DEPARTMENT OF BUILDING SURVEYING
FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING
UNIVERSITI TEKNOLOGI MARA
PERAK

MAINTENANCE WORKS OF AIR CONDITIONING AT FACULTY OF OFFICE MANAGEMENT (FPP) UNIVERSITI TEKNOLOGI MARA (PERAK)

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DIPLOMA IN BUILDING SURVEYING

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ABSTRACT

Maintenance should be considered as an integral part of the project during all phases of the design and preferably during the preparation of the brief. The management of building services maintenance, the reason for such maintenance and its implementation need to be clearly defined. Maintenance of building services should considered:

- *Planned maintenance* – cleaning, replacing filters, lubrication etc.
- *Statutory Maintenance and Inspection*
- *Breakdown Maintenance* – repair and replacement of component
- Replacing, updating and changing equipment to improve standards or for changing business uses.

The main contractor should provide the following information: Records drawings showing locations and depths of all external services installed by all contractors and public utilities Details and locations of all access manholes, valves, etc. for the services Details of all tests carried out on external service mains and all statutory approval.

The services sub-contractor should provide the following record information: Specially prepared drawings for all piped and wired services, showing all the services installed will full annotations. Updated ductwork, wiring and control panel drawings showing the work as fitted. Updated schedules of all equipment installed, with full means of identifications by site label numbers, component serial number , test certificates, dated installed etc.

This Academic building blocks using split unit air-conditioning system Split unit is a separate air conditioning system units evaporation and condensation. The unit is divided into two parts, units and outdoor units. Unit consists of the evaporator and evaporator fan. The outdoor unit consists of a condenser, piping, condenser fan and other add-ons installed locally. Both inside and outside the unit installed separately.

There are two types of Split units that used in Academic Block :-

I. Wall Mounted

II. Ceiling Cassette

Maintenance of the air conditioning system in the academic block done by the Cekap Maju Amanah services (CMA services) and it is monitored by two civil technicians, Mr. Faiz and Mr Nazren. The work done is washing the air conditioner of split type units that are divided with two parts, internal and external.

For indoor air conditioning maintenance to be done once a month to ensure that no dust stuck in the internal air conditioning vent. This allows the air conditioning system works well and can survive in the long term. While the external air conditioner maintenance, it is done every six months or twice a year to ensure the engine air-conditioning system is functioning properly and smoothly.

There is also a huge damage as damage to the compressor; big damage like this usually goes through the quotation process will be done by the UiTM by inviting outside contractors to repair the damage that occurs in the air-conditioning system.

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Apart from that, I would like to dedicate my appreciation to the company for accepting me and friends to learn and experience the reality of working in this field. It is undeniable that the industrial training has exposed me to many great experiences which were good and bad. However, I believe that all of these will benefit me once I enter the working phase one fine day. Besides, the staffs in the company have given me infinite guidance especially regarding to the course. I would also be happy to dedicate my gratitude to the employer for the never-stop supports and guidance. He has also accepted all the mistakes made during the industrial training. This has definitely motivated me to perform better for the practical and the company. Despite all the hard works, I am happy because the company has put high hopes and trust on me. This could be seen by the countless outstation job opportunities given to me. This clearly told me that the company trusts me to do the work that was supposedly done by the more experienced worker.

Last but not least, my special thank you is dedicated to family members and friends for the countless supports and helps in terms of motivations, money and time. It is unquestionable that I am pioneer in this industrial training. There are lots of improvements to be made. Thus, my friends have continuously helped me throughout the practical. Whereas, my family members have never stop motivated me to keep on strive for the success.

CHAPTER 1:

COMPANY BACKGROUND

CHAPTER 1.0: INTRODUCTION OF COMPANY BACKGROUND.

1.1 History of UiTM PERAK

Figure 1.0 Building of Administration

UiTM Perak was established on January 1, 1985 and was inaugurated by the Chief Minister of Perak, Dato 'Ramli Ngah Talib. Opening of Phase I groundbreaking in UiTM Seri Iskandar campus was done in 1995.

On July 21, 1997 Opening Ceremony of Phase I Campus Seri Iskandar was launched by HRH Paduka Seri Sultan of Perak. The transition from a temporary campus in Seri Manjung to permanent campus in Seri Iskandar started since January 1996 until July 2002.Universiti Teknologi MARA (Perak) was established with the co-operation of the Perak State Government and officially opened in 1985 at Bandar Baru Seri Manjung.

The campus is now located at Bandar Seri Iskandar, Perak Tengah District and occupies an area of approximately 392.36 acres. This campus is strategically located along the Ipoh – Lumut main road, which provides easy access to both Ipoh and Lumut.

The campus has built new hostels for the students and is able to accommodate a maximum of 8000 students. As of now, there are 9665 full-time students in 30 programs and 418 part time students in seven programs, with 539 full time lecturers and 359 administrative and support staff.

Apart from the classrooms, other facilities available are 38 computer laboratories with more than 1,000 computers, 10 technology-enabled classroom (TEC), drafting studios, building and ceramic workshops, a multipurpose hall, a library and various state of art sporting facilities. *(uitm.perak.edu.my)*

1985	Development and Maintenance unit (DMU) was established in UiTM Manjung ,Perak. Number of staff working with only three (3) people. The main role of this division at that time was to maintain five (5) shop houses that are used as classrooms
2002	UPP transferred to UiTM Seri Iskandar and been renamed the Building Maintenance Unit and Area.
2005	Changed name to the Development Civil and Electrical/Mechanical that fully responsible for the campus area of 392.36 acres.
2006	The change of new name Facilities Management Campus Division effective from 7 April 2006
2012	The change of new name Office of Department College and Facilities.

Table 1.0 : show the year of changing department

Ref : Circular Facilities Management Office No.3 of 2006). The staff in 2010 was total 47.

This division is responsible for managing cases related to the development and maintenance of UiTM Perak. In addition, this section also provides electrical, mechanical, civil and projects because it is a very important service. Electrical service conducted by Electric unit including maintenance and repair electrical and telephone and air-conditioning systems in fully maintenance by the Mechanical Unit. Civil units are fully responsible for the maintenance and repair of buildings which includes pest control, cleaning and plumbing system in UiTM Perak

In other words, Facilities Management Division is one (1) unit of the most important in managing on matters relating to development and maintenance of the university.

The units in facilities management division are: -

1) Administration

2) Civil Unit

3) Electrical Unit

4) Mechanical Unit

5) Project Unit

6) Unit Council and Landscape

Enhance the achievement of the vision in University Teknologi MARA towards becoming a world-class civil education institutions globally, restructuring and renaming of the Facility Management Division was created in October 2011 and officially changed its name to the Division of Facilities Development and Management. This division is headed by the Chief BPPF and assisted by Engineer.

System service include:-

1) Office of the General Administration

2) Project Development Division

3) Division of Facilities Management

4) Contracts and Monitoring Unit Project

Beginning in October 2012 distribution method in campus facilities management area zoning system was introduced and led by the Assistant Engineer.

Zone system used is as follows:-

1) ***Zone 1*** – Administrative Block, Main Hall (DSI) Multipurpose Hall (DSG), the Islamic Centre and Library BPPF.

2) ***Zone 2*** – Block Academic / Faculty

3) ***Zone 3*** – College & Dining Hall

4) ***Zone 4*** – Student Center (PMU), Uptown, Central Sports, Health Unit, Main Post, Metro Campus.

1.2.1 Vision

Make the Development and Facilities Management as part of supporting the efforts UiTM (Perak) to achieve the vision of the top universities.

1.2.2 Mission

To serve the infrastructure and complete facilities through the development projects and campus facilities management with quality and structured.

1.2.3 Company Objective

To ensure that the operations, project management , customer service, management and occupational safety and health towards the efficient maintenance asset and effective so that education and teaching activities may function properly.

1.3 Organization Chart (refer appendix for A3 size)

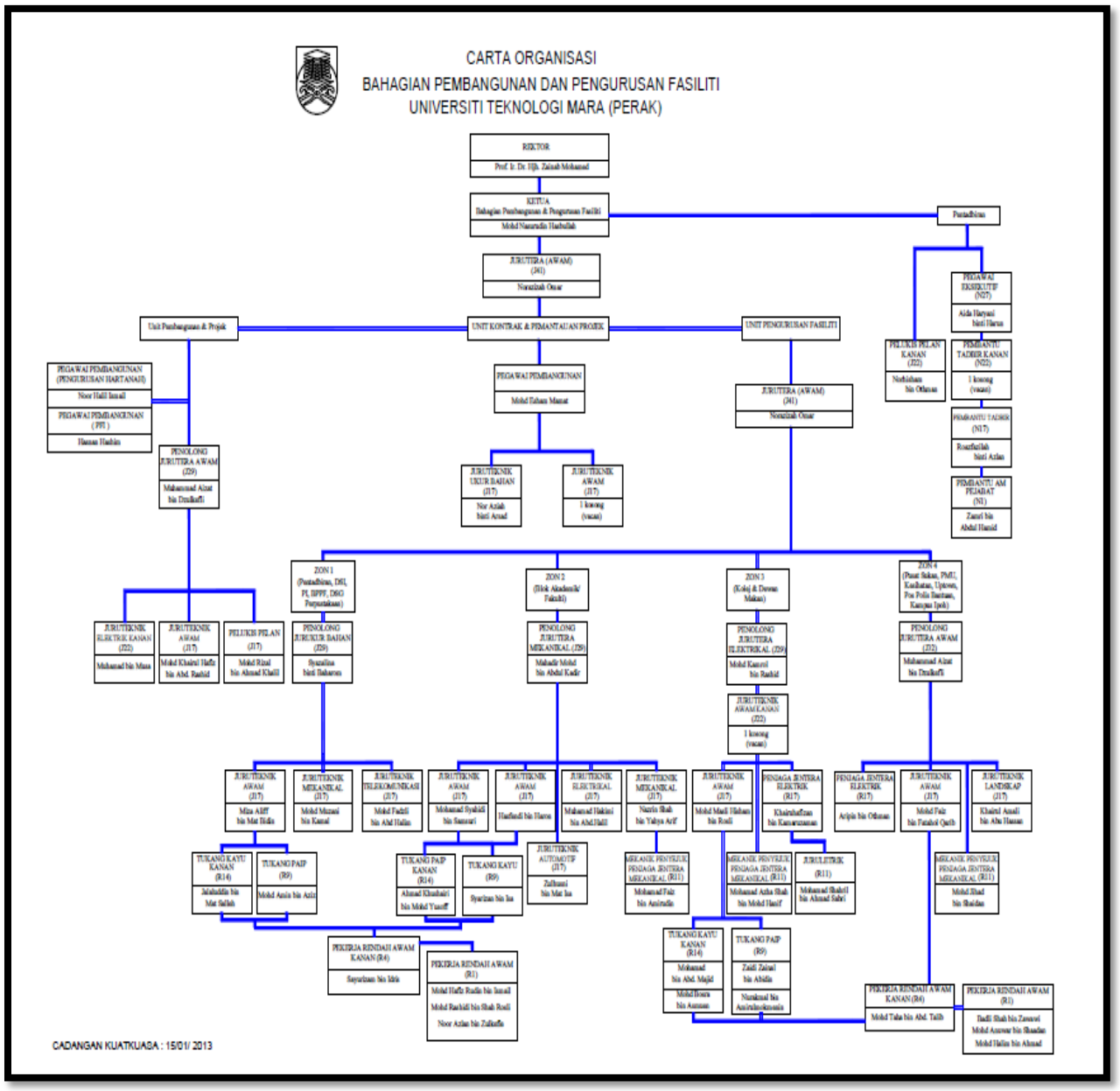


Figure 1.1 Building of Administration

1.3.1 Organization Chart (ZON 2)

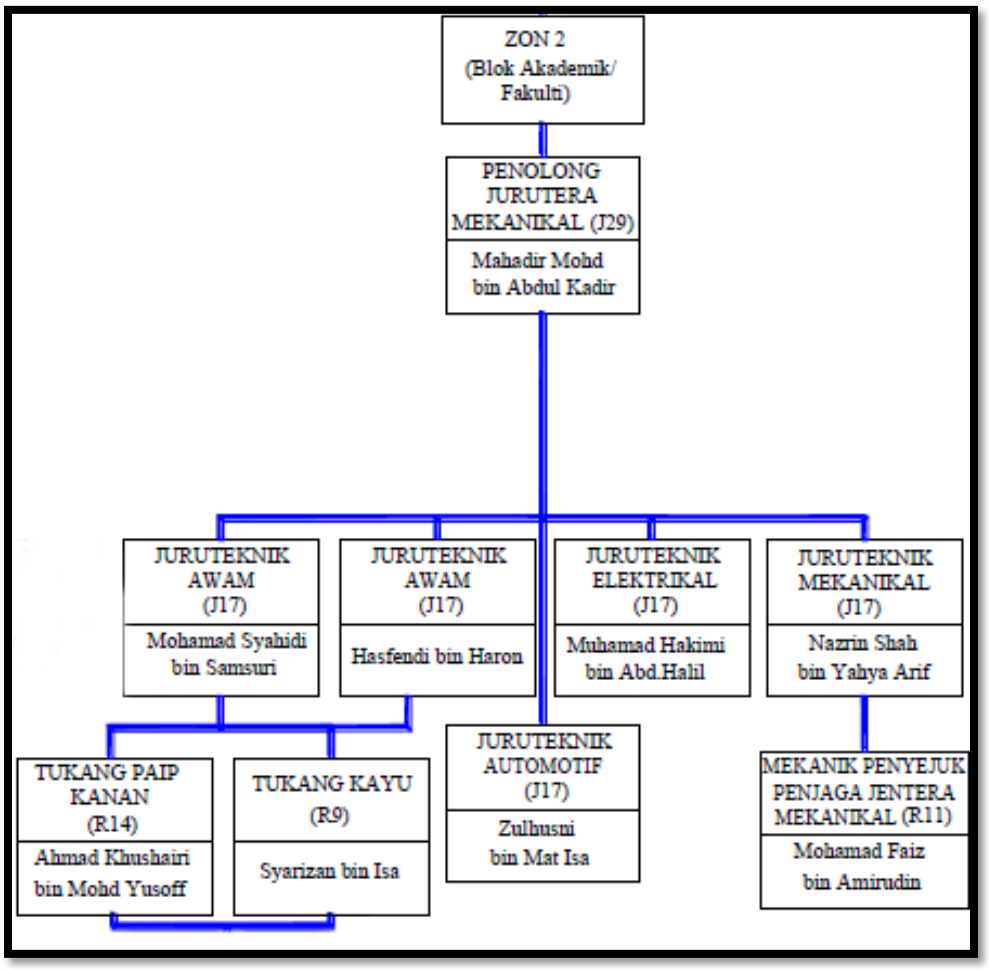


Figure 1.2 Organization chart

1. Students practical for Zone 2 is placed under the supervision of Civil Technician, Mr. Mohammad Syahidi B Samsuri.

2. The underlying consists of 2 master plumber right of Mr. Ahmad Khushairi B Mohd Yusoff and Mr. Syarizan B Isa carpenter

1.4 BPPF Function

1.4.1 Public Administration

The function of Public Administration is to Manage general administration office manage the affairs of the department of posts and service., Arrange for the purchase of office equipment ,Manage and control the records and files department and Act as the secretariat for the meeting of Head of Division / Unit. Public Administration also provides advice and counselling to staff the department and also manage staff welfare. Furthermore, Public administration also Manage logistics requirement for training and Manage the Service Scheme (PCS) and Training. On the other Hand Public Administration also manage and train the Practical Student. Planning and Managing the training and career development staff

1.4.2 Division of Project Management

Division of Project Management is provides the summary of project. It also ensure the implementation according to the Uitm to make the plan according the Uitm cost. Division of project management also help the UPP in the preparation of project budget for approval of the procurement Committee Uitm (Perak). It also Supervise and Coordinate the work undertaken by the consultant. On the other hand, helping monitoring & supervision at construction sites with contractor to determine the specifications & the contractor follow the building plan. Besides that Division of project management also prepared detailed expenditure & get additional provisions if necessary. The function Division of Project Management also Check & confirm the payment to the contractor and ensure all projects submitted in an orderly manner to be maintained by the Division of Facilities Management by zone

1.4.3 Unit of Contract and Project Supervision

To improve payment – payment of Iktisas fees, Preparation of Offer Letter and Checking of Bon & Insurances is one of the functions Unit of Contract and Project Supervision. They also make a Preparation of Agreement Document & Contract Document and Contract Management Besides that Unit of Contract and Project Supervision also make an Investigation of Contract Issues and Manage and coordinate with the Bendahari the procurement tender document for

privation including the other affairs. On the other hand, Unit of Contract and Project Supervision also manage the appointment of contractor and the consultant after getting the approvals from board of procurement and supervise the progress of project / operation / consulting in contractual terms. Next function is, checking and supervises the payments of project improvement and operation in contractual term

1.4.4 Department of Facilities Management

The department of facilities management have a control all the building about the maintenance. The department to manage the building have the follow the procedure the maintenance. The procedure is the make sure the level 'down time' for each PABX not exceeding 600 minutes for 1 year period and for each telephone not exceeding 30 ,minutes for 1 year period ,implement the scheduled maintenance work , serve the maintenance of air conditioning and freezing services and then serve the alarm system maintenance and fire extinguisher services. The other maintenance is serve the lift system maintenance services , dining hall kitchen instruments ,punch and 'building automation system' (BAS) ,manage and supervise the vehicles maintenance works and also UITM official vehicles ,manage the sewerage water system and the cleanliness of building and areas.

