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Building Services [ARC2423]

Project 1: Case Study and Documentation of Building Services Systems

Case Study of Kuala Lumpur Performing Arts Center

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1.0 INTRODUCTION

1.1 Abstract

In this research report, we looked into the details of the services in Kuala Lumpur Performing Arts Center such as the fire protection system, air conditioning system, mechanical ventilation system, electricity supply system, mechanical transportation system, water system and sewage system. In depth and detailed analysis were made on the components. The functions of these systems are researched upon as well to further understand the importance of these systems in ensuring a building's smooth operation. A conclusion of these systems will be made through our understanding of these services.

1.2 Acknowledgement

Firstly, we would like to thank our lecture, Ar. Sateerah Hassan for giving us guidance throughout the entire process of the project. We would also like to thank Mr Sathish for his patience in guiding us around through the services system and explaining their functions to us. We would also want to express our gratitude to YTL architects for providing us with the PDF drawings so that we could understand the building better. Last but not least, we would like to thank each and every group member for contributing their efforts in meeting the deadline of the project.

1.3 Details and Description of Building

Figure 1.3.1 Kuala Lumpur Performing Arts Center (KLPAC)

Also Called	:	KLPAC, Pentas Seni KL
Location	:	Jalan Strachan, Sentul, Kuala Lumpur, Malaysia
Established	:	May 2004
Veneus	:	The Actors Studio (TAS) at Lot 10, Performing Arts Center a Sentul Park
Designed by	:	Seksan Design Sdn Bhd

KL PAC is one of the most well-known performaing arts center in Malaysia. This performing art center is founded by Joe Hasham and Dato' Faridah Merican. Every year, KL PAC host more than hundreds of events.

This inspiring building was once a railway warehouse in Sentul park. It was then renovated with the addition of glass windows along the front façade as well as having a walkway which leads to the building.

From a wood-crafting workshop and sawmill in the 1800s to becoming a railway depot and workshop in 1906 and being bombed during world war 2 until the conversion into a makeshift golf clubhouse in the late 1960, this building has a long history which stretched far back in time.

2.0 WATER SUPPLY SYSTEM

2.1 Literature review

According to the Collin English Dictionary, water supply can be defined as an arrangement of reservoirs, purification plant, distribution pipes, etc, for providing water to a community or the supply of treated and purified water for a community. Water supply is the provision of water by public utilities, commercial organisations, community endeavors or by individuals, usually via a system of pumps and pipes.

The main purpose of having a water supply system in every country is to ensure the people can always access to fresh, clean water without any issues. We human demands water for drinking, cleansing and hygiene ,transportation uses and even cooling. Water is no doubt a daily need for human, so a properly designed water distribution system is always a prior concern of the government to fight against an increasing per capita consumption of water.

Fresh water can be obtain from nature in 3 places of earth, in the air as clouds, in the subsurface and lastly being on ground. However, the water we got straight from all these sources are not ready to be use just yet, a series of treatment must be done before it's being use by human for safety reason.

When all the water are treated, then it's ready to deliver to the people via the water distribution system, which is a network of piping running underground where it channel the water from storage tanks to residential areas, commercial blocks, agriculture or industrial areas. The system can be further categories into 3 smaller systems, which are gravity system, direct pumped system and gravity and direct pumped system.

In Kuala Lumpur, the water supply system is under the care of Syarikat Bekalan Air Selangor Sdn Bhd (SYABAS) which was incorporated on 8th July 1996 under the Malaysian Companies Act, 1965 to undertake the privatisation of water supply services in the State of Selangor and the Federal Territories of Kuala Lumpur and Putrajaya.

2.2 Introduction

This part of research paper is to study the water distribution system starting from the main source, in this case is the PUAS(Perbadanan Urus Air Selangor Berhad (Malaysia) under SYABAS, until our case study building KLPAC(Kuala Lumpur Performing Art Centre).

The investigation carried out is to study and understand how and where does the fresh water come from, then from the storage tank, how does the water is delivered to every floors of the building for drinking, plumbing and etc.

In KLPAC, pressure water service system is used to transfer the water to upper floors from storage tank located underground. This system operating with the aid of hydropneumatic pumping system that pump the water directly to distribution pipe in the building without going through the internal storage tank.

2.3 Finding and analysis

2.3.1 External Water Distribution System

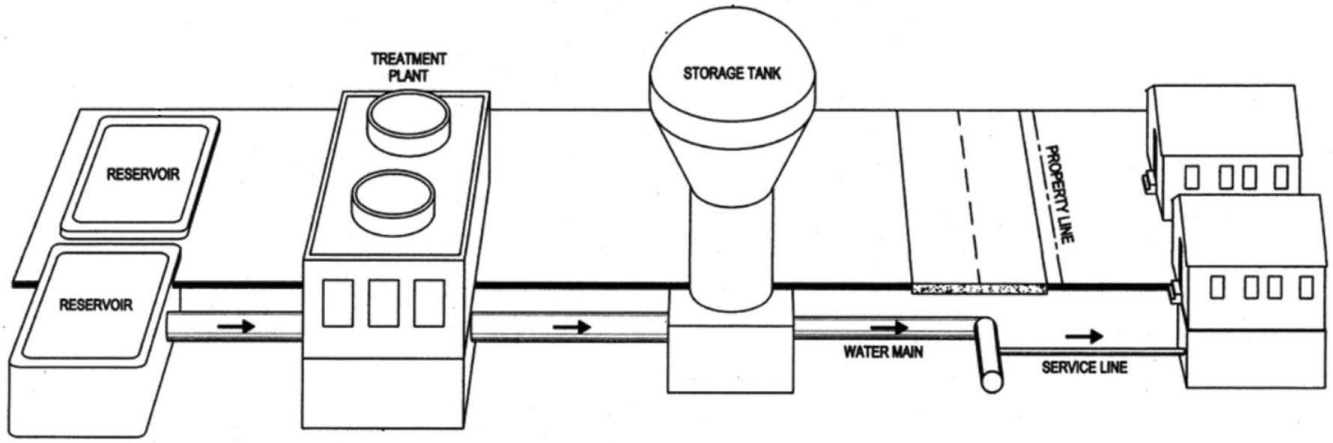


Diagram 2.3.1.1 This diagram show how fresh water reaches consumers.

In general, fresh water will be transfer to the consumers through water distribution system as below:

a) The gravity system. The water storage tank is located at high ground, so that the water can be distribute to service areas with the help of gravitational pull. This system is normally preferable by most for its low operational costs.

b) The pumped and gravity combination system. In this case, the water resources are located at lower ground, the water collected will be pump to water storage tank which its location is higher than service area so that once again water can be distribute to consumer without any aids of mechanical system at this stage.

c) The direct pump system. This is the least favorable system because the operational cost is so much higher than the previous 2 but however, we do need this system as some of the residential areas are in high ground such as hilltop. The water will be travel and be pump under high pressure to go against the gravity to reach consumers.

Water treatment and supply

In Malaysia, fresh water supply is under the care of SYABAS. They are responsible in delivering fresh water to the consumers. The very first step of water distribution is to collect water. The water resource will either be rainwater, underground water or from rivers and lakes. Then, the water will be store in reservoir for before it goes to treatment plant. Water treatment is crucial as the water collected is not ready for use just yet as it might contain unwanted compound such as chemicals that kill, contaminants or viruses. In order to deal with this, water is send to treatment plant to remove all these compounds mentioned above. Firstly, coagulation has to be done to remove the dirt particles from the water. Coagulants are added to water in this stage so that the heavy particles in water will stick together and form large clumps. Then, water is allowed to settle in a tank and the heavy particles will sink to the bottom through sedimentation. These particles are then scraped away to be used as fertilizer. After that, water will go through filtration plant to be filtered through layers of fine granulated materials. As the unwanted compounds are removed, turbidity diminishes and clear water emerges. Disinfection will come next to kill the germs. To protect against any bacteria, viruses and microbes that might remain, disinfectant is added before the water is channel to the storage tank. The pH value is maintained by adding substances to reduce corrosion in the distribution system. Lastly, in storage tank, the water is already safe to be use and it’s ready to be distribute to the people through water main pipes and communication pipes.

2.3.2 Water Supply System In KLPAC

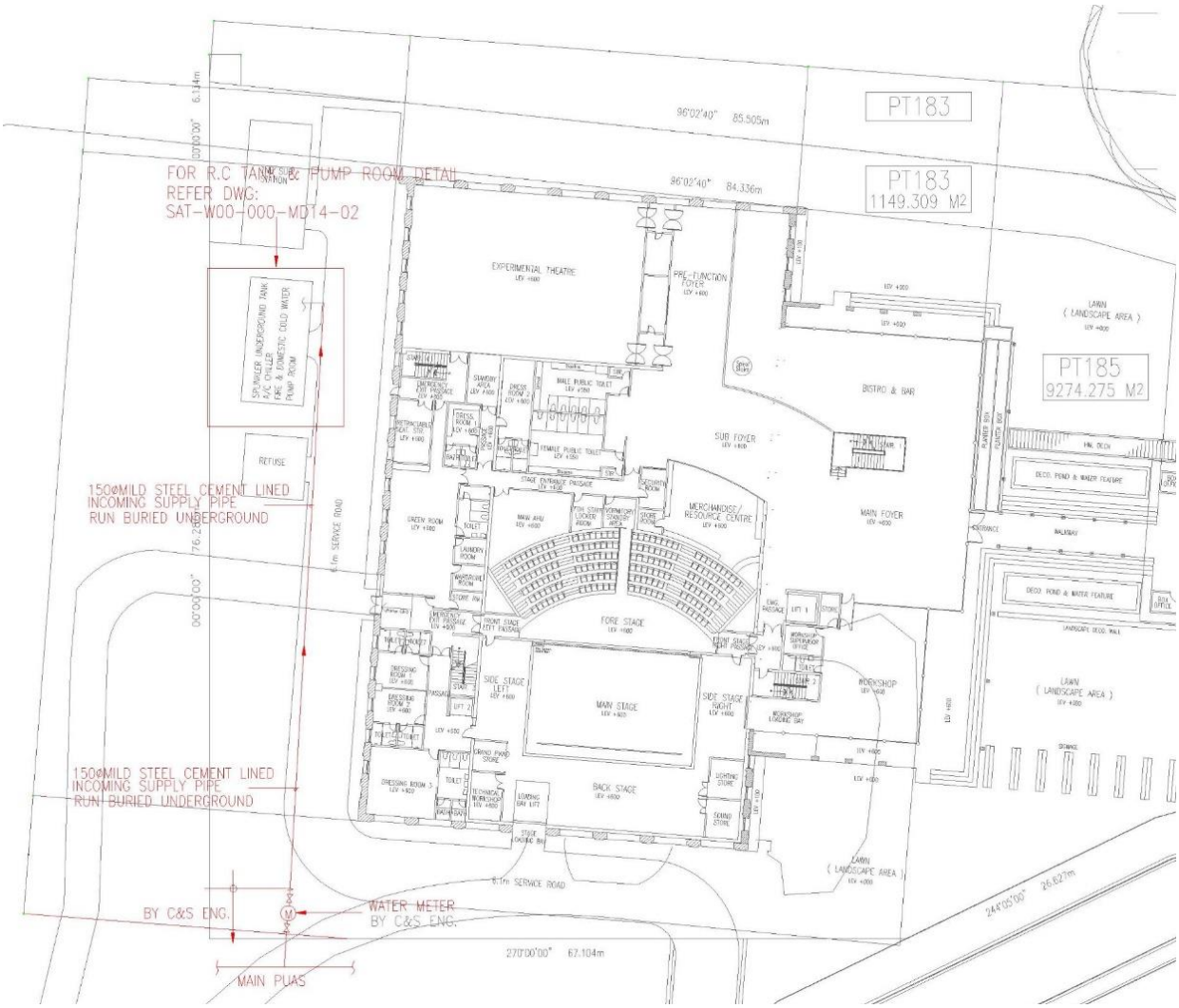


Diagram 2.3.2.1 Site plan of KLPAC. This diagram shows how water distribution from PUAS to KLPAC's RC domestic storage tank.

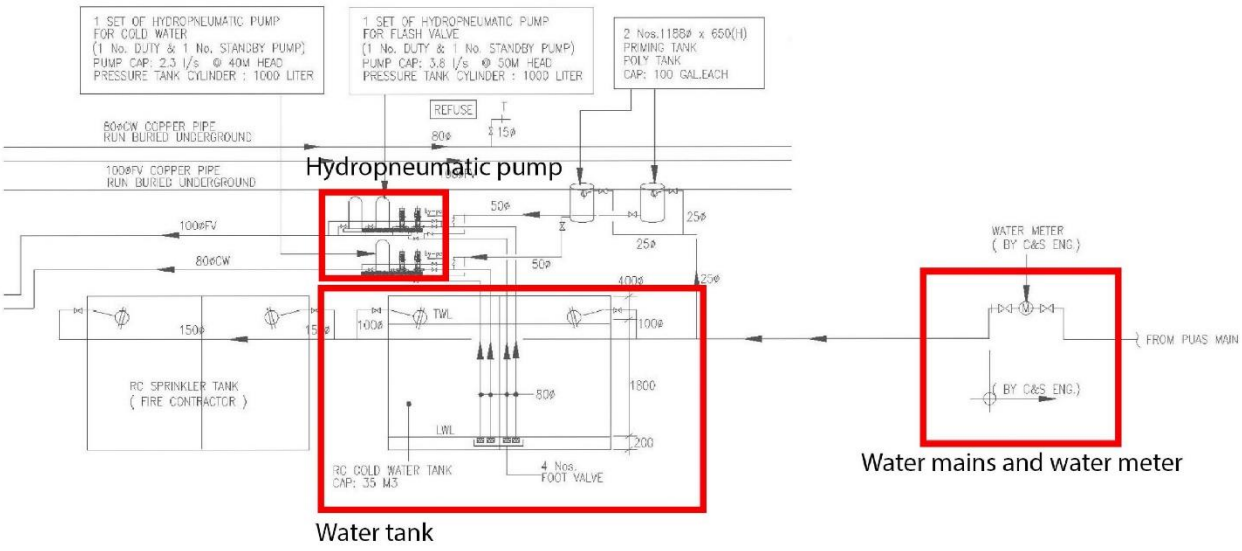
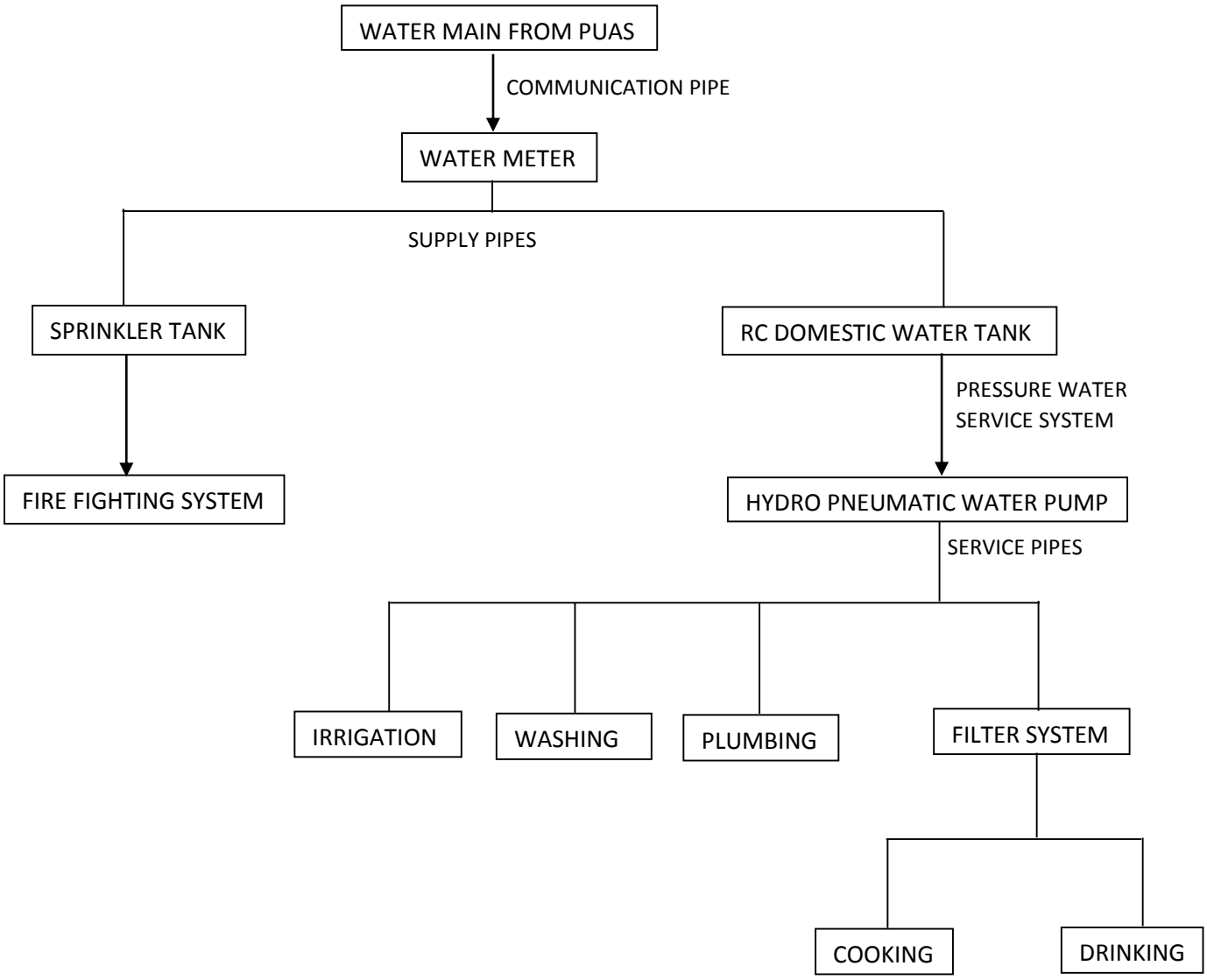


Diagram 2.3.2.2 Showing Hydropneumatic pump

In KLPAC, pressure water service system is used to distribute water among the building. The water from PUAS will directly go to the RC domestic water tank located outside of the building. The water tank is located underground so a pumping system is needed to channel the water to upper floor of KLPAC. In our case, which is in KLPAC, they use hydropneumatic system to pump the water from underground to upper level. From the studies we got, the reason why they don't have a water tank in a ceiling could be because of the KLPAC's theaters have to be high enough for certain purposes, so no way they can have a ceiling where water tank is located.

Before the water reaches the inside of the building, it has to pass through the water meter, then from the communication pipe to the water tank. Then, water in the reinforced concrete domestic water tank will to be pump to upper floors through the service pipes.

2.3.2.1 Water distribution of KLPAC



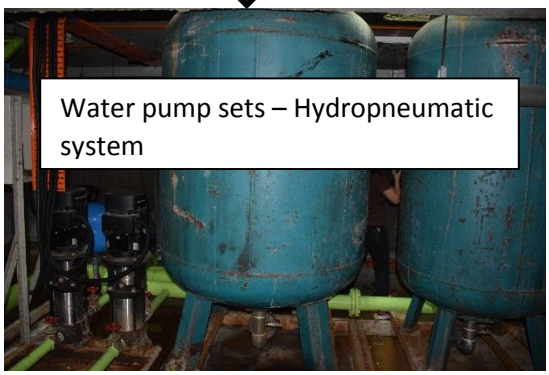
Water distribution from external to internal

Main water supply from PUAS

For internal use

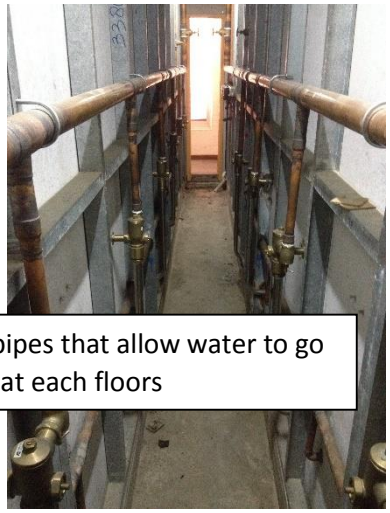
For fire fighting system

RC Domestic Water Tank



Water pump sets – Hydropneumatic system

Last destination of water – toilets, kitchen and etc



Service pipes that allow water to go through at each floors

Pipes rise above from water

Components along the water distribution system

Globe valve - to be use when we can't turn off the water supply using the internal stop valve, or when need to repair a leak on supply pipe

Strainer - a type of perforated metal sieve used to strain or filter out solid debris in the water system. Different varieties are used in residential premises and for industrial or commercial applications.

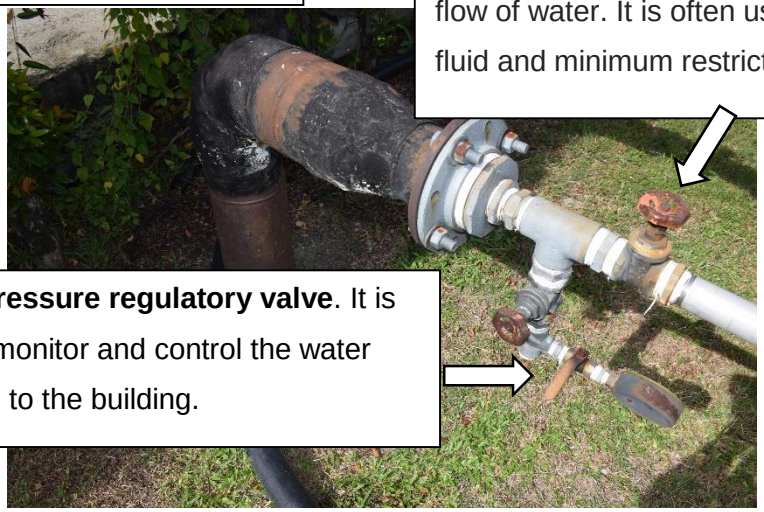
Water meter for fire fighting system

Water meter for the internal water usage

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.

Communicating pipes for KLPAC

G**ate valve**, also known as a **sluice valve**, is a valve that are primarily used to permit or prevent the flow of water. It is often used when a straight-line flow of fluid and minimum restriction is desired.



Water pressure regulatory valve. It is used to monitor and control the water pressure to the building.

Globe valve details

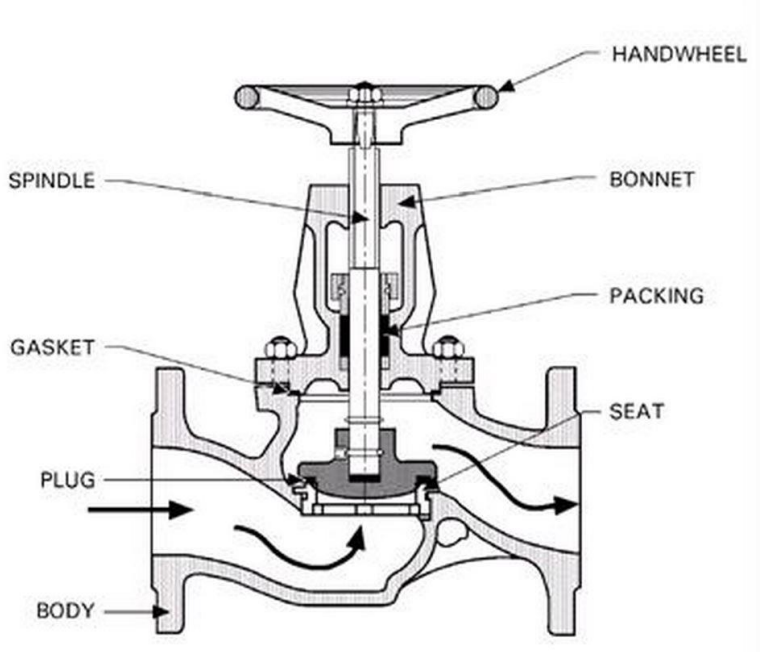
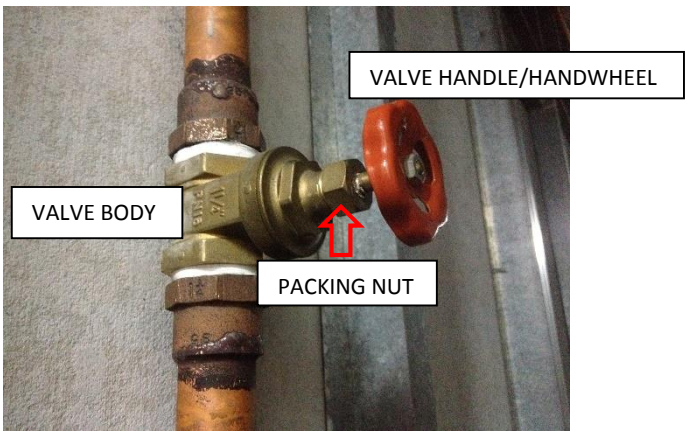
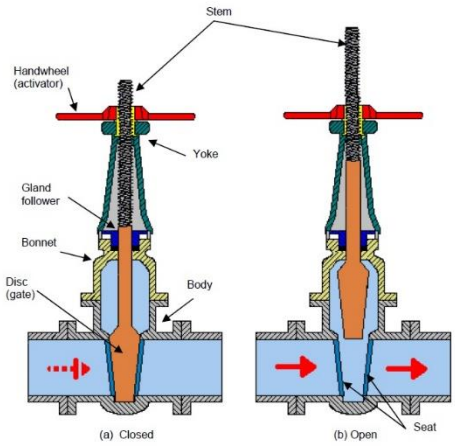


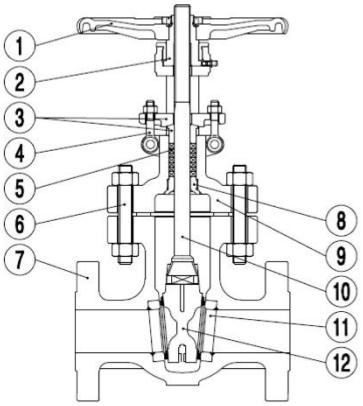
Diagram 2.3.2.1.1 Section drawing of globe valve.

Globe valve, normally known as stop valve, is used to regulate the flow of water in pipelines. This valve can be operated in any position, from the fully closed position to fully opened position. The valve operates by raising and lowering the valve disc(the plug) into a circular seat. There is no contact between the seat and disc ends when the flow through the valve starts. There are partitions inside a globe valve, making sure the fluid flowing through make two 90 degree turns. The flow is “under and over” to prevent wear to the seat. Therefore, there is a high pressure drop in the valve, resulting o the ease in controlling this flow.

Gate Valve Detail







IT.	DESCRIPTION
1	HANDWHEEL
2	YOKE SLEEVE
3	GLAND FLANGE
4	GLAND EYE BOLT
5	PACKING
6	BONNET BOLT
7	BODY
8	BONNET
9	BACK SEAT
10	STEM
11	SEAT RING
12	WEDGE

Diagram 2.3.2.1.2 (A), (b) & (c) Globe valve details

Gate valve utilize a moveable gate to prevent or allow flow of water. In most cases the gate is raised or lowered using a mechanical assist – generally a threaded screw. Flow is initiated by raising the gate while preventing by lowering the gate as shown as the diagram above.

2.3.3 Water piping system

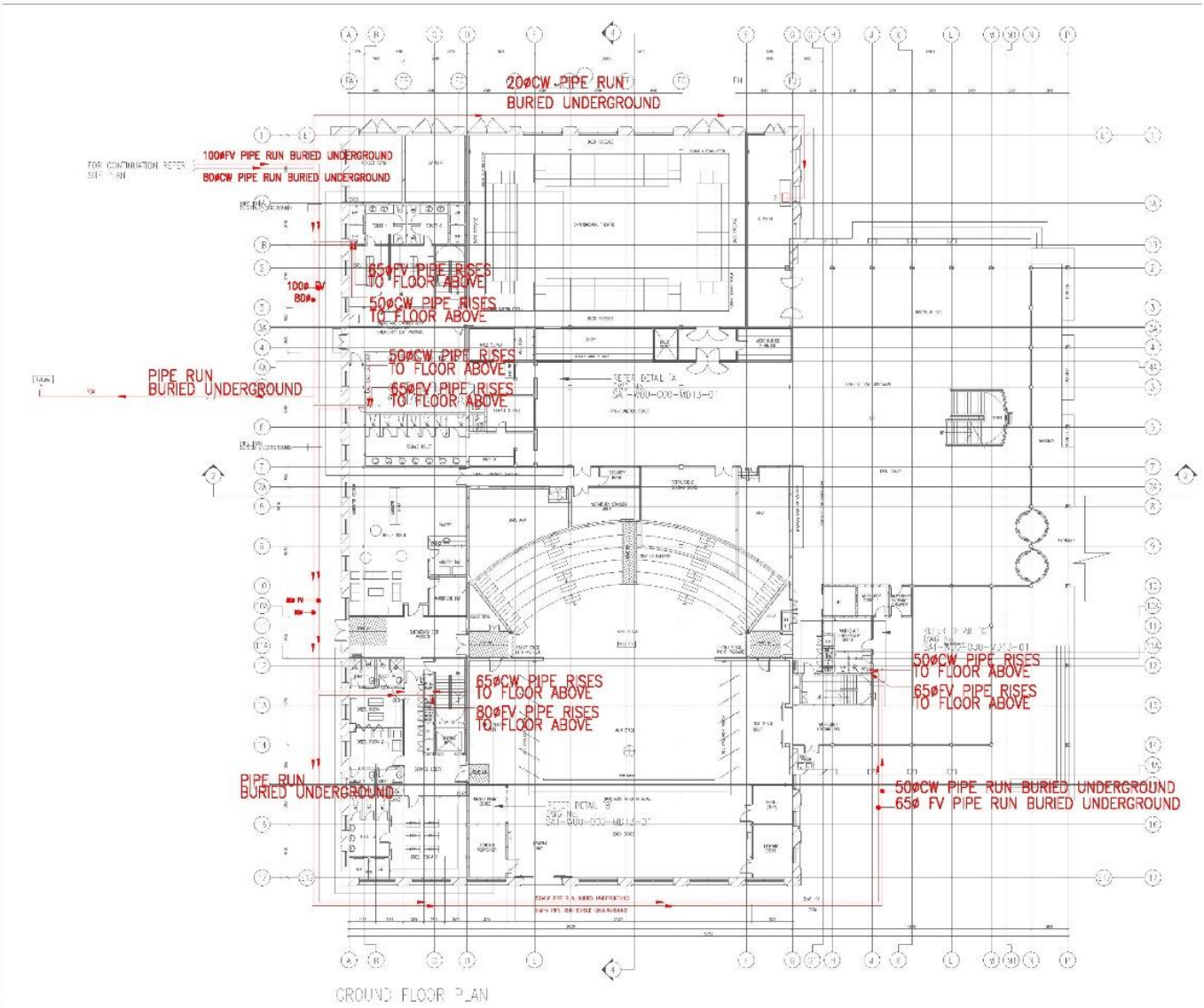


Diagram 2.3.3.1 Ground floor plan of KLPAC showing how the piping networks work.

From the plan above, we identify the location of pipes for cold water and water for fire fighting system that rise to upper floor.

2.3.3.1 Dimensions and Types of Pipes

Along the network of piping, pipes of different diameter are used to control the water pressure for different occasions. As we can see from the plan above, the pipes that serve the current floor level and kitchen will be smaller in diameter compared to the pipes rise to upper floor because the water to upper floor has to be travelling in higher water pressure because it go against gravity. In general, the pipes for fire fighting system are much larger in diameter as the water has to be in high pressure so that in case of there is fire, the water can be transfer faster under higher pressure and of course further away when it's shot from fire fighting hose.

The type of pipes used are different as well. By studying the floor plan given to us, we are able to identify the types and dimensions of pipes in KLPAC. At external areas of KLPAC, **steel cement lined incoming supply pipes** are used for supply water from PUAS to water tank. This kind of pipe is suitable to be use externally as it's resistance to corrosion and oxidizing agents such as ozone and chlorine, no tendency to incrustation which improves operational character of the pipeline, and also very high abrasion resistance allows high flow rate of fluids. For internal use, **copper pipes** are chose for service pipes due to its high stability which ensure the safety of consumers. Lastly, at water storage area, **cast iron pipes** are used because it's stable and well suited for high water pressure especially in where the water pump system is.

