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BUILDING SERVICE [ARC 2423]

Project 2 - Case Study, Analysis and Documentation of Building Services Systems

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1.0 Introduction

Subang Parade is the first shopping centre in Subang Jaya, Selangor, Malaysia. It is located near Wisma Consplant (formerly Wisma Tractors until 1995) and Empire Subang in SS16. Its anchor tenant is the Parkson Department store. Subang Parade was constructed between 1987 and 1988. It was officially opened by Almarhum Sultan Salahuddin Abdul Aziz Shah of Selangor on 13 August 1988. Between 1998 and 2003, Subang Parade was managed by The Lion Group. In 2003, Subang Parade was sold to The Hektar Group before being sold into the Hektar REIT (Real Estate Investment Trust). In 2004, there were refurbishment phases which started with the creation of Digital One, Subang Jaya's first dedicated IT centre. Later, the washrooms were fully renovated.
1.1 Floor Plans

BASEMENT FLOOR PLAN

LOWER GROUND FLOOR PLAN
2.0 Mechanical Ventilation and Air-Conditioning

2.1 Introduction

A high rise building with a great of user would trap heat inside the building because of lacking open spaces, so that people need centralised air conditioning system to low down the temperature of building and obtain the optimum of thermal comfort, well ventilation, and comfortable spaces. Air conditioners centralised system use refrigeration to chill indoor air. When a liquid converts to a gas, it absorbs heat. Air conditioners exploit this feature of phase conversion by forcing special chemical compounds to evaporate and condense over and over again in a closed system of coils. The compounds involved are refrigerants that have properties enabling them to change at relatively low temperatures. In fact, central air conditioners have a whole system of ducts designed to funnel air to and from serpentine, air-chilling coils.

There are few types of air conditioning which is ceiling cassette air conditioner, ceiling suspended air conditioner, floor air conditioner and centralised air conditioning system. A centralised system is only functioned in a large building to control the air movement in the building.

2.1 Literature Review

A central air-conditioning system have a complicated pathway which turn the hot air to cool air and supply to the whole building. When hot air flows over the cold, low-pressure evaporator coils, the refrigerant inside absorbs heat as it changes from a liquid to a gaseous state. To keep cooling efficiently, the air conditioner has to convert the refrigerant gas back to a liquid again. To do that, a compressor puts the gas under high pressure, a process that creates unwanted heat. All the extra heat created by compressing the gas is then evacuated to the outdoors with the help of a second set of coils called condenser coils, and a second fan. As the gas cools, it changes back to a liquid, and the process starts all over again. Think of it as an endless, elegant cycle: liquid refrigerant, phase conversion to a gas/ heat absorption, compression and phase transition back to a liquid again.
2.1.1 Mechanical Ventilation

Mechanical ventilation is to control the air movement inside the building. The natural ventilation of a building is not easy to obtain the optimum of thermal comfort. In order to achieve the quality of indoor air, ventilation system help to limit the pollution at the source and provide a well ventilation air flow inside the building.

2.1.2 HVAC System

HVAC stands for heating, ventilation, and air conditioning. HVAC systems control the ambient environment (temperature, humidity, air flow, and air filtering) and must be planned for and operated along with other data center components such as computing hardware, cabling, data storage, fire protection, physical security systems and power. The purpose of HVAC systems is to create acceptable indoor air quality, maintain temperature control, and to provide a system that is cost effective for consumers. This system can be divided into four main types:

1) Direct refrigerant system,

2) All-air systems,

3) Air and water systems and

4) All-water system.

Our case study building utilizes two of the system types stated above, the all-air system and the all water system.
2.3 Case Study

Subang Parade have been chosen as project case study. Although Subang Parade is the oldest shopping mall in Petaling Jaya, but it have a proper system of central air conditioner and have been upgraded their system in this few years. Cooling tower, chiller, pump, plant room, AHU, Fan Coil Unit, exhaust fan, diffuser are included as part of building air conditioning system

2.3.1 Air conditioning system schematic diagram

![Air Conditioning System Running Sketch Map](image-url)
2.3.2 Cooling Tower

A cooling tower (Figure 2.3.2.1) is a heat rejection device, which extracts waste heat to the atmosphere through the cooling of a water stream to a lower temperature. Common applications for cooling towers are providing cooled water for air-conditioning, manufacturing and electric power generation. The generic term "cooling tower" is used to describe both direct (open circuit) and indirect (closed circuit) heat rejection equipment. A direct, or open-circuit cooling tower is an enclosed structure with internal means to distribute the warm water fed to it over a labyrinth-like packing or "fill". There are total six cooling towers on the roof top of Subang Parade. Five are operating while one is on standby in case of any breakdown. There are two separate part of cooling towers which can be operate at separately. The cooling tower is placed on a concrete beam grid to allowing gap between floor level for ventilation and maintenance purposes.

UBBL MS 1525 code 8.8:
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.

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2.3.2.1 Microbiocide

Microbiocide (Figure 2.3.2.1.1) would be added into the cooling tower every two weeks to prevent the growth of algae and fungus. On the pipe is a motorized valve to control the volume of water when needed.
2.3.3 Water Supply

Water tank which placed beside the cooling tower on the roof top of Subang Parade is for supplying the water to air-conditioning system.

The pipe supplies water straight away to the cooling towers when the main water supply is unavailable. (Figure 2.3.3.2)
2.3.4 Water Piping System

There are four water piping in Subang Parade which is Condensed water supply (CWS), Condensed water return (CWR), Chilled water supply (CHWS), Chilled water Return (CHWR). The water piping is to supply cool water between cooling towers to the air-handling units where the water temperature have to maintain around 4 to 5 degree Celsius. There are various size of the galvanised iron pipes from 25 to 200mm.

CWS - Condensed water supply: To help the mechanical equipments lose heat
CWR - Condensed water return: To be recycle to lose heat gained
CHWS - Chilled Water Supply: To cool the refrigerant
CHWR - Chilled Water Return: Return to Cooling Tower

UBBL MS 1525 code 8.5:
All piping installed to serve buildings and within buildings should be adequately insulated to prevent excessive energy losses. Additional insulation with vapour barriers may be required to prevent condensation under some conditions.
2.3.5 Plant System

The refrigerant is cooled in the plant room and distributed to the air handling unit located at different levels of the building. Treated and cooled air is then supplied from the air handling unit to the rooms in the same levels through the ducts. The plant system control the chiller, chiller water pump, water pump, control panel and air compressor. The plant system is placed at the ground level in Subang Parade due to the safety purpose and noise control.
2.3.6 Condenser Water Pump

The function of condenser water pumps are Heating, Ventilation and Air Conditioning (HVAC) systems. It keep the surroundings of buildings and vehicles bearable. These systems control temperature and humidity by heating and cooling water. It is also used for reject water from the refrigerant and condense the refrigerant back to a liquid. The condenser water pump is located at the ground level in the plant room. It distributes cold water received from the 200Ø pipe from the cooling tower to the air conditioning units. There are two big and two pump in the plant room while only one big pump and one small pump are operating daily, the other two are on standby mode. The three big pumps operate at 1500W while the two small pumps operate at 750W. All the pumps are placed on an inertia block and 150mm thick concrete plinth to absorb the vibration caused by the pumps. There are also have two big chilled water primary pump and two small shilled water primary pump in Subang Parade, which only operate one big chilled water pump daily from 9.30a.m. ro 9.30p.m..The smaller chilled water pump is only operates on half a day, either from 9.00a.m. to 1.00p.m. or 1.00p.m. to 7.00p.m..
2.3.7 Chiller Water Distribution Pump (CWDP)

Water pumps move water that does not contain suspended solids or particulates. Chilled water distribution pump operates at 1025hp to supply to the evaporator. There are five chilled water distribution pumps in Subang Parade. However, the operator only operates the same two pumps every day, the others is all on standby mode.
2.3.8 Make-Up Tank

A make-up tank usually implies water is being used in a process causes water loss, the make-up replenishes that lost or used water. There are two make-up tank in Subang Parade which placed at the plant room.
2.3.9 Chiller

Also called a data centre chiller. A chiller cooling system removes heat from one element and deposits into another element. In large data centres the chiller is used to cool the water used in their heating, ventilation and air-conditioning units. Due to the amount of heat produced by many servers and systems in a data centre, the chiller cooling system would be operational around-the-clock. As such, a large percentage of the electricity consumed in a data centre is used by the chiller. The chillers used in Subang Parade are from the brand “York”. It is around 6 degree Celsius before running it to the air-handling unit via the chill water riser. There are connected to the cooling towers to expel the heat to the atmosphere. It is regularly checked with chemicals to ensure that there is no algae formation or acid build up. The chillers are covered with insulation to maintain the temperature of the chiller and prevent any damage to the chiller. A chiller consist of three basic mechanical parts: a compressor, condenser and evaporator.
2.3.9.1 Condenser

The air conditioning condenser is a heat exchanger. Located in front of the vehicle, right in front of the radiator, this part receives high-pressure, hot refrigerant from the compressor. Refrigerant flows through the condenser and cools off from either the wind when driving at highway speeds, or air blowing from electric cooling fans or the fan clutch at low speeds and idle.

2.3.9.2 Evaporator

The evaporator works the opposite of the condenser, here refrigerant liquid is converted to gas, absorbing heat from the air in the compartment. When the liquid refrigerant reaches the evaporator its pressure has been reduced, dissipating its heat content and making it much cooler than the fan air flowing around it. This causes the refrigerant to absorb heat from the warm air and reach its low boiling point rapidly. The refrigerant then vaporizes, absorbing the maximum amount of heat. This heat is then carried by the refrigerant from the evaporator as a low-pressure gas through a hose or line to the low side of the compressor, where the whole refrigeration cycle is repeated. The evaporator removes heat from the area that is to be cooled.

2.3.9.3 Compressor

The compressor compresses the refrigerant vapour from the evaporator and pumps the refrigerant throughout the system. The refrigerant vapour then enters the compressor through the suction valve and fills the cylinder. This refrigerant is cool but it absorbs heat in the evaporator. Most of the heat absorbed changes state from liquid to vapour. The compressor then compresses this vapour, causing it to become very warm. This hot gas will then flow from the compressor into the condenser.
2.3.10 Air-Handling Unit (AHU)

UBBL MS 1525 code 8.6:

Air handling duct system insulation:

All ducts, plenums and enclosures installed in or on buildings should be adequately insulated to prevent excessive energy losses. Additional insulation with vapour barriers may be required to prevent condensation under some conditions.
An air handling unit (AHU, Figure 2.3.10.1), is a device used to condition and circulate air as part of a heating, ventilating, and air-conditioning (HVAC) system. Usually, an air handler is a large metal box containing a blower, heating and/or cooling elements, filter racks or chambers, sound attenuators, and dampers. Air handlers usually connect to ductwork that distributes the conditioned air through the building, and returns it to the AHU. Sometimes AHUs discharge (supply) and admit (return) air directly to and from the space served, without ductwork. In Subang Parade, several devices are used in the duct system for the main areas which is ceiling diffuser, return air grill, dampers and exhaust fan. Dampers are used for even distribution of air over the bottom face of the diffuser. It is made out of galvanized steel with matt black as standard finish. Furthermore, return air grills are used indoors for returning air. The frame is made out of galvanized steel finishes with white powder coated, while the blade is made out of stainless steel.

2.3.11 Exhaust Fan

Exhaust fans are used to exhaust air from the building. The double flanged casing and rigid motor support are made out of heavy gauge steel. An exhaust fan is a fan which is used to control the interior environment by venting out unwanted odors, particulates, smoke, moisture, and other contaminants which may be present in the air. Exhaust fans can also be integrated into a heating and cooling system. Common locations for exhaust fans include
bathrooms and kitchens, and these fans are usually very easy to install, so they can be situated in many other locations as well. For installation, people do need a few tools, and they must be comfortable working with electricity to wire the fan in place. An exhaust fan can be used to vent the warm, moist air to the outside, where it can disperse harmlessly. In Subang Parade, exhaust fan is made of double flanged casing and rigid motor support are made out of heavy gauge steel.

2.3.12 Fan Coil Unit

A fan coil unit (FCU) is a simple device consisting of a heating or cooling coil and fan. It is part of an HVAC system found in residential, commercial, and industrial buildings. A Fan Coil unit is a factory made assembly which provides the functions of cooling and/or heating air using chilled or hot water with air flow to the room ensured by one or more electrically driven fans. Fan Coil Units may be of the cabinet style, within a room, for free air delivery, or of the chassis style, concealed within the building structure with minimal ducting appropriately connected to the inlet and/or outlet of the unit. In Subang Parade, there are total ten fan coil unit spread in the building, it is private properties which located in different units of stall.
2.3.13 Ducting

An air conditioning duct is a type of pipe or tunnel that is used to distribute air throughout a structure. Systems of ducts, known as ductwork, are a central component of a building’s heating, ventilation, and air conditioning (HVAC) system. In most systems, only one set of ductwork is present, which is used to transport cool air and heated air, along with as air required for general ventilation needs. Air conditioning duct is used only with central air units. The cooled air blown into an air conditioning duct system, where it is distributed to various rooms. The cool air enters the rooms through air terminal units installed at the end of each duct line, which generally take the form of diffusers or grilles. This network of ducts that transport cool air from the unit to each room is called the supply ductwork.

UBBL MS 1525 code 8.7.1:

High-pressure and medium-pressure ducts should be leak tested in accordance with HVAC Air Duct Leakage Test Manual published by SMACNA or any other equivalent standards, with the rate of leakage not to exceed the maximum rate specification.

Figure 2.3.13.1 Ducting

Figure 2.3.13.2 Ducting Pathway Diagram
2.3.14 Supply Air Diffusers

An air diffuser is a device that is designed to provide uniform air flow throughout a room. It works to increase the efficiency of air conditioning units by dividing and distributing cooled air. When an even airflow is maintained, drafts and hotspots in a room are eliminated, providing greater comfort to occupants, while increasing energy efficiency. A ceiling is the most common location for an air diffuser which Subang Parade used and it is made out of aluminium finished with white powder coat and galvanized steel coated with white powder.