Therefore, the department have maintained the building such as repairing and upgraded below RM 200,000 and the infrastructure such as roadway and all fitting , monsoon drain, gate, parking, sewerage system, slope stability and else. The other procedure is manage the environment facilities services such as pest control, cleaning instrument and waste collection and manage all the event department/faculty in UITM , implement the maintenance building work scheduled and planning the upgraded works of college building.

The facilities management can repairing and upgrading the sport facilities and the defect on building structures , planning and manage the work appraisal facilities audit and managing system and then customer services and information and last is supervisor the services of delivering and department performance.

1.4.5 Customer charter

To all UiTM customers:

a) Student
b) Staff
c) Parents
d) Industry
e) Local authority
f)

2. We offer a quality service, ethics and integrity and promise that:
3. All basic facilities for education, teaching, research and the environment needs JKIPTA and professional bodies.
4. All approved academic program, managed and administered in accordance with the constitutional rules and procedures of the Senate.
5. All academic graduates are recognized by the government and meet the needs and meet the needs of the industry and relevant professional bodies.
6. All graduation given within the prescribed period after fulfilling all conditions.
7. All achievements identified and awarded annually.
8. All proposals and a formal complaint be taken within 1 week.
9. Always ready to give his services to the community.
10. Always friendly and professional service.

1.4.5.1 Customer Responsibilities

Charter to allow UiTM implement this efficiently and effectively, we request that the Customer:

I. Understanding the customer's right in this charter.
II. Comply with all applicable laws, directives, regulations and guidelines.
III. Use of the facilities provided in a responsible manner.

1.5 Campus Map

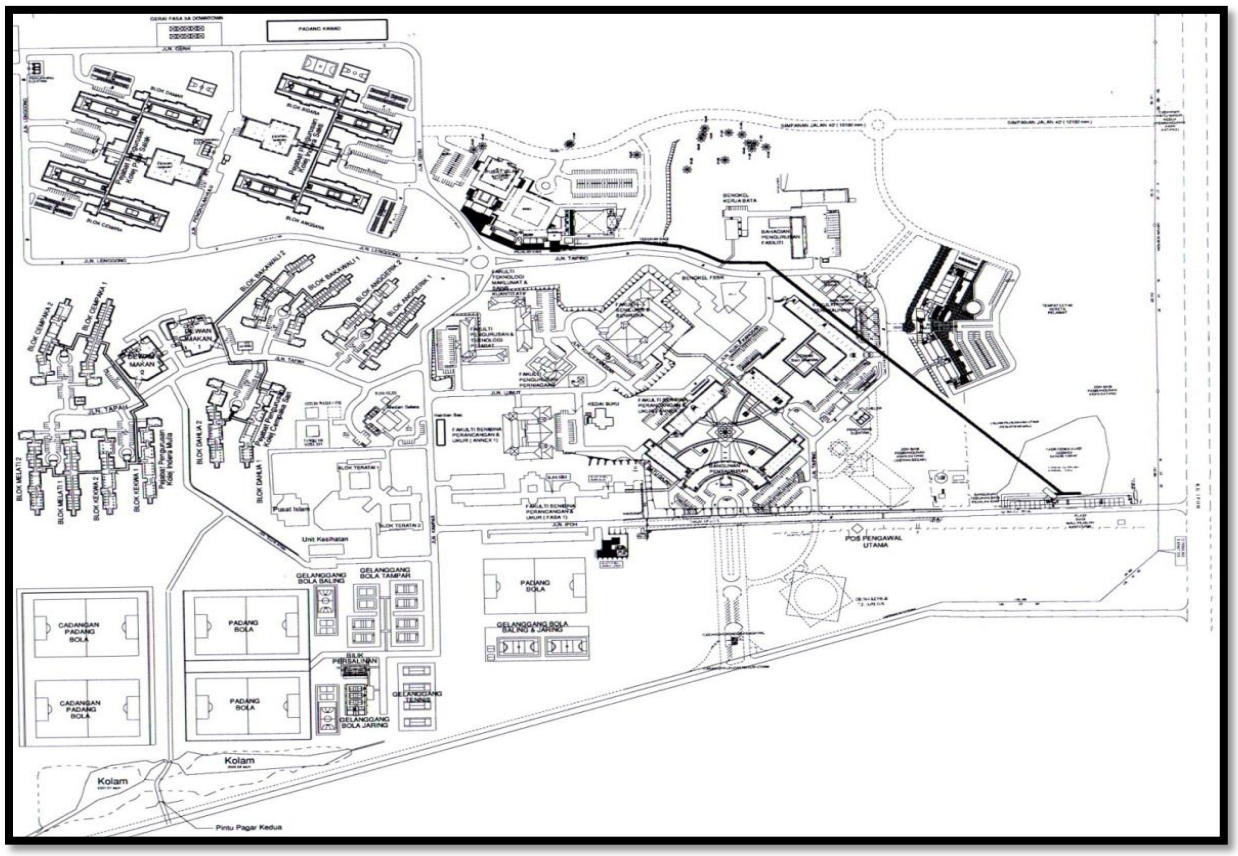


Figure 1.3 shows a plan that indicates the direction to move around the campus. The plan is showing on which area the classes and faculties are located, as well as offices, dormitories and other buildings inside the campus.

AREA	ACRE
Area of Campus Seri Iskandar	382.35
Area that has been upgraded	284

Table 1.2: Size of UiTM Perak

1.6 Location Map

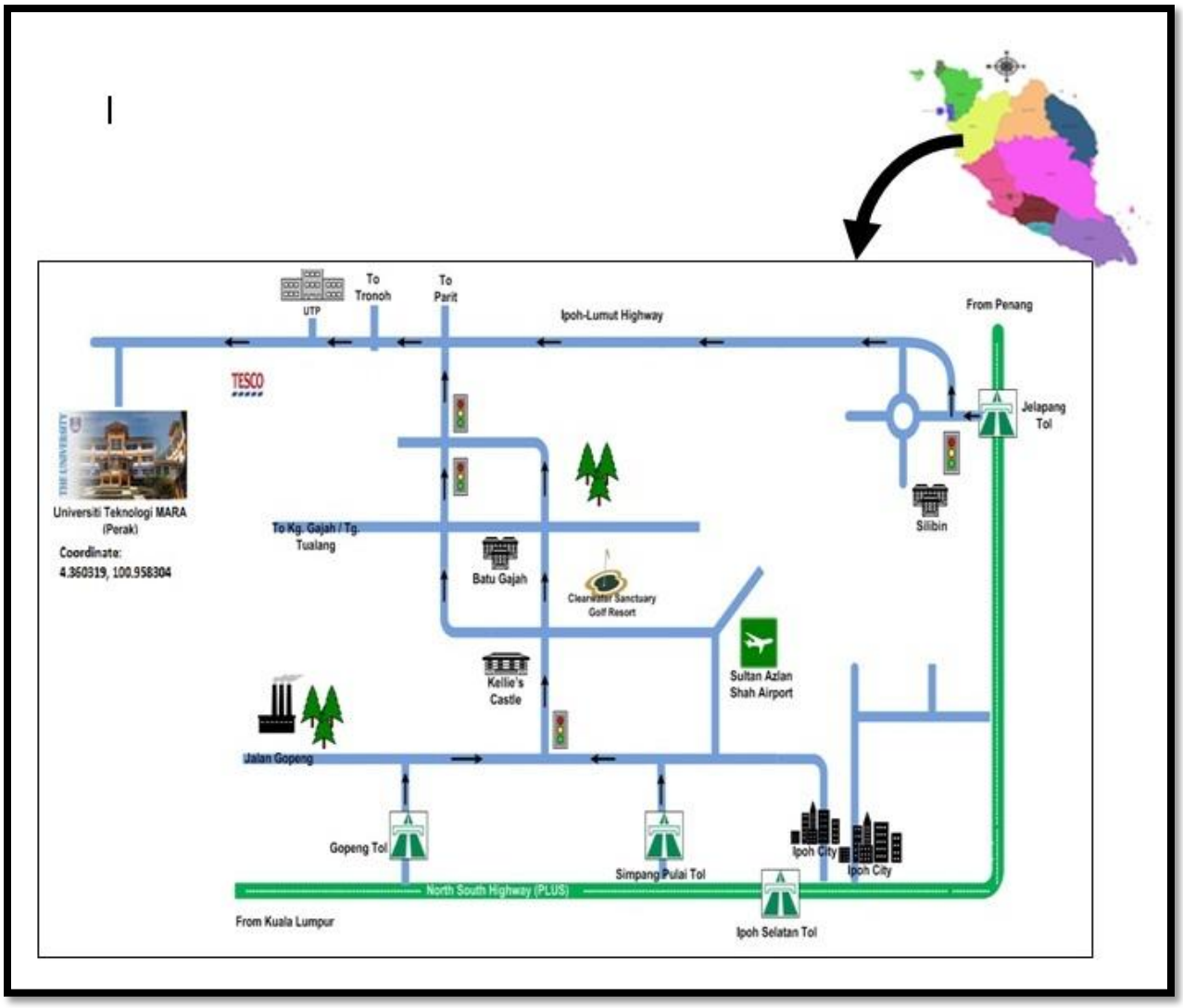


Figure 1.4 Location map of UiTM Seri Iskandar

Seri Iskandar is well connected to the North-South Expressway. It can be reached through ipoh via Exit 137: Simpang Pulai or Exit 139: Ipoh Selatan. For those whom are directly heading to conference venue at Seri Iskandar, take the Exit 153: Gopeng and look for signage to Batu Gajah, Seri Iskandar or Lumut.

1.7 Objective of Department of Facilities and Management

Principle management

Division of Facilities Management has outlined six (6) core objectives in order to realize the desire to become a professional indigenous facilities management organization to world-class universities such as the following:

I. Provides management services and complete facilities to create an atmosphere of learning, teaching and research environment and safety
II. Provides a planned package of facility management and strategic to increase the efficiency of service delivery facilities
III. Ensure that the standard implementation of facility management is measured by the index of achievement outlined in Article 5.2
IV. Securing and enhancing strong customer service conjunction with its status Article 4.4.2
V. Generate the University, through a number of financial packages that are appropriate to the portfolio of sustainable facility management, and
VI. It is a reference management organization (referral organization) in the field of facility management.

1.8 Scope of work Bppf

I. Projects and Contracts Unit

II. Building and Infrastructure Operations Unit

III. Mechanical and Electrical Services Unit Telecommunications

IV. Administrative Unit

V. Operating Unit Council and Landscape

1) **Main functions: Project and Contract Unit**

Scope of work:-

I. Site investigation work and project cost estimates
II. Quotation document preparation
III. Preparation of tender documents
IV. Work preparation quotes job offer
V. Tender bid preparation work
VI. Job work payment

2) **Main functions: Building Operations and Infrastructure Unit**

Scope of work:-

I. Provide quotation document
II. Prepare tender documents
III. Civil damage repair
IV. Building cleaning services and area

3) **Main function: Mechanical Electrical Service Unit and Telecommunications**

Scope of work:-

I. Repair of Mechanical and Electrical damage complaints
II. The M & E services of UiTM
III. Scheduled maintenance for high voltage power supply systems
IV. Electrical substation fault repair
V. Site investigation and the estimated cost of project.
VI. Work preparation quotation documents
VII. Job offer quotation preparation
VIII. Working payment

4) Main function: Administrative unit

Scope of work:-

I. Responsible for the correspondence
II. Manages the application and hiring office equipment
III. Responsible for recording and updating the staff leave
IV. Handling telephone calls to customers (Special Assistant)
V. Prepare reports punch card
VI. Receive damage complaints

5) Main function: Operation and Unit council Unit

Scope of work:-

I. Installation banner, backdrop and bunting
II. Managing the site preparation and equipment
III. Maintenance and landscape areas
IV. Preparation of flower decoration for council
V. Preparation of tree flower decoration for office furnishings
VI. Crop preparation
VII. Emergency works
VIII. Retail quote
IX. Official quotation

1.9 General Administrative Regulations

General

I. Staff need to record time in / out on the card provided.

II. Staff are required to fill the holidays form and supported by the Head of week before being forwarded to the Engineer approved.

