 30.5 metres above fire appliance access level.

(2) A hose connection shall be provided in each firefighting access lobby.

(3) Wet risers shall be of minimum 152.4 millimetres diameter and shall be hydrostatically tested at a pressure 50% above the working pressure required and not less than 14 bars for at least twenty-four hours.

(4) Each wet riser outlet shall comprise standard 63.5 millimetres instantaneous coupling fitted with a hose of not less than 38.1 millimetres diameter equipped with an approved typed cradle and a variable for nozzle.

(5) A wet riser shall be provided in every staircase which extends from the ground floor level to the roof and shall be equipped with a three-way 63.5 millimetres outlets above the roof line.

(6) Each stage of the wet riser shall not exceed 61 metres, unless expressly permitted by D.G.F.S but in no case exceeding 70.15 metres.

According to UBBL 1984 Section 248: Marking on wet riser, etc.

(1) Wet risers, dry risers, sprinkler and other fire installation pipes and fittings shall be painted red.

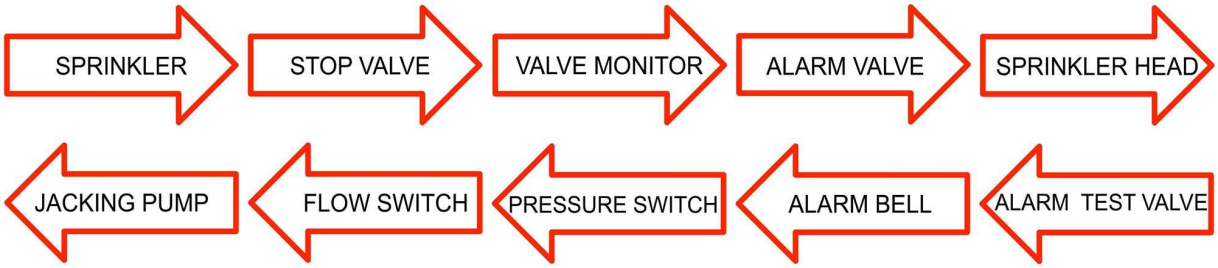
(2) All cabinets and areas recessed in walls for location of fire installations and extinguishers shall be clearly identified to the satisfaction of the Fire Authority or otherwise clearly identified.

The fire Hose Reel is a very important component which is intended for the users of the building. All the hose reels can actually deliver much more water than portable extinguishers, and given that it contains a large amount of water source makes it a key device that could save many lives and the building in a fire system. The hose length should be at least 45 meters made of reinforced rubber. The hose reel can be found along the corridors most of the time.

2.3.12.2 Wet Riser

Use to supply water when a fire occurs. Wet risers are permanently charged with water from a pressurized supply, so water will not run out when needed. In order to pressurize water from the water tank to the Wet Risers, the Jockey Pump, Duty Pump and Standby Pump will all be connected to the wet riser.

2.3.13 Sprinkler



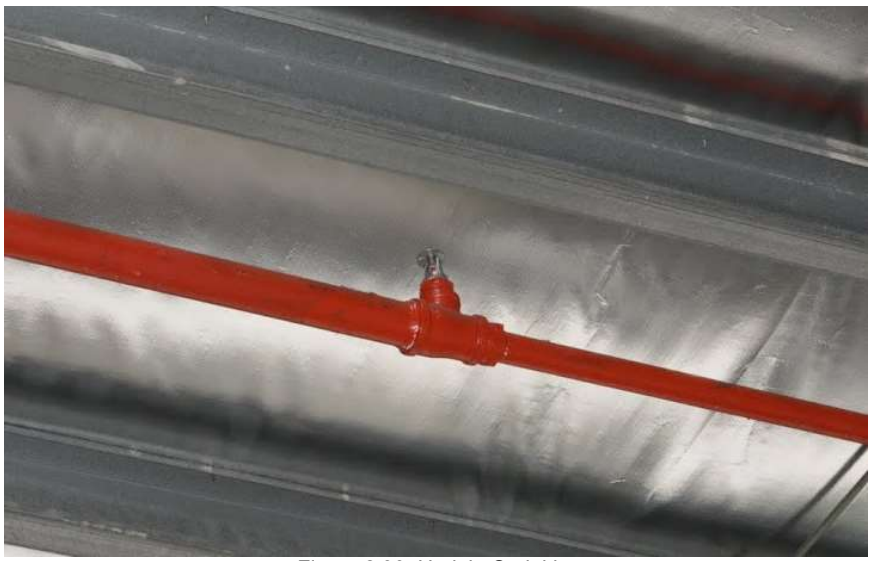


Figure 2.30: Upright Sprinkler

According to UBBL 1984 Section 226: Automatic system for hazardous occupancy.

Where hazardous processes, storage or occupancy are of such character as to require automatic sprinklers or other automatic extinguishing system, it shall be of a type and standard appropriate to extinguish fires in the hazardous materials stored or handled or for the safety of the occupants.

2.3.13.1 Upright Sprinkler

Water is projected upwards from the Upright Sprinkler and has a built in deflector that deflects water downwards. Water is sprayed in a circle motion because of to the deflector. The Upright Sprinklers are usually built in inaccessible areas such as mechanical room that contains obstructions such as ducts or areas that are lack of ceiling for the pipe to be built into.

Figure 2.31: Recessed Pendant Sprinkler

2.3.13.2 Recessed Pendant Sprinkler

The Recessed Pendant Sprinkler shoots water downwards from the ceiling and shoots out water in a circle motion (just like Upright Sprinkler). These types of sprinklers are much more common and are used in almost any type of rooms that’re accessible such as office, hotel room, and the lobby. Since the Recessed Pendant Sprinkler is built on the ceiling, the connecting pipes will be hidden in the ceiling to avoid unattractive appearance.

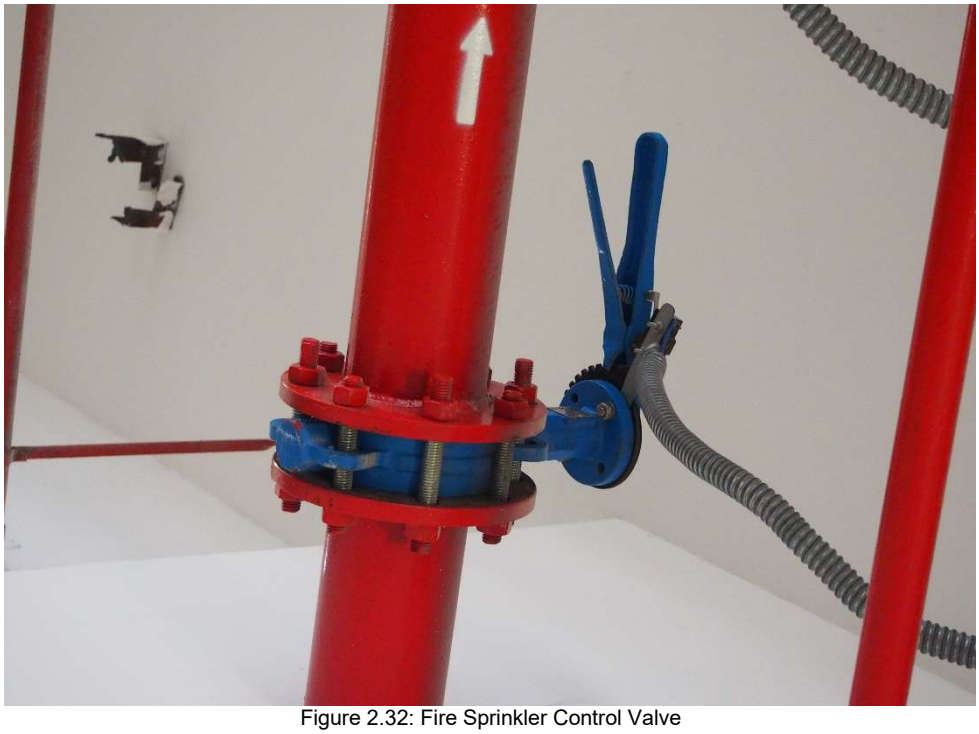


Figure 2.32: Fire Sprinkler Control Valve

According to UBBL 1984 Section 228: Sprinkles valves.

(1) Sprinkler valves shall be located in a safe and enclosed position on the exterior wall and shall be readily accessible to the Fire Authority.

(2) All sprinkler systems shall be electricity connected to the nearest fire station to provide immediate and automatic relay of the alarm when activated.

2.3.13.3 Fire Sprinkler Control Valve

The Fire Sprinkler Control Valve is attached to the Suction Tank and the pipes to all the sprinklers exist in the building. It is used to switch on or off the existing sprinklers. Sometimes the worker will turn the sprinklers on to check for any faults, the control valve will be activated.

2.3.14 Carbon Dioxide Suppression System

Figure 2.33: Carbon Dioxide Suppression System

The Carbon Dioxide Fire Suppression system is a type of fire suppression agent that can be found in Swiss Inn Hotel. Pressurized Carbon Dioxide and Halon are stored in all the cylinder tanks. They are usually installed in facilities room such as mechanical room and electrical room that consist of electrical apparatus that will cause danger to the occupants in the building. When a fire is detected, the tanks will release carbon dioxide (through control panel), creating a heavy blanket of gas that reduces the oxygen level in that area to a point where combustion will not take place. Since Carbon Dioxide is a colourless and odourless gas, no clean-up is required after releasing, causing minimal amount of mess to the rooms.

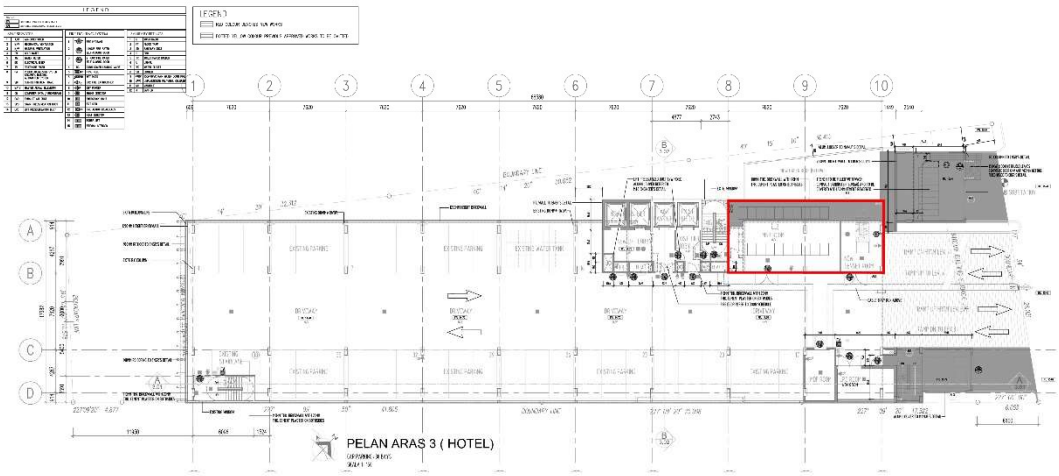


Figure 2.34: Carbon Dioxide Suppression System location in Third Floor Parking Lot

2.3.15 Gas Suppression Control Panel

Figure 2.35: Gas Suppression Control Panel

Gas Suppression Control Panel controls the amount of Carbon Dioxide release from the Carbon Dioxide Fire Suppression tank. When fire occurs in the mechanical rooms, Carbon Dioxide can be released upon controlling the switch. After the fire is suppressed, the switch can be turned off to stop the release of Carbon Dioxide gas.

2.3.16 Fire Extinguisher

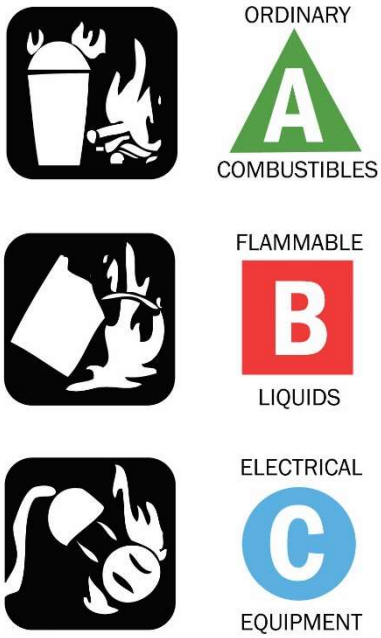


Figure 2.36: Fire Extinguisher

According to UBBL Section 227: Portable extinguishers.

Portable extinguisher shall be provided in accordance with the relevant codes of practice and shall be sited in prominent positions on exit routes to be visible from all directions and similar extinguishers in a building shall be of the same method of operation.

An active fire protection device that is used to control fire, the Fire Extinguisher is made to be portable and in case of a fire emergency that happens slightly distant from the main fire device such as hose reels, the portable fire extinguisher will be the best choice of all. Swiss Inn uses one type of fire extinguisher, which is dry powder extinguisher. This type of extinguisher contains fluidized and siliconized Monoammonium Phosphate powder, which is found in extinguishers that are rated class A, B and C.

CO_2 is a clean gaseous agent which displaces oxygen, however this type of extinguisher are not meant for class A fires as the high-pressure cloud of gas can scatter burning materials. CO_2 is not suitable for use on fires containing their own oxygen source, metals or cooking media. Although it can be rather effective on a person on fire, it should be avoided because it can cause frostbite and suffocation to that person.

Analysis

Red = Dry powder extinguisher

Blue = CO_2 extinguisher

As seen from the plans, there are more red dots (Dry powder extinguisher) because Dry Powder is a highly versatile medium for tackling most types of fire. It is extremely effective with electrical hazards, flammable liquids and gases, which make it more ideal for hotel. On the other hand, CO_2 fire extinguishers are ideal for electrical fires or flammable liquid fires. CO_2 is harmless to electrical equipment and so is ideal for offices and electric rooms. Both dry powder and carbon dioxide extinguishers have non-conductive, anti-static horns.