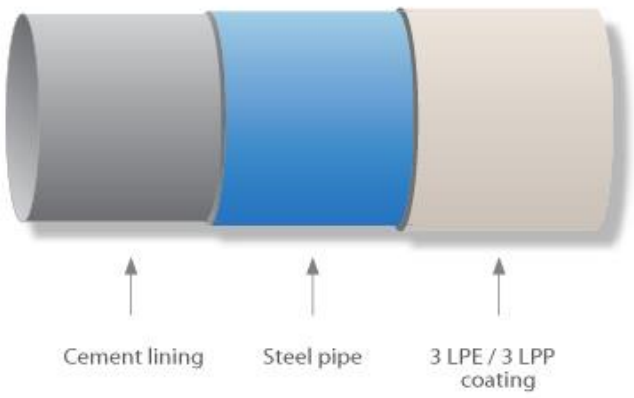
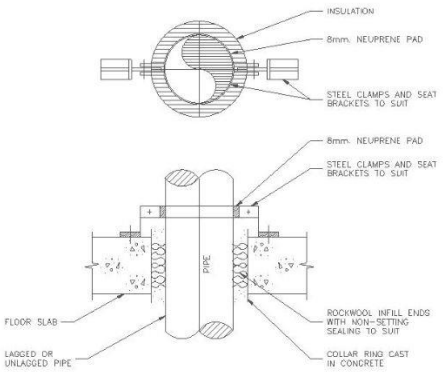


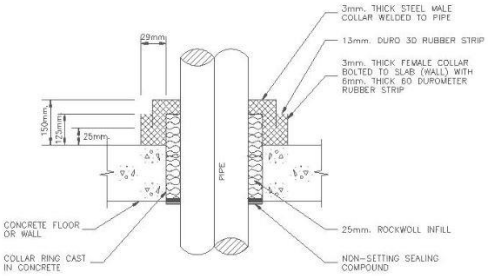
Figure 2.3.3.1.1 Detailing of steel cement lined pipes.

2.3.3.2 Piping Details

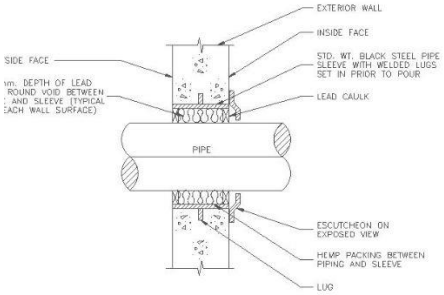
Pipes detailing of KLPAC - A



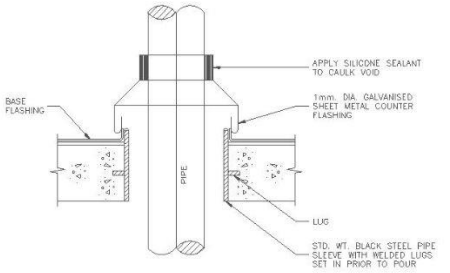
TYPICAL FLOOR/WALL PIPE PENETRATION DETAILS
N.T.S.



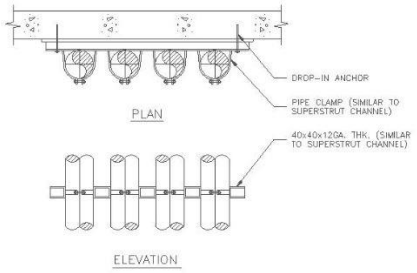
TYPICAL VERTICAL (OR HORIZONTAL) PIPE PENETRATION THROUGH CRITICAL AREA
N.T.S.



WATERPROOFED SLEEVES THROUGH EXTERIOR WALLS
N.T.S.

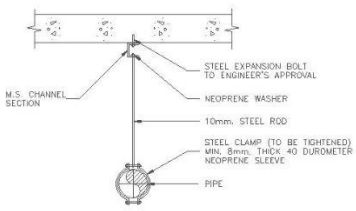


FLASHING OF PIPING & SLEEVES THROUGH ROOF
N.T.S.



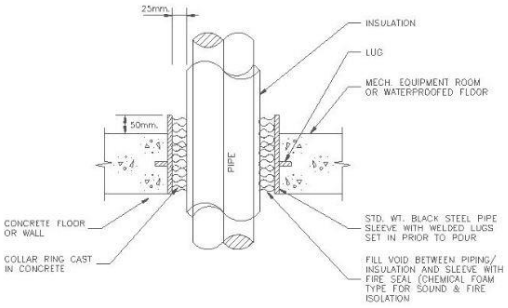
PIPE SIZE	SUPPORT CHANNEL	ANCHOR SIZE
20mm. TO 40mm.	40mm.x40mm.x12GA. THK.	10mm.
50mm. TO 150mm.	40mm.x40mm.x12GA. THK.	12mm.

TYPICAL VERTICAL PIPE SUPPORT
N.T.S.

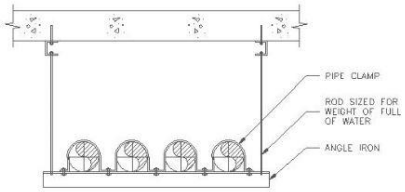


TYPICAL SINGLE PIPE HANGER DETAIL
N.T.S.

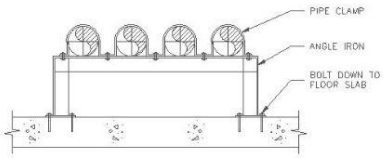
Pipes detailing for KLPAC – B



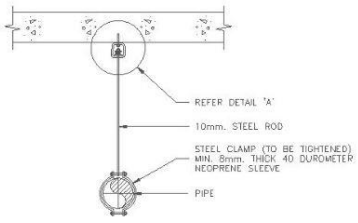
SLEEVES LOCATED IN MECH. EQUIPMENT ROOM FLOORS & SPECIFIED LOCATIONS FOR MEMBRANE, WATERPROOFED FLOORS (SUCH AS : KITCHENS, FOOD PREPARATION, CAR WASHING AREAS, ETC)
N.T.S.



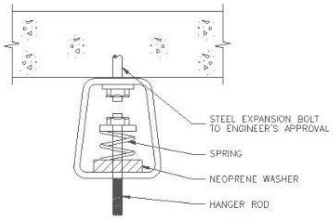
TYPICAL PIPE HANGER (MORE THAN ONE PIPE)
N.T.S.



TYPICAL HORIZONTAL PIPE SUPPORT AT ROOF LEVEL
N.T.S.



TYPICAL PIPE HANGER WITH SPRING ISOLATOR
N.T.S.



DETAIL 'A'
N.T.S.

2.3.4 Water Pumping System

Hydro Pneumatic system

This system is a water pumping system that are used in KLPAC. Hydropneumatic tank is part of the components where it contains pressurized air and water. It does not have a bladder and air is in direct contact with the water. The compressed air acts as a cushion exerting or absorbing pressure. Hydro pneumatic tank serves three main functions:

1. Delivers water within a selected pressure range so the well pump is not continuously running.
2. Prevents a pump from starting up every time there is a minor call for water from the distribution system.
3. Minimizes pressure surges (water hammer). Well pumps and booster pumps work with pressure tanks to maintain a consistent pressure range in the system.

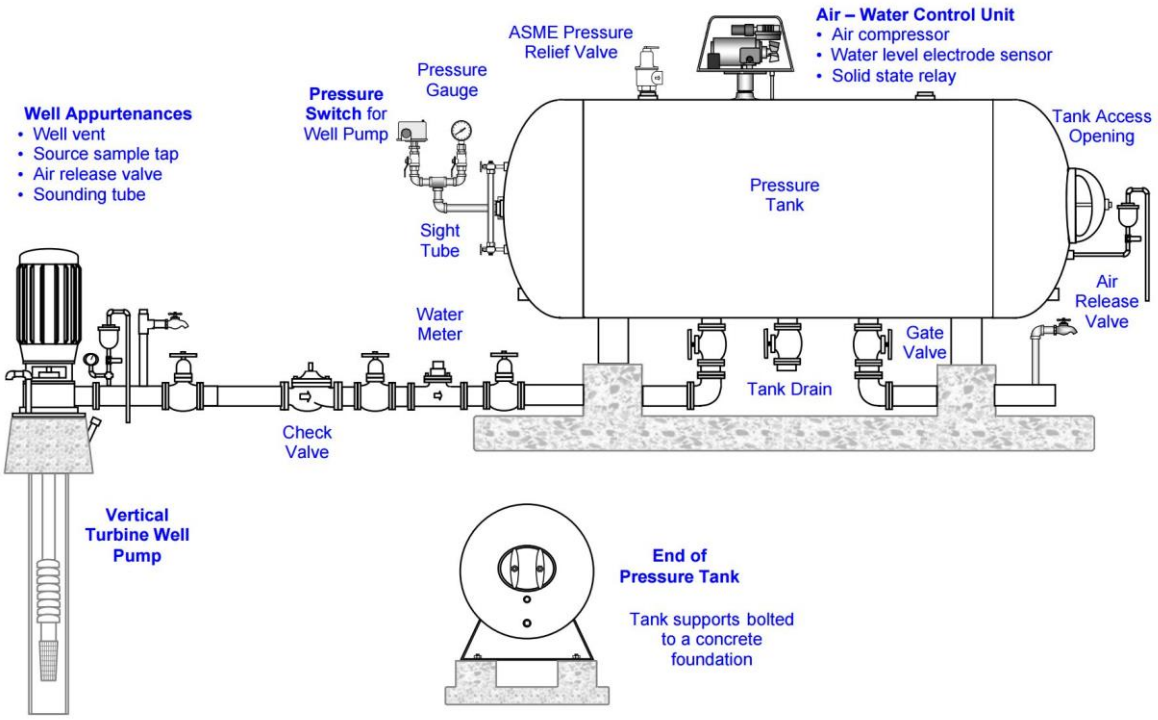
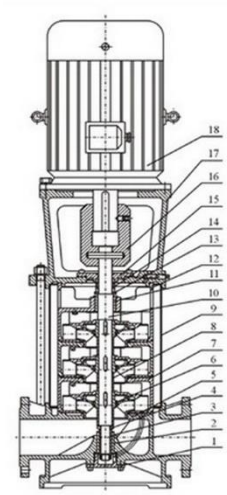


Diagram 2.3.4.1 General mechanism of hydro pneumatic tank control system.

The KLPAC's hydro booster sets consist of 2 grunfos CR Pumps that are identical to each other that mounted on a common base frame, together with a control cabinet with motor protection and integrated controller. These pumps operate automatically according to the demand by means of pressure switches. This hydro booster set come with suction and discharge manifolds, isolating valves, pressure gauge and pressure switches to maintain the water pressure at optimum level.

Vertical Booster Pump

Figure 2.3.4.1 Vertical Booster Pump



NO.	Names of Parts	NO.	Names of Parts
1	Bottom Cover Plate	10	Pump Shaft
2	Lower Bearing	11	Upper Bearing
3	Shaft Sleeve	12	Discharge Casing
4	Lower Bearing Pad	13	Mechanical Seal Gasket
5	Suction and Discharge Casings	14	Mechanical Seal
6	Impeller	15	Sealing Gland
7	Stage Casing	16	Jackctcd Coupler
8	Impeller Retaining Ring	17	Pump Cover
9	Casing Pipe	18	Motor

Diagram 2.3.4.2 Mechanism for typical vertical turbine pump.

A specialized centrifugal pumps designed to move water from underground. The **vertical turbine pumps** have the motor located above ground, connected via a long vertical shaft to impellers at the bottom of the pump. These pumps are driven by AC electric induction motor. In some cases, under multi-stage configuration, a few impellers on the same shaft will be used to generate higher pressure.

Working principles of vertical booster pumps

When water enters the pump at the bottom through a bell-shaped part called the suction bell, the pump started to work. The water velocity will be raised when it moves into the first stage impeller. The water then enters the diffuser bowl immediately above the impeller, where this high velocity energy is converted into high pressure. This diffuser bowl will then allow the water to flow into the next impeller located immediately above the bowl, and this process continues through all of the stages of the pump.

The water passes through a long vertical column pipe as it rises up the well bore toward the surface after it leaves the last diffuser bowl. The spinning shaft inside this column is supported at three- or five-foot intervals with sleeve bushings that are mounted inside the column and lubricated by the water moving past them. The pump discharge head at the surface will direct the water towards the discharge pipe. A vertical high thrust A.C. motor is mounted above the discharge head in order to run the whole system.

Pressure tank

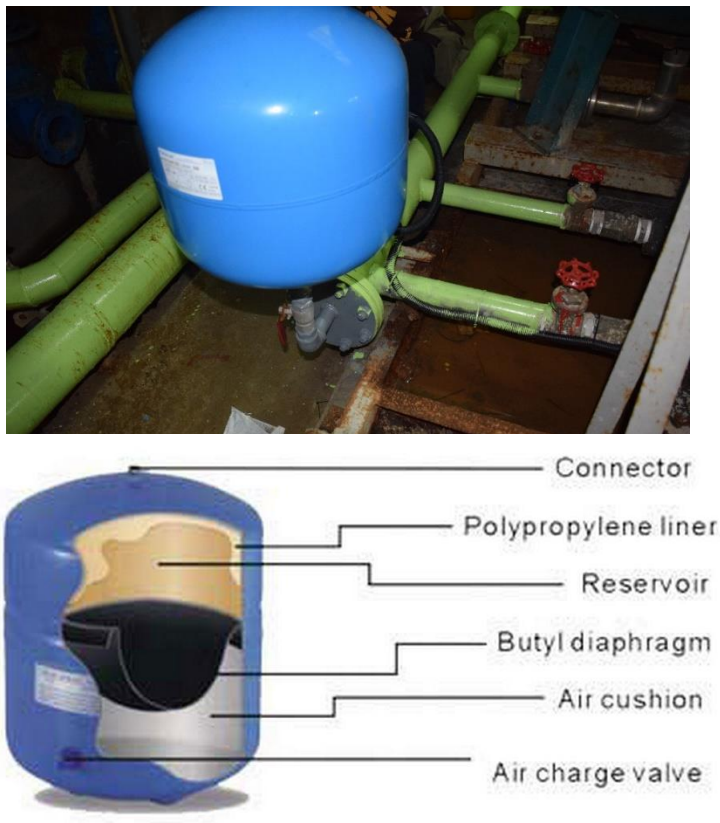


Figure 2.3.4.2 Section of pressure tank showing the mechanism.

Pressurized water that are ready to be distribute to different areas were stored in this pressurized tank. The tanks operate by using drops in pressure below a certain point to activate the pumps which replenish the water and raise the pressure. The pumps lifespan can be elongated by using a pressurized tank because they allow them to run when they are needed verses staying on. The tank allows water to be drawn from the system without the need for the pump to cycle on and off each time the water is turned on. This cuts down the on and off cycles on wear and tear and hence, prolongs the pump's life.

Other components in hydro pneumatic system

Water pressure control cabinet. This is to manually shut down or operate the pumping system in case of failure.

Water pressure regulator valve. This valve is used to reduce the high incoming water pressure to a lower, more functional water pressure for distribution inside the building.

2.3.5 Water Storage System

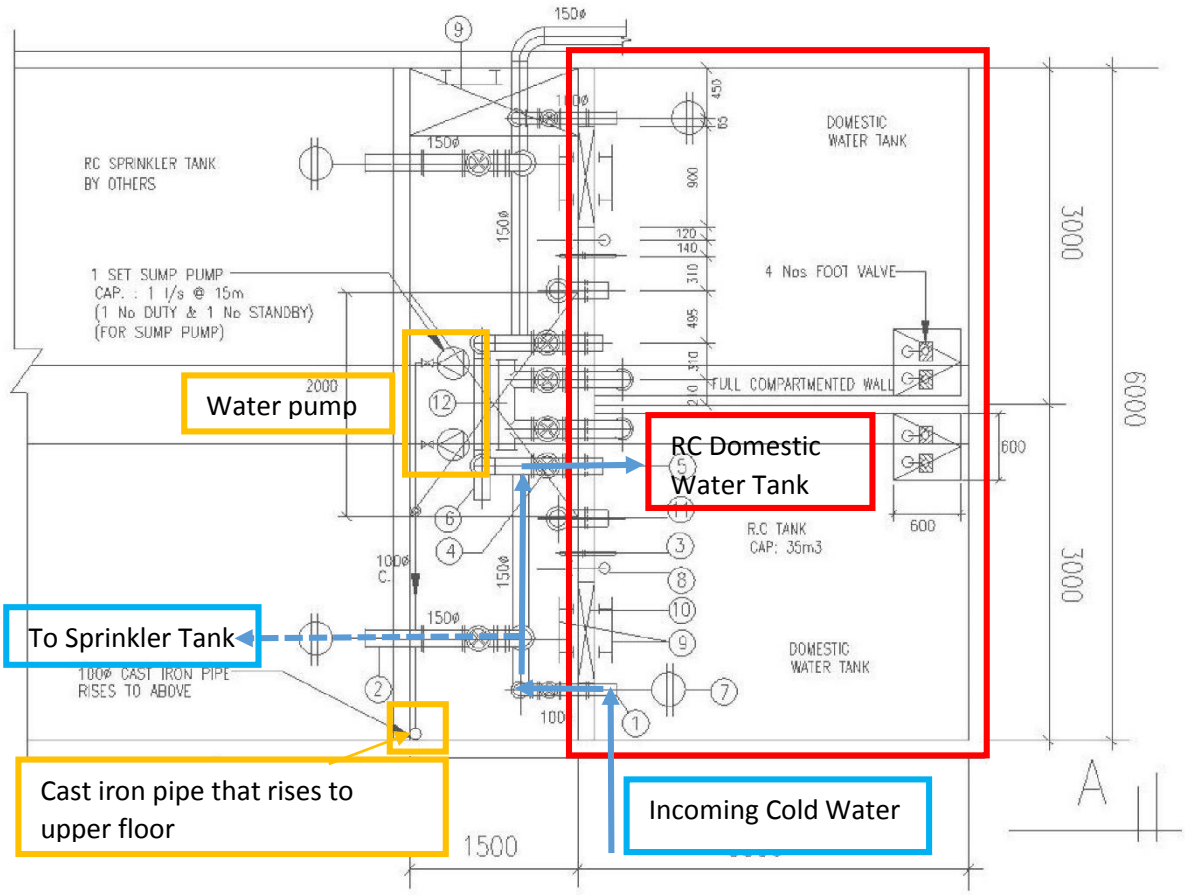


Diagram 2.3.5.1 Water Tank Plan View

Water supply will first come to the water storage station before it goes to consumer for flushing, cleaning or cooking. The incoming cold water will distribute accordingly to sprinkle tank and domestic water tank. Then, from domestic water tank, the water will be channel to water pump to be pump to upper floor.

Components around RC domestic water tank

The **scour pipes** are used to flush out sediments or release water. This temporary water storage is made to deal with overflow. In case of overflow, the water will be release here and the water pumps inside will pump the water for other usage. According to the maintenance, they used the overflowed water for landscaping.

The pipes that channel the cold water to the inside of the building.

Overflow pipes

Figure 2.3.5.1 Overflow Pipes

These overflow pipes are also called warning pipes and the end must be placed where any discharge can be seen clearly. In case of overflow, the water will flow out automatically as there is no float valve that is controlling the overflow system. If there is an emergency and the water must be release then scour pipes will be used instead. Releasing the scour pipes valve work the same as overflow pipes but it release water from bottom of the tank.

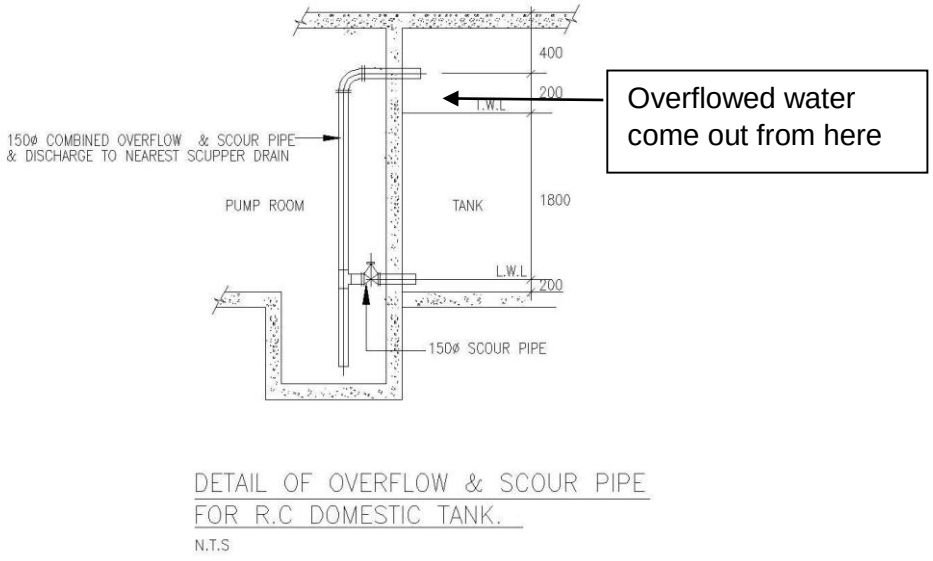


Diagram 2.3.5.2 Detail section drawing of overflow pipes.

Inspection hole

Figure 2.3.5.2 Inspection Hole

Inspection hole for the RC domestic tank. This inspection hole is used to check whether the water is safe to be use or not if there is a case of water contamination. In case of there is any leakage or contamination, the water inside will be drained and the repairing work could be done by entering from this hole. The inspections have to be carry out once in a while to assure that the tank's physical integrity, water quality, and security are in compliance.

2.4 Conclusion

In conclusion, the cold water supply system in KLPAC can be said that it's completed. The water distribution used in KLPAC consists of R.C domestic water tank where it can be temporarily use as a water supply in case of water shortage. In addition, the pressure of water supply from main is low, so to cope with this problem, KLPAC has prepared a hydro pneumatic water pump system to pump the water to the entire building through supply pipes. Most importantly, the overall maintenance of the water supply system in KLPAC is considered great as they have the water distribution system running under a very systematic way to ensure the water supply is smooth and safe to be use every time.

Suggestion for improvement:

The water distribution system used in KLPAC can be somehow improve by having another water storage tank on roof top area as this tank can be used for another back-up water supply beside the domestic tank located underground. This means that KLPAC can have more water supply to spare when having both water storage at roof top and underground in case of serious water shortage. Another solid reason to have another water storage tank at roof top is that the water from domestic tank can be pump all the way to this tank and then distribute to entire building in one go. This kind of water distribution can save more energy as the water distribution from water storage at roof top to the entire building is driven by gravitational pull, so more energy can be saved.

3.0 ELECTRICAL SUPPLY SYSTEM

3.1 Literature Review

3.1.1 Power Transmission System

Kuala Lumpur Performing Art Centre is located at Jalan Strachan, Sentul, Kuala Lumpur. This building was established on 4th of May, 2004. It provides event halls which serves as performance center, studio room for practice uses and an Indicine.

The building needed a huge amount of electricity to run all of the electrical services for the performances. Electricity are mostly use for lighting system, air conditioning, mechanical transport such as elevators, fire alarm system and appliances. All of the electricity are provided by Tenaga National Berhad. Electricity travels in closed circuits. It must have a complete path from the power station through wires and back. Transfomer will steps up voltage for transmission and the transmission will step down the voltage to all of the pole in living area and the pole will step down the voltage again for all uses in housing area.

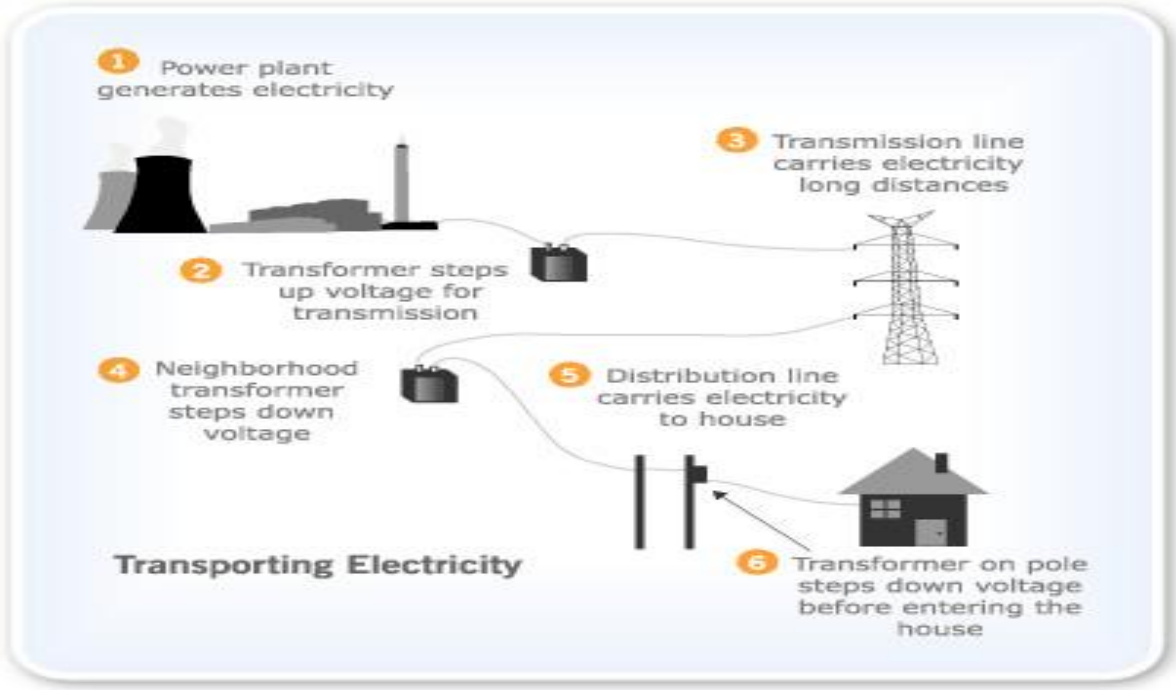


Figure 3.1.1.1 Power Transmission System

3.1.2 Electrical Components

Electrical supply system is divide into two, off-site power system and on-site power system. On-site power system contains normal power sources such as transformer, auxiliary power supply, cables and emergency power supply (generator). The power system consist of the grid, generators, transmission and distribution systems.

Electrical supply from TNB is firstly distribute to the main switch room of a building. Then the main switch room will distribute the electricity to all of the distribution board room on each floor of the building for all kind of uses. Generators room can usually be found in private buildings, they are used to store electricity for emergency uses.

3.2 Introduction

Electricity is s set of physical phenomena associated with the presence and flow of electric charge. Electricity gives a wide variety of well-known effects such as lighting, static electricity and electric current.

Electricity is a very important component which used in almost every services in a building It provides electrical supply to parts such as lighting, air conditioning, communication equipment, mechanical transport system and fire alarm system. A building must consists of an emergency storage of electricity because electricity is very crucial for a building and will paralyze a facility.

3.3 Finding and Analysis

Kl Performing Art Centre receives its electricity supply directly from the TNB Substation. Electricity is receive by the main switch room 1 and 2 and sent to all of the distribution board room at each floor. The transmission voltage in Malaysia are 500kv, 275 kv, 132 kv and the distribution voltages are 33kv, 11kv and 400/230v which is usually used in residential buildings.

3.3.1 Main Switch Room

The main switch room is usually located at an easy access area for TNB for maintenance or repairing purpose. In KL PAC, the main switch room is located on the ground floor beside the main building. It is usually protected with a wire screen enclosure and necessary sign of danger outside the main switch room.

The switch gear located in the main switch room is in charge of regulating the flow of electricity in the whole electrical system in the building. The switch gear also function for emergency stopping or switching for maintenance purposes. Emergency switching is used when there is a power failure. The switch gear will run the backup electricity from the generators of the building.

The electricity reaches the switch gear in main switch room before it is sent to the transformer. A step down transformer will be located in the main switch room and it will step down the current before it was transferred to the distributed board room for all kind of uses.

Switch gear room require to have circuit breakers. This is because it will act as a protective device to protect the fuse and switch. It allows the circuit to be close or open easily. This helps to prevent overflow of electricity and short circuit by cutting off the power immediately. The floor of the main switch room are covered with sands in order to prevent users from directly electric shock if there is any electrical leakage.

Figure 3.3.1.1 Components in main switch room

3.3.2 Wiring system and raceways

Various types of wire can be use for electricity transfer. They are usually made of copper or aluminum. Electricity provided are carried through these wires which are covered by raceways. Raceways are made up of insulators to prevent electric shock. They are also act as a casing and protection for the wiring system. They are usually mounted on the ceiling. Some buildings use them as decoration too. For KL Pac, the casing for wiring system is orange color, this makes them to be easier to differentiate with other pipe casings.

Figure 2.3.2 Raceway in KLPAC

3.3.3 Distribution Board Room

Distribution board (also known as panel board or breaker panel) is a component of an electricity supply system which divides an electrical power feed into subsidiary circuits, while providing a protective fuse or circuit breaker for each circuit in a common enclosure. Distribution board room are located at each floor of the building. Its purpose is to distribute the electricity provided by main switch room to all electrical equipment. Switch gear are also located in the distribution board room.

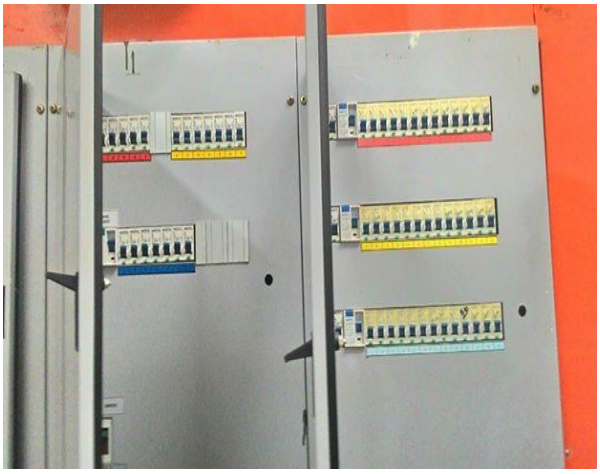


Figure 2.3.3 Switch board in DB room

3.3.4 Generator Set Room

Generator act as a container to store electricity for emergency use when there is an electrical failure in the building. The generator set room is located beside the main switch room. This is to prevent electricity loss and increase efficiency. The generator will automatically run when there is any power failures. For KL PAC, the generator was capable to use for only two days for normal electricity usage, it can't afford to be use for any performance or function. The generator set will have maintenance work every month.

Figure 3.3.4.1 Generator Set in KLPAC

3.3.5 Swithces

Switces are used as a controller for all of the electricity in the building. There are many swtiches in KL PAC which the most important switch is the switches inside the main switch room. The swithces in main switch room act as a safety mechanism if any short circuit or electrical failure occurs, it can shut down all the system by cutting off the electricity immeidiately.

Figure 3.3.5.1 Type of Swiches used i KLPAC

Figure 3.3.5.2 Type of Swiches used i KL PAC

3.3.6 Fuse

Fuse is a mechanism which control the amount of electricity flow in the whole circuit. Fuse can act as an emergency switch to cut down the electricity if there are any overflow or electrical leakage and overheating in the circuit. There are always fuse in the switch board to prevent any electrical leakage that will cause serious accident.

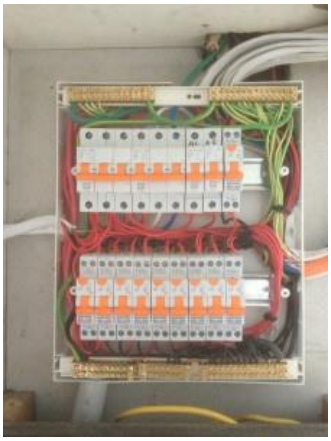


Figure 3.3.6.1 Example of Fuse

Figure 3.3.6.2 Fuse used in KLPAC

3.3.7 Lightings

The lightings provided there are mainly for normal usage and for performance. The requirement of lighting system in the buildings are highly required because there are many performance and function having at KL Pac. All of the electricity of lighthings are supply by main switch room to all distribution board room at each floor and then to the lightings system on each floor.

Figure 3.3.7.1 Lighting in main lobby of KLPAC

Figure 3.3.7.2 Lightings in studio room of KLPAC

3.4 Conclusion

Electrical supply system of any building is complicated and need to be well maintained. The arrangement of the system is also an important issue. For KL PAC, the organization of electrical supply system are well thought and the maintenance of whole system are well done to ensure the system to function correctly for daily activities of KL PAC. A smooth electrical supply system is needed to run all kind of activities in every building.

Being able to visit the electrical supply system of KL PAC, I gained better knowledge on electrical system and how the specific system or component function. In order to have a good electrical supply system, the architects and engineers in charge must follow the rules and regulations set by the Uniform Building By-Law (UBBL).