Distinctive

I. Provide cost estimates

II. budget based on the specifications and plan/layout

III. budget based on plans only

IV. budget based on Malaysian Standard Method of Measurement of Building Works Second Edition (SMM2)

V. budget based on schedule of small work rates and repair

VI. provides tender price quotation

VII. based on JKR 203 / JKR 203A

VIII. Provides analysis/report of call notice

IX. Arrange payment to the contractor for the project in accordance with the procedures set

X. Department Orders and Work Validation Form

Others

I. Staff needs to spend annual leave.

II. To bring the holidays to the following year, staff must obtain the approval of the service of UiTM Seri Iskandar Perak, with support of the Engineer and Director of Campus

CHAPTER 2:

LITERATURE REVIEW OF AIR CONDITIONING SYSTEM

CHAPTER 2.0 : INTRODUCTION OF AIR CONDITIONING SYSTEM

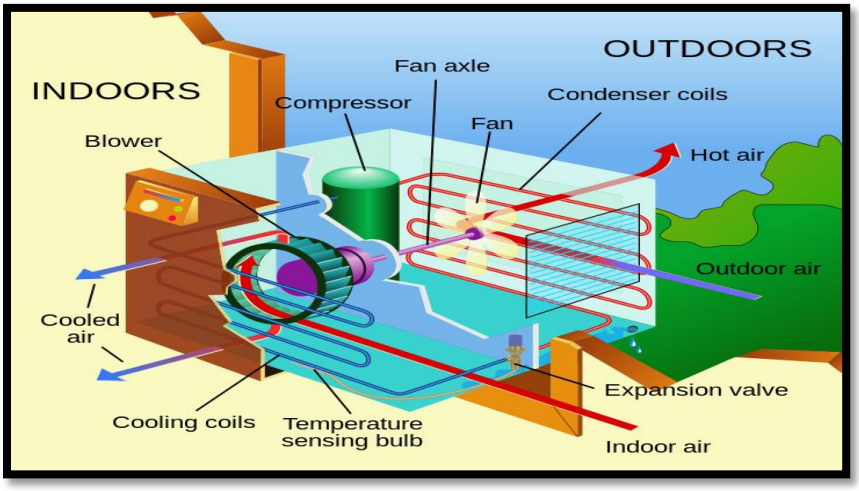


Figure 2.0 view of air-con system

Air conditioning (often referred to as **air on**, **AC** or **A/C**) is the process of altering the properties of air (primarily temperature and humidity) to more favorable conditions. More generally, air conditioning can refer to any form of technological cooling, heating, ventilation, or disinfection that modifies the condition of air.[1]

An *air conditioner* is a major or home appliance, system, or mechanism designed to change the air temperature and humidity within an area (used for cooling and sometimes heating depending on the air properties at a given time). The cooling is typically done using a simple refrigeration cycle, but sometimes evaporation is used, commonly for comfort cooling in buildings and motor vehicles. In construction, a complete system of heating, ventilation and air conditioning is referred to as "HVAC".

Air conditioning can also be provided by a simple process called free cooling which uses pumps to circulate a coolant (typically water or a glycol mix) from a cold source, which in turn acts as a heat sink for the energy that is removed from the cooled space. Free cooling systems can have very high efficiencies, and are sometimes combined with seasonal thermal energy storage (STES) so the cold of winter can be used for summer air conditioning. Common storage media are deep aquifers or a natural underground rock mass accessed via a cluster of small-diameter, heat exchanger equipped boreholes. Some systems with small storage are hybrids,

using free cooling early in the cooling season, and later employing a heat pump to chill the circulation coming from the storage. The heat pump is added-in because the temperature of the storage gradually increases during the cooling season, thereby declining in effectiveness. Free cooling and hybrid systems are mature technology.

2.1 Maintenance of Mechanical Ventilation and Air Conditioning System

Ac System Selection Criteria:-

Air-conditioning design and selection criteria can be classified as follow:-

1. **Comfort criteria**
   I. These criteria include noise considerations, accuracy of control space conditions, amount of fresh air and air filtration, and tolerance of the effects of failure in the AC system.
2. **Space considerations**
   I. AC systems occupy substantial space and AC components may require special support from structure.
   II. Space considerations include space required to house the equipment and the distribution ductwork and pipework.
      - *AHU room - ≈ 3% of total floor area cooled by that unit*
      - *Plant room - ≈ 5% of total cooled floor area*
   III. Another major consideration is the accessibility of the equipment for maintenance purposes.
3. **First cost**
   I. An important consideration in the design and selection of AC systems.
   II. There is a tendency for owners to prefer low first cost.
   III. Careful consideration should be given to the expandability of the system as well as to implications on the operating costs.

4. **Operating cost**
   I. One of the most important considerations in the design selection of air-conditioning systems.
   II. The energy cost should be calculated and competing systems should be compared in terms of their life cycle cost which takes into account capital, energy and maintenance costs over the whole life of the systems.
5. **Flexibility & maintenance**
   I. The system should be flexible enough to meet changes in the use of building.
   II. The reliability, maintainability and the cost of maintenance contracts as well as the cost of replacement of major components should be considered in deciding between alternative systems.
6. **Others**
   I. Fire protection & smoke control, interior & exterior appearance and environmental effects

2.2 Types of air conditioners system

2.2.1 Room Air Conditioners

I. Room air conditioners are the simplest form of an air-conditioning system.
II. It is assembled inside a casing, suitable for installation on windows or wall.

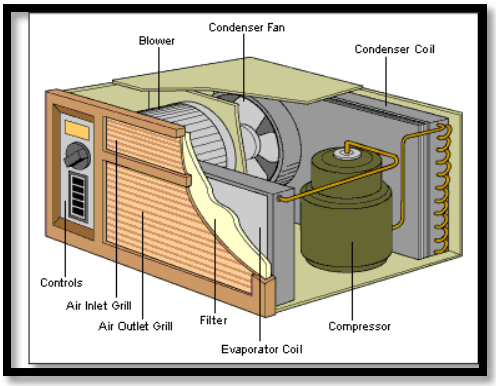


Figure 2.2 room air-con

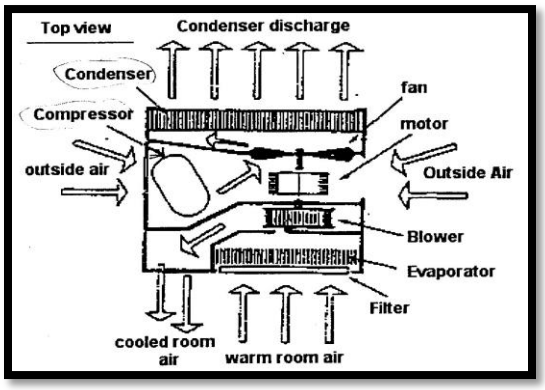
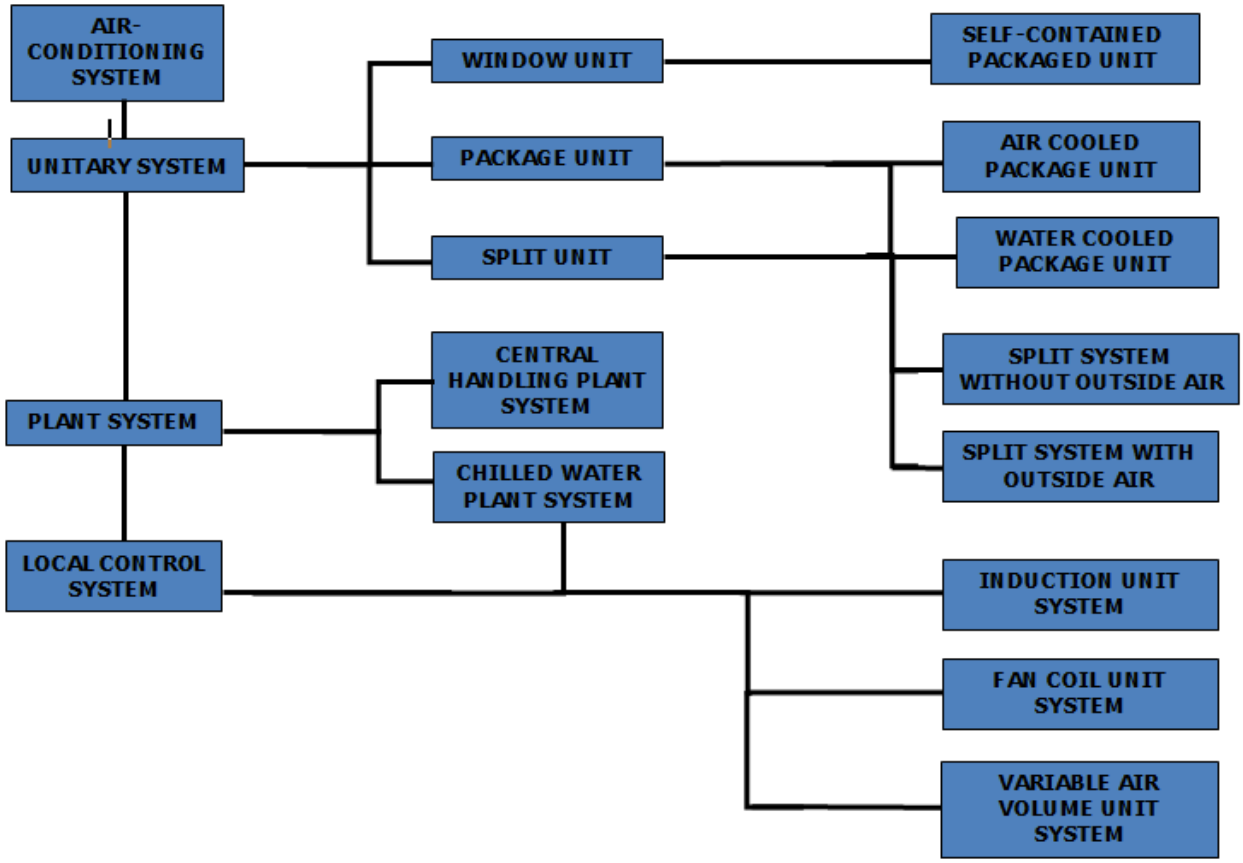


Figure 2.3 view of room air-con

2.2.2 Classification of Air-Conditioning Systems



(Classification based on layout arrangement, equipment and components)

2.2.3 A/C Window Unit types

I. It is important to understand the component and its operation before it can be maintained (recall your memory in Building Services lecture) :

Figure 2.4 window unit

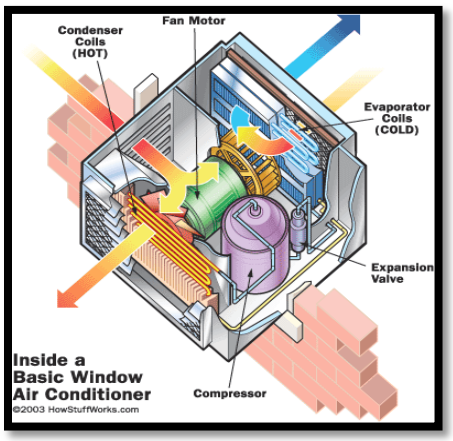


Figure 2.5 inside of window unit

2.2.4 Package Air Conditioner

I. These systems are used primarily on mobile or modular homes or older homes on a crawl space with the ductwork beneath the floor. Occasionally package units are installed on residential flat roofs with exposed ductwork. The easiest way to determine if you have a package type system (or self-contained as they are sometimes called) is to look outside at your air conditioner.

II. Package units are generally large and will always have 2 large, squares or round ducts connected directly to them.

Figure 2.6 package unit air-cons

I. They are bigger versions of the room air conditioners and available in nominal capacities of 3, 5, 7, 10 and 15 tons.

II. Like the room air conditioners, the package unit also houses:

   a. Air filtering

   b. Cooling-humidifying

   c. Air handling components

III. The package air conditioners are usually factory assembled and condensers can be air-cooled or water-cooled type.

Figure 2.7single package unit

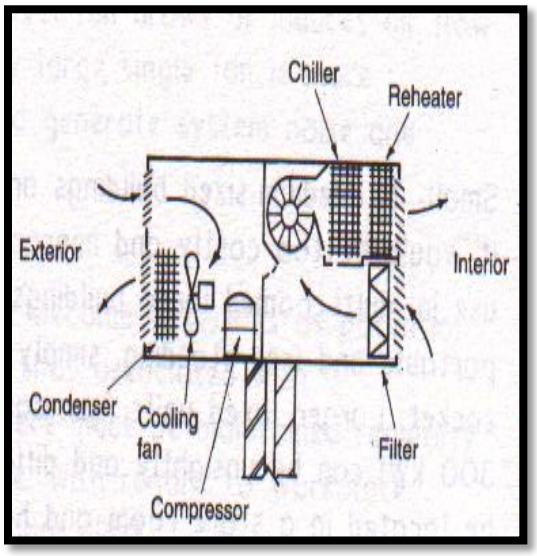


Figure 2.8 package unit air-cons

(Single package wall opening unit)

2.2.5 Split units

The split air-conditioning unit comprises of:-

1. **The indoor unit**

   I. Consists of an evaporator coil, evaporator blower with its own separate motor, capillary tube, control panel and variable speed selection of the fan/blower, air filter, supply and return air grills.

2. **An outdoor unit**

   I. Consists of a compressor, air-cooled condenser, condenser fan and motor.

Figure 2.9 split unit air-cons indoor and outdoor

2.2.6 Type of Split units:-

Interior Units:

Figure 2.10 ceiling type

Figure 2.11 wall mounted

Figure 2.12 ceiling cassette

Exterior Units:

Figure 2.13 outdoor unit

2.3 Centralized air-conditioning system

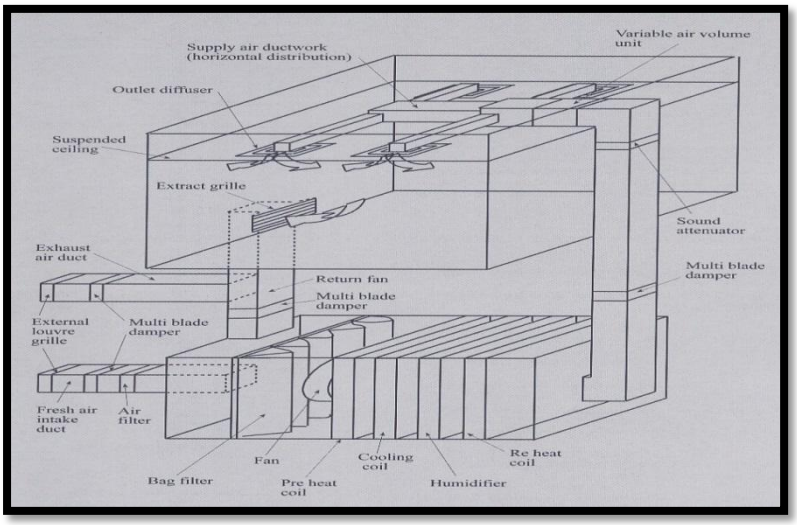


Figure 2.14 Centralized system

2.4 Air Handling Unit (AHU)

An air handler, or air handling unit (often abbreviated to AHU), is a device used to condition and circulate air as part of a heating, ventilating, and air-conditioning (HVAC) system. An air handler is usually a large metal box containing a blower, heating or cooling elements filter racks or chambers, sound attenuators, and dampers. Air handlers usually connect to a ductwork ventilation system that distributes the conditioned air through the building and returns it to the AHU. Sometimes AHUs discharge (*supply*) and admit (*return*) air directly to and from the space served without ductwork.

Small air handlers, for local use, are called terminal units, and may only include an air filter, coil, and blower; these simple terminal units are called blower coils or fan coil units. A larger air handler that conditions 100% outside air, and no recalculated air, is known as a makeup air unit (MAU). An air handler designed for outdoor use, typically on roofs, is known as a packaged unit (PU) or rooftop unit (RTU).

