

**THE EFFECTIVENESS OF NATURAL VENTILATION
DESIGN IN LOW COST HOUSING**

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**THE EFFECTIVENESS OF NATURAL VENTILATION DESIGN
IN LOW COST HOUSING**

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**A thesis submitted in fulfillment of the
requirements for the award of the degree of
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DEDICATION

To my beloved wife and family

ACKNOWLEDGEMENT

In preparing this project, I was contact with many people, researchers, acedemians and practioners. They have contributed towards my understanding and thoughts. In particular, I wish to express my sincere appreciation to my main project supervisor, Dr. Shaiful Amri Mansur, for encouragement, guidance, critics and friendship. Also, I wish to thank the following individuals who are En. Razaman bin Udin and Puan Norizan from the Ministry of Housing and Local Government for their valuable information, En. Shukri B. Shuib from Perbadanan Kemajuan Negeri Selangor (PKNS) and Assc. Prof. Seti Mariam Bt. Ayop from Universiti Teknologi Mara. I am grateful for their cooperation and willingness to assist me in this matter.

My thanks also go to the residents of Section 18, 20 and 24, who took part in the study especially, Mohd. Najib, Norzila, Haslinda and Nurul Huda for their assistance.

Last but not least, I wish to thank my beloved parents, Tuan Haji Abdullah @ Abu Bakar B. Che' Min and Hajjah Wan Meriam Binti Wan Sulaiman, my wife Nurhasyimah Ishak and not forgetting friends, Nur Azfahani Ahmad and Mukram Idris who gave me their undivided attention and support throughout this research.

ABSTRACT

Housing low-income families is one of the greatest problems that ail humanity. With the ever increasing awareness and concerns in building low cost houses for the low-income earners the government had set up in the 7th Malaysia Plan (1996 – 2000) a target to reach 200,000 units of low cost houses to accommodate this group. This was announced by the former Ministry of Housing and Local Government, Datuk Ting Chew Peh. Despite the steps that have been taken has it really given these people a healthy and comfortable living environment? From what has been observed most flats and low cost terraces are poorly built. This includes the materials used and also the design of the building such as openings for ventilation. Ventilation design in particular has not been taken into great consideration where problems such as window openings that do not follow the standard size requirement and rooms not having any openings at all still exist to this day. The purpose of this research was to identify the effectiveness and occupant's satisfaction level of the design of natural ventilation for low cost terrace houses. A study will be done on single and double storey houses as well as renovated single and double. The effectiveness of these designs will be assessed from the type of occupants, the time heat is most felt and the frequency of mechanical equipment used. In order to identify the level of satisfaction among occupants, a test is conducted by using a comfy meter. From the surveys and findings being carried out, it was found that the UBBL requirements that are applied to the low cost houses are no longer viable or effective. The results achieved are only in theoretical forms and can be applied for further study in order to obtain a more accurate and suitable multi design component. The results can also be applied to other problems.