4.0 SEWERAGE, SANITARY AND DRAINAGE SYSTEM

4.1 Introduction

Sanitary and sewage system plays an important role in every building as it determines the quality of life enjoyed by a community. It helps in the removal of excreta, and household sullage (domestic wastes) through a pipe or sewer network which we called drainage system and finally comes to a treatment works or a disposal point before discharging back to the rivers. This system usually operates based on by gravity due to the slope of the pipe which reduces the high cost required for pumping.

However, the system must be functioning well because the improper functioning of this system will lead to pollution and contamination of various aspects in our surrounding which affect human health and life. For your information, sewage and wastewater contain bacteria, fungi, parasites, and viruses that can cause various diseases such as diarrhoea, fever, coughing and most seriously will lead to infection of lung and even liver disease. Therefore, regular maintenance has to be done to the existing sewerage system and appropriate design have to be used to the new sewerage systems to ensure the whole systems are always in good condition.

In Malaysia, sewerage system consists of public sewerage systems and private on-site system (individual septic tank). Indah Water Konsortium (IWK) is responsible for the former, while the latter will be by others, e.g. developers or the owner of the facilities. IWK not only provide services and maintenance to the public sewage treatment plants and all the underground pipes, but also provide desludging services to the individual septic tank. In short, there are two types of pipe which public pipe is under responsibility of IWK and the private pipe is under individual responsibility. Note that any services needed for private pipes by IWK have to be charged.

4.2 Literature Review

4.2.1 Transportation of Sewage/ Wastewater

Sewage is usually transported through sewer pipes which then connected to the sewer mains. These sewer mains can be differentiated to small and large sewer mains which the former usually made of clay, concrete, or asbestos cement while the latter are made of reinforced concrete construction. The large sewer mains can be located about 1.8m deep or more than that along the centerline of a street or pathway.

The flow of wastewater is countered with the water-supply system which our daily water supply to the building is transported by the application of pressure while the wastewater from each building is flowing through sewer pipes by means of gravity. Therefore, the sewer pipe must lay on slope surface to allow the wastewater to flow at a velocity of at least 0.8m/s and not more than 4m/s. (MS1228:1991). If the wastewater flows at velocity lower than 0.8m/s, the solid material tends to settle in the pipe which will lead to blockage. After sewer mains, wastewater will be transferred either to wastewater treatment facility or discharged back to the river depends on the system used in the area.

4.2.2 Types of Sewer System

Sewers can be classified into 2 categories, which are separated sewer and combined sewer while separated sewer can be further divided to 2 sub sewers which are sanitary sewers and storm sewers. The classification of sewers depends on the type of wastewater that each of it carries.

Sanitary sewers are designed to carry domestic wastes such as the waste water from cooking and washing and the wastes from toilets. It functions to serve houses, commercial and industrial sewage, by transferring those sewage from sanitary sewer line to main sewer and lastly to be sent to sewage treatment plant.

Storm sewers are designed to carry storm water from roofs, paved areas, pavements and roads with the help of gutter and catch basin. This type of sewer serves to transfer the storm water directly back to the river since they are not carriers of any infection which it is believed to not causing pollution. Storm water mains have similar structure as sanitary sewers but they have larger diameter than it.

Combined sewer is a combination of both sanitary and storm sewers in a single pipe system. This type of sewer is not suggested as it could cause serious water pollution due to CSOs (Combine Sewer Overflows). CSOs occur when the combined wastewater is too full causing it to overflow to the river directly before having a proper depuration at wastewater treatment center. This problem usually occurs during raining season. Combined sewers usually made of brick or reinforced concrete as they carry higher loads than others pipe.

In Malaysia, most of the towns and cities used the separate sewer system, including the building we researched- KL Pac at Kuala Lumpur city center.

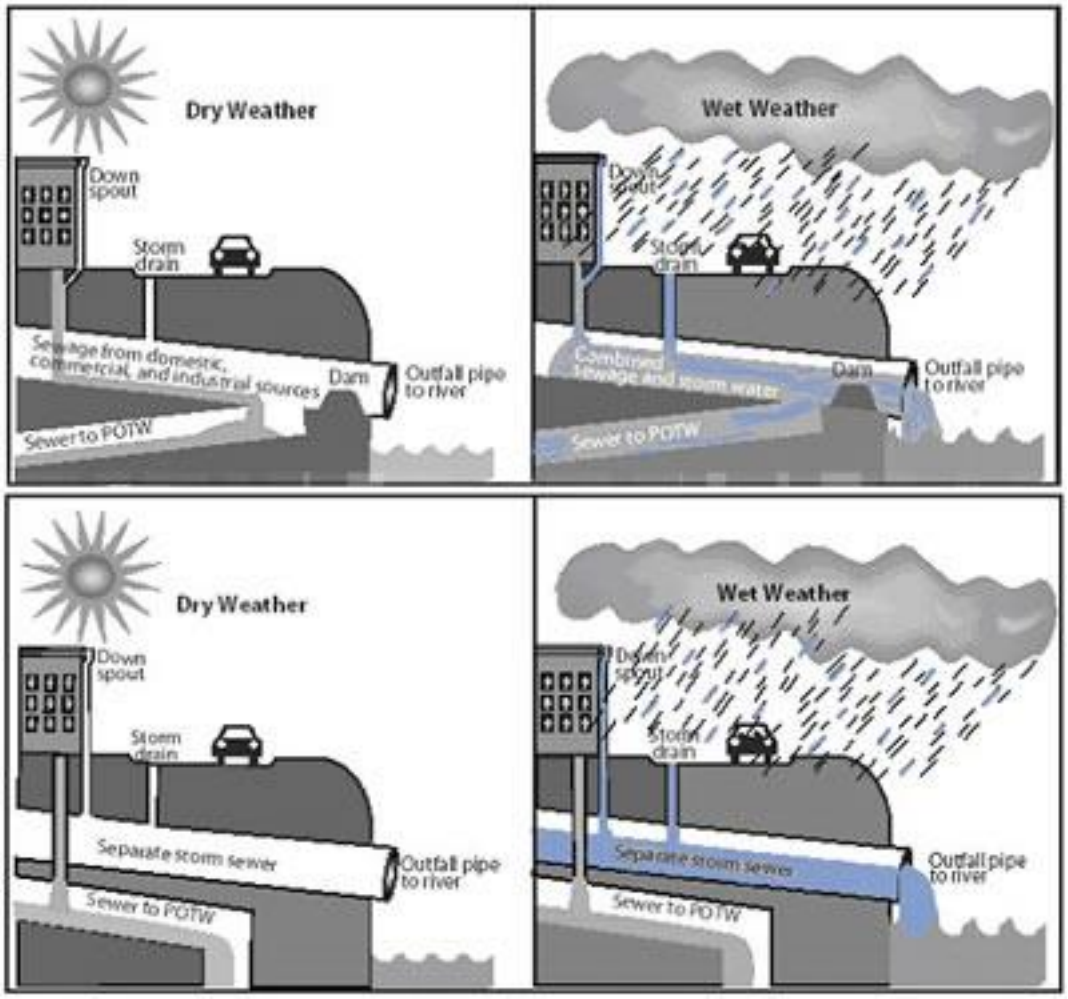


Figure 4.2.2.1 showing both Combined and Separated sewers

4.3 Case Study

4.3.1 Sanitary Appliances

Details of WC:

- Concealed cistern single flush valve, with button
- Includes seat, cover, fittings and wall frame
- Material: Vitreous China
- Colour: White

Figure 4.3.1.1.1 Wall Mounted WC at KL Pac

4.3.1.1 Water Closet

There are only one type of water closet (WC) that can be found in KL Pac, which is wall mounted water closet. This type of WC is commonly used in Malaysia although it's not economical, yet it's simple and efficient.

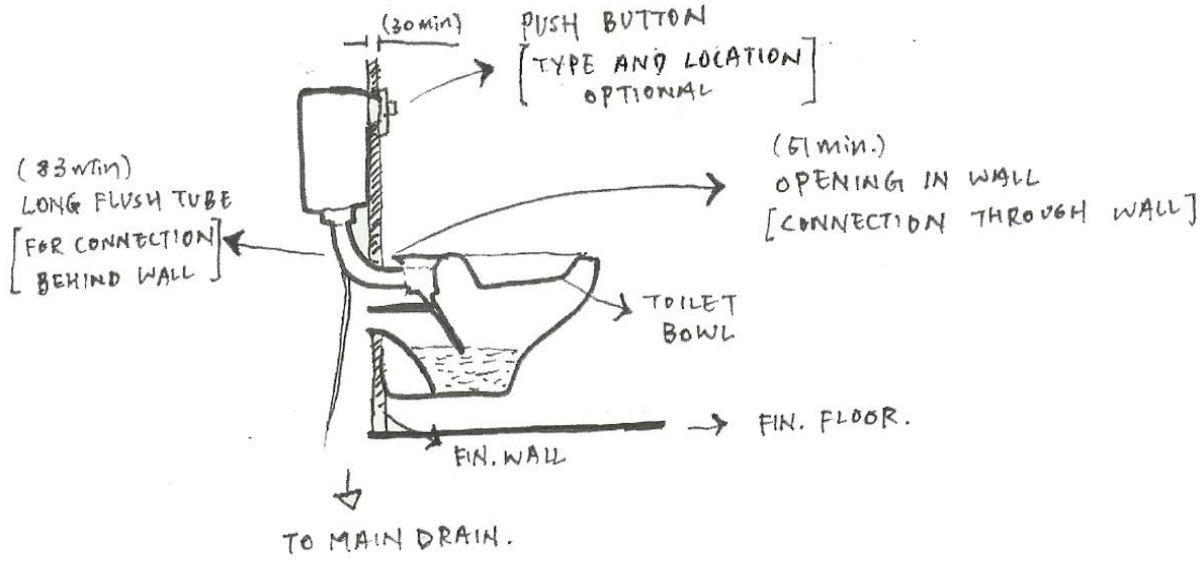


Diagram 4.3.1.1.1 Section Drawing of Wall Mounted WC at KL Pac

4.3.1.2 Urinals

Figure 4.3.1.2.1 Urinals at KL Pac

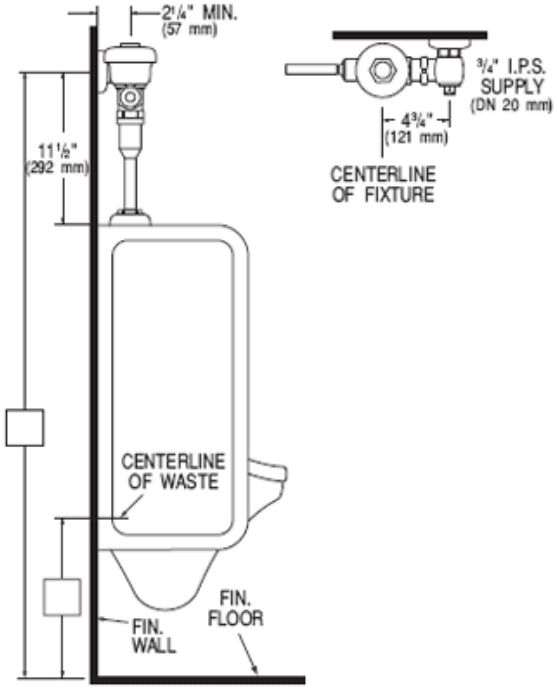


Figure 4.3.1.2.2 Typical Regal Flushometer Urinal

Urinals are usually found in male toilet and it is only for urination. It's installed usually in a large complex building like shopping mall or in a working area as to prevent washrooms crowded with people. In busy washrooms, compared with normal WC, its usage is faster because it has no room which there are no doors, and locks that will slow down the time of a people using it. Plus, it takes lesser space, simpler and consumes less water flush than a flush WC. For KL Pac, urinals are only installed in ground floor toilet as ground floor is an exhibition space that opened for public and urinals are needed for efficiency.

Urinals can be differentiated by its flushing system which there are several types such as manual handles, timed flush, door-regulated flush and automatic flush. From the photo, we know that KL Pac used manual handles for its urinals. Each urinals is equipped with a short level to activate the flush, with users expected to operate it when they leave. Such a directly controlled system is the most efficient system if compared to the others.

4.3.1.3 Wash Basins and Water Seal Trap


Figure 4.3.1.3.1 (a) & (b) Wash Basins and water seal trap taken in the washroom of KL Pac

A wash basin, also known as sink, is a plumbing fixture used for hand and dish washing or other purposes. It generally have taps that supply water and a drain below to remove used water.

The materials used for the sinks in KL Pac is concrete as for aesthetic purpose since they can be manufactured in a very wide range of shapes and colors. It's heavy and durable and they're resistant to hot and cold objects but they can be damaged by sharp impacts. Aggressive cleaning will dull the surface, leading it to more dirt accumulation.

From figure 4.3.1.3.1 (b), there are bottle traps below the wash basins which they function to provide a water seal between the drainage piping and the outlet of plumbing fixtures. The water seal is to prevent the backflow of odors, sewage gases and vermin from the sewer. Thus, it helps in maintaining the hygiene of the washroom and keeping it safe for users. If a plumbing fixtures has not been used for months, water inside the trap will evaporate, causing the foul gases to enter the room.

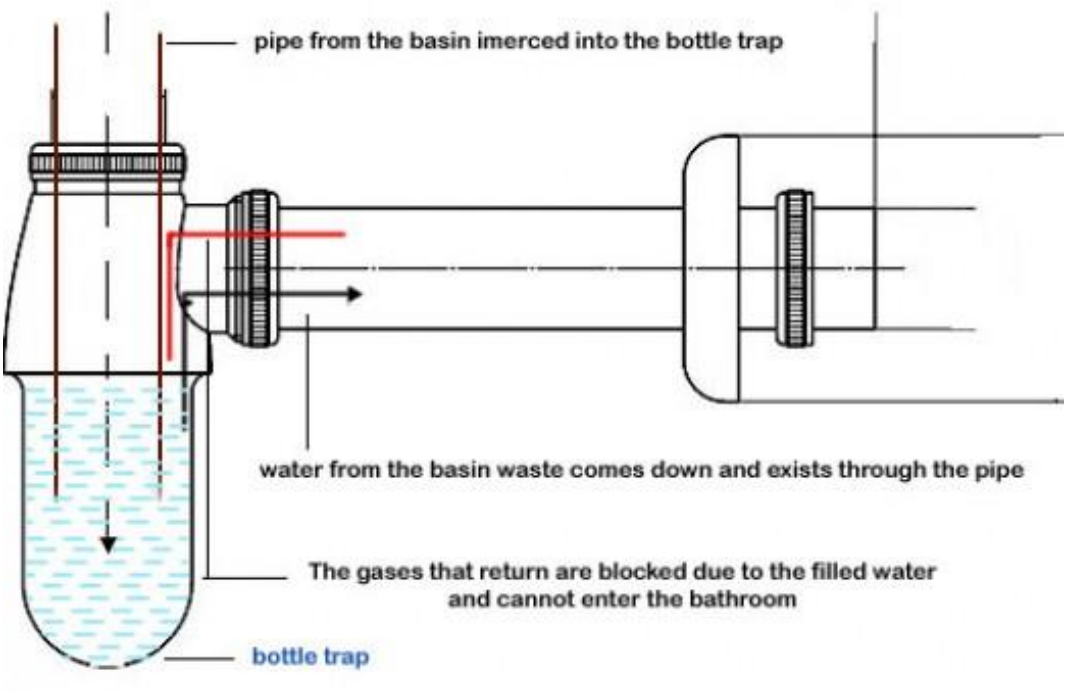


Diagram 4.3.1.3.1 Function of a Bottle Trap

Bottle trap is different with the other pipes as it has a bigger diameter if compared with them. The plumbing pipe from the basin is long and it connect directly into the water that filled previously during the installation in the bottle trap. When more water gushes into the water from the basin, it will overflow to the drain pipe and hence the water in the trap has been renewed. Thus, a trap should always filled with a certain amount of water and the pipe from the basin should immersed straight into this water inside the bottle trap.

When the sewer gases re-enter the system through the outlet pipes, they'll reach the bottle trap. From here, the sewer gases will be sealed with the water in the bottle trap due to the basin pipe that immersed in the water remains closed and doesn't allow the return waste and gases to enter it. Hence, preventing foul gases from paving their way upwards into and out of the basin into the washroom.

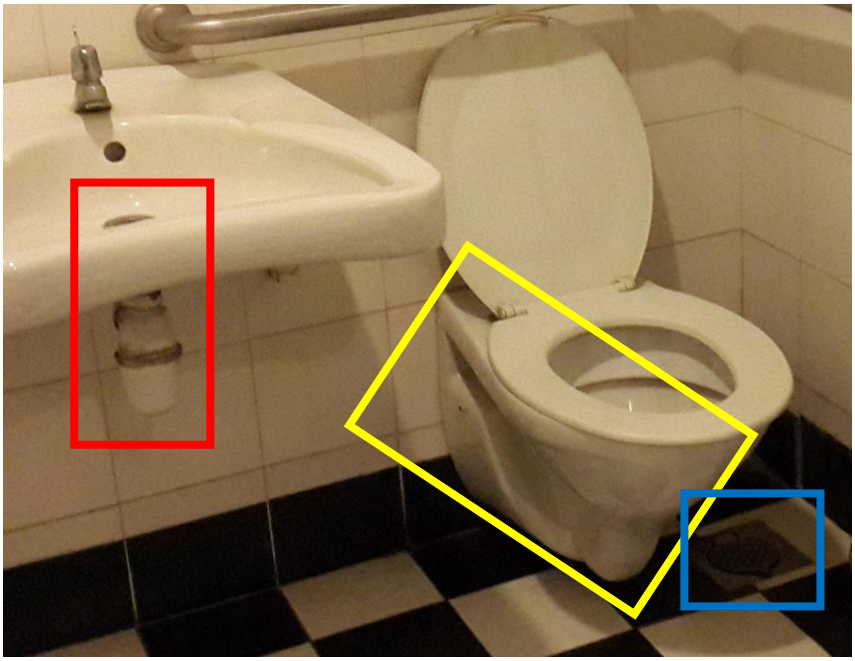


Figure 4.3.1.3.2 Sanitary Appliances at KL Pac

Besides the trap under the basins, there are also many other traps can be found in a washroom in order to serve the same function of the bottle trap- preventing external sewage gases entering the washroom. For water closet, it has an inbuilt trap itself that function exactly like the bottle trap. Also, there are always a floor trap that owns a similar kind of system for maintaining a safety and better hygiene washroom. From figure 4.3.1.3.2, bottle trap, in-built trap in WC and floor trap are found in the washroom of KL Pac which are highlighted in red, yellow and blue respectively.

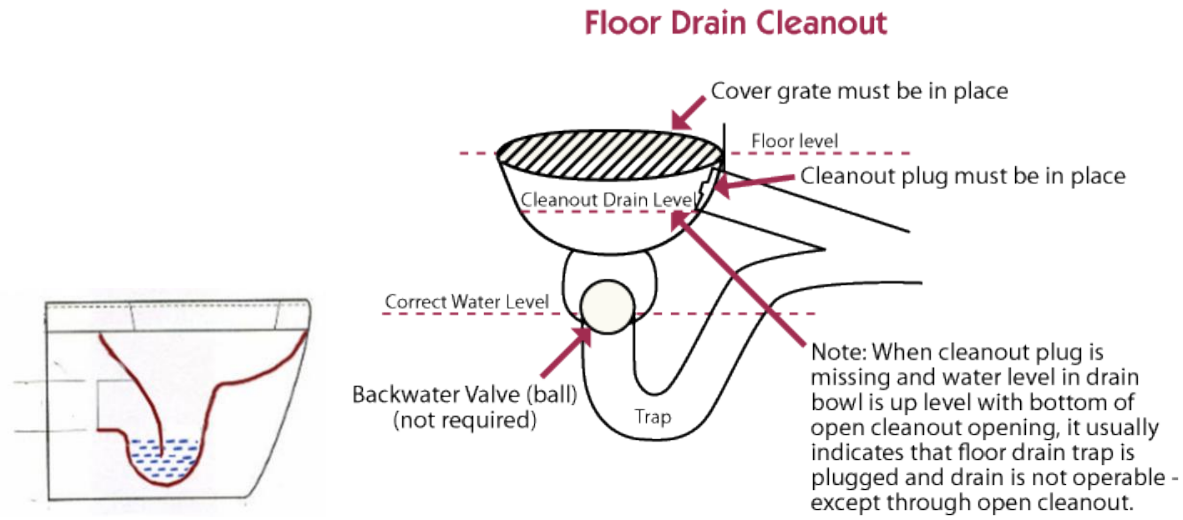
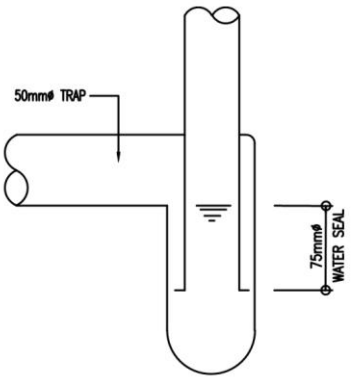
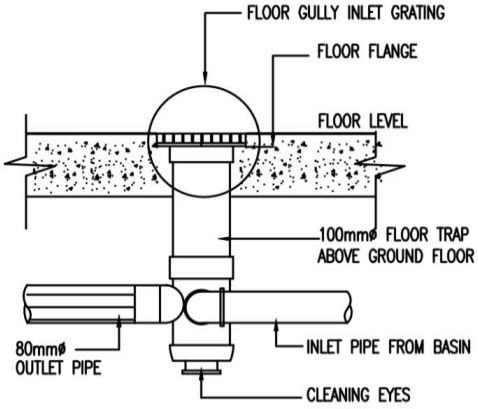


Diagram 4.3.1.3.2 (a) & (b) Typical diagram of In-built trap in WC & Floor Trap

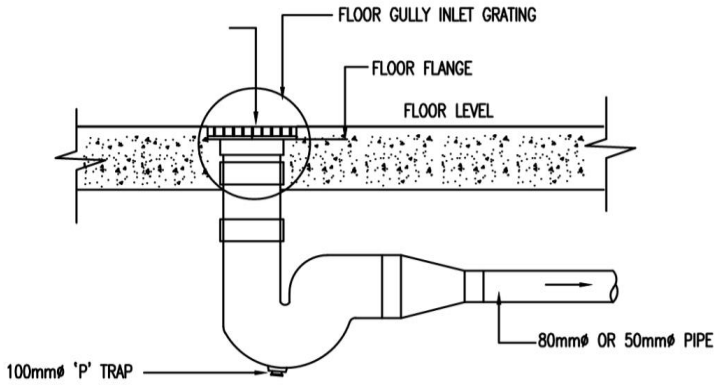


DETAIL OF BOTTLE TRAP
FOR BASIN



DETAIL OF FLOOR TRAP

RISING PIECE WITH 150mm SQ.TOP
TO SUIT STANDARD FLOOR TILES



DETAIL OF FLOOR TRAP

Diagram 4.3.1.3.3 Detail drawings of traps found in KL Pac

4.3.1.4 Vent Pipe

Figure 4.3.1.4.1 Typical Roof Vent

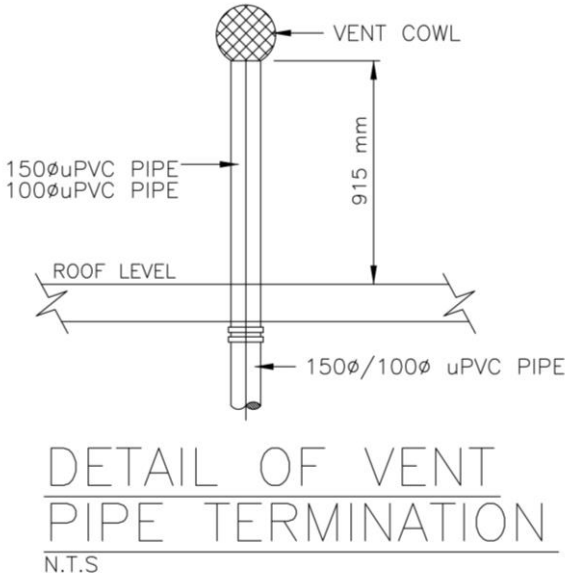


Diagram 4.3.1.4.1 Detail drawing of vent pipe at KL Pac

As mentioned before, all plumbing fixtures must contain traps to prevent sewer gases from leaking into the building. Through traps, all fixtures are connected to waste lines, which in turn take the waste to a soil stack. The vent pipe is attached to the building drain system (usually inside a wall) and out of the roof. Thus, the sewer gases will be released from the soil stack out from the building via the vent pipe.

Another important fact is vents provide a way to equalize the pressure on both side of traps, thereby allowing the trap to hold water, which is needed to maintain effectiveness of the trap. Plus, it also admit oxygen (O_2) from the outside to the waste system to provide aerobic sewage digestion which is a bacterial process occurring with the presence of O_2 resembling a continuation of the activated sludge process.

4.3.1.5 Gully Trap

Figure 4.3.1.5.1 Gully Trap at KL Pac

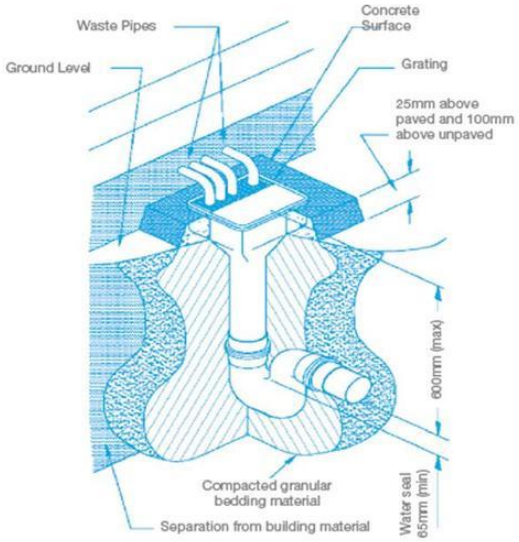


Diagram 4.3.1.5.1 Gully Trap terminology

These traps are constructed outside the building to carry waste water discharge from washbasin, sinks, and from the surface of road, paved etc. to enter the sewer main. They usually connected to the nearest building drain or sewer so that foul gases from sewer do not come to the building. It's bigger in size due to the heavy amount of water especially from heavy rain fall that it supposed to collect. The type of gully used in KL Pac is back-inlet gully.

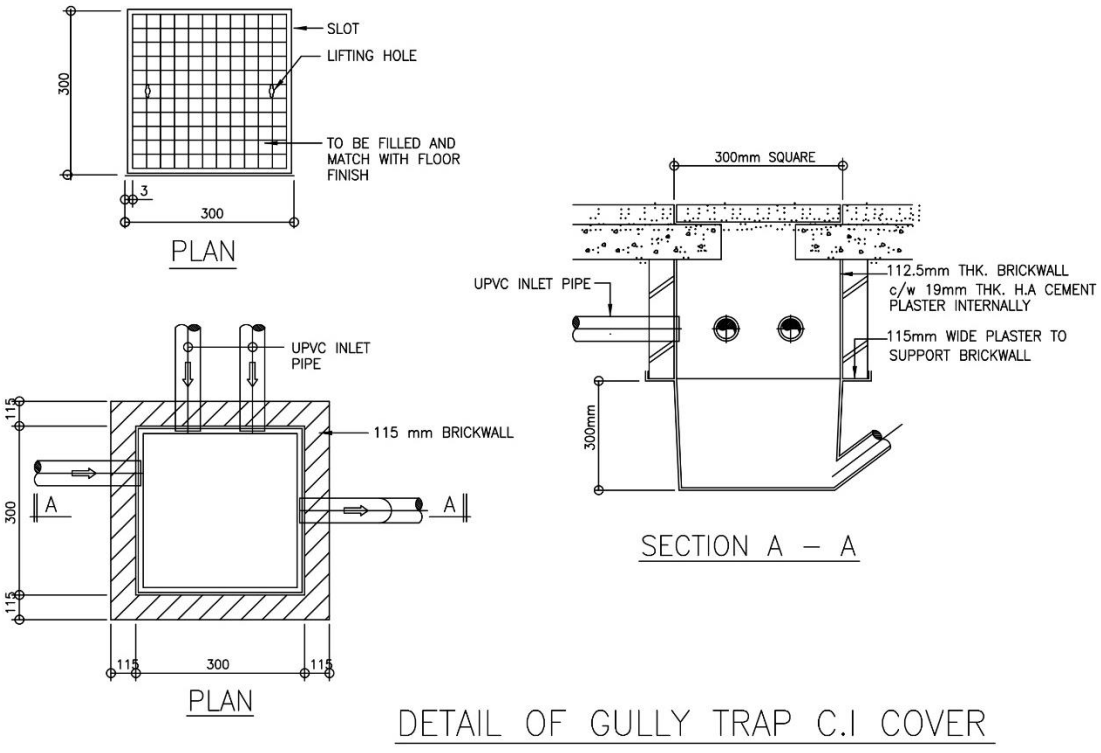


Diagram 4.3.1.5.2 Detail Drawings of Gully Trap

4.3.1.6 Inspection Chamber and Manhole

There are a few types of chamber that used for connection to the sewer main which are access chamber, inspection chamber and manhole.

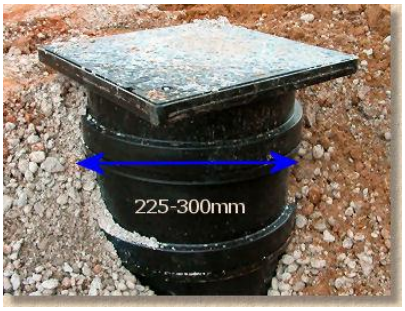


Figure 4.3.1.6.1 Access Chamber

Figure 4.3.1.6.2 Inspection Chamber at KL Pac

Access chambers are intended to provide simple access for drain rods or other maintenance equipment. They are not intended to provide access for a maintenance operative and are generally not more than 600mm deep.

Inspection chambers are larger than access chambers, typically a minimum 450mm diameter. They serve the same function as access chamber by providing access for maintenance equipment, but they tend to have more branches/ spurs feeding into them and are often up to 1000mm deep. They can be found in both circular and rectangular shape.