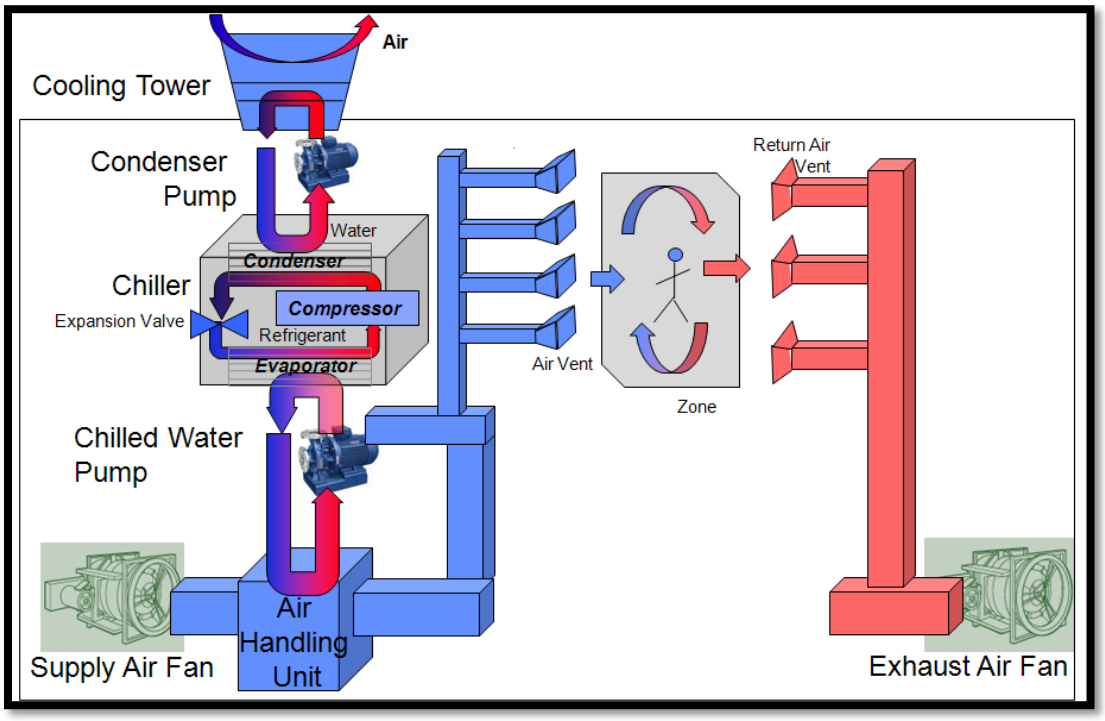


Figure 2.15 AHU system

2.5 Central Plant

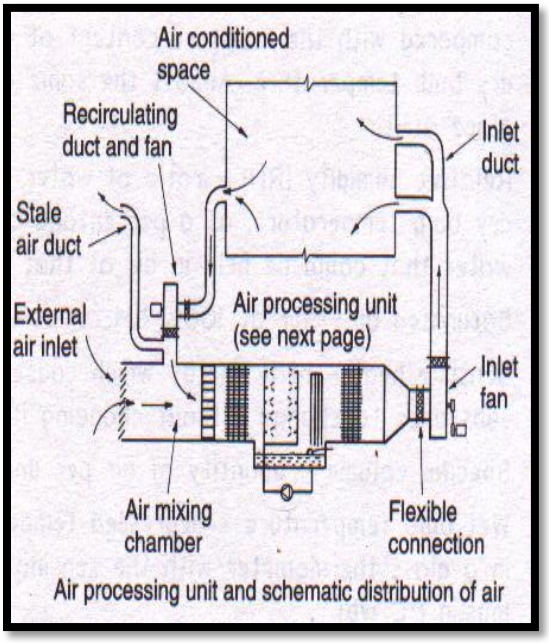


Figure 2.16 Central Plant system

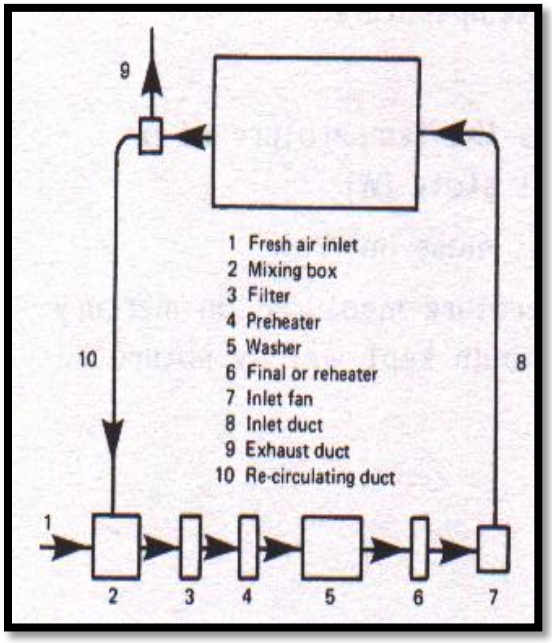


Figure 2.17 Central plant

Figure 2.18Central Plant with cooling tower

Figure 2.19 with cooling tower

CHAPTER 3:

CASE STUDY

CHAPTER 3.0: MAINTENANCE WORK FOR AIR-CONDITIONING

Introduction of Academic block

Figure 3.0 Central Plant with cooling tower

Academic block building was built in 2008, April 16 and was completed in October 30, 2010. This building was built to accommodate students from the state office management courses, apart from that it is also used for special occasions organized by UiTM.

Company that involved the construction of Academic block faculty of office management:-

FAA architects ltd.
Aidid Consulting Civil and Structure.
Perwira Al Shura construction Mechanical and Electrical engineering
Syarikat Lingkaran Muhibah contractors ltd.

Table 3.0: Company that involve the construction of Academic Block

3.1 Scope of works and Specifications

The work covered by this specifications is for the supply of materials, appliances, labour and necessary incidentals for the complete installation, testing commissioning of the Air Conditioning System as described further in specification. The system must be completed in all respects when handed over to the Client and must be in strict accordance with this specification and adjusted to produce the designed conditions.

The scope of works to be carried out under this system shall consists at least of the following main services:-

I. Section 2 : design criteria
II. Section 3 : chiller
III. Section 4 : pumps
IV. Section 5 : air handling unit
V. Section 6 :
VI. Section 7 : expansion tank
VII. Section 8 : air filtration system
VIII. Section 9 : air cooled split unit
IX. Section 10 : variable refrigerant system
X. Section 11 : air cooled direct expansion unit
XI. Section 12 : air distribution equipment
XII. Section 13 : thermal and acoustic insulation
XIII. Section 14 : ventilation fan
XIV. Section 15 : smoke ventilation
XV. Section 16 : interfacing
XVI. Section 17 automatic control
XVII. Section 18 : noise control and vibration elimination
XVIII. Section 19 : ductwork and air distribution
XIX. Section 20 : pipework and fittings
XX. Section 21 : electrical works
XXI. Section 22 : testing and commissioning
XXII. Section 23 : service and maintenance

3.1.1 Design Criteria

The design data for the Air Conditioning and Ventilation System shall be as follows :

a) Inside Design Condition

Inside design condition shall be as indicated in Table 1. The contractor shall ensure that all installations by him shall comply with the requirement as stated in the section mentioned and ASHRAE requirements.

b) Outside Ambient Air Conditions

The outside ambient conditions shall be taken in the range 28 Celsius / 65% and 35 Celsius / 65%

c) Fresh Air Ventilation

Fresh air ventilation shall be at least as indicated in **Table 1** and **Table 2** and as per ASHRAE 62-89 requirements and any local authority requirements.

Room Temp. Design	Room Temp (c)	Noise Criteria Level NC/dBA
Assembly Hall	23.0 + -1	40/45
Office Room	23.0 + -1	35/40
Lobby	24.0 + -1	40/45
Meeting Room	22.0 + -1	35/40
Lecture Room	23.0 + -1	35/40

Table 3.1 : Air Conditioned Area

Room Designation	Air change/hr	Noise level NC/dBA
Male/Female toilet	10	42/52
Kitchen	25	50/57
Stores	5	50/57
M & E Plant Room	15	55/61

Table 3.2 : Mechanical Ventilated Area

3.2 Scope of work for Air Conditioning System

Unit shall be Air Cooled, VRV Type Air Conditioner consisting of one outdoor unit and multiple indoor units each having capability to cool independently of requirements of the rooms.

Up to 10 different type and capacity indoor units can be connected to one refrigerant and controller individually.

Compressor shall be equipped with inverter controller, and capable of changing the rotating speed to follow variations in cooling and heating load.

Outdoor unit shall be suitable for mix- match connection of following models.

I. Ceiling mounted cassette type (double flow)
II. Ceiling mounted cassette type (multi flow) – super cassette
III. Ceiling mounted cassette low silhouette duct type
IV. Ceiling mounted built-in type
V. Ceiling mounted built-in (rear suction) type
VI. Ceiling mounted duct type
VII. Ceiling suspended type
VIII. Wall mounted type
IX. Floor standing type
X. Concealed floor standing type
XI. Ceiling mounted cassette corner type

The refrigerant piping shall be extended up to 100m with 50m level difference without any oil traps.

Both Indoor unit and Outdoor units are assembled, tested and charged with refrigerant R22 at the factory.

3.2.1 Air conditioning system

1. Air Cooled Condensing unit

The Air Cooled Condensing Unit shall be a factory assembled unit housed in a sturdy weatherproof casing constructed from rust-proof mild steel panels coated with a baked enamel finish. The condensing unit shall be designed to operate safely when connected to multiple fan coil units which have a combined operation nominal capacity varying from 8% to 130% of nominal compressor capacity. The noise level shall not be more than 57dBA measured horizontally 1m away and 1.5m above ground. The condensing unit shall have the flexibility to connect the piping circuit from three places, front side and bottom of the unit to provide for greater freedom of layout.

The Condensing Unit shall come equipped with the following of hermetically sealed compressors;

5hp and 6hp o/door units	1 nos. compressor
8hp and 10hp o/door units	2 nos. compressor
16hp, 18hp and 20hp o/door units	4 nos. compressor
24hp,26hp,28hp and 30hp o/door units	6 nos. compressor

Table3.3 : the Condensing unit

The Condensing Unit shall be modular in design and should be allowed for side by side installation.

2. Compressor

The Compressor shall be of highly efficient hermetically sealed scroll compressors and equipped with inverter control capable of changing the speed linearly in accordance to the room load requirement. It shall be able to vary the load from 8% to 130% of its normal capacity. The inverter shall be of IGBT (Insulated Gate Bipolar Transistor) Type. The 8 and 10hp unit shall have at least 20 steps capacity control to meet the load fluctuation and indoor unit individual control. The 5hp outdoor unit shall gave at least 13 steps of capacity control.

For any combination of compressors at least one of them shall be inverter driven.

3. Condenser Assembly

The Air Cooled Condenser shall be constructed with cooper tubes mechanically bonded to aluminum fins to form a cross fin coil. The condenser shall have large face area to minimize noise and give a high EER for heat transfer. Condenser should be of waffle louver fins and Hi-X tubes design for high efficiency performance. The Condensing Unit shall be chemically coated with anti-corrosion film for the fins. The thickness of the coating must be between 2.0 to 3.0 microns

4. Condenser Fan and Motor

The Condenser Fan shall be of multi-blade low speed noise type made from pressed out aluminum and dynamically and statically balanced for minimum noise and vibration. The Condenser Fan shall be directly coupled to an induction motor. The axial of the fan shall be perpendicular to the face of the condenser to ensure smooth air flow. The condenser fan and motor shall be of the high efficiency type with minimum power consumption. The fan motor shall be equipped with pole change control so that it can be stepped down to low speed when the requirement is low.

5. Fan Coil units

Each Fan Coil Unit shall be of the ceiling mounted type , or ceiling ducted type, or ceiling suspended type, ceiling mounted cassette corner type, or wall mounted type or floor mounted type as specified in the drawing.

Each Fan Coil Unit shall be equipped with a self-diagnosis remote controller and having the feature of setting of room temperature (with digital indicator of room temperature), timer air discharge direction (for cassette units), fan speed selections, self-diagnosis circuit with malfunction code display.

6. Cross Fin Evaporator

The Cross Fin Evaporator Coil shall be constructed from strong clean copper tubes bonded to aluminum fins suitably spaced to ensure maximum heat transfer. The inlet of the coil shall be factory brazed to an electronic control valve. The face velocity shall be exceptionally low to ensure quiet operation.

7. Electronic Control Valve

An Electronic expansion valve shall be factory brazed to the inlet of the coil. It shall modulate the refrigerant volume continuously in respond to load variations of the room. Thus maintain a precise constant temperature of 0.5 Celsius.

8. Evaporator Fan

The evaporator fan shall be of the dual suction multi-blade type with its length designed to match the coil width. The fan shall be statically and dynamically balanced to ensure low noise and vibration free operations. It shall be directly driven by a 2 speed induction motor. The motor shall operate on 230 volts single phase 50Hz.

The address of the indoor unit shall be set automatically in case of individual and group control.

9. Refrigerant Circuit

The refrigerant circuit shall include an accumulator, liquid and gas shut off valves solenoid valves and an electronic expansion valve. All necessary safety devices should be provided to ensure the safety operation of the system

10. Accumulator

The cylindrical accumulator shall be constructed from mild steel plates pressed into shape. The accumulator shall have sufficient capacity to prevent any liquid refrigerant from flowing back into compressor suction.

11. Safety Devices

The following safety devices shall be part of the condensing unit. High pressure switch, fuse, crankcase heater, fusible plug, over current relay for compressor, thermal protectors for compressor and fan motors, recycling guard timer.

12. Pressurize Testing

The complete refrigerant circuit should be subjected to a pressure test of 28.0g sq. cm. for at least 24 hours without any drop in pressure.

13. Pipe Material

The refrigerant pipe shall be of de-oxidized phosphorous seamless copper pipe conform to JIS H300 – C1220T

14. Oil Recovery System

Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigerant piping (system installing with oil traps is not acceptable).

15. Control

The control system should be connected by using 2-wire multiplex transmission system links a single outdoor unit to multiple indoor units with a 2-core cable. In addition, the control system must come equipped with automatic address setting function (No manual setting of addressing is allowed in case that Outdoor Units have to be linked together for Centralized Control). An automatic checking function for connections error of wiring and piping must come standard with the system. Wiring of Remote Controller to Fan Coil Unit must also be of 2-core Non – polarity wire.

Computerized PID control shall be used to maintain a correct room temperature with minimum power consumption. Unite shall be equipped with its own 2 speed fan controller, timer on/off switch thermostat and LED indicators.

It shall also be equipped with a self-diagnosis circuit for easy and quick maintenance and service; it shall be able to indicate malfunction code displays. The LCD remote Controller shall memorize the latest malfunction code for easy maintenance.

16. Soft Start (Starters)

All Condensing Units shall be of soft-start to ensure low staring current.

The inverter compressor shall be able to start at the minimum load and gradually increased t the required frequency according to the actual load requirement.

A recycling guard timer shall be provided to prevent the compressor to restart again immediately after it was stopped.