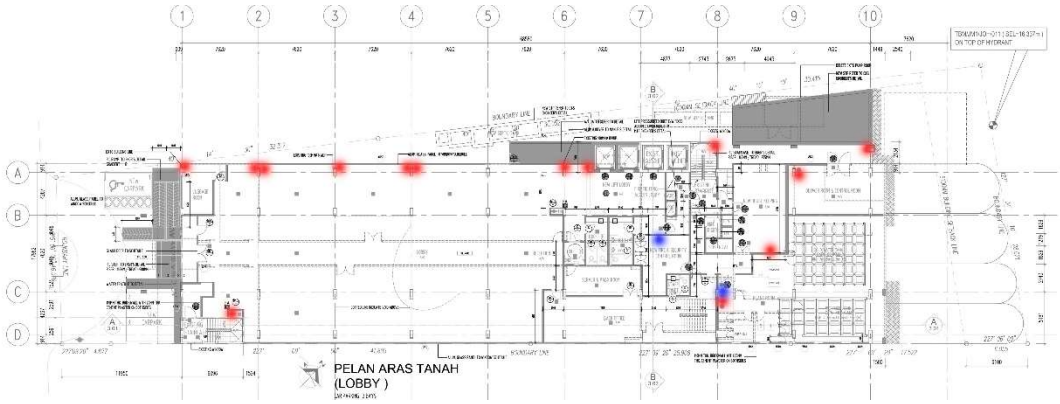


Figure 2.37: Ground Floor Lobby Fire Extinguisher

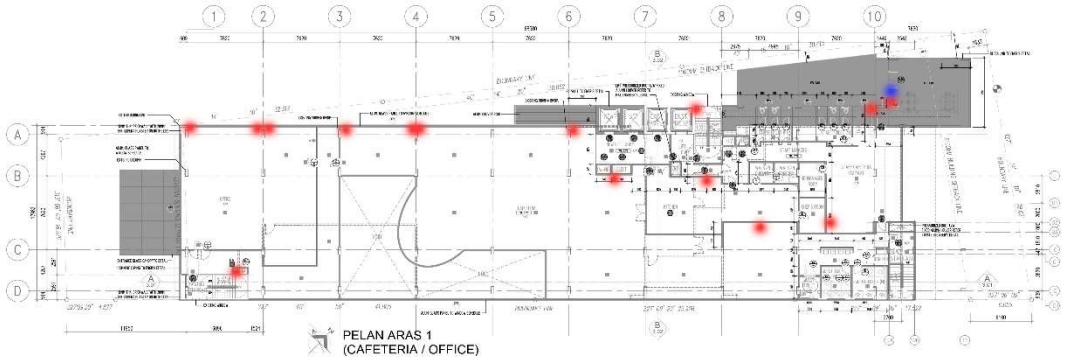


Figure 2.38: First Floor Café Fire Extinguisher

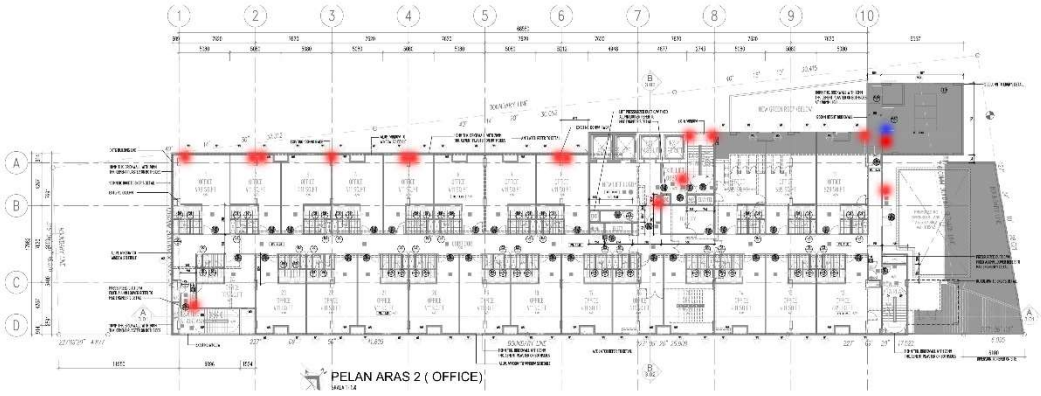


Figure 2.39: Second Floor Office Fire Extinguisher

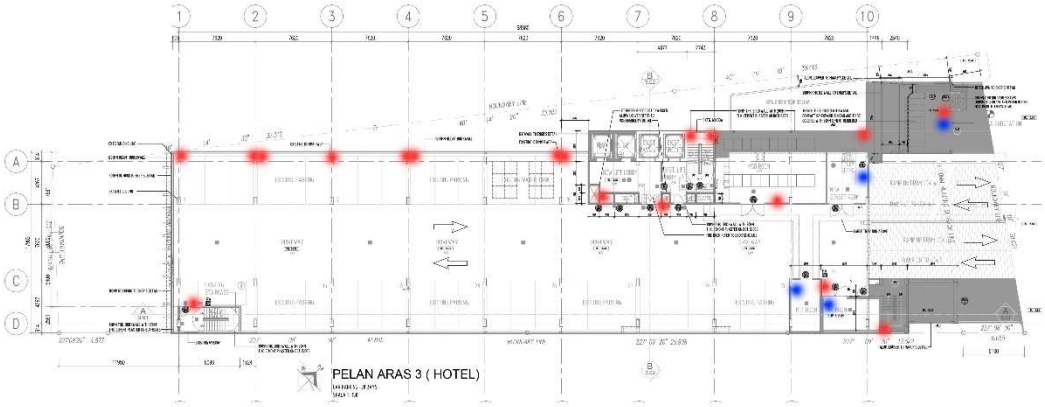


Figure 2.40: Third Floor Parking Lot Fire Extinguisher

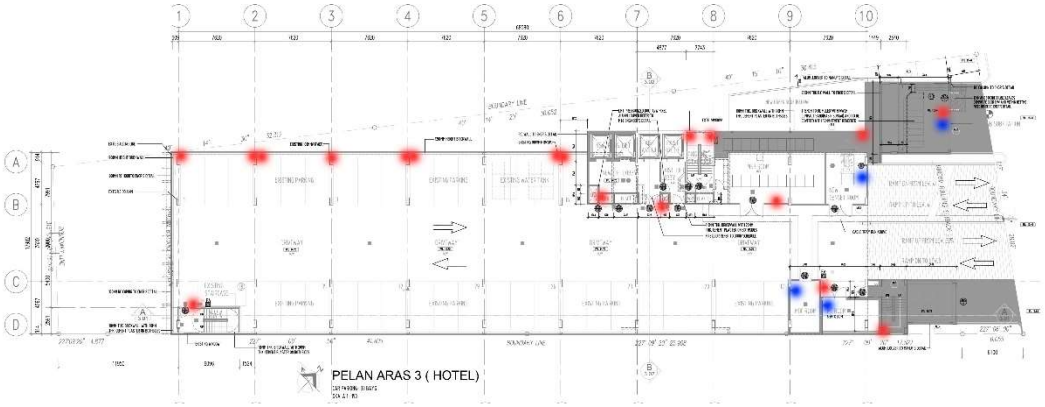
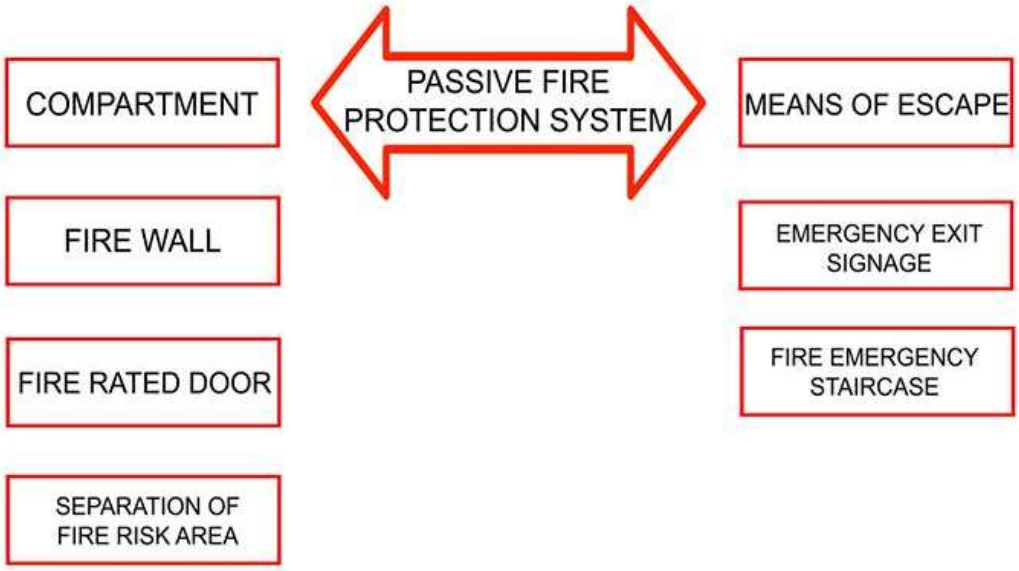


Figure 2.41: Eight Floor Hotel Room Fire Extinguisher

2.4 Passive Fire Protection System



2.4.1 Fire Wall

Figure 2.42: Fire Wall used in Emergency Staircase

A firewall is a fire resistant barrier used to preclude the spread of fire for a rated period of time. Firewalls can be used to subdivide a building into separate fire areas and are constructed in accordance with the locally applicable building codes. Firewalls are a part of a passive fire protection system. Fire barrier walls are typically made of drywall/gypsum board partitions with wood or metal framed studs. They are typically continuous from a floor below to a floor or roof above, or from one fire barrier wall to another fire barrier wall, having a fire resistance rating equal to or greater than the required rating for the application.

2.4.2 Fire Rated Door

Figure 2.43: Fire Rated Door

According to UBBL 1984 Section 162: Fire doors in compartment walls and separating walls.

(1) Fire doors of a appropriate FRP shall be provided.

(2) Openings in compartment walls and separating walls shall be protected by a fire door having a FRP in accordance with the requirements for that wall specified in the Ninth Schedule to these Bylaws.

(3) Openings in protecting structures shall be protected by fire doors having FRP of not less than half the requirement for the surrounding wall specified in the Ninth Schedule to these By-laws but in no case less than half hour.

(4) Openings in partitions enclosing a protected corridor or lobby shall be protected by fire doors having FRP of half-hour.

(5) Fire doors including frames shall be constructed to a specification which can be shown to meet the requirements for the relevant FRP when tested in accordance with section 3 of BS 476:1951.

A passive fire protection system that provides fire resistance rating. The fire rated door can delay the fire from spreading and is an ideal fireproofing device. Fire doors are usually built along the escape routes and fire escape stair's corridors to ensure safety while the occupants are escaping the fire. All the fire rate doors in Swiss Inn Hotel are 2 hours rated. Most fire doors are intended to

be shut at all times whereas some doors are designed to stay open under normal circumstances, and close automatically in the event of a fire. Some fire doors in Swiss Inn Hotel are held open with an electromagnet.

Analysis

As seen as the plans below, most of the doors used in this building are fire rated doors. Especially all the hotel rooms door. This ensures all the occupants and guest in the hotel to have maximum safety during a fire breakout.

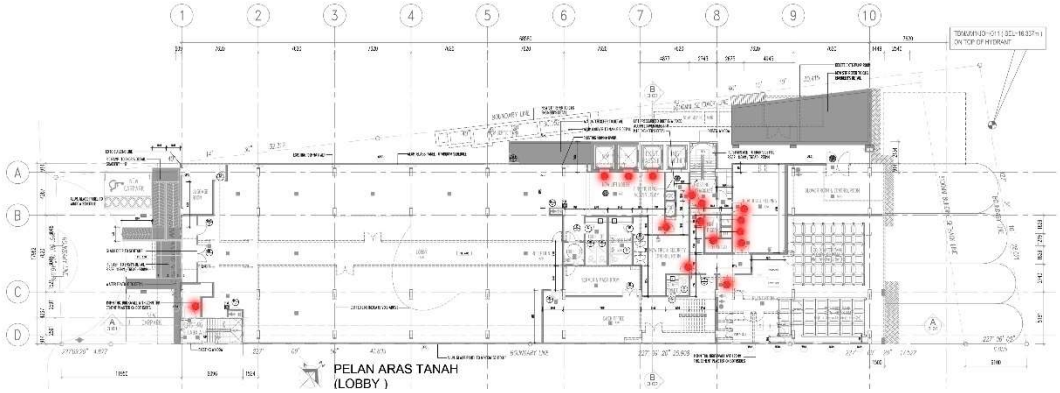


Figure 2.44: Ground Floor Lobby Fire Door

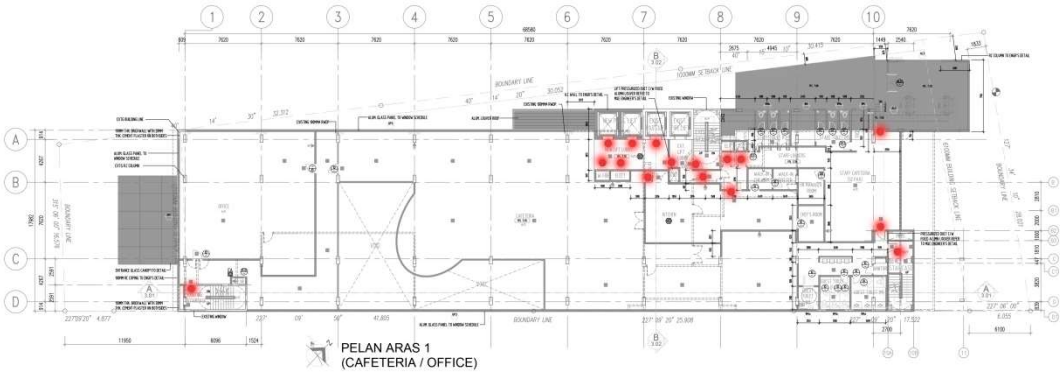


Figure 2.45: First Floor Cafe Fire Door

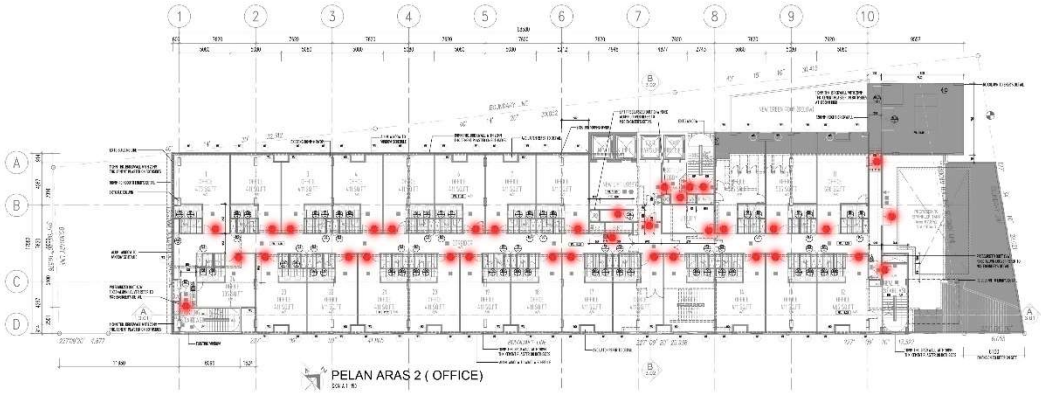


Figure 2.46: Second Floor Office Fire Door

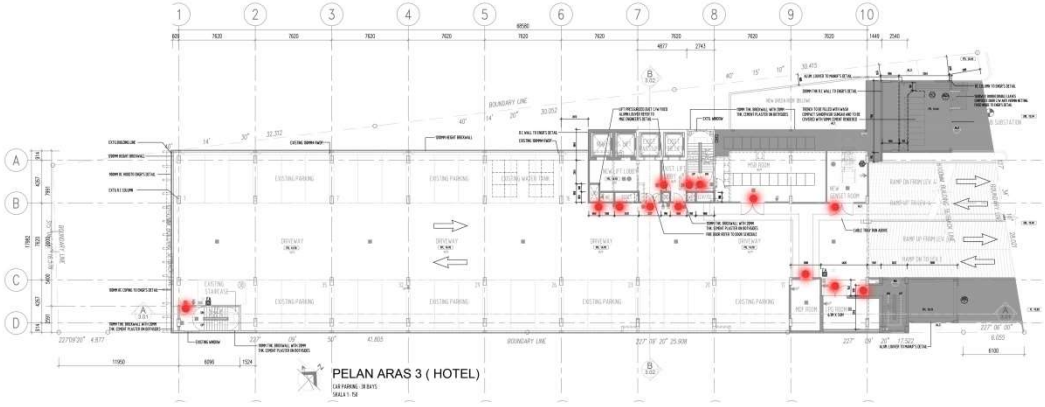


Figure 2.47: Third Floor Parking Lot Fire Door

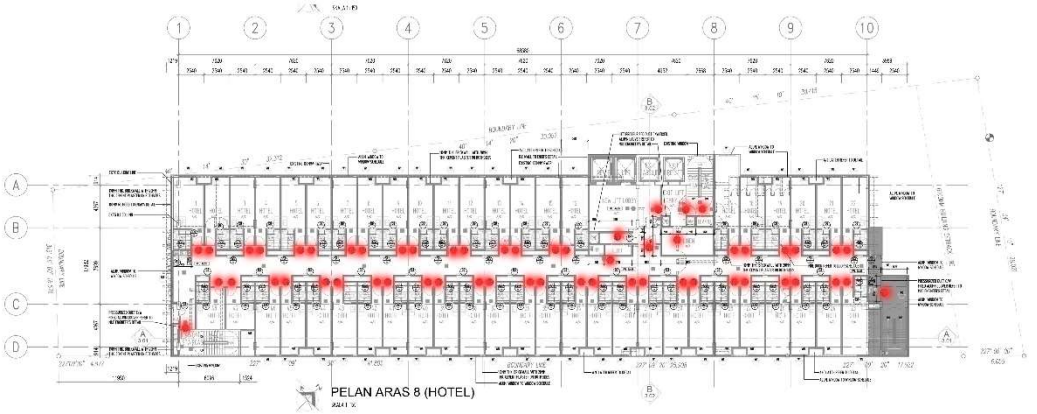


Figure 2.48: Eight Floor Hotel Room Fire Door

2.4.3 Separation of fire risk area (fire escape)

According to UBBL 1984 Section 169: Exit route.