2.3.15 Return Air Grillers
Due to convection, eventually the cold air gains energy and becomes warm. Due to the activities and users within the space. This warm air should then be extracted and transferred back to the AHU rooms to be cooled again. This extraction of air goes through the Return Air Grilles. These Return Air Grilles is built side by side with the diffusers for they basically have the same but opposite functions; return air grilles as extracting the air from the spaces and diffusers as injecting the air into the spaces.

2.4 Analysis

Centralised air conditioning provide efficient cooling for large building such as Subang Parade. It is easier to operate and maintain the air quality in the large building by using centralised air conditioning system. The component can be inspected without disrupting occupied area and shopping mall areas such as cooling tower are located the rooftop of the building where are on an open spaces. Besides, noise and vibration can be more easily and effectively controlled when not immediately adjacent to occupied areas. Moreover, large components of the system with higher efficiency and lower initial cost per unit output can be used. However, there is the need to provide large space area for mechanical room and large components for the centralised air conditioning system.

According to Clause 8 of Malaysian Standard Code of Practice on Energy Efficiency and Use of Renewable Energy for Non-Residential Buildings (MS1525, 2007), section 8.2.2, where chillers are used and when the design load is greater than 1000kw, a minimum of two chillers or a single multi-compressor should be provided meet the required load. In Subang parade, there have two chiller and one small chiller is on standby mode which is suit to the UBBL requirement.

This complies with the section 8.3.1 where multiple units of the same equipment, such as multiple chillers, with combined capacities exceeding the design load may be specified to operate concurrently only if controls are provide which sequence. In Subang Parade, three chillers work in turns where one in rest and two work in work. In case, there is any breakdown the third one would take turn from it.
Section 8.5 states that all piping installed to serve buildings and within buildings should be adequately insulated to prevent excessive energy losses. The piping for the Air-Conditioning system in Subang Parade is well insulated either by exterior insulation or polyurethane (PU) that is then covered with metal sheets.

As a conclusion, Subang Parade basically in line with the by-laws in building requirement.

2.5 Conclusion

In conclusion, Subang Parade is using the centralized air-conditioning system which is AHU system. All of the system such as AHU, cooling tower, chiller, pump and controlled plant system are placed at suitable level which is more at rooftop and basement due to the factor of noise and heat. AHU room is located at private area where visitor cannot go through the room. The well arrangement help the ventilation of the building and comfort the users within the building. Besides, this is also a safety arrangement for the users of the building. Based on the reason above, it is understood that Subang Parade has been catered for the most suitable air-conditioning system for its type of building structure and the system does not affect the thermal comfort and the user’s activities, concluded as a well system in this building.
3.0 Electrical System

3.1 Introduction

Electrical system supplies electricity for electric outlets and lighting, motive power for elevators, air-conditioned and other electrical appliances in a building. There are numerous codes and standards that have to be met by buildings services in order for it to run appropriately and effortlessly. It can be categorized into three stages, which are generation, transmission and distribution. Generation is the stage that generating and producing electrical power by power station. Transmission is the stage that power be transformed to higher voltage power, while distribution is stage that electrical power be distributed to various substations and buildings after it.

The electricity supply of Peninsular Malaysia is controlled by Tenaga Nasional Berhad (TNB), which is also the largest electric utility company in Malaysia. Its core activities involved in the generation, transmission, distribution and selling electricity to consumer. Besides, it involved in the aspect of planning, installations and maintenances of electricity. The transmission voltage networks of TNB are 400kV, 275kV and 132kV, whilst the distribution voltages are 33kV, 11kV and 400/230 volts.

3.2 Literature Review

Electricity distribution system can be categorized into three parts that are generation, transmission and distribution. Starting from the power station (power plant), electrical power will be generated and step up through the power transformers to provide higher voltage electricity. There are six sources of energy used at power station which are coal at Thermal Power Station, oil at Thermal Power Station, Nuclear at Nuclear Power Station, natural gas at Combined Cycle Power Station, water flow at Hydro Electric Power Station and wind at Wind Powered Generator. In Malaysia, water flow is used as the main source of power generation.

According to Figure 3.1, after the stage of generation, electricity from transformers will be transmitted to transmission and distribution substations through high voltage transmission lines, distribution grids and underground cables. The substations will then decrease the
voltage of electricity by using step down transformers and distribute electricity supply to commercial, industrial and residential consumers.

In Malaysia, electricity from transmission lines can be transmitted through two types of alternating current system, which are single phase 2 wire system and three phase 4 wire system. Single phase system is mostly serves for residential consumers, whereas three phase system is commonly used for huge consumers such as commercial and industrial consumers as it is more economical compared to single phase system at same power capacity. Three phase system can use cheaper and lighter-gauge wire, lower in cost and more efficient three-phase motors.

From substations, the electricity supply of building will be controlled by circuit breaker that can protect the electrical circuit against short-circuit and overload of electricity by tripping the electrical supply. Besides, main switchboards, sub-switchboards and distribution boards operate as switches to control the usage of electricity. Upon the using of electricity, electric meter will note and measure the amount used of electricity. Overused of electricity may cause fire or breakage of devices. To avoid these accident, safety devices such as circuit breakers...
and fuses are installed. These devices cut the circuit down by a simple fuse or a big tools immediately to avoid the occurrence of accident.

3.3 Case Study

Subang Parade which located at Jalan SS16, Subang Jaya receives electricity from Tenaga Nasional Berhad (TNB) substation.

3.3.1 Electrical Distribution System

The electrical system is basically divided into two parts which is the outdoor distribution system and the indoor distribution system.

3.3.1.1 Outdoor Distribution

![Diagram](image)

Figure 3.2: Diagram shows how the power being transformed to low voltage electricity.

In Malaysia, the transmission voltage networks are 500kV, 275kV and 132kV, whilst the distribution voltages are 33kV, 11kV, and 400/230V. Residential usually used the latter
while the rest are used for industrial. In this case study, Subang Parade obtains the electricity at 11kV directly from the TNB Substation.

### 3.3.1.2 Indoor Distribution

The electricity is transmitted from the TNB Substation to the High Voltage Area of Subang Parade which is the Switchgear Room and the Transformer Room. In some buildings, the Switchgear Room and the Transformer Room may combined in one housing to function as the TNB Power Station (SSU) which is TNB Substation in the building. In this case, Subang Parade has separate rooms for the Switchgear Room and the Transformer Room. The high voltage electricity is stepped down into low voltage electricity by the transformers and then flows to the low voltage area. The low voltage area includes the main switchboard room and the distribution board rooms.

![Diagram of High Voltage and Low Voltage Areas](image)

**Figure 3.3** illustrates transformation of high voltage to the low voltage.

The above diagram illustrates how electricity from the TNB Power Station (SSU) reaches into the Subang Parade. Before the TNB Power Station (SSU), it reaches the TNB main metering kiosks as this building is charged as with six different bills. After the meter, it reaches the TNB Power Station (SSU). However, since the Switchgear Room and the Transformer Room are separated, the electricity reaches switchgear first. After that it goes to the Vacuum Circuit Breaker before reaching the transformer, known also as the main switch which helps to protect the transformer when it is overloaded by disconnection the power which is at 11kV.
The transformer further steps down the voltage to 433kV before transferring it to the Low Voltage area located at the next room. They are all located close to each other to further increase efficiency and to prevent energy loss. Air Circuit Breakers are installed to prevent leakage of current for transformer, which could zap a person to death if leaked. After the transformer, it reaches the distribution panel (switchboard) which it furthers distributes to the rest of the Subang Parade through the riser.

Figure 3.4: Floor plan shows the location of switchgear room, transformer room and main switchboard room.
Figure 3.5: Enlarged floor plan of the switchgear room, transformer room and the main switchboard room.

Figure 3.6: Diagram illustrates the schematic diagram of Subang Parade.
3.3.2 Switchgear Room (TNB HT Room)

A switchgear room is a room in a building which contains switchgear. It is typically a locked room in the ground floor of a building where the service enters the property. The Switchgear Room of Subang Parade is located at the lower ground floor of the building facing the road. It is easily accessible by the authorized personnel who are the electrical engineers from TNB and the electrical engineers from Subang Parade. It houses the switchgears. The main electricity meters are contained in the Switchgear Room as well. The Switchgear Room is air conditioned 24 hours. There are CO2 fire extinguishers and heat sensor for water sprinkle of fire safety system in the room.

For the sub-station inside the building, it must strictly be provided good ventilation, fire alarm system and CO2 fire suppression system for safety. It will be locked and managed by TNB.

Figure 3.7 & Figure 3.8: Photos show the CO2 fire extinguishers and heat sensor of fire safety system found in the Switchgear Room.
There are six main electricity meters in this room. The electricity used by the building is calculated by the meters. The unit of measurement is kilowatt per hour (kW/H). The amount of used electricity will be recorded everyday to check back the total amount per month by the end of the month to ensure the electricity usage is stable and tally. The six meters recorded usage of electricity of different area.
3.3.2.2 Switchgear

Figure 3.10: Photo shows the switchgears equipped with vacuum circuit breaker.

The electricity transmitted from the TNB Substation to Subang Parade is at 11kV. Medium switchgear system which is suitable for 3kV to 36kV is used in this case. The building has three switchgears. These switch gears regulate the flow of electricity within the electrical system. Switchgear provides protection against overload of current, short circuit current and insulation failure. It is an insulating barrier between open contacts which is clearly visible and also a fail-proof mechanical indicator. The many functions of the switch gear includes functional switching, emergency switching, emergency stopping and also stopping of entire mechanism for maintenance. Emergency switching is used when there is a failure in power, the switchgear would run on the backup generators providing the power needed.
3.3.2.3 Vacuum Circuit Breaker

A circuit breaker is a device which is able to open and close a circuit in a quick time. Vacuum circuit breaker is a medium-voltage circuit breakers which will interrupt the current by creating and extinguishing the arc in a vacuum container once the current rated over 11kV. It is installed with the switchgear to protect it from damages by high voltage electricity. Among different types of medium-voltage circuit breakers, vacuum circuit breakers tend to have longer life expectancy than other types.

Electricity Regulations 1997, it is listed that:-
Regulation 16, Switch, switch fuse, fuse switch, circuit breaker, contractor, fuse, etc.
(3) Any fuse or circuit breaker shall be
(a) constructed and arranged in such a manner so as to break the current when it exceeds a given value for such a sufficient time to prevent danger; and
(b) Constructed guarded or placed in a manner as to prevent danger or overheating, arcing or from the scattering of hot metal or other substances or enclosure.
3.3.3 Transformer Room (TNB HT Room)

As required by TNB, this room must be fully air-conditioned, 24 degree and 50% relative humidity and the floor should be able to withstand 10kN/m² in force. There should be no columns and cross beams to prevent obstructions.

Figure 3.12: Photo shows the ventilated louvers on the door of transformer room.

A transformer room is a room in a building which contains transformers. Same as Switchgear Room where in some building both rooms are housed together in a room, it is typically a locked room in the located near to Switchgear Room. The Transformer Room of Subang Parade is located at the lower ground floor of the building facing the road, right next to the Switchgear Room. It is easily accessible by the authorized personnel who are the electrical engineers from TNB and the electrical engineers from Subang Parade. Safety in the Transformer Room is focused. There is a manual guide of CPR and CO2 fire extinguisher in the room. The room is also connected to the telephone line of fire engine.
Figure 3.13, Figure 3.14 & Figure 3.15: Photos show the CPR guide, CO2 Fire Extinguisher and the telephone line connected to fire engine.

![Figure 3.13, Figure 3.14 & Figure 3.15](image)

Figure 3.16: If the red light above the door is lightened up, one must not enter the room.

3.3.3.1 Transformer

![Figure 3.17](image)

Figure 3.17: Photo shows transformers in the Transformer Room.

Transformer is a plant or device that reduces or increases the voltage of alternative current. The sole purpose of the step down transformer in this case study is to step down high voltage current from 11kV to 433kV through the machinery shown in the Figure. There are five transformers in the Transformer Room of Subang Parade. The electricity from the feeder is stepped down to make it suitable to transfer to the main switch boards. The room is air-conditioned to keep the machineries cool and properly functioning for a longer period of time.
3.3.3.2 Silica Gel Blue Indicator

Silica Gel Blue Indicator is used to absorb moisture, anti-rusting of the transformers in enclosed conditions. After absorbing moisture, it turns from blue to pink, visually indicating the relative humidity of the transformer. When it turns pink, it will be replaced with new dry Silica Gel Blue Indicator to maintain the low relative humidity of the transformer.
3.3.4 Main Switchboard Room

A switchboard room is a room in a building which contains switchboards. It is typically a locked room in the ground floor of a building where only authorized personnel who are the electrical engineers from TNB and the electrical engineers from building can access into it. The Main Switchboard Room of Subang Parade is located at the lower ground floor of the building beside the Transformer Room. The Main Switchboard Room of Subang Parade contains the main switchboards for electricity distribution and also generator-sets.

3.3.4.1 Main Switchboard

Figure 3.20: Photo shows the main switchboards of Subang Parade.

The main switchboard is a large assembly panels which contains switches that allow electricity to be redirected. It divides the main current into smaller current for further distribution control of current. With this board, one can control the electrical supply of the entire network from just one area. There are three switchboards in Subang Parade which each equipped with air circuit breakers which interrupt currents by shooting compressed air to extinguish electrical discharges. The incoming power supply from the transformers is divided
into separate circuits, each controlled and protected by the fuses of the switchboard. The switchboard is divided into a number of functional units. Each units comprise all the electrical and mechanical elements of a given function.