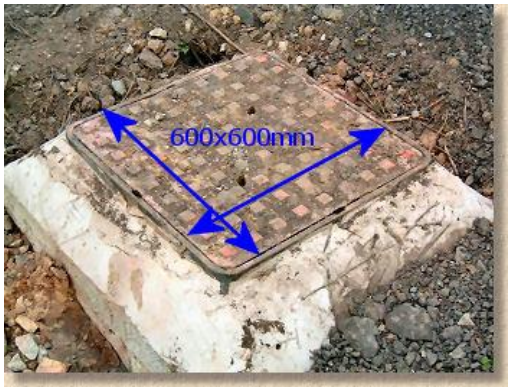
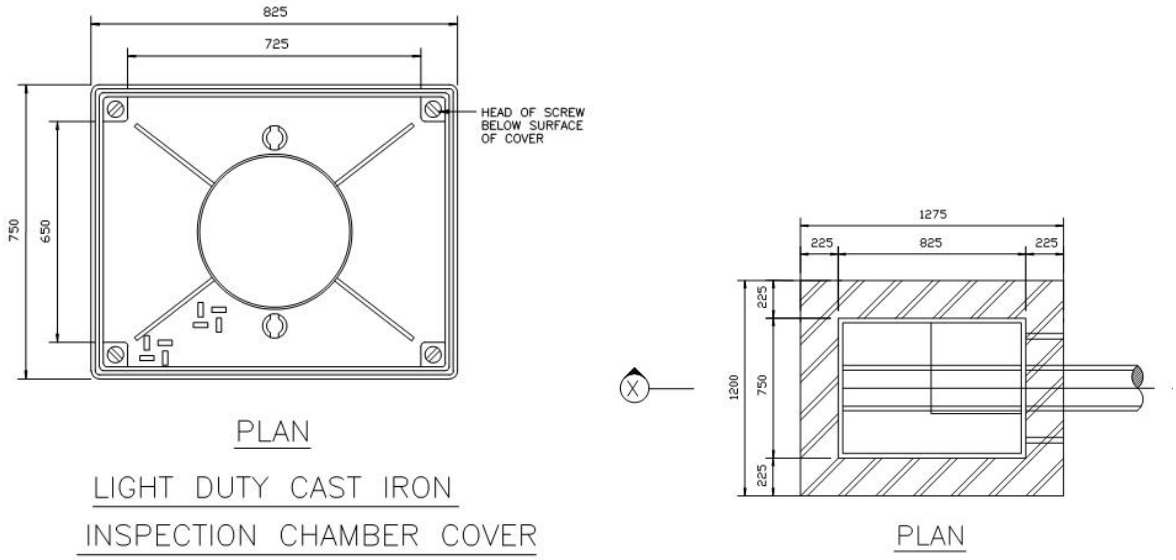
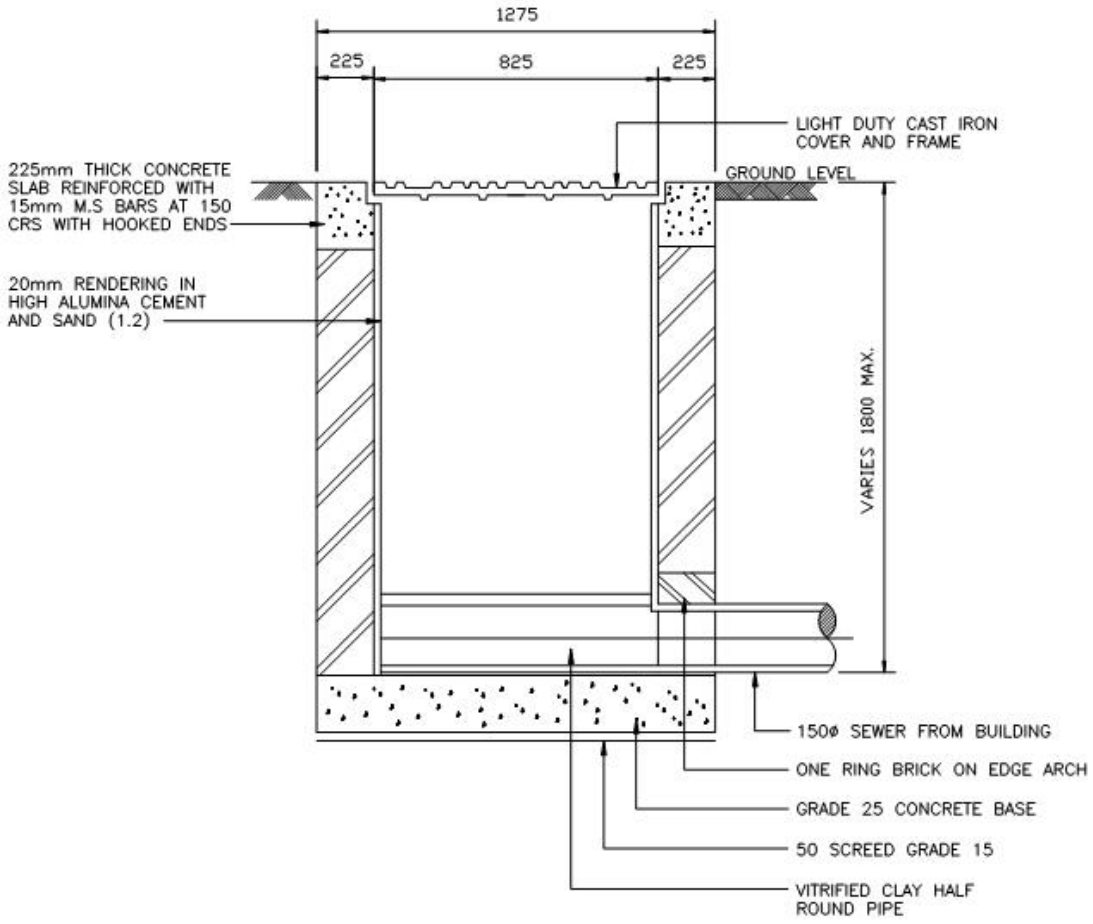


Figure 4.3.1.6.3 Manhole

Manholes (MH) are the largest chambers providing access to a sewer or drain for maintenance equipment, and in some cases, for operatives to enter the system itself. The minimum internal dimensions of a manhole are 600x900mm and they can of any depth, although most modern manholes tend to be at least 1 m deep with inspection chambers used for shallower depth.

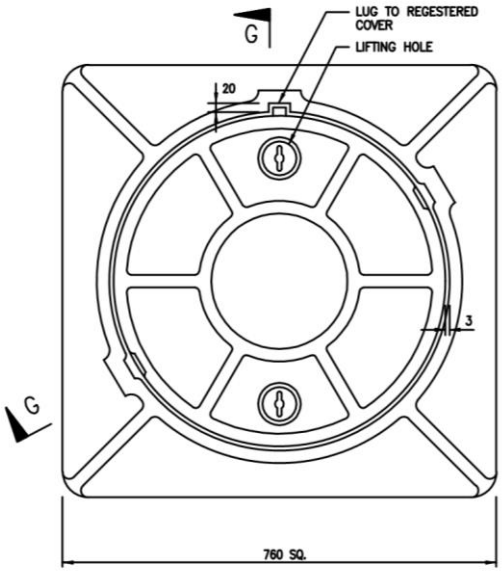




SECTION X – X

DETAIL OF INSPECTION CHAMBER

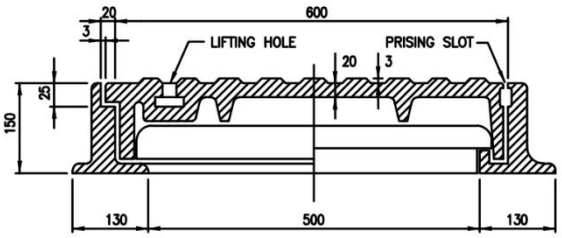
Diagram 4.3.1.6.1 Detail Drawings of Inspection Chamber of KL Pac



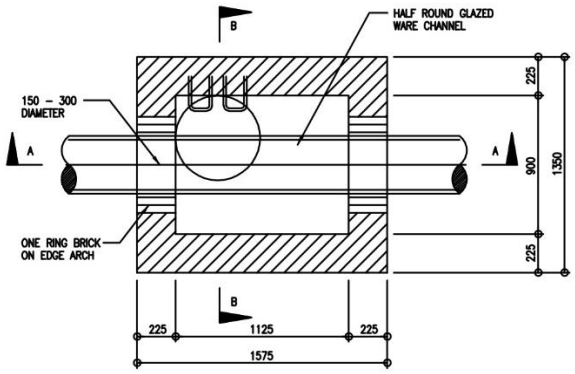
PLAN

CAST IRON MANHOLE FRAME AND COVER

TYPE I HEAVY DUTY APPROX WEIGHT 235 kg.
TYPE II MEDIUM DUTY APPROX WEIGHT 120 kg.
TYPE III LIGHT DUTY APPROX WEIGHT 65 kg.



SECTION G – G

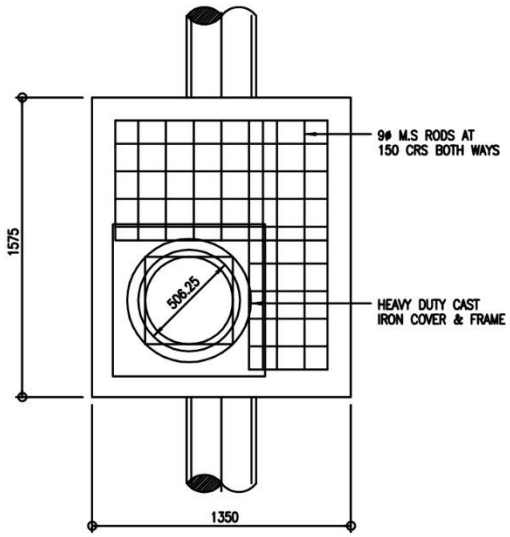


PLAN

POSITION OF ACCESS COVER AND CENTRE LINE OF DRAIN WILL BE DETERMINED ON SITE

TYPE A – 1

STRAIGHT THROUGH FOR MANHOLE 150ø TO 300ø DEPTH TO INVERT NOT EXCEEDING 2400



PLAN AT C – C

Diagram 4.3.1.6.2 (A) Detail Drawings of Manhole of KL Pac

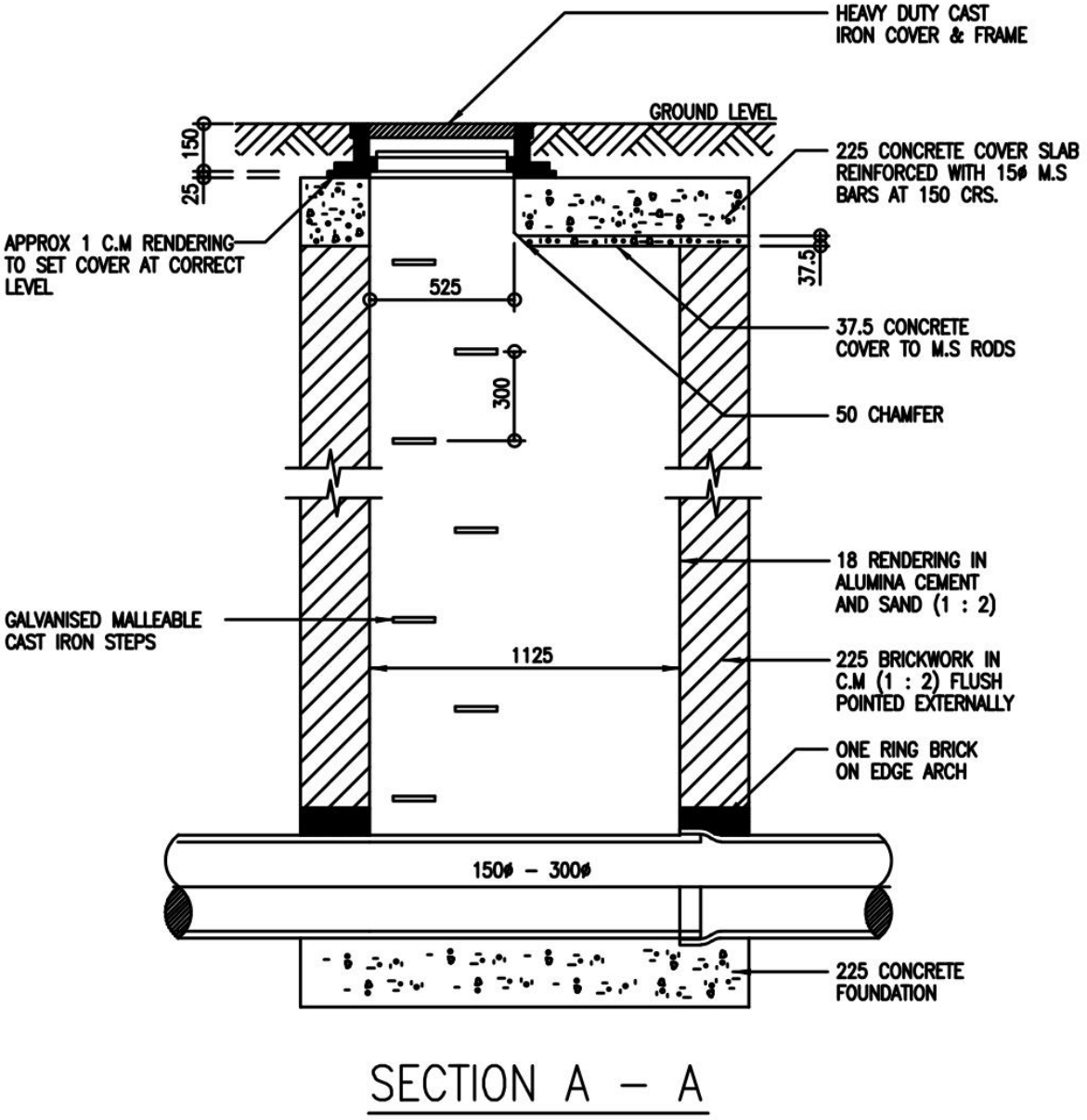
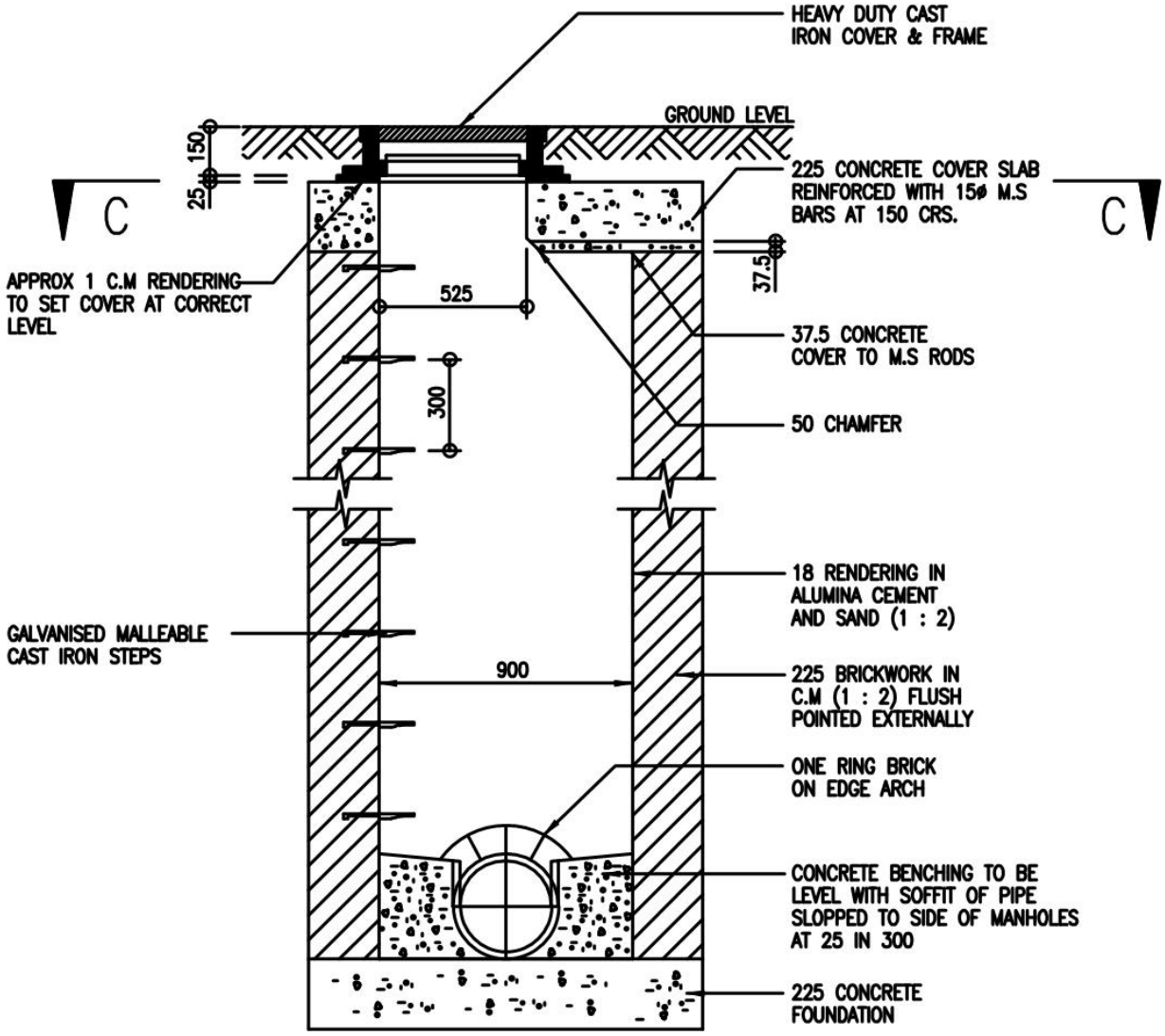


Diagram 4.3.1.6.2 (B) Detail Drawings of Manhole of KL Pac



SECTION B – B

Diagram 4.3.1.6.2 (C) Detail Drawings of Manhole of KL Pac

4.3.1.7 Septic Tank

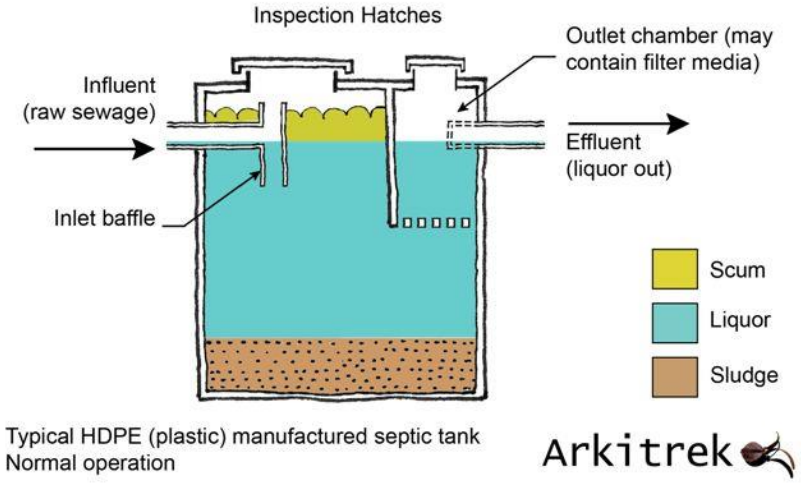


Diagram 4.3.1.7.1 Typical Septic Tank in Section View

A septic tank is a small-scale sewage treatment system common in areas without any connection to main sewage pipes provided by local government or private corporations. It's a watertight settling tank which receives the discharge of a drainage system or part thereof and is designed and constructed so as to separate solids from the liquid, digest organic matter through a period of detention, and allow the liquids to discharge into the soil outside the tank through a system of open joint or perforated piping or disposal pit.

Maintenance has to be done periodically as to remove solids that remain and gradually fill the tank to prevent solids from escaping the tank and clog the clarified liquid effluent disposal system.

Due to unavailable of public sewer on the site of KL Pac area, installation of septic system is needed. According to the guide, soil evaluation and percolation test have done before to allow the installation including a groundwater determination as well.

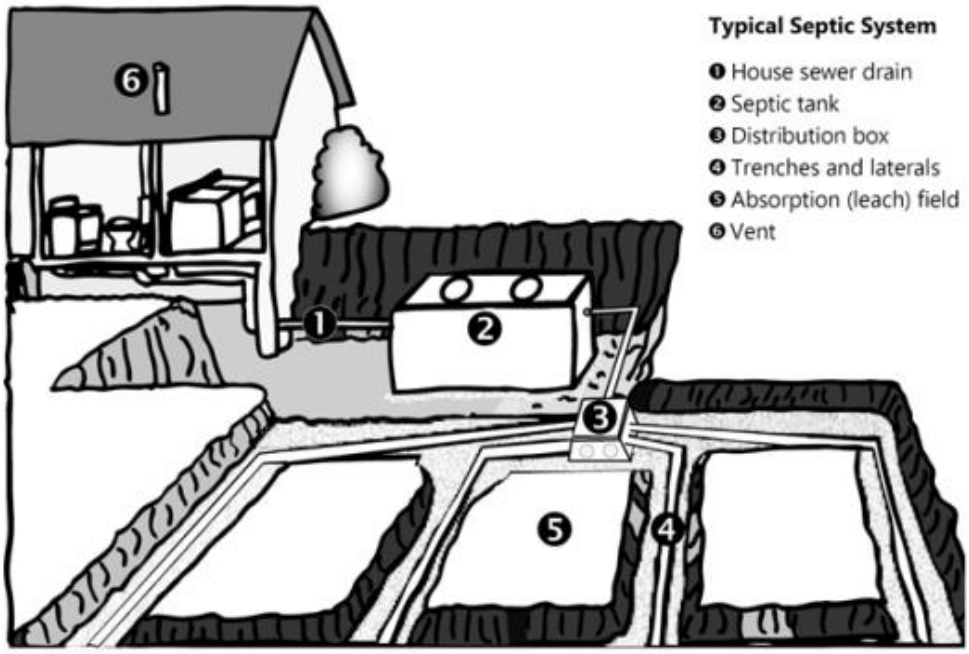


Figure 4.3.1.7.1 Typical Septic System

Usually there are 2 chambers in a septic tank. Wastewater 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. The excess liquid, now in a relatively clear condition, drains from the outlet into the leach field/ drain field via distribution box. A percolation test is required prior for installation to ensure the porosity of the soil is adequate to serve as a drain field.

The remaining impurities are trapped and eliminated in the soil, with the excess water eliminated through percolation into the soil, through evaporation, and by uptake through the root system of plants and eventually transpiration take place or entering groundwater. A piping network which distributes the wastewater throughout the field with multiple drainage holes in the network is connected by a distribution box. 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 devices to increase the volume and velocity of outflow to the drainage field. These help to fill the drainage pipe more evenly and extend the drainage field life by preventing premature clogging.

4.3.2 Sanitary Sewer System

A sanitary sewer system consists of several types of discharge pipe such as single stack, branching and vent pipe. Single stack pipe is installed vertically to ease the discharge of soil and wastewater. Branching pipe is connected from sanitary appliances to single stack pipe. While the vent pipe is function to release compressed air.

Besides, there are 3 system employed in the installation of soil and waste water discharge pipes which are single stack system, single pipe system and dual pipe system.

4.3.2.1 Single Stack System

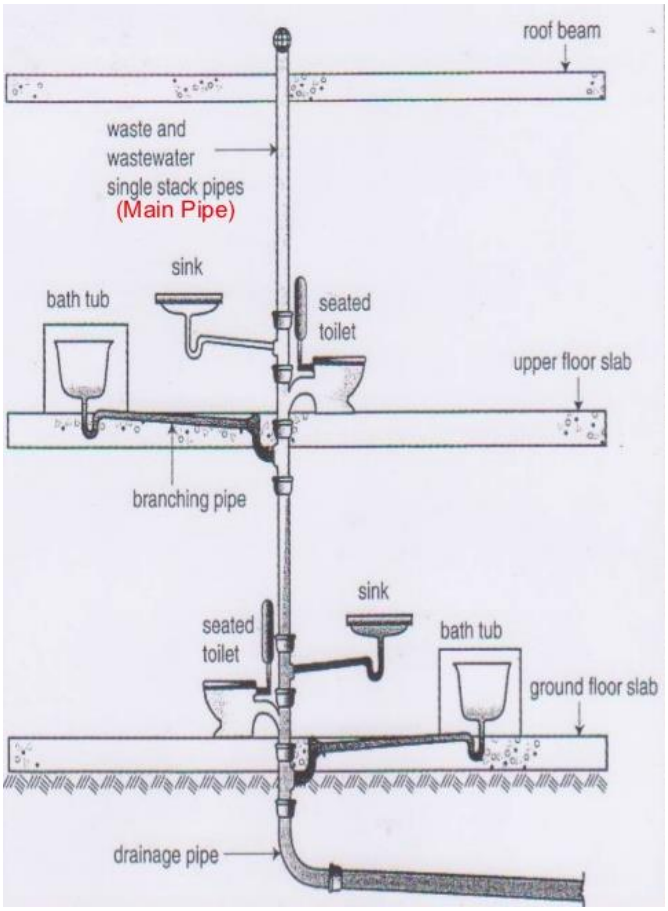


Diagram 4.3.2.1.1 Single Stack System

It's a system where only 1 pipe is required and vent pipe is not required as it can function as vent pipe. All the branching pipes from sanitary fittings are transferred into the single stack pipe and then drained into the drainage pipe. Priority, all the sanitary fittings should be connected to the pipe separately.

4.3.2.2 Single Pipe System

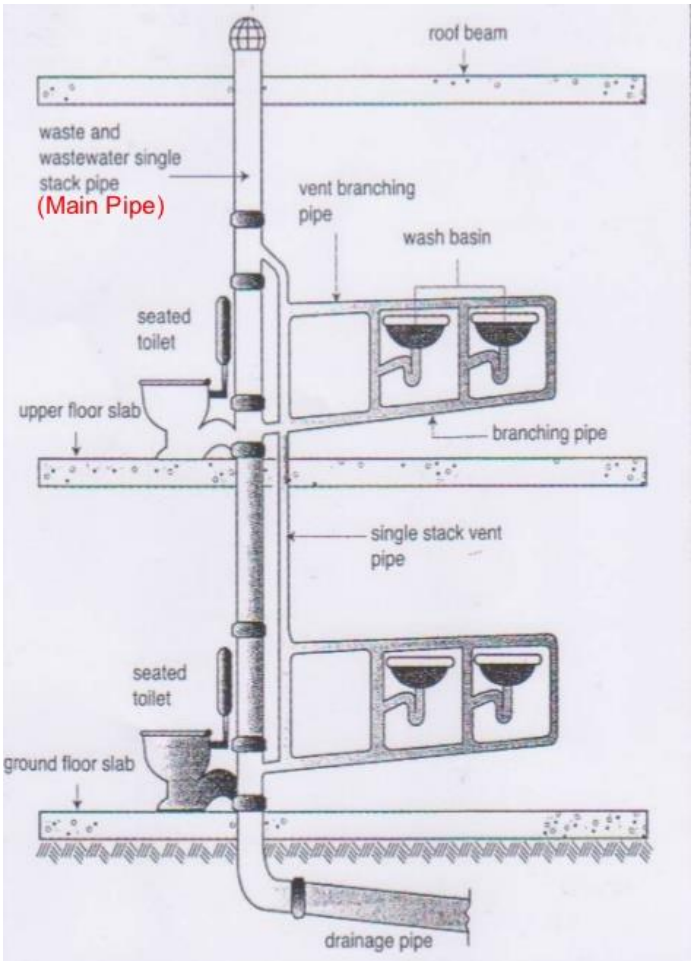


Diagram 4.3.2.1.2 Single Pipe System

The difference between single pipe system and single stack system is the former use only 1 pipe in collecting and discharging the wastewater from all the sanitary fittings. In other words, all the branching pipes that serve for discharging wastewater and compressed air are connected in a single pipe only. This system is very well for multi storey buildings and it's far more economical than two pipe system.

4.3.2.3 Dual Pipe System

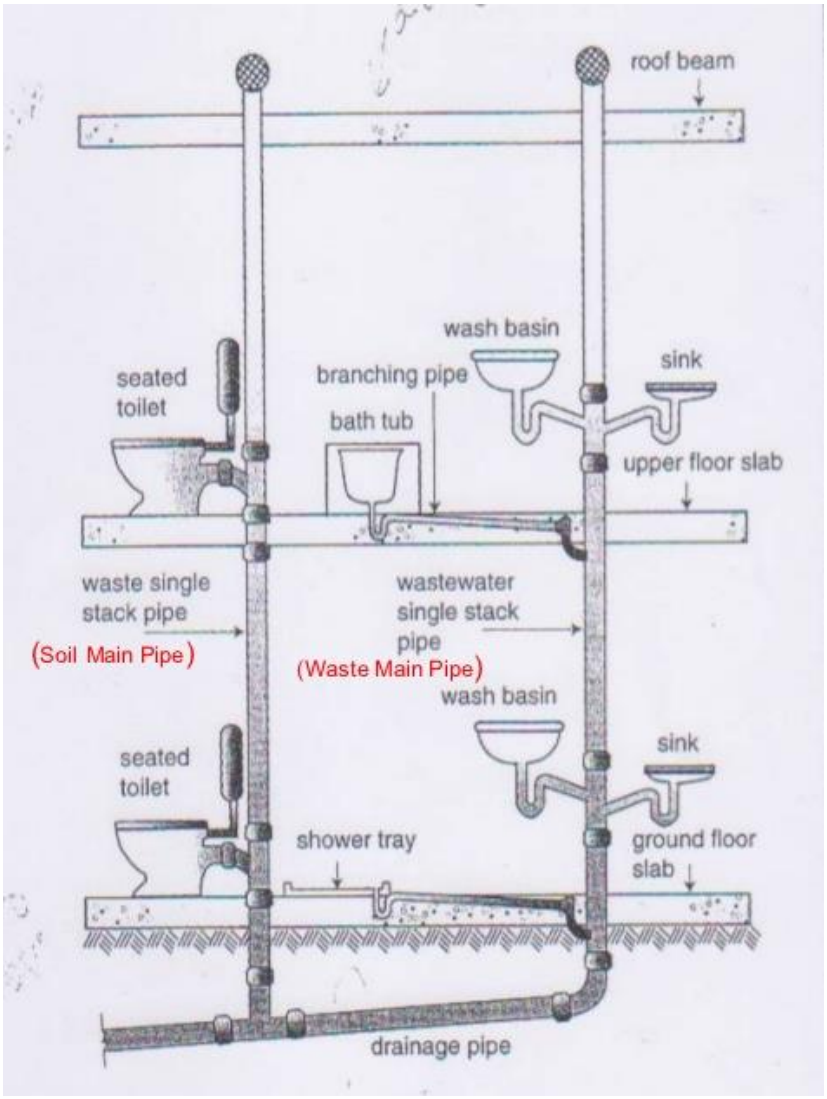


Diagram 4.3.2.1.3 Dual Pipe System

This system consists of 2 single stack pipes, one for waste disposal and the other is for soil disposal which both of them have their own ventilation system. The waste discharge pipe drains wastewater from the wash basins and floor traps while the soil discharge pipe drains soil water from water closet and urinal. Both the single stack pipes are then connected to the underground drainage pipe.

4.3.2.4 Schematic drawing of sanitary system in KL Pac

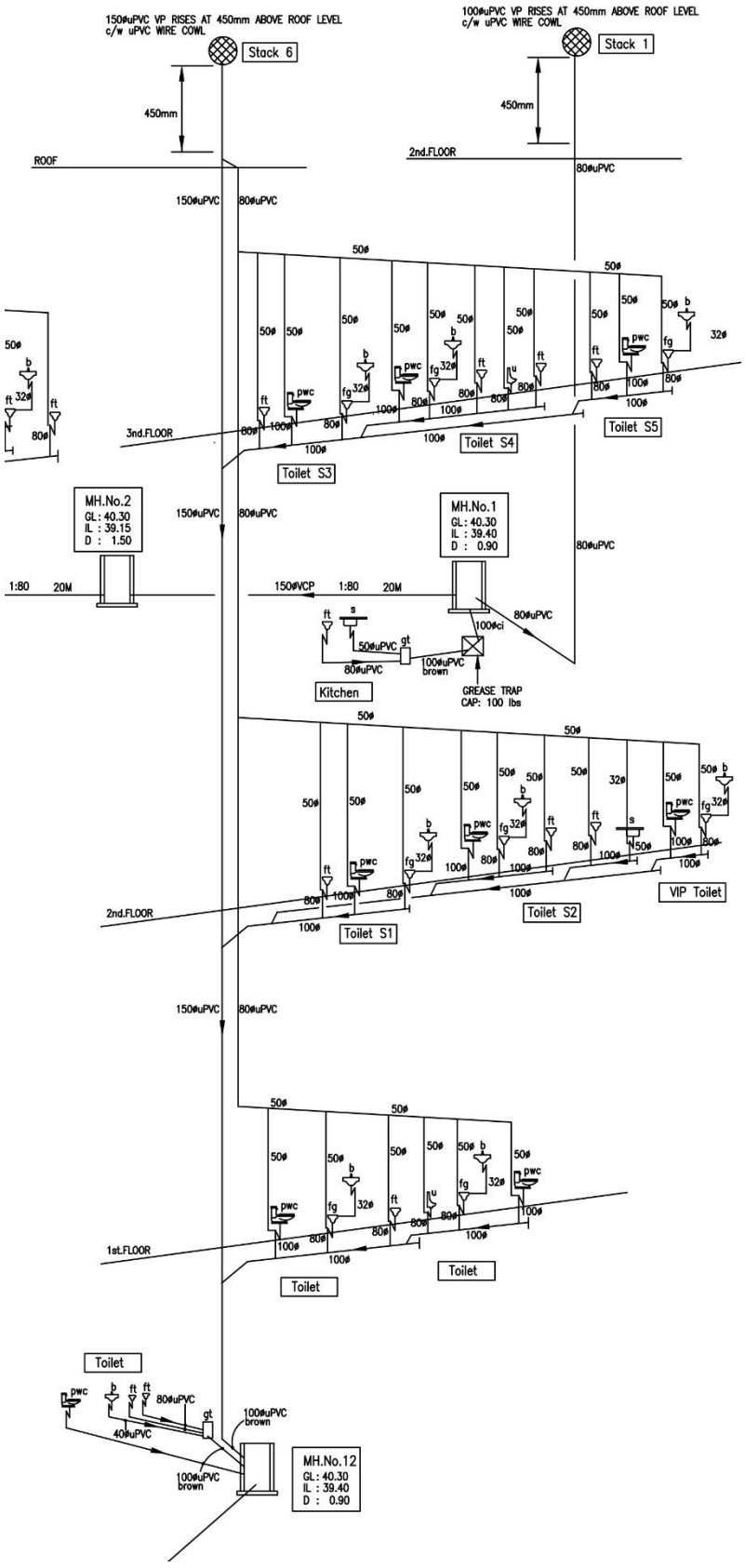


Diagram 4.3.2.1.4 Single Pipe System at KL Pac

4.3.3 Storm Sewer/ Storm Drainage system

As mentioned before, storm sewers are designed to carry excess water to sea or reservoirs or any other suitable place. The excess water can be collected from roof and paved area where the former is discharged via gutter that connected to the rainwater pipes and to the perimeter drain while the latter is discharged to perimeter drain directly which finally ends up in river or etc.