ABSTRAK

Pembinaan rumah untuk golongan berpendapatan rendah adalah satu masalah yang telah lama menghantui manusia. Dengan kesedaran yang semakin meningkat untuk menyediakan dan membina rumah kos rendah untuk golongan tersebut, kerajaan telah mengatur strategi dalam Rancangan Malaysia ke-7 (RM7) Ini telah dimaklumkan oleh bekas Menteri Perumahan dan Kerajaan Tempatan, Dato' Tin Chew Peh. Walaupun demikian, persekitaran yang diwujudkan dalam rumah tersebut tidak menyumbang kepada persekitaran yang sihat dan selesa. Dari kajian yang telah dilakukan oleh pelbagai pihak, kebanyakan rumah-rumah kos rendah yang dibina kurangkan memuaskan. Ini termasuklah penggunaan bahan binaan serta rekabentuk bangunan yang digunakan seperti bukaan dan pengudaraan. Rekabentuk pengudaraan ini kurang diberi perhatian dimana masalah seperti bukaan tingkap yang tidak mengikut keperluan saiz piawai. Terdapat juga bilik dan ruang yang tidak mempunyai sebarang bukaan pada dinding yang masih wujud sehingga hari ini. Tujuan penyelidikan ini dijalankan ialah untuk mengenalpasti keberkesanan dan kepuasan penduduk terhadap pengudaraan semula jadi bagi rumah teres kos rendah. Penyelidikan juga akan dilakukan pada rumah satu dan dua tingkat dan juga rumah yang telah diubahsuai. Keberkesanan rekabentuk akan dinilai melalui jenis-jenis penduduk, waktu kepanasan atau keadaan paling tidak selesa yang paling kerap dirasakan, dan kekerapan penggunaan peralatan mekanikal. Untuk mengenalpasti tahap kepuasan penduduk, sebuah alat yang dinamakan sebagai 'Comfy Meter' digunakan untuk tujuan pengukuran dan mengambil data. Daripada penyelidikan dan penemuan yang diperolehi menunjukkan keperluan yang digunapakai di dalam Uniform Building By Law (UBBL) untuk rekabentuk sudah tidak relevan. Ini kerana banyak faktor lain yang mempengaruhi keadaan persekitaran yang menjadikan ia tidak

relevan. Keputusan yang diperolehi adalah dalam bentuk teori dan hanya dapat digunakan untuk kajian selanjutnya untuk mendapatkan kajian pelbagai bagi mendapatkan suatu keputusan yang lebih tepat dan keputusan ini boleh digunakan untuk tujuan kajian dari aspek lain.

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CHAPTER 1

INTRODUCTION

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INTRODUCTION

1.1. GENERAL

The effectiveness of thermal performance depends on natural atmospheric conditions, microclimate and the operating of windows or other opening in the building being ventilated, in which the occupants control the operation of the openings. These indoor quality problems have been associated with poor plan maintenance, high concentration of internally generated pollutants and low indoor air supply rates.

A good flow of air movement can provide comfortable natural ventilation and thermal conditions and healthy environment besides reducing the requirement for mechanical ventilation. Careful design of the internal spaces and openings allows airflows driven by the buoyancy of warmer air to draw cooler fresh air into building. Removing the need for ventilation equipments can save money and space and also reduces health risks associated with highly serviced 'sick building syndrome'.

This project is important because the conditions of the environment in low cost housing are not up to standard. This is because the various problems that arise are not well understood. The main problems found on the natural ventilation of low cost housing are to fulfil the demand of occupants and followed by the limitation of land, design, which influences the thermal performance of the building. As mentioned above, there are no specified rules or regulations in order to eradicate the problems for the relevant parties to follow the standard procedure.

1.2. SOURCES OF DATA

Sources of data are vitally important in order to obtain information necessary for this research. The sources of data will support the facts that have been gathered and as a means to make certain decisions and obtaining results. Many of the information will come from the various government agencies including Perbadanan Kemajuan Negeri Selangor (PKNS) and MBSA along with the feedback from the occupants themselves. These sources of data will come in two forms:-

1.2.1. Primary Data

Primary data will be obtained orally from interviews on the occupants and officers, case studies and so forth which rely on individuals and their cooperation. This will be the first stage of getting primary data.

1.2.2. Secondary Data

Secondary data will be obtained from written and officially and unofficially published sources such as journals, books related articles and extracts from past research.

1.3. AIM

The aim of the study is to improved the natural ventilation design for low cost housing in Malaysia. The improvement will facilitate the government bodies and agencies in term of assisting them in making their development planning on low cost housing.

1.4. OBJECTIVE OF STUDY

Generally, an objective is a means of achieving a required target by undergoing a research on the related topic. Among the objectives that will be reached are the following: -

- 1.4.1. To identify the effectiveness and thermal sensation level of the design of ventilation openings in low cost houses.
- 1.4.2. To determine whether these houses are built according to the Uniform Building By Laws (UBBL).

- 1.4.3. To proposed recommendation to improved the aspects of natural ventilation design in these houses.