3.3.4.2 Air Circuit Breaker

![Air Circuit Breaker](image)

Figure 3.21: Photo shows the air circuit breaker of the main switchboard.

The working principle of this breaker is rather different from those in any other types of circuit breakers. The main aim of all kind of circuit breaker is to prevent the reestablishment of arcing after current zero by creating a situation where in the contact gap will withstand the system recovery voltage. The air circuit breaker does the same but in different manner. For interrupting arc it creates an arc voltage in excess of the supply voltage. Arc voltage is defined as the minimum voltage required maintaining the arc.
3.3.5 Electrical Riser Room

Electrical riser rooms as located at every floor of a building. In Subang Parade, there are 16 riser rooms for every floor of the building. Electrical conduits that feed the various equipment, A/C units and sub panels and fire pumps originate here.

3.3.5.1 Conductors

![MICC cabling used in Subang Parade](image)

Figure 3.22: Photo shows the MICC cabling used in Subang Parade.

Conductors could be round wires, rectangular cross section or stands that are usually made out of metals either copper or aluminium. Current is carried through these wires which are covered with a raceway. Conductors are wrapped with insulators to prevent them from causing electric shock. Insulators are called raceway. MICC cabling, which stands for Mineral-insulated copper-clad cable is used in Subang Parade. These cables are made of copper conductors inside a copper sheath, insulated by inorganic magnesium oxide powder, as such they are highly resistant to fires.
3.3.5.2 Raceways

Figure 3.23: Photo shows the raceways and risers.

Raceways are generally enclosure of wires and metallic raceways must be grounded. Rigid conduit and tubing are mostly used in this building as they have fire stopping elements and they protect the cables from being damaged.

3.3.5.3 Risers

Electrical risers are used to carry electrical supply to upper floors and distribute them to each floor in the SCC; we can find most these risers in AHU rooms’ car parks and at the service areas.
3.3.5.4 Sub-switchboard (SSB)

Figure 3.24: Photo shows the sub-switchboard in a riser electrical room of Subang Parade.

The sub-switchboard has the same functionality of the main switch board which is to connect and disconnect the electric supply from the main switchboard. Normally, high voltage appliances such as lifts and elevators take their powers directly from SSB whereas the low voltage appliances such as lightings are to be managed by Distribution Boards. In other words, SSB controls high power facilities, whereas the lightings go under Distribution Boards.
3.3.5.5 Distribution Boards (DB)

![Distribution Board in a riser electrical room of Subang Parade.](image)

Figure 3.25: Photo shows the distribution board in a riser electrical room of Subang Parade.

The Distribution Board functions as an extension and power control for areas far away from the risers. The building uses a 3 phase power supply to accommodate for the large usage of electricity throughout the day. This also allows easier distribution of power supply. From DB, the electricity is further delivered to Miniature Circuit Board (MCB) and Earth Leakage Circuit Board (ELCB). The final current readings for the tenant are normally divided into 2 different amperes, which they can be categorized under 20A and 12A for lightings and electrical appliances respectively.
3.3.5.6 Meter

Figure 3.26: Photo shows the meters of different tenants.

The usage of the electricity of the tenants is measured by the meter. The electricity reaches the meter before it is distributed to the tenants. Each tenants are to pay their electricity bill monthly according to the readings on the meter inside the electrical riser room.

3.3.6 Back-up System

Back-up system is a standby generator which may include lighting, electric generators, fuel cells, uninterruptible power supplies and other apparatus, to provide backup power resources in a crisis or when regular systems fail. It can rely on generators, deep cycle batteries, and flywheel energy storage or hydrogen fuel cells.
3.3.6.1 Generator Set

Figure 3.27: Photo shows the gen-set used in Subang Parade.

Subang Parade uses a standby system which relies on generator sets. Generator set is a device that converts mechanical energy to electrical energy. A generator set forces electric current to flow through an external circuit. Subang Parade which is a shopping mall need a system that would protect and prevent them from having any sort of financial loss. The generator will start running automatically when there is a power failure or a power shortage. The system will automatically detect the power shortage and start the generator set based on the power needed to prevent any clash. The generator set consists of three components which are the fuel system, space housing the equipment and the set itself. Using a gen-set gives the building an unlimited kVA capacity and is only set back by the size of the fuel tank. It has to be properly maintained to ensure that it does not fail if there is a power failure. Gen-sets of Subang Parade are placed in the Main Switchboard Room.

Under UBBL Section 253(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.
Figure 3.28: Photo shows the storage battery charger which is attached to genset provide the preliminary power for the start-up of genset.

3.4 Analysis

Transformers

A transformer is device that changes or transformers alternating current (ac) of one voltage to alternating current of another voltage. A varying current in the transformer's primary winding creates a varying magnetic flux in the core and a varying magnetic field impinging on the secondary winding.

Under MS1525; 7: Electric power and distribution

This clause applies to the energy efficiency requirements of electric motors, transformers and distribution systems of buildings except those required for emergency purposes.

All electrical power distribution equipment should be selected for their energy efficiency and to minimize cost of ownership. Cost of ownership includes the capital cost and the cost of energy over the equipment life time.

Supply system voltage has significant impact on losses. Hence, the supply voltage should be maintained as close as possible to the design/optimum voltage of the equipment installed.
Subang Parade has a gen set that has its own transformers to step down its current just for it. The figure below show the transformer own by gen-set. It is not necessary for a gen set to have its own transformer as they cost relatively expensive. The gen set system should be connected to the other two transformers that are still able to handle the load of the gen sets. One less transformer means one less equipment to maintain and handle. The transformers, switchboards and gen sets are all located very near to each other to lower down the cost of consumption of electricity. The designers put in thought on how to minimize space area and also to cleverly design a room which is properly organized.

Generator Set

The generator sets provide adequate power and supply for the entire building to run under emergencies such as fire and also as a standby system where it is always ready to power the building. The generator will start running automatically when there is a power failure or a power shortage. The system will automatically detect the power shortage and start the gen set based on the power needed to prevent any clash. The generator set consists of three components which are the fuel system, space housing the equipment and the set itself.

Under UBBL Section 253(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.

The Subang Parade provides all the above statement. Diesel generator is used as a standby system to provide sufficient power when break down occur. Besides that, sufficient fuel provided as well beside the generator to make sure the generator can work properly for a long time during power shortage.
3.5 Conclusion

The electrical system of Subang Parade is comprehensive and safe as it obeyed the Uniform Building By-Law and Tenage Nasional Berhad requirements. Although the building is an old building, but the electrical system is up to date with modern equipment. Besides, all the rooms are well-thought of for fire protection and well-maintenance as the technician team will checked the systems regularly to make sure all the systems are in good condition to prevent short circuit incident. Every systems are supporting each other functions to carry out the electrical system. As an overall, it provides a well-designed electrical system in Subang Parade.
4.0 Cold Water Supply System

4.1 Introduction

Water supply is the provision of water by public utilities, commercial organizations, community endeavors or by individuals, usually via a system of pumps and pipes. Irrigation is covered separately.

This chapter is about the study of water services that are available in the case study of Subang parade. Water supply system and water distribution system are the main topic that will be studied in this chapter. The case study will explain how the systems are used and function inside the entire building.

Besides that, the water services study also covers the water supply piping system and water pump system and water meter. All the components will be further explained in the subtopics below.

4.2 Literature Review

The water supply, as the basic element that we need in our daily life, as important as air and energy, to provide consumers hygiene and cleaning, consumers use water for drinking, cooking, bathing, irrigation and watering plants; uses as protective purpose to against fire, water storage as fire emergency, water standby in fire stand pipes and sprinkler piping; to provide circulation, hot water is use for heating while chilled water is use for cooling, circulate the water in swimming pool and water features; and power generation to generate electricity.

The massive needs of water supply in our lives require us to protect the water source on the Earth. But with the times flies and technologies evolving, the amount of pollution we create, the water supply is usually dependent on processing to eliminate all the possible threats. Gigantic infrastructures are needed in our community to ensure the quality and supply to every needed place.
There are several water companies that run in the country to provide the water supply to millions of consumers in Malaysia. Since our case study is located in Kuala Lumpur area, the responsible water company is SYABAS. SYABAS was incorporated on 8 July 1996 under the Malaysian Companies Act, 1965 to undertake the privatization of water supply services in the State of Selangor and the Federal Territories of Kuala Lumpur and Putrajaya. Rain falls and river flows will be pumped to the water treatment plant, and the raw water is treated through the process of aeration, coagulation, flocculation, sedimentation, filtration, disinfection and conditioning. The treated water that is safe for drinking will be pumped to reservoirs. From here, the water is supplied to the consumers.

4.3 Case Study

The water supply system is supplied from 5 water tank that is located on the basement of Subang Parade. The pipe supplies water straight to the contributions.

Figure 4.3 a: Water supply system location
Figure 4.3 b: Main water supply contribution (WC) location

4.4. Water Supply

Supply flow diagram

1. Tropical forest
2. River catchment
3. Run-Off
4. Abstraction from river
5. Raw water transfer
6. Abstraction from river
7. Distribution system
8. To Subang Parade mall

GROUNDFLOOR PLAN

Main water supply contribution (WC)
Water supply system, infrastructure for the collection, transmission, treatment, storage, and distribution of water for homes, commercial establishments, industry, and irrigation, as well as for such public needs as firefighting and street flushing. Of all municipal services, provision of potable water is perhaps the most vital. People depend on water for drinking, cooking, washing, carrying away wastes, and other domestic needs. Water supply systems must also meet requirements for public, commercial, and industrial activities. In all cases, the water must fulfill both quality and quantity requirements.

**Water supply system**

The water supply system is supplied from 5 water tank that is located on the basement of Subang Parade. The pipe supplies water straight to the contributions.

![Water Supply System Diagram]

Figure 4.4 b: Water Supply system
4.4.1 Water Tank

A water tank is a container for storing water. The need for a water tank is as old as civilisation, providing storage of water for *drinking water*, *irrigation* agriculture, *fire* suppression, *agricultural* farming, both for plants and livestock, *chemical* manufacturing, *food preparation* as well as many other applications. *Water* tank parameters include the general design of the tank, and choice of construction materials. Various materials are used for making a water tank: *plastics* (*polyethylene*, *polypropylene*), *fiberglass*, *concrete*, *stone*, *steel* (welded or bolted, carbon, or stainless), Earthen ponds function as water storage.
There are 5 Water tank in Subang Parade which is Water Tank A, B, C, D and E. They separated 5 of them in to 2 group, 1st group of water tank is water tank A, B and C which are connecting to the main pipe and going thru all the location in Subang Parade. 2nd group of water tank is water tank D and E which are connecting to a small pipe.
4.4.2 Water Pump system

The pumping of water is a basic and practical technique, far more practical than scooping it up with one's hands or lifting it in a hand-held bucket. This is true whether the water is drawn from a fresh source, moved to a needed location, purified, or used for irrigation, washing, or sewage treatment, or for evacuating water from an undesirable location. Regardless of the outcome, the energy required to pump water is an extremely demanding component of water consumption. All other processes depend or benefit either from water descending from a higher elevation or some pressurized plumbing system.

The ancient concept of the aqueduct took simple and eloquent advantage of maintaining elevation of water for as long and far a distance as possible. Thus, as water moves over great distances, it retains a larger component of its kinetic energy by spending small portions of this energy flowing down a slight gradation. Granted, a useful aqueduct system ultimately depends on a fresh water source existing at a higher elevation than the location where the water can be of use. Gravity does all the work. In all other instances, pumps are necessary.
In day-to-day situations, available water is often contaminated, unhealthy, or even naturally poisonous, so that it is necessary to pump potable water from lower levels to higher levels, where it can be of use. A fresh water source in a lower stream, river, pond, or lake is often pumped to higher ground for irrigation, livestock, and cooking, cleaning or other uses by humans, who quite naturally need fresh water. This will purify mostly fresh water, and the treatment of largely contaminated water refers endlessly to pumping.

Figure 4.4.2 a: Water pump system

Water pump is located beside the suction tank, fire tank and the break tank to pump the water up the certain level that against the gravity rule. Water is distributed by using hydro pneumatic system. The pressure vessel contains water with a pressurized air space provide high pressure to pump the water. The pump will start to operate to pump up the water due to the low pressure. When the water reaches the upper level, the pump will turn off. The pressure vessels will have a neoprene bladder to separate the air from the water. The advantage of hydro pneumatic system is that it can decrease the need of extra overhead tanks. These systems are easy available in the industry and easy to construct.

Water from the supply pipes arrives at the water tank at the basement level and is continuously refilled to compensate for the water that is pumped up to the upper floor.
UBBL Section 123:

(2) The access openings to ducts or enclosures shall be long enough and suitably placed to enable lengths of pipe to be installed and removed.
4.4.3 Water Piping System

Water pipes are pipes or tubes, frequently made of polyvinyl chloride (PVC/uPVC), ductile iron, steel, cast iron, polypropylene, polyethylene, copper, or (formerly) lead, that carry pressurized and treated fresh water to buildings (as part of a municipal water system), as well as inside the buildings.

![Water pipe](image)

Figure 4.4.3 b: Water pipe

The water pipes (figure 4.4.3 b) are part of a water pump. They are connected to the water pump via the auto transformer. The water pipes are used to pump the pressure generated the water into the main distribution pipe. The pressure is generated via electro signals from the autotransformer. The water pressure is controlled and monitored by a pressure gauge at the common pipes before it is sent to the upper floor.
Figure 4.4.3 b: Cooled water return (CWR) & cooled water supply (CWS)

The water pipes (Figure 4.4.3 b) are galvanized iron pipes that have various sizes from 25 to 200mm diameter pipes. These pipes distribute cooled water in two main directions; Cooled water supply (CWS) and Cooled water return (CWR). CWS is carried from the cooling tower to the air conditioning units and CWR which is the waste water from the condenser unit is transferred back to the cooling tower where it is cooled to 4 to 5 degree Celsius.