No exit route may reduce in width along its path of travel from storey exit to the final exit.

Based on the law stated in UBBL, the width of all escaping routes should be the same in order to prevent occupants from escaping without sufficient human space. Not only that, the separations of fire risk area should involve in the spatial planning of the building to prevent fire spreading quickly from one point to the other point. All the mechanical and electrical rooms in Swiss Inn Hotel are carefully planned and located in such that fire will not spread around quickly. By planning it wisely, the risk of fire will be reduced greatly and the amount of injuries and accidents will decrease drastically.

2.4.4 Emergency Light

Figure 2.49: Emergency Light

Emergency lighting is normally required to function fully automatically and give illumination of a necessarily high level to enable all users to evacuate the building safely during a fire emergency. Most new buildings now have emergency light installed during construction. It is a part of the fire safety facility of a building. A backup lighting will automatically come on when the power supply to the normal lighting provision fails. If the emergency lights failed to operate, it may lead to sudden darkness and a possible danger to the occupants, either through physical danger or panic.

2.4.5 Escape Routes/ Emergency Floor Plan

Figure 2.50: Ninth Floor Emergency Floor Plan

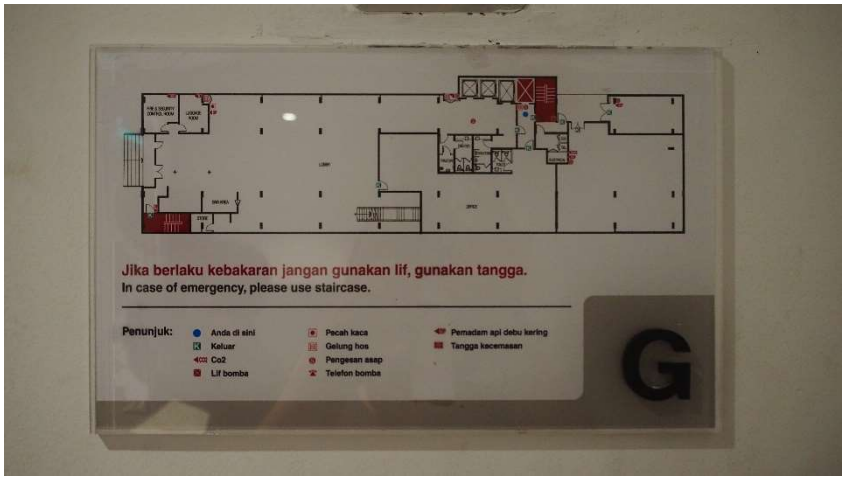


Figure 2.51: Ground Floor Emergency Floor Plan

According to UBBL 1984 Section 178: Exits for institutional and other places of assembly.

In buildings classified as institutional or places of assembly, exits to a street or large open space, together with staircases, corridors and passages leading to such exits shall be located, separated or protected as to avoid any undue danger to the occupants of the place of assembly from fire originating in the other occupancy or smoke therefrom.

Emergency floor plans are located in every single floor and are all drawn according to the plan of that floor, usually located outside of the elevator, fire doors, and for hotels like Swiss Inn Hotel, a copy of the emergency floor plan will be located on every room's door for the guests to view at. Fire exit and emergency staircase must be stated very clearly in the plan and every shortest possible escape routes must also be stated in the plan. During a fire emergency, occupants must always follow the plan in order to get to the safety.

2.4.6 Emergency Exit Signage

Figure 2.52: Emergency Exit Signage

According to UBBL 1984 Section 172: Emergency exit signs.

(1) Storey exits and access to such exits shall be marked by readily visible signs and shall not be obscured by any decorations, furnishings or other equipment.
(2) A sign reading "KELUAR" with an arrow indicating the direction shall be placed in every location where the direction of travel to reach the nearest exit is not immediately apparent.
(3) Every exit sign shall have the word "KELUAR" in plainly legible letters not less than 150 millimetres high with the principal strokes of the letters not less than 18 millimetres wide. The lettering shall be in red against a black background.
(4) All exits signs shall be illuminated continuously during periods of occupancy.
(5) Illuminated signs shall be provided with two electric lamps of not less than fifteen watts each.

Fire Escape Signage directs the path to safety a safety area, usually to the outdoor or the assembly area. It is located on top of the all the doors that lead to the outside of the building, and can be seen with the word “Keluar” (meaning Exit). Emergency lights will be installed within the sign to provide light in case the electricity source was cut off during a fire. The bright neon green colour and big block letters written on provides a clear signage to the occupants, thus during an emergency, occupants will be directed accordingly to safety by following the sign and confusion will be reduced.

2.4.7 Fire Door Open/ Close System (Magnetic Switch)

Figure 2.53: Fire Door Closing System

According to UBBL 1984 Section 164: Door closers for fire doors.

(1) All fire doors shall be fitted with automatic door closers of the hydraulically spring operated type in the case of swing doors and of wire rope and weight type in the case of sliding doors.
(2) Double doors with rabbeted meeting stiles shall be provided with co-ordinating device to ensure that leafs close in the proper sequence.
(3) Fire doors may be held open provided the hold open device incorporates a heat actuated device to release the door. Heat actuated devices shall not be permitted on fire doors protecting openings to protected corridors or protected staircases.

The Magnetic Switch is a device that is wired to a fire alarm system and is attached to the fire door. When fire occurs, if the electric power fails or the fire alarm is activated, the coil will de-energized and will repulse the other magnet attached to the door, pushing the door to close on its own. Wireless, battery operated fire door retainers can also be used to safely and legally hold fire doors open.

2.4.8 Fire Emergency Staircase

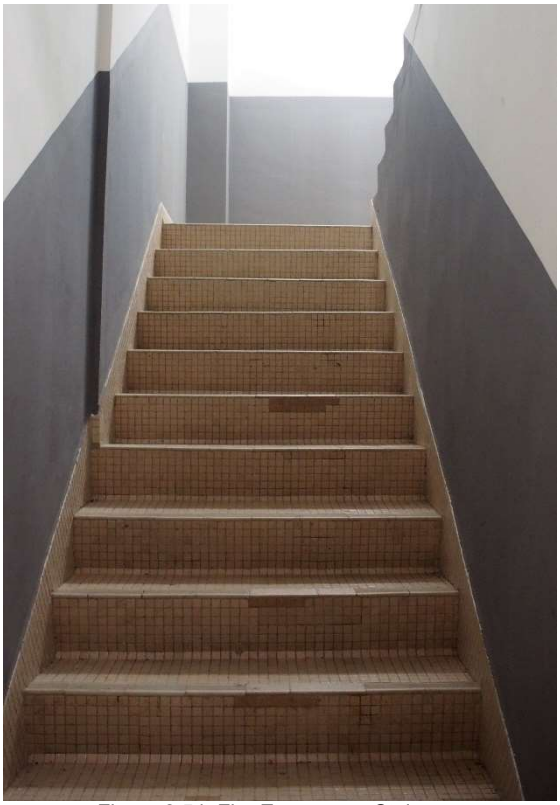


Figure 2.54: Fire Emergency Staircase

According to UBBL 1984 Section 168: Staircases.

(1) Except as provided for in by-laws 194 every upper floor shall have means of egress via at least two separate staircases.
(2) Staircases shall be of such width that in the event of any one staircase not being available for escape purpose the remaining staircases shall accommodate the highest occupancy load of any one floor discharging into it calculated in accordance with provisions in the Seventh Schedule to these Bylaws.
(3) The required width of staircase shall be the clear width between walls but handrails may be permitted to encroach on this width to a maximum of 75 millimetres
(4) The required width of a staircase shall be maintained throughout its length including at landings.
(5) Doors giving access to staircases shall be so positioned that their swing shall at no point encroach on the required width of the staircase or landing.

The Fire Emergency Staircase leads the occupants of the building to escape to a safer area or an assembly area during a fire or an emergency incident. Base on the law, all building should not have at least two means of different exits that consist of separate exits or doors that leads to a passage or other space giving access to separate exits in different directions. According to standards, the thread of the stairs should not be more than 255mm and the riser should be lesser than 180mm.

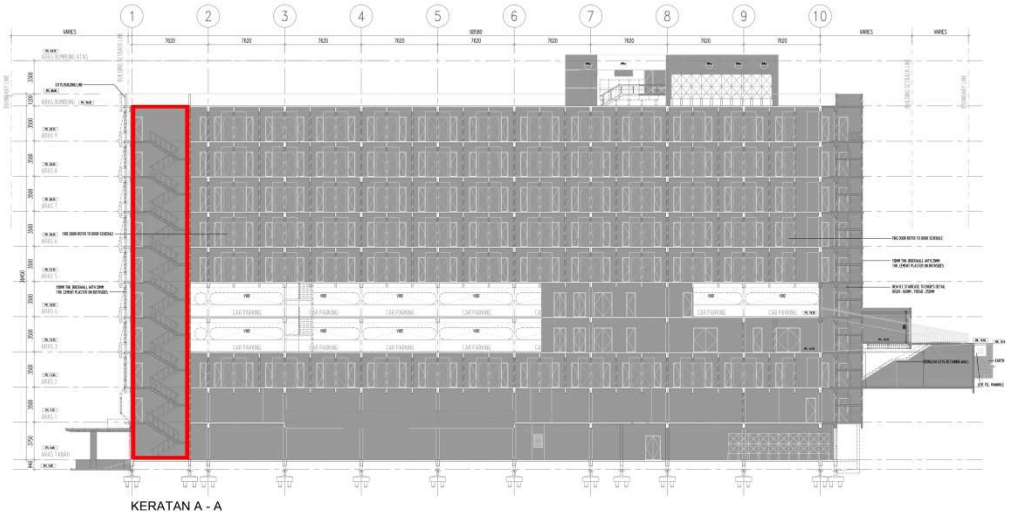


Figure 2.55: Fire Emergency Staircase from Section View

2.5 Conclusion and Recommendation

In conclusion, both active and passive fire protection system play an important role to protect a building during a fire breakdown. The overall system of the firefighting system in Swiss Inn Johor Bahru complies with the UBBL by laws and is very systematic as a control panel controls the entire system. This will avoid the cause of false alarm in the building that will disturb the occupants. Besides that, the building also has updated their appliances following the requirements of Bomba and every core of the building is filled with fire appliances for the safety of the occupants. The overall system in the building has a proper appliance which used for different function of the spaces to ensure the safety of occupants. There are no further recommendations that we could suggest for the fire because the fire safety coverage area in the building is wide enough to ensure the occupants safety.

3.0 Air Conditioning System

3.1 Introduction

Air conditioned units system are used to control the temperature, humidity air cleanliness and air movement and heat radiation in a particular area through mechanical means in order to achieve human thermal comfort. Usually, the air-handling unit (AHU) distributes conditioned air throughout the building through a network of ductwork. The temperature of the air is then regulated by the chilled water plant using chilled water. A cooling tower is also required in order to cool down the refrigerant. The main function of the system will be to expel stale air which comprised of airborne chemical , carbon dioxide and other pollutants from within the building the outside while drawing fresh air from the outside to circulate the house.

3.2 Case Study - Air Conditioned Unit System in Swiss Inn Hotel

The Swiss Inn Hotel makes use of a combination of Variable Refrigerant Volume and split-unit system. The former is used primarily for the ground and first floor which is the main lobby and the cafeteria of the hotel while the latter is used for the floors above which consist of the individual hotel rooms and the corridors itself.

In accordance with the rules and regulations set forth by various bodies of authorities are also being referred to. The standards used in this section include Uniform Building By-Laws 1995 (UBBL 1995) and Malaysian Standard 1525 - 2007 (MS1525-2007).

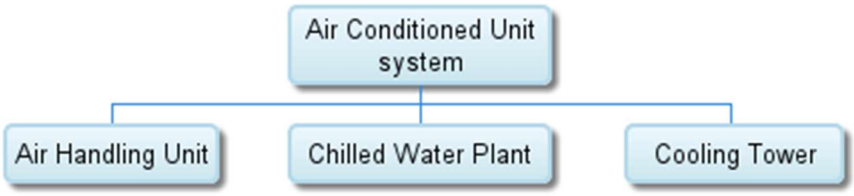
3.3 Literature Review

3.3.1 Air Conditioning system

The main components in an air conditioning systems are the cooling tower, chilled water plant, AHU, ducts, pipes and diffusers. Water is only used to transfer heat between the 3 components, AHU, chilled water plant and the cooling tower. However the refrigerant is used here in order to transfer heat back inside the chilled water plant.

Functions of the AHU is too recycle and cool the air inside the hotel. The air in the AHU is chilled by the water that comes directly from the chilled water plant and is then mixed with the fresh air which was extracted from the outdoor before being released and distributed into the premises of the hotel via the air duct system and diffusers. Then, the warm chilled water will be transported back to the chilled water plant and the refrigerant system in the plant will cool the incoming warm water through the refrigerant cycle. Then the chilled water will be transported back to the AHU and the process will be repeated again.

The refrigerant will too generate heat that will be cooled separately by water that comes from the cooling tower.



Components of a centralized air-conditioning systems.