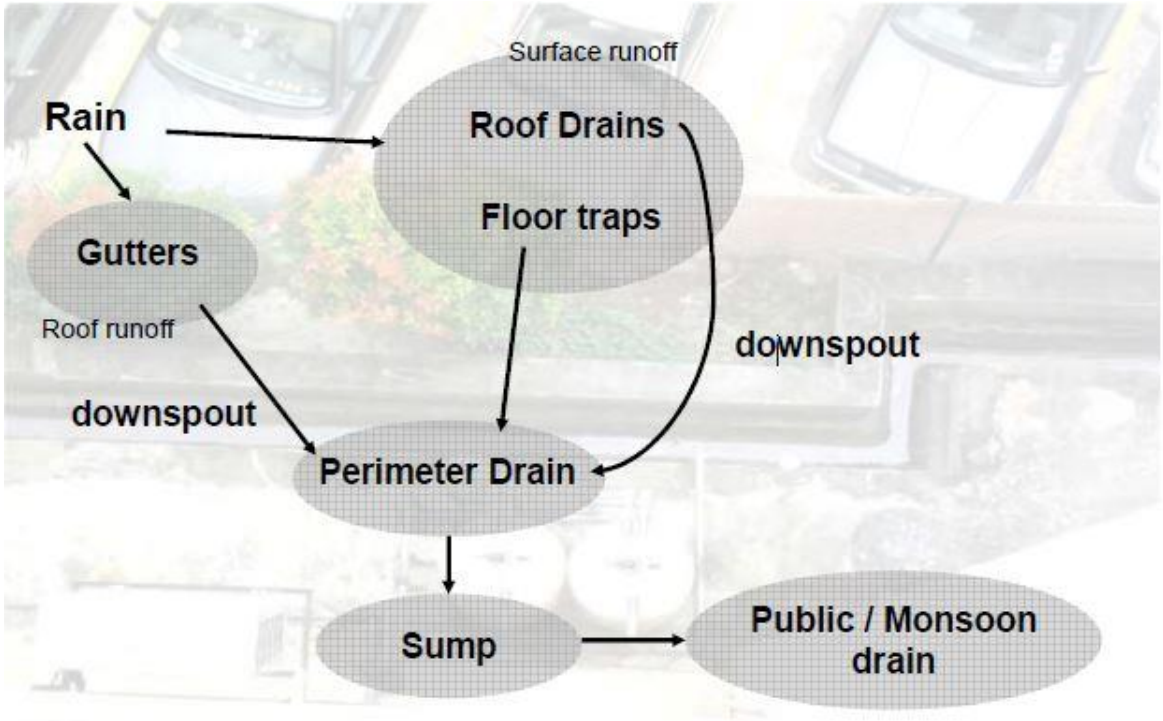


Diagram 4.3.3.1 The flow diagram of rainwater

4.3.3.1 Fittings for storm sewer

Gutter

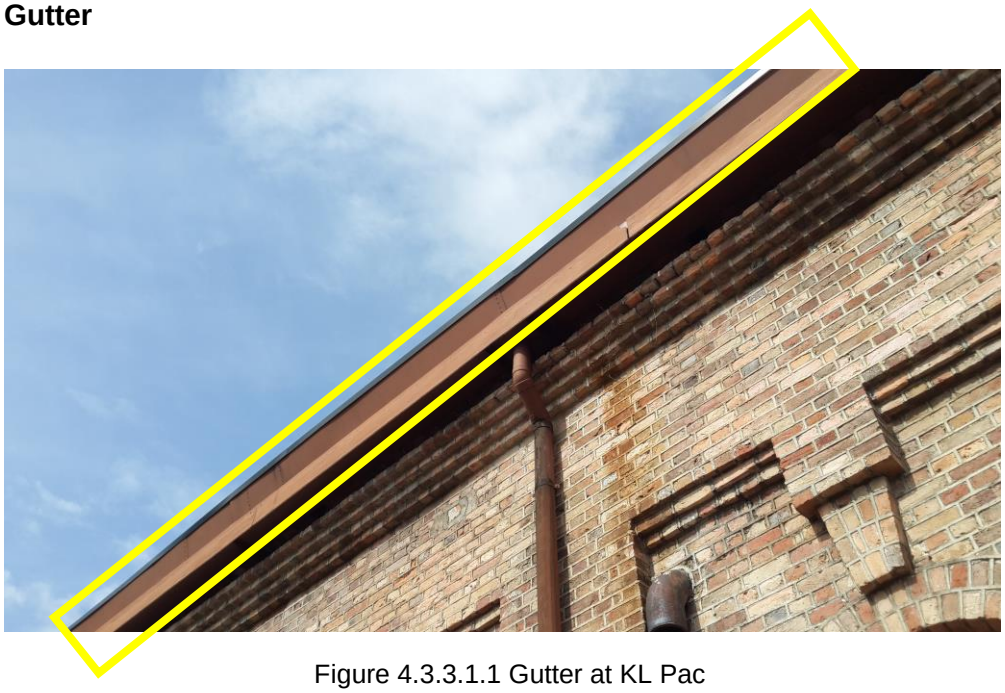
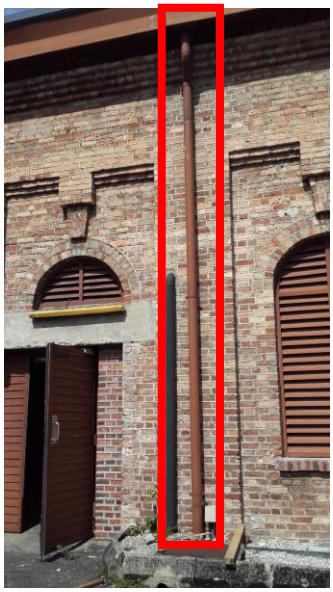


Figure 4.3.3.1.1 Gutter at KL Pac

The main function of a gutter is to collect and divert the rainwater from the roof to protect the building's foundation. It also helps in preventing leakage and reduces erosion of the building. These gutter pipes are usually made of cast iron, lead, zinc, galvanized steel, painted aluminium and PVC. For KL Pac, aluminium had been used as the material for gutter with painted in brown color.

Downspout



Downspouts serve as drainage pipes that connect the rainwater from the roof to the ground, either to a gully trap or directly to a perimeter drain. Without downspout, rainwater might be trapped on the roof, causing flood and leakage on the roof.

From figure 4.3.3.1.2, shown that the downspout directs rainwater from the roof to a gully trap.

Figure 4.3.3.1.2 Rainwater down pipe at KL Pac

Perimeter Drain

Figure 4.3.3.1.3 Perimeter Drain

Perimeter Drain is used to collect rainwater from downspout or floor traps and discharged it away from the building. It comes in several types of design depends on the site itself, but all of them serve the same function.

4.3.4 Schematic Drawing of Sewage System in KL Pac

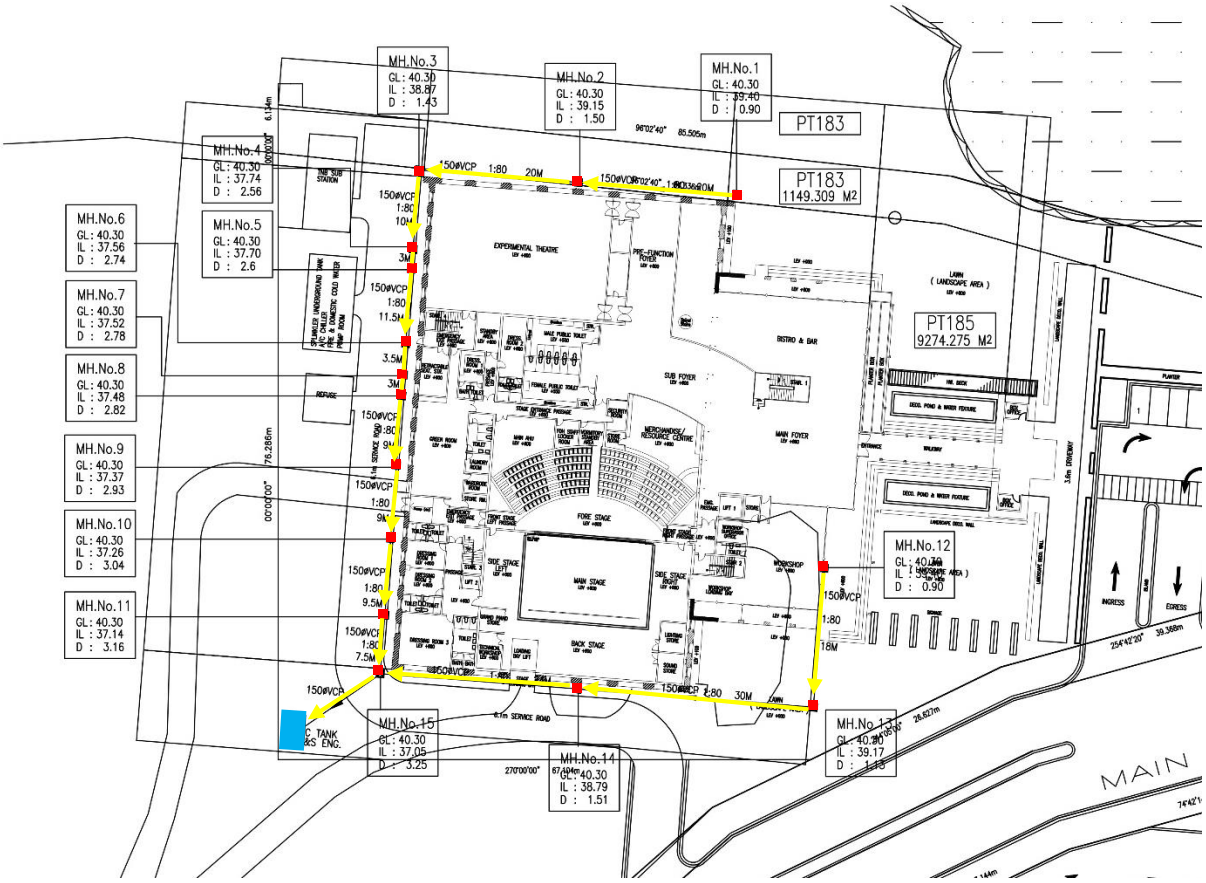


Diagram 4.3.4.1 Site Plan of KL Pac with sewage flow details

Manhole Septic Tank Flows of sewage

FITTING	PIPE SIZE (ABOVE GROUND) B.S. 4514		PIPE SIZE (UNDERGROUND) B.S. 4514 & B.S 4660
	SOIL & WASTE PIPE	VENT PIPE	50mmØuPVC
SINK	40mmØ uPVC	32mmØ uPVC	40mmØuPVC
BASIN	32mmØ uPVC	32mmØ uPVC	40mmØuPVC
WATER CLOSET	100mmØ uPVC	50mmØ uPVC	100mmØuPVC
FLOOR TRAP	80mmØ uPVC	50mmØ uPVC	80mmØuPVC
GULLY TRAP	--	--	100mmØuPVC
VENT ABOVE ROOF LEVEL – uPVC			

Table 4.3.4.1 Schedule of soil and waste pipe sizes and materials used in KL Pac

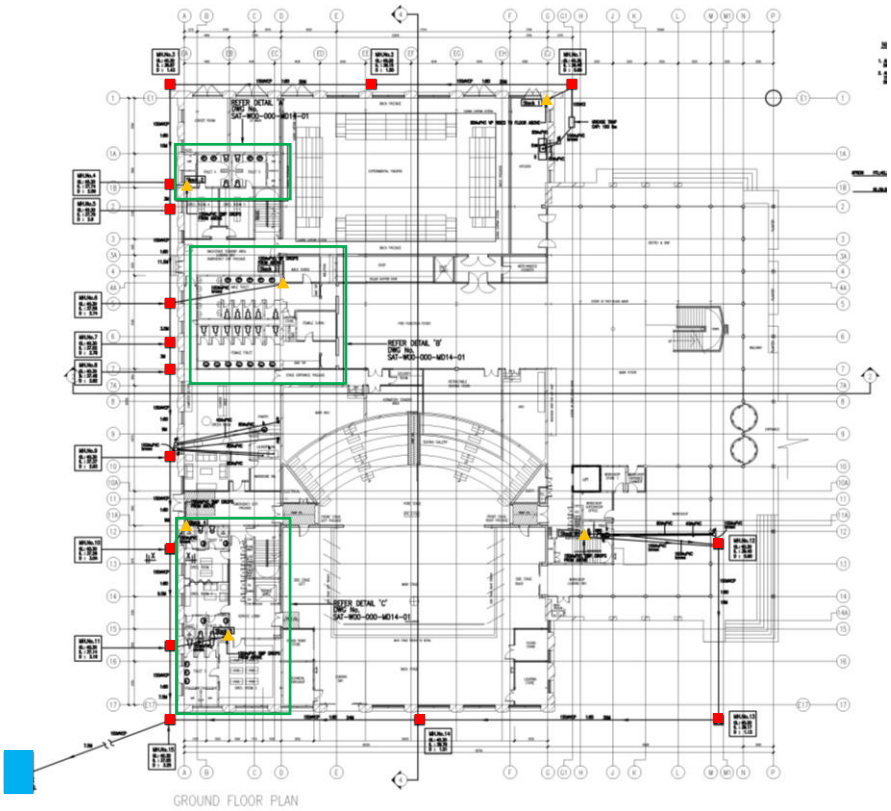


Diagram 4.3.4.2 Ground Floor Plan

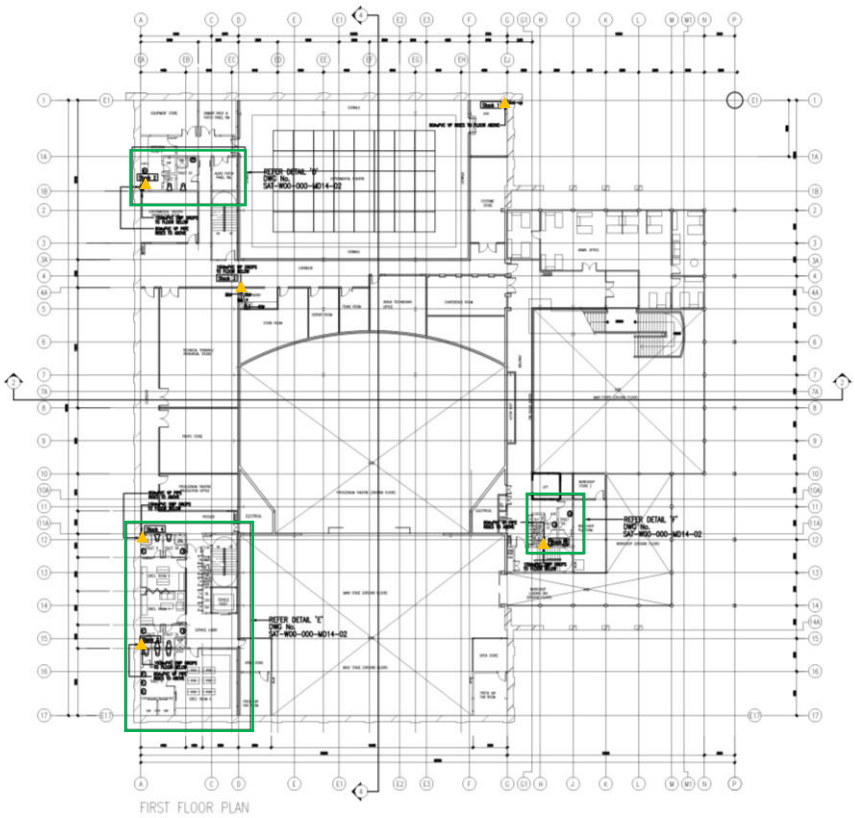


Diagram 4.3.4.3 First Floor Plan

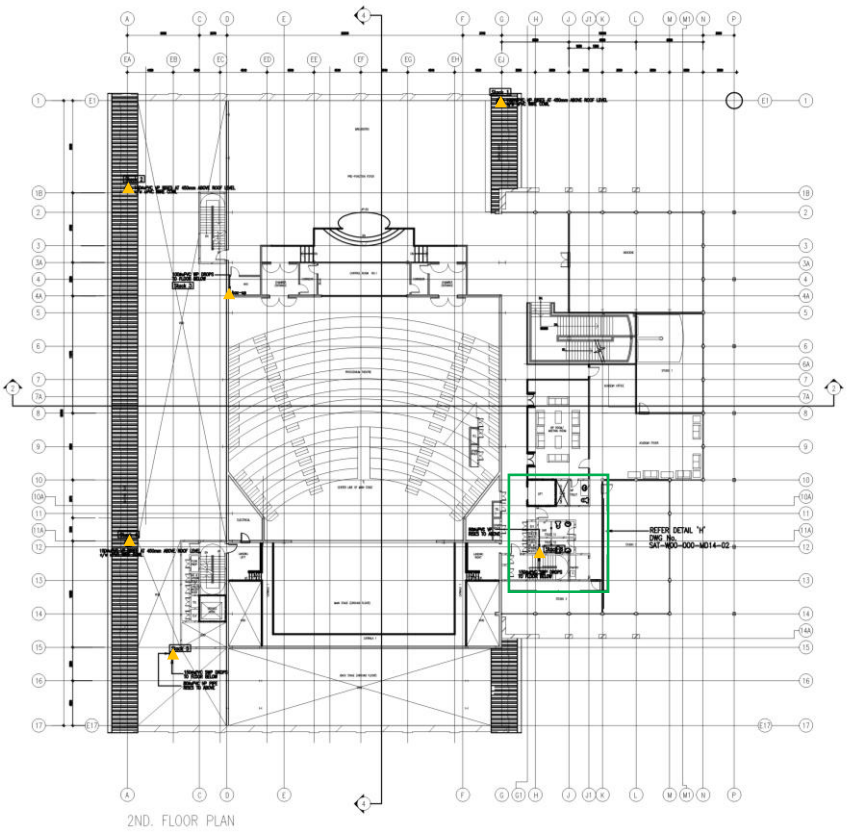


Diagram 4.3.4.4 Second Floor Plan

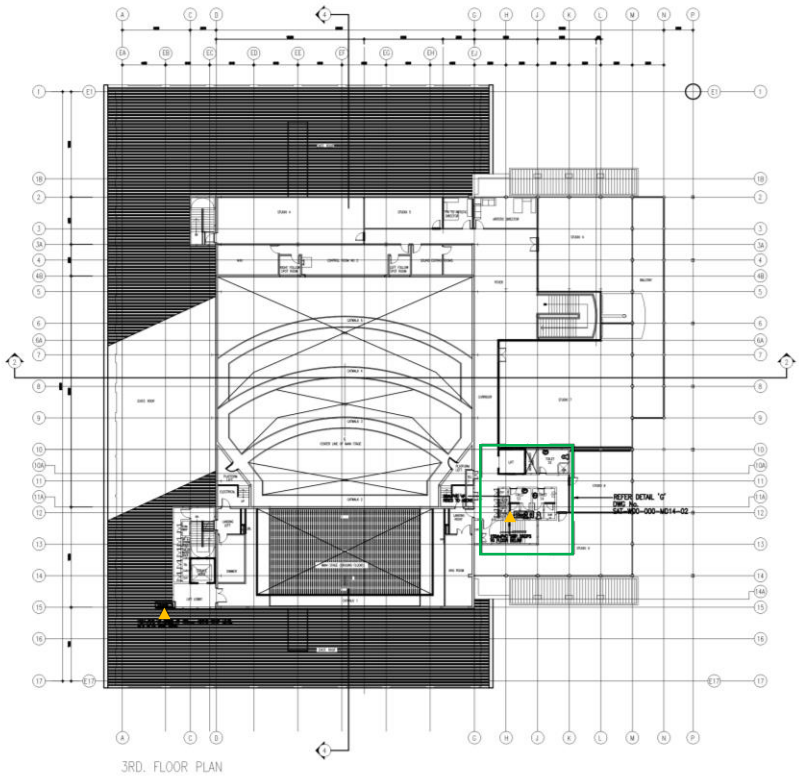


Diagram 4.3.4.5 Third Floor Plan

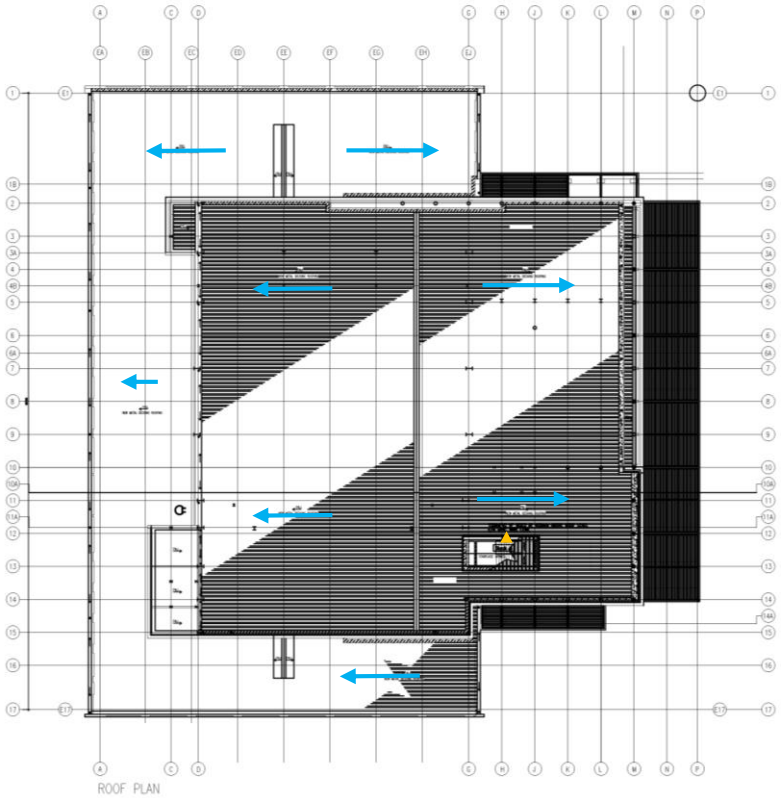


Diagram 4.3.4.6 Roof Plan

Manhole Septic Tank Washroom Stack

Direction of flow of storm water at roof plan

4.4 Findings

4.4.1 Law 43th

According Law 43th noted the minimum dimension of latrines, water closets and bathrooms.

In all buildings, the sizes of latrines and water closets should be:

(a) In the case of latrines or water with pedestal type closet fittings, not less than 1.5m by 0.75m
(b) In the case of water closet with fittings other than pedestal type closet fittings not less than 1.25m by 0.75m

According Law 123th noted the requirement of pipes and service ducts:

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

(a) Sufficiently large to permit access to cleaning eyes. Stop cocks and other controls there 10 enable repairs, extensions and modifications to be made to each or call of the services accommodated.
(b) Adequate for the accommodation of the pipes, cables or conduits and for crossings of branches and mains together with supports and fixing.
(c) The access, openings to ducts or enclosures shall be long enough and suitably places to enable length of pipe to be installed and remved.

4.4.2 UBBL

82. (1) wherever the dampness or position of the site of a building renders it necessary, the subsoil of the site shall be effectively drained or such other steps shall be taken as will effectively protect the building against damage from moisture.

84. (1) Suitable measures shall be taken to prevent the penetration of dampness and moisture into a building.

(2) Damp proof courses where provide shall comply with BS 743 (materials for horizontal D.P.C)

4.5 Conclusion

In short, the sewage system applied in KL Pac is neither separated nor combined sewage system. All the domestic wastewater of KL Pac is transported finally to a septic tank owned by KL Pac itself which in turns of regular maintenance have to be carried to ensure the whole system always in good condition. However, application of septic tank is not efficient as connected to public sewage as it costs more in terms of maintenance fees in long term. For storm water, it will be transferred from perimeter drain to a large open channel and finally ended in soakaway which is the “leach field” mentioned before. Soakaway serves the same function as the leach field as to dissipate the storm water into the ground, where it then merges with the local ground water. In conclude, all the wastewater of KL Pac will be treated and discharged back to the ground.

5.0 MECHANICAL TRANSPORTATION SYSTEM

5.1 Literature Review

There are total 4 storey in KLPAC, each floor is connected by stair and elevator. As it is a light commercial type of building, it only provide one mechanical transportation system in order to serve OKU people and provide convention for delivery thing. The main purpose of mechanical transportation system is to make the circulation become more efficient.

Mechanical Transportation system in a building refer to a system that can carry passenger and goods from one floor to another. Mechanical transportation can be divide into 2 type by horizontal and vertical transportation.

Vertical transportation can be easily found in common high rises building. Vertical transportation can know as elevator or lift, people mostly prefer using elevator rather than staircase is because it save our time and energy. Due to the market requirement now a days, lift have become the most important element in high rises building design.

Horizontal transportation is also the common system in nowadays commercial building. Example such as travellator, moving walkway etc. They also function as transport people or good but they only can connect to limited height of floor, common used to travel to one floor above or below.

In this topic we mainly focus on vertical transportation analysis, because our building KLPAC only have one elevator.

5.2 Schematic

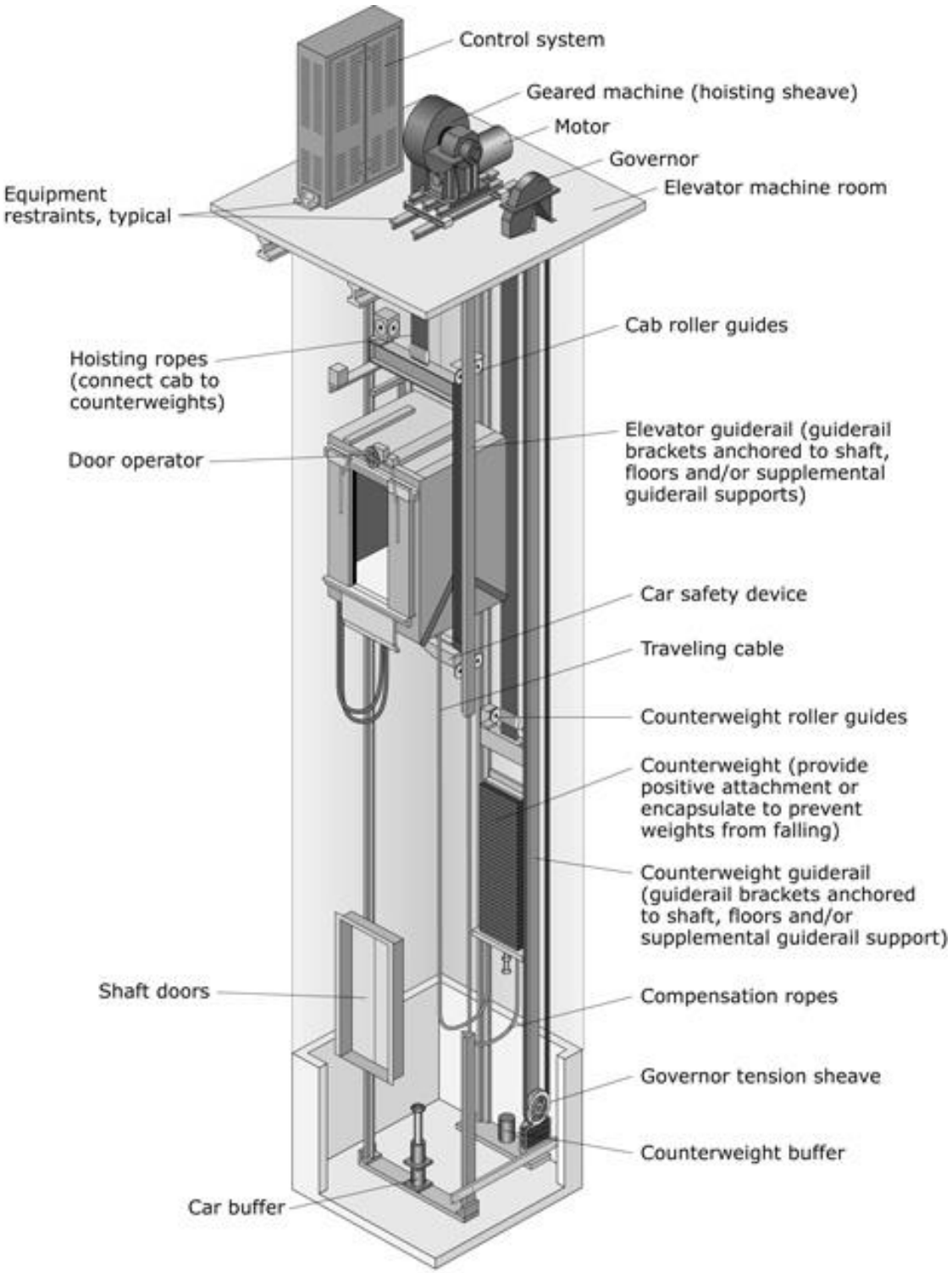


Figure 5.2.1 Schematic of elevator – components of lift

5.3 Vertical Transportation

According to UBBL law (124), for all non-residential building exceeding 4 storey above or below the main access level at least one lift shall be provided.

5.3.1 Elevator

Elevator is a type of permanent vertical transportation equipment. The standard elevators will include the few basic components, there **are Car, Hoist way, Machine/Drive system, Control System and safety system. (Show in diagram 6.2)** The standard elevator is classified according to the rated load, starting from 320kg up to 800kg or more than 800kg up to 1600kg.

The standard elevator car can be classified according to the number of entrances and their location as follows:

1. Normal Cabin
2. Open through Cabin
3. Diagonal Cabin

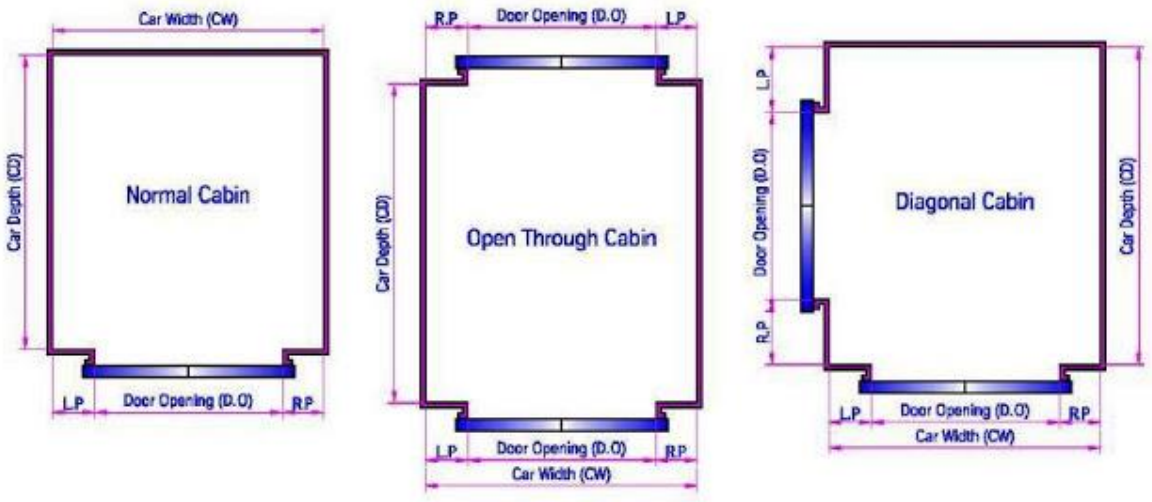
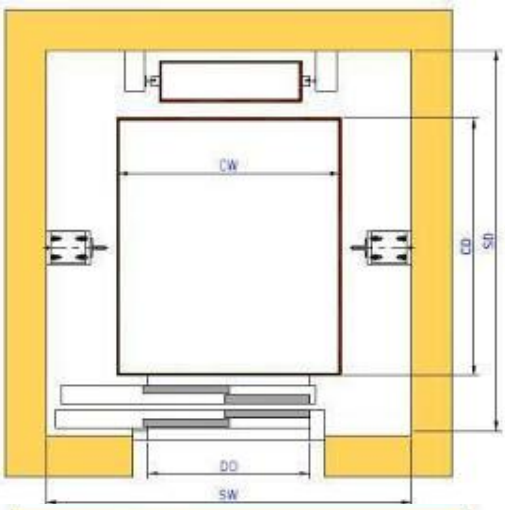
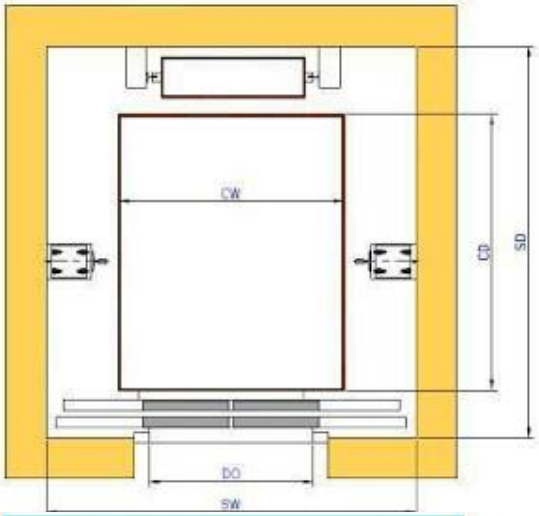


Diagram 5.3.1.1 Elevator Car Types Diagram

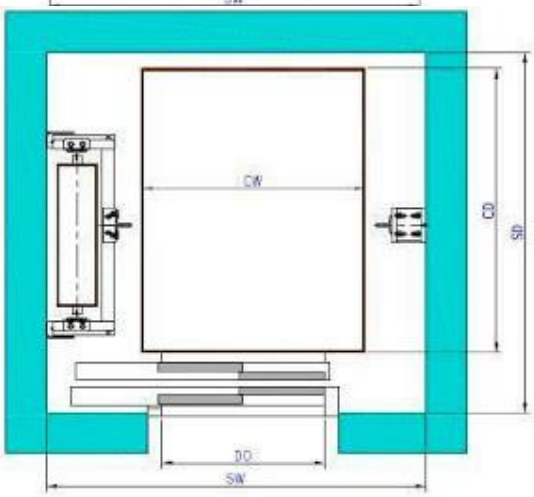
The Standard Elevator can be arranged in the few different layout according to site requirement and conditional.