UBBL Section 123:
(2) The access openings to ducts or enclosures shall be long enough and suitably placed to enable lengths of pipe to be installed and removed
4.4.4 Water Meter

Water metering is the process of measuring water use. In many developed countries water meters are used to measure the volume of water used by residential and commercial building that are supplied with water by a public water supply system. Water meters can also be used at the water source, well, or throughout a water system to determine flow through a particular portion of the system. In most of the world water meters measure flow in cubic meters (m$^3$) or liters $[^1]$ but in the USA and some other countries water meters are calibrated in cubic feet (ft.$^3$) or US gallons on a mechanical or electronic register. Some electronic meter registers can display rate-of-flow in addition to total usage.

There are several types of water meters in common use. The choice depends on the flow measurement method, the type of end user, the required flow rates, and accuracy requirements.

![Water meter](image)

Figure 4.4.4a: Water meter

Water meter are located at water pump that beside the water tank. Water bulk mains supply carry water from the water company to the building. The size of these pipes is designed to transfer enough water for all the buildings serviced by the water company in a 24 hour period. The size of pipes used is according to the standard of 300mm to 150mm. The water
meter is to indicate the volume of water used by residential and commercial buildings that are supplied with water by a public water supply system. Water meters can also be used at the water source and throughout a water system to determine the flow of the water through the system. A main water valve will function as water shutoff. The water will deliver to the fire tank and water tank.

Figure 4.4.4a: Water meter diagrams
4.5 Conclusion

Based on the study of the water services in Subang Parade, the services are all completely except for the water filtration due to the building does not need the system to purified the rain water, all water are directed from the water tank. The water distribution is efficient to supply the whole mall. Due to it is not a new building, the design of the space which divides the service room can be enhance.

The water supply system also has a good contingency plan in which they have standby devices which can be used in the case of device failure as already indicated by the water pipes at the basement.

The toilets on each floor are situated one above the other and therefore make water distribution efficient. Even the plumbing fixtures installed have design a take the backflow of water into consideration.

The water tanks are located on the basement and roof away from human activity (uninterrupted space) so that they are not visible as they take up a lot of floor area and are not aesthetically pleasing. Even the communication pipes are located away from the main entrances and utility rooms are used to conceal the distribution pipes.

All these factors contribute to creating a well-designed water supply system which serves well both functionally and aesthetically.
5.0 Sewerage and sanitary system

5.1 Introduction

Sewerage and sanitary system plays an important role in ensuring public health, environmental protection and enhancing the standard of living of the general population. Sanitary sewers are constructed primarily to transport the wastewater of a community to a point of treatment or ultimate disposal. Inflow, infiltration and leakage are common problems in waste water collection system. Infiltration is water (groundwater and/or subsurface flow) that leaks into a sewer through defective joints and cracked or broken sewer pipes or manholes. Inflow is mainly water from surface runoff that enters the sewer via manholes. Leakage is water seepage through cracks and improperly joints of piping. Both leakage affect flow in the sewer. Drainage system was a simple matter, a pipe containing wastewater led to a sewer. Before long, the noxious gases that were created by the anaerobic conditions in sewers become a treat to the health of those indoors. Sanitary appliances is a fixture connected to the sewer pipe. It allows a person to put in sewage or liquids into the sewage system. Water is used to flush the sewage into the sewer pipe. Thus, the trap was invented to block the pipe so that the gases could not pass. In this chapter, sewage and sanitary systems and drainage in Subang Parade are examined. The existing facilities, service capacities and limitations of each type of system are discussed.
5.2 Literature Review

There are many strategies to dispose of waste water but first it has to be understood that waste water is any water that has been adversely affected by anthropogenic influence (Burton, 2003). In relation to the research, the waste water subset that is to be focused are storm water waste, grey water waste and also black water waste. After understanding the definition and works of the water waste subset, the system of each subset will then be introduced and informed in general.

The first subset that will be looked at is black water waste which is also known as sewage. Black water is a term used to describe wastewater containing faecal matter and urine which is deposited into the urinal or toilet. Black water waste disposal has many different strategies within its disposal system but its basic disposal ends with its treatment of the sewage because black water waste must be decomposed of the pathogens before they can be released safely into the environment (Burton, 2003). The route to the treatment area can be located within the site or at the external treatment plant which is under the supervision of the local authority appointed contractor such as Indah Water Consortium and a few others. The basic route of a black water waste disposal system would start from the toilet or urinal which is connected to the soil pipes which are usually of a bigger diameter than the grey water waste pipes which then flows into the soil stacks that flows pass a manhole inspection chamber and into a septic system in site or through the sewer which leads to the external treatment plant. The second subset of wastewater that will be looked at is grey water waste. Grey water or sullage is wastewater generated from domestic activities such as water used from washing hands, bathing, laundry and dishwashing (Trimble, 2007). Grey water differs in that of black water because it does not contain human waste such as urine and human faeces. It can be reused on-site for irrigations or even for wash closet flushing for certain systems that implements its use. Grey water waste disposal system can be integrated with the black water waste disposal system but due to impractical disposal, it is usually a separate system. The disposal system starts from the wash basin or floor trap which is the point from where the waste water is directed into the drain pipes and stacks which then flows through a series of pipes which is directed to the perimeter drain or even directly to the main storm drain alike storm water waste, it will then flow to main water sources to continue the hydrologic cycle.
As we look first at storm water waste, it is a subset of wastewater that is produced by precipitation also known as rain or snow and even from a hail storm, the water that has fallen accumulates and becomes surface water runoff. Storm water is considered as harmful because of the collection of contaminants during precipitation and also while the water runoff from the ground and road surface that is already contaminated (Burton, 2003). Storm water waste management is important to keep the surface water uncontaminated and also to prevent its direct contact and intake by humans. Storm water is usually accumulated by the roof or sloped ground surface which directs the storm water waste to roof gutters or scupper drains which is then flowed to the main storm drain. The storm water waste is then flowed to main sources of water such as lakes, rivers and ocean where it will continue the hydrologic cycle.

Sewage treatment and sewage passage is usually the responsibility of the authorities but only starts at the boundary of the private building with the exception of the septic system which is on site. The system within the building and within the boundary is under the responsibility of the property owner, which of course is subjected to rules and regulations of its components.
Schematic drawing of the sewerage system of Subang Parade
5.3.1 Sanitary Appliances

5.3.1.1 Water Closet

The simple but ingenious mechanics of the toilet have changed very little since the earliest “water closet” was invented by Thomas Crapper in the nineteenth century. The toilet, though not one of the more glamorous of home fixtures, is designed to do a very specific job—to carry away waste and prevent sewer gasses from entering the house. And unless something goes wrong with a toilet, it handles its job efficiently. As shown in the drawings above (Figure 5.3.1.1b), a toilet has two main parts, both made from vitreous china: a tank and a bowl. Some toilets are cast as a single piece others are made in two separate parts that are joined together. The tank, which houses all the working parts, is where various types of toilets differ the most. Several different types of mechanisms are used to accomplish a toilet’s basic operation. When a toilet is ready for use, both tank and bowl are partly filled with water. Passages between the bowl and the closet bend (the top of the waste pipe) form a trap that remains filled with water at all times, blocking the rise of sewer gasses. When you flush the trip lever, it lifts a rubber stopper—called a tank ball, flush valve seat ball, or the newer, more effective, flapper or flapper ball—from the flush valve, letting the water in the tank flow into the bowl. The pressure of the cascading water forces the bowl’s water and waste down the

UBBL Section 43:
In all buildings, the size of the latrines, water-closets and bathrooms shall be
(a) In the case of latrines or water-closets with pedestal-type closet fittings, not less than 1.5 metres by 0.75 metre
waste pipe. The water flowing into the bowl also cleans the bowl. The bowl’s water is replenished by water entering from the tank through a refill tube. The flush valve and the flapper together are called—not surprisingly—the flapper valve. Most flush valves are 2 1/2 inches in diameter, although some of the newer models can be as large as 4 inches, as is the ball-shaped part of the flapper. The flapper hinges onto the vertical overflow pipe that’s next to the valve, and a small chain connects the flapper to the trip lever. The advantage of a flapper over the earlier stoppers is that it doesn’t have as many parts to foul or get hung up, so it’s less likely to let the tank “run” or leak into the bowl. As the tank of a conventional toilet empties, a float ball drops, activating the ballcock (simply a water valve), which releases water into the tank. (Some new ballcocks operate on water pressure—they don’t have a float ball.) The water is delivered to the ballcock through a supply tube that’s connected to a valve at the wall or floor. When turned clockwise, this valve shuts off the flow of water to the tank. To prevent overflow and flooding, the top of the overflow tube is open and acts as a drain if the tank’s water level rises too high.

In today’s water-conserving models, a minimum-flush mechanism seals the flush valve seat when the tank is still partially full, keeping full pressure on the flush but using less water. A pressurized cylinder inside the toilet tank cuts water usage by putting a small amount of flush water under pressure—either from compressed air or from the house supply line’s water pressure. A pressure-activated ballcock is activated by a drop in the tank’s water pressure. This type, easily adjusted to deliver various amounts of water to the tank, eliminates the need for a float. The conventional float-ball, lift-wire, and tank-ball mechanism has been the standard flushing device for many years. The cut-away view shows the relationship of the tank to the bowl and how the toilet’s base forms a trap to block sewer gasses. The flush handle raises the trip lever, raising the flush valve or seat ball from the flush valve seat, letting water rush into the bowl. The stop valve at the wall delivers water through a supply tube to the ballcock. When the float ball drops, the ballcock opens, filling the tank until the ball floats back to its upper position. The overflow tube sends excess tank water to the bowl. The refill tube replenishes water in the tank through the overflow tube.
The washstand was the first bathroom sink made in the United States in the late 18th century. The washstands were small tables on which were placed a pitcher and a deep bowl, following the English tradition. Sometimes the table had a hole where the large bowl rested into, which lead to the making of dry sinks. From about 1820 to 1900 the dry sink evolved by adding a wooden cabinet with a trough built on the top and lined with zinc or lead. This is where the bowls or buckets for water were held into. Splashboards were sometimes added to the back wall, as well as shelves and drawers, the more elaborate designs usually placed in the kitchens. Stainless steel is commonly used in kitchens and commercial applications because it represents a good trade-off between cost, usability, durability, and ease of cleaning. Most stainless steel sinks are made by drawing a sheet of stainless steel over a die. Some very deep sinks are fabricated by welding. Stainless steel sinks will not be damaged by hot or cold objects and resist damage from impacts. One disadvantage of stainless steel is that, being made of thin metal, they tend to be noisier than most other sink materials, although better sinks apply a heavy coating of vibration-damping material to the underside of the sink.

Enamel over cast iron is a popular material for kitchen and bathroom sinks. Heavy and durable, these sinks can also be manufactured in a very wide range of shapes and colours. Like stainless steel, they are very resistant to hot or cold objects, but they can be damaged by sharp impacts and once the glass surface is breached, the underlying cast iron will often corrode, spilling off more of the glass. Aggressive cleaning will dull the surface, leading to
more dirt accumulation. Enamel over steel is a similar-appearing but far less rugged and less cost-effective alternative.

Solid ceramic sinks have many of the same characteristics as enamel over cast iron, but without the risk of surface damage leading to corrosion. Soapstone sinks were once common, but today tend to be used only in very-high-end applications or applications that must resist caustic chemicals that would damage more-conventional sinks. Wood sinks are from the early days of sinks and baths were made from natural teak with no additional finishing. Teak is chosen because of its natural waterproofing properties – it has been used for hundreds of years in the marine industry for this reason. Teak also has natural antiseptic properties, which is a bonus for its use in baths and sinks. Glass sinks, a current trend in bathroom design is the handmade glass sink (often referred to as a vessel sink) which has become fashionable for wealthy homeowners. Stone sinks have been used for ages. Some of the more popular stones used are: marble, travertine, onyx, granite, and soap stone on high end sinks. Glass, concrete, and terrazzo sinks are usually designed for their aesthetic appeal and can be obtained in a wide variety of unusual shapes and colours such as floral shapes. Concrete and terrazzo are occasionally also used in very-heavy-duty applications such as janitorial sinks.

Subang Parade promotes Seima's premier quality ceramic basins that are designed for visual impact without compromising functionality. Bring a sense of style and luxury to your bathroom by contemporary, classic, funky, sculptural, minimalist, square or organic styles and create the very own ambience.
5.3.2 Traps

5.3.2.1 Water Seal

The function of water seal is to prevent the entry of waste water gases and pest into the building, water seals traps are fitted just after the sanitary appliances, traps some flushing water, create a water seal in the waste water pipe. It’s normally made of steel, cast iron, plastic or brass, vitreous china or porcelain. For toilet bowl and urinal, traps are cast together with the sanitary appliance.

5.3.2.1.1 Bottle Traps

Bottle trap is a name used for several different objects. Among these are a piece of material used in bathroom plumbing, as well as various traps that are made out of discarded bottles and which are used to trap animals as different as beetles, mice, fish and octopuses. This article is about the use of modified bottles to trap flying insects. In this context, a bottle trap is a type of baited arboreal insect trap for collecting either prized or harmful frugivorous beetles, especially flower beetles, leaf chafers and longhorn beetles as well as wasps and other unwanted flying insects.

A bottle trap is an insect trap made out of a plastic bottle. Most collectors use bottles of 1.5 or 2 litres to make these traps but smaller bottles are sometimes used as well. There are basically two types:
Funnel type. These bottle traps are made by cutting off the neck of the bottle as well as the complete tapering part of the top. The neck and cap are discarded. For catching wasps only the cap is removed, while leaving the neck in place. The tapering part is placed upside down on top of the rest of the bottle, thereby effectively forming a funnel. This funnel is then fixed to the bottle by piercing both bottle and funnel at two opposing sides. A wire fitted through these holes ensures the funnel solidly fits on the bottle, while the trap can easily be opened when required. After putting the bait in the bottle the trap is placed at the desired location.