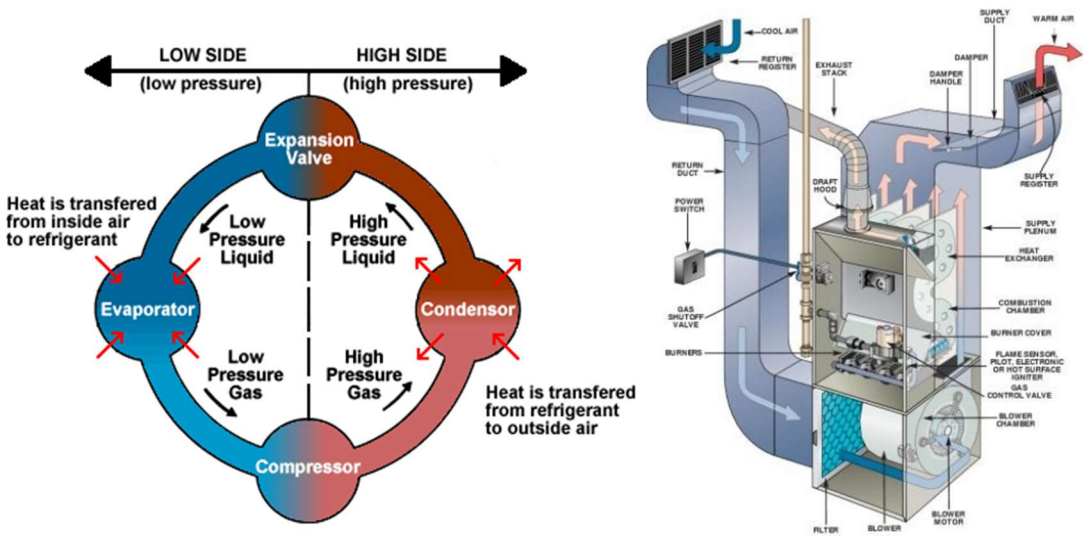


Figure 3.1 Refrigerant and Air Cycle

3.4 Air- Handling Unit (AHU)

Functions of an AHU is to basically handle the airflow entering and exiting the entire building structure. The air in the hotel is constantly being circulated by being drawn into the AHU. The air drawn back in removed from the system due to containing impurities that are detrimental to human health while mixing fresh and chilled air into the AHU to be distributed within the premises.

Chilled water from the chilled water plant is brought into the AHU in order to cool the air. The chilled water pipe is connected to the base of the AHU in order to remove unwanted air bubbles that could cause problems like airlock and energy wastage which could occur if the chilled water were to be poured into the AHU. The chilled water is here to absorb heat generated in order to cool down the air inside the AHU. Then, warmed water will be delivered back to the chilled water plant and the process will be repeated again and again.

According to UBBL 1996, section 41:

1. Where permanent mechanical ventilation or air-conditioning is intended, the relevant building by-laws relating to natural ventilation, natural lighting and heights of rooms may be waived at the discretion of the local authority.
2. Any application for the waiver of the relevant by-laws shall only be considered if in addition to the permanent air-conditioning system there is provided alternative approved means of ventilating the air-conditioned enclosure, such that within half an hour of the air-conditioning system failing, not less than the stipulated volume of fresh air specified hereinafter shall be introduced into the enclosure during the period when the air-conditioning system is not functioning.
3. The provisions of the Third Schedule to these By-laws shall apply to buildings which are mechanically ventilated or air-conditioned.
4. Where permanent mechanical ventilation in respect of lavatories, water closets, bathrooms or corridors is provided for and maintained in accordance with the requirements of the Third Schedule to these By-laws, the provisions of these By-laws relating to natural ventilation and natural lighting shall not apply to such lavatories, water-closets, bathrooms or corridors.

According to MS1525:2007, code 8.7 Air handling duct system insulation:

All ducts, plenums and enclosures installed in or on buildings shall be adequately insulated to prevent excessive energy losses. Additional insulation with vapour barriers may be required to prevent condensation under some conditions.

3.5 Cooling Tower

The purpose of the cooling tower is to absorb and remove the heat from the hot condensed water coming from the chilled water plant into the atmosphere.

The water is then once again cooled down to be transported chilled water plant to absorb heat again. The hot condensed water will be transported into the cooling tower to be sprinkled inside the tower to form water droplets. Then, air from the atmosphere will be drawn into the tower via induction fan which is located right on top of the tower. Heat will then hence exchanged will occur between the water droplet and the drawn-in air and the cooled water will drop from the ceiling and accumulated and then pumped back into the chilled water plant.

According to MS 1525:2007, code 8.8 Balancing:
The system design should provide means for balancing the air and water system such as but not limited to dampers, temperature and pressure test connections and balancing valves.

3.6 Piping system

There are two types of pipes that are involved in the air-conditioning systems. They are known as the chilled water pipe and the chilled water pipe.

3.6.1 Condensed water pipe

Condensed water pipes supply cooled water from the cooling tower to the condenser within the chilled water plant and will also return hot water from the condenser to the cooling tower

3.6.2 Chilled water pipe

The chilled water pipes serves to transport chilled water directly from the evaporator in the chilled water plant to the AHU room. It also functions to return warmed water from the AHU back to the chilled water plant.

According to MS 1525:207, code 8.6 piping insulation:
All piping installed to serve buildings and within building should be adequately insulated to prevent excessive energy losses. Additional insulation with vapour barriers may be required to prevent condensation under some conditions.

3.7 Chilled water system

The chilled water system consist of a chilled water plant that is made up of 4 components. Namely, the evaporator, compressor, condenser and the expansion valve. It is then connected to the AHU room and the cooling tower through a chilled water pump and the condensed water pump.

Here, water is chilled in the plant will then be transported to the AHU. The water will then be chilled by the refrigerant in the water plant as the refrigerant cycle occurs within the plant. The cycle here goes as such that the liquid refrigerant converts itself into vapour and then back to liquid, and thus the cycle repeats itself.

According to MS1525:2007:
Code 8.2.2:
Where chillers are used and when the design load is greater than 1000 kWr, a minimum of two chillers or a single multi-compressor chiller should be provided to meet the required load.

Code 8.2.3:
Multiple units of the same equipment type, such as multiple chillers, with combined capabilities exceeding the design load may be specified to operate concurrently only if controls are provided which sequence or otherwise optimally control the operation of each unit based on the required cooling load.

3.7.1 Evaporator

The evaporator functions as a heat-absorbing surface and is connected to the AHU via the chilled water pipes. The boiling refrigerant inside the evaporator will absorb the heat from the AHU's warm water and then evaporate it into a vaporous state. The chilled water would then be pumped back to the AHU to repeat the air cycle. The vapour will pass through the compressor before reaching back into the condenser.

3.7.2 Compressor

The compressors compress the refrigerant vapour from the evaporator and pump the refrigerant throughout the system. The vapour enters the compressor through the suction valve and fills the cylinder. This refrigerant is cool but it absorbs heat from the evaporator as it is changing from liquid state to vapour state. By compressing the vapour, this creates a high temperature up to 200F and is pumped to the condenser.

3.7.3 Condenser

The condenser acts as another heat exchanger in the system and is connected to the cooling tower via condensed water pipes. Condensers will reject the heat absorbed by the evaporator. The refrigerant here changes the vapour into a liquid state inside the condenser. During this change of state, a great amount of heat is released into the outside. The now heat-absorbed water will return to the cooling tower before entering the condenser to repeat the cycle.

3.7.4 Thermostatic Expansion Valve

The thermostatic expansion valve is a valve or small fixed-size tubing or orifice which meters liquid refrigerant into the evaporator. The liquid refrigerant from the condenser will pass through the thermostatic expansion valve before the evaporator to repeat the refrigerant cycle.

3.8 Ductwork System

According to MS1525:2007, code 8.7 Air handling duct systems insulation:

All ducts, plenums and enclosures installed in or on buildings shall be adequately insulated to prevent excessive energy losses. Additional insulation with vapour barriers may be required to prevent condensation under some conditions.

3.8.1 Duct system

Duct systems functions to carry fresh cooled air from the AHU and distributes it throughout the rooms which require air-condition. It also carries the returned air from the building to the AHU. However, in cases service rooms and basements, the air is released to the outside without passing through the AHU. A diffuser is also placed at the end of the unit where air exits.

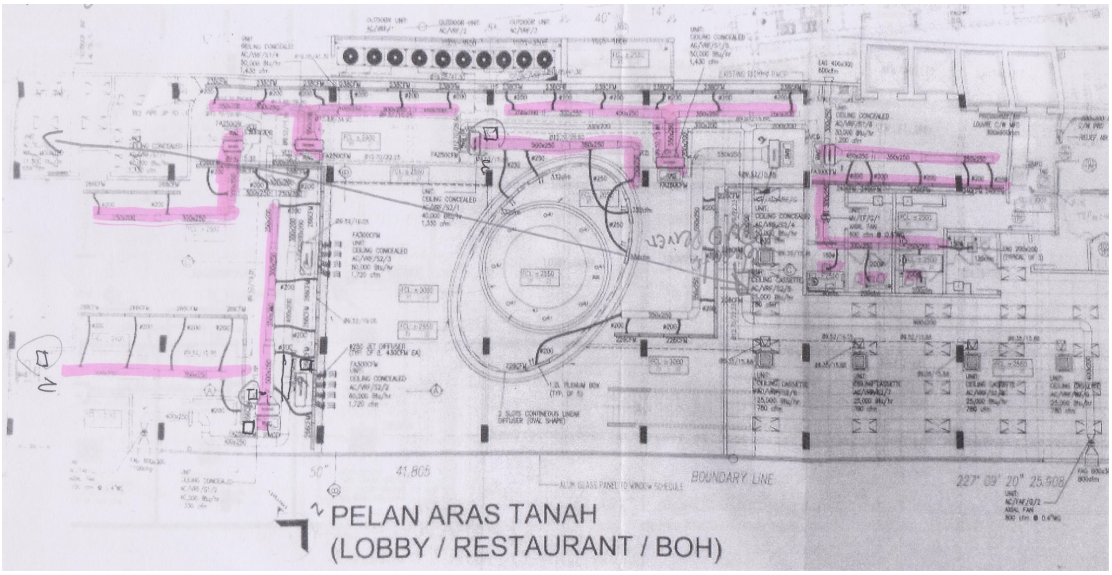


Figure 3.1.1 Pink line representing ductwork pipe

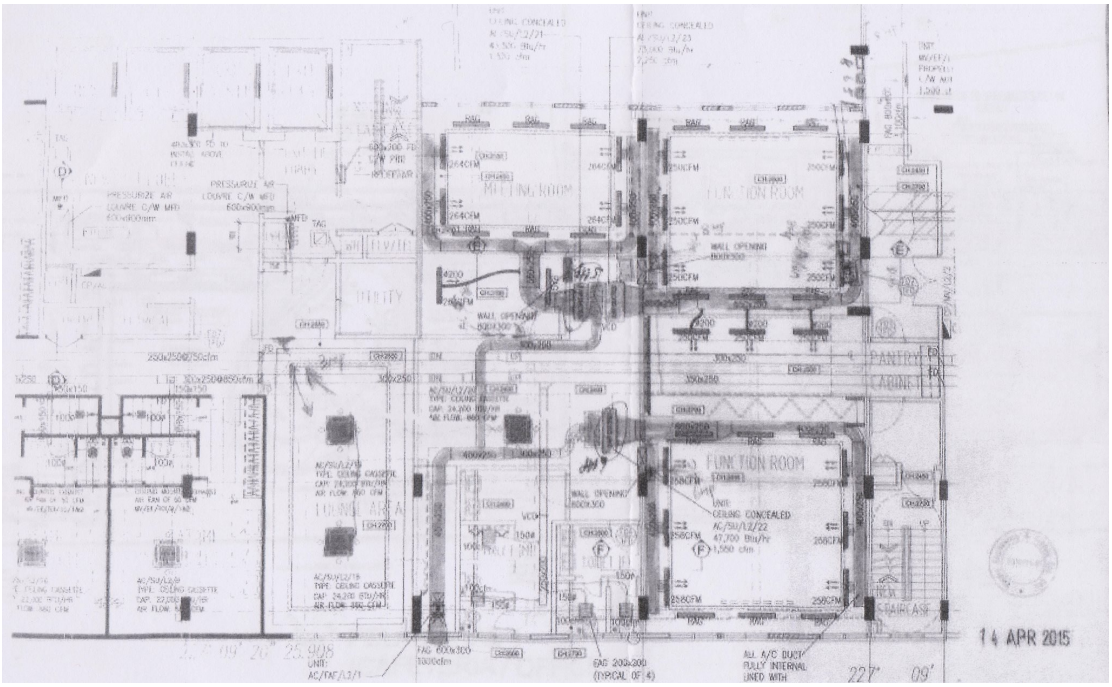


Figure 3.1.2 Black line representing ductwork pipe

Figure 3.2 Ductwork on Building Exterior

According to UBBL 1996, section 123: Pipes and service ducts.

(1) Where ducts or enclosures are provided in any building to accommodate pipes, cables or conduits the dimensions of such ducts or enclosures shall be –

(a) adequate for the accommodation of pipes, cable or conduits and for crossings of branches and mains together with supports and fixing; and

(b) sufficiently large to permit access to cleaning eyes, stop cocks and other controls there to enable repairs, extensions and modifications to be made to each or all of the services accommodated.

(2) The access opening to ducts or enclosures shall be long enough and suitably placed to enable lengths of pipe to be installed and removed.

3.8.2 Diffuser

Diffusers are usually found at the end of the ducts. At our Swiss Inn, there are 3 working diffusers and a return air grilles. The diffusers are present only throughout the Ground floor and the 1st floor. The openings' sizes remain

constant throughout the two floors. However, each indoor unit can cool or heat independently and the temperatures can be changed also.

Figure 3.3 Indoor Unit Controller

3.8.2.1 Supply Air Diffuser

Supply air diffusers distribute air from the ducts evenly throughout the placement it was made for. By splitting the air into smaller air streams towards the diffusers and reducing the air velocity, less noise will be created.

Figure 3.4 Linear Diffuser

Figure 3.5 Round Diffuser

3.8.2.2 Return Air Grilles

The return air grilles main function is to extract the air back to the specific AHU on each floor. The fan behind the air grilles will pull in the warm air from the room to the AHU unit. Behind the air grilles, therein will exist a filter to help filtrate most of the dirty air. Dirty filters will affect the air-conditioner efficiency and is best to be replaced once each month during cooler seasons.

Figure 3.6 Return Air Grilles

3.9 Variable Refrigerant Volume (VRV)

The variable refrigerant volume (VRV) is a multi-split system air conditioner for commercial buildings that uses variable refrigerant flow control. This system allows the user to maintain individual zone control of different indoor air-conditioner units. By having individual control over different indoor units, energy consumption can be minimized to deliver optimum energy savings. As for our building which is a 9 floor building, there are 10 VRV outdoor units which are connected to the indoor units of our building's ground floor and 1st floor. The ground floor and first floor has a lobby and cafeteria which requires a huge space to be ventilated and hence the usage of VRV .Not to mention, VRV system also enables simultaneous heating and cooling for each individual indoor unit.

3.10 Split unit Air Conditioning System

Ductless split unit air-conditioning system are a popular choice for air conditioning system for smaller buildings. Here the main components basically consist of an outdoor unit that serves as a condenser and an indoor unit that acts an as evaporator. The ductless split unit air-conditioning system only circulates and recycles indoor air. Any indoor air will be drawn into the unit to be cooled by the refrigerant cycle in the evaporator and the condenser and then re-released back into the room. The air-conditioning unit can be either be stand-alone, wall mounted, floor mounted and ceiling mounted. In

Swiss Inn Hotel, only the second floor to the ninth floor utilizes split unit air conditioning system as those floors only has the individual hotel rooms.

Figure 3.7 Wall Mounted Indoor Unit

Figure 3.8 Ceiling Mounted Indoor Unit in the Individual Hotel Rooms

Figure 3.9 Ceiling Mounted Indoor Unit

Figure 3.10 Outdoor Units on the Roof

Figure 3.11 Outdoor Units in the Basement

3.11 Finding and Analysis

Thermal comfort is achieved in Swiss Inn Hotel as the room temperature is maintained at an average of 22°C throughout the area.