Arrangement 1: Car with side opening door and the counterweight is located at the back wall



Arrangement 2: Car with central opening door and the counterweight is located at the back wall



Arrangement 3: Car with side opening door and the counterweight is located at the one side

In order to prevent overloading of the car by persons, the space of the elevator is design to limited and related to the nominal/ rated load of the elevator. The number of passengers shall be obtained from the formula:

Number of passengers = rated load /75

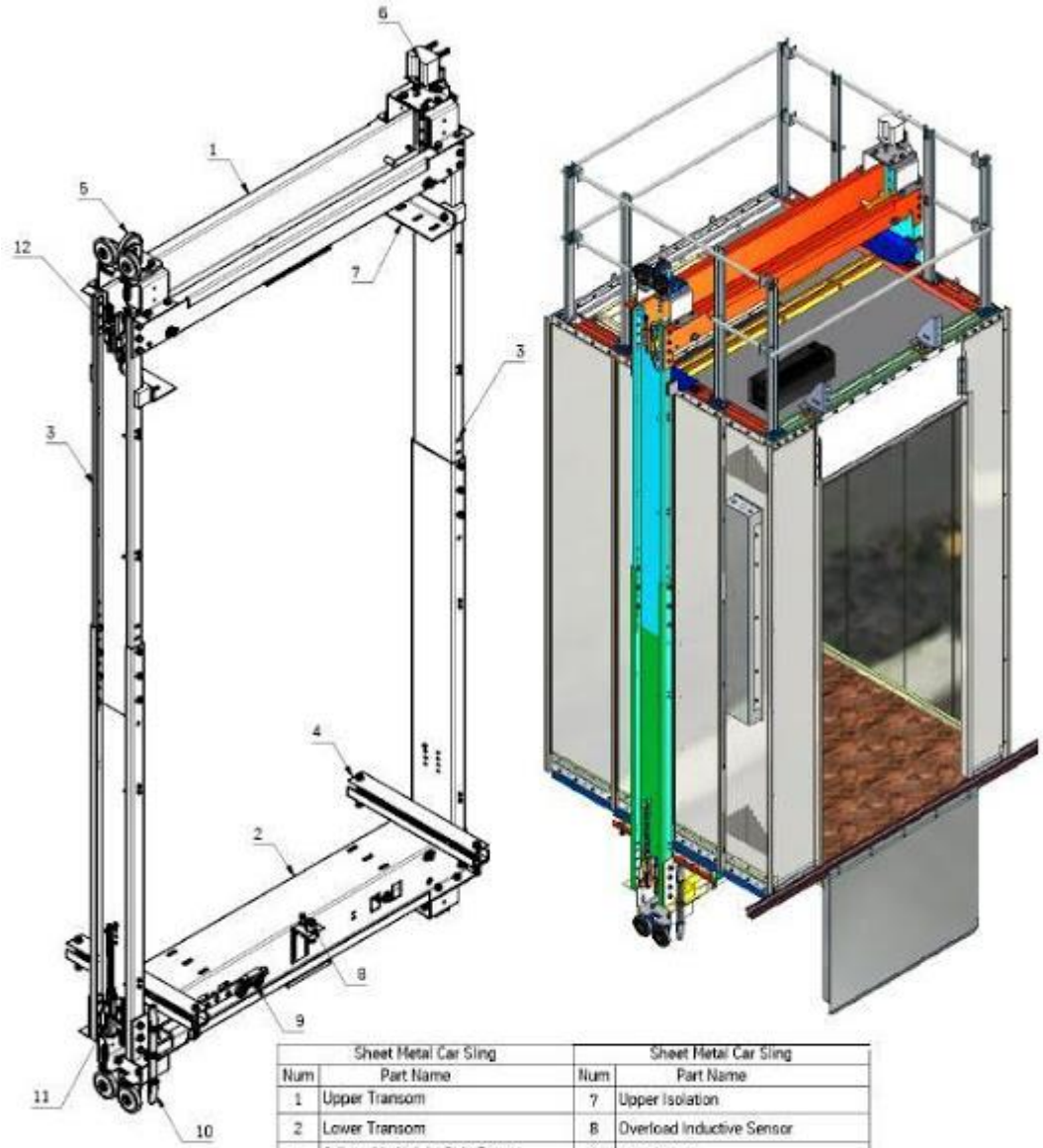
Where 75 represent the average weight of a person in KG, the value obtained for the number of passengers shall be rounded to the nearest whole number.

Type	Q (Kg)	Persons	CW(mm)	CD(mm)
Type (I)	320	4	1000	900
			900	1000
	400	5	1100	1000
			1000	1100
	480	6	1200	1100
			1100	1200
	630	8	1400	1100
			1100	1400
			1200	1300
	750	10	1400	1300
			1300	1400
	800	10	1400	1350
			1350	1400
Type (II)	1000	13	1600	1400
			1400	1600
			1100	2100
	1050	14	1600	1500
	1350	18	1600	1800
	1600	21	2100	1600
			1400	2400

Table 5.3.1.1

The Elevator Car's components:

1. Car sling, a metal framework connected to the means of suspension
2. The elevator cabin
3. Mechanical accessories which are : car door and door operation, Guide shoes, door protective device



Sheet Metal Car Sling		Sheet Metal Car Sling	
Num	Part Name	Num	Part Name
1	Upper Transom	7	Upper Isolation
2	Lower Transom	8	Overload Inductive Sensor
3	Adjustable Height Side Frame	9	Limit Switch
4	Lower Isolation	10	Actuation Lever
5	Roller Guide Shoe	11	Safety Gear (Catch Clamp)
6	Sliding Guide Shoe With Lubricator	12	Braking System (Catch Clamp)

Diagram 5.3.1.2 Car Sling Component

Elevator cabinets shall be completely enclosed by walls, floors and ceiling, the only permissible opening being are the car door, emergency trap door and ventilation apertures.

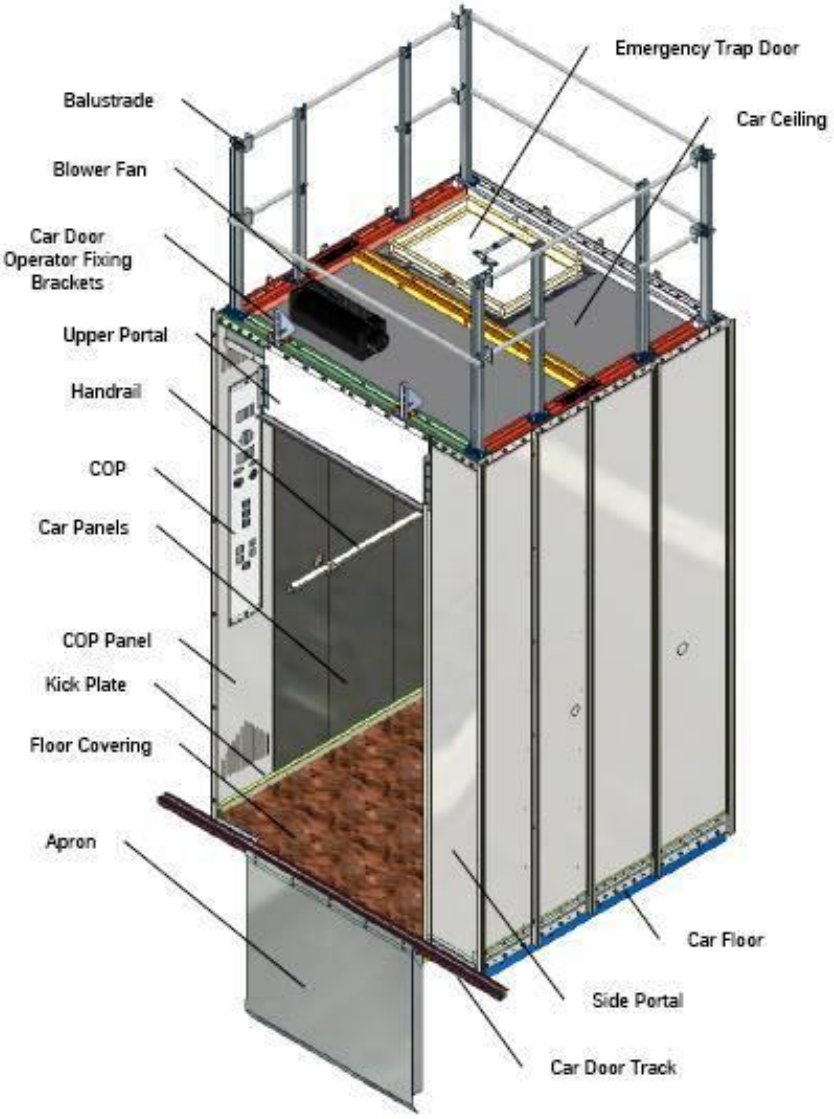


Diagram 5.3.1.3 Elevator car Component

5.3.2 Machine Room

It is located in a room on top of the lift area, aka Overhead Traction. The room is ventilated with exhaust fan above the entrance help to remove moisture and heat in the room. The machines room can be divide into several part to serve different function. The Room is make for extra strong reinforcement concrete slab by adding extra beam and steel structure on top of the motor in order to support the heavy load and prevent collapse issue happen. The machine used by KLPAC is geared-traction machine. It is powered by AC-DC electrical motor.

Figure 5.3.2.1 Exhaust Fan located in machine room

Figure 5.3.2.2 The Geared Machine on top of I-Beam Structure

Geared Machine

The geared electric motor in this design drives a gear type reduction unit, which turns the hoisting sheave. While slower than a typical gearless elevator, the gear reduction offers the advantage of requiring typically operate at speed from 350 to 500 feet per minute and carry loads of up to 1300 kg. An electrically controlled brake between the motor and the reduction unit stops the elevator, holding the car at the desired floor level.

Geared machine used in low and midrise applications. This design utilizes a mechanical speed reduction gear set to reduce the rpm of the drive motor to suit the required speed of the drive sheave and elevator.

The Component of Geared Motor: **Drive motor, brake, speed reduction unit, drive sheave, bedplate and deflector sheave.**

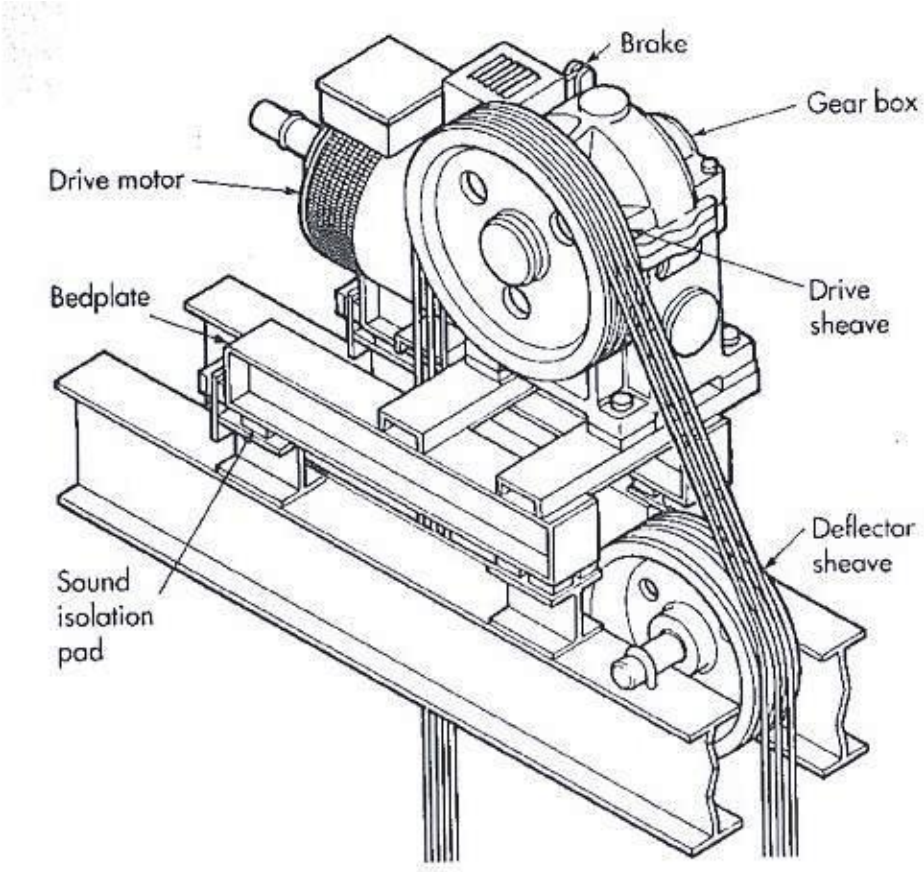


Diagram 5.3.2.1 Gear Machines Components

Fire Intercom

There are fire intercom in machine room, it serve as communication equipment during fire or for lift service specialist communicate with the control room while servicing at machine room.

Figure 5.3.2.3 Fire Intercom

5.4 Conclusion

As conclusion, the mechanical transportation system in KLPAC is serve for OKU or loading purpose, less focus on user, elevator is the only one transportation system we can found in KLPAC. The design and the application of the lift is very basic and less advance compare to other commercial building. A majority of the components adhere to their basic requirements and follow the UBBL and MS1525 requirements.

6.0 MECHANICAL VENTILATION AND AIR-CONDITIONING SYSTEM

6.1 LITERATURE REVIEW

The purpose of ventilation is to provide fresh air for comfort and to ensure healthy indoor air quality by diluting contaminants. Historically people have ventilated buildings to provide source control for both combustion products and objectionable odours (Sherman, 2004) .Nowadays, there are many type of ventilation technologies is available to provide ventilation in building including mechanical system and air conditioning system. In Malaysia, air conditioning system is the most common ventilation system we used in building services.

Air Conditioning and mechanical ventilation is a very important element inside building service. The main service of this system is to control the air circulation and maintain a good air quality. It also control air temperature and humidity in order to create a comfortable environment to users.

This research paper covers the air conditioning system and mechanical ventilation adopted by the chosen building, KL PAC which is a 4 storey of art performing centre with a 504 seats proscenium theatre. The building design to be open and airy space will require large amount of cooling load and air ventilation when having an event or show. Air-conditioning system are used as cooling strategy for the theatre to ensure sufficient fresh air are provided through air circulation.

There are four major air conditioning system – Individual system (Split unit), packaged system, Space conditioning system and Centralized conditioning system. The main type of air conditioning system used in KLPAC are **Split unit air-conditioning system** and **Centralized/Plant air-conditioning system.**

6.2 Centralized/ Plant air-conditioning system

A central air conditioning system consists of a central plant in which a boiler and chillers are located, a water system to transport hot and chilled water from the central plant to the AHUs, and an air system often with AHUs to conditioned space. There are two return air system, **Refrigerant cycle** and **Air cycle** are involved for energy saving.

6.2.1 Refrigerant Cycle and Air Cycle

The Refrigeration cycle uses a fluid, called a refrigerant, to remove heat from one place to another. There are 4 main component in this refrigerant cycle, **Compressor, Condenser, Metering Device and Evaporator**. The Compressor is the most important in these system, the compressor pumps the refrigerant through the air conditioning system at a designed flow rate and pressure. Usually the refrigerant enters the compressor it is in a vapour state and when leaving the compressor will be very high temperature. After the high temperature vapour refrigerant passes into a condenser coil will be cool down by the air passes over the coil and becomes a liquid. Thirdly, the metering device controls the flow of the liquid refrigerant to the next component which is the evaporator. Evaporator has a fan blowing across the refrigerant and let the hot air flow through the low pressure liquid refrigerant and transfer the heat into it. Since heat was removed from the air blowing over evaporator coil, the air leaving the evaporator coil is cold. This cycle usually done in cooling tower.

Air cycle is a process to distribute treated air (Cold air produced after the refrigerant cycle) into the room that needs to be conditioned. The latent heat inside the room is removed when the hot air is absorbed by the evaporator. The distribution of air can be either through ducts or chilled water pipes. Normally there will be a filter before pass through the evaporator at the air cycle is to remove the bacterial and odour from existing air and provide healthy air for the rooms. Secondly, heat inside the rooms is removed and slowly the internal air becomes cooler.

6.2.1.1 Refrigerant

Refrigerant is a chemical compound what make air conditioning possible. It can converts from liquid to gas and back to liquid in a continuous cycle. For years, the most common refrigerant used in air-conditioning system was R-22 (figure 3.2.1.1). But due to nowadays in response to growing environment concerns, production of system using R-22 refrigerant is being reduce. The main reason for this reduction is because R-22 is hydrochioroflurocarbon (HCFC) compound, which contains ozone-depleting chlorine. The refrigerant used by the air conditioning system of KLPAC is R-410A (Figure 3.2.1.1), this refrigerant contains no chlorine, it is considered ozone-friendly. R-410A design to be improve reliability, quieter operation, improved dehumidification and enhanced heat pump performance.

Figure 6.2.1.1.1 The type of refrigerant (R-22) .

Figure 6.2.1.1.2 Type of refrigerant (R-410A) used in KLPAC's air conditioning system

6.2.1.2 Components

Condenser Water Pump

Condenser water pump optimized the flow rates in the condenser water system provide installed and operating cost savings in chilled-water system.

Condenser pumps do not run continuously. They are usually connected to a tank into which steam condenses into water. There is a float in this tank that tells the condenser pump when to turn on and when to turn off. When there is enough water in the condensation tank (the float is high enough) the pump turns on. When there is very little water in the condensation tank (the float is low) the pump turns off. Some tanks have two floats or a single float that registers two levels. At the first level the pump starts, but the second level is reached and the entire HVAC system is closed down. When the second level is reached it means something is blocking the functioning of the condenser water pump. (Pick, 2015)

Figure 6.2.1.2.1 Condenser Water Pump with Condenser water supply pipe

Water chiller System

Water chiller is a machine that removes heat from a water via a basic refrigeration cycle. A direct water chilling system utilizes a refrigerated cooling coil that can absorb the heat from the water. Once the water reaches the desired temperature, it will be pumped to air handling unit through chiller pipe, as known as CHWS – chiller water supply and return through CHWR-chill water return.

Figure 6.2.1.2.2 Row of the outdoor water chiller located beside the KLPAC.

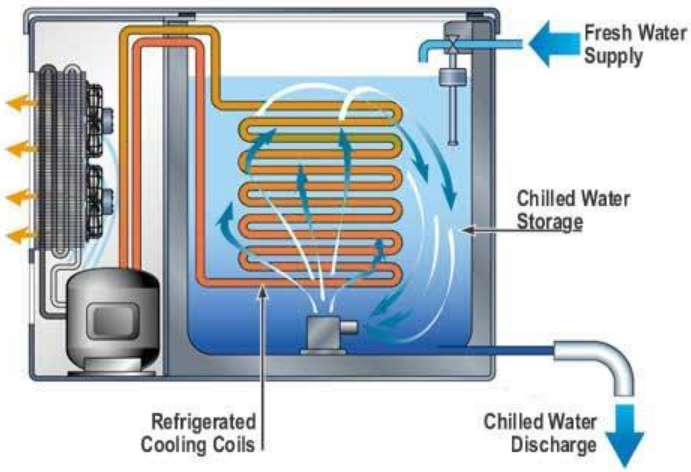


Figure 6.1.2.2.3 Direct water chilling system diagram.

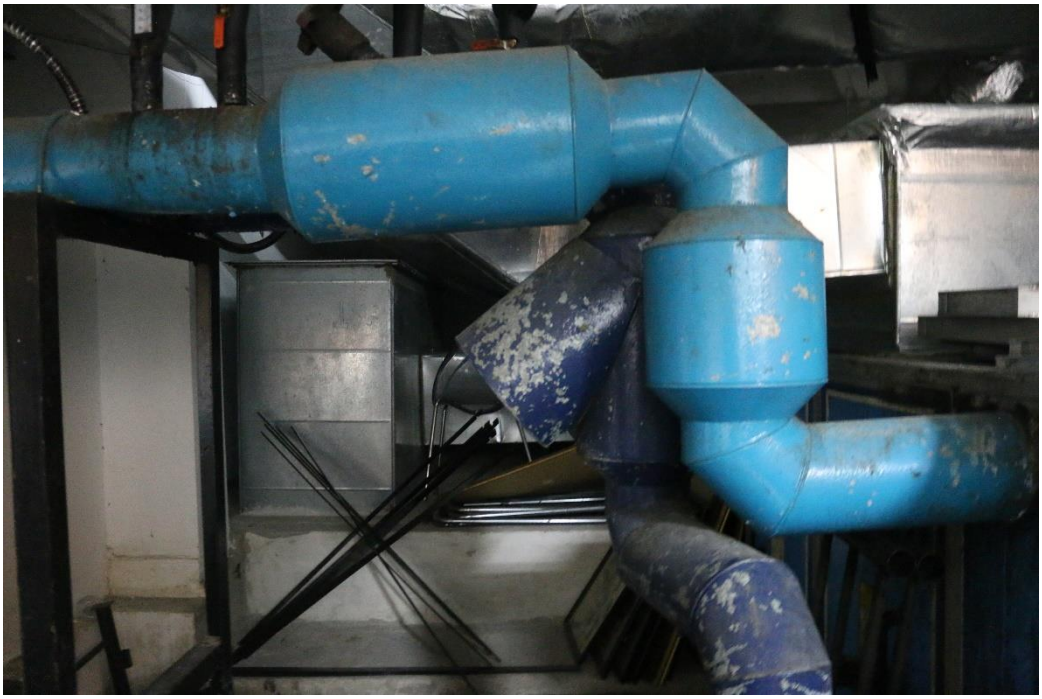


Figure 6.1.2.2.4 Chiller water supply Pipe (CHWS)

Figure 6.1.2.2.5 Chiller water Return Pipe (CHWS)

6.2.2 HVAC (Heating, Ventilation and Air Conditioning) system

According to UBBL Law 41(2): Any application for the waiver of the relevant by-laws shall only be considered if in addition to the permanent air-conditioning system there is provided alternative approved means of ventilating the air-conditioned enclosure, such that within half an hour of the air-conditioning system failing, not less than the stipulated volume of fresh air specified hereinafter shall be introduced into the enclosure during the period when the air-conditioning system is not functioning.

HVAC is a system comprises of the heating or cooling producing equipment, pumps and fans, piping network and exchangers transferring or absorbing heat from a space or a process. HVAC system usually will be install on larger building such as offices, shopping mall and commercial building etc. There are three main components: refrigeration plant, air handling unit (AHU)/Fan coil unit (FCU) and chiller. In this topic we going to study more on Air handling unit and Fan coil Unit which it is installed and used at the KLPAC.

6.2.2.1 Air Handling Unit

An air handling unit is the primary equipment in a centralize air conditioning system. It handles and conditions the air and distributes it to various conditioned spaces. In an AHU, the required amounts of outdoor air and recirculating air are often mixed and conditioned. The temperature of the discharge air is then maintained with predetermined limit by means of control systems. After that, the conditioned supply air is provide with motive force and is distributed to various conditioned spaces through duct work and space diffusion devices. (K.Wang, 2001)

Classifications of Air Handling Units:

- Horizontal/ Vertical Unit
- Draw-Through Unit
- Outdoor Air AHU / Mixing AHU
- Single-Zone AHU/ Multi-zone AHU
- Factory-Fabricated AHU
- Rooftop AHU/ Indoor AHU

Main Components of AHU:

- Casing
- Fans
- Coils
- Filters
- Humidifiers

Horizontal Unit

There are total 5 horizontal air handling unit install in KLPAC. In the Horizontal unit all of the main components are installed at the same level. Horizontal unit need more space for installation and they are mainly used as large AHUs. Most horizontal unit are installed inside the specific fan room.

Figure 6.2.2.1.1 Horizontal Air Handling Unit with modular design

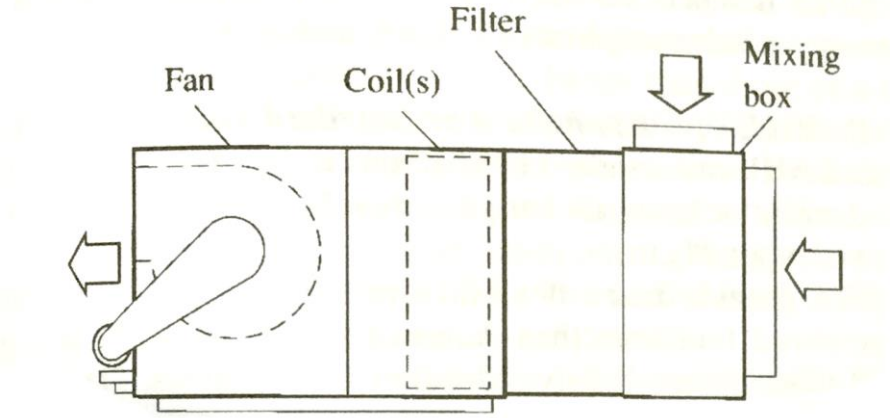


Figure 6.2.2.1.2 Horizontal Air Unit Diagram

Duct System

Duct system are used for delivery and remove air to AHU, through sheet metal ducts. These sheet metal duct discharge the air into the office space, and supply through air diffuser located on the drop ceiling or on the wall. The outside air is drawn through a duct which is usually located on the roof of the building, and the return air is delivered to the supply fan by the return or exhaust fan.

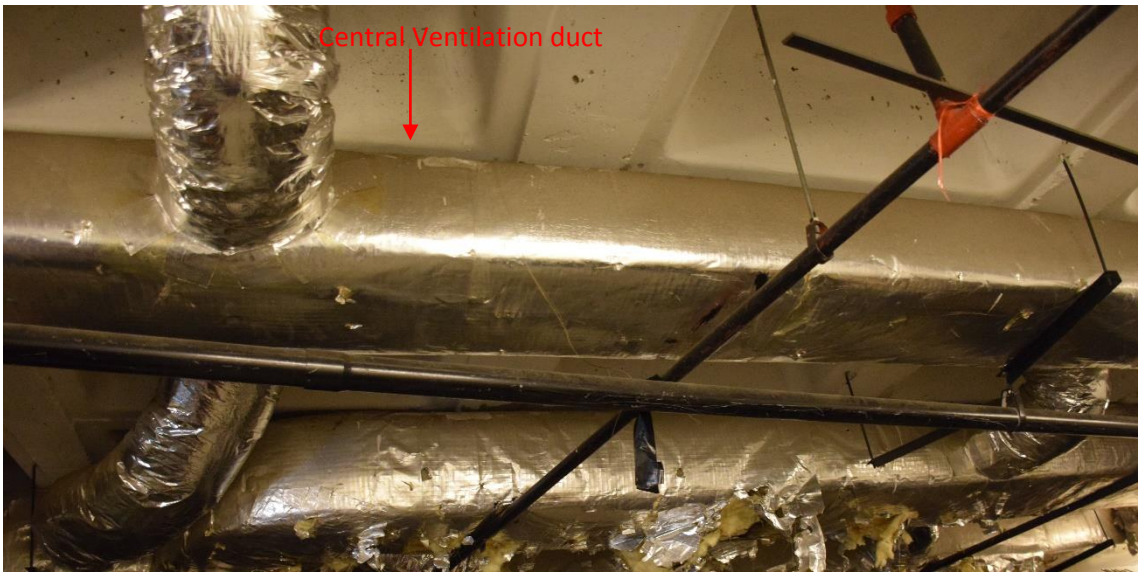


Figure 6.2.2.1.3 Sheet metal Duct System

Figure 6.2.2.1.4 Sheet metal Duct output from AHU

Figure 6.2.2.1.5 Ceiling Diffuser

Figure 6.2.2.1.6 Service Main whole for Ducting system

6.2.2.3 Fan Coil Unit

A two pipe fan-coil system includes boilers and chiller s in the central plant, water system supplying chilled or hot water to the fan coils, a space recirculating system using fan coils to condition the space recirculating air, and dedicated outdoor ventilation air system using an outdoor air AHU to condition the outdoor air. Both the space recirculating and dedicated outdoor air systems have duct, diffusers, inlets, controls, and accessories

Fan coil unit in the form of terminals, are installed directly above or within the conditioned space, or very near to it. There is no return duct in a space conditioning system except the large core water-source heat pumps. Only a delivery outlet or a short recirculating duct supplies conditioned air to the perimeter zone. There is less cross-contamination between rooms and control zones. There is only low efficiency filter are used in fan coils unit. It unable to remove particulates of size less than 3um. (K.Wang, 2001)

Figure 6.2.2.3.1 Fan Coil Unit

Figure 6.2.2.3.2 Fan Coil Unit Diffuser

Figure 6.2.2.3.3 Fan Coil Unit Diffuser (Cassette Type)

6.3 Conclusion

The Mechanical Ventilation System of KLPAC was installed according to the UBBL requirement and regulation, each mechanical ventilation system is equipped with the components that required by UBBL. Air Ventilation is the most important part inside a building, it provide fresh air to the indoor and improve the air quality. It also provide a comfortable environment for the user and increase the work efficiency.

As Conclusion, although KLPAC is a small size commercial centre, but the mechanical ventilation system of KLPAC is in appropriate to the building size. Every mechanical components are also adequate for a building of that scale. An appropriate mechanical ventilation system will save the costing of electrical bill and more sustainable to our environment.

7.0 FIRE PROTECTION SYSTEM

7.1 Literature review

Fire has always been a threat to users' safety within or within a close proximity with a building. Hence, establishing a proper and well-maintained fire protection system is essential in ensuring the safety of the users.

Fire services should respond to fire at the soonest possible so that the damages caused can be mitigated. Also, the construction of buildings in Malaysia must be done in accordance with Uniform Building by-Laws (UBBL).

In general, fire protection system can be classified into two main categories as illustrated in the diagram below.

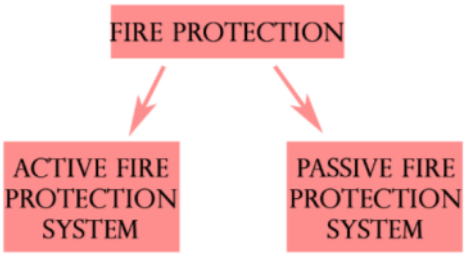


Figure 7.1.1

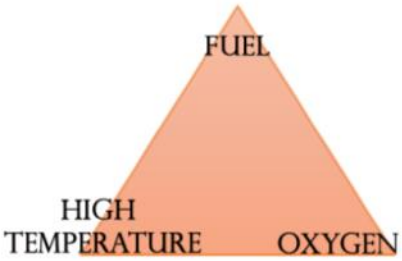


Figure 7.1.2 Triangle of needs

Figure 2 shows the 3 different requirements needed to trigger a fire. In the absence of any one, the fire will be extinguished.

For a fire to keep its combustion there must be enough oxygen, heat and high temperature. Vice versa, to put fire out, these elements have to be in absence.

HEAT (High temperature)

A fire cannot be ignited unless there is a certain amount of heat present. A fire will also not grow without the presence of heat. Thus, to put fire out, one of the very first steps firefighters do is to introduce a cooling agent, which in general, is water or fire extinguishers.