Advantages: Insects can't escape from this type of trap, since they fly up along the side of the bottle, not finding the exit, which is in the middle. Bats and large moths can't enter the trap, since they are too large to fit through the funnel. This type can, unlike the other kind, also be used to collect troublesome wasps.

Disadvantages: Not only insects but also rain will funnel into the trap. This trap is therefore normally only used in dry seasons. This construction requires a bit more work than the side door type.

Side-door type. A side-door bottle trap consists of a bottle with cap of which the higher end of one upright side is cut open. A simple rectangular shape is cut out, taking care that it stays attached to the bottle on its upside. This plastic flap is then bend upward, effectively forming a rain shield over the entrance.[4] After adding some bait the trap is put in its place.

Advantages: Because of its opening with rain shield very little rain enters the trap, making it effective in wet seasons too. Construction is very simple and requires no additional materials.

Disadvantages: The wider opening allows for small bats and large moths to enter. These may die in the trap and pollute it, as well as forming, with their wings, a bridge to the exit. Captured beetles may escape again since they may simply fly upward along the side of the bottle.
5.3.2.1.2 “S” Traps

In plumbing, a trap is an S or J-shaped pipe located below or within a plumbing fixture. An S-shaped trap is also known as the S-bend invented by Alexander Cummings in 1775 but became known as the U-bend following the introduction of the U-shaped trap by Thomas Crapper in 1880. The new U-bend could not jam, so, unlike the S-bend, it did not need an overflow. The bend is used to prevent sewer gases from entering buildings. In refinery applications, it also prevents hydrocarbons and other dangerous gases from escaping outside through drains. The most common of these traps in houses is referred to as a P-trap. It is the addition of a 90 degree fitting on the outlet side of a U-bend, thereby creating a P-like shape. It can also be referred to as a sink trap due to the fact it is installed under most house sinks. Because of its shape, the trap retains a small amount of water after the fixture’s use. This water in the trap creates a seal that prevents sewer gas from passing from the drain pipes back into the occupied space of the building. Essentially all plumbing fixtures including sinks, bathtubs, and toilets must be equipped with either an internal or external trap. Because it is a localized low-point in the plumbing, sink traps also tend to capture heavy objects (such as jewellery) that are inadvertently dropped into the sink. Traps also tend to collect hair, sand, and other debris and limit the ultimate size of objects that will pass on into the rest of the plumbing, thereby catching over-sized objects. For all of these reasons, most traps can either be disassembled for cleaning or they provide some sort of cleanout feature.
5.3.2.2 Interceptor Traps

To prevent blockages, devices called interceptors are installed just after the sanitary appliance or at the waste water inlet to trap solid object or substances from entering the rest of the waste water pipe. They include gratings at the waste water inlet to trap hair or solids and interceptor traps grease and food remains.

5.3.2.2.1 Gully Trap

Gully traps receive discharge from wastewater fixtures. One gully trap may receive discharge pipes from several outlets. Each residential building must have at least one gully trap. If a drainage system becomes blocked, the gully trap provides the point where sewage can overflow outside the building, instead of building up inside the pipe and overflowing inside the building. Gully traps must have an overflow rim at least 150 mm below the overflow level of the lowest fixture served by the system, located within the legal boundary of the land on which the building stands, to prevent surface water from entering the trap, be constructed so the grate will lift to allow surcharge, have at least one discharge pipe feeding into it to maintain the water seal. A floor waste gully acts as a floor drain as well as receiving the discharge from wastewater fixtures. It may only receive discharge pipes from wastewater fixtures that are located in the same room. It may also be used as a shower outlet but cannot receive solid waste, for example, from a WC pan. The advantage of using a floor waste gully is that it reduces the number of connections required to the drain and the length of pipe. They may be used in buildings where overflowing water could enter another property.
5.3.2.2.2 Grating

A grating is any regularly spaced collection of essentially identical, parallel, elongated elements. Gratings usually consist of a single set of elongated elements, but can consist of two sets, in which case the second set is usually perpendicular to the first (Diagram 5.3.2.2.1a). When the two sets are perpendicular, this is also known as a grid or a mesh. All sanitary appliances outlet holes (except for WCs and bidets) to the waste water pipes are fitted with a grate or perforated cover. A grating covering a drain (Diagram 5.3.2.2.1b) can be a collection of iron bars (the identical, elongated elements) held together (to ensure the bars are parallel and regularly spaced) by a lighter iron frame. Gratings over drains and air vents are used as filters, to block movement of large particles (such as leaves) and to allow movement of small particles (such as water or air).
5.3.3 Stacks

5.3.3.1 Waste Pipe

The system of pipes that carries water and waste to a sewer line or septic tank is called the drain-waste-vent (DWV) system. As the name implies, it has three components: Drain lines collect water from sinks, showers, and tubs; waste lines carry waste from toilets; and vent lines exhaust sewer gases and allow wastes to flow freely. All drain and waste lines slope slightly downward from the fixture toward the sewer or septic system. Water and wastes are carried by gravity.

The pipes are large in diameter—typically 1 1/4 inches to 4 inches—to minimize the possibility of blockages. The main soil stack for toilets is normally a 4-inch pipe; showers usually have a 2-inch pipe. Sinks, lavatories, bathtubs, and laundry tubs may be served by 1 1/4- to 2-inch pipes. Though some old homes may have pipes made of lead, most drain piping is ABS plastic, cast iron, or copper. Some vent pipes are galvanized iron. To operate properly and safely, each drain must be served by a vent line that carries sewer gases out through the roof. Several vents may be connected together and joined to one larger soil stack as long as there is no drain above the connection point. Or vents may pass through the roof on their own. Wherever vent pipes penetrate the roof, special flashing protects against roof leaks. (For a closer view of vent flashing, see How Roof Flashing Works.)
All waste pipes should have cleanouts at easily accessible locations. A cleanout is simply a Y-shaped fitting in the line that is capped off. If a blockage occurs in the drainpipe, a cleanout offers a convenient place for a plumber to snake out the line. To prevent sewer gases and odours from entering the house, drains are protected by traps. A trap is a curved section of drainpipe that fills up with water, providing a seal. Drains that penetrate a wall have a P trap; those that go through the floor have an S trap. The water held by the trap is replaced each time the fixture is used.

This is the best and most improved system of plumbing. Two sets of vertical pipes, one for excreta (night soil) as soil pipe and another for sullage as waste pipe. The soil pipes as well as waste pipes are separately ventilated, by providing, separate vent pipe or anti-siphon age pipe. This system has four vertical pipes. The ventilation is usually achieved by providing a fresh air inlet connected to the lower-most manhole or inspection chamber. Fresh air from the atmosphere will enter through this inlet into the manhole, and finally goes out at top through the vent pipe. The air along with foul gases will finally escape out from the cowl provided at the top. A flap valve is provided at the inlet of fresh air into the inspection chamber, to avoid the escape of foul gases in the street or courtyard.
5.3.3 Septic Tanks

A septic tank generally consists of a tank (or sometimes more than one tank) of between 1,000 and 2,000 gallons (4000 and 7500 litres) connected to an inlet wastewater pipe at one end and a septic drain field at the other. In general, these pipe connections are made via a T pipe, which allows liquid to enter and exit without disturbing any crust on the surface. Today, the design of the tank usually incorporates two chambers (each equipped with a manhole cover), which are separated by means of a dividing wall that has openings located about midway between the floor and roof of the tank.

Waste water enters the first chamber of the tank, allowing solids to settle and scum to float. The settled solids are anaerobically digested, reducing the volume of solids. The liquid component flows through the dividing wall into the second chamber, where further settlement takes place, with the excess liquid then draining in a relatively clear condition from the outlet into the leach field, also referred to as a drain field or seepage field, depending upon locality. A percolation test is required to establish the porosity of the local soil conditions for the drain field design. The remaining impurities are trapped and eliminated in the soil, with the excess water eliminated through percolation into the soil (eventually returning to the groundwater), through evaporation, and by uptake through the root system of plants and eventual transpiration. A piping network, often laid in a stone-filled trench (see weeping tile), distributes the wastewater throughout the field with multiple drainage holes in the network. The size of the leach field is proportional to the volume of wastewater and inversely proportional to the porosity of the drainage field. The entire septic system can operate by gravity alone or, where topographic considerations require, with inclusion of a lift pump.
Certain septic tank designs include siphons or other methods of increasing the volume and velocity of outflow to the drainage field. This helps to load all portions of the drainage pipe more evenly and extends the drainage field life by preventing premature clogging.

An Inhofe tank is a two-stage septic system where the sludge is digested in a separate tank. This avoids mixing digested sludge with incoming sewage. Also, some septic tank designs have a second stage where the effluent from the anaerobic first stage is aerated before it drains into the seepage field. Waste that is not decomposed by the anaerobic digestion eventually has to be removed from the septic tank, or else the septic tank fills up and wastewater containing undecomposed material discharges directly to the drainage field. Not only is this detrimental for the environment but, if the sludge overflows the septic tank into the leach field, it may clog the leach field piping or decrease the soil porosity itself, requiring expensive repairs.

How often the septic tank has to be emptied depends on the volume of the tank relative to the input of solids, the amount of indigestible solids, and the ambient temperature (because anaerobic digestion occurs more efficiently at higher temperatures), as well as usage, system characteristics and the requirements of the relevant authority. Some health authorities require tanks to be emptied at prescribed intervals, while others leave it up to the determination of an inspector. Some systems require pumping every few years or sooner, while others may be able to go 10–20 years between pumping. An older system with an undersized tank that is being used by a large family will require much more frequent pumping than a new system used by only a few people. Anaerobic decomposition is rapidly restarted when the tank re-fills. A properly designed and normally operating septic system is odour-free and, besides periodic inspection and pumping of the septic tank, should last for decades with no maintenance. A well designed and maintained concrete, fiberglass, or plastic tank should last about 50 years.
5.3.4 Manholes

Manholes or maintenance holes are underground chambers which are dug into the ground to ensure that sewer lines and other utilities such as electrical cables are able to be checked for damage and maintenance. Sewer lines run across manholes, and if they are damaged, manholes are access points to get to the damaged pipe. Manhole openings are protected by a manhole cover (also known as a "biscuit"), a flat plug designed to prevent accidental or unauthorized access to the manhole. Those plugs are traditionally made of metal, but may be constructed from precast concrete, glass reinforced plastic or other composite material (especially in Europe, or where cover theft is of concern).

Manholes are usually outfitted with metal, polypropylene, or fiberglass steps installed in the inner side of the wall to allow easy descent into the utility space. Because of legislation restricting acceptable manual handling weights, Europe has seen a move toward lighter weight composite manhole cover materials, which also have the benefits of greater slip resistance and electrical insulating properties. The access openings are usually circular in shape to prevent accidental fall of the cover into the hole.

Manholes are generally found in urban areas, in streets and occasionally under sidewalks. In rural and undeveloped areas, services such as telephone and electricity are usually carried on utility poles or even pylons rather than underground.
The drainage system is an essential part of living in a city or urban area, as it reduces flood damage by carrying water away. When it rains, some water naturally seeps into the ground. The rest makes its way through drainage systems, into rivers and creeks and eventually into the bays, or directly to the bays through storm water beach outlets.

In areas with houses, shops and roads we need to create alternative ways for this water to drain away. Large amounts of water can build up quickly during heavy rain and storms, and without adequate drainage this flows towards low-lying land, causing flooding, and damage and safety risks.

For this reason, we work with local councils to provide a drainage system that safely carries storm water away from built-up areas and into rivers and creeks.

Here’s how it works:
1. storm water runs off Subang Parade’s properties and their roofs through house gutters and downpipes, and into residential drains
2. residential drains connect to streets and roads or council drains
3. council drains connect to regional drains
4. regional drains direct water into the nearest river or creek or directly to the bay
5. rivers and creeks eventually empty into Port Phillip Bay or Western Port

Entering storm water drains is dangerous and illegal, and could cost you your life or endanger others who rescue you.

Conditions inside a drain can become very hazardous without warning. For example:

- water levels can rise even on a dry, sunny day
- rainwater can arrive suddenly, having fallen many kilometres away
- slow moving flows can quickly become raging torrents
- areas with poisonous gases and low oxygen can be deadly
- drains may contain steep, hidden slopes, making it easy to slip and difficult for others to hear you call for help

We can’t cover up all storm water drains and grilles – this would restrict water flows and cause a build-up of litter and debris, leading to flooding. Warning signs are placed at entrances to drains around Subang Parade.
5.4 Analysis

Wastewater also known as liquid waste can cause water pollution and increase the Biochemical Oxygen Demand (BOD) and will cause disease to human being as well as animals if not treated well. In compliance to Building by-Laws, for the protection of public health and safety, toilets not only must it sufficient but located in rooms separated from places where food is stored or prepared. Toilets are designed and installed with safe sanitary disposal of wastewater from the sanitary appliances in a building to ensure the following does not occur.

In Subang Parade, liquid waste are being release in sanitary appliances and being flush into the vertical waste pipe also called as stacks. From Stacks in then travel to the septic tank in the basement of the building and through a soil pipe, wastewater is being pumped into the public sewer line. Wastewater is then travel along the public sewer line to a wastewater treatment plant nearby for treatment before clean water being send to the nearby water sources.

However, grease interceptor trap are use only at ground level of the building where restaurant is located. Grease or fat from wastewater can cause pipes to block as they solidify on the inner wall of the pipe. A grease interceptor trap consists of a tank which holds water in a sufficient amount to cause the washing up water to stagnate and cool. Thus allows the grease to float to the water surface and maybe solidify and thrown away while the normal liquid being sent out through an outlet pipe. It usually also fitted with a wire basket to trap solid waste which enter the tank with the wastewater.