1.5. SCOPE OF LIMITATION

The study will be on the concerns of the design of ventilation openings and layout principally in low cost houses in Seksyen 18, 20 and 24 at Shah Alam, which is the related case study. The research will be concentrated on the single and double storey terrace as well as renovated houses. To obtain direct facts interviews visits will be carried out was distributed to the occupants and others who are concerned with the research. There will be no study made on outdoor climate and air exchange rate.

To measure thermal sensation level, the tests are conducted in the morning, afternoon and night on residential low cost houses. These houses will be chosen based on the similarity in design principle, opening and material. The reasons for conducting these tests are: -

- 1.5.1. To collect various data related to indoor thermal condition that emphasize on air temperature, relative humidity, air speed, mean radiant temperature, and operative temperature.
- 1.5.2. To determine the natural ventilation present in each houses which highlight on the thermal sensation level, i.e. cold, cool, slightly warm, warm and hot. Also the level of dissatisfaction can be determined once the sensation level has been identified.

1.6. PROBLEM STATEMENT

As we are all aware, low cost houses and flats are built to accommodate those who have low and medium income with prices as low as RM 25,000 and over. Therefore the qualities of these houses are not always up to the standard. In terms of ventilation these houses do not even have proper windows and some do not even have any openings for air. The spaces provided are often too small. Improper ventilation can result in poor air circulation which means poor air quality, a built up of excessive heat inside the house, and excessive use of electricity because fans are turned on most of the time as well as other contributing factors. Throughout the years this has been an ongoing problem that needs to be improved if not solved. These occupants should not be neglected as they have equal rights as the others. Malaysia, as a developing country should play a greater role in housing its people in better living condition.

1.7. METHODOLOGY

A methodology is a method of how such information should be gathered, analyzed and maintained. This information comes from various sources either from primary or secondary data. The information gathering starts from the third semester and with the guide of the set objectives it will be ensured that it will go according to plan. The following are the stages of preparing this dissertation: -