3.2.2 Company that responsibility for air conditioning maintenance:

Company Name	Cekap Maju Amanah Services Sdn. Bhd. (CMA services)
Specialties	Air Conditioning maintenance
Address	No,47 Jalan Seri Putra 1/4 , Bandar Seri Putra Bangi, 43000 Kajang Selangor Darul Ehsan.
No. telephone	03-8926 5826
Fax No.	03-8926 8826
Email	Cmas_sb@yahoo.com

Table 3.4: Air conditioning services

Company Name	Perwira Al-Shura Consulting Engineers Sdn. Bhd.
Specialties	Mechanical & Electrical
Address	No. 33-1, Jalan 3A/2B,Taman Desa Bakti,68100 Kuala Lumpur
No. telephone	03-6137 1711
Fax No.	03-6137 1712

Table 3.5 : Mechanical & Electrical services

3.3 Faculty of Office Management (FPP) floor plan (refer appendix for A3 size)

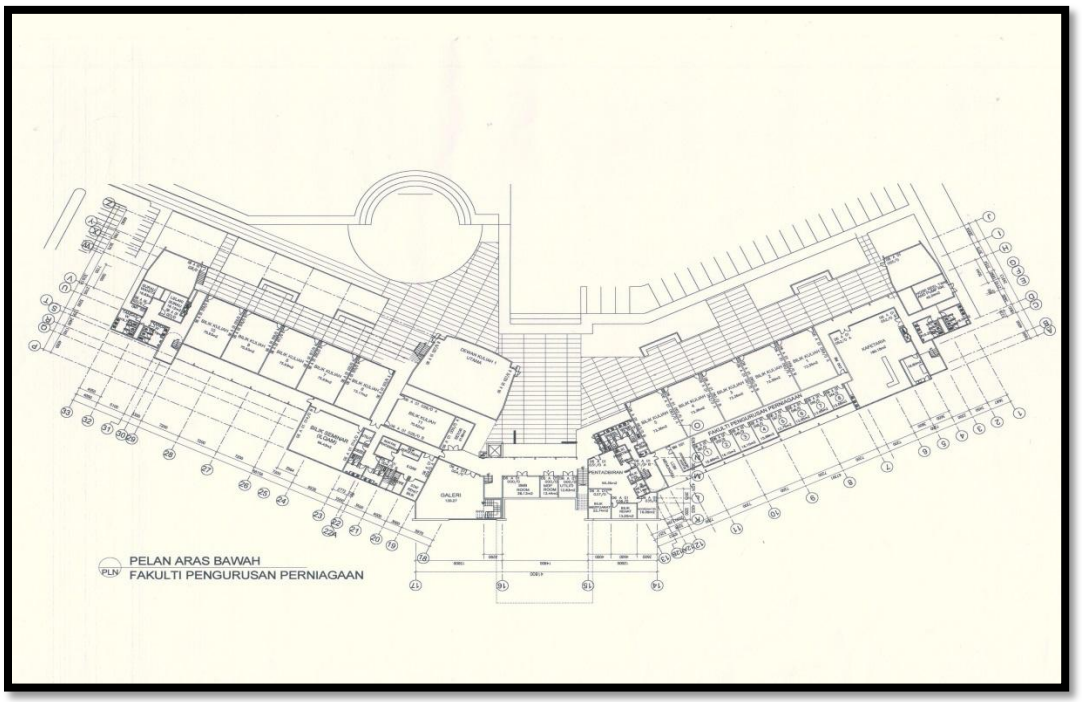


Figure 3.1 Ground level

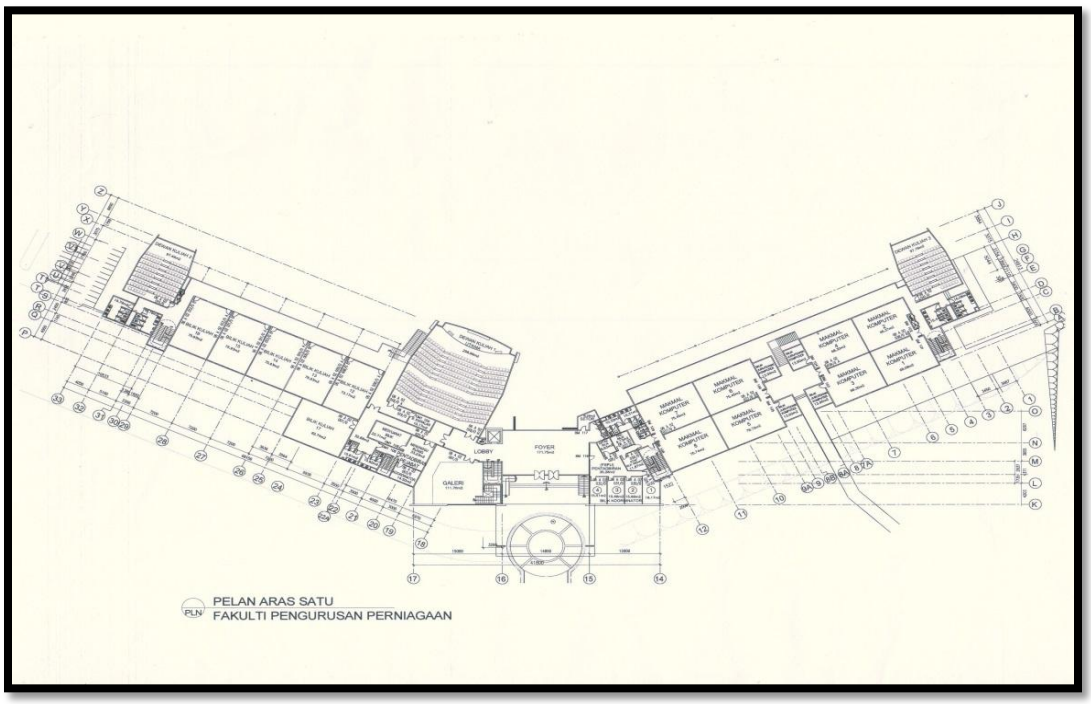


Figure 3.2 1st Floors

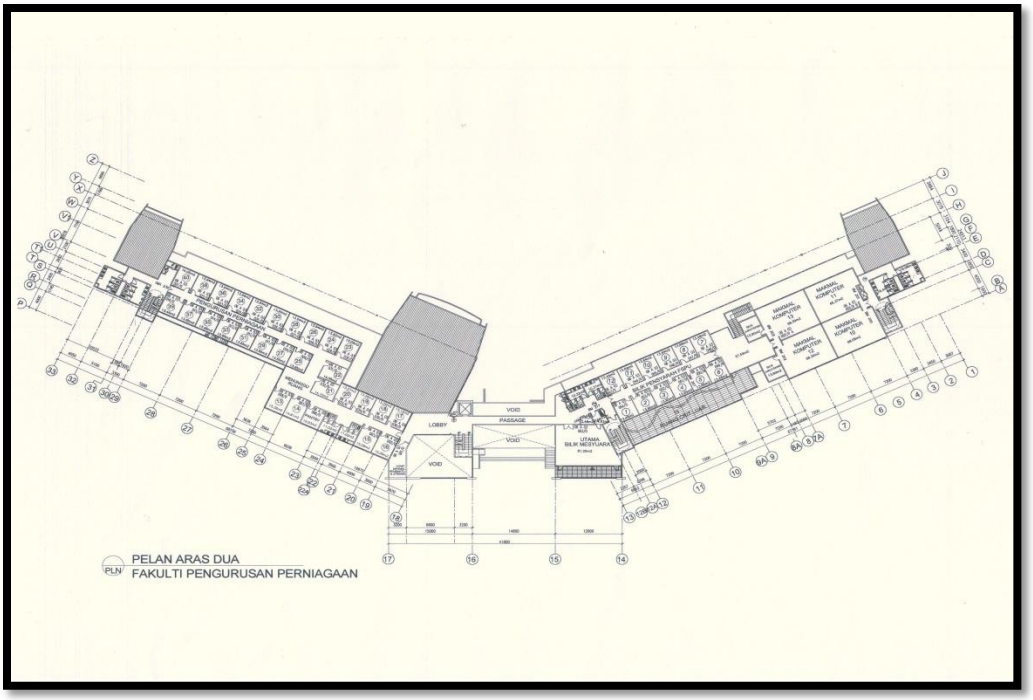


Figure 3.3 2nd Floors

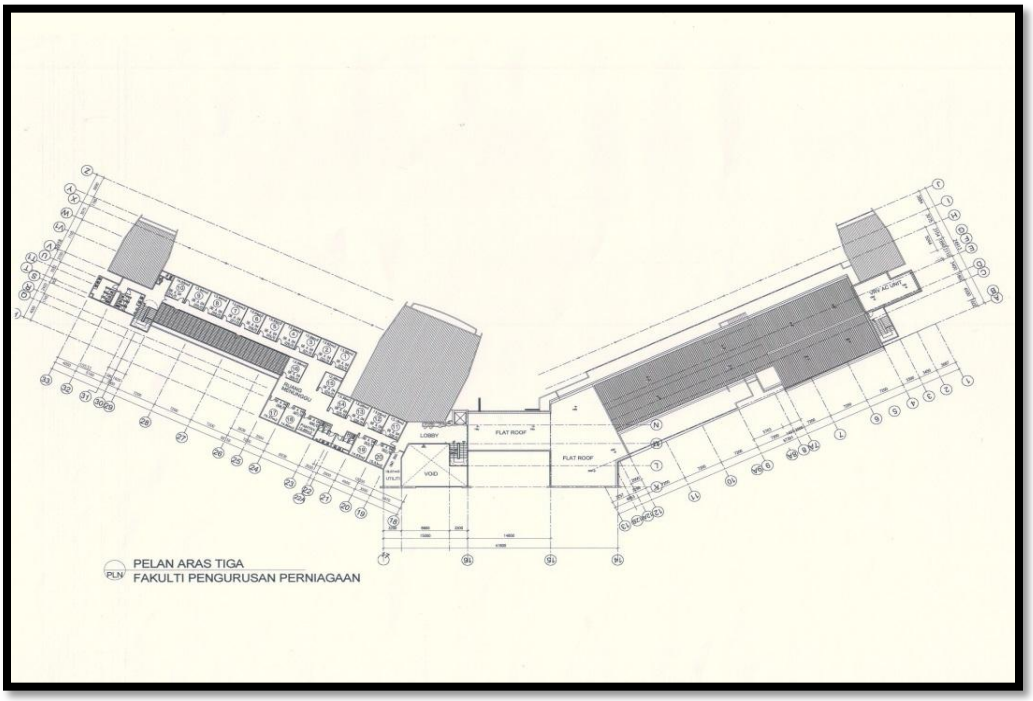


Figure 3.4 3rd Floors

3.3 Faculty of Office Management (FPP) air-con plan (refer appendix A3 size)

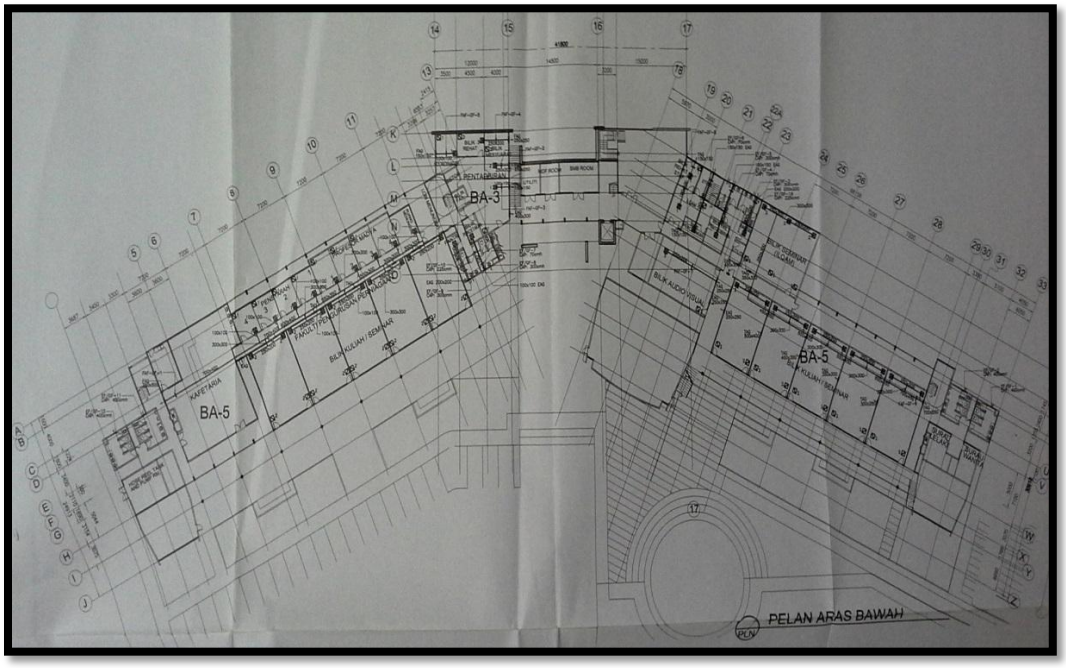


Figure 3.5 Ground level

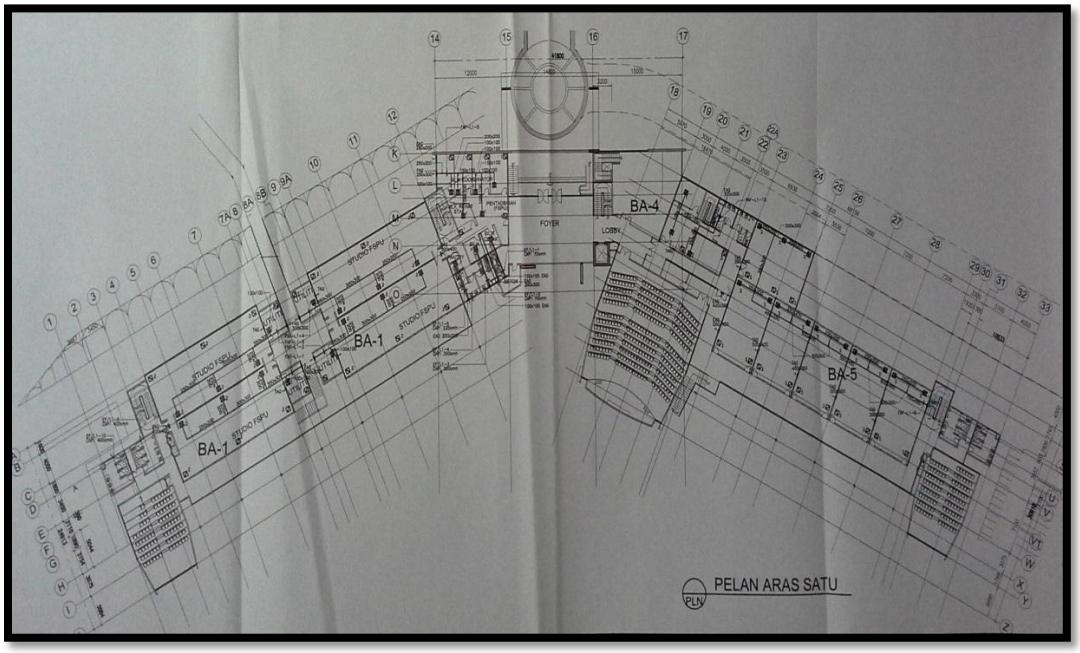


Figure 3.6 1st Floors

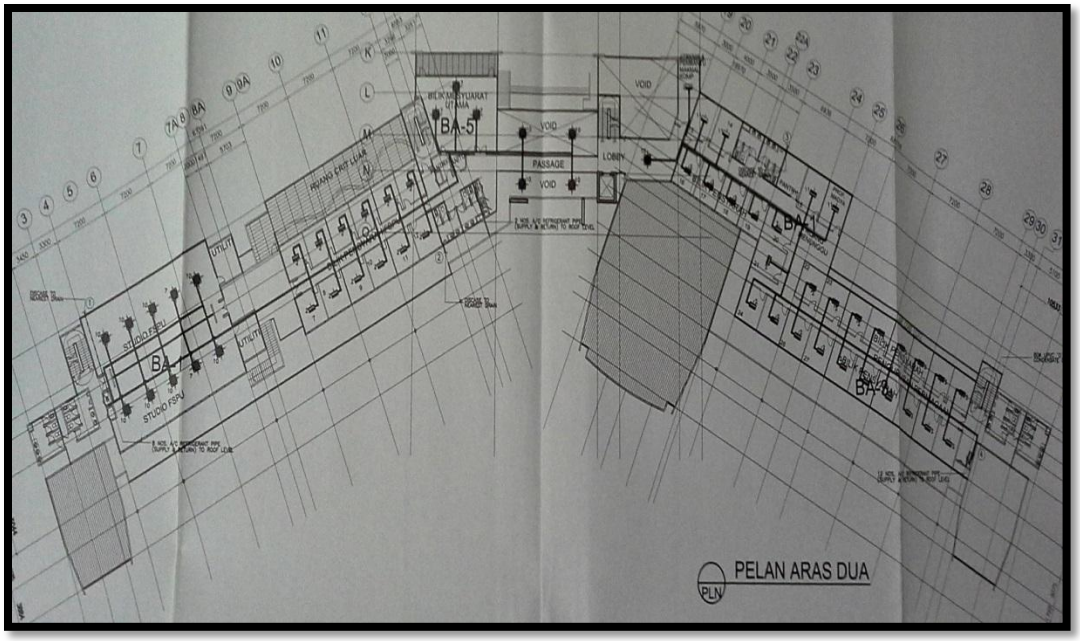


Figure 3.7 2nd Floors

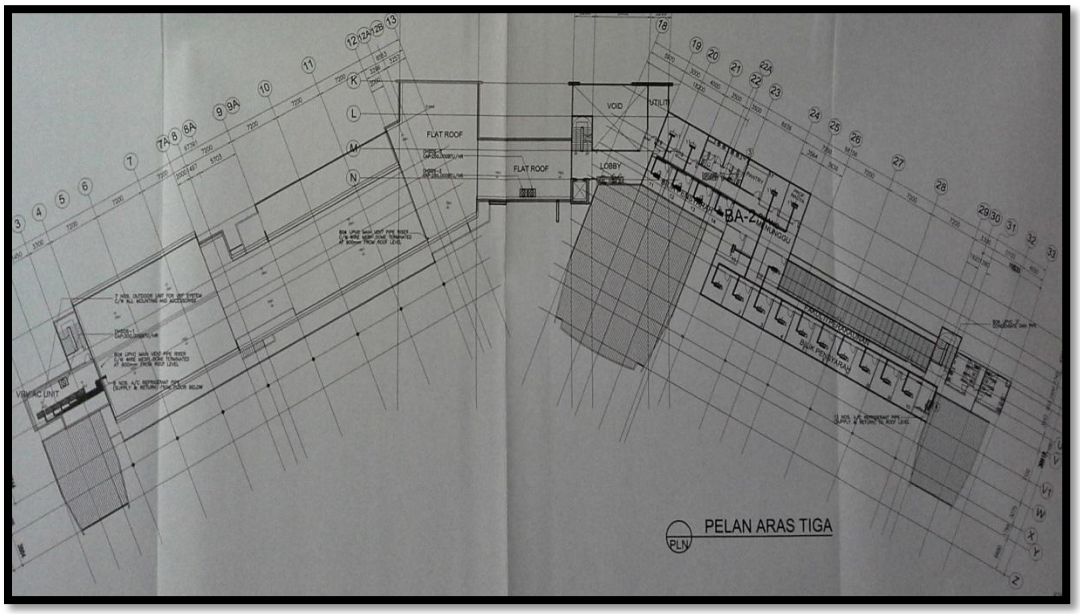


Figure 3.8 3rd Floors

3.4 Schematic Diagram of Air Conditioning System (refer appendix for A3 size)

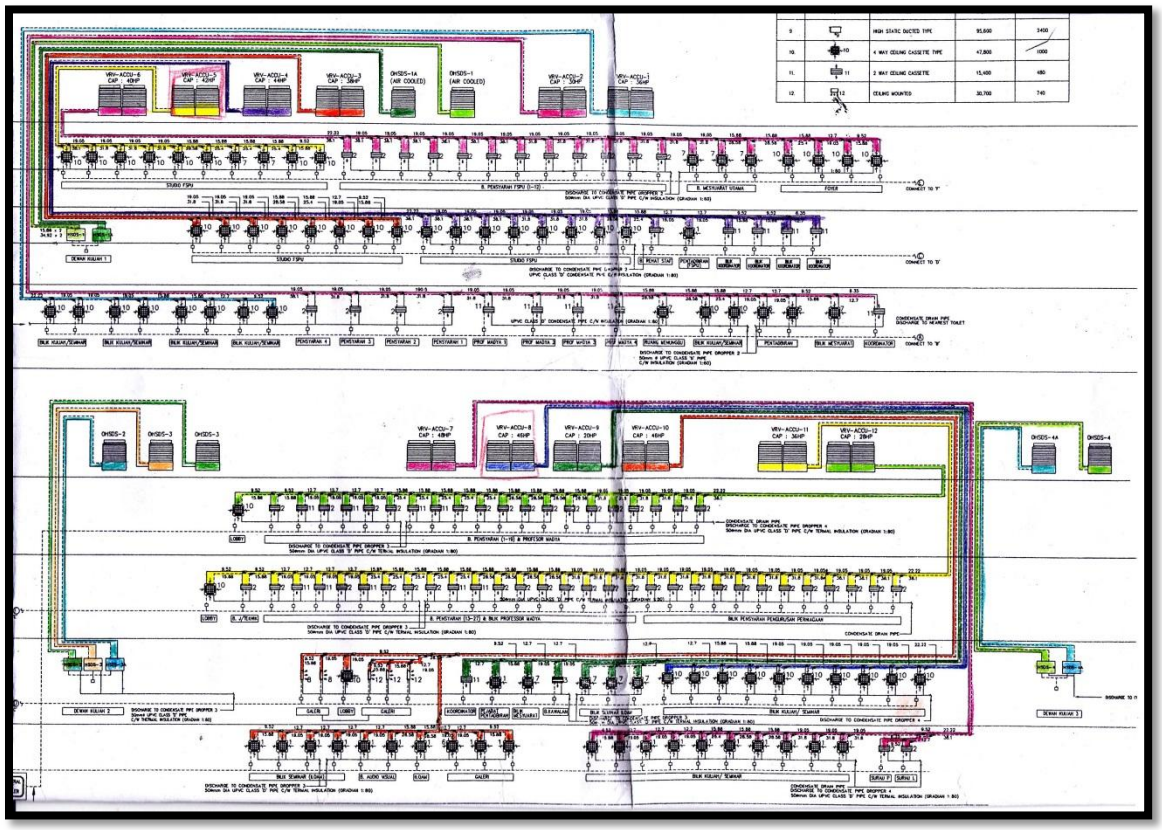


Figure 3.9 show the Schematic Diagram of Air conditioning system

BM, OM, & OD	Quantity
Outdoor unit	23 unit
Indoor unit	81 unit
Compressor	31 unit
Total for **indoor** & **outdoor** unit	**104 unit**

Table 3.6 : total of air conditioning at Academic Block in June 2012

3.5 List of Air conditioning location at Academic Block (refer appendix)

UNIVERSITI TEKNOLOGI MARA
PEJABAT PENGURUSAN FASILITI

LOKASI : BLOK AKADEMIK(INDOOR UNIT)

BULAN : June 2012
TARIKH : 25/6/12

INVERTER UNIT

Senarai Unit Hawadingin di UITM

BIL	NO. BILIK	BRAND	JENIS	MODEL INDOOR	SERIAL NO.	MODEL OUTDOOR	SERIAL NO.	POWER LOAD (HP/KW/AMP/RPM)	REMARKS
1	MAKMAL KOMPUTER (BM 106) L2	MITSUBISHI	CASSETTE	FDT140KXE6	A14001855QK				TO CHEMICAL ID
2	MAKMAL KOMPUTER (BM 104) L2	MITSUBISHI	CASSETTE	FDT140KXE6	C14101718QK				TO CHEMICAL ID
3	MAKMAL KOMPUTER (BM 104) L2	MITSUBISHI	CASSETTE	FDT140KXE6	A14001878QK				TO CHEMICAL ID
4	MAKMAL KOMPUTER (BM 103) L2	MITSUBISHI	CASSETTE	FDT140KXE6	A14001877QK				TO CHEMICAL ID
5	MAKMAL KOMPUTER (BM 103) L2	MITSUBISHI	CASSETTE	FDT140KXE6	A14001876QK				TO CHEMICAL ID
6	MAKMAL KOMPUTER (BM 101) L2	MITSUBISHI	CASSETTE	FDT140KXE6	A14001860QK				TO CHEMICAL ID
7	MAKMAL KOMPUTER (BM 101) L2	MITSUBISHI	CASSETTE	FDT140KXE6	A14001866QK				TO CHEMICAL ID
8	MAKMAL KOMPUTER (BM 102) L2	MITSUBISHI	CASSETTE	FDT140KXE6	A14001875QK				TO CHEMICAL ID
9	MAKMAL KOMPUTER (BM 102) L2	MITSUBISHI	CASSETTE	FDT140KXE6	A14001871QK				TO CHEMICAL ID
10	LOBY UNIT TINGGI	MITSUBISHI	CASSETTE	FDT140KXE6	C1410696QK				TO CHEMICAL ID
11	LOBY UNIT TINGGI	MITSUBISHI	CASSETTE	FDT140KXE6	C14101724QK				TO CHEMICAL ID