Most of the sewage pipes and vents, including the storm drains and sewer are hidden and cannot be seen. Most sewage pipes run across above ceiling panels, and behind walls. Therefore, this is a good thing for the aesthetics of the building interior and exterior. Even the pipes beneath washroom sinks are hidden by a concrete surface. The smell and odour around the building is kept fresh, as every plumbing fixture and sewage inlet such as water closets and floor traps are connected to a stack vent, and every stack vent has a vent at the top (roof) to allow the smell of the sewage to escape the building, rather than trapping it inside the building. So, the hygiene is maintained quite well.
5.5 Conclusion

Subang Parade is a very efficient design in terms of sanitation and drainage. It has all the basic requirements of sanitation services and storm water systems, which is executed at affordable costs. As a conclusion, the sanitation systems in the building are functional, efficient, and aesthetically acceptable. The wastewater system for Subang Parade is well planned and it complies with standards and requirement of regulatory bodies in Malaysia. The availability of wastewater treatment plant nearby is an advantage for the building as it allows wastewater to be discharge into the public sewer line, which reduces the cost as well as the maintenance cost for a septic tank or a treatment system in the building itself.
6.0 Mechanical Transportation System

6.1 Introduction

The mechanical transportation of people and goods is an energy-using service which needs the designer’s attention at the earliest stages of building design. Hand powered lifts or hoists in various forms have been in use since the days of Pyramid construction in Egypt in 2600 BC. In China hand powered winches were used to draw water as far back as 236 BC. Today the lifts have the best safety record of any form of transportation systems and its installation in buildings is accepted as an essential requirement. One of the many decisions that must be made by the designer of a multi-story building, probably none is more important than the selection of the vertical transportation equipment - that is the passenger, service, and freight elevators and the escalators. The principles of transportation systems are outlined and reference is made to movement between buildings. Hence, this movement should be accelerating comfortably, rapid, smooth and economical. The quality of elevator service is also an important factor in a tenant’s choice of space in competing buildings. The spatial needs and impact of transportation systems have revolutionized building design and such equipment can only be regarded as an integral part of the normal building services process.

According to Malaysia Uniform Building By-Laws 1984, clause 124
For all non-residential buildings exceeding 4 storeys above or below the main access level at least one lift shall be provided.
6.2 Literature Review

There are two main classes of elevators which are used by Subang Parade which are the traction elevators and hydraulic elevators. Traction elevators are then further subdivided into two categories: geared and gearless. The elevators that Subang Parade used is geared traction elevators. The selection of elevators not only depending on its classes and motors but also based on the efficiency and effectiveness of elevators installations on site by calculating its round up trip (RTT). Average time required for a car to make a round trip - starting from the lower terminal and returning to it. The RT time during up-peak traffic conditions, used for calculating elevator requirements is the sum of 4 factors:

I. time to accelerate and decelerate

II. time to open and close doors at all stops

III. time to load and unload

IV. Running time.

The complete process is a summation of a number of simple calculations relating the elevator’s function through its cycle.

The following are the standard formulae used for the calculation.
6.3 Location of Transportation System

There are about 18 standard escalators and 4 bubble lift that is using hydraulic system.
Legend
- Green: Excavator
- Yellow: Elevators machine room
- Red: Elevators
- Blue: Bublee Lifts

LOWER GROUND FLOOR PLAN

BASEMENT FLOOR PLAN
Position of elevator is located in 7 different zones inside the building. Elevators are separated into standard distance from each other.

When a number of lift is required, it is best to group them together as it

a. reduces time of waiting and  
b. reduces the cost of installation
6.4 Elevator

6.4.1 Case Study

An elevator (or lift in the Commonwealth excluding Canada) is a type of vertical transport equipment that efficiently moves people or goods between floors (levels, decks) of a building, vessel or other structures.

Subang Parade is also one of the representatives of retail store in Malaysia as it is the first shopping complex in Malaysia. Therefore, it is also integrated with standard mechanical transportation system to ease the movement and circulation of consumer in the building.

Elevator Performance depends on:

- Acceleration
- Retardation
- Car Speed
- Speed of Door Operation
- Stability of Speed and performance with variations of car load.

There are two types of elevators that are used by Subang Parade which are:

I. Geared Traction Elevator
II. Plunger Hydraulic Elevator (which is known as bubble lift)
6.4.2 Geared Traction Elevator

A geared traction machine has a worm and gear interposed between the driving motor and the hoisting sheave. The elevator machine room is always located directly on top of the elevator so that less energy is needed to control the elevator. The driving motor can therefore be smaller, cheaper, high-speed unit rather the large, low-speed unit required by a gearless installation. The car, cables, elevator machine, control equipment, counterweights, hoist way, rails, penthouse, and pit are the principle parts of a traction elevator installation.

Figures show components of a Geared Traction elevator installation with one solid state control and motor drive.
Control system in the machine room floor.

Gear Traction Machine

Figures show a typical dc geared traction elevator machine.
Pictures show the geared traction machines used for the traction elevator in Subang Parade which is located above the lift.

Cross Section of the Geared Traction Machine.

Safeties are activated by a governor when the elevator moves too quickly. Most governor systems are built around a sheave positioned at the top of the elevator shaft. The governor rope is looped around the governor sheave and another weighted sheave at the bottom of the shaft. The rope is also connected to the elevator car, so it moves when the car goes up or down. As the car speeds up, so does the governor. Picture below shows the governor in the machine room in Subang Parade.
These are used for car speeds up to 2.3 m/s and maximum rise of about 90 m.
With an appropriate drive and control system, a geared traction machine can give almost the same high-quality, accurate, smooth ride as is available from a gearless installation.
Car

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, 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.
Guide Rails
Steel tracks in the form of “I” that run the length of the hoist way, round, or formed sections with guiding surfaces to guide and direct the course of travel of an elevator counterweight and usually mounted to the sides of the hoist way.

Counterweight
The counter weight 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. Its weight equals that of the empty car plus 40% of the rated live load.
It serves several purposes:
• Provide adequate traction at the sheave for car lifting, to reduce the size of the traction machine, and to reduce power demand and energy cost.
• Higher initial cost due to strengthen the overhead machine room floor, which must carry the additional structural load of the counter weight.

Shaft
The shaft or hoist-way is the vertical passageway for the car and counterweights. On the side walls are the car guide rails and certain mechanical and electrical auxiliaries of the control apparatus.

Suspension Rope
Suspensions means, for the car and counterweight, which are represented by steel wire rope. They are used on traction type elevators, and usually attached to the crosshead and extending up into the machine room looping over the sheave on the motor and then down to the counterweight.

Buffer
A device designed to stop a descending car or counterweight beyond its normal limit and to soften the force with which the elevator runs into the pit during the emergency. They may be of polyurethane or oil type in respect of raced speed.
6.4.3 Arrangement of Elevator Machines, Sheaves and Cables

Number of pulleys and the wrapping ratios increased to improve resistance to slippage. The mechanical advantage of the 2:1 roping is that it permits the use of a high-speed, low power (lower cost) traction machine.

Safety Device

Main brake of an elevator is mounted directly on the shaft. The lift is first slowed by dynamic braking of the motor and the brake then operates to clamp the brake drum, thus holding the car still at floor.

A dual safety device is used to stop the car automatically in case of over-speed:
- A centrifugal governor or an electronic speed control sensor cuts the power of the traction motor and sets the brake in case of limited over-speed.

- If over-speeding continues, governor actuates two safety rail clamps, which are mounted at the bottom of the car and one either side.

Oil or spring buffers are usually placed in the pit, not to stop a falling car but to bring it to a somewhat cushioned stop if it over-travels the lower terminal.

The governor or velocity transducers regulate over-speed, clamping the safety trip rope and releasing the safety jaws, which exerts a constant retarding force on the car rails, thus bringing the car to a gradual and safe stop.
6.4.4 Plunger Hydraulic Elevator

The major advantage of hydraulic unit is the absence of an overhead machine room, a penthouse, and traction equipment. Hydraulic lift/elevator systems lift a car using a hydraulic ram, a fluid driven piston mounted inside a cylinder. It is normally used for low-rise buildings.

Holed (Conventional) Hydraulic Elevators

They have a sheave that extends below the floor of the elevator pit, which accepts the retracting piston as the elevator descends. Some configurations have a telescoping piston that collapses and requires a shallower hole below the pit.
Section of plunger hydraulic system

Elevator load is carried by the ground not by the structure. In contrast, traction units place a large structural load on the penthouse and machine room floors and overhead steel as well. Hoist-way is smaller due to the absence of a counterweight and its guide rail. Cars can be lowered manually by the operation of oil valves. It is particularly useful and important in the time when the failure of the control equipment or outrage of power. Essentially there is no lifting limit. Operating expensive is higher due to absence of counterweight. These are limited to low-rise, low-speed applications. Ride quality is also inferior.

Oil pump and oil reservoir tank for the plunger hydraulic elevator.
All Hydraulic elevators today use oil and obtain their motive power from a sealed oil-piping circuit powered by an oil pump. The system operates the same way as a hydraulic automobile jack. Oil from a reservoir is pumped under the plunger, thereby raising it and the car. The pump is stopped during downward motion, the car being lowered by gravity and controlled by the action of bypass valves, which also control the positioning of the car during upward motion.
6.4.5 Elevator Car Control

The movement of an elevator car and all of its parts is controlled by three different systems that combine and interact to provide an unfail control system. The three systems are:

1. Drive Control System (Ward Leonard System)
2. Operating Control System
3. Supervisory System

6.4.5.1 Drive Control System

Drive Control System, also known as motion control system determines the car’s acceleration, velocity, braking, leveling and regenerative braking plus all aspect of door motion. Elevator car acceleration and deceleration are accomplished by controlling the speed of the motor that drives the elevator traction machine.

This speed control can be accomplished in a number of ways.

Ward Leonard System (which is also known as UMV (unit multivoltage) drive)

This variable dc was obtained from an auxiliary m-g set comprising an ac motor and a dc generator. It is a high classic high-quality elevator drive arrangement and is found in the vast majority of better-quality geared and gearless installations. The most valuable features in Ward Leonard control system is its smooth starting and very good speed control even at the slow speeds. The performance of the Ward Leonard drive is dominated by the electrical time constant of the generator shunt field and by the electromechanical time constant associated
with the inertia of the motor shaft. This makes the Ward Leonard drive smooth to accelerate and decelerate. (K.A. Yeomans 1968, 144-148).

Subang Parade chooses this system as their motor’s speed drive.

6.4.5.2 Operating Control System

Elevator Operating Control System determines when and where physical motion of a car and its doors should occur. This system takes over the operation of the car doors and the incorporation of car buttons, lanterns and passenger-operated devices into the overall control and indicating system. In a UMV system the car’s m-g set is started, whereas the solid-state motion control the power immediately. Specifically, the motion of a car is regulated by the action of three principal items of equipment, the car controller, the motion controls and the system supervisory equipment.

6.4.5.3 Supervisory System

One of the effective and useful systems to control a bank of elevator cars is the system wherein the choice of a car to serve one of the hall calls with respective functions generated at the respective floors of an office building is decided by taking note of the traffic condition and car travelling condition in the whole building.

This system is called the assigning system which is most commonly employed at present in the group supervisory system of elevator cars and can provide considerably improved service,
compared to the conventional elevator control system, i.e. the so called one-round operating system, in which the elevator cars are operated with proper intervals regardless of generation of the hall calls. Subang Parade used selective collective system in this case.

6.4.5.4 Selective Collective Operation

The major disadvantages of the selective collective control are its inherent and strong tendency toward bunching of cars can result in long waiting periods. This characteristic is particularly annoying with groups of three cars due to certain situation which passengers arrived at a landing find that all three cars have just passed, going in the same direction. For this reason, operation of more than two cars with this system is not recommended. That is why Subang Parade had only two cars operating with system at once.

Lobby Elevator Panel

Lobby elevator control today has become one or more computer monitor screens positioned at a lobby desk or in the building maintenance office.

The lobby elevator panel in Subang Parade is located in its surveillance office.

The control functions available at the computer terminal permit intervention to establish special types of operation including:

i. Car movement without operating the usual audible and visual signals (inconspicuous riser)
ii. One or more cars removed from supervisory control and operated manually (attendant or independent service)

iii. Cars selected for night or weekend service while the other cars are shut down

iv. Cars assigned to a particular floor on a fixed or priority basis call (convention feature or priority)

v. Switching off power between cars in the event of emergency

vi. Two way communication with each car and other selected locations.

6.4.6 Special Considerations

Fire Safety

The procedures that elevator control equipment is implemented once a fire emergency has been initiated in Subang parade are as follows:

i. All cars close their doors and return nonstop to the lobby or another designated floor, where they park with the doors open. Thereafter, they are operable

ii. In manual mode only, by use of the firefighter’s key in the car panel.

iii. All cars and hall calls are canceled, and call-registered lights and directional arrows deactivated.

iv. The fire emergency light or message panel in each car is activated to inform passengers of the nature of the alert and that cars are returning to a designated terminal.

v. Door sensors and in-car emergency stop switches are deactivated.

vi. Traveling cars stop at the landing without opening their doors and then proceed to the designated terminal.
The cars can then be used by trained personnel to transport firefighters and equipment and for evacuation.

According to Malaysia Uniform Building By-Laws, clause 151
Where openings to lift shafts are not connected to protected lobbies, such lift shafts shall be provided with vents of not less than 0.09 square meter per lift located at the top of the shaft. Where the vent does not discharge directly to the open air the lift shafts shall be vented to the exterior through a duct of the required FRP as for the lift shafts.