FUEL

In order to keep the combustion, a fire needs fuel source. These sources can be anything as long as it is flammable, ranging from wood to chemicals. Once the fuel element is removed, the fire will extinguish.

Oxygen

This is an essential component of fire combustion. A decrease in the oxygen concentration retards the process of combustion.

However, this is normally not an option for firefighters in an extended area because it is impossible to decrease the oxygen concentration.

According to http://www.firesafe.org.uk/, there are three stages of fire, which are the incipient stage, the smoldering stage and the flame stage.

Incipient stage

This stage is a region where preheating, distillation and slow pyrolysis are in progress.

Smoldering stage

This stage is a region of fully developed pyrolysis that begins with ignition and includes the initial stage of combustion

Flaming stage

This stage is a region of rapid reaction that covers the period of initial occurrence of flame to a fully developed fire.

7.2 Active Fire Protection System

7.2.1 Introduction

Active fire protection is a process of protecting a building from fire using methods which involves the action of moving parts. They can range from being automatic or manual-operation. This system plays an essential role in protecting the property as well as occupants of the buildings.

One main feature of active fire protection system is that this system involves the action ranging from reducing the progress of fire to notifying the presence of fire as well as smoke conditions. This active system is unlike passive fire protection which uses things that could slow or contain a fire.

There are a few stages to the active fire protection. The stages are as follow:-

1) Detecting the fire, by detecting the presence of heat, smoke or flames. The detection is normally done by the automatic fire alarm system.
2) Once they are detected, the active system will be operated automatically.

The active system is exceptional useful in larger buildings where it is difficult to ventilate the central areas through openings. One of its purposes is to improve the visibility in the building to enable occupants to escape smoothly as well as preventing flashover.

According to UBBL, “wet rising system” means any permanently charged vertical water main installed for fire-fighting purposes, of an appropriate size and fitted with connections suitable for use by the Fire Authority and to comply with the requirements of BSCP 402.101.

7.2.2 Riser system

7.2.2.1 Introduction

In large buildings, they have an internal system of water mains, also known as standpipes which are connected to fire-hose stations and landing valves.

There are 2 types of riser systems, which are ‘Wet risers’ and ‘Dry risers’.

7.2.2.2 Analysis

<u>WET RISERS</u>

Wet risers are a form of internal hydrant for the fireman to use and are always charged with water. This system comprises duty fire pumps with standby pump discharging into rise pipe with landing valves at every level and to jet at the fire.

Jockey pump is installed to maintain the system pressure.

Fire pumps are installed to boost the water pressure in the sprinkler and standpipe systems. They also deliver the required amount of water. Their pipes are also supplying pressurized water to the hoses at all times.

Pumps included are:-

1) Jockey pump

   The first pump to start will be this pump. The controlling pressure switch is set to have the pump started when the pressure reading indicates 150 psi and to stop when the pressure hits 230 psi.

   Connected to a fire sprinkler, this pump is intended to maintain the pressure in the sprinkler system at an artificially high level. At the operation of the fire sprinkler, the pressure drop will be detected by the fire pump automatic controller, hence prompting the fire pump to start.

   The function of jockey pump is to maintain the water pressure in the pipes at a specific level at the absence of fire, thus preventing the sprinkler system from going off.
   Also, if there is minor leakage in the wet riser piping, the pump will start too to compensate for the leak.

Figure 7.2.2.2.1 Jockey pump

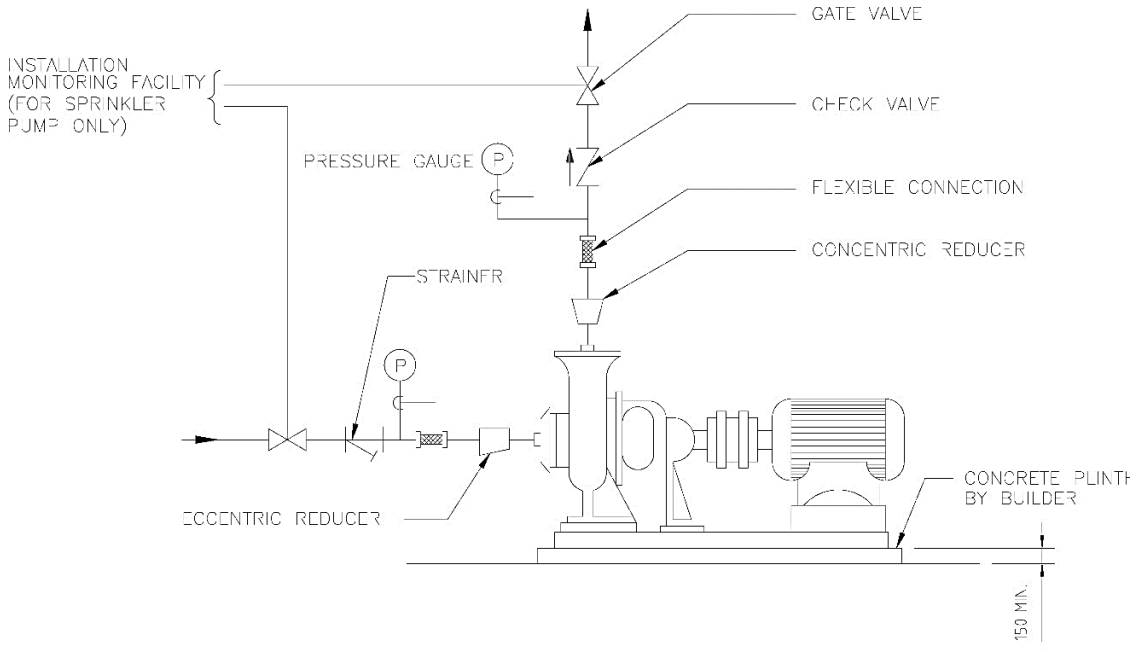


Diagram 7.2.2.2.1 Typical pump connection detail

2) Duty pump

When the pressure in the pipe goes down to below 125 psi, this means either a hose reel gate valve or a wet riser landing valve has been opened. Hence, duty pipe will be commanded on by the pressure switch which detects the drop in pressure.

However, if the Duty pump fails to function, an alarm will be issued and standby pump will be activated automatically by the system.

The standby-pump will continue its operation until the duty pump is fixed and functional again.

Figure 7.2.2.2.2 Duty pump

3) Stand-by pump

However, if the pressure keeps dropping to below 125 psi, it means that either the duty pump is not started or is not available. The stand-by pump is set to be started at a pressure reading of 95 psi.

Once water is no longer requited, the pressure will build up in the piping network. Once the pressure reached 220 psi, the duty pump or stand-by pump will stop.

Figure 7.2.2.2.3 Stand-by Pump

DRY RISERS

Dry risers are a form of internal hydrant system for the usage of the firemen.

These risers are normally dry, as its name implies. This system is dependent on the fire engine to pump water into the system.

Dry riser system has a riser pipe with landing valves at every floor to in which rubber-lined hose with nozzles can be connected to direct the water jet at the fire.

This system is commonly found in cold countries because when the temperature gets below freezing point, it would be hard to keep the pipes insulated.

According to UBBL Section 133, “dry rising system” means a vertical water main which is normally dry, of appropriate size, and fitted with hydrant outlets which can be charged with water by the Fire Authority’s pumps via a fire service inlet and shall comply with BS 3980 and BSCP 402.101

7.2.3 Suppression gas system

7.2.3.1 Introduction

Suppression gas extinguisher system encompasses of gas cylinders, discharge nozzles, steel piping, heat and smoke detector and a control panel which serves to monitor the space which is responsible in releasing the gas.

7.2.3.2 Analysis

The gas would only be discharged after a time delay which is used to warn the occupants to evacuate from the room. This system is normally provided for electrical transformer room or switch room. This system should not however, be installed in room which is normally occupied.

As the gas is dry and non-conductive, this made it an ideal choice to contain fires from electrical equipment. Also, due to the properties of carbon dioxide which is heavier than air and can flow around obstacles to reduce the oxygen content from 21% to 15%, this reduces greatly the important component in the combustion process.

Figure 1.2.3.2.1 Carbon dioxide suppression system

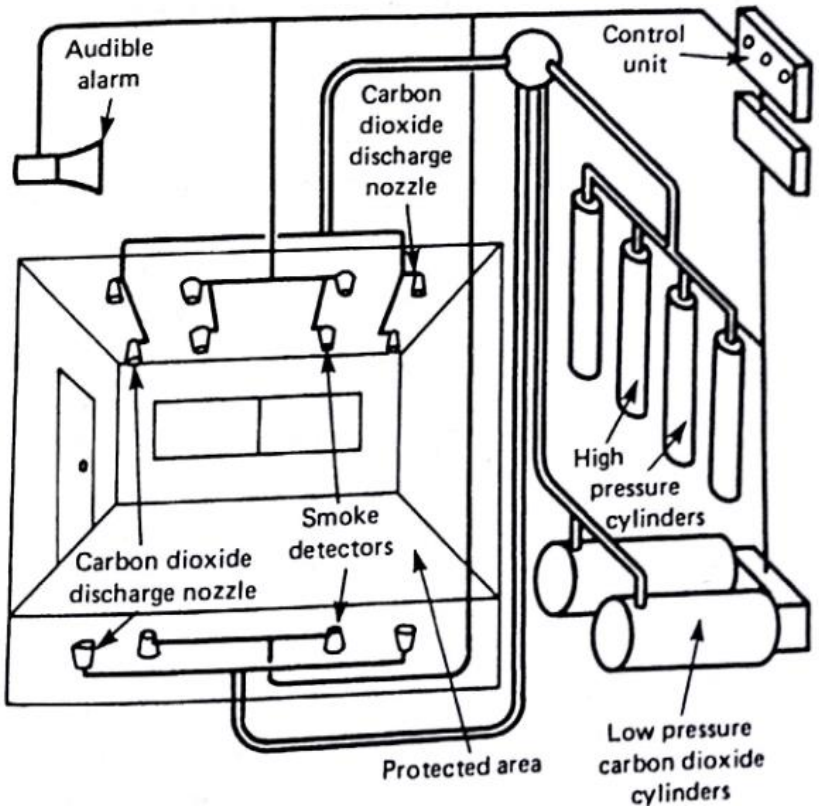


Diagram 7.2.3.2.1 Carbon dioxide suppression system installation

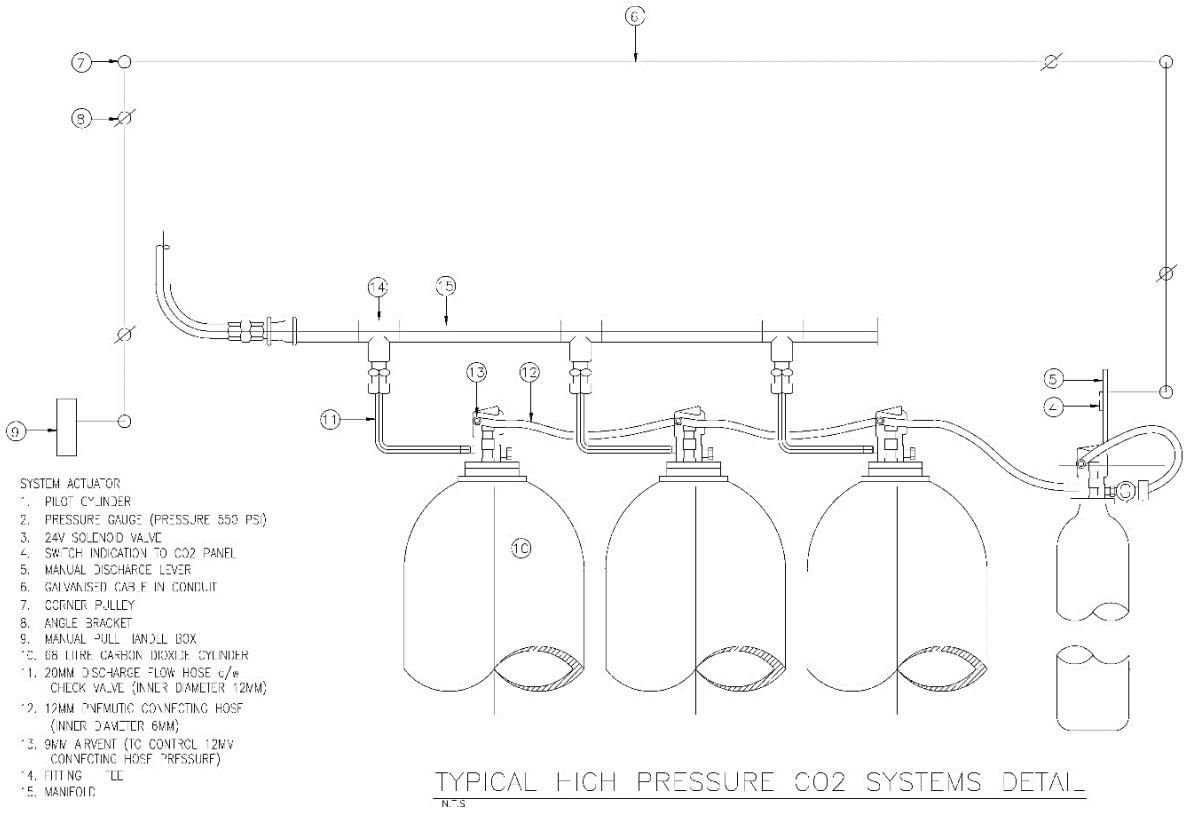


Diagram 7.2.3.2.2 Typical High Pressure Carbon dioxide Systems Detail

7.2.4 Fire extinguishers

7.2.4.1 Introduction

There are four different types of fire extinguishers. Each type is meant for different type of fire. Each fire extinguisher also has a numerical rating in which the fire-fighting power increases as the number goes higher.

7.2.4.2 Analysis

CLASS A

This type of fire extinguisher is for normal combustible materials like paper, cardboard or wood.

The numerical ratings indicated are the amount of water they hold and the amount of fire they can put out.

CLASS B

This type of fire extinguisher is designed for flammable or combustible liquids like gasoline, grease, kerosene and oil.

The numerical rating indicated is to inform users the approximation number of square feet fire it can put out.

CLASS C

This type of fire extinguisher is for electrical equipment like circuit breakers, wirings and outlets. It is important to note that water must never be used to extinguish class C fire as there is the risk of getting electrocuted.

There is no numerical rating for Class C extinguishers.

Figure 7.2.4.2.1 Fire Extinguishers

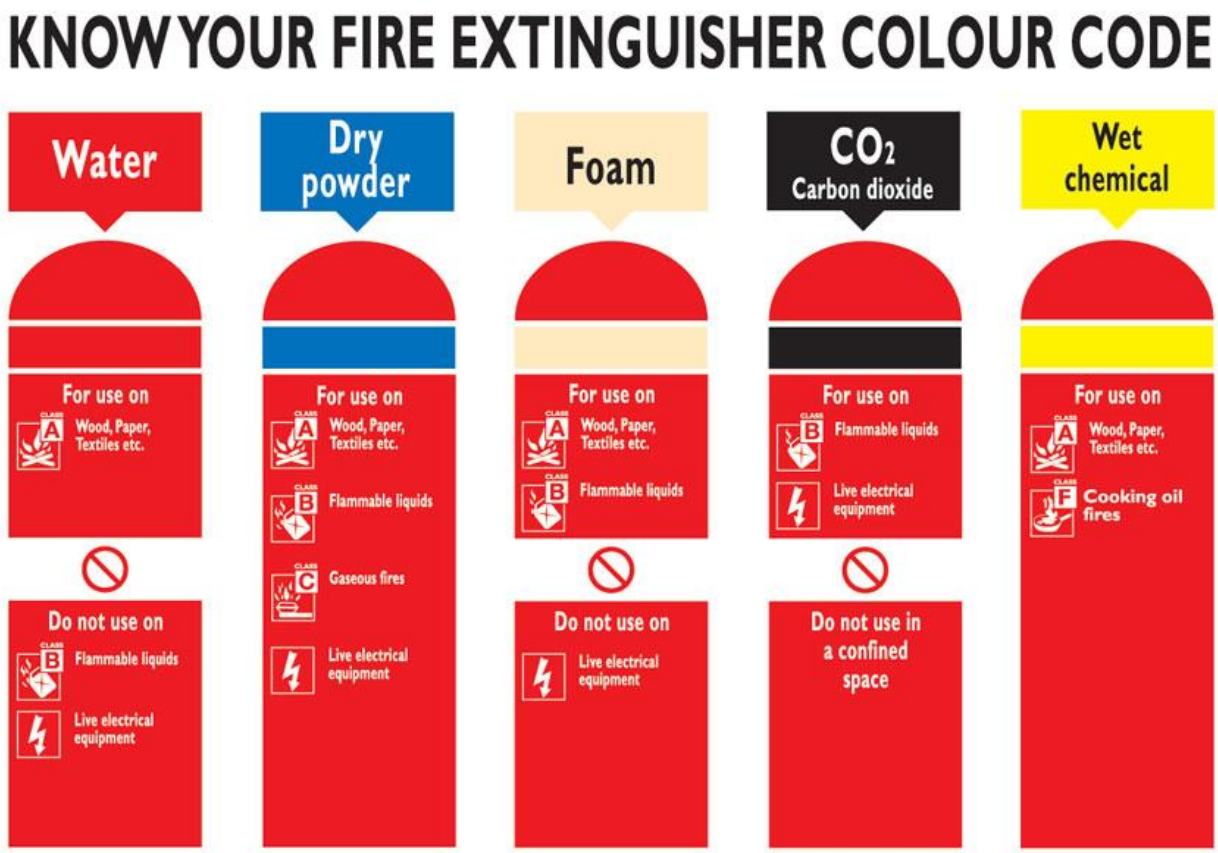


Figure 7.2.4.2.2 Fire Extinguishers Color Coding

7.2.5 Fire sprinkler system

7.2.5.1 Introduction

The sprinkler system consists of a network of water pipes distributed throughout the building. This system, also known as water sprinkler is an automatic spray which responds immediately to heat. At the presence of high temperature, the sprinkler heads which have temperature sensitive elements (small discharge nozzles with liquid filled with glass bulbs) will open automatically and emits water spray.

7.2.5.2 Analysis

When there is fire, heat emitted from the fire expands the liquid in the glass bulbs of the sprinkler heads causes the glass to break which then release water onto the fire.

Provision must also be made to ensure there are adequate water supply, pressure and backup pumping power. Maintenance must be carried out to make sure the system can be put to function in the event of a fire.

Sprinkler pump sets which are located In pump rooms boost the water flow and pressure in the system when a sprinkler head is activated.

Also, sprinkler system uses less water to keep fire in control if compared to firefighting services. This can then reduce the damage from excess water.

According to UBBL Section 133, “Sprinkler installation” means an installation of water supplies, pump, pipes, valves and delivery points so arranged as to automatically detect a fire and attack it with water, sound an alarm and installed in accordance with the current edition of the F.O.C. Rules for automatic sprinkler installations or other approved standards.

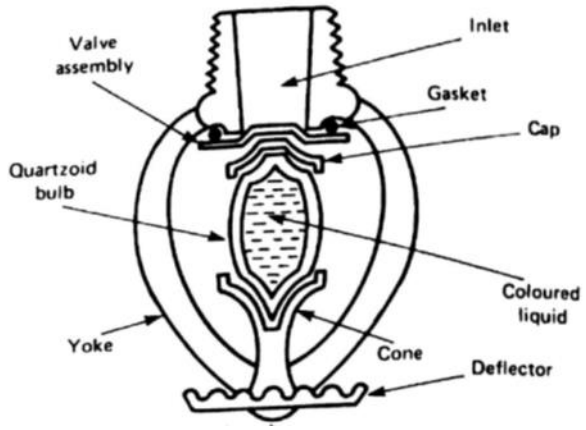


Diagram 7.2.5.2.1 Bulb head detailing

Figure 7.2.5.2.1 Sprinkler head

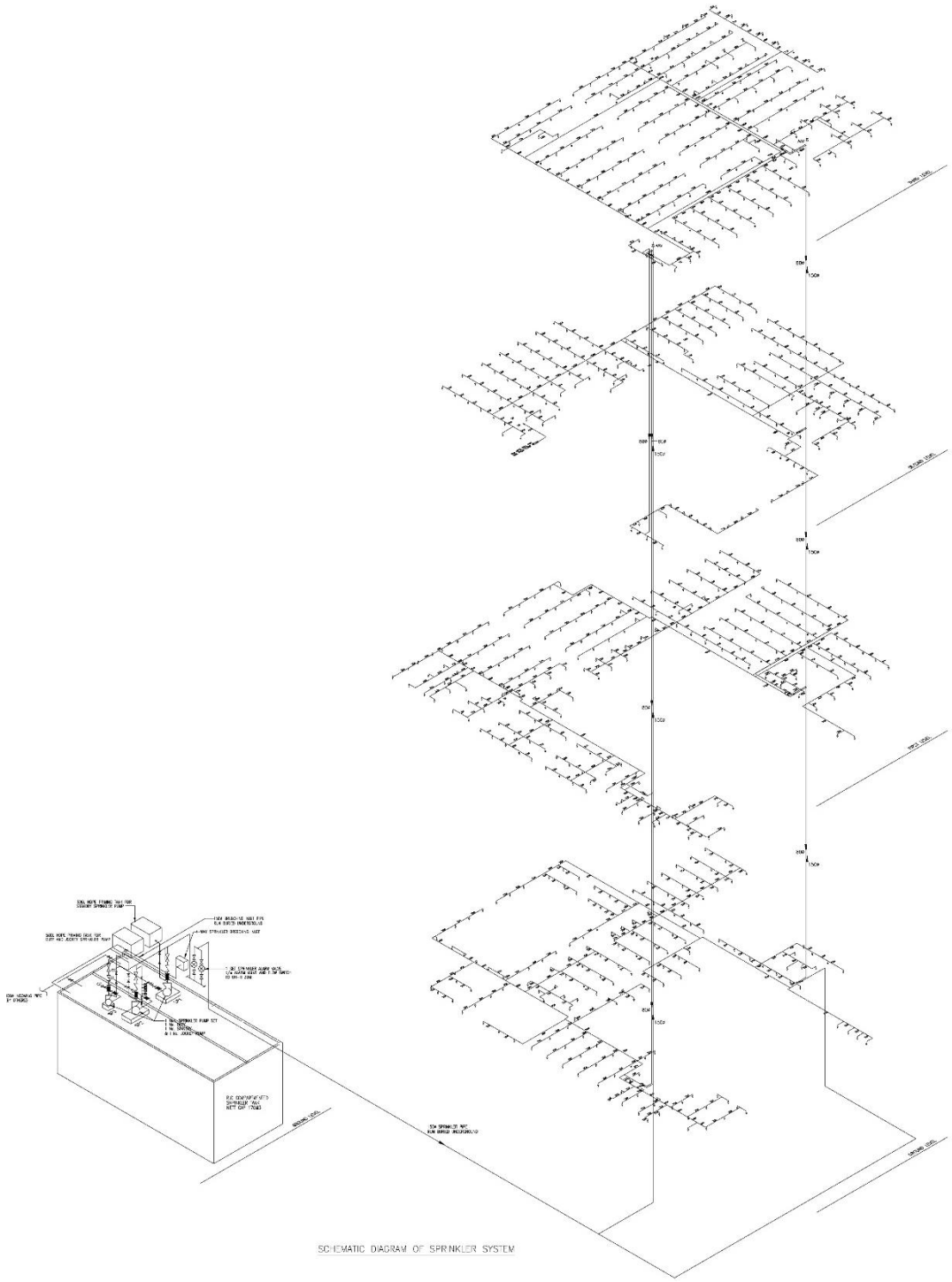


Figure 7.2.5.2.2 Sprinkler System network

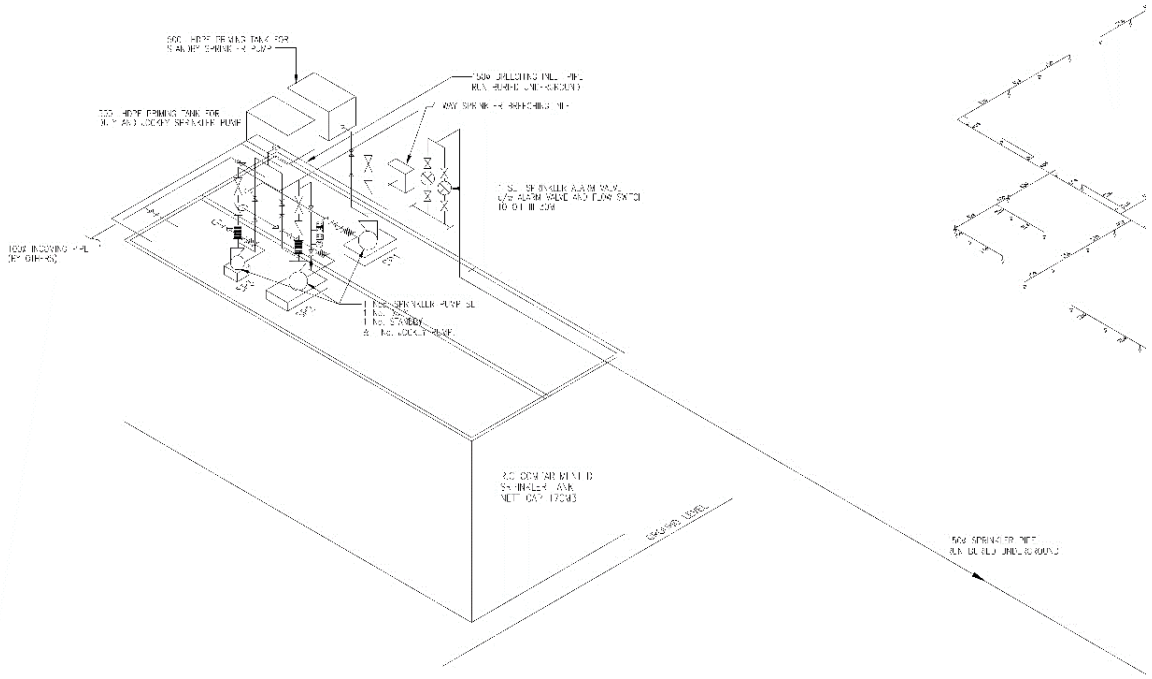


Figure 7.2.5.2.3 Close up of the pump system

7.2.6 Hose reel system

7.2.6.1 Introduction

The hose reel system installation is inclusive of the following:

1. 1 no. of 2HP Duty and Standby electrical pump located in the fire pump room.
2. 1 no. of starter control panels located in the pump room.
3. 15 nos. of 1” diameter swing type hydraulic hose reel drums

7.2.6.2 Analysis

In the case of pressure dropping caused by the use of Hose Reel, the Hose Reel duty pump would start automatically once the pressure drop to 90% of the standing pressure. The duty pump will stop automatically at standing load pressure.

Intended for the occupant to use during the early stages of a fire, hose reel system comprises hose reel pumps, hose reels, fire water storage tank, pipe work and valves.

Hose reels should be located where users are at lowest risk to be endangered by fire. They are connected to the pipe risers at each floor. Designed to provide a front line defense against small fires, they are also manually operated.

According to UBBL Section 135, “hose reel installation” means an installation of pipes, water tanks, pumps and hose reels in a building to provide a ready means by which a jet of water can be delivered in any part of the building for the purpose of firefighting and to comply with BSCP 402.101.

Figure 7.2.6.2.1 Hose Reel

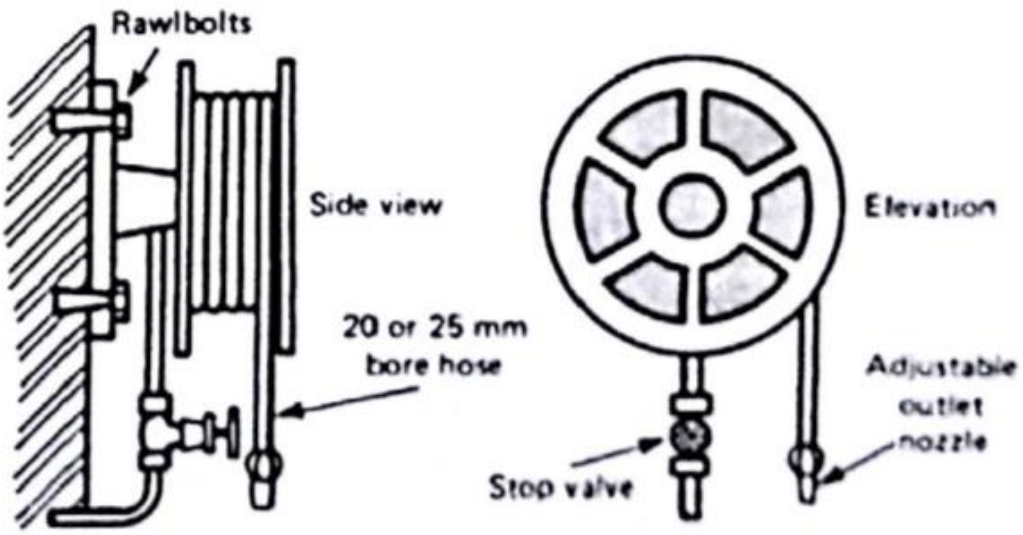


Diagram 7.2.6.2.1 Typical Hose Reel Detailing

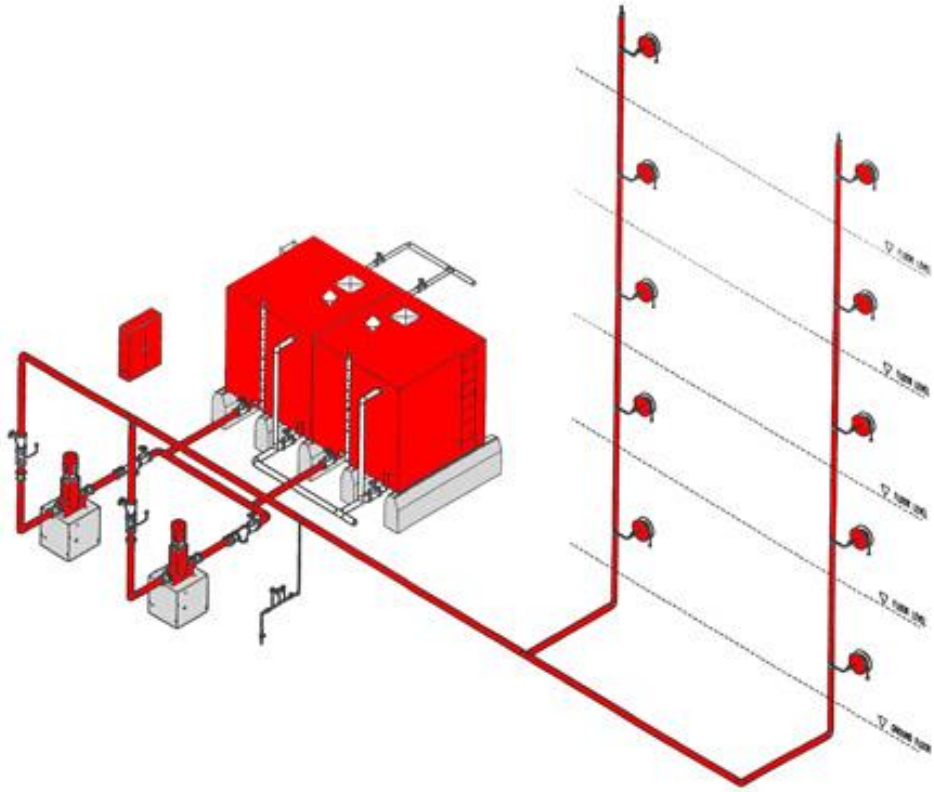


Figure 18 Hose Reel System Distribution Diagram

7.2.7 External water hydrant

7.2.7.1 Introduction

Fire hydrant installation is a pipe work system connected directly to the water supply main which provide water to all hydrant outlets. Their function is to provide fireman with water to fight a fire.

7.2.7.2 Analysis

Water will be discharged into the fire engine form which will then be pumped and sprayed over fire.

The pipe network is constantly under pressure. Hence, when the water hydrant is operated for fire extinguishing it will immediately channel water supply, starting the hydrant pump automatically.

Jockey pump is installed in case of minor leakages. The pump maintains the pipe network under pressure. During fire operation however, the small capacity of jockey pump cannot maintain the pressure hence the main pumps will be operated automatically, supplying water to the system.