12	LOBY UNIT TINGGI	MITSUBISHI	CASSETTE	FDT140KXE6	C14101720QK				TO CHEMICAL ID
13	LOBY UNIT TINGGI	MITSUBISHI	CASSETTE	FDT140KXE6	C14101723QK				TO CHEMICAL ID
14	B.PENSYARAH L1 (031/0A) BM	MITSUBISHI	CASSETTE	FDT71KXE6	A71002595QK				TO CHEMICAL ID
15	B.PENSYARAH L1 (031/0A) BM	MITSUBISHI	CASSETTE	FDT71KXE6	A71003861QK				TO CHEMICAL ID
16	B.PENSYARAH L1 (035/0) BM	MITSUBISHI	CASSETTE	FDTW45KXE6	G45100063MK				TO CHEMICAL ID
17	B.PENSYARAH L1 (037/0) BM	MITSUBISHI	CASSETTE	FDT112KXE6A	C11102249QK				TO CHEMICAL ID
18	B.KULIAH L1 (059/0) BM	MITSUBISHI	CASSETTE	FDT140KXE6	A14001864QK				TO CHEMICAL ID
19	B.KULIAH L1 (059/0) BM	MITSUBISHI	CASSETTE	FDT140KXE6	A14001865QK				TO CHEMICAL ID
20	B.KULIAH L1 (060/0) BM	MITSUBISHI	CASSETTE	FDT140KXE6	A14001872QK				TO CHEMICAL ID

NOTA :
VRF INDOOR -20 UNIT

DIPERIKSA OLEH :
1:- AZIZUL
2:- FAIZ
3:- .....

DISAHKAN OLEH :
1:- .....MUHAMMAD AZHARUDDIN MOHD NANI
2:- .....Mekanik Penyelia (K2 Kanan)
Bahagian Pengurusan Fasiliti
Universiti Teknologi Mara Perak
Kampus Seri Iskandar

UNIVERSITI TEKNOLOGI MARA
PEJABAT PENGURUSAN FASILITI

BULAN : JUNE 2012
TARIKH : 19/6/12

LOKASI : BLOK AKADEMIK(OUTDOOR UNIT)

INVERTER UNIT

Senarai Unit Hawadingin di UITM

BIL	NO. BILIK	BRAND	JENIS	MODEL INDOOR	SERIAL NO.	MODEL OUTDOOR	SERIAL NO.	POWER LOAD (HP/KW/AMP/RPM)	REMARKS
1	1.CU4 (BM)	MITSUBISHI				FDCA615HKXE4D	261100006GF		TO CHEMICAL OD
2	1.CU4 (BM)	MITSUBISHI				FDCA615HKXE4D	2611000017		TO CHEMICAL OD
3	G.CU1 (BM)	MITSUBISHI				FDCA504HKXE4D	250100075GF		TO CHEMICAL OD
4	G.CU1 (BM)	MITSUBISHI				FDCA504HKXE4D	250100070GF		TO CHEMICAL OD
5	G.CU2 (BM)	MITSUBISHI				FDCA400HKXE4D	240100090GF		TO CHEMICAL OD
6	G.CU2 (BM)	MITSUBISHI				FDCA450HKXE4D	245100133GF		TO CHEMICAL OD
7	2.CU6 (BM)	MITSUBISHI				FDCA560HKXE4BR	656100109LF		TO CHEMICAL OD
8	2.CU6 (BM)	MITSUBISHI				FDCA560HKXE4BR	656100110LF		TO CHEMICAL OD
9	2.CU5 (BM)	MITSUBISHI				FDCA615HKXE4D	2610000014GF		TO CHEMICAL OD
10	2.CU5 (BM)	MITSUBISHI				FDCA500HKXE4BR	656100074LF		TO CHEMICAL OD
11	1.CU3 (BM)	MITSUBISHI				FDCA500HKXE4BR	656100095LF		TO CHEMICAL OD
12	1.CU3 (BM)	MITSUBISHI				FDCA504HKXE4D	2501000749F		TO CHEMICAL OD
13	G.CU7 (OM)	MITSUBISHI				FDCA680HKXE4BR	668100112LF		TO CHEMICAL OD
14	G.CU7 (OM)	MITSUBISHI				FDCA680HKXE4BR	668100134LF		TO CHEMICAL OD
15	G.1.CU10 (OM)	MITSUBISHI				FDCA615HKXE4D	261000013GF		TO CHEMICAL OD
16	G.1.CU10 (OM)	MITSUBISHI				FDCA680HKXE4BR	668100114LF		TO CHEMICAL OD
17	1.CU8 (OM)	MITSUBISHI				FDCA680HKXE4BR	668100031LF		TO CHEMICAL OD
18	1.CU8 (OM)	MITSUBISHI				FDCA680HKXE4BR	668100140LF		TO CHEMICAL OD
19	1.CU9 (OM)	MITSUBISHI				FDCA560HKXE4BR	656100099LF		TO CHEMICAL OD
20	2.CU11 (OM)	MITSUBISHI				FDCA504HKXE4D	450100009GF		TO CHEMICAL OD
21	2.CU11 (OM)	MITSUBISHI				FDCA504HKXE4D	450100003GFG		TO CHEMICAL OD
22	3.CU12 (OM)	MITSUBISHI				FDCA400HKXE4D	240100082GF		TO CHEMICAL OD
23	3.CU12 (OM)	MITSUBISHI				FDCA400HKXE4D	240100084GF		TO CHEMICAL OD
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									

BAHAGIAN OPERASI MEKANIKAL

NOTA :
VRF OUTDOOR - 34 UNIT

DIPERIKSA OLEH :
1:- AZLAN
2:- FAIZ
3:- .....