According to Malaysia Uniform Building By-Laws, clause 152
1. Every opening in a lift shaft or lift entrance shall not 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.
2. Landing doors shall have a FRP of not less than half the FRP of the hoist-way structure with a minimum FRP of half hour.
3. No glass shall be used for in landing doors except for vision in which case any vision panel shall or be glazed with wired safety glass, and shall not be more than 0.0161 square meters and the total area of one of more vision panels in any landing door shall be not more than 0.0156 square meters.
4. Each clear panel opening shall reject a sphere 150mm in diameter.
5. Provision shall be made for the opening of all landing doors by means of an emergency key irrespective of the position of the lift car.

6.5 Escalators

6.5.1 Case Study
The moving stairway, also referred to as an escalator or an electric stairway, is a modern successors deliver passengers comfortably, rapidly, safely, and continuously at constant speed and usually with no delay at the boarding level. The annoyance of waiting for elevators is eliminated.
Also, no time is lost by acceleration, retardation, leveling, and door operation, or by passenger interference in getting in or out of the cars.
Instead of formal lobbies and hallways leading to a bank of elevators on each floor and a ride in a small, enclosed box, the electric stairway is always in motion, inviting passengers to ride on an open, airy, observation type conveyance that can never trap them due to equipment or power failure. The angle of inclination is normally 30°, but may increase to 35° if the vertical rise does not exceed 6 m and the speed is limited to 0.5 ms⁻¹.

6.5.2 Arrangement of Escalators

Stack Parallel Walk Arrangement
Side and end elevations and plan views of escalators in stacked parallel arrangements. In the stacked arrangement the rider must traverse the entire length of the escalator at each level in order to continue, since the escalators are stacked vertically each floor.

The principal advantage of the parallel arrangement is its impressive appearance. The stacked arrangement must be used with caution due to the inconvenience to the rider of an enforced long walk-around to continue the trip. The forced walk-around is much less objectionable, as many people are there to browse and window-shop rather than to purchase and leave. Escalators between two contiguous levels do not present the continued trip problem and therefore are frequently used in the parallel arrangement do not present the continued trip problem and therefore are frequently used in the parallel arrangement.

Crisscross Arrangement

This layout is simpler to visualize and also more common.
Side and end elevations and plan views of the crisscross escalator arrangements. In the spiral operation mode, separating the escalators forces the rider to walk distance D to continue a trip. In the walk-around operation mode, escalators are frequently separated to provide a walk-around pathway.

The layout that Subang Parade used for the crisscross arrangement is the spiral operation, and the entire installation is referred to as crisscross spiral operation.
When stairs L1A and L2A are operated in the up direction, a passenger from the lower terminal travels up in a spiral with only turnaround at each level. The same goes to the down passenger.

This crisscross arrangement is rapid, pleasant and very economical of space because the stairs nest into each other. It can be used for as many as five floors without excessive annoyance to the rider.
6.5.3 Location

Escalators are always the main line of the horizontal and vertical trip in the building therefore it is essential to placed it directly to the mainline of the traffic to ease the circulation around the building. It is to be placed in the area served, often with a dominating presence allow people to locate, recognize destination and move easily and comfortably. Sufficient lobby space also must be provided at the base for queuing where anticipated, particularly at discharge point.

To avoid traffic movement disorientation, Subang Parade provides:

1. A well-marked escalator with sufficient traffic capacity.
2. Collecting space at the intermediate landings so that passenger pressure can be relieved.
3. A Physical divider at the intermediate landing turnaround points that guides riders away from the discharge point, and provide adequate space and time
4. For riders either to leave that level or to follow the guide around and continue the trip.
5. A slight setback for the next escalator so that the necessary 180 degree turn can readily be negotiated.

At the exit terminus, an escalator is discharged into an open area with no turns or choice of direction. The landing space beyond the escalator newels is a minimum of 2.4m for 0.81m units and 3m for 1.22m units for a standard 0.5-m/s speed. The parallel arrangement, being less efficient and more expensive, has a compensating virtue a very impressive appearance that strongly draws people to it.
6.5.4 Components

View of a standard escalator showing the principal parts.

The truss is a welded steel frame that supports the entire apparatus. The tracks are steel angles attached to the truss on which the step rollers are guided, thus controlling the motion of the steps. The sprocket assemblies, chains and machine provide the motive power for the units. The handrail is driven by sheaves powered from the top sprocket assembly.
6.5.5 Safety Feature

Protection of passengers during normal operation is ensured by a number of safety features associated with moving stairways.

I. Handrails and steps travel at exactly the same speed to ensure steadiness and balance and to aid stepping on or off the comb plates.

II. The steps are large and steady, ad are designed to prevent slipping.

III. Step design and step leveling with the comb plates at each landing prevent tripping upon entering or leaving the escalator. This is accomplished with 2 or 3

IV. Horizontal steps at either end of the escalator.

V. The balustrade is designed to prevent catching of passengers’ clothing or packages. Close clearances provide safety near the comb plates and step treads.

VI. Adequate illumination is provided at all landings, at the comb plates and completely down all stairways. Some escalator designs provide built-in lighting.

VII. An automatic service brake will bring the stairway to a smooth stop if:
   i. The drive chain or the step chain is broken or abnormally stretched
   ii. A foreign object is jammed into the handrail inlet, between the skirt guard and step, or between steps, causing them to separate
   iii. A power failure occurs
   iv. The emergency stop button is operated (one is located at either end of escalator)
   v. Any of the fire safety system devices operates
   vi. A tread sags, rises or breaks
   vii. A drive motor malfunction occurs

6.6 Conclusion

In the nutshell, the mechanical transportation system in Subang Parade is appropriate for the function of the building as a shopping centre. It is designed and planned all accordingly to provide an optimum experience for its customers.
7.0 Fire Protection System

7.1 Introduction

Fire protection system must always been a serious concern in large building design with many occupants inside the building. Not only the architectural design of the building, but the mechanism design of the fire protection must also support the building in terms of aesthetic and practicality.

In Subang Parade, adequate fire protection ranging from active to passive fire protection have been present since the first it was built. The fire safety system which run automatic fire detection and extinguishing will be elaborately discussed along with the prevention mechanism that has been employed to minimize risk of potential fire and risk of property damage along with the initial fire safety inside the building.

With the reference of Malaysia- Uniform Building By Law, the existing system will be discussed in detail along with the mechanism of the system. Analysis will be provided in the end for the effectiveness of the functionality of the system. Following the literature review to explain the main concept behind the fire protection system.

7.2 Literature Review

7.2.1 Fire

Fire is a form of released heat and light energy during a chemical oxidation reaction commonly known as combustion. It is a result of chain reaction between fuel, molecules of oxygen, and heat energy.

It has three main component or factors that make up the reaction

- **Fuel**: combustible material
- **Oxygen**: main source of chemical component used in the reaction
- **Heat**: result of the chemical reaction
These three main components will then trigger fire as the result of the reaction.
Fire in small state are controllable and beneficial in a lot of ways. But in large state, its wild and uncontrollable, it will destroy and burn anything that it can get its hands on. The result is very destructive.

7.2.2 Fire Protection

In order to mitigate the destructive property of the fire, fire protection is very important in the design of a building, as it will affect the life of the occupants and the property value of the building. A lot of measure has to be taken in order to ensure the continuity of operation of the building along with the relation to other system in the building.

Fire protection in building can be separated into two categories of the design strategy:

- Active Fire Protection
- Passive Fire Protection

7.2.2.1 Active Fire Protection

Active fire protection is the mean of direct action against the occurrence of fire to retard the progress of fire spread and to putting out the fire, supported by the detection system that aid the speed of response in the occurrence of fire.

It is divided by two categories including fire suppression and fire detection.

Fire suppression system is divided into water based fire suppression system and non-water based fire suppression system.

7.2.2.2 Passive Fire Protection

The primary measure in designing the building in strategic way to ensure fire safety and protection against fire, heat and smoke. The aim is also to maintain the structural stability and
the control over fire by compartmentalization by zoning the building and separation of fire safety exit as a safe mean for escape.

The system include the design consideration over the building elements such as

- Wall and openings
- Floor
- Fire resistance materials
- Emergency access and escape route

7.3 Case Study

Case study chosen is Subang Parade. It has wide span of floor area with 5 different floor level including two basement level. It has wide range of fire protection mechanism to ensure the safety of the occupants inside the building.

7.3.1 Active Fire Protection System

Active fire protection is characterised by items and/or systems, which require a certain amount of motion and response in order to work, contrary to passive fire protection. (Wikipedia, The Free Encyclopaedia)

Subang Parade mall fire protection system provide several firefighting equipment’s in the active fire protection system. It is separated in two, water based fire protection system, and non-water based fire protection system.

7.3.1.1 Non-Water Based Fire Protection System

Non water-based system is the alternative of water as the mean of putting out fire, it is used in consideration of the property inside the space that is being extinguish that may be damaged if water is being sprayed.
7.3.1.1 Portable Fire Extinguisher

Portable fire extinguisher is used in initial control of fire accident or outbreak. It can be used to control and extinguish fire effectively using the dry chemical contain inside the small gas tank/tube

**Specification**

Type of portable fire extinguisher used in Subang Parade is normal type of ABCE dry powder extinguisher weighting of 6kg.

- Class A fire (common combustible material, paper, wood, etc)
- Class B fire (flammable liquid or gases)
- Class C fire (electrical equipment)
- Class E fire (kitchen oil and fat)

These portable fire extinguisher can be found inside the mall in several spot on all level, placed inside a compartment/shelf consisting of 4 of the extinguisher.

Figure 7.3.1.1a A set of Portable Fire Extinguisher (6kg) in a compartment found throughout the building
The portable extinguisher can also be found in several other places such as transformer room, plan room, or other service room. Some are found in smaller form size of the portable extinguisher.

![Figure 7.3.1.1b Smaller size 2kg portable fire extinguisher found in transformer room](image)

**UBBL 1984 section 227: Active fire protection requirements**

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

Standard requirement has been fulfilled in the availability of the portable fire extinguisher in Subang Parade.

**7.3.1.1.2 Automatic CO$_2$ Fire Extinguisher System**

Classified as Clean Agent Fire Suppression, CO$_2$ has many advantages in extinguishing fire than water. CO$_2$ inert gas is stored in liquid state under high pressurized steel cylinder and vaporized when release and interrupt combustion process by mixing with the air (Mechanical and Electrical Equipment for Building). It doesn’t deteriorate and can be store for indefinite time.
It is non-combustible, non-corrosive and does not conduct electricity thus safe for electrical equipment, there is also no residual as the gas escape to atmosphere after the fire is extinguished through CO₂.

CO₂ is specifically used confined space for important electrical appliances/ equipment that are free of people such as transformer room and plan room in Subang Parade. Each room has different number of cylinder depending on the size of the space and how fast the fire

Mechanism include storage cylinder, pilot cylinder, detector, discharge valve, and manual switch, and control panel.

1. Pilot Cylinder: activator for the storage cylinder allowing flow of the CO₂ to distribution pipe

2. Cylinder units: Main storage of liquid CO₂

3. Discharge valve: control the amount of release CO₂

Figure 7.3.1.2a CO₂ cylinders inside transformer room

In the event of fire, the alarm will trigger alerting any personnel inside the space to evacuate before the gas is discharge from the cylinder. Sometimes false discharge may happen in the operating condition which are regarded as normal especially in generator or transformer room.

The gas discharge will be controlled by discharge valve on each of the cylinder which then will be go to piping and release to the air by the discharge nozzle. It will need 85% of total amount of CO₂ inside the space to extinguish the fire in 2 minute.
Manual trigger (Figure 7.3.1.1.2d) can also be used in event of automatic system failure or fast response for the fire accident. Manual discharge trigger is place outside the exit door for the safety of the operator.

Figure 7.3.1.1.2b
Mechanism of the Automatic CO$_2$ Fire Extinguisher

Figure 7.3.1.1.2c Smoke detector nozzle connected to the CO$_2$ cylinder system
Figure 7.3.1.1.2e Gas control unit and manual switch trigger outside the room

Figure 7.3.1.1.2f Fresh air inlet and outlet vent to discharge hot air or CO₂

Besides to provide fresh air and discharge hot air for the transformer room, the fresh air inlet and outlet fan is equipped with fan extractor and also grill which can automatically closed to allow CO₂ to flood the room in order to extinguish the fire before it is discharge to outside atmosphere.
7.3.1.2 Water Based Fire Protection System

7.3.1.2.1 Fire Hydrant System

Several fire hydrants have been placed in the perimeter around Subang Parade approximately 100m next to each other. In the event of a fire accident in the building, it gives fire brigade a large supply of water from underground pipes that carry water. When connected to a hose reel, the water then discharges to the main engine to be pressurised and used to fight the fire.

Figure 7.3.1.2.1a Three way fire hydrant located outside the building, painted in noticeable colour.

UBBL 1984

140. (1) Away from obstruction such as street furniture, phone booths, etc.
(2) Not less than 2m from adjacent building and overhang
(3) Between 0.61m to 2.4m from fire appliances access away from risked vehicular.
(4) Not more than 90m apart from each other

7.3.1.2.2 Water Supply Tank and Pump for Fire Protection

Subang Parade fire protection system is supplied by two separate tanks, wet riser tank and water sprinkler tank, both located in the same space with other water supply tanks in basement floor. Sprinkler tank has more capacity than wet riser due to fire hydrant usage around the building to supply water to wet riser while sprinkler only has one source from main water supply.
Figure 7.3.1.2.2a Fire water supply tank location in basement floor close to basement car park.

There are three type of pumps that are used to supply the water for fire protection of the building.

1. **Duty Pump**: Pump that activated when the water pressure in the system goes down and supply water enough to maintain the pressure in the system. This situation happened in a fire emergency which require stable pressure of water in order to maintain the water supply in both wet riser and water sprinkler. Can be manually switched with control panel. Work on water pressure between 120 to 180psi. After the system pressure reach the required level, the pump will stop.