According to MS1525:2007 —
Code 8.1.2 Indoor design conditions:
In general, an individual feels comfortable when metabolic heat is dissipated at the rate at which it is produced. The human body temperature needs to be maintained at a constant 37 ± 0.5 oC regardless of the prevailing ambient condition. The higher the space relative humidity, the lower the amount of heat the human body will be able to transfer by means of perspiration.

Code 13a:
At normal comfort room temperature (23 to 26°c), the acceptable air velocity would be in the region of 0.15 to 0.5 m/s. The indoor design conditions of an air-conditioned space for comfort cooling is recommended to have dry bulb of 23 to 26°c. The recommended design relative humidity is 55-70%. The recommended air movement is 0.15 to 0.5 m/s. According to Department of Malaysian Standards, the maximum air movement is 0.7m/s.

Moreover, the hotel has operating hours that runs all day. There are manual switches that can be used to control the system after working peak hours in order to prevent energy wastage. The Individual hotel rooms each has a keycard system that powers the room when it's being occupied and when the occupants leave the room ,the keycard is removed and everything is shut down in the room which saves energy too.

Backup systems exist in the hotel in order to prepare the hotel for future unforeseen system failure or emergencies.

3.12 Conclusion and Recommendation

Based on the study and research conducted in this section, it is concluded that both the VRV system and split unit air-conditioning system are both suitable for the Swiss Inn's 9 storeys large commercial space. The VRV systems are used for the lobby and cafeteria which is suitable in providing certain temperatures based on the space usage. As for the split units in the hotel rooms, it is much better to have individual units for each user for convenience.

The Swiss Inn also complies with the UBBL and MS1525 in terms of installation as well as the air conditioning system. They also have indoor air quality checks and manual off-hour control which serve to ease the users.

4.0 Mechanical Ventilation System

4.1 Introduction

Ventilation is vital in a building to remove ‘stale air’ and replace it with ‘fresh air’. Ventilation helps to moderate internal temperate and replenish oxygen when a cooler fresh air replaces the warmer air in the room. Besides it also helps to reduce the accumulation of moisture, odours, bacteria, dust, carbon dioxide, smoke and other contaminants that can build up during occupied periods. It creates air movement in the room which improves the comfort of occupants.

In this report the main target of study is mechanical ventilation, however natural ventilation will also be studied for certain rooms such as machine room for lift.

4.2 Literature Review

There are two types of mechanical ventilation system, mainly spot ventilation, which includes supply system, extract system or a balanced system; and also energy-recovery ventilation system. In a supply system, fresh air is supplied by a central supply fan and stale air goes outside naturally. This system is usually used in boiler plants and factories. On the other hand, an extract system creates a negative pressure inside the building, causing air to move in naturally, though stale air is channelled out using exhaust fans. This system usually functions in basements, indoor toilets or bathrooms. For a combination system, it consists of both supply and extract system, therefore the building's goes through slight air pressurization by using an extract fan smaller than an inlet fan. Fresh air is supplied and stale air is picked up from multiple points. This system usually works in cinemas, theatres, sports centres and so on. For an energy recovery ventilation system (ERV), it includes a controlled heat exchanger, with one or more fans pushing air through the machine. However, it is less cost-effective and not commonly used in Malaysia as it is mainly made for countries with extreme summer and winter climates.

In Swiss Inn, Johor Bahru, a balanced system is used. A balanced system uses both inlet and extract fans, maintaining the internal air pressure at a similar level to the outside air and so reducing air infiltration and draughts.

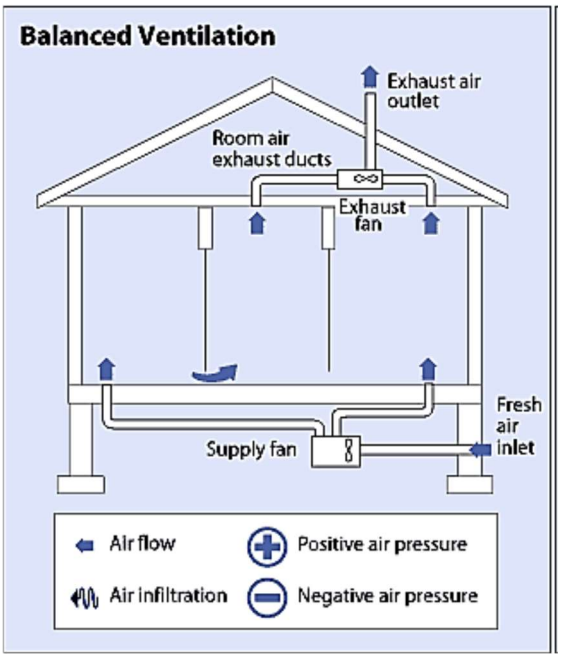


Figure 4.1 Illustration of Balanced Ventilation

4.2.1 Components in Mechanical Ventilation

There are 5 main components in mechanical ventilation, all of them are necessary for the mechanical ventilation to work.

- Fan - A device for impelling air through inlet point or ducts, forming part of the distribution system.
- Filter – To sift external air before releasing into the room, to trap and prevent dust, smoke and bacteria from entering the room
- Ductwork – To channel outside air towards the room or the air from the room towards the outside.
- Fire Damper – To avoid the fire from spreading from one room to other through ductwork.
- Grille and Diffuser – Located at the edge of the ductwork where the air is released into the room.

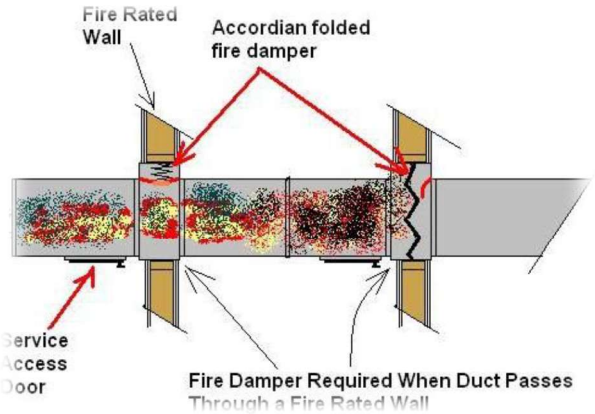


Figure 4.2 Main Components in Mechanical Ventilation

4.3 Natural Ventilation

It is very important to have a good ventilation in any room especially rooms where people will stay in for a long duration, area which is vital for escape in case of any emergency and also operation room such as lift motor room.

4.3.1 Staircase and Machine Room

According to UBBL 1984 Section 39: Natural lighting and ventilation.

(1) Every room designed, adapted or used for residential, business or other purposes except hospitals and schools shall be provided natural lighting and natural ventilation by means of one or more windows having a total area of not less than 10% of the clear floor area of such room and shall have openings capable of allowing a free uninterrupted passage of air of not less than 5% of such floor area.

According to UBBL 1984 Section 198: Ventilation of staircase enclosures.

(1) All staircase enclosures shall be ventilated at each floor or landing level by either permanent openings or openable windows to the open air having a free area not less than 1 square meter per floor.

Figure 4.3 Lift Motor Room window

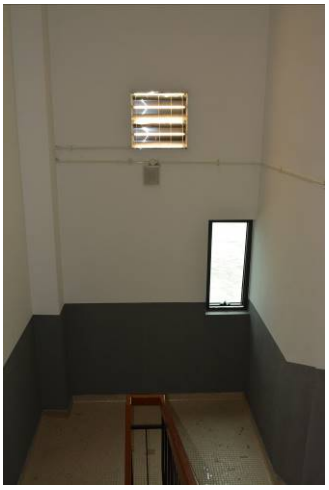


Figure 4.4 Staircase window

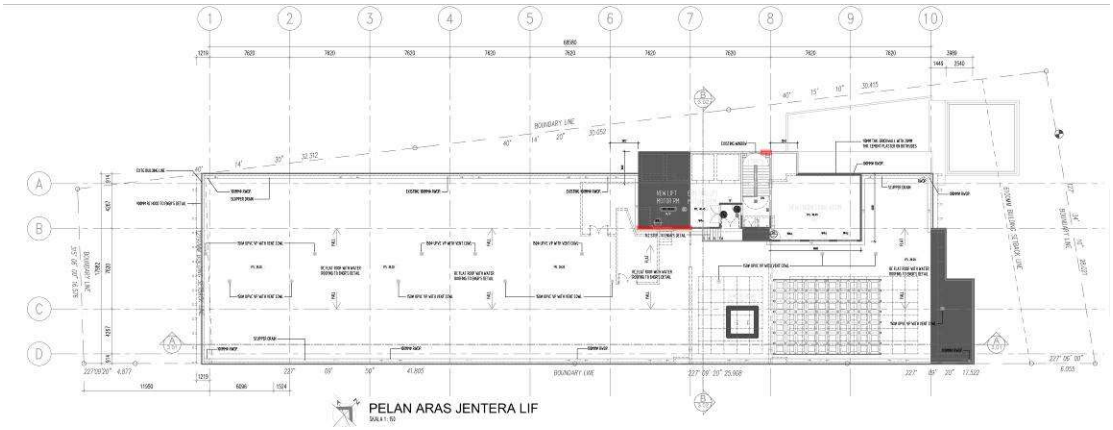


Figure 4.5 Natural Ventilation for Lift Motor Room and Staircase

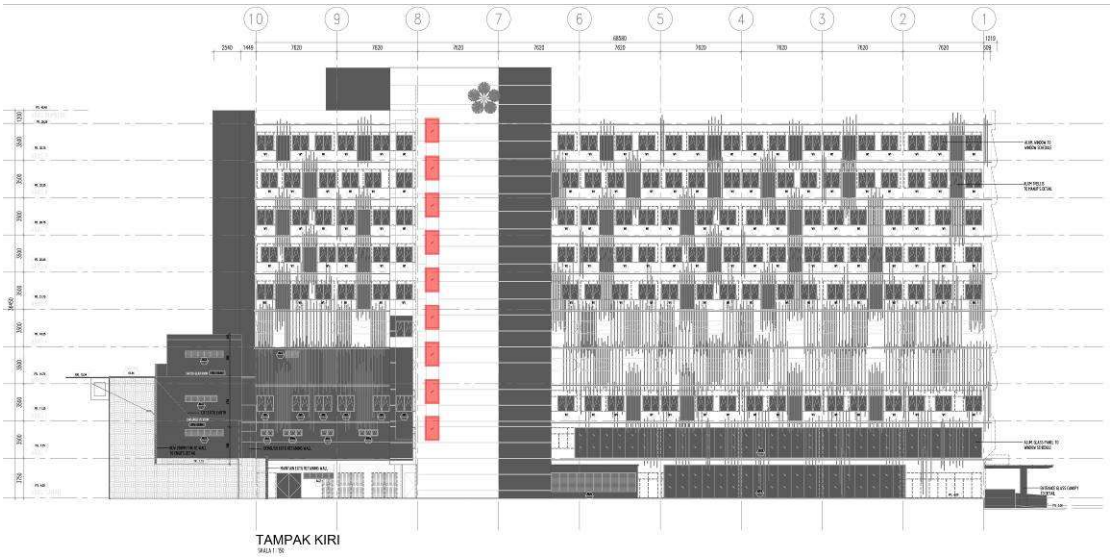
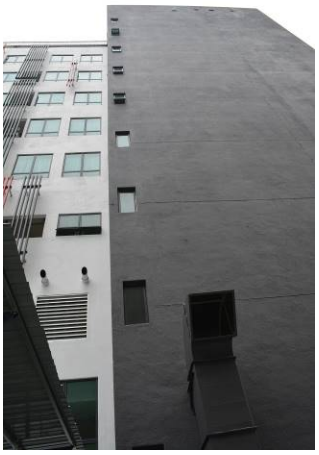


Figure 4.6 Elevation showing windows on staircase



As we can clearly see from the elevation and picture, necessary windows are provided at each floors at the fire escape staircase. Swiss Inn has chosen openable window, this is mainly because they have staircase pressurize system, and this system will work perfectly when windows are closed.

Figure 4.7 Windows on staircase

4.3.2 Carpark

It is essential to ensure a good ventilation in car park area as a lot of exhausted gases from vehicle are harmful to our health. For basement carpark it is necessary to have mechanical vents to draw out poisonous gases.

However, the car park area for Swiss Inn is located at 3rd and 4th floor. There is no need for mechanical vent as the whole area has minimum walls and it will creates a good cross ventilation.

Figure 4.8 Elevation showing car park cross ventilation

Figure 4.9 Openings at car park floor

4.4 Mechanical Ventilation

4.4.1 Pressurized system for lift lobby and staircase

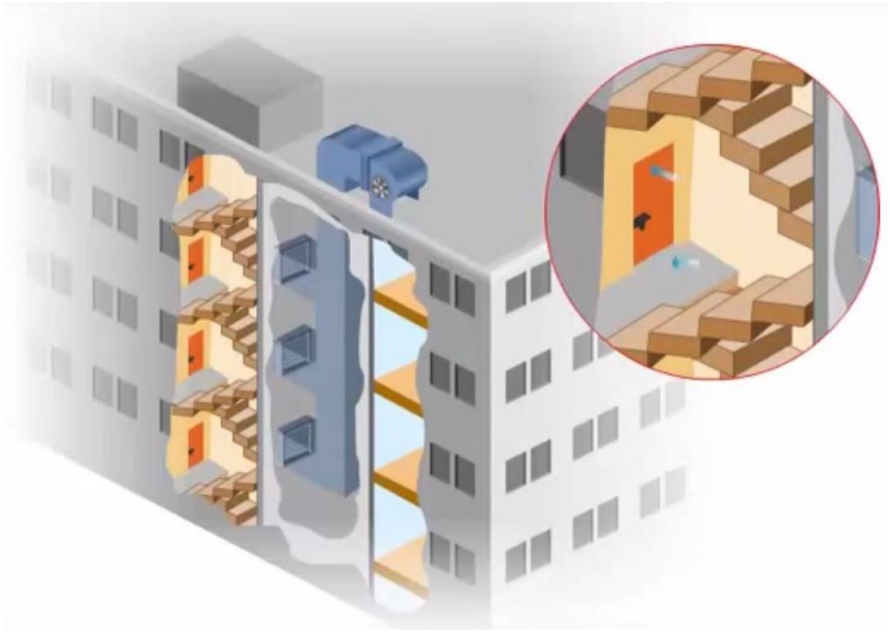
Swiss Inn has 9 floors in total and its height exceeds 18 meters above ground level, hence a mechanical pressurisation is needed as a means of escape during fire. The main function of this mechanism provide a smoke free evacuation path during a fire.

According to UBBL 1984 Section 200: Ventilation of staircase enclosures in buildings exceeding 18 metres.

For staircase in buildings exceeding 18 metres above ground level that are not ventilated in accordance with by-law 198, two alternative methods of preventing the infiltration smoke into the staircase enclosures may be permitted by providing –

(a) permanent ventilation at the top of the staircase enclosure of not less than 5% of the area of the enclosure and in addition at suitable intervals in the height of the staircase a mechanically ventilated shaft to achieve not less than 20 air charges per hour to be automatically activated by a signal from the fire alarm panel; or

(b) mechanical pressurisation of the staircase enclose to the standard of performance as specified in section 7 of the Australian Standard 1668, Part 1 - 1974 or any other system meeting the functional requirements of the D.G.F.S.