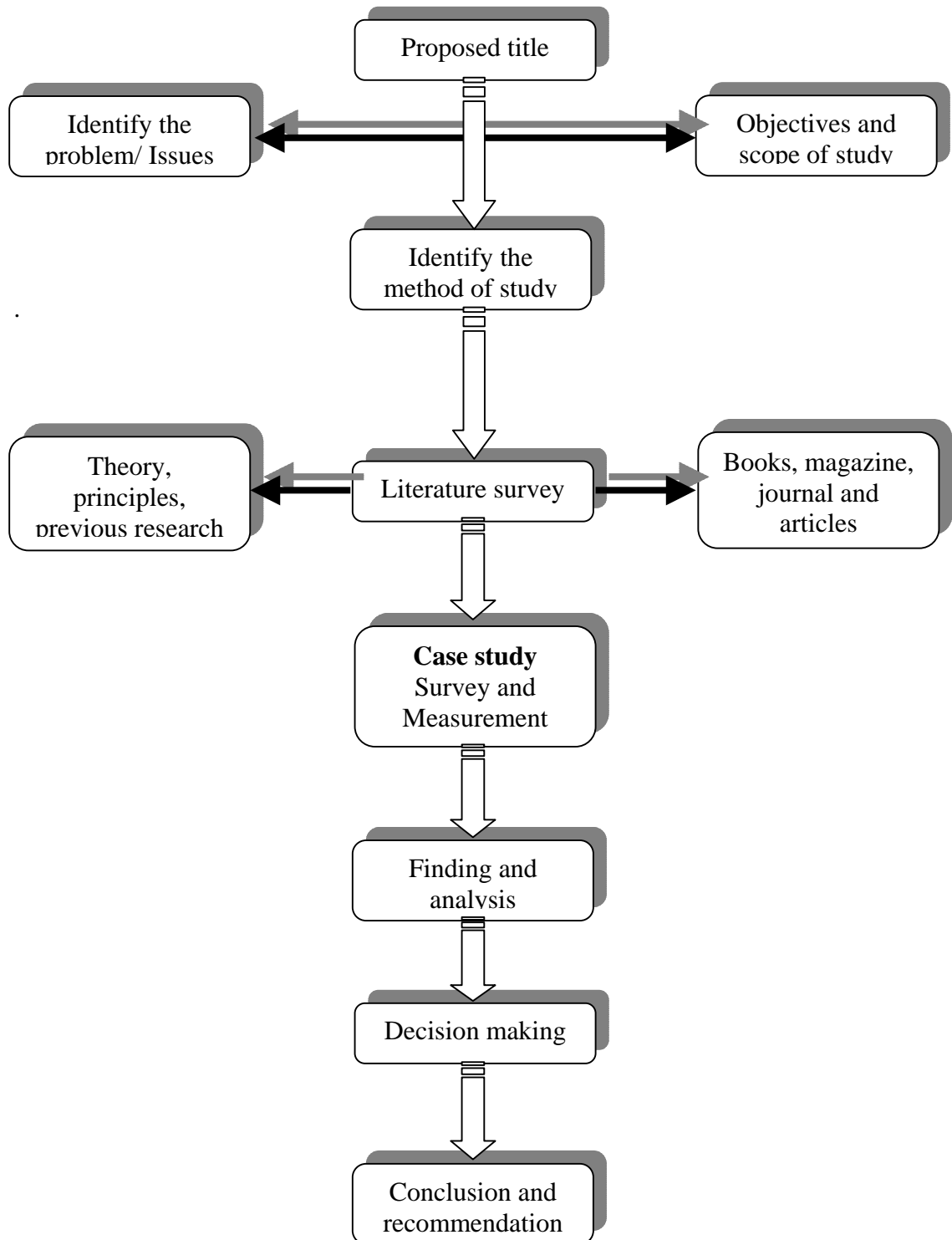


Figure 1.1 : Methodology

1.7.1. Literature Review

In this section, the theory of thermal environment and ventilation system are briefly discussed. Information was obtained from reference such as books, articles and journals. The purpose of this is to get a general overview of the topic on the effectiveness of ventilation design and thermal environment comfort in low cost houses.

1.7.2. Site Survey

Survey forms were distributed to occupants of single and double storey terrace houses. 50 sets of survey forms were distributed randomly around houses in Shah Alam.

The survey form is based on the research from books, articles and journal. Its will be on how the design and layout of ventilation openings effect their everyday living and problems that occur. This is another way of getting direct information from the occupants.

Survey forms are prepared and distributed based on the detail of property, the effectiveness of the surrounding environment and other related aspects. A number of 50 houses are surveyed for the purpose of the study. The survey include are as follows:-

1.5.2.1. details on types of openings; and

1.5.2.2. the floor area and the area of opening;

During this exercise also, the measurements of the case studies are carried out by the surveyor and is compiled in a table which is contained in the survey form. A letter of identification is prepared in order for the surveyor to carry out the work as well as to gain permission from the occupant and to inform the surveyor's presence.

The survey forms are filled up by the occupants with the assistance of the surveyor. The survey covers original and renovated houses. All complete forms are collected and analyzed. Basically, the survey forms are divided into 2 parts i.e (1) detail of property and (2) detail of ventilation effectiveness.

1.7.3. Interviews

Interviews will be held between the writer and occupants as well as the management such as Majlis Bandaraya Shah Alam (MBSA), the Ministry of Housing and Local Government, Perbadanan Kemajuan Negeri Selangor (PKNS).

This method will allow better insight towards the issue and at the same time supports the facts given in the research.

1.7.4. Site measurement

The measurement of thermal sensation level will be carried out at the above mentioned houses. The thermal conditions that will take into considerations are air temperature; globe temperature; relative humidity; air speed and operative temperature. The measurement will be made in three different sites. The purpose of these measurements is to determine the actual parameters of thermal conditions of these houses. The following are the method for testing procedure:-

1.7.4.1. Introduction

A Comfy meter CM-015 is designed to evaluate of indoor thermal environment. Its function is to measure, record and playback the 4 contents which consist of room temperature, humidity, air velocity and radiant temperature of indoor thermal environment.