DISAHKAN OLEH :
1:- .....
2:- .....

MUHAMMAD AZMI BIN MOHD HANI
Mekanik Penyejuk (K2 Kanan)
Bahagian Pengurusan Fasiliti
Universiti Teknologi Mara Perak
Kampus Seri Iskandar

UNIVERSITI TEKNOLOGI MARA
PEJABAT PENGURUSAN FASILITI

BULAN : JUNE 2012
TARIKH : 21/6/12

LOKASI : BLOK AKADEMIK(INDOOR UNIT)

INVERTER UNIT

Senarai Unit Hawadingin di UITM

BIL	NO. BILIK	BRAND	JENIS	MODEL INDOOR	SERIAL NO.	MODEL OUTDOOR	SERIAL NO.	POWER LOAD (HP/KW/AMP/RPM)	REMARKS
1	B.PENSYARAH (BM L3) 043.0	MITSUBISHI	CASSETTE						TIADA ORANG
2	B.PENSYARAH (BM L3) 044.0	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100298LK				TO CHEMICAL ID
3	B.PENSYARAH (BM L3) 045.0	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100255LK				TO CHEMICAL ID
4	B.PENSYARAH (BM L3) 046.0	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100274LK				TO CHEMICAL ID
5	B.PENSYARAH (BM I3) 047.0	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100300LK				TO CHEMICAL ID
6	B.PENSYARAH (BM L3) 048.0	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100305LK				TO CHEMICAL ID
7	B.PENSYARAH (BM L3) 049.0	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100264LK				TO CHEMICAL ID
8	B.PENSYARAH (BM L3) 050.0	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100261LK				TO CHEMICAL ID
9	B.PENSYARAH (BM L3) 051.0	MITSUBISHI	CASSETTE						TIADA ORANG
10	B.PENSYARAH (BM L3) 052.0	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100297LK				TO CHEMICAL ID
11	B.PENSYARAH (BM L3) 053.0	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100250LK				TO CHEMICAL ID
12	B.PENSYARAH (BM L3) 054.0	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100303LK				TO CHEMICAL ID
13	MAKMAL KOMPUTER (BM FPTP4) L3	MITSUBISHI	CASSETTE	FDT140KXE6A	C14101714QK				TO CHEMICAL ID
14	MAKMAL KOMPUTER (BM FPTP4) L3	MITSUBISHI	CASSETTE	FDT140KXE6A	C14101712QK				TO CHEMICAL ID
15	MAKMAL KOMPUTER (BM FPTP4) L3	MITSUBISHI	CASSETTE	FDT140KXE6A	C14101698QK				TO CHEMICAL ID
16	MAKMAL KOMPUTER (BM FPTP6) L3	MITSUBISHI	CASSETTE	FDT140KXE6A	C14101708QK				TO CHEMICAL ID
17	MAKMAL KOMPUTER (BM FPTP6) L3	MITSUBISHI	CASSETTE	FDT140KXE6A	C14101695QK				TO CHEMICAL ID
18	MAKMAL KOMPUTER (BM FPTP6) L3	MITSUBISHI	CASSETTE	FDT140KXE6A	C14101701QK				TO CHEMICAL ID
19	MAKMAL KOMPUTER (BM FPTP7) L3	MITSUBISHI	CASSETTE	FDT112KXE6A	C11102247QK				TO CHEMICAL ID
20	MAKMAL KOMPUTER (BM FPTP7) L3	MITSUBISHI	CASSETTE	FDT140KXE6A	C14101693QK				TO CHEMICAL ID

BAHAGIAN OPERASI MEKANIKAL

NOTA :

VRF INDOOR -20 UNIT

DIPERIKSA OLEH :

1:- AZIZUL

2:- FAID

3:- .....

DISAHKAN OLEH :

1:- .....

2:- .....

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TARIKH : 23/6/12

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BIL	NO. BILIK	BRAND	JENIS	MODEL INDOOR	SERIAL NO.	MODEL OUTDOOR	SERIAL NO.	POWER LOAD (HP/KW/AMP/RPM)	REMARKS
1	MAKMALKOMPUTER (BM FPTP5) L3	MITSUBISHI	CASSETTE						SENTIASA ADA KELAS
2	MAKMALKOMPUTER (BM FPTP5) L3	MITSUBISHI	CASSETTE						SENTIASA ADA KELAS
3	B.MESYUARAT (BM 063/0) L3	MITSUBISHI	CASSETTE	FDT112KXE6A	C11102251QK				TO CHEMICAL ID
4	B.MESYUARAT (BM 063/0) L3	MITSUBISHI	CASSETTE	FDT112KXE6A	C11102250QK				TO CHEMICAL ID
5	B.MESYUARAT (BM 063/0) L3	MITSUBISHI	CASSETTE	FDT112KXE6A	C11102274QK				TO CHEMICAL ID
6	PEJABAT ARAS LOBY (BM 025/0) L2	MITSUBISHI	CASSETTE	FDT90KXE6A	C90102296QK				TO CHEMICAL ID
7	PEJABAT ARAS LOBY (BM 026/0) L2	MITSUBISHI	CASSETTE						TIADA ORANG
8	PEJABAT ARAS LOBY (BM 027/0) L2	MITSUBISHI	CASSETTE						TIADA ORANG
9	PEJABAT ARAS LOBY (BM 028/0) L2	MITSUBISHI	CASSETTE	FDT90KXE6A	C36100279QK				TO CHEMICAL ID
10	PEJABAT ARAS LOBY (BM 029/0) L2	MITSUBISHI	CASSETTE	FDTW45KXE6	G45100051MK				TO CHEMICAL ID & ERROR E 09 01
11	PEJABAT ARAS LOBY (BM 030/0) L2	MITSUBISHI	CASSETTE	FDTW45KXE6	G45100058MK				TO CHEMICAL ID
12	PEJABAT ARAS LOBY (BM 031/0) L2	MITSUBISHI	CASSETTE						TIADA ORANG
13	PEJABAT ARAS LOBY (BM 032/0) L2	MITSUBISHI	CASSETTE	FDTW45KXE6	G45100092MK				TO CHEMICAL ID
14	MAKMAL KOMPUTER(BM 107) L2	MITSUBISHI	CASSETTE	FDT140KXE6A	C14101702QK				TO CHEMICAL ID
15	MAKMAL KOMPUTER (BM 107) L2	MITSUBISHI	CASSETTE	FDT140KXE6A	C14101697QK				TO CHEMICAL ID
16	MAKMAL KOMPUTER (BM 108) L2	MITSUBISHI	CASSETTE	FDT140KXE6A	C14101709QK				TO CHEMICAL ID
17	MAKMAL KOMPUTER (BM 108) L2	MITSUBISHI	CASSETTE	FDT140KXE6A	C14101713QK				TO CHEMICAL ID
18	MAKMAL KOMPUTER (BM 105) L2	MITSUBISHI	CASSETTE	FDT140KXE6A	A14101867QK				TO CHEMICAL ID
19	MAKMAL KOMPUTER (BM 105) L2	MITSUBISHI	CASSETTE	FDT140KXE6A	A14001862QK				TO CHEMICAL ID
20	MAKMAL KOMPUTER (BM 106) L2	MITSUBISHI	CASSETTE	FDT140KXE6A	A14001859QK				TO CHEMICAL ID

BAHAGIAN OPERASI MEKANIKAL

NOTA :

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BIL	NO. BILIK	BRAND	JENIS	MODEL INDOOR	SERIAL NO.	MODEL OUTDOOR	SERIAL NO.	POWER LOAD (HP/KW/AMP/RPM)	REMARKS
1	B.KULIAH L1 (060/0) BM	MITSUBISHI	CASSETTE	FDT140KXE6	A14001868QK				TO CHEMICAL ID
2	B.KULIAH L1 (061/0) BM	MITSUBISHI	CASSETTE	FDT140KXE6	A14001869QK				TO CHEMICAL ID
3	B.KULIAH L1 (061/0) BM	MITSUBISHI	CASSETTE	FDT140KXE6	A14001853QK				TO CHEMICAL ID
4	B.KULIAH L1 (062/0) BM	MITSUBISHI	CASSETTE	FDT140KXE6	A14001876QK				TO CHEMICAL ID
5	B.KULIAH L1 (062/0) BM	MITSUBISHI	CASSETTE	FDT140KXE6	A14001863QK				TO CHEMICAL ID
6	B.KULIAH L1 (063/0) BM	MITSUBISHI	CASSETTE	FDT140KXE6	A14001857QK				TO CHEMICAL ID
7	B.KULIAH L1 (063/0) BM	MITSUBISHI	CASSETTE	FDT140KXE6	A14001858QK				TO CHEMICAL ID
8	B.PENSYARAH L1 (043/0) BM	MITSUBISHI	CASSETTE	FDT112KXE6A	C11102271QK				TO CHEMICAL ID
9	B.PENSYARAH L1 (044/0) BM	MITSUBISHI	CASSETTE						TIADA ORANG
10	B.PENSYARAH L1 (045/0) BM	MITSUBISHI	CASSETTE						TIADA ORANG
11	B.PENSYARAH L1 (046/0) BM	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100292LK				TO CHEMICAL ID
12	B.PENSYARAH L1 (047/0) BM	MITSUBISHI	CASSETTE	FDT36KXE6	C36100275LK				TO CHEMICAL ID
13	B.PENSYARAH L1 (048/0) BM	MITSUBISHI	CASSETTE	FDTW45KXE6	G45100050MK				TO CHEMICAL ID
14	B.PENSYARAH L1 (049/0) BM	MITSUBISHI	CASSETTE	FDTW45KXE6	G45100052MK				TO CHEMICAL ID
15	B.PENSYARAH L1 (050/0) BM	MITSUBISHI	CASSETTE						TIADA ORANG
16	B.PENSYARAH L1 (051/0) BM	MITSUBISHI	CASSETTE						TIADA ORANG
17	DEPAN LIFT L4 (OM)	MITSUBISHI	CASSETTE	FDT140KXE6A	C14101710QK				TO CHEMICAL ID
18	BILIK P.RAJA MAYANG L4 (OM)	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100294LK				TO CHEMICAL ID
19	BILIK SITI AISHAH L4 (OM)	MITSUBISHI	CASSETTE						TIADA ORANG
20	BILIK P.NORHASIMAH L4 (OM)	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100306LK				TO CHEMICAL ID

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BIL	NO. BILIK	BRAND	JENIS	MODEL INDOOR	SERIAL NO.	MODEL OUTDOOR	SERIAL NO.	POWER LOAD (HP/KW/AMP/RPM)	REMARKS
1	BILIK IZZAMIR L4 (OM)	MITSUBISHI	CASSETTE						TIADA ORANG
2	BILIK NORAFIZA L4 (OM)	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100267LK				TO CHEMICAL ID
3	BILIK NORDAYANA L4 (OM)	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100258LK				TO CHEMICAL ID
4	BILIK IMA SHANAZ L4 (OM)	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100304LK				TO CHEMICAL ID
5	BILIK MAIMAN L4 (OM)	MITSUBISHI	CASSETTE	FDTW45KXE6	G45100054MK				TO CHEMICAL ID
6	BILIK ROHANA L4 (OM)	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100282LK				TO CHEMICAL ID
7	BILIK ROZITA L4 (OM)	MITSUBISHI	CASSETTE						TIADA ORANG
8	BILIK ZATTUL HIMMAH	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100271LK				TO CHEMICAL ID
9	BILIK HAFIZAH L4 (OM)	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100252LK				TO CHEMICAL ID
10	BILIK AHMAD KAMAL L4 (OM)	MITSUBISHI	CASSETTE						TIADA ORANG
11	BILIK DAYANG YUSLINA L4 (OM)	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100266LK				TO CHEMICAL ID
12	BILIK NORLINA L4 (OM)	MITSUBISHI	CASSETTE						TIADA ORANG
13	BILIK WAN NARITA L4 (OM)	MITSUBISHI	CASSETTE						TIADA ORANG
14	BILIK MD LEHAN L4 (OM)	MITSUBISHI	CASSETTE						TIADA ORANG
15	BILIK SHAFEK L4 (OM)	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100248LK				TO CHEMICAL ID
16	DEPAN LIFT L3 (OM)	MITSUBISHI	CASSETTE	FDT140KXE6A	C14101700QK				TO CHEMICAL ID
17	BILIK NURLAILATUL L3 (OM)	MITSUBISHI	CASSETTE						TIADA ORANG
18	BILIK 06 A 03 035/0 L3 (OM)	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100283LK				TO CHEMICAL ID
19	BILIK SYAHIRINA 06A 03 034/0 L3 (OM)	MITSUBISHI	CASSETTE	FDTQ36KXE6	C36100290LK				TO CHEMICAL ID
20	BILIK HARZIAZADATUL L3 (OM)	MITSUBISHI	CASSETTE	FDT36KXE6	C36100295LK				TO CHEMICAL ID

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3.6 Type of Air Conditioning at Academic Block (FPP)

This Academic building blocks using split unit air-conditioning system:

Split unit is a separate air conditioning system units evaporation and condensation. The unit is divided into two parts, units and outdoor units. Unit consists of the evaporator and evaporator fan. The outdoor unit consists of a condenser, piping, condenser fan and other add-ons installed locally. Both inside and outside the unit installed separately.

There are two types of Split units that used in Academic Block :-

I. Wall Mounted
II. Ceiling Cassette

I) Wall Mounted

Figure 3.10 show the wall mounted

Components of wall mounted air conditioning:-

1. Evaporator
2. Bulb seasoning
3. Fan
4. Fan motor
5. Filter
6. Expansion valve thermostat

II) Ceiling Cassette

Figure 3.11 show the ceiling cassette

Component of Ceiling Cassette:-

1. Evaporator
2. Bulb seasoning
3. Fan
4. Fan motor
5. Filter
6. Expansion valve thermostat

The functions of this type of air conditioning are same as Wall mounted, but this type of ceiling cassette are used 4 way ceiling cassette.