During a fire the fan usually located above roof will be activated and it will pump in air through a vertical duct into the stairwell to create a high pressure zone so that smoke cannot flow in.

Figure 4.10 Fan to pump in air

Figure 4.11 Aluminium Diffuser

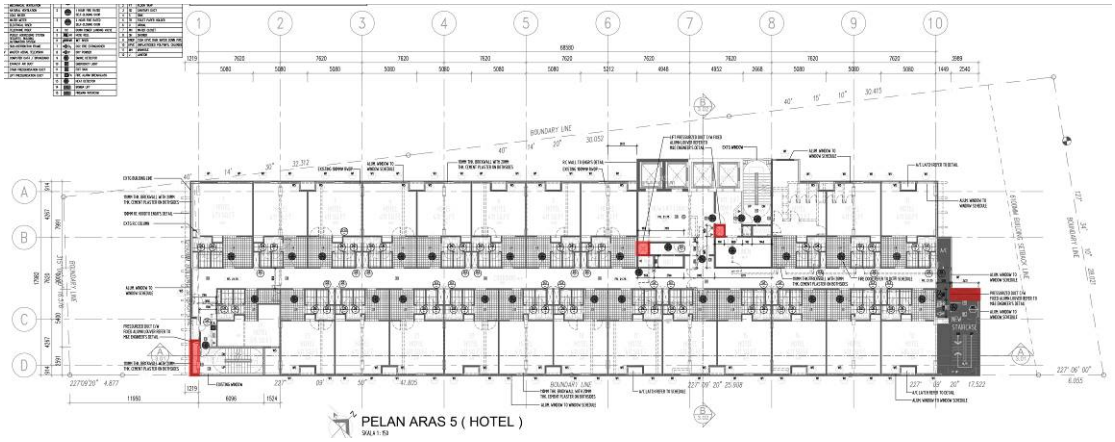


Figure 4.12 Location of Pressurized Duct

There are total of 3 fire escape staircase including the core for circulation at the middle of the building which has elevators. All of them has a pressurisation system which would ensure smoke free escape routes.

According to UBBL 1984 Section 202: Pressurized system for staircase

All staircases serving buildings of more than 45.75 metres in height where there is no adequate ventilation as required shall be provided with a basic system of pressurization –

(d) where the mechanical system to prevent smoke from entering the staircase shall be automatically by a suitable heat detecting device, manual or automatic alarm or automatic wet pipe sprinkle system;

The automated control panel that control the fan for pressurized system. When a fire is detected, the fan will be automatically turned on to pressurise the escape routes.

Figure 4.13 Pressurized System Control Panel

4.4.2 Kitchen

The kitchen area uses a balanced system. An exhaust system is a must in a kitchen to extract heat, oil, and food smell away from kitchen to prevent the restaurant to be filled with oily smell. However exhaust system alone is not sufficient to keep the restaurant air fresh, hence there is also a supply system to further circulate the air.

Figure 4.14 Control Panel for balanced system in kitchen

Figure 4.15 Exhaust from kitchen

4.4.3 Gen Set Room

It is important to have a proper ventilation in the genset room as the generator is powered by diesel, the smoke and fumes exhausted from the combustion might fill up the room if it is not ventilated. Besides, oxygen is also needed for the combustion, therefore, it must have an intake grille.

It is located at 3rd floor parking area and the exhaust grille from the generator will be channelled directly outside the building.

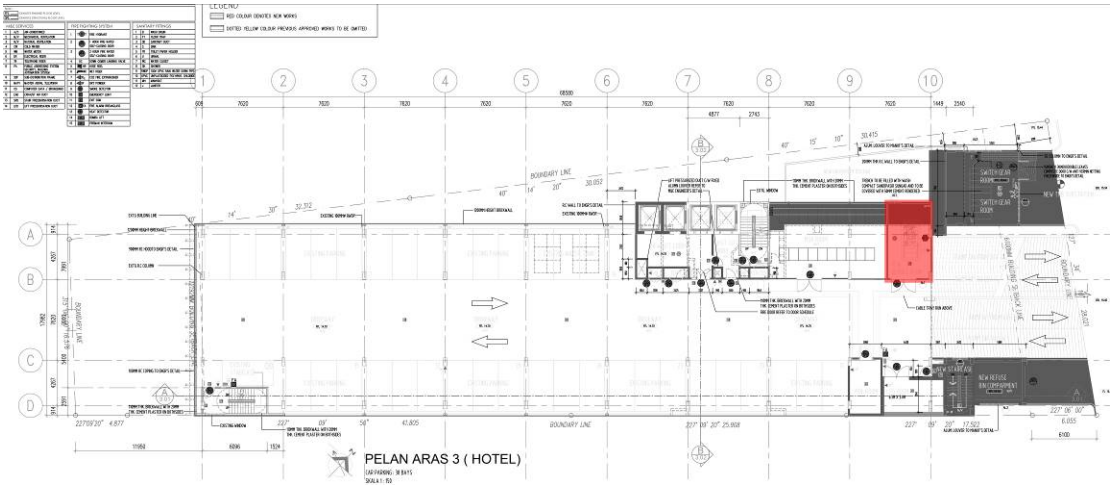


Figure 4.16 Gen Set location

Figure 4.17 Diesel Generator

Figure 4.18 Air intake diffuser

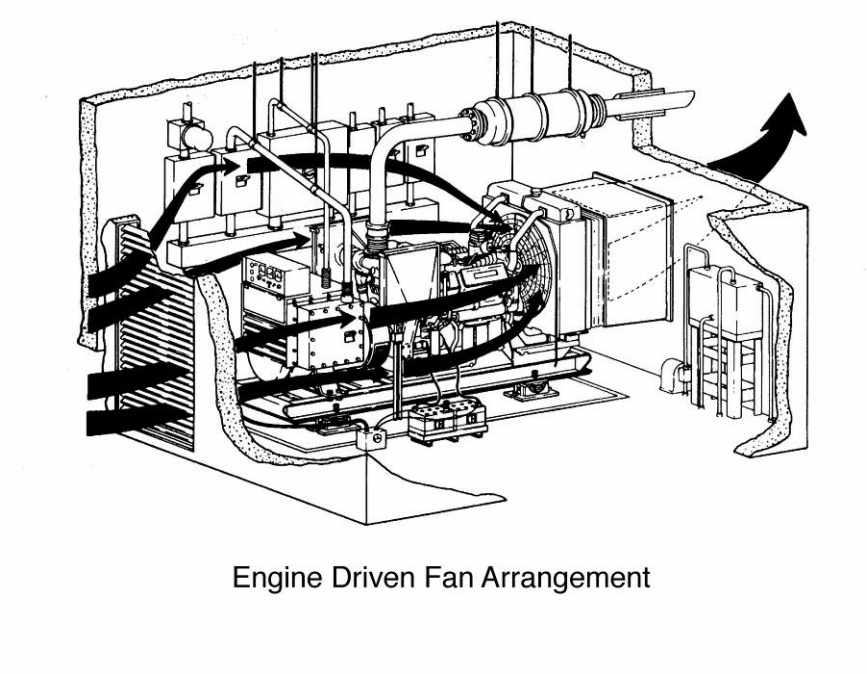


Figure 4.19 Ventilation for generator

4.4.4 Pump Room

Pump room is a room where water tanks will be located, together with pumps to pump the water vertically up for cold water supply. For the pump to perform at its optimal performance, it should not overheat, overheating will easily occur in a stale air room, hence it is necessary to provide mechanical ventilation in pump room.

When the room temperature rise to a certain temperature, the propeller fan will be activated to extract the warmer air in the room.

Figure 4.20 Propeller fan

Figure 4.21 Pump room

Figure 4.22 Control Panel with temperature sensor

4.4.5 Toilet

Every toilet needs a good ventilation to extract faulty smell and gases away. In Swiss Inn, every toilet has a mechanical vent to bring away the faulty smell. Then those gases will be released at the roof top.

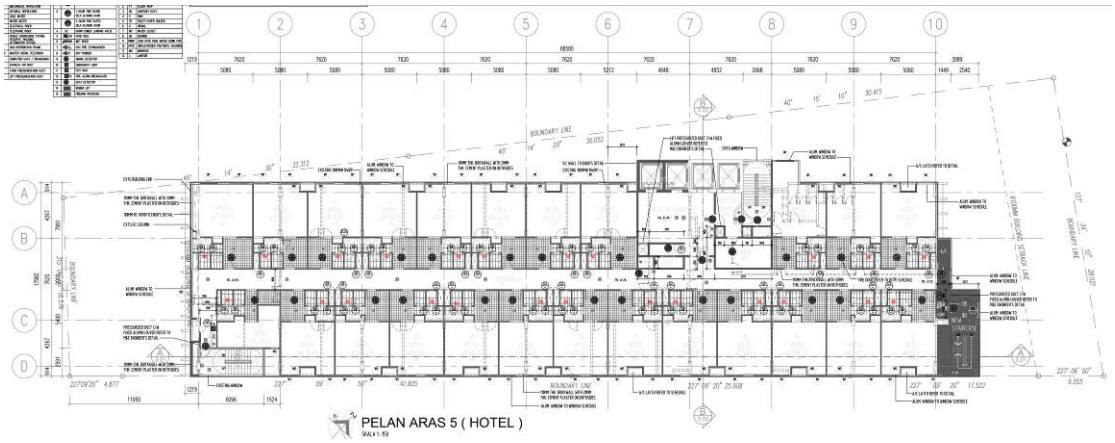


Figure 4.23 Location of toilet vent

Figure 4.24 Diffuser in toilet

Figure 4.25 Exhaust at the roof top

4.4.6 Elevator

A lift car is totally sealed when the door is closed. Therefore, a mechanical ventilation is needed to supply air into the lift car. A blower fan is used to bring in air supply.

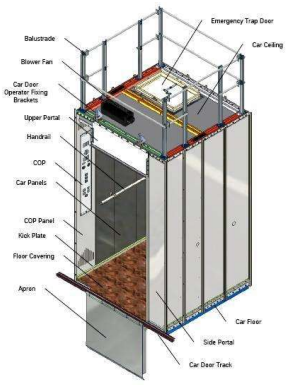


Figure 4.26 Lift car components

Figure 4.27 Diffuser

A blower fan in lift car is always located on the ceiling, it will bring the outside air into the car.

4.4.7 Lift Motor Room

In a machine room, ventilation is very important as a cool environment would increase the efficiency of the machine. Although the room is natural ventilated, but it is still not enough. Propeller fan is used to extract out the warmer air to maintain a cooler internal room temperature.

Figure 4.28 Natural Ventilation in Lift Motor Room

Figure 4.29 Propeller fan

4.5 Conclusion and Recommendation

Swiss Inn, Johor Bahru have various type of mechanical ventilations to achieve thermal comfort for the user and also to maximise the efficiency for the machines. Through observation, we can see that the mechanical ventilation of the building had achieved the UBBL requirements. All the necessary ventilations are provided. However, the front staircase ventilation is still not that good compared to the other two because the openings for ventilation cannot be closed, during a fire, the pressurized system might not perform that well. If that openings can be changed to a openable window, it will be better.

5.0 Mechanical Transportation System

5.1 Introduction

Mechanical transportation is essential for high rise building or any building that is serve for the elderly or disabled. Such building include shopping mall, office building and hotel. These transportation system are designed to allow the user or goods to be transported in a quick and efficient way. Mechanical Transportation System that is available in Swiss Inn Hotel, Johor Bahru, is only the Geared Traction Elevator System. This chapter will cover the component that can be found from the lift pit to the car to the machine room as well as comparing it with the Uniformed Building By Law (UBBL).

5.2 Literature review

CODES AND STANDARDS

Perhaps more than any other item of construction, elevators are governed by strict installation codes. The "bible" of the industry in the United States is the American Society of Mechanical Engineers ANSI/ASME Standard A17.1, Safety Code for Elevators and Escalators, the latest version of which should be in every architect's and engineer's working library. The code has legal force in most parts of the United States. In addition, ANSI/ASME Standard A17.3 covers existing elevators and escalators, and Standard A17.4 covers emergency evacuation of passengers from elevators. As with other building systems, some states and municipalities have their own elevator codes (Massachusetts, Wisconsin, Pennsylvania, New York City, Seattle, and Boston, among others) that are generally based upon, and more stringent than, the ANSI/ASME code. In addition to the elevator code, other construction and installation codes have an influence on elevator work. Thus, NFPA 101, the Life Safety Code, states certain fire safety requirements; NFPA 70 (the National Electrical Code) governs some of the electrical aspects of elevator construction; and state and local laws add a multitude of requirements and restrictions bearing on fire safety, emergency power, security regulations, and special accommodations for handicapped persons. Provisions for the disabled are covered by ANSI A117.1 (Accessible and Usable Buildings and Facilities), a special industry code, by the requirements of the Americans with Disabilities Act (ADA), and, in most locations, by local law. Like most large industries, the elevator industry is self-regulating and standardized. The National Elevator Industry, Inc. (NEII) publishes standard elevator layouts for traction and hydraulic installations. Elevator consultants and elevator company representatives are normally knowledgeable about all of the codes and standards in force, but this does not relieve the architect-engineer of legal responsibility for the design. Therefore, we strongly recommend that in the preliminary planning stage all pertinent regulations concerning vertical transportation be acquired and studied.

PRINCIPAL COMPONENTS

The car, cables, elevator machine, control equipment, counterweights, hoistway, rails, penthouse, and pit are the principal parts of a traction elevator

installation. The car is the only item with which the average passenger is familiar. Indeed, some of a building's prestige depends upon proper design of the car. Essentially, the car is a cage of some fire resistant material supported on a structural frame, to the top member of which the lifting cables are fastened. By means of guide shoes on the side members, the car is guided in its vertical travel in the shaft. The car is provided with safety doors, operating control equipment, floor level indicators, illumination, emergency exits, and ventilation. It is designed for long life, quiet operation, and low maintenance. The cables (ropes) that are connected to the crosshead (top beam of the elevator) and carry the weight of the car and its live load are made of groups of steel wires especially designed for this application. Four to eight cables, depending on car speed and capacity, are placed in parallel. Although multiple ropes are used primarily to increase the traction area on the drive sheaves, they also increase the elevator safety factor inasmuch as each rope is normally capable of supporting the entire load. The minimum factor of safety varies from 7.6 to 12.0 for passenger elevators and from 6.6 to 11.0 for freight elevators. The cables from the top of the car pass over a motor driven cylindrical sheave at the traction machine (grooved for the cables) and then downward to the counterweight. The counterweight is made up of cut steel plates stacked in a frame attached to the opposite ends of the cables to which the car is fastened. It is guided in its travel up and down the shaft by two guide rails typically installed on the back wall Off the shaft. Its weight equals that of the empty car plus 40% of the rated live load. It serves several purposes: to provide adequate traction at the sheave for car lifting, reduce the size of the traction machine, and reduce power demand and energy cost. (These advantages come at the price of strengthening the overhead machine room floor, which must carry the additional structural load of the counterweight.)