As index of indoor thermal comfort, a comfy meter calculates and display metabolism and clothing by using from PPD/ PPV of ISO 7730 as measurement value. Measured data can be read or edited using a spread sheet software. Also it has a simple simulation function for each index.

1.7.4.2. Content and compartment

For the purposed of the research, an instrument to measure thermal comfort will be used. The instrument is known as ‘Comfy Meter CM – 015’ that consist of the following items: -

- i. Room Temperature and Humidity Thermometer
- ii. Air Velocity Sensor
- iii. Connector Base – Connector each sensor
- iv. Tripod
- v. Converter – Interface between personal laptop and Comfy Meter
- vi. Connecting Cable
- vii. Storage Case
- viii. Floppy Disk – Measuring/ Analysis software
- ix. Manual of Comfy Meter
- x. Personal Laptop – NEC PC series. MS DOS 3.3 or higher is not acceptable
- xi. RS-232C Cable – Straight (normal). The connecting side for converter is D-Sub25 pin male

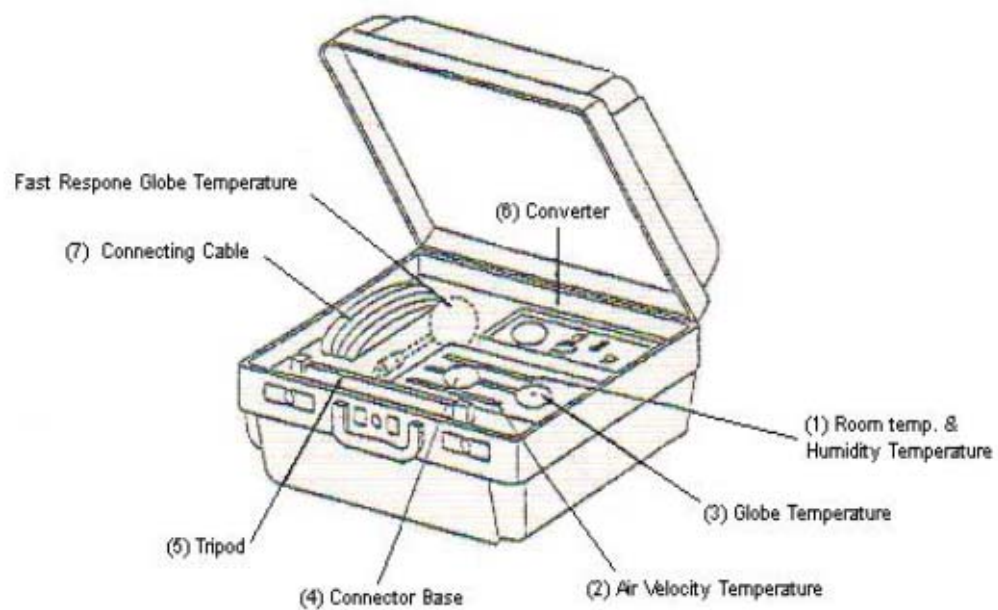


Figure 1.2 : Compartment of Comfy Meter

1.7.4.3. Assembling and Connecting

Firstly, extend the tripod to an appropriate height and fix on site. Then, screw the connector base to the tripod (height 1.10m from stand high). Secondly, connect each of the sensors and connection cables to the connector base. Making sure the screws of the connectors are fastened tightly. The other side of the connector cable is connected to 'sensor in' of the converter. Next, connect the converter and personal laptop with RS-232C straight normal cable. Lastly, connect the power cable of the converter to AC 100V and turn the switch 'ON'. At the same time, one to be aware of the high temperature of the top part of their velocity meter.