2. **Standby Pump**: Pump that serves as backup to the main duty pump in case of failure on the duty pump in maintaining the minimum pressure of system of duty pump that failed to operate.

3. **Jockey Pump**: Jockey pump is a pump that trigger the other pump to operate, it is called pressure maintenance pump. It helps to elevate the system’s water pressure to certain level when system is inactive, therefore the main pump doesn’t have to run all the time.
The main pumps are separated to different zones of the water distribution, low-zones including basement and service tunnels (close range) area and high-zones including first floor and ground floor of Subang Parade.

Figure 7.3.1.2.2b Wet riser supply tank and pumps  Figure 7.3.1.2.2c Water sprinkler supply tank and pumps

**Under UBBL 1984 section 247(2): Water storage**

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.

Each of the pump air pressure is maintain through the analog pressure gauge monitor and setting, separated for wet riser and sprinkler (close range & far range).
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<td>75</td>
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</tr>
<tr>
<td>Duty 1</td>
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<td>Duty 2</td>
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<tr>
<td>Standby 1</td>
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<td>Standby 2</td>
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Figure 7.3.1.2.2d Pressure gauge monitor for sprinkler pumps and setting

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<td>Standby</td>
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Figure 7.3.1.2.2e Pressure gauge monitor and setting for wet riser pump

In addition to the pressure monitor and setting for the sprinkler pump, the switches can also be found inside the sprinkler box.
Under UBBL 1984 law 228: Sprinkler valve

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

The valves is already located in secured enclosed room off public at basement level and easily accessible by fire brigade in emergency case.

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

The fire sprinkler system control and the pumps are connected to the main control room.
7.3.1.2.3 Fire Hose Reel and Wet Riser

Fire hose reel is internal firefighting hose equipment which directly connected to the wet riser pipe in every floor that which also connected to wet riser firewater storage tank with the wet riser pump located in the basement. The hose reel contain huge flow of water and it is difficult for untrained people to manage, but it has adjustable pressure reducer at the end of the pipe. It is located in different zones of building near lift lobbies, emergency escape route or stairs and several access points.
UBBL 1984, law 248: Marking on wet riser

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

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

Subang Parade has successfully applying the law requirement above. All fire safety devices are painted red to be easily identified, and hose reel and wet riser closet is indicated by logo on the closet door.

Wet riser pipe is found in all the recessed closet room along with the hose reel and canvas hoses. It function as internal hydrant to supply water for the hose reel and canvas pipe. The water supply comes from the pumps at basement level and controlled by landing valve located at each level. The landing valve allows excess water back to the wet riser tank through drain pipe. The canvas pipe has standard diameter of 60mm and maximum length of 30metres without any pressure reducer at the end of the hose pipe.

Figure 7.3.1.2.3d Distribution of landing valve position on each level
UBBL 1984, law 23:- Installation and testing of wet rising system

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

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

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

UBBL requirement above has been fulfilled in terms of placement of wet riser pipe along with the landing pipe on each floor. The nozzle and hose outlet has follow the standard.

Figure 7.3.1.2.3e Common detail of landing valve on wet riser pipe
7.3.1.2.4 Automatic Sprinkler System

Sprinkler system can be found throughout the building location except for electrical sensitive room such as transformer room or plan room. Wet sprinkler system is used in Subang Parade, where the pipe always containing pressurised water at all time, allowing water to immediately flow in when the glass bulb break in the event of fire.

Sprinkle system is most effective and reliable in controlling the fire and providing safer condition for the occupants to evacuate from the building. Sprinkler system is installed in same dimension/distance throughout the building. It is placed 3metres above the floor level with spacing in between approximately 4metres between each sprinkler.

The sprinkler type used in Subang Parade is Pendent sprinkler (Figure 7.3.1.2.1d) type with red glass bulb.

![Diagram of Pendent type sprinkler](image)

In the event of fire emergency, due to the heat that gather in the ceiling, the liquid inside the glass bulb will expand thus breaking the glass. Then the cap will drop and allows pressurised water to flow down to the deflector and bursting the water.
Figure 7.3.1.2.4d Sequence of the activation of the sprinkler water system

There are two ways of the activation of the sprinkler system

1. Through the sprinkler

   Water sprinkler burst / break – water sprinkle – control room notice – fire alarm activated

2. Through smoke detector

   Smoke detector – control panel room notice – water sprinkler – fire alarm

According to UBBL the distance between 2 sprinklers should be at a maximum distance of 4.6 meters.

Distance between 2 sprinklers is about 3 meters, hence, respecting the UBBL law, and offering maximum protection in case of fire

1. Fire water supply tank
2. Sprinkler pump
3. Pump control panel
4. Main control valve
5. Butterfly switch
6. Sprinkle head
7. Sprinkle drain
Figure 7.3.1.2.4d Distribution of sprinkler system

Figure 7.3.1.2.4e Sprinkler main control valve and piping distribution of sprinkler water pipe at the water tank and pump room
Figure 7.3.1.2.4f Detail of the main sprinkler control valve
MS 1910.159(a)(2): Automatic sprinkler system

For automatic sprinkler systems used to meet OSHA requirements and installed prior to the effective date of this standard, compliance with the National Fire Protection Association (NFPA) or the National Board of Fire Underwriters (NBFU) standard in effect at the time of the system's installation will be acceptable as compliance with this section.

UBBL 1984

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

288. (1) Sprinkle 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 sprinkle systems shall be electricity connected to the nearest fire station to provide immediate and automatic relay of the alarm when activated.
7.3.1.3 Fire Detection & Alarm System

7.3.1.3.1 Smoke Detector

Smoke detector is a precautionary step in order to identify and be aware of a fire emergency situation in any building. It gives signal to the main control room which will active the alarm system when it detects smoke or heat.

It is scattered through the building area especially in lift lobbies area near to emergency exit or in high-risk area such as transformer room. Located on the ceiling and will detect any heat or smoke running through the ceiling.

Figure 7.3.1.3.1a Typical smoke detector planted on ceiling

Figure 7.3.1.3.1b Mechanism and sequence diagrams of photoelectric smoke detector

Type of smoke detector used is high responsive photoelectric / photodiode smoke detector which inside consist of light projecting source, light trap, and the sensor placed in $90^\circ$ position. If the smoke entered the detector, the light will be scattered and projected to the sensor, completing the circuit thus activating the alarm and signal to the main control. The system provide several minute waiting time before alarm activation in case of false-alarm, giving time for the technician to check the real situation.
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 pre-set time.

Smoke detector is presence in all lift lobbies / fire protected room along with the interior part of the building.

7.3.1.3.2 Manual Call Point / Break Glass

Break glass is required in any public building in order for the occupant to manually send the signal of fire emergency and activate the emergency alarm. Break glass placed in many location near to escape route or emergency staircase. Its distinctive colour make it easily noticeable in every location under the alarm bell, as implying to the regulation UBBL from fire department

Figure 7.3.1.3.2a & b Fire break glass / manual call point placed under alarm bell

Figure 7.3.1.3.2c Manual call station located outside transformer room
7.3.1.3.3 Control Room

House all operating equipment for the building safety including surveillance and fire control. It holds all the control switch for the sprinkler and alarm system in the building as well as to monitor the condition of each of the fire safety components. All the panel are have complete indication of the location and status of every component with LED indicator, making the personnel easily identify the origin of fire. Signal from the detection system will come directly to the control room before any action is taken by the personnel working in this room.
The control room is also completed with the log system that log and print all the details of the emergency situation, false alarm, or practice along with the sequence of the mechanism activation. Fire control room is connected directly to the Fire Department /BOMBA with telephone / direct voice communication.

Figure 7.3.1.3.3b Direct communication line with Fire Department

Figure 7.3.1.3.3c Main manual system control and log printer
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.

Subang Parade has follow the requirement of the command and control center as part of the fire safety protection of the building with all the appropriate equipment in monitoring the safety of the building.
7.3.1.3.4 Fireman Intercom System

Used by the fireman in the event of fire emergency. Provides communication between the control room master console to the fireman of this handset station. It is located at staircases of each floor. At the Master control panel, a call alert lamp shall flash with audible signal when there is incoming call. Upon lifting the handset, the audible signal will be silenced. The master control panel is also equipped with a fault indicator unit to indicate the type of fault.

Figure 7.3.1.3.4a Remote Handset of fireman intercom system

7.3.2 Passive Fire Protection

Passive fire protection is secondary layer of fire resistance system which applied in the building overall design and management. Passive fire protection doesn’t hold any firefighting act.

7.3.2.1 Compartmentalization and Zoning

Subang Parade has wide area of floor span which require several zoning between the area inside the building. The zoning are categorized in different usage of the building shopping area, some has mixed usage. Different zoning yield different level of fire hazard. In order to prevent the fire for spreading fast, compartmentalization and zoning is required so that the fire will only posed threat and hazard in the place where it initially start. Zoning is also connected to firefighting act where the equipment is controlled according to the zoning of the floor.
Figure 7.3.2.1a, b, c Floor plan area zoning of the Subang Parade in different level

Roller Shutter or fire shutter is used in defining the zoning of the building and prevent fire to spread to other area or zone. It is operate able by a small control box located near the corner of the fire shutter.

Figure 7.3.2.1d Fire shutter as the indicator of zone transition

Figure 7.3.2.1e New automatic motorized fire shutter control.
Fire shutter has specification of 2 hour fire resistance to hold of the fire in the event of fire emergency. Additional independent door is provided in the sides of the fire shutter to allow evacuation of the occupant in case of fire emergency.

7.3.2.2 Means of Escape

Means of escape is to create a safe route for the evacuation in the event of fire emergency to minimize the exposure smoke and fire. In Subang Parade, means of escape can be separated into three key role

Fire escape staircase: provide safe place for the occupants to evacuate from the building. Equipped with pressure ventilation air and fire rated door to prevent fire from entering the fire escape staircase.

Fire lift: fire lift of BOMBA lift can be used by fireman to quickly reach certain level within building. Fire lift has bigger space compared with other normal lift and is equipped with fire retardant material to protect the lift from fire.

Fire protected area: is the area that connects the lift and the staircase as they function as one. It is equipped with fire rated emergency door to protect the occupants that evacuate to this area. Several fire protected area can be found in the building.

7.3.2.3 Fire Escape Door

Fire escape door located in every fire exit staircase or fire protected area in the building. With standard specification of 1 hour fire resistance. It is made from hardwood core with asbestos insulating board.

Two types of fire escape door are found throughout Subang Parade:

Single leaf 900mm x 2100mm x 38mm
Double leaf 1800mm x 2100mm x 38mm
To ensure the fire escape door is closed at all time, hydraulic spring is installed to close the door automatically.

All the fire door requirement is already been fulfilled, but the door is not equipped (or maybe broken) with coordinating device, therefore the door is not completely closed eventhough hydraulic spring is already installed.
7.3.2.4 Fire Escape Staircase

Fire Escape Plan with fire escape location in Subang Parade

Figure 7.3.2.4 a Lower Ground Level Fire Escape Plan

Figure 7.3.2.4 b Ground Level Fire Escape Plan
Figure 7.3.2.4 c First Level Fire Escape Plan

Figure 7.3.2.4 d Basement Level Fire Escape Plan
Fire escape staircase is located after the fire protected zone. By having a double layer of fire protection door, it is hoped to delay fire entering to the protected space. It is essential elements in escape route and designed to be able to gives escape access to the all the amount of occupants in the entire floor. It emphasize on practicality of the evacuation in the fire emergency as it is very important to ensure the occupants to be able to exit the building safely. The dimension and the number of stairs thread affects the flow of people who are ascending and descending through the staircase.

Distance between one fire exit and another is within 45 meters in floor area. Ensuring all zones are provided with close ranged fire exit staircase.
The fire staircase in Subang Parade is also provided with smoke vent to increase the air pressure inside the staircase area and preventing smoke to enter. It also equipped with additional fire sprinkler to increase the safety in case of fire entering the staircase.

Figure 7.3.2.4g Pressurized air vent and fire sprinkler in the fire staircase.

Dimensions of the railing in the fire exit is approximate 1m x 0.05m in diameter width, painted in grey color. The entire stairway is constructed with non-flammable materials. A landing is provided to ensure the users to have enough circulation space in the stairs to avoid any injuries or accidents during an emergency.

Figure 7.3.2.4h Railing for safety when walking down the fire staircase

**UBBL 201 Staircases enclosure below ground level**

All staircase enclosures below ground level shall be provided with suitable means of preventing the ingress of smoke.

**UBBL 168 Staircases**

1. Except as provided for in by-law 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 purposes 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 By-laws.

3. The required width of a staircase shall be the clear width between walls but handrails may be permitted to encroach on this width to a maximum of 75mm.

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.

With the accordance of the UBBL, it is found that the standard requirement of the staircase is already full filled in Subang Parade. It is totally enclosed till rooftop area, and due to the wide area of the floor, each and every of the staircase space is wide allowing large flow quantity of people.

**UBBL 157 Protected Shafts consisting of Staircase**

A protected staircase containing a staircase shall not contain any pipe conveying gas or oil or any ventilating duct other than a duct serving only that staircase.

In Subang Parade, the fire staircase is clean from any hazardous piping and ducting that can endanger the people walking down the staircase.

**7.3.2.5 Exit sign / Keluar Sign**

Keluar sign is placed above every fire protected area door with glowing green colour that is lit at all time. It is to ensure it understandable by all and can always be spotted even with the smoke condition.

Figure 7.3.2.5a Keluar sign box above fire protected area door seen from outside
7.4 Conclusion

Subang Parade has employed almost all of the fire protection requirement for building thus fire safety of the occupants are covered. But, the system used may be outdated due to the building that has been built 20 to 30 years ago. Analog system used in the building is already outdated and require more effort in managing all the appliances. Some of the equipment can be upgraded to better types of equipment using automatic management methods that can be easily monitored and maintain.
8.0 References