Approximately 75% of the energy expended in lifting a car is returned to the system by regeneration when the car is lowered. Regeneration is the process in which the traction motor becomes a generator when the car is lowered and feeds power back into the electrical system. The lost energy appears as heat, primarily in the machine room. To compensate for the hoist rope weight, which becomes an important factor in high rise elevators, cables are attached to the bottom of the car and the counterweight, thus equalizing loads regardless of the cab position. The elevator machine turns the sheave and lifts or lowers the car. It consists of a heavy structural frame on which are mounted the sheave and driving motor, the gears (if any), the brakes, the magnetic safety brake, and certain other auxiliaries. In many existing installations the elevator driving (traction) motor receives its energy from a separate motor-generator (m-g) set, which is in operation during the period that the particular elevator is available for handling traffic. This m-g set is properly considered a part of the elevator machine, although it may be located some distance from it. In modern installations, solid state power and control equipment replaces the m-g set. A governor, which limits the car to safe speeds, is mounted on or near the elevator machine. The control equipment is usually divided into three groups:

1. Drive (motion) control is concerned with the velocity, acceleration, position determination, and leveling of the car.
2. Operating control covers car door operation and functioning of car signals, including floor call buttons and all indicating devices.
3. Supervisory control is concerned with group operation of multiple car installations. The actual physical devices in these control systems were electromechanical in the past but are solid state in modern installations. The indicating and control devices that are seen and used by the elevator user, including car and hallway buttons, lanterns, and audible devices, are all coordinated into the overall operational control scheme, which produces rapid, safe, and comfortable vertical transportation. The shaft, or hoistway, is the vertical passageway for the car and counterweights. On its sidewalls are the car guide rails and certain mechanical and electrical auxiliaries of the control apparatus. At the bottom of the shaft are the car and counterweight buffers. At the top is the structural platform on which the elevator machine rests. The elevator machine room (which may occupy one or two levels) is usually directly above the hoistway. It contains the traction machine and the m-g set or solid state control that supplies energy to the elevator machine and control equipment. Machinery and control equipment are designed for quiet, vibration-free operation.

5.3 Swiss Inn Hotel Overview

5.3.1 Lift Lobby

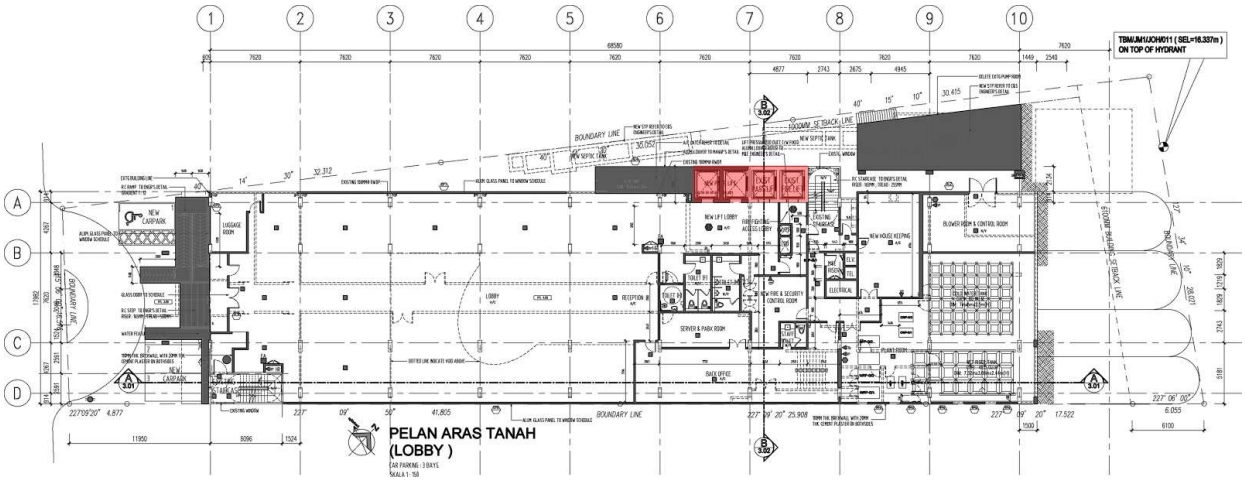


Figure 5.1: Ground Floor plan indicating the placement of lift

Lift should be carefully plan and placed in a centralized area such as entrance lobby. This is to allow the user to have an easy access to the the lift lobby. It is also essential for lift to be group together to reduce waiting time, cost of installation and convenience. Lift lobby should be large enough to allow traffic to move in two direction.

5.3.2 Fireman's Lift

The fire staircase is placed next to the lift lobby to allow user to access during emergency. It is also common to place a fireman's lift near the lift lobby & fire staircase.

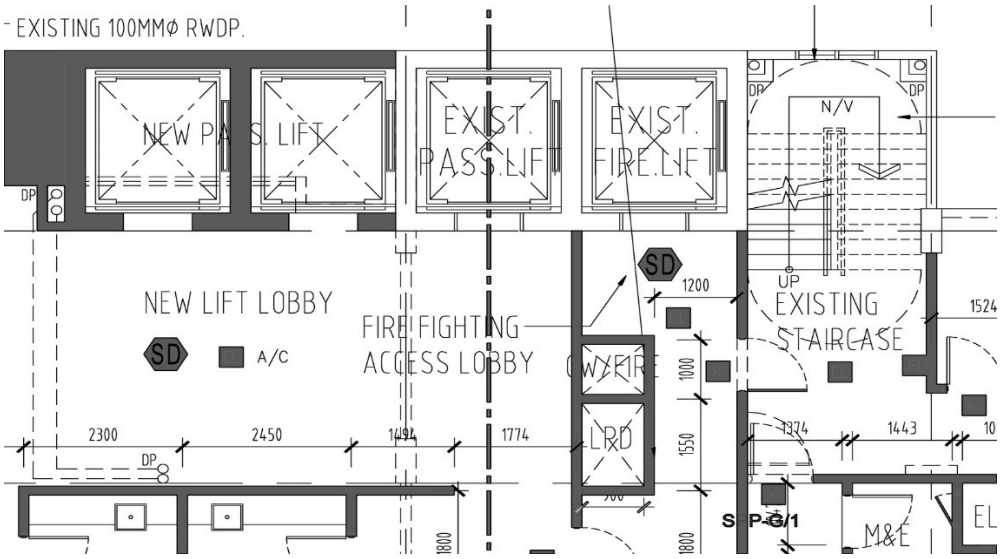


Figure 5.2 Zoom in view of the Lift Lobby to indicate position of Fire Staircase & Fireman's Lift

Figure 5.3 Fireman's lift of Swiss Inn Hotel

Characteristic of Fireman's Lift

- Break -glass key switch (at G/F to control the lift)
- glass key switch (at G/F to control the lift)
- Min. duty load, say 630 kg (for firefighting equipment)
- Manufactured from non-combustible material
- A two-way intercom
- 1 hour fire-resisting doors
- Dual power supplies (normal + emergency)

According to UBBL 1974 Section 243. Fire lifts.

(3) The first lifts shall be located within a separate protected shaft if it opens into a separate lobby.
(4) Fire lifts shall be provided at the rate of one lift in every group of lifts which discharge into the same protected enclosure or smoke lobby containing the rising main, provided that the fire lifts are located not more than 61 metres travel distance from the furthermost point of the floor.

5.3.3 Building Height

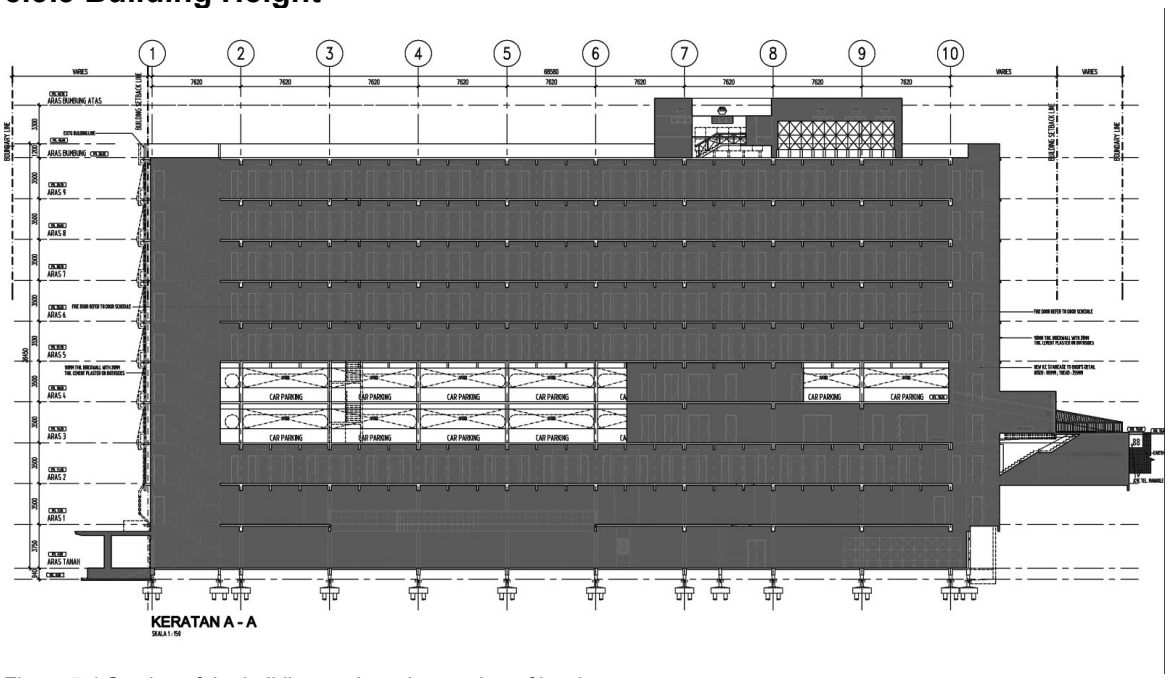


Figure 5.4 Section of the building to show the number of levels.

Non-residential building that is higher than 4 floor or to cater for elderly and the disabled should provide lift to allow easy access to different floor.

According to UBBL 1974 Section 124. Lifts.

For all non-residential buildings exceeding 4 storeys above or below the main access level at least one lift shall be provided.

5.4 External Components

5.4.1 Lift Door

Figure 5.5 7th floor lift lobby

The car door of Swiss Inn Hotel is a single speed center opening type that consist of two power operated panels that part simultaneously with a brisk, noiseless motion, faster passenger loading than side opening.

Elevator doors are normally opened by a power unit that is located on top of the elevator car. When an elevator car is level with a floor landing, the power unit moves the car door open or closed. A pick-up arm (clutch, vane, bayonet, or cam) contacts rollers on the hoistway door which releases the door latch on the hoistway door. The power unit opens the car door which in turn opens the hoistway door. The door rollers and pick-up arm may be different on various elevators but they all work on the same principle.

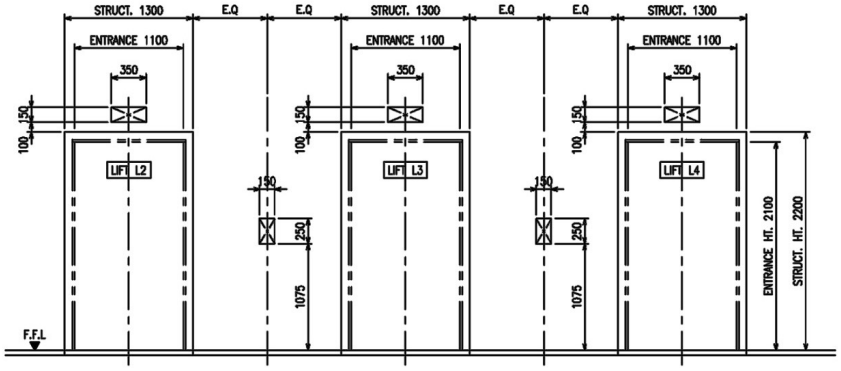


Figure 5.6 Structure Entrance Opening

According to UBBL 1974 Section 152. Openings in lift shafts.

(1) Every opening in a lift shaft or lift entrance shall open into a protected lobby unless other suitable means of protection to the opening to the satisfaction of the local authority is provided. These requirements shall not apply to open type industrial and other special buildings as may be approved by the D.G.F.S.

5.4.2 Call Button

Call Buttons are used to request an elevator. They are mounted 105 cm above the finished floor and consist of an up button and a down button that illuminate to indicate the request has been received and an elevator is on the way.

5.4.3 Hall Lantern

Hall lanterns are always be visible from outside because their primary purpose is to help people decide whether or not to get on the elevator.Hall lanterns are mounted a minimum of 180 cm above the finished floor and must be visible from the vicinity of the call buttons. The arrows on hall lanterns must be a minimum of 6 cm tall.


Figure 5.7 Hall lantern

5.4.4 Fireman's Lift Switch

Figure 5.8 Fireman's Lift Switch on the ground floor

The fireman's lift switch operates when the switch is been toggle on. The lift then overwrite all other level's command and prioritize the floor which the switch has been toggle on. This allow fireman to go to the designated floor to put out the fire immediately.

5.4.5 Smoke Detector

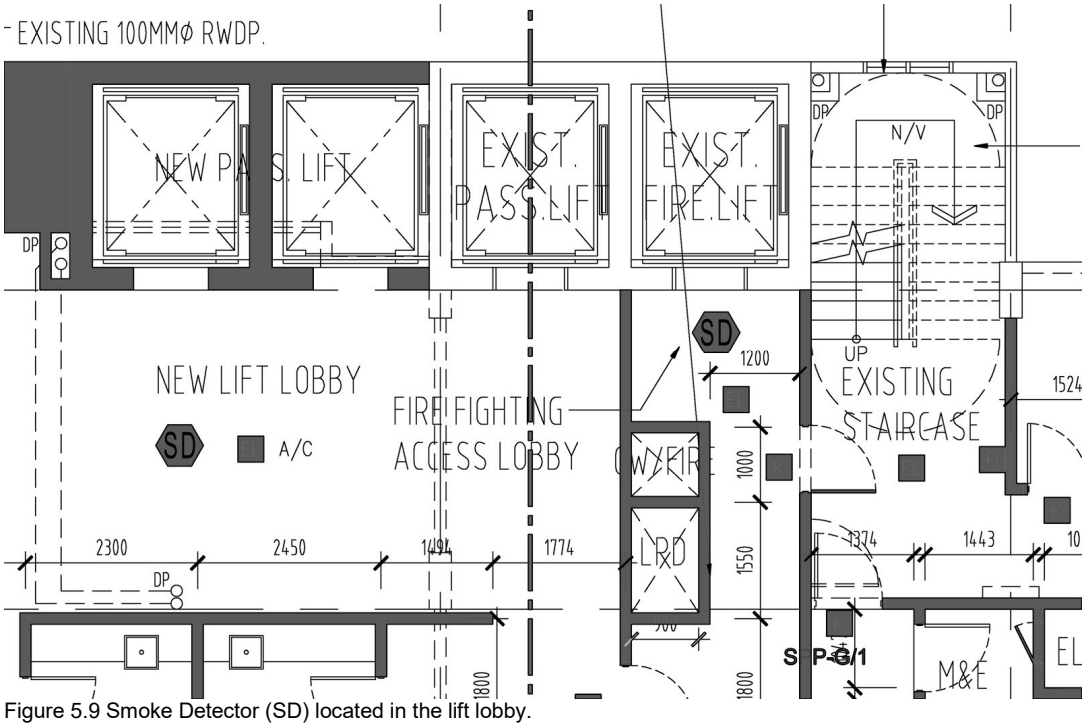


Figure 5.9 Smoke Detector (SD) located in the lift lobby.

Smoke detector are to be place in the lift lobby to detect smoke. If the smoke detector activated, all lift except for the fireman's lift will be move to the ground floor and then deactivated. Only the fireman's lift can only to operate during this time.