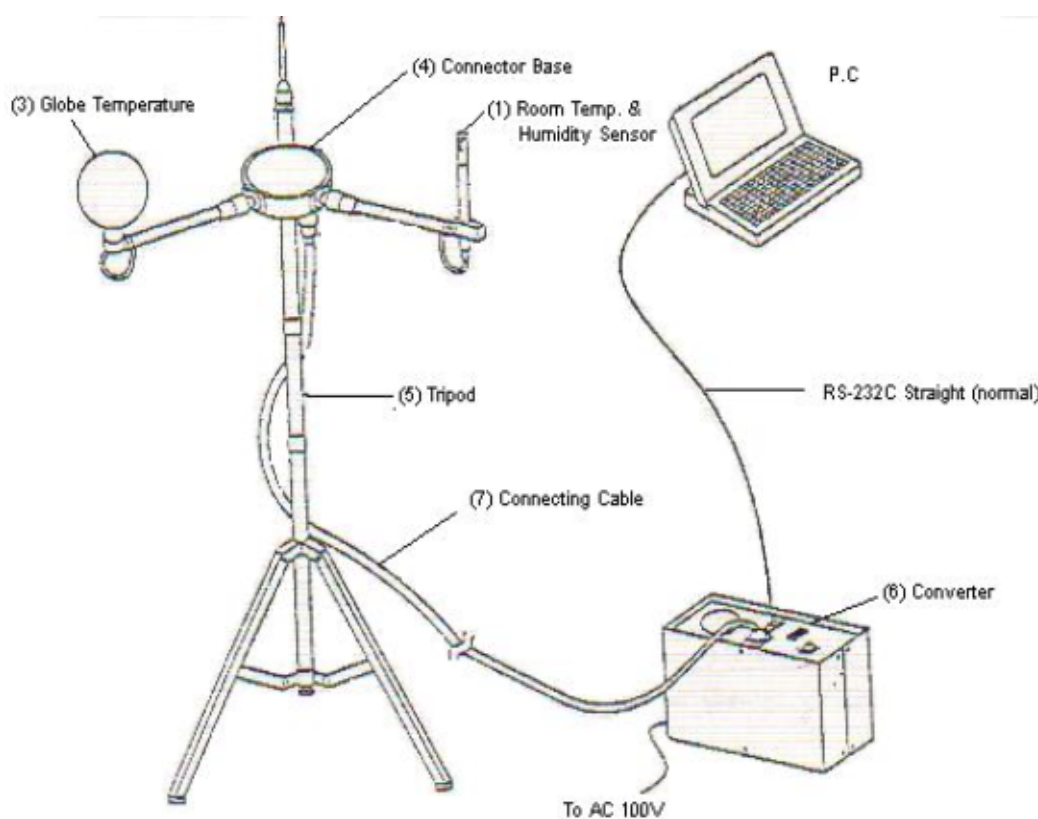


Figure 1.3 : Connection of the Comfy Meter components

1.7.4.4. Installation of Comfy Meter CM-15 Software

The procedure below describes the setting up of Comfy Meter CM-15, personal laptop NEC PC9821 La13/S14R and how to start the software.

First, attach the port bar to personal laptop. Then attach the FDD to personal laptop and connect the RS-232C cable. For the laptop, connect a small RS-232C connector to RS-232C port to the back side of personal laptop port bar. Next, connect a large RS-232C port to the comfy meter and switch 'ON' the laptop (the same way apply when shutting down). Then, switch on the comfy meter by pressing the red button. In order to start the software, type 'COMFY' and then press 'ENTER'.

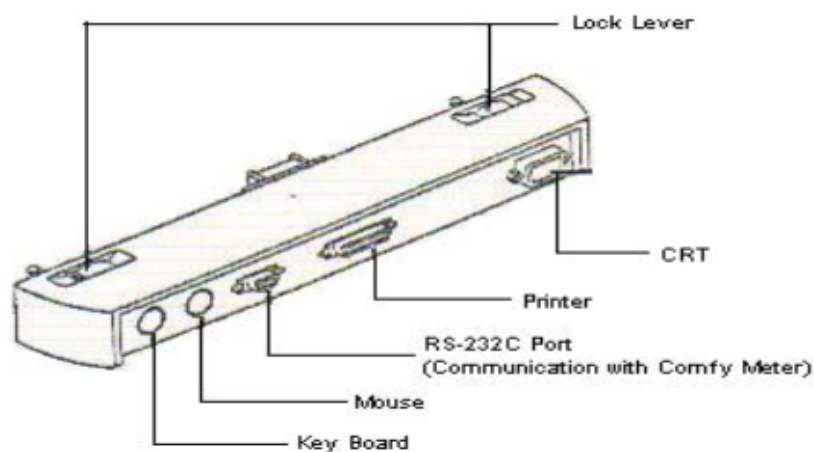


Figure 1.4 : Port bar

1.7.4.5. Measurement

i. Preparation

Assemble sensor parts and connect to converter before selecting 'measurement in main menu'.