Figure 7.2.7.2.1 External Fire Hydrant

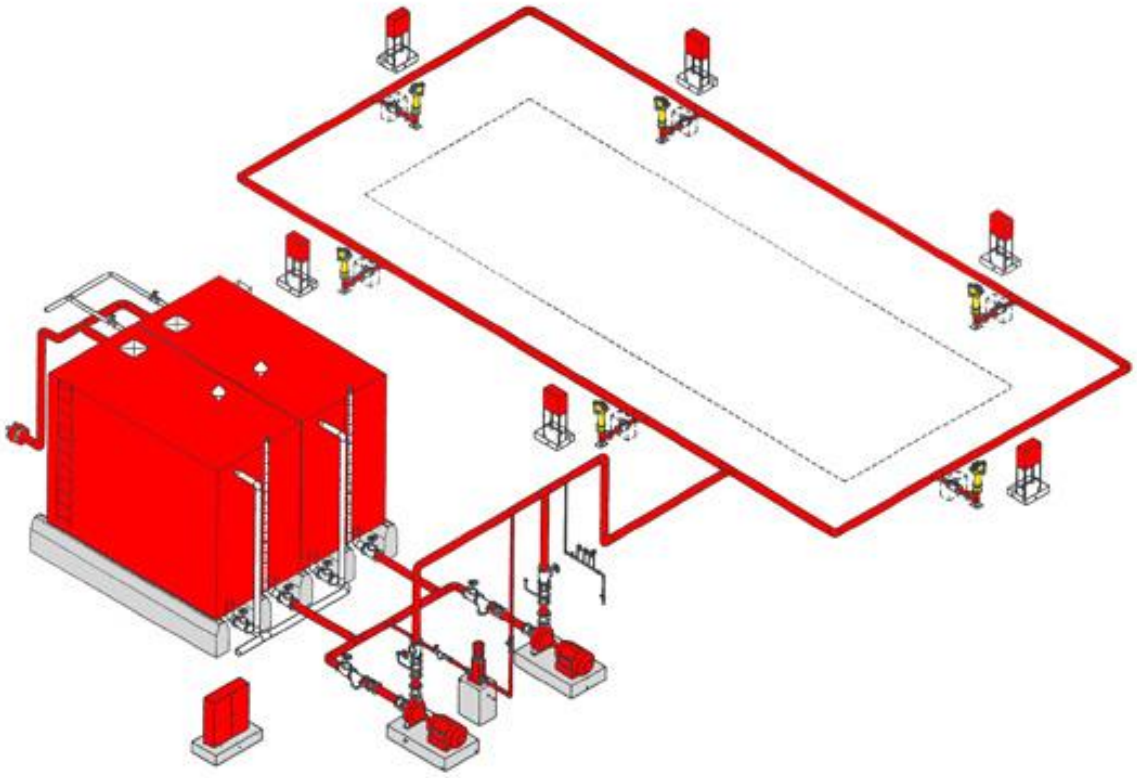


Figure 7.2.7.2.2 Fire Hydrant System Distribution Diagram

Figure 7.2.7.2.2 shows the flow of water from the storage tank through the jockey, and standby-by pumps to the external fire hydrants.

7.2.8 Smoke extraction and ventilation system

7.2.8.1 Introduction

Smoke kills more people in fires than heat, flames or structural collapse. Hence, it has made the public more aware of the importance to have efficient smoke extraction system.

The automatic fire ventilation functions it to remove smoke. Heat and toxic gases from the building. The roof can be divided into sections through the usage of fireproof screens which may be permanent or functions only in the event of smoke detection.

7.2.8.2 Analysis

The fire vents are fitted at the highest part of each roof sections. As smoke and heat rise to the roof section, the ventilators will then open.

This removes the smoke and provides the occupants with a clear vision, free from the smoke. Hence, the occupants can escape swiftly.

This system is therefore essential to make ensure appropriate fire safety within a building and maybe useful for: -

a) Life safety
   The system is to be designed to maintain tenable conditions on escape route and in other areas throughout the period they are likely to be used in by occupants of the building.
b) Smoke purging
   The system is to be designed to enable smoke to be cleared from a building after the fire is brought under control.

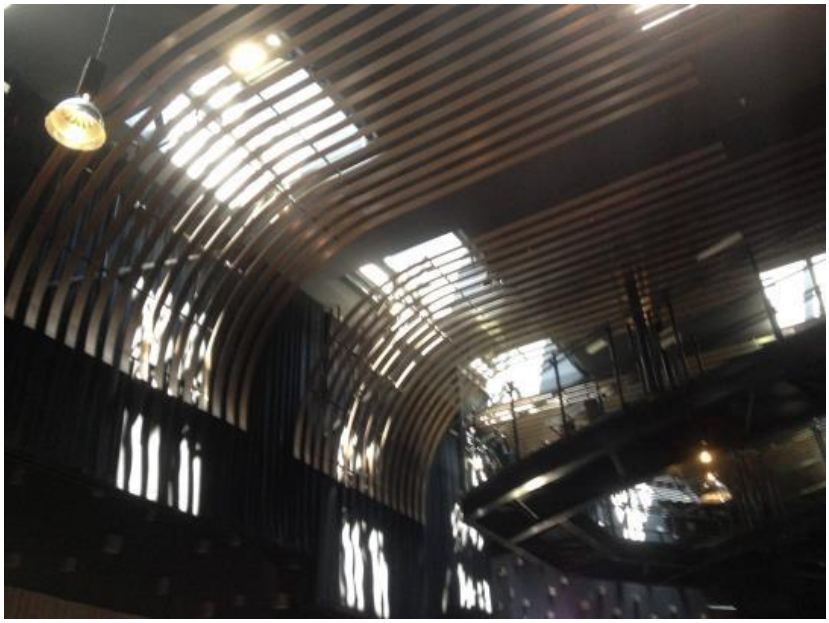


Figure 7.2.8.2.1 Smoke Ventilation Flap

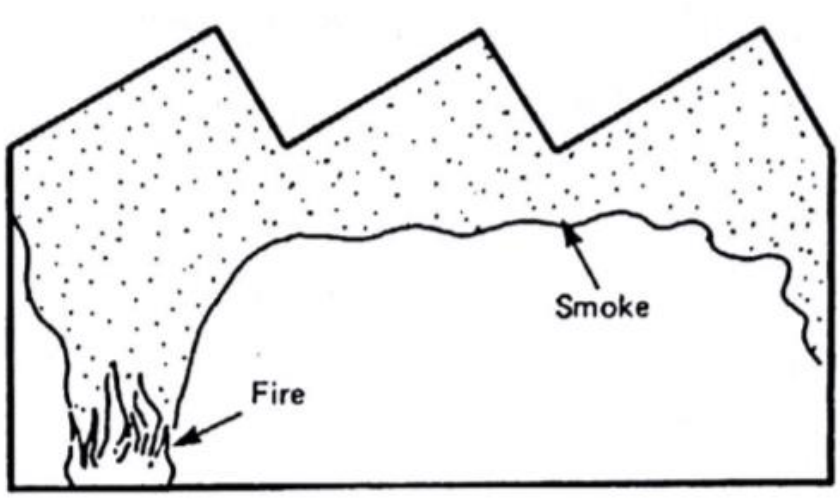


Figure 7.2.8.2.2 Fire in unvented building showing unrestricted spread of smoke

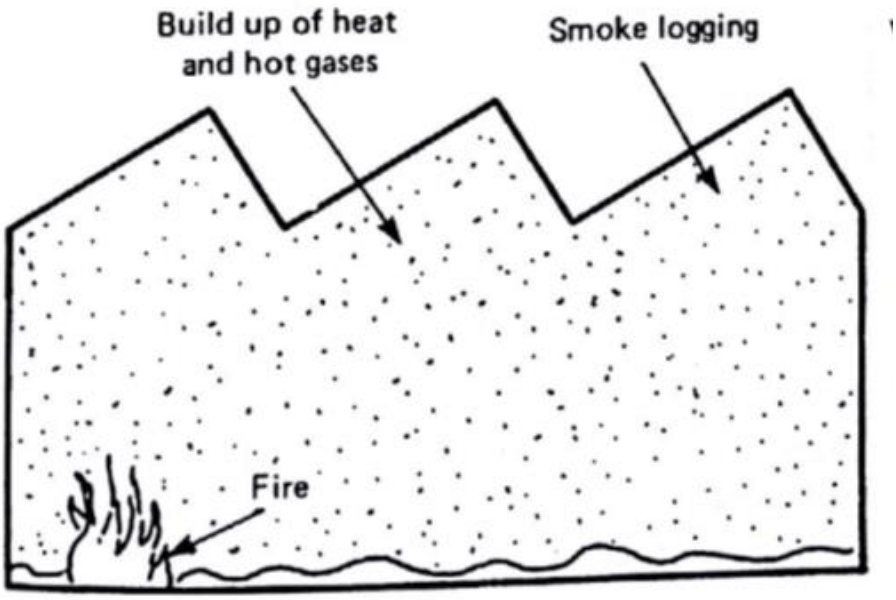


Figure 7.2.8.2.3 Fire in unvented building showing ultimate smoke logging

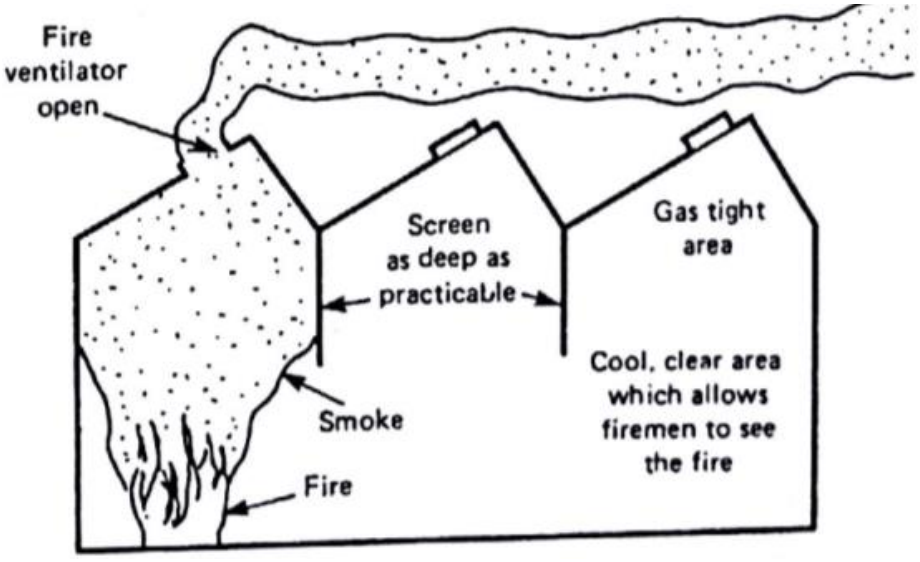


Figure 7.2.8.2.4 Fire in vented building showing restricted spread of smoke.

The fire ventilator may also be used for normal ventilation

7.2.9 Smoke detector

7.2.9.1 Introduction

There are four types of smoke alarm –ionization, photoelectric, heat and combined. The smoke alarm employed in KL PAC is photoelectric smoke detectors.

7.2.9.2 Analysis

A light beam of light shoots directly above a photoelectric sensor which receives and detects the light. Normally, the beam of light hits the sensor. However, when a high concentration of smoke is present, the some particles disrupt the light beam and act like mirrors which reflects the light and hence the light bounces off the sensor. This will then trigger an alarm to sound.

According to UBBL Section 153.1, all lift lobbies shall be provided with smoke detectors.

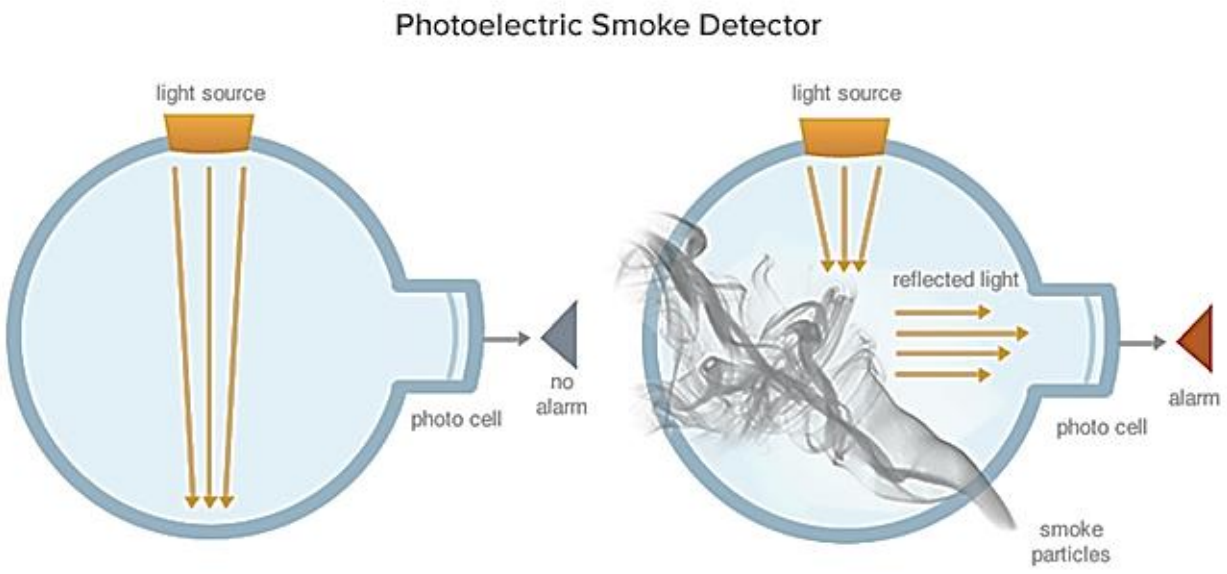


Figure 7.2.9.2.1 Photoelectric Smoke Detector

Figure 7.2.8.2.2 Smoke Detector

7.2.10 Manual fire activation

7.2.10.1 Introduction

This fire alarm system is a device which enable occupants to start the fire alarm if there is a fire incident through breaking the glass to activate it.

7.2.10.2 Analysis

Unlike smoke and heat detectors, manual fire alarm requires human activation. In general, most manual fire alarm activation in Malaysia is a manual call point. Nearly all call points operated through the breaking of the glass surface which then activates the micro-switch inside the call point. Also, they are generally connected to the fire alarm system of the building too.

Manual call points should be located at all escape routes and final exits so that as occupants evacuates the building, they could operate them to alert others about the danger. Each call point's distance should be no more than 45 meters from one another. However, for places with high risks, the travel distance should be below 25 meters.

The frame's height of the call points' box should be at 1.4 meters from floor level and the frame box should at least project by 15mm from the wall. This increases the visibility of the call points from the side.

Figure 7.2.10.2.1 Manual Fire Alarm

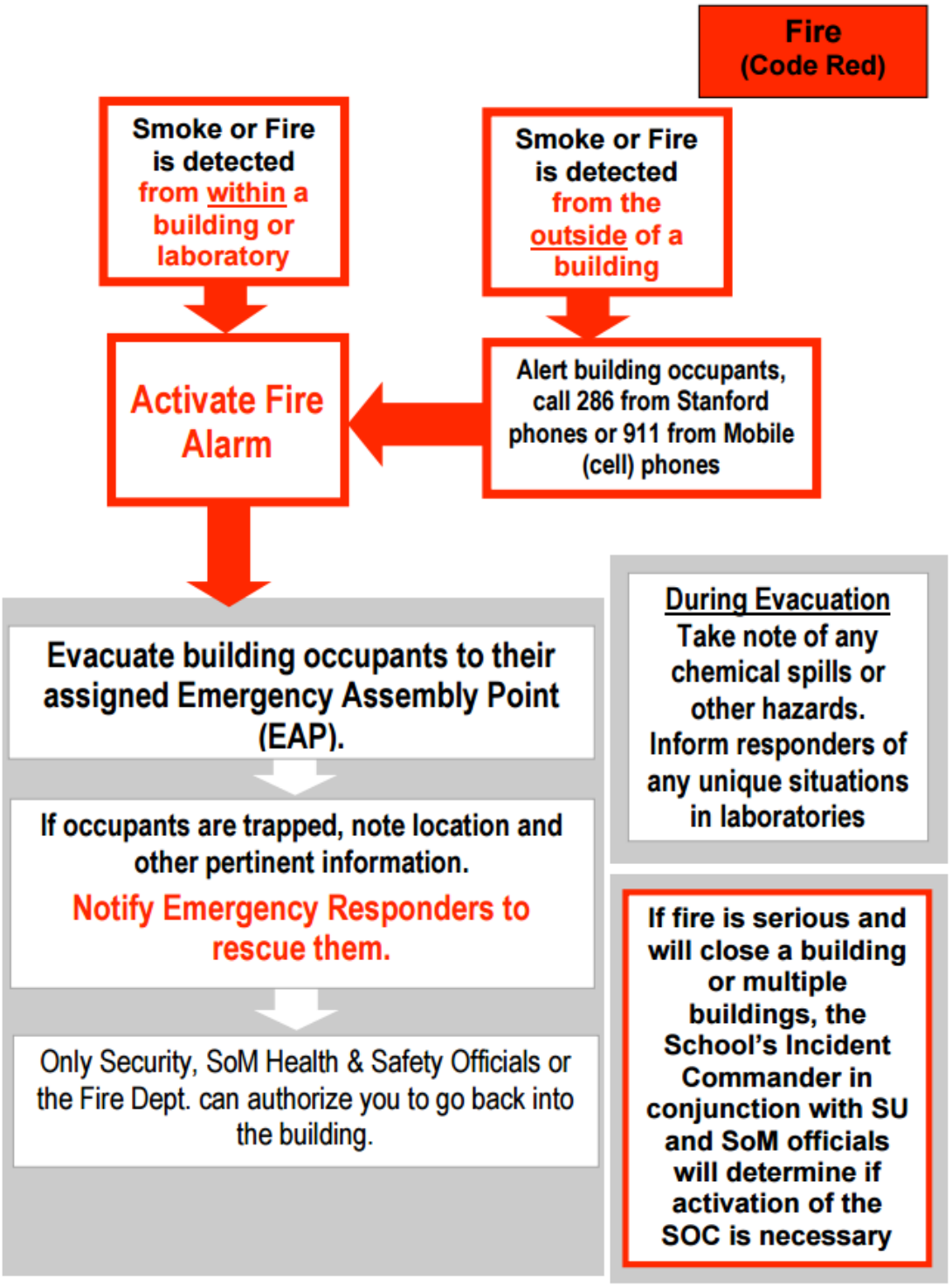


Diagram 7.2.10.2.1 Procedures upon of Fire Alarm

7.2.11 Fire control room

7.2.11.1 Introduction and Analysis

Fire control room is the core center of every building. This is a center to assist and speed up fire fighters' progress in putting our fire when there is a fire emergency. The control room should be placed near the main entrance or lobby of every building. Also, it must also be located in an area which it's aim of monitoring emergency incidents can be acheieved and utilised fully.

According to dfes.wa.gov.au, the general requirements for a Fire Control Room are as follows. It should:

1. Have a minimum floor area of 10m2, can be larger depending on the equipment required.
2. Preferably be adjacent to a fire lift lobby or any other location as designated by the relevant authority.
3. Be accessible via 2 paths of travel. One from the front entrance and the other from a public
   place or fire-isolated passageway which leads to a public place and has a two hour fire rated door.
4. Have an independent air handing system if mechanical ventilation is provided throughout
   the building.
5. Be adequately illuminated.
6. Provide the ability to communicate (e.g. via telephones and loudspeakers) with all parts of
   the building, and with fire and other emergency services.
7. Be provided with insulation from ambient building noise.
8. Be under the control of the Chief Fire Warden (or similar appointed person).

Figure 7.2.11.1.1 Fire Control Room Panels

7.2.12 Fire shutter gate

7.2.12.1 Introduction

Fire shutters like other fire protection systems which respond to smoke, heat and fire, it also serves as an emergency system which protects occupants and properties from fire.

Fire shutters function in such a way which when they shut, they divide buildings into sections, also known as compartment. Hence, this prevents the fire from spreading rapidly and lengthens the time for evacuation and escape.

Even though fire shutters work well in controlling fire, however if they are installed wrongly, they will not perform well as expected. Also, no objects should be placed under or near the fire shutter gate as this might obstruct the fire shutter from closing properly.

Besides, fire shutter can also function as a security gate system when needed as well.

7.2.12.2 Analysis

Fire shutter, as its name suggest, operates only at the event of a fire. Hence, fire detection system is linked to fire shutters. This triggers the shutter to function once it receives signals from the fire detection system.

One of the advantages of fire shutter gates is that, instead of having solid walls, fire shutters can be employed. This provides the flexibility of maintaining the building's openness while keeping it possible to compartmentalise the interior in the event of a fire.

Figure 7.2.12.2.1 Fire Shutter Gate

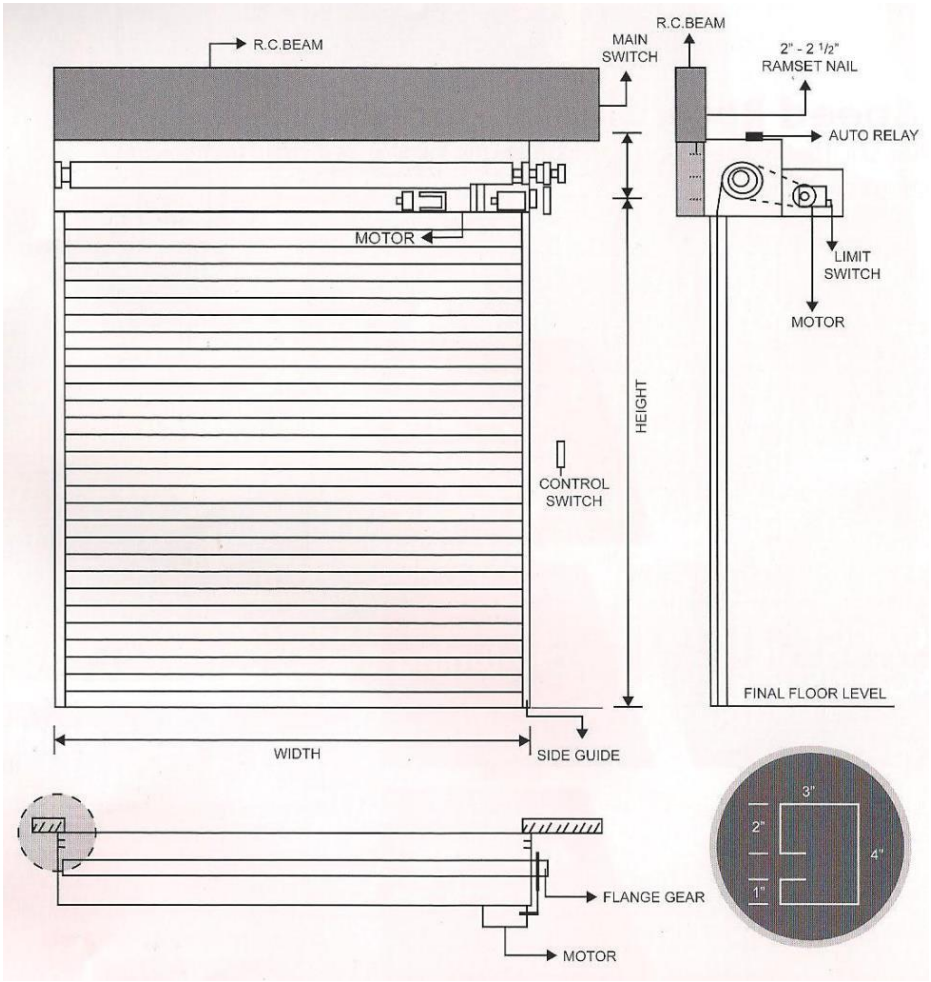


Figure 31 Fire Shutter Gate Mechanism

7.3 PASSIVE FIRE PROTECTION

7.3.1 Introduction

Passive fire protection systems are barrier systems which are integrated into the structure of a building which is used to contain and slow the rate at which fire spreads. This is achieved through creating fire resistant doors, walls and floors. This protection system also protects the load bearing columns and the critical structures from collapsing during the event of a fire.

Through the creation of fire resistant compartments between rooms and floors, this greatly slows and reduces the spread of fire from its source. Hence, reducing the damaging impact on sustained by the building. Also, this lengthens the time to evacuate the buildings towards safety for the occupants.

Passive fire protection is a system which does not require any motion or activation by electronics.

7.3.2 Fire escape stairs

7.3.2.1 Introduction and Analysis

Fire escape is used by the occupants to evacuate from the building when there is an emergency situation, such as a fire. It serves an important role in enabling occupants to evacuate safely from the building. Hence, the location of these escape stairs is very important. They should be located at strategic locations with an exit signage leading to it.

Also, the tread of the stairs should be less than 255 millimeters while the riser should be lesser than 180 millimeters. It is essential for the dimensions of the tread and riser to be constant and consistent for the whole escape stairs in order for the occupants to evacuate smoothly.

Figure 7.3.2.1.1 Fire Escape Stairs

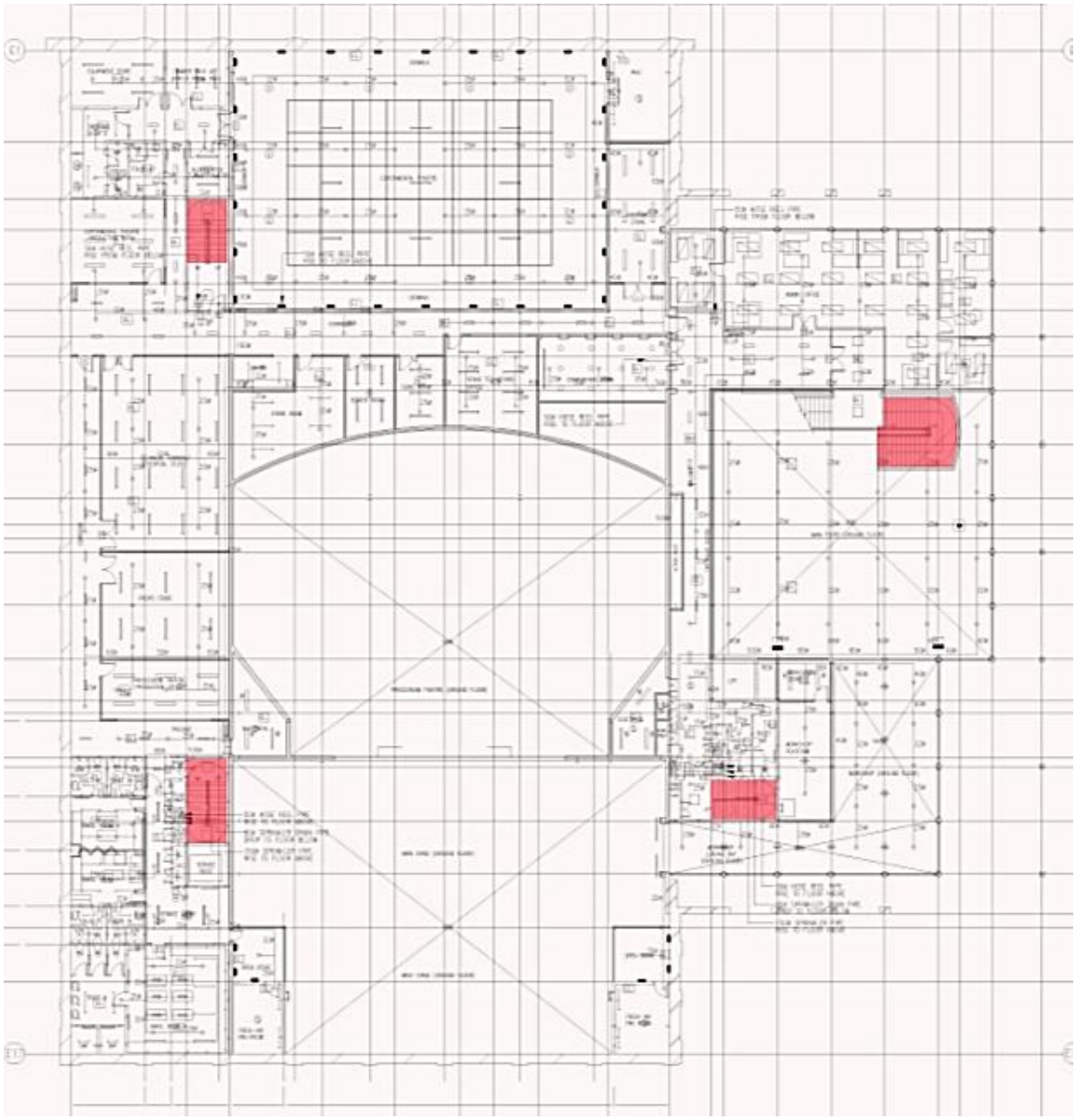


Figure 7.3.2.1.2 Highlighted red are the locations of the escape stairs

7.3.3 Fire safety and evacuation plans

7.3.3.1 Introduction and analysis

Fire safety and evacuation plans should be placed at each level especailly in places which most traffic flow and near the exits. The plans serve as a guidance and directions for occupants in escaping the building effectively.

According to gov.uk, these plans must consist of:

- a clear passageway to all escape routes
- clearly marked escape routes that are as short and direct as possible
- enough exits and routes for all people to escape
- emergency doors that open easily
- emergency lighting where needed
- training for all employees to know and use the escape routes
- a safe meeting point for staff

Figure 7.3.3.1.1 Fire safety and evacuation plan found on ground floor

7.3.4 Fire rated doors

7.3.4.1 Introduction and analysis

Fire doors are doors which is fire-resistance rated. Their main functions is to weaken the spread of smoke and fire in the buildings. They are made up of a combination of materials which mainly have fire-resistant properties. In general, the fire rating of the doors are between one to two hour(s).

According to MS EN 81-1:2012, it is stated that emergency doors shall be capable of being self-closing. This is to compartmentalize the building into sections to control the escalation of fire. Also, because these doors are mainly installed for the escape stairs, it is essential to prevent fire and smoke from entering the escape route.

According to UBBL, Section 173.1, all exit doors shall be openable from the inside without the use of a key or any special knowledge or effort.

In Section 173.2, it is stated that exit doors shall close automatically when released and all door devices including magnetic door holders, shall release the door upon power failure or actuation if the fire alarm.

Figure 7.3.4.1.1 Fire rated door

7.3.5 Exit sign

7.3.5.1 Introduction and analysis

Exit sign is of absolute importance in event of emergency. This is because in the episode of a crisis, users must be directed to the most efficient escape route at the shortest time duration. Most visitors do not understand the building's layout as familiar as the workers there. Especially when there is smoke which greatly affects the visibility, light illuminated from exit signs is crucial as a guidance for occupants to escape.

In the occurance of power failure, the light illuminated from the exit sign should be kept litted for a certain amount of time with the back-up power.

The design and function of the exit sign should be in compliance with Malaysia Standards MS:983:2000, IP20.

According to OSHA 1019.37(b)(2), each exit must be clearly visible and marked by a sign reading "Exit". Also, in OSHA 1910.37(b)(3), each exit route door must be free of decorations or signs that obscure the visibility of the exit route door.

In accordance with UBBL, Section 172.2, a sign reading "KELUAR" with an arrow indicaion the direction shall be placed in every location wher the direction of the rtavel to reach the nearest exit is not immediately apparent.

Also in Section 172.3, every exit sign shall have the word "KELUAR" in plainly legible letters not less than 150 millimetres high with the principal stroke of the letters not less than 18 millimeters wide. The lettering shall be in red against black background.

In Section 172.4, it is stated that all exit signs shall be illuminated continuously during the period of occupancy.

Figure 7.3.5.1.1 Exit sign

7.4 Conclusion

In conclusion, both active and passive fire protection system play important role in ensuring the occupants' safety in the event of a fire. Also, having proper and functioning fire protection system can reduce the damages and impact done by the fire not only on the building, but on the environment as well. All fire equipment and systems must be maintained and checked regularly in order to ensure they will function as required if there is a fire. Fire extinguishers must be checked by annually while fire pump system at least once every two years.

8.0 OVERALL REVIEW

In conclusion, services in KL Pac is well designed and has taken careful considerations to ensure the safety and comfort of occupants, complying with the requirements of Uniform Building By-Law (UBBL). Most of the system functions well to suit the purpose of the building and client's requirement.

Through this project, we have gained knowledge to understand and explain the principles and system related to water and electrical supply, sewerage, mechanical ventilation and air conditioning, as well as fire protection systems. Also, we're able to identify the components by part of each services even include with some dimensions and space required for it. No doubt, it has benefit us in our studies and had a chance to experience as an engineering student.

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