According to UBBL 1974 Section 153. Smoke detectors for lift lobbies.
(1) All lift lobbies shall be provided with smoke detectors

5.5 Internal Components

5.5.1 Car Operating Panel (COP)

Figure 5.10 COP in fireman's lift

Car operating panel COP is a panel mounted in the car containing the car operating controls, such as call register buttons, door open and close, alarm emergency stop and whatever other buttons or key switches are required for operation.

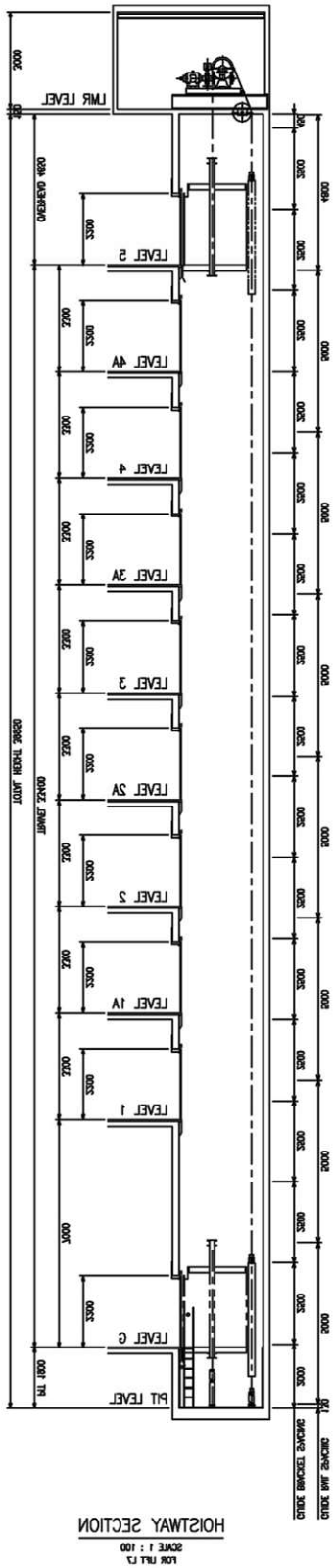
5.5.2 Handrail

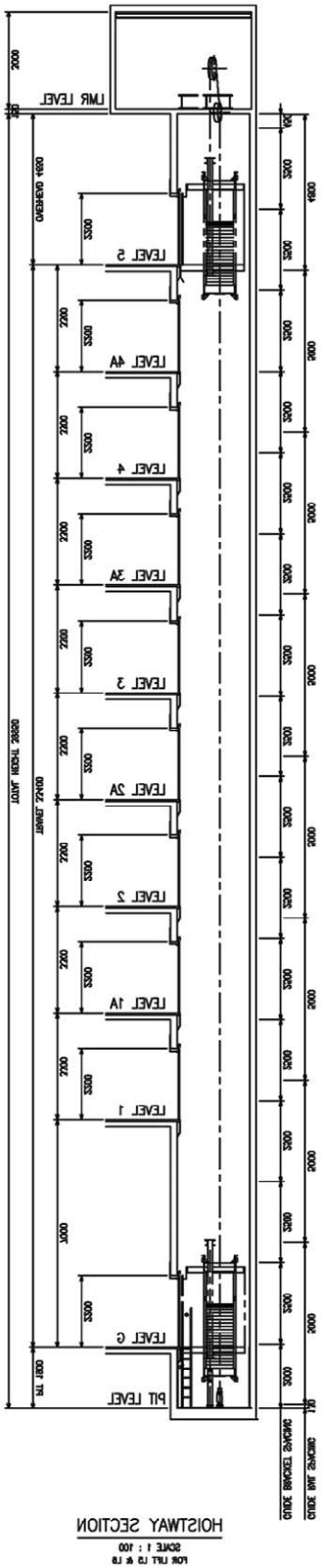
Figure 5.11 Interior of the car

- Hand Rail is a rail within the elevator car which passengers can use for support.
- Elevator car in most cases is provided by a handrail at one side, two sides or on all sides of the cabin.
- At least one side of the car has a handrail installed in case of using the elevator for passengers including persons with disabilities.
- Hand Rails come with different finishes like stainless steel styles or painted in selected color upon client requirements.
- There are two types of handrail, cylindrical handrail and flat type handrail.

5.6 Hoistway

5.6.1 Hoistway





Hoistway is the space enclosed by fireproof walls and elevator doors for the travel of one or more elevators, dumbwaiters or material lifts. It includes the pit and terminates at the underside of the overhead machinery space floor or grating or at the underside of the roof where the hoistway does not penetrate the roof.

<u>Hoistway components</u>

- Guide rails for both the car and counterweight.
- Counterweight.
- Suspension Cables
- Buffers in the pit.

Figure 5.12 Hoistway of Swiss Inn Hotel

5.6.2 Guided Rail

Guide Rails are Steel Tracks in the form of a “T” that run the length of the hoistway, round, or formed sections with guiding surfaces to guide and direct the course of travel of an elevator car and elevator counterweights and usually mounted to the sides of the hoistway. Car Guide rails are fixed to the hoistway by means of steel brackets. While counterweight guide rails are fixed to the hoistway by means of side steel brackets

5.6.3 Counterweight

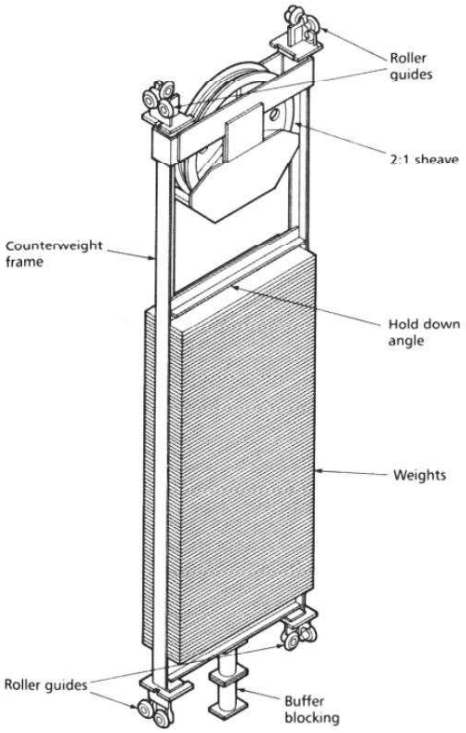


Figure 5.13 Typical counterweight counterweight

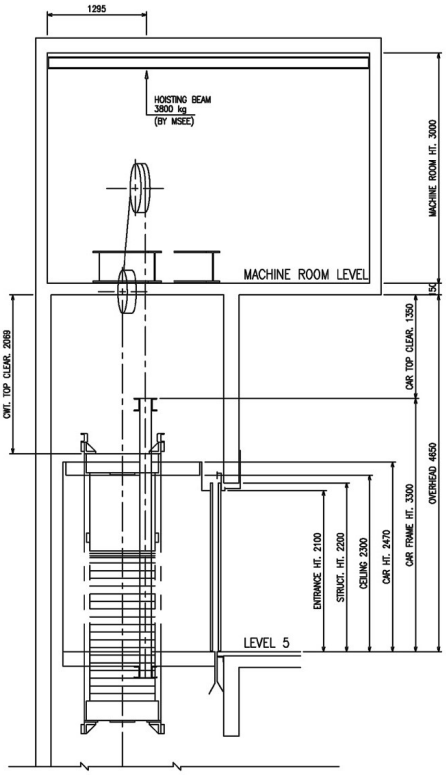


Figure 5.14 Section view of hoistway to show

Elevator cars are pulled up by means of rolling steel ropes over a deeply grooved pulley, commonly called a sheave in the industry. The weight of the car is balanced by a counterweight.

Counterweight counterbalances the load of the elevator carriage, so the motor lifts much less of the carriage's weight (specifically, the counterweight is the weight of the carriage plus 40-50% of its rated capacity). The counterweight also increases the ascending acceleration force and decreases the descending acceleration force to reduce the amount of power needed by the motor. The elevator carriage and the counterweights both have wheel roller guides attached to them to prevent irregular movement and provide a smoother ride for the passengers.

5.6.4 Suspension Cables

Figure 5.15 Suspension cables in the traction machine

Suspension cables are suspension means for car and counterweight, which are represented by steel wire ropes. They are used on traction type elevators, usually attached to the crosshead and extending up into the machine room looping over the sheave on the motor and then down to the counter weights. Hoisting cable are generally 3 to 6 in number. These ropes are usually 1/2”or 5/8” in diameter.

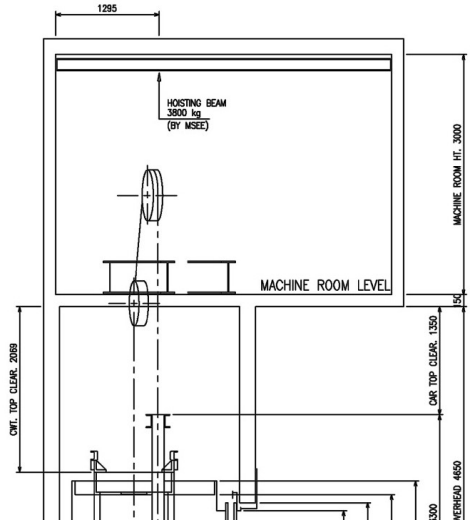


Figure 5.16 Single wrap: rope passes over sheave once and connected to counterweight.

5.6.5 Buffer

Figure 5.17 Standard buffer

Figure 5.18 Oil Buffer

An Oil Buffer is type of buffer more commonly found on traction elevators with speeds higher than 200 feet per minute. This type of buffer uses a combination of oil and springs to cushion a descending car or counterweight and are most commonly located in the elevator pit, because of their location in the pit buffers have a tendency to be exposed to water and flooding. They require routine cleaning and painting to assure they maintain their proper performance specifications. Oil buffers also need their oil checked and changed if exposed to flooding.

5.6.6 Safety Gear (Safety Device)

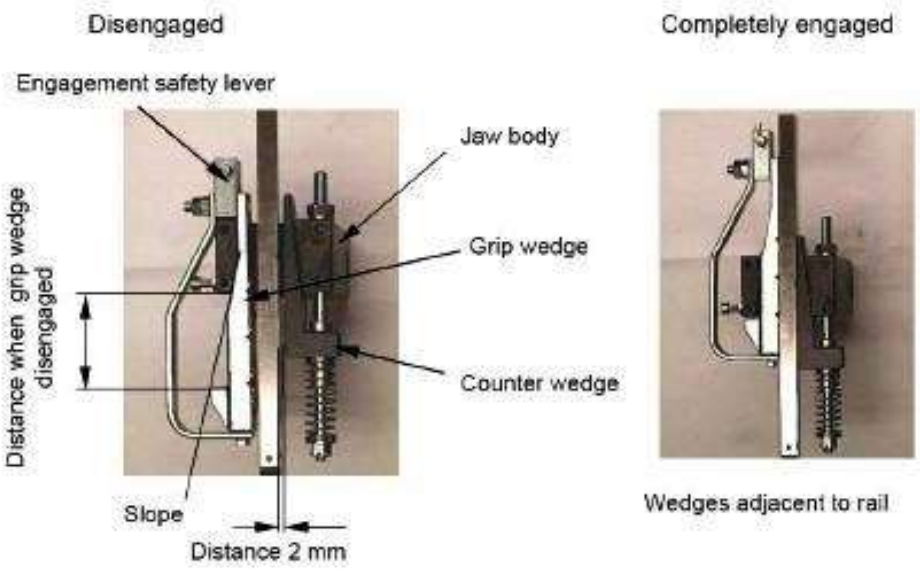


Figure 5.19 Progressive Safety Gear

Safety gear is a mechanical device for stopping the car (or counterweight) by gripping the guide rails in the event of car speed attaining a predetermined value in a downward direction of travel, irrespective what the reason for the increase in speed may be. Progressive safety gear retardation is affected by a braking action on the guide rails and for which special provisions are made so as to limit the forces on the car, counterweight or balancing weight to a permissible value. Pair of safety gears is mounted in the lower part of car sling and operated simultaneously by a linkage mechanism that actuated by governor.

<u>Operation of Safety Mechanism:</u>
Dependent on the direction the safety lever is pulled upwards or downwards; the movement of the lever is transmitted to the shearing mechanism by means of a rocker. The grip wedges of progressive safety gear or braking device which are linked with the safety-gear levers are released from their rest position between rail and jaw body which is maintained by a spring assembly. The safety-gear lever assembly which is arranged in the form of a shearing mechanism ensures that the progressive safety gears and/or braking device are activated simultaneously and in pairs.

5.7 Machine Room

5.7.1 Geared Traction Machine

Figure 5.20 Geared traction machine

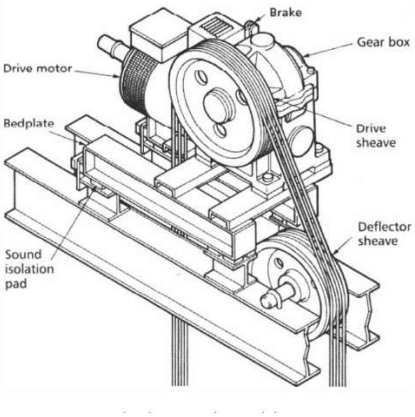


Figure 5.21 Component of a typical geared traction machine

Geared traction elevator have a gearbox that is attached to the motor, which drives the wheel that moves the ropes. Geared traction elevators are capable of travel speeds up to 3 m/s. The maximum travel distance for a geared traction elevator is around 75 metres.

Geared traction elevators are middle of the road in terms of initial cost, ongoing maintenance costs, and energy consumption. It is important that traction elevator ropes and sheaves are checked for wear on a regular basis. As they wear, the traction between the sheave and the cables is reduced and slippage becomes more regular, which reduces the efficiency and can become dangerous if left unchecked.

5.7.2 Governor (Safety Device)

Figure 5.22 Governor

Governor function is to actuate the safety gear if the car speed exceeds 115% of its rated value.
Usually a cable is attached to the safeties on the underside of the car, called the governor rope. This rope runs down through a pulley at the bottom of the shaft and back up to the machine room and around the governor sheave. When over-speeding is detected, the governor grips the cable which applies the safeties that wedge against the guide rails and stops the car. The governor works on the floating principle with a cam curve and roller guided rocker. It is situated either in the machine room or in the head room. Governor is provided by a factory adjusted switch activated when the tripped speed is reached to disconnect the machine drive starting with governor pulley blocking.

5.8 Conclusion and Recommendation

The lift is strategically placed in a centralized area (Lobby) to give convenience to the user. Locating next to the lift is the fire staircase and fireman’s lift. The machine room is located directly above the lift hoistway for maximum efficiency. In Conclusion, Swiss Inn Hotel, Johor Bahru critically planned their location of lift, fireman's lift, machine room for maximum efficiency as well as adhere the uniform building by-laws.

6.0 CONCLUSION

In conclusion, Swiss Inn, Johor Bahru provides excellent building services which follows Uniform Building By Law (UBBL) 1984. Those services are:

- Fire Protection System
- Air Conditioning System
- Mechanical Ventilation System
- Mechanical Transportation System

Especially in fire protection system, we does not only see those typical fire protection amenities, some uncommon active fire protection system like the magnetic fire door can also be seen.

Once again we appreciate the chance given to us to have a real-life experiential learning through site visit. We have learned lots of thing that is not taught in classes, an on-site learning made us to understand faster.

7.0 REFERENCES

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