3.6.1 Compressor (Outdoor unit)

Figure 3.12 show the compressor at Academic blocks

Component of Compressor:-

1. Evaporator
2. Dryer
3. Low Pressure Regulator
4. Compressor
5. Filter
6. Valves Counter Reverse
7. Capillary Tube
8. Accumulator
9. Sub-accumulator
10. Solenoid Valve
11. Receiver
12. Heat Transfer

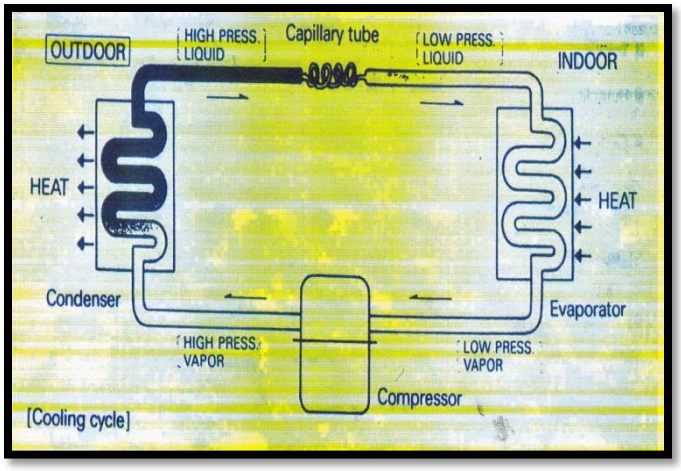

Figure 3.13 show how the compressor works

Figure 3.14 show inside of compressor

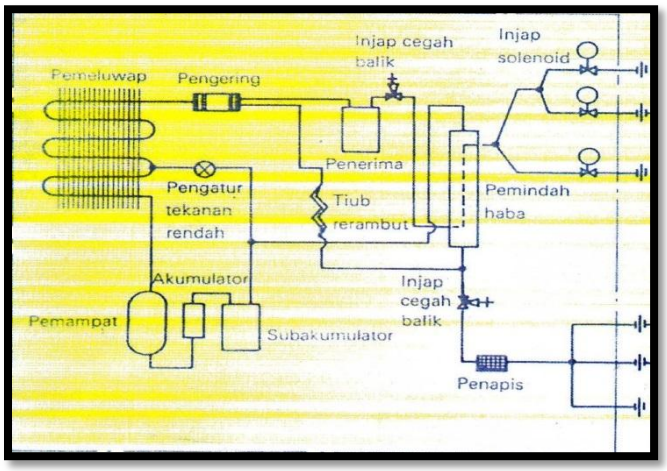

Figure 3.15 show the compressor schematic diagram

3.7 Advantages of this Split unit Air Conditioning system:

I. A compressor can be used for two or three evaporators.
II. Easier installation compared to the installation of window units.
III. Cost lower electricity consumption and system piping units are not much different with two or three units. Acknowledge the outside unit was able to compress and remove heat and two or three evaporators. Therefore, many tools plus used, as sub-accumulator, solenoid valves, low pressure regulator, heat transfer and the recipient. The aim is to increase their capabilities and as a safety measure to keep the unit.

3.8 Maintenance for Air-Conditioning at Academic Block (FPP)

Maintenance of the air conditioning system in the academic block done by the Cekap Maju Amanah services (CMA services) and it is monitored by two civil technicians, Mr. Faiz and Mr Nazren. The work done is washing the air conditioner of split type units that are divided with two parts, internal and external.

For indoor air conditioning maintenance to be done once a month to ensure that no dust stuck in the internal air conditioning vent. This allows the air conditioning system works well and can survive in the long term. While the external air conditioner maintenance, it is done every six months or twice a year to ensure the engine air-conditioning system is functioning properly and smoothly.

There is also a huge damage as damage to the compressor; big damage like this usually goes through the quotation process will be done by the UiTM by inviting outside contractors to repair the damage that occurs in the air-conditioning system.

3.8.1 Type of Maintenance:-

a) Routine Maintenance

Performed repeatedly in a certain time frame.

b) Preventive Maintenance

Maintenance is not done over and over but only occasionally done to prevent something from happening heavy damage.

c) Force Maintenance

Carried out in the event of unexpected damage. For example, damage caused by natural disasters such as floods, storms, fallen trees, etc.

3.8.2 Purpose of Maintenance

a) Ensure that the system continues to operate at the level of the actual capacity.
b) Help prolong the lifespan of the components in the system.
c) Not easily determine system problems and damage inflicted during operation

3.8.3 Cleaning and Services

a) Clean and wash the air filter.
b) Cleaning and sanitization of the evaporator coil fin.
c) Condenser coil cleaning and sanitization.
d) Cleaning of building water pipelines.
e) Cleans the entire outdoor unit.
f) Cleanse the body of water in cooling towers.
g) Making lubrication (greasing) on bearing.
h) Tighten the screw, bolt and nut loose.
i) Cleans starter circuit switchboards and dust.
j) Tighten the screw fasteners on each terminal wiring.

3.8.4 Record Inspection Report

a) Each criterion examination conducted either in the current, temperature and pressure should be maintained on a service report form. From here the results of analysis can be made.
b) In certain circumstances, the right decision should be made after reading analyzed current, temperature and pressure.
c) Avoid making decisions through a reading only.

3.8.5 Services

Maintenance services, care and cleaning of the outer parts of the system, especially the air conditioning unit to produce a more effective cooling.

a) Maintenance of system

1) *Mechanical Parts*

I. Compressor
II. Evaporator
III. Additional Parts
IV. Condenser
V. Charging
VI. Metering devices

2*) Electrical Parts*

I. Motor (Compressor/Fan)
II. Switch
III. Overload
IV. Others component
V. Temperature
VI. Wire Cable

b) Guide Services

1) Monthly Services.

I. Clean the filter

II. Severe case of cleansing impurities will be done more often.

2) Yearly Services.

I. Clears the compressor, condenser, evaporator, fan, motor, casing and so on.

II. Inspection or service more often if dirty fast.

3) Inspections

I. On the fan or blower motor lubricant additives or remove excess oil on the blades in particular.

II. Fastening screws (Mounting Screw) is tightened.

III. Fan blade (rotation, Friction, weight balancing).

3.8.6 Care and Maintenance

a) How to clean air conditioning system.

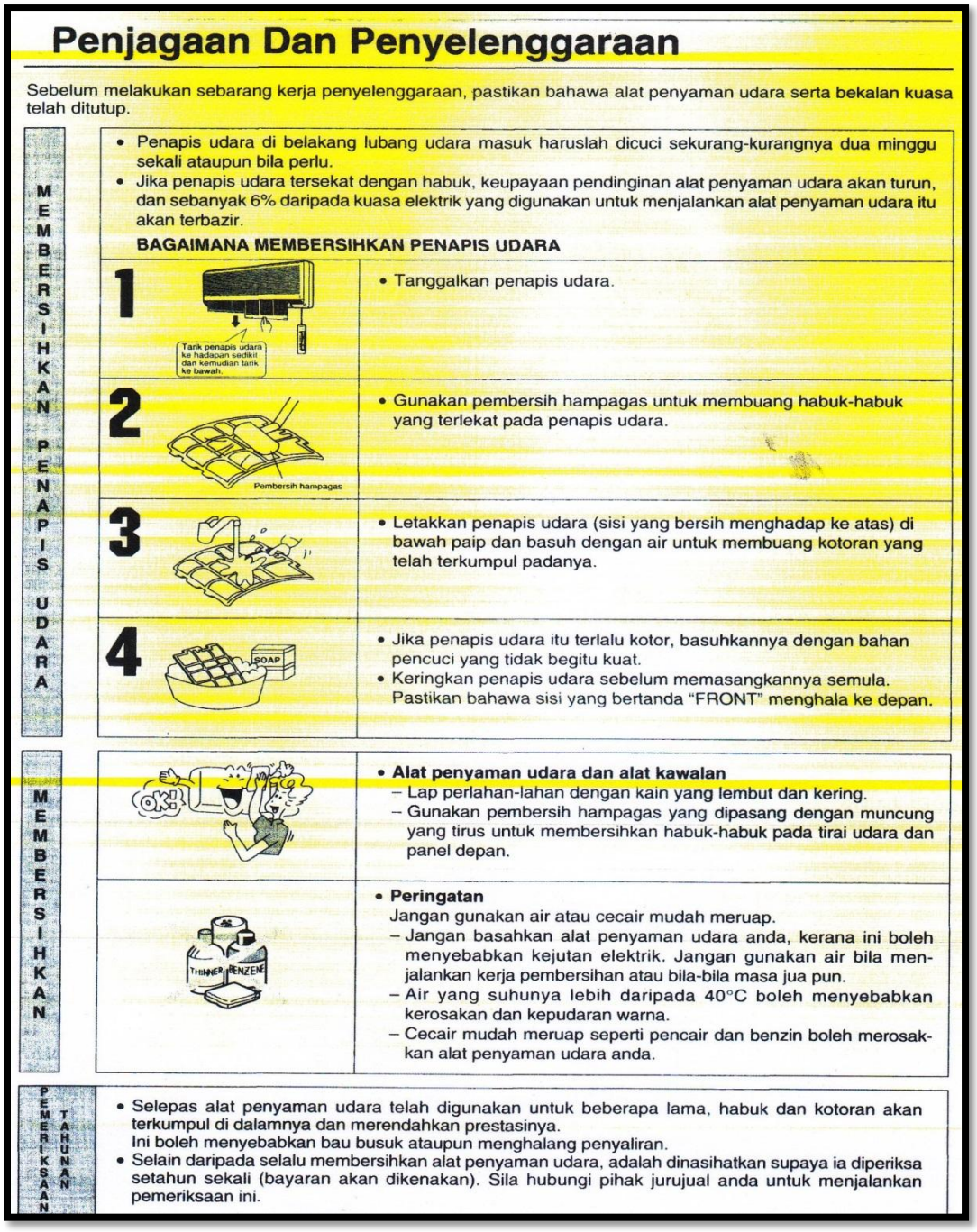

Figure 3.16 show how to clean air conditioning

b) Service Condenser

Condenser is serves to dissipate the heat from the refrigerant gas temperature and pressure so that the gas turns into a liquid without changing temperature and pressure.

1) Condenser cooling water will be treated with:-

I. Entering the detergent into the water and left some time - exchanged water.

II. Using round wire brush (wire rod).

2) Air-cooled condenser will be treated with:-

I. Blown by the blower (light stains).

II. Ejected with high pressure water.

III. Cleaned / soaked in cleaning material ejected by water.

c) Service Evaporator Fan and Fan Motor

Fans are the components used to produce airflow. When using a water conditioner unit air duct fan will be used as a power mover airflow into the space to be reconditioning. Fans can be divided in two types, namely type and axial flow centrifugal type. Because the unit cool water using a centrifugal fan, it is better to focus on this type of fan only.

Centrifugal fan used in air management system. It can move a large volume of high resistance against low noise levels. Propeller efficiency depends on the type of blade used. Types include the type of curve radial front and rear curve.

I. How to clean?

For example, we use a cooling coil in the water conditioning unit. Cooling coil dust clogged by impurities, reduce the cooling capacity. By the pen conditioning coils be washed with water squirted through it. The fins are bent to be straightened by using a plastic fin comb.

Reminder: Before work carried sprayed water on the evaporator fins should cover the hole with plastic coolant tubes that tie so no water entered the ejected into the evaporator fins.

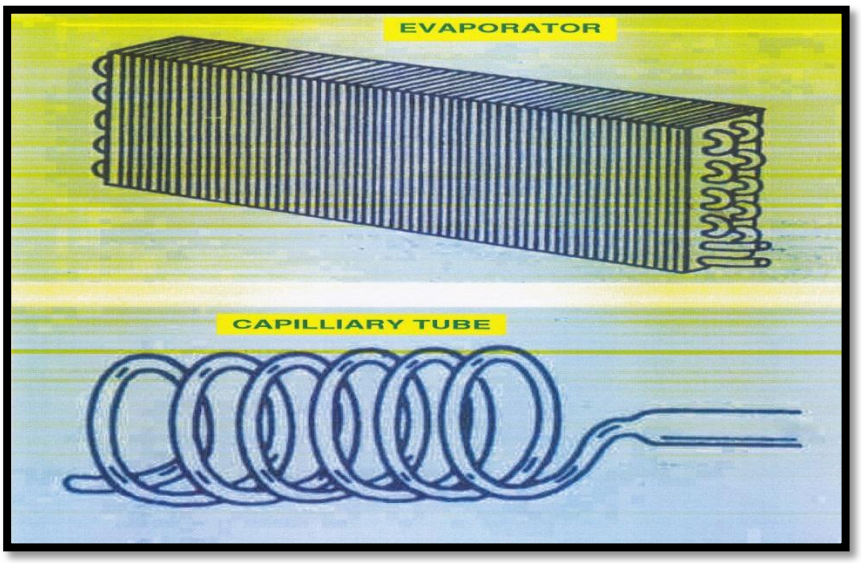

Figure 3.17 evaporator and capillary tube

d) Service Compressor

I. The outer

Bole exterior wash soap mixed with water. But be careful not to hit the fan motor and cause the fan terminal.

II. Fan blade

Way to clean it is to use a damp cloth, wipe completion, should be dry with a blower to dry quickly and no dust caught after work and wash wipe.

III. Fan Motor

servicing the fan motor includes an examination of the connection terminal fan fan insulation test, continuity test the fan motor, washing machine motor coil and blower fan to wash the outside with a dry cloth.

IV. Screw and Nut

In this case, after the work-related ends, screws and nuts that involve the fan motor and fan housing must be tightened back and make sure nothing is lost, missed or corrupted.

V. Fan motor shaft and bearings.

During last servicing the fan, make sure the motor shaft is also in good condition and bearing propeller must be at a good level and do not wear out as this will give the fans and the disadvantages of the unit itself.

3.9 Type of gas

I. For split unit it used gas VRV/VRF (R410A) it is expensive but good for split units system that are used for big building.

II. It's also save the electricity energy of this academic block.

Figure 3.18: example of gas R-410 A

3.10 System of Air Conditioning at Academic Blocks (FPP)

This academic building blocks using the switch control system where the system is able to detect damage to the air conditioner quickly and efficiently without the need of public technicians monitor. The system name is Mitsubishi VRV control system.

This system was created by Cekap Maju Amanah Services Sdn .Bhd. The advantage of using this system is easy to handle and easy to overcome any damage to the air conditioner in the academic block, because this system uses sensors to detect damage. However, the shortcoming in this system is the high cost when there is damage. For example when there is damage to the main control switch it will cause great expense because this system has a lot of sensors and very complex.

Figure 3.19: Mitsubishi VRV Control System Sensor

CHAPTER 4:

PROBLEM, RECOMMENDATION & CONCLUSION

4.0 Problems

As human beings, problems come and go without giving a tiny hint. That is one of the reasons why maintenance is important and significant. It helps to keep things in good condition, or even when it is already broken, it won't get worse in the future.

There are a few problems occurred when the maintenance work is in process, the problems are;

I. In case of severe damage, especially in air conditioning compressor, the UiTM Technicians cannot do it alone because the air conditioning system of the building to the Academic Block is very complex as it involves a lot of automated systems and wireless sensor. So the UiTM should call the appropriate maintenance to fix it.

II. Have high costs in maintenance of air conditioning systems

III. Have less maintenance craftsman

4.1 Recommendations

Every problem has its own solution. Here are some recommendations that I think are convenient to use to upgrade the maintenance work process and can also be use whenever problems occurred.

I. UiTM party should have certain Initiative to ensure these Arrangements are able to perform maintenance without hiring other contractors, in this way the UiTM can reduce air conditioning costs of maintenance
II. UiTM party should also my review of air conditioning maintenance costs and provide a way how to reduce maintenance costs.
III. Searching for a maintenance worker to ensure the air conditioning system maintained and effective.

4.2 Conclusion

The above report has briefly about some of the maintenance work done by the Department of Maintenance and Facilities in UiTM Perak, Seri Iskandar. Maintenance is expected to play even much bigger role in years to follow, as industries worldwide are going through an increasing and stiff competition and increased automation of plants. The down time cost for such systems is expected to be very high. To meet these challenges, maintenance has to use latest technology and management skills in all spheres of activities to perform its effective role in profitability of the company.

CHAPTER 5:

REFERENCES

REFERENCE

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4. http://www.cooleasy.co.uk/categories/Ceiling-Cassette

5. http://splitductless.com

6. IKM lumut