ii. Setting Condition Screen

To set up the condition screen, a data file is initially set to year/ month/ date at the beginning of the measurement process; the date will change accordingly. Upon the completion of the measurement process the data file is saved automatically on daily basis. Only selected period of time will be saved on the data file. The instrument will continue taking data until it is switch off but data collected half an hour before it is switch of will not be safe. The measurement was setting and recorded at 5 min intervals

iii. Monitor

The monitor can be changed from 'value screen' to the 'graphic screen' by pressing 'display value' or 'display graph' buttons.

iv. Auto-Continue Measurement

In the following situation, the measurement will automatically continue the next time a program is started. Conditions of the measurement

will be recorded. In case of electricity shutdown during measurement, only starting up program process is included in AUTOEXEC.BAT, will re-continue the measurement after the electricity supply recovers.

v. Data transfer

All the measurement collected will be transferred to Microsoft windows manually. This is because the data saved in the laptop cannot be transferred automatically.

vi. Analysis

Data transferred will be analyzed manually based on PMV against PPD.

1.7.4.6. Theoretical Information

i. Predicted Mean Vote (PMV)

The PMV is an index that predicts the mean value of the vote of a large group of persons on the following 7 point thermal sensation scale. The PMV often called as a statement of PMV or a statement of Predicted Sense Temperature Mean Vote (PSTMV).

Table 1.1 : Predicted Mean Value Scale

PMV Scale	Thermal Sensation
+3	Hot
+2	Warm
+1	Slightly Warm
0	Neutral
-1	Slightly Cool
-2	Cool
-3	Cold

ii. Predicted Percentage of Dissatisfaction (PPD)

The PPD index establishes a quantitative prediction of the of thermally dissatisfied persons. It is also called the percentage of Predicted Dissatisfied Persons.

1.8. ORGANISATION OF THE THESIS

The thesis contains a total of 7 chapters. A brief of the following chapters is described as follows: -

1.8.1. Chapter 1 – Introduction

Chapter 1 is an introduction of the topic of research together with the objectives and methods of how this research should be carried out. Roughly, Chapter 1 is a guideline on how the research should be done.

1.8.2. Chapter 2 – Literature Review On Ventilation

This chapter will be concentrated on ventilation and the importance of ventilation in residential buildings. The main concern is the influence of the design of ventilation openings in residential buildings. This chapter also explains the types and application of natural ventilation. This chapter also discussed on thermal comfort level and their principle.

1.8.3. Chapter 3 - Ventilation In Low Cost Houses

The following chapter will be on the aspects of ventilation in low cost houses in Malaysia. This chapter also explains ventilation problems and design requirement for low cost houses.

1.8.4. Chapter 4 - Case Studies

Chapter 4 will be the case study of the low cost terraced houses in Shah Alam. To gather specific information, references to certain bodies and organizations will be carried out. Survey form, interviews and testing method are applied and distributed to the residents as part of the study. To measure sensation level of thermal condition, a testing method was conducted.

1.8.5. Chapter 5 - Analysis Of Results

The analysis is carried out on this chapter regarding the findings from the research. The results from the analysis are based on the information gathered from the residents themselves through surveys and testing.

1.8.6. Chapter 6 – Recommendation And Conclusion

In the final chapter the conclusion and necessary recommendation will be made based on the findings as a summary for the whole study.

1.9. CONCLUSION

As a conclusion, Chapter 1 gives an insight of what the project is about and how it is carried out. An introduction of the problems of ventilation and its affect on low cost houses is discussed briefly. Among others are the objective of the study, problem statement, scope of study and sources of data